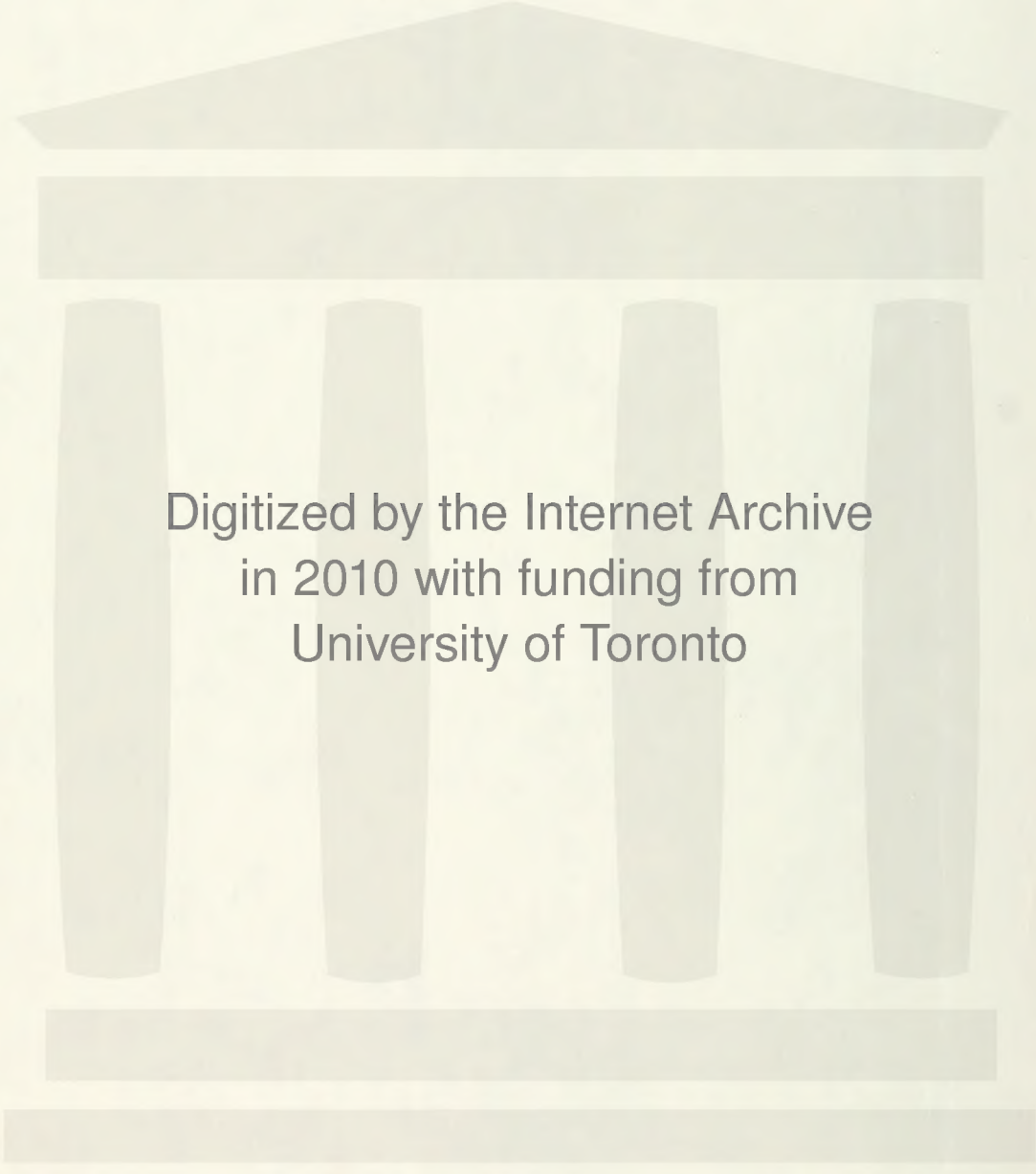


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THE ELECTRICAL WORLD

A REVIEW OF CURRENT PROGRESS IN ELECTRICITY
AND ITS PRACTICAL APPLICATIONS

VOLUME LIV

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Taxing Corporations on Profits.

The latest development of the agitation against corporation finds its expression in the new tax scheme proposed by President Taft and up for discussion in Congress this week. We can hardly imagine such a scheme going through without a great deal of discussion; in fact, it is difficult to believe it can be carried at all if the proper opposition is lined up. As an alternative measure to an income tax, the plan to tax net corporate profits may have some constitutional merits, but it is certainly open to the fundamental objection that it aims a direct blow at the modern method of corporate operation, and discriminates against the corporation in favor of the business owned by an individual. This is indeed very significant and is a reversal of all the tendencies of the past hundred years, during which the entire aim of legislation has been to foster the creation and growth of corporations and to render it possible for a man with small capital to escape the limitation of enterprise thus inflicted by giving him the opportunity to associate his capital with that of others and also to become interested in large corporations as a part owner. All this is now to be changed, for while the profits of any and every stock enterprise are to be taxed, those of exactly the same business, if conducted as copartnerships or by individuals, are left free of this burden. It does not seem possible that discrimination of such a wholesale character can be constitutional; but if it is the corporate principle has received one more serious blow.

It is particularly corporations of the public-utility character that are hit by imposts of this kind. Huge and small manufacturing and industrial enterprises are carried on without resort to the stock ownership principle; but the unincorporated public utilities, in the hands of one or two men, are extremely rare and very few of them are large. It might be reasonably claimed that but for the operation of the corporate principle these utilities could not have come into existence, depending as they do upon the massing of large amounts of capital and the division of the risks. Now these utilities, in addition to all the heavy and special taxes laid upon them by the locality and the State, will have to submit to a further burden inflicted by the national Government. In a general way, a manufacturing concern can shift the burden of such a tax by adding it to the price of the goods, but a local company, bound by commissions laws, ordinances and franchises, cannot change its rates for service or supply. There will, however, be the effort, more or less conscious, to check the actual incidence of such a tax on the net profits, and that means simply a serious temptation to skimp the service so as to maintain the dividend.

When it is considered that a sum of $25,000,000 is estimated as the yield of this tax, it would seem as though some better way could be found of securing that relatively small part of the $800,000,000 now collected by the Government. The tremendous

system of espionage necessary if the tax is to be honestly collected is one of the things to be deplored, equally with the attack on modern forms of investment and the check on habits of saving. Probably a million corporations will have this constant worry and a new artificial incentive to "dishonesty" akin to that fostered by the process of collecting customs from sea passengers at the wharves. But there are also many other points involved in determining net profits, in limiting conversion of stocks into bonds, of which the fixed charges must come off before the "net" can be reached. There is no need for us to enumerate here all the intricate questions that cluster thick around any such plan as this.

— —

In 20 years the national taxation has risen from $6 to about $11 per capita. The population of the county has increased 45 per cent. The expenses of administering the affairs of the nation have jumped 170 per cent. It would seem that in the cure of this terrible disproportion might lie the full measure of relief. But if not, there are many forms of taxation better than this one with so many dubious aspects. For example, the stamp tax on checks and commercial paper is one of good yield from an infinite number of sources, yet is one of the easiest in the world to collect, and falls as righteously upon the rich individual as upon the struggling little corporation. We trust that those interested in public utilities will give this taxation scheme the consideration that many of them have not deigned to accord to the new tariff itself. Supine indifference and acquiescence can sometimes be carried a little too far.

Guarantee of Heating Devices.

The article elsewhere in this issue, by Mr. W. H. Wissing, of St. Louis, is a strong endorsement of the practice of the central-station company in that city of selling electric heating appliances with a guarantee by which the company assumes all responsibility of replacing defective devices. The prices charged are somewhat higher than usual rates—$6 for a 6-lb. iron, and other prices in proportion. With this, however, the company practically assumes the responsibility of maintaining these appliances in good condition indefinitely and without quibbling. It appears that irons have been sold at a considerably less price by St. Louis department stores, but without any guarantee. The policy of maintaining irons and heating appliances is somewhat akin to the policy of free lamp renewals so far as the central-station company is concerned. Both policies insure good service to the consumer. It is no advantage to a central-station company to have a lot of electric irons and other devices in its consumers' houses which are not in use on account of small defects, and which can only be repaired by an annoying experience with some local electrician. Many central-station companies have practically assumed the maintenance of electric irons and cords without so guaranteeing at the time of sale, as they have felt that to charge for repairs of this kind would be to discourage the business in its beginnings. Nearly all makes of irons have developed more or less trouble with cords and probably always will, as cords will wear out just as shoes or wearing apparel. Of course the time will come, and in fact has arrived in many towns, when the consumer would expect to pay something in the way of electric iron repairs for the use of the iron. It is to the interest of the central-station company, however, either to make these repairs itself at a minimum of expense and inconvenience to the consumer, or to follow the St. Louis practice of charging a sufficient price in the first place so that the iron can be maintained as long as it lasts.

Gas Engines in Small Central Stations.

The report of the National Electric Light Association committee on gas engines this year, as in previous years, dealt mainly with the larger sizes of gas engines, although the lists of actual installations included engines as low as 50 hp. The gas engine is really of much more immediate interest to small than to large central-station companies. In fact, the economies offered by the gas engine in small plants as compared with steam engines are likely to be relatively greater than in the case of large plants. The reason for this is that small gas engines show nearly as low a consumption of gas per kw-hour as the largest sizes. On the other hand, there is a great difference between the coal consumption per kw-hour in small steam plants and large ones. The relative economy of the gas engine compared with the steam engine in larger plants is, therefore, not so attractive to the large central-station company. The investment per kilowatt of capacity is much larger with gas engines than with steam engines, both in large and small plants. In the case of a small plant the gas engine and producer which give high economy of fuel come in competition with a steam engine and boiler costing much less per kilowatt of capacity, but usually giving very low economy of fuel. Until the small suction bituminous coal producer is more firmly established as a commercial success than at present, the competition will usually be between bituminous steam coal at a low price as compared with anthracite gas-producer coal at a considerably higher price. As the relative costs of these two kinds of fuel vary in different locations, the choice between a producer gas-engine plant and a steam plant for central-station service must be figured out in every case. At the present time, with the central-station load factors, which are common in well-developed central-station properties serving towns of 3500 and over and giving 24-hour service, the total cost of production per kw-hour, including interest on investment with both steam and gas plants, indicates that a considerably larger use of producers and gas engines will be justified in the future.

Children Should Be Instructed to Shun All Wires.

Not long ago this journal called attention in a news note to the number of accidents due to children touching or playing with electric wires in presumably inaccessible positions. It is gratifying to note, following this publication, that Mr. William Carroll, city electrician of Chicago, has sent a letter to the president of the Board of Education of that city directing attention to this important subject. Mr. Carroll thinks, and with good reason, that instruction on this subject should be given to the children of the public schools. There have been so many accidents caused to boys who come in contact with live electric wires by climbing poles on a "dare"; by picking up the loose ends of telephone wires that have come in contact with electric wires carrying dangerous potentials; by taking hold of broken electric-light wires; by throwing pieces of wire over trolley or other overhead wires to "see the sparks fly"; by using a piece of wire as a string with which to fly kites and

having the wire come in contact with live electric wires, or by similar causes—that the danger is shown by experience to be a very real one, which must be guarded against. Mr. Carroll contends that the children should be taught to avoid wires of all kinds as they would rattlesnakes. However harmless a wire may look, as Mr. Carroll says, there is a possibility that it may be connected in some manner with a high-potential circuit and consequently be dangerous to life.

This advice is timely and important. It is difficult to place wires carrying dangerous currents of electricity in such a remote position that the adventurous small boy will not climb up to them in a spirit of enterprise or mischief and receive possibly a fatal shock. The electrical company is not to be blamed when such an accident occurs, for usually it has done its best to make it impossible. The remedy seems to be educational in its nature. Children, and particularly boys, should be impressed with the fact by all parents and teachers that they must not touch wires any more than sample at random the contents of bottles in the medicine closet. Their foray may end in death in either case. Mr. Carroll has done wisely in calling this matter to the attention of the Board of Education of Chicago, and his example may well be followed in other cities.

ALTERNATOR ARMATURE WINDINGS.

In studying the voltage relations in the conductors composing an armature winding, it is convenient to hold continually in mind the fact that the electromotive force produced in each surface conductor on the armature is the same as that in each other surface conductor, while the electrical-time-degree relation of the individual electromotive forces is identical with the electrical-space-degree relation of the slots in which the conductors are placed. That is to say, when two slots are separated by 10 electrical-space degrees, the electromotive forces produced in the conductors occupying these slots are out of phase by 10 electrical-time degres. With thse facts in mind one can readily assign to the electromotive force of each conductor, or group of conductors, a definite value and time-phase position, and thereby determine the vector sum of the voltage obtained by interconnecting the various conductors to form a phase winding.

An article by Mr. Edgar Knowlton discussing in detail the method outlined above appears elsewhere in this issue. The author states that it is of value principally when the connections are unsymmetrical, and he proves its usefulness for analysis in this case. However, it is worthy of note that none of the advantageous features of the method is lacking when the connections are symmetrical; in fact, it possesses fundamental characteristics which render it useful under all conditions. In applying this method it is necessary to distinguish carefully between mechanical-space degrees and electrical-space degrees; for example, in a four-pole machine five mechanical-space degrees equal 10 electrical-space degrees. The fact that practically all machines are constructed with a certain definite integral number of slots per pair of poles allows one to assign a definite electrical-space position to each slot of a pole-pair, and the same position applies to a corresponding slot in each of the other pole-pairs. Any interconnection of the conductors which will give the proper value and relative time-phase position to the resultant electromotive forces in the armature is satisfactory from an operating point of view, but economy of constructive material and ease of assembly often dictate the selection of that interconnection which requires the least amount of material for the cross-connections and permits the use of symmetrical coils.

INTERFERENCE BETWEEN TELEPHONE AND ALTERNATING-CURRENT CIRCUITS.

All electrical workers are familiar with the disturbances that may be produced in a telephone circuit by the electric or magnetic inductive influence of neighboring alternating-current circuits. A loud hum is usually heard in the telephone, of a pitch corresponding to the frequency of the alternating current in the neighboring wire. The loudness of this hum may be so great as to make telephonic conversation impossible, while even a comparatively faint hum may give rise to inconvenience and distress in listening. An article by Herr Martin Höchstädter on this subject has recently appeared in the *Elektrotechnische Zeitschrift*, as referred to in the Digest. It deals with means for protecting the subscriber's station from such disturbances, or rather for reducing the effect of such disturbance to a minimum. The ordinary method of getting rid of such disturbance is by the transposition of wires. Either the telephone wires or the electric lighting wires, or both sets, may be transposed for this purpose; but the telephone wires are usually transposed, being the lighter and easier to manipulate. This method means overhauling the line, and may be troublesome to carry out. Moreover, there may be conditions under which transposition of the wires is insufficient to remove the disturbance. The article suggests two plans, or a combination of both, for reducing the disturbance, without any necessary change in the line wires.

The first plan is to insert a very small condenser in the receiving telephone circuit—say, a condenser of 0.05 microfarad. This condenser would naturally offer a relatively high condensance, or condenser-reactance, to the low fundamental frequency of the electric lighting circuit, and a much lower condensance to the vocal frequencies of telephonic operation. Consequently, the vocal alternating currents would be diminished to some extent by the condenser, but the induced low-frequency disturbances would be reduced much more. The second plan is to bridge the primary of an induction coil across the telephone circuit, and to connect the secondary to the receiver terminals through a suitable resistance in such a manner that the low-frequency induced disturbance current may not only be diverted across the telephone line through the primary, but that its inductive action in the secondary may be opposed in the telephone receiver to the residual direct action producing the hum therein. Of course, the voice currents will also leak across the telephone circuit through the induction-coil primary to some extent, but not nearly so much as the low-frequency disturbing current. By means of either, or both, of these methods conversational conditions may be restored to the telephone line. We are not here discussing the novelty of these methods, because that is a matter of considerable doubt, but the feasibility of such methods is of important interest to many electrical engineers who are bothered by noisy telephone circuits.

Twenty-Sixth Annual Convention of the American Institute of Electrical Engineers.

The Hotel Frontenac, Thousand Islands, New York, is the scene this week of the twenty-sixth annual convention of the American Institute of Electrical Engineers. Following its excellent custom the society has sought a place where there are many attractions but few distractions, and where a large attendance can therefore be counted on at all the sessions.

The number present is gratifyingly large, the registration up to Tuesday morning being no less than 250. A great many members reached the pretty island on Friday or Saturday and nearly four score had got their badges by Sunday. The recent hot weather made the coolness of the spot all the more appreciable.

The exercises were opened at 10 a. m. on Monday by President Ferguson, who delivered a brief but most interesting address on "The Centralization of Power Supply." Urging that this is a day of consolidation, he pointed out that the advantages in the electric-power industry from the manufacture in large quantities and with improved methods began to stand out boldly on the economical side; while the investor was favorably impressed with securities that were broad-based and required no detailed information. These securities were more easily marketed and on more favorable terms than had been the smaller issues of minor companies. The most important result was the economy effected by combined investment and output. The load factor of American central stations, i. e., the ratio of the average load to the maximum load, controlled absolutely the earning capacity of the investment. In modern large power systems the operating costs are now so low they represented a comparatively small part of the total costs. The fixed charges constituted by far the larger part; hence the importance of the load factor.

After discussing the conditions of the load factor, President Ferguson pointed out that the larger output of combined loads permitted the use of generating units with a high performance efficiency and requiring a small operating force, with the result of a further reduction of costs. He touched on the standardization of apparatus as the result of centralization, and on harmonization of frequency and voltage, and as an incidental gain to the community instanced the reaching of a higher public standard of cleanliness in every direction. He then noted typical examples of electricity supply, such as Newcastle, England, Niagara, California and Chicago. He spoke with great emphasis of the value of the diversity factor which "in most cases enables the supply company to underbid independent producers." In fact, it might be said: "The diversity factor is the very foundation rock of centralized energy supply. It is the birthright of the central station, the fundamental reason for its existence; and its resultant value belongs to the central station company."

Mr. Ferguson then spoke of the taking on of electric railway loads which were small as compared with the total requirements of any given metropolitan area, and said that by combining all systems of neighboring cities within a radius of 30 or 40 miles into a single centralized system, a great saving in production would result as well as a great improvement in service.

"The progressive work of the electrical engineer will determine whether we can reach out into these larger fields. . . . It is for the commercial electrical engineer—which really includes nearly all of us—to educate the layman and particularly the power user to an appreciation of the superiority and desirability of electric service, and to emphasize the material and ethical advantages to a community of centralized power production." It was also the duty of the technical electrical engineer to furnish the leadership and sinews of war in conquest of the fields where waste and useless dissipation of energy still prevail.

The reception on Monday evening was a very successful affair under the guidance of Mr. C. W. Stone, chairman of the committee in charge. Among those in the receiving line were President and Mrs. L. J. Ferguson, President-elect and Mrs. L. B. Stillwell, Vice-President Calvert Townley and mother and Vice-President J. G. White and Mrs. White.

A Proposed Tax on All Corporations.

An amendment to the Senate tariff bill was offered by Senator Aldrich last week carrying into effect the Taft plan of a tax on the net profits of all stock corporations. The measure comes up for debate this week. Practically every character of incorporated institution organized for profit is brought within the provisions of the corporation tax. The provision defining the concerns from which it will be collected is as follows:

"That every corporation, joint stock company, or association, organized for profit and having a capital stock represented by shares, and every insurance company, now or hereafter organized under the laws of the United States or of any State or Territory of the United States, or under the acts of Congress applicable to Alaska or the District of Columbia, or organized under the laws of any foreign country and engaged in business in any State or Territory of the United States or in Alaska or in the District of Columbia, shall be subject to pay annually a special excise tax with respect to the carrying on or doing business by such corporation, joint stock company, or association, or insurance company, equivalent to 2 percentum upon the entire net income, over and above $5,000, received by it from all sources during such year, exclusive of amounts received by it as dividends upon stock of other corporations, joint stock companies or associations, or insurance companies subject to the tax hereby imposed, or if organized under the laws of any foreign country, upon the amount of net income, over and above $5,000, received by it from business transacted and capital invested within the United States and its Territories, Alaska, and the District of Columbia during such year, exclusive of amounts so received by it as dividends upon stock of other corporations, joint stock companies or associations, or insurance companies, subject to the tax hereby imposed.

"Such net income shall be ascertained by deducting from the gross amount of the income of such corporation, joint stock company, or association, or insurance company from all sources:

"All the ordinary and necessary expenses actually paid within the year out of income in the maintenance and operation of its business and properties.

"All losses actually sustained within the year, and not compensated by insurance or otherwise, including a reasonable allowance for depreciation of property, if any, and in the case of insurance companies the sums required by law to be carried to premium reserve fund.

"Interest actually paid within the year on its bonded or other indebtedness not exceeding the paid-up capital stock of such corporation, joint stock company or association, or insurance company outstanding at the close of the year.

"All sums paid by it within the year for taxes imposed under the authority of the United States or of any State or Territory thereof.

"All amounts received by it within the year as dividends upon stock of other corporations, joint stock companies or associations, or insurance companies, subject to the tax hereby imposed."

Foreign corporations are also brought within the scope of the measure, so far as net profits in America are concerned. Every corporation liable to the tax is to make a sworn return through some official on or before March 1 as to all the essential items of its business, revealing capital and profits, and a false return carries with it a fine of $1,000 or a year in prison, or both. After returns have been made to the office of the Commissioner of Internal Revenue and assessments have been made, the returns become public records open to inspection.

Convention of Association of Iron and Steel Electrical Engineers.

The Association of Iron and Steel Electrical Engineers held its second annual convention in Buffalo June 23, 24 and 25. The program of papers previously printed in these columns was presented. Visits to the Niagara Falls power plants, Lackawanna Steel plant, and to other iron and steel industries of Buffalo and immediate vicinity were scheduled for the closing day, so that only a brief meeting was held on that day. Before closing the business session Pittsburgh was selected as the next meeting place.

Boston Section of the American Society of Mechanical Engineers.

The first regular meeting of the Boston section of the American Society of Mechanical Engineers was held at the Lowell Building, Massachusetts Institute of Technology, on June 11. Chairman I. N. Hollis presided, and the paper of Mr. G. A. Orrok on the "Small Steam Turbine," read before the recent Washington convention of the society, was discussed. Among the speakers were Prof. I. N. Hollis, Harvard University; Prof. E. T. Miller, of the Massachusetts Institute of Technology; Mr. C. B. Burleigh, General Electric Company, Boston; Dr. Lowenstein, General Electric Company, Lynn; Mr. R. H. Rice, General Electric Company, Lynn; Mr. C. B. Rennick, Ken Turbine Company; Chief Engineer London, of the Terry Steam Turbine Company; Mr. F. B. Dowst, of the B. F. Sturtevant Company, Hyde Park, Mass.; Mr. Holmes, of the De Laval Steam Turbine Company; Professor Reed, of the Worcester Polytechnic Institute; Mr. C. H. Bigelow, of Stone & Webster; Capt. C. H. Manning, of the Amoskeag Manufacturing Company, Manchester, N. H., and Mr. Hawkins, of the Boston steam engineering school of that name.

International Railway Fuel Association.

Organized in Chicago last November, the International Railway Fuel Association held its first annual meeting in the Auditorium Hotel, Chicago, June 21 to 23. The purpose of the association is to benefit its members in relation to the best methods of purchasing, inspecting, weighing, distributing, handling and accounting for fuel. To be an active member one must be an officer of a railway company or an assistant officer, but men having general knowledge of fuel and fuel economies are eligible as associate members. As the fuel bill of the railroads of the United States is approximately $300,000,000 a year, the association deems that it has an important field. Among the papers read at the recent meeting was one by Mr. C. T. Malcolmson, of Chicago, on "Briquetted Coal, and Its Value as a Railroad Fuel." Other papers were: "How to Burn Locomotive Fuel Coal Successfully," "Difficulties Encountered in Producing Clean Coal for Locomotive Use," "Best Method of Accounting for Railway Fuel," "Correct Weighing of Coal at Mines and on Railroad Track Scales," and "Standard Types of Coaling Stations." The address of President McAulliffe was a thoughtful review of the fuel situation. Officers were elected as follows: President, Mr. Eugene McAulliffe, general fuel agent, Rock Island Railroad, Chicago; first vice-president, Mr. W. C. Hayes, Erie Railroad, New York City; second vice-president, Mr. J. H. Hibben, Missouri, Kansas & Texas Railway, Parsons, Kan.; secretary, Mr. D. B. Sebastian, fuel supervisor, Chicago & Eastern Illinois Railroad, Chicago; treasurer, Mr. J. McNanamy, Pére Marquette Railroad, Grand Rapids, Mich.

While this association is intended mainly for railroad men, it will welcome the co-operation of power-plant owners and all other large fuel consumers interested in the subject of coal testing and the economical production and utilization of fuel.

Convention of Brooklyn Edison Section of the N. E. L. A.

The first annual convention of the Brooklyn Edison section of the National Electric Light Association was held at the Oriental Hotel, Coney Island, June 23. There were nearly 300 members present, and the meeting was presided over by Mr. Geo. L. Knight, chairman. The papers read and discussed were for the most part abstracts of the papers presented at the recent Atlantic City convention of the National Electric Light Association, their purpose being to convey to the members of the Brooklyn branch some of the information and inspiration that were necessarily available directly to only the few who could attend the main convention.

SUBWAY CONSTRUCTION.

The first business was the presentation of an original paper on "Subway Construction," by Mr. J. J. Leddy, of the distribution department of the Brooklyn Company. In this paper the principal features of manufacture of the various types of conduits, cables, etc., installed by the Brooklyn Edison Illuminating Company were described. The process of burning clay ducts has always been one of uncertainty. To determine the temperature of the kilns and to reduce the time of burning to a minimum several of the kilns of the Great Eastern Clay Company have been equipped with the Frink pyrometer. The fiber duct manufactured by the Orangeburg Fiber Company was described in detail from the raw fiber as received from the Canadian forests to the finished product. Mr. Leddy next described the manufacture of the two 1,000,000-circ. mil concentric direct-current feeder cable used by the Brooklyn Edison Company, also the three-conductor 250,000-circ. mil, 6600-volt, three-phase feeder. The former cable is designed to carry 1250 amp at 240 volts for four hours without injury to its insulation. The three-phase feeder cable consists of three conductors having a cross-section of 250,000 circ. mils each. It is tested at the factory at a potential of 15,000 volts alternating current for 30 minutes. Sub-surface construction, drawing-in of cables and jointing were described in a practical manner.

Following the paper by Mr. Leddy, abstracts with comment were given from various papers presented at the National Convention. The presentation of these papers was made by Messrs. G. L. Knight, P. D. Sharkey, F. H. Harrison, J. J. Leddy, E. W. Babcock, C. A. Graves, J. F. Becker, M. S. Seelman, Jr., and J. L. Wiltse. The commercial papers seemed to arouse more interest than the technical ones.

There was an especially interesting and vigorous discussion on the "Relation of Electric Vehicles to Central Stations," a paper presented by Mr. J. T. Hutchings, of Rochester, at the National Convention and reviewed by Mr. Graves. Mr. W. W. Freeman, vice-president of the company, also spoke on this subject, indicating to those present the possibility of helping the work along in this direction.

At the evening session Mr. W. C. L. Eglin made a few remarks on the relations of the parent and branch organizations, and spoke encouragingly of the work that was being accomplished by both. Mr. P. H. Bartlett, of Philadelphia, spoke of the work being done by the Philadelphia section.

The principal feature of the evening session was the address of Mr. Caryl D. Haskins, of the General Electric Company. Mr. Haskins gave a general review of development in the various branches of the electrical field, particularly electric lighting, and cited his own experiences, especially those in England. His references to the then rough and untried methods of attaining results were amusing in the light of present knowledge. He finally considered the fuel and power problems of the future when coal becomes exhausted, and expressed the belief that the utilization of water-power would offer the main solution. The election of officers for the ensuring year resulted as follows: Chairman, Mr. Jos. F. Becker; vice-chairman, Mr. F. W. Harrison; secretary, Mr. E. A. Bailey; treasurer, Mr. F. C. Hill.

Convention of Association of Railway Telegraph Superintendents.

The twenty-eighth annual convention of the Association of Railway Telegraph Superintendents was held at the Hotel Pontchartrain, Detroit, June 23, 24 and 25, with an attendance of about 75 active members. President W. J. Camp, of Montreal, presided, and at the opening of the meeting the delegates were welcomed by the Mayor of Detroit and the vice-president of the Detroit Board of Commerce.

After disposing of routine matters, Mr. W. K. Morley, of Grand Rapids, the first president and organizer of the association, addressed the convention. He told of the steps which led to the formation of the association 27 years ago, it being the outgrowth of monthly meetings held in Chicago in the office of Mr. F. H. Tubbs, superintendent of the Western Union Telegraph, of telegraph superintendents having their headquarters in and about that city.

Among the reports presented at the convention was one on "High-Tension Wire Crossings," prepared by a committee consisting of Mr. G. A. Cellar, chairman, and Messrs. G. H. Groce and Charles Selden. The report recommended 700 volts as a dividing line between high-tension and low-tension work, and specifications were given for overhead and underground crossings of wires carrying 700 volts or over, and also for less than 700 volts. A paper, entitled "Preservation of Poles," was then presented by Mr. H. P. Folsom, and led to an interesting discussion.

FOLSOM PAPER.

The paper by Mr. Folsom opened with a discussion as to the cause of decay of poles at the ground line. The conclusion was that it is the result of a fungus growth, and that the germ attacks the pole from the outside and not the inside. The paper is largely devoted to a description of a patented method for arresting the decay of poles, and full details are given as to its application. Briefly, a hole about 14 in. deep is dug about the pole, a layer of Portland cement placed at the bottom of the hole, and the surface of the pole cleaned to a point somewhat above the level of the ground. Next a jacket made from a sheet composed of asbestos and asphaltum is placed about the pole, leaving an annular space of about 2 in. deep, which is filled with a germicide in a dry state mixed with sand. The germicide consists of slacked lime, common salt and a small quantity of sulphate of copper. Around the top of the jacket a cap or collar of Portland cement is formed, this being reinforced, if desired, with old telegraph or telephone wire. This collar protects the chemicals and jacket from the action of the rain and snow, and also protects the pole against grass fires. It is stated that the chemicals are slowly dissolved by the natural moisture in the pole, and pass into the same by the action of capillary attraction, thus destroying the fungi and wood-eating insects. A gang of three men can treat from 20 to 30 25-ft. poles per day at a cost of about 75 cents to $1 per pole, including royalty. Very large poles costing from $50 to $75 have been treated at a cost ranging from $1.50 to $2.50. It is stated that poles thus treated when they were partially decayed have, after nine years, shown no increase of decay, and that the protecting device is still in good condition.

In the discussion of the paper Mr. J. McMillan, superintendent of telegraph construction of the Canadian Pacific Railway, at Calgary, Alberta, stated that in part of his territory the decay of poles, instead of beginning at the ground line, starts 4 ft. or 5 ft. below the surface.

Other papers presented were as follows: "Telephone Construction," by Prof. J. C. Kelsey, which included data and specifications for standard work; "Efficiency of Office Organization," by Mr. J. B. Sheldon, of Omaha, superintendent of telegraph of the Union Pacific Railway; "Wire Testing and Care of Wires," by Mr. V. T. Kissinger, Lincoln, Neb., assistant superintendent of telegraph of the Burlington system; "Difference Between a Trouble-shooter and a Division Lineman," by Mr. H. D. Teed, of St. Louis, superintendent of telegraph of the St. Louis & San Francisco Railroad, and "Dry Batteries," by Mr. F. H. Loveridge, of Chicago. Exhibits of telegraph and telephone apparatus and supplies were displayed in rooms of the Hotel Pontchartrain by a score or more of manufacturers and dealers.

Following are the officers elected for the ensuing year: President, Mr. John L. Davis, of Chicago, superintendent of telegraph of the Chicago & Eastern Illinois Railroad; vice-presidents, Mr. I. T. Dyer, of Los Angeles, superintendent of telegraph for the San Pedro, Los Angeles & Salt Lake Railroad, and Mr. George A. Cellar, of Pittsburgh, superintendent of telegraph of the Pennsylvania Lines West of Pittsburgh; secretary and treasurer, Mr. P. W. Drew, of Chicago, superintendent of telegraph of the Chicago division of the Minnesota, St. Paul & Sault Ste. Marie Railroad.

It was voted to hold the annual convention next year at Los Angeles about the middle of May.

Nunn Building at Cornell.

For the purpose of maintaining at Cornell University a number of students who are to pursue research work in engineering, Mr. L. L. Nunn, of Telluride, Col., is building on the Cornell campus and will endow a clubhouse in which the investigators that he sends to Ithaca are to live. The house is to be situated directly north of the Delta Upsilon house, near West Avenue.

Mr. Nunn is one of the pioneers in electrical power transmission, and well known from his connection with the Telluride and allied plants in Colorado and Utah; one of the great Niagara Falls power developments is also due to his initiative. For years past electrical research work of an advanced kind has been done in connection with the operation of the Nunn plants, which work has had a notable influence on the advancement of electrical power transmission, particularly with respect to the use of higher and higher voltages, and switching arrangements. It is understood that Mr. Nunn wishes now to have this work, so far as possible, done where the results can be assured of permanent scientific as well as of immediately economic value, and that he has selected Cornell University for this purpose.

From the university trustees Mr. Nunn has obtained a lease of ground north of the Delta Upsilon house, and he is there erecting a dormitory. The plans provide for a three-story and basement structure measuring about 45 ft. x 90 ft. It will be somewhat like a fraternity house, with living rooms on the first floor and about 20 sleeping rooms on the two upper floors. It will be finished, if possible, so as to be put to use when the university reopens next fall. The house, it is stated, will be endowed by Mr. Nunn.

Bell-Independent Telephone Toll Contracts in Ohio.

The Bell telephone people are reported to have completed long-distance connections with the independent exchange at Willoughby, a town east of Cleveland. It is reported that a contract has also been signed with the United Telephone Company, of Bellefontaine, Ohio. Further, the Bell interests claim to have several other contracts with independent companies ready to sign. This, it seems, is the beginning of the warfare to be waged under the recent decision of Judge Robert W. Tayler, of the United States District Court. For a time it was thought that both sides would be slow to move into each other's stronghold, for the decision applies both ways. The United States Telephone Company may force connections with the Bell local exchanges on the same basis as the Bell connects with independent companies, if the decision is understood rightly. It seems that a local company which has long-distance connections with another company cannot deny connections with still others on the basis that the first one was admitted to take business. It only depends upon whether the companies desire to enter such a contest.

Boston Street Lighting Contract Sustained.

Corporation Counsel Thomas M. Babson, of Boston, has given an opinion that Mayor Hibbard and Superintendent of Streets Emerson acted entirely within their legal rights in signing the recent street-lighting contract with the Edison Electric Illuminating Company. It was recently claimed that the Board of Aldermen's consent was necessary to the making of such a contract. Mr. Babson cites statutes forbidding any member of the city government to take part directly or indirectly in the making of a contract. The superintendent of streets has employed methods of lighting which have been approved by the Board of Aldermen, which has favored the use of electricity, gas and naphtha in the past. Mr. Babson stated that there is no doubt about the right of the Mayor to make a contract for the smaller street lighting upon the basis of bids scheduled to be opened June 28. The legislative powers of the City Council are confined to such matters as the approval of pole locations and heights.

Plant Extensions at Cedar Rapids, Iowa.

Extensive additions to the plant of the Cedar Rapids & Iowa City Railway & Light Company, of Cedar Rapids, Ia., are to be made, and plans for the work are being prepared by H. M. Byllesby & Company, of Chicago. The boiler-room of the station will be completely remodeled, and new boilers, having a capacity of 1400 hp. will be installed. These boilers will probably be equipped with automatic stokers, and the necessary pumps, etc., will also be needed. It is probable also that coal- and ash-handling apparatus will be installed. A new steel chimney, 10 ft. in inside diameter, will be built. The plans also provide for the addition of three 2000-kw turbo-generators in the engine-room. The present engine-room equipment consists of a 1500-kw Allis-Chalmers turbo-generator, a 800-hp Fulton engine driving a Bullock generator, and a 400-hp Buckeye engine driving a Westinghouse generator. The president and general manager of the Cedar Rapids & Iowa City Railway & Light Company is Mr. William G. Dows, and the manager of the lighting department is Mr. W. J. Greene.

Space Between Passing Street Railway Cars.

At a meeting of the Chicago City Council committee on local transportation, on June 23, Mr. George Weston, the member of the Board of Supervising Engineers representing the city, presented a communication on the subject of clearance between passing street-railway cars in Chicago. As readers of this journal are aware, this subject is attracting much attention owing to accidents which have caused the death of a number of persons by being crushed between passing cars on the "death strip," as it has been called, left between passing cars by the present standard type of construction in Chicago. Mr. Weston gave an account of the extended consideration which the board has given this subject. The question relates to the distance to be left between track centers, width of the cars and the space remaining for wagon traffic between the sides of the cars and the curb, which is, of course, particularly important in narrow streets.

Although at one time he coincided with other members of the board in favoring the narrow space, Mr. Bion J. Arnold, chairman of the board, now advocates a space of 20 in. between passing cars, to be obtained by increasing the distance between track centers from 9 ft. 8½ in. to 10 ft. 2 in., and by reducing the width of the cars from 9 ft. to 8 ft. 6 in. This would leave a space of 20 in. between passing cars. Mr. Weston believes that the clearance between cars, to be perfectly safe, should be not less than 30 in. He is not convinced that the net results for safety would be greater with a 20-in. space than with an 8½-in. space. Many persons who have studied the subject, he says, believe that a 20-in. space would result in a condition that would invite people to seek refuge in the space, with the result that very likely they would be knocked down and dragged under the cars, thereby increasing the number of crossing accidents.

Mr. Weston says that this is not a technical question and that he has interviewed a number of crossing policemen on the subject. In every instance these men said that if the space cannot be widened enough to be safe, it would better remain as it is. On the other hand, it is self-evident that a man caught in an 8½-in. space will be crushed, whereas, in a 20-in. space, he would have a chance for his life. As to the distance between cars and curb the minimum should be 9 ft. 8 in., in Mr. Weston's judgment, particularly in the business streets with a 38-ft. roadway, because with the ordinary delivery wagon backed up to the curb, the space mentioned is just sufficient to allow a car to pass.

While Mr. Weston is doubtful, he appears now to be willing to try the 20-in. space. Mr. H. B. Fleming, of the Chicago City Railway Company, is believed to have favored the 8½-in. space from the first. Mr. Arnold, as pointed out, has been converted from the 8½-in. space to the 20-in. space. Mr. John Z. Murphy, the remaining member of the board representing the Chicago Railways Company, favors the 20-in. space. Mr. Murphy is a large man, but he has stood between passing freight cars with a 20-in. clearance. He says that no man who keeps his head need be killed if caught between passing cars with a 20-in. clearance. The present agreement seems to be that there should be no further extensions having the 8½-in. clearance. The subject will be further considered at a future meeting of city officials, members of the board and officers of the traction companies.

In the discussion of this subject in the daily newspapers there has been much diversity of opinion. Teaming interests do not want the space between cars and curb contracted in narrow streets. One suggestion is that the space between tracks should be widened only at street intersections and for a short distance on either side, leaving the width between tracks in the middle of the block as at present. Another is that cars carry conspicuous signs reading: "Look Out for Passing Cars," or "Death Between Passing Cars." A number of other suggestions have been offered. The general opinion seems to be, however, that a 20-in. clearance would at least offer an adult person a chance for his life if caught between cars, whereas, with an 8½-in. clearance, he would be almost sure to be killed, and, therefore, that the wider space (although still narrower than the clearance required for absolute assured safety) should be adopted.

Rensselaer Polytechnic Engineering Laboratory.

At the eighty-third commencement of the Rensselaer Polytechnic Institute, on June 15, the Russell Sage engineering laboratory was formally opened. The laboratory is the gift of Mrs. Russell Sage, and cost, with its equipment, $405,000. Of this amount $300,000 was taken from a donation of $1,000,000 made by Mrs. Sage, the remaining $700,000 being reserved as an endowment fund. Among those present at the exercises were Prof. Dean F. A. Goetz and Prof. W. H. Burr, of Columbia University; Prof. H. W. Spangler, of the University of Pennsylvania; Mr. E. W. Rice, Jr., vice-president of the General Electric Company, and Mr. L. B. Stillwell, president-elect of the American Institute of Electrical Engineers.

Courses in mechanical and electrical engineering were instituted at the Rensselaer Polytechnic Institute last year in pursuance to a resolution adopted by the board of directors in March of that year. Dr. W. Lispenard Robb is in charge of the electrical engineering department. The laboratory, which is shown in the accompanying illustration, consists of a central portion 50 ft. wide by 100 ft. deep, and two wings each 100 ft. wide and 80 ft. deep, the building being four stories in height. The east wing contains the department of electrical engineering, and the west wing that of mechanical engineering, the central

portion being devoted to a large lecture room, reference library, museum and drawing-room. The principal addresses delivered during the exercises were by Mr. Jesse M. Smith, president of the American Society of Mechanical Engineers, and Mr. L. W. Stillwell, president-elect of the American Institute of Electrical Engineers.

Mr. Stillwell in sketching the growth of the industrial arts said that, while practice in America in the mechanical and electrical arts compares favorably as a whole with that of any other country, the discovery of the facts upon which practice is based has been more often European than American. Even in the practical application of physical sciences it happens not infrequently that we follow and do not lead. While the United States takes high rank in technical education, a point has been reached where scientific methods and scientifically trained men are needed as they never have been needed before. From now on the industrial and commercial progress must depend more upon refinements of practice and less upon the expansion of new fields; and to the attainment of such refinements the knowledge and training that students will have an opportunity to attain in the laboratories of the technical schools are factors fundamentally essential. Training imparted in laboratories such as that being dedicated preëminently fits men, not only to be mechanical and electrical engineers, but also to attack with success the economic and essentially scientific problems which arise in almost every department of the manufacturing industry. In the electrical field there is constant need of more workers,



RENSSELAER POLYTECHNIC ENGINEERING LABORATORY.

and especially of trained workers. For many years to come the demand for mechanical and electrical equipment will continue to increase at a rate exceeding the average rate of increase for other manufactured products, and consequently the field for trained workers in the practical application of mechanical and electrical sciences is an expanding one.

But the actual field available for graduates of an institution like the Rensselaer Institute is much wider than would be gathered from a mere consideration of those spheres of effort which are regarded as peculiarly the province of the engineer, owing to the fact that no other training so well fits a man for success in the many more or less closely related departments of practical industry. Moreover, beyond the great value of an engineering laboratory as a school for training students in engineering courses lies another possible, and even probable, greater value—the opportunity which it affords, and the stimulus which it may be expected to impart to latent talent in the fascinating and wonderful field of original research. Mr. Stillwell expressed the hope that among the young men destined to work within the walls of the Sage laboratory some will be found whose preference would be for pure science rather than for its applications, and whose patient research work in later years will result in further additions to the still far from complete basis of scientific knowledge upon which present engineering practice rests.

Electric Pumping for Irrigation.

The water for the great system of canals and ditches of the Mercedes, Tex., irrigation system is pumped from the Rio Grande by means of electrical energy which is supplied from a central power plant situated in the town of Mercedes, seven miles from the pumping station. The Mercedes enterprise will be one of the largest electrical pumping irrigation propositions in the world when the plans are fully rounded out. Water will be supplied for more than 200,000 acres of land, situated in the valley of the lower Rio Grande. The central power plant at present generates at 6600 volts, the three-phase currents being transmitted to the pumping station, situated upon the bank of the river, seven miles distant, and operates an induction motor-driven pump, which has a capacity of 60,000 gal. per minute. The equipment of the central power plant consists of two generators of 300 kw each and a 15-kw lighting set for the town of Mercedes, when the main set is shut down. The main canal of this system is already completed for many miles across the valley land, and carries a stream of water 145 ft. wide and 10 ft. deep. The canal is capable of being navigated by barges and



ELECTRIC PUMPING FOR IRRIGATION AT MERCEDES, TEX.

boats. There are a number of other small electric pumping plants along the upper course of the Rio Grande River, particularly in the vicinity of Laredo, where a number of farmers receive electrical energy for operating their respective pumping stations from the electric power plant in the town.

New York Public Service Commission News.

The Public Service Commission of the First District of New York has addressed a letter to the Board of Estimate and Apportionment, asking for authority to advertise for bids on all the subway routes which were laid out by the old Rapid Transit Commission. The routes mentioned in the letter include the Lexington Avenue, the River Avenue, the Rome Avenue elevated, the Southern Boulevard and Westchester Avenue, the Canal Street, the Manhattan Bridge routes and the Brooklyn Loop line from the Williamsburgh Bridge to Ashland Place in Brooklyn. It also desires authority to make contracts for the equipment and operation of the Fourth Avenue, Bensonhurst, Bath Beach and Coney Island route, contracts for which have already been let by the city, and to contract for the operation of the Manhattan Bridge loop. This action, which is in the nature of forcing the hand of the Board of Estimate, contemplates the construction of more than $100,000,000 worth of

new subways, and the expenditure of a like amount for equipment. The commission suggests that bids be asked for this work under the three forms now permitted by law; by public money, by private capital and by assessment of the property owners benefited by the subways. The Board of Estimate has not yet taken any action on the matter, but promises that it will consider it at an early date.

The Public Service Commission has not as yet received any new subway plans or proposals from the Interborough Rapid Transit Company, although it has been notified that these plans are being matured and will be offered within a very short time. It is stated that when the Interborough's new proposals are made they will practically cover all of the subway routes authorized by the old Rapid Transit Commission.

The case brought in the Appellate Division of the Supreme Court of the city of New York, by the South Shore Traction Company against the Public Service Commission, to test the latter's right to withhold its approval of the franchise already granted by the Board of Estimate and Apportionment, was argued last week by counsel for the two principals, and also by the corporation counsel of the city. There is a desire on all sides to push the matter to an early conclusion, and to get a decision settling the commission's authority before the adjournment of the courts.

At a hearing before Public Service Commissioner Maltbie, in a continuation of the investigation of electric light and power companies of New York City, Messrs. A. H. Larkin and James H. Sims testified as to the franchises of the Richmond Light & Railroad Company. A map covering these franchises has been prepared by the chief of the commission's franchise bureau, Mr. Delos F. Wilcox. It was shown in the testimony that the present company succeeded to the rights of the Richmond County Electric Light Company, which itself was a consolidation of a number of local companies, such as the Port Richmond Electric Light Company and the New York & Staten Island Electric Company. These smaller companies owned franchises and contracts for public lighting, which had been granted by village and town authorities and by highway commissioners. It was claimed by the witnesses that under the rights derived from these companies which were absorbed, that the Richmond Light & Railroad Company now possesses franchises and contracts covering the entire Borough of Richmond. The investigation is but one step in the commission's work of making a thorough record of all existing franchises for light and power in the territory under its jurisdiction.

The Public Service Commission has disapproved of the type of wheelguard now in use on the Second Avenue Railroad, New York. The guard, which is known as the "Pilot Fender," does not, it is claimed, operate close enough to the ground.

Mayor McClellan has notified the Board of Estimate that he has approved the franchise of the Hudson & Manhattan Railroad Company for the extension of its lines under Sixth Avenue from Thirty-third Street to the Grand Central Station. Mr. McAdoo, president of the road, states that work will be begun as soon as sufficient property agreements can be secured, and predicts that trains will be running in the new tube by 1911.

The Public Service Commission of the Second District of New York has given authority to the Westchester Lighting Company to purchase the entire capital stock and bonds of the Northern Westchester Lighting Company, and the common stock and bonds of the Peekskill Lighting & Railroad Company. This practically sanctions the merger of all of the lighting properties in the northern section of Westchester County under one management. The Westchester Company is controlled by the Consolidated Gas Company, a Standard Oil interest.

Peoria Electrolysis Case.

Another stage of the important and long-drawn-out litigation usually referred to as the "Peoria electrolysis case" was reached on June 22 when Mr. Frank L. Wean, of Chicago, as special master in chancery, filed a second report to the United States Circuit Court for the Northern District of Illinois. The complainant in this case is the Peoria Water Works Company and the defendant is the Peoria Railway Company. The suit, which has been pending in one form or another, for perhaps 15 years, arose out of the damage to the plaintiff's buried water mains alleged to be due to escaping current from the defendant's return electric circuit. It has attracted wide attention among electric and street-railway men, owing to similar allegations of damage to water pipes and other buried metallic structures from escaping electricity in other cities. The second reference to the master was to determine, among other things, what remedy could be applied to minimize or prevent the injury complained of.

The master reports that in March, 1908, the railway company was operating about 50 miles of single-track railway in Peoria and vicinity. The rails in use were largely of the girder type, 7 in. high, 60 ft. long and weighing 80 lb. to the yard. In the business portion of the city these rails were laid on hardwood ties embedded in concrete, with the space between the rails and adjoining the rails paved with brick. The return system consists of the rails bonded at each rail joint with two No. 0 copper wires in the manner known as "channel-pin bond." At the time mentioned the "brazed bond" had been applied to about three miles of track. This "brazed bond," according to the evidence, is one of the most efficient devices for continuing the electric conductivity of the rail return at joints, but is no more efficient, says the master, than the welded joint or certain other methods of bonding which have been in use for a long time. Where special work existed the rails were cross-bonded. The defendant also had as a part of its return about six miles of negative overhead wires running from its power station to different parts of the system. These wires were connected with rail and tracks at one end and at the other to the negative busbar in the power house.

Since the close of the defendant's evidence on the former hearing, the railway load has perhaps doubled, and although the conductivity of the return has been improved by heavier rails double rail bonds, cross-bonding, additional negative return feeders and, so far as it has been applied, the brazed bond, still the master finds it is more difficult to prevent the escape of electric current to the water pipes of the complainant owing to the increased traffic and the passage of large interurban cars. The master holds that the evidence shows that notwithstanding all preventive means adopted the current flow on the waterworks system has gradually increased; a portion of the current has continued to escape and work damage to the proximate underground metallic structures.

The master says that in many cases the complainant's water mains have been injured and in some cases rendered useless by the return current of the railway company. In these distributing mains since 1893 there have been discovered 119 joint leaks in 30-in. mains, 14 in 20-in. mains, 43 in 16-in. mains and 47 in other mains. Two breaks have occurred in 30-in. mains and nine in 20-in. mains. Electrical surveys made as late as March 25, 1908, showed the most current flowing on the pipes in about the places where the greatest number of joint leaks and breaks occurred. The pittings in the mains, caused by flow of electricity from the defendant's system, have been constantly increasing in depth, according to the master. On South Adams Street, where the depth of a pitting, according to the evidence at the former hearing, was ⅛ in. in March, 1908, instances were found where the depth of the pitting was 0.55 in in a main having metal normally ⅞ in. thick.

The defendant offered witnesses who testified that all danger could be prevented by the use of the brazed bond on all rail joints in addition to the present bonding, together with proper cross-bonding and "jumpers" and proper maintenance of overhead negative return wires. On cross examination some of these witnesses testified that the plan proposed could not wholly prevent the escape of electric current, but that the amount escaping would be so small as to do no damage. The complainant's witnesses controverted this position. The master's finding is as follows:

"The evidence offered on this re-reference fails to disclose

any method which will completely or substantially prevent the injury complained of; and all the evidence fails to disclose the discovery, since the hearing under the previous order of reference, of any new principle or fundamental law, regarding the nature and effect of electric current or of any new method of preventing the escape of such current different in principle from those known at the time of the former hearing. In other words, the evidence on this reference, taken as a whole, tends to confirm the findings stated in this special master's former report."

The former conclusions which the master fails to change are in effect that a difference in potential of a fraction of a volt may cause electrolysis, and from the conditions found the ultimate destruction of the complainant's pipes by electricity escaping from the defendant's system is said to be a question only of time and pressure. Further, no method is disclosed by which the complainant, by its own action, can protect itself from the electric currents of the defendant's single trolley railways. Entire removal of electric current from the water mains is impossible, in this case, as long as the return currents are grounded or in electric contact with the earth.

Objections to the master's report have been filed by the defendant's counsel, Mr. John P. Wilson, of Chicago, and Mr. I. C. Pinkney, of Peoria, who contend that many of the findings of the master are contrary to the evidence, particularly the statement that it is more difficult to prevent the escape of current since the former hearing, owing to the increase of traffic and the passage of large interurban cars. Categorically, findings as to injury to pipes, pitting and the alleged injury to the complainant's distributing system are objected to as being contrary to the greater weight of evidence.

The next step in this litigation probably will be a motion by the complainant's attorneys to have the master's report confirmed by the court. Undoubtedly the judge hearing that motion will take the case under advisement, and it will probably be some time before the court's decision is announced. Accompanying the master's report was about 1000 pages of typewritten testimony taken on the re-reference.

Internal Combustion Engine Trades Convention.

The National Gas and Gasoline Engine Trades Association held a three days' convention in South Bend, Ind., June 22, 23 and 24, closing with a banquet at the Oliver Hotel. The opening session was called to order by the president, Mr. H. T. Wilson, of Middletown, Ohio. Mayor Fogarty tendered a cordial welcome to the visitors and a happy response was made by President Wilson. The convention then took up the first paper on the program, entitled "Storage Batteries for Ignition Purposes" by Mr. G. L. Chandler, of the Willard Storage Battery Company, of Cleveland, Ohio. This was followed by a paper by Mr. Charles Kratsch, of Chicago, on "Gas Engines." These papers formed the subjects for discussion for the first session, which was participated in by a goodly number of delegates.

At subsequent sessions a number of interesting papers were presented, among them being one entitled "The Suction-Gas Producer for Small Power Plants," by Mr. C. J. Atkinson, followed by a paper on "Gas Engine Construction for Producer Gas Use," by Mr. H. F. Smith. Both papers were interestingly discussed. The "Advantages and Disadvantages of Selling Gas Engines Through the Jobbers and Dealers" was clearly defined in a paper read by Mr. M. F. Bates, and "Twenty Years as a Gas Engine Jobber" was the subject of an interesting paper presented by Mr. J. N. Shoemaker. The incidents and experiences brought out by these papers awakened quite an interesting discussion. "Jump-Spark Coils for High-Compression Engines" formed the subject of an illustrated talk by Mr. J. A. Williams. "Dry Cell and the Advantages of Multiple Batteries for Ignition" were treated in a paper by Mr. A. L. Haskell, and provoked an extended discussion.

After adopting a resolution of thanks to the Oliver Hotel, the city press and the committee of entertainment, headed by Mr. O. M. Knoblock, and others who had done so much to make the convention a great success, the entire party of 100 or more was taken on a trolley excursion to St. Joseph, Mich., by and through the courtesy of *Gas Power*, the trade journal published at that place. The next meeting place was left with the board of directors, and the date will be some time in December. The officers of the association are as follows: Mr. Harry T. Wilson, Middletown, Ohio, president; Mr. M. A. Loeb, Cincinnati, Ohio, vice-president; Mr. Otto M. Knoblock, South Bend, Ind., treasurer, and Mr. Albert Stratmatter, Cincinnati, Ohio, secretary.

The Late Charles L. Buckingham.

The death of Mr. C. L. Buckingham, which occurred May 31, and was noted in the *Electrical World* of June 10, suggests a somewhat more extended sketch of his career as a lawyer and electrical engineer.

Charles Luman Buckingham was born Oct. 14, 1852, in Berlin Heights, Ohio; the son of George and Ariadne (Andrews) Buckingham. He was the eighth in descent from Thomas Buckingham, the founder of the American family and one of the Puritans who, in the year after his landing at Boston (June 26, 1637) founded the city of New Haven, and subsequently settled Milford, Conn., in 1639. A son of this pioneer, through whom the subject of this sketch descended, was the Rev. Thomas Buckingham, one of the founders of Yale College in 1700. After the early death of his father, Charles was graduated in 1875 from the University of Michigan as a civil engineer, and acted for four years as an examiner in the Patent Office at Washington. During this period he pursued a course at the law school of the Columbian University, from which he was graduated as bachelor of laws. In 1880 he took the position of advisory expert and assistant counsel for the Western Union Telegraph Company, which position soon became that of patent expert and counsel.

Thus Mr. Buckingham came into the field of electrical patent litigation at a time when very few lawyers possessed any knowledge of the theory and practice of electrical generation, distribution or utilization. Very early in his work in that field he demonstrated his capacity to grasp readily the most complex conditions of operation and the mathematical expressions of those conditions and, thus fortified, to conduct without electrical expert assistance the cross-examination of specialists in abstruse cases. His record is so notable that the story of his labors in that field may be said to be closely interwoven with the history of successful patent litigation, and the results of those labors have shaped to a material extent the commercial development of the telegraphic, electric light and electric power branches of the modern art.

His first important work for the Western Union Company was with E. M. Dickerson in the famous case of Gold & Stock Telegraph Company vs. Commercial Telegram Company et al., for infringement by the latter's stock-tickers, of reissue patent No. 3,810 to Edward A. Calahan, dated Jan. 25, 1870, in which suit application for preliminary injunction was argued before Judge Wallace, June 13, 1884, and a permanent injunction granted by Judge Shipman, April 1, 1885 (23 Fed. Rep. 340), restraining the Commercial company from further use of its tickers. This early triumph was the more notable because of the array of opposing counsel, including Roscoe Conkling, David Dudley Field and Samuel A. Duncan. Later, in 1885 to 1887, the Western Union sued the Baltimore & Ohio Telegraph Company for infringement of the Stearns divisional reissue patents Nos. 10,033, 10,034, 10,035, dated Feb. 7, 1882, involving the use of condensers in duplex and quadruplex telegraphy, an element so important that the continued existence of the defendant was the real issue in the case. As a result, the Baltimore & Ohio sold out to the complainant company. In 1892-1894 the cases brought by the Magnetic Separator Company against the International Ore Separating Company and William D. Hoffman, re-

spectively, under several patents of Ball, Norton & Porter, resulted in injunctions after final hearing.

Mr. Buckingham's experience in the exhaustive analysis of telegraph patents and apparatus doubtless led to his own conception of the rapid telegraph system which he invented and developed during the time of his connection with Western Union affairs, and with which his name is so intimately associated that his patient and original labors in this direction need be referred to only briefly. His U. S. patents on this system and apparatus are about 25 in number, issued at various times from No. 487,981, Dec. 13, 1892, to No. 880,275, Feb. 25, 1908. His corresponding foreign patents remained in his hands at the time of his death.

But it was as counsel for defendant that Mr. Buckingham exhibited his full power and attained his full measure of reputation. One of his first cases of this kind was Postal Telegraph-Cable Company vs. Delaware and Atlantic Telegraph & Telephone Company. In the case of Brush Electric Light Company vs. Schuyler Electric Light Company his record in defense was so evidently conclusive of the weakness of the patent at issue that the Brush company never forced the case to a hearing. In the later suit of Edison Electric Light Company vs. New Haven Electric Light Company for infringement of the Edison three-wire generation and distribution patent No. 274,290, dated March 17, 1883, which was so generally feared and respected that it lived out its 17 years of great usefulness without being judicially sustained, Mr. Buckingham searched the archives of the principal patent offices of the world and held the situation until the consolidation of 1892, in which this patent played an important part, brought the contestants together in the General Electric Company, and terminated the suit before the rebuttal testimony was commenced.

Quickly following that merger he was retained by the consolidated interests to defend the suit of Westinghouse Electric & Manufacturing Company vs. Thomson-Houston Electric Company filed May 24, 1893, for infringement of the Tesla basic multiphase generation, distribution and motor patents Nos. 381,968 and 382,280, which had, in the five years following their date of issue, come to represent so vital a factor in electrical transmission of power. He represented the defense of the suit of Siemens & Halske Electric Company of America vs. Metropolitan & West Side Elevated Railway Company, a customer of the General Electric Company, on the strongest of the Siemens patents, No. 324,176, covering rheostatic control of electric motors. Still later, Dec. 2, 1897, came the defense in the suit popularly known as the Hutin & Leblanc case against the General Electric Company, which, after four years of preparation, was ready for hearing when the contest was given up and settlement out of court was reached.

Just before his departure for Europe last year in an effort to regain his health, Mr. Buckingham completed his defence in the case of Harry Ward Leonard vs. General Electric Company, patent No. 478,344, for multi-volt motor control; a suit well illustrating his tireless pertinacity in searches for prior public uses beyond the information possessed by the Patent Office.

For over 12 years prior to his death Mr. Buckingham had been in charge of the defence of 12 suits under three Schlesinger patents, of which the most important, No. 546,059, claims the use of a certain arrangement of feeding conductors in a system of electric railway distribution. His last work was on the defendant's brief in the principal suit of this group, preparatory to its expected final hearing in July; also the closing of four years' work in the Edison litigation, New York Phonograph Company vs. National Phonograph Company and Thos. A. Edison, by a settlement which leaves the entire manufacture and the commercial business in the management of Mr. Edison and his organization. To this important phonograph issue (in which he was assisted first by Mr. Charles M. Hough, now Justice of the U. S. District Court, and afterward by ex-Justice William H. Wallace) Mr. Buckingham gave his unremitting efforts during the last year or more of failing strength, undermining his remarkable physique. Even after being forced to leave his office, he kept on his feet until the fourth day before his death, when he was compelled to give up the unequal fight.

Deprived by the death of his wife nearly 20 years ago of the full measure of home life and domestic enjoyment which under ideal conditions constitute the relaxation from persistent business activity which is so important to the prolongation of usefulness in this strenuous age, Mr. Buckingham devoted himself unreservedly to the detail of his legal cases, with only occasional respite in short trips to Europe, or visits to his aged mother in Ohio, or days in the society of his boys during their school life, or evenings with his small circle of close friends whom it seemed to delight him to entertain in his inimitable way.

This concentration of his great personal strength and energy upon his deliberate and exhaustive methods of analysis and accumulation of masses of evidence and judicial opinion to support his positions, made him one of the most formidable opponents at the American Bar. Always genial and courteous, he possessed in an eminent degree that indomitable persistency which looks upon obstacles less as a discouragement than as a stimulus to greater endeavor. It never appeared to occur to him to place limitations upon his own endurance or that of those associated with him. He was intemperate only in the persistency of his labors, and failed in generosity only in his requirements of those who were under his command in his struggles for victory. He could not refuse the appeal of human distress, and the maintenance of anything but a fair, open warfare was utterly foreign to his nature.

As early as 1894 the late Henry Morton, then president of the Stevens Institute of Technology, in speaking of the high position which had been attained by Mr. Buckingham in his chosen profession, said:

"His success is largely due to the prodigious amount of work he is capable of performing. He is conscientious in thoroughly mastering the details of his cases, which often involve an amount of study and labor quite beyond the reach of the general practitioner. His scholarly research in matters pertaining to his specialty is profound and comprehensive, and is the admiration of all familiar with the subject. It is particularly apparent in his numerous writings on telegraphy, all of which indicate entire familiarity with the subject of electricity in all its relations."

The loss which the legal profession has sustained was tersely expressed by His Honor Mr. Justice Lacombe in granting a motion made by Justice Hough at the memorial service held in the United States Circuit Court for the Southern District of New York on Friday, June 11, in these strong words:

"As the years go by these mournful occasions present themselves and give notice to us all that we are moving on. The Court feels it unnecessary to add anything to the remarks which have been made here, except to express in behalf of the whole Bench the sense of loss which we feel and an appreciation of the fact that our friend will be no longer before us. His ability was of the very highest order, his presentation of his cases always earnest and extremely luminous, and impressed as he was with the very highest ideas as a lawyer and as a man, his loss is one to be deplored. The clerk will make the proper entry in the minutes."

Mr. Buckingham became a charter member of the American Institute of Electrical Engineers on April 15, 1884, when its first meeting was held, and the following year he was elected a manager and served one term on the Council (now called the Board of Directors), 1885-8. He was one of five who purchased for donation to the library of the Institute a valuable classified collection of all the United States electrical patents issued down to 1891, numbering more than 100 volumes. He was also a member of the American Association for the Advancement of Science, the American Academy of Political and Social Science, the Metropolitan and Union clubs of Washington, and the Engineers' Club, University Club and Ohio Society of New York.

Mr. Buckingham's mother, Mrs. A. A. Hopkins, survives him. She is a woman of exceptional attainments and character. His older son, Harry, married the daughter of his

father's college classmate, Prof. R. C. Carpenter, of Cornell University, and has lived for some time in the far West. The younger son, Charles, is just completing his freshman year at Yale. *W. J. J.*

It is difficult for one who enjoyed the confidence of the late Charles L. Buckingham to speak or write with moderation concerning his amiable qualities as a friend and his admirable character as a man. He was a strong, forceful personality; generous in the old sense of the term, and unfailing in every obligation of friendship, often going far beyond the conventional requirements of such a relation and interpreting by his own large nature his duties toward one in whom he took a personal interest. He never received a favor which he did not endeavor to requite in multiple; and somewhere within him must have lain the feeling that a kindness shown to him was something which was beyond his power of repayment.

The bigness of the man was evident in his powerful frame, his hearty voice, his straightforward manner, and all his methods of dealing with his associates or opponents. There was never any doubt as to what his opinions were, and no one engaged in controversy with him could ever have suspected underhand modes of treatment, however he might dread the strength of the opposition which he was certain to encounter.

Besides being a good friend, Mr. Buckingham was an equally good enemy. He had a strong lust for battle, but it was fair fighting and no favor. If he made a hostile move, it was only after an open declaration of hostility and according to all the rules of civilized warfare. He was too self-reliant for petty envy, but he did not spare an opponent through false sentiment. His rule was to play the game. He was ambitious to win and he used all the legitimate methods at his command to secure that end.

In the opinion of those who were most familiar with his work as a patent lawyer, he was one of the leading members of the Patent Bar, and as counsel for the defense in patent litigation, a position for which he was especially suited by nature and training, it is doubtful if he has ever had a superior among American lawyers.

While it may have seemed to his opponents in many instances that he carried too far the resemblances and analogies appearing in the prior art as compared with the patent in suit, yet no one could question the fact that the defense which he built up was the strongest possible rejoinder to the claims set up in a patent suit. He was fruitful in expedients for taking every fair advantage of the circumstances. There was little, if anything, remaining to be done when his case was in final shape.

This does not necessarily mean that Mr. Buckingham was always successful in his patent litigation work, but it means that he made the best possible use of the materials at hand; and it is a fact well known among the members of the Patent Bar that, on the strength of the defense set up by him, suits were often compromised in preference to taking the risk of carrying them to final hearing.

In his professional work he pursued methods of his own, some of which have been derided by lesser men. His preparation for the conduct of a case fas most thorough in every detail.

Nothing was too small to escape his notice, provided it had a bearing upon the issue of the controversy; yet his general conception and treatment of a patent suit were broad and drawn on large lines. In some of the most intricate cases calling for special technical knowledge of electrical matters, he made himself by general and special studies so proficient that he was able to teach his own experts what they had previously failed to appreciate. The writer well remembers a remark made to him by Mr. George R. Blodgett, chief patent attorney for the General Electric Company, while the famous suits on the Tesla patents were pending, to the effect that Mr. Buckingham, who conducted the defense, had surprised them all by his technical understanding of the principles involved. Mr. Blodgett considered that Mr. Buckingham had made himself one pre-eminent expert in the Tesla art, which at that time was not so generally well understood as now; and that whoever wished to master the technicalities of that art could learn much by consulting him.

Nor was he less scrupulous in the detailed preparation of his cases from a legal standpoint than he was from a technical and scientific standpoint; and there can be no question that his methods were effective.

He was himself an inventor of recognized ability. The perforator and printer which he invented while patent counsel for the Western Union Telegraph Company and the American rights for which he sold to that company, are examples of his tireless work upon subjects which interested him, and they display inventive ability of a rare order. The perforator is in constant use by the Western Union Company, although the printer has, it is understood, been set aside. In the production of these two devices Mr. Buckingham spent years of time, endless labor and large sums of money in overseeing the development of practical working apparatus at the shops of the model makers, and his triumph in the end was due to the same kind of pertinacity and attention to details which marked all his other work.

As a writer he possessed lucidity and a power of condensed expression that would not be expected by one who was familiar only with his legal briefs. This was illustrated by his contribution, "The Telegraph of To-day," to a series, "Electricity in Daily Life," first published in *Scribner's Magazine,* and later in book form (1891). In this series Mr. Buckingham was associated with such scholarly and eminent teachers as President Morton of Stevens Institute and Professor Brackett of Princeton College.

In the death of Mr. Buckingham the world has lost a powerful personality, and the Patent Bar one of its most notable members. *G. H. S.*

It is not to be doubted that, in the close circle of those who, during the last 25 years, have been sufficiently familiar with Mr. Buckingham's work to appreciate the quality of its silent triumphs, a sentiment of deep regret prevails that, in a large measure, he had not attained the fame which would have been his had his field of labor been more within the popular eye. In fact, it is almost pathetic that the enormous energies which he expended and the intricate and far-reaching legal campaigns which he developed in the defense of suits vigorously prosecuted by high talent, on such issues as the validity of the fundamental patents on the arc-light regulator, the rheostat control of the electric car, the three-wire system, the Tesla motor, and the Hutin & Leblanc multiphase system, should have remained undisclosed even to the major part of his professional brethren.

The consolidation of the opposing interests in almost all of these causes brought about their settlement before they could be passed upon by the courts, and the colossal structures which had been built up with such tireless zeal were withheld from view. In these instances, the fruit of his labors was the advantage which his clients derived from the resulting mergers, and that they were fully appreciative was made manifest by their virtual monopoly of his services up to the time that he laid down the burden of his life's work.

That his victories were not all in the public forum does not lessen their importance, but to those who loved the great-hearted lawyer and were proud of his remarkable accomplishments, it will ever remain a disappointment that so much of his intellectual activity should have been veiled from those not immediately associated with him.

The foregoing notices speak in terms of temperate moderation of the public and professional activity of our friend. Of that inner life, illuminating his being, and which, from afar, as one saw him approach, warmed the heart, it is impossible to think without emotion. Peace to his kindly and generous shade! Green be his memory among us! *J. C. P.*

CURRENT NEWS AND NOTES.

TECHNICAL GRADUATES OF UNIVERSITY OF ILLINOIS.—At the recent commencement 26 of the 156 graduates of the College of Engineering of the University of Illinois received the degree of bachelor of science in electrical engineering. In addition the advanced degree of electrical engineer was conferred on six post-graduates.

TELEPHONE OPERATORS' SCHOOL.—A telephone operators' school is being installed in the Springfield, Mass., exchange, where operators will be trained not only for the Springfield exchange, but for those in Chicopee, Indian Orchard, Holyoke, Westfield, Northampton, and perhaps other exchanges. There will be a similar school at Worcester to provide for the Worcester district. Operators will be given a regular course of lectures, study and practice in telephone operation.

MALICIOUS CUTTING OF TELEPHONE CABLES.—Owing to recent losses of the Chicago Telephone Company from the malicious cutting of its cables, some of them underground, the police department of Chicago has issued an order directing that especial attention be paid to the protection of this property. In addition, the telephone company has offered a reward of $500 for the arrest and conviction of persons damaging the cables and thus interfering with the telephone service.

CONVENTION OF AUTOMOBILE ENGINEERS.—The annual meeting of the Society of Automobile Engineers, of which Mr. Alexander Churchward, of New York, is secretary, will be held in Chicago on Aug. 5, 6 and 7. One session of the convention will be devoted to the discussion of various problems connected with electric automobiles. Mr. F. J. Newman, of the Woods Motor Vehicle Company, Chicago, a member of the board of managers of the society, is chairman of the committee making the local arrangements.

STEEL VERSUS WOODEN CARS.—A member of the Indiana Railroad Commission who has made an investigation of the recent disastrous accident on the Chicago, Lake Shore & South Bend Interurban Railway, between Gary and Chesterton, Ind., draws a lesson of considerable significance from the wreck. He points out that one of the cars in the eastbound train was of an old type and constructed almost entirely of wood. All the loss of life was in this car. No one was injured seriously in the other eastbound car, which was partly of steel construction.

WIRELESS ATLANTIC SERVICE.—A committee of the Imperial Press Conference, recently in session in London, reported that Marconi had stated to the committee that by August he hopes to supply a press service for 15,000 words a day, at least, across the Atlantic at 5 cents per word; the present cable rate is 10 cents per word. Marconi also said that he believes it possible in the near future to communicate by wireless over a distance of 6000 miles or even more. The present speed of wireless messages across the Atlantic is, he said, 35 words a minute, but it is hoped soon to increase this to 50 words.

NEW ORDER IN NEW YORK METROPOLITAN RECEIVERSHIP.—Judge Lacombe, of the United States Circuit Court, has amended the original order for the administration of the Metropolitan Street Railway Company by the receivers. There has been considerable dissatisfaction expressed among those interested in the affairs of the company as to the manner in which certain accounts were kept, and for this reason the original directions of the court have been amended. Under the new rule the methods of the receivers in the matter of keeping the books of the corporation and of accounting for receipts and disbursements are expected to be greatly improved. The judge has instructed the receivers and all parties interested in the company to agree in writing upon the manner and form in which the books shall be kept, and the final order, when issued, will embrace this agreement.

NEW ARCO WIRELESS SYSTEM.—Count von Arco, inventor of the Telefunken system of wireless telegraphy, has announced a new system of wireless telegraphy which he calls "Tonende Funken" (sounding sparks). This system, it is stated, is covered by applications for about 70 patents. In the new system, which is based upon discoveries in physics made by Professor Wien, and published in 1906, it is said that definite spark sequences anywhere from 40 up to 200 per second can be maintained. It is claimed that through the use of "sounding sparks" the serious limitations which have previously existed in wireless telegraphy have been entirely overcome.

GEORGIA WATER POWERS.—Prof. S. W. McCallie, State geologist of Georgia, is the author of a pamphlet entitled "Inventory of the Water Powers of Georgia," which gives all of the available data relating to Georgia undeveloped water powers. Professor McCallie divides the State into the "Savannah basin," the "Altamahe basin," the "Ogeechee basin," the "Mobile basin," the "Apalachicola basin" and the "Tennessee basin." An appreciation of the work of Professor McCallie is implied in a request by Mr. Gifford Pinchot, chairman of the National Conservation Commission, for copies of the pamphlet for each State chairman of the Conservation Commission.

GOVERNMENT REPORT ON ALASKAN COPPER.—Messrs. F. H. Moffit and A. G. Maddern have prepared a report upon the Alaskan copper deposits which has just been issued by the United States Geological Survey as "Bulletin 374." The report is especially devoted to the Copper River-Chitina River region and includes an account of the geography and history of the region and of its general geology, as well as notes on the copper minerals and ores, the source and character of the deposits, and detailed descriptions of the various properties, and is accompanied by geologic and topographic maps, graphic geologic sections, and reproductions of photographs. It may be obtained upon application to the Survey.

NAVAL WIRELESS TELEPHONY.—As a result of representations made by the company which supplied the wireless telephone equipment to the battleship fleet prior to its cruise around the world, the Navy Department is making an investigation of the alleged facts upon which a report condemnatory of the wireless telephone equipment was based. Although this report condenmed the wireless telephone as useless, an officer on one of the ships has stated that by its means conversation could be maintained between ships 10 and 15 miles apart. The guarantee of the company which supplied the apparatus was limited to a radius of five miles, and it is claimed that the system was actually successful over this range.

BUFFALO MIDSUMMER EXPOSITION.—Buffalo's Midsummer exposition was opened on Monday, June 21, when Mayor Adam threw in the main switch which lighted the 9000 incandescent lamps used for lighting the grounds. Electrical energy is supplied to the transformer station on the grounds by the Buffalo General Electric Company from its overhead 2200-volt, three-phase, 25-cycle system. Seven 25-kw, oil-cooled transformers are used and all worked at an overload as they are in service only between three and three and one-half hours. The Buffalo General Electric Company has one man in attendance at the exposition. The exposition will probably be an annual affair and it is expected to grow in size and significance. One point not pleasing to the electrical man is the use in a number of the manufacturer's booths of gas arcs for illumination, besides a number at the main entrance to supplement the electrical equipment. The illumination arrangement as a whole has been subject to criticism

INDIANA ELECTRIC LIGHT ASSOCIATION CONVENTION.—The Indiana Electric Light Association convention will be held at French Lick Springs Aug. 18 and 19, 1909. Mr. Fred Leslie, general manager of the Muncie Electric Light Company, is secretary and treasurer.

OUTING OF COMMONWEALTH EDISON BRANCH, N. E. L. A.—It is announced that the Commonwealth Edison branch in Chicago of the National Electric Light Association will give an outing or field day at some date in August to be fixed later, at which various games and athletic contests will be enjoyed. The arrangements are in charge of Mr. J. W. Ferguson, the assistant general contract agent of the company.

ELECTRIFICATION OF CHICAGO RAILROAD TERMINALS.—The Illinois Central is continuing its study of the electrification problem, and Mr. L. C. Fritch, the railroad company's electrification adviser, is making a further study of electrified lines in the vicinity of New York City. The company's delay in announcing a beginning of the electrification work is ascribed to the difficulty in rearranging its terminals for electrical operation.

DANGER TO BOYS IN TOUCHING ELECTRIC WIRES.—Mr. William Carroll, city electrician of Chicago, has written a letter to Mr. O. C. Schneider, president of the Board of Education of that city, suggesting that school children should be drilled in the danger of touching electric wires. So many accidents have been caused to mischievous boys by pranks of this description that Mr. Carroll believes that children should be taught to avoid wires of all kinds as they would venomous serpents.

THE CHEAPER KIND WOULD DO.—The *Edison Round Table,* published by the Commonwealth Edison branch of the National Electric Light Association in Chicago, tells the story of a woman customer in reduced circumstances who recently came in to pay her electric-light bill and at the same time made a timid request that was unusual. She said that she noticed that the bill was made out for 12 kw-hours at 14 cents and 8 kw-hours at 9 cents. "You know I don't do any entertaining to speak of," and added, "it would really be quite satisfactory if you would send only the 9-cent variety hereafter."

A BAD INTERURBAN ACCIDENT.—A head-on collision on June 19 between eastbound and westbound trains on the new Chicago, Lake Shore & South Bend Electric Railway, between Gary and Michigan City, Ind., resulted in the death of 10 persons and the injury of 28 others, of whom 3 may die. An official statement issued by Mr. H. U. Wallace, of Michigan City, general manager of the interurban line, states that the crew of the eastbound train was entirely to blame for the disaster. Orders were delivered to the men in control of that train to stop at a place known as Wilson siding, and if this had been done the accident would not have occurred. It seems to be established that the orders were delivered, and no explanation remains other than that the crew of the eastbound train simply forgot its order, not being accustomed to stop at this siding, and ran past the switch. The injuries were confined almost entirely to passengers on the eastbound train.

MUNICIPAL OWNERSHIP IN INDIANA.—At the nineteenth annual convention of the Indiana Municipal League, held at Lafayette, Ind., June 22 to 24, the subject of municipal ownership was discussed at length. While the majority of those who spoke expressed themselves in favor of municipal ownership, the delegate from the Logansport Council said his experience taught him that municipal operation was more successful when applied to water-works than to electric light plants. Mayor Becker, of Hammond, while advocating municipal ownership, referred to lack of management of public plants, and recommended the passage of a law requiring city engineers and managers of municipal plants to be technical graduates. Attempts to secure expressions of opinions from mayors who represented cities known to have unfortunate experience in municipal ownership were unsuccessful. Mr. Joseph T. McNary, of Logansport, was re-elected president of the league, and Mr. C. W. Merrill, of Richmond, continued as secretary.

ELECTRIC CLUB OF CHICAGO.—At the meeting of the Electric Club of Chicago on June 23 it was announced that by the courtesy of Mr. Stewart Spalding, of the Coliseum Garden, the members of the club had been invited to attend the concert and ballet at the Coliseum, on the evening of June 28, as the guests of the management. The invitation was accepted and a vote of thanks was extended to Mr. Spalding. From the house committee Mr. A. A. Gray reported that the prospects for making an arrangement to hold the meetings in the new Hotel La Salle were not flattering, but that negotiations were still in progress. Mr. J. J. Schayer, chairman of the entertainment committee, outlined the arrangements for a picnic to be held by the club on July 17 at Michigan City. The members of the club and their guests, including women and children, will leave for Michigan City by boat at 10 a. m. and return to Chicago about 10:30 p. m. An attractive schedule of games and athletic contests is being arranged. The principal speaker of the meeting was Mr. E. W. Lloyd, of the Commonwealth Edison Company, who gave a resumé of the proceedings of the recent Atlantic City convention of the National Electric Light Association.

THE N. E. L. A. CONVENTION IN RETROSPECT.—Two meetings were recently held in Chicago in which portions of the great mass of material presented at the recent Atlantic City convention of the National Electric Light Association were discussed. The first of these was that of the Commonwealth Edison branch of the N. E. L. A. on June 22, at which a written report was received from Mr. John C. Manley, one of the delegates elected to represent the Commonwealth branch at the convention. Mr. L. E. Marshall presided at the Chicago meeting in the absence of Chairman George H. Jones, and introduced Mr. Manley. The speaker gave summaries of a number of the Atlantic City papers. Taken as a whole, Mr. Manley was of the opinion that the papers presented were superior to those at any previous convention of the association, and he advised all members of the branch to read them carefully. The second meeting at which the convention was discussed was that of the Electric Club on June 23. The speaker was Mr. E. W. Lloyd, general contract agent of the Commonwealth Edison Company, who touched on the "high spots" of the Atlantic City gathering. Mr. Lloyd said that the convention was one of the most notable in recent years, and he mentioned a few of its features. In referring to the three "power papers"—Mr. Lloyd on "Load Factors," Mr. Gille on "Electric Power" and Mr. Graves on "Group or Individual Drive"—he said these contributions were of great value in studying power conditions in order to build up the day load and improve load factors. The tendency must be toward improvement of load factors of central stations. It is true that the power load is on the peak to some extent, but the consumption of energy of industrial electric motors begins to decrease to a marked degree at 4:30 p. m.; between 4:30 p. m. and 5 p. m. perhaps 50 per cent of the peak is due to power load. The extended report of the committee on meters, headed by Mr. Geo. Ross Green, was referred to in terms of admiration. In the discussion of this report at the convention, as pointed out by the speaker, someone said that meters now cost the central station about $30 a kilowatt for connected load. This cost would seem to be too high, and it should be reduced. There is also a demand for maximum recording meters for polyphase circuits. Mr. Lloyd concluded by a reference to the report of the committee on public policy, calling particular attention to that part of the report having to do with the growth of pension systems for employees of manufacturing and operating companies. There seems to be a decided tendency toward the establishment of pension funds of this character by large companies.

Plant of the Greenville Light, Water & Ice Company, Greenville, Ky.

By JAMES S. KNOWLSON.

THE average city man scarcely expects to find the conveniences and comforts of urban existence in a rural community of perhaps 1800 souls, tucked away in a mining and agricultural district fully a mile and a half from a railroad. Such a community, however, is Greenville, Ky., situated in the middle western section of the State, a little off the line of the Illinois Central Railroad. The latest census report



FIG. 1.—EXTERIOR VIEW OF THE GREENVILLE STATION.

gives the population as 1051. Optimistic local estimates place the figure as high as 2000, but 1800 is probably more than generous. At first glance it is a typical country town; but streets and houses are lighted by electricity, water mains run through the streets and artificial ice is made and delivered to customers.

A description of the Greenville Light, Water & Ice Company's plant, which serves this community, should prove interesting to all those who are concerned in the ways and means of supplying public utilities to the smaller communities, for two reasons: (1) The organization of the company seems to have solved successfully and satisfactorily the problem of municipal versus corporate ownership. (2) During the very first year of its existence, the gross revenue of the company has amounted to approximately $7.80 per capita and has been well in excess of the operating expenses.

Advocates of municipal ownership claim as the basic principle of their plan, that public utilities—being of direct and immediate concern to the people at large—should be owned and controlled by the people; that the success of the municipal plant is guaranteed because the interest of the community as a whole is centered in the enterprise, and further, that with a municipal plant, the consumer receives the commodity at the lowest price which will cover production costs. Those who do not believe in the practical success of municipal ownership hold, and their opinions seem to be borne out by facts, that "What is everybody's business is nobody's business"; that municipal plants are rarely under competent management or have a fixed and definite policy, and, that red tape and graft preclude economical operation. For this reason a corporate plant, under good and consistent management, can usually supply its commodity to the consumer at a lower price than the municipal plant, and at the same time net a just return to the investors.

There are two sides to every argument, but in the organization of the Greenville company a happy medium seems to have been reached. The authorized liabilities are: Capital stock, $40,000; bonds, $12,000, of which $37,000 of stock and $11,000 of bonds are outstanding. So far, all stock and bonds have been subscribed for locally, and paid for at par. The number of stockholders totals over 150, 90 of whom hold but one share of stock each, while $6,000 represents the share of the largest stockholder. The executive officers are the most prominent business and financial men in the community and the entire management of the plant is under Mr. J. H. Gilman, civil and mechanical engineer, to whom the plant owes its inception.

The wide and entirely local distribution of stock means that the plant is practically owned by the consumers and is almost as much of a public institution as a municipal plant. All profits made by the company return to the pockets of the consumers. At the same time, the company organization guarantees consistent, careful and businesslike management which completely removes the objections advanced to municipal ownership.

The plant was first put in operation on April 7, 1908, and today shows an investment of $51,000. This investment covers all property, apparatus and material necessary to the carrying out of its three-fold function of supplying water, electricity and ice to the town. The power-house building is a brick structure 58 ft. x 37 ft. x 19 ft., the same roof covering boiler- and engine-room. In the boiler-room are installed two 100 hp. return tubular boilers which supply steam for the whole plant. The coal pocket is located at the side of the boiler-room, and is built into the face of a small hill which simplifies dumping of fuel as wagons may drive direct over the trap opening.

Directly behind the power house is a water reservior covering 5.6 acres, with a capacity of 30,000,000 gal., held by a dam 25 ft. high, 300 ft. long, built of earth reinforced by concrete. The reservoir is enclosed by a high wire fence. The water system is a direct-pressure one and two compound duplex pumps, built by the Platt Iron Works, which force the water through a little over 11,000 ft. of 6-in., 4-in. and 1¼-in. pipe at a pressure great enough to throw a stream over the largest building. Water for houses and stores is paid for at a meter rate of 25 cents per 1000 gal., with a minimum charge of $1 a month. The city contracts for eight hydrants, and three additional hydrants have been installed for private consumers who desire additional fire protection.

The electrical equipment is entirely of General Electric Company manufacture and consists of one 105-kw, three-phase, 60-cycle, 2300-volt generator, direct connected to a 14-in. x 16-in. McEwen simple engine. The streets are lighted from a series alternating system and commercial lighting is fed from single-phase, 2300-volt circuits. About five miles of pole line has been erected and the distribution is constantly being extended. The city contract covers 21 acres which operate on an effective moonlight, all-night basis, and are paid for at the rate of $65 per year per lamp. Residence and business lighting is metered



FIG. 2. WATER RESERVOIR OF GREENVILLE COMPANY.

and charged for at 12 cents per kw-hour for the former and 10 cents for the latter, with a minimum charge of $1.25 per month.

The equipment of the ice plant consists of a 15-ton absorption ice machine, built by the American Machine Company. The freezing tanks are installed in a brick and frame building, 56 ft. x 24 ft., located adjacent to the main power house. This building also contains a cold-storage room. Ice is retailed at rates ranging from 25 to 50 cents per 100 lb., depending on the

quantity taken. Ice has found a ready market not only in Greenville itself, but in the mines and smaller communities in the vicinity, and the cold-storage room has been greatly appreciated by the local meat dealers.

The first year is, of course, a hard one for a central station supplying electricity and water, for all houses must be wired and piped before service can be rendered, and this is a slow and as a general rule, a laborious task. The wide distribution of stock and the general interest of the community in the enterprise has been shown in the rapidly increasing number of meter connections, both for lamps and water. On Sept. 1, 1908, 95 electric meters and 55 water meters had been installed. On April 1, 1909, 140 electric meters and 90 water meters were in operation. At the end of the year, April 1, the balance sheet of the operating account shows the following:

REVENUE.		
Water	$1,120.07	
Electricity	4,037.87	
Ice and cold storage	5,094.91	
House wiring and supplies	3,896.11	
Total		$14,149.56
EXPENSE.		
Operating expense	$8,086.51	
House wiring and tools	3,974.26	
Total		12,060.77
Net revenue		$2,088.79

The construction and supply business has been carried at cost and in reality shows a small loss for the year. The net revenue, or the balance of profit is, of course, not very large, but when it is remembered that this is the first year of the company's existence, the amount is surprisingly good.

The operation of the plant is carried on by a standing force of four men. The manager, electrician, and two engineers, one night and one day man. In the spring and fall, one additional man is employed as an ice maker, and in midsummer the total force numbers six, an icemaker being employed on each shift. This force is exclusive of the ice delivery, which is this summer being delivered by the company's own wagon and team.

People of the town are extremely proud of their plant, not only because of the daily conveniences which it supplies, but on account of the adequate fire protection which they have never had prior to this time. About two months after the plant started a fire broke out in the principal business block. It was extinguished without much loss, but it is estimated that over $60,000 worth of damage would have been done if this fire had started before the adequate water supply was available. The Greenville Company is just starting on the second year of its existence, with an established business and an ever increasing load. It is safe to say that the revenue for this year will exceed the last by at least 25 per cent and at a better profit. Great credit is due Mr. Gilman for his competent management, and hundreds of other communities which, with equal resources, are without equal conveniences, might with advantage follow the example of this progressive town.

Small English Central Station.

By Charles Dawson.

Having been for a number of years in the United States and being conversant with American practice, the writer feels that possibly a description of the class of electric light and power stations to be found in small English towns will be of interest as showing wherein the practice of both countries differ. In English towns some of the stations are owned by the corporations of the towns and others by public or private companies. It should be borne in mind that in England there are severe government regulations which call for work of a certain high character. No overhead conductors are tolerated, and rules as to the size of conductors, insulation and methods of installing them must be complied with, so that a much larger outlay is required than for a similar size plant in the United States.

As a rule, in England there is but very little day service in small towns, so that it becomes necessary to install a storage battery, which also is used to carry the load after midnight, the arc lamps being usually extinguished at that time. The incandescent lamps at present employed have carbon filaments, but metallic-filament lamps are coming into use with very satisfactory results. As a typical example of a small English cen-



FIG. 1.—EXTERIOR OF POWER HOUSE.

tral station, that of the Urban Electric Supply Company, at Godalming, in the County of Surrey, and about 34 miles from London, may be cited. The station is situated in a very picturesque valley surrounded by wooded hills. The buildings are well built of red brick and contain, beside the power equipment, storerooms and offices. They are surrounded by a well-kept garden and, taken altogether, the surroundings are quite charming.

The distribution mains and feeders are installed in a durable manner. No poles are used, greatly to the advantage of the town, and when cables have been placed underground the road has been carefully relaid and is none the worse for having been opened. Street connections and feeder connections are made in underground brick manholes with cement and iron covers. Godalming has a population of 10,000 and an area of 706 acres.

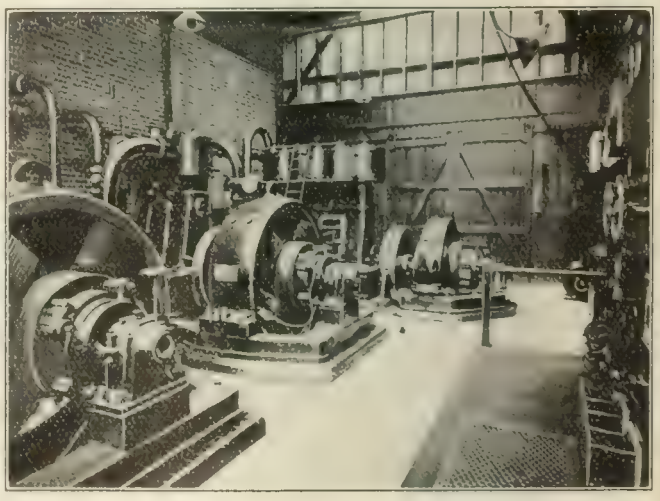


FIG. 2.—INTERIOR OF ENGINE-ROOM.

The power house was erected in July, 1902, and at the end of the year the connected lighting load was 180 kw and the output 63 kw. There was at the close of 1907 a connected load of 380 kw and an output of 250 kw; the full rating of the plant being 400 kw.

The equipment in the power house comprises three water-tube boilers supplying steam to as many high-speed Bellis en-

gines at a pressure of 150 lb. The boilers are fired by mechanical chain-grate stokers using soft coal and there is an absence of smoke from the stack at all times. On its way to the engines the steam is superheated 250 deg. Fahr. The engines are direct-coupled to the dynamos, which were built by Fowler & Company, and general direct current at a potential of 480 volts which is used on a three-wire system. One of the generators is rated at 200 kw and the two others are rated at 90 kw. A storage battery rated at 250 kw and having a maximum discharge rate of 80 amp is also in service. The average discharge during the daytime, from 9 a. m. to 6 p. m., is about 20 amp. During the day there is practically no load except 40 hp in motors in a manufacturing plant.

The engines operate condensing and the feed water, which contains much foreign matter in solution, is heated to about 200 deg. Fahr. before being fed to the boilers. As will be seen from the illustration of the engine-room, the equipment is well arranged and, being of the best, the capital outlay is much heavier than for a similar-size plant in America, although the price for energy is higher than obtains in the United States. The staff is also much larger than is required in a plant of this size in the States, but the wages paid are less. Under the management of the resident and service engineers, the upkeep is admirable. The life of all concerned is much easier than would be the case in the United States under similar conditions and the operating force seems to be contented with its lot. There is not much extra work as the boilers have to be cleaned only once a year, and the plant has been free from breakdowns of a serious nature.

The main feeders are single, vulcanized bitumen, three-cored armored cable laid in wood troughs with tile covers. Distributors run from feeder pillars and these in turn are subdivided in underground brick boxes. There are about three miles of feeders and approximately 15 miles of street wires. Ten series-arc lamps are used for lighting the streets and 230 50-cp and 25-cp incandescent lamps. The drop between the power house and the farthest point in the service is 18 volts. It might be mentioned that the Government rules require a conductor of such section that the rise in temperature caused by the current passing through it must not be over 35 deg. Fahr. The price charged for electricity is 12 cents, with a discount of 2½ per cent for payment within a month. If supplied through a prepayment meter the rate is 14 cents per kw-hour. The charge for the meters, which are the property of the company, is 50 cents and $1 per quarter according to size. Energy sold for motors is subject to a 5-cent rate and the 2½ per cent discount. The streets are lighted from one-half hour after sunset to midnight, there being no public lighting after that hour. Energy for house service is, however, available from the storage battery.

The working staff consists of one engineer, two firemen, three boys and from two to three line and service men, all of whom work 56 hours per week. The office staff consists of the chief engineer, one chief clerk and two junior clerks. The cost of fuel delivered into the bins is about $3.75 per ton and the coal is hand-fired into the hoppers of the stokers. The cost of fuel per kw-hour generated is 1.34 cents; oil, 0.08 cent; wages, 0.42 cent, and repairs, 0.42 cent, making a total of 2.26 cents. If all expenses, including salaries and upkeep, are taken into account the cost per kw-hour is 3.36 cents.

The prepayment meters have since been discontinued because they did not pay at the rates charged, which included wiring. This can be understood from the fact that the average consumption per house was only about 2 kw-hours per month. On the whole, the plant is a very good example of the kind where a private company holds the franchise for a small country town. It is remarkable that a profit can be made on a station operating for so few hours and with so small a day load, the latter being, in fact, too small to warrant the installation of batteries. The plant is but one of a number of small stations owned by the company. Up to Dec. 31, 1907, the total expense of the plant, including distribution and every outlay, was $277,904, while the revenue from all sources amounted to $25,027. The sum of $11,447 was applied to dividends for the year 1907. This shows about a 5 per cent dividend on the investment, and as it includes new work on the capital account and as the sale of energy is only about 62 per cent of the maximum output, it would seem that a higher dividend might be looked for when the plant is fully loaded. An item of expense which might strike an American as heavy for an urban plant is the sum paid for rates and taxes, which amounts to $629.

Central-Station at Mount Carmel, Ill.

The plant of the Mount Carmel Gas & Electric Company, of Mount Carmel, Ill., is a good example of a property which has been brought up within a few years from a very much underdeveloped condition to one of the best organized systems in a town of its size in the State. The development which has taken

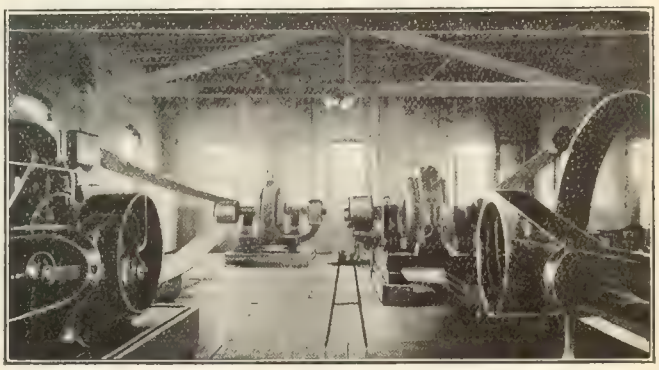


FIG. 1.—ENGINE-ROOM, MOUNT CARMEL.

place in the past seven years has been largely the result of the efforts of Mr. A. R. Manley, the present manager of the company. It has been entirely the result of a management sufficiently effective to make it possible to borrow money from time to time to enlarge the property. Unlike many other systems, at the time Mr. Manley took hold, the company had no particular financial backing and its credit was de-

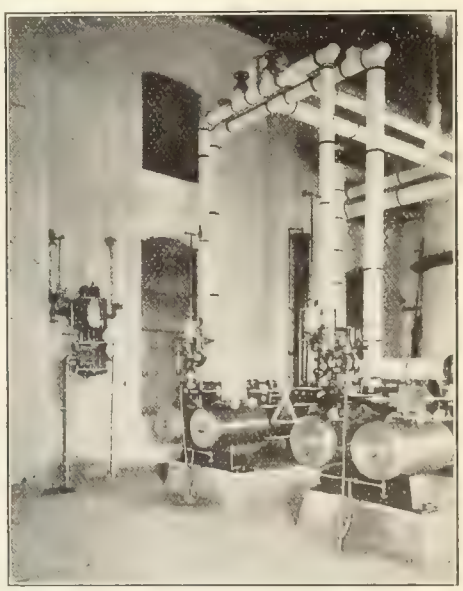


FIG. 2.—HEATING SYSTEM PUMPS.

pendent entirely on the financial showing made from operation as a result of good management.

Previous to January, 1902, the town of Mount Carmel, which had in 1900 a population of 4311, depended for its electric light service on an organization known as the Mount Carmel Light & Water Company, which operated a water-works system and at the same plant had one 40-kw, 133-cycle National alternator

and one 40-light Wood arc machine with 33 arcs. There were about 600 incandescent lamps connected. From this it will be seen that the central-station business in Mount Carmel was very much underdeveloped. In January, 1902, a new generating station was started and two 90-kw, 60-cycle, 2300-volt units in-

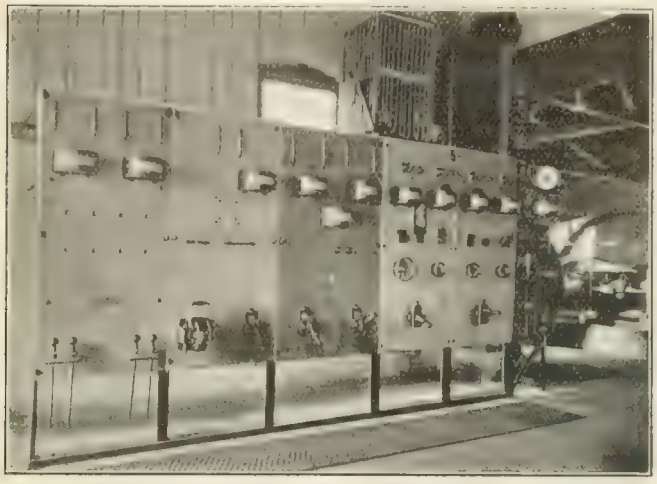


FIG. 3.—SWITCHBOARD.

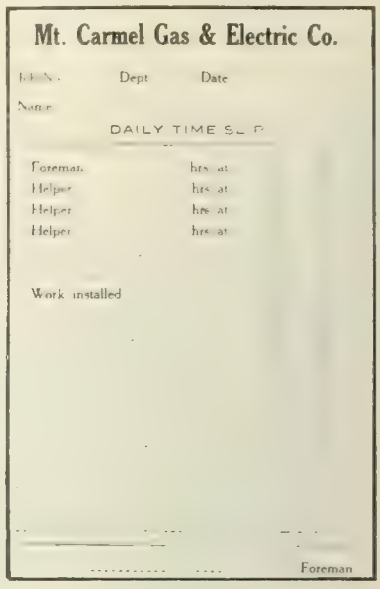
stalled. Before the plant was completed one of these units was displaced by a 150-kw set. The plant now has two 150-kw, two-phase Bullock alternators, shown in Fig. 1, and is about to add a 300-kw, direct-connected unit. The boiler equipment consists of one 300-hp Stirling boiler and two 150-hp Stirling boilers, making a total of 600 rated hp. The engine equipment consists of one Lane & Bodley Corliss running at 95 r.p.m. and belted through a lineshaft to a 150-kw alternator, and a Russel medium-speed engine direct-belted to a 150-kw alternator.

In connection with this plant there is operated a hot-water heating system designed by Mr. W. H. Schott. About 40,000 sq. ft. of radiation is connected to this system. The mains have a capacity of 100,000 sq. ft. Heating service is given from Sept. 15 to May 15 each year. The day load, which is from 60 kw to 100 kw, is such that exhaust steam can be used almost entirely for this heating and very little live steam has to be used. This heating plant was started in 1907. The pumps for the heating system, shown in Fig. 2, consist of two circulating pumps and one condensation pump.

The two generating units now in the power plant have operated for the past five years without a single shut-down due to an accident. The station operating force consists of three engineers and four firemen, working eight-hour shifts. One of these firemen also attends to the water-pumping station. In one end of the boiler-room is a well-equipped machine shop. Fig. 3 shows the switchboard, which contains two generator, two feeder and one series-arc panel.

At the time the plant was moved from the water-works to a location alongside the Southern Railway more favorable for receiving coal, electric pumping was inaugurated at the water-works plant. Water is pumped directly from the Wabash River to a standpipe on the river bluff. There are two triplex pumps, made by Deane, of Holyoke, running at 50 r.p.m. One is driven by a 35-hp Wagner single-phase motor and the other by a 30-hp motor of the same type. These pumps work against 80-lb. pressure. Two steam pumps and one 50-hp boiler are still kept at the water-works plant as a reserve.

The following facts and figures regarding the company's business indicate the state of development: The present population of Mount Carmel is estimated at 8500. The number of electricity consumers is 817; there are 13,000 lamp sockets connected. One hundred and seventy-nine hp in motors of 3-hp rating and over is connected. The fan load comprises about 300 desk fans and 100 ceiling fans. About 350 electric irons are in use. The refrigerating business is represented by one 20-hp motor in a meat-packing plant. There are 40 steam-heat customers aggregating 40,000 sq. ft. of radiation. The electric sign business has been well worked for a small town, as there are 11 such signs. There are also some illuminated signs placed on blank sides of buildings lighted by means of incandescent lamps covered with half shades. The company does an electric wiring and supply business, the gross revenue from


Mt. Carmel Gas & Electric Co.

No. Dept Date

Name

DAILY TIME SLIP

Foreman hrs. at

Helper hrs. at

Helper hrs. at

Helper hrs. at

Work installed

Foreman

FIG. 4.—TIME SLIP.

which amounts to about $20,000 per annum. About three men are kept busy on interior wiring.

A gas plant has recently been erected, but has not been in service long enough to be an important factor in the business. The water system, although owned by a separate corporation, is operated by the same force as the Mount Carmel Gas & Electric Company. With the electric light, steam heat, water and gas business to take care of, a much larger and more specialized organization is possible than would be for the electric lighting business alone. The organization is an unusually



FIG. 5.—EXTERIOR VIEW OF STATION.

perfect one for a small company. The head of each department is held responsible for the men under him and for the results obtained in his department. The organization of departments is as follows: One man is in charge of meters and inside wiring, and he does the testing of meters himself. Another man,

who is called the general foreman, has charge of the water-works system and the electric line work. The assistant superintendent has charge of the gas department, including construction and operation. The chief bookkeeper has entire charge of the office and records. Collecting and timekeeping is in charge of one man. A storekeeper is maintained, who is responsible for all supplies in stock. As the system of records worked out

Workman No. . . . . Name . . . . . .

Pay Roll No

$ 19

Received of Mt. Carmel Gas and Electric Co. Mt Carmel

the sum of . . . . Dollars Cents.

for . . . . . being in full to 19

Job .

Correct . . Timekeeper

Signed

Approved . . . . . Supt

FIG. 6.—WORKMAN'S RECEIPT.

by this company is unusually complete, some detailed description of it will be given.

Meters are read the twenty-sixth of the month. It takes four men to read the gas and electric meters, each man reading about 200 meters in nine hours. From the meter reader's book, entry is made direct to a loose-leaf duplicate invoice or bill book. Three of these bills are placed on a page separated by perforations. When the billing has been completed the bills are torn out and mailed, leaving the duplicates, from which the ledger is posted, The carbon duplicates of the bills are in the same order as the meter reader's books, which are arranged by routes. The ledgers are also arranged by routes so that the ledgers are easily posted direct from the duplicate bill sheets. By keeping duplicate bills it is possible to mail consumers' bills as soon as the bills are made out without waiting to post the ledger. They can then be posted to the ledger at leisure and consumers' accounts are collected several days sooner than would otherwise be possible. The gas, electric, water and heat invoices are distinguished by

Mt. Carmel, Ill., _____ 190

DEPOSIT NO

Mt. Carmel Gas and Electric Company

DISTRIBUTION OF ACCOUNTS AMOUNT

Accts Rec. Electric, Consumers

" " Water, "

" " Heating "

" " Gas, "

Accts Rec Electric, Mdse

" " Water, "

" " Heating, "

" " Gas, "

Cash Sales, Electric, Mdse

" " Water, "

" " Heating, "

" " Gas, "

Other Receipts (Detail)

Total, $

Approved Supt

We credit your Acct with $

DEPOSITED THIS DATE

AMERICAN NATIONAL BANK

Teller

FIG. 7.—DEPOSIT SLIP.

four different colors. This also applies to work orders for the different departments.

On electric wiring contract jobs a triplicate record is kept. The cost of time and material is kept on all contract jobs. A complete record of each job is kept together by keeping the slips relating to time and material in one envelope. The daily time slip is reproduced herewith, Fig. 4. The former work order is also shown, which has the list of materials on the reverse side. This, however, is about to be changed so that a duplicate will be kept on this also. Workmen sign receipts of the form shown in Fig. 6, when paid.

Petty cash is paid out upon a receipt blank properly filled out. All money received is deposited in the bank with a statement as to the distribution of accounts to which it is credited on the company's boooks. One of these deposit cards is shown in Fig. 7. The prime reason for this method of handling is that the auditor of the company is in another city and these deposit cards can be mailed to him as a continuous record of deposit.

The tungsten lamp has been extensively installed all through the business district; in fact, arc lamps have been practically replaced with them. The rates for power and lighting are: 8 cents for first 50 kw-hours per month; 7 cents for the second 50 kw-hours; 6 cents for the next 100 kw-hours, and 5 cents for all over 300 kw-hours. The minimum bill on lamp circuits is $1 per consumer, and on motor circuits 1 per horse-power. A deposit of $3 or a guarantee from some property owner is required before running a service because of the transient nature of the population

Electric Light and Power at Montreal.

BY WILLIAM H. STUART.

The electric light and power business in the city of Montreal, Canada, is conducted by the Montreal Heat, Light & Power Company. This company was formed in 1901, absorbing the following minor companies: Royal Electric Company, Lachine Rapids Hydraulic & Land Company, Ltd., Montreal Gas Company, Standard Light & Power Company, the Montreal & St. Lawrence Light & Power Company, the Imperial Electric Light Company, the Citizens' Light & Power Company, Ltd., and the Temple Electric Company. Up to the fall of 1907 the company was handicapped considerably for lack of space and proper office accommodations. The company has since erected a commodious office building at the corner of Craig and St. Urbain streets, opposite the Street Railway Chambers. Its new home has been appropriately called the Power Building and is located in the business center of the city, close to the Post Office and the leading banks, where every convenience for the speedy transaction of business is assured.

In the basement are the vaults and storage-room. Space is also provided for substation equipment. As this portion of the building is very deep and it is not wholly used, the company conceived the idea of utilizing part of it for sign and large motor displays. Signs of every description are hung close to the ceiling in rows of three and four, and are controlled from a panel box provided with switches for throwing each sign into circuit separately.

On the main floor is the contract department, the office of the chief agent, a display-room containing over 1000 sq. ft. of exhibition space, and the bookkeeping and accounting departments. On the second floor are located the offices of the construction and operating departments; on the third are the executive offices, the board-room, the offices of the president, vice-president, secretary, treasurer, and of the auditing and legal departments. The fourth, fifth and sixth floors are rented and the seventh and top floors contains a convention hall and lunch-room for employees.

The salesroom is one of the show places of the building. The room faces Craig Street and has three large show windows, in which are generally placed electric lighting apparatus. From the main entrance through to the cashier's window, the display space is railed off by a large polished-brass railing. In this space are exhibited a great many gas and electric appliances, placed so as to be easily and practically demonstrated. The company's idea in maintaining this exhibition is to get on consignment appliances from various manufacturers and to act as their sales agent. Each of the appliances has a tag attached to it giving its consumption, cost of operation, first cost, etc. On small tables is placed the descriptive literature. All placards are printed in French and English. The entire

display is in charge of a salesman and a lady assistant, whose duty is to explain the various appliances to any one evincing interest. All orders for either service or appliances are noted by the salesman and turned over to the contract department.

The company has always had a contract department, but the work was not systematized in any way until 1906, when the department was reorganized and started afresh under the supervision of Mr. J. J. Cagney as chief agent. A card system was adopted and on these was placed a note of every house number in the city. The cards were first made up from the gas and electric meter-record books, and given the solicitors who went out and secured information on the lighting and power conditions. The cards are filed away and are kept posted up to date. Every year a place will be visited and the conditions noted upon the cards, which are looked upon as a valuable asset in the new business work. The city is divided up into five districts, to each of which a solicitor is allotted. Each man covers his district every day and reports on call cards the information which is transferred to large index cards. One man looks after the sign business, and the company also employs a special power man. In this end of the new business department it has been the policy of the company to co-operate with the large manufacturing companies, who notify the company of power prospects, and the company sends a list to the different motor or appliance houses so that they may all have an equal chance to effect a sale. In this way the field is very thoroughly covered by more than one man looking for business.

The company has never advertised on a large scale, but has at certain times featured some side of the business, such as sign work or window lighting. The advertising matter that is sent by the manufacturing companies is used a great deal, especially in the display department.

In the matter of signs the company furnishes a panel sign of 24 4-cp lamps at the rate of $2 per week on a flat rate. There are no signs on a meter basis. The charge of $2 per week includes everything. The signs burn from 6 to 12 o'clock every night, and are turned on and off by men in the company's employ. There is a penalty clause inserted in the sign contract to the effect that a consumer will be obliged to pay a fine of $10 if the sign is found burning when it should not. The sign is removed entirely if the consumer repeatedly violates the contract, and while the company generally allows a first offence to pass over, on the second the consumer is forced to pay the fine.

The growth of Montreal can be attributed in a large part to the utilization of electric power. Montreal, it is claimed, consumes more electrical energy per capita than any other city in the world. Twenty cities and towns surrounding the city are also lighted by the company. The price of electric lighting service in 1884 was $11 per 16-cp lamp per year. This has been reduced to a basic meter rate of 15 cents per kw-hour, subject to varying discounts, depending upon consumption, under which the cost of burning a 16-cp lamp during ordinary lighting hours does not exceed $3 per year. In 1894 the Royal Electric Company was supplying the equivalent of 14,700 16-cp lamps and 50 hp in motors. Its total number of consumers did not exceed 300, and none of the various heating appliances was heard of. At the present day the Montreal Heat, Light & Power Company has connected to its system the equivalent of 600,000 16-cp lamps, about 40,000 hp in motors and upward of 1200 appliances for heating, cooking, refrigerating, etc. The company serves upward of 20,000 electric consumers and about 55,000 gas consumers, or a total of 75,000 consumers. From May 1 to Oct. 31, 1908, there was a gain of 17 1/3 per cent as compared with the same period of the previous year. The increase in motors connected for the same period was 262 per cent. There was no increase in the amount of salary paid in the contract department, the business being obtained by introducing system into the work.

The lighting rates of the company were revised and reduced early last year. The old rates were 15 cents per kw-hour, less 5 per cent on one-year contracts, and 15 cents, less 15 per cent on five-year contracts. The new rates take into account residential and commercial service. The residential service rates are based on a one-year and a five-year contract. The one-year contract calls for a charge of 15 cents with a discount of 10 per cent on all energy consumed during the first 30 hours' use per month, per lamp installed, known as primary usage. On all energy consumed in excess of 30 hours' use per month, per lamp installed as above, known as secondary usage, there is a discount of 50 per cent. On the five-year contracts all energy consumed during the first 30 hours' use per month, per lamp of installation, known as primary usage, is charged for at 15 cents per kw-hour, with a discount of 20 per cent, and on all energy consumed in excess of 30 hours' use per month, per lamp installed as above, known as secondary usage, there is a discount of 60 per cent.

The commercial service rates are based on one-year and five-year contracts. On the one-year contract all energy consumed during the first 60 hours' use per month, per lamp of installation, known as primary usage, is charged for at 15 cents per kw-hour, less 10 per cent. On all energy consumed in excess of 60 hours' use per month, per lamp installed as above, known as secondary usage, there is a discount of 50 per cent. On the five-year contracts all energy consumed during the first 60 hours' use per month, per lamp of installation, is charged for at 15 cents, with a discount of 20 per cent. On all energy consumed in excess of this amount there is a discount of 60 per cent.

The company's motor rates are of particular interest in view of the success which has been attained in the broadening of the load curve. Non-peak power users are encouraged by a special concession, as will be seen by the following brief discussion of the rates at present in force. The power services are classified as follows: Unlimited day service, 10 hours straight, 7 a. m. to 6 p. m.; unlimited day and night service, 24 hours continuous; limited day service (off peak) from 7 a. m. to 6 p. m. throughout the year except from 4 to 6 p. m. between Sept. 15 and March 15; limited day and night service (off peak) 24 hours per day throughout the year except between 4 and 7 p. m between Sept. 15 and March 15.

On the limited day service the reductions given by the company amount to 25 per cent of the unlimited day rate. The same ratio of difference applies to the unlimited day and night service and the limited or off-peak day and night service. Three systems of charging are in vogue: A straight flat rate per hp-year, varying according to the average maximum load as determined by test; a readiness-to-serve charge based on the average maximum demand, plus a meter charge per hp-hour or kw-hour, also varying according to demand, and a straight meter rate per kw-hour or hp-hour as the customer chooses, likewise varying according to demand. The power meter rate is $0.02 per hp-hour, plus a minimum charge. The minimum charge is $3 per horse-power up to 5 hp; from 5 hp to 10 hp the rate is $2.50. A test is made of the motor load and the minimum charge is based on the test. For instance, a 1-hp motor which is only operated at 75 per cent of its rating is assessed $2.25 per month. A 5-hp motor at full load would have an assessment of $15 per month, plus energy consumed at $0.02 per hp-hour. The minimum power factor of motors when operating the consumer's maximum load is required to be as follows: Motors not exceeding 5 hp, at least 75 per cent; motors over 5 hp and not over 10 hp, 80 per cent; motors over 10 hp, 85 per cent. The flat rate is based on $55 per horse-power per year at full load, 24 hours per day service. A charge for a 10-hp motor under these conditions per year would be $550. This rate is reduced 25 per cent if the motor is not used during peak load.

The result of encouraging the non-peak business is very apparent. Starting in at 5 a. m. the curve gradually rises and reaches its highest point at about 8:30 p. m. From 12 to 1 p. m. the load drops considerably and starts again at 1 p. m. at about where it was at noon. About 3 p. m. the curve reaches its highest point and from there runs down until at 6 p. m. it drops again. From 7 to 9 p. m. it again goes up and then gradually through the rest of the night runs down to its lowest

point. The company has found that about 40 per cent of its customers can switch the motors out of circuit at the time of peak without detriment. Among the various customers are cotton mills, with 3500 hp, which start at 7 a. m. instead of 8 and which allow a half hour for lunch, stopping work at 4:30 p. m. The workers in the mills in many instances prefer to follow these hours and go home early than begin later and finish later. Among the off-peak consumers are the various morning and afternoon papers, to whom the company supplies over 400 hp. Brickyards require entirely a summer service and get about 50 per cent of the regular rates on seven months operation. The equipment amounts to about 700 hp, the motors being used to drive casting machines, mixers and conveyors. Other non-peak consumers are the local water company, which requires 1200 hp for pumping drinking water. Then there is 6000 hp which is used by a cement concern. These non-peak rates are as yet only given to trustworthy customers consuming relatively large amounts of power. An installation of 20 hp or 25 hp is the limit below which the non-peak rate is not as yet granted. Separate circuits are not run and time switches have not as yet been used to any extent, although the latter is being considered by the company.

The company controls practically all the developable and commercially practicable water-power within transmission distance of Montreal. The present plants include a 12,000 hp station at Lachine Rapids, a 22,500 hp plant at Chambly on the Richelieu River, the selling rights in Montreal of the large Shawinigan plant and 10,000 hp in steam plants on Queen Street and elsewhere in Montreal. There has been recently added a 2000 hp steam turbine to the steam plant at the Queen Street station. The company has a new plant on the Soulanges Canal, about 38 miles from the city.

Conditions Encountered by Towers in High-Tension Transmission Lines.

By N. J. Neall.

THE very characteristic of native receptivity and adaptability which rendered so successful the early introduction of high-potential transmission in this country and enabled America to surpass Europe in this respect for some time, likewise imposed upon the practice certain features, such as the wood-pole line, which, as concerns engineering completeness, can be regarded as far below the power house and substation which it connects. By a natural selection of materials long since made familiar by the telegraph practice of this country and with hardly no recognition of the limitations soon to be imposed by the rapidly diminishing forests, wood poles have continued in use for electric lines of all classes, the only difference among them consists in the requisite degree of insulation for the service and the increased size of poles and cross-arms as the voltages to be carried increased in value.

In the early days of high-voltage transmission the potentials generated and the distance to which energy could be economically carried were, in general, not very great; in fact, today the grand divisions of commercial voltages practically indicate closely the steps by which the art advanced. Of course, in this, as in all things, there were exceptions at the outset. For example, Messrs. L. L. and P. N. Nunn erected and put in successful operation near Salt Lake City, Utah, a 40,000-volt line long before the general practice in the art reached so high a potential.

It is needless to dwell further on the backwardness of pole-line construction save to point out that the initial use of wood-pole lines was an economic necessity and in this respect provided a solution as to the feasibility in cost of energy transmission that might otherwise have been prohibitive. As time has gone on and new projects of a similar character have been developed the question of line supports has become more and more serious. The problem itself is very simple. It is this: In view of the decreasing lumber supply and consequent increased cost of selected large poles can any given long-distance electrical transmission line project find some other form of support as a satisfactory substitute? It seems almost useless to ask such a question when the answer in the form of metal-tower construction, reinforced-concrete poles, etc., is now so well known.

The first towers for modern electrical transmission purposes noted officially in American engineering literature were descriptions of European practice.[1] It is curious to observe how different are these from our own in many respects. In the first place, the arrangement of insulators and circuits in the vertical plane as contrasted with our standard triangular arrangement is very marked. Again, the latticed tower is one not generally used in this country, outside of special city work and steam-railroad electrifications—except where the available space is limited. In fact, it may be put down as strictly typical of American practice to evolve a type for its own purposes; the most natural for this use was the familiar light-weight steel windmill tower. In this way one was at once enabled to secure a form of suspension which not only permitted longer spans, less total insulators, etc., but applicability in places where ordinary pole construction might be unduly expensive, if not prohibitive. The first installation of this character, which was in Mexico, has been described by Mr. Norman Rowe.[2] This innovation in long-distance transmission subsequently received considerable attention from the American Institute of Electrical Engineers under the auspices of the High-Tension Committee beginning in 1902, and at the International Electrical Congress, St. Louis, 1904, and since then the use of this device, the number of manufacturers and variety of types available have become greatly extended.

The engineer can to-day use several forms for his purposes. These are Class 1: Standard metal wind-mill work; standard structural steel for latticed and other tower forms. Class 2: Reinforced-concrete poles.

The limitations of the various forms of support listed in the preceding paragraphs are best brought out by an analysis of the service requirements, as follows:

Voltage.—The voltage is a fundamental element and governs the spacing between the conductors and the safe distance between the live parts and ground. The average spacing between wires for 60,000-volt service is from 6 ft. to 7 ft. The usual minimum safe working distance between live part and ground at all parts save the insulators is approximately ½ in. for every 1000 volts; thus for a 60,000-volt service a 30-in. clearance, if possible, should be maintained. It is obvious from this fact that the general over-all dimensions are governed by the voltage rating so that with the primary requirement of a clearance above ground for the lowest point of a space of from 18 ft. to 22 ft., the total height of the tower becomes, in turn, dependent on the allowable sag and the length of the span to be employed.

Span.—The maximum permissible span is solely a matter of adjustment among several quantities, including the power factor and frequency to be used in transmission, which for given voltage determine the size of the wire and the maximum safe strain to which the material selected for a conductor may be subjected, and the most economical span and corresponding tower cost, respectively, involved by the given conditions of voltage, load and methods of operation.[3] Since for a uniform strain the sag of any given span varies directly as the square of the length of the span, the final height of a support is determined accordingly.

Loads.—The preceding primary conditions affect only the

[1] *Transactions A. I. E. E.*, 1904, Vol. XXIII, Page 147.
[2] *Proceedings A. I. E. E.*, 1907, Vol. XXVI, Part II, Page 1239.
[3] *Transactions A. I. E. E.*, 1907, Vol. XXI, Part II, Page 1233.
Inasmuch as it is solely the purpose here to indicate the general procedure in tower selection for which the electrical engineer is primarily responsible, no analysis of the tower size and form in relation to the most economical span will be made. It must be remembered, however, that the tower finally selected should be the result of a reciprocal adjustment between the requirements of the electrical engineer on the one hand and the structural possibilities at the command of the tower builder on the other. The design of transmission towers is a field by itself and with its details the electrical engineer has only a broad concern.

dimensions of the support; the strength and size of its members depend entirely on the loads which the service imposes. These loads are as follows:

Dead weight of conductors and other span strains. Additional extraordinary weight of sleet, which in some localities may be taken as ½-in. layer of ice, or a total increase of 1 in. in the effective diameter of the conductor; this is a variable quantity dependent on known local meteorological conditions; in some parts of the world it may be neglected. Wind strains on conductors and tower in a direction perpendicular to the length of the circuit.

Special.—In addition to the preceding requirements for line supports on a level right-of-way, special conditions, such as river crossings, angles, cross-overs, line-sections, railroad and foreign wire crossings, etc., by reason either of extraordinary span characteristics or high safety against failure call for supports of special form and strength. These structures differ merely in degree from the fundamental form discussed and need no further consideration here.

Anchors.—Having once determined these general characteristics of the supports above ground, it is necessary to decide upon a form of anchorage sufficient to keep them erect in service. It is clear that the best tower possible may fail utterly if not properly anchored. This condition covers the nature of the soil involved as much as the anchor pieces themselves.

The anchorage of the tower for ordinary soil may be said to consist usually of two parts: the extension of the tower proper —the so-called legs—and the means employed to weight the legs. One style of anchor for this purpose consists of a piece of comparatively heavy angle iron from 6 ft. to 7 ft. in length—to which the tower is later bolted—flattened at one end to hold rigidly another piece of angle iron fastened cross-wise to it. The latter when in place is at the bottom of the hole. The proportions and depth are merely dependent upon the load above ground. For weighting various measures are taken; in general the following may be employed: Concrete; cast-iron molded on the leg at the lowest point; special structural beams laid under ground; special arrangement of wood ties and rods, etc.; carefully tamped earth—that is, zero weighting in the sense of this paragraph.

If the earth in which a tower is located is of sand and loam or gravel, or mixtures of these closely packed and firm, there will result a surprising strength against pull out from the mere resistance of the earth alone. Theoretically, the resisting force depends on the weight of the anchor piece plus that of the entire prism of earth extending at an angle of approximately 30 deg. with the vertical from the bottom of the anchor piece[1] and can be considered as effective in estimating the moments of the tower about the base at any given point as a fulcrum. As a matter of fact, tests that have been made show the strength to be apparently much greater, due perhaps, to the resistance of such a mass against shearing from its surroundings. Furthermore, in the case of towers having a square base, or a broad rectangular one, the mutual support against overturning by the various pairs of anchors involved, may greatly assist in this respect. Naturally the character of the soil has an important bearing on the matter. In the erection of a transmission line across dry country the mere omission of concrete at anchors, by reason of the decrease in cost, may make a critical difference in the possibility of their adoption.

The second element in anchoring a tower which affects its costs and suitability is the requirement whether it shall be a support having dead-end strength; that is to say, to stand up against the worst possible strains, due to failures of conductors or to predetermined maximum wind velocities; or to be merely a line support without such staying qualities under great stresses.

It is clear that between these two extremes a great variety of arrangement is possible. For example, for the major part of the line light weight towers with just sufficient strength to prevent being blown over may be used—guys being employed at given intervals to give the effect of anchor towers against destructive mechanical surges in the event of a line failure. Again, a mixture of dead-end towers and the lighter weight towers may be employed. At best, but of course at greatest expense, the dead-end tower may be used throughout. These are only a few of the arrangements followed; they may be said to depend entirely upon conditions of the right-of-way and on local requirements of safety and stability. The necessary strength of a support may then be said to be governed by conductor strains, dead weight and wind pressure; and of these, under normal conditions, the wind pressure is considered the most serious.

Insulators.—Owing to the recent introduction of suspension type of insulators and of their particular utilization for voltages much in excess of the present highest general practice—that is to say, for all potentials over 60,000 volts—tower dimensions, shapes and strengths are accordingly much modified from those designed to support the pin type of insulator. The general problem involved, however, is not affected except in detail.

Tower Materials.—Standard structural-steel parts, such as angles, channels, pipes, rods, etc., of the lightest available and feasible weights form the basis of metal tower construction. It is in their combinations, however, that the variations in manufacture and practice arise. The general form of tower is a rectangular prism, each side of the prism being made up of panels consisting of angle irons, channels or similar material, braced diagonally by some form of tension rod. The apex of the tower is usually the distinctive feature, since it is here that arrangements are made for supporting the line wires. Some towers in the form of triangular prisms have been installed, but they are comparatively few.

Following up wind-mill practice the greatest number of towers now in use are given a galvanized finish. Some towers, however, are painted in the usual way. There is some discussion as to the lasting quality of galvanizing, but inasmuch as this is usually put on after all machining is completed, there is little invitation to form rust save in the bolt threads and even these are given a galvanized finish by some manufacturers. There seems little reason to suppose that galvanizing will not be reasonably durable. A ready means of comparison on this point can be supplied by metal wind-mill towers which have been in use a considerable number of years. Some of the tower manufacturers have extensive galvanizing plants and the cost of this treatment needs scarcely any further consideration here. Care in inspection is a prime requisite.

Ease of Erection.—A necessary condition in tower design is compactness for shipment and ease for assembling and erection. These requirements are met by care in design and the use of bolts and nuts for assembling. For example, all parts of the tower are carefully marked with a significant letter chosen by the manufacturer to correspond with the diagram of the tower used by the field foreman. Bolts and nuts of the requisite quantity per tower may be packed in bags or boxes. All other tower parts are bundled in unit lots. By shipping such parts in car-load lots a minimum of freight expense and maximum ease of local distribution may be obtained.

In a typical case of this kind the anchorages are sent into the field and installed considerably ahead of the towers to secure as much as possible a restoration of the earth fill—if such be used—to the same compactness as its surroundings. These anchorages project sufficiently above ground to furnish later a fulcrum for placing the tower.

GENERAL PROBLEM.

In order to give some idea of the work involved in such a proposition consider the following typical case:

Energy at the rate of 10,000 kw, three-phase, 60 cycles, at 80 per cent power factor, is to be transmitted 70 miles over fairly rolling country, including a range of hills rising to a maximum of 2000 ft. above the surrounding country for about 10 miles and across a navigable river 1000 ft. wide with a total voltage drop not to exceed 10 per cent of the voltage delivered.

A preliminary analysis of the problem would indicate that the best e.m.f. for delivery will probably be in the neighbor-

[1] *Transactions A. I. E. E.*, 1907, Vol. XXVI, Part II, Page 1233. Trautwine On the Theory of Retaining Walls.

hood of 60,000 volts; that two circuits are required both to keep within the limit set for maximum voltage drop and to secure greater continuity of service in case one of the circuits should at any time be interrupted.

Before going further, certain electrical calculations must be made to fix the voltage and to determine the size of conductor. On a basis of 60,000 volts delivered, a spacing of 7 ft. may be selected for the conductors. This length insures against the dielectric losses discussed by Scott, Ryan and Mershon and is conservative from the standpoint of the arcing-over clearance required by the possible intrusion, from time to time, of large birds. The proper size of wire for the requirements is found tentatively by calculation to be a No. 2-0 B. & S. copper cable or a wire of an equivalent conductivity.

The following calculations are made on the basis of one-half the nominal power transmitted on a single-phase circuit of identical spacing of conductors, etc., as for three-phase; the resulting percentage losses are correct for either case—the actual energy losses for the three-phase circuit are just twice the values calculated for the single-phase circuit at half power:

Constants.

1. Resistance. R at 68 deg. Fahr. = 0.822 ohm per loop-mile.
   Total R = 57.5 ohms for 70 miles.
2. Inductive ohms $2\pi 60 L = 1.51$ ohms per loop-mile.
   Total inductive ohms = 106.
3. Capacity susceptance = 0.00000282 mhos per mile.
   Total susceptance = 0.000197.

Volts at generator end of line = 65200

$$\text{Voltage drop} = \frac{5200}{6000} = 8.67 \text{ per cent.}$$

Load and power factor at generator end of line = 5270 kw at 89.0 per cent lagging.

$$\text{Per cent line loss} = \frac{5270 - 5000}{5000} = 5.4 \text{ per cent.}$$

From the above it will be seen that a No. 2-0 B. & S. copper conductor is a satisfactory size to meet the electrical requirements.

It is important at this point to decide upon the make-up of this cable. One may make use of a simple stranded hard-drawn copper cable, a stranded cable with solid core of softer wire, a stranded cable with copper cable core, a stranded cable with hemp core, or a stranded aluminum cable.

The whole point of this range of selection lies in the strength of the central strand of the cable. Since the unit cable is made up of seven strands consisting of a central wire with six others of the same diameter wrapped spirally around it, it is clear that under severe stress the central wire receives the first impact of the load and may be ruptured while the six spirally wound layers are merely tightening down to a firmer bedding. The cable core (by the substitution of a cable of smaller wires giving the same diameter as the solid wire for the center) is thought to introduce an improvement in strength. A similar improvement also appears possible by introducing a central wire of softer temper so that while allowing extension under the strain it does not permit the remaining wires to lose their shape very much. The much discussed hemp core has only the feature of preserving the cable shape and a lesser number of conductors of larger size to recommend it. There may be some advantage in the lubrication afforded by the preservative used on the hemp, but this is problematical.

Before making a final selection, tests in any event should be made for tensile strength, modulus of elasticity and breaking strength of the material to be used. For simplicity the present study will be confined to a stranded, hard-drawn copper cable having a conductivity of No. 2-0 B. & S. solid copper wire. The effective area (mechanical) = 0.1045 sq. in. Since the breaking strength of such a cable may be taken for the purpose of this study at 60,000 lb. per square inch and the elastic limit at 30,000 lb. per square inch it is clear that the wire allows the use of an absolutely maximum strain of 6300 lb. approximately and a working maximum of 3100 lb. approximately (the elastic limit) giving roughly a safety factor of two for the theoretically worst strain possible. On this basis one can proceed to determine the maximum strain on straight run-away work on fairly level ground.

A transmission line is effected by all of the natural elements: heat, cold, wind, rain, sleet, etc.; practice has indicated that the limiting condition of span selection depends upon the maximum temperature and maximum wind velocity on the one hand and minimum temperature with sleet and moderate wind on the other. The effect of these elements will be shown in the following calculation:

For many parts of the country the U. S. Weather Bureau has been collecting various meteorological data for the last 30 years or more. From this source, therefore, may be obtained information as to the average, maximum and minimum temperatures, rainfall, sleet, thunder storms, etc., for all days of the year.

Temperature.—For the present discussion the temperature may be assumed to be —20 deg. Fahr. for the lowest and 130 deg. Fahr. for the highest, or a temperature variation of 150 deg. Fahr.

Wind.—The pressure brought upon the conductors and tower by the wind is an important one, and yet the constants for the wind are not uniformly agreed upon. The United States Government measures wind velocity by the anemometer and for this value a certain correction is necessary to determine the effective velocity. This correction is:

Wind Velocities—		Lbs. per sq. ft. for plane surfaces —		
Indicated m.p.h.	Actual m.p.h.	Buck[1] and Smeaton $p = .005\ V^2$.	Marvin[2] (U. S. Wea. Bu.) $p = .004\ V^2$.	Berlin-Zossen Tests[3] $p = .0027\ V^2$ Calc.
0	0.	0.	0.	0
...	...	—	—	—
10	9.6	.450	.369	.249
20	17.8	1.59	1.27	.859
30	25.7	3.30	2.64	1.78
40	33.3	5.56	4.44	3.00
50	40.8	8.33	6.66	4.49
60	48.0	11.50	9.22	6.23
70	55.2	15.30	12.20	8.24
80	62.2	19.40	15.50	10.45
90[4]	69.1	24.00	19.20	12.95

On cylindrical bodies the pressure is usually taken at one-half of that on a plane surface having the same projected area. The only tests on record as having been made on an actual cable strand indicates $p = 0.005\ V^2$ to be the correct equivalent value for plane surfaces.[4] This value will be used in the following calculations. In the report of the Berlin Zossen Electric Railway test a value $p = 0.0027\ V^2$ is deduced. This is carefully worked out from a number of readings and is worthy of note; there is no good reason to reject it save that while theoretically wind pressure can be as satisfactorily measured by a predetermined velocity of projection of a plane surface against the wind as the reverse, nevertheless in the case where it is to be applied to a transmission line the adoption of these values without further confirmation may be doubtful and unsafe. There is the additional advantage in the higher values that an excess allowance which may develop over actual needs is just so much of a factor of safety. The want of explicit values on the subject, coupled with the absence of detailed wind velocities for such conditions as prevail on the average transmission line is very marked. It is to be hoped that such information will be shortly forthcoming. In the meanwhile there seems to be every justification for generosity in allowances against wind pressure, sleet load, etc., especially on long spans and in localities where bad storms are likely to occur suddenly.

Although such an authority as Mr. H. W. Buck has stated[5] that "the records of the Weather Bureau are all taken at high

[1] *Trans. Int. Elec. Congress*, St. Louis, 1904, Vol. II, Page 318.

[2] U. S. Dept. Agriculture, Weather Bureau, Note 3, Circular D, and Instrument Div. Anemometer.

[3] Berlin-Zossen Elec. Ry. Tests, 1903, McGraw Pub. Co., Page 29 and Plates XI, XII and XIII.

[4] Excerpt from letter March 2 to Messrs. Thomas & Neall, by C. F. Marvin, professor in charge, instrument division, Weather Bureau, U. S. Dept. of Agriculture.

"The values given in the table are already exprest in proportion to the indicated velocities of the anemometer. Unfortunately, however, investigations upon wind velocities at high velocities, that is, 50 to 100 miles per hour, can only be made with great difficulty and elaborate apparatus, and experiments over this range have not been adequate, as yet, to supply perfectly acceptable data. The pressures given in the table referred to are regarded as generally exact, but we are not prepared to vouch for the accuracy of the values above 50 miles per hour, and especially not at 100 miles per hour."

[5] *Transactions, Internat. Elec. Congress*, 1904, Vol. II, Page 320.

points, such as at the top of high buildings, etc., which are 100 ft. or more above the ground, the wind velocity decreases rapidly as the ground level is approached and at the level of an ordinary transmission line the velocity is about 30 per cent less than at a point 100 ft. or more above the ground," yet the differences in elevation of the several Weather Bureau stations involved, as well as the varying height of different parts of long line spans ranging from 60 ft. to 100 ft. maximum above ground, together with the natural exposures of one kind or another through which the line passes may subject the line, in parts at least, to such high wind velocities that the full reduction proposed by Buck should perhaps not be made. It is obvious that any extensive tower transmission with long spans requires a careful study of the weather characteristics.

Assume, therefore, that the maximum wind velocity as given by the Weather Bureau for the territory of this particular transmission project is 90 miles per hour indicated; the maximum noted simultaneously with sleet is 30 miles per hour indicated, tornadoes or similar vicious storms being very rare. By reference to the above table the actual velocities involved are found to be 69.2 and 25.7, respectively.

Sleet.—Sufficiently frequent occurrence in a given locality of as thick a layer as 0.5 in. warrants the use of 1 in. as the increased effective diameter of the conductor in calculating the wind pressures. Sleet is much more tenacious than is commonly supposed and although it probably does not form in a perfect cylinder, being thicker on the under side than on top of the conductor, the allowance here made is certainly none too much. In calculation, the unit weight of ice is taken as a basis.

Furthermore, fairly high wind with sleet is not so impossible as one might think. Experiments which anyone may make with a sleet-covered wire will show how hard it is to dislocate this coating by shaking. The Weather Bureau notes the presence of low-velocity winds simultaneously with sleet. The calculation is as follows:

Unit weight of ice = 57.4 lb. per cubic foot.

For our purposes we will use = 0.40 lb. per square inch per foot—that is, a cylinder having a length of 1 ft. and an end area = 1 sq. in.

Total weight of ice for this case is:

Diam. of No. 2-0 cable = 0.42
Sleet additional = 1.00

1.42 = total diameter under wind pressure.

Total area in square inches = 1.58 sq. in.
Copper area in square inches = 0.14 sq. in.

Ice area = 1.44

1.44 × 0.4 = 0.576 lb. per linear foot of No. 2-0 cable for ice.

Unit weight of ice and cable.

No. 2-0 copper cable per foot = 0.406 lb.
No. 2-0 ice cable per foot = 0.576 lb.

Dead weight of copper and ice = 0.982 lb.

RESULTANT UNIT WEIGHTS.

Load	Wind m.p.h. indicated	Wind strain per lin. foot.	Resultant weight and wind.	Angle of deflection from vertical at center of span.	Cos α.
0	0	0.	.406	0	1.00
sleet	"	"	.982	0	1.00
sleet	30	0.195	1.01	11° 15′ app.	0.981
0	90	0.42	0.584	46° app.	0.695

At this point consideration should also be given to overhead grounded wire (lightning protection) and to telephone wires which are to be carried on the same tower.

Lightning Protection.—In a preceding paragraph the statement is made that the voltage and the allowable span determine the general dimensions of the tower. This statement is entirely true if line lightning protection is not considered. In some parts of our country lightning is so severe and often so local over a long transmission line that serious damage may be done, against which no amount of protective apparatus at the distant stations can be of any assistance. The Taylors Falls experiments[1] have shown this fact forcibly and they indicate the simple means available to give the desired immunity.

If a line lightning protection device is used, then since it consists of grounded wires suspended over or above the main conductors, the actual height of the tower is increased accordingly. Since the conductivity is of minor importance, use may be made of a stranded steel cable which is both light and effective. Calculations for the overhead ground wire or wires are made similarly to those for the main conductor.

Inasmuch as the grounded wire is not in general called upon to carry current nor is it necessary to insulate it from the ground, the attachment to the tower may be made directly by the best mechanical means available. Since the primary purpose of the overhead grounded wire is to carry off to earth static discharges or even direct strokes of lightning, all that is necessary is a complete metallic circuit between the conductor and earth, which is, of course, directly obtained when the line

SUMMARY.*

Standard span — 700 ft.

	Load Copper	Temp. Cable.	Wind m.p.h. indicated. Max. strain assumed	Deflection.	Strain in cable lb.	Deflec. fr. vertical at center of span.	Effective sag (vertically). calc. T = 3,000 lb.
1.	0	—20° F.	0	16.1	1540	0	16.1
2.	Sleet	"	30	20.4	3000	11° 15′	20.0
3.	"	32° F.	0	22.0	2740	"	22.0
4.	0	130° F.	0	21.8	1139	0	21.8
5.	0	"	90	22.9	1563	46°	16.0
Overhead Ground Wire. T max. by calc. to give same sag as in No. 2 preceding = 2,610 lb.							
1.	0	—20° F.	0	16.6	1090	0	16.6
2.	Sleet	"	30	20.4	2610	12° 35′	20.0
3.	"	32° F	0	21.5	2425	0	21.5
4.	0	130° F.	"	20.8	870	0	20.8
5.	0	"	90	21.8	1340	51° 50′	13.5
Telephone "wire" T max. to conform to preceding requirement = 2,050 lb.							
1.	0	—20° F.	0	14.6	713	0	14.6
2.	Sleet	"	30	20.4	2050	15°	19.7
3.	"	32° F.	0	21.4	1890	0	28.40
4.	0	130° F.	"	19.1	545	0	19.1
5.	0	"	90	20.8	995	59° 40′	10.6

*F. O. Blackwell, *Transactions of Int. Elec. Congress*, St. Louis, 1904, Vol. II, page 345.

support itself is of metal. Again, since the kind of metal is ordinarily of no consequence for the purpose of protection the selection can be confined to such materials as promise either certain strength or certain endurance.

Since the best information in the matter of overhead ground protection calls for two or more such conductors above the circuit to be protected, every consideration of all possible interference with the electric circuit by breakage or otherwise must be well weighed before deciding on copper whose life is beyond question and steel cable whose lightness and strength are more desirable but the depreciation of which compared to copper is known to be very great. Where the investment is closely concerned, copper need not be considered; particularly at such prices as prevailed in 1907. There is much to be said for steel cable; with care in manufacture, together with thorough galvanizing, this material should be entirely satisfactory for the service.

For this problem two overhead ground wires are required. The details of their make-up, loads involved, etc., are listed below:

RESULTANT UNIT WEIGHTS.

High Strength 3/8-in. Extra Galvanized 7-Wire Crucible Steel Strand.

Load.	Wind, miles per hour indicated.	Strain per linear foot.	Resultant strain per linear foot.	Angle of deflection from vertical at center of span.	Cos α.
0	0	0	.795 app.	0	1.00
Sleet	0	0	.847	0	1.00
Sleet	30	.189	.869	12° 35′ app.	0.976
0	90	.375	.478	51° 50′ app	0.618

This strand is rated by the makers, American Steel & Wire Company, with an elastic limit of 80,000 lb. per square inch and a breaking strength of 11,500 lb. or with an effective area of 7 wires 0.125 in. each in diameter 134,000 lb. per square inch equivalent. It should be noted that the apparently unusual strength of this material for the purpose is required to make its use effective as an overhead anchorage. In this way, without consideration of the additional advantages arising from the relative leverages of the various groups of wires, it will be

[1] *Transactions A. I. E. E.*, 1908, Vol. XXVII, May meeting.

clear that the two overhead ground wires may thus have sufficient strength to hold the tower in shape and position, even though all of the other conductors should fail.

Telephone Service.—The only question here is one of minimum size of wire permissible for the long spans involved; whether a steel wire would be selected for this service in place of copper wire on the score of greater strength or decreased first cost is a secondary matter. An investigation of sizes permissible leads to the selection of 9/32-in. special Siemen's-Martin strand.

RESULTANT UNIT WEIGHTS.

Special Siemen's-Martin 9/32-in. strand extra galvanized.

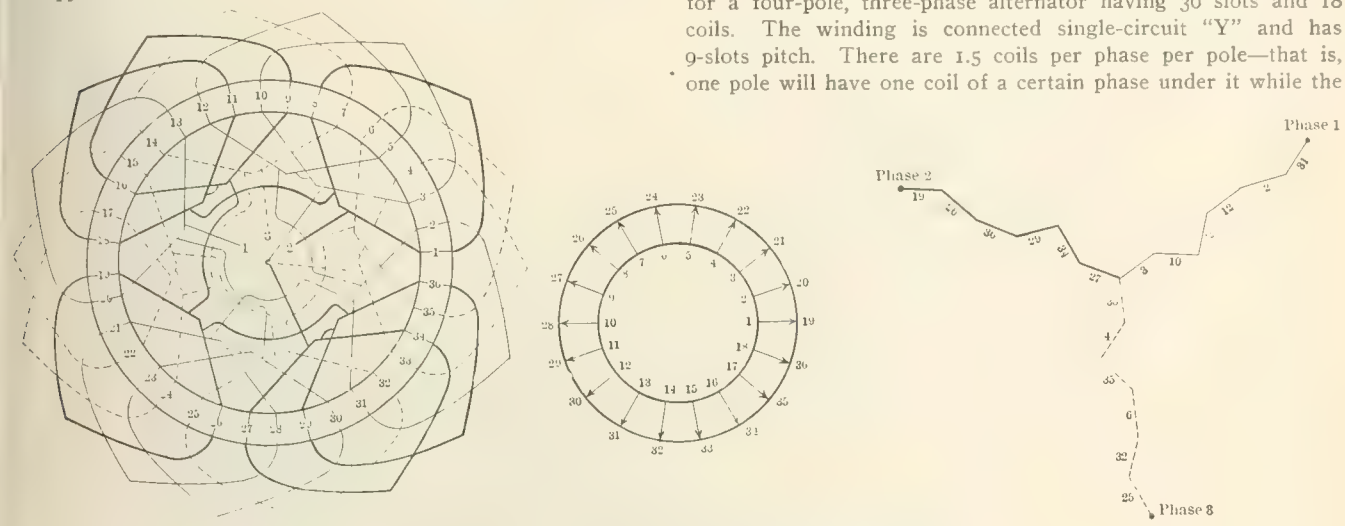
Load.	Wind. m.p.h.	Strain per linear foot.	Resultant strain per linear foot weight and wind.	Angle of deflection from vertical.	Cos α.
0	0	0	.17 lb.	0	1.00
Sleet	0	0	.662	0	1.00
Sleet	30	.177	.685	15° approx.	0.966
0	90	.291	.337	59° 40′	0.505

Modulus of Elasticity.—This is an important item and yet one not easily determined. Since the manufacturer usually gives an approximate figure, tests should be conducted on samples to cover this point. For this case the following values will be assumed:

Copper cable, 16,000,000.
Steel cable, from 18,000,000 to 23,000,000.
23,000,000 used.

The various loads to which the tower will be subjected by the conductors may now be designated. The summary is given on the preceding page.

In a subsequent article the above outline of conditions and requirements will be applied in the selection of towers for specific installations.



FIGS. 1, 2 AND 3.—SYMMETRICAL THREE-PHASE WINDING.

Alternator Armature Windings.

By Edgar Knowlton.

The following methods of determining the correctness of armature connections are of value principally when the connections are unsymmetrical. The first case considered is a winding for a four-pole, three-phase alternator having 36 slots and 18 coils. The winding is connected single-circuit "Y" and has 9-slots pitch. There are 1.5 coils per phase per pole—that is, one pole will have one coil of a certain phase under it while the adjacent pole will have two coils of the same phase. In Fig. 1 the first phase winding is represented by a light line, the second by a heavy line, and the third by a dotted line. Slot No. 1 is placed on the horizontal diameter to the right, and is the end

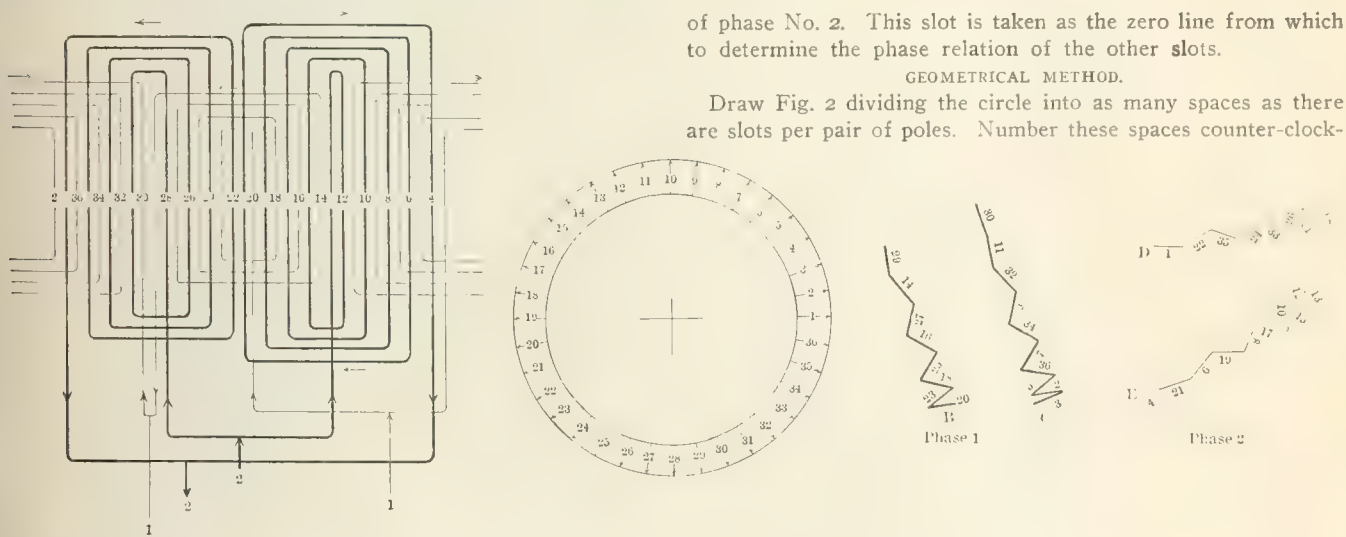
No. 1.	No. 2.	No. 3.
3	27	33
10	34	4
5	29	35
12	36	6
2	26	32
31	19	25
21	9	15
28	16	22
23	11	17
30	18	24
20	8	14
13	1	7

of phase No. 2. This slot is taken as the zero line from which to determine the phase relation of the other slots.

GEOMETRICAL METHOD.

Draw Fig. 2 dividing the circle into as many spaces as there are slots per pair of poles. Number these spaces counter-clockwise, beginning as shown. This diagram shows the time-degrees displacement between the e.m.fs. generated in the various slots for any pair of poles. In this case the time-phase difference between adjacent slots is 20 deg. Make a table of the numbers of the slots through which each phase winding passes.

The first slot from the "Y" connections in phase winding No. 1 is No. 3. Draw line 3 in Fig. 3 parallel to line 3 in Fig. 2. Lay off on this line any suitable length to represent the e.m.f. generated in one slot. The next slot through which the winding of phase No. 1 passes is No. 10. The time-phase relation



FIGS. 4, 5 AND 6.—UNSYMMETRICAL TWO-PHASE WINDING.

of slot No. 3 to slot No. 1 is (3-1) 20 deg. = 40 deg. The time phase relation of slot No. 10 to No. 1 is (10-1) 20 deg. + 180 deg. = 360 deg. The 180 deg. is added because the winding passes through slot No. 10 in the opposite direction to that in slot No. 1, as can be seen by the diagram Fig. 1. Proceed in this manner with slots 5-12-2-31. This gives the e.m.f. diagram for one pair of poles. The diagram for the balance of the slots in this phase (21-28-23-30-20-13) is a repetition, consequently it is unnecessary to draw them. Treat phase-windings Nos. 2 and 3 in the same manner. The results show the correctness of the connections.

APPLICATION OF THE TRIGONOMETRICAL METHOD.

In the accompanying table the sine and cosine of the time-phase angle of each slot is tabulated and added, giving consideration to the sign of the quantities according to the principles of trigonometry. For instance, in phase winding No. 3 there are cosines + 1.61334 and − 0.67365 which equals + 0.93969. The sine is − 5.32928 and the tan − 5.6713 which is the tan of 280 deg.

Phase Winding, No. 1.

Slot.	Phase Relation to Slot 1.	Cosine +	Cosine −	Sine +	Sine −	Tan.
3	2 × 20 = 40	.76604		.64279		
10	9 × 20 + 180 = 360	1.00000		0.00000		
5	4 × 20 = 80	.17365		.98481		
12	11 × 20 + 180 = 400	.76604		.64279		
2	1 × 20 = 20	.93969		.34202		
31	30 × 20 + 180 = 780	.50000		.86603		
	Total	4.14542		3.47844		+ 5.8911

Phase Winding, No. 2.

Slot.	Phase Relation to Slot 1.	Cosine +	Cosine −	Sine +	Sine −	Tan.
27	26 × 20 = 520		.93969	.34202		
34	33 × 20 + 180 = 840		.50000	.86603		
29	28 × 20 = 560		.93969		.34202	
36	35 × 20 + 180 = 880		.93969	.34202		
26	25 × 20 = 500		.76604	.64279		
19	18 × 20 + 180 = 540		1.00000	0.00000		
				2.19286	.34202	
	Total		5.08511	1.85084		−.36397

Phase Winding, No. 3.

Slot	Phase Relation to Slot 1.	Cosine +	Cosine −	Sine +	Sine −	Tan.
33	32 × 20 = 640	.17365			.98481	
4	3 × 20 + 180 = 240		.50000		.86603	
35	34 × 20 = 680	.76604			.64279	
6	5 × 20 + 180 = 280	.17365			.98481	
32	31 × 20 = 620		.17365		.98481	
25	24 × 20 + 180 = 660	.50000			.86603	
		1.61334	.67365			
	Total	.93969			5.32928	−5.6713

+ .83910 = tan 40°
.36397 = tan 160°
− 5.6713 = tan 280°

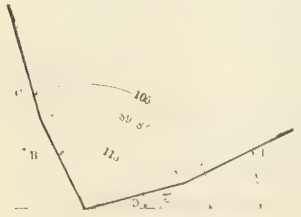


FIG. 7.—VOLTAGE RELATION IN TWO-PHASE WINDING.

The resultant voltage of phase winding No. 1 is displaced 40 time degrees from the voltage of slot No. 1. This is also true of slots 3 and 12. Assume that 200 volts are generated in each slot. The resultant voltage of phase winding No. 1 is

Cos (3-3) 20		= Cos	0	1.00000
" (10-3) 20	+ 180	"	320	.76604
" (5-3) 20		"	40	.76604
" (12-3) 20	+ 180	"	300	1.00000
" (2-3) 20		"	20°	.93969
" (31-3) 20	+ 180	"	740	.93969
				5.41146

or 2 (cos 0 deg. + cos 20 deg. + cos 40 deg) × 200 volts = 1082 volts for that part of the winding under consideration. The total for the phase winding is 2 × 1082 = 2164 and between phase leads is $\sqrt{3} \times 2164 = 3744$ volts.

A more complicated case is that of the winding indicated digrammatically in Fig. 4. This manner of connecting is chosen to simplify the mechanical connections in a very special case. The alternator has two poles, two phases, 36 slots, 18 coils, and it is desired to connect the winding in two circuits. The e.m.f. diagrams of Figs. 5 and 6 show that the connections are incorrect, there being 10 time degrees between the voltages of circuits *B* and *C* and the same time angle between that of the circuits *D* and *E*. The resultant voltages in the circuits of either phase are also unequal.

An inspection of the diagrams of Figs. 5 and 6 gives rise to the question as to the effect of omitting slots Nos. 3 and 30 in phase windings No. 1 and 13 and 4 in phase winding 2. These changes bring the e.m.fs. of circuits *B* and *C* into phase, but *D* and *E* are then 20 deg. out of phase.

The result of connecting circuit *B* in series with *C* and *D* in series with *E* is shown in Fig. 7. The difference in time-phase between the e.m.fs. of the two phase windings is 89 deg. 8 min. instead of 90 deg. The value is so nearly correct that probably no trouble would be experienced in actual service.

The Construction of High-Frequency Apparatus.

By George T. Hanchett.

THE average student who reads and understands the time-honored experiments of Tesla and Thomson in high-frequency work and who realizes the simplicity of the apparatus by which such startling results were reached, very often desires to reproduce the experiments on a small scale. When high-frequency phenomena were first discovered they were of academic interest only and had little practical value, except that they afforded a beautiful exemplification of the principles of inductance and capacity. The high-frequency discharge is now of commercial importance, being used in wireless telegraphy

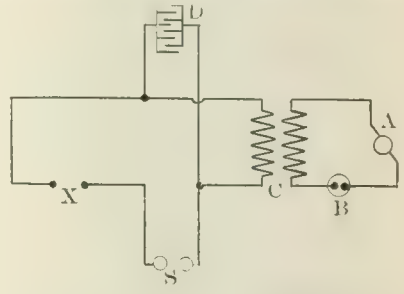


FIG. 1.—DIAGRAM OF CONNECTIONS.

and in investigating the behavior of lightning arresters of various types, which are designed to deal with high-frequency condenser discharge.

The writer has had occasion to construct high-frequency apparatus and has encountered various details in construction which, if neglected, seriously impair results and may even render the efforts of the constructor futile. Some of the features are to be recommended by reason of their convenience and low cost, and although the subject is old it is believed that these considerations make a description of more or less interest.

Alternating currents of any of the commercial frequencies are best for producing the Tesla discharges. Very good results are obtained with 60-cycle current at 110 volts, using about 40 amp. It is necessary to step this potential up by a transformer of some sort from 10,000 volts to 20,000 volts. High-voltage, low-frequency current is passed directly to a condenser of the proper capacity, which is permitted to discharge across a short spark-gap, made preferably with screw adjustment and of moderately massive ball-shaped terminals. The discharge circuit of the condenser carries the high-frequency currents which it is desired to study, and the many beautiful and now familiar phenomena are obtained by connecting the different pieces of apparatus in series with this discharge circuit. An elementary diagram is shown in Fig. 1, where *A* represents the alternating-current source of supply, suitably controlled by a rheostat or adjustable inductance *B*. C represents the step-up transformer, *D* the condenser, *S* the spark-gap, and at *X* in the condenser discharge circuit is connected the apparatus on which it is desired to impress high-frequency currents.

The most expensive and troublesome part of the apparatus is the step-up transformer. Several ordinary transformers

may be used to obtain the high-tension currents, but it will be found better, if time and means afford, to construct a special transformer of the open magnetic-circuit, oil-insulated type, of the transformer consists of a fiber tube of the dimensions given filled with fine, straight iron wire. This tube is fastened tightly to a thick cover, which may be of wood turned up in a

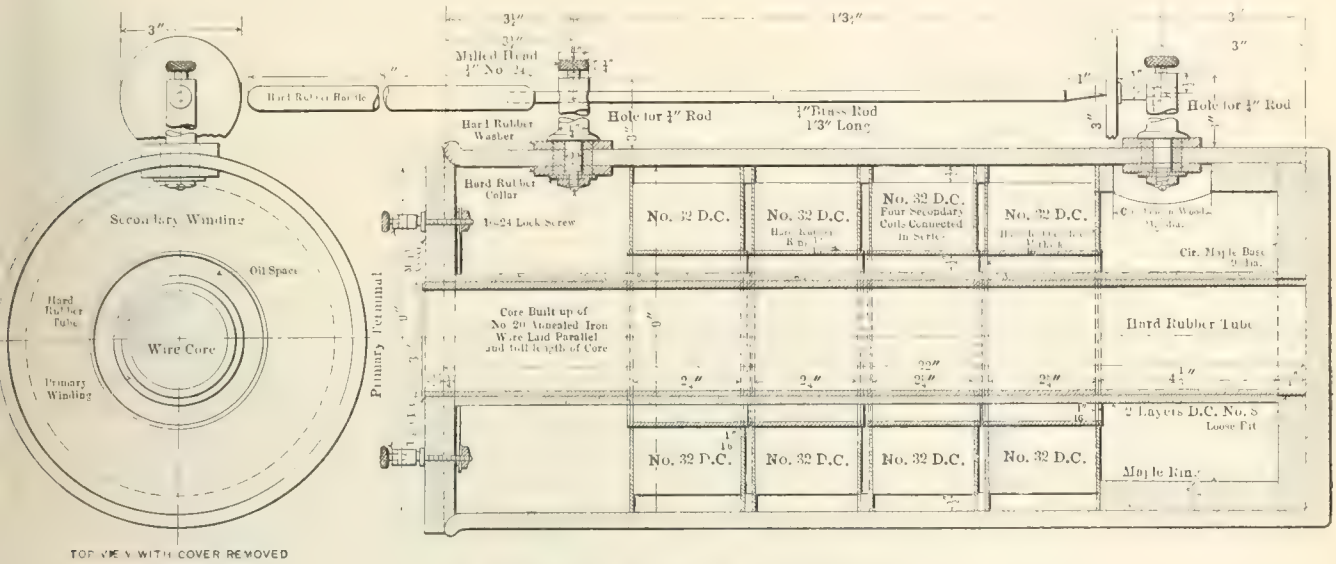


FIG. 2.—DETAILS OF STEP-UP TRANSFORMER

for the surges that obtain in such a circuit are apt to puncture the insulation of the ordinary commercial apparatus. The writer has found a very successful arrangement in Fig. 2, which is a

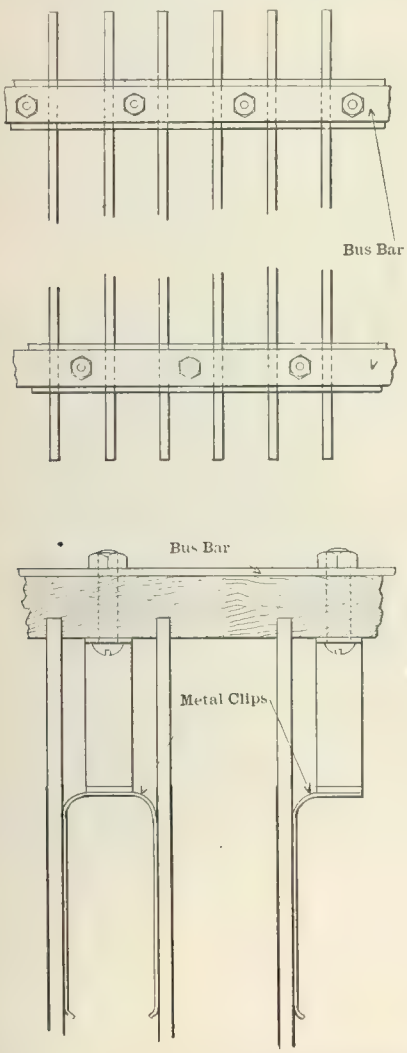


FIG. 3.—TOP AND SIDE VIEW OF CONDENSER RACK

dimensional drawing of a transformer suitable for this purpose. The containing jar of this transformer is made of indurated fiber, which is oil tight and an excellent insulator. The primary lathe and impregnated with asphaltic compound. The two terminals of the primary may be brought to binding posts mounted on the wood. The advantage of this arrangement is found in the fact that removing the cover removes the primary coil also for inspection and also leaves the secondaries open so that they can be examined. The primary is wound with two layers of No. 8 double-cotton covered copper wire. Considerable care is necessary in insulating the layers from one another, particularly at the top where the primary coil is supported by the wood, for this top is likely to protrude out of the oil and between the layers at this point the highest difference of potential obtains. It is well, therefore, to use several layers of oiled linen to separate the primary layers at this point. The bottom of the indurated fiber jar contains a round disk of wood with a hole in the center which loosely fits the ends of the primary and keeps it central.

The secondary coils are wound on hard-rubber spools, made of tubes and collars, and using No. 32, double cotton-covered wire. Between each layer of wire should be placed a layer of unsized white paper, and care should be taken not to wind

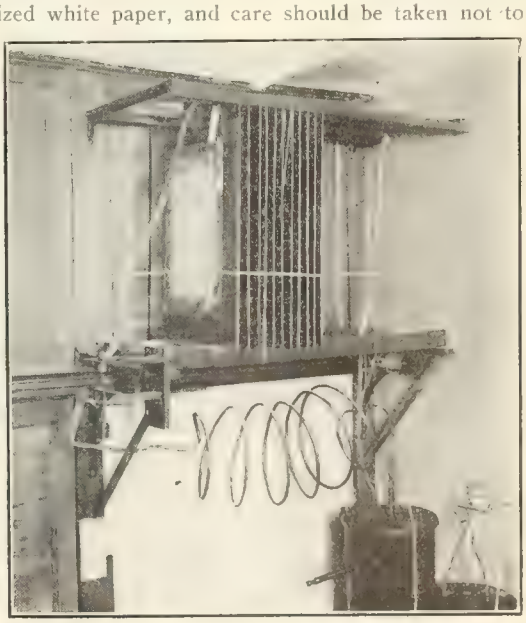


FIG. 4.—CONDENSER, SPARK GAP AND INDUCTANCE

the layers clear across the full width of the spool. A space ¼ in. wide should be left at each end so that there will be no danger of the end turns dropping down between the spool col-

lars and the coil itself. The coils when completed should be boiled in paraffin, which should then be allowed to cool, and when the wax is of a mushy consistency the coil should be removed and pressed between two plates of glass with a weight. In this way much of the wax which would otherwise drain out between the interstices of the coil will remain there intact and afford valuable protection and insulation.

The finished coils may be assembled on the spools by slipping the latter through them, and the spools may then be placed in

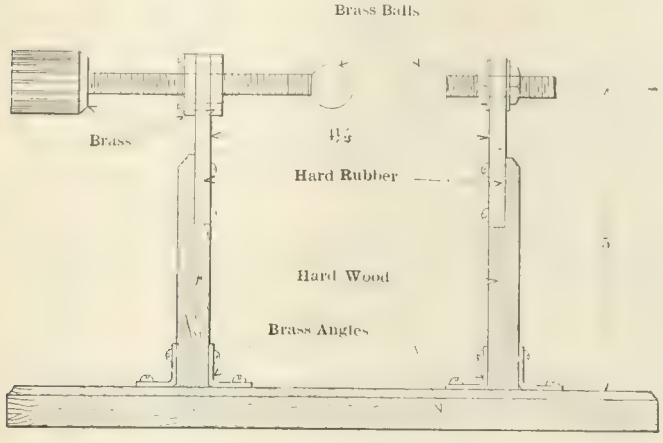


FIG. 5.—DISCHARGE CAP.

the jar, wooden rings being used as spreaders to separate them. Attention is called to the liberal spaces allowed between the primary and secondary, and when the jar is filled with a good grade of transformer oil the insulation between the primary and secondry is homogeneous and complete. An oil cock may be added at the bottom of the jar for the purpose of draining it and, as it is very hard to get the joints for the terminals tight, the jar may be placed in a metal pan which will catch all leakage.

The secondary terminals of the transformers are attached to hard-rubber tubes threaded into hard-rubber plates, which may be bent to fit the contour of the jar by placing them in hot water and securing them by bolts. The joints may be made tight with thick shellac. It may be well to bring the secondary terminals out from the ends of the coils, using a number of twisted wires for this purpose, instead of a single wire, which is likely to break and perhaps burn off.

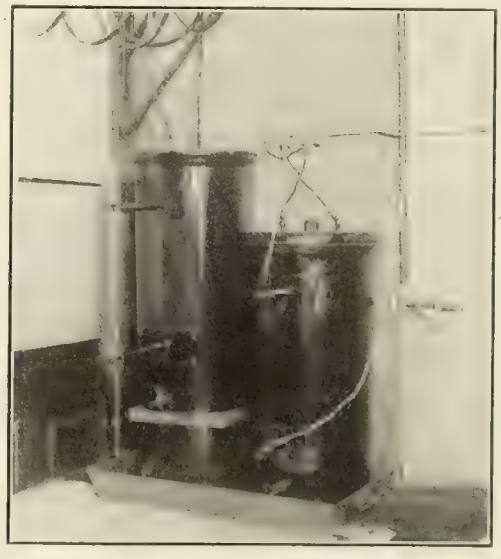
A coil constructed in this way serves not only the purpose of a transformer, but, used in connection with the electrolytic interrupter with direct current, will provide discharges of low frequency and very high tension, 75,000 volts to 100,000 volts, and may be profitably used for breakdown testing of insulating materials.

For the Tesla experiments, however, this coil should be excited with alternating current, and the current from the secondaries should be led off to charge a condenser which may be made in the following manner: A dozen plates of glass (ordinary window glass of double thickness will answer) should be provided and a wooden rack made to contain them. The plates of glass are 18 in. x 24 in. and are covered with tin foil on each side, a space being left between the edge of the glass and the tin foil of at least 3 in. It will be well to shellac the plates and the edges of the tin foil, and the tin foil can be fastened to the plates with shellac very advantageously. The plates are assembled in the rack, which may be made of strips of wood having equally spaced saw cuts, and a set of busbars may be mounted upon strips of wood with similar saw cuts and carrying clips which extend down between the plates and make contact with the tin foil. Fig. 3 shows how this may be done, and Fig. 4 shows a photograph of the actual condenser constructed in this manner. The arrangement is to be recommended rather than the more economical one of placing the plates closely together and using alternate strips of tin foil between them, for the reason that if any plate should be overheated and crack through sparking, it can be removed without disturbing the others.

The discharge gap may be mounted on a wooden frame; the discharge points being carried on light pieces of hard rubber and equipped with balls ⅝ in. in diameter. One of the discharge points should be screw controlled through a nut so that the gap may be varied. A drawing of this discharge cap is shown in Fig. 5.

The apparatus upon which high-frequency currents are to be impressed is connected at X and the discharge gap shortened, so that when the switch is closed, the discharge jumps across the gap making a very noisy white spark, which is inclined to be calorific and not sharply broken off, but which can be corrected by opening the discharge gap a little, after the discharge is once started. In fact, it will be found to be best to do this to obtain the maximum results. If an inductance consisting of a coil of copper wire, say No. 2-0 trolley wire, be wound 8 in. in diameter and with 6 turns, and connected across the points X, the oscillatory current will experience considerable difficulty in traversing it. If a spark gap be shunted around this coil, it will be found that a potential of from 8,000 to 10,000 volts exists there. A vacuum tube of any type will be brilliantly illuminated, if connected in shunt around this apparent short circuit. Still





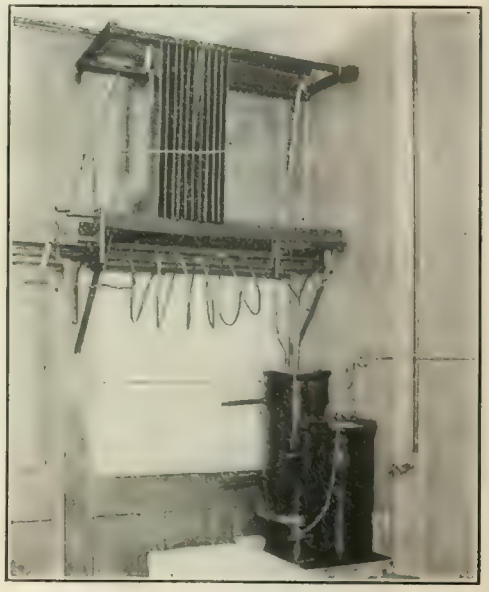


FIG. 6.—FRACTURED GLASS JAR OF TESLA COIL. FIG. 7.—TRANSFORMER AND TESLA COIL. FIG. 8.—GENERAL VIEW OF EQUIPMENT.

more puzzling is the fact that an incandescent lamp connected across the terminals of this coil, and apparently on dead short circuit, will light up brightly, but even under these conditions the experimenter will be presented with the curious phenomenon of the discharge striking across the terminals of the lamp within the bulb and also without, showing the existence of a high potential, and yet the filament will burn as it would under its normal 0.5 amp current.

A piece of No. 36 wire 3 or 4 ft. long, shunted across this coil will become red hot and burn out, and if the wire be coiled in approved magnet fashion on a glass tube with the insulated

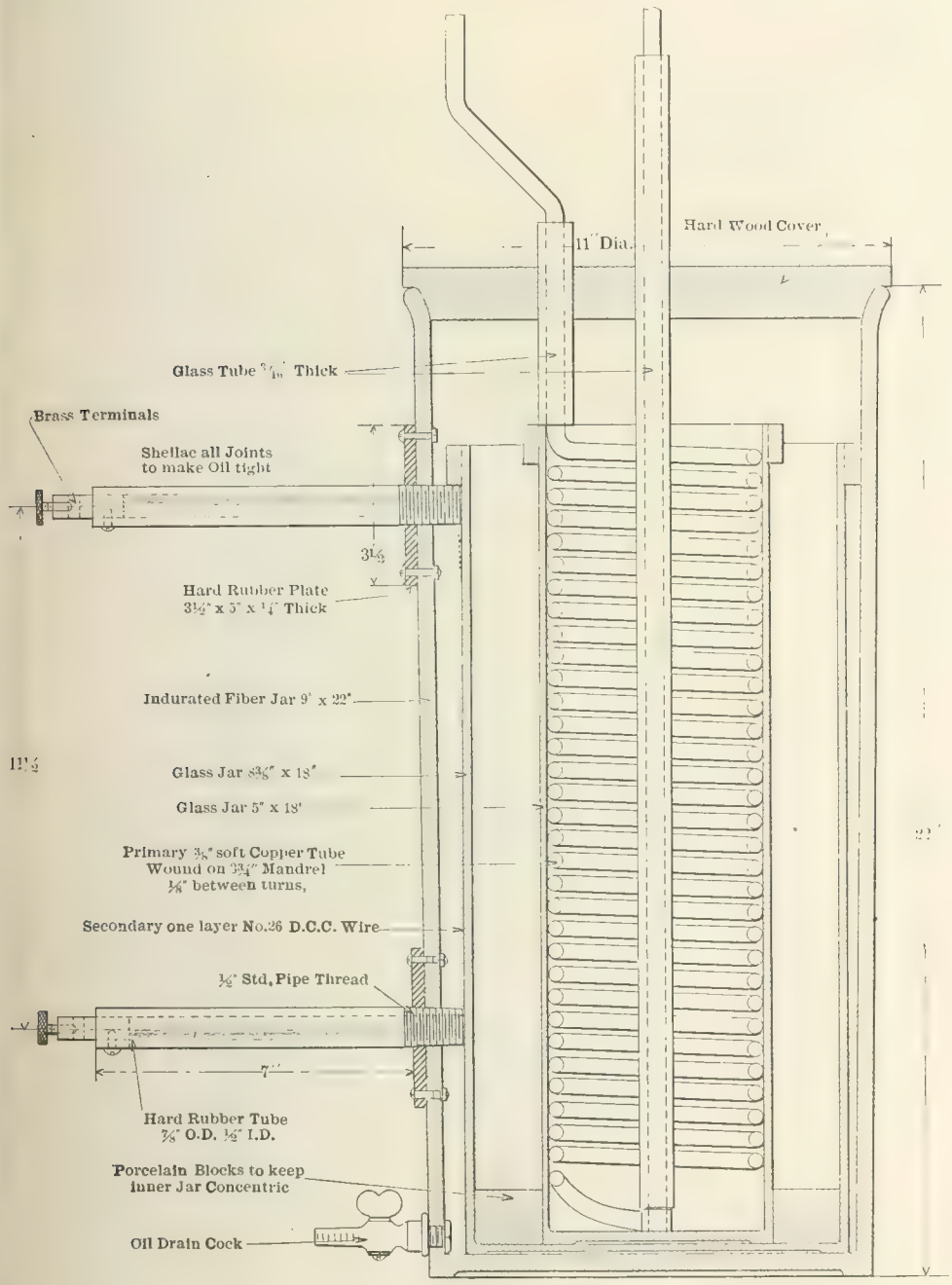


FIG. 9.—DETAILS OF TESLA COIL.

turns in close proximity and connected as above described, the current will jump from turn to turn on the coil rather than go through it. A very pretty experiment can be made by connecting at the point *X* a pair of busbars across which are shunted a spark gap, a vacuum tube, a 110-volt lamp, a 50-volt lamp, and at the extremities of the busbars a dead short circuit. With a little adjustment and manipulation, all of the lamps and tubes will light up simultaneously, while sparks will jump across the gap.

The Tesla experiments are not complete unless the step-up Tesla transformer is constructed. The coil described below is capable of producing voltages in the neighborhood of 150,000, and must, therefore, be insulated with a great deal of care. The primary coil consists of about 30 turns of No. 2-0 trolley wire, or a thin copper tube of the same diameter. This wire or tube is stiff enough to be wound in a single helix, having a return through the center, as shown in Fig. 6. The wire or tube should be coiled inside of a long glass jar, and one of those commonly employed in preserving specimens in alcohol will be found very suitable. The jar shown in the drawing is equipped with a heavy lip, the top of which is ground flat. The primary terminals are brought out through heavy glass tubes through the wooden cover, as shown in the drawing, and connected to the point *X*, Fig. 1.

The secondary coil consists of about 500 turns of No. 26 wire wound upon the outside surface of a second glass jar of considerably larger diameter than the first, but of about the same height. Care should be taken to wind these coils so that they do not pass beyond the high-tension terminals, for if this is not done, the turns beyond are likely to short-circuit against the lead brought up from the bottom of the jar or down from the top as the case may be. The coil should end at the terminals. The jar may be shellacked before winding the coil and allowed to dry, and after the coil is completed, a second coat of shellac should be given to prevent the wire from unwinding when manipulated. Double cotton-covered wire should be used.

The whole outfit may be immersed in oil in an umbrella jar of the same type as was used in the manufacture of the high-tension transformer, but it will be well to bring the terminals out farther in the case of the high-tension transformer, as the discharge is very unmanageable and will be found to strike into anything that may be within convenient reach. If the terminals are too short, the discharge will strike through the indurated fiber and oil back to the coil, and is likely to snap the wire of which the secondary is wound as neatly as if it were cut with a pair of shears. The terminals should be 12 in. apart. Like the case of the high-tension transformer, it is well to equip the jar with a drain cock.

The insulation of the Tesla coil may seem extravagant, but in the writer's opinion it is none too good, and perhaps may be improved upon. In the first experiments, the writer endeavored to construct a coil omitting the central jar, with the result that the jar was heavily punctured, the inside splintered and gnawed by the discharge, and the bottom of the jar was found to contain at least a heaping teaspoonful of powdered glass. This rupture is somewhat interesting for the reason that it was beyond all doubt the result of many successive punctures, and from the length of the rupture it was evident

that the discharge did not simply puncture one hole and enlarge it, but punctured again in another place rather than overcome the inductance of the slightly longer path through the original hole.

Owing to the fact that the high tension terminals of the Tesla coil make everything in the vicinity of opposite polarity by electrostatic induction, this coil should be well insulated from the ground. This may be conveniently done by setting the whole jar on a heavy piece of marble or glass resting on a second indurated fiber jar. The photograph showing the high-tension coil and the Tesla coil in action illustrates a suitable arrangement. In this case both the high-tension transformer and the Tesla coil are contained in a shallow iron pan.

Vacuum tubes of any length can be illuminated by simple contact with one terminal. The current from these terminals is not dangerous, although the shock obtained by taking both terminals in the hands would probably be somewhat uncomfortable, and it is well to take the discharge, if it is to be taken into the body, through a metal rod so as to avoid burns at the point where the discharge enters. The experimenter may seat himself upon an ordinary wooden stool, keeping his feet clear from the floor, and need not fear to take from one of the terminals of the Tesla coil a fat, hot spark 6 in. long, using, of course, a metal rod to protect his fingers against burning. He may hold in his free hand a wire leading to an ordinary 8-cp incandescent lamp, another experimenter holding the second wire, but standing on the floor. Enough current will be transmitted through his body to light the lamp. Or seated upon the stool in this way, he may ignite the gas with his fingers, or may light vacuum tubes by touching them, or deliver sparks to an observer standing upon the floor; in fact, there is no end of variations of phenomena. In conclusion, the writer would earnestly caution the experimenter to confine these experiments to the discharge from the Tesla coil alone. The terminals of the high-tension transformer are highly dangerous, and any wires connected with them are, of course, equally so, and should be adequately supported and securely placed beyond the range of accidental contact.

Methods of Firing Soft and Hard Coal.

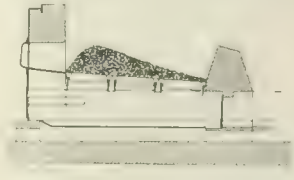
By Wm. Kavanagh.

When soft coal is used straight—that is, unmixed with hard coal dust—the coking method of firing is superior to either the pancake, humpback or scoop methods, because by this means very little gas is allowed to escape to the chimney unconsumed. In order to carry on the coking method successfully, wedge firing should be used, the thickest end of the wedge being against the furnace door and the wedge tapering rapidly toward the bridge wall, as shown in the accompanying illustration. Having built up a heavy wedge, the furnace door is closed and the fire allowed to do its work until the steam gage indicates a slight drop in pressure, say, 1 lb. or 2 lb. The furnace door is then opened and the coked portion of the wedge is pushed toward the bridge wall. The fire should be closely scanned to see that no cold air is finding its way into the furnace through the back of the grate bars, and the front of the furnace should again be filled with a fresh charge of coal. This method of coking should be alternately applied to each side, if more than one door is fitted to the furnace. In this way one side of the fire is coked and doing its work while the other side receives a fresh charge of fuel. The thinnest part of the wedge being against the bridge wall, more air is admitted here than in the heavier portion of the wedge, and hence the back of the furnace becomes a highly heated region through which the liberated gases from the front portion of the furnace must pass. This insures their complete combustion and renders the furnace very efficient.

If the fire becomes sluggish and burns with difficulty, it is a sign that there is too much resistance offered to the air in its passage through the fuel bed. In such a case, the slice bar should be pushed underneath the fuel and close to the grate bars, when by resting the slice bar on the dead plate the coal may be lifted gently from the bars. This process of slicing should be practised across the entire furnace; but in no case should the slice bar be allowed to break through the surface of the fire. It will be found that in this way the intensity of the fire may be increased with consequent greater evaporation.

Bituminous slack or soft coal dust can be successfully burned by first building a fire out of lump coal and then covering it with slack previously well wetted. The wet slack should be spread over the entire surface of the furnace bed and allowed to cake and afterward coke. The slice bar may then be used to lift the coked bed and permit the air to pass through the body of the fuel more readily. When flames appear on the surface of the wet slack, another layer should be applied and this method of firing continued until a bed heavy enough to suit draft and load is obtained. If the draft is of sufficient strength, a medium fire should be built up and after this has been properly sliced, the fire may be allowed to grow or increase in temperature. This method of firing will be found to give good results, especially since the furnace door need not be opened often. Bituminous slack can also be burned when mixed in equal proportions with hard-coal dust by first wetting the mixture and then firing it after the manner just described.

There are numerous grades of anthracite coal employed for the generation of steam, known as "bird's-eye," "rice," "buckwheat" and "pea coal"; the buckwheat and pea coal are numbered according to the different sizes. The great object in the firing of any grade of coal is to use as little as possible and at the same time maintain satisfactory steam pressure. In



WEDGE FIRING.

order to accomplish this the heat of the furnace, or at least a portion of it, must be kept at a high temperature so as to ignite the rich gases as they are formed and effect their combustion before they escape beyond the boiler-heating surface. The means by which this is done is as follows: Having built up a clear, clean fire, one side may be lightly covered and allowed to burn; then at the next firing the fuel may be thrown on the other side of the furnace and in this way the sides of the furnace may be alternately covered. The uncovered side is, therefore, at a high heat, and the gases generated from the covered side are thus burned and a useful effect on the heating surface of the boiler is the result. In firing any of the small grades of anthracite, the expert fireman is capable of spreading a shovelful of the fuel over one side of the furnace, the coal falling evenly all over the entire surface. If the furnace is extra large it may require two shovelfuls to cover the one side, but in general one side of a furnace 5 ft. x 6 ft. in size can be thinly covered with one or two shovelfuls of coal. It requires some experience to throw the coal in this way, but this may be easily acquired by practice. In learning to throw the coal as described, the fireman should practise with both hands; it is important to fire right- and left-handed in order to cover the fire properly.

Economy is not always realized in sprinkling one side of the furnace at a time, owing to the frequency of opening the furnace door and thereby admitting much cold air. There is more economy in firing one side fairly heavy and allowing it to become incandescent before covering the other side. "Fairly heavy" does not mean shoveling on great quantities of coal. The depth of the new covering of coal depends in a great measure on the intensity of the draft. With a strong draft, the thickness of the bed can be increased, while with a weak draft the fire must be thin. Right here experience is required in order to obtain the most satisfactory results.

There are two practical ways of cleaning fires. One method

is as follows: About half an hour before cleaning time the back of the fire should be coaled heavier than usual to insure a sufficient quantity of live coal to light the fresh fuel which will be used in building up the new fire. The front of the bed should be allowed to burn out; and if good judgment has been used there will be very little fire to pull out on the boiler-room floor. The slice bar may then be run under the burned-out portion of the fire and the ashes and clinkers broken up. The "lazy bar" may now be put in position and the ashes hauled out of the furnace. The good fire may then be pulled to the front, and the remaining ashes at the back raked down through the bars with the rake or "devil's claw." Any clinkers remaining may be jumped over the fire and hauled out of the doors. The good fire should be spread over the grate surface and a light covering of green coal thrown on. The furnace door should then be closed and the coal allowed to burn until incandescent, when fresh fuel may be again applied. After two or three light coverings the fire will be sufficiently strong to make steam.

The other method consists in cleaning one side of the furnace at a time, then coaling, and when the fuel becomes incandescent the other side is cleaned and built up in a similar manner. If dumping bars are used the good fire may be pushed back and the ashes in front dumped. The good fire can then be pulled to the front bars and the back portion dumped. The fire should then be spread over the surface of the grate bars and a light layer of coal thrown on and allowed to burn briskly. After the first covering is well ignited another shovelful or two of coal may be thrown on, and so on until the fire is hot and deep enough to continue in regular operation.

The Prevention and Removal of Boiler Scale.—II.

By W. H. WAKEMAN.

IN the previous article three boiler compound feeders were described. None of these is capable of holding very much of the softening solution, and where a device with sufficient capacity to hold several gallons of compound is desired, that shown in Fig. 1 is applicable. This is intended more especially for cases where the scale resolvent is purchased in dry form, after which it must be dissolved in water, and as it is advisable to prepare a weak solution the feeder ought to be large accordingly. When this is not required for immediate use the globe valve 2 is opened, the cross valve 3 is closed and valves 4 and

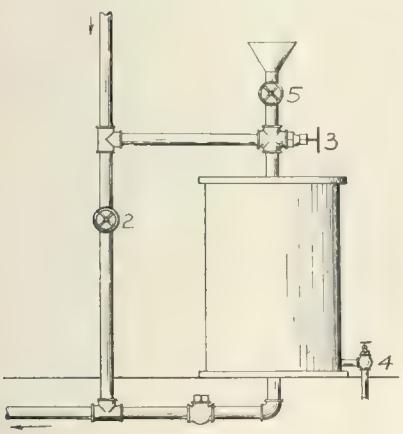


FIG. 1.—FEEDER FOR DRY SCALE RESOLVENT.

5 are opened. This allows water with which the body is filled to drain into the sewer. If the feed pump is in operation when this is shut off care must be taken to handle these valves in the order named so as to permit water to pass through without obstruction. When more compound is to be put into the boilers valve 4 should be shut and the body filled or the desired quantity of the mixture poured in and enough water added to fill the feeder in order to exclude the air. Then valve 5 should be shut, valve 3 opened and valve 2 closed, which will cause water to circulate through the body of the feeder, carrying the compound with it.

Fig. 2 illustrates a boiler-feed pump, a feed-water heater and a water purifier, in the order named. The combination is operated as follows: If water is to be pumped directly into the boilers (without passing through the devices shown), valve 2 is opened, while valves 3, 4, 5 and 6 are closed. When water

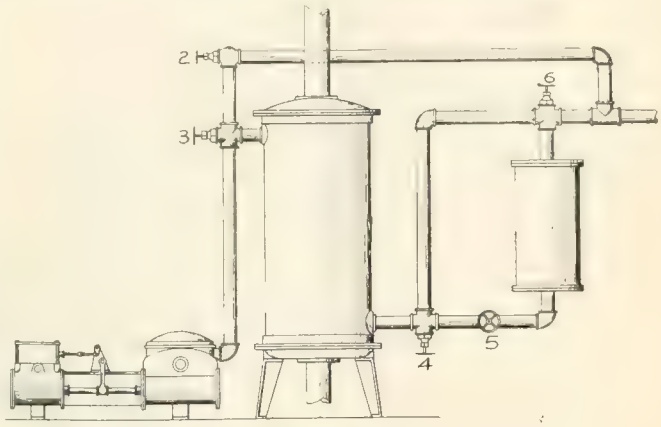


FIG. 2.—FEED PUMP, HEATER AND PURIFIER.

is to be sent through the heater only valves 3 and 4 should be opened and valve 2 closed. To feed through both heater and feeder valves 3, 5 and 6 are opened and valves 2 and 4 closed. By operating these valves in the order named the danger of shutting off all passages at once will be avoided.

It will be noted that no provision is made for filling this purifier with compound, for the simple reason that none is used. The device is patented and users are not informed concerning its contents except to state that it contains plates which destroy the affinity of the small particles of scale-making impurities for each other, and for the boiler shell and tubes. The effect of this is to preserve them in granular form, hence they can be blown out while the boiler is under pressure or thoroughly washed out when it is cool and nearly empty. Care should be taken to clean a boiler frequently if it was badly scaled before this device is applied, as there is danger of burning the plates where pieces of old scale accumulate and prevent water from absorbing the heat rapidly, provided the purifier does the work for which it was designed. This device is called a purifier by the manufacturer, but it is difficult to

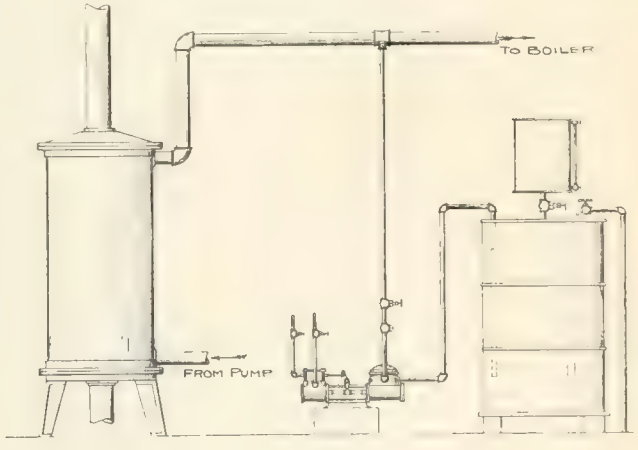


FIG. 3.—FEED-WATER HEATER AND MIXING TANK.

understand how any device can be properly called a purifier that does not remove impurities from the feed water. It only prepares them to be removed by other means, for if a boiler should be equipped with one of them and then operated for a year without being blown down or opened for thorough renovation there would be just as much foreign material in it as if the device had never been applied. It appears as if the name "scale preventer" would be more appropriate.

Fig. 3 illustrates a feed-water heater at the left hand into

which water from the pump enters and after being duly heated it is sent to the boiler, as shown, but a scale-removing compound is pumped into the hot feed-water on its way to the boiler by a small pump provided for this purpose. A mixing tank is shown at the right in which the required quantity of compound is prepared. The small pump takes it from this and delivers it into the feed pipe, as shown, at any desired rate. If a certain quantity of the compound, undiluted, is put into this tank and enough water added to fill the same, by running the pump slowly, it is possible to secure a very slow delivery, which is usually considered better than to send it in quickly. After all of the compound is taken out of the tank (to use a common expression, which means the greater portion of it), a comparatively large quantity of clear water ought to be run in and pumped out, in order to secure the full benefit of all material used.

If a small quantity is prepared each day this precaution becomes more important than if a much larger amount is used once a week or a month, as the possible waste is a greater percentage of the total. This is especially recommended where several boilers are in a plant, in order to distribute the remedy evenly, for if, say, 5 gal. of the diluted article is intended for each boiler separately, enough water should be used to insure the actual delivery of this amount. Unless intelligent attention is given to this matter some of the boilers will receive more and others less than their share, which is evidently not good practice. Even the plan of feeding it nearly continuously is not proof against this evil, because the average fireman will use more water in some boilers than in others, hence the compound will not be evenly distributed.

It is quite possible for one boiler of a battery to receive more than its share, even if each uses the same quantity of water. Suppose that the specific gravity of the compound is less than unity, or the standard for pure water. A large feed pipe is located across all of the fronts, with a branch pipe coming out of the top for each boiler. In this case the compound will travel along the upper side of the main pipe and more than an equal share of it will go into the first branch pipe. If it is practicable to shut off the feed water from all boilers but one, and then force the desired quantity of compound into that one, it will insure an equal distribution of the scale resolvent, which is an important consideration.

Fig. 4 illustrates a compound feeder that is fastened directly to the feed pipe, but there is nothing to prevent the feed water from taking a straight course past the device and if it follows the law which causes anything that is forced into motion, to take the path which offers the least resistance, but little water will circulate through the body. However, the compound will disappear if given time enough for the process, but it is not a positive motion.

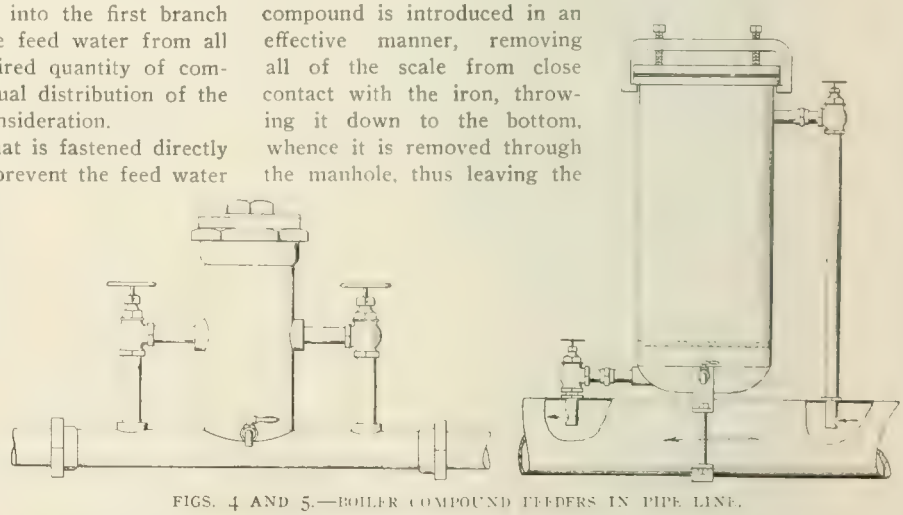
The device shown in Fig. 5 must be located on the feed pipe so that water on its way to the boiler will flow as indicated by the large arrow. If for any reason it is not practical to do this, the feeder should be turned from its present position on the pipe so as to bring the faucet on the opposite side. The long vertical inlet pipe which is surmounted by an angle valve will then be at the left instead of the right-hand. This pipe is extended into the feed pipe with an opening that is turned toward the advancing water, hence a portion of it is deflected into this pipe and thence through the feeder, taking the compound with it. The cover of this feeder is held in place by a strong wrought iron clamp and two screws. This cover must be packed in order to make it water-tight; but the same rubber gasket can be used many times if care is taken to coat it with graphite, on one side, and to put the cover always in the same position.

It requires more coal under certain conditions to evaporate a given weight of water in a boiler that is coated with scale than it does in a clean boiler, but the difference is not as great as it is sometimes represented to be. It is claimed that scale 1/16 in. thick causes a loss of 13 per cent of fuel, and if this thickness is increased to ⅛ in. the loss is raised to 28 per cent, while ¼ in. of scale causes a loss of 60 per cent. It would be a difficult matter to find a boiler that is coated with scale ¼ in. thick on every square foot of its internal surface, but it is not impossible to locate one or more that are partially coated to this extent, while nearly all of the remaining surface carries more or less scale on it, but if such a boiler is cleaned, the resulting economy will not be a saving of 28 per cent, which is a reasonable average for a boiler that carries scale ¼ in. thick on some of its internal parts, and much less on others.

This difference is accounted for on a rational basis as follows: Boiler scale is not all alike; some of it is porous, while other kinds are almost or quite as dense as porcelain. Taking the worst specimens, it is found that its conductivity, when compared with iron plate, is as 1 to 37; therefore, if scale 1/32 in. thick cleaves to the iron, it is equivalent to increasing that iron 1 in. in thickness. That comparison looks formidable, but from extensive and carefully conducted experiments made by eminent engineers the facts given below were secured.

The difference in temperature between the furnace and the internal surface of the boiler plate varied from 301 deg. Fahr. to 1128 deg. Fahr., and the difference in thickness of plate was just 1 in. In order to reduce the results secured from these tests to a common base, the rate of transmission of heat per square foot of surface for each degree difference of temperature is given, which seems to be an impartial method. When all results are reviewed it is found that taking the thick plate as a standard the thin plate allowed 50 per cent more heat to pass through to the water.

Applying this to practice, suppose that a boiler with plates ⅜ in. thick has a coating of scale of uniform thickness that is equivalent to one additional inch, as above explained. Steam is carried at 100 lb. by the gage, and conditions are such that the temperature of the escaping gases is 340 deg. Fahr., or practically equal to the temperature of the steam. An efficient boiler compound is introduced in an effective manner, removing all of the scale from close contact with the iron, throwing it down to the bottom, whence it is removed through the manhole, thus leaving the plates and tubes as clean as they were when new. In order to preserve a proper basis for comparison of results, no change is made in other conditions. Heat now passes much more rapidly from the furnace to the water through the plates that are exposed to the direct action of the flames, and in a tubular boiler the tubes near the rear head transmit the heat more rapidly than before, consequently when the products of combustion have reached a point about midway between the two heads their temperature is reduced to 340 deg. as they were when arriving at the front head under previous conditions. This temperature is maintained until the gases are discharged into the stack, because no more heat can pass from them into the water on account of the equilibrium of temperature that has been established. In some cases it is possible for heat to pass from the water into the gases by the law of nature which causes heat to pass from a hot to a comparatively cool substance.

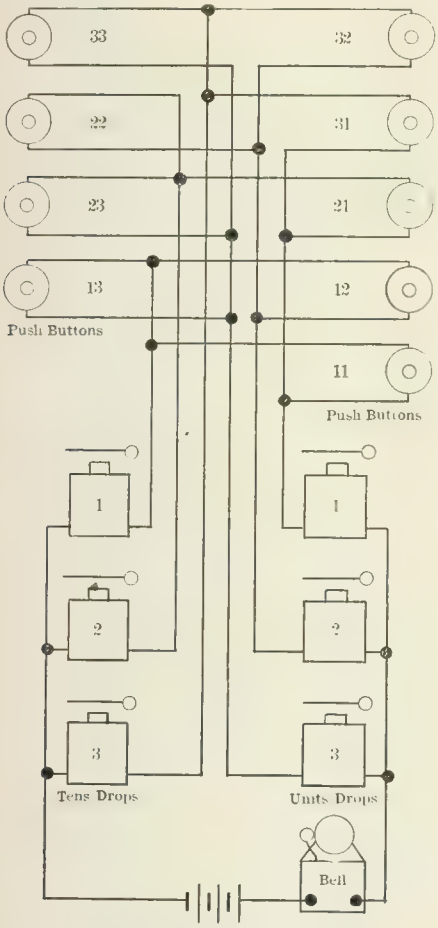


FIGS. 4 AND 5.—BOILER COMPOUND FEEDERS IN PIPE LINE.

LETTERS ON PRACTICAL SUBJECTS

A METHOD FOR WIRING ANNUNCIATORS.

The object of the scheme here described is to lower the expense of installing an annunciator by reducing the number of drops and the amount of wire required. To make clear the method, a special case is discussed. Assume that it is required to install an annunciator in a three-story building, on each floor of which are three rooms to be connected to the annunciator. A suitable method of numbering these rooms is to call the first-floor rooms 11, 12, 13, the second-floor rooms 21, 22, 23, and the third-floor rooms 31, 32, 33. An annunciator with six drops is used. Three of these drops are designated as tens drops and bear the numbers 1, 2, 3, respectively. The other three are units drops, also bearing the respective numbers 1, 2, 3. For convenience in reading the indications, the tens drops should be to the left of the units drops. Pushing a button in any room actuates two drops, corresponding to the tens and units figures in the number of the room. The manner in which this is accomplished is shown in the illustration. One pole of the battery is connected to one terminal of each of the drop magnets in one group, and the other pole of the battery is similarly connected to the other group. A bell may be introduced in one of these connections, as shown. The remaining terminals of the drop magnets are connected to the line wires. There is a line wire for every drop. Each push-button is connected to the line wires corresponding to the drops which that button operates. In this case six drops are required instead of nine, but where the number of rooms is greater, a greater proportionate saving is possible. To connect an annunciator with 90 rooms, numbered from 10 to 99, by this method, an annunciator with nine tens drops, numbered 1 to 9, and 10 units drops, numbered 0 to 9, is required, a total of 19 drops. The amount of wire saved by this method depends on the relative location of the push buttons, and a general discussion of it would be of little value. This arrangement is unsuitable where calls are received by the annunciator in rapid succession, for if a second call is received before a previous one is noted, it is generally impossible to determine from which rooms the calls proceeded.



ANNUNCIATOR WIRING DIAGRAM.

ELIZABETH, N. J. F. P. MCDERMOTT, JR.

A PECULIAR GROUND.

A consumer filed a complaint at the office, saying his electric light bills for his residence were high. The electric meter was tested and found to register correctly. The wiring was also tested and reported clear of grounds. When these tests were made, it was reported that, with all lamps turned off, the meter disk would not rotate. The connected load on the meter was 38 16-cp lamps, service being supplied from a two-wire overhead, secondary system which was grounded outside of the building in the regular way. Sometime later the consumer complained that frequently his electric meter would run when all the lamps were turned off.

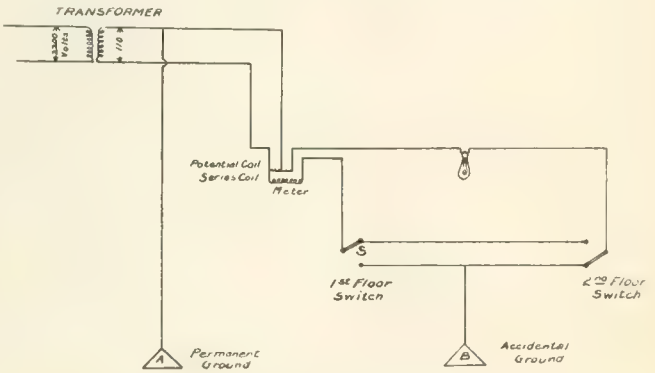


FIG. 1.—DIAGRAM OF CONNECTIONS.

The writer was requested to make a personal investigation, and upon arriving at the house, found the meter running and registering at the rate of 85 watts per hour, with all lamps turned off. The trouble was traced to a circuit which had two three-way switches for operating the first and second-floor hall lamps. The first-floor switch was turned on and the second-floor switch turned off and the meter stopped. It was found that each alternate time the lamps were turned on at the first-floor switch and turned off at the second-floor switch, the meter kept on running, although no lamps were burning. An accidental ground was located on one of the two wires which connect the two three-way switches. Referring to Fig. 1, it will be readily seen that switch *S* connects the accidental ground to the ungrounded side of the system through the series coil of the meter, and causes registration, whereas, in Fig. 2, the accidental ground is connected to the grounded side of the system, and there is no registration. The accidental ground was cleared, and there was no further trouble.

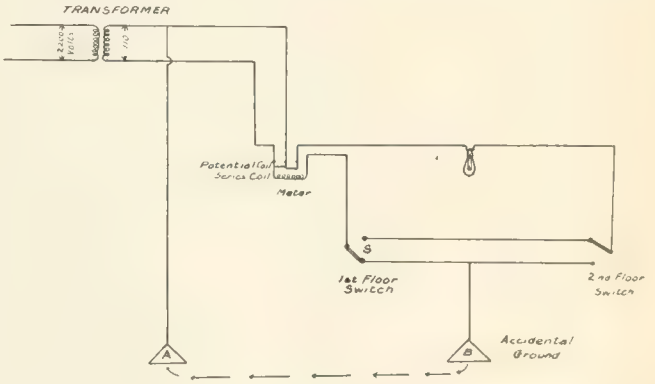


FIG. 2.—ACCIDENTAL GROUND.

MT. VERNON, N. Y. F. J. MURMANN.

TROLLEY-WIRING A PUBLIC SQUARE.

It recently became necessary to lay out the wiring for trolley supports in a public square, the sides of which were each 160 ft. long, with intersecting streets 40 ft. wide. As represented by Fig. 1, the wiring did not cross but intersected through the medium of four 90-deg. curves. The wiring could

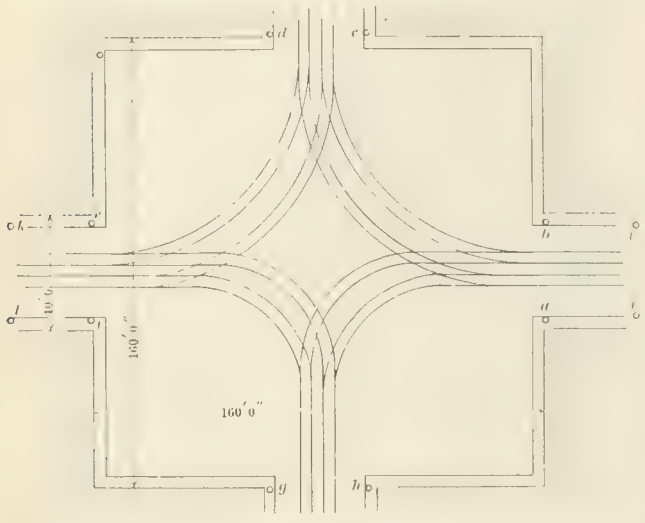


FIG. 1.—SQUARE TO BE WIRED.

not be attached or fastened to any of the buildings, but must needs be supported entirely by the poles *a, b, c, d, e, f, g* and *h*, which were located as shown at the intersections of streets and square, but placed flush with the building line, and also flush with the curb in the street edge of the sidewalks, which are shown extending entirely around the square. Fig. 2 represents the manner in which the wiring supports were laid out and suspended entirely from the trolley-wire poles. It will be noted that the entire wiring is attached directly to and supported by poles *a, b, c, d, e, f, g, h*, but these poles are in turn supported by guy-wiring from the tops of these poles to the foot of each adjacent pole, as shown at *i, j, k, l*, where poles *a, b* are guy-wired to the lower portion of poles *i, j*. This prevents the load of trolley wiring and its supports from pulling the tops of the poles toward the center of the square. The entire load of wires and supports is carried by the eight wires *a o, b o,*

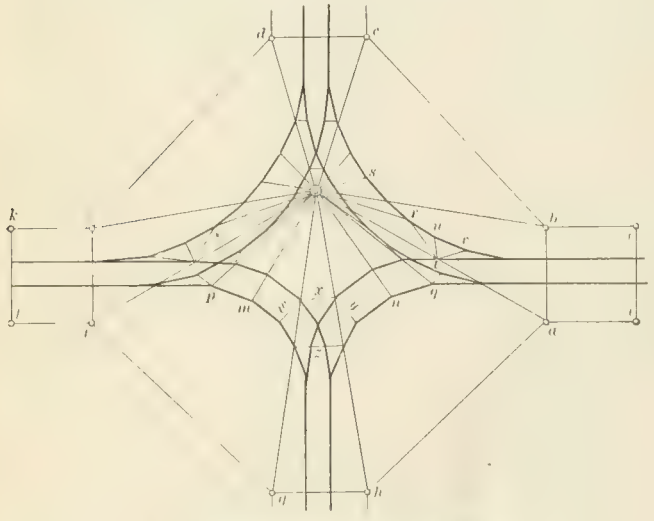


FIG. 2.—PROPOSED TROLLEY WIRING.

c o, d o, etc. Each of these wires is made fast to the ring *o*, which is located a little to one side of the square for a reason which will be stated later. The wires *a b, c d*, etc., are the regular trolley-wire supports, and to relieve the system from any possible side strain which might cause the above-mentioned wires to sag, the tie wires *b c, d e*, etc., were placed as shown, thus preventing absolutely any possible unsupported side strain upon the poles. The feed or trolley wires were attached direct (through the usual insulation) to the wires *a o, b o*, etc., and the other short wires, *m o, n o*, etc., which were placed as the angles between the tangents into which the 90-deg. curves were divided. Other wires, *o p, o q*, etc., were placed as found necessary, then still other wires, *o r, o s*, were connected direct to ring *o*. But several curve angles still remained unsupported, as at *u, v, r*, etc., which were fastened to a convenient angle-point in *a o*, at *t*. Still other parts of the curve-tangents had to be supported by tie-wires, as at *w, x*, and another type of tie-wire was added, as at *z*. Then it was found that every angle into which the feed wire was divided had at its apex a supporting wire which pulled outward in direct ratio to the pull of the feed wire. The writer would be pleased to read criticisms of this lay-out, and to ascertain which wires, if any, could be dispensed with and still leave the installation of ample strength and stiffness.

New York City. James Francis.

TROUBLE WITH A TELEPHONE.

A certain desk telephone set had been complained of for many months. While speech could be heard with distinctness from other instruments, people outside had trouble in understanding what was said through this particular telephone. The trouble man had been to see it several times and could find nothing the matter with it, except that he reported the dry battery useless and replaced it with a couple of new dry cells. This always improved the performance of the telephone for a while, but after a time it would resume its old condition of imperfect enunciation and hard-to-hear speech. Finally, in

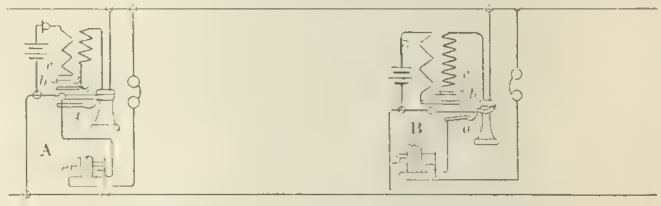


FIG. 1.—DIAGRAM OF TELEPHONE CONNECTIONS.

talking over the matter with the trouble man, who, although quite a young man, had much experience, he casually asked why the dry cells which he placed with that telephone always became wet on the outside in a few months—and sometimes within several weeks, he afterward added. The young man was told that a dry cell would never get wet unless there was a hole in the zinc case which enclosed the cell and which formed one of the elements thereof. The matter of a hole in any of the numerous cells which had been placed with that desk telephone was stoutly denied by the young man, who was presently prevailed upon to bring up the faulty cells and give the writer a look at them. When they came, it was found that not only was there a hole in the case of each cell, but that the entire zinc shell in which each cell was encased had been eaten away by the chemical action developed inside of the cell during its very few weeks of use. There was only one solution possible to this problem; there was a ground somewhere or a short circuit, which had caused a continual flow of current until the cells were almost entirely consumed. The lineman maintained stoutly that there was no short circuit and that the telephone worked perfectly until the cells became wet again, which was within a few weeks. There could be no short circuit or ground, he maintained, as long as the telephone talked well and gave and took call signals properly. Finally, the gentleman was prevailed upon to bring the telephone to my office, and we at once proceeded to investigate. The transmitter was taken off and found to be properly connected. The receiver was also perfect and properly connected into the circuits. The instrument was made for central-energy work, but in use it was supplied with a ringing current (when central did the ringing) from a battery of 65 dry cells operated in series, through a pole changer

which in turn was driven by a single Edison cell. The speaking current for each section of the exchange switchboard was obtained from three gravity cells, in series, and three panels were in use in the little exchange, hence nine gravity cells supplied that department. As stated, two dry cells supplied the speaking current at the instrument, the signaling being done by magneto, the automatic switch of which instrument was so



FIG. 2.—OBSCURE SHORT CIRCUIT.

arranged that the magneto was normally short circuited; but the switch opened at the first turn of the magneto crank, bridging the ringing current across the line circuit, through the underneath contact *a*, Fig. 1. The connections were carefully tagged as they were taken down, and the most careful search failed to find anything wrongly connected in the wiring, which was as shown by sketch *A*, Fig. 1. It was observed that the carbon transmitter was in series with the battery which gave trouble, and that when the receiver was off the hook for talking, the dry battery was short circuited through the transmitter, the spring contacts *b* and *c*, and the central spring of the desk set stand which is represented in the diagram by the receiver lever itself. The contact *a*, being the bridge-ringing contact which was broken when the receiver was taken from its hook, thereby cutting out the ringer while talking.

Nothing could be found wrong with any of the connections, as stated, and the instrument was reported all right when the writer observed that there was very little space between the spring contacts *b* and *c*, at *A*. Upon looking at another instrument, as is shown at *B*, much more space was observed between the contacts in question. An adjustment was made of these springs, so that they would remain normally apart when the receiver was on the hook. It was decided that the position described, in which the contacts *b* and *c* had been found, was the cause of the trouble with the telephone, for, with permanent contact between springs *a* and *b*, while the receiver was on the hook, two paths would be provided for the current from the dry cells at the subscriber's instrument. One path would be through the transmitter, the primary and secondary induction coils in series, the line and the ringer coils of the other, which in this case was the central station instrument. The other path was through the transmitter and both coils in series as above, thence across through the ringer coils. Thus the two paths were about equal in resistance, save that of the line, which in this instance was very short. Hence the dry battery was permanently in series with two sets of ringer-coils in multiple. Having found this trouble, the desk telephone was returned to the subscriber with the natural good feeling which comes from solving a problem of this kind, but to the disgust

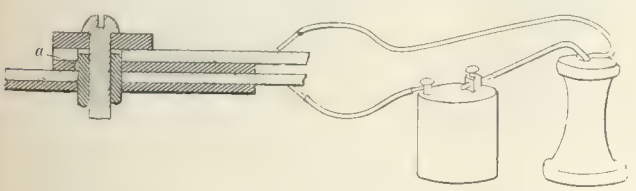


FIG. 3.—TESTING FOR CROSS CONNECTION.

of the trouble man and the writer, the trouble was not remedied by any means, for the battery drain continued. Another desk instrument was substituted at the subscriber's office, and the defective instrument was placed on the operating table for a thorough inspection. Unfortunately, at this point, the defective telephone was returned with a lot of extra material to the main supply room before the cause of the trouble could be learned, but, as luck would have it, the same trouble developed in another instrument, in seemingly exactly the same manner. In this case, there was no trouble with the spring contacts—they were in good shape and proper position, and the trouble was only found after the connections had been unsoldered from the spring contacts and tested out with receiver and battery, for insulation and for good connections. Finally, the desk stand interior was reduced to the condition represented by Fig. 2, all the wires having been unsoldered and the leak remaining under test with the assembly, as shown by the illustration in question. It was thus demonstrated that the trouble must be in the construction of the apparatus, and not in any of the external electrical connections. Fig. 3 shows the manner of testing for electrical contact between the parts of the telephone. A receiver and a dry cell were connected in series and the free ends of the wires applied to the metal parts between which a short circuit was suspected. One or both the wire-ends were dragged across the metal portions while listening at the receiver. When no sound was heard during the movement of the wires over the suspected parts, it was assumed that there was no electrical connection between said parts sufficient to vitiate the insulation. But it was found that noise could be heard in the receiver when the wires were scraped across the two upper springs shown in Fig. 2, but no sound could be heard when any two other parts were thus tested. Fig. 3 shows a section of the springs—or of two of them, down through one of the fastening screws. The dark shaded portions represent the vulcanite insulation, and it is shown that a bit of tube is placed around the screw which fastens the springs together. It was only after the device had been taken down that the cause of the trouble was finally discovered at *a*, where, barely visible among the cross-section lines, is represented a bit of very fine wire which had accidentally got into the hole during the process of assembling the instrument. This wire was even finer than the magnet wire used for winding receiver magnet-coils. In fact, it seemed to have come off of, or out of, the tinsel-like threads of which the flexible cords used for receiver connections are made up. This bit of metal was removed, the instrument reassembled, and there was no more trouble with that desk telephone. The cure was complete and permanent. Twice since, the writer has had similar trouble, and in both these instances, after locating the two members between which it was suspected that a fragmentary metallic circuit existed, a heavy current was turned into the suspected parts and the connection was burned out, leaving the parts so well insulated that the receiver could detect no noise when the parts were scraped with terminals across which 65 volts were maintained. A 110-volt light circuit with a 32-cp lamp was used for burning out the suspected connection. The second time the burning-out method was effected, a ringing current from 65 dry cells was tried. The same current was used for testing with the receiver, then the current from the entire battery was sent through the suspected short circuit. The current was taken from the binding posts of the pole-changer, and it did not interfere with the ringing for more than half a second. The frail connection was evidently burned out in a second, for even when tested with the entire current from 65 cells, no noise could be heard when the contacts moved over the springs shown in Fig. 2.

WILLOUGHBY, OHIO. JAMES E. HOBAN.

A NOVEL AND USEFUL TROLLEY LINE

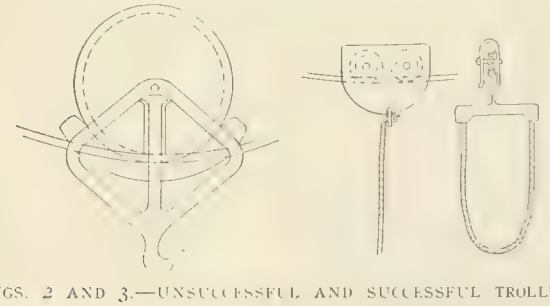
A certain isolated central station which combines both waterworks and light supply is situated upon the bank of a small river which at certain times is very swift and deep. At all stages of the river, it is necessary for the linemen and the water-men frequently to cross this river in order to care for the intake and a portion of the lamp circuits. A bridge was suspended upon wire cables and did duty for several years, but the comfort of the men and the safety of the bridge were very questionable on windy days. When the wind was blowing a gale, it would get under the flimsy structure and toss it into the air as far as the cables would permit, and the flooring would

be wrenched loose and carried away. So much of the structure was repeatedly carried away by the wind that it was finally decided to abandon the foot-way, and by using the same cables to transform the bridge into a double-track passenger trolley. Fig. 1 gives an idea of the looks of the apparatus after the change was made. The same cables and the same four poles were used, also the same anchorages, and approaches, with the



FIG. 1.—SKETCH OF TROLLEY.

addition of one on one side of the river, where the ground served as a landing stage. Originally, both the cables were made fast to the poles and level with the top of the stairs. Had the poles been tall enough to permit the raising of one end of each cable above the landing, then the cables could have been left with the landings as they were originally placed. But it was found necessary to lower one end of each cable, as well as to raise the other end, in order to secure the necessary drop, which was found to be 1 ft. to each 14 ft. span. By placing the landing end of each cable under the starting stage, there was no interference of trolley or landing stage. A little difficulty was experienced when the trolleys were first rigged up, and the arrangement shown by Fig. 2 proved a complete failure. The movement of the passenger seemed to throw a good deal of pressure against the flanges of the sheave, and the first thing the passenger knew, he had lost headway and was suspended between starting and landing places. He then had to pull himself along the cable, hand over hand. Next, a tandem pair of wheels was rigged, as shown by Fig. 3—a couple of trolley wheels from a street railway shop being pressed into service, and a housing was made for them of 3-16-in. plate which was bent up as shown; the parts to receive the rope swing being simply turned at right angles to the body of the carrier. The most comfortable way to travel in this vehicle is to sit down in the swing, as shown in Fig. 1; but the passenger can place one or both feet in the swing and stand if he chooses. His head will then be above the trolley cable, which position may be of advantage if looking for trouble, as is often the case when using a trolley, as shown in Fig. 4. The latter illustration



FIGS. 2 AND 3.—UNSUCCESSFUL AND SUCCESSFUL TROLLEY.

represents the poles of a long aerial transportation system fitted with the double-sliding trolley as a means of getting quickly from one pole to another, something which has to be done quite frequently when there are a pair of pulleys to be oiled and kept in good condition on the top of each of the poles, some of which are 80 to 90 ft. above ground, and, as shown by the engraving, sometimes very rough ground, too.

The writer can bring to mind, and the reader will also think of many instances, where an arrangement of this kind would be of great value for crossing torrents, chasms, and for even passing from one portion of a large building to another. Even for the oiler, who must visit difficult places, a trolley line of this character, modified to suit the conditions, would prove of great value. An arrangement of this kind rigged from the top of a battery of boilers to a distant part of the factory or station would prove a most welcome means of escape when it is required to close the stop-valves on top of the boiler in case of accident to the other valves, or to the pipe line through the station. The writer has seen the time when it was impossible to get away fast enough from the cloud of hot steam. In arranging this trolley for passage in either direction, it is necessary that the cables be separated a distance greater than the length of the cross arm of the traveler. This is to prevent two passengers from colliding when they are passing each other. When the travel is in one direction only, of course this precaution is unnecessary. When erecting a new line, it is easy to hang both cables to the same pole by simply inclining the pole so that the cables and consequently the carriers or travelers will hang clear of each other. Were this to be done with the line pictured in Fig. 1, the poles must stand at a sidewise angle of 2 ft. in each 5 ft. of height. This would call for another dead-man anchorage at right angles to the line, and it would also call for the inclination of alternate poles in the opposite direction all along the line. Some kind of hand-propelling apparatus will be necessary when this line is to be used for repairs and inspection, for upon stopping near the landing end of the line, some convenient form of grip must be

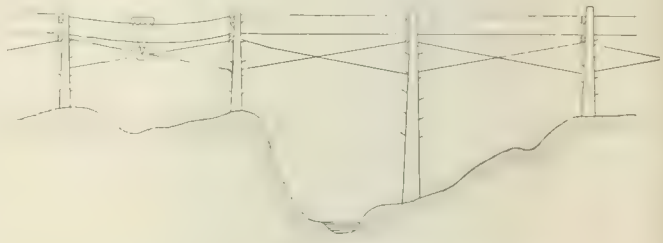


FIG. 4.—TROLLEY AUXILIARY TO CONVEYOR LINE.

attached to the end of a short rod for the purpose of pulling one's self along after stopping midway between stations. A flat U-shaped forging attached to the end of a small rod or a stick would prove all that is necessary, if so arranged that pushing or pulling on the rod would cramp the U-shaped forging against the cable.

Newcomerstown, Ohio. Frederick J. Haines.

CARE OF GAGE GLASSES.

In the boiler-room, the gage glass very often receives but scant attention. When one breaks every engineer knows it is not a very comfortable matter to shut the valves leading to the glass and replace it. Spare glasses should always be kept on hand for just such emergencies and in the keeping of these spare glasses some care is called for. For instance, it is very common to find spare glasses strung upon a wire, and unless a soft wire like copper be used, the glass, if moved much, is sure to be scratched by the wire which leads to its early breakage. It is singular how sensitive the inner surface of a gage glass is to injury of this sort, the slight friction of an iron or steel wire being sufficient to cause the glass to break from apparently no cause whatever. The experiment may be tried any time by rubbing the inner surface of a gage glass with an iron wire and then placing the gage glass carefully away. In a great majority of cases it will be found that if the glass has not broken spontaneously in the course of time, its life, when in service, will be very short. Another fault to be found with gage glasses in boiler-rooms is that they are set in such poor shape and so ill lighted that proper care is seldom vouchsafed to them. It is an easy matter to place an incandescent lamp near the gage so that it may be readily seen at all times; but too often nothing of the sort is provided and the gage cannot be read with ease. This, coupled with the dirty conditions in the boiler-room, soon obscures water in the glass altogether so that it is a very easy matter for the fireman to make a mistake which may prove costly. If a gage glass breaks the fireman can bind up his arm and hand and close the lower valve without danger.

Birmingham, Ala. Chester Adams.

The Detroit Residence Rate System.

A system of rates for residence consumers employed by the Detroit Edison Company for several years is beginning to find favor with several smaller companies and has certain features of interest to which but little attention has been called in articles and discussions on the rate question. The Detroit plan is to charge 16 cents per kw-hour up to a point where the customer's consumption equals 2 kw-hours per month for each of the rooms in the house, which are counted, and 4 cents per kw-hour for all electricity used in excess of that amount. The characteristic or peculiar feature of this system is that it is based on the theory that a consumer's maximum demand is in proportion to the number of rooms in the house rather than in proportion to the number of lamps actually connected. In determining the amount which must be used before the lower rate is secured by the Detroit system, only the principal rooms of a house are counted. Two kw-hours per month is the equivalent of 60 hours' use per month of 33 watts per room or 30 hours' use per month of 66 watts per room counted. As a basis for the rate all of the rooms of the house are included except the kitchen, laundry, storeroom and three bedrooms. The same system has been adopted by the Jefferson City (Mo.) Light, Heat & Power Company.

The Lawrenceville Light & Water Company, Lawrenceville, Ill., on June 1, 1908, adopted a residence rate system based on the same principle, but differing somewhat as to the method of counting. The Lawrenceville plan is to multiply the number of rooms counted by 1200 watt-hours. This gives an amount which is billed at the rate of 15 cents per kw-hour. Electricity in excess of this amount and up to 2400 watt-hours per room counted per month is billed at 6 cents per kw-hour. All in excess of 2400 watt-hours per month per room counted is billed at 5 cents per kw-hour. Consumers are given the option between this rate and a straight 10-cent per kw-hour rate. Heating appliances and flatirons are not counted as influencing the maximum demand. The practical effect of this is to give a low rate to non-peak business, such as flatirons, and to favor the residence consumer using electricity many hours per day. The majority of the resident consumers are on this rate. The portion charged at the high rate is equivalent to 30 hours' use per month of a maximum demand of 40 watts per room counted. The method of counting rooms is somewhat different from that at Detroit. All of the rooms of the house are counted, except bathrooms, basement, porches, stairways, attic, storerooms, small halls, entrances, woodsheds and barns. The rooms counted are, therefore, the regularly occupied rooms of the house.

It is now generally accepted that an equitable system of charging is one based on the consumer's maximum demand and that the average rate per kw-hour which he pays must be dependent upon the number of hours that maximum demand is used per year. It is the maximum demand which determines the investment which must be put in by the company to serve the consumer. Aside from the Detroit system, there have been two methods extensively employed for determining the consumer's maximum demand as a basis for charging. The most common system has been to assume that this maximum demand is a certain per cent, say, about 40 per cent, of the total connected load in the residence. An objection offered to this plan is that it puts a penalty on the use of numerous very convenient lamps in closets and other places where they are turned on but a very few moments at a time and which really have very little influence on the consumer's maximum demand. It is not desirable that a consumer be virtually obliged to pay a higher rate per kw-hour simply because he has these conveniences, because it restricts their use and cuts down the total consumption of energy.

The other method of counting the maximum demand has been to install a maximum-demand meter, but the expense of such meters has prevented the extensive use of this method among small residence consumers, although it is in use in a few large cities. It is, of course, more accurate than any assumed figures.

The advantage claimed for the Detroit system is that it does not put an unjust penalty on the use of as many convenient sockets as the consumer desires. It is based on the broad assumption that the consumer's maximum demand is approximately proportional to the number of regularly occupied rooms in the house. The argument against it is sometimes advanced that in some houses with very large rooms the number of lamps per room is greater than in a small house. While this is true, on the other hand, the large house is likely to have more of its rooms unoccupied at one time than is the small house. This tends to keep the ratio of maximum demand to rooms about the same for the different houses.

Value of Electrical Association to the Industry.

By H. W. Hillman.

In the histories of the arts there is no more interesting study than that which has to do with the electrical industry. By leaps and bounds its various branches have been advanced to a degree which has made the electrical industry at least more interesting, if not more important, than all the others. During the past quarter-century electrical students have accomplished feats of engineering which have placed them foremost among the greatest engineers which the country has known. When we think of the development of the electric street railway, we marvel at the wonderful extension of this branch of the industry since 1887, a period of but 22 years.

It has been particularly noticeable how rapidly advances have been made in the electrical arts. One reason for such quick results from the factory to the consumer lies in the activity of the electrical associations, and perhaps we do not appreciate the value of these associations. One of the most conspicuous State associations was that organized in Ohio during the early years of the history of the industry. The writer entertains fond recollections of the Ohio State conventions which he attended in 1896 and 1897. The association at that time had quite a good membership, and every active central-station man would save his time during the year to be sure to have a full week for the Ohio State convention in August.

Manufacturers and supply dealers appreciated the value of such gatherings, and were always glad to exhibit new devices at such times, and sent the best men available as an indication of their interest in such meetings. About the time mentioned the series-alternating system of street lighting was receiving marked attention. The Ohio State association was one of the first to devote time and energy to the study of its merits. As a result, the greatest numbers of alternating street lighting systems were installed among the cities and towns of Ohio.

Then the small-motor business became prominent, and at the earliest moment that the factory engineers could say that designs were ready for the consumer, the officers of the Ohio State Association found ways and means for accurately informing its members regarding their merits. How wise it now seems that such close attention was given to the subject, because the years which have since passed have been filled with new ideas and extensions of designs which never could have been advanced so rapidly had it not been for the activity of the Ohio and other kindred associations.

A vast amount of credit is due the National Electric Light Association for its aggressiveness and its continual activity in the field. When Mr. Henry L. Doherty introduced such drastic measures for increasing the membership of that association one did not realize how valuable it would be to the industry in the years of 1906, 1907 and 1908. It seems to have been just the thing to do exactly as he did, because later, when the ideas of the Co-operative Development Association were promulgated through the channels of that association the information was spread broadcast and its ideas were quickly acted upon by the members of that association, the real life of the electrical industry, and great was the benefit therefrom.

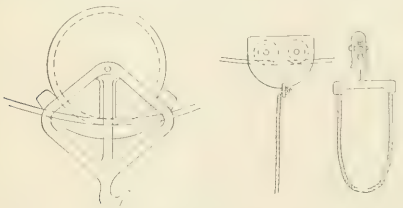
Early in the development of the steam turbine work, the

be wrenched loose and carried away. So much of the structure was repeatedly carried away by the wind that it was finally decided to abandon the foot-way, and by using the same cables to transform the bridge into a double-track passenger trolley. Fig. 1 gives an idea of the looks of the apparatus after the change was made. The same cables and the same four poles were used, also the same anchorages, and approaches, with the



FIG. 1.—SKETCH OF TROLLEY.

addition of one on one side of the river, where the ground served as a landing stage. Originally, both the cables were made fast to the poles and level with the top of the stairs. Had the poles been tall enough to permit the raising of one end of each cable above the landing, then the cables could have been left with the landings as they were originally placed. But it was found necessary to lower one end of each cable, as well as to raise the other end, in order to secure the necessary drop, which was found to be 1 ft. to each 14 ft. span. By placing the landing end of each cable under the starting stage, there was no interference of trolley or landing stage. A little difficulty was experienced when the trolleys were first rigged up, and the arrangement shown by Fig. 2 proved a complete failure. The movement of the passenger seemed to throw a good deal of pressure against the flanges of the sheave, and the first thing the passenger knew, he had lost headway and was suspended between starting and landing places. He then had to pull himself along the cable, hand over hand. Next, a tandem pair of wheels was rigged, as shown by Fig. 3—a couple of trolley wheels from a street railway shop being pressed into service, and a housing was made for them of 3-16-in. plate which was bent up as shown; the parts to receive the rope swing being simply turned at right angles to the body of the carrier. The most comfortable way to travel in this vehicle is to sit down in the swing, as shown in Fig. 1; but the passenger can place one or both feet in the swing and stand if he chooses. His head will then be above the trolley cable, which position may be of advantage if looking for trouble, as is often the case when using a trolley, as shown in Fig. 4. The latter illustration



FIGS. 2 AND 3.—UNSUCCESSFUL AND SUCCESSFUL TROLLEY.

represents the poles of a long aerial transportation system fitted with the double-sliding trolley as a means of getting quickly from one pole to another, something which has to be done quite frequently when there are a pair of pulleys to be oiled and kept in good condition on the top of each of the poles, some of which are 80 to 90 ft. above ground, and, as shown by the engraving, sometimes very rough ground, too.

The writer can bring to mind, and the reader will also think of many instances, where an arrangement of this kind would be of great value for crossing torrents, chasms, and for even passing from one portion of a large building to another. Even for the oiler, who must visit difficult places, a trolley line of this character, modified to suit the conditions, would prove of great value. An arrangement of this kind rigged from the top of a battery of boilers to a distant part of the factory or station would prove a most welcome means of escape when it is required to close the stop-valves on top of the boiler in case of accident to the other valves, or to the pipe line through the station. The writer has seen the time when it was impossible to get away fast enough from the cloud of hot steam. In arranging this trolley for passage in either direction, it is necessary that the cables be separated a distance greater than the length of the cross arm of the traveler. This is to prevent two passengers from colliding when they are passing each other. When the travel is in one direction only, of course this precaution is unnecessary. When erecting a new line, it is easy to hang both cables to the same pole by simply inclining the pole so that the cables and consequently the carriers or travelers will hang clear of each other. Were this to be done with the line pictured in Fig. 1, the poles must stand at a sidewise angle of 2 ft. in each 5 ft. of height. This would call for another dead-man anchorage at right angles to the line, and it would also call for the inclination of alternate poles in the opposite direction all along the line. Some kind of hand-propelling apparatus will be necessary when this line is to be used for repairs and inspection, for upon stopping near the landing end of the line, some convenient form of grip must be

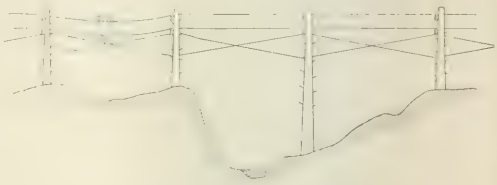


FIG. 4.—TROLLEY AUXILIARY TO CONVEYOR LINE.

attached to the end of a short rod for the purpose of pulling one's self along after stopping midway between stations. A flat U-shaped forging attached to the end of a small rod or a stick would prove all that is necessary, if so arranged that pushing or pulling on the rod would cramp the U-shaped forging against the cable.

NEWCOMERSTOWN, OHIO. FREDERICK J. HAINES.

CARE OF GAGE GLASSES.

In the boiler-room, the gage glass very often receives but scant attention. When one breaks every engineer knows it is not a very comfortable matter to shut the valves leading to the glass and replace it. Spare glasses should always be kept on hand for just such emergencies and in the keeping of these spare glasses some care is called for. For instance, it is very common to find spare glasses strung upon a wire, and unless a soft wire like copper be used, the glass, if moved much, is sure to be scratched by the wire which leads to its early breakage. It is singular how sensitive the inner surface of a gage glass is to injury of this sort, the slight friction of an iron or steel wire being sufficient to cause the glass to break from apparently no cause whatever. The experiment may be tried any time by rubbing the inner surface of a gage glass with an iron wire and then placing the gage glass carefully away. In a great majority of cases it will be found that if the glass has not broken spontaneously in the course of time, its life, when in service, will be very short. Another fault to be found with gage glasses in boiler-rooms is that they are set in such poor shape and so ill lighted that proper care is seldom vouchsafed to them. It is an easy matter to place an incandescent lamp near the gage so that it may be readily seen at all times; but too often nothing of the sort is provided and the gage cannot be read with ease. This, coupled with the dirty conditions in the boiler-room, soon obscures water in the glass altogether so that it is a very easy matter for the fireman to make a mistake which may prove costly. If a gage glass breaks the fireman can bind up his arm and hand and close the lower valve without danger.

BIRMINGHAM, ALA. CHESTER ADAMS.

The Detroit Residence Rate System.

A system of rates for residence consumers employed by the Detroit Edison Company for several years is beginning to find favor with several smaller companies and has certain features of interest to which but little attention has been called in articles and discussions on the rate question. The Detroit plan is to charge 16 cents per kw-hour up to a point where the customer's consumption equals 2 kw-hours per month for each of the rooms in the house, which are counted, and 4 cents per kw-hour for all electricity used in excess of that amount. The characteristic or peculiar feature of this system is that it is based on the theory that a consumer's maximum demand is in proportion to the number of rooms in the house rather than in proportion to the number of lamps actually connected. In determining the amount which must be used before the lower rate is secured by the Detroit system, only the principal rooms of a house are counted. Two kw-hours per month is the equivalent of 60 hours' use per month of 33 watts per room or 30 hours' use per month of 66 watts per room counted. As a basis for the rate all of the rooms of the house are included except the kitchen, laundry, storeroom and three bedrooms. The same system has been adopted by the Jefferson City (Mo.) Light, Heat & Power Company.

The Lawrenceville Light & Water Company, Lawrenceville, Ill., on June 1, 1908, adopted a residence rate system based on the same principle, but differing somewhat as to the method of counting. The Lawrenceville plan is to multiply the number of rooms counted by 1200 watt-hours. This gives an amount which is billed at the rate of 15 cents per kw-hour. Electricity in excess of this amount and up to 2400 watt-hours per room counted per month is billed at 6 cents per kw-hour. All in excess of 2400 watt-hours per month per room counted is billed at 5 cents per kw-hour. Consumers are given the option between this rate and a straight 10-cent per kw-hour rate. Heating appliances and flatirons are not counted as influencing the maximum demand. The practical effect of this is to give a low rate to non-peak business, such as flatirons, and to favor the residence consumer using electricity many hours per day. The majority of the resident consumers are on this rate. The portion charged at the high rate is equivalent to 30 hours' use per month of a maximum demand of 40 watts per room counted. The method of counting rooms is somewhat different from that at Detroit. All of the rooms of the house are counted, except bathrooms, basement, porches, stairways, attic, storerooms, small halls, entrances, woodsheds and barns. The rooms counted are, therefore, the regularly occupied rooms of the house.

It is now generally accepted that an equitable system of charging is one based on the consumer's maximum demand and that the average rate per kw-hour which he pays must be dependent upon the number of hours that maximum demand is used per year. It is the maximum demand which determines the investment which must be put in by the company to serve the consumer. Aside from the Detroit system, there have been two methods extensively employed for determining the consumer's maximum demand as a basis for charging. The most common system has been to assume that this maximum demand is a certain per cent, say, about 40 per cent, of the total connected load in the residence. An objection offered to this plan is that it puts a penalty on the use of numerous very convenient lamps in closets and other places where they are turned on but a very few moments at a time and which really have very little influence on the consumer's maximum demand. It is not desirable that a consumer be virtually obliged to pay a higher rate per kw-hour simply because he has these conveniences, because it restricts their use and cuts down the total consumption of energy.

The other method of counting the maximum demand has been to install a maximum-demand meter, but the expense of such meters has prevented the extensive use of this method among small residence consumers, although it is in use in a few large cities. It is, of course, more accurate than any assumed figures.

The advantage claimed for the Detroit system is that it does not put an unjust penalty on the use of as many convenient sockets as the consumer desires. It is based on the broad assumption that the consumer's maximum demand is approximately proportional to the number of regularly occupied rooms in the house. The argument against it is sometimes advanced that in some houses with very large rooms the number of lamps per room is greater than in a small house. While this is true, on the other hand, the large house is likely to have more of its rooms unoccupied at one time than is the small house. This tends to keep the ratio of maximum demand to rooms about the same for the different houses.

Value of Electrical Association to the Industry.

BY H. W. HILLMAN.

In the histories of the arts there is no more interesting study than that which has to do with the electrical industry. By leaps and bounds its various branches have been advanced to a degree which has made the electrical industry at least more interesting, if not more important, than all the others. During the past quarter-century electrical students have accomplished feats of engineering which have placed them foremost among the greatest engineers which the country has known. When we think of the development of the electric street railway, we marvel at the wonderful extension of this branch of the industry since 1887, a period of but 22 years.

It has been particularly noticeable how rapidly advances have been made in the electrical arts. One reason for such quick results from the factory to the consumer lies in the activity of the electrical associations, and perhaps we do not appreciate the value of these associations. One of the most conspicuous State associations was that organized in Ohio during the early years of the history of the industry. The writer entertains fond recollections of the Ohio State conventions which he attended in 1896 and 1897. The association at that time had quite a good membership, and every active central-station man would save his time during the year to be sure to have a full week for the Ohio State convention in August.

Manufacturers and supply dealers appreciated the value of such gatherings, and were always glad to exhibit new devices at such times, and sent the best men available as an indication of their interest in such meetings. About the time mentioned the series-alternating system of street lighting was receiving marked attention. The Ohio State association was one of the first to devote time and energy to the study of its merits. As a result, the greatest numbers of alternating street lighting systems were installed among the cities and towns of Ohio.

Then the small-motor business became prominent, and at the earliest moment that the factory engineers could say that designs were ready for the consumer, the officers of the Ohio State Association found ways and means for accurately informing its members regarding their merits. How wise it now seems that such close attention was given to the subject, because the years which have since passed have been filled with new ideas and extensions of designs which never could have been advanced so rapidly had it not been for the activity of the Ohio and other kindred associations.

A vast amount of credit is due the National Electric Light Association for its aggressiveness and its continual activity in the field. When Mr. Henry L. Doherty introduced such drastic measures for increasing the membership of that association one did not realize how valuable it would be to the industry in the years of 1906, 1907 and 1908. It seems to have been just the thing to do exactly as he did, because later, when the ideas of the Co-operative Development Association were promulgated through the channels of that association the information was spread broadcast and its ideas were quickly acted upon by the members of that association, the real life of the electrical industry, and great was the benefit therefrom.

Early in the development of the steam turbine work, the

National Electric Light Association appointed a turbine committee whose energies and activities led to a remarkable change in central-station equipment, wonderful changes and results being secured in a marvelously short period.

In late years there has been hardly a meeting of the National Association which has not included a paper or discussion from some famous engineer representing a central station from some foreign country, and frequently there have been several members who have returned from Europe particularly to attend the convention and favor the other members with their experiences, which have always been interesting and valuable. Is it any wonder that the industry has advanced so rapidly when one considers such organization, such facilities, and such close relationship between manufacturers and kindred associations?

My experience as president of the Michigan Electric Association has led me heartily to indorse electrical associations. It is quite evident that the central-station people of Michigan believe in them when one considers that the membership of the Michigan Association was considerably more than doubled during the year 1908. For three days of each year the members come together and vie with each other in setting forth the latest and most up-to-date methods adopted in handling the various branches of the business; always endeavoring to impart information which will be helpful to other members in the conduct of their business. In this respect the Michigan Electric Association is a highly co-operative and beneficial organization.

At the last meeting the association was favored with the presence of Dr. Steinmetz, who remained for two days, taking part in the discussions and adding greatly to the interest of the convention. On one of the evenings he presented the subject of "Lightning Phenomena" before the association in a manner that was keenly enjoyed. This lecture was not only of much benefit to the association, but also to the power company of Grand Rapids. Several hundred of its prominent customers were invited to attend; the occasion was generally enjoyed, particularly by the members of the association, and was very instructive.

The association was favored, also, by the presence of Mr. Alex. Dow, of Detroit, who entered into the discussions of the proceedings in a way which added keen interest and value to the meetings. As past-president of one of the most famous electrical associations which this country has ever known, and as a most prominent electrical man of the State of Michigan, the association felt grateful for his presence and interest.

The association was also favored by the presence of Mr. J. R. Cravath, associate editor of the *Electrical World* at Chicago. His past tests and knowledge of electrical heating devices benefited us when discussing these subjects, but the greatest help of all was his presence and the manner in which our discussions and proceedings were set forth later in the *Electrical World*. We soon commenced to appreciate that we were not only a local State body, but a part of the great electrical fraternity, destined to help build up this vast industry shoulder to shoulder with other State associations; hand in hand with the great National Electric Light Association; always appreciating the efforts of the dignified but famous Association of Edison Illuminating Companies and thankful for the efforts and interest of the electric manufacturers and supply men actively engaged in the work which we are all pledged to promote.

The writer emphasizes these points because it is the association itself which has brought about such co-operation and harmony between individuals interested in the entire industry. Therefore, let us cherish electrical associations, and as we approach another season when plans are being made for more meetings of each organization, let us one and all try to arrange to attend. Let us cheerfully interest ourselves in the promotion of the good work being done by the associations. whose officers and committees are giving of their time and substance to make the meetings interesting and valuable to the members.

Central Station Methods of Selling Electrical Devices for Domestic Purposes at St. Louis.

By W. H. Wissing.

When the company with which the writer is connected became convinced that electrical devices were not experimental, but were practical and economical in operation, in addition to possessing advantages over other apparatus designed to do work of similar character using coal or gas, it determined to get them on its lines at once, but by methods, the fundamentals of which should never conflict with the sound business principles governing the introduction and sale of other necessities, to the public by commercial houses.

Conceding the value of these devices as factors tending to increase the day load at hours when the central station can best afford to furnish it, and fully realizing the importance of selling as many of them as possible, in the shortest space of time, to improve the income from residential sources, a campaign was planned upon lines which, in the company's judgment, would result not only in getting them out quickly, but with a margin of profit from their sale that would enable it to make them stick and be conducive to the sale of more of them.

A FREE TRIAL AT YOUR HOME.

Any of the articles listed below will be delivered to you by wagon, for trial, during the period indicated opposite each item, without charge for delivery, trial or return.

Article	Size, Style, Weight		Catalogue No.	Selling Price	Terms of Payment After Trial and Acceptance: Cash with Confirming Order	With First Monthly Bill for Current	Monthly Thereafter Until Paid	At Your Disposal For
Smoothing Iron	Nickel	3 lbs	38,124	$5.00		$2.00	$1.50	30 Days
"	Aluminum	6 "	46,815	6.00		2.00	2.00	30 "
"	Gun Metal	6 "	75,120	6.25		2.25	2.00	30 "
"	Nickel	6 "	75,115	6.25		2.25	2.00	15 "
"	Aluminum	8 "	75,126	7.00		3.00	2.00	15 "
"	Gun Metal	8 "	75,135	7.25		3.25	2.00	15 "
"	Nickel	8 "	75,130	7.25		3.25	2.00	15 "
Tailors Iron		12 "	45,321	12.00		4.00	4.00	10 "
"		15 "	47,357	12.75		4.75	4.00	10 "
"		18 "	47,362	14.00		6.00	4.00	10 "
"		24 "	47,367	15.00		6.50	4.25	10 "
*Curling Iron Heater	Nickel		1,274	3.00		1.50	1.50	10 "
"	Polished Brass		1,275	3.25		2.00	1.25	10 "
Shaving Mugs			44,303	3.00		2.00	1.00	10 "
Corn Poppers			45,028	5.75		2.75	1.50	10 "
Toasters			1,710	5.00		3.00	2.00	5 "
Disc Stoves		6-inch	38,651	6.00		2.00	2.00	5 "
"		8 "	38,652	11.25		4.25	3.50	5 "
"		10 "	38,653	11.50		5.50	4.50	5 "
Travelers Stove	One half Pint		1,710	5.00		2.50	2.50	5 "
Cigar Lighter	Table		75,234	2.75		2.75		5 "
"	Pendant		39,523	2.75		2.75		5 "
Foot Warmers	9" x 10"		1,371	5.00		2.50	2.50	5 "
"	9" x 12"		1,375	7.50		3.75	3.75	5 "
Hair Dryers				35.00	$13.00	11.00	11.00	5 "
Vibrators				35.00	13.00	11.00	11.00	5 "
French Hat Irons			1,527	6.00		2.00	2.00	5 "
Washing Machine	1900			$55.00	25.00	15.00	15.00	5 "
"	Steiner's		No. 2	60.00	30.00	15.00	15.00	5 "
Mission Portables			223	3.00		1.50	1.50	5 Days
Sunlight Portables			655½	4.00		2.00	2.00	5 "
Extension Portables			2**	3.75		2.00	1.75	5 "
Turn Down Lamp	4 Cords			1.25		1.25		5 "
"	6' "			1.50		1.50		5 "
"	8' "			1.65		1.65		5 "
"	10 "			1.75		1.75		5 "
Water Bag Heater	Standard			2.00		2.00		5 Days
Luminous Radiator	Portable Oxidized		42,177	18.50		8.50	5.00	5 Days
Tubular Air Heaters	Floor Type		75,210	14.50		5.50	4.50	5 "
" " "	Wall "		75,205	15.50		6.50	4.50	5 "

LIST OF HEATING DEVICES AND RATES OF PAYMENT.

The popular or common method of loaning irons was immediately put into effect, with modifications or amplifications, of the general plan employed in other cities. The irons were loaned for 30 days, with the stipulation that if, at the termination of the trial, the customer was entirely satisfied with their performance, they would retain them, paying $6 for irons up to 6 lb. in weight, without deviation from this figure to any customer under any pretext.

This price was maintained (it still holds) while some of the department stores were selling some other iron at $3.98 or less, but with no specific guarantee. The latter were not equipped to repair or maintain electrical devices; when they went wrong and out of commission, purchasers needing repairs to their irons were referred to their local electrician, and must needs wait until the damaged part could be gotten from the manufacturer, and then pay (even if a very small margin of profit be added) a price for the repairs usually more than enough

to wipe out the difference between the original purchase price and our $6 charge.

The Union Electric Light & Power Company determined to see to it that these desirable and convenient devices should win recognition on their merits. It determined, also, that there should enter into their introduction to the public not the slightest element of chance or speculation on the part of the purchaser. It prepared at once to assume all responsibility, to get squarely behind them, and to permit no quibbling in exchanging defective or ineffective apparatus for new or other devices better suited to the customers' needs.

In this lies the warrant and justification for asking prices that, while neither exorbitant or prohibitive, hold a sufficient margin of profit to enable the company to make guarantees that would at once establish and maintain an ever-increasing degree of confidence in them not possible otherwise without loss.

In connection with the iron, the guarantee is practically perpetual. It reads thus: "Thereafter your company is to renew, without charge to me, such parts of the 3 and 6 lb. irons (excepting the iron bodies) as may prove defective, if the iron has been used exclusively on your electric service." The company lives up to the letter and the spirit of this guarantee, even in the face of evident discord at home, in which the iron sometimes appears to have played a leading part.

This very broad guarantee covers in its printed matter the 3 and 6 lb. irons only, but its spirit and import applies to the entire line of devices: the disposition always is to take the customer's view of his troubles and help him out in the same degree that he feels justified in paying the lighting company a trifle more for an article that he is assured by its guarantee will not, if it meets with a mishap, cost him for repairs something approaching the price he would be compelled to pay for one not thus protected.

To obtain the best possible results from this arrangement, the company is careful that apparatus is not sold for any purpose for which it is not well designed. It is especially insistent that the prospective customer shall know what it will cost him to operate the device he may purchase, giving him the limit always. It has frequently declined to loan articles for trial where it knew that the first month's bills would bring back with it the device with its reputation irretrievably blasted in the estimation of its user.

The luminous radiator is an excellent instance of what it is best not to sell except for the purpose it was designed to serve; yet the company has sold several hundred of them. It begins with the warning that the 750-watt radiator will cost (at residential rates, 12 cts.) 9 cts. an hour to operate, and the 1500-watt 18 cts. an hour; that to attempt to use it for general heating is at present absurd, but that for temporary use in the morning while dressing, for additional heat in the bathroom or nursery, it is ideal and not expensive. The customer thus prepared does not come back with complaints about excessive operating costs. He uses them for the purpose intended, likes them, and commends them to others.

The reference to the department store was in no sense intended as in disparagement of them. As mediums for the quick introduction of any new thing they are unequaled. They are in daily contact with thousands who are there to purchase, while those who come to the company usually come to pay. The mental attitude is, therefore, different and much in their favor, but the company holds, in connection with electrical devices, that until they have become standardized, with repair parts as easily obtainable and replaced as other household apparatus, that they should be handled exclusively by central stations or dealers as agents, backed by the manufacturers, who will make it their special business to guard the purchaser against acquiring apparatus not suited to his requirements, and that when they do sell, the apparatus shall represent thereafter the absolute maximum of convenience with a minimum of trouble and expense. You cannot maintain this position at $3.98 per.

A year or so ago, a young man of modest appearance and address came to our show room and, somewhat diffidently inquiring the price of a coffee percolater, said that as soon as he could afford it he would purchase one. It developed that he had a chafing dish and a 6-in. disk stove, and that his wife, who was his cook as well, found them so convenient and inexpensive to use that they were saving up for the next addition—the percolator. He was asked if he cared to purchase one at once, and pay for it in several installments. He did. The company immediately got busy with the installment plan, evolving the schedule on the preceding page, which it recommends highly, with the rest, as an additional inducement to customers to add gradually to their stock of electric devices.

In its experience, in developing this class of business it has found the best market among those who do some or all of their own work. Nearly 75 washing machines at $55 each, paid for "on time," are in use on its lines, saving their original cost and $20 to spare every year, counting the cost of a wash woman at $1.50 per week "and found" as saved by the use of them.

A word as to the method of keeping track of repairs, renewals, exchanges, etc., in this connection. It is simple, easy and effective, especially in cases where devices come back too often, and works as a check on the careless. A set of blank forms is kept as follows:

When a trial is desired by a customer, Form No. 1 must be signed and sent in. Form No. 2 is the receipt for the article and is attached to Form No. 1, completing the transaction until trial is finished. Form No. 3, "Confirming Order," is signed, and with Form No. 2 is attached to Form No. 1 and charged up, all being placed in an envelope with customer's name and address.

If madame's iron or curling tongs get out of order, she does not hesitate to apprise the company of the fact, which sends for it, using Form No. 4, which is an order on her to deliver it. When it is repaired, it goes back to her on Form No. 2, her second receipt showing what was done to it and marked *no charge*. If this is repeated too often, the company reminds her courteously that on the different dates shown by her receipts it made repairs, the nature of which indicated harsh usage, and that while it would continue to keep it going, there are limits beyond which good irons and tongs are not useful, etc.

It contends, in conclusion, that the ideal way to introduce electrical devices is to charge for them a price that will enable one to *maintain them;* that in doing this, each of them is made a valuable selling agent for others; that the cost of this method represents a goodly profit left after all repairs, exchanges, etc., have been deducted; that selling electrical devices is not an advertising stunt, but a cold, legitimate business proposition, based upon commercial common sense that will make "both ends meet" and overlap; that giving away good, honest, serviceable and popular necessities is a crime with no excuse to support it; and as proof that these deductions are correct and that it is indulging in no fantastic dream, the company has a record of nearly 4000 families using these devices with entire satisfaction and no complaint either as to the price they paid for them or the manner in which they are cared for.

Business conducted upon business principles will win out always. If this paper will serve the purpose of checking the reckless sacrifice of articles that have merit and value far beyond those operated in the old way, it will be worth while.

Methods of Building Up a Day Load in Small Central Stations.

At the recent Minnesota Electrical Association convention at Minneapolis one session was given to papers and discussions on development of a day load in small central stations. Mr. Adolph Wagner, superintendent of the municipal plant at New Ulm, Minn., gave a paper on the general subject. He expressed the opinion that except where unusual local conditions prevail, day service can be established profitably in any town of 1000 inhabitants or more. If the proposition is taken up in a half-hearted manner it is not likely to succeed. On the other hand, it should not be expected that a service started to-day will

be on a paying basis to-morrow. The author cites the case of a town of about 2000 inhabitants which recently came to his attention. The town had no factories of any size, and yet a young man offered to take hold of the plant and have day service on a paying basis in four months. If the company had taken up the proposition the result would have been a failure and another station would report that day service in a small town does not pay. In this same town, however, a profitable day load could be secured in a reasonable time.

The equipment of a station may be such that only comparatively large units are available. In this case it may be necessary to install an additional small unit to take care of the day service. A central station that recently started a day service decided to install an additional boiler before starting this service. It found later that because of the better attention given to cleaning boilers, because there was an extra boiler, the fuel required with the all-day service was actually less than for the night service only. Before starting the day service the company should connect all consumers on meters.

When a day service is once started the company should let everybody know that it is there for them to use and that it is reliable. With day service, reliability is of as much importance as for the lighting service at night. The service should also be advertised. The man or woman who does not read any newspaper is not likely to be a customer of the central station. Advertising matter for various energy-consuming devices can be secured from the manufacturers gratis. In starting the campaign for day service some form of card index should be used to keep a record of prospects and the success had with them. Every residence consumer should be on the card index and a note made whether an electric laundry iron is used.

Mr. Wagner is convinced that a small central station should carry electrical supplies and do wiring, and when wiring a building see that provision is made for laundry iron, coffee-grinder or other apparatus that it expects to sell a consumer later. His company carries a stock of small motors and several sizes of pulleys and belts ready for installation in case a possible consumer's engine breaks down. Immediate service at such times secures a customer. The company should not only keep a stock of energy-consuming devices, but arrange to show its confidence in the quality and reliability of the apparatus by offering to place them on trial. This scheme has been successfully used by both large and small central stations. If a prospective customer can be induced to allow the installation of a motor on 30 or 60 days' trial, free of expense except for the energy used, with the understanding that if not satisfactory the company will remove it, he will usually decide to keep it.

In soliciting business for day service the load factor should not be overlooked and the sale and use of apparatus that consumes a large amount of energy for a short time should be discouraged. Frequently such installations are thrown in circuit at the most inconvenient time.

What can be done in the line of day load is well shown, Mr. Wagner said, in an article in the *Electrical World* of Jan. 21, 1909, which told of a small central station that has its yearly peak load on Tuesday afternoon in midsummer. Motor business is essential to day service, but there are other good and very profitable appliances, such as laundry irons, washing-machine motors, fan motors and devices which bring in small individual revenue, but swell the total and make electric service indispensable. It is advisable in wiring either old or new residences to anticipate the use of electrical cooking devices and run sufficiently heavy wires to proper outlets in the kitchen and dining-room. In most small towns water is pumped at large expense and can be done considerably cheaper by motors.

Inquiry among customers brings out the statement that they have no use for light during the daytime. It is, however, surprising how much light is used during the day when the service is available. Stores having dark corners that were not used before will use the light to make these corners available. Basements will also be more generally used.

Inquiry among Minnesota central stations shows that day service is given in seven towns of 1000 to 2000 inhabitants; eight of 2000 to 3000 inhabitants; seven of 3000 to 5000 inhabitants; 15 of 5000 to 10,000—a total of 37 giving day service out of a possible 112. Three stations have a so-called ironing day; that is, they operate one-half day each week to permit of electric ironing. Of the seven stations in towns between 1000 and 2000 inhabitants giving day service, four use storage batteries for the purpose.

HEATING DEVICES FOR DAY LOAD.

Mr. E. L. Callahan, of the General Electric Company, gave a paper on the building up of a day load with the aid of electric heating appliances. He said that no central-station company now questions the profitableness of a day load obtained from electric heating appliances. While much had been said regarding the use of electric motors for building up day loads, he pointed out that conditions are favorable to creating a day heating appliance load among residences. He took, as an example, a residence consumer having 1 kw maximum demand and yielding a revenue for lighting alone of $24 per year. By the use of the electric flatiron this revenue might be increased $10 per year, and with a toaster $6 per year, making $16 per year added without the increase of a cent in the installation to serve the consumer. He called attention to the practice of the central station at Grand Rapids, Mich., which makes it a point to see that an electric iron is placed in a house wherever a new meter is installed. He read letters from various central stations on the number of irons in use. At Burlington, Wis., with a population of 3000, there are 250. At Huntington, Ind., population 20,000, there are 750.

ELECTRIC MOTORS FOR DEVELOPING DAY LOAD.

Mr. George J. Cadwell, manufacturers' agent, Minneapolis, presented a paper on small electric motors and their possibilities in developing day load. He called attention to the specific applications for electric motors found in small towns. Beginning at the hotel, there are dumb-waiters, potato-peelers, meat-choppers, dish-washers, knife-grinders, silver-buffers, ice-cream freezers and dough-mixers. In the hotel laundry there are washing machines, and every hotel should have a vacuum cleaner. In hotels, restaurants and saloons motor-driven refrigerators reduce the cost of refrigerating considerably. The ventilating of such places cannot be handled better than by motor-driven fans. The restaurants can also use all of the kitchen machinery mentioned in connection with the hotel. The saloon should have a motor-driven beer-pumping and carbonating machine. In the dry-goods business the electric motor can be applied to dumb-waiters, moving window displays, cash-carriers and elevators. The drug store can use motors for ice-cream freezing and carbonating machinery. The grocery has its coffee-grinder and the meat market its meat-grinder and meat-chopper, also refrigerating machinery. Offices use motors for turning adding machines, addressing machines and phonographs, while electric exhaust fans take care of the ventilation and the vacuum apparatus keeps the office clean. At the bakery, dough mixing and the making and pulling of candy can be done by electric motors. In the shoe shop shoes are repaired while you wait, thanks to the small motor. In the barber shop vibrator motors massage the face and polishing motors shine shoes. Newspapers and job printing establishments are equipped with motors. The livery stable uses a motor for clipping and grooming and another for the feed. The blacksmith shop has a motor-driven forge blower, drill press and grindstone. In laundry work there are especial advantages for motors for direct driving, doing away with the dirty belts and saving loss in transmission. The grain elevator has conveyors, cleaners and corn shellers for motor possibilities; the dairy has a motor for churning, cream separators, pumps and refrigerating machines. Doctors use motors for static machines and dentists use them for running drills and lathes. Moving-picture shows use motors for the picture machines, for ventilating fans and for the automatic pianos. Theaters use them for ventilating, for raising and lowering curtains, as well as for vacuum cleaning. Churches need motors for vacuum cleaning, heating and ventilating fans, also for the organ blower. In the residence there is much work that can be done by motors. It is comparatively easy to apply

one motor to a number of different tasks, such as running the washing machine, sewing machine and dish washer. The motor being small can be mounted on a portable stand and connected to a plug in a lamp socket. Another application of general interest is that of the small motor-driven house pump, both for general water supply and for seepage and sewerage. Where there are apartment houses or flats, vacuum cleaning is an attractive field. Where a town consists of small detached residences a profitable business may be worked up by some enterprising man with a portable electric cleaning outfit which could be easily connected up wherever the residences are wired. Mr. Cadwell also called attention to the possibility of extending lines to farms in the surrounding country.

DISCUSSION.

Mr. B. W. Cowperthwait, of Faribault, gave it as his experience that 90 per cent of the irons connected on trial stay in service. The 10 per cent that come back do so, not because they are unsatisfactory, but because there is some special reason why the consumer has no use for the iron. He also called attention to the fact that electric irons have an important influence on the increase of a consumer's bill, whereas small motors do not add greatly to the revenue.

Mr. H. J. Gille, of Minneapolis, commented on the paragraph in Mr. Wagner's paper discouraging the solicitation of business having a poor load factor which yields small revenue and creates high maximum demand. He thought that if such business did not come on during the peak load it might be profitable, and that 33 per cent load factor for a machine shop, which had been spoken of, was remarkably high. In most cities a 20 per cent load factor for a machine shop would be excellent. Although the small motor might not add greatly to the revenue of a central station it was one of the numerous things which make electric service desirable and popularize the use of electricity. He reported 3000 electric irons in use in Minneapolis. In one case he found that there were seven irons in a house: two in the laundry, one in the kitchen, one in the girl's room, etc. He also pointed out that whatever industrial work in the shape of heating or power load is done in the home does not come on during the peak.

Mr. A. C. Westphal, formerly superintendent of the municipal plant at Staples, gave his experience in starting a day service at that place. Before day service was started considerable advertising was done in the papers. At the offices of the plant various devices for using electricity which would be used during the day were displayed and the amount of electricity consumed by each was given. The cost for producing electrical energy in the plant previous to starting the day load was 5 cents per kw-hour. The first month the day service was given this cost was increased to 7.5 cents per kw-hour because of the extra man required to run the plant during the day. By December, however, the cost per kw-hour had been reduced below what it was 12 months previous. The plant had started with 154 customers in the fall of 1907 and had 480 when he left, Feb. 1, 1909. There were 180 electric irons connected and 60 hp in small motors. A number of these operated pumps for consumers beyond the reach of the city waterworks. Another member reported 400 consumers in a town of 2300 population. There were 40 to 50 flatirons and a number of washing-machine motors.

Mr. N. M. Argabrite, of Winona, did not think it necessary to keep motor and lighting service on entirely separate feeders in all cases. His company has some very large motors on feeders used exclusively for that purpose. Some of the smaller factories, using 25 hp and less, were placed on a mixed motor and lighting feeder. The more important lighting of business and residence districts is accomplished on separate lighting feeders.

Mr. F. C. Nelson, of South St. Paul, reported that his company had nearly all motors on lighting circuits. He called attention to the application of an electric motor for portable wood-sawing outfits instead of the gasoline engine formerly used. Such an outfit has a motor running at 1200 r.p.m., direct-connected to a circular saw.

Mr. H. J. Gille, of Minneapolis, said that modern methods of heating and ventilating buildings all required the use of fans. He called attention to the fireless electric cooker as a substitute for the oven, and thought this destined to be one of the most popular electrical devices known and advised members to investigate its merits.

Mr. Alfred Horne, of Fairmount, reported having one complete electric cooking outfit in use, which is placed on a separate meter and billed at a 4-cent rate. The cost to the family is $4.50 to $5 per month. An effort is made to get all residences wired for electric cooking when the house is built. A number of washing machines in the town are motor-driven. A shaft is put up in the laundry, the washing machines, water pumps, mangles, etc., being run from the same motor. The revenue from electric flatirons in Fairmount averages about $1 per month per iron.

Mr. A. H. Lane, of Glencoe, pointed out that it takes several motors to yield as much revenue as one good cooking utensil.

Mr. N. M. Argabrite, of Winona, by way of illustration of the fireless-cooking principle, cited the example of one of the employees of his company who had done a remarkable amount of electric cooking simply by placing a 2-cp incandescent lamp inside of a hay stove. In speaking of the relative desirability of a load which consists of a number of small motors as compared with one large motor, Mr. Argabrite was impressed favorably by the small motor load because these small motors usually yield a better rate per kw-hour and there is usually a sufficient diversity in their hours of use so that the load does not all come on at once as in the case of a large motor.

INTERIOR WIRING AND ILLUMINATION

Fixtures for Artistic Interiors.

At the meeting of the Chicago section of the Illuminating Engineers' Society, June 17, Mr. Albert Frank Horton, of the "Electric Shop" of the Commonwealth Edison Company, gave a lecture illustrated with stereopticon on fixtures for artistic interiors. He first called attention to the fact that the architect is the storm center of the various constructing and decorative interests. The decorator has a contempt for any piece of work which does not show a liberal expenditure for his branch of the work. The woodworker looks only at the wood finish. The speaker, as a lighting-fixture man, thought that the lighting fixtures should receive first consideration. The general effect of the work of the interior decorations will depend very much on the lighting fixtures and their arrangements. Fixtures are also decorative features in themselves. The illuminating engineer and architect should co-operate and work in harmony. He thought that 5 per cent. of the cost of the building should be the minimum amount appropriated for lighting fixtures. These fixtures are the most permanent feature in the room. Walls and woodwork require re-finishing, but good fixtures will be lasting. He brought out the effect of illumination on the dimensions of a room. By highly illuminating, the ceiling walls or floor, they are made to recede. Light ceilings seem to make high ceilings; with light walls the room will seem larger than with dark. He thought that the floor should be comparatively dark to make it seem solid, as a light floor gives a sense of uncertainty.

Local lighting for special purposes, such as reading or sewing, should be considered separately from general lighting. The danger to avoid with general lighting is that of making it too local or uneven. With local lighting the danger is that the lighting may be too concentrated without sufficient general lighting.

He condemns the use of opaque or concentrated reflectors with no light in the room except that thrown by the reflector. He then showed a large number of lantern slides

giving photographs and drawings of very artistic interiors, and called attention to the good and bad points of each. These slides and his remarks related almost entirely to the most expensive class of work.

Street Lighting at Shawnee, Okla.

Mr. F. W. Caldwell, manager of the Shawnee Gas & Electric Company, of Shawnee, Okla., gave some interesting statistics relative to street lighting in his city at a recent meeting of the Oklahoma Electric Light, Railway and Gas Association. During the latter part of June 1908, his company installed a block-lighting system on Main Street, and during the following month four additional blocks were lighted. Extending 5 ft. over the sidewalk from the front of the building, and fastened to a Cutler elite street hood bracket, 60-watt tungsten lamps were installed every 25 ft. Each lamp was enclosed in a 10-in. diameter, 4-in. top, opal globe, and the company received $5 per installation and $1.50 per month for each fixture, the lamps burning from dusk until 10 o'clock every night excepting Saturday, when they burn until midnight. The cost of each fixture is given as follows:

Bracket and socket	$1.25
Opal ball	.60
Weatherproof holder	.40
60-watt tungsten lamp	1.30
Freight on above	.30
Wiring bracket	.15
Total	$4.00

The service leads are run along the front of the buildings at a cost not exceeding $1 for each installation, and the company furnishes lamp renewals. During the summer the watt-hour consumption per fixture is as follows:

One 60-watt lamp, two hours	120 watt-hours per night
One 60-watt lamp, two hours for 26 nights	3,120 watt-hours
One 60-watt lamp, four hours for 4 nights	960 watt hours
Total for month	4,080 watt-hours

During the winter this consumption is more than doubled.

The lamps are installed sufficiently high so as not to interfere with window lighting, and opal globes giving a mellow carnival light are selected, so as not to detract from the sign lighting. The lamps in each block are controlled by one switch, and the flat-rate window lamps and signs are cut in on the same circuit. While the company appreciates that a fair income can be secured by this class of business, the main consideration is that it is one of the best possible advertisements for the city. The night retail trade is also thereby stimulated, since the people remain on the streets longer at night, and the gross income from lighting is materially increased. Mr. Caldwell stated that the block-lighting system has pleased the people of his city more than all the other schemes his company has tried combined.

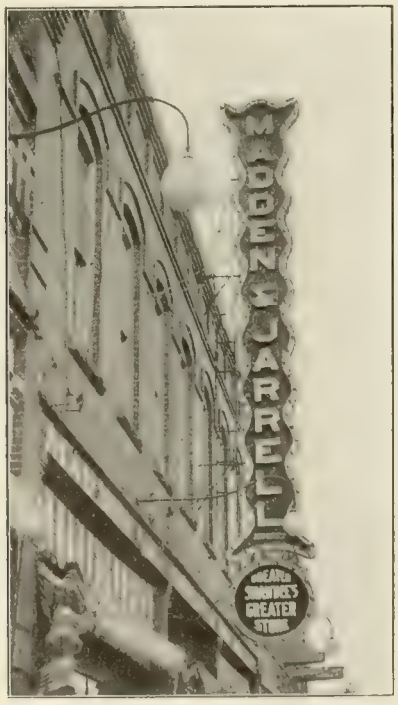


FIG. 1.—DETAILS OF LAMP BRACKETS

In soliciting for this business the company determined, as nearly as possible, what each merchant could afford for this service. The service was designed so as not to interfere with the window or sign lighting, and the cost was based on an installation that would look attractive by day as well as by night. The merchants on one block were then approached and a solicitor stated that the company proposed to experiment with a block-lighting system and that the cost would be 5 cents per night and $5 for the installation, provided everyone on both sides of the street agreed to maintain the service. The store merchants were also informed that if after the system had been perfected and all did not feel that it was worth the cost, that the company would remove the fixtures, etc. After securing one block it was found that committees on other blocks immediately took up the work in self-defense. The Shawnee Gas & Electric Company feels that a flat rate is best for this service for many reasons. In the collection of accounts it is the policy of the company not to cut off a customer for non-payment. If there are many delinquents the matter is taken up with the commercial club, board of trade or town boosters, who thoroughly appreciate that the town cannot afford to lose the block-lighting system when once installed, and who either maintain the system or assist the company in collecting the bill. The accompanying illustrations show the details of this lighting system.



FIG. 2.—BLOCK LIGHTING AT SHAWNEE, OKLA.

Scheme for Pulling Conductors in Conduit.

By Arthur Gillman.

Various methods have been described from time to time for fishing conduit and for fastening the fish wire to conductors or to pulling-in lines. In drawing the wire into the conduit, many methods prevail and it is the intention of the writer to discuss in the present article methods of drawing the pulling-in line into the conduit with the fish wire and also to describe some schemes employed in drawing in the conductors, especially in heavy work.

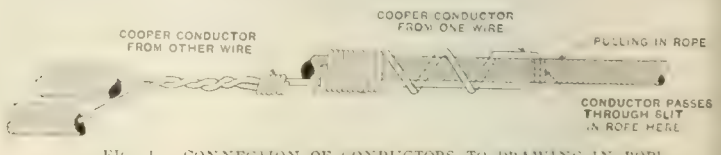


FIG. 1.—CONNECTION OF CONDUCTORS TO DRAWING-IN ROPE.

ADJUSTING THE PULLING-IN LINE.

Assuming that a fishing wire has been pushed through a conduit and attached to the drawing-in line by one of the methods in use, the drawing-in line is pulled into the conduit. Usually no great tension is necessary to accomplish this.

The wiremen merely take hold of the end of the fishing wire extending from one conduit outlet, pull on it and the drawing-in line is drawn in at the other outlet. If the drawing-in line is one strand of galvanized steel the conductors to be pulled in are made fast to it and served with tape so as to form a conical

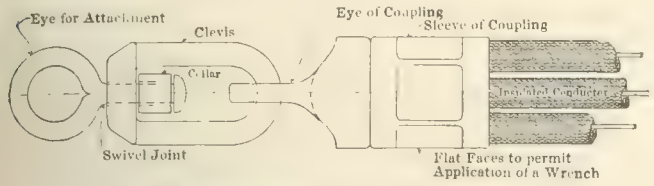


FIG. 2.—CONDUCTORS WEDGED IN COUPLING.

wedge. If two strands are used for drawing in, the conductors may be passed through the loop and bound with copper wire serving after being bent back on themselves.

Conductors are attached to a drawing-in rope in the manner delineated in Fig. 1, wherein one conductor is passed through a slit cut in the rope and then "made up" around it and the second conductor is "made up" around the first one. The connection is, of course, afterward thoroughly taped. Where a severe tension is to be expected it is a good precaution against untwisting to solder the conductors where one is served around another and at any other points where soldering is feasible and would retard any tendency to untwist. Appliances have been developed by means of which conductors can be quickly fastened to pulling-in lines without its being necessary to make time-consuming servings and splices. These convenient devices have not been used much in interior conduit

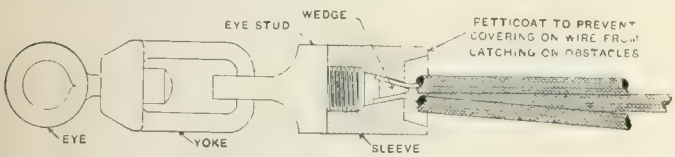


FIG. 3.—SECTION SHOWING WEDGE.

work. It appears that all types were designed for drawing cables into underground conduit where no sharp turns occur and most of them would not draw around the elbows that are standard in wrought-iron conduit construction. Unquestionably it would pay to use such devices, or modifications thereof, on wrought-iron conduit jobs involving large conductors where the value of the time taken in making connection between pulling-in lines and conductors runs into astonishing figures. Fig. 2 illustrates one type of coupling, designed for attaching three-phase underground cables to a steel cable pulling-in line and it could be used successfully for pulling conductors into straight runs of wrought-iron conduit. Fig. 2, an assembled view, shows the conductors held in position ready to be drawn in. Because of the tendency of steel cable to twist when put under tension, the swivel joint shown is necessary. If it were omitted probably a cable being drawn in would be twisted. Fig. 3 indicates at the sectional portion the manner in which a conical wedge clamps the three conductors to the coupling. Dimensional details of the device are given in Fig. 4. The eye, yoke, conical wedge and key are of wrought iron and the sleeve is of bronze. Figs. 2, 3 and 4



FIG. 5.—SLEEVE FOR TWO-WIRE COUPLING.

show a coupling designed to accommodate three wires. To adapt one for two wires a different sleeve and wedge (shown in Fig. 5) would be required. In using the device the conductors are bared, placed in position in the hole in the sleeve and the conical wedge inserted and given a smart blow with a hammer. This sets the wedge and tension on the conductors intensifies the clamping action.

Inasmuch as the complication of the yoke and eye (see Fig.

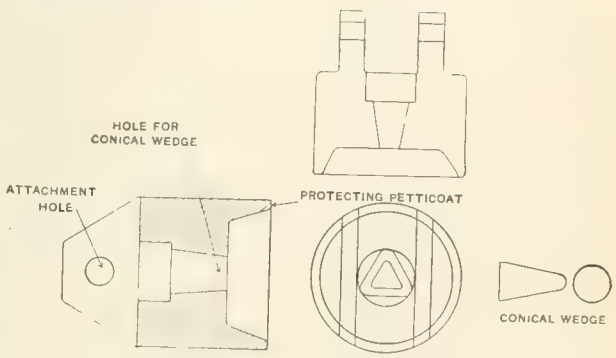


FIG. 6.—MODIFIED COUPLING.

4) is only necessary where a twisted steel cable or a twisted rope is used for pulling, for interior conduit work (where braided ropes or galvanized-steel wires are the rule), the involved construction shown in Fig. 4 can be changed to that indicated in Fig. 6. This illustration shows a coupling for three-wire work. For two-wire work such an appliance should follow the design detailed in Fig. 5. The pulling-in line is attached directly to the coupling shown in Fig. 6 by making it up through the attachment hole indicated. The protecting petticoat extends out far enough to prevent the insulating covering on the conductors from catching in a conduit. The coupling should be made of bronze and the conical wedge of steel.

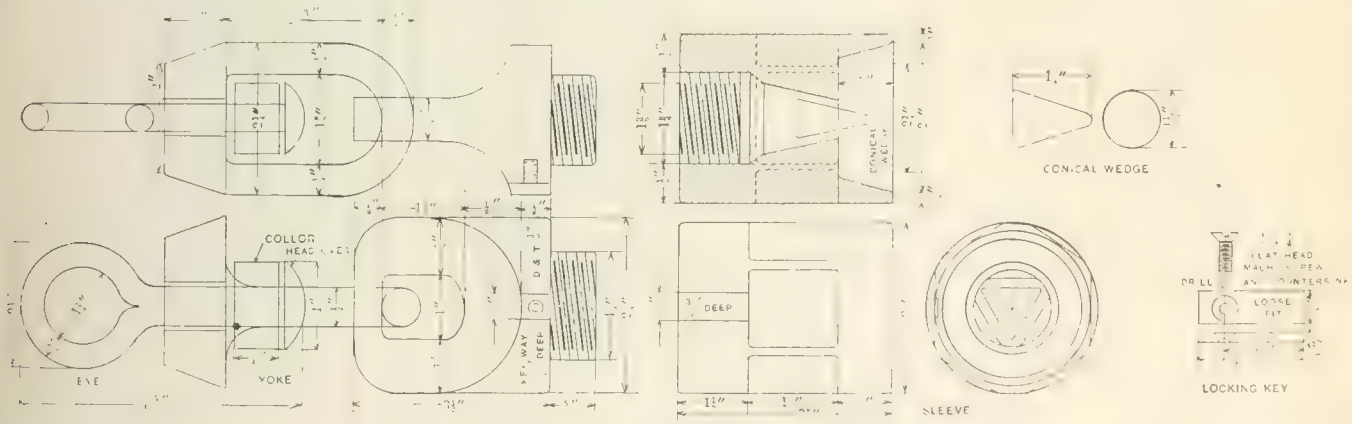


FIG. 4.—DETAILS OF COUPLING.

DRAWING THE CONDUCTOR INTO THE CONDUIT.

The fishing wire having been fastened to the conductors as described, the latter may be drawn into the conduit. If a ribbon fishing wire is to be used for pulling-in it follows that the

conductors are small and the pull light. A heavy pull should not be attempted with a ribbon wire, as it will doubtless be rendered unfit for future service. If more force is required for the pulling than can be exerted by two men, each having a hold on the wire and walking along the floor, either galvanized steel wire or braided rope should be used for a pulling-in line. As outlined above, for very heavy pulls it is advisable

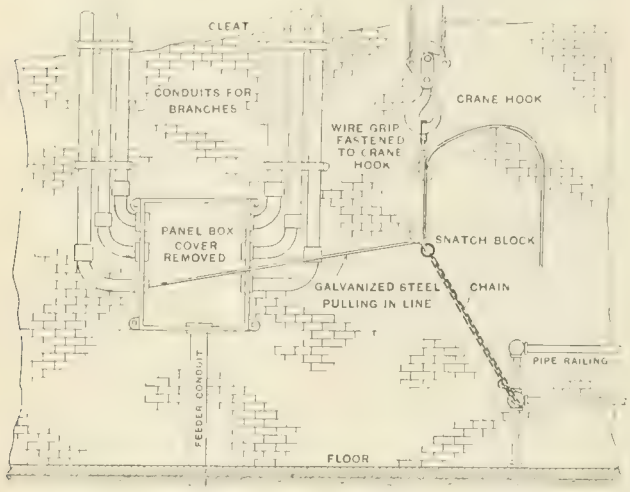


FIG. 7.—PULLING WIRE WITH CRANE HOOK.

to use several strands of steel wire and the copper conductor servings at the point of connection between the conductors and the pulling-in line should be soldered. It is very diffucult to get a secure grasp on a ribbon fishing wire with the hands when it is being used for pulling in, and it is almost impossible to pull against any considerable strain by this method. Wiremen sometimes bend the bight of the wire around a stick or otherwise distort it in order to gain a hold, but this is bad practice as the kinks so formed can never be entirely removed, though they may appear to be so. A wire so punished will always give trouble when used for fishing.

An excellent method of securing a hold is through the means of a parallel jaw-grip, used extensively in line work. The surfaces of the two parallel plates between which the wire is clamped are smooth and will not mar the fishing wire. The fact that this type of grip is successfully used for pulling up hard-drawn copper wire is sufficient recommendation. A spring, with which the clamps are equipped, tends to clamp the grip lightly on its wire, preventing it from falling off. When a

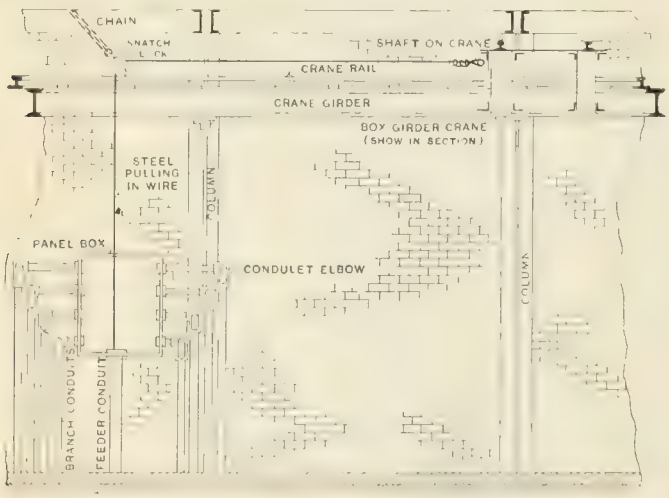


FIG. 8.—PULLING IN A FEEDER WITH BRIDGE CRANE.

pulling strain is applied at the loop, the clamping effect is intensified. Three sizes of this clamp are manufactured, each respectively capable of accommodating from an infinitely thin wire to No. 6, No. 0 and No. 0000. In using the grip it is placed on the wire to be pulled and a rope is tied into the loop. The rope provides a good hold for the wireman's hands.

Heavy conductors can be drawn in with the fishing wire if it be of galvanized steel, therefore all of the methods to be described in what follows are applicable in such a case.

The necessity of a pulling-in line implies a heavy pull. The usual method of getting the desired force is through the means of a set of tackle blocks. One block of the set is provided with a loop and the other with a hook. The block with the loop is made fast to some substantial object and the hook of the other block is engaged with the pulling-in line, either by a knot if the line is of rope or by a clamp of the parallel-jaw grip type if the line is of wire. Able-bodied wiremen and helpers at the free end of the rope from the tackle blocks supply the power. Obviously it is but a matter of enough men and sufficiently heavy tackle to pull in the most difficult run. But it is slow work, as the ordinary run of tackle blocks will have three or four pulleys each, which means that the men must carry the free end of the rope from the blocks six or eight times as far as the conductors are drawn into the conduit. Each time the blocks are pulled to their limit, the pulling-in line must be disengaged from the block hook, the blocks pulled as far apart as the line will permit and the pulling-in line from the vertical to one parallel to the crane girder. Where

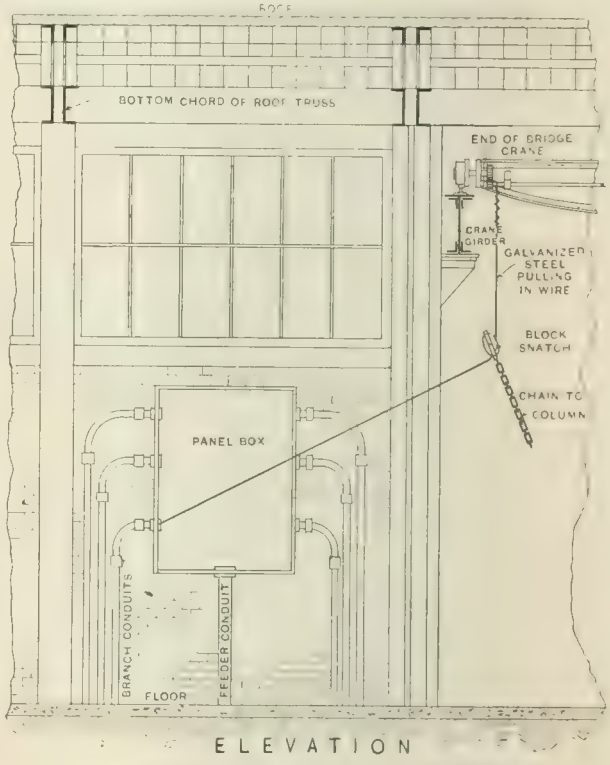


FIG. 9.—PULLING IN FEEDER AROUND A CORNER.

cranes are available the method described below is a time-saver.

Cranes are used freely in industrial plants. They are frequently installed in buildings under construction as soon as there is enough steel erected to carry them, inasmuch as they are availed of in handling construction materials and equipment for the new building. The electrical construction man can use them for pulling in wire economically and quickly.

Fig. 7 illustrates how conductors can be pulled into a branch conduit with the hoisting hooks of a crane. The pulling-in line is shown as of galvanized steel and attachment is effected between it and the crane hook through the means of a parallel-jaw wire grip. In order to insure that the pulling-in line shall pass out directly from the branch conduit without excessive binding the snatch block is restrained with a chain, as shown. A crane capable of hoisting, say, three to five tons 75 ft. or 100 ft. a minute, makes short work of a condition such as that shown. In Fig. 8 are shown the arrangements necessary to pull in a vertical feeder with a bridge crane. Steel wire is used for a pulling-in line and is attached to the crane. A snatch block alters the direction of the pulling-in line from the vertical to one parallel to crane girder. Where

feasible it is better to attach to the crane bridge rather than to the hook, as the bridge speed is usually faster than the hook speed and it is usually possible to pull in a much greater length at one setting by the bridge method.

In a building where there are cranes it is seldom that a conduit outlet will be so situated that it cannot be pulled from, in some way, by one of them. Several snatch blocks may be required in difficult cases, but unless too many changes in direction are necessary it will probably pay to utilize the cranes. Fig. 9 illustrates an instance where a pull is being made around a corner. The method of connection between fishing wire and crane is the same as described in connection with Fig. 8. Monorail cranes can be pressed into service in the manner indicated by Fig. 11, which requires no description. This type of crane is much lighter than the bridge type and sometimes on heavy pulls the wheels slip and spin around on the I-beam rail. If this occurs two or three of them may be coupled together in tandem, or if this fails the pulling-in line should be rerun so that the pulling can be done by the crane hook. The hook may be capable of raising three to five tons. Occasionally conditions are such that yard locomotives in industrial plants can be used for pulling-in wire and in certain installations many hundred feet have been drawn in by this method. It is a very satisfying spectacle to observe the ease with which a yard locomotive will haul in conductors which have responded but feebly to block-and-tackle and man method.

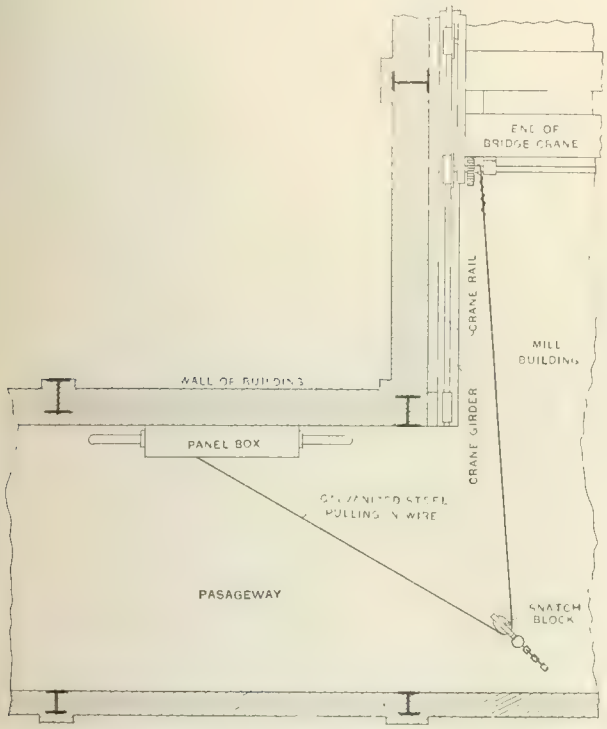


FIG. 10.—PLAN VIEW OF PULLING ARRANGEMENT SHOWN IN FIG. 9.

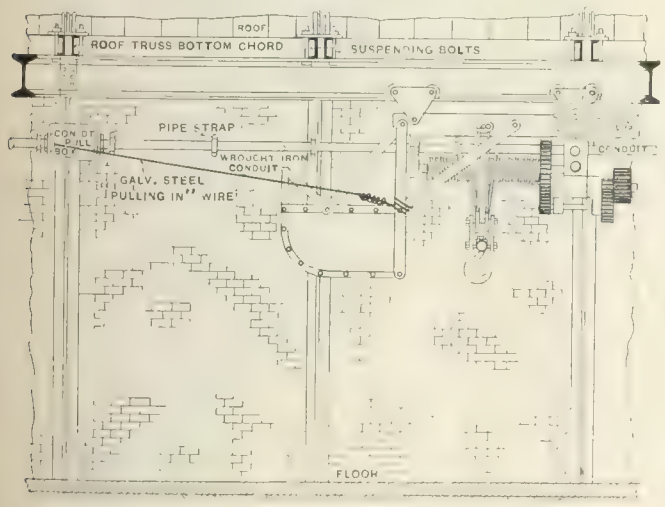


FIG. 11.—PULLING-IN FEEDER WITH MONORAIL CRANE.

LETTER TO THE EDITORS.

Electric Heating Devices.

To the Editors of Electrical World:

SIRS:—It is strangely singular, though by no means inexplicable, how central-station managers, and solicitors in particular, will induce a consumer to load up his circuits with almost every conceivable form of electric-heating device without any thought as to the ability of the consumer to keep such apparatus in operation. Seldom—and this point has been emphasized often—does the manager or solicitor stop to ask himself whether the consumer's income is such as to warrant the installation of certain heating devices, especially if the energy is not sold at very low rates. It is generally admitted that unless low rates for heating circuits prevail, it is out of the question for an average clerk to roast meats in an electric oven in competition with other fuel, unless, of course, there are very urgent reasons for using electricity.

The average solicitor, if he felt that a consumer would take his advice, would suggest that the entire house be electrically equipped, and could frame up enough arguments to convince an easily-led individual that that would be the proper thing to do. This is not only detrimental to the central station and to the manufacturer of heating devices, but to the whole art as well. Even customers who can afford to pay high rates in return for the cleanliness and convenience of electricity, have installed cooking and heating apparatus often at great expense, and discarded it again after a short period of use. Granting that the apparatus itself is thoroughly reliable, it is but right that a consumer be apprised of all the facts in connection with it. The luminous radiator, for instance, is a very pretty piece of apparatus; but as an economical heat producer it is an admitted failure, and for a manager to push apparatus of this kind without stating that it is especially serviceable for bathrooms, sitting-rooms, etc., where heat is required for short periods of time only or to take the chill off the room, only tends to bring discredit and to hinder the legitimate development of the business in other directions. Unless a man has a fairly large income, can he afford to place electric cooking utensils in the hand of the average cook in a family of more than five, for instance? In the first place, the cost of some kettles is such that it would be possible for the same sum to buy a whole outfit of ordinary cooking utensils. Renewals are also costly, and if the manufacturers of heating apparatus would make heating elements in sections and make them as readily replaceable as fuses in a circuit, for example, progress will be made.

There are numerous devices on the market which are very serviceable and which come within the means of even the poorest, or at least anyone having electricity in his dwelling. The first cost is usually the only hindrance to their introduction, and if central stations would rent these as they do flatirons, etc., on a basis commensurable with their convenience, the general public will be likely to entertain the suggestion of the most persuasive and eloquent canvassers employed. There is no doubt a field for extensive operations in this direction if approached in the proper manner. That manner is certainly not to try to bankrupt a consumer by installing apparatus consuming more energy than he is able to buy.

A manager may as well be frank with a patron of his company, and if in his estimation it would be detrimental to the interests of a customer to install certain apparatus, although seemingly advantageous to the electric-light company at first, it would be wise for him so to advise the customer. Such frankness and solicitude always bring their reward.

NEW YORK. JOHN F. ROBERTSON.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Dynamos, Motors and Transformers.

Single-Phase Commutator Motors.—J. Fischer-Hinnen.—The conclusion of his long article giving the principal rules for the predetermination of single-phase commutator motors, both series motors and repulsion motors being discussed. The article is concluded by a comparison of series and repulsion motors.—*Elek. Zeit.,* June 10.

Stray Field of Induction Motors.—Two communications, one by K. Simons and W. Rogowski, the other by R. E. Hillmund, on some discrepancies in the theories developed by these two parties in recent papers on the stray field of induction motors, with special reference to the zigzag stray field.—*Elek. Zeit.,* June 10.

Lamps and Lighting.

Tungsten Lamp.—A note on a recent British patent of the Siemens & Halske Company (19,311, 1908; June 3, 1909). In spite of opposition a patent has been granted on this application. The process described consists in first reducing a mixture of nickel tungstate and tungstic acid, so that an intimate and ductile mixture of nickel and tungsten is obtained. This is rolled and drawn into filaments, the nickel being afterward removed by heating in a vacuum.—Lond. *Elec. Eng'ing,* June 10.

Metallic Vapor Lamp.—O. Vogel.—A continuation of his long illustrated serial on the history and the evolution of the metallic vapor lamp and the present status of its development —*Zeit. f. Beleucht.,* May 30 and June 10.

Power.

Steam Generating Stations.—G. Rizzo.—An abstract of an illustrated report made to the International Association of Tramways and Light Railways and based on the replies received in response to the questionnaire sent out to members The author first discusses the various aspects of the boiler-house problem, and shows how, by the use of superheated steam and proper attention to good stoking, much greater efficiency could be obtained than is at present. He then passes on to consider the heat cycles produced by both reciprocating engines and turbines when working under various conditions and shows how a vacuum which is most efficient to use depends on a number of conflicting factors. A summary of the costs for erecting a station containing all the most modern improvements is given in conclusion. The example here given is that of a station supplying a tramway load and containing three horizontal tandem engines, the expansion of which can be varied by a regulator, and which work condensing and on superheated steam at 300 deg. C. Each machine is capable of developing 1450 effective hp continuously when working at a pressure of 12 atmospheres and a condenser pressure of 7 cm of mercury. This power corresponds to an admission of a volume of steam equal to 28 per cent of that of the high-pressure cylinder. The diameter of the high-pressure cylinder is 2 ft. 4 in. and that of the low-pressure cylinder 4 ft. The stroke of the pistons is 4 ft. and the speed is 94 r.p.m. Each machine is directly coupled to a 1000-kw, three-phase alternator, the power factor being 0.9. The rotor of this alternator is of the flywheel type, its moment of inertia being 1100 tons-m^2. The exciter sets, which work at 110 volts, are fixed on the end of the shaft of each machine. The switchboard contains all the measuring instruments and usual switchgear, together with the feeder panels and the switches for operating auxiliary machinery. The boiler house contains four boilers of the Babcock & Wilcox type, having a heating surface of 3700 sq. ft. An interior superheater delivers steam at 325 deg., while the boilers are fitted with automatic stokers. The installation also has four groups of Green economizers of 90 tubes each, steam-feed pump and another electrically driven. The chimney is 180 ft. high and has a diameter of 8.6 ft. at the top. It is capable of exerting a draft of 13 mm at the furnace registers, and allows the operation of all the six boilers at full load at the same time. The capital outlay for this installation is given in the following table:

Engines, including pipe work	$72,000
Generators, including exciters, etc	36,000
Switchboard and cables	9,000
Boilers	33,000
Economizers	12,000
Pumps and pipe work	14,000
Coal conveyor	5,000
Coal stores	10,000
Land and buildings	50,000
Chimney, cranes and erection	20,000
Miscellaneous	10,000
Total	$271,000

As regards the consumption of coal per kw-hour, it may be noted that with the alternator at one-third load the machine consumes 5200 calories per kw-hour, at half load 5130, at three-quarter load 5530, and at full load 4850. By applying the correction due to the efficiency of the pipe work and that of the boiler, the generating set when running at one-third load develops 1 kw-hour per 6800 calories, at half load 1 kw-hour per 6700 calories, at three-quarter load 1 kw-hour per 5960, and at full load 1 kw-hour per 6400 calories. One kw-hour can therefore be produced per 1.8 lb. of coal, if the load on the network varies between 666 kw and 2000 kw. This consumption of 1.8 lb. of coal takes into account all the losses, including that of lighting the boilers in the morning. Taking the total output of the station as 8,500,000 kw-hours, that is 2850 kw-hours per kilowatt installed, and taking 5 per cent interest on capital, together with a depreciation of 4.6 per cent for the machinery and 3 per cent for the buildings, an expenditure of 0.28 cent per kw-hour is obtained. The other expenses of the station, including wages, lubrication and maintenance charges, may be estimated at 0.14 cent per kw-hour, while coal may be taken as costing 0.45 cent per kw-hour. The total cost per kw-hour, therefore, works out at 0.87 cent.—Lond. *Electrician,* June 11.

Electric Brakes.—M. Müller.—It is a well known fact that the self-excitation of series dynamos does not succeed if the external resistance is beyond a certain value. This is of importance for electric braking on tramways, cranes, rolling mills, etc., where series motors are used, and the braking effect is obtained by running the motors as generators. This is to be taken into consideration in dimensioning the braking resistances in order to get a sure brake effect. The author discusses the excitation of series motors operating as generators, as a function of the resistance of the breaking circuit and the speed of the motor. For special cases, he defines a "critical resistance." He finally shows how to predetermine the instantaneous variation of the exciting current from the technical data of the motor. The author finds that for the proper production of the braking effect the following points are of chief importance: First, the magnetizing curve at low current, and the remanent magnetism of the motor. The excitation will be the quicker the smaller the ratio of the total ohmic resistance of the braking circuit to the speed of the motor. The braking effect is not obtained if this ratio is above a certain value. Other things being equal, the time required to obtain complete excitation is directly proportional to the number of the field windings and inversely proportional to the number of armature conductors connected in series.—*Elek. Zeit.,* June 10.

Magnetic Cranes.—C. Michenfelder.—The conclusion of his illustrated article on electromagnetic cranes for loading and unloading. Besides a review of recent progress made in the design of such cranes, the author gives an account of the favorable results obtained in a large German rail plant with magnetic cranes for loading rails.—*Elek. Zeit.,* June 10.

Petrol Motors.—Watson.—An illustrated paper on the thermal and combustion efficiency of a four-cylinder petrol motor, which contains what is probably by far the most complete

record of a series of trials with a motor under varying conditions which has yet been published.—Lond. *Engineering*, June 11.

Traction.

Overhead Construction for Railways.—An illustrated article on the electrification of the L. B. & S. C. Railway's South London line. The article gives considerable details of the overhead construction. Each catenary is separately erected and separately adjustable by means of two turnbuckles placed in each catenary span. Only three types of insulators are used and the insulators of each type are interchangeable. All three types of insulators are of the spool pattern, and they are all used in such a way that the axis of the insulator is in the horizontal plane, so as to provide for the surfaces of the corrugations being kept fairly clean by natural means. Double insulation is used throughout the whole construction, and only porcelain is used as an insulator. The double insulation is supplied by what is called the main insulator and a smaller one known as the auxiliary one. All the main insulators have been tested to 65,000 volts for 30 minutes, and the auxiliary ones to 25,000 volts for the same period. The third type is used in connection with the section insulators and for supporting the trolley or collector bow fixed to the top of the motor-car roof. The trolley wire is circular in section and 1 in. in diameter, having a groove on either side into which the mechanical clips fit by means of which the conductor is supported from the catenaries. The droppers supporting the trolley wire are solid rods, having loops at one end hung in corresponding loops, fixed by means of special clips to the trolley wire. When the length of a dropper exceeds 3 ft. 6 in., droppers composed of two sections, one hung from the other by means of a loop, are used, so as to give the greatest flexibility in the vertical plane while assuring the greatest rigidity in the horizontal one. The relative weight of the clips to that of the trolley wire was so small that, with the arrangement of supports adopted, there is no knock of any kind when the collector bow passes under a trolley-wire clip.—Lond. *Electrician*, June 11.

Steam and Electric Traction.—W. E. DALBY.—A Royal Institution lecture on the relative merits of steam and electric traction. There was, he said, little difference between actual efficiency of the two methods, as in each case about 4 per cent of the energy of combustion of the coal was utilized for traction. For long, non-stop runs steam was most satisfactory. The traveling public would not pay for high speeds, but, if they wanted them, electric traction would have to be employed. For frequently stopping trains with high schedule speeds, electric traction was inevitable.—Lond. *Elec. Eng'ing*, June 10.

Speed Curves.—T. FARMER.—An article in which the author sets forth a simple method of utilizing the distance-time curve for obtaining velocity and acceleration readings direct.—*Elec. Rail'y Jour.*, June 19.

Installations, Systems and Appliances.

Melbourne.—J. H. DAVIES.—An illustrated description of the municipal electric central station of Melbourne. There are two distinct systems of generation: direct current at 460 volts between outers and single-phase alternating current at 4000 volts. In the engine house these systems are kept entirely separate—being installed at opposite ends of the room. The direct-current generating plant is rated at 3850 kw. The single-phase plant contains two generating units, each being a 750-kw turbo-alternator. The direct-current arc lighting of the streets is done by 135 Excello converging-carbon flame lamps, burning nine in series across the 460-volt outers of the direct-current system. In the center of the city the lamps are 25 ft. above the ground, and are spaced about 80 yd. apart. The lighting of the by-streets and rights-of-way is now done by 32-cp, 230-volt carbon-filament lamps. The single-phase current is transmitted to 18 transformer substations. There are two sets of transformers in a substation, one stepping down to 400 volts for supply to private customers and for incandescent street lighting, and the other transforming to 1200 volts for public arc lighting. The middle point of the secondary side of the 400-volt transformers is earthed at the substations, and supply is given on the three-wire system, incandescent lighting and small motor supplies being at 220 volts, while motors of 2 hp are connected to the outers. The transformers for public arc lighting have a number of taps brought out from the unearthed end of the secondary winding, so that various pressures from 800 volts to 1200 volts may be used according to the number of lamps in the circuit. These arc lamps are of the A. E. G.'s converging-carbon flame type, some 550 in all. The lighting of the lanes is done by 200-volt, 32-cp incandescent lamps. The Council does considerable business in hiring out arc lamps. Contracts are made including the hire, supply of energy, carbons, and all switch and attendance. This arrangement is very popular, and some 1100 lamps are let on hire on this plan, and mostly for illumination outside shop windows. Contracts are also made for attendance and recarboning of consumers' own lamps; or lamps may be hired and cared for by the user, who only pays in addition for energy.—Lond. *Elec. Review*, June 4.

Extensions of Sydney Station; Protection of Condenser Tubes.—Considerable extensions are to be made to the power house at Sydney, which now has an annual output of 9,000,000 kw-hours. Major Cardew, who has just reported on the undertaking, recommends the installation of 4000-kw turbo-alternators and the erection of a coal-conveying plant. Troubles have been experienced with the condenser tubes, and different methods of preventing corrosion due to electrolytic action are being tried. W. H. Allen, Son & Company use plain brass tubes in conjunction with cast-iron water boxes and end covers, the tube plate being of the same composition as the tube. Zinc plates are placed in the water boxes and in the suction culvert for circulating water. The method adopted in the Harris-Anderson system consists in using aluminum plates supported from the tube plate in the water spaces at either end of the condenser. Aluminum, continues Cardew, is more strongly electropositive than zinc or brass, and he suggests that aluminum plates should be tried instead of the zinc plates now being tried at Sydney, although it would be more difficult to ensure a thorough metallic connection between the tubes and the plates. Experiments are also being made with tinned and untinned tubes. Cardew favors the use of the latter, and suggests that they should be made of an alloy of 71.4 per cent copper to 28.6 per cent zinc. They should be connected to the tube plates by lead grommets.—Lond. *Elec. Eng'ing*, June 10.

Distribution Department.—H. F. J. THOMPSON.—An article on the proper organization of the distribution department of an electric central station. The author discusses the composition of the staff, and the organization of the meter department, the clerical department, the publicity and installation department, the handling of applications for the supply, the handling of complaints, the making of repairs, etc., in emergency cases.—Lond. *Elec. Review*, June 11.

High-Tension Circuit-Breakers.—HENRY.—The first part of a serial on modern high-tension circuit-breakers, principles of their construction, methods of automatic operation, etc.—*L'Industrie Elec.*, June 10.

Fuel Economy.—J. IZART.—The conclusion of his illustrated serial on methods of improving the fuel economy in central stations, emphasizing especially the advantages of recording instruments.—*L'Industrie Elec.*, June 10.

Wires, Wiring and Conduits.

Transmission Poles.—A note on a recent investigation by Gaisset on the calculation of the transmission poles and conductors. The maximum stress must never exceed about one-quarter to one-third of the breaking stress. The wires should, of course, be so arranged that they can never touch each other, and the installation costs per kilometer of the conductors should never exceed with the greatest possible span a certain fixed limit. Calculations made by the author show that the costs per kilometer on a straight run are a function of the height of the poles. The results are given in Fig. 1, where

curve 1 is for wooden poles, curve 2 for U-iron poles, curve 3 for armored concrete poles, and curve 4 for lattice-work poles It will be seen from these that for each type of mast there is a certain height for which the installation costs of the line are a minimum. It is only possible to compare together seriously curves 3 and 4, as with these a mean life of 30 years can be obtained, while the average life of the wooden poles is only

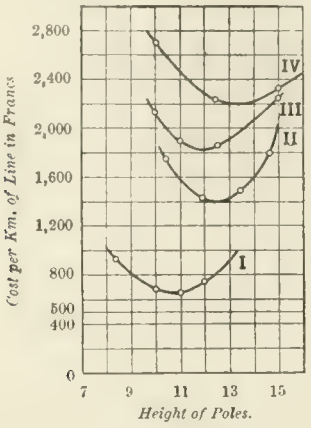


FIG. 1.—TRANSMISSION POLES.

about 15 years. The values given for curve 1 should, therefore, really be doubled. For transmission lines with many curves the values for wooden and concrete poles have to be taken considerably higher, owing to the necessary stiffening required.—Lond. *Electrician*, June 11.

Fittings.—W. A. Toppin.—The author emphasises the importance of proper provision for attaching electric fittings to the wiring of the building. Seven different methods of attachment are illustrated by diagrams and their merits are critically compared.—Lond. *Elec. Review*, June 11.

Electrophysics and Magnetism.

Inertia and Mass.—V. Dwelshauvers-Dery.—A paper discussing the question whether modern physics has demonstrated that what rational mechanics calls "mass" varies with the speed, the latter science having thus been upset down to its very foundations. The author strongly denies that the work of Abraham and Kaufmann has in any way demonstrated that the material mass of bodies is variable, as they use the terms inertia and mass wrongly. "On supposing it to be finally demonstrated by experience that this resistance of electromagnetic origin, wrongly styled 'inertia or mass,' follows in the case of cathodic corpuscles the laws indicated by the new theory it would not signify that these laws could be extended to free material, non-charged, points. The supposition that the real inertia of matter has an origin, even an electromagnetic origin, is only an evasion without scientific value, which conceals the simple change of signification given to the word mass."—Lond. *Engineering*, June 11.

Electrochemistry and Batteries.

Fixation of Atmospheric Nitrogen.—A Bernthsen.—A paper read before the International Congress of Applied Chemistry in London. The author deals especially with the new Schoenherr process of the Badische Company, recently described in the Digest. Concerning the efficiency of this process it is stated that the gases leaving the tube contain about 2 per cent of nitric oxide, that is, they are from one and a half times to nearly twice as concentrated as the gases which Birkeland and Eyde produce. It is interesting to note that the arcs produced in Schoenherr's process send out electrical waves, and as a result of this a method has been worked out by the Badische Anilin & Soda Fabrik for producing electrical oscillations of great frequency suitable for use in wireless telegraphy.—Lond. *Electrician*, June 11.

Fixation of Atmospheric Nitrogen.—S. Eyde.—A paper read before the Royal Society of Arts in London on the Birkeland-Eyde process. The author describes the chemical methods of working up the dilute gas mixture containing nitrogen oxides in the marketable products.—Lond. *Electrician*, June 11.

Calcium Carbide and Cyanamide.—The conclusion of the very long and fully illustrated serial on a large new Norwegian electric furnace plant for making calcium carbide and cyanamide.—Lond. *Engineering*, June 11.

Cyanamide.—J. Escard.—An illustrated article on the electrochemical method of making calcium cyanamide and its properties and industrial applications.—*L'Industrie Elec.*, June 10.

International Congress.—An account of the papers of electrochemical interest presented before the International Congress of Applied Chemistry in London. They deal with the use of the electric furnace in the iron and steel industry, the fixation of atmospheric nitrogen, and the electrolytic production of caustic and chlorine.—Lond. *Elec. Review*, June 4 and 11; Lond. *Engineering*, June 4 and 11.

Units, Measurements and Instruments.

Differential Methods for Measuring Hysteresis Losses.—R. Beattie and P. M. Elton.—The conclusion of this article, the first part of which was abstracted in the Digest last week. The authors give experimental results of the method described. Besides this method (which is a "single specimen" method) there are other possible ways in which the differential ballistic principle, as applied to hysteresis measurements, can be carried out. All these alternative methods, however, require the use of two exactly similar specimens and the duplication of the magnetizing coil. The simplest and most practical of these alternative methods is represented in Fig. 2. Two magnetizing coils, which must be wound with exactly the same number of turns per centimeter length, are in this case connected in parallel with equal resistances R_1R_1 in series. A resistance R_2 can be thrown into the circuit of either coil by means of the key K, which is an ordinary two-way key constructed so as not to break circuit in passing from one contact to another. As shown, the secondary coils wound round the test pieces are connected in series with the ballistic galvanometer G. To operate this method, K is placed in its mid position, which allows exactly equal magnetizing currents to flow through the two coils. The commutator C is then reversed a few times and stopped in its mid position. K is next set to one side and the commutator thrown over in the direction in which it was last moving. Lastly, K is thrown quickly over to the other contact, cutting R_2 out of the circuit and inserting it in the other. Provided the secondary coils are connected up so that the quantities induced by these two flux changes go in opposite directions through the galvanometer, the ballistic throw will measure δB. The special advantage of this method is that the induction changes take place simultaneously and not successively,

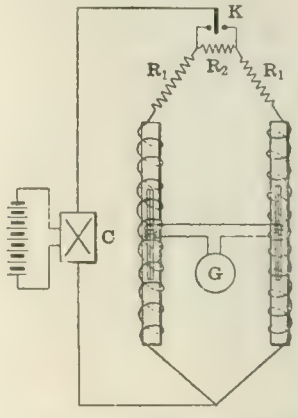


FIG. 2.—MEASURING HYSTERESIS LOSSES.

as, of necessity, they must in the "single-specimen" method. The key K may, therefore, be operated as quickly as one pleases; the key itself need not be of special construction.—Lond. *Electrician*, June 11.

Bifilar Vibration Galvanometer.—W. Duddell.—An abstract of a paper read before the Physical Society of London. The paper describes a new type of vibration galvanometer and a

series tests made upon it. Vibration galvanometers may be divided into two types: (1) those in which the moving part consists of a piece of iron and steel and the current to be measured flows round fixed coils as in the case of the Thomson galvanometer; (2) those in which the current to be measured flows round a moving coil placed in a fixed magnetic field on the syphon-recorder principle. The vibration galvanometers of Max Wien and Rubens belong to the first class, while Campbell's vibration galvanometer and the one described in the paper belong to the second. In the instrument described, the mass of moving parts is reduced to a minimum, the moving coil being reduced to the two wires forming its two sides, similar to a bifilar oscillograph, but with this difference: Whereas the bifilar oscillograph is designed so as to make the damping a periodic, the vibration galvanometer is designed so as to keep the damping as small as possible. A series of tests made upon the instrument showed that the total range of frequency was very large, namely, from 90 cycles per second up to 1900 cycles per second. The damping is very small, so that the resonance is very sharp. A series of measurements on the sensitiveness of the instrument showed that the sensitiveness to alternating current decreases very nearly inversely as the frequency for which the instrument is adjusted, whereas for direct current the sensitiveness decreases approximately inversely as the square of the frequency for which the instrument is adjusted, which is what usually takes place with direct-current galvanometers. The sensitiveness of the galvanometer for detecting small alternating voltages is reduced by the back e.m.f. of the instrument, and the paper concludes with a determination of the magnitude of the back e.m.f. in the instrument shown at the meeting. The advantages of the galvanometer are its simplicity, ease in tuning, wide range of frequency for which it can be tuned, high sensitiveness, negligible self-induction and comparatively small back e.m.f.—Lond. *Elec. Eng'ing*, June 10.

Interrupter.—J. REYVAL.—In the conclusion of his illustrated article on the recent exposition of the French Physical Society instruments of general physics and apparatus for therapeutic applications of electricity are described. Fig. 3 shows the in-

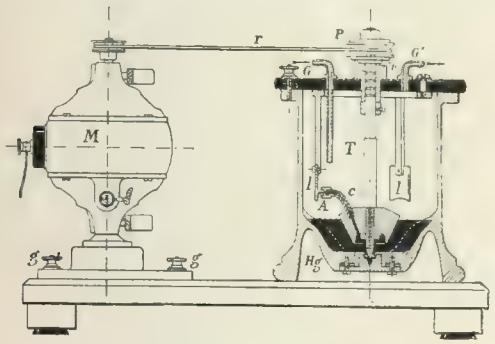


FIG. 3.—INTERRUPTER.

terrupter exhibited by a Paris firm. *M* is a small motor which drives the axle *T* of the interrupter. The latter contains mercury *Hg* in the bottom, which is sucked in and by means of centrifugal force is driven into the channel *c* and thrown out of the aperture *A*, so as to make contact successively with four metallic plates *l*. To prevent the deterioration of the mercury an inert gas is used in the apparatus entering through *G* and leaving through *g'*.—*La Lumière Elec.*, June 5.

Mercury Switch and Meters.—A note on a recent British patent of G. Hookham (13,215, 1908; June 3, 1909). In mercury motor meters it is necessary that the mercury should be in intimate contact with the metal armature, and it has been usual to coat the latter with a film of platinum and finally a film of a readily amalgamated metal, such as silver or copper. This outer film, however, has not proved satisfactory, as it comes off easily. According to this invention, a thin film of palladium is used over the platinum covering or direct on the metal armature. This readily amalgamates and lasts a long time. Such a film of paladium may also be applied to the contacts of mercury switches and other apparatus where intimate contacts between mercury and other material is required. It will adhere to. carbon or insulating material.—Lond. *Elec. Eng'ing*, June 10.

Telegraphy, Telephony and Signals.

Wireless Telegraphy; New Telefunken System.—J. A. FLEMING.—An article on the new system of the Telefunken Company, the discharger being based on the known fact that the damping of very short sparks is extremely large, and that if we can "quench" or stop the primary oscillations after one or two swings the secondary circuit then continues to oscillate freely with a single period, as shown in Fig. 4. The discharger

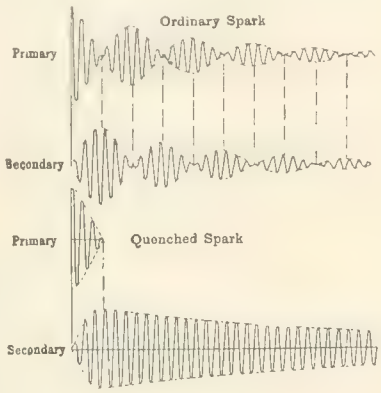


FIG. 4.—OSCILLATIONS IN INDUCTIVELY COUPLED CIRCUITS.

used in the experiments of the author consisted of 12 round flanged plates of copper, 5 in. in diameter, the surfaces being turned true and having a groove in them (see Fig. 5). A mica ring is interposed between each pair of copper plates of such size that the mica half covers each groove. This groove is important, for without it the discharge spark tends to take place always at the edge of the mica. The mica is of such thickness as to make an air space of not greater than 0.01 in. between the flat copper surfaces. In this discharger there are 11 air-gaps, each about 0.01 in. wide and of circular section. When this discharger replaces the ordinary spark-gap in the primary circuit it damps out instantly the primary spark, and hence excites the free oscillations in the secondary circuit "by shock"("Stosserregung" in German). In consequence of this rapid damping it is possible to employ an alternator having a frequency of 1000 to 2000 to create a corresponding number of

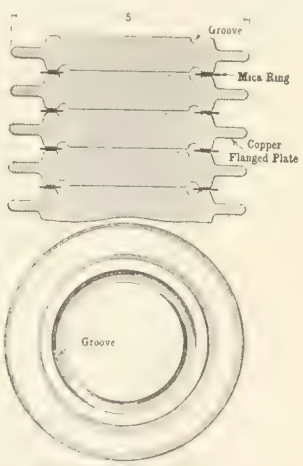


FIG. 5.—PLAN AND SECTION SHOWING PORTION OF DISCHARGER

primary discharge sparks per second, without producing any true arc discharge. The rapid cooling of the discharge surfaces entirely prevents it. The rapid succession of highly damped primary sparks creates then an equally rapid succession of very feebly damped trains of oscillations in the secondary circuit having a very large mean-square value, and therefore possessing many of the properties of undamped oscillations generated without any true-arc effect.—Lond. *Electrician*, June 11. The same system is described at great length and with

many illustrations in an article by Count Arco, the first part of which appears in *Elek. Zeit.*, June 10.

Wireless Telegraphy.—A. S. M. Sörensen.—A paper read before the New Castle Section of the (Brit.) Inst. Elec. Eng. on the wireless telegraph station at Cullercoats. The installation comprises a "spark" apparatus with de Forest electrolytic receiver, as well as the more recently installed complete Poulsen "arc" equipment with which, by a photographic printing arrangement, messages have been received from Lyngby, in Denmark, at the rate of 100 words per minute. Fig. 6 gives the comparative power curves for arc and spark

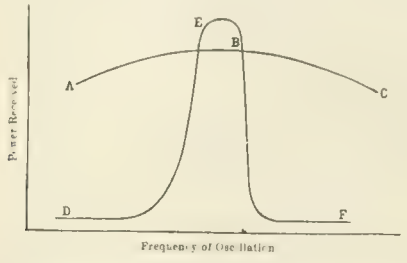


FIG. 6.—POWER CURVES FOR ARC AND SPARK EXCITATION.

excitation. The abscissas represent the frequency and the ordinates the power received; the relatively flat curve *ABC* refers to spark excitation, the curve *DEF* to arc excitation. A small variation in frequency produces large difference in power, rendering tuning or variation of frequency a good method of securing non-interference. Tuning to the extent of half of 1 per cent is possible by an arc working in an atmosphere of hydrogen. Frequencies of 100,000 per second are necessary for radiotelegraphic transmission by arc excitation, and the function of the hydrogen atmosphere is to bring the frequency above the maximum of 40,000 obtained with arcs working in air.—Lond. *Elec. Eng'ing*, June 10.

Wireless Telegraphy.—J. A. Fleming.—A Royal Inst. lecture giving a review of recent researches in wireless telegraphy. The author pointed out that there was very little absorption of the energy of the electric waves when they were traveling over sea water, which was a good conductor; but that over dry soil or rocks the waves penetrated deep, and there was much absorption. The multiple-gap transmitter of the Telefunken Company for general continuous oscillations was described, and the conditions for successful tuning were discussed.—Lond. *Elec. Eng'ing*, June 10.

Telephone Lines on Transmission Poles.—G. Laporte.—An article on the best methods of supporting a telephone line on the same poles which also carry a power transmission line. It is emphasized that the telephone line should be constructed just like a good power transmission line; that is, ordinary telephone insulation should not be used, but high-tension insulators, say, of 10,000 volts. The distance between the telephone wires and the power wires should be at least 1 m (3 1/3 ft.). The author also gives notes on apparatus advisable on such lines, repairs, etc.—*L'Industrie Elec.*, June 10.

Wireless Telegraphy.—J. A. Fleming.—When a radiating antenna in a wireless telegraphic station is coupled inductively and not very loosely to a spark-condenser circuit, it is well known that a compound radiation which may be resolved into waves of two wave lengths is radiated from it. If a corresponding receiving antenna is set up it is generally syntonized only to one of these wave lengths, and hence a considerable part of the radiated energy may not be absorbed by the receiver circuit. Such a system can be made more efficient if both the waves radiated simultaneously from the transmitter at the receiving end are absorbed. This can be done by employing two receiving sets coupled independently to one receiving antenna, as in Marconi's method for the simultaneous reception of two sets of signals, one of these syntonized to one of the wave lengths of the inductively coupled transmitting antenna and the other one to the second wave length. Associated with these two receiving sets a double-wound telephone should be employed, one circuit of which is in connection with the detector of one receiving set and the other with that of the other.—Lond. *Electrician*, June 11.

Miscellaneous.

Electrical Accidents.—A report of G. Scott Ram, the electrical inspector to the (British) Home Office Department, on electrical accidents in 1908. Although in many respects the report closely parallels that for the previous year, there is a marked increase in the number of electrical accidents in generating stations and substations, approximately 30 per cent; the number of fatal accidents in factories and workshops has increased in a still greater ratio, though the number of non-fatal accidents shows a fall of 14 per cent. It is hoped that the situation will be improved by the new regulations drawn up by the Home Office which are to go into effect in factories and workshops on July 1, and in electrical stations on Jan. 1. The inspector believes that nearly all the cases of bad and dangerous work and conditions that he has described and commented on in his annual reports are now covered by the regulations, and he confidently looks forward to more cheerful and reassuring reports in future years.—Lond. *Elec. Review*, June 11.

Electrical Industries in Continental Europe.—A review of the continental electrical industries and unfavorable prospects for the present year. Notes are given on various German, French, Belgian and Austrian manufacturing companies.—Lond. *Elec. Review*, June 4.

BOOK REVIEWS.

Elektromagnetische Ausgleichsvorgange in Freileitungen und Kabeln. By Karl Willy Wagner. Leipzig: B. G. Teubner. 109 pages, 23 ills. Price, 2.40 marks.

This little volume contains an elementary disquisition on electromagnetic waves and transitory disturbances in electric conductors, such as are used in practice. It is intended for advanced students of electrical engineering, being highly mathematical. A good presentation is given of the movement of waves to and fro along an electric circuit. The treatment is as simple as the present elementary condition of our knowledge on this subject permits.

Power Stations and Power Transmission. By George C. Shaad. Chicago: American School of Correspondence. 155 pages, 86 ills. Price, $1.

This manual describes approved American practice in the construction, equipment and management of electrical generating stations, substations and transmission lines. Descriptions are given of both steam and hydraulic plants, direct-current and alternating-current generators, transforming apparatus, transmission lines and distributing circuits. Theories are discussed only when a slight knowledge of theory is necessary to an understanding of the relative merits of several different arrangements. In addition to the descriptive matter, much information is given in the form of tables and diagrams. The book is suitable for self-instruction and home study, for which it was intended.

The Economy Factor in Steam-Power Plants. By George W. Hawkins. New York: Hill Publishing Company. 133 pages. Illustrated. Price, $3.

This book discusses the various types of steam engines and auxiliaries, with special reference to the steam consumption, also, numerous types of boilers as steam producers, and oil fuel as the source of energy. Its chief value lies in the large amount of specific information relating to the efficiency of engines, boilers, etc., which seems to have been compiled with exceptional care. The author has selected an analytical method of treatment, and the descriptive matter covers only those facts which have a bearing on the production or utilization of steam, no apparatus being described or illustrated. The presentation is in simple terms, and the information is arranged for immediate use by persons interested in the design of economical steam plants.

NEW APPARATUS AND APPLIANCES

Device for Photometric Comparisons.

The increasing use of high-efficiency tungsten lamps in connection with reflectors or shades has created a demand for some simple method by which the intensity of light derived from two sources can readily be compared. The average photometric measurement is not well adapted for use by a layman who does not care to know, as a rule, the intensity of a source of light or an illumination in terms of a standard, but simply desires a visual comparison which will indicate which source gives the brighter light without caring to know just how much brighter one source is than the other. To meet this condition, a simple, practical method of comparing the intensity of illumination has been worked out in the fixture branch of the Central Electric Company, Chicago, Ill.

The method is simply one of comparison, the two sources to be compared being located approximately as shown in the illustration, in which the intensity of the light reflected from one source is being compared with the intensity of the light reflected from another source. The usual practice is to mount two sockets and shade holders approximately 4 ft. apart on the ceiling of the fixture or display-room and equip each holder with the desired shade, care being taken to have the sockets connected to the same source of supply in order to operate the lamps under the proper voltage conditions. Care should also be taken to select lamps having approximately the same watt consumption in order to secure a fair comparison.

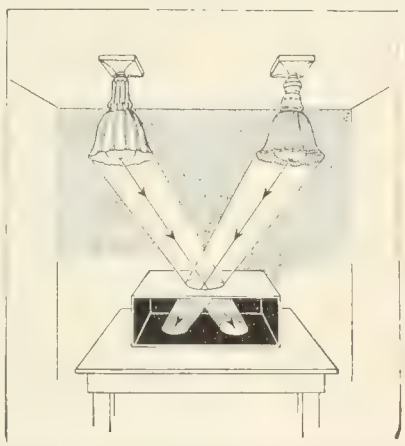
The measuring or comparison device is placed on a table and consists of a rectangular box provided with a round hole in the top, this hole being so located that a ray of light emitting from either of the lamps will throw a light spot on the horizontal shelf on which is placed a piece of white paper. One side of the box (see cut in next column) is left open so that an observer can readily see the interior. With two sources of light located as shown in the diagram, two light spots are thrown on the white paper, and it is a very easy matter to select the brightest spot. It should be remembered that the light rays cross; that is, the light from the left lamp is thrown at the right-hand side of the measuring device, the light from the right being thrown at the left-hand side of the measuring box when facing it.

The Compensarc.

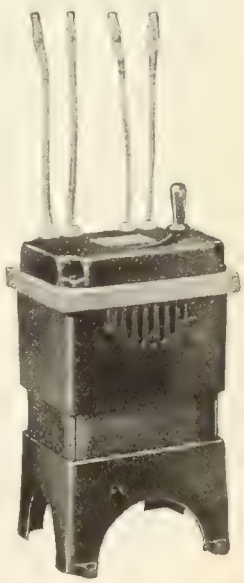
Some kind of a device for controlling arc lamps on moving-picture machines is necessary for the reason that moving-picture machine arc lamps operate at approximately 35 volts at the arc, while the voltage obtainable from practically all commercial lighting circuits is either 110 volts or 220 volts. Formerly iron-wire or grid resistance rheostats were used, but these result in a waste of all that energy supplied from the line over and above that actually required by the lamp. The Fort Wayne Electric Works is placing on the market a special type of adjustable auto-transformer known as the "Compensarc," which insures in this service a great saving in power, with, it is claimed, a superior quality of light in color, intensity and stability. The device is rated at 2 kw for 110 volts or 2½ kw for 220 volts, and wound for either 60 cycles or 133 cycles. The general appearance of the "Compensarc" is shown in the illustration. The core is made of the highest grade sheet-steel laminations, similar to standard transformer construction. The outer surface of the core is fully exposed to the air. The coils are mounted within the core and are completely protected and thoroughly insulated. The core and coils are given vacuum treatment, making them moisture- and water-proof.

The assembled core and coils are supported by a cast-iron base having four legs which hold the device at a convenient height from the floor. The case is also of cast iron and rests on the top of the core. It is liberally ventilated and encloses the ends of the coils and protects the connections on the inside. A slate top supports the switch blade and clips; a long, heavy bolt passes through each corner of the slate case and base outside the core, thus holding these parts together firmly.

A horizontal, three-step, continuous circuit switch is mounted on the slate top, providing three adjustments for intensity of light. Each adjustment is so designed that it maintains approximately the same voltage at the arc while passing from one step to the next, without at any time opening the circuit, which would break the arc and produce flickering. There is no waiting for the arc to settle and become steady before the intensity of the light can be determined. A cast-iron cover over the slate top completely encloses the switch blade and contacts, making it impossible for accidental short circuits to occur, and also removes all danger to the operator. The terminals to the line and lamp are brought out through porcelain insulators in the cover. The lamp terminals are plainly designated, and with a little care the "Compensarc" can be installed by any operator.



DEVICE FOR PHOTOMETRIC COMPARISONS.



COMPENSARC.

The device is approved by the National Board of Fire Underwriters, there being no fire risk attached, as no noticeable rise in temperature occurs even after several pictures have been run through the machine. The "Compensarc" cannot be short-circuited. Even though the switch blade is at an intermediate point and thus bridging two adjacent contacts, it will not burn out. The adjustments possible with the "Compensarc" are very essential to successful moving-picture work, and the fact that the "Compensarc" provides these adjustments without breaking the circuit and putting out the light makes it all the more desirable. It is claimed that the "Compensarc" saves 66 2/3 per cent on light bills for moving-picture arc lamps.

Electric Motors in a Pattern Shop.

One of the best installations of electrical apparatus in a pattern shop in western Pennsylvania is located at West Homestead in the works of the Mesta Machine Company. The two floors of a reinforced concrete building are devoted exclusively to the pattern shop, giving it an exceptionally favorable location in every respect. The natural light is excellent, the machines are all driven by individual motors so that there are no overhead belts, and the wiring is entirely concealed, making the

general appearance of the shop particularly clean and attractive.

The shop is equipped throughout with new machinery suitable for the preparation of the patterns required for the large engines and rolling mill machinery manufactured by this company, and everything is modern and up to date in the equipment. An idea of the general layout of the shop is given in the illustrations. One of these shows the shop floor cleared of work, while another photograph was taken with patterns of various descriptions in different states of completion.

The equipment includes three bench saws, three band saws, a swing saw, three surfacers, three jointers, three lathes, a pony planer and a pattern scroll saw. Each machine is driven by its own motor, either belted or, in a few cases, as with the two-speed lathes, direct connected. The planer and the surfacers are driven by a countershaft to which the motor is direct connected. The motor for the scroll pattern saw is directly coupled to the crank wheel, providing a most compact equipment.

The capacities of the motors, and the machines to which they are connected, are given in full in the accompanying table. It is to be particularly noted that the motors are largely 3½ hp or 5 hp. This is due to the fact that it was desired to secure as many motors as possible of one size in order to keep the repair parts carried in stock a minimum. These 5 hp motors, running at 1600 r.p.m., and the 3½ hp motors, running at 1050 r.p.m., are built on the same frame, and all parts, except armatures and field windings, are interchangeable. Spare armatures and field coils of each type are kept in stock in readiness for any accident. These motors are of the direct-current, 220-volt, shunt-wound type.

PATTERN SHOP INSTALLATIONS.

Machine			Motor	
Type.	Make.	Size.	Hp.	Speed.
Cut-off saw	Oliver	No. 60, 14 in.	5	1600
Cut-off saw	Oliver	No. 60, 14 in.	5	1600
Rip saw	Oliver	No. 60, 14 in.	5	1600
Surfacer	Oliver	No. 61,	5	1600
Surfacer	Oliver	24 in. x 9 ft.	5	1600
Jointer	Oliver	B, 20 in.	5	1600
Jointer	Oliver	B, 20 in.	5	1600
Jointer	Oliver	24 in.	5	1600
Lathe	Oliver	B, 30 in.	5½	450-1350
Speed lathe	Oliver	12 in.	¾	500-1500
Speed lathe	Oliver	No. 24, 20 in	¾	500-1500
Bank saws	Oliver	36 in.	3½	1050
Bank saws	Oliver	36 in.	3½	1050
Bank saws	Oliver	36 in.	3½	1050
Swing saw	Oliver	No. 36, B	3½	1050
Pattern scroll saw	Oliver	No. 1,	¾	*700
Pony planer	Fay & Egan	24 in.	5	1600
Surfacer	Towsley Mfg. Co.		5	1600
Saw filer	Black Diamond Mach. Wks.	6 in. x 40 in.	3½	†1050
Knife grinder	Oliver			

* Direct connected. † Group drive.

To prevent damage to the commutator by the accumulation of dust and dirt, the electrical superintendent, Mr. F. G. Galbraith, has devised a neat wire covering which affords ample ventilation and yet prevents the shavings, etc., from getting inside the motor. Protection to the belts from dirt, etc., and to the operator in case of a broken belt, is afforded by a special steel guard which is fastened to the floor and to the motor frame, and completely encloses the belt. This device, made by the Mesta Machine Company for this purpose, is shown in the illustrations.

The wiring is all carried in an 8-in. conduit in the floor, which runs the full length of the shop, with outlets at each machine. This conduit is packed with kiln-dried silica sand which absolutely prevents any possibility of arcing or fires. The switchboard is in a separate room where the saw filing and knife grinding are done by an automatic filing machine, which is so arranged that the band saws may be loosely looped over an old band saw wheel.

In addition to the motor there are nine glue pots, electrically heated, where all the glue is warmed. Practically the entire motor equipment, together with the glue pots, was supplied by the Westinghouse Electric & Manufacturing Company.





FIGS. 1 AND 2.—INTERIOR OF ELECTRICALLY EQUIPPED PATTERN SHOP.

New Hydraulic Jacks.

Anyone who has much heavy lifting to do appreciates that there are pleasanter tasks than carrying around a jack from one place to another, especially when it weighs more than 100 lb. It means rather a heavy load if carried by hand, and if the jack is loaded on a truck and reloaded with each using, this also involves considerable work.

The new Watson-Stillman shop jack, shown in Fig. 1, was designed to render unnecessary much of this labor. This jack, made in 11 sizes, of from 20 to 50 tons capacity and for lifts of 12 in. and 18 in., fills all the ordinary requirements of lifting heavy machinery and for general shop work. The wheels on the base and the handle on the cylinder facilitate moving the jack quickly from one place to another without the exertion of a great deal of work. The wheels touch the floor only when the jack is tilted, so they are never in the way during the lifting operation. If it is desired to use the jack at an angle, it can be tilted in the opposite direction to the wheels; and when it is laid flat upon the side, the ram will push out its entire lifting length. The head is enlarged sufficiently that the jack will not stop working for lack of filling, even if there has been slight leakage. An independent steel claw (not shown in the illustration) can be used when desired for lifting from near the ground. This is more convenient than a permanently attached claw, as the independent part is easily applied when a low lift is required, and its removal at other times allows the jack to be made of considerable lighter weight. The weight, however, is comparatively small, as the whole jack is made from steel, and the parts under greatest strain, such as the ram and cylinder, are machined from a solid bar of higher carbon steel than usually found in hydraulic or other jacks.

It is sometimes inconvenient to work the lever of a jack of the internal pump type because of the lack of room, or insufficient footing. There are other places where only a short space is available to place the jack, a condition which cannot be met successfully with the ordinary inside pump jack. To meet these conditions the Watson-Stillman Company has put on the market the independent pump hydraulic jack shown in Fig. 2, in 53



FIG. 1.—SHOP JACK.

sizes of from 2 to 1200 tons capacity. The various sizes of the jack proper have maximum ram movements of from 4 in. to 8 in. The pump is connected to the jack by means of flexible copper tubing, which may be of any length suitable to the work in question. The jack may be operated up to a pressure of 450 lb. per square inch on the ram by means of the hand lever shown on the pump, and further worked to full capacity by means of the extension lever. The gage may read in pounds

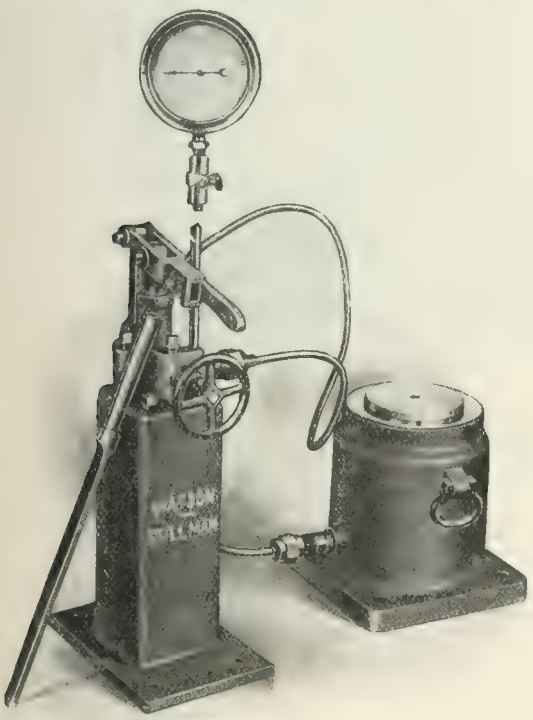


FIG. 2.—INDEPENDENT PUMP HYDRAULIC JACK.

per square inch, or in tons load upon the jack, or both. This is not furnished when the jack is to be used for ordinary lifting, but is necessary in testing. When equipped with the gage, the jack may be used between two fixed platens for making compression tests, testing the tightness of forced fits, etc. Both of the above jacks are made by the Watson-Stillman Company, of New York.

A Large Telephone Cable.

On Tuesday, June 8, the Western Electric Company shipped the first sections of submarine telephone cable designed to connect San Francisco with Oakland, by way of Goat Island, beneath the waters of San Francisco Bay. The cable is 2⅞ in. in diameter, containing 69 pairs of telephone wire—26 pairs of No. 13 and 43 pairs of No. 19 conductors. On the big reel the first section, 4250 ft. in length, weighed 26½ tons.

The truck on which this cable was hauled weighed about 5 tons, and 16 horses dragged the heavy load. The wagon was built very low, with a clearance of only 8 in. between its lowest part and the ground. Guiding eight teams of horses through the streets of New York and around the narrow corners is an unusual sight as well as a difficult task, and many stared at the cavalcade as it made its way along Bethune Street from West Street to Eighth Avenue, thence up to Twenty-seventh Street and west to the river, where the freight dock of the Lehigh Valley Railroad is located. The second consignment of 4250 ft. left the Western Electric Company's factory in the same manner two days later.

The first two sections of this cable, 8500 ft. altogether in length, are to extend from San Francisco to Goat Island. When the other two sections of 7800 ft. arrive, they are to be stretched from the island to Oakland Mole. On Goat Island connection with land cable is to be made. The entire 16,300 ft. of cable is one of the largest orders for paper-insulated submarine telephone cable ever placed. The cable is consigned to the Pacific Telephone & Telegraph Company.

Condenser-Lead Circuit Breaker.

The Westinghouse Electric & Manufacturing Company has developed and placed on the market a heavy-capacity oil circuit-breaker, which is made for voltages of 44,000, 66,000, 88,000 and 110,000. This new type consists of single-pole units, each enclosed in its individual boiler-steel tank with separate operating mechanism, leads, etc. All the operating parts are mounted on the cast-iron top, and are operative on the top so that the mechanism may be lined up before it is dropped into the oil tank. Eye bolts are provided for handling the top as a unit. Since the connection between poles is simply a piece of ¾-in. gas pipe, the poles may be spaced any convenient distance apart. The pipe is used as a pull rod, being in tension only. It is impossible for the different poles to stick due to improper alignment, as they may be placed several inches out of line without making the angle of pull sufficient to jam the mechanism.

The breaker may be either hand- or solenoid-operated, and of any number of poles. The automatic circuit-breaker is furnished either for use with series transformers or with a self-contained series trip. Time-limit features may be incorporated if desired.

The breaking capacity is practically unlimited, the heavy boiler-steel tanks and cast-iron top giving strength against internal pressures. The total travel of the moving contacts is large, there being two breaks in series at each pole. Each break takes place in a separate compartment, separated from the other pole by double barriers of insulated material. The break is between brass and copper, materials which have been found to give the best protection against burning. Each moving contact piece has its own heavy steel spring to take up any wear due to arcing, and slides across the stationary piece with a rubbing motion, keeping the contacts bright. The insulation features of this breaker are stated to be probably superior to those of any device of its character ever designed. While this is in a great measure due to the condenser type of lead, as will be explained, in any type of apparatus the insulation is dependent on the number of paths to ground, or, in other words, the number of insulation points. It will be noted that in this form of circuit-breaker there are only three such points: namely, the two leads and the wooden rod. The rod being of moderate cross-section, can be easily and thoroughly dried and impreg-

nated, and it will function in oil at all times, so that its factor of safety is large.

The condenser type of lead used is claimed to be probably the greatest advance in high-tension work that has been made for some time. The problem of carrying a high-tension conductor through a grounded surface has been one of the limiting factors in developing higher voltages. Due to the fact that it was impossible to maintain the same stresses in all layers of insulating material, on account of the unequal distribution of potential in

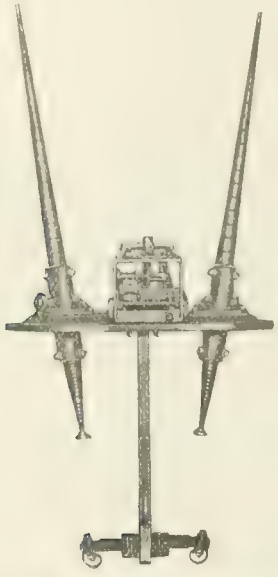


FIG. 1.—60,000 VOLT OIL CIRCUIT-BREAKER, OPEN.

them, excessive amounts of insulation were required to secure safety. It was even found necessary to remove all grounded material from the neighborhood of the conductor, and various further makeshifts have been used, such as oil-filled terminals, double or triple porcelains, and excessive amounts of varnished cloth or paper. In the Westinghouse type of breaker for 66,000-volt transmissions, which provides protection for both the Niagara and Southern Power company lines, heavy soapstone

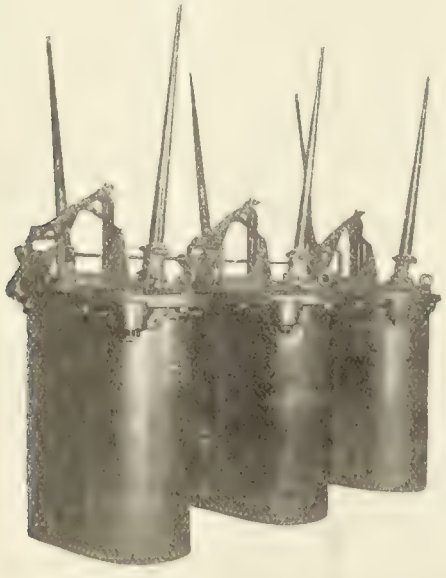


FIG. 2.—60,000-VOLT, THREE-POLE OIL CIRCUIT-BREAKER.

tops, varnished cambric leads, and expensive and cumbersome porcelains were required. The contrast with the new type is surprising. A moderate-sized lead made up of alternate layers of tinfoil and insulation is fastened solidly into cast-iron flanges, and at voltages far in excess of that required to break down former construction, these leads show no static discharge or other evidences of strain.

The development of this condenser lead has been carefully worked out, expensive machinery for producing it having been installed, and every point in connection with its manufacture is stated to be thoroughly covered by patents. That this breaker is appreciated is shown by the fact that the Westinghouse company has supplied, or has orders at the present time, for over 200 single-pole units for 44,000-volt, 66,000-volt and 110,000-volt lines, and has other large orders in immediate prospect.

Linolite Lighting in a Rug Store.

In a large Wabash Avenue rug store, in Chicago, there is an interesting example of linolite tubular lighting applied to the illumination of rugs vertically displayed on a frame with horizontal arms in the manner illustrated. The rugs shown here are domestic rugs. The Oriental rugs are displayed on the floor in the front part of the store under four-light and five-light clusters of 60-watt tungsten lamps on Federal electric fixtures having inverted cones of opalescent glass suspended from the ceiling by chains.

In the rear of the store is a strongly built framework supporting 72 movable arms at a height of about 13 ft. from the floor. These arms are pivoted in a strong metal plate fastened to the principal supporting column of the framework and they



LINOLITE LIGHTING IN A RUG STORE.

are suitably braced to hold up the heavy rugs. From the top of each arm two rugs are suspended, back to back. The capacity of this display device, which is illustrated herewith, is 144 rugs 9 ft. x 12 ft. in size. The arms are revolvable in a half-circle about the central support, and thus the rugs may be shifted for inspection something like the leaves of a book.

To light these vertically displayed rugs there is arranged in a semicircle just above the level of the rugs 20 sections of linolite tubing, each provided with a suitable reflector, as shown in the picture. Each section is provided with a straight, horizontal 16-cp carbon filament; but as the light from every part of the filament is exactly focused by the reflector, it is said that each of the 20 units gives an equivalent of 40 cp. Each section is about 1 ft. long, and the arrangement approximates one long incandescent filament, extending in a half-circle above the rugs, the light being directed just where needed by the reflectors. Mr. Pushman, of Pushman Brothers, who own the rug store, says that this form of rug lighting is very satisfactory. It is interesting to note that the H. W. Johns-Manville Company, which makes "linolite," is experimenting with tungsten filaments in its horizontal tube lamps, and apparently with good chances of success.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Continued improvement has been shown in all branches of trade during the past week. This is largely due to better weather and to the improved condition of crops. At this, the most critical period for crops, the conditions are regarded as eminently satisfactory. Reports from retailers are still irregular, and the excessive heat is credited with retarding trade in some sections. Clearance sales are being used all over the West in order to stimulate distribution. The jobbers and wholesalers report a slight improvement in reorders, and numerous inquiries for next fall and spring delivery. The industrial business, led by iron and steel, continues to show expansion of operation, and in many places advances in wages. More men are being employed in almost every line, and there is great confidence for the future. The noteworthy feature of the week was the purchase of 135,000 tons of steel rails by the Harriman system; 80,000 tons of this went to mills in the Chicago district. The railways are in the market for cars and liberal orders are expected in the near future. Building continues to be active almost all over the country, but is still largely of the steel and concrete type. Railway earnings show large improvements over those of last year and rolling stock is now fairly well employed on all sides. Collections continue to be only fair, but there is little pressure being exerted by creditors. Business failures for the week ended June 24 were 225, against 213 for the previous week, 258 in the same week of 1908, 150 in 1907, 146 in 1906 and 186 in 1905.

THE COPPER MARKET.

There has been considerable speculative buying of copper during the past week and some takings by domestic consumers. About 10,000,000 lb. was taken within a few days, resulting in a slight advance in electrolytic and casting grades. Carefully prepared statistics show that there came to light in this country from Jan. 1 to June 1 marketable copper to the amount of 687,182,382 lb., which includes the stock on hand at the beginning of the year. Deliveries during that time were 517,334,241 lb., leaving stocks June 1 at 169,384,141 lb., an increase in the five months of 47,490,875 lb. In addition to this it is very well known that the takings by Europe have vastly exceeded the consumption and that the warehouses of both England and the Continent are loaded down. The purchases in the United States are also believed to be far in excess of the actual consumption, indicating heavy accumulations for future business. For instance, domestic takings in May were 61,300,000 lb., considerably more than was ever used in one month at the highest period of business boom. These figures do not indicate any material advance in prices. Exports continue to be very heavy, being for the month of June, up to and including June 28, 31,975 tons. Quotations on the Metal Exchange on the same date were:

Lake	13¼ @ 13½
Electrolytic	13 @ 13⅛
Casting	12¾ @ 13

The London prices June 28 were as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	58 17 6	59 2 6
Standard copper, futures	59 15 0	60 0 0
Market	Weak	Steady
Sales of spot		200 tons
Sales of futures		1,800 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	.....	.....
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

MILWAUKEE WESTERN ELECTRIC RAILWAY.—The preliminary work of the new Milwaukee Western Electric Railway Company has now proceeded so far that a brief statement of the objects of the enterprise can be made. The company has its headquarters in Milwaukee with an office in the Majestic Building. Its president is Val. Zimmerman, Jr., who is also president of the Mitchell Street Bank of Milwaukee. The engineer retained by the company is C. A. Chapman, Inc., 204 Dearborn Street, Chicago. An electric railway will be built in a general northwestern direction from Milwaukee to Beaver Dam, Wis., having a total length of main line and branch of 68 miles. It will pass through the villages and towns of Butler, Templeton, Sussex, Merton, North Lake, Alderly, Neosho, Hustisford and Juneau. Connecting with the main line at Sussex there will be a branch extending in a southern direction through Pewaukee to Waukesha. The surveys for the line are just being completed, and construction will probably be begun within the next three months. The general engineering characteristics, such as overhead or third-rail construction, kind and voltage of current to be used, are now under consideration. A general contract for the construction of this railway has been awarded to the Chapman Company, of Chicago.

McGRAW-HILL BOOK COMPANY.—The book departments of the McGraw Publishing Company and the Hill Publishing Company have consolidated under the corporate name of the McGraw-Hill Book Company, with offices after July 1 at 239 West Thirty-ninth Street, New York. This consolidation brings together two of the most active publishers of technical books in the country. The new company takes over the book departments of both houses with a list of about 250 titles, both industrial and college text books, covering all lines of engineering. It will continue as well the retail, importing and jobbing business of the two houses. The officers of the new company are as follows: President, John A. Hill; vice-president, James H. McGraw; treasurer, Edward Caldwell; secretary, Martin M. Foss. Mr. Hill is head of the Hill Publishing Company, which controls the *American Machinist, Engineering and Mining Journal, Power and the Engineer.* Mr. McGraw is head of the McGraw Publishing Company, which issues the *Electrical World, Electric Railway Journal* and *Engineering Record.* Mr. Caldwell has been manager of the McGraw book department for several years and Mr. Foss manager of the Hill book department.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in the present issue are announcements of proposed new plants or considerable extensions of present plants at Waterbury, Conn.; Methow, Wash.; Brazil, Ind.; McKurtain, Okla.; Denver, Col.; Fulton, N. Y.; Orange, N. J.; Post Falls, Idaho; Madisonville, Ky.; Spring Valley, Ill.; Franklinville, N. Y.; Lowell, Mass.; Binghamton, Tenn.; Antigo, Wis.; Seymour, Ia.; Zionsville, Ind.; Des Moines, Ia.; Hyrum, Utah; Toronto, Ont., Can.; Kenosha, Wis.; Valley View, Ky.; Columbus, Ga.; Hawkinsville, Ga.; Lone Wolf, Okla.; Sinton, Tex.; Bartlesville, Okla.; Brookneal, Va.; Camp Hill, Va.; Crosbyton, Tex.; Quincy, Fla.; McMinnville, Ore.; Middletown, Conn.; Glendale, Cal.; Benson, Ariz.; Kankakee, Ill.; Jacksonville, Fla., and Philadelphia, Pa.

BUFFALO ELECTRIC PUMPS.—Owing to trouble with the third electric pump equipment for the Buffalo water works, which has extended over some months, two steam pumps have been ordered for further extension of the pumping service. The trouble has been entirely due to various defects in the design and construction of the centrifugal pump part of the unit, but as the frequent notices in the newspapers as to deficiencies always referred to the "electric pump," electric pumping service as a whole has locally lost in confidence.

GERMAN ELECTRICAL ENTERPRISE IN CHINA.—A consular report from China speaks of the activity of a German in Berlin in a campaign for selling central station plants in China. The firm has opened branches in a number of Chinese cities where sample plants, lines of electrical supplies, etc., are kept. Plants recently installed are as follows: At Kirin, two 165-kw, 5000-volt, direct-connected, three-phase units; at Soochow, two 175-kw, 2200-volt, direct-connected, three-phase units; at Mukden, a 350-kw unit.

INTERBOROUGH MAKES LARGE EQUIPMENT CONTRACTS.—The Interborough Rapid Transit Company, New York, has placed its contracts for the equipment of the 350 new cars which were ordered some weeks ago. It has contracted with the General Electric Company for 380 200-hp motors for the equipment of 190 new steel cars for the subway, and also for 190 equipments of control for the same cars. In addition, the General Electric Company will supply 40 equipments of control for elevated motor cars, 60 trailer equipments for the subway and 40 trailer equipments for the elevated. The Interborough company also bought from the Westinghouse Electric & Manufacturing Company 120 125-hp motors for the equipment of 60 elevated cars, and 20 equipments of control for these cars. The steel cars are being made by the American Car & Foundry Company, Standard Steel Car Company and the Pressed Steel Car Company. The wooden trailer cars for the elevated are being built by the St. Louis Car Company and the Wasson Manufacturing Company. The motor cars for the elevated are divided, 20 to the Jewett Car Company, of Newark, Ohio, and 40 to the Barney & Smith Car Company, Dayton, Ohio. In addition to these purchases for car equipments, the Interborough has contracted with the Westinghouse Electric & Manufacturing Company for the building of two 3000-kw, three-phase rotary converters, and six 1100 kv-amp, single-phase transformers. It is stated that one of these sets is for substation No. 6, and the other for substation No. 7. The steel cars, which will be of the side-door pattern, ordered by the Public Service Commission, will be delivered, about one-half during the fall and the balance next spring. The trailers and elevated cars will be delivered in September. This total order for car equipments is one of the largest recently placed, and altogether will amount to something like a million dollars, of which the General Electric will receive 75 or 80 per cent.

BUSINESS OF THE ELECTRICAL COMPANIES.—A review of the business now being done by the General Electric Company and the Westinghouse Electric & Manufacturing Company, made by a New York financial paper, estimates that in 1909 the former will do a business of about $53,000,000, and the latter a business of about $25,000,000. Speaking of the present condition of these companies, the review says: "The General Electric and Westinghouse companies are now well fortified from the standpoint of working capital, and they can engage in large enterprises without assistance from banking institutions. As an illustration, the General Electric Company on Jan. 31, last reported cash holdings of $22,234,000, which is almost twice the amount held the year previous. The company has a working capital of approximately $57,000,000. The Westinghouse Electric & Manufacturing Company, as a result of the reorganization, is stronger from the standpoint of cash and working assets than at any time in its history. It recently reported cash holdings of close to $13,000,000." The General Electric Company, it is stated, now has a floor space of 7,000,000 sq. ft., and employs 23,000 hands.

CUTLER-HAMMER BUYS SCHUREMAN COMPANY.—An official announcement has been made by the Cutler-Hammer Manufacturing Company, of Milwaukee, that it has purchased the plant, business and patents of the J. L. Schureman Company, of Chicago. The latter concern manufactured the Schureman controlling apparatus and other electrical appliances. The manufacture of this apparatus will be continued, and all agreements and contracts will be carried out by the purchasers. It is also announced that S. M. McFedries, who has been general manager of the Schureman Company, has been retained by the Cutler-Hammer Company, and will remain in active charge of the manufacture and sale of Schureman apparatus. J. L. Schureman retires from the business. Until further notice the Schureman Company will retain its old address, 70 West Jackson Boulevard, Chicago.

NEW WESTERN CONSTRUCTION CONCERN.—The Chapman Company, of 204 Dearborn Street, Chicago, has been incorporated recently to make investigations and reports and to design and construct steam railways, electric railways, public service systems, private industrial plants and the like. The officers of this new company are: President, W. D. Chapman; vice-president, H. W. Davis; secretary and treasurer, J. H. Adams. The Chapman Company has entered into a contract with C. A. Chapman, Inc., by which the latter concern will do all of the engineering for the former. The two corporations are not further related, however, although W. D. Chapman, the president of the Chapman Company, is the father of Charles A. Chapman, president of C. A. Chapman, Inc. The Chapman Company has in hand the construction of a steam railroad in Mexico and a new electric interurban line in Wisconsin.

ELECTRICAL SUPPLIES FOR ISTHMIAN CANAL COMMISSION.—The general purchasing officer for the Isthmian Canal Commission invites sealed proposals in triplicate for a quantity of electrical supplies to be furnished by steamer free of all charges on the dock at either Colon or Port of Ancon, Isthmus of Panama. There are 59 items of lighting material to be used for the berm and chamber cranes, Pedro Miguel and Miraflores locks and Ancon crushing plant, embracing loricated conduit, fittings, wiring and accessories. Lightning arrester equipment and cable are required at the Pedro Miguel substation and railway material to be used for third rail and feeders at Pedro Miguel and Miraflores for the berm and chamber cranes. Bids must be received not later than 2.30 p. m. on July 6 at the office of the commission in Washington.

SUITS AGAINST CONDUIT COMPANIES.—Francis K. Pendleton, corporation counsel for the city of New York, has filed suits in the Supreme Court against the Consolidated Telegraph & Electrical Subway Company and the Empire City Subway Company for the recovery of $4,348,686, which he alleges the city has been defrauded out of by means of false accounts and reports. He also demands a detailed accounting to show the actual cost of the subway, for which the city paid $12,388,519. The two companies recently entered a claim against the city for $8,000,000 alleging that this sum represented the loss sustained in the operation of the subways since 1899. It was this claim which caused the city's attorney to start an investigation the result of which is the present suit.

HUDSON TUNNELS TO OPEN JULY 19.—W. G. McAdoo, president of the Hudson & Manhattan Railroad Company, has announced that the downtown tunnels, which run from the Hudson Terminal Building, in Manhattan, to the Pennsylvania Railroad station, at Jersey City, will be opened at 3 o'clock on the afternoon of July 19. An elaborate celebration will be held in Jersey City at this time. The entire tunnel system, which extends from the Pennsylvania station north to the Erie and Lackawanna stations, joining the uptown tunnel, will be, it is said, ready for operation on July 19, but the inability to secure sufficient cars from the builders will delay the opening of this branch until August 2.

ELECTRICAL PROMOTION IN TURKEY.—The Department of Commerce and Labor has received information from the consul at Brunswick that a German-French combination has recently been formed for the purpose of promoting electrical enterprises in Turkey. A number of French, German, Belgian and Swiss banks have joined the combine, and it is said that the syndicate is under the leadership of the Deutsche Bank of Berlin. This institution is closely allied with the Siemens-Schuckert Company.

BUSINESS REVIVAL IN THE WEST.—Reports from Chicago say that buyers of electrical apparatus are not only talking in a more encouraging way, but they are actually making purchases of machinery and supplies in considerable quantities. One indication of the truth of this statement is the fact that, during the month of June, 11 turbo-generator sets of good size were sold by the Chicago offices of the Westinghouse Electric & Manufacturing Company and the Westinghouse Machine Company.

HARVARD STADIUM "JOAN OF ARC" ELECTRICAL INSTALLATION.—The electrical apparatus used in the remarkable production of "Joan of Arc" in the Harvard Stadium, an account of which was printed in these pages last week, was supplied by the Rossiter-MacGovern Company, New York.

WESTCHESTER LIGHTING MERGER APPROVED.—The Public Service Commission of the Second District of New York has granted permission to the Westchester Lighting Company to purchase the entire $804,000 capital stock of the Northern Westchester Lighting Company, and the $90,000 par value of its first consolidated mortgage bonds at a price not to exceed $81,000, and also to purchase the $500,000 of common stock of the Peekskill Lighting & Railroad Company, and 750 shares of the company's 6 per cent cumulative preferred stock at a price not to exceed $75,000. The commission says in its opinion that the turning of the control of these properties over to the Westchester Lighting Company will result in su-

perior facilities, in that the plant of one company will thereby become serviceable to the other company, and that the demand for increased service in the territories supplied by these companies may more readily be met. The Westchester Company is also authorized to issue first collateral trust bonds to the par value of $580,000, to mature in 10 years, bearing 5 per cent, and the proceeds of these bonds are to be used in acquiring the stock issues.

Financial Intelligence.

THE WEEK IN WALL STREET.

At the beginning of last week there was a rather sharp bear attack made upon stocks in Wall Street, which was the culmination of a downward market which had lasted for a fortnight. From a practical point of view the attack was a failure, and its most prominent result was that it brought out strong support which gave the market an important upward tendency, and accentuated the buoyant feeling that had existed throughout the spring and early summer. Trading, while not very heavy, was always with the advantage on the buying side, and the result is that during the week there have been marked recoveries in all of the important and active issues. Such depressing rumors as the bears could command; Harriman's ill health, the corporation tax and our old friend "crop damage," had practically no effect on general market conditions. There is a disposition to buy stocks, both by professional traders, and, more cautiously, by outsiders. The amount of stock for sale is apparently limited, and under such circumstances any continued depression is impossible. It is not often that the stock market is as strong in tone and as persistently elastic at this season of the year as it is to-day. The demand for bonds continues to be one of the remarkable features of the financial world. There seems to be no end to the amount of money that is ready to be invested in good securities, and all issues are eagerly sought by underwriting syndicates and financial houses. Good industrial and railway securities are being oversubscribed at prices that will net the purchasers barely 5 per cent, and this in reality is the most substantial feature of the entire security situation. Money continues to be remarkably cheap, and, in spite of exports of gold, very plenty. Quotations June 28 were: call 1¾ @ 2 per cent, 90-day 2¼ @ 2¾ per cent. The quotations in the table are those of the close June 28.

NEW YORK.

	June 28.	July 5.	Shares Sold.		June 28.	July 5.	Shares Sold.
All.-Ch.	15¼	15¼*	600	Int.-Met., pfd.	44⅝	52	110,050
All. Ch., pfd..	51⅞*	51½	1,800	Mackay Cos..	79½	81*	2,650
Amal. Cop....	78¼	81	131,270	M'c'ky Cos., p.	74*	74½*	———
Am. D. T....	29*	29*	———	Man. Elev.....	143	143⅞*	225
Am. Loc.....	58⅛	59¼	10,310	Met. St. Ry..	25	25⅜*	762
Am. Loc. Pfd.	117¾*	117¾*	120	N.Y.&N.J. Tel.	129	137*	300
Am. Tel.&Chl.	80*	80*	———	Steel, com....	64¼	66¾	319,676
Am. T. & T..	140⅛	142	14,750	Steel, pfd.....	121	124⅜	28,625
B. R. T.....	77¼	76⅝	26,190	W. U. T.....	72⅝	72	8,600
Gen. Elec....	160	161½*	3,200	West'h, com...	83	85	5,111
Int.-Met., com.	17¼	17	44,050	West'h pfd...	121*	121*	———

PHILADELPHIA.

	June 28.	July 5.	Shares Sold.		June 28.	July 5.	Shares Sold.
Am Rys....	45¾*	45¾*	———	Phila Elec...	11⅜*	11¾	———
Elec. Co. of A.	12⅜*	12⅜*	———	Phila. R. T...	28⅜	28	———
Elec. St. B'ty.	53*	52⅜*	———	Phila. Trac...	91*	91*	———
E. S. B'ty. pfd.	49*	49*	———	Union Trac...	52	52⅛	———

CHICAGO.

	June 28.	July 5.	Shares Sold.		June 28.	July 5.	Shares Sold.
Chi City Ry..	180*	180*	———	Chi. Tel. Co...	132½*	134*	———
Chi. Rs., Ser.1.	107*	107*	———	Met. El., com.	19*	17½*	———
Chi. Rs.,Ser.2.	36½*	37⅜	———	Met. El., pfd.	54*	56*	———
Com. Edison...	118	119½	———	Nat'l Carbon..	93*	92	———
Chi. Sub'ws...	24¼*	24*	———	Nat'l C., pfd..	118*	117*	———

BOSTON.

	June 28.	July 5.	Shares Sold.		June 28.	July 5.	Shares Sold.
Am. T. & T..	140¾	142⅛	———	Mex. Tel..	2½	2¾*	———
Cum. Tel....	133½	133½*	———	Mex. Tel., pfd.	6*	6*	———
Edison E. Ill..	249	248	———	N. E. Tel....	132	133½	———
Gen. Elec....	160	161	———	W. T. & T....	10*	10½	———
Mass. E. Ry..	12	13	———	W. T. & T., p.	85*	86	———
Mass. E. R., p.	67½	69½	———				

*Last price quoted.
Shares sold are for week June 21 to June 26.

DIVIDENDS.

Bell Telephone Company of Missouri, quarterly, 2 per cent, payable July 1.

Boston Suburban Electric Company, preferred, quarterly, 75 cents per share, payable July 15.

Central & South American Telegraph Company, quarterly, 1½ per cent, payable July 9.

Central District & Printing Company, quarterly, 2 per cent, payable July 31.

Chelsea (Mass.) Gas Light Company, quarterly, 2½ per cent, payable June 30.

Consolidated Traction Company of New Jersey, semi-annual, 2 per cent, payable July 15.

Electric Light & Power Company of Abington and Rockland, semi-annual, $4 per share, payable July 1.

Indianapolis Traction & Terminal Company, 1 per cent, payable June 30.

Knoxville (Tenn.) Railway & Light Company, quarterly, preferred 1½ per cent, common 1 per cent, and extra 1 per cent, all payable June 30.

Little Rock Railway & Lighting Company, common, semi-annual, 2½ per cent, extra 1½ per cent, preferred, semi-annual, 3 per cent, all payable June 30.

Massachusetts Lighting Companies, quarterly, 1½ per cent, extra, ¼ per cent, payable July 15.

Mexican Light & Power Company, 1 per cent, payable July 15.

Mexican Telegraph Company, quarterly, 2½ per cent, payable July 15.

National Light, Heat & Power Company, quarterly, 1¼ per cent, payable July 1.

New York & New Jersey Telephone Company, quarterly, 1¾ per cent, payable July 15.

Puget Sound Electric Railway, preferred, semi-annual, 3 per cent, payable July 1.

Seattle Electric Company, common, 3 per cent, payable July 15.

United Railways Company of St. Louis, preferred, quarterly, 1¼ per cent, payable July 10.

United States Smelting & Refining Company, quarterly, preferred 1¾ per cent, common 1 per cent, both payable July 15.

Washington, Alexandria & Mt. Vernon Railway Company, 1 per cent, payable July 1.

Wheeling (W. Va.) Traction Company, 1 per cent, payable July 15.

THIRD AVENUE REORGANIZATION PLAN ANNOUNCED.—The reorganization plan formulated by the bondholders' committee representing $37,560,000 first mortgage bonds of the Third Avenue Railroad Company has been submitted to the Public Service Commission for its approval. The plan involves the purchase of the property by a new company at the foreclosure sale in September. New securities are to be issued to the old stock and bondholders, and at the same time $7,500,000 of new money is to be put into the company. It is proposed to issue immediately $16,516,800 of refunding mortgage bonds, $32,000,000 of adjustment mortgage 5 per cent cumulative bonds and $20,000,000 of stock. The old stockholders are to be assessed $25 a share. The refunding bonds are to be redeemable at $105 and accrued interest after July 1, 1914; $5,000,000 of these bonds are to be taken by an underwriting syndicate and $10,516,800 are to be issued to the holders of the present consolidated bonds, this being 8 per cent for unpaid interest and 20 per cent on account of principal; $11,445,000 shall be reserved to take up the underlying bonds, and $1,000,000 are to be used at once to provide for necessary extensions. In addition, $12,038,200 of bonds are to be reserved to make future extensions and improvements under restrictions that are to be defined in the mortgage. These are to be issued with the approval of the Public Service Commission. The adjustment bonds, which are cumulative, shall be entitled to elect the majority of the directors until the full interest, including accumulations has been received for five consecutive years. Of these bonds $30,048,000 are to be issued to the holders of the present consolidated bonds, being 80 per cent of the principal. The present stockholders are to receive upon the payment of $25 per share 125 per cent of their present holdings in the stock of the new company. It is estimated that this plan of reorganization will give the road the necessary capital to take up the receiver's certificates, and make the improvements that are deemed advisable. In submitting the plan the committee points out the fact that twice within a generation the development of street railways has necessitated the entire reconstruction of the Third Avenue Railroad, first by the installation of the cable system and, second, by electrification, and intimates that progress may possibly hereafter demand further reconstruction. The committee is composed of James N. Wallace, Adrian Iselin, Edmund D. Randolph, Mortimer L. Schiff, James Timpson and Harry Bronner.

OPPOSITION TO McCALL FERRY PLANS.—Some of the bondholders of the McCall Ferry Power Company have issued a circular through Sanderson & Porter protesting against the plan for the reorganization of the company which has been suggested by a committee composed of William M. Barnum, A. C. Bedford, S. Reading Bertron, Charles A. Coffin and Gardiner M. Lane. The plan of reorganization was detailed in our issue of June 17. The bondholders' circular claims that in order for the old bondholders to come out even under the plan it will be necessary for the new common stock to sell at par, in which event those who put up the new money would realize a profit of more than 100 per cent. The dissenters believe that it is possible to form a syndicate to take a small issue of first mortgage bonds on the property, enough to complete the work, if the old bondholders will accept par in new preferred stock with a division of the common stock between the present bondholders and the syndicate which would take the new bonds.

CALIFORNIA LIGHTING CONSOLIDATION.—Articles of incorporation have been filed at Los Angeles for the incorporation of a gas and electric company with $30,000,000 stock, which, it is claimed, is designed to control the lighting situation in Southern California. It is to be known as the Los Angeles Gas & Electric Corporation and will succeed to the property of the Los Angeles Gas & Electric Company. Walter B. Cline, president of the latter company, is the promoter of the new consolidation. At the office of N. W. Harris & Company, the fiscal agent of the Edison Electric Company in Los Angeles, it was claimed that the new corporation had nothing to do with the California properties in which the Harris firm is interested.

CHICAGO ELEVATED MERGER RENEWED.—The stockholders of the South Side Elevated Railroad of Chicago, representing a number of large holdings, are taking steps to bring about a renewal of the negotiations with the committee representing the proposed Central Terminal Company, which sought to lease the property on a guaranteed basis of yearly rentals, but failed to agree upon terms. Overtures have been made to the Illinois Trust and Savings Bank, and to the trustees of the Marshall Field estate, large holders of South Side Elevated stock, and it is hoped that through these influences a renewal of the negotiations may be brought about.

WESTERN UNION CONTROL RUMORS.—Again a rumor is abroad in financial circles that the American Telephone & Telegraph Company has secured control of the Western Union Telegraph Company. This time the story comes from Philadelphia and is given out with a considerable wealth of detail. The officials of the Western Union in this city when questioned about the matter declared that they have never heard, except in the form of rumors, of any such change of ownership. President T. N. Vail, of the American Telephone & Telegraph Company, states there is no truth in the rumor.

COPPER CONSOLIDATION IN PROSPECT.—Adolph Lewisohn was last week elected a director in the British Columbia Copper Company. It has been known for some time that Mr. Lewisohn has been acquiring a considerable interest in these mining properties. The company hopes soon to put in operation its plant, and expects to have an output of 2000 tons of ore daily. It is claimed that copper can be produced at 8 cents per pound. In this connection rumors have been circulated that a consolidation between this company and the Dominion Copper Company is not improbable.

INDEPENDENT TELEPHONES IN PENNSYLVANIA.—On July 7 application will be made at Harrisburg for a charter for the National Telephone & Telegraph Company. This charter is asked by Charles E. Wilson, general manager, and Clarence L. Harper, a director in the Keystone Telephone Company. Frank R. Shattuck, who represents independent interests in St. Louis, is also connected with the new company. It is claimed that this is one step in a plan for joining independent telephone companies into a big connected system throughout the Middle West.

AMERICAN LIGHT & TRACTION COMPANY.—The executive committee of the American Light & Traction Company has voted to recommend to the board of directors that at the July meeting the regular quarterly dividend of 1½ per cent on the preferred stock and 2 per cent on the common stock be declared, and also an extra cash dividend of 1 per cent on the common stock; and an extra 10 per cent stock dividend on the same issue. All the cash dividends will be paid on Aug. 1, while the stock dividend will probably be disbursed Sept. 1.

DETROIT EDISON ON THE STOCK EXCHANGE.—Application has been made on the New York stock exchange to list $7,979,000 of 5 per cent first mortgage bonds of the Detroit Edison Company, also $5,000,000 of capital stock already issued and $1,000,000 of stock to be issued in exchange for convertible bonds. The application states that the stock is distributed among 200 holders, and that there is no controlling interest of syndicate or otherwise.

WILMINGTON (DEL.) GAS & ELECTRICITY COMPANY.—Charles H. Dawes, of Chicago, ex-Comptroller of Currency, is at the head of a syndicate which has purchased the Wilmington Gas & Electricity Company from John and James Dobson, Philadelphia. The price paid for the property was $1,325,000. The company has a monopoly in the district it serves.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Telephone & Telegraph Company:					
May, 1909	$2,307,259	$213,176	$2,184,083	$546,667	$1,637,415
May, 1908	1,807,528	151,066	1,656,461	647,501	1,008,960
Chicago Railways Company:					
April, 1909	997,348	665,258	332,090	171,522	127,682
Copper Range Railroad Company:					
March, 1909	62,080	39,622	22,458	12,937	9,521
March, 1908	56,666	40,863	15,803	12,837	2,966
Cumberland Telephone & Telegraph Company:					
May, 1909	524,954	297,454	227,500	41,110	186,390
May, 1908	503,358	292,790	210,568	36,107	174,461
Cumberland Telephone & Telegraph Company:					
May, 1909	524,954	297,454	227,500	41,110	186,390
May, 1908	503,358	292,970	210,568	36,107	174,461
Fairmont & Clarksburg (W. Va.) Traction Company:					
April, 1909	31,296	12,643	22,251	1,892	20,358
April, 1908	29,272	10,850	20,362	1,069	19,293
Hudson & Manhattan Railroad Company:					
Quarter ended March 31, 1909	202,466	123,012	79,454	.....	.....
Lexington (Ky.) Interurban Railways Company:					
April, 1909	45,507	35,255	10,251	.....	.....
April, 1908	44,801	32,456	12,345	.....	.....
Minneapolis General Electric Company:					
April, 1909	84,450	39,901	44,548	30,098	14,450
April, 1908	76,475	34,475	42,548	30,098	10,927
Northern Ohio Traction & Light Company:					
May, 1909	188,749	103,832	84,917	43,809	41,107
May, 1908	158,400	94,878	63,531	44,154	19,377
Puget Sound Electric Railway Company:					
April, 1909	147,943	108,249	39,694	42,093	*2,399
April, 1908	132,490	84,064	48,426	38,883	9,543
Sao Paulo (Brazil) Tramway Light & Power Company:					
Year, 1908	2,287,411	783,051	1,504,360	365,468	1,138,892
Year, 1907	2,111,523	715,650	1,395,873	359,422	1,036,451
Seattle Electric Company:					
April, 1909	422,128	261,842	160,285	92,629	67,656
April, 1908	350,089	212,484	143,604	77,380	66,223
Toledo Railways & Light Company:					
May, 1909	212,845	126,611	86,224	70,871	15,673
May, 1908	198,978	109,444	89,529	71,719	17,891
United Railways Company of St. Louis:					
May, 1909	975,544	597,240	378,304	232,792	145,512
May, 1908	920,765	591,543	329,222	232,278	96,944

*Deficit.

GENERAL NEWS

Construction News.

CAMP HILL, ALA.—Edgar B. Kay, of the engineering department of the University of Alabama, University, Ala., has been engaged to prepare plans for the proposed municipal electric light plant, for which $10,000 in bonds was recently voted. Power for the plant will be secured from a hydro-electric plant on Sandy Creek or from Dadeville, Ala.

UNIONTOWN, ALA.—Edgar B. Kay, of University of Alabama, University, Ala., has been engaged to prepare plans for rebuilding the electric light and water station.

BENSON, ARIZ.—Plans are being considered by the Benson Water Company for extending its water service and also for the installation of an electric light plant in the near future.

PHOENIX, ARIZ.—A compromise has been entered into between the Pacific Gas & Electric Company and the parties interested in the proposed new company whereby the franchise for a competing gas and electric company will not be asked for at least six months after Aug. 1. The Pacific Gas & Electric Company has announced a reduction in its schedule of rates to take effect from Aug. 1, under which all consumers will receive a substantial reduction. Under the new schedule, the minimum charge will be $1, instead of $1.50, the present minimum rate for both electric and gas service. The maximum rate for electricity is 15 cents per kw-hour, with 10 per cent discount on all bills paid by the tenth of the month. For commercial lighting a net rate of 10 cents per kw-hour is made. The charge for gas is $2 per 1000 cu. ft., with a discount of 10 per cent for prompt payment.

MANSFIELD, ARK.—The City Council has granted the Boothe Telephone Company permission to erect and operate a telephone system in Mansfield.

BEAUMONT, CAL.—A pipe line is being constructed in connection with the system which will connect the Beaumont Land & Water Company's shaft with the lower pumping shaft and enable the company to generate electrical power to the amount of 260 hp. The plant will furnish electricity to operate the lower and upper pumping plants, and also for lighting La Mesa Mira Valley, and for lamps and motors in Beaumont.

BERKELEY, CAL.—The Southern Pacific Railroad Company has decided to equip its railway on Shattuck Avenue to be operated by electricity instead of steam power. The board of trustees has granted the company permission to make the change.

GLENDALE, CAL.—The citizens on June 22 voted to issue $60,000 in bonds, the proceeds to be used for the construction of a new municipal electric light plant.

MONTEREY, CAL.—We are informed that the Monterey & Del Monte Railway Company, which proposes to construct an electric railway to connect Monterey and Seaside, five miles in length, will commence work on the proposed railway about July 15. The company will do its own construction work with the exception of the bridge, 200 ft. long, across Lake Del Ray. Materials for the road are now being purchased. The company is capitalized at $100,000. H. R. O'Bryan, of Monterey, is president.

OROVILLE, CAL.—It is reported that the Messilla Valley Gold Gravel Mining Company has decided to remodel its prospecting tunnel into a full-size timbered one. Plans are being prepared for electrical equipment. J. W. Coffin is president of the company.

ROSEVILLE, CAL.—Extensive improvements are being made at the California Granite Works, which will include the installation of electric travelers and other apparatus.

SAN BENITO, CAL.—The Town Board of San Juan has accepted the bid of the San Benito Light & Power Company for a franchise through the town. The amount paid for the franchise was $50.

SAN FRANCISCO, CAL.—At a special election held June 24 the citizens voted against the municipal street railway proposition. It was proposed to issue bonds to the amount of $1,950,000 for the reconstruction of the Geary Street railway, the plan being to replace the old cable system by an underground electric conduit system.

SAN FRANCISCO, CAL.—It is reported that the United Railroads Company has agreed to construct a railway on Cortland Avenue and through the Bernal Heights District from Mission to Folsom streets as soon as the subscriptions amounting to $5,000 have been deposited in a bank. The new line will be about one mile in length and will cost about $28,000.

SAN FRANCISCO, CAL.—It is reported that the San Francisco Gas & Electric Company and the Spring Valley Water Company will ask the United States circuit court for an injunction restraining the Supervisors from enforcing the rates adopted for the coming fiscal year, which will become operative July 1. It is said that the telephone company will not oppose the reduction in rates ordered by the city authorities.

SANTA ANA, CAL.—The franchise applied for by the Santa Ana Valley Irrigation Company for the erection of transmission lines through the Santa Ana Canyon has been ordered to be sold July 15 to the highest bidder.

DENVER, COL.—It is reported that the Denver Gas & Electric Company will rebuild the generating plant, recently damaged by an explosion. Frank W. Frueauff is vice-president and general manager.

MIDDLETOWN, CONN.—The Middletown Electric Light Company is installing a new 250-hp boiler in its plant on Court Street.

STONINGTON, CONN.—At a special meeting held June 14 the citizens voted to authorize the warden and burgesses to enter into a contract with the Mystic Power Company for street lighting for a term of ten years at the rate of $15 per lamp per year, which is the same price paid under the present contract.

WATERBURY, CONN.—It is reported that the Connecticut Company has appropriated $500,000 for the construction of a large power plant in Waterbury, which will be located near the present substation. It is said that the plant will supply electrical energy for the New Haven, Waterbury and Bridgeport lines. David B. Neth is superintendent of the local electrical department.

WASHINGTON, D. C.—The superintendent of U. S. Capitol building and grounds will soon call for bids to be opened July 10 for installing an electric clock system in the U. S. Senate office building, which will consist of one master clock and 275 secondary clocks.

WASHINGTON, D. C.—Bids will be received until July 13 by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing the following supplies: Mare Island, Cal., Schedule 1363—1250 dry battery cells. Mare Island, Cal., or Brooklyn, N. Y., Schedule 1364—39 watertight annunciators, 6000 carbons for arc lamps, 3750 searchlight carbons, 350 lb. magnet wire, 25,000 ft. silicon bronze wire, 25,000 ft. single conductor wire, micanite plate, etc. Schedule 1365—4500 lb. seamless drawn copper wire. Washington, D. C., Schedule 1373—remodeling 110-ton electric traveling crane.

WASHINGTON, D. C.—Bids will be received until July 6 at the Bureau of Supplies and Accounts, Washington, D. C., for furnishing the following supplies: Mare Island, Cal., Schedule 2—Combination ferrules, cast-iron tees and elbows; automatic continuous draining steam traps, etc.; standard brass globe valves and brass nickel-plated, rough body valves; one 144-gal. electric weld coil boiler and a storage tank. Brooklyn, N. Y., Schedule 3—Double-braided, rubber-covered wire, four propeller fans. Schedule 4—Asbestos magnesia pipe covering, etc. Schedule 4—1500 ft. magnesia sectional pipe covering; 12,200 lb. metal lath and galvanized staples. Annapolis, Md.—Schedule 1372—Four water-tube boilers.

JACKSONVILLE, FLA.—Plans are being considered for extending the municipal street lighting system by the installation of 100 or more magnetite arc lamps. R. N. Ellis is superintendent.

QUINCY, FLA.—Plans are being made for extensions to the municipal electric light plant, which will involve an expenditure of about $9,000.

ATLANTA, GA.—The Piedmont Power Company has applied to the County Commissioners for a franchise to erect its high-tension transmission lines along the county roads which lead into Atlanta. The company proposes to supply electricity from its plant at Tallequah Falls in Atlanta. Louis B. Magid is president of the company.

ATLANTA, GA.—The North Georgia Power Company has filed a petition with the City Council asking for an extension of 12 months of its franchise to operate in Atlanta. Steel towers have been built up to the city limits from Gainesville and the company is supplying several large suburban manufacturing plants near this city. It is said that the company would have been in Atlanta before but for the stringent times of the fall, and winter of 1907-1908.

CEDARTOWN, GA.—Beginning with July 1, the municipal electric light plant will establish a day service, which will be maintained until fall, at least. W. T. Hardy is superintendent.

COLUMBUS, GA.—The Columbus Railroad Company has contracted with the Stone & Webster Engineering Corporation for the reconstruction of the City Mills plant to increase the output of the station to 600 kw, 2300-volt, alternating-current and 200 kw, direct current for railway service. The work will include the installation of a new two-phase generator with auxiliaries and replacing two water wheels.

HAWKINSVILLE, GA.—It is reported that J. B. McCrary & Company, of Atlanta, Ga., have been engaged to prepare plans for the proposed municipal electric light plant. It is stated that contracts for construction of plant will be awarded soon.

SAVANNAH, GA.—The Savannah Electric Company has entered into a contract with the Stone & Webster Engineering Corporation, of Boston, Mass., for the installation of a new 1000-kw turbine and auxiliaries in the Indian Street Station.

WAYCROSS, GA.—At an election held June 19 the citizens voted against the proposition to issue $36,000 in bonds to establish a municipal electric light plant. The purchase of the plant of the Waycross Electric Light & Power Company has been under consideration.

GARDEN VALLEY, IDAHO.—The Weston dam on the Payette River, located near Garden Valley, is completed. The dam is owned by the Boston & Idaho Dredging Company, and will be utilized to generate electricity for the placer and quartz mines in the basin, and will also furnish electrical power to operate several dredges owned by the company. The water wheels have been installed and the dynamos are ready to be placed. The plant will have an output of 2000 hp. [illegible] Ingalls is engineer.

POST FALLS, IDAHO.—The Washington Water Power Company, of Spokane, Wash., has purchased all the property of the Cable Milling Company in Post Falls, consisting of a large flouring mill, grain elevators, water power, railroad spurs, and several acres of land adjoining the falls on the bank of the Spokane River. The Washington Water Power Company will enlarge the mill and operate it by electricity. An electric plant has already been installed in the mill to furnish electricity.

HIGHWOOD, ILL.—The Chicago & Milwaukee Electric Railroad Company has recently placed contracts with the General Electric Company, of Schenectady, N. Y., for one 1500-kw, 25-cycle, 600-volt rotary converter, three air-blast 13,200-volt to 430-volt 185-kw transformers, together with the necessary reactive coils, oil switches and switchboard panels.

KANKAKEE, ILL.—The Foley-Williams Manufacturing Company is equipping its factory for electric motor drive. The equipment will include 140 motors, varying from one-quarter to 30 hp. It is said that a saving of 50 per cent will be made in the cost under the new service, the old costing about $6,000 yearly.

KANKAKEE, ILL.—Arrangements are being made by the Kankakee Electric Light Company for the construction of an electric plant with an output of 1000 hp at its dam in this city. The new plant will be operated in conjunction with its present plant, which now develops 1000 hp. Steam power will be used as an auxiliary to the water power plant. The company recently closed a large contract with the Foley-Williams Manufacturing Company to furnish electricity for operating its plant.

PEORIA, ILL.—The Peoria Railway Terminal Company has been granted a 40-year franchise by the City Council to construct a street railway on Washington Street.

PETERSBURG, ILL.—The City Council has granted the Springfield, Beardstown & Quincy Interurban Railway Company a 50-year franchise in Petersburg.

QUINCY, ILL.—We are informed that the Illinois Soldiers' and Sailors' Home, of Quincy, is in the market for equipment for a complete electric lighting plant.

SPRING VALLEY, ILL.—Plans are being considered by the Spring Valley Electric Light Company for rebuilding its entire system and establishing a day service. Charles Robinson is manager.

BATESVILLE, IND.—The American Furniture Company, owner of the local electric plant, is contemplating establishing an electric storage garage in connection with its electric plant. A. W. Romweber is secretary and manager.

BRAZIL, IND.—The Knight-Brinkerhoff Power Company is asking for bids for the construction of three buildings for a steam and electric power plant which the company proposes to install. It is said that plans and specifications will be ready for engines, boilers and generators about July 1. H. B. McMillan is architect.

CRAWFORDSVILLE, IND.—The Home Telephone Company has been reorganized and is now controlled by local citizens. The officers are: Theodore H. Restine, president; D. M. Peck, vice-president; Chas. W. Hymer, secretary, and J. K. Johnson, treasurer. The company is erecting a new exchange and office building and is preparing to install the automatic telephone system throughout the city.

DANVILLE, IND.—E. D. Crawley is erecting a factory building to be equipped with modern machinery for the manufacture of lightning arresters under the Hiatt patent. The device is for use on telephone wires. The plant will be operated by electricity.

EVANSVILLE, IND.—The contract for the lighting of the City of Evansville with gas for the next five years has been awarded to the Evansville Gas & Electric Light Company. A material reduction has been made for electric arc lamps.

HAGERSTOWN, IND.—The City Council has granted a franchise to Messrs. Hancock and McMillan for the construction and operation of a combined water works and electric light plant.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company has paid the city $8,877.27, its annual dues under the company's franchise, which calls for the payment to the city of 5 per cent of its gross earnings.

INDIANAPOLIS, IND.—The Indianapolis Telephone Company has commenced work on improvements to its system, as required by the amended franchise recently granted by the city, which will involve an expenditure of $500,000. The work of rebuilding the entire district north of Fall Creek by changing overhead construction to underground and installing additional cable is under way. The company will next install a new switchboard in the north exchange building, increasing the capacity 1500, and construct and equip a new building on Bevelle Avenue in order to enlarge the eastern division of its system. These improvements will be followed by the completion of the central exchange building, in which new equipment will be installed.

LAFAYETTE, IND.—Bids will be received by A. C. McCord, chairman Board of Trustees State Soldiers' Home, until July 10 for the [illegible] for lighting.

VALPARAISO, IND.—The capital stock of the Valparaiso & Northern Railway Company has been increased to $250,000. The company is planning to construct an interurban railway to connect Valparaiso, Chesterton and Gary. Lewis E. Woodward is secretary.

ZIONSVILLE, IND.—The Zionsville Water & Electric Light Company has recently replaced its 32-cp incandescent lamps with 40-cp tungsten lamps for street lighting. The company is contemplating installing a new high-speed automatic engine to replace the present engine, and equipping its boilers with improved grates and furnaces. As the street lamps are connected to the commercial lighting circuit it is proposed to install Johnston & Johnston cut-offs for independent control of the street lamps. W. H. Pike [illegible]

BEDFORD, IA.—The citizens have voted to grant a lighting franchise to Bedford to Mr. Bair.

DES MOINES, IA.—Contracts have been awarded by the Des Moines Electric Company in connection with its new power plant as follows: For construction of power house, to W. H. Brereton, for $67,000; the Des Moines Bridge & Iron Company, for structural steel, and the Turner Improvement Company, for placing wires underground, for $80,000.

SEYMOUR, IA.—The question of rebuilding the municipal electric plant this year is under consideration. F. Kellogg is superintendent.

WEBSTER CITY, IA.—It is reported that the Fort Dodge, Des Moines & Southern Interurban Railway will equip the creek road to be operated by electricity and extend its lines through Blairsburg, Dows and Clarion.

CHAPMAN, KAN.—The Dickinson County Light & Power Company is contemplating the installation of a 50-hp gasoline engine this fall. M. P. Smith [illegible]

LINDSBORG, KAN.—Plans are being considered for the installation of a new 100-hp engine, a 150-kw alternating-current, 3-phase generator, in the municipal electric light plant. M. H. Blaine is superintendent.

NICKERSON, KAN.—The Town Council is considering the question of installing a municipal electric light plant and water-works system.

WICHITA, KAN.—We are informed that the Wichita Railroad & Light Company is planning to construct about four miles of track. W. R. Morrison is superintendent.

CYNTHIANA, KY.—Bids will be received by W. M. Moore, chairman finance committee, until Aug. 2 for lighting the streets, alleys and other public places for a term of six or ten years beginning April 1, 1910, with 40 or more arc lamps; bids will also be received at the same time for an incandescent-lamp system requiring 90 or more 40-cp lamps under specifications now on file in the office of the city clerk. For further information address W. W. Van Deren.

MADISONVILLE, KY.—Plans are being considered by the managers of the municipal electric light plant for extensions and improvements to the plant, including the installation of a 200-kw generator, an engine and 100-hp boiler. E. B. Robuck [illegible]

NICHOLASVILLE, KY.—The contract for grading the Nicholasville interurban railway has been awarded to J. W. Oliver, of Knoxville, Tenn., for approximately $150,000. The proposed railway will connect Knoxville and Nicholasville.

VALLEY VIEW, KY.—Plans are being made by the Lexington Interurban & Railways Company for the construction of its proposed power plant at Valley View, work on which will soon commence. Electricity generated at the plant will be transmitted to Lexington, Ky., where it will be utilized for the interurban railways and commercial lighting. The cost of the plant is estimated at $250,000. I. L. Oppenheimer is general manager; J. G. White & Company, of New York, N. Y., are engineers and contractors.

UNION BRIDGE, MD.—It is reported that E. A. Buckey is interested in a proposed electric light plant, work on which has already commenced.

LOWELL, MASS.—Mayor George H. Brown has recommended to the City Council a proposition to improve the street lighting system of the main thoroughfares of the city. It is proposed to replace the present arc lamps with cluster lamps, which would involve an expenditure of $25,000 and would cost $6,500 additional a year to maintain, the cost of the installation to be borne by the Lowell Electric Light Corporation, which it is said the company is willing to assume. The plans call for replacing [illegible] lamps, for which the city pays $[illegible] each per year, with four cluster lamps at $22.50 each per year, making the [illegible]

WORCESTER, MASS.—The Connecticut River Power & Transmission Company has applied to the Board of Aldermen for permission to enter the city for the purpose of furnishing electricity for lamps and motors in Worcester. The company has already a contract with the American Steel & Wire Company to furnish electricity for the Grove Street plant.

ALBANY, MINN.—Bids will be received by the Village Council for the sale of bonds to the amount of $7,000, the proceeds to be used for establishing a lighting system for streets, public buildings and for commercial and private use.

HIBBING, MINN.—The Village Board has granted the petition of the citizens living in the Penobscot district asking for lamps along the road from the village a distance of about half a mile.

MILAN, MINN.—The construction of a telephone line to Appleton is under consideration by the Milan Mutual Telephone Company.

MINNEAPOLIS, MINN.—At a meeting of the City Council held June 11, the Minneapolis General Electric Company announced a reduction in its rates for electricity to all consumers, to become effective July 1. The reduction for residential lighting will amount to about 17 per cent, and from 10 to 17 per cent on commercial lighting, according to the amount consumed. The reduction for electricity for motors varies from 9 to 20 per cent.

NORTHFIELD, MINN.—The Northfield Telephone Company has applied for a franchise in Northfield. The question will be submitted to a vote July 12.

PRINCETON, MINN.—The City Council is reported to have decided to install a storage battery in the municipal electric light plant. The cost is estimated at $3,000.

ROCHESTER, MINN.—The citizens are considering the question of calling an election to vote on the proposition to issue bonds for the construction of an electric light plant.

BRANDON, MISS.—W. F. Owen is reported to be interested in a proposed electric light plant which will have sufficient output to supply 300 lamps.

JACKSON, MISS.—The City Council has adopted an ordinance under which the lighting committee of the Council is directed to enter into a 10-year contract with the Jackson Light & Railway Company on a basis of $87.50 per lamp per year under an all-night schedule, which is $26.40 less than the price under the present contract. The city now pays $114 for each arc lamp. It is expected that the company will refuse to accept the terms of the ordinance. Through error this item was published in the issue of June 24 under Jackson, Fla.

SILVER CREEK, MISS.—The Council is considering the question of granting a franchise for an electric light plant.

MONETT, MO.—An election will soon be held to vote on the proposition to issue $35,000 in bonds for the construction of a municipal electric light plant. The city has been without street lamps for over a year, owing to failure to come to an agreement with the local electric light company.

SPRINGFIELD, MO.—The City Council has passed the measure providing for an extension of the franchise of the Springfield Electric & Gas Company. It is said that Mayor Ernst will sign the ordinance, when it will be submitted to a vote of the people at a special election to be called by the Mayor.

GORDON, NEB.—Work will soon commence on the construction of a central telephone exchange in Gordon.

GOLDFIELD, NEV.—All the mines and mills of Goldfield, Tonapah and Rhyolite, and those in other parts of Southern Nevada dependent upon the Bishop power plant, have been obliged to close down, owing to the dam having been destroyed by floods.

ORANGE, N. J.—The street committee of the Common Council has decided to recommend to the City Council the appointment of Runyon & Carey, of Newark, N. J., consulting engineers, to have charge of the construction of the municipal electric light plant. The engineers agree to prepare plans and specifications for the proposed plant and to supervise the work, and have also agreed to take charge of the lighting system for the first year without extra compensation.

BROOKLYN, N. Y.—Bids will be received until July 6 by C. B. J. Snyder, superintendent of school buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, New York, N. Y., for installing electric light wiring and fixtures, etc., in classrooms Nos. 3, 7, 10, 14, 18, 29, 33 and 44, and fire signal system in Public School 16, on Wilson Street, Borough of Brooklyn.

BUFFALO, N. Y.—Work has commenced on the installation of the new electric plant and equipment for the city hall. It is expected to have the plant completed and in operation by Nov. 1.

BUFFALO, N. Y.—The report of the Finance Committee of the Common Council, recommending that a contract be made for placing the overhead wires of the Police and Fire department underground, has been adopted by the Board of Aldermen.

BUFFALO, N. Y.—Bids will be received by the Department of Public Works, City Hall, Buffalo, until July 6 for a 100-kw, 125-volt turbo-generator set. Plans and specifications can be seen and forms of proposals can be secured on application to the Bureau of Water. Francis G. Ward is commissioner.

FORT TOTTEN, N. Y.—The contract for installing an electric lighting system at Fort Totten, N. Y., was awarded to Coburn & Cooke, of Newport News, Va., for $15,374.

FRANKLINVILLE, N. Y.—The Empire Electric Company is making extensive additions and improvements to its plant, which include the installation of a 375-kw alternator, a 500-hp engine, and 200-hp boiler with Roney stokers. G. W. G. Ferris is treasurer and manager.

FULTON, N. Y.—Announcement has been made that the Fulton Light, Heat & Power Company has changed its plans in regard to the construction of an auxiliary steam plant. It is said that the building will be twice the size originally planned and the equipment will be increased in proportion. L. W. Emerick is vice-president and manager.

HILTON, N. Y.—The Board of Trustees has granted John E. Cooper a franchise for the erection of transmission lines for the distribution of electricity for lamps and motors in Hilton.

HORNELL, N. Y.—The Common Council has renewed the contract for street lighting with the Hornell Electric Company for a period of five years from June 1. Under the terms of the new contract the company is to furnish arc lamps at $78 per lamp per year and $14 each per year for incandescent lamps, which is quite a reduction on the previous contract.

MT. VERNON, N. Y.—The Public Service Commission has granted the Westchester Lighting Company permission to purchase the entire $804,000 capital stock of the Northern Westchester Lighting Company and all the $500,000 common stock of the Peekskill Lighting & Railroad Company, of Peekskill, N. Y., the $505,000, and $75,000 of its 6 per cent cumulative preferred stock at $75,000; also $90,000 of the first consolidated mortgage bonds of the Northern Westchester Lighting Company at $81,000. The Westchester Lighting Company is authorized to issue $580,000 5 per cent first collateral trust bonds, the proceeds to be used for acquiring stocks authorized to be transferred to it by the Northern Westchester Lighting Company and the Peekskill Lighting & Railroad Company.

NEW YORK, N. Y.—Plans for the new substation of the New York Edison Company to be erected at 49 West Twenty-sixth Street have been completed. The building will be 50x100 ft. and will cost about $150,000.

NEW YORK, N. Y.—Bids will be received by John W. Brannan, president of the Board of Trustees of Bellevue and Allied Hospitals, Twenty-sixth Street and First Avenue, New York, N. Y., until July 7, for electric lamps. Blank forms may be obtained at the office of the contract clerk, at 419 East Twenty-sixth Street, New York, N. Y., where bids and deposits are to be delivered.

NEW YORK, N. Y.—The contract for installing electric equipment in new Public School 101, Borough of Manhattan, has been awarded to E. J. Duggan, New York, N. Y., for $9,463. Contract for installing electric equipment in addition to and alteration in Public School 30, Borough of Bronx, was awarded to the New York Construction Company for $4,956. C. B. J. Snyder is superintendent of school buildings.

ONEIDA, N. Y.—The Public Service Commission, Second District, has granted the Oneida Railway Company a certificate of necessity for the construction of its proposed extension from Sherill to Kenwood, a distance of one and one-half miles, which will involve an expenditure of about $68,000.

UTICA, N. Y.—The Home Telephone Company has awarded the contract for the construction of a subway on three streets in this city to N. D. Peters & Company, of Utica.

UTICA, N. Y.—The Utica Southern Railroad Company has filed an amendment to its charter with the Secretary of State as to the location of its proposed railway. Under the present plan it is proposed to build from Clinton to Hamilton, with the Deansboro-Waterville branch, and thence to Hamilton to Norwich, which will add 27 miles to the original length of the railway. The company will apply to the Public Service Commission, Second District, for permission to build the extension.

WAVERLY, N. Y.—The Elmira, Corning & Waverly Railroad Company has been granted permission by the State Highway Commission to construct its proposed electric railway from Elmira to Wellsburg on the State highway.

RALEIGH, N. C.—Formal announcement has been made of the sale, in equity of the property and holdings of the Rockingham Power Company to take place in Wadesboro, N. C., on July 12 at which there will be offered for sale all of the property of the company. The property embraces extensive water rights, water powers, etc., along the Pee Dee River, in North Carolina, together with properties, etc., conveyed by Hugh MacRae & Company, of Wilmington, to the Rockingham Contracting Company, also all rights, titles, easements, etc., secured for the Rockingham Power Company by the said Hugh MacRae Company and dams, power house, material structures, telephone lines, etc., and electrical machinery and appliances, plans, specifications, correspondence and all personal property belonging to the Rockingham Power Comany, also 250 miles of rights of way, etc., the purchaser to put up $25,000 cash or to furnish $100,000 bonds issued to the Knickerbocker Trust Company, the remainder of the purchase price to be paid in bonds issued under the aforesaid mortgage. This property and plant has been the subject of much tangled litigation. The property is well located and a large sum has already been expended in this electrical development. William H. Browne and W. A. Leland are receivers of the Rockingham Power Company.

WINSTON-SALEM, N. C.—The Southern Power Company is erecting a substation in this town for the distribution of electrical energy.

BANTRY, N. D.—The Bantry Telephone Company, it is said, will erect at least 10 miles of telephone line this summer.

BEACH, N. D.—Application has been made to the Village Council for a franchise to construct and operate electric light and water works plant.

MINOT, N. D.—The capital stock of the Minot Light & Telephone Company has been increased from $100,000 to $200,000.

STREETER, N. D.—The Central Telephone Company is planning to install between 30 and 40 miles of new telephone line.

ALLIANCE, OHIO.—Arrangements are being made by the Stark Electric Railroad Company for the installation in its power house of one 100-kw Westinghouse turbine, with condenser and other accessories, orders for which have already been placed. Knox Engineering Company, Fisher Building, Chicago, Ill., are engineers.

CLEVELAND, OHIO.—The directors of the Cleveland, Barberton, Coshocton & Zanesville Railway Company have authorized an issue of $6,000,000 in bonds, the proceeds to be used for the construction of an electric railway from Cleveland to Zanesville. J. J. Breitinger is president.

COLUMBUS, OHIO.—The City Council on June 21 passed the electric light rate ordinance over Acting Mayor Rightmire's veto. The ordinance makes the rate seven cents per kw-hour, the same as the present rate.

CUYAHOGA FALLS, OHIO.—Bids will be received at the office of C. D. Crumb, Village Clerk, until July 10 for the purchase of $4,000 in bonds, the proceeds to be used for improvements to the municipal electric light system.

DAYTON, OHIO.—Plans are being considered by the Dayton & Troy Electric Railway Company for an extension of its railway in the southern part of Piqua County, at a cost of about $25,000. C. M. Paxton is general manager.

LIMA, OHIO.—F. D. Carpenter, general manager of the Western Ohio Railway Company, writes that the company has purchased a 1000-kw Westinghouse low-pressure turbine.

MT. HEALTHY, OHIO.—The Council has granted the Mt. Healthy Power & Light Company a 25-year franchise to furnish electricity and gas in Mt. Healthy. Paul Hooven and B. Seevers, of Hamilton, Ohio, are promoters of the project.

NORWOOD, OHIO.—The Southwestern Ohio Traction Company has applied to the City Council for a franchise to operate a street railway on various streets in Norwood.

WEST LIBERTY, OHIO.—It is reported that the local electric light plant owned by R. M. Kelley has been purchased by Arthur Hartzler for $10,000. It is said that improvements will be made to the plant and service.

YOUNGSTOWN, OHIO.—Plans are being considered by the Youngstown Park & Falls Street Railway Company for improvements to its system, which will include some double tracking.

BARTLESVILLE, OKLA.—The Bartlesville Light & Water Company, recently incorporated, proposes to operate an electric light plant with an output of 1700 hp. The company is capitalized at $200,000 and the officers are: S. J. Smallwood, president; L. W. Rowland, vice-president; R. L. Beatie, treasurer, and V. McFadden, secretary.

DURANT, OKLA.—An election will soon be held to vote on the proposition to issue $20,000 in bonds for the installation of an electric light plant.

LONE WOLF, OKLA.—The city is reported to have awarded the contract for construction of an electric light and water works system for $42,000.

McCURTAIN, OKLA.—The City Electric Light & Power Company, it is reported, is planning to install a plant to cost $8,000. O. C. Gleim, of McCurtain, is engineer, and A. R. Brauham is secretary.

McMINNVILLE, ORE.—At an election held recently the citizens voted to issue $30,000 in bonds, the proceeds to be used to complete the municipal electric light plant and to improve the water works system.

PORTLAND, ORE.—The sub-station of the Portland Railway, Light & Power Company, on Seventh Street, was badly damaged by fire June 14. The damage to the machinery is estimated at about $100,000.

ST. HELENS, ORE.—The McCormick Lumber Company has been granted a franchise by the Council to install and operate an electric plant in St. Helens.

SALEM, ORE.—The contract for rewiring the State Capitol was awarded to the Pacific Electric Engineering Company for $5,212.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until July 6 for furnishing electrical material, including fixtures, fittings, cable, wire, line material, rail attachments, track drills, hardware, crossarms, solder tape, etc. Blanks and information pertaining to this circular (No. 520-A) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y., and 316 Hibernia Bank Building, New Orleans, La.; also from the U. S. Engineer offices in Pittsburgh, Pa.; Chicago, Ill., and St. Louis, Mo. Captain F. C. Boggs is general purchasing officer.

ALLENTOWN, PA.—It is reported that the directors of the Lehigh Valley Transit Company have authorized President R. P. Stevens to construct the new railway requested by the City Council and to order new equipment for the proposed belt line, work on which has just commenced. It is said that plans are being made to improve the electric railway service, which will involve an expenditure of about $1,000,000.

HANOVER, PA.—The Hanover Light, Heat & Power Company has placed a contract with the General Electric Company, Schenectady, N. Y., for one 300-kw motor-generator set, with switchboard panels, arranged to feed the railway service and reversed for supplying 2200 volts for lighting service. Robert E. Manley is manager.

MEDIA, PA.—The stockholders of the Media Electric Light Company, of Media; the Citizens' Electric Light & Power Company, of Clifton Heights; the Farraday Light Company, of Morton, and the Philadelphia Suburban Electric Light Company, of Lansdowne, on June 21 voted to consolidate the companies under the name of the Delaware County Electric Company, which now practically owns all the electric light companies in Delaware County. It is understood that the present plans contemplate the construction of a large central power plant. The plants will be operated under one management. The following officers were elected: W. Roger Fronefield, of Media, president; William F. Morris, of Penn Yan, vice-president; Joseph W. Taylor, of New York, N. Y., secretary and treasurer, and J. W. Barstow, of New York, N. Y., general superintendent and engineer.

PHILADELPHIA, PA.—At a meeting of the board of directors of the Philadelphia Rapid Transit Company held June 21 extensions and improvements to the power station of the company at Thirty-third Street and Market Street were decided upon, which will involve an expenditure of about $225,000. The purchase of a 600-kw Westinghouse exhaust steam turbine was authorized for the above-named station, and $100,000 was appropriated for the foundation for an extension of the power house on North Delaware Avenue.

PHILADELPHIA, PA.—The Keystone Telephone interests are taking a leading part in the Pennsylvania arrangements for carrying into effect the project of joining independent telephone companies into one system, which will be able to give long-distance service, as well as local service, to compete with the Bell system. On July 7 application will be made at Harrisburg for a charter for the National Telephone & Telegraph Company by Charles E. Wilson, general manager, and Clarence L. Harper, a director of the Keystone Company, and Frank Shattuck, who represents them and important St. Louis interests. The new company proposes to construct and operate a long-distance telephone line at a cost of $1,000,000, from Philadelphia to the Ohio line, via Pittsburgh. Another company by the same name will carry the telephone line across Ohio. Similar companies will be organized in New York, Indiana and other states to provide a long-distance telephone system connecting local systems between Philadelphia and St. Louis.

SLATINGTON, PA.—The contract for lighting the streets of Slatington has been awarded to the Lehigh Valley Transit Company, of Allentown, Pa., for a period of five years. The company is to furnish arc lamps at $77 each per year, and 32-cp. tungsten lamps at $17 per lamp per year, with an all-night service.

TOWANDA, PA.—It is reported that Melkelham & Dinsmore, of New York, N. Y., are interested in a project to build a dam across the Susquehanna River at Towanda. The cost of the dam is estimated at $1,000,000, and electricity will be generated for distribution in this section of the state. About 15,000 hp will be developed.

WOONSOCKET, R. I.—The Blackstone Valley Gas & Electric Company has commenced work on the construction of a 13,000-volt transmission line, with a carrying capacity of 1000 kw, from the South Station in Pawtucket to Station No. 1, Woonsocket, together with new transformer stations at each end. The Stone & Webster Engineering Corporation, of Boston, Mass., has charge of the construction work.

ROCK HILL, S. C.—Arrangements have been completed for improving the local telephone system. R. M. Lewis, of Atlanta, Ga., will have charge of the work, which will include the installation of switchboard and the common battery system.

BINGHAMTON, TENN.—Plans are being made by the Binghamton Light & Power Company to double the boiler and generator capacity of its plant by September, 1909. W. M. Tucker is manager.

CHATTANOOGA, TENN.—The hydro-electric plant at the lock and dam at Hale's Bar, 17 miles distant from the city, has been placed in operation and is now ready to furnish electricity for manufacturing purposes in Chattanooga. The lock, dam, power house and transmission line cost over $3,000,000. The power plant has an output of 50,000 hp.

NASHVILLE, TENN.—The Nashville Railway & Light Company has filed amendments to its charter, giving the company the right to make several extensions to its system, which will enable it to construct several lines to connect Nashville with many interesting and historic points in the county.

NASHVILLE, TENN.—The Nashville Interurban Railway Company has increased its capital stock from $400,000 to $600,000. The company proposes to build an electric railway from Franklin to Mt. Pleasant, a distance of 40 miles. It is understood that work will commence on the proposed extension this year.

CROSBYTON, TEX.—It is reported that Chicago capitalists are interested in the construction of a proposed hydro-electric power plant at Silver Falls, on White River, four miles from Crosbyton. For further information address F. E. White, secretary of Crosbyton Commercial Club.

FORT WORTH, TEX.—The Northern Texas Traction Company is considering the question of constructing an electric railway to Riverside.

SAN MARCOS, TEX.—The City Council has adopted a resolution agreeing to extend the franchise of the San Marcos Electric Company, its franchise having recently expired. The proposition provides for a maximum rate for electricity for lamps in the city, and for a more extensive system of street lighting than is now provided. The company recently passed into the control of bondholders at a foreclosure sale, and it is not yet known whether the proposition will be accepted or not.

SINTON, TEX.—J. M. Greer, of Livingston, Tex., is reported to be interested in a project to establish an electric light plant in connection

with a 10-ton ice plant. A company has been organized with a capital stock of $10,000 to operate the plant.

HYRUM, UTAH.—The City Council has decided to remodel the municipal electric light plant so as to increase the service. It is also proposed to extend the transmission line to the town of Wellsville to furnish electricity for lamps.

BASIC CITY, VA.—W. M. Page, city treasurer, writes that the contract for the construction of the municipal hydro-electric plant has been awarded to the Morrison Machinery & Supply Company, of Richmond, Va., for $20,000.

BROOKNEAL, VA.—The Staunton River Power Company, which proposes to develop water power at Brookneal and McIvor's Falls, on Staunton River, is reported as having made arrangements with New York capitalists for financing the proposed hydro-electric plant. It is estimated that from 8000 to 10,000 hp can be developed for transmission by electricity. E. R. Monroe and associates are interested in the projects.

FORT HUNT, VA.—Contracts for the equipment for the pumping station at Fort Hunt, Va., have been awarded as follows: To the G. & W. Manufacturing Company, of New York, N. Y., for power plant machinery, which includes boilers, generators, pumps and compressors, for $9,700; the John W. Danforth Company, of Buffalo, N. Y., for construction of pumping station, including plumbing, electric wiring and fixtures, and repairing and installing two generator sets, for $11,250, and construction of reinforced-concrete reservoir, to Lyons Brothers, of Tippett, Md., for $4,500. Captain H. L. Pettus is constructing quartermaster.

RICHMOND, VA.—The ordinance committee of the City Council has instructed the city attorney to prepare an ordinance to require the Southern Bell Telephone Company to improve its local system or surrender its charter.

BELLINGHAM, WASH.—O. E. Booby and H. W. Swain have made application to the County Commissioners for a franchise to operate an electric light system in Nooksack and Everson.

HUSUM, WASH.—The Husum Light & Power Company has completed its transmission line into White Salmon, and will soon be prepared to furnish electricity for lamps and motors in that town. It is said that several large ranch owners in this vicinity will take advantage of the service for power purposes. The residents of Trout Lake and vicinity are negotiating with the company to supply electricity for lamps and motors. Trout Lake is about 18 miles distant.

METHOW, WASH.—Plans are being made to develop the water power of the Methow River in Okanogan County for the purpose of furnishing electricity for lamps and motors in the small towns in the county and for operating the pumps for irrigating thousands of acres of land. The Columbia Water Power Company, of which Samuel Berry, J. B. Valentine and Sidney Berry, of Spokane, Wash., are interested in the enterprise. The present plans include the construction of a large dam on the Methow River, about eight miles from its mouth, at a cost of $25,000. From the dam a flume about a mile in length will be extended down the river, where a power plant will be erected at a cost of at least $50,000. Transmission lines will be erected from the power house to Bridgeport, Brewster, Pateros, Methow and other towns in this vicinity to distribute electricity for lamps and motors for irrigation purposes.

PASCO, WASH.—The Moore tract, consisting of 1000 acres, near this city, has been purchased by J. W. Culver and W. H. Todd. The new owners propose to irrigate the tract, and have entered into a contract with the Yakima Water Power Company to furnish electricity for the project. The initial unit will be of 100 hp. As soon as the work is completed 500-hp pumps will be installed.

PORT ORCHARD, WASH.—The Board of Control has awarded contracts for the construction of the administration building and power plant at the Veterans' Home, at Port Orchard, amounting to $51,050. The contract for the building was awarded to Lance & Peters, of Seattle, for $28,800, and for the installation of heating plant and construction of power house to the Seattle Heating & Plumbing Company for $22,250.

REPUBLIC, WASH.—The new power plant of the New Republic Company is nearly completed and will soon be placed in operation. It will furnish electricity to operate the mine of the Republic company, also for the San Poil mine and the Blacktail mines. R. J. Howard and W. B. Parker are interested in the New Republic Company.

SPOKANE, WASH.—Mayor F. S. Pratt recommends to the City Council that the dam at the up-river pumping station be raised, to install electric motors at the station to increase the output of the pumps from 29,000,000 to 40,000,000 gallons a day, and to erect a down-town auxiliary pumping station at either Mission Avenue or Division Street and install an independent high-pressure fire system.

MARTINSBURG, W. VA.—The large hydro-electric power plant being erected by the Martinsburg Power Company on the Potomac River at Dam No. 4 is nearly completed and will be placed in operation within a few weeks. The equipment includes two turbine wheels of 1000 hp each and two generators with the same rating. Electricity will be transmitted from the plant to Martinsburg through Sheperdstown, a distance of 15 miles.

WHEELING, W. VA.—It is reported that the National Telephone Corporation, controlling telephone lines in New York, Pennsylvania, Ohio, West Virginia and Maryland, has acquired control of the West Virginia Western Company, of Parkersburg, W. Va., which operates 6000 telephones in West Virginia and Ohio. The consideration is said to be $600,000.

ANTIGO, WIS.—The Antigo Electric Company is planning to rebuild its plant this summer and will change the system from direct to alternating-current. Charles M. Cleveland is vice-president and manager.

FRIENDSHIP, WIS.—The question of installing an electric light plant in Friendship is under consideration.

KENOSHA, WIS.—Arrangements are being made by the Kenosha Electric Railway Company for the construction of a new power house, for which contracts for equipment have been placed, including one 300-kw Allis-Chalmers turbo-generator, one 200-kw Westinghouse motor generator, three 125-k.v.a. Westinghouse transformers and 180 metallic flame arc lamps.

MINERAL POINT, WIS.—The Mineral Point Electric Light Company is building a high-tension transmission line to Linden to supply electricity in that place for lamps and motors. F. C. Ludden is secretary and manager.

TWO RIVERS, WIS.—A rural telephone company has been organized to construct about 15 miles of telephone line. The company is capitalized at $6,000. Nelson LeClair is president.

WAUSAU, WIS.—Preliminary arrangements have been made by the Wisconsin River Traction & Power Company towards the construction of a dam at Trappe City. It is reported that the construction of the dam means an interurban railway between this city and Merrill, work on which will begin next spring. The right of way from Wausau to Brokaw was given to the Traction company by the St. Paul Company, it is said, in consideration of an agreement to relieve the steam railroad company of a long contract with the Wausau Paper Company requiring it to run the "scoot" which is said to be a losing proposition.

FORT YELLOWSTONE, WYO.—The contract for the construction of the reservoir in connection with the hydro-electric plant at this post has been awarded to the D'Olier Engineering Company, of Philadelphia, Pa. G. C. Smith is constructing quartermaster.

WINNIPEG, MAN., CAN.—The contract for installing electrical fixtures in the new Grand Trunk-Pacific depot, Winnipeg, has been awarded to the Robert Mitchell Company, of Winnipeg, for approximately $30,000.

TORONTO, ONT., CAN.—Bids will soon be received by the City of Toronto for the following apparatus: Two 1500-hp induction motors direct connected to turbine pumps; four 1500-hp synchronous motors with turbine pumps; four 500-hp synchronous motors with turbine pumps; two 500-hp induction motors with turbine pumps; two 300-hp induction motors with turbine pumps; two 225-hp synchronous motors with turbine pumps, together with valves, piping, bed plates, couplings, switchboards, connecting material, etc. For further information apply to the city engineer's department, Toronto, Ont., Can.

Company Elections.

BRISTOL, N. H.—At the annual meeting of the Bristol Electric Light Company the following-named officers were elected: H. H. Pattee, president; Marshall Ballou, vice-president, and George A. Emerson, treasurer and manager.

PITTSBURGH, PA.—At the annual meeting of the Philadelphia Company held recently the following-named directors were elected: J. H. Reed, president; H. J. Bowdoin, Patrick Calhoun, James D. Callery, George E. McCague, B. S. Guinness, Edwin Smith, R. H. Boggs, Sidney H. March and George E. Tener. Mr. Tener was elected to fill the vacancy caused by the death of Joshua Rhodes. All of the present officers were re-elected except Matthew Bigger, purchasing agent, who is succeeded by J. H. Reed, Jr.

PITTSBURGH, PA.—At the annual meeting of the Pittsburgh Railway Company the following directors were elected: James D. Callery, J. H. Reed, George E. McCague, H. J. Bowdoin, George W. Bacon, Patrick Calhoun, Edwin W. Smith, R. H. Boggs and George E. Tener.

TORONTO, ONT., CAN.—At a special meeting of the Lake Superior Corporation held recently, J. Frater Taylor, of New York, N. Y.; H. Coppell, of Plainfield, N. J., and J. S. Dale, of New York, N. Y., were elected directors of the corporation, to take the places of Charles S. Hinchman, of Philadelphia, Pa.; L. H. Hirt, of New York, N. Y., and R. Wilson Smith, of Montreal, Can. The other directors are: C. D. Warren, of Toronto, Can.; J. T. Lea, of Philadelphia, Pa.; T. J. Drummond, of Montreal; J. T. Terry, Jr., of New York, N. Y.; W. Gow, of Toronto, Can.; F. McOwen, of Philadelphia, Pa.; R. L. Austin, of Philadelphia, Pa., and W. K. Whigham, of New York, N. Y.

New Industrial Companies.

THE AHLM-ZORN ENGINEERING COMPANY, of Cleveland, Ohio, has been chartered with a capital stock of $10,000 by C. E. F. Ahlm and others.

THE AMERICAN WIRELESS BURGLAR ALARM COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $25,000, by S. E. Ostrom, of Brooklyn, N. Y.; M. A. Kammer, of New York,

N. Y., and S. F. Austin, of Highwood, N. J. The company proposes to manufacture and sell burglar alarms.

THE BLAUVELT & WEST COMPANY, of Montclair, N. J., has been chartered by W. E. Blauvelt, R. W. Cole, Brooklyn, N. Y.; E. West, of New York, N. Y., and J. Schneider, of Montclair, N. J. The company is capitalized at $250,000 and proposes to do a mechanical and electrical engineering business; toolmakers, machinists, etc.

THE COPLEN, KIDDER & HEGEL MANUFACTURING COMPANY, of St. Louis, Mo., has been chartered with a capital stock of $250,000, by Elbert M. Coplen, Daniel G. Kidder and K. Hegel. The company proposes to manufacture boilers and supplies.

THE ELECTRIC STEEL COMPANY OF NEW YORK, N. Y., has been incorporated, with a capital stock of $100,000, to manufacture and deal in iron, steel and ores, by W. J. Du Bois, of New York, N. Y.; J. H. Wallace, Mariners' Harbor, N. Y., and H. F. Kinney, of Brooklyn, N. Y.

THE McMILLAN PUMP, POWER & MANUFACTURING COMPANY, of Kansas City, Mo., has been incorporated by Milton McMillan, Daniel E. Bird, Benjamin F. Rounds and others. The company is capitalized at $25,000 and proposes to manufacture pumps.

THE NATIONAL TELEPHONE SELECTOR COMPANY, of Jersey City, N. J., has filed articles of incorporation with a capital stock of $500,000, for the purpose of manufacturing telephone signals or selectors, railway signals, etc. The incorporators are E. Kleinschmidt, J. A. Hughes and W. C. Merriam, Jr., of Jersey City, N. J.

THE REPEATING ELECTRIC SIGN COMPANY, of Syracuse, N. Y., has been chartered, with a capital stock of $2,500, by William H. Hall, Jr., Charles W. Webb, Edward D. Kilburn, all of Syracuse, N. Y.

THE RICE GAS ENGINE COMPANY, of Jersey City, N. J., has filed articles of incorporation, with a capital stock of $1,000,000, for the purpose of manufacturing engines, tools, machinery, etc. The incorporators are: A. J. Denahan, R. R. Hanna and J. D. Baker, of Jersey City, N. J.

THE I. J. ROYCE & COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $25,000 by Kendal & Luby, 84 La Salle Street, Chicago, Ill. The company proposes to manufacture machinery and supplies.

THE SECURITY ELECTRIC & CONSTRUCTION COMPANY, of Augusta, Maine, has been chartered, with a capital stock of $1,000,000, to manufacture mechanical and electrical machinery. E. M. Leavitt, of Winthrop, Maine, is president and treasurer.

THE STANLEY S. DE NOVENS COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $5,000 by Stanley S. de Novens, Frank A. Belling and Joseph Belling, all of Brooklyn, N. Y. The company proposes to do a general engineering and building business.

THE A. B. C. TRAIN OPERATING COMPANY, of Chicago, Ill., has been chartered with a capital stock of $100,000 for the purpose of manufacturing machinery and appliances by Heidman & Street, of Chicago, Ill.

THE TURBINE MOTOR ELECTRIC CAR COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $50,000 by John T. Lister and others.

THE WATERHOUSE CARBURETOR COMPANY, of Boston, Mass., has filed articles of incorporation with a capital stock of $100,000 and the following-named officers: Harold D. Waterhouse, president; Frank G. Conway, vice-president, both of Boston, Mass., and Frederick C. Hersee, of Rolindale, treasurer.

New Incorporations.

PHOENIX, ARIZ.—The Suburban Railway Company has filed articles of incorporation with a capital stock of $500,000 to construct an electric railway in Phoenix. The directors are: A. B. King, B. A. Fowler, J. W. Dorris, George M. Halm and E. J. Bennett.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Company has filed articles of incorporation, with a capital stock of $30,000,000. It is said that the company has been organized to control all the gas and lighting plants in southern California. W. B. Cline, president of the Los Angeles Gas & Electric Company, is president of the new company.

WILMINGTON, DEL.—The Ohio Central Electric Railway Company has been incorporated, with a capital stock of $500,000, by Martin E. Smith, of Wilmington, Del.; Carl C. Conkle, Pittsburgh, Pa.; Harry L. Thompson, of Uhrichsville, Ohio, and Wylie H. Taylor, of Wellsburgh, Ohio.

JENKINSBURG, GA.—The Jenkinsburg Telephone Company has been chartered with a capital stock of $2,000 by B. F. Aiken, J. F. Tingle and others.

AURORA, ILL.—Articles of incorporation have been filed for the Chicago, Aurora & DeKalb Railroad Company by J. H. Bliss, of Sugar Grove; F. W. Ravlin, of Kaneville; E. L. Lyon, F. M. Killian and J. C. Murphy, of Aurora, Ill. The company is capitalized at $50,000 and proposes to build an electric railway from Aurora to De Kalb.

DE KALB, ILL.—The De Kalb & Western Railway Company has been chartered by Newton Taylor, of Elgin, Ill.; J. F. Pearce, L. D. Grier, Frederick Krengel and Asman F. Cole, all of Chicago, Ill. The company is capitalized at $25,000 and proposes to construct an electric railway from Chicago to Rock Island.

MILL HALL, PA.—The Mill Hall & Kittany Telephone Company has been incorporated with a capital stock of $5,000. W. H. Pifer, of Lock Haven, is treasurer.

NEW CUMBERLAND, PA.—The West Shore Telephone Company has been chartered with a capital stock of $50,000 to operate in the territory from New Cumberland to Marysville and Mechanicsburg. The incorporators are: Dr. J. C. Stem, of Lemoyne, Pa.; Solomon Rupp, of Shiremanstown, Pa.; Jacob Reiff, of New Cumberland, Pa., and others.

HALLS, TENN.—Articles of incorporation have been filed for the Halls Light, Water & Ice Company, by R. A. Greer, L. S. Prescott, E. R. Parham, T. B. Caldwell and C. D. M. Greer.

LA WARD, TEXAS.—Articles of incorporation have been filed for the Bay Telephone Company by L. N. Mitchell and A. C. Joines.

NIXON (P. O.), TEX.—The Nixon Telephone Company has been incorporated, with a capital stock of $6,200, by C. S. Penfield, P. H. Tom and D. N. Campbell.

ROCKWALL, TEX.—The Rockwall Light, Ice & Gin Company has been chartered with a capital stock of $20,000 by H. A. Briscoe, M. A. Parish, M. S. Bailey and T. W. Bailey.

SAN ANTONIO, TEX.—The Metropolitan Steam & Electric Railway Company has been chartered under the laws of Delaware for the purpose of constructing electric railways in Texas. The company is capitalized at $100,000, and the incorporators are: John G. Marmion, of San Antonio, Tex.; M. Kaufman, Yorktown, Tex., and E. L. Squire, of Wilmington, Del.

TEMPLE, TEX.—The Temple Electric Light Company has been chartered with a capital stock of $5,000 by W. S. Brown, W. F. Evans, D. S. Brady and others.

TULIA, TEX.—The Tulia Light & Ice Company has been incorporated with a capital stock of $10,000 by J. W. Schwarz, J. E. McCune and E. D. Smith.

WACO, TEX.—Articles of incorporation have been filed for the Rotan Water & Light Company, with a capital stock of $10,000, by C. Hamilton, E. Rotan and C. H. Sherman.

SALT LAKE CITY, UTAH.—The Borkman Electric Company has filed articles of incorporation, with a capital stock of $25,000. The incorporators are: G. Borkman, president; P. C. Dykes and J. H. Parkes.

SUFFOLK, VA.—The Suffolk Light Company has filed articles of incorporation with a capital stock of $250,000. The officers of the company are: W. L. Williams, president; R. B. Tunstall, vice-president; A. R. Williams, secretary and treasurer, all of Norfolk, Va.

SOUTH BEND, WASH.—The Willapa Harbor Telephone Company has been organized with a capital stock of $30,000. The company has purchased the local South Bend and Raymond systems, and also the line to Bay Center. The officers of the company are: C. S. Gilchrist, of Centralia, Wash., president; F. A. Hazeltine, of South Bend, Wash, vice-president; John T. Welsh, of South Bend, secretary; H. W. McPhail, of Raymond, Wash., treasurer, and W. W. Canon, of Centralia, Wash., general manager.

TACOMA, WASH.—The Connell Northern Railway Company has been incorporated with a capital stock of $50,000 to construct an electric railway from Connell to Ritzville and Tokio.

WHEELING, W. VA.—The National Telephone Corporation, capitalized at $15,000,000, has been incorporated by John A. Howard, of Wheeling, W. Va.; Alfred S. Hayes, of Boston, Mass.; S. Stanwood Manken, of New York, N. Y.; Samuel W. Harper, of Wheeling, W. Va., and William M. Clark, of New York, N. Y. It is said that the company proposes to construct two trunk lines across the continent and absorb many of the independent telephone lines. John A. Howard is president of the company.

STURGEON BAY, WIS.—Articles of incorporation have been filed for the Peninsula Telephone Company by G. W. Greaves, John G. Walker, August Moeller. The company is capitalized at $5,000.

VANCOUVER, B. C., CAN.—The Western Canadian Power Company has been formed, with a capital of $5,000,000, to take over the plant and assets of the Stav Lake Power Company. William McNeil is secretary.

FINGAL, ONT., CAN.—The Fingal Rural Telephone Company has been incorporated to erect rural telephone lines. J. Steele is interested in the enterprise.

TORONTO, ONT., CAN.—The Erindale Power Company, with mair office in Toronto, has been incorporated, with a capital of $250,000.

DAWSON CITY, Y. T., CAN.—The Northern Light, Power & Coal Company has been incorporated, with a capital of $3,000,000.

Personal.

MR. CHARLES PARRISH, formerly of the Westinghouse Electric & Manufacturing Company, has been appointed Pittsburgh representative of the Excello Arc Lamp Company.

MR. B. E. SUNNY, president of the Chicago Telephone Company, is about to sail for Europe with the members of his family, to enjoy a vacation of about six weeks' duration.

MR. S. P. GRACE, of the Central District & Printing Telegraph Company, is the author of an article entitled "The Transmission of Telephone Currents," which appears in the current issue of *The Michigan Technics*, of the University of Michigan.

MR. BENJAMIN WALL, formerly of the Metropolitan Engineering Company, New York, has connected himself with Messrs. Betts & Betts, the well-known electric sign builders. Mr. Wall will have the management of their central station department.

MR. GEORGE E. MILLER, manager of the Cleveland office of the Westinghouse Electric & Manufacturing Company, was married in St. Louis on June 24 to Miss Anna B. Miller, of the latter city. Mr. and Mrs. Miller will be at home in Cleveland after Aug. 1.

MR. F. MATTHEWS, of Sherman, Tex., has been appointed superintendent of the Water and Light Department of Roff, Okla. Mr. Matthews has been a resident of Sherman for several years and has been connected with the electric light plant for six or seven years.

MR. HENRY H. TAYLOR has severed his connection with the Gardner Electric Light & Power Company, Gardner, Mass., with which he has been connected for the past 20 years, to accept the position as superintendent of the Buzzards Bay Electric Light Company, with headquarters at Falmouth, Mass.

MR. HERBERT G. LOWELL has resigned as superintendent of the municipal electric light plant at Templeton, Mass., to accept the position as superintendent of the Gardner Electric Light & Power Company, Gardner, Mass. Mr. Edward B. Waite has been elected superintendent of the Templeton electric light department to succed Mr. Lowell.

MR. EDWARD B. ELLICOTT, chief electrical engineer for the Sanitary District of Chicago, has received an increase in salary from $6,000 to $7,500 a year. Mr. Ellicott, who was formerly city electrician of Chicago, designed the hydro-electric plant on the Drainage Canal at Lockport, Ill., as well as the entire electrical transmission and distribution system of the Sanitary District. Supervising the electrical work of the board, he has performed his duties with ability, zeal and untiring industry.

MR. SAMUEL L. NICHOLSON has been made sales manager of the Westinghouse Electric & Manufacturing Company. This is a new position in the Westinghouse organization and it is a compliment to Mr. Nicholson's business ability that he was selected to fill it. Mr. Nicholson was until recently manager of the industrial and power department of the company. His headquarters as sales manager will be in Pittsburgh. Mr. Charles Robbins has been made manager of the industrial and power department, with which he has been connected for some time, succeeding Mr. Nicholson.

MR. WILLIAM ALGERNON BRACKENRIDGE has resigned as a member of the Advisory Board of Consulting Engineers of the new barge canal in New York to take the management of the Edison Electric Company, of Los Angeles, Col. Mr. Brackenridge is well known as a hydraulic engineer, and the company of which he assumes charge derives almost all of its power from hydro-electric plants. It operates two stations on the Santa Ana River, two on Mill Creek, one on Lytle Creek and one on Kern River. The company has about 600 miles of transmission lines and operates at 33,000 and 60,000-volt primary and 10,000-volt secondary.

MR. BYRON BRIGGS BRACKETT, A. M., PH. D., has been appointed to the chair of Electrical Engineering at the South Dakota State College, Brookings, S. D. During the past six years he has held the chair of Electrical Engineering at the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y. Dr. Brackett is not only an experienced teacher, but has had considerable experience in practical electrical engineering, having had charge of the inspection and testing of all the cable manufactured by the General Electric Company for the U. S. Army during the Spanish-American war, as well as other important work.

PROF. ELIHU THOMSON, electrician; Mr. E. W. Rice, Jr., vice-president; Mr. G. E. Emmons, Schenectady works manager; Mr. W. C. Fish, Lynn works manager, and Mr. F. C. Pratt, assistant to Mr. Rice, all of the General Electric Company, formed a party of gentlemen visiting electrical plants in Chicago and vicinity on June 21 and 22. The Fisk Street and Quarry Street generating stations of the Commonwealth Edison Company were inspected on Monday forenoon, and on that day the party was entertained at luncheon at the Union League Club, with some of the officers of the Commonwealth Edison Company, by Mr. J. W. Johnson, Chicago manager of the General Electric Company. In the afternoon there was a demonstration of the new electric fire boat *Graeme Stewart*, which was of unusual interest. Following this the party repaired to the Chicago Athletic Club, where, by the thoughtful courtesy of Mr. L. A. Ferguson, vice-president of the Commonwealth Edison Company, the gentlemen enjoyed a plunge in the fine swimming pool of that club. On Monday evening the entire party was entertained at dinner at the Chicago Club by Mr. B. E. Sunny, president of the Chicago Telephone Company, and formerly vice-president of the General Electric Company. Tuesday was spent at Gary, Ind., where Mr. W. P. Gleason, general superintendent for the Indiana Steel Company, was host. The visitors were taken about the great electrically operated steel mills and also inspected the city of Gary under the guidance of Mr. Gleason and members of his staff. Luncheon was taken at the hotel in Gary, Mr. Gleason doing the honors. The visiting electrical men, who left for the East on Tuesday evening, expressed themselves as greatly pleased with their sojourn in the Chicago area.

Obituary.

MR. WILLIAM F. EMERSON, connected with the securities department of the branch of Stone & Webster in Chicago, died of pneumonia at the Presbyterian Hospital in Chicago, after a short illness, on June 23. Mr. Emerson, who was but 26 years of age, was a graduate of Harvard College in the class of 1906. At college he was interested in athletics and was manager of the 1906 crew which went to England to row against Oxford and Cambridge. Mr. Emerson was a grandson of Ralph Waldo Emerson and is survived by his parents, living at Concord, N. H.

MR. ALBERT PAULDING BRAYTON, president and founder of the Pelton Water Wheel Company, of San Francisco and New York, died at his home in Oakland, Cal., on the 25th inst., aged 82 years. Mr. Brayton went to California in the early fifties and was conspicuous in the development of the industries of the Pacific Coast, particularly in connection with the machinery industry as applied to mining and hydro-electric development. For many years he was a member of the firm of Rankin, Brayton & Co., who operated the Pacific Iron Works, one of the pioneer concerns in the metal industry in San Francisco. He retired from this concern in 1888 and established the business of the Pelton Water Wheel Company, which, under his able and vigorous administration, has since grown to be one of the most prominent concerns in the field of hydraulic power development.

MR. ORRIN S. WOOD, one of the first telegraphers and builders of telegraph lines in the United States, died at his home in Turners, N. Y., June 22, at the age of 91 years. He entered the telegraph service in Washington in 1844, and was an operator on the original wire between Baltimore and Washington, having received his instruction in telegraphy from Prof. S. F. B. Morse. He superintended the construction of the first telegraph line between New York and Philadelphia in 1845, and opened the first telegraph office in New York, at Hanover Street and Exchange Place. The next year he built a line between Albany and Buffalo, and in 1847, through his work, communication was established with Buffalo, Niagara Falls, Toronto, Montreal and Quebec. Then he became superintendent of the Montreal Telegraph Company, which post he filled until 1866, and afterward reconstructed all telegraph lines northwest of Chicago. When this was completed the system of lines was sold to Jay Gould, and it was included later in the Western Union lines. Mr. Wood was born in Sherburne, N. Y., and retired from active business 35 years ago.

Legal.

RECEIVER APPOINTED.—The Consolidated Street Railway & Power Company, of Fayetteville, N. C., has been placed in the hands of a receiver by Judge Lyon, of the State court, W. D. McNeill, president of the company, being named receiver. This step follows the institution of several suits, while the company has been unable to float certain bonds issued, hence the acceptance of the court's protection. The operation of the road is not affected.

THE KENNETT ELECTRIC LIGHT, HEAT & POWER COMPANY IN RECEIVERS' HANDS.—Augustus Brosius, of Avondale, Pa., has been appointed receiver of the Kennett Electric Light, Heat & Power Company, of Kennett Square, Pa. The company has been in financial straits for some time. A letter issued a short time ago by Ralph Rhoads, the manager of the company, charges gross criminal misrepresentation and mismanagement on the part of those financing the company. He states that there are $165,000 first-mortgage bonds, $300,000 in stock, $27,000 overdue notes, $3,000 unpaid bills and $1,000 in unpaid salaries against the company. The interest on the bonds has never been earned, but paid out of stocks sold, and that if the plant was to be sold at a forced sale it would not bring $50,000. The plant was built by local capitalists several years ago and has changed hands several times since, and is said to be now controlled by the United Public Service Corporation, with headquarters in Philadelphia.

Trade Publications.

WATT-HOUR METERS FOR SWITCHBOARD SERVICE.—Bulletin No. 4662, issued by the General Electric Company, illustrates and describes the various types of Thomson watt-hour meters and their parts built by the company for switchboard service. The instruments are designed to retain accuracy for a long period, and are essentially high-torque devices in which the ratio of torque to friction is a maximum.

WESCO APPARATUS.—The Wesco Supply Company, of St. Louis, Mo., is distributing a series of bulletins given full information and illustrations of Wesco transformers, alternating-current generators, induction motors, bipolar generators and motors, multipolar belted generators and motors, switchboard instruments, direct and alternating current switchboards and direct-current motors. A copy of either or the entire set of bulletins can be obtained on request.

CONDUITS FOR INTERIOR CONSTRUCTION.—"Loricated" conduit is a mild steel welded tube enameled inside and outside, and "Galvaduct" has its surface thoroughly galvanized, and the tube is then treated on the interior with flexible enamel. Both of these conduits are made by the Safety-Armorite Conduit Company, of Pittsburgh, Pa., which, in a well executed catalog, presents data and illustrations relative

to its product for interior construction work. A large number of half-tones are employed to illustrate some of the large and well-known buildings in which the company's product was used.

SIDE CRANK STEAM ENGINES.—A handsomely executed catalog is that of the Ball Engine Company, of Erie, Penn., designated Catalog P, and devoted to a description of the side crank type steam engines designed and built by the company. These embrace simple, tandem-compound, cross-compound and Corliss engines. The side crank avoids the undesirable feature of an overhanging wheel, which in the case of belt driving constantly tends to wear the bearings out of line and is particularly objectionable where alternating-current generators are direct driven, because of the heavy flywheels usually required for this work. The side crank construction also eliminates the necessity for three bearings in engines direct-connected to generators.

Business Notes.

STANDARD UNDERGROUND CABLE PACIFIC SLOPE OFFICE.—On June 19 the general Pacific Coast offices of the Standard Underground Cable Co. were moved to the First National Bank building, Market, Montgomery and Post Streets, San Francisco, Cal.

COLORADO POWER COMPANIES—Notice has been received that the Central Colorado Power Company, the Eastern Colorado Power Company and the Leadville Light & Power Company have removed to their permanent offices, 1210 Seventeenth Street, Denver, Col.

H. H. CUDMORE, president of the Brilliant Electric Company, Cleveland, Ohio, asks that announcement be made that he has no longer any interest, directly or indirectly, in the Ambos-Cudmore Company, of which he was one of the founders. Mr. Cudmore's present activities are concentrated entirely in the manufacture and sale of Brilliant lamps.

M. & M. CIRCUIT FITTINGS.—Owing to the manner in which orders for M. & M. "Shallowest" flush push-button switches, receptacles and plugs, screw receptacles, wall cases, pendant switches and panel boards have increased during the past six months, the Machem & Mayer Electrical Mfg. Co., Philadelphia, found it necessary to move to a factory twice the size of its former one, and hereafter will be located at Seventeenth and Vine streets, Philadelphia.

ARMY BOILER CONTRACT.—The E. Keeler Company, of Williamsport, Pa., has been awarded a contract by the U. S. Government for boilers for three separate electrical installations at Pacific Coast fortifications. There will be two 100-hp water-tube boilers for Fort Stephens, Ore., at the mouth of the Columbia River, about 110 miles west of Portland; two of 150-hp each at Fort Casey, on Puget Sound, about 40 miles north of Seattle; and two of 200-hp each at Fort Scott for the Presidio, which adjoins the city of San Francisco, Cal. The boilers will use oil as fuel.

MULTIPLE MOTOR, VARIABLE-SPEED ELECTRIC DRIVE FOR PAPER-MAKING MACHINES.—The Standard Engineering Corporation, of Wilmington, Del., paper-mill contractors and engineers, has developed a combination with a paper-making machine of separate electric motors to drive the individual parts or sections thereof, with means for maintaining a constant working speed for the entire machine as desired, yet with the facility for varying the working speed of the individual parts or sections of the machine within small limits. The driving of paper-making machines has heretofore been accomplished electrically by the application of a variable-speed motor to a line of shafting, transmitting power to the paper machine through a complication of belts, cone pulleys, friction clutches and bevel gears. It is claimed that the new system does away with all this apparatus, and consists merely of a motor and a pair of spur gears for each section of the machine located on the machine room floor. It is, therefore, unnecessary to provide any basement under the machine, as heretofore required by the cumbersome line shafting and pulleys. The first installation of this drive was made by the Standard Engineering Corporation at the mill of the Gould Paper Company, Lyons Falls, N. Y., and has been running for a number of months, and is understood to be doing excellent work. The same company has recently secured an order from the Lincoln Paper Mills Company, Merritton, Ont., for a large electric drive for its new paper machine, an important feature of which is that the drive is designed to give a range in paper speed of from 80 to 400 ft. per minute without the usual aggregation of step pulleys, cone pulleys and change speed gear. The speed control for the entire machine will be obtained by regulating the generator rheostat.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Lloyd Lyon, Mobile, Ala.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City.

American Electro-chemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next meeting, New York City, 1909.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, 557 Frick Building Annex, Pittsburgh, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia. Next meeting, Denver, Col., Oct., 1909.

American Street & Interurban Railway Engineering Association. Secretary, John S. Corning, Boston Electric Railway Company, Boston. Next meeting, Denver, Col., Oct. 4-8, 1909.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York. Next meeting, Denver, Col., Oct. 4-8, 1909.

Association of Car Lighting Engineers. Secretary, G. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next meeting, Chicago, Oct. 5, 6, 7 and 8, 1909.

Association of Edison Illuminating Companies. Secretary, D. L. Hunting, Spokane, Wash. Next meeting, Briarcliff Manor, N. Y., Aug. 31, Sept. 2, 1909.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Lift Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Col. Next meeting, Denver, Oct. 12, 1909.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland and Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle and Central Station Association. Secretary, H. T. Sands, 139 Pleasant street, Malden, Mass.

Electric Club, Chicago. Secretary, W. S. Taussig, 204 Dearborn St., Chicago. Meets every Wednesday noon at Chicago Automobile Club.

Electric Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

Electrical Contractors' Association of State of Missouri. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, Nov. 4, 1909.

Electric Trades Association of Philadelphia. Secretary, E. A. Symmes, 1324 Land Litle Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York. Next meeting, New York City, October, 1909.

Florida Electric Light and Power Association. Secretary, G. F. Doig, Gainesville, Fla. Next meeting, Tampa, Fla., April 21, 1910.

Illinois State Electric Association. Secretary, H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Light Association. Secretary, Fred. Leslie, Muncie, Ind. Next meeting, French Lick Springs, Ind., Aug. 18 and 19, 1909.

INTERNAL COMBINATION ENGINE ASSOCIATION. Secretary, Walter I. Sittig, 61 Ward St., Chicago.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., Sept. 14, 15 and 16, 1909.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., Eng.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. C. Davis.

IOWA ELECTRIC ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting second Wednesday in March each year.

IOWA STREET & INTERURBAN ASSOCIATION.. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Sioux City, April, 1910.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Wichita, Kan., Sept. 22 and 23, 1909.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting Detroit, Aug. 17, 18 and 19, 1909.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, B. W. Cowperthwait, Faribault, Minn. Next meeting St. Paul, third week in March, 1910.

MISSISSIPPI ELECTRIC ASSOCIATION. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, Jefferson City, Mo., April 14, 15 and 16, 1910.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN & BRACKETT ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, John F. Gilchrist, 139 Adams St., Chicago. Headquarters, 33 West 39th St., New York.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Toledo, Ohio, July 21, 1909.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings second and fourth Tuesday of each month.

NEW YORK ELECTRICAL SHOW. Madison Square Garden, Oct. 11-21, 1909.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash. Next meeting, Seattle, Sept. 7, 8 and 9, 1909.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, John S. Allen, Lake Geneva, Wis. Next meeting, Milwaukee, January, 1910.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Toledo, July 13-15, 1909.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL ELECTRICAL & STEAM ENGINEERS. Secretary, David Gaehr, Schofield Building, Cleveland, Ohio. Next meeting, Lima, Ohio, Nov. 19 and 20, 1909.

OKLAHOMA PUBLIC UTILITIES ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla. Next meeting Sapulpa, Okla., 1910.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, F. J. Scherrer, 195 Broadway, New York. Next meeting, Pittsburgh, Pa., Aug. 17, 18 and 19, 1909.

PACIFIC COAST ELECTRIC AUTOMOBILE ASSOCIATION. Secretary, J. T. Halloran, 604 Mission St., San Francisco, Cal. Next meeting, Oakland, Cal., February, 1910.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. L. Smith, Towanda, Pa. Next meeting, Eagles Mere, Pa., Sept. 8, 9 and 10, 1909.

PENNSYLVANIA STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado, Springs, Col. Meetings, second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, C. E. Russell, Boston, Mass. Monthly meeting, fourth Monday of each month.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D. Next meeting Jan. 11 and 12, 1910.

SOUTHWESTERN ELECTRIC & GAS ASSOCIATION. Secretary, E. T. Moore, Dallas, Texas.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, care of J. G. White & Co., New York.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRIC ASSOCIATION. Secretary, A. B. Marsden, Manchester, Vt.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Detroit, Mich., Oct. 26, 27 and 28, 1909.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WIRELESS INSTITUTE. Secretary, Sidney L. Williams, 42 Broadway, New York.

WISCONSIN ELECTRIC & INTERURBAN RAILWAY ASSOCIATION. Secretary, Dudley Montgomery, Madison, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 22, 1909.

[Conducted by Wm. F. Bissing, Pat. Law, 2 Rector St., N. Y. City.]

925,452. BATTERY HOLDER; S. A. Brown, Buffalo, N. Y. App. filed Jan. 6, 1908. For connecting batteries to the instruments which they operate, by means of an insulating plate attachable to a wall and having two pins to which wires are attached.

925,495. REGULATING STEP SWITCH; B. McInnerney, Council Bluffs, Ia. App. filed June 28, 1907. Magnetically operating switches actuated at intervals in which a movable member varies the intensity of the field of the magnetic circuit and a series of unequally disposed switches are within the range of the field.

925,499. DYNAMO-ELECTRIC MACHINERY; C. A. Parsons and A. H. Law, Newcastle-upon-Tyne, England. App. filed Oct. 8, 1906. Regulates dynamos by regulating the voltage as the load increases by means of field magnets, magnetic material in proximity thereto and a winding on the magnetic material with means for supplying alternating current to the winding.

925,504. POWER TRANSMISSION; F. Porsche, Wiener-Neustadt, Austria-Hungary. App. filed Feb. 13, 1909. For driving spindles by means of a shaft, an armature thereon and a spring forming a driving connection between the shaft and armature, together with a second armature carried by the driven shaft.

925,539. FUSE PLUG; A. Weber, Jr., Schenectady, N. Y. App. filed Jan. 16, 1909. A base of insulating material for fuse plugs having a ventilating groove and a ventilating aperture extending from the groove.

925,549. TROLLEY HOLDING AND RETRIEVING DEVICE; J. W. Woodward, Rochester, N. Y. App. filed June 13, 1908. Trolley holding and retrieving device which when the wheel runs off the wire is automatically brought back. The trolley pole spring is automatically disengaged when the trolley jumps and the pole descends by gravity to a point below the wire.

925,551. RHEOSTAT; W. G. Abbott, Jr., Schenectady, N. Y. App. filed July 3, 1907. A resistance stick made hollow so as to provide a passage for cooling fluid.

925,561. SUSPENSION OF HIGH-TENSION LINES; H. W. Buck, New York, and E. M. Hewlett, Schenectady, N. Y. App. filed Oct. 31, 1907. For high potentials. Combines periodically dead ended spans, dead ended at the crossarm through two chains of insulators and intervening spans suitably suspended by means of crossarms.

925,573. TELEPHONE EXCHANGE SYSTEM; W. A. Fricke, Chicago, Ill. App. filed April 11, 1908. Telephone system for houses in which

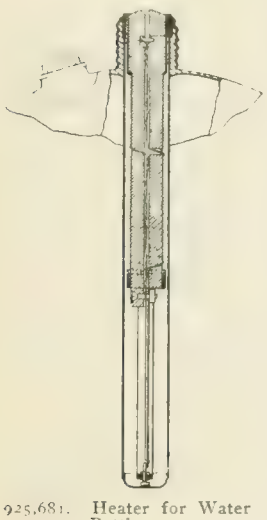
the home keys take part in the control of the application of the battery to the transmitters of telephone lines in addition to resetting the calling keys. The number of retardation coils is reduced.

925,575. AUTOMATIC FIRE ALARM; H. Furlani, Uirano, Austria-Hungary. App. filed Dec. 30, 1908. The alarm is set in operation by the fusing of an insulated mass disposed between conductive members.

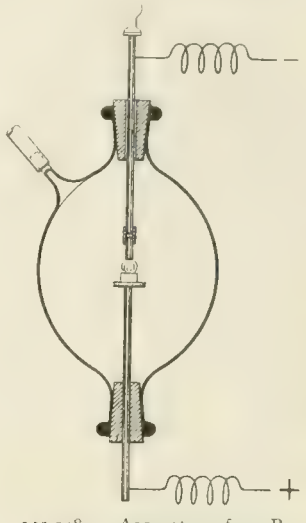
925,594. FAULT LOCATOR FOR ELECTRIC CABLES; W. O. Pennell and H. L. Hoffman, Kansas City, Mo. App. filed May 8, 1908. Varies the current which flows through the conductor by way of the fault and causes said current to induce a current in the circuit of a detecting instrument, the instrument being made neutral with respect to current flowing in the sheath of the cable.

925,599. ELECTROPLATING APPARATUS; J. B. Russ, Shelton, and C. H. Poland, Bridgeport, Conn. App. filed Aug. 19, 1908. The work to be plated is contained in a perforated tumbling drum immersed in an electrolytic solution.

925,606. MEANS FOR AND METHOD OF DETERMINING POTENTIAL GRADIENTS; W. Stanley, Great Barrington, Mass. App. filed



925,681. Heater for Water Bottles.



925,798. Apparatus for Producing Homogeneous Ductile Bodies from Metals of a Highly Refractory Nature.

May 13, 1905. Means and method of determining the potential gradient of a dynamo excited by alternating current.

925,607. SYSTEM FOR GENERATING ALTERNATING CURRENTS; W. Stanley, Great Barrington, Mass. App. filed May 13, 1905. System for generating alternating current and controlling the potential gradient of the current by means of automatic reactions taking place in the system.

925,609. MICROPHONE; H. R. Stuart, Wheeling, Va. App. filed March 21, 1908. Telephone relay having two or more magnetic circuits with a microphone connected therein.

925,611. BLOCK SIGNAL SYSTEM; R. W. Taynton, Tacoma, Wash. App. filed Oct. 19, 1908. For controlling the operation of trains in connection with an interlocking semaphore system of signals. Makes use of a generator, two circuits, a switch connecting either circuit to a line, an electromagnet in each circuit, a common armature for both magnets, and an index on the armature to indicate the circuit to which the switch has connected the line wire.

925,620. VAPOR ELECTRIC APPARATUS; C. Bradway, Schenectady, N. Y. App. filed April 4, 1904. Automatic means for starting the device by creating a gap so as to produce an electrical discharge. The gap is created by an expansible element whose length changes by the heat of the current, said element being initially in circuit with the electrode.

925,622. ELECTRIC RAILWAY SIGNAL SYSTEM; C. M. Cleavland, Wausau, Wis. App. filed June 4, 1908. For warning approaching trains. The train carries an independent source of energy for sending a signal to another train and also a visual alarm. A hollow conductor rail contains the telephone or telegraph conductors.

925,666. ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINE; W. Stanley, Great Barrington, Mass. App. filed May 13, 1905. A dynamo having an automatically compounded field for predetermining and governing the electromotive force.

925,681. HEATER FOR WATER BOTTLES; H. W. Christian, Longbeach, Cal. App. filed May 18, 1908. A water bottle with a casing extending therein and a built-up device fitting in the casing, comprising a heating coil and adjustable means for short circuiting a portion of the coil until a prearranged temperature is reached.

925,708. APPARATUS FOR VENTILATING AND COOLING STORAGE BATTERY SYSTEMS; S. Lake, Bridgeport, Conn. App. filed Oct. 31, 1908. A suitable air duct extends throughout the length of the battery compartment and is provided with a series of branch pipes extending through the covers of the cells. Particularly for submarine boats, the air duct being provided with a suction fan and having a discharge end extending through the top of the hull of the vessel.

925,732. ELECTRICAL SWITCHBOARD FOR THEATERS; C. T. Waddell, Birmingham, Ala. App. filed Feb. 21, 1906. A one or two pole board manipulated to produce the dissolving or blending of the colors and containing a minimum number of dimmers.

925,737. TELEGRAPH KEY; L. Wilson, Sidney, W. Va. App. filed March 11, 1908. A telegraph key with a secondary lever disposed over the key and arranged to automatically open and close the circuit upon gripping the key or releasing the key in the sending of the message.

925,756. TELEPHONY; G. C. Cummings, Western Springs, Ill. App. filed July 28, 1908. A telephone system with a plurality of receiving stations with receivers included in conductors which offer different degrees of deflective resistance to the voice currents, the conductor nearer the transmitting station having more effective resistance than each more distant conductor.

925,775. APPLIANCE FOR USE WITH TELEPHONE TRANSMITTERS; E. F. Hutton, New York, N. Y., and G. A. Ellis Jr., Bay Shore, N. Y. App. filed June 20, 1908. The telephone transmitter stand is placed inside the casing with sound-proof walls, the mouth of the casing being arranged to accommodate the face of the speaker.

925,776. ELECTRIC CURRENT REGULATOR; H. A. Keip, Rochester, N. Y. App. filed Oct. 1, 1908. A resistance wire with a split drum about which the wire is wrapped, made of spring material and held against expansion by the resistance wire.

925,798. APPARATUS FOR PRODUCING HOMOGENEOUS DUCTILE BODIES FROM METALS OF A HIGHLY REFRACTORY NATURE; W. Von Bolton, Charlottenburg, Germany. App. filed Sept. 29, 1905. For making ductile metals from the rare elements, by means of an exhausted air chamber containing electrodes, one of them provided with means for supporting a powder of the metal to be acted upon and the other adjustable.

925,806. APPLIANCE FOR USE WITH TELEPHONE TRANSMITTERS; O. H. Goodrich, Castleton Corners, N. Y. App. filed Sept. 14, 1908. Enclosing casing with a circuit-changing switch, and a door for the casing with an opening for the face, a telephone transmitter stand being inside the casing.

925,808. LIGHTING ATTACHMENT FOR GASEOUS FUEL BURNERS; C. E. Heft, Portland, Ore. App. filed June 5, 1908. Automatic lighting attachment for gas stoves, including a gas tube, a valve therefor, lever secured thereto, and a connecting rod pivoted to the lever and associated with the main burner valve, together with a shaft carrying a contact to produce the ignition.

925,823. SHIELD FOR CIRCUIT WIRE CONNECTIONS; T. E. Murray, New York, N. Y. App. filed Sept. 2, 1908. To prevent access to the circuit wires where they enter a block or holder, shown in patent No. 905,905, by means of a detachable tubular shield.

925,830. MULTIPLE CLUSTER LAMP RECEPTACLE; F. S. Ober, New York, N. Y. App. filed Feb. 26, 1909. For two, three or four incandescent lamps which project radially from the cluster. Made up of a blank comprising a plate with integral curved corrugated extremities constituting threaded shells.

925,884. ALTERNATING-CURRENT, DYNAMO-ELECTRIC MACHINE; B. Elshoff, Norwood, Ohio. App. filed Nov. 30, 1906. Induction motors with means for operating a short-circuiting switch. Has means for shifting an axially movable contact, comprising a toggle mechanism located within the collector rings and a push button for operating the toggle.

925,925. TELEGRAPH TRANSMITTER; C. W. Leiser, Salt Lake City, Utah. App. filed Jan. 29, 1909. Separate keys are employed, one operating the line circuit direct for making dashes and the other operating the local circuit to produce dots. Details.

925,951. MAGNET; H. Ruthardt, Stuttgart, Germany. App. filed April 3, 1908. A field magnet for magnetic inductors, such as ignitors, with a C-shaped plate forming part of the field and a circular armature gap therein, the plate gradually increasing in width toward the gap.

925,976. HIGH-SPEED DYNAMO-ELECTRIC MACHINE; A. H. Wouters, Norwood, Ohio. App. filed Nov. 3, 1906. For turbo generators. Provided with a field yoke, separable field poles and distributed auxiliary field coils on the inner ends of the poles, together with additional means for holding the coils so that the main field coils may be removed without disturbing the auxiliary coils.

925,991. VENTILATING MEANS FOR LAMINATED CORES; A. J. Brown, Norwood, Ohio. App. filed Oct. 19, 1905. Permits the free circulation of air by proving a spacer for the laminae comprising a U-shaped member with a lateral projection.

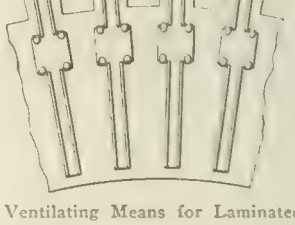
925,994. OIL SWITCH; H. W. Cheney, Norwood, Ohio. App. filed Aug. 30, 1905. A switch with a pair of contacts both movable, with contact rods on which the contacts are supported extending out of the tank through the cover.

925,995. CONTROLLER; H. W. Cheney, Norwood, Ohio. App. filed Jan. 8, 1908. A rheostat having a brush movable over contacts, carried by a pivoted arm with a spring rotatable about the same pivot as the arm, with means for preventing relative movement of the spring and arm unless the spring is first raised from the brush.

926,001. SWITCH; G. W. Hart, Hartford, Conn. App. filed Oct. 15, 1908. A push-button switch which can be operated manually at the switch, and also electromagnetically from a distance. Details.

926,020. TROLLEY ATTACHMENT; F. V. Polakoskey, Peekskill, N. Y. App. filed June 23, 1908. Keeps the trolley on the line and provides an additional means of conducting current from the line.

926,022. ELECTRIC BLOCK RAILWAY SIGNAL; E. B. Samuels, Deatsville, Ky. App. filed Oct. 22, 1907. For electric block railway



925,991. Ventilating Means for Laminated Cores.

signals in which the train automatically sets the signals by spreading spring arms through contact with the wheel of the train, which arms control the circuits.

926,057. ADJUSTABLE SUPPORT FOR VAPOR LAMPS; Stanwood E. Flichtner, Englewood, N. J. App. filed Jan. 9, 1905. A bracket which permits tilting of the lamp so as to start it.

926,069. PROCESS OF TREATING METALLIC FILAMENTS FOR ELECTRIC INCANDESCENT LAMPS; W. Majert, Berlin, Germany. App. filed July 10, 1908. The process of cleaning metallic filaments by highly heating them twice in succession by an electric current, the first time in a neutral gas atmosphere and the second time when they are in a practically evacuated space.

926,086. DYNAMO-ELECTRIC MACHINE; B. A. Behrend, Norwood, Ohio. App. filed Aug. 21, 1905. An annular stationary member for dynamos having circumferential air passages closed at the inner periphery, and at its middle an enlarged circumferential air passage open at the inner periphery and communicating with the first passage.

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The Institute Convention.

A very interesting and enjoyable convention of the American Institute of Electrical Engineers was held at the Thousand Islands last week. It was notably sociable, for one thing, a kind of house party on a large scale. A better attendance might have been expected and was indeed desirable, for a gathering of less than 300 can hardly be regarded as representative of a society with a membership of over 6000, of which 30 per cent lies probably within a striking distance of 500 miles from the Hotel Frontenac. Indeed, we believe that, had a little time been given to publicity work as to the many attractions of such a delightful resort, the figures of attendance would have been very largely increased. In general enjoyment there has been no such convention since that of happy memory at Great Barrington, Mass., but the diversions were not distractions, and all the sessions were remarkably well attended. Moreover, there were delegates from no fewer than 25 sections and branches—not counting New York—and the dinner, devoted to a discussion of "What Shall We Do with Our Sections?" or words to that effect, was crowded and enthusiastic to a most significant extent. It is evident that the Institute and other kindred bodies are reaching a very important stage of their development in regard to this question of sections—technical, territorial, local, interrelated, popularized and other kinds—and the happy solution of that problem will mean much for engineering in America. Elsewhere in this issue will be found several pages of reports and abstracts.

Power Characteristics of the Tungsten Filament.

An interesting article, by Dr. Steinmetz, on the power characteristics of the tungsten filament incandescent lamp appears on page 89 of this issue. The article gives a number of photometric and electric observations on a particular tungsten lamp, between the limits of 2 horizontal candle-power and 320 horizontal candle-power. The power consumed ranged from 12.3 to 123 watts, or increased tenfold; while the current increased in the ratio 2.35, the voltage in the ratio 2.05, and the inferred resistance in the ratio 1.8. Taking the electrical observations, Dr. Steinmetz shows that the power consumed by the lamp increases as the 1.6th power of the terminal voltage, the agreement between the observations and this relation being remarkably close. The deviations are all less than 1 per cent. The article shows, moreover, that if the resistivity of tungsten is in direct proportion to the absolute temperature, and if the power dissipated is all radiated according to the Stefan law of the fourth power of the absolute temperature, then the power must increase as the 1.6th power of the terminal voltage. The deduction is, therefore, that the resistivity of tungsten must be closely in proportion to the absolute temperature. Data on this point are still very scarce, but the resistivity is known to be at least approximately proportional to the absolute temperature, like that of other pure metals. For ex-

ample, very nearly pure copper, whose resistivity behavior is best known to us, acts as though its resistivity were proportional to an absolute temperature commencing at or near −238 deg. C., instead of −273 deg. C., as reckoned by chemists and steam engineers. If copper resistivity were proportional to the chemists' absolute temperature, its temperature coefficient would be 0.366 per cent, like that of gas expansion, instead of 0.42 per cent, as actually observed.

We may, however, in spite of trivial dubitations of the above nature, safely say that the watts as the 1.6th power of the terminal volts is a rational physical law of the tungsten filament reported; whereas, the hysteretic watts as the 1.6th power of the flux density in cyclic magnetization is still only an empirical law, not yet accounted for. In fact, it seems likely that the hysteretic 1.6th power is connected with some law of probability for the rupture of magnetic chains in vast hordes of molecular magnets cyclically rotated about their axes. Indeed, the power is believed to increase slightly at high flux-densities in a gradual manner out of keeping with a precise physical law. We owe, then, two 1.6th laws to Dr. Steinmetz, one, as yet an empirical law of hysteretic energy loss, and the other this new and physically explainable law of power in a tungsten filament, as a function of terminal voltage. The series of tests contained in the article indicates, besides, that the horizontal candle-power of this lamp was approximately proportional to the square of the watts supplied. Thus, taking 32 cp at 39.3 watts, the lamp, at three times the power, or 117.9 watts, should give nine times the candles, or 288. Test No. 25 of the table indicates that 288 candles were, in fact, observed at 117.9 watts. The agreement at this point is exact with a law of squares. It is, however, only maintained within a few per cent throughout the entire series, and is by no means so close as in the electric 1.6th power relation pointed out. Below 10 cp the deviation is considerable. It would be interesting to have this relation tested in other lamps. Photometric observations might naturally be expected to have less precision than electric observations, especially with change of color at low candle-power.

Complete Solution of Transmission Line with Distributed Capacity and Leakage.

As power transmission by electric currents increases year by year, both in kilowatt capacity and in distance of transmission, electrical engineers are beginning to raise their formulas for alternating-current line calculation. In the very early days of alternating-current delivery, when the distances covered were very short, Ohm's law, as known in direct-current service, was applied. In other words, nothing was taken into account in line calculation except ohmic resistance and ohmic drop of pressure. As the line lengths increased from stone's throw to common-shot range, inductance and reactance were found to be worthy of consideration, if any degree of precision was to be attained, and the line calculations were changed to include reactance and impedance drop. About twenty years ago the introduction of high-voltage alternating-current transmission from Deptford to London was found to be accompanied by a slight rise of voltage toward the receiving end of the line at no load. This unexpected phenomenon was named the Ferranti effect. An investigation of this phenomenon led to developing the whole theory of transmission over long lines at any practicable frequency. This theory included distributed resistance, inductance, capacity and leakance. It was worked out and published by various engineers, along different lines, but was far in advance of the transmission needs of that time.

Soon afterward, however, the transmission lines became long enough to require taking their capacity into account. This was done by lumping the capacity either into one middle condenser, or into two equal terminal condensers. The latter is usually the simpler device. It gives a practical and simple set of line formulas sufficiently nearly correct for all present transmission requirements. When, however, the line is made very long, or the frequency is increased to harmonic ranges, the split condenser plan is unreliable, owing to lumpiness error. It is known that a simple formula can correct the split-condenser method for lumpiness, but the usual plan is to fall back upon the formulas for distributed constants. The line engineers are beginning to be practically interested in the complete line theory. It is at present impossible to write down short accurate formulas for long line calculation with distributed constants, unless hyperbolic functions are used. Using algebraic and circular functions, the formulas are all long and unwieldy. It is merely a choice between them as to which is the least long or least unwieldy. An able paper recently presented on this subject to the Frontenac convention of the American Institute of Electrical Engineers developed some practicable formulas that appear to establish a record for length in engineering literature.

The interesting article on page 90, by Dr. Harold Pender, who has a happy faculty for bringing complicated cases of analysis within the range of engineering computation, gives a skilful solution of the same problem, and presents formulas that are accurate in deduction and in practice workable. Until we can avail ourselves of complete tables of hyperbolic functions, it would seem that the formulas in this article are the shortest yet offered, when the full line treatment is required with distributed constants, including leakance. The example worked out in the article relates to a 700-mile three-phase transmission at 25 cycles per second. This is a much greater transmission-distance than any yet covered in practice. Nevertheless, at the frequency of 25 cycles per second there is hardly any difference, from a practical standpoint, between the solutions of this problem by the split-condenser method and by the full line method with distributed constants, such as is given in the article. Consequently, although the full computation which Dr. Pender's formulas render practicable is well to fall back upon, engineers will not go far astray if they continue to rely for preliminary estimates on the shorter condenser methods of line calculation.

Influence of Alternating Current Upon Life of Tantalum Lamps.

It is well known that incandescent lamps provided with filaments of tantalum do not last so long on alternating-current mains as on direct-current mains, all other conditions being alike. Moreover, it has been found that the higher the frequency of the alternating current, at least up to 120 cycles per second, the greater the depreciation in life, in something approaching direct proportion. A low-power microscopic examination of tantalum filaments which have been quickly slaughtered on the altar of

a high-frequency alternating-current service, has shown that their surfaces have lost their pristine glossy smoothness and have taken on a remarkable roughly crystalline appearance, in blocks that call to mind the basaltic pillars of Fingal's Cave. The same disrupted semi-crystalline surface condition may also be observed in tantalum filaments which have died a more prolonged and natural death on direct-current service; but in these, the degree of disruption and disintegration appears to be less marked.

The reasons for the more rapid deterioration of tantalum filaments under alternating-current supply have been recently investigated by Prof. O. Scarpa, in an article discussed by the *Elektrotechnischer Anzeiger*. A number of such filaments were arranged to be operated either by alternating or direct currents, at will, while under examination in a microscope. It appeared that the microscopic image of the filaments was larger with alternating- than with direct-current operation, a condition attributed to rapid transverse vibrations of the filaments. When the filaments are new, their mechanical condition is amorphous. When old, and broken down under alternating-current operation, it is highly crystalline. The disruption of the filament occurs in passing from the amorphous to the crystalline condition. The circumstances that are most favorable to the transformation of any material from the amorphous to the crystalline state are temperature elevation and mechanical vibration. In these tantalum filaments the temperature elevation is nearly the same with alternating- and direct-current operation, although it tends to be a little higher, in each cycle, with the former operation, especially at low frequencies. Since, however, the destructive effects of the alternating current are greater with higher frequencies, it seems safe to conclude that the temperature effect is substantially the same in both alternating- and direct-current operation. But in regard to vibration, the filaments supplied with alternating current have a much more active and exciting experience than those supplied with direct currents.

The vibrations excited in filaments supplied by alternating current may be either of thermal or of magnetic origin. The temperature of a filament subjected to alternating-current operation must fluctuate through a certain range, with double the frequency of the current, and this alone might be expected to produce some vibration of the filament, due to slight periodic changes in length by contraction and expansion. The magnetic vibrations are caused by the motor forces acting on each part of the filament in the magnetic field at its location. The earth's magnetic field alone would be capable of setting up a certain small range of vibration, but the local field is in a larger measure produced by neighboring parts of the same filament. At each reversal of the current the motor force on each portion of the filament either reverses sign, or waxes and wanes, thus tending to set up vibrations, either of the same or double the frequency of the current. We may, therefore, infer that because vibration should occur theoretically in such a filament under alternating-current operation, and is actually observed to occur; and also because such vibration is known to favor crystallic degeneration in a metal—the disintegration of tantalum filaments on alternating-current service is at least in part accounted for. It may still be unsafe to assume that all of the destructive action of alternating currents is due to mechanical vibration. There might be additional, deeper-seated, and more complex molecular actions.

LARGE RAILROAD TERMINAL PLANT.

The new station of the Chicago & Northwestern Railroad, described elsewhere in this issue, is one of the big things of the City of Superlatives. It is not only of very exceptional size, but it is beautiful and well planned. As in most recent terminal stations, the very large electrical supply required for lights and motors is provided by a special plant, in this case of more than usual interest. The output required for the terminal building rises to more than 500 hp in motors, aside from all the lighting demanded by an area of 13 acres in use day and night, and necessarily lighted with exceptional brilliancy. The new power plant is therefore big and planned for the most economical operation. The feature of greatest interest in it is the dynamo and prime mover equipment, in which the exhaust steam turbine plays an important part. The main generators are three 250-volt, 750-kw units driven by compound non-condensing engines. In conjunction with these is a 500-kw exhaust steam set, the turbine being of the Rateau pattern, and guaranteed to deliver the kw-hour on 43.5 lb. of steam at 1 lb. gage pressure with 27-in. vacuum. This is a good performance for such a unit. It will be most interesting later to learn what the practical economy of the scheme may be as thus applied to a new and carefully designed plant. The condenser plant for the turbo-generator is equipped with a cooling tower.

Electrically—the system being intended mainly for work in a very limited area—it is in the main a direct-current proposition with balancer sets to take care of the three-wire distribution. For the yards and freight houses, however, the distances are inconveniently long, and we find the very unusual feature of motor-generators with 250-volt, direct-current motors and 6000-volt, three-phase generators for the long-range work—a complete reversal of every-day precedents brought about by the unusual conditions of distribution. There are two such sets each of 500 kw capacity. In a general way, the plant presents few special mechanical features, automatic conveying and stoking being applied as usual to the regulation thing in water-tube boilers. It is a little surprising not to find the elevators in the main building electrically driven in preference to sending live steam from the power house 1500 ft. to work the pumps. We should have been disposed to think that the balance of economy in such a case would have been on the side of the electric drive. We most earnestly hope that the economic results of this plant will be made public after it has been in service a sufficient period. Data on really large and first-class isolated plants are scarce and not always reliable. Here, however, is a generating station of considerable output working under rather favorable load conditions and designed with economy especially in view. It ought to give excellent results and we want to see them in due time published. The use of exhaust steam is particularly interesting, and we are anxious to learn what the net total water consumption per kw-hour may be under these unusual conditions. The guaranteed steam consumptions for both reciprocating engines and turbines are good, yet it is to be proved how the two will work together, as compared with a regular condensing plant of either kind.

Convention of National Electrical Contractors' Association.

Arrangements for the convention of the National Electrical Contractors' Association, to be held at Toledo, July 21, 22 and 23, have been practically completed. The headquarters of the convention will be in the Boody House, and the open meetings will be held in the auditorium of the Chamber of Commerce. It is expected that the convention will be one of the most successful in the history of the association, invitations having been issued to all contractors, whether electrical or not, to participate as non-members in the open meetings. Among the social features will be a ladies' trolley ride up and down the Maumee Valley, with a luncheon at the beach. July 23 will be devoted to an outing, one of the features of which will be a baseball game between Eastern and Western contractors, captained by Mr. Jas. R. Strong, of New York, for the Eastern team, and Mr. E. McCleary, of Chicago, for the Western team.

At the open sessions on the mornings of July 21 and 22 a number of addresses will be delivered on subjects of interest to electrical contractors. These will include an address by Mr. W. H. Blood, Jr., of Boston, on "The National Electrical Code and the Relation of the Contractor to the Central Station," and another by Mr. Jas. R. Strong, of New York, on "The National Electrical Contractors' Association." Mr. E. L. Elliott, of New York, will address the meeting on the subject of "Illuminating Engineering in the Contracting Field," and Mr. Geo. C. Nimmons, of Chicago, will have as the subject of an address, "The Relation of the Contractor to the Architect." Two other subjects will later be added to this program, which will be considered at open meetings on the mornings of July 21 and 22. The principal topic to be discussed at the closed or business meetings of the association will be license legislation in the various States.

Three Aspects of Railroad Electrification.

At the meeting of the Electric Club, of Chicago, on June 30, Secretary W. S. Taussig presided and the speaker of the occasion was Mr. Edward N. Lake, a division engineer with the Board of Supervising Engineers, of Chicago. Mr. Lake said that he would give a three-phase talk—that is, consider his subject under three aspects. These were the growth, centers and systems of the electric railway, with particular reference to the electrification of steam railroads. The speaker sketched the development of electric street and elevated railways and also the development of electricity as applied to the operation of steam railroads. He mentioned the fact that at the Louisville Exposition of 1883 a small electric locomotive was shown; but nevertheless it is only about two years since the important electrification of the New York Central terminal was accomplished. The commercial world is loth to take up anything new; but when it does take it up, the growth of anything really meritorious is remarkable, as has been the case with the electric railway.

Mr. Lake gave a table showing the growth of the street-railway systems of the United States. In 1890 there were 8123 miles of single-track street railways in the United States, of which 1262 miles were operated by electricity, or 15.5 per cent. In 1907, 17 years later, the total number of miles of street railways was 34,404, of which 34,060 miles were operated by electricity, or 99 per cent. Electric railways have developed suburban areas, and so suburban lines have extended. The tip ends of these suburban lines in nearby areas of population have been connected by interurban electric railways. Thus, the development of the electric railway has been by zones around centers of population: First, urban lines; next the suburban, then the interurban, and now there are a few examples of electrified steam-railroad terminals serving a still wider zone of suburbs and adjacent towns. New York has two electrified railroad terminals and Boston likely will soon have another. It is probable that these zones will in the future be connected by an electric trunk-line railway.

Within the next 10 years it is probable that there will be great activity in the line of the electrification of steam railroads. New York is the great Eastern center of population from which electrified steam roads may be expected to reach out toward other population centers. Chicago may be considered as a similar center for the Middle West. A circle having a radius of 400 miles, with New York as its center, includes all or the larger part of 13 States. A similar circle, with Chicago as its center, includes all or a large part of nine States. Comparing these groups, Mr. Lake showed that in population they were about the same and together included nearly two-thirds of the entire population of the country. In land area in the United States the Chicago group is about twice as large as the New York group and also in railroad mileage the Chicago group has twice the mileage of the New York group. In commercial values of railroad operating property the two groups are about the same. As electrification proceeds these two centers will undoubtedly be electric-railroad centers as they are now steam-railroad centers.

Railroad electrification is a simple matter in its elements and only affects a small percentage of the value of the railway property. It means the substitution for the steam locomotive of three electrical elements: generating, distributing and motive systems. On June 30, 1908, the estimated value of all steam railroad property in the country was $13,000,000,000. Of this the locomotives represented a value of $632,500,000, or 4.86 per cent of the total value. As the average life of a steam locomotive is only about 20 years it is apparent that each of the locomotives displaced by electricity will have abundant opportunity to finish its life on some branch line or remote service, so that no loss by "scrapping" of serviceable equipment need be apprehended. The average nominal horse-power of the steam locomotive is about 500, while the stationary units of a modern electric-power station have a rating of from 10,000 hp to 20,000 hp.

In the New York electrified railroad terminals two different systems have been installed and are in process of trying out. One makes use of the direct current delivered by a third-rail; the other makes use of alternating current delivered by an overhead trolley wire. Similarly in the Middle West in the railroad tunnels under the St. Clair and Detroit rivers, one of which is now building, these two systems will be tried out. The Port Huron tunnel under the St. Clair River is operated by alternating current and the Michigan Central tunnel, now under construction under the Detroit River, will be equipped for direct current. This trying out of the two systems side by side is fortunate for the ultimate development and success of steam-road electrification. Railroad men using these two systems advocate the one with which they are most familiar, but partisans of both sides unite in an emphatic endorsement of the general advantages of using electrically transmitted power for the operation of railroad trains.

Large Fire Loss from Oil Transformer Explosion.

In a recent note brief mention was made of the partial destruction by fire of the station of the Trinidad (Col.) Electric Light & Power Company. From later information it is learned that the total loss was somewhat under $100,000, and that the fire was primarily due to the arcing over of a rotary converter, which short-circuited coils in three oil transformers installed on a wood floor in the same building. Probably owing to low oil, in the case, one of the transformers, which blew the top off, rent holes in the side and scattered burning oil over the wood floor. Within a few minutes the engine-room was untenable, and by the greatest effort only were the fires drawn under boilers and danger of explosion averted before the boiler-house roof fell in. The fire department was helpless when it did arrive, as oil had been by that time blown about from all the transformers in the station. The switchboard was dropped through to the basement. The new high-tension portion of the station was not cut off by a fire wall and was completely destroyed. The only pieces of apparatus in the entire station

not seriously injured were the boilers, two steam turbine units and the storage battery, which latter was only partially cut off and suffered considerable damage from broken plates and jars. No insurance policies were in force, as upon the reorganization of the company a few years ago the risk was re-rated with increases owing to wood floor in bad condition, oil transformers on wood floor and large masses of combustible insulation beneath the wood floor from generators to switchboard. As a consequence the company concluded that it could better afford to carry its own insurance, though the result has hardly borne out this belief.

Joint Wisconsin and Northwestern Convention.

The Wisconsin Electric and Interurban Railway Association and the Northwestern Electrical Association held a joint meeting at the Grand View Hotel, Chain O' Lakes, near Waupaca June 28 and 29. This summer meeting was called by the officers of the two associations to furnish a means of discussing operating topics of interest to electric railway and light companies and incidentally to give members a chance for a brief outing. Sixteen electric railway and lighting companies of Wisconsin were represented. The sessions were presided over alternately by Mr. Clement C. Smith, of Milwaukee, president of the Wisconsin Electric and Interurban Railway Association, and Mr Ernest Gonzenbach, of Sheboygan, president of the Northwestern Electrical Association.

One of the important results of the meeting was the consolidation of the two associations, which has been talked about for some 18 months as being desirable and probably inevitable. The sentiment was unanimous in favor of this consolidation, inasmuch as both associations are now practically limited to the State of Wisconsin. Years ago the Northwestern Electrical Association was formed to cover a number of States, but the organization of various State associations within the territory has gradually limited the association to the State of Wisconsin. The Wisconsin Electric and Interurban Railway Association, consisting of electric railway and lighting companies in the State of Wisconsin, was organized recently with the double object of having occasional meetings for the discussion of operating topics and for taking up various matters in connection with the Wisconsin commission and Wisconsin Legislature The consolidation of the two associations has been hindered somewhat by the fact that the Northwestern Electrical Association has not technically been limited to the State of Wisconsin Under the new arrangement, individual membership in the association, without vote, but with all other privileges of the association, is given to all former individual members. Individual membership will cost $5 per year. The company or Class A members, with voting power, pay dues at the rate of one-tenth of 1 per cent of their gross receipts.

The question of consolidation of the associations was first brought up in an executive committee meeting of the Northwestern Electrical Association the afternoon of June 28. It then appeared from the statement of the secretary and treasurer, Mr. John S. Allen, that the records and finances of the Northwestern association are in very bad shape. There is no authentic list of Northwestern members, and the association has unpaid bills of over $300, with no money in the treasury. After considerable discussion it was decided to recommend to the two associations a consolidation, to be carried out as follows: The name of the association is to be the Wisconsin Electrical Association. The membership is to consist of companies and individuals as before outlined. Various company members of the Wisconsin association agreed to subscribe enough to wipe out the debt of the Northwestern association, thus allowing the consolidated association to start with a clean slate. Dues are to be paid beginning with Jan. 1, 1910. Owing to the incompleteness of records, no attempt will be made to collect delinquent dues All present and former members wishing to continue membership will pay alike, beginning with Jan. 1, 1910.

This plan of the executive committee was presented to the association at the morning session June 29 and was unanimously adopted by both associations. The executive committees of the two associations were then directed to draft a constitution and by-laws and nominate officers to serve until the annual meeting in January, 1910. At a special meeting held at 2 p. m., June 29. Mr. C. C. Smith, speaking for the joint committee, reported in favor of a constitution the same as that of the Wisconsin Electric and Interurban Railway Association, with the additional provisions for membership recommended by the executive committee as already outlined. The committee placed in nomination two tickets, one consisting of the former officers of the Wisconsin association and the other of the former officers of the Northwestern association. The election resulted in a mixed ticket from the officers of the two associations, as follows: Mr Ernest Gonzenbach, of Sheboygan, formerly president of the Northwestern association, was elected president; Mr. Clement C. Smith, of Milwaukee, former president of the Wisconsin association, was elected first vice-president; Mr. Irving P. Lord. of Waupaca, was made second vice-president, and Mr. George B. Wheeler, of Eau Claire, was made third vice-president. The secretary and treasurer is Mr. John S. Allen, of Lake Geneva, formerly secretary of the Northwestern association.

This consolidation will result in one good, strong association for Wisconsin, and will relieve the uncertainty as to the future of the Northwestern Electrical Association which has been hanging over it for some eight years past. Every one was agreed as to the importance of keeping up the work of the Wisconsin Electric and Interurban Railway Association as regards legislative matters.

Lest there be some misunderstanding as to just what this work consists of, a brief account of the association's method of handling legislative matters is apropos. It is well known that whenever a State Legislature convenes numerous bills are proposed which are ill advised and likely to do damage to the industries which they affect. It is necessary that the bad points of these bills be made clear and brought out forcibly to the attention of legislative committees or other members of the Legislature if the passage of such legislation is to be avoided Under the old methods of handling these matters, the smaller companies of a State were obliged either to ignore such injurious proposed legislation and trust to luck that it be not passed, or go to considerable expense and trouble to present their cases individually. The plan now in use in Wisconsin, and rather imperfectly carried out in some other States also, is for the association to employ some competent attorney to keep track of proposed legislation affecting electric railway and lighting companies and to present openly to the committees or to the individual legislators reasons why such legislation should not pass. The expense of maintaining this service by a competent attorney is borne by the various members of the association, and the cost is much less than if dependence were placed in the individual efforts of various companies. In many cases the managers of individual companies would take chances on the passage of a bill rather than go to the expense of a trip to Madison. Under the present arrangement no such chances need be taken as to obscure measures, as the association's attorney watches all legislation affecting its members.

At the first session, which was held Monday morning, June 28, Mr. E. W. Fairchild, of Milwaukee, the attorney who has handled the association's legislative matters for the past year. made a report on recent legislation in Wisconsin affecting public utilities. He said that but little legislation affecting such utilities had been passed the last session. The reason for this is that the public-utility law providing for the commission has solved so many of the problems which come up in connection with public utilities. Matters are now left to the commission which formerly would have been the subject of bills before the Legislature. He called attention to the large amount of work involved in keeping track of proposed legislation. Every bill must be read carefully sentence by sentence, because some overlooked paragraph or joker in a bill may be of great importance and may be passed by the Legislature without full knowledge of its intent. The most radical measures in Wisconsin now originate with what are called the "Socialist" members. While these

members are in the minority and cannot pass measures which are known by the name of "Socialist," their ideas find more favor than in former years, because of a gradual change in public sentiment.

Amendments to the Wisconsin public-utility law were made last session to cover the following points of interest to electric light companies: The time before which companies may voluntarily give up their franchises and avail themselves of an indeterminate franchise under the power of the commission, was extended from July 1, 1908, to Jan. 1, 1911. On the latter date the question may be reopened as to whether all companies shall be forced to give up their franchises and take indeterminate permits. Mr. Fairchild said that it looked very much as if such action would be taken in 1911. The Wisconsin commission is very much in favor of the indeterminate permit idea, on the grounds that a definite period of expiration of the franchise involves uncertainty as to the future of the property and necessitates higher rates than would be necessary if the company could continue to do business indefinitely on its good behavior.

Another change in the utility law makes it necessary to have a vote of the people in a city or town before any public utility can be purchased by the municipality. The law now makes prosecution of those caught stealing electricity easier than before, because it removes the value limitation previously imposed. The law regarding uniform rates to consumers has been modified so that a company can legally give a lower rate to a consumer who provides part of his equipment in the way of meters, lamps, etc., than to one who does not provide such equipment, but requires it to be furnished by the company.

In the discussion which followed, Mr. Fairchild was asked as to whether there seemed to be any likelihood that the present commission law of the State would be repealed, as there had been some agitation on that subject. Mr. Fairchild replied that he thought such a move extremely improbable. The movement against the commission originated in one town which failed to get reduced rates in a certain hearing, and had made but little progress. The Legislature and commission are working in very close touch and harmony, and the ideas of the commission on any subject are taken almost as law by the Legislature.

Mr. R. T. Gunn, general manager of the Eastern Wisconsin Railway & Light Company, Fond du Lac, read a paper on "Purchase of Coal on Straight Contract or Heat-Unit Basis," which will be printed in abstract in another issue, together with a discussion on that subject.

On Thursday morning Prof. Cyril M. Jansky gave a talk on the work which the University of Wisconsin is doing to spread scientific information of every-day use among those engaged in various industries. The old idea, he believed, was to cultivate culture simply for culture's sake, and that culture was only for gentlemen. To advance the welfare of a people scientific principles must be applied to all things industrial. Scientific knowledge must be made to permeate down among the masses. He then told of the Wisconsin university extension work which is being conducted to help men in various industries to learn more about the processes which they handle and to become instructed in the principles and so become more effective and useful members of society and better employees of the companies for which they work. These courses are carried on by correspondence and by occasional visits of instructors to places where classes may be formed. The general plan is to fit the work to the individual in each case, which, of course, involves much work by the instructors. The work is carried on by means of a State appropriation for the purpose, but a nominal fee is charged for tuition because people in general do not appreciate things which are free. The work differs from ordinary commercial correspondence-school work in that it is not a commercial or money-making scheme, being supported by the State.

Professor Jansky's remarks were received with much interest and appreciated by the managers present, and it appeared from the discussion that all prized the opportunities which this university extension work offers to men in the employ of the various companies who wish to become better posted along various lines of value to themselves and their companies. Mr. John S. Allen, of Lake Geneva, spoke specifically of having a boiler-room man who is looking for just this kind of instruction. Mr. Clement C. Smith suggested that where there is a group of properties or network of interurban lines, classes might be formed to meet at some central point. The question was then asked as to the effect on the men of such instruction and whether it did not soon result in their employment by other companies in better positions. The consensus of opinion and experience seemed to be that men who work diligently at correspondence or other courses are likely to become too valuable to remain in the same position long, but this was not considered an objection to the plan, but rather as a proof of its success. As one member put it, "We want the kind of men that are going ahead. We do not want men that no other company wants." Mr. R. T. Gunn said that the employees of his company had derived much benefit from a kind of instructional meeting which is held every two weeks.

Mr. Ernest Gonzenbach emphasized the point that there is really no place on an electric railway system for a purely unskilled laborer. Even the least skilled man of the lot who is worked along the track needs a certain amount of special knowledge, and the scale of wages should be such as to hold these specially good men. Considerable was said during the discussion about better instruction of men in the boiler-room. Mr. Gonzenbach thought that more intelligent men were needed in the car shop even more than in the boiler-room. Mr. C. N. Duffy expressed much appreciation of the address of Professor Jansky and of the university work of which he spoke. He thought the point should be strongly emphasized that the greatest work that the university can do is in the instruction of the unskilled laborer. The more men there are who leave operating companies because they are too good for the companies the better it will be for all of the companies. All that had been said about need for better knowledge in the boiler-room equally applied to the common worker in the accounting department.

In closing Professor Jansky called attention to the university's six weeks' summer school for artisans, in which those taking correspondence work can come to the university and have the advantages of the regular laboratories and learn laboratory methods. Nearly everything can be learned by correspondence except knowledge of laboratory methods and apparatus, and this can be obtained in the six weeks' summer course.

Mr. Ernest Gonzenbach gave a talk on "Desirable Kinds of Business," an abstract of which will be given in another issue.

Another Large Mexican Hydro-Electric Plant.

Manuel Cuesta, of Guadalajara, who is at the head of the Chapala Power & Irrigation Company, which has just been organized with a capital stock of $8,000,000 Mexican money, says that the hydro-electric plant which the company will construct for the purpose of providing water for irrigation will cost more than $2,000,000. It is probable that two of these power plants will be built—one to be located on the Santiago River near Guadalajara and the other on a stream that empties into Lake Chapala. Transmission lines will be built to operate the pumps which will be located upon the shore of Lake Chapala, the water of which will be used to reclaim 75,000 acres of land. The Government loan of $3,000,000 which was recently made to the company is secured by a lien upon the land that is to be reclaimed on a basis of $100 per acre. An additional loan of $2,000,000 has been made the company by the Caja de Prestamos, or Loan Bank, of this city. This money will be used to build about 110 miles of main irrigating canals, and to establish three pumping stations. While the first unit of this great system of irrigation will provide for the reclaiming of 75,000 acres of land, the plans when completely rounded out will involve the irrigation of more than 500,000 acres. The Pimintel interests of the City of Mexico, which own the street railway, light and power systems of Guadalajara, are associated with Mr. Cuesta in the enterprise.

Convention of the American Institute of Electrical Engineers.

General Report of the Proceedings at Frontenac, New York, June 28 to July 1, 1909.

THE twenty-sixth annual convention of the American Institute of Electrical Engineers, held at Frontenac, June 28 to July 1, was one of the most pleasant in the history of the Institute, in this respect ranking with the meeting at Great Barrington, Mass., in 1902. As the distractions incident to meetings in large centers were absent, the sessions had a full attendance, and the discussions were fairly complete. The total registered attendance at the convention was 252. Abstracts of all of the papers presented, grouped according to subjects, and of the following discussions, will be found elsewhere in this issue.

MONDAY MORNING, JUNE 28.

The convention was opened by President L. A. Ferguson at 10 a. m. Monday, June 28, who then delivered his presidential address, an abstract of which was printed in these columns last week.

The president-elect, Mr. Lewis B. Stillwell, New York, was then escorted to the platform. He replied in a brief speech, touching upon the continuity of the Institute organization and the steady development illustrated by the six changes in the constitution during the past 25 years. These changes show that the Institute is a progressive body. There never was a time when a professional and scientific organization had a better chance to impress itself upon the world of industry. Manufactured products doubled in the 10 years ending in 1907 in the United States, while electrical products doubled in the five years ending then. The Institute has now about 600 members and 6000 associates. As the art advances, new opportunities develop, and new specialties enter the field. How to dignify the organization and how to facilitate the interchange of views among specialists is a problem. Mr. Stillwell then emphasized the importance of the electrical engineer's taking some part in community affairs, to help secure proper national developments and to ward off projected adverse legislation. The engineer is often too busy to take much part in the details of public affairs, but they are none the less important; they bear directly upon the welfare of the individual, and deserve more attention in the future. Thus, at the recent Congress on Waterways, held in Washington, there was little evidence of an engineering character presented to show the financial savings in the cost of handling transportation by water. In conclusion the president-elect said that proper education is a subject close to the hearts of Institute members; that the demand of the times is for men who are capable of doing real engineering work, rather than for "intellectual mechanics," who can be hired in any number for small salaries. Broader training in the English branches is essential. Unless an engineer can present the facts in a clear and comprehensive way his schemes are not likely to be carried out by those who control the funds. A large part of the time of the modern engineer is expended in presenting projects and recommendations to boards of directors and committees in responsible charge of expenditures. Unless these recommendations can be properly presented it is difficult to secure the necessary appropriations.

The first paper on the program was "The Connection of Heat from Small Copper Wires," by Messrs. A. E. Kennelly, C. A. Wright and J. S. Van Bylevelt. Dr. Kennelly abstracted this, and a discussion followed which was participated in by Prof. Vladimir Karapetoff, of Cornell University; Dr. C. P. Steinmetz, of Schenectady, N. Y.; Mr. Charles F. Scott, of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., and Mr. Paul M. Lincoln, of the Westinghouse Company. The discussion centered around the terminology of the paper and possible vitiating conditions bearing upon the experiments. In general, the paper showed a remarkable difference in the radiation and connection losses in relation to free and forced connection, and the possible bearing of the quantitative results secured upon the measurement of air velocities, together with the influence of such investigations upon dynamo design were considered.

Mr. E. F. W. Alexanderson then read his paper, "Alternator for 100,000 Cycles," which was briefly discussed by Messrs. J. B. Taylor, J. C. Lincoln, D. B. Rushmore, Carl J. Fechheimer and A. E. Kennelly. The changes in design of several forms of this machine were considered, with precautions against trouble at high speeds.

The next paper was by Mr. L. W. Chubb, on a "Method of Testing Transformer Core Losses, Giving Sine-Wave Results on Commercial Circuits." It was discussed by Dr. Frederick Bedell, Cornell University.; Dr. C. P. Steinmetz; Dr. M. G. Lloyd, Washington, D. C.; Messrs. L. T. Robinson, Schenectady, and Charles F. Scott, Pittsburgh. The discussion centered on the advantages and the limitations of the core loss voltmeter described in the paper.

The next paper was on "The Testing of Transformer Steel," by Messrs. M. G. Lloyd and J. V. S. Fisher. It was discussed by Messrs. L. T. Robinson, V. Karapetoff, C. F. Scott, for C. E. Skinner, Tinker and E. E. F. Creighton. Considerable difference of opinion existed as to the relative value of the various methods of testing magnetic material, with particular reference to checking results and the quantity of material desirable in each test.

MONDAY AFTERNOON.

The afternoon session was opened by Dr. M. G. Lloyd's concluding discussion of his paper on the "Testing of Transformer Steel," carried over from the morning session. He defended the accuracy of the methods described in his paper and maintained that by these the weight of the test piece could be cut down from over 20 lb. to 4 lb. He urged the development of any number of testing methods which could be found serviceable and concluded with a few brief remarks about the use of silicon steel in transformers.

Mr. F. Creedy then read in abstract his paper on "A Sketch of the Theory of the Adjustable Speed, Single-Phase, Shunt Induction Motor," and Mr. E. F. W. Alexanderson his paper entitled "Repulsion Motor with Variable-Speed Shunt Characteristics." Mr. Creedy's paper was an exhaustive consideration of the theory of the machine, and it included a succinct review of the experiments of Mr. F. Punza and himself, also those of Dr. Alfred Fraenckel. He concluded that the problem of building high-frequency motors reduces to that of building high-speed commutators. An 8-pole, 60-cycle machine could probably be built to run successfully up to 2000 r.p.m. if equipped with a mechanically good commutator, and it would not be much more expensive than the compensated single-phase induction motor running near synchronism. The efficiency would be rather low, however.

Mr. Alexanderson said that the shunt repulsion motor is capable of a speed variation of 3 to 1 with armature control and 1.5 to 1 with field control; it is simpler than the three-phase shunt repulsion motor in its control, and its power factor is susceptible to the same sort of regulation as in the case of the synchronous motor. The work of Milch in compensating for power factor was fundamental. Mr. Alexanderson also gave a résumé of the principles of this motor.

The above papers were discussed together briefly by Messrs. Alexanderson, Creedy and Karapetoff. The first speaker complimented Mr. Creedy upon his review of the subject, while Mr. Creedy sketched a number of typical motor connections upon the blackboard and took up their salient features. Professor Karapetoff was not quite satisfied with Mr. Creedy's terminology.

The paper, "Heating of Induction Motors," by Mr. A. Miller Gray, was read by title only, in the absence of the author. This paper described methods of calculating heating losses in advance of their occurrence and reinforced the discussion with a considerable number of tests in actual practice. There was no discussion of this paper.

Mr. S. B. Charters, Jr., and Mr. W. A. Hillebrand's joint paper on "Reduction in Capacity in Polyphase Motors Due to Unbalancing in Voltage" was then read by Mr. Charters, in abstract. The paper submitted a number of tests on induction

and synchronous motors, showing the effects of phase shifting and voltage unbalancing. The authors concluded that unbalancing is likely to become of increasing importance as transmission and distribution networks extend. The paper was discussed by Messrs. R. E. Hellmund, Abell, A. M. Dudley, J. C. Parker, C. P. Steinmetz, C. F. Scott and H. L. Wallan. The general opinion was that the design of the motor is fundamentally important in fixing its behavior under unbalancing, and that first-class machines will stand a moderate amount of unbalancing without much trouble. The commercial importance of balanced circuits to hydro-electric power companies was mentioned, with the penalizing clauses sometimes incorporated in power contracts. It was also shown that sometimes the regulation of the motor may be the limiting condition rather than the heating.

Prof. A. S. Langsdorf then abstracted his paper on "The Current Losses of the Single-Phase Induction Motor." By vector diagrams and resulting equations the author maintained that the current losses of this machine is a true circle, and not a curve of the higher order, as frequently claimed. Prof. V. Karapetoff discussed the paper, emphasizing the value of Ferrari's assumption of two fields revolving in opposite directions in conceiving this subject from the pedagogical point of view He also criticised the author's equations as more complex than necessary.

The final paper of the afternoon was abstracted by Mr. H. G. Reist, joint author with Mr. H. Maxwell, the title being "Multi-speed Induction Motors." The authors discussed the advantages of changing the number of poles by different methods, and presented diagrams for motors connected in concatenation. The paper was discussed by Messrs. H. C. Specht, A. M. Dudley and C. P. Steinmetz. It was shown that there is little to gain by concatenation, from the standpoint of practical design. The session adjourned with a general feeling of satisfaction that the highly specialized topic of the induction motor in its latest developments had been given a thorough airing; that the modified forms of this well-established machine bid fair to meet the more immediate commercial requirements of the near future; and that much further progress may be looked for in the development of alternating-current motors for variable speed service. There was a strong undercurrent of appreciation of the importance of this line of work to the general power world, although the commercial side of the case was not directly treated at any length by the designing engineers who attended the session.

MONDAY EVENING.

On Monday evening the south parlor of the Hotel Frontenac was the scene of a brilliant throng of convention members and guests, including many handsomely gowned ladies and their more soberly clad escorts. The occasion was a reception by the higher officers of the Institute and their wives to the delegates and members present. Music was furnished by the hotel orchestra of five stringed instruments and light liquid refreshment was served in an adjoining ante-room. The receiving line included Mr. C. W. Stone, chairman of the convention committee; President and Mrs. L. A. Ferguson, President-elect and Mrs. L. B. Stillwell, Vice-President and Mrs. James G. White, and Vice-President Calvert Townley and mother. After the reception dancing was enjoyed by many of those present. During the evening there were many informal reunions of friends from different parts of the country who chanced upon each other in the hotel or on the beautiful grounds of the Island. Several private yachts anchored at the pier also lent an added charm to the evening.

TUESDAY MORNING, JUNE 29

Tuesday morning opened clear and cool, in pleasing contrast to the weather of the preceding week, and the first event was the departure at 10 o'clock of a great majority of the ladies for a steamer trip of about 2½ hours among the islands. The course extended from Frontenac down the river to a point near Alexandria Bay. Many of the gentlemen accompanied the party. The various points of interest along the route were announced by an official for the benefit of those taking the trip, and all voted the affair most enjoyable.

The business session began promptly at 10 o'clock, and the morning was devoted to the general subject of transmission phenomena. Mr. Percy H. Thomas first read his two papers in abstract, "Output and Regulation in Long-Distance Lines" and "Calculation of the High-Tension Line." They were discussed by Prof. Thos. R. Roseburgh, Dr. A. E. Kennelly, J. B Taylor, Prof. D. C. Jackson, Dr. C. P. Steinmetz, P. M. Lincoln, R. D. Mershon, Prof. J. B. Whitehead and Charles F. Scott. Opinions differed considerably as to the comparative ease of calculation with Mr. Thomas' equations and with those submitted by Professors Roseburgh and Kennelly. The use of hyperbolic functions was recommended, but it was conceded that the tables of these functions are still somewhat lacking in completeness from the standpoint of the alternating-current engineer. Mr. Thomas disclaimed special mathematical skill in reviewing his papers, but there was a general disposition to dispute this. A note was sounded as to the importance of such calculations in the great power projects which are sure to come in the future, and stress was laid upon the surpassing importance of the so-called minor factors in transmission, as the voltage and distance increase. It was plainly evident from the discussion that the calculation of line phenomena in detail is a problem for the specialist, although approximate calculations can be made to a fair degree of commercial accuracy by the general engineer.

Mr. J. B. Taylor then abstracted his paper, "Even Harmonics in Alternating-Current Circuits." It was discussed briefly by Messrs. Frederick Bedell, C. F. Scott, Karapetoff and Steinmetz. Professor Bedell stated that the effect of direct current in a transformer is less than is generally realized. The other speakers touched upon the method of cancelling even harmonics, experience with transformers and the constancy of hysteresis losses in spite of unsymmetrical waves, so long as the height of the cycle remained fixed.

Prof. J. B. Whitehead then read his paper, "The Resistance and Reactance of Armored Cables," in abstract. Calculations and measurements were presented. There was no discussion, and the session adjourned.

TUESDAY EVENING

On Tuesday evening an enthusiastic meeting and dinner were held in one of the hotel private dining-rooms by the officers of the Institute and the delegates from the different sections to the convention. A golf tournament began in the afternoon and in the evening a women's bridge whist tournament was held, the winners being Mrs. J. M. Wakeman, New York, and Miss Alice A. Reed, Newark, N. J.

The only evening session of the convention was held at 8 o'clock on Tuesday. The first paper was read in abstract by Mr. W. S. Moody, joint author with Mr. G. Faccioli, the subject being "Corona Phenomena in Air and Oil, and Their Relation to Transformer Design." A considerable number of interesting experiments were described, and the authors concluded that the subject will have to be studied still further in relation to transformer design for very high potentials. The paper was discussed by Prof. J. B. Whitehead, and Messrs. J C. Lincoln, R. D. Mershon and S. B. Charters, Jr. The general opinion was that the subject offers a fertile field for investigation, with relation to different conditions. In small test circuits the amount of energy thus dissipated is scarcely measureable by any ordinary apparatus, it is so slight.

Mr. S. D. Sprong, joint author with Prof. E. E. F. Creighton, then abstracted his paper on "Surges on Cable Systems with Aluminum Cell Protection." The paper gave a large number of oscillograms and comments upon some surge experiments on the underground circuits of the United Electric Light & Power Company of New York in 1908. The discussion was carried on by Mr. J. L. R. Hayden, Mr. H. W. Fisher, Mr. J. B. Taylor, Mr. R. W. Mershon, Dr. C. P. Steinmetz and Prof. E. E. F. Creighton. The authors were complimented for taking the risk of such experiments, and in general, the value of the aluminum cell arrester was conceded. In closing Professor Creighton

gave an outline description of the forms which this arrester takes in modern manufacturing.

Mr. J. L. Woodbridge next abstracted his paper, "Split-Pole Converters and Storage Battery Regulation." He described the latest application of this character at the Gary plant, and showed that the improved voltage regulation increases the steel plant output per day. The paper was discussed briefly by Mr. D. B. Rushmore and Mr. Edward Van Wagenen, who emphasized the several fluctuations of load in rolling mill service.

The concluding paper of the evening was abstracted by its author, Mr. H. W. Fisher, the title being "Losses, Induced Volts, and Amperes in Armor and Lead Cores of Cables." A large number of interesting tests were presented, showing the increased losses in single-phase, alternating-current, armored cables under different conditions. The paper was discussed by Messrs. R. D. Mershon, Prof. J. B. Whitehead, and Dr. C. P. Steinmetz. It was shown that single-phase armored cables are undesirable except in special cases, where the runs are extremely short or other conditions are favorable. The session then adjourned.

WEDNESDAY MORNING, JUNE 30.

Two simultaneous sessions were held on Wednesday morning, one in the banquet hall and the other in the women's dining-room of the hotel. The former was devoted to the recent triumphs of electricity in the steel mill and the latter to problems of circuit measurement, dynamo and fuse designing. In the industrial meeting, the first paper abstracted was by Mr. C. T. Henderson, on "Electrical Control of Rollling Mill Motors." He described the recent advances in control which have made successful steel mill practice possible by electrical methods, showing the need of continuous service, the importance of instantaneous interchangeability, and the character of control required in special steel mill machinery. President Ferguson announced that all the steel mill papers would be discussed together, to save time and to broaden out the scope of the meeting.

Mr. H. E. White then abstracted his paper on "Automatic Motor Control," discussing the modern methods of contactor working, with circuit diagrams. Mr. B. Wiley abstracted his paper, "Power Requirements for Rolling High-Carbon Steel of Small Section," giving a large number of valuable test data. Mr. H. C. Specht abstracted his paper, "Function of Flywheels in Electrically Driven Rolling Millls." Mr. R. Tschentscher then presented a written discussion of the development of the Illinois Steel Company at South Chicago in the past 10 years from an electric power rating of 160 kw to 26,000 kw in 1909, and reviewed some of the requirements of the steel mills in electrical engineering. He also cited an interesting application of synchronous condensers to improve the power factor on an 11-mile line. The papers of Messrs. E. W. Yearsley on "Rolling Mill Motors," and E. Friedlander, on "Electrically Driven Rolling Mills," were abstracted by Mr. D. B. Rushmore.

The steel mill electrical papers were discussed by Messrs. J. C. Reed, D. B. Rushmore, C. F. Scott, K. A. Pauly, J. C. Parker, H. C. Specht, A. M. Dudley, H. E. White, J. B. Taylor, C. T. Henderson and W. L. Abbott. The remarks of a reflected great enthusiasm for the future of electricity in this field, which is likely to develop enormous power requirements. It was suggested that the central station and the steel mill may find it advantageous to co-operate. The value of the output in the steel mill is so great that the cost of apparatus is relatively unimportant. Intensified production at lower unit cost is the issue being solved by electricity in steel making.

WEDNESDAY AFTERNOON.

On Wednesday afternoon a vigorously fought baseball game was played by two nines umpired by Prof. G. F. Sever, of Columbia University. The teams were called the "Has Beens" and the "Never Wases." The battle was won by the "Never Was" aggregation, the score being 21 to 20. An enthusiastic and appreciative row of "fans" of both sexes lined up on the field to cheer the plays. Hard hitting and frequent bases on balls were the features of the game. The pleasures of the national game were supplemented by the semi-finals of the golf tournament, which offered attractions to large numbers of spectators.

WEDNESDAY EVENING.

On Wednesday evening an informal education dinner was held, at which Dr. C. P. Steinmetz was host and Prof. Dugald C. Jackson master of ceremonies. It was attended by about a score of men associated with collegiate engineering work, and a brief discussion of the curriculum question was presented by Messrs. Karapetoff, Jackson, Magnusson, Brooks, Scott and Steinmetz.

A searchlight excursion, with music and refreshments en route, was taken Wednesday evening on the steamer *St. Lawrence* by a delegation of about 150 ladies and gentlemen. The total convention registration on this day reached about 250 net. After the searchlight trip a dance was held in the hotel.

THURSDAY MORNING, JULY 1.

The final session of the convention was held on Thursday morning, and practically the entire time was taken up in the discussion of educational problems. Dr. C. P. Steinmetz and Mr. C. R. Dooley read their papers upon the "Value of the Classics in Engineering Education" and the "Training of Non-Technical Men." As might be expected from the great breadth of the subject, many diverse opinions as to the best character of training were presented in the discussion. Those who took part were Prof. C. A. Adams, Mr. C. F. Scott, Mr. Farley Osgood, Dr. M. G. Floyd, Mr. J. C. Parker, Mr. D. B. Rushmore, Dr. C. H. Sharp, Mr. J. G. White, Prof. G. F. Sever and the authors. The general opinion seemed to be that Dr. Steinmetz's recommendations in regard to Greek and Latin were somewhat radical; that a more thorough study of English is essential, and that Spanish is a desirable adjunct in American engineering education. It seems clear that many different kinds of education are needed. Dr. Steinmetz struck a high note in closing, when he stated that the production of engineers who are also broad-minded, intelligent citizens of the Republic is what is needed.

Mr. F. B. Jewett's paper on "The Modern Telephone Cable" was not read on account of the author's absence. The final paper, "Pole Face Losses," by Messrs. C. A. Adams, A. C. Lanier, C. C. Pope and C. O. Schooley was briefly abstracted by Professor Adams. It was very highly praised by Dr. Steinmetz.

A pleasant feature of the morning was the presentation of a past-president's badge to President Ferguson by Mr. D. B. Rushmore, for the directors.

The convention adjourned at 1:15 p. m., and with the finals in the golf tournament in the afternoon the twenty-sixth annual meeting of the Institute passed into history as one of the most successful and enjoyable ever held.

CONVENTION NOTES.

LOCAL SECTIONS.—Under the presidency of Mr. Paul Spencer, chairman of the committee on local sections, a dinner of the sections was held on Tuesday evening, June 29, when over 40 participated in a very full and frank discussion of the duties and possibilities of the Institute in regard to this important feature of its work. The dinner lasted over three hours, and earnest speeches were made by Messrs. Spencer, Ferguson, Whitehead, D. C. Jackson, Koiner, Magnusson, Peck (Atlanta), Troy, Rushmore, Steinmetz, Nichols, R. W. Pope, C. F. Scott, Hale (City of Mexico), Stillwell and Abbott. It had been intended to make the affair brief, and to adjourn to the regular evening session, but the deep interest manifested made this impossible. President Ferguson urged a more active initiative on the part of the sections, rather than a dependence on the work of the headquarters or of visiting engineers. The local section chairman should encourage interest by having papers read by good local men. There were too many different overlapping organizations, however, in the various localities; and he instanced what had been done in Chicago to prevent waste, duplicate effort of this kind. Mr. Abbott, of Chicago, gave a very interesting account of this work. Dr. Steinmetz made a strong plea in favor of "technical" sections, as a means of stopping disintegration and disruption into a number of smaller

bodies. President-elect Stillwell made a deep impression with a thoughtful speech along the lines of conservatism. He favored a "quality" Institute rather than a "quantity" one. Dilution and large number were not always the main factors for useful work. There was an American tendency just now to get over-organized, and it hardly seemed possible to carry out all the plans for more local sections, technical sections, and inter-sections without getting into confusion and more lost motion than ever. He approved heartily the plan fostered by President Ferguson for a secretary of sections, and endorsed by the council. This should remove many conditions of dissatisfaction and serve as a general stimulus. The dinner was attended by Past-Presidents Sprague and Martin and Vice-President J. G. White and Messrs. Townley, Lincoln, Brooks, Stone, Percy Thomas, Carlton and Rushmore, of the board. Twenty-five sections and branches were represented.

The Convention Committee this year consisted of Messrs. C. W. Stone, chairman; A. W. Berresford, W. A. Burke, S. Hosmer, J. W. Lieb, Jr., J. C. McQuiston, D. F. Schick, A. M. Schoen, S. D. Sprong, E. Wheeler, J. G. Wray, L. S. Streng. The burden of the work fell on the robust shoulders of Mr. Stone, and too much praise cannot be awarded him and his associates for the general completeness and success of the arrangements. Everything went smoothly from start to finish, and as one member said, "it was just like a large and well-managed house party." The glorious weather of the whole week contributed largely to the success of every event and entertainment.

Past-Presidents.—It is the custom of the past-presidents of the Institute and the present incumbent to meet once or twice a year and discuss society matters informally. This year the following past-presidents attended: Messrs. Martin, Kennelly, Scott, Steinmetz, Sprague, and on Wednesday morning they were met at breakfast by President Ferguson, and Mr. Stillwell, the president-elect. Dr. Kennelly was unfortunately called away on Tuesday evening. Mr. Scott, who had distinguished himself as a fisherman, provided a splendid catch of pickerel and bass for his colleagues, who sat in earnest converse for about three hours, during which very few points in Institute policy were overlooked.

Convention Sports.—During the week there were various contests which excited great interest and for which a number of beautiful prizes were provided. The list of events and prize winners is as follows: Cards, Mrs. J. M. Wakeman, first prize, gold-enameled pin with pearl setting; second, Miss Alice A. Reed, gold barpins in enamel and pearls. Golf driving contest, Prof. C. A. Adams, first prize, score 28, silver cigarette box; C. W. Stone, second, score 27, silver match box. Golf putting contest for ladies, Mrs. L. A. Ferguson, first prize, silver card case; Miss A. A. Reed, second, gold enameled belt buckle, tie between Mesdames W. I. Slichter, H. G. Reist and E. E. Donohoe, won in the play-off for third prize by Mrs. Donohoe, topaz hat pin. In addition a solid silver card case pencil was presented to each of the numerous contestants. Handicap golf tournament, F. E. Donohoe, best gross score, mahogany humidor; Frank P. Cox, best net score, silver Gillette razor set; Louis A. Ferguson, runner-up, small cut-glass decanter; A. I. Totten, winner, large decanter. Fishing contest, John H. Finney, winner, largest fish, silver flask; Frank H. Gale, largest catch of game fish, set of smoking pipes. The prizes were all on view at the hotel and were presented to the winners before the convention disbanded.

Interludes.—A delightful piano recital was given by Prof. V. Karapetoff, of Cornell University, in one of the parlors of the Hotel Frontenac during the afternoon of Wednesday, June 30. The Tuesday daylight excursion for ladies was largely patronized, and the attractions of the trip among the Islands were so strong that many gentlemen took advantage of the occasion. On Wednesday evening about 165 convention delegates, members and ladies, enjoyed a two-hour searchlight trip on the St. Lawrence River. Music and light refreshments were provided on the steamer, and the party sang college songs and had a merry time generally. On the return to Frontenac an informal dance was held. During Wednesday afternoon the "Has Beens" and the "Never Wases," captained respectively by Messrs Wagner and Gray, had a startling game of baseball, which the "Nevers" won by one run with a score of 21 piled up in six innings. Professor Sever was umpire and Ellery Paine scorer.

Press Representatives.—The *Electrical World* was represented at the meeting by Messrs. J. M. Wakeman, T. C. Martin, H. S. Knowlton and O. A. Kenyon.

Educational Dinner.—An informal dinner was enjoyed in the ladies' café on Wednesday evening by members whose professional work lies along educational lines. It was presided over by Dr. Steinmetz, while Prof. D. C. Jackson acted as master of ceremonies. Both spoke, as well as Professors Karapetoff and Magnusson and Mr. C. F. Scott. Over a score participated in the affair. The remarks made were addressed to the subject of the education of electrical engineers.

Employees' Saving Fund of Commonwealth Edison Company.

The Commonwealth Edison Company, of Chicago, has adopted a plan for the creation of an employees' saving fund which became effective on July 1. Any employee of the company who has been in its service for one year or longer may become a subscriber to this fund. He will then pay into the fund during a subscription period of five years an amount equal to 3 or 5 per cent of his salary, as he may elect. At the end of the subscription period the subscriber or his estate will receive back all money contributed by him with interest compounded semi-annually at the rate of 6 per cent; but if before the five years has elapsed the subscriber elects to discontinue his subscription agreement while still employed by the company his rate of interest will be reduced from 6 per cent to 4 per cent. If the subscriber resigns or is discharged before the expiration of the five years, he will receive his money back, with 6 per cent interest. But if a subscriber fails to make three or more payments when due, his interest will be reduced to 3 per cent during that year.

If the subscription period continue for the full five years the subscriber may exercise an option to receive, instead of cash, the same amount in the company's capital stock at par, if the stock of the company is then selling at or above par, or at the average market price during the two preceding months if the selling price of the stock is then below par.

This is a really generous offer on the part of the Commonwealth Company, and at the price the stock of the company is now selling means a return to the subscriber of a trifle less than 16 per cent per annum. For instance, if a subscriber puts in $2 a month for a period of 60 months, at the end of that time he can receive in cash $139.80, being his principal ($120) with interest at 6 per cent compounded semi-annually. Should he prefer stock, however, as would naturally be the case, the company will issue to him stock having a par value of $139.80. As Commonwealth Edison stock is now selling at about 120, this would mean that the market value of the subscriber's investment would be $167.76. Thus, the increment of the subscriber's deposit of $120 would be $47.76. As the average amount on deposit during the five years would be $60, the return on this, $47.76, would make the interest on the deposit reach the rather surprising figure of a trifle less than 16 per cent a year. This is on the supposition that the stock is selling at 120 at the end of the period. Subscribers, it will be seen, have an incentive to make the stock so valuable that it will sell in the public market at a premium. But in any event the depositor is guaranteed 6 per cent, whereas the rate in Chicago savings banks is 3 per cent. In addition, the saving would be made with absolute safety in all human probability. The subscriber is furnished a pass-book resembling those issued by savings banks.

The Commonwealth Edison Company has about 2500 employees, with a payroll of $2,000,000 a year. Between 1500 and 2000 of these will be eligible to subscribe to the fund. The scheme was worked out by a committee of heads of depart-

ments and was adopted by the directors of the company practically without change. About 200 applications for admission to the fund were received on the first day. The committee in charge of the fund, appointed by the board of directors, consists of Mr. Samuel Insull, president of the company; Mr. Edward L. Brewster, director; Mr. Benjamin Carpenter, director; Mr. Louis A. Ferguson, second vice-president; Mr. J. H. Gulick, construction superintendent; Mr. W. L. Abbott, chief operating engineer, and Mr. P. Junkersfeld, electrical engineer. The officers of this committee are: Chairman, Mr. Insull; secretary, Mr. John F. Gilchrist; treasurer, Mr. Wm. A. Fox; auditor, Mr. John H. Gulick. Careful rules and regulations governing the fund have been drawn up with the aid of legal counsel, and the plan seems to be one which will be heartily welcomed by the employees of the company.

Wisconsin Rate Commission News.

A suit was instituted in the Circuit Court of Kenosha, Wis., on June 28, which has for its purpose a test of the public utilities act of the State. The suit was brought in the name of the State at the instigation of the Kenosha Gas & Electric Company against the Kenosha Electric Railway Company, for the purpose of prohibiting the railway company from accepting any privileges granted to it under a franchise for a system of electric lighting recently passed by the City Council. Previous to the passage of the ordinance the Kenosha Gas & Electric Company surrendered its franchise and accepted in lieu of this an indeterminate permit from the State. The railway company secured no permit from the State Railroad Commission nor did it ask for a certificate of necessity and convenience. The State holds that under the law no franchise could be granted by the City Council to the street railway company.

The fiscal year of the Railway Commission closes on June 30 and the annual reports of all the utility companies operating in the State must be closed upon the same date. The commission has prepared a special form of report for each kind of utility and all reports must be filled out and returned to the commission not later than August 1, except in the case of those smaller companies that have received special dispensation. These report forms are very complete and are designed to contain every detail of information which could possibly be of value to the commission in fixing rates or in adjudging the adequacy of service, and at the same time to introduce a uniform system of accounting. The commission's system of accounting, while apparently very complex, is in reality very simple on account of its systematic arrangement. The majority of the companies have found little trouble in changing from their systems to the commission's. But the call for such a detailed report has brought to light a woeful lack of knowledge in many cases concerning the most important items of economic station management, and the necessity of obtaining the data called for will go a long way toward putting such stations on an intelligent working basis.

In Milwaukee, on June 25, a hearing was commenced in the case of the city of West Allis against the Milwaukee Electric Railway & Lighting Company. The street railway company has been charging double fare from the city of Milwaukee to the city of West Allis, a suburb of Milwaukee. West Allis is a manufacturing center and the majority of the men employed there reside in Milwaukee. Because of the double fare, the plaintiff claims that, when times are good, it is difficult to obtain labor, for the workingmen seek naturally to obtain employment within the most convenient distance of their homes and where the facilities for getting to and from work are the best. Many of the men now walk from 6 to 15 blocks in order to reach the one-fare limit. This condition of affairs, the plaintiff asserts, is very seriously affecting the growth and prosperity of West Allis and a one-fare rate is asked for.

The Wausaw Electric Railway Company has petitioned the commission for a rehearing in regard to the schedule of rates recently ordered by the commission.

The Cumberland Telephone Company was granted authority to increase its rates on business telephones from $1.50 to $2 per month. The Cumberland Telephone Company had combined with a competing company which had gained entrance to the city. After examining the balance sheets of both companies and considering the added service accruing to the subscribers as a result of the combination, the above increase in rates was ordered. This is, however, a tentative order pending a valuation of the companies' property.

The Midway Telephone Company petitioned for an increase in rates on business telephones from $1.25 to $1.50. The company operates two exchanges and it is proposed to connect them and give the subscribers the benefit of both exchanges. As the higher rate was already in force at one of the exchanges the commission ordered it put into effect at the other also.

Space Between Passing Street-Railway Cars.

An end has been made, apparently, to the agitation in Chicago relating to the space to be left between passing street-railway cars. At a meeting of the Board of Supervising Engineers on June 29 resolutions were adopted to the effect that the distance between track centers should be extended from 9 ft. 8½ in. to 10 ft. 2 in. for all new work which has not progressed so far that it is impracticable to make the change. Further, it is given as the judgment of the board that all future cars to be built for operating on the surface lines of Chicago shall not exceed 8 ft. 6 in. in width over all. As the present pay-as-you-enter cars are 9 ft. wide, this decrease in width of the cars and increase between track centers will increase the width between passing cars from 8½ in. to 20 in.

Mr. Bion J. Arnold, chief engineer of the board, has issued a statement in which he says that 20 in. between passing cars is the greatest space that can be provided practically in Chicago with the standard 38-ft. roadway. He points out that even this distance of 20 in., however, cannot be obtained upon tracks already reconstructed nor so long as the present wider cars are operated. He says that it is only fair to the representatives of the Chicago City Railway Company to state that the purchase of its present 9-ft. cars was approved by the full board and that that company remains firmly of opinion that fewer accidents will occur if the present narrow space between cars be uniformly maintained. Mr. Arnold himself concurred in this opinion at one time, but on further investigation he believes that the wider space will at least give a person caught between passing cars a chance for his life.

Invention in Electric Welding.

Mr. J. A. Hunnewell, the general superintendent of the Lowell Electric Light Corporation, of Lowell, Mass., directs our attention to an opportunity for invention or improvement in the field of electric welding. An inquiry has reached his company which he refers to as follows: "The welding of steel edges to iron backs in the manufacture of chippers and planing knives certainly offers a wide field for electricity. The single concern in which we are interested is building two other plants in other parts of the country. This firm is thoroughly interested in electric welding, and if some electrical concern is interested enough to investigate the field, it will find the proprietors of the plant willing to go more than half way in overcoming the obstacles. We have been unable, as yet, to find any concern which either has entered or is willing to enter this field.

"The process of welding is at present somewhat as follows: Steel strips about 2 in. wide and ⅜ in. thick and varying in length from 4 in. to 50 in. are laid along the edge of iron backs which are 6 in. or 8 in. wide and about 1 in. thick. In this position they are placed in a gas-heated furnace and then put through hammers and rolls, this process being repeated several times for the same knife. Both the large chippers and the small planers are made in a similar manner. There is no uniformity in the size of the product as conducted at present, but this could probably be arranged to a considerable extent."

New York Public Service Commission News.

The prospect for new subways in New York seems very bright at the present time. On June 30 the Public Service Commission received a definite offer from the Interborough Rapid Transit Company proposing the construction of subways and elevated tracks to an extent involving an expenditure of between $75,000,000 and $100,000,000. These plans contemplate a four-track subway down the Seventh Avenue route from Times Square to Canal Street with a two-track line from there to the Battery; the third tracking of the Ninth Avenue elevated from Fourteenth Street to Battery Place; a two-track subway under Canal Street over the new Manhattan Bridge to connect with the present subway at Nevins Street, Brooklyn; the third tracking of both the Second and Third Avenue elevated lines and an extension of the former to bring its tracks all the way to the Brooklyn Bridge; the sale of the Steinway tunnel to the city, at cost, with the guarantee of a 5 per cent fare from its eastern terminus to any point in Manhattan reached by the Interborough's lines; the building of a spur from the Second Avenue elevated over the Queensboro Bridge with a five-cent fare; the construction of a two-track express subway under Third Avenue and a two-track local subway under Lexington Avenue from Forty-sixth Street north to the Harlem River and the extension of the present elevated structure from 155th Street and Eighth Avenue across the Macomb's Dam Bridge and up Jerome Avenue to 194th Street. The commission has taken no action on these proposals, but it is not at all likely that they will be approved. The commission has already adopted the modified Broadway-Lexington Avenue route originally authorized by the Rapid Transit Commission and is not inclined to depart from that plan. It is pointed out that the proposals of the Interborough do not carry out that plan but take up pieces of the routes at different places so as to effectually block any other company from constructing the line. The Interborough is willing that its elevated and its subway proposals be considered as separate propositions, but it makes the purchase of the Steinway tunnel a necessary feature of the subway plans. The total amount of new track involved in the plan is about 68½ miles and it is the Interborough's suggestion that the city bear a considerable portion of the expense. It also wants franchises that will be parallel to those now held by its subway and elevated lines.

In the meantime the Public Service Commission is prepared to act independently of all formal proposals. The Board of Estimate and Apportionment has granted the request of the commission, and authorized it to advertise for bids for the construction and operation of the subway and elevated lines adopted in 1906 by the old Rapid Transit Board. Specifications for the plans and forms of contracts for these bids are now being prepared and the advertisements will soon be published. This course will bring all the rival interests to one point. If they want to build subways they must bid under the commission's plan and the commission will have then the option of placing the work where it will be most advantageously done for the city or of accepting some of the proposals that have been made to it.

The South Flatbush Railroad Company has withdrawn its application to the Public Service Commission for permission to construct a rectangular line from Avenue Q station on the Brighton Beach elevated line to Flatbush Avenue giving as a reason that the company is to be reorganized and after this is done amended plans will be filed.

The Public Service Commission, by a unanimous vote, has decided that the Coney Island & Brooklyn Railroad Company is justified in charging a 10-cent fare on Sundays and holidays, but that it should charge only five cents on other days. The company has let it be known that this expression on the part of the commission will make no difference in its present plan of charging two fares all the time and that it will fight the reduction in the courts if necessary. The ruling of the commission was made after receiving the report of Bion J. Arnold, its engineer, that the physical value of the road was $5,000,000.

The Public Service Commission for the Second District has denied the application of the Niagara Falls Lighting Company for authority to exercise rights and privileges granted to it by the city of Niagara Falls, under which the company proposed to enter the lighting field in opposition to the company now giving service in that city. The reasons given for the refusal are that the evidence did not disclose that the existing lighting system was so inadequate or inefficient as to justify the introduction of a competing plant. The existing company has stipulated to the commission that it will reduce the price of arc lamps from $65 to $52 per year, the latter amount required by the commission

Alleged Interference with Telegraph and Telephone Operation by a Single-Phase Railway.

The new Chicago, Lake Shore & South Bend Interurban Railway, between Chicago and South Bend, Ind., is a single-phase road 77½ miles long, with operating potential on the trolley wire of 6600 volts. Passing around the southern end of Lake Michigan it parallels for a long distance the Lake Shore steam railroad and the wires of the Western Union and Postal telegraph companies. The steam railroad and the telegraph companies allege that their telegraph and telephone service has been seriously interfered with by induction from the high-potential, single-phase trolley wires of the railway company. They seek to enjoin the Interurban people from operating their cars on the ground that the high voltage has demoralized by induction their methods of electrical communication. As previously noted in these columns, the judge who was asked to issue the injunction refused to do so, holding that no company has a monopoly of the air. The telegraph companies and the steam-railroad company have now taken an appeal to the Supreme Court of Indiana, so that the matter remains undecided. The Lake Shore steam railroad uses the telephone to a considerable extent to supplement the telegraph in transmitting train orders, and it declares that the operation of the 6600-volt overhead-trolley circuit by single-phase, alternating current is a serious hindrance in the use of both its telephone and telegraph wires.

Magnetic Tests of Common and Silicon Steel.

A circular issued under date of June 1 by the Bureau of Standards, Washington, on the subject of magnetic testing, sets forth the scope of the Bureau in this line of work, and includes a description of the methods employed and a schedule of fees. Two tables are printed in the circular which give the results of the magnetic tests of ordinary steel and of silicon steel. It is pointed out that ordinary sheet steel in common use varies very widely in its magnetic qualities, and that the quality is not closely related to the cost. While the watt loss when tested with alternating current varies in the case of ordinary steel from 1.25 to 2.36 watts per pound for sheets of No. 29 gage, at a frequency of 60 cycles and a magnetic induction of 10,000 gausses, silicon steel varies only from 0.66 to 1 watt per pound under the same conditions. In addition to this variation there is a great difference in the constancy of magnetic properties with time. Some metals show very decided aging, which in one case amounted to as much as 67 per cent in 500 hours; other specimens, including most silicon steels, show little or no variation with use.

As to the commercial significance of the tests, the design of a 5-kw transformer is taken for an illustration. If instead of material showing a core loss of 45 watts another showing a core loss of 32.2 watts is taken, the saving in operation for 8760 hours, or one year, amounts to 112 kw-hours. At a cost of 1 cent per kw-hour this amounts to $1.12, which at 10 per cent, allowing for depreciation as well as interest, represents a capital of $11.20; in other words, the buyer could, with advantage, pay any amount up to $11 more for the sake of getting better material in his core, and the manufacturer could pay 28

cents per pound more for the 40 lb. of material used. If the better silicon steel were to cost 2.8 cents more than the other (which is improbable) the difference in cost of the steel would be $1.12, and the user would each year save 100 per cent of extra cost.

The comparison between the power silicon steel and the ordinary steel is even more marked. In a case cited the difference in core loss would be the equivalent of $2.45 per year, thus practically reducing the value of the transformer by $24.50; yet the difference in cost of the material is only $1.70 if the price of silicon steel delivered at the factory is taken at 7½ cents per pound and that of ordinary steel at 3¼ cents per pound, assuming 40 lb. to be necessary.

CURRENT NEWS AND NOTES.

SAN FRANCISCO VOTES AGAINST MUNICIPAL OWNERSHIP.—By a popular vote San Francisco has decided against a municipal underground-conduit surface electric railway. A two-thirds vote was necessary to carry the measure, which was defeated by 403 votes.

CINCINNATI "DAYLIGHT" ORDINANCE.—On July 1 Acting-Mayor Galvin, of Cincinnati, approved an ordinance whereby clocks in that city will, it is hoped, be set back one hour from May 1 to Oct. 1, thus giving "one more hour of daylight" to those who rise an hour earlier.

HALF MILLION FOR ROSE POLYTECHNIC.—The Rose Polytechnic Institute of Terre Haute has received a bequest of one-half million dollars by the will of the late Susan Frances Heminway, one of the chief heirs of Mr. Rose, founder of the school. In addition, Mrs. Heminway leaves the Rose homestead, an entire block in the heart of the city, for the use of this school.

EDISON STORAGE BATTERY.—In a newspaper interview, Mr. Thomas A. Edison has announced that he has finally completed his storage battery. He stated that he had been working on the problem for years, and four years ago thought he had solved it, but was too cautious to make positive announcement of a victory then. Now he says he has absolutely no doubt of triumph.

NIAGARA DAM.—The International Waterways Commission, which has been investigating the practicability of constructing a dam across Niagara River to raise the water level of the Great Lakes, has about finished its work, and the report, it is said, will be made next month. It is understood that a majority of both Canadian and American commissioners will recommend the building of the dam.

TELEGRAPH TIME-FILING LAW UPHELD.—The Court of Appeals of Maryland has upheld the constitutionality of an act passed at the last session of the Maryland Legislature requiring the time of sending and receiving every telegram to be placed upon messages sent from and to all points within the State. The case was brought up for review in an appeal by the Postal Telegraph Company against the State, a fine of $10 having been imposed against that company for having refused to obey the law.

SIXTY-CENT GAS IN INDIANAPOLIS.—Judge Anderson, of the Federal Court, sitting at Indianapolis, has denied an injunction asked by the Indianapolis Gas Company against the city and State to prevent the enforcement of a 60-cent gas rate. The court refused to consider any of the allegations of the company, saying that it had two years and four months in which to go into court, and that it was unfair to wait until within two days of its expiration. Judge Anderson also citicised the company plan to furnish gas on a sliding scale at 60 cents per thousand to large users, raising to 90 cents to small consumers. According to the new law the Indianapolis Gas Company must in the future sell gas at 60 cents per 1000 cu. ft.

QUAINT DEFINITIONS.—In the course of a recent talk on railroad electrification before the Electric Club, of Chicago, Mr. E. N. Lake took occasion to allude to two amusing definitions that he had found in an old book published in New York in 1818 and entitled "The New York Expositor," being, among other things, "A collection of the most useful words in the English language." In this little work are these two definitions: *Electricity*—A property in bodies whereby, when rubbed, they draw substances and emit fire. *Engineer*—One who manages engines or directs artillery.

TESLA ON WIRELESS.—In a recent newspaper interview Nikola Tesla stated that it would soon be possible for a business man in New York to dictate instructions and have them instantly appear in type in London and elsewhere. He will also be able to call up from his desk and talk with any telephone subscriber in the world, the only means to this end necessary being an inexpensive instrument no bigger than a watch. Similarly any kind of picture, drawing or print can be transferred from one place to another by wireless. As to the transmission of power without wires, he said that he has been experimenting with a motor boat operated by wireless power, and the results indicate that ocean liners may be propelled across the Atlantic Ocean at high speed by power sent from a wireless station on shore.

READINESS-TO-SERVE RATE UPHELD IN COURT.—At the recent meeting of the Canadian Electrical Association, Mr. G. S. Chambers, of the Truro, Nova Scotia, central station, gave an account of litigation following the adoption of the readiness-to-serve system of rates. About two years ago the Nova Scotia Legislature passed an act instituting Government control of rates, and just prior to its enforcement the Truro company filed a new rate schedule under which a readiness-to-serve charge was established of 10 cents per 16-cp lamp for the first nine lamps connected, with 3 cents for each additional lamp, together with a meter charge of 10 cents per kw-hour, less 10 per cent for cash. The legality of this system of rates was contested through the various courts up to the Supreme Court, the contention being that readiness-to-serve could not be made the basis of a charge. All of the courts sustained the central-station schedule.

LIQUEFIED GAS.—A consular report gives some information in detail concerning the manufacture of liquefied gas, sometimes known as "Blau gas," as carried on under the Wolf process near Zurich. It is stated that a factory equipped for this process will be erected in Boston. The liquefied gas is sold in cylinders containing 20 lb., 40 lb. and 80 lb. each at 15 cents per pound. The liquid gas is obtained by the dry distillation of raw petroleum and of by-products of the lignite and oil industries. The raw materials are decomposed in retorts by the action of a high temperature; the vapors and gases produced then pass through the tar separators and the cleaner, losing here the easily condensable gases (tar, benzine, etc.), as well as any deleterious and malodorous by-products that may be present, by means of patented apparatus, and the use of cold and pressure, a separation of the difficultly liquefiable gases, such as hydrogen, methane, etc., from the more easily liquefiable ethane, propane, pentane, etc., is obtained. These are then liquefied, carbureted and filled into steel transport cylinders provided with a valve and sold as "liquid gas." It is easily transportable and utilizable and has a high illuminating and heating power. The report states that the liquefied gas is used in a number of towns supplied with electric lighting plants.

PENNSYLVANIA ELECTRIC ASSOCIATION.—The next convention of the Pennsylvania Electric Association will be held at Eagles Mere, Pa., Sept. 8, 9 and 10, 1909. Mr. E. L. Smith, of Towanda, Pa., is secretary of the association.

DRUDGERY OF TRUDGERY.—A recent jingling catch-line to advertise the telephone service is embodied in the announcement that "Telephonia" is emancipating the world from the "drudgery of trudgery." The Chicago Telephone Company is making use of this phrase in some of its advertising matter.

OHIO ELECTRIC RAILWAYS.—According to information secured for the United States Commissioner of Corporations, the subscribed working capital of the electric roads of Ohio is $150,000,000. Capital of steam roads operating in the State is about $725,000,000. This information was secured from returns under the Willis and Cole tax laws and does not include any of the corporations that are delinquent.

CANADIAN ELECTRICAL ASSOCIATION CONVENTION.—In our issue of June 24 a report in part was given of the annual convention of the Canadian Electrical Association, accompanied by a statement that a supplementary report would appear in a following issue. We regret that, owing to a complication that arose in connection with arrangements for reporting the meeting, this promise cannot be fulfilled.

OHIO ELECTRIC RAILWAY PUTS ON THROUGH FREIGHT TRAINS.—Arrangements have been made by this company to run through freight cars between Toledo and Dayton by way of Lima and Springfield. Only through business from Toledo and Lima will be taken on these cars. It is said that the business has grown beyond expectation and that the company has arranged for the additional facilities in order to take better care of the freight that is offered for through shipment between these points.

REFINING STEEL ELECTRICALLY.—In a paper presented before the Faraday Society on electric furnaces as applied to the manufacture of iron and steel, M. Charles A. Keller stated that the results obtained with electric furnaces of his design in operation at the Holtzer Steer Works at Unieux, indicate that a 20-ton, three-phase furnace of 1800 kw could now be constructed. Such a furnace could purify 250 to 300 tons of steel per day, supplied by a Thomas converter, at an operating cost of $3 to $4 per ton, with electrical energy at 0.3 cent per kw-hour obtained by utilizing blast-furnace gas.

ELECTRIC TRACTION IN FRANCE.—At last the constant agitation of the subject by engineers has produced an effect upon one of the main railroad lines of France, which will now undertake a large scheme of electrification. The Chemin de Fer du Midi has just given out the first contracts for a project which includes 400 km of its main track from Bordeaux to Toulouse. The work will be divided among the more important manufacturing companies. This installation will be single-phase, 15 cycles, and the first section should be in operation about a year hence. It is believed that the action of this railroad will help in crystallizing other projects in France.

HARD-DRAWN COPPER WIRE SPECIFICATIONS.—At the meeting in Philadelphia last week of the American Society for Testing Materials, a committee of the body presented a set of standard specifications for hard-drawn copper wire. The specifications, which were accepted and ordered to be sent out for letter ballot by members of the society, comprise 18 sections, four of which apply to grooved trolley wire and five to cable or stranded wire. Determinations of electric conductivity are specified to be made at 20 deg. C. (68 deg. Fahr.), and the following maximum limits imposed: For diameters 0.460 in. to 0.325 in., 900.77 lb. per mile-ohm; for diameters 0.324 in. to 0.040 in., 910.15 lb. per mile-ohm.

ILLINOIS TUNNEL COMPANY'S TELEPHONE FRANCHISE.—Final disposition of the matter of extending the telephone franchise of the Illinois Tunnel Company, in Chicago, was made for the present by the Chicago City Council on June 28. The tunnel company was given until June 1, 1911, to install the 20,000 telephones required by the terms of its franchise; further, it may not sell its telephone franchise before Jan. 1, 1911, to any purchaser except the Chicago Telephone Company. This action was taken so that the proposed merger may be before the Council in June, 1910, when the possible revision of telephone rates of the Chicago Telephone Company under the ordinance by which the latter company operates will come up.

ELECTRICAL CLOCK.—The English electrical journals describe an electrical clock known as Kutnow's 1000-day clock. The clock derives its motive power from a single dry cell, the current from which is utilized to energize periodically a small electromagnet carried by a balance wheel. The base-plate of the clock is of iron, and it is the mutual attraction between this iron plate and the electromagnet attached to the balance wheel which furnishes the energy necessary to drive the clock. Contact is made and broken at regular intervals by a suitably disposed contact spring, and the balance wheel is controlled by a reacting spring similar to the hair-spring of a watch. The oscillations of the balance wheel in either direction represent one second.

PROPOSED RICHMOND (VA.) MUNICIPAL PLANT.—The proposed Richmond (Va.) municipal lighting plant, for which large appropriations have been made, will in all probability require considerably more money than was first anticipated before the system is fully provided for. The first additional matter is in relation to lighting all of the alleyways of the city, and cost of the same. The appropriations, it is said, do not include the overhead work, nor the electric light line, both of which will be expensive items, only the machinery and power plant being included in the heretofore published estimates and awards. The city will be compelled to build a complete system of street electric lines to replace the old system which has been used under lease from the old Virginia Passenger & Power Company. The city has declined to purchase these lines, poles, wires, etc., desiring to put in a new system. To date the money available by bond issues is $250,000 for construction purposes and $100,000 for machinery in the lighting power plant.

BOMB EXPLOSION IN CHICAGO CAUSES TELEPHONE DAMAGE.—Considerable excitement was caused in Chicago by an explosion supposed to be due to a dynamite bomb in a manhole of the Chicago Telephone Company near the Central exchange, in the rear of 100 Washington Street, on June 27. So far as the telephone company was concerned, the principal force of the explosion was downward, and a number of cables were broken. Windows were also broken in the building containing the exchange, but the wire-glass used in these windows prevented much damage here and demonstrated its efficiency. Considerable damage was done to surrounding buildings and several persons were injured. The identity of the persons placing the bomb is unknown, but as there have been several previous explosions of this character in Chicago, the affair has attracted a great deal of attention, and the City Council has directed the Mayor to offer a reward of $3,000 to any person or persons who may furnish the police department information that will lead to the arrest and conviction of the perpetrators of the outrage. To this amount the Chicago Telephone Company has added a further reward of $2,000, making a total reward of $5,000. In view of some statements in the daily press hinting that the Electrical Workers' Union, with which the company has had some difficulty, may have had something to do with the explosion, it is proper to add that both Mr. A. S. Hibbard, vice-president and general manager of the company, and the business agent of the union, unite in scouting any such suspicion as absurd.

Electrical Features of the New Northwestern Railroad Terminal in Chicago.

WITHOUT doubt the most important construction work now under way in Chicago is the new passenger terminal of the Chicago & Northwestern Railway, work on which is actively in progress. This undertaking involves the building of an entirely new terminal for a great railroad system, and it will represent an expenditure of about $20,000,000 or more. While the tearing down of old buildings on the site and the new structural work has been under way for several months, plans for the generation and application of electricity have only recently been decided upon, and, indeed, some of the details are still to be worked out. A brief general account of the electrical features will be given herewith.

The premises covered by the new terminal station comprise about four city blocks and consist essentially of the terminal station building, the train sheds (with baggage-rooms, cab and automobile stands, emigrants' quarters, etc., beneath the tracks) and the power house. These structures will be erected in the space bounded by Milwaukee Avenue on the north, Canal Street on the east, Madison Street on the south and Clinton Street on the west. This space is traversed by Lake Street, Randolph Street and Washington Boulevard, which are east-and-west streets, the greater dimension of the terminal site being from north to south. These three streets will cross the terminal in subways, the tracks of the terminal being carried on an elevated structure.



FIG. 1.—MAIN ENTRANCE CHICAGO & NORTHWESTERN RAILWAY PASSENGER TERMINAL, CHICAGO.

The terminal station proper will front on Madison Street. It will be an imposing building of granite with one story on the street level, one on the track level and two upper stories for offices and rest rooms. This station building occupies the greater portion of the city block bounded by Madison, Canal and Clinton streets and Washington Boulevard. The first or ground floor is approximately 18 ft. in height. Above this on the track-level floor is the main waiting-room, 100 ft. x 200 ft., with a total height of 82 ft. to the apex of the vaulted ceiling. Around this main waiting-room is a ledge which is 46 ft. from the floor. Surrounding the waiting-room is a gallery or second floor, and likewise a third floor, both being divided into offices and various rooms for station purposes. The fourth story is devoted to locker-rooms and storage space. The building fronts 320 ft. on Madison Street, running north on Clinton and Canal streets a distance of 272 ft.

North of this building the train sheds extend practically to Lake Street, a distance of about 900 ft., with a width throughout of 320 ft. These sheds are substantially the same as those of the Lackawanna terminal at Hoboken, N. J., having low roofs with an opening in the roof above the center line of each track. The locomotive stack is in line with this opening, so that all gases are exhausted directly into the air above the sheds. Sixteen tracks will be used for through passenger and suburban service, and on each of these tracks two ordinary trains may be accommodated at one time. In other words, each of the 16 tracks has a capacity for 13 Pullman coaches or 16 day coaches. The new terminal will have facilities for handling 250,000 passengers daily and the area covered by it will be about 13 acres, while practically 10 acres of floor space will be devoted to public use.

Between Washington Boulevard and Randolph Street there is provided a suburban concourse. This is 50 ft. wide and extends from Clinton Street to Canal Street underneath the overhead steel structure. Stairways lead to each of the platforms above, each platform serving two trains. All of the remainder of the space below the track structure will be occupied by outgoing baggage-rooms, emigrants' quarters, mail and express-rooms, automobile and cab stands and private carriage and bus driveways. The concourse for the through passenger service is on the track level and connects the station building proper with the train sheds.

POWER HOUSE.

All of the electricity for lighting and power purposes will be generated in a power house placed in the triangular block north of Lake Street, bounded on the north and east by Milwaukee Avenue, on the south by Lake Street and on the west by Clinton street.

The boiler plant consists of three batteries of two boilers each. These are Babcock & Wilcox wrought-steel, vertical-header boilers, each containing 5000 sq. ft. of heating surface. The boilers are set high and are fired from what is usually considered the rear end. Each boiler is to be equipped with a Foster superheater designed to raise the temperature of the steam 70 deg. Fahr. above that due to a pressure of 155 lb. by gage. Green traveling chain-grate stokers are to be fitted to the boilers.

Coal will be delivered to the power station by cars run in on

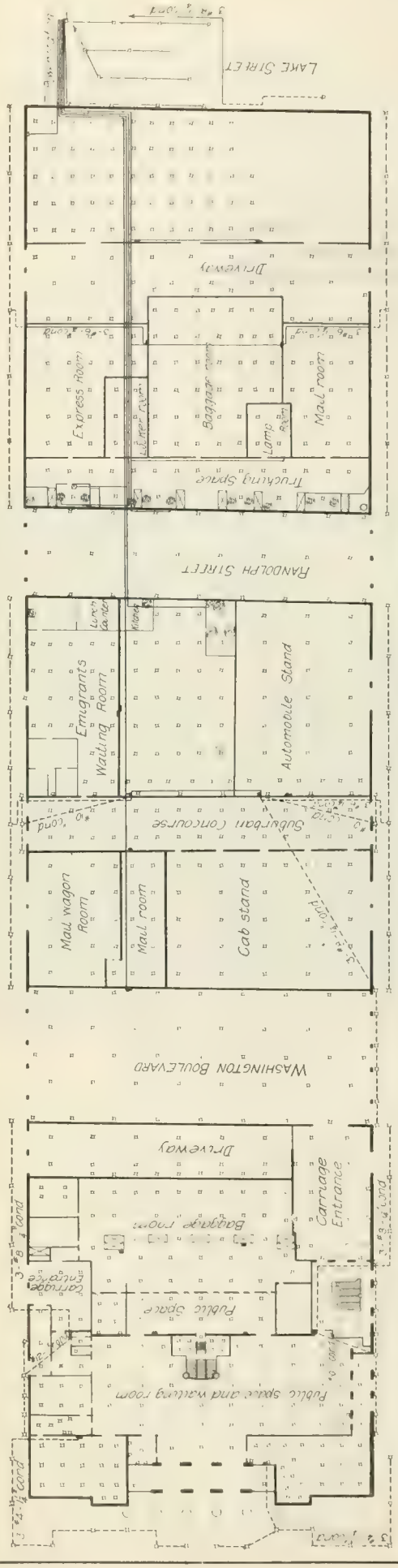


FIG. 2.—CONDUIT AND WIRING DIAGRAM, NORTHWESTERN TERMINAL

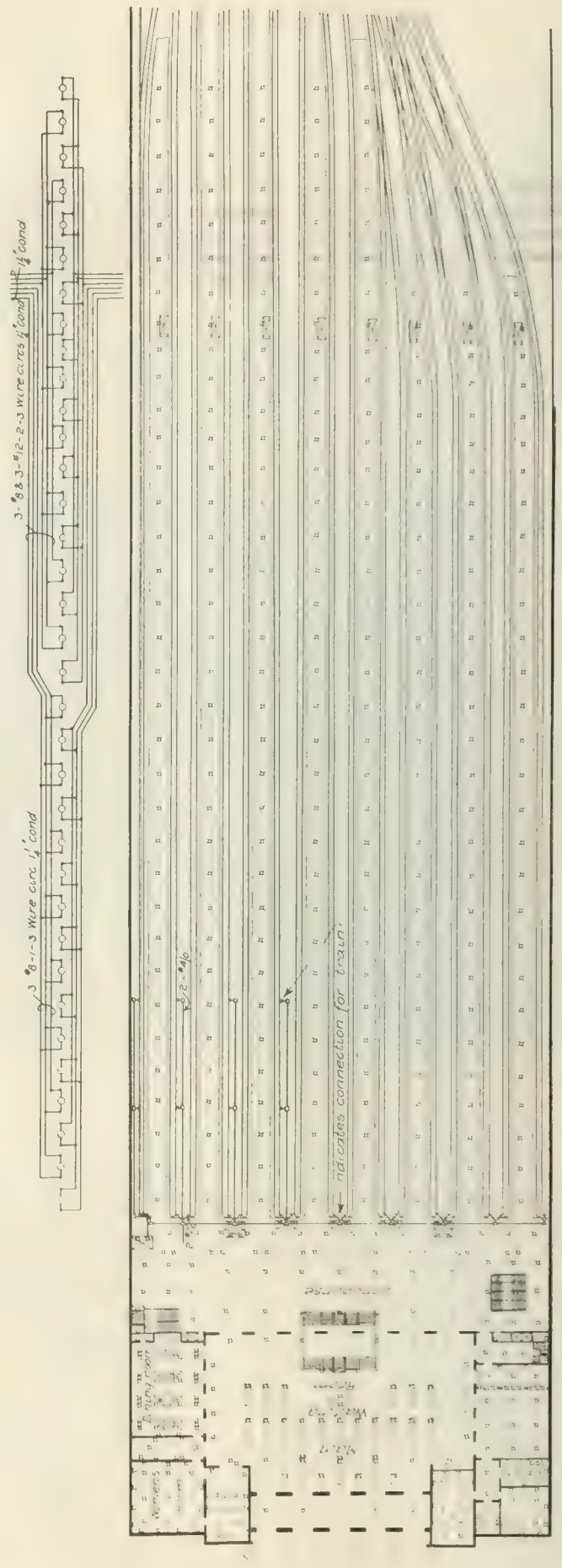


FIG. 3.—PLAN OF WAITING-ROOM AND TRAIN SHEDS, SHOWING PLATFORM LIGHTING CIRCUITS.

ELECTRICAL FEATURES OF THE NEW NORTHWESTERN RAILROAD TERMINAL IN CHICAGO.

a spur track, below which has been provided three steel coal hoppers. From these hoppers coal is delivered through suitably arranged spouts to a traveling steel-belt conveyor which passes it to a crusher. This crusher in turn delivers the coal to a cross steel-belt conveyor, from which it is spouted to a pivoted-bucket conveyor, which carries the fuel to concrete coal bunkers overhead. The pivoted-bucket coal conveyor also is to be used for ashes. The refuse is delivered from the ash pits below the boilers into the conveyor, carried up to the top of the building and there dumped into a transverse steel-belt conveyor, which in turn delivers the ashes into a double compartment overhead bunker, whence they will be dumped into the empty cars on the spur track.

The chimney will be located at the northern angle of the triangular block. It will have a clear inside diameter of 11 ft. and will extend practically 250 ft. above the boiler-room floor. The base of the chimney will be square to a height of about 40 ft. Above that there will be a circular shaft built of radial brick. Two lightning rods will be attached to the chimney. These will be connected at the top to four or six platinum-coated points. The point rods on the top of the chimney will be of solid round copper bar 5/8 in. in diameter and about 6 ft. high, securely fastened to the circuit with bronze slide connections. The conductors to ground will be placed on opposite sides of the chimney, each one extending 20 ft. into moist earth and grounded with a copper plate. Each conductor will consist of a rope-laid standard copper cable having a cross-section of not less than 254,000 circ. mils. The ground plates will be round, 7 in. in diameter, ½ in. thick, and provided with suitable holes, to which will be fastened the ends of the conductors. The breeching and the boiler uptakes will be made of very heavy sheet-steel plate. This breeching will extend over the top of the boilers at the rear and beneath the coal bunkers, and at the north end will enter the reinforced-concrete breeching, which is extended on a curve through the north end of the boiler-room wall into the base of the chimney.

In the engine-room there will be three vertical, cross-compound, non-condensing Allis-Chalmers engines rated at 1200 ihp under guaranteed steam consumption of 19 lb. per indicated hp-hour with steam at 150 lb. pressure by gage and 60 deg. superheat. To each will be direct-connected a 750-kw, 250-volt, direct-current General Electric generator turning at 100 r.p.m. Space is provided for a fourth unit.

One of the most interesting features of the power plant is the fact that there has been provided a 500-kw horizontal Rateau exhaust-steam turbine made by the Western Electric Company and directly connected to a 250-volt direct-current generator made by the same company. Space is left for the addition of a future exhaust-steam turbine unit. This turbine unit is guaranteed to develop a kw-hour on 43.5 lb. of steam at full load, this steam being delivered to the turbine at 16 lb. absolute pressure (1 lb. pressure by gage) with a vacuum of 27 in. in the exhaust chamber. The turbine speed is 1500 r.p.m. The unit is guaranteed under normal operating conditions to vary but 2 per cent between no load and full load. Momentary variation in speed due to sudden changes in load is not to exceed 4 per cent. The generators of the steam-turbine unit will be operated in multiple with the engine-driven generators. It is well known that high-pressure steam can be used to best advantage in reciprocating engines and low-pressure steam in turbines. The principle of using the exhaust steam from non-condensing reciprocating engines in low-pressure turbines has been used in extending existing plants, but the power house under description appears to be the first in the country to install from the beginning an exhaust-steam turbine in series with non-condensing reciprocating engines.

The condensing apparatus used in connection with the turbine is to be furnished by Henry R. Worthington, the condenser being of the surface type, with centrifugal, circulating and hot-well pumps motor-driven. On the roof of the building above the boiler house will be located a cooling tower of the four-fan type, each set of fans having extended shafts and being driven by an electric motor. One portion of the power plant is underneath the elevated-track structure and here, extending east from the engine-room, will be located various auxiliary apparatus, such as the condensing machinery, air compressors, boiler-feed pumps, motor-generator sets, station balancer sets and some other machinery.

There are two motor-generator sets. They consist of direct-current motors driving 500-kw, 6000-volt, 60-cycle, three-phase generators for furnishing electricity to be used outside of the terminal station for lighting yards, freight houses, etc. Direct current also will be furnished from the power house for the operation of the new Northwestern bascule railroad bridge across the North Branch of the Chicago River connecting with the present Wells Street station. The electricity to operate the signal towers will also be supplied from this power house. The total initial generating capacity of the plant will be 2750 kw. The engine-room is to be equipped with a 25-ton, three-motor, overhead traveling crane manufactured by the Shaw Electric Crane Company.



FIG. 4.—PORTION OF CANAL STREET FRONT, CHICAGO & NORTHWESTERN RAILWAY PASSENGER TERMINAL, CHICAGO.

The main switchboard in the power house will be placed on a gallery at the south end of the building. Cables will be carried through steel troughs in the elevated structure crossing Lake Street, from which point cables for delivering electricity to the main terminal station building will be carried through a vertical shaft to an overhead structure built above the train sheds, leading south to the station building and there dropping through a similar shaft to the basement of the building where they will connect to a distributing switchboard. Other cables for under-track service will be carried under the track structure, supported from the steel work.

In the block between Washington Boulevard and Randolph Street will be located three balancer sets. These will be of the same size—one for the three-wire distribution in the block between Randolph and Lake streets, another for the block in which the balancer sets are located, and a third being used as a relay set. In the basement of the terminal station building balancer sets will be provided to care for the unbalancing of the

lighting loads in that building. Another balancer set will be installed for lighting trains standing in the train sheds. Here also a relay unit will be provided.

Direct current on the three-wire system will be used both for lamps and motors throughout the terminal. It was selected rather than alternating current primarily on account of the number of motors requiring speed control. this being an essential feature of the extremely comprehensive ventilating system; further, while the elevators in the main terminal station building and the baggage lifts at the south end of the train sheds will be hydraulic, there will be eight baggage lifts north of Randolph Street which will be electrically operated. With direct current there will be less complication of machinery and appliances, simpler switchboard construction and easier manipulation of the switchboard, while no transformers or motor-generator sets will be required. The motor-generator sets previously mentioned will be used for providing alternating current to be used outside of the terminal. Preliminary proposals were received for both alternating-current and direct-current apparatus, and it was found that a saving of about $20,000 could be made by the use of direct current, making allowance for the increased amount of copper required. Taking all of these facts into consideration it was deemed that there was sufficient warrant for the installation of a direct-current plant.

LIGHTING FEATURES.

A comprehensive system of electric lighting has been provided in the station building and other parts of the terminal premises. The main waiting-room in particular will be supplied with ornamental standards and bracket fixtures around the wall of the great room, and in addition concealed lamps will be placed along the ledges on the north and south sides of the room, which will light by reflection from the vaulted ceiling the large open space of the lofty apartment.

In the train sheds lamps have been provided over the platforms and underneath the tracks the illumination will be ample for all requirements. To light the façade of the station building and also the sidewalks adjoining the terminal premises, ornamental posts with electric lamps will be provided for street lighting, forming a continuous line along Clinton, Madison and Canal streets and extending into Milwaukee Avenue. The Washington Boulevard, Randolph and Lake streets and Milwaukee Avenue posts are especially designed, those on Clinton and Canal streets being arranged for four incandescent lamps, three of which will be mounted in a downward position and one pointing upward. The posts on Madison Street will have five lamps, four pointing downward.

In addition to these posts, which will be placed on the curb line, there will be four beautiful, large, bronze lamp standards of massive and artistic design in front of the Madison Street façade of the terminal station building, two on each side of the main entrance. These handsome standards will form part of the architectural effect of the building and are clearly shown in Fig. 1.

Likewise shown in Fig. 1 are the two clock towers on the Madison Street front, and there will also be street clocks on the train-shed walls on Clinton and Canal streets over the Washington Boulevard subway. All of these clock dials will be especially illuminated by means of light reflected from large steel disks, somewhat larger in diameter than the dials themselves and placed immediately back of the dials. The lighting will be done by incandescent lamps placed in a trough surrounding the disks. The light is first reflected onto the disk, from which it is further reflected to the glass clock dial. As the main clock dials are over 11 ft. in diameter the trough containing the lamps has been made circular in shape and will revolve on rollers, so that it will be possible for the attendant, standing on the floor, to renew the lamps by simply turning the trough.

The lamps in the main waiting-room, street-level waiting-room and in the subways, as well as all street lamps and clock-dial lamps, will be controlled from a central point in the terminal station building. It will be possible to switch these lamps in circuit in sections, the operation being by means of remote-control switches operated from a central point by momentary-contact push buttons. A similar arrangement is planned in the case of the train sheds, where the lamps will be arranged in long rows, each gateman having a small lockbox from which he can control the lamps on his own platform. The lamps are wired alternately and every other one of them or all may be used. The remote-control switches for this purpose are placed at the south end of the train sheds, the particular advantage in this case being that while the power house is at the north end of the terminal premises, the control is at the extreme south end.

One unusual feature will be the installation of two 18-in. projectors on the Canal Street side of the train sheds, one over Washington Boulevard and one over Randolph Street. From these projectors vertical beams of light will be thrown into the air, and these will serve to make the terminal location conspicuous at night, guiding the traveler, particularly if a stranger in the city, on his way to the station. The beams of light will be visible for a long distance and will be particularly useful inasmuch as the traveling public has, for many years, been familiar with the Wells Street location of the Northwestern railroad station. The beacons of light will give a visual manifestation, not to be mistaken, of the change in location.

Another interesting characteristic of the lighting service is the means provided for lighting trains that are standing in the sheds. The train-lighting service is operated at 110 volts, and each train will take approximately 25 kw. A special set of feeders has been provided for this service, arranged on the three-wire, 220-volt system connected to a balancer set. From this balancer, which is placed in the terminal station building, three wires are run to and along the train sheds near the line of the bumpers. Each track is provided with a panel board located on the ceiling of the train shed, on which are placed magnet switches controlled by the electrician in charge of the train-lighting service, by means of momentary-contact push-button switches placed in cast-iron cases on the bumper posts.

These push-button switches are arranged in connection with the magnet switches, so the operator may throw in a particular train one either side of the three-wire circuit. For indicating the condition of the line before the particular train is thrown in, a shunt has been provided in the neutral before connection is made to the train-lighting bus, and from this shunt leads are run to small zero-reading ammeters located in each box with the push buttons.

Ordinarily connection for lighting service for trains standing in sheds is made from the platform level at the bumper post or from service boxes at the track level. In the Northwestern terminal, however, a method has been provided for making this connection from an overhead winding cable properly encased and placed on a drum provided with a retrieving spring. These cable drums or spools will be placed over the bumper post of each track and also at intervals down the line of the track in the train shed, so that cars other than the end one may be reached. The electrician is provided with a short pole having a hook, by means of which he can reach the end of the cable and pull it down, and is thus able to make connection to the car. When disconnected the cable is wound up in much the same way that a Hartshorn shade roller is operated. This arrangement permits of connecting the cable to cars of varying lengths.

Cables of 2,000,000 circ. mil area are run from the power house to the terminal station building. These are to be provided with suitable switches so that any cable or pair of cables may be cut out during periods of relatively light load, thus resulting in obtaining close feeder regulation. There will be 12 of these cables altogether—eight for general lighting purposes, two for motor service and two for train lighting. The great part of the run of these cables from the power house to the terminal station building is made in the cableway previously mentioned as being on the roof of the train sheds. This cableway is of fireproof construction and is entirely enclosed. On this account, and also owing to the low voltage of the system, weatherproof wire is used, thus materially reducing the first cost

of the installation and also providing an installation in which depreciation is reduced to a minimum.

MOTOR AND MISCELLANEOUS SERVICE.

Including the north baggage lifts, of which there are eight, there will be at least 500 hp in electric motors installed throughout the premises. Motors will be used for driving heating and ventilating apparatus in the terminal station building and also for the centrifugal house pumps, the ejector sewage system, pneumatic-tube system and the dumb waiters; and in addition there will be electric motors installed for operating mail conveyors.

All elevators in the terminal station building, both passenger and baggage lifts, including a service elevator, are to be hydraulic, being driven by high-duty, steam-actuated pumps, the steam for which will be transmitted from the power house direct, a distance of 1500 ft.

The exhaust available from these pumps will be utilized for heating purposes during cold weather, and in the summer the greater portion of this steam will be available for heating water for use in the kitchen and restaurant and for the hot-water service in the building.

Intercommunicating telephone and fire-alarm systems have been provided. A special electrical signaling system will be used, by means of which the towerman can signal the gateman and the train conductors when a track is made clear for an outgoing train.

This signaling system has been ingeniously worked out so that by means of push buttons and electric light signals the towerman, train conductor and gateman keep in close touch with one another at the time of the departure of trains, to the end that there may be greater safety in dispatching the trains promptly on schedule time.

President Marvin Hughitt, of the Chicago & Northwestern Railway Company, devoted a large amount of his personal attention to the details of the mechanical and electrical equipment of this new passenger terminal. The direct charge of the work, however, is under the supervision of Mr. John M. Whitman, vice-president of the company, in charge of construction. All engineering details are passed upon by the chief engineer of the company, Mr. E. C. Carter. Frost & Granger are the architects for the railway company, and Pierce, Richardson & Neiler are the consulting and designing engineers. Mr. W. C. Armstrong is the terminal engineer in charge of all the structural work of the new terminal. The officers of the Northwestern company believe that the premises will be ready for occupancy early next year.

Power Characteristics of the Tungsten Filament.

By CHARLES P. STEINMETZ.

As in the tungsten-filament incandescent lamp the resistance increases with the temperature, the power consumption varies at a rate which is less than proportional to the square of the impressed voltage. It, therefore, was interesting to investigate experimentally the manner in which the power consumption increases with increase of voltage.

In pursuit of an extended investigation on the radiation law of the tungsten filament, a series of tests had been made with special care on a number of modern tungsten lamps, extending over a wide range of candle-powers. Taking the readings very quickly, by experts especially trained in photometric work, it was possible to reach 10 times the rated candle-power of the lamps, without any appreciable impairment or change of the filament or blackening of the globes, as evidenced by the lamp showing its original candle-power and efficiency after the test. For these data the writer is indebted to Mr. F. C. Marshall, of the Harrison Lamp Works.

Analyzing the relation between the power consumption and the impressed voltage, the interesting result was found that the power consumption varies proportional to the 1.6 power of the voltage; that is, follows a law analogous to that of the hysteresis loss in iron in an alternating magnetic field, and thus can be expressed by the equation:

$$w = c\, e^{1.6}$$

The following table gives in the first four columns the observed values of candle-power L, impressed voltage e, and current i of one of these lamps, a 32-cp, 40-watt lamp. The fifth column gives the watts w derived by multiplying volts and amperes. The values of this column can be expressed by the equation

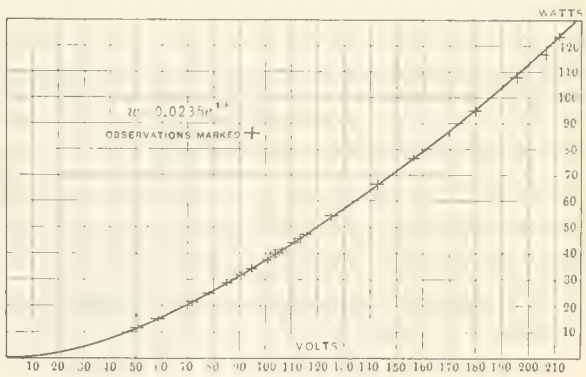
$$w = 0.0235\, e^{1.6}$$

In the sixth column of the table are given the values calculated by this equation of the 1.6 power, and in the last two columns, the differences between observed values of power w and values calculated by the 1.6 power law. As will be seen the difference in no case reaches 1 per cent.

No. of Test.	L CP.	e Volts.	i Amps.	w Watts.	Watts Calculated.	Difference.	%
1	2	49.6	.247	12.25	12.14	.11	−.9
2	4	59.6	.274	16.33	16.26	−.07	−.4
3	8	70.6	.302	21.35	21.40	+.05	+.2
4	12	79.0	.324	25.60	25.55	−.05	−.2
5	16	85.3	.339	28.91	28.89	−.02	−.1
6	20	90.4	.350	31.64	31.70	+.06	+.2
7	24	95.7	.361	34.55	34.70	+.25	+.7
8	28	100.5	.371	37.29	37.47	+.18	+.5
9	32	103.3	.380	39.26	39.25	−.01	−.0
10	36	106.6	.389	41.47	41.30	−.17	−.4
11	40	110.9	.398	44.14	44.00	−.14	−.3
12	44	113.3	.401	45.42	45.50	+.08	+.2
13	48	115.6	.407	47.05	47.20	+.15	+.3
14	32	103.5	.380	39.33	.....	...	..
15	64	126.6	.429	54.31	54.40	+.09	+.2
16	32	103.6	.381	39.46	.....	...	..
17	96	142.9	.460	65.73	65.95	+.22	+.3
18	32	103.3	.380	39.23	...	..	..
19	128	157	.489	76.77	76.68	−.09	−.1
20	32	103.4	.380	39.29	...	...	..
21	192	180	.529	95.24	95.45	+.21	+.2
22	32	103.0	.380	39.14	.....	...	..
23	256	196	.556	109.00	109.4	+.40	+.4
24	32	103.2	.380	39.22	.....	...	..
25	288	206.5	.571	117.9	118.9	+1.00	+.8
26	32	103.8	.381	39.55	...	...	..
27	320	212	.580	123.0	124.0	+1.10	+.9
28	32	103.8	.380	39.45	.....	....	+.9

In the accompanying illustration is shown the curve of 1.6 power, with the observed values of power marked by crosses. As will be seen, the coincidence is so close as to give no noticeable deviation in the scale of the curve.

About 18 years ago the writer observed that the relation between the power loss in iron in an alternating magnetic field and the magnetic density can, with good approximation, be empirically expressed by a law of 1.6 power:



EXPONENTIAL CURVE, 1.6 POWER.

$$w = \eta B^{1.6}$$

This law of hysteresis is still an empirical law, and all attempts to derive it rationally from theoretical considerations have thus far failed. It therefore is especially interesting to observe the same law of the 1.6 power, showing the relation between the consumption and voltage of tungsten lamps, especially as in the tungsten lamp the law of the 1.6 power is not only an empirical law, but can rationally be derived as a theoretical conclusion from the temperature law of metallic resistance,

$$r = a\, T$$

and the normal radiation law,

$$R = b\, T^4$$

where T = absolute temperature and R = total radiation power.

Complete Solution of Transmission Line with Distributed Capacity and Leakage.

By Harold Pender.

In transmission lines of considerable length and high voltage, the effect of the line capacity becomes quite appreciable. This effect is usually calculated by assuming that the capacity of the line is equivalent to two condensers, each of half the capacity of the line, one shunted across the line at the receiving end and the other shunted across the line at the generating end. As is well known, this assumption gives only an approximate solution.

The complete solution of a line with capacity and leakage has been given by a number of authors, but the formulas deduced are so complicated that few engineers attempt to use them, but accept the approximate formulas as sufficiently accurate for practical purposes. It is always well, however, to check an approximate formula when used for important work, and it is therefore highly desirable to have accurate formulas in a shape which can be readily applied.

It is the purpose of this paper to put these accurate formulas in the simplest possible shape for practical use, and at the same time to show how the formulas in question are derived. By introducing the power-factor angles of the line impedance and leakage admittance, the deduction of the formulas is greatly simplified, as well as the final formulas themselves.

The article is arranged as follows: First, the quantities involved are clearly defined, then the final working formulas are given; this is followed by a numerical example worked out both algebraically and graphically, and finally is given the deduction of the formulas.

Summary of Working Formulas.

To avoid the use of numbers of many figures, in the following definitions and formulas the line voltage is expressed in kilovolts, the leakage resistance in megohms and the capacity in microfarads.

Let V_o = kilovolts (thousands of volts) between each wire and neutral at receiving end.

I_o = amperes per wire at receiving end.

ϕ_o = power-factor angle of receiver ($\cos \phi_o$ = power factor of receiver).

These same symbols without the subscript "$_o$" refer to the generator end of the line.

$z = \sqrt{r^2 + x^2}$ = impedance of each wire per unit length, where r and x are, respectively, the resistance and reactance in ohms per unit length.

ε = power-factor angle of the impedance $\left(\cos \varepsilon = \frac{r}{z}\right)$

$y = \sqrt{g^2 + b^2}$ = leakage admittance of each wire per unit length, where g equals the reciprocal of the insulation resistance to neutral[1] in megohms per unit length, and $b = 2\pi f C$, where f is the frequency and C the capacity to neutral[1] in microfarads per unit length.

η = power-factor angle of admittance $\left(\cos \eta = \frac{g}{y}\right)$

l = length of line.

Calculate the following quantities (angles are represented by Greek letters and are expressed in degrees, the logarithm is to the base 10).

$$a = \sqrt{\frac{z}{y}} \qquad \text{and} \qquad S = 10^3 l \sqrt{y z}$$

$$\delta = \frac{\eta + \varepsilon}{2} \qquad \text{and} \qquad \gamma = \frac{\eta - \varepsilon}{2}$$

$$\log k = 0.4343\, S \cos \delta \qquad \mu = 114.6\, S \sin \delta \qquad \text{(take } k \text{ from table of logarithms).}$$

$$\theta_o = \phi_o + \gamma.$$

$$I_o = a I_o$$

$$A = \frac{k}{2} \sqrt{V_o^2 + I_o^2 a^2 + 2 V_o I_o a \cos \theta_o}$$

$$B = \frac{k}{2} \sqrt{V_o^2 + I_o^2 a^2 - 2 V_o I_o a \cos \theta_o}$$

$$\cos \beta_o = \frac{V_o^2 - I_o^2 a^2}{4 A B} \qquad \text{(take } \beta_o \text{ from table of cosines).}$$

β_o has the same sign as θ_o.

$$\beta = \beta_o - \mu.$$

$$V = \sqrt{A^2 + B^2 + 2 A B \cos \beta}$$

$$I = \sqrt{A^2 + B^2 - 2 A B \cos \beta}.$$

$$\cos \Theta = \frac{A^2 - B^2}{V I} \qquad \text{(take } \Theta \text{ from table of cosines).}$$

Θ has the same sign as β.

Then

Kilovolts to neutral at generator end is V.

Amperes per wire at generator end is $I = \frac{J}{k}$

Power factor at generator end is $\cos \phi = \cos (\Theta - \gamma)$.

For a single-phase line the total kilowatts generated will then be $2 V I \cos \phi$, and for a three-phase line the total kilowatts generated will be $3 V I \cos \phi$.[2]

Numerical Example.

Length of line, 700 miles.
Power delivered, 40,000 kw, three-phase.
Voltage delivered, 150,000 volts; frequency, 25 cycles.
Power factor of delivered power, 0.918.
Resistance of each wire per mile, 0.085.
Reactance of each wire per mile, 0.3095.
Impedance of each wire per mile, 0.3215.
Capacity susceptance of each wire per mile, 2.386; no leakage.

$$V_o = \frac{150}{\sqrt{3}} = 86.6$$

$\cos \phi_o = 0.918$, therefore $\phi_o = 23.37°$

$$I_o = \frac{40{,}000}{\sqrt{3} \times 150 \times 0.918} = 167.7$$

$z = 0.3215.$

$$\cos \varepsilon = \frac{0.085}{0.3215} = 0.2644, \text{ therefore } \varepsilon = 74.67°$$

$y = 2.386$

$\cos \eta = 1$, therefore $\eta = 90.00°$

Then

$$a = \sqrt{\frac{0.3215}{2.386}} = 0.3671$$

$$S = 10^3 \times 700 \sqrt{0.3215 \times 2.386} = 0.6131$$

$$\delta = \frac{90.00 + 74.67}{2} = 82.34°,$$

therefore $\cos \delta = 0.1334$ and $\sin \delta = 0.9911$

$$\gamma = \frac{90.00 - 74.67}{2} = 7.66°$$

$\log k = 0.4343 \times 0.6131 \times 0.1334 = 0.03552$

therefore $k = 1.0853$

$\mu = 114.6 \times 0.6131 \times 0.9911 = 69.64°$

$\theta_o = 23.37 + 7.66 = 31.03°$, therefore $\cos \theta_o = 0.8569$

$I_o = 0.3671 \times 167.7 = 61.56$

$$A = \frac{1.0853}{2} \times \sqrt{(86.6)^2 + (61.56)^2 + 2 \times 86.6 \times 61.56 \times 0.8569} = 77.55$$

$$B = \frac{1}{2 \times 1.0853} \times \sqrt{(86.6)^2 + (61.56)^2 - 2 \times 86.6 \times 61.56 \times 0.8569} = 21.38$$

$$\cos \beta_o = \frac{(86.6)^2 - (61.56)^2}{4 \times 77.55 \times 21.38} = 55.83, \text{ therefore } \beta_o = 56.06°$$

$\beta = 56.06 - 69.64 = -13.03°$, therefore $\cos \beta = 0.9718$

[1] For either a single-phase (two-wire) line or a three-phase (three-wire) line with wires symmetrically arranged, the insulation resistance to neutral is one-half the insulation resistance between any pair of wires, and the capacity to neutral is twice the capacity of the condenser formed by any pair of wires; this relation holds for lead-covered cables, as well as for overhead lines. Note, however, that, with respect to the triple harmonic, a three-phase line with grounded neutral should be treated as a single-phase line with the three conductors in parallel and the ground as the return, and that the insulation resistance and capacity should be determined for this condition.

[2] The above working formulas, in slightly different shape, were first published by the author in "Power Conductors," by W. A. Del Mar. (Van Nostrand.)

$$I = \sqrt{(77.55)^2 + (21.38)^2 + 2 \times 77.55 \times 21.38 \times 0.9718} = 98.46$$

$$J = \sqrt{(77.55)^2 + (21.38)^2 - 2 \times 77.55 \times 21.38 \times 0.9718} = 56.99$$

$$\cos \Theta = \frac{(77.55)^2 - (21.38)^2}{98.46 \times 56.99} = 0.9905, \text{ therefore } \Theta = -7.90^\circ$$

(Note that in each pair of radical expressions the second differs from the first only in the sign before the third term; the numerical calculation of these quantities is, therefore, by no means as complicated as appears when the formulas are written out in full.)

Hence kilovolts between wires at generator end:

$$98.46 \sqrt{3} = 170.5$$

Amperes per wire at generator end: $\frac{56.99}{0.3671} = 155.2$

Power factor at generator end: $\cos(-7.90 - 7.66) = 0.9634$.

Since the power-factor angle at the generator is negative (-15.56°), the current at the generator is leading.

DERIVATION OF FORMULAS.

The derivation of the above formulas is given below; note that a uniform system of units is used throughout; the working formulas given above, involving the compound units, kilovolts, megohms and microfarads, are derived from the final formulas deduced by introducing the proper coefficients.

Let l = distance of any point on the line from the receiving end.

r = resistance of each wire per unit length.

L = self-induction of each wire per unit length.

g = leakage conductance between each wire and neutral per unit length.[1]

C = capacity between each wire and neutral per unit length.[1]

v = instantaneous value of pressure between wire and neutral at point under consideration.

i = instantaneous value of current in the line wire at point under consideration.

t = time.

At any point on the line we then have

$$\frac{dv}{dl} = ri + L\frac{di}{dt} \qquad (1)$$

$$\frac{di}{dl} = gv + C\frac{dv}{dt} \qquad (2)$$

Differentiating these equations with respect to l and remembering that $\frac{d}{dl}\left(\frac{dv}{dt}\right) = \frac{d}{dt}\left(\frac{dv}{dl}\right)$ and similarly that $\frac{d}{dl}\left(\frac{di}{dt}\right) = \frac{d}{dt}\left(\frac{di}{dl}\right)$ and noting that $\frac{dv}{dl}$ is given by equation (1) and $\frac{di}{dl}$ by equation (2), we get

$$\frac{d^2v}{dl^2} = rgv + (rC + gL)\frac{dv}{dt} + LC\frac{d^2v}{dt^2} \qquad (3)$$

$$\frac{d^2i}{dl^2} = rgi + (rC + gL)\frac{di}{dt} + LC\frac{d^2i}{dt^2} \qquad (4)$$

The coefficients of these two differential equations are identical, their integrals will, therefore, differ only in the constants of integration. The general integral of a differential equation of this form can be represented by a Fourier's series in which each term is of the form

$$A_0 e^{ml+ht}\sin(\omega t + nl + \alpha_0) \qquad (5)$$

where the constants are all real quantities.

Each of these terms represents a wave of frequency $\frac{\omega}{2\pi}$ and wave length $\frac{2\pi}{n}$ advancing along the line toward the generating end with a velocity equal to $\frac{\omega}{n}$; the amplitude of the wave at any point is $A_0 e^{ml+ht}$; the angle α_0 represents the phase of the disturbance at the receiver at time $t = 0$. If sufficient time is assumed to have elapsed after closing the circuit for the amplitude of the current and voltage at each point to have attained a constant value, the factor e^{ht} becomes unity (h is a negative quantity), and the above expression becomes

$$A_0 e^{ml}\sin(\omega t + nl + \alpha_0) \qquad (6)$$

Each term of this kind in the Fourier's series must satisfy the differential equations separately, since the differential equations are linear. Therefore, putting

$$v = A_0 e^{ml}\sin(\omega t + nl + \alpha_0) \qquad (7)$$

and substituting in equation (3) and equating coefficients we get

$$m^2 - n^2 = rg - \omega^2 LC$$

$$2mn = \omega(rC + gL) \qquad (8)$$

But $\omega L = x$, the reactance per unit length, and $\omega C = b$, the capacity susceptance per unit length, therefore these equations may be written

$$m^2 - n^2 = rg - bx$$

$$2mn = b(r + gx) \qquad (9)$$

If we represent the impedance $\sqrt{r^2 + x^2}$ by z and the ad-

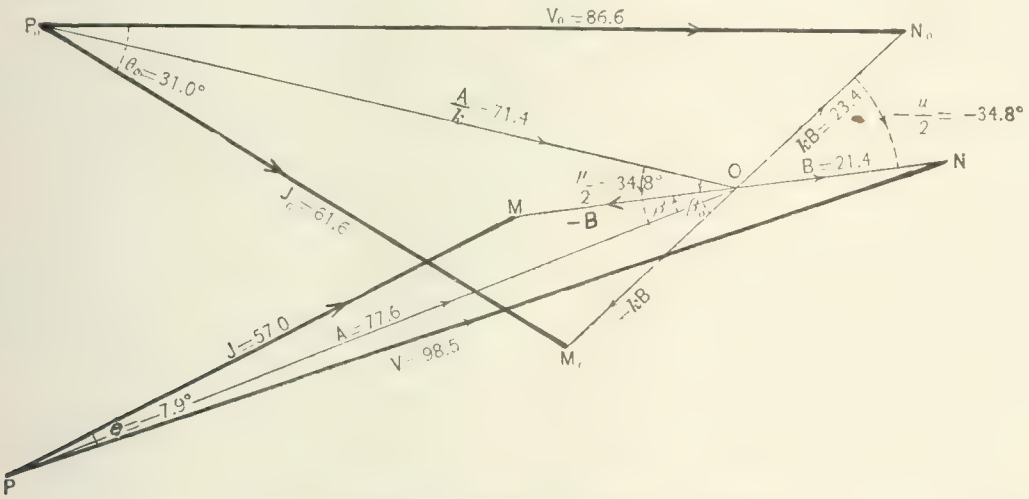


FIG. 1.—GRAPHICAL SOLUTION OF NUMERICAL EXAMPLE.

Lay off $P_0N_0 = V_0$ and $P_0M_0 = I_0$, making the angle θ with each other. Then measure the length of the line $ON_0 = \frac{OA_0}{A}$, making the angle $\frac{\alpha}{2}$ with P_0N_0. Calculate $\frac{\alpha}{2}$ and $\frac{\beta}{2}$ from the formulæ given above. Then lay off $OM = \frac{OA_0}{A}$, making the angle $\frac{\alpha}{2}$ with P_0N_0, and $PO = B_0$, making the angle $\frac{\beta}{2}$ with P_0O. Then $P_0N = V$, $PM = J$, and $\theta = NPM$. Note that in this example β is less than α, and therefore θ is to be taken negative.

[1] For either a single-phase (2-wire) or a three-phase (3-wire) system with wires symmetrically arranged $C = 2c$ (capacity between any two wires), and $g = 2s$ (leakage conductance between any two wires).

mittance $\sqrt{g^2+b^2}$ by y, and the power-factor angles of the impedance and admittance by $\epsilon\left(=\cos^{-1}\frac{r}{z}\right)$ and $\eta\left(=\cos^{-1}\frac{g}{y}\right)$ respectively, we have that

$$r = z\cos\epsilon \qquad g = y\cos\eta$$
$$x = z\sin\epsilon \qquad b = y\sin\eta \qquad (10)$$

which substituted in (9) give

$$m^2 - n^2 - yz(\cos\eta\cos\epsilon - \sin\eta\sin\epsilon) = yz\cos(\eta+\epsilon)$$
$$2mn - y(\sin\eta\cos\epsilon + \cos\eta\sin\epsilon) = yz\sin(\eta+\epsilon) \qquad (11)$$

Squaring and adding these two equations, and taking the square root of the sum gives[1]

$$m^2+n^2 = yz \qquad (12)$$

Combining (12) with the first of equations (11) we get

$$m = \pm\sqrt{yz}\sqrt{\frac{1+\cos(\eta+\epsilon)}{2}} = \pm\sqrt{yz}\cos\left(\frac{\eta+\epsilon}{2}\right)$$

and (13)

$$n = \pm\sqrt{yz}\sqrt{\frac{1-\cos(\eta+\epsilon)}{2}} = \pm\sqrt{yz}\sin\left(\frac{\eta+\epsilon}{2}\right)$$

Since b and x are always positive under the conditions of the problem in hand, η and ϵ are each positive and less than 90 deg., therefore the angle $(\eta+\epsilon)$ and the expressions $\sqrt{yz}\cos\left(\frac{\eta+\epsilon}{2}\right)$ and $\sqrt{yz}\sin\left(\frac{\eta+\epsilon}{2}\right)$ are positive quantities, and from the second of equation (11) we also have that the product mn must also be positive. Consequently there are two, and only two pairs of values of m and n, which will satisfy the physical conditions of the problem, namely,

$$m = +\sqrt{yz}\cos\left(\frac{\eta+\epsilon}{2}\right) \text{ and } n = +\sqrt{yz}\sin\left(\frac{\eta+\epsilon}{2}\right)$$

and

$$m = -\sqrt{yz}\cos\left(\frac{\eta+\epsilon}{2}\right) \text{ and } n = -\sqrt{yz}\sin\left(\frac{\eta+\epsilon}{2}\right) \qquad (13a)$$

Therefore the complete solution of equation (3) for the term having the frequency $\frac{\omega}{2\pi}$ is

$$i = A_0 e^{ml}\sin(\omega t + nl + \alpha_0) + B_0 e^{-ml}\sin(\omega t - nl + \beta_0) \qquad (14)$$

where m and n are given by equation (13) using the positive sign. The quantities A_0, B_0, α_0 and β_0 are integration constants fixed by the terminal conditions. By properly choosing the time from which t is measured we can put $\alpha_0 = 0$ and equation (14) may be written

$$i = A_0 e^{ml}\sin(\omega t + nl) + B_0 e^{-ml}\sin(\omega t - nl + \beta_0) \qquad (14a)$$

The physical meaning of this equation is that the pressure along the line is due to two waves of pressure, one advancing along the line in the direction of the receiver with a gradually diminishing amplitude, the other traveling in the opposite direction with the same velocity, but with an increasing amplitude; the second wave may be looked upon as a reflected wave.

The value of the current at any point along the line may now be determined by substituting (14a) in (2) we get

$$\frac{di}{dl} = gA_0 e^{ml}\sin(\omega t + nl) + gB_0 e^{-ml}\sin(\omega t - nl + \beta_0)$$
$$+ bA_0 e^{ml}\cos(\omega t + nl) + bB_0 e^{-ml}\cos(\omega t - nl + \beta_0)$$

which integrated with respect to l gives[2]

$$i = \sqrt{\frac{y}{z}}\left[A_0 e^{ml}\sin\left(\omega t + nl + \frac{\eta+\epsilon}{2}\right) - B_0 e^{-ml}\sin\left(\omega t - nl + \beta_0 + \frac{\eta-\epsilon}{2}\right)\right] \qquad (15)$$

which means that the current at any point in the line is the resultant of two waves of current, a direct and a reflected wave, the amplitudes of which are proportional to the amplitudes of the corresponding pressure waves, the direct current-wave leading the pressure-wave by the angle $\frac{\eta-\epsilon}{2}$ and the reflected current-wave leading the reflected pressure-wave by the angle $\frac{\eta-\epsilon}{2}$.

Or, interpreting equations (14a) and (15) in terms of vectors, we have that the pressure at the receiver ($l=0$) is the sum of two vectors A_0 and B_0 making the angle β_0 with each other, and that the current at the receiver is equal to the difference of these same two vectors multiplied by $\sqrt{\frac{y}{z}}$ and turned through an angle $\left(\frac{\eta-\epsilon}{2}\right)$. As we go along the line toward the generating end the vector A increases in length to $A_0 e^{ml}$ and rotates in the positive direction through an angle (nl), while the vector B decreases in length to $B_0 e^{-ml}$ and rotates in the opposite direction through an equal angle $(-nl)$; the pressure at any point is therefore the sum of the two vectors $A\ (=A_0 e^{ml})$ and $B\ (=B_0 e^{-ml})$ making an angle $(\beta_0 - 2nl)$ with each other, and the current is equal to the difference of the same two vectors multiplied by $\sqrt{\frac{y}{z}}$ and turned through an angle $\left(\frac{\eta-\epsilon}{2}\right)$. If we let

V = vector representing pressure at any point on the line
I = vector representing current at this point
A = vector representing $A_0 e^{ml}\sin(\omega t + nl)$ at this point
B = vector representing $B_0 e^{-ml}\sin(\omega t - nl + \beta_0)$ at this point
J = vector representing $I\sqrt{\frac{z}{y}}$ turned through the angle $\left(\frac{\eta-\epsilon}{2}\right)$
ϕ = angle that I lags behind V, i.e., the power-factor angle
$\Theta = \phi + \frac{\eta-\epsilon}{2}$ = angle by which J lags behind V,

we then have diagrammatically Figs. 2 and 3.

Fig. 2 enables us to determine immediately the constants A_0, B_0 and β_0 in terms of the pressure, current and power factor at the receiver. This may be done graphically as indicated by the figure or algebraically from the following formulas

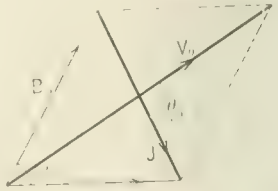


FIG. 2.—AT THE RECEIVER.

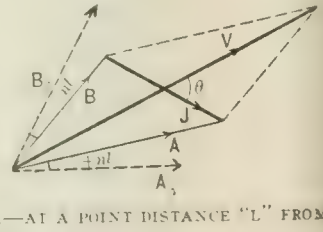


FIG. 3.—AT A POINT DISTANCE "L" FROM RECEIVER.

$$4A_0^2 = V_0^2 + J_0^2 + 2V_0J_0\cos\Theta_0$$
$$4B_0^2 = V_0^2 + J_0^2 - 2V_0J_0\cos\Theta_0$$
$$\cos\beta_0 = \frac{V_0^2 - J_0^2}{4A_0B_0} \qquad (16)$$

The pressure, current and power-factor angle at a point a distance l from the receiver can then be determined from the following formulas, which are derived immediately from Fig. 3.

$$V^2 = A^2 + B^2 + 2AB\cos(\beta_0 - 2nl)$$
$$J^2 = A^2 + B^2 - 2AB\cos(\beta_0 - 2nl)$$
$$\cos\Theta = \frac{A^2 - B^2}{VJ} \qquad (17)$$

where

$$A = A_0 e^{ml} \text{ and } B = B_0 e^{-ml}$$

For numerical calculations these formulas can be put in the more convenient shape given at the beginning of this discussion.

If harmonics are present in the pressure impressed on the line, there will be a similar set of equations for each frequency that may be present.

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[1] Mathematically we also get $m^2 - n^2 = -yz$, but since m and n are both real quantities and y and z represent two positive physical quantities, this relation is inconsistent with the physical conditions of the problem.

[2] Note that $\frac{d}{dl}e^{ml}\sin nl = me^{ml}\sin nl + ne^{ml}\cos nl$

and that $e^{ml}\cos nl = \frac{me^{ml}\cos nl + ne^{ml}\sin nl}{m^2+n^2}$

whence, making use of the relations (12) and (13) and the definition of the angle η, we get equation (15).

Special Motor-Controlling Devices in the Rolling Mill of the Indiana Steel Company, Gary, Ind.

OUR issues for May 13 and 20, 1909, contained articles by Mr. E. A. Lof describing the switchboard equipment and the distributing circuits installed in the Gary plant of the Indiana Steel Company, the generators for which were described in our issue for Sept. 26, 1908, and the motor equipment, March 18, 1909. When it is recalled that although the mill is driven exclusively by electric motors and 100,000 tons of rails are turned out per month, yet only eight motor operators are required, it will be appreciated that the problems connected with the control of the motors have been well solved. In the present article will be given an outline of the motor-controlling devices employed in operating the rolling mill.

As noted in previous issues, two 2000-hp induction motors of the constant-speed type serve for driving the four sets of rolls for the 40-in., two-high blooming mills. These motors cover four of the 18 "passes" intervening between the "soaking pit" and the "hot bed," or from the heated stock in the rough to the finished rail.

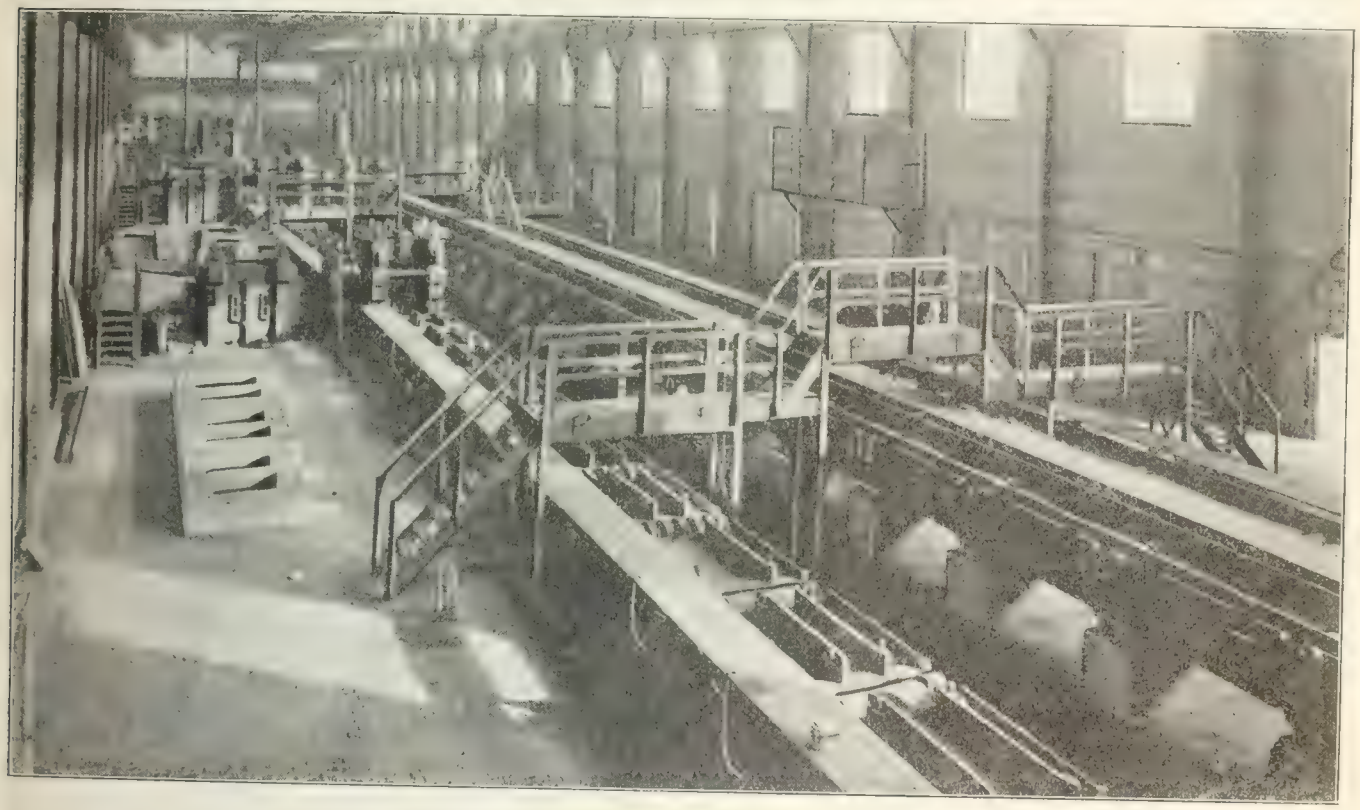


FIG. I.—GENERAL VIEW OF RAIL MILL.

Two 6000-hp induction motors operate passes Nos. 5, 6, 7, 8, 9, 10, 11, 12, 16 and 17, while one 2000-hp and one 6000-hp induction motors operate the remaining passes, Nos. 13, 14, 15 and 18. Each pass represents the movement of the heated steel between rolls and results in a decrease in cross-section with increase in length of the mass. The rolls, during normal operation, are driven at approximately constant speed so that the controlling apparatus for the induction motors could be of the simple type suitable merely for bringing the machines to full speed from complete rest at the proper rate. However, the load on these motors is of a violently fluctuating nature and means are employed for reducing the fluctuations in their demand for power from the supply system. In addition to the large flywheels with which one of the machines is provided, each motor is equipped with automatic devices for increasing the secondary resistance with increase of load on the machine and decreasing the resistance when the load is removed.

Between each pass the stock is turned through 90 deg., while at the three-high blooming mill it must be elevated and lowered, according to the direction in which it is to travel. Moreover, the stock must be shifted in horizontal position at two points. For accomplishing these results there are provided 21 tables and two transfers. Each table is equipped with small rolls, for causing the stock to move in the desired direction, the rolls being driven by motors of the mill type resembling steel-car motors. Each of these motors is equipped with an automatic current-limiting controller. The controller is of the contactor type, the arrangement being such that as the starting resistance is decreased step-by-step the current is kept within definite limits. When the operator closes the switch all of the resistance is in circuit. The first section can be short-circuited only when the current has decreased to the value for which the controller is adjusted; similarly the second, third, fourth, etc., sections. The contactors are closed by electromagnets whose coils are inoperative when the current exceeds the permissible value. The transfers are operated by motors of the mill type equipped with current-limiting controllers similar to those just described. The act of moving the stock horizontally on the transfer is accomplished by means of motor-driven chains, the controller being so adjusted that when the operator places the handle in the forward position the chain moves the rail to the proper place and automatically comes to rest.

Probably the most interesting electrical feature of the installation is the equipment provided for operating the lifting table used in connection with the three-high blooming mill. The table, which weighs about 250,000 lb., is lifted or lowered as required through a distance of 43 in. in the remarkably short time of three seconds. This task is performed by a 250-hp motor designed for a normal speed of 100 r.p.m. Even if the motor were to run at full speed throughout the whole of the three seconds, it would complete only five revolutions. Considering the time consumed in accelerating and in coming to rest, it will be seen that the motor actually does its whole work of lifting the table while making less than four complete revolutions. The table is supported on huge bell cranks, which are connected to a rotating crank driven by the motors. By means of automatic controlling devices the throwing of a master lever starts the table

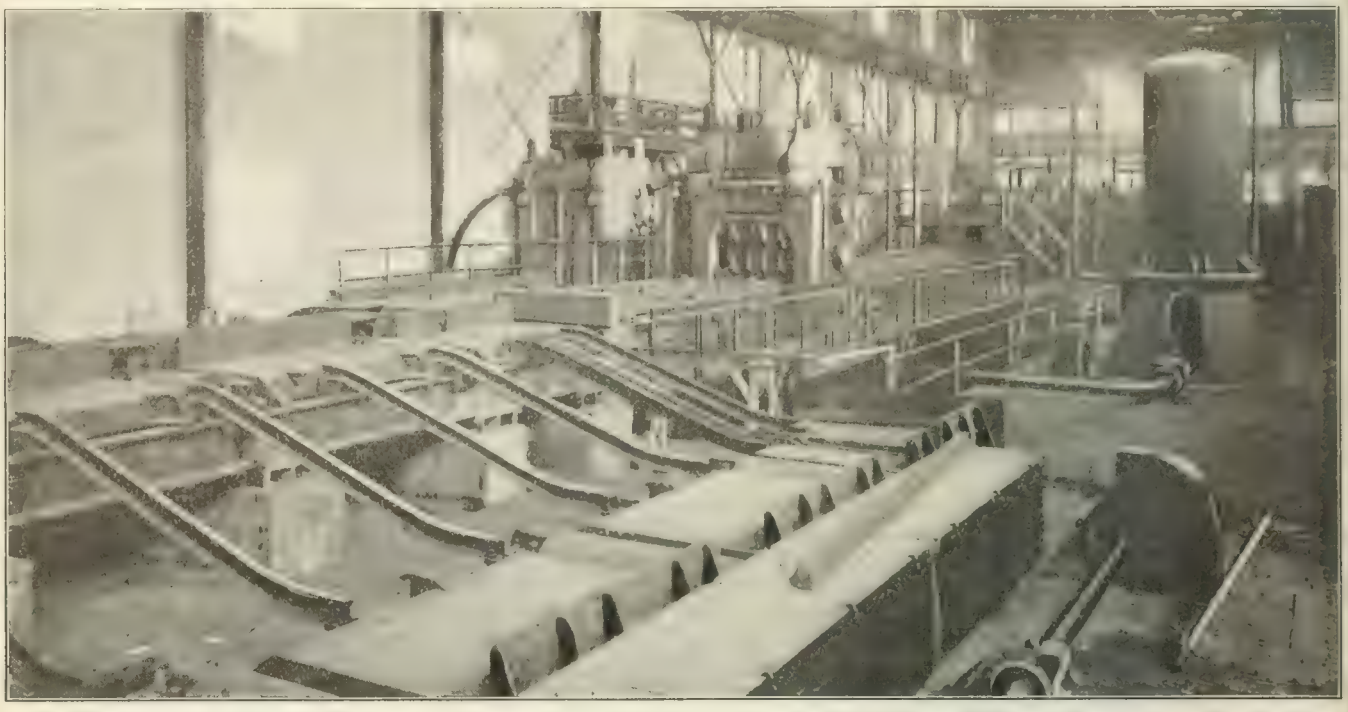


FIG. 2.—43-IN., THREE-HIGH BLOOMING MILL, WITH MOTOR-OPERATED ELEVATING TABLE.

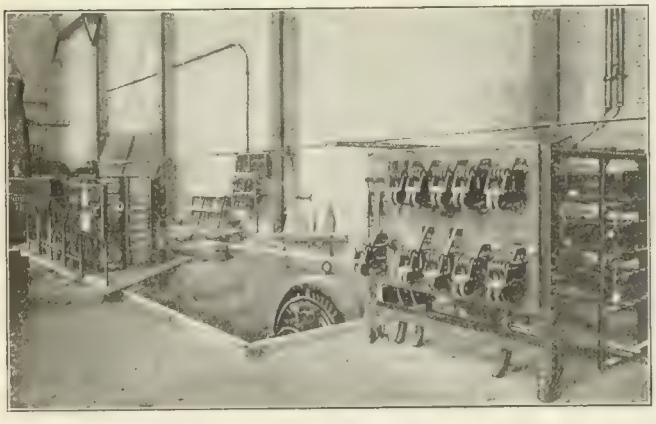


FIG. 3.—CONTROLLER FOR 250-HP DIRECT-CURRENT MOTOR USED TO RAISE AND LOWER BLOOMING-MILL TABLE.

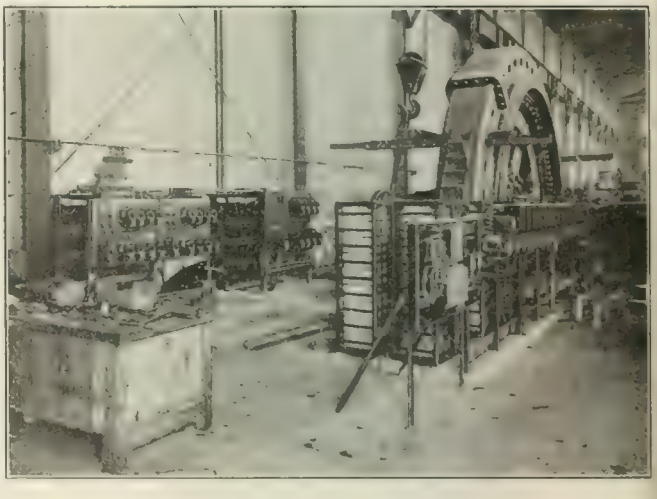


FIG. 5.—6000-HP MOTOR AND CONTROLLER.

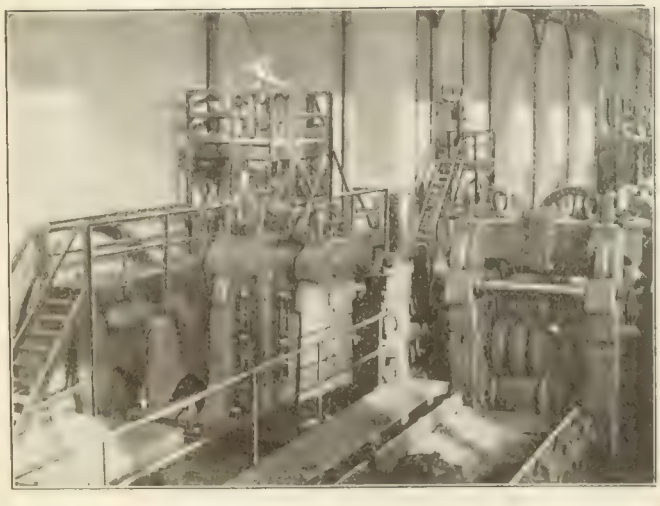


FIG. 4.—OPERATING PULPIT, THREE-HIGH ROUGHING MILL.

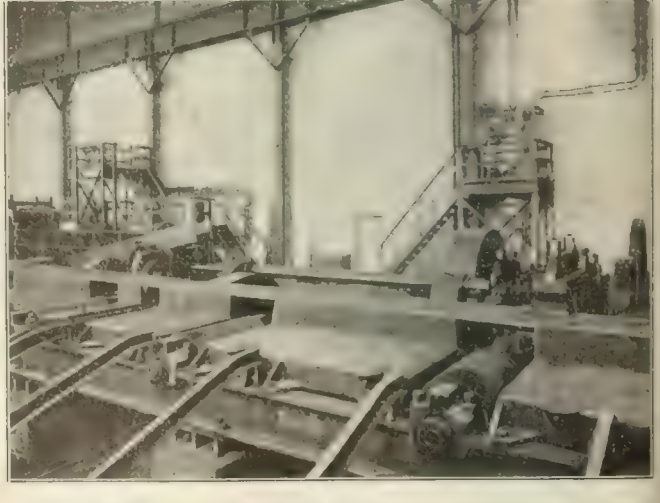


FIG. 6.—LOOKING ACROSS RAIL TRANSFERS AND BLOOM SHEAR TABLES.

SPECIAL MOTOR CONTROLLING DEVICES IN THE ROLLING MILL OF THE INDIANA STEEL COMPANY, GARY, IND.

from the low-level position and raises it to the highest level, where it is automatically stopped. In lifting the table from the low to the high level, the rotating crank revolves through an arc of 180 deg. in the same direction, thereby bringing the table to the low level once more. The operation of raising or lowering the table, which is accomplished in a period of three seconds, is quite remarkable when the masses to be accelerated, slowed

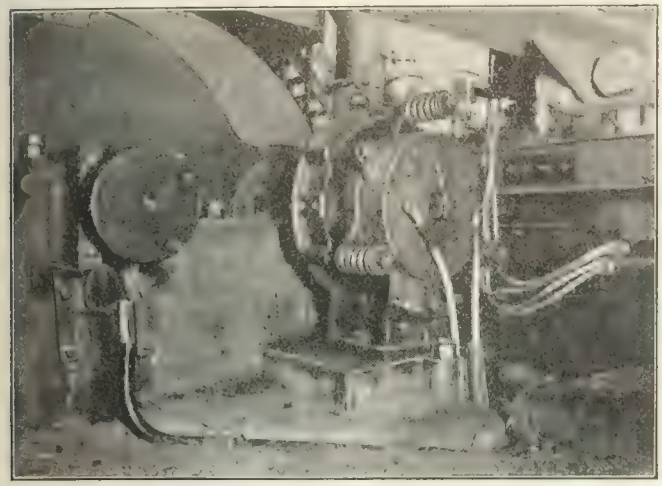


FIG. 7.—VIEW UNDERNEATH TILTING TABLE AT THREE-HIGH RAIL ROUGHING MILL.

down and stopped are considered. A portion of the weight of the table is counterbalanced hydraulically and pneumatically. The bell cranks carrying the table are connected to hydraulic cylinders piped to a compression tank partially filled with air at 500 lb. pressure. When the table is down the air pressure in the compression tank overcounterweights the table by 25 per

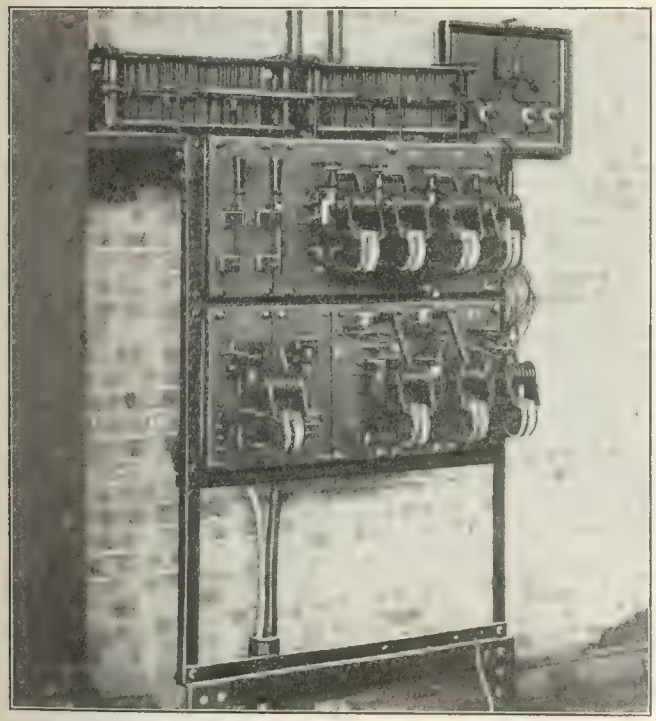


FIG. 8.—TYPICAL CONTACTOR CONTROLLER INSTALLATION.

cent. When the table is up it is undercounterweighted by 25 per cent. This result is accomplished by a proper proportion of the air and water in the system. Observations have shown that the motor reaches almost full speed before the table begins to change its speed appreciably, so that the motor requires little more than full-load current at any one time in spite of the trying conditions under which it operates. A solenoid brake is provided for bringing the motor to rest at the exact point required.

One of the tilting tables used with the three-high roughing mill is pivoted and the other end is supported on a bell crank driven by a 150-hp direct-current motor, by which it is moved 26 in. either up or down in 1.5 seconds. The controller for this motor is similar to that for the lifting-table motor.

Between passes Nos. 9 and 10 the stock, which has been reduced from a sectional area of 375 sq. in. to 59 sq. in. and increased in length from 6.7 ft. to 43 ft., is cut into two unequal lengths by means of bloom shears driven by a 75-hp induction motor, while the pin on the clutch is driven by a direct-current 5-hp auxiliary motor. The circuit of the latter motor is interlocked with the controlling device for the alternating-current motor so that the former cannot be operated except when the latter is running at full speed. The latch is operated by a crank to which the smaller motor is geared. Pressure on a push button under control of the operator causes the motor to run long enough to revolve the crank through 360 deg., thereby releasing the clutch and returning the pin to the initial or "off" position.

The ingots from which the rails are rolled are taken from soaking pits, in which they are reheated after leaving the open-hearth furnaces. There are 12 soaking pits in all, six on either side of the rail mill. Two electrically operated ingot buggies



FIG. 9.—THREE OF THE FIVE HOT SAWS FOR SAWING RAILS.

deliver the heated ingots to the rail mill, each buggy serving six pits. For the operation of these ingot buggies there has been developed an ingenious arrangement of controlling devices. On account of the length of the building in which the soaking pits are located, it is impossible for the operator stationed at the mill to see when an ingot buggy is opposite a particular pit. It was deemed necessary to guard against the possibility of the operator becoming confused and bringing both ingot buggies to the mill at the same time, which would result, of course, in a collision. The special automatic controlling system provided guards against this contingency, while at the same time it enables the operator to stop the ingot buggy at any of the pits by merely setting a controlling lever on the notch corresponding to the pit in front of which it is desired to halt the buggy. The operator in the mill has in front of him two master levers for the control of the two buggies. Each of these controlling levers can be set in any of eight positions, one of these positions corresponding to the mill itself, six to the six soaking pits, which the buggy serves, and one off position. If, when one of the ingot buggies is at the mill, the operator desires it to go to pit No. 5, for example, and there stop, he merely moves the controlling lever to the position corresponding to pit No. 5 and the buggy proceeds to that point and is there automatically stopped. A suitable interlock which is provided between the two controlling levers renders it impossible for the operator to throw both levers to the mill position at the same time, thus insuring a clear track for each buggy.

The current-limiting controller and the special controlling devices used with the direct-current motors described above were designed and built by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

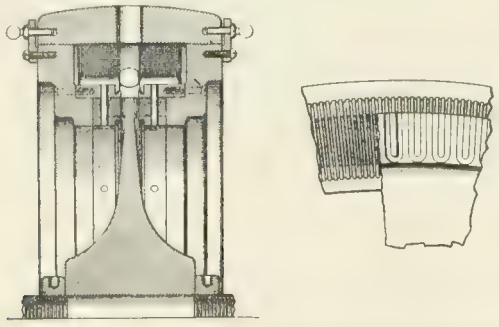
Abstracts of A. I. E. E. Convention Papers and Discussions

FOLLOWING are abstracts of the papers presented last week at the Frontenac convention of the American Institute of Electrical Engineers, together with abstracts of the discussions to which they gave rise. The arrangement is not in order of presentation, but in groups according to general subject. Elsewhere is given an account in detail of the proceedings of the convention, including its social features.

Electrical Design and Testing.

ALTERNATORS FOR WIRELESS SERVICE.

An alternator rated at 2 kw and 100,000 cycles per second, intended for wireless service, was described in a paper by Mr. E. F. W. Alexanderson, of the General Electric Company. In building such a machine difficulties are encountered on account of the large losses and by reason of the high speed required. The constructive details of the machine are shown in Figs. 1 and 2. The armature has 600 slots with one conductor per slot of 0.013-in. copper wire triple-silk covered and varnished. The wire is wound in a continuous wave up and down in the successive slots, as indicated in Fig. 2. The rotating field core has 300 projections which, as the machine is of the inductor type, correspond to 600 poles. The air-gap, which is adjustable, is set at about 0.015 in. The shaft is of the flexible type, designed



FIGS. 1 AND 2.—ALEXANDERSON HIGH-FREQUENCY ALTERNATOR

like a stiff spring with uniform strength, 1.25 in. in diameter at the middle, and 0.625 in. in diameter at the ends, the length between the center of the bearings being 28 in. In order to minimize air friction the 300 slots between the revolving field slots are filled with non-magnetic material. The peripheral speed is 1000 ft. per second. The alternator has a no-load e.m.f. of 110 volts, and when used in conjunction with a suitable condenser in series delivers 30 amp at 70 volts or 2.1 kw at full load. Regarding the possibilities of building high-frequency alternators of higher output, the author mentioned that a machine for 50,000 cycles is being designed for an output of 35 kw.

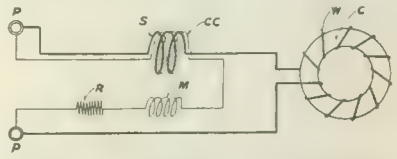
Discussion.

Mr. D. B. Rushmore, Schenectady, pointed out the tendency toward the use of velocities limited only by the strength of the materials. Dr. Kennelly, Harvard University, emphasized the more interesting features of the paper, and in reply to questions by Messrs. J. B. Taylor, Schenectady; J. C. Lincoln, Cleveland, and C. J. Fechheimer, Milwaukee, Mr. Alexanderson said that in this machine the falling off in voltage with increasing field excitation is due to the saturation of the whole space between the armature and the rotary member, as in the ordinary inductor alternator. The useful output of the alternator can be increased by placing a condenser in series with the armature. In the machine described a diameter of 1 ft. was taken as an even dimension, and the cost of manufacture was less with a small machine. A high-frequency machine is now being built 36 in. in diameter for an output of 35 kw. The shock feels the same with the small machine as a direct-current shock. The mechanical resonance of the shaft has nothing to do with the critical speed. The bearings are self-aligning.

CORE-LOSS VOLTMETER.

The accompanying diagram relates to the circuits of a core-loss voltmeter discussed in a paper by Mr. L. W. Chubb, of the Westinghouse Electric & Manufacturing Company. The voltmeter consists essentially of a ring or core of laminated steel excited by a winding, and a wattmeter of suitable design on which to read the power input to the ring and all copper circuits in the instrument. The core and meter are mounted in a wooden case.

On the laminated core *C* is placed a winding *W*, the core member and winding being securely mounted in the lower case, and the two leads of the winding brought through the top and



CIRCUITS OF IRON-LOSS VOLTMETER.

into the instrument case, which contains the meter movement. A stationary current coil *S* is connected in series with the winding *W* and the terminals *PP*. The shunt circuit consists of the moving coil *M*, the non-inductive resistance *R*, and the compensating or adding coil *CC*, which is wound parallel to the series coil and of an equal number of turns.

Before calibrating the instrument for a certain frequency, the adjustment of the ratio of eddy loss in the ring plus shunt copper loss, to the total loss, is made by changing the non-inductive resistance in the shunt circuit and the turns on the ring. This ratio of I^2R losses to total loss is made to be 20 per cent at about six-tenths of full-scale voltage. After this adjustment is made, the instrument is calibrated in parallel with an alternating-current voltmeter on the pure sine-voltage wave of the required frequency from a small smooth-core alternator. The scale is drawn in to agree with the alternating-current instrument.

The iron-loss voltmeter may be used as a portable voltmeter in testing transformer core losses on any reasonably distorted wave of voltage. The test may be conducted without any knowledge of the wave-form. The voltage may be regulated through a considerable range by the aid of resistance or inductance, thus dispensing with the usual multi-voltage transformer or means of varying the field current of the alternator. The frequency need only approximate the normal value; and the final result of core loss as measured on a wattmeter will be the value which would be obtained on a sine wave of voltage at the normal frequency and voltage of the transformer.

The instrument possesses the disadvantage of being heavier than the ordinary alternating-current voltmeter. The internal losses of the instrument are high and in testing very small transformers the correction for instrument losses is as large as the core loss of the transformer. For high-voltage tests the usual voltage transformer cannot be used on account of the relatively large current taken by the instrument and its poor power factor. A voltage transformer to be used with the iron-loss voltmeter must be specially designed with heavier copper and low reactance. The instrument can be made direct reading for only one frequency, and, when used on other frequencies, must be used with a calibration curve. The author claimed that

these disadvantages are not of great importance, as there are generally low-voltage taps on high-voltage transformers, to which the meter can be connected, and there are only a few standard frequencies in terms of which tests will be required.

Discussion.

Prof. Frederick Bedell, Cornell University, stated that if the instrument can be depended upon it will be very valuable. Dr. C. P. Steinmetz said that the definition of "form factor" in the paper is unfortunate. The correct definition is the ratio of the effective divided by the mean in the actual wave to the effective divided by the mean in the sine wave. Dr. M. G. Lloyd, Washington, D. C., suggested that the difficulties of getting a true sine wave might limit the value of the instrument in engineering service. The readings are accurate when eddy current losses bear a definite proportion to the hysteresis losses. Different varieties of steel might limit the use of the instrument. Its excessive weight hardly allows it to be classed as portable. Mr. L. T. Robinson, Schenectady, said that, in his opinion, the instrument is limited in its application to a line of transformers built by certain designers. Professor Bedell spoke of the German definition of "form factor" as the ratio of the mean to the effective value of the wave, giving 0.9 for the sine wave and 1.00 for the square-topped wave. Mr. C. F. Scott called attention to the instrument as essentially a practical device. It enables the use of many other instruments to be avoided, and obviates the use of elaborate, extensive and cumbersome measurements. It has proved of great value in the factory. Dr. Steinmetz described a method of obtaining a sine wave from a circuit containing inductance, resistance and capacity. He said that the instrument is useful and interesting, but that it is generally desirable to take only a small amount of power in testing transformers. Mr. Chubb in closing said that the instrument has now been in service practically 2½ years. It is very useful in testing large transformers, which could not be satisfactorily run from small generators. It has no air-gap and is built of non-aging material. It develops an error of perhaps 0.1 per cent in a month. It can be used on transformers built of either open-hearth or silicon steel, and is in all cases more accurate than the root-mean-square instrument.

THE TESTING OF TRANSFORMER STEEL.

A paper by Messrs. M. G. Lloyd and J. V. S. Fisher, of the Bureau of Standards, discussed the conditions which should be realized in the measurement of energy losses in sheet iron and steel subjected to alternating magnetization, with a description of a modification of the Epstein method, which has been adopted as standard in Germany. This method is believed to better satisfy the desired conditions and to give an accuracy of 1 per cent with the use of less than 2 kg (4.4 lb.) of material. Results were given showing a wide range in the quality of material in general use, quality having slight connection with price. Several foreign specimens of ordinary steel and silicon steel were included for comparison with the American product. Silicon steel contains from 3 to 4 per cent silicon, the quality not depending upon the exact percentage of silicon.

By making measurements at two frequencies, the eddy current and hysteresis losses were separated and a study was made of the variation of each with flux density. The values of the hysteretic constant and the total loss in watts per pound at 60 cycles and 10,000 gausses were tabulated.

The effects of artificial aging are shown to depend upon the flux density selected for test, the hysteresis increasing more for 5000 than for 10,000 gausses. The authors stated that tests should, therefore, be made at the density to be used. They found that the aging is usually negligible in silicon steels.

Discussion.

Mr. L. T. Robinson, Schenectady, spoke of the value of the Epstein and other long-established methods of testing iron and steel samples, and said that in the General Electric factory the cost of each test per sample has been cut to 5 cents. Professor Karapetoff, of Cornell University, touched upon the disadvantages of using separate corner pieces, in the Lloyd tests, giving two joints instead of one, as in the Epstein method. A written communication was presented from Mr. C. E. Skinner, Pittsburgh, complimenting the work of Dr. Lloyd, with a few slight differences of opinion. Mr. Andrew Pinkerton, Pittsburgh, suggested that the time required to build up test sheets is an objection to the methods described, and Prof. E. E. F. Creighton, Schenectady, touched upon the great difference in magnetic material resulting from the methods of cutting up sheets and the furnace treatment.

In closing the discussion, Dr. Lloyd said that the Epstein method is not as accurate or satisfactory for separating the eddy current and hysteresis losses. He could see no harm in developing any number of good testing methods. One cannot expect any alternating-current method to give the results of the ballistic method. The latter is not a criterion of the accuracy of the alternating-current measurements. The methods described in the paper give an accuracy of 1 per cent. Ordinarily the same material as the test pieces are used in the joints at the corners. He considers it best not to anneal test pieces after receiving them. The usual tests require a 22-lb. piece, but here a 4-lb. sample is sufficient. It is undesirable to let the exciting current run too high. The magnetizing current of silicon steel has nothing to do with the regulation and a high magnetizing current is not objectionable on that ground.

REPULSION MOTOR WITH VARIABLE-SPEED SHUNT CHARACTERISTICS.

Mr. E. F. W. Alexanderson, of the General Electric Company presented a paper dealing with a so-called "repulsion motor with variable-speed shunt characteristics." This machine is a commutator type of alternating-current motor provided with two pairs of brushes in magnetic quadrature. One pair of brushes is placed in line with the main primary magnetism and carries the power current, while the other pair carries the exciting current. The no-load speed of the machine is synchronism when the brush pairs are short-circuited; when a voltage from the outside is introduced into either the circuit of the main brushes or the circuit of the exciting brushes, a corresponding change is made in the no-load speed. The impressed e.m.f. can be either positive or negative, and consequently the speed can be regulated below synchronism as well as above synchronism. This type of motor is being developed for doing the work of the adjustable-speed, shunt-connected, direct-current motor where only alternating current is available.

This paper was discussed in connection with Mr. Creedy's paper, which follows:

ADJUSTABLE-SPEED SINGLE-PHASE COMMUTATOR MOTOR.

A paper by Mr. F. Creedy, of the Westinghouse Electric & Manufacturing Company, gave a sketch of the theory of the adjustable-speed, single-phase, "shunt induction motor," which is a single-phase commutator motor possessing speed characteristics similar to those of a shunt-connected, direct-current motor. The machine is provided with two pairs of brushes, one in line with the main primary field flux and the other in magnetic quadrature therewith. In series with the latter pair of brushes there is connected either an inductive or a condensive circuit, the former raises the speed, while the latter lowers it. The author expressed the opinion that the use of inductance in conjunction with a small adjustable compensating transformer offers a very promising means of varying the speed. However, the efficiency is low on account of the large commutator losses.

Discussion.

Professor Karapetoff questioned the terminology of Mr. Creedy's paper. Mr. Alexanderson said that Mr. Creedy had presented an excellent review of the work of that type of motor. The system of compensating for power factor as developed by Milch is fundamental. Good methods of speed regulation are now reasonably available. With armature control a speed variation of 3 to 1 can be obtained, and with field control a range of 1.5 to 1. There is simpler control with the single-phase shunt motor than with the three-phase machines. Mr. Creedy, in closing, considered various wiring schemes and reviewed the more important points of Mr. Alexanderson's paper, specially noting the speed variation secured below synchronism. He ap-

plies the general term "induction motor" to any motor having current "induced" in the rotating member.

THE HEATING OF INDUCTION MOTORS.

The limitations imposed on the designer of induction motors by the heating of the machine, and methods for predetermining the heating were outlined in a paper by Mr. A. Miller Gray, of the Allis-Chalmers Company. He called attention to the fact that the stirring up of the air within the machine is of equally as much importance in an enclosed motor as it is in one of the open type.

There was no discussion on this paper.

THE CURRENT LOCUS OF THE SINGLE-PHASE INDUCTION MOTOR.

Prof. A. S. Langsdorf, of Washington University, presented a paper giving a mathematical demonstration tending to show that the equivalent electric circuits of the single-phase induction motor contains a variable admittance component as well as a variable conductance component in parallel, but that the current locus for constant impressed e.m.f. is a time-circle. The demonstration is somewhat similar to that given by Mr. K. J. Laurell in our issue for July 11, 1908, but differs therefrom in that the shunted admittance of the speed field is assumed to vary inversely with the square of the speed. The author's conclusions differ from those of Mr. Laurell with reference only to the center of the circular current locus.

Discussion.

Professor Karapetoff urged the need of considering the subject from a simpler point of view, so far as teaching it is concerned. Professor Langsdorf discarded Ferrari's assumption of two fields revolving in opposite directions, in the former's effort to come down to physical conditions. From the pedagogical standpoint the conception of the squirrel-cage motor as a revolving transformer is desirable. The reaction is not the same from point to point in the squirrel-cage and phase-wound machines. The expression given for the impedance of the motor is complex on account of the reciprocals used. Presumably admittances could be substituted to simplify it. Professor Langsdorf, in closing, adhered to the equations presented in the paper as the simplest available.

MULTISPEED INDUCTION MOTOR.

A paper by Messrs. H. G. Reist and H. Maxwell, of the General Electric Company, which was read by the former, outlined the characteristics of induction motors arranged for multispeed service. They discussed three methods for varying the effective number of poles, namely, regrouping a single set of coils, using two sets of coils, and concatenation. Referring to these types as *a*, *b* and *c*, respectively, the authors made the following suggestions:

1. For two speeds having a ratio of 2:1, use motor type (*a*).
2. For two speeds having other ratios than 2:1, use motor type (*b*), except when the winding and insulation require too much space.
3. When three speeds are required, two having a ratio of 2:1, the other being intermediate, type (*b*) may be used with one winding connected as in (*a*).
4. If four speeds are necessary, one speed being one-half of the highest speed, and the lowest speed one-half of the next highest speed, type (*b*) may be used, with each winding such as is used in type (*a*).
5. Use type (*c*) concatenated motors, when two or more speeds close together are required.
6. Use concatenated motors when polar windings on the rotor are necessary with more than two speeds, or if the two speeds differ from 2:1.
7. Use concatenated motors for high-voltage machines except when type (*a*) can be used.

Discussion.

Mr. H. C. Specht, Pittsburgh, pointed out that for the various schemes of connections the number of leads is generally dependent upon the number of poles and the type of winding. The maximum output is dependent on the limited density in the copper and iron, and the stresses in the mechanical parts. If the synchronous speed of the second motor is higher than that of the differential concatenation, then the second motor may be connected to the line instead of to the first motor. In the case where neither one of the two motors has a lower synchronous speed than that of the differential concatenation, the speed for the latter cannot be obtained without auxiliary means. Mechanical interconnection has its field where different speeds are required. By a cascade set practically any possible combination of speeds can be obtained, but this cannot be done by multi-speed single motor equipment. The individual motors of a cascade set can be designed for greater width and smaller diameter, thus keeping the peripheral speed lower than would be the case for a single motor for the same speeds. Mr. A. M. Dudley, Swissvale, Pa., suggested that another method of getting multi-speed service is by internal concatenation, putting a two-speed winding on the stator member and also on the rotor. The idle primary is short-circuited and the speed depends upon the number of poles.

Dr. C. P. Steinmetz said that there is not much, if any, gain in concatenation or cascade connection compared with changing the poles. The difficulty is to avoid too many poles and hence too large a motor. If one doubles the number of poles to get half the speed, the motor constant is thereby made inferior. In any case the motor has to be designed better than for high speeds. In concatenation each motor always keeps the same number of poles. One motor only reacts on the supply circuit, and it carries the exciting current of the other motor. The electrical constants of a concatenated couple are inferior, and the characteristics are the same as those of a motor which changes its number of poles. The latter is superior mechanically and from the point of view of manufacturing. Concatenation may be used in railway service. The reactance of the second motor upon the first cannot be overlooked, however.

CORONA PHENOMENA.

In a paper by Messrs. W. S. Moody and G. Faccioli, of the General Electric Company, much interesting information was given concerning certain unexpected results obtained while investigating corona phenomena in air and oil. When between a conducting rod and metallic disk there was impressed an e.m.f. of sinusoidal time-wave shape corona appeared at 57,000 volts; when a conducting cylinder was placed around the center of the rod the corona appeared at 62,300 volts, but when insulating type was wrapped on the center of the rod the corona was formed at a lower e.m.f. A certain rod, ¼ in. in diameter, which glowed at 57,000 volts when its length was 45 in., required 83,500 volts to form a glow when its length was decreased to 12.0 in., the distance to the metallic plate remaining constant at 12.0 in. In all of the experiments reported the shape of the "ends" of the rods had no effect upon the character of the phenomena. In fact, similar results were obtained whether the rod-ends were spheres of large or small diameters or mere ends of cylinders. Moreover, the distances between the rods and the metallic plates, as well as the size of the plates, affected only the voltage to produce corona, and not the general character of the phenomena. The authors concluded from their experiments that the voltage at which corona appears in apparatus not only depends upon the dimensions of the apparatus itself, but is also a complex function of several qualities and conditions. In discussing the effect of oil, they express the opinion that oil does not eliminate corona. For example, when two needles 12 in. apart were submerged in oil no glow is noticeable when the e.m.f. is raised to 100,000 volts, but at 101,000 volts the glowing is very perceptible in the shape of a small, steady brush, noiseless and green in color. When the needles were separated by only 6 in. the glow was established at 78,000 volts, while for 3-in. separation the required e.m.f. was 72,000 volts. The above-mentioned phenomena are of predominating importance in the design of transformers for very high voltages.

Discussion.

Dr. J. B. Whitehead, Johns Hopkins University, spoke of the difficulties of making calculated and experimental breakdown

voltages agree. They sometimes differ 50 per cent. Laboratory investigations are now being made in regard to the potential gradient necessary to start discharge. Prof. J. J. Thomson's theory of spark discharges requires about 500,000 volts per cm for a discharge in air; by Hobbs' corpuscular theory 800,000 volts per cm are required. Ionization by collision takes place at lower values than are required to start and maintain a brush discharge, say 30,000 volts per cm. Mr. J. C. Lincoln, Cleveland, asked if any measure was made of energy dissipated from the wire at the point just below where the corona appeared. Mr. R. D. Mershon, New York, spoke of the relation between the critical point and the point where the discharge begins to take place. Apparently there has to be a considerable loss before there is any noticeable manifestation. The critical point is probably affected by the moisture in the air. Prof. E. B. Charters, Jr., of Stanford University, spoke of tests by Professor Ryan and himself which agree with those of Mr. Moody. A No. 34 wire inside a 4-in. cylinder produced tremendous vibration in oil under the static strain. Mr. Moody, in closing, said that no power measurements were attempted, in view of the small quantities available.

DESIGNING HEAVY-DUTY FUSES.

The relative merits of single-link and multiple-link fuses of the enclosed type were discussed at length in a paper by Mr. Louis W. Downes, of the D. & W. Fuse Company. Tests were reported to show that single-link fuses for heavy duty are unsatisfactory and dangerous, while multiple-link fuses are quiet and satisfactory. These results were attributed to the more intimate relation between the vaporized metal and the cooling filler of the multiple-link as compared with the single-link fuse.

Discussion.

Mr. C. Francis Harding drew attention to the lack of comparisons between the two methods and suggested there should also be some data to show how much heat is dissipated from the soldered joints, what effect the length has and also what effect arises due to the difference between single and multiple arrangement. He considered the statement made as to moisture content misleading, as this would undoubtedly vary with weather conditions. Mr. W. S. Andrews gave a short historical review of fuse history. In 1879 he made the first fusible links for Edison lamp circuits. Early patents show a very crude form of copper-wire ends with soft-lead wire connected between, and troubles were frequently due to bad mechanical construction. Mr. Downes said there is no difference in construction between single and multiple fuses, the only difference being in the support of the fusible link. The object of the filling in an enclosed fuse is to act as a condenser for cooling for the hot gases in order to reduce the vapors from conductors at high temperature to non-conductors at low temperature. Moisture is hard to drive off during operation. Every manufacturer uses practically the same material, namely, the different salts of calcium, such as calcium carbonate. In the original material there is something like 18 per cent of moisture, but by heating this to 600 deg. to 700 deg. it will be reduced to about 5 per cent, above which practice shows no appreciable increase. In answer to a question why tests are made on short-circuit, he stated that manufacturers have been troubled by explosions of the enclosed fuse, and, therefore, feel that the short-circuit test is necessary to realize the worst conditions of operation. It is not difficult to obtain an accuracy within 10 per cent of the rating. The thermal conductivity of the material used for filling decreases rapidly after the temperature rises; several methods are employed to overcome this, such as notching and air-drums—that is, retaining a small air space at the central portion of the link.

COST OF ALTERNATORS.

Mr. Carl J. Fechheimer, of the Allis-Chalmers Company, presented a paper dealing with the comparative costs of 25-cycle and 60-cycle alternators. The author determined the value of flux to render the cost of the alternator of each rating with its exciter a minimum, and used this value of flux for determining the cost of the exciter, the approximate diameter and length of machine, and the weights and costs of material in each of the principal parts of the alternator. Costs were determined for alternators to be driven at 300 and at 100 r.p.m., the former being turbine-type and the latter engine-type machines. The results indicate that a 25-cycle machine is about 42 per cent more expensive at 300 r.p.m. and 30 per cent more costly at 100 r.p.m. than a 60-cycle machine for the same output, voltage and number of phases.

Discussion.

In reply to questions, Mr. Fechheimer said that in armature design formerly 500-amp to 600-amp conductor per inch had been used, but that it is possible to get good insulation and increase this constant. Nearly all 300-r.p.m. machines are for water-wheel connection and, therefore, the bases, shafts and bearings must be furnished with them; while 100-r.p.m. machines are for engine drive and the engine builder furnishes the bases, shaft and bearings.

IRON LOSSES IN DYNAMOS.

Mr. I. E. Hanssen, of the Westinghouse Electric & Manufacturing Company, gave an outline of the causes to which may be attributed the increase in actual iron loss above the value calculated from iron-loss curves applied to dynamo-electric machinery. On account of lack of uniformity of flux distribution when toothed armatures are used, the loss in the iron back of the slots is about 30, 35 and 40 per cent for 25, 40 and 60-cycle machines, respectively, above the value calculated for uniform flux. The losses in the teeth will be 30, 60 and 80 per cent larger for 25, 40 and 60-cycles, respectively. The slot openings cause a high-frequency variation in the flux density; the loss occasioned thereby can be calculated from test data obtained on machines already constructed, although values were not specified by the author.

Discussion.

Mr. A. E. Averrett considered the statement concerning the effect of a slight cut in the lathe increasing the surface losses about 50 per cent open to discussion. He believed that grinding is more serious than turning, but if properly done, not serious, while filing is. Silicon steel in high-frequency machines decreases the losses and appears profitable to use. Prof. V. Karapetoff believed that a safe procedure in estimating iron losses is not to depend upon measurements obtained from stationary samples, but to obtain data from actual machines. Mr. H. M. Hobart approved of the latter method. He also called attention to the pictures of lines of magnetic induction, and states that they are, of course, not pictures of magnetic lines, but photographs of colored fluid between plates of glass so arranged as to make the analogy reliable.

AUXILIARY-POLE MACHINES.

The designing and testing of auxiliary poles for direct-current machines were treated in a paper by Mr. John N. Dodd, of the New York Public Service Commission. After discussing commutation phenomena as affected by auxiliary poles, the author arrived at the conclusion that poor commutation in a direct-current machine is due to the fact that the coils undergoing commutation are in the magnetic field produced by the armature magnetomotive force, which is identical with armature self-induction. He stated that when this field is annulled so that the current can be collected according to Ohm's law, the commutation is perfect. This condition exists when a direct-current voltmeter registers zero volts between points on the commutator under the brush.

Discussion.

Mr. C. J. Hopkins asked what effect the bearing wear might have. He quoted English practice and mentioned that the use of ball bearings had given twice as much life as plain bearings. Prof. V. Karapetoff said that the leakage is considerable between the main pole and the auxiliary and must be taken into account; he also asked in what respect Mr. Dodd's method differed from that of Hobart, and if so what is his criticism of the latter.

Prof. C. A. Adams said that Mr. Dodd had brought up an old

point of discussion, which is, namely, the separation of the main armature flux from the short-circuit flux of the coil. Professor Adams favored such separation because owing to the characteristics of design there is a considerable pulsation at the point of commutation; that is, the designer must take into account the so-called reacting forces.

Mr. Dodd said that in regard to railroad motors ordinarily mechanical considerations are the limiting conditions of air-gap limits. The use of auxiliary poles to cut down the cost increases the weight. The measurement of volts per bar is a fairly easy matter as one can measure the average voltage with a low-reading voltmeter. He had not noticed any special difference in the iron loss, but a decided difference in the leakage. There is nothing novel in his method, although he had worked this out for himself, but originality is claimed in the measurement proposed. The calculation of flux due to the reversal of current is the whole thing; in other words, the auxiliary pole produces an annulling flux. If the stability factor is poor, the cross-field is very marked.

ELECTROMOTIVE FORCE WAVE-SHAPE IN ALTERNATORS.

Professor Comfort A. Adams, of Harvard University, read a paper in which he applied the method of combining the e.m.fs. of single-armature conductors to determine the resultant e.m.f. of the whole armature winding of an alternator. In carrying out this method, he analyzed the electrical space distribution curve of the field flux into its fundamental and its various harmonics. On the basis of similarity of the electrical time-wave of the e.m.f. of each conductor and the electrical space-wave of the field flux, he made a vector addition of the fundamentals of the proper slot e.m.fs. to obtain the fundamental of the e.m.f. of the whole winding; a similar treatment was given to each harmonic, and the terminal e.m.f. was found as the resultant of the fundamental and the several harmonics. On account of what was termed "belt differential, pitch differential, mid-coil differential and phase differential" actions, the harmonics in the space-wave of the flux appear in reduced form in the time-wave of the alternator e.m.f. By a proper choice of windings so as to obtain certain combinations of the various differential sections, it is possible to reduce all of the harmonics in the e.m.f. time-wave to very low values, even when the space distribution of the flux is far from being sinusoidal.

POLE-FACE LOSSES.

Messrs. C. A. Adams, A. C. Lanier, C. C. Pope and C. O. Schooley, of Harvard University, reported the results of an investigation of the losses in the pole faces of generators and motors. Use was made of a machine having detachable poles and pole-shoes, and three armatures, each with a different number of teeth. Three sets of pole-shoes were used, one set being of solid annealed steel casting, one set of 0.014-in. laminations, and the third set of 0.06-in. laminations. The air-gap was varied by means of shims placed behind the pole-pieces. The pole-face losses were measured by running the machine light as a motor, measuring the input and subtracting the other losses.

On account of the lateness of the hour it was impossible to discuss this paper, but Messrs. Osgood, Rushmore and Steinmetz congratulated the author upon its usefulness, and the last speaker stated that it marked a classic advance in the art.

Operation of Electric Apparatus.

UNBALANCE OF VOLTAGE IN POLYPHASE MOTOR.

Messrs. S. B. Charters and W. A. Hillebrand, of Stanford University, in a paper read by Mr. Charters reported the results of tests relating to the reduction in the permissible output of polyphase motors due to an unbalance in voltage. The tests showed that unbalancing of voltage and shift of phase tend to cause serious overheating in polyphase motors. Where it is possible to separate the effects due to phase shift and voltage unbalance, phase shift is found to be relatively of more importance. The reduction in permissible load due to either phase shift or voltage unbalance varies approximately directly with the cause. In the induction motor the existence of phase shift and voltage unbalance causes a worse performance than would be expected from either irregularity alone, whereas in the synchronous motor the reverse is true. The performance of the induction motor supplied from an unbalanced circuit is materially affected by its design.

Discussion.

Mr. R. E. Hellmund, Pittsburgh, pointed out that the interchange of heat between the various stator parts is comparatively good as a rule, since coils and iron are at about the same temperatures when tested, no matter how the losses are distributed between the iron and the copper. Most motors will withstand a certain amount of unbalancing without any reduction in rating. The amount of unbalancing usually decreases with the loads, and is, therefore, smallest for the overload; that is, for the condition for which increased heating through unbalancing is the least desirable. Unbalancing depends on the design of the motor as well as the unbalancing of the voltage. The no-load reactance current is, therefore, most affected. Mr. Abell pointed out that unbalancing is very serious in its effect on the heating. Almost any three-phase motor will give 40 per cent of its output when run single-phase. Mr. A. M. Dudley, Swissvale, Pa., touched upon the relation of torque to the square of the voltage. Mr. J. C. Parker, Rochester, N. Y., said that the commercial side of unbalancing is serious. Many hydro-electric companies require a clause in their "power" contracts calling for a balanced load, otherwise the consumer may be penalized.

Dr. Steinmetz emphasized the importance of defining the torque meant in considering induction motor phenomena. The maximum torque of a motor varies with the square of the voltage, while the safe heating torque varies not in proportion to either the voltage or its square—the heating depending on the current and magnetic flux. The maximum safe heating torque is greatest at a certain voltage. If the voltage is high in one phase there is a shift of the magnetic field. The torque falls off at constant heating only very litte with unbalancing of voltage. The design of the motor affects the unbalancing. Local heating may be troublesome and the relations very complex.

Mr. C. F. Scott suggested that it is dangerous to apply the results of this paper promiscuously. The practical point is the effect of the unbalancing upon the safe capacity of the motor. Sometimes the heating of the motor is not the limiting condition. Regulation may be the point at issue. Unbalancing may make it difficult to start. The motor acts as a transformer. Energy may be transferred from one circuit to another. Motors differ among themselves in both temperature distribution and their excellence as transformers, tending to equalize unbalancing between circuits. A small motor may have more difficulty during unbalancing than does a large machine. Mr. H. L. Wallace, Cleveland, cited a case where the voltage dropped on two phases and rose on one in unbalancing at a motor.

SURGES IN CABLES.

A paper by Messrs. E. E. F. Creighton and S. D. Sprong, of the General Electric Company, was devoted to an experimental investigation of the surges in the underground 2300-volt, three-wire, two-phase system of the United Electric Light & Power Company, of New York City. During the investigation use was made of aluminum-cell surge protectors, and spark-gaps were inserted at different points to indicate excess potentials. Surges were produced artificially by starting an arc between one phase lead and ground. Oscillographic records were made of the voltage across a potential regulator coil, the current in the grounded leg of the surge protector and the current in the spark-gap circuit to ground. The records showed that the energy of the static charge of the cable passes into electro-magnetic energy in the potential regulator and is re-transformed from one to the other until dissipated. When the number of feeder cables connected to the same busbar was increased, it was found that the "natural frequency of oscilla-

tion" diminished with each additional feeder, while there was an increase in the current through the arc to ground. During normal operation the surges seldom reach potentials much greater than twice the normal.

Discussion.

Mr. J. L. R. Hoyden, Schenectady, described some experiments made in Schenectady to illustrate the protective value of the aluminum cell arrester in cases of artificial resonance and surges. The phenomena were illustrated by oscillograms. Mr. H. W. Fisher, Pittsburgh, commended Mr. Sprong for the financial risks assumed in making the tests described in the paper. Mr. J. B. Taylor, Schenectady, asked about the decrease in frequency as feeders were added. He stated that there is a tendency to overestimate the dangers of harmonics in commercial service. Mr. R. D. Mershon asked about the form and character of construction of the aluminum cell arresters. Dr. C. P. Steinmetz said that the frequency decreased with the number of feeders in circuit, since there were from 1 to 12 feeders, each with its potential regulator and all in multiple through single regulator to ground, all being thus in series with a constant inductance. In closing, Professor Creighton said that the 13th harmonic may be brought out by a proper length of arc connecting to the ground or by proper inductance and capacity combinations. It may appear at any time. There are three types of aluminum cell protectors. The first has vested plates and a series gap set at about 25 per cent above line voltage. The normal construction gives 30 minutes' operation without damage to the arrester. The lower voltage arresters operate longer, having a large surface for heat dissipation. In one case 110,000 volts applied 40 minutes gave 18 deg. rise of temperature at the top of the oil. The second type of arrester is for direct-current service, having no series gap. One of these operated at 300 volts had an internal loss of 0.3 watt. The third type consists of a number of cells in series direct connected to the line. There is more loss of energy than in the direct-current arrester. A potential regulator or auto-transformer is put across each cell. At double voltage these cells discharge at from 200 amp to 400 amp, and at about 0.1 amp to 0.2 amp at normal voltage. The larger the plate area the more discharges one gets at double potential. If the cell is too small it will still cut down the peak, reducing the amount of the surge. Some cells have had five times normal voltage upon them for a short time, without trouble. The cells became luminescent, and a surface arc apparently formed. The cells divide the voltage fairly well, but the use of the auto-transformer enables a better operation to be secured. The film consists of a skeleton part, which takes a long time to form, and a gas or liquid which dissolves out if the cell is let stand without current or if current is reversed in it. A higher radiating surface can be obtained by immersing the cell in oil. The gap should be closed once a day by a switch provided, since each day that the cell stands the initial current rush is greater.

Dr. Steinmetz then explained with diagrams the action of the aluminum cell arrester.

Transmission and Distribution.

HIGH-TENSION TRANSMISSION LINES.

Mr. Percy H. Thomas, consulting engineer, presented two papers dealing with transmission systems. In one, the author derived a formula for calculating the true current, voltage and power factor at the generator end of a transmission line when the current, voltage and power factor at the receiving end are known. The second paper discussed the output and regulation in long-distance lines. The author suggested the use of inductance coils shunted across the transmission line to consume lagging current to balance the normal leading exciting current, and advocated dividing each transmission conductor into several wires in order to control the "ratio of the line inductance to the line capacity." Non-synchronous (induction) generators were suggested for the power house where it is desired to supply leading wattless current from the receiving end of the line, the synchronous apparatus at the receiving end serving for controlling purposes.

Discussion.

Prof. Thomas R. Rosebrough, University of Toronto, presented the following equations, with the Steinmetz notation, for complex quantities, E_1 and I_1, E_0 and I_0, describing the voltage and current at the transmitting and receiving ends of the line, respectively, which he considers simpler to apply than the method given in the paper:

$$E_1 = E_0 + z I_0 + \tfrac{1}{2} zyE_0 + \tfrac{1}{8} z^2 yI_0 + \ldots$$
$$I_1 = I_0 + yE_0 + \tfrac{1}{2} yzI_0 + \tfrac{1}{8} yz^2E_0 + \ldots$$

He stated that these equations are also more general because leakage conductance is accounted for. In using them one approaches greater accuracy, as each term is included, stopping as soon as any term calculated is found to be of small value. He then showed how Mr. Thomas, by making certain replacements in his final expressions, could include the effect of distributed leakage and obtain results of equal generality. He advocated the calculation of a three-phase circuit per se. as a star grouping of three transmissions instead of in terms of fictitious single-phase circuits.

Dr. A. E. Kennelly, of Harvard University, criticised Mr. Thomas' formulas on account of their length, which increases the chances of numerical error. He then discussed the application of hyperbolic formulas to line calculations (see *Electrical World,* Jan. 6, 1894, and *Transactions,* A. I. E. E., Vol XII, page 133). Dr. Kennelly said that the paper will be of use to engineers, if only in the collection of formulas which it exemplifies. He pointed out that hyperbolic trigonometry is as easy as circular trigonometry and readily applicable to alternating-current line work. He concluded with a discussion of the fact that the linear capacity in c.g.s. electrostatic units is the reciprocal of the external linear inductance in c.g.s. magnetic units. This enables one to choose, in any uniform distribution of overhead line conductors, split or unsplit, whether we shall compute the external linear inductance of the system, or the linear capacity, and then the other quantity follows as a simple reciprocal.

Prof. Vladimir Karapetoff stated that the first paper is prophetic in its importance. He suggested as to the second paper, on calculating lines, that engineers will find Professor MacMahon's book on hyperbolic functions very useful to engineers working in this field. Some may prefer Dr. Steinmetz's logarithmic treatment of complex quantities. Thomas' treatment is legitimate and useful, but no single method is the only one worth while. Mr. J. B. Taylor, Schenectady, touched upon limitations other than the cost of copper in practical cases of alternating-current transmission. Inductance can be reduced by multiple circuits or by splitting conductors, but at considerable financial cost.

Prof. D. C. Jackson, of the Massachusetts Institute of Technology, approved the use of the terms "lagging" and "leading energy." Formulas are needed for problems of network distribution. Dr. Steinmetz presented equations last year which add to knowledge, but which are not satisfactory to the computation needs of the working engineer. Modern transmission is tending toward overhead or underground networks. We must often depend upon the receiving station to take care of its own primary voltages. Mr. Thomas was justified in using circular trigonometry. The paper makes a start toward the computation of the great projects of the future, where power networks are likely to cover great States, and perhaps national areas. Inductance and capacity must be considered as distributed.

Dr. C. P. Steinmetz commended the use of the terms "leading" and "lagging power." Reactive power is an existing absolute quantity. There is no such absolute thing as leading or lagging "current." The magnetizing current is only wattless with reference to the induced e.m.f. In a 700-mile, 60-cycle transmission, if the current and voltage are in phase at the generator, then at the receiving end the current will be about 90 deg. out of phase with the generator voltage, but in phase with its own voltage at the receiving end of the line. The terms

"lagging" and "leading current" are misleading. For economical transmission it is necessary to balance the lagging and the leading energies. One must have methods of controlling the power factor and voltage at the receiving end in these long lines. In railway transmission with rotary-converter substations, the phase relations are automatically varied from lag to lead. An approximate method of considering capacity is to assume it as concentrated at the generating end, and then at the receiving end. By averaging these two results one gets closer figures than where the capacity is assumed as located at the middle of the line. When the charging current runs from 10 to 30 per cent of the full load of the line these approximations are sufficient, but above this one needs the intricate formulas.

Mr. P. M. Lincoln, Pittsburgh, said that the paper is chiefly of assistance for the distant future. Mr. Thomas has really made careful analysis of a certain type of resonance. Mr. R. D. Mershon then said that a synchronous motor at the end of the line is not exactly like a condenser, since the inherent regulation is a function of the line and the machine. The mechanical objections to the use of a split conductor are considerable. The cost would tend to run high and the possibilities of trouble from sleet might be considerable. Mr. H. W. Fisher, Pittsburgh, said that some of his tests on a line having 85 per cent power factor at the distant end, with high capacity and low self-inductance, gave a power factor close to 100 per cent at the generator end.

Prof. J. B. Whitehead, of Johns Hopkins University, stated that the author has performed valuable service in presenting his rare formulas as checks upon the use of the split capacity formula. However, the losses between lines, over insulators, etc., have been neglected. These would appear as parallel-connected resistances if developed in a formula. Subdivision of wires would lead to increased insulator loss and circulating or secondary currents in one line's branches due to inductive action of the others. A series of accurate measurements on existing lines would be helpful. He criticized the language of the paper as somewhat confusing in places, and made a plea for the retention of current and e.m.f. as standards of reference where variation with time is involved, and the direction of the resultant flow of energy where variations in space are involved, as in Bynting's theorem based on Maxwell's equations.

Mr. C. F. Scott, Pittsburgh, said that the author deserves credit for his careful extended analysis of the simple conditions assumed. As distances and voltages increase quantities and conditions once of minor importance become very significant. If the line conditions are established for full load it is of minor consequence what happens to efficiency at the lighter loads. A synchronous machine at the end of a line is not dependent upon the various currents and voltages coming in over the line. Possibly two wires would answer nearly as well as three in splitting conductors.

Mr. Thomas, in closing, said that he had tried to simplify the work as much as possible. He referred enthusiastically to Dr. Kennelly's fine work on the subject in 1895. There would probably be a gain in the leakage into air by the use of a conductor split into three parts. He could not see that there would be much increase in expense of labor for stringing three conductors making up No. 0000 section compared with erecting the single cable.

EVEN HARMONICS.

A paper by Mr. J. B. Taylor, of the General Electric Company, discussed certain of the conditions under which even harmonics are produced in alternating current circuits. They exist when an alternator has an unsymmetrical winding with unsymmetrical poles; when a three-phase system is operated with the neutrals grounded at both ends and direct current is in the ground. The direct current gives biased magnetization to the core, and the primary current possesses an unsymmetrical time-wave shape. However, the extra heating produced by the direct current in the transformer circuit will seldom be of such value as to affect the operation of the equipment.

Discussion.

Prof. F. Bedell, Cornell, said that direct current in the transformer increases the iron and the copper losses less than is usually supposed. Twenty per cent direct current increases the effective value of the alternating current only 2 per cent. Professor Karapetoff, Cornell, showed mathematically why it is impossible to get direct current from an alternator without a commutator. The even harmonics induced in consecutive conductors are mutually cancelled. Mr. C. F. Scott, Pittsburgh, referred to early experiences with rotary converters and also mentioned the case of a transformer which had a small output for its voltage relations, and considerable resistance in the primary circuit. When direct current got into the secondary circuit the magnetizing current reversed and did damage. Dr. Steinmetz said that with the same height of cycle the hysteresis losses are the same, regardless of the symmetry of the wave. Eddy currents are probably increased by the greater abruptness of the change. Even harmonics are probably as frequent as odd harmonics. The constant term, which is the first term of the even harmonic, cannot exist in a machine without a rectifying device.

IMPEDANCE OF ARMORED CONDUCTORS.

Prof. J. B. Whitehead, of Johns Hopkins University, described calculations and measurements made upon certain armored conductors when used as single conductors widely separated from the return circuit. The calculations show that the reactance of the usual type of single-conductor, iron-armored cable may be from 2 to 4.5 times that of unarmored cable, depending on the distance to return conductor; the factor increases with decreasing distance. In cables as manufactured the reactance is about 0.7 of the maximum theoretical value. The effective resistance as measured varies little with the distance to return conductor and is about 1.6 and 2 times the dead resistance at 25 and 60 cycles, respectively, and a current density of 1 amp per 1000 circ. mils. The impedance for distances under 12 in. is about 3 times the dead resistance at 60 cycles and 1.7 to 2 times the dead resistance at 25 cycles. With the sheathing and the armor grounded at both ends the impedance is somewhat lessened and is largely of the nature of resistance. The impedance of a double-conductor, iron-armored cable, with conductors located 0.873 in. apart between centers, and at the current density given above, is about 7 per cent greater at 60 cycles and 3 per cent greater at 25 cycles than the calculated value. The increase is in effective resistance, due to eddy curents in the lead sheathing.

There was no discussion on this paper.

LOSSES AND CURRENTS IN METALLIC COVERS OF CABLES.

Mr. H. W. Fisher, of the Standard Underground Cable Company, presented a paper giving a large amount of data relating to the losses, induced volts and amperes in the armors and lead covers of cables. In certain single-conductor cables covered with lead and bound with steel wires, the total loss was double the loss in the conductor alone. In a certain lead-covered copper-armored cable the effective impedance was found to be greater when the lead circuit was connected at both ends of the cable than when not so connected. The conditions under which such a result is obtained were discussed mathematically and graphically. The tests on a No. 0 single-copper conductor lead-covered cable armored with steel tape showed that the impedances are greatest when the armor and lead are not connected and that a sharply defined maximum is reached with a conductor of about 80 amp. Short-circuiting the armor at each end of the cable decreases the impedance only slightly. However, when both the lead cover and the steel armor are short-circuited, the impedance is very much reduced and it varies only slightly with the value of the current in the conductor. In such a cable the impedance may be 13 times the conductor resistance when the cover and armor are disconnected; when they are short-circuited the impedance may be only 3.5 times the conductor resistance.

Discussion.

Mr. R. D. Mershon, New York, spoke of certain difficulties in finding any sheath losses in three-conductor, three-phase cables. Mr. Fisher cited a case where there was a 10 per cent rise in ohmic loss over the conductor loss in a 500,000 circ. mil three-phase cable due to the induced loss in the sheath. Professor Whitehead cited the use of single-phase cables in a draw-

bridge installation as 50 per cent cheaper than multiphase cable construction for the same work. Dr. C. P. Steinmetz said that in steel-armored, single-conductor cable one may get high heating, impedance and resistance. These change with the bonding arrangement of the armor and conductor and the current. Single-conductor steel-armored cable is very undesirable, but when necessarily used the phases should be put very far apart and tests made over the entire range of normal and abnormal service conditions. A far better plan is to spend more money in a two-conductor cable.

INSTRUMENT TRANSFORMERS.

The errors encountered in making measurements by means of the so-called "current" and "potential" transformers and the methods for minimizing them were discussed in a paper by Mr. L. T. Robinson, of the General Electric Company. For measuring large alternating currents and voltages, "current" and "potential" transformers must usually be employed. If these are carefully designed they may be used with small errors resulting with various devices connected in the secondary circuit, and with primary current varying between the limits of the connected instrument scales, also with voltage and frequency variation usually encountered in practice. If some care is not used in selecting suitable apparatus to meet conditions, errors as great as 5 or 10 per cent or more may occur. If the transformers are constructed with special reference to handling a given load, the errors may be limited to almost any required amount. To meet conditions of testing where low power-factor is present, or where a high degree of accuracy must be attained, carefully determined corrections for ratio and phase-angle must be applied. Such corrections, once determined for any given transformer, are permanent, and by their use the transformers may be considered precision instruments. Wattmeters, when used without "current" or "potential" transformers, may be made to give indications correct within the limits of error of observation down to a power-factor as low as 10 per cent. Under certain conditions which may occur in practical work, it is well to know and apply corrections to the instruments themselves. If the conditions are such that the wattmeter must be corrected for phase-angle to insure suitable accuracy, "current" and "potential" transformers should not be used, unless the conditions are somewhat favorable, and the corrections for the transformers are determined and applied with great care.

Electricity in Rolling Mills.

STORAGE BATTERIES AT GARY.

The operation of the storage battery for regulating the load on the alternators at the plant of the Indiana Steel Company, Gary, Ind., was described in a paper by Mr. J. Lester Woodbridge, of the Electric Storage Battery Company. The battery is rated at 8640 × 1 amp-hours, although it can give a momentary output of 25,000 amp. Its e.m.f. varies from 200 volts to 225 volts. Two split-pole converters serve for transferring energy to or from the battery from or to the alternating-current system. The converters are operated as two-part pole machines. Two-thirds of each pole is subjected to constant excitation, obtained at 250 volts from exciter busbars, while the other third receives an excitation which varies with the load on the system. The latter excitation comes from an exciter whose voltage varies directly with the load on the alternating-current system, being zero at a specified mean load. Experience has shown that the battery maintains good voltage regulation and allows the rolling mill to be operated at its highest and most economical speed. Moreover, the battery is an ever present source of energy in case of some emergency such as the sudden shutting down of one of the prime movers or any other partial interruption of the supply. The necessity for continuous energy supply to a steel rolling mill is well understood. The author expressed the opinion that the effect of the battery in eliminating costly delays in the operation of the mill would warrant the fixed charges against the battery investment, even if these were not largely offset by the saving in investment for additional generators which the battery renders unnecessary.

FLYWHEELS IN ROLLING MILLS.

The advantages of employing flywheels in connection with electrically operated rolling mills were pointed out in a paper by Mr. H. C. Specht, of the Westinghouse Electric & Manufacturing Company, who gave an outline of a method for determining the effect of the flywheel on the performance of the driving motor. When a flywheel is used, the motor can be made much smaller, and even with the heavy additional flywheel the total cost for the complete motor outfit might be lower than for the larger motor without the flywheel. Moreover, the higher efficiency, higher power factor, and low average current make it possible to reduce the equipment of the generating plant and distributing system, while the operating expenses are lowered.

ROLLING-MILL MOTORS.

Mr. E. W. Yearsley, of the Midvale Steel Company, read a paper outlining briefly the features to be considered in driving a steel mill by electric motors. He said that for large main-drive motors the advantage of continuous running at constant speed is so great that it would appear advisable to make the design of the mill suit the characteristics of the motor, and avoid the extra expense and complication of devices like the reversing drive. There seems to be no great difficulty in designing mills for continuous-running motors. By combining such motors with a suitable flywheel, it should be possible to keep the line load sufficiently uniform. However, in some installations the flywheel has been so badly proportioned as to be detrimental to the operation of the motor. The controlling apparatus for mill service is usually the weak part of the system; it is much less satisfactory than the motors. Mechanical strength and simplicity are the main points to be observed in designing this apparatus. Heavier and more mechanical switches and circuit-breakers, better protected and more durable rheostats, and more dependable automatic controlling devices, requiring less attention, are badly needed. This is a problem more difficult of solution than improvement of the motor, but no less necessary.

ELECTRICALLY DRIVEN ROLLING MILLS.

A paper by Mr. E. Friedlander, of the Carnegie Steel Company, showed in what respects the electric motor is preferable to the steam engine for driving rolling mills. The author stated that the absence of the heavy and troublesome lifting tables in the non-reversing mill is a welcome feature of the reversing mill. Although the first cost of a reversing mill is higher, its lower depreciation, better operation and lower cost of maintenance should justify its installation. Operation of electric-driven reversing mills is nearly automatic; no skilled operator is required and all danger to the motor and the mill is eliminated. The speed of acceleration is prearranged, and no matter how fast the operator moves his levers, the maximum current and the speed are limited. Reversing is done with the least shocks in rolls and couplings and the danger of overstraining the machinery is eliminated.

POWER REQUIRED FOR ROLLING STEEL.

Mr. Brent Wiley, of the Westinghouse Electric & Manufacturing Company, presented a paper giving data relating to the power required for rolling high-carbon steel of small section. In the case of a steel containing 1.29 per cent of carbon there were required 71.2 kw-hours per ton of metal rolled from 5.5 ft. in length to 36.0 ft. Owing to the high percentage of carbon the harder steel billet must not be heated to as high a temperature as the milder steel, and it is rolled at a lower temperature at a greater cost for energy; however, for the same rolling temperature high-carbon steel requires no more energy than does ordinary mill steel.

CONTROL FOR ROLLING-MILL MOTORS.

Mr. C. T. Henderson, of the Cutler-Hammer Company, presented a paper describing the problems encountered in designing

controllers for rolling-mill motors and describing briefly the solutions obtained in certain instances. The prime requirement is continuity of service, since the loss from interruption of service in a blooming mill costs from $300 to $1,000 per hour. For the protection of both the motors and the rolls driven by them, use is made of controllers which automatically maintain the accelerating current between certain well-defined limits or adjusts it properly for the cycle through which the motors operate. At one blooming mill a certain 160-hp motor having a normal speed of 88 r.p.m. is required to accelerate to full speed ⅝ second run at full load for 1⅝ seconds and then come to rest in ⅝ second. The controlling apparatus has been so designed, with current limiting devices, that the cycle is completed without the motor requiring more than full-load current at any time. This motor operates the elevating table for a set of three-high rolls. The table weighs 118,000 lb. and is raised a total distance of 40 in. in 2⅝ seconds.

AUTOMATIC MOTOR CONTROL.

Mr. H. E. White, of the General Electric Company, presented a paper discussing the advantages of that type of motor controller which makes use of electrically actuated switches controlled by automatic or semi-automatic means. This type was claimed to possess the ability to control motors of any size with facility and with slight muscular effort; to control many motors from one conveniently chosen place; to control large motors from a distance with comparatively inexpensive connecting cables; to limit the current input to the motor, either during or after starting; to use sensitive devices, such as pressure gages or thermostats, to start motors operating machines such as pumps or blowers; to obtain "no-voltage release" and automatic re-starting features without additional complication; to secure interchangeability of parts to an extent not possible with any other type of control, and to secure automatic stopping by limit switches to prevent overwinding or to stop the motor at predetermined places.

Discussion.

The discussion of the above papers on the application of electric power in rolling mills, which were, with the exception of the paper by Mr. Woodbridge, presented at a special session, did not follow closely the subjects of the papers, and therefore it is given below without reference to the titles of these.

Mr. D. B. Rushmore, Schenectady, said that in rolling mill practice there are as wide fluctuations in load and through as great magnitude as in any other classes of industrial service. We have the very exacting condition of a prime mover working at best efficiency through a narrow range of output and perhaps not the best regulation. Continuous operation is necessary also. Turbines floating on the line may be used as over-excited synchronous motors to load down the prime movers to the point of constant output. The solution at Gary was the most desirable one. In answer to a question by Mr. Edward Van Wagenen, New York, Mr. Woodbridge said, in closing, that the voltage regulation at Gary is excellent.

Mr. D. B. Rushmore, Schenectady, said that the object of these papers was to bring out a discussion upon the most interesting phase of present industrial power work. He urged the steel-mill men present to bring out at Institute meetings the engineering features in which they are interested. Steel mill operating engineers and the manufacturing engineers should co-operate. Reliability is the greatest requirement of steel-mill work. Too much stress upon price always means a certain sacrifice of engineering features. In steel work the value of the output is great in comparison with the value of the machinery. The engineer of the steel mills is the man to buy the apparatus, rather than the purchasing agent. The development of the control is one of the most important phases of the subject. We are entering an era when practically all the steel mills will have to be electrified in order to meet competition. Mr. C. F. Scott, Pittsburgh, endorsed Mr. Rushmore's remarks. In no field has electrical development been as rapid as in the steel mills. The electric furnace is coming into steel making more and more; the electrical engineer is occupying a controlling position instead of one that is auxiliary.

Mr. R. Tschentscher, of the Illinois Steel Company, South Chicago, presented a typewritten discussion of electric power problems in steel mills. He classified the mills, and cited the South Chicago plant as an example of a self-contained installation supplying power to other industries. The evolution of the plant is illustrated by a capacity 10 years ago of 160 kw compared with a present capacity of 26,000 kw. To-day's installation includes 2000 motors, having a total rating of 75,000 hp, a 1200-kw storage battery outfit, 7000 kw in converting apparatus, and 33,000 kw in transformers. He then discussed the enormous waste of heat in a steel mill. One of the services of this plant is to supply power to 7000 kw of induction motors driving a cement mill 11 miles away. The power factor was 70 per cent, but two 1650-kw synchronous condensers are being installed at the end of the line to improve conditions, the guaranteed saving being $10,000 a year in the net cost of power at the delivery point. A 15-ton, three-phase electric furnace has been in operation in South Chicago for two months, supplied with power from three 750-kw, 25-cycle, 2200-volt to 100-volt transformers. The amount of power required for electric steel furnace service of 4000 tons per day capacity would be about 25,000 kw. The speaker believes that electric steel making will soon be in general use. A typical self-contained plant having a capacity of 2,000,000 tons per year, including cement manufacture also, would require 100,000 kw in machinery, using no coal and depending upon blast furnace and coke-oven gases. The steel-mill engineer must be about 60 per cent business man and 40 per cent engineer. He still has the sentiment of the rolling mill superintendent to contend with, and if any man on earth must be "shown," he is the one.

Mr. K. A. Pauly, Schenectady, emphasized the value of non-automatic control for rail-mill motors over a limited range, say of from 10 per cent to 15 per cent. Referring to Mr. Specht's paper, he said that in determining the capacity of a fly-wheel, the cost of power, the generating station and the rolling-mill motor enter. The economical size of fly-wheel is greater where the power cost is high or where the over-load capacity is small. As the number of mills driven from a single station increases, the station peaks decrease, and the extent of fly-wheel capacity necessary tends to go down. Mr. J. C. Parker, Rochester, N. Y., emphasized the importance of Mr. Specht's paper in central-station work. Fly-wheel apparatus had wide importance in smaller service where motors are applied. The effect on the central station is of less importance than the quality of service rendered at the machine. He questioned the advisability of the independently driven fly-wheel.

Mr. C. F. Scott, Pittsburgh, reviewed the early history of steel-mill motor designs, pointing out the importance of an extremely reliable machine for this service. Continuity of service is of enormous importance. The peculiar conditions of power supply and the fluctuating load call for the broadest kind of engineering. The cost of power is not the vital point. Mr. Tschentscher saved $1.50 per year per motor horse-power, but in this case the power factor increased the cost of the power only from 5 per cent to 10 per cent. Savings in labor and increase of output would overbalance the saving in power. Effective operation was the important point. Discussing Mr. Friedlander's paper, Mr. Scott said that the electric drive and measurements enabled one to study the performance of the rolls quantitatively and to check the condition of equipment and study the conditions of mill work in a scientific way. The machine shop offers an analogous case. The reason for the electric drive is the increased output possible rather than the economy. Much will be gained by centralizing the power in a steel mill and applying electrical distribution.

Mr. Specht said that a separate fly-wheel was installed in a case described by him because the electrical design of the motor did not take such a device into account. He thanked Mr. Rushmore for getting the rolling mill and electrical men together. Mr. H. E. White, closing, said that in regard to the use of a

dynamic brake in connection with a wound secondary of an induction motor, there is no present means of bringing such a machine to rest by alternating current without imparting a tendency to start it in the opposite direction. Mr. A. M. Dudley pointed out that there is no advantage in weight in using a separate fly-wheel, but that the motor can be built somewhat lighter. It is not difficult to stop a direct-current motor by putting direct-current into it. Mr. C. T. Henderson, in closing, said that a peculiarity of English instruments is that the scales read from right to left. The automatic slip regulators at Gary have been criticised as being too slow, but if it had been desirable, their action could have been quickened by the use of current relays operating directly on the contractor windings. He could not agree with Mr. White that direct-current contractors are slower than alternating-current contractors. If it were so, it could easily be corrected by a permanent resistance in the contractor winding. Neither did he agree with Mr. Yearsley that the controlling apparatus is not as reliable as the other equipment. It is necessary to have adequate apparatus to limit the motor current in rolling-mill practice, since the mill cannot stand the time required for a circuit-breaker to go out and be re-set. At this point Mr. White interjected a good word for the alternating-current contractor. Mr. W. L. Abbott, Chicago, outlined a method of calculating fly-wheel sizes by averaging a power wave diagram. Mr. J. C. Parker, Rochester, said there is a blast furnace plant on the Niagara frontier taking 16,000 hp from an outside source. The interests of the central station and the steel mill may not be far apart. The Solvay people have utilized some of their by-product power for industrial service.

Miscellaneous.

CONVECTION OF HEAT FROM WIRES.

In a paper by Messrs. A. E. Kennelly, C. A. Wright and J. S. Van Bylevelt, of Harvard University, were reported the results of experiments relating to the convection of heat from small copper wires. The tests were conducted by varying the atmospheric pressure surrounding the wire, under conditions of free convection, and by subjecting the wire to varying wind and velocity under conditions of forced convection, in each case measuring the change of electric power required to maintain the wire at constant temperature elevation. Use was made of wires of small diameter in order to minimize the loss by radiation. Wires having diameters of 0.0114 cm, 0.0262 cm and 0.0691 cm had linear convections of 5300, 5600 and 8500 abwatts per centimeter per degree centigrade at atmospheric pressure. The experiments showed that the convection varies directly with the square root of the wind velocity when forced cooling is employed. The free convection from the wires at rest corresponded to a forced convection at a virtual wind velocity of about 25 cm per second. If this velocity be added to all the actual wind velocities in forced convection tests the linear convections conform satisfactorily to the law of square roots of wind velocity from 2000 cm per second down to 0 cm per second. The results were expressed as empirical formulas.

Discussion.

Prof. Vladimir Karapetoff, of Cornell University, asked if the formulae for free and forced convection near the end of the paper could be evaluated by other than the method of least squares. Dr. Charles P. Steinmetz, of Schenectady, N. Y., said that while a corrective term in a formula is annoying, the parabolic law can be obtained by the interpolation of the logarithmic curve. Mr. C. F. Scott, Pittsburgh, Pa., suggested that the experiments may be somewhat affected by the movement of the heated air in the free convection tests, which would give a relative velocity to the wire and air, even when the former was suspended in a closed vessel. Mr. P. M. Lincoln, Pittsburgh, pointed out the value of the paper in the scientific study of ventilation in electrical machinery. Dr. Kennelly closed the discussion by emphasizing the semi-physical nature of the paper, the need of using units consistently and in accordance with scientific conceptions. The parabolic term is preferable to the word "exponential" as used. No labor would have been escaped by defining the atmosphere otherwise. Except at low speeds the convections of the logarithmic curves are small.

TELEPHONE CABLES.

A paper by Mr. Frank B. Jewett, of the American Telegraph & Telephone Company, discussed the characteristics of the modern telephone cable and outlined briefly the cable specifications employed by the associated Bell companies. The specifications require each conductor to be insulated with a single wrap of paper spirally applied. Between each conductor and all the rest and the cable sheath the insulating resistance must be not less than 500 megohms per mile of cable at 68 deg. Fahr. The insulation of each conductor must withstand a potential of 500 volts without rupture. The mutual electro-static capacity of any pair must not exceed certain specified values—0.084 microfarad per mile for a 300-pair cable and 0.079 microfarad for a 240-pair cable. The core must be enclosed in a sheath composed of an alloy of lead with not less than 3 per cent of tin.

THE TRAINING OF NON-TECHNICAL MEN.

The training of non-technical men as conducted at East Pittsburgh was outlined in a paper by Mr. C. R. Dooley, of the Westinghouse Electric & Manufacturing Company. The work is accomplished by means of an apprenticeship system and by a night school. The apprentices receive instruction both in the shop and in the class-room, the class work including mechanical drawing and shop arithmetic. The night school, which requires 25 instructors, has an enrollment of about 300 students, practically all of whom are employed in the shops for nine and three-quarters hours per day, besides attending school for three hours on three evenings of each week. Only ambitious boys undertake this work, and the results have been very gratifying.

CLASSICS IN ENGINEERING EDUCATION.

Dr. C. P. Steinmetz, of the General Electric Company, presented a paper briefly outlining the value of the classics in engineering education. He expressed the opinion that the neglect of the classics is one of the most serious mistakes of modern education, and that the study of the classics is very important and valuable, and more so in the education of the engineer than in most other professions, for the reason that the avocation of an engineer is specially liable to make the man one sided. By dealing exclusively with empirical science and its applications, the engineer is led to forget, or never to realize, that there are other branches of human thought besides empirical science, and equally important as factors of a broad general education and intellectual development. It is true that the classics are not necessary if the aim is to fit the student to ply the trade of engineer, just as that of plumber or boiler maker, and the world, and especially the United States, is full of such men who have learned the trade of engineer. However, such learning of the engineering trade can hardly be called receiving an education, and certainly does not fit the man to perform intelligently his duties as citizen of the Republic during the stormy times of industrial and social reorganization which are before us. Dr. Steinmetz said that the modern languages are not in the same class with the classic languages, and he considers them of practically no educational value. Their utilitarian value to the college student is negligible, for on account of the limited time, the absence of practice, and the large number of other more important subjects of study, very few of the college graduates retain even a rudiment of their knowledge of modern languages, and even those few do so only because they are especially interested in them, have occasion to practice them, and therefore would probably have learned them outside of college. To the engineer particularly, the knowledge of foreign modern languages offers no appreciable help in following the engineering progress of other countries, because practically all that is worth reading is translated into English either in full or in abstract. Since the modern languages have no appreciable educational value, they should be dropped from the engineering curriculum of the college

Discussion.

The papers by Dr. Steinmetz and Mr. Dooley were discussed together. Mr. Dooley said that the fundamental idea of the night school is to train men in a broad way. Dr. Steinmetz stated that his paper grew out of his interest in recent discussions of the sphere and qualifications of the engineer, and referred to the recent Institute paper of Mr. F. P. Fish on the subject of patents as an example of a contribution which no mere engineer could have written. The unsatisfactory position of the engineer in public life is largely due to ourselves.

President Ferguson referred to Mr. Fish's paper as one of the best ever presented before the Institute. He read a letter from Mr. Fish, who said that he felt the obligations of the Institute to Dr. Steinmetz for calling attention to this subject. He concurred in the general conclusions of the Steinmetz paper. He considered it most unfortunate that engineers do not have the opportunity to study the great authors of Greece and Rome. It is broadening to become saturated with the modes of life of other civilizations. The classics better fit a man to judge human nature and affairs. The great difficulty is that few men in active work have the time for such studies. The curriculum cannot be made long enough to inculcate even the principles of engineering. Mr. Fish said that he personally owed more to the work he did to the classics than to any other branch.

Prof. C. A. Adams, of Harvard University, voiced his appreciation of Mr. Dooley's paper and work. A new attitude on the part of the manufacturing companies is that of taking account of the efficiency of the human machine. He doubted the value of the classics in immediate relation to engineering education. Individual tastes vary widely. It is not so certain that a narrowness of concentration is undesirable. Mr. C. F. Scott, Pittsburgh, referred to recent papers before the Society for the Promotion of Engineering Education and commended the process of self-sorting which goes on in Mr. Dooley's school. The work lifts up men who have not had technical advantages. He referred to the necessity of the engineers being able to solve broad problems, and said that Dr. Steinmetz is speaking for a broader view of affairs than is sometimes considered possible. The classical man deals with the speculative or philosophic situation, while the engineer deals with facts.

Mr. Farley Osgood, general superintendent of the Public Service Corporation of New Jersey, emphasized the need of the specialist in the designing engineer. In the operating company the greatest difficulty is to get young college men who can think quickly, rapidly and accurately. Designing engineers get into ruts and are anxious to become specialists because of competition. The operating man must meet the public and handle financial problems as well as technical questions, and make his boards of directors give up money in lines of business that they do not understand. Too many engineering graduates think they must go into the factory, but while this is well, there are other things in the world than making machines. In many cases it would be desirable for the college graduate to come directly into the operating company. Mr. Osgood said that his engineers frequently go to the colleges to get the men direct and thus save the four years spent in the factory. The professors are apt to have too little knowledge of the great breadth of work done by the operating engineer.

Dr. M. G. Lloyd, Washington, said that the condition which Dr. Steinmetz mentions is general among all Americans. The classics are extraneous to the technical part of education. Languages should be put down into the lower schools and the sciences taken out of them. In the technical school, technical education is the main issue, and in teaching any subject more depends upon the instructor than upon the subject. Mr. John C. Parker, Rochester, said that Mr. Dooley's work does away with class consciousness and would be justified on that basis alone. Social and economic problems, managerial and financial work are scientific in character, if not belonging to the exact sciences. Mr. D. B. Rushmore, Schenectady, said that man's first object must be a source of income. Whatever else education does, it should provide that. The college education is only the base of a pyramid which we wish to build high. If the base is too broad one cannot reach the height soon enough, and if it is too narrow the pyramid becomes unstable. The man who is to be purely an engineer must confine himself closely to technicalities. Dr. C. H. Sharp voiced the need of men of various sorts and degrees of training; he did not agree that the classics furnished the best way of securing breadth. It may be possible to over-rate the value of the classics. Little can be done in a short time with languages. In many cases it costs too much to take the kind of work Dr. Steinmetz lays out. Higher professional training leading to the degree of doctor of engineering is very desirable.

Mr. J. G. White, New York, said that the alpha and omega of the engineer is presented in the two papers. Only a few can take such broad training as Dr. Steinmetz recommends. The value of the classics is clear, and at least the English classics should be studied. The principal objects of engineering education are: first, to learn to think; second, to learn to express one's thoughts; third, to acquire a fundamental knowledge of general principles; fourth, the ability to find information in regard to the solution of any problem and put this into shape for the solution, and, fifth, to apply this general ability in a commercial way. Many other subjects would do fully as well as Latin or Greek. An elementary knowledge is very useful, but a knowledge of Spanish is of greater value to the American engineer than of any other language. Opportunities in Cuba, the Philippines and South America are constantly increasing, and a knowledge of Spanish often is the key to the situation. Scarcely one graduate in 10,000 has any real use for German. English and its literature are most essential.

Prof. G. F. Sever, of Columbia University, spoke of the differences in opinion as to the best methods among educators and briefly described the six-year optional course in engineering at Columbia, in which three years are devoted to elective collegiate studies and three years to engineering. No languages are studied in the engineering course. The University of Missouri now has a five-years engineering course. Professor Adams, of Harvard, emphasized the ability of the specialist to see into questions with less social bias than others.

At this point Mr. D. B. Rushmore took occasion to discuss the many-sided features of the Institute in its professional work and social intercourse. He spoke of the value of the work and experience of the presidents, and on behalf of the board of directors, while the audience rose, presented President Ferguson with an emblem signifying his becoming a past-president of the organization. President Ferguson replied in a happy vein, speaking of the unexpected situation in which he found himself, pointing out how the co-operation of the directors had dissipated his early anxieties as to the success of the administration and expressing his happiness in the work of the office during the year. He paid a glowing tribute to the faithful work of the different committees.

Mr. Dooley, in closing, said that there is a need for many different kinds of education and that children should be guided during their early years in the direction of their future work. President Ferguson offered an address delivered in December, 1908, by him at the Massachusetts Institute of Technology on "The Training of the Electrical Engineer," as a contribution to the discussion. Dr. Steinmetz said that in his paper he was striving to train the intelligent being to be a broad citizen of the Republic in the field of electrical engineering. The main point is to teach the boy how to live. Earning money is not the purpose of life, but a means to an end. The great fault of our nation and age is that we mistake the purposes of life and the means of living, which were better understood in former ages. Numerous factors contribute to a broader education. Pressure from within and without the engineering profession will provide the necessary method of broadening. The immediate step is to establish from two to three years of Latin and from two to three years of high-school Greek as an entrance requirement of the technical school and college. Classic languages should be received as an equivalent to modern languages in college entrance, taking any two out of Latin, Greek, Spanish, French or German.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Street-Car Card Advertising Contest.

In order to obtain suggestions for street-car advertising the advertising committee of the Commonwealth Edison Company has established a prize contest for designs for a standard street-car card, 11 in. x 21 in., directing attention to the electrical service of the central-station company. Prizes of $15, $10 and $5 are offered for the three best suggestions submitted to the committee on advertising at 84 Market Street, Chicago, before Aug. 1. Only members of the Commonwealth Edison branch of the National Electric Light Association may engage in this competition.

Chicago Central-Station Department Directory.

The Commonwealth Edison Company of Chicago has long outgrown its headquarters in the Edison Building at 139 Adams Street. Various departments have been moved from time to time to another downtown building of the company known as the Electric Building at 84 Market Street. This is a large eight-story building with all but its two upper floors occupied by the central-station company, and these remaining floors will be used in another year. In addition to these two office buildings the company has space in other downtown buildings for various departments. There have been a number of changes this year, so that it may be useful to give the location of the various departments with the revised addresses. The subjoined list will also serve to give some idea of the varied activities of the company.

CENTRAL-STATION DEPARTMENT DIRECTORY.

	Address.
Advertising Department	84 Market Street.....Room 201
Arc Lamp Department	84 Market Street.....Room 305
Attorney	139 Adams Street.....Room 32
Auditing Department	139 Adams Street.....Fifth floor
Auditor	139 Adams Street.....Fifth floor
Cashier	139 Adams Street.....Room 1
Claim Department	139 Adams Street.....Room 21
Contract Department	139 Adams Street.....Second floor
General Contract Agent	139 Adams Street.....Room 22
Construction Department	84 Market Street.....Room 301
Superintendent of Construction	139 Adams Street.....Room 61
Customers' Repairs	72 Market Street,
Electric Shop	Michigan and Jackson Blvds.
Employment Bureau	139 Adams Street.....Room 57
Engineering Department	84 Market Street.....Room 602
Electrical Engineer	139 Adams Street.....Room 62
Engineer, Electrical Construction	84 Market Street.....Room 602
Engineer, Electrical Design	84 Market Street.....Room 602
Exhibition Room	139 Adams Street.....Second floor
Fuel Agent	139 Adams Street.....Fifth floor
Inspection Department	84 Market Street.....Room 601
General Inspector	84 Market Street.....Room 601
Lamp Renewals	82 Market Street.
Library	139 Adams Street.....Room 59
Load Dispatcher	139 Adams Street.....Room 65
Meter Department	84 Market Street.....Room 501
Superintendent Meter Department	84 Market Street.....Room 501
Operating Department	139 Adams Street.....Room 65
Chief Operating Engineer	139 Adams Street.....Room 65
Paymaster	139 Adams Street.....Fourth floor
President	139 Adams Street.....Room 53
Assistant to the President	139 Adams Street.....Room 53
Purchasing Department	139 Adams Street.....Sixth floor
Repair Shops	76 Market Street.
Salesman, General Merchandise	139 Adams Street.....Room 47
Sales Room	139 Adams Street.....Room 2
Second Vice-President	139 Adams Street.....Room 42
Asst. to the Second Vice-President	139 Adams Street.....Room 42
Secretary Advisory Committee	139 Adams Street.....Room 58
Secretary-Treasurer	139 Adams Street.....Room 32
Sign Department	84 Market Street.....Room 305
Statistical Bureau	1010 Home Insurance Bldg.
Stores Department	202 South Peoria Street.
General Storekeeper	202 South Peoria Street.
Street Department	84 Market Street.....Room 408
Superintendent Bldg. Construction	84 Market Street.....Room 602
Superintendent Edison Buildings	139 Adams Street.....Room 56
Superintendent Storage Batteries	139 Adams Street.....Room 65
Superintendent Substations	139 Adams Street.....Room 65
Testing Department	84 Market Street.
Transportation Department	South Morgan Street.
Treasury Department	139 Adams Street.....Fourth floor

Desirable and Undesirable Load.

At a meeting of the Wisconsin Electrical Association, at Waupaca, June 29, Mr. Ernest Gonzenbach, general manager of the Sheboygan Railway, Light & Power Company, gave a talk on desirable and undesirable railway and lighting business. As to the lighting business which is undesirable, he said that the idea of simply getting business had been too prevalent among the electric light men and that they had not sufficiently considered before going after a prospect what kind of a consumer he might be or whether he might better be left to the gas company. He said that he had yet to see the large store in the smaller cities that offered a profitable load. The power-station investment is likely to be in the neighborhood of $150 per kilowatt of capacity. The investment in lines and meters is from $75 to $100 per kilowatt of capacity. This makes the total investment per kilowatt from $200 to $250. On this the interest and depreciation will be at least $30 per year per kilowatt of capacity. If the store uses its maximum demand, 700 hours per year, a rate of 15 cents per kw-hour would just take care of interest and depreciation, leaving nothing for operating expenses. The lighting of factories which close at 5 or 6 o'clock every day is another class of very unprofitable business.

In discussion Mr. R. N. Kimball, of Kenosha, said that while some of this peak business might not be directly profitable, one must remember its advertising effect. If electric light is used in the large store it is likely to bring about its use in many other places.

Summer Selling of Electrical Appliances.

BY H. H. MCPHERSON.

The summer season was once considered to be the dull season in the sale of electric appliances. When the old-line gas companies began to feel the competition of the electric companies there were many who imagined that their days were numbered. But the wonderful increase in the use of gas for domestic and industrial fuel purposes, together with the rapid progress made in the use of gas for long-hour lighting have made the net returns from the gas business much larger than ever before. In much the same way the electric companies are building up their motor load and are creating a large domestic day load by selling large numbers of electric appliances, such as flatirons.

The summer selling of electric appliances is quite a different thing from selling of electric summer appliances. The summer season is the best time of the year for the selling of electric appliances for exactly the same reasons that almost everything sells better during the summer than during any other time of the year. In addition, the appliances add more to the comfort and convenience of the user during the summer months than they do at other seasons of the year. In recognition of the conditions which make the late spring and the summer months the most opportune time at which the sale of electric appliances can be pushed, most companies appropriate large amounts of money to the new-business and advertising departments to be used for this purpose.

The present article will not attempt to argue how this money can be spent to the best advantage, but will simply try to show how the soliciting end can be made to produce much better individual results by employing business methods from other similar business enterprises.

The selling of electric appliances is essentially a proposition of a large number of comparatively small sales which must be

made within a period of about four months. If this meant that the great majority of the buyers had to be educated and the sales closed in that length of time the task would be almost impossible. But such is not the case. While there may be a very large number of persons who can be properly called prospective customers because they do not have these appliances, the greater part of them can be classified by the first canvass, as far as the present season's work is concerned, into two classes—good and poor. The others may be called very poor, and, therefore eliminated from consideration. While it is perfectly true that every person is a prospective customer as long as he is without an appliance, and he should be visited periodically until the appliance is sold, whether it takes one month or three years, yet it may happen that a dead list of names is consuming a man's time while his real live prospective customers are waiting in vain to be called on.

With a good business house a careful campaign along any special line means, first, a list of prospective customers; second, a list of live prospective customers, and, third, and by no means least, an efficient follow-up system. The average representative for an electric company does the first very well, the second fairly well, and the third almost not at all. He usually makes his initial canvass with diligence and he places a note after each name showing whether he considers the possibility of sale good, poor or very poor, and also when he thinks another call should be made. That list and those notations are worth much in prospective to him and to his company, but in a memorandum book in successive order they are worth only cents instead of dollars, because it is almost impossible to follow them up.

Any average district in charge of a representative will yield, say, 2000 prospective electric-iron customers. How can any man expect to follow up a list like that, no matter what system he uses? Appliance sales are not usually made in one or two calls.

The lowest possible average number of calls per sale in an appliance season is five. The easy-going scientific salesman may make a better record than that. If he does one may rest assured that he has only hit the high places. The great body of good prospective customers whom several properly timed calls would have converted into buyers have probably never been called on even the second time. On the other hand, the salesman just mentioned will beyond a doubt make more sales than will the man who, in his desire to cover his list thoroughly, wastes the time on poor and very poor names that he should have spent on the good ones.

The hardest things in the business for an inexperienced man to overcome are the temptations which draw him away from his carefully thought-out plan. He allows the exceptions to swamp his rule. A typical case was that of a good grocery salesman who entered the electric new-business field with the selling idea uppermost in his mind. In his previous work he simply had to make rounds every so often, so his prospect work was almost nothing. On his new work he started in to make a complete canvass of his district. When he had covered about half of it he found that he had enough prospective customers to keep him busy, so he neglected the other half of the canvass. One month of the four was gone before his employer discovered that his early high sales record was due to the neglect of one-half of the district. The former grocery man was shown how to classify his prospective customers so that he could handle them and yet have time to complete his canvass. In this way his best energies were devoted to the best names, and the poorer ones were called on only when his first list had been properly followed up.

The form used for the prospect list follow-up depends on whether the man who uses it is to devote his whole time to the selling of appliances, or has additional work to do. In either case the list should be kept on cards in a "date-ahead" file, and there should be a separate card provided for each prospective customer.

A standard size 3 × 5 in. card cut in half lengthwise makes a card which is sufficiently large to contain all needed information, and one of them can be put in each side of a standard-size vest-pocket card holder which has been sewed together lengthwise down the middle. On each card is put the date called on, name and address of prospective customer, name of the appliance which he may buy, date for next call, etc. If the card is plain each man can arrange this information as he sees fit. He would probably do so in any case. At night he simply drops each card in the file behind the guide card bearing the next call date. When he commences to make second calls he first picks out all the cards labeled "good." If he thinks he can call on more people than these good cards represent, he takes out enough of the poor cards to fill up his time, always being sure to select the most promising ones. After each call he checks each card properly and writes on a miscellaneous card any information in general which does not properly belong on the cards. At night he puts all of the cards taken out, whether the calls have been made or not, behind the date card for the next call or into the rear of the file if a sale has been made. He checks any information from the miscellaneous card onto the proper cards in the file, and then files these altered cards in their proper places for the next call. Then he takes out the next day's cards, and so on.

There are many honest differences of opinion regarding such a plan as this. It was once said by some famous man, "Always remember that the other fellow's idea is a scheme; yours is a plan." This particular plan is designed to cure a specific trouble which is common to all men who keep an up-to-date list of prospective customers. Many systems could be made more elaborate than this one, but the writer knows of none more concise and practical. The special fault with most other systems is that they require too much time and labor in keeping them up to date. If the necessary time is not spent such a system soon becomes a useless maze of red tape.

The cards for the above system have been chosen from standard-size material because such material can easily be obtained. They have been made small because a larger size is not needed and enough of them can, therefore, be carried so that each memorandum is written directly upon the card to be filed and not copied from some other pad. The "date-ahead" system is used because all that is necessary each night is to file the cards by next call dates and to pull out the next day's cards. Even the filing can be neglected for a few days if time is lacking. Moreover, the date-ahead system keeps important facts ever before one. The information is never lost or buried, and it is easy to sort delayed matter into the days ahead. A glance at the pile of cards behind each date card will tell how heavy a day's work lies ahead, and the cards in the rear of the file are a never-failing spur to the sales record.

A word should be said about other systems. The old memorandum book means no flexibility, dead lists and an improper "follow-up." The "date-ahead" book is somewhat better, but the spaces for each day are uniform in size, which means too much room in some spaces and too little in others. The card system with indexes by names or streets and date tabs means more time used in keeping it up to date because it is necessary to put a date tab on each card, find the name index card and put it in and then having to go through the reverse process to take it out.

In addition, it does not show at a glance the amount of work ahead nor the sales made. The card-index system of cards for each kind of appliance means no flexibility, a constantly growing mass of dead timber, and it is really little better than the old-style memorandum book. If date-ahead tabs are added to it, it becomes the equal of the date-ahead book.

With some such system as has been described it is possible to keep an almost perfect "follow-up" in an up-to-date condition with only five or ten minutes work per night. The sales value of such a system has been shown conclusively by the sales record of the man who first used it. Working on nothing but old prospective customers he doubled the sales record of the previous year, which included new houses as well as old.

INTERIOR WIRING AND ILLUMINATION

Decorative Lighting at the Arion Club, New York City.

During the recent convention of singing societies held at Madison Square Garden, New York City, the Arion Society, one of the largest German singing organizations in the city, was the principal host of the visiting singers. Appropriate to the occasion, the Arion Society had the exterior as well as the interior of its large and commodious clubhouse at the southeast corner of Park Avenue and Fifty-ninth Street profusely decorated with electric lights. The accompanying illustration gives a view of the outside illumination by night. The system of exterior lighting here shown is that including the use of stranded duplex Elblight cable containing 4-cp electric lights attached by pin-socket contacts. The star design and the lettering shown in the picture were outlined by standard 4-cp screw-base and socket lamps. In the illumination 4000 all-frosted 4-cp carbon lamps were used, giving a most striking effect. The current supply for the decorative lighting was from the alternating-current mains of the United Electric Light & Power Company, New York City.



DECORATIVE LIGHTING AT THE ARION CLUB, NEW YORK CITY.

Some Faults in Conduit Wiring.

BY THOMAS NORTON.

Assuming that well-insulated wire is employed, the function of metal conduit is evidently to provide the necessary channels for wires to be drawn through a building and to protect them throughout their entire length when in position from mechanical, chemical or electrolytic damage. Iron and steel, of course, offer the best mechanical protection; but being affected themselves by acid, alkalies, water and moist air, they must be protected from damage also. From an electrical viewpoint, nothing meets the requirements of wiring practice so satisfactorily, nor is there any material possessing equal or better protective qualities for the same cost as iron pipe.

When installing conduit continuity of the system and proper earth connections are necessary. On this point the underwriters mark that it is essential that the metal of conduit systems be joined so as to afford electrical conductivity sufficient to allow the largest fuse or circuit-breaker in the circuit to operate before a dangerous rise in temperature in the conduit system can occur. Conduits and gas pipes must be securely fastened in metal outlet boxes so as to secure good electrical connection. Where boxes used for centers of distribution do not afford good electrical connection, the conduits must be joined around them by suitable bond wires. Where sections of metal conduit are installed without being fastened to the metal structure of the buildings or grounded metal piping, they must be bonded together and joined to a permanent and efficient ground connection. It is recommended that cables, outlet boxes and fittings have conductive coatings in order to insure better electrical contact at all points throughout the conduit system, and if the conduit, couplings, outlet boxes or fittings have protective coatings of non-conducting material such as enamel, such coating must be removed from threads of both couplings and conduit and from surfaces of boxes and fittings where the conduit is secured in order to obtain the requisite good connection. It is well to note that fires have occurred through leakages from conduit to soft metal gas pipes, and while continuity and grounding are admittedly necessary as a protection against danger to persons they are by no means an absolute safeguard against fire risk. A ground wire of small sectional area was formerly considered all that was necessary to minimize the risk to persons from shock or burn; but it was soon found that a fault on a main protected by a fuse large enough, would result in dangerous overheating of a small ground wire, so that ground wires should have ample cross-section. It is best, if possible, to have two independent grounds to every installation and to protect the ground wire by conduit or molding.

A point that should receive consideration in conduit work, especially in concrete buildings and in refrigerating rooms, is the draining of the conduit. In all conduit work condensation is bound to occur because of temperature changes, and if pockets are formed in the conduit where water will gravitate, condensation breakdowns are liable to result. Undoubtedly a wire of good quality properly vulcanized with outside braiding treated with a good weather-resisting compound and showing a good insulation test after 24 hours' immersion in water, cannot be harmed much through the existence of condensation in the conduit. But if a wire has been injured when being pulled through the conduit, kinks formed in it, tools dropped on it or persons with heavy shoes permitted to walk on it for any length of time, a breakdown can be looked for at such spots where injury might have occurred before installation. Water may also creep along the wire and cause trouble at ceiling outlets, switches, etc. This latter defect can be remedied by the employment of suitable compound or rubber tape near the contact. If all connections have been sweated bitumen can be poured in the junction boxes where excessive condensation exists with good results. The outlets of junction boxes on vertical runs can be drained by an outlet at the bottom of the tube or a T employed instead of a bend. If free circulation of air is prevented condensation troubles may be reduced to a minimum.

To increase the durability of the pipe, it is common to use a black Japan varnish with a paraffin base or with a linseed oil base. Galvanizing is also very generally employed. In grounding such pipes good contact should be obtained and the ground connection should be made in such a way that the ground can be removed easily and periodic tests made to see that clearance from foreign grounds exists. It is rarely that a dead short occurs on a good grounded pipe system, the defects being generally connected with faulty switch wires and lamps. If contractors and wiremen use care in manipulating conduit and fittings so as not to knock off the enamel or other coating unnecessarily, the conduit will not deteriorate rapidly. It is possible, for instance, where conduits are cut into joists and boarded over to drive a nail through the conduit if it is thin, and where the conduit has been subjected to hard usage and the coating scraped off, it deteriorates and rusts so that it can be easily penetrated by a nail at any time. Where the conduit is galvanized, the coating cannot be so easily removed and the metal is better protected from the action of the air and moisture.

Electrical Effects at the Wright Brothers Celebration at Dayton, Ohio.

On June 17 and 18 the city of Dayton celebrated the home-coming of the Wright brothers, the distinguished aviators. The streets were especially decorated for the occasion and the work,



FIG. 1.—NIGHT VIEW OF COURT OF HONOR FROM TOP OF BUILDING.

done by the Dayton Lighting Company, made the display more attractive by night than by day. The accompanying illustrations show Main Street by day and night. There were 30,000



FIG. 2. NIGHT VIEW OF COURT OF HONOR.

4-cp lamps installed. The formal demonstration lasted two days, but the company carried the display two days longer for the benefit of the town people. The court of honor on the

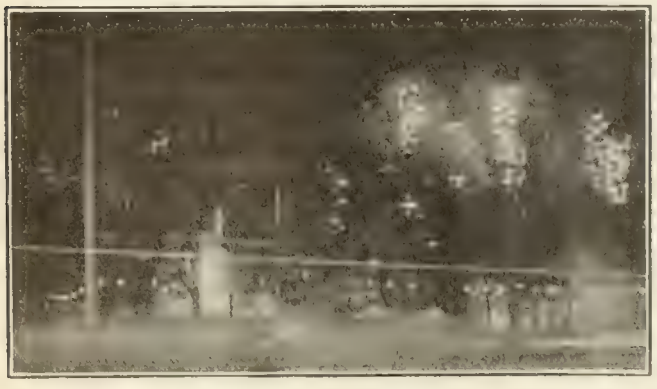


FIG. 3.—PARK ILLUMINATION "BUNCH OF GRAPES" EFFECT.

main street was very attractive at night, as shown by Figs. 1 and 2, Fig. 1 being taken from a high building. Fig. 3 was taken in one of the parks, showing the result obtained with 4000 16 cp lamps, so hung as to produce the effect of huge bunches of grapes. Celluloid cases in various colors, about 8 in. in diameter, were loaned by the National Cash Register Company to cover the lamps. The effect is very inadequately shown by the reproductions of the photographs. Those competent to judge pronounced it one of the finest pieces of decorative illumination ever accomplished. Besides the bunches of grapes in the trees, there were vertical strings and streamers of lamps. This tree decoration occupied about one full city square.

The court of honor is shown by day in Fig. 4. It was installed by the committee on arrangements, but the Dayton Lighting Company planned the lighting effects throughout. Besides the street and park decoration, four searchlights were located on the tops of four of the most prominent buildings and were



FIG. 4.—DAY VIEW OF COURT OF HONOR.

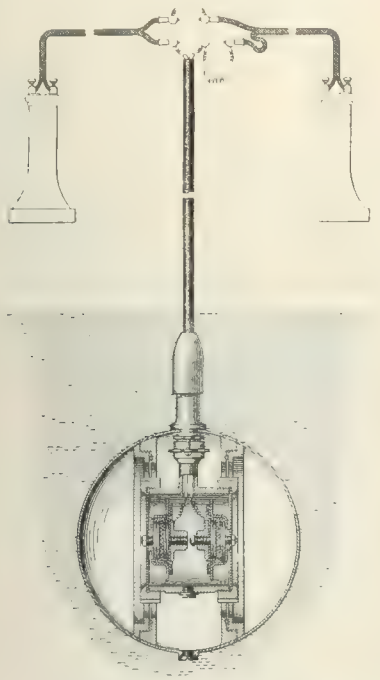
operated so that they attracted attention all over the surrounding country. This temporary installation is a good example of the vigorous way in which the Dayton Lighting Company, under the management of Mr. F. M. Tait, secretary-elect of the National Electric Light Association, takes hold of public enterprises in its city.

New Telephone Patents.

TRANSMITTERS.

For audiphone uses the telephone transmitter must be adapted to pick up sounds from certain directions, rather to the exclusion of those from other directions. For this purpose a transmitter is usually of rather a different type from that for ordinary telephone working. With a view to increasing the efficiency of such a transmitter Mr. O. L. Falk, of Belleville, N. J., has patented a concentrator for mounting on the face of the transmitter. This comprises a conical tube of sheet metal, the outer, or wide end, of which is extended all around into a convex flange, having such a curvature that its edges lie in the plane of the small end of the tube. This device is of sheet metal and is arranged to be mounted in front of the transmitter with the small end of the tube confronting the center of the diaphragm. It is so placed that there is left a narrow slit all around between the outer edges of the convex flange and the transmitter face. When the transmitter is directed toward the source of sound this is received in two ways. First, through the conical tube, and, second, reflection from the face of the transmitter and through the narrow slit, and thence from the rear side of the convex flange to the diaphragm. The inventor's idea is to sufficiently exclude disturbing sounds not coming from the desired direction, so adjusting screws are provided by means of which the width of the slit between the transmitter face and the flange may be reduced at will. Mr. Falk has assigned his patent to the American Telephone & Telegraph Company.

For receiving submarine signals by means of the telephone it is essential that a water-tight receptacle be provided for the transmitting elements which are to pick up the sounds traveling through the water and transmit them to receivers located on shipboard. Mr. A. J. Mundy, of Boston, Mass., has patented such a receptacle and assigned his patent to the Marion Signal Company. The receptacle is spherical in shape, the sphere being divided into three compartments by two parallel



MUNDY SUBMARINE TELEPHONE.

cross-partitions. Both the partitions are perforated with a large central perforation, which is closed by the diaphragm of the two transmitters. The microphone buttons occupy the middle compartment lying between these two diaphragms. The remaining compartments, with their spherical sides, act as concentrators to receive vibrations from the water and focus them upon the diaphragms. This arrangement is shown herewith.

COMBINED ALARM AND TELEPHONE SYSTEM.

Mr. E. E. Salisbury, of Chicago, Ill., has obtained a patent for a combined telephone and signaling system, his apparatus providing for both still alarms and general alarms. The alarms are, of course, sent in by means of step-by-step signal devices after the general nature of a messenger-call apparatus. The devices are so interlocked that the telephone will never interfere with the alarm signal and when a general alarm is being sent in no secret one can be started in a manner to interfere with it. This patent is assigned to the Signalphone Alarm Company.

NEW SUBSCRIBER STATION APPARATUS.

With private lines worked on the common-battery system, wherein the battery supply is at some point between stations, it has always been somewhat of a problem to enable the stations to signal each other because of the shunting effect of the battery-supply tap on the ringing current. Several schemes have been suggested by the use of slow-acting relays, etc., but all are more or less complicated. Mr. F. S. Davenport, of Atlanta, Ga., now suggests the use of the condenser discharge for this purpose. To this end, he provides at each station a rotary circuit-breaking device, which normally comes to rest in the open-circuit position, but which upon rotation will produce a series of momentary short-circuits in the line. Accompanying each short-circuit, the condensers at all stations discharge through their bells, in series with them, and, with the following opening of the short, the condensers become recharged through the bells. This rapid charging and discharging of the condenser result in an alternating-current flow in the magneto bells, which will result in operating them to produce the calling signals.

Recently there has been a considerable movement in favor of the use of two ear pieces at subscriber stations. One of the schemes put upon the market is an auxiliary earcap, attached to the receiver earcap by means of a rubber sound-conducting tube. Another scheme is the provision of an auxiliary receiver of the watchcase type, the cords of which are connected in multiple to the cord terminals of the main receiver. Mr. W. H. Taylor, of Stanford, Conn., has obtained a patent for the combination with a supporting hook, of such an auxiliary receiver connected in parallel with the main receiver, its cords being attached to the main receiver terminals.

A sound shield forms the subject of a patent granted to Mr. M. P. Flack, of New York City. This comprises a conical appliance, adapted to be clamped upon the face of a transmitter by means of the regular mouthpiece. The small end is just the size of the lip of the mouthpiece, while the large end is of a size sufficient to take the nose and mouth of the telephone user. The edge of the cone is faced with a pneumatic cushion, which will form a soft rest for the face and which will sufficiently follow the contour of the face to prevent the escape of speech. Small vents are left in the walls of the cone to permit of easy breathing, but these are not of sufficient bore to permit the escape of sound.

MISCELLANEOUS APPARATUS.

The plug socket of a switchboard has in the past been used in a number of different ways to cause the operation of switches to effect special changes required in the circuits. Mr. C. D. Enochs, of La Crosse, Wis., has now planned to use the socket to restore clearing-out drops. To this end he mounts his clearing-out drop in the face of the switchboard, immediately above the keyboard, while by means of a linkage associated with the plug socket, causes the shutter of the drop to be restored when the plug reaches the seat. Mr. Enochs has assigned his patent to the Vote-Berger Company.

A call-registering system forms the subject of a patent granted to Mr. J. H. Meyer, of Magdeburg, Germany. The call-registering apparatus is located at the central office and is responsive to special keys associated with the various cord circuits and in position to be manipulated by the operator. An auxiliary relay is so associated with each cord circuit that it is possible to register but once for each connection.

LETTER TO THE EDITORS.

Spark Ignition.

To the Editors of Electrical World:

SIRS:—Referring to the article by Prof. F. W. Springer in your issue of June 24, together with your editorial upon the same, some experiments that I have been fortunate enough to be able to conduct with the endeavor to seek the proper character of spark for igniting the gases in an internal combustion engine may be of interest.

The engine was equipped with a coil of abundant power, and means were provided to control its output. The engine card was continually under observation by means of a manograph which traced the card in the form of a spot of light on a ground glass screen. The experiments were started with a spark just feeble enough to jump the points and ignite the mixture. The strength of the spark was gradually increased, the manograph being closely observed as this was done. The engine, it may be added, was kept at constant load and was controlled by a throttling governor.

With a light spark it was noticed that the explosion line of the card was considerably inclined toward the toe. As the strength of the spark was increased the explosion line straightened up and became practically at right angles with the intake line. The initial pressure was reduced, the mean effective pressure, of course, remaining the same. The energy of the primary circuit was measured and found to be about six watts.

The efficiency of transformation of the coil was unknown because of the lack of adequate instruments to measure the secondary output.

It was believed that there was no virtue in increasing the spark beyond the point where the explosion line became vertical, for this of course gave for all practical purposes instantaneous ignition of the mixture.

From this it would appear that there is a decided difference in the performance of an engine when ignited by sparks of different calorific power. This has been observed practically by many when switching the ignition system from a starting battery to a dynamo or magneto, or switching the ignition system from a weak battery to a strong one. As was very correctly stated in the editorial, the battery economy is becoming less and less of a factor. In the opinion of the writer, the spark provided should be such as to make the explosion line vertical under the worst possible condition of mixture that may be obtained, and beyond that every effort should be concentrated on making the ignition apparatus thoroughly reliable, the difference of economy with so small an amount of power as 6 or 8 watts being distinctly secondary.

New York. George T. Hanchett.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

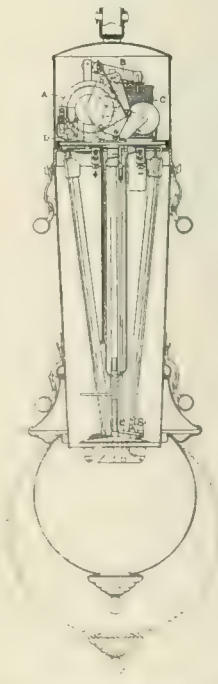
Dynamo Brushes.—J. Liska.—An abstract of a thesis on the friction of dynamo brushes. The author investigated the friction coefficient as a function of the pressure, speed, temperature, current density, direction of current, etc. Twelve different dynamo brushes were tested. The friction coefficient was determined as the ratio of the force of friction to the pressure. Concerning its dependence on the pressure at constant temperature and speed, when current is zero, it is found that an increase of the pressure (from 0.06 kg to 0.5 kg per square cubic meter) increases the friction coefficient; but generally much more slowly than the pressure, although it is different in some special cases. The friction coefficient was then investigated as a function of the peripheral speed (between 2 m and 25 m per second) at constant pressure and temperature. For most brushes it is independent of the speed and decreases very little with increased speed, although two exceptions were found. The friction coefficient was then determined as a function of the temperature between 15 deg. C. and 100 deg. C., with constant pressure and speed. For most brushes the friction coefficient is constant, in a few it increases slowly, in others the decrease reaches 50 per cent. The effect of a change of current density (between 0 amp and 15 amp per square centimeter) was then determined. For most brushes the friction coefficient is smaller if the current passes from the brushes to the ring, then in the opposite direction. For alternating current the friction coefficient has about the mean value. The deviations amount generally to 15 per cent or 20 per cent. The Morganite brush is exceptional in several of the above respects. Finally the material and the condition of the contact surfaces are investigated. On a dry copper commutator the friction coefficient is in the average 20 per cent to 50 per cent smaller than on the bronze ring. Lubrication with oil or fat increases the friction; lubrication with kerosene decreases the friction coefficient by about 50 per cent. The absolute value of the friction coefficient varies with graphite brushes between 0.06 and 0.2; with carbon brushes between 0.06 and 0.35; with metallic graphite brushes between 0.05 and 0.3, and with metallic brushes between 0.1 and 0.5.—*Elek. Zeit.*, June 17.

Series Transformers.—M. Seidner.—An article giving the theory of series transformers used in compounding methods and booster transformers. The author first investigates the case of constant secondary resistance and then the case of variable secondary resistance with constant-phase difference; the case of constant secondary impedance with varying phase difference; the case in which the secondary impedance varies inversely as the primary current; the case in which the secondary resistance brakes the current variations. The article is illustrated by diagrams.—*Elek. und Masch.* (Vienna), June 6.

Induction-Motor Diagram.—W. Rogowski.—An article illustrated by diagrams giving a simple derivation of the Heyland and Ossana circular diagrams of the induction motor.—*Elek. und Masch.* (Vienna), May 30.

Lamps and Lighting.

Flame-Arc Lamp.—An illustrated description of the new "Flamgold," double-carbon, gravity-feed, flame-arc lamp. The two pairs of carbons are burnt alternately, the arc changing over every 15 to 20 minutes. Interesting features of the lamp are the bell-shaped brass economizer, and the magnets for the control of the arc. A 9-amp, direct-current lamp burns for 20 hours on one trimming, and an alternating-current lamp for 18 hours. Although there are two pairs of carbons, there is only one clockwork mechanism, and no change-over device is needed, the carbons being fed down simultaneously. The action is as follows: The two pairs of carbons are connected in parallel, and on switching in the lamp, the arc is struck between one pair. The series solenoid then immediately draws out the arc to its proper length by means of a rod attached to a sliding plate or collar surrounding the negative carbons and carried on rollers. As the carbons are consumed, the clockwork is released by a detent on the regulating lever, and the carbons are allowed to feed. This feeding goes on for from 15 to 20 minutes, during which time the pair of carbons not in use gradually approach one another and finally touch, causing the arc to strike across the other pair. The arc is, however, instantaneously drawn between the second pair of carbons and



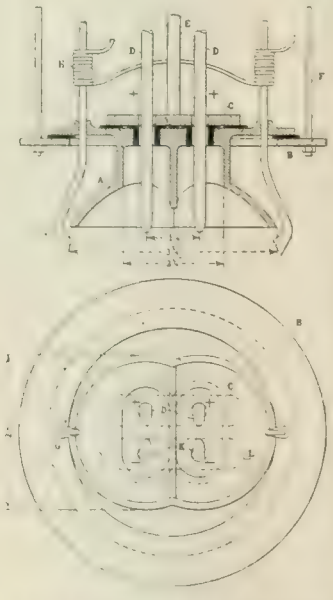


FIG. 1.—MECHANISM OF LAMP. FIG. 2.—DIAGRAM OF ECONOMIZER SHOWING CONTROLLING MAGNETS.

extinguished on the other pair by the action of the series solenoid which separates the carbons in consequence of the increase of current. Feeding of both pairs of carbons then takes place until the first pair again comes in contact and causes the arc to strike across the second pair. A general view of the mechanism of the lamp is given in Fig. 1. The carbons are suspended from an insulated drum *A* by means of woven copper

cords, the usual beaded flexible connections being dispensed with. The copper cord supporting the positive pair of carbons is passed twice round and fixed to one-half of the drum, while the cord for the negative carbons is fixed to the other half. Two revolutions of the drum correspond to the full feed of the carbons, and to obviate the necessity for rubbing contacts a coiled copper strip in each half of the drum is fixed at one extremity to the drum, and at the other to a fixed terminal, and thus gives an unbroken circuit from lamp terminals to carbon holders. The clockwork train ends in a brake wheel *B* to which is attached a fan blade, and is released when the detent *C* on the regulating lever lifts the brake from the wheel under the influence of the shunt coil. The economizer, together with the blow-out arrangement, is shown in Fig. 2. The economizer itself is a bell-shaped casting *A* divided into two halves by a partition. Insulating bushings are provided where the positive carbons pass through the roof, and mica insulation is provided between the economizer and the positive guide plate *C* and the frame plate *B* respectively. The sliding plate or collar *L* runs on little metal wheels on the top of the economizer to ensure smooth regulation and evenness of burning. The blow-out magnets are also shown in the same illustration.—Lond. *Elec. Eng'ing,* June 17.

Auto Transformers for Metallic-Filament Lamps.—J. I. CATTAUX.—A note on some details which have to be observed in the use of auto-transformers for low-voltage metallic-filament lamps. Owing to the supply pressure being usually slightly higher than the declared voltage, especially at times of light load, it has become fairly common practice to use 105-volt lamps on 110-volt circuits, and 210-volt lamps on 200-volt circuits, but a similar precaution is just as necessary for low-voltage lamps with auto-transformers. The transformer should therefore, in most cases, be wound for a supply voltage 5 per cent above the normal, unless in some few cases it is known that the supply is never above the normal. The regulation itself also has an important bearing on this point, and in properly designed apparatus it should not exceed 4 per cent to 6 per cent over-all (the higher figure in the smallest sizes only). It is a common error to suppose that 2 volts or 3 volts overrunning will not matter; it is entirely a question of percentage, and 2 volts extra on 25 has just the same effect upon the lamps as 8 volts extra on 100. Even if trouble is not experienced by the blackening of the bulbs, the life of the lamps must necessarily be materially shorter than if they burned at their correct voltage. A point which is often overlooked in low-voltage installations is the advisability of using a certain percentage of carbon-filament lamps in places where light is only required intermittently and for short periods.—Lond. *Elec. Review,* June 18.

Efficiency of Lamps.—In a report presented by the German Government to the German Congress on the occasion of the recent proposed, but rejected, tax of electricity and gas, the following figures were given: For the efficiency of electric lamps the hefner cp-hours per kw-hour are: Ordinary incandescent lamps, 330; improved incandescent lamps, 500; Nernst lamps and tantalum lamps, 500; osram, tungsten, and zirconium lamps, 700 to 1000; alternating-current arc lamps, 800; direct-current arc lamps, 1000; flame-arc lamps, 2000; mercury-vapor lamps, 1600; quartz tube, mercury-vapor lamps, 3000. For gas lamps the cp-hours per cubic meter of gas are: Welsbach incandescent gas lamps, 560; inverse gas lamps, 1000; and compressed-gas lamps, 1000.—*La Revue Elec.,* June 15.

Tungsten Lamp.—A note on a recent British patent of W. D. Coolidge (17,621, 1908; June 10, 1909). Fine tungsten powder reduced from tungsten trioxide is mixed with a binding agent, consisting of 42 per cent cadmium, 53 per cent mercury, and 5 per cent bismuth. The product, containing from 30 to 40 per cent of tungsten, is squirted into rods which are drawn into filaments, or is squirted into filaments directly. These are baked in an open furnace for from 15 to 45 minutes, and then fired in a furnace until all except the tungsten is evaporated and the latter sintered to the required degree. For this last treatment the filaments are placed in graphite boats and raised to a temperature of about 1800 deg. C. in the presence of hydrogen.—Lond. *Elec. Eng'ing,* June 17.

Reducing Carbon in Metallic-Filament Lamps.—A note on a recent British patent of the Wolfram Lampen A. G. (10,891, 1908; June 10, 1909). The filaments are brought to a red heat by the passage of a current in an atmosphere of hydrogen and sulphuretted hydrogen. The latter is decomposed, the sulphur combining with the carbon in the filament, while the free hydrogen reduces any metallic sulphide that may be formed. The gases should be at a greatly reduced pressure, and free from air and moisture.—Lond. *Elec. Eng'ing,* June 17.

Metallic-Filament Lamps.—A note on a recent British patent of A. Kroll and B. Saklatwalla (27,144, 1908; June 10, 1909). In squirting the filaments a double die composed of two dies placed coaxially is used. The outer die is fed with collodion gelatinized in alcohol-ether and the inner die with the metallic paste. Colloidal tungstic acid may be used as the collodion coating is impervious to water, and prevents the filament loosing its water and getting inflexible before the sintering treatment. The outer die protrudes over the orifice of the inner one, and the metallic core can be compressed by adjusting the pressure of supply, and a fine filament produced without using a fine die. Lond. *Elec. Eng'ing,* June 17.

Power.

Gas-Power.—CHARLES E. LUCKE.—A paper on the value of gas-power. It is particularly valuable on account of a number of numerical tables for estimating energy costs for plants up to 250 hp. Besides giving values for the cost of energy they show all the elements entering into it, together with their relative importance. The total cost of energy per hp-hour increases with the cost of coal per ton, but by no means in direct proportion; thus, for 75 hp an increase of five times in the coal cost changes the total energy as follows: Total energy cost between 1½ times for half time, full load as a maximum, and 1⅛ times for quarter time, full load as a minimum. This shows the importance of coal cost by itself. The effect on operating cost is not very different, as this is increased at the same time between 1¾ times to 1⅞ times, a little more, which is explained by the relation of operating and fixed charges. The same limits will apply to total cost for the larger engines, so that the cost of coal per ton has no relation to the size of the engines so far as its effect on this total cost is concerned; but by reason of the difference in the ratio of operating to fixed charges the effect on operating cost will be different, lying between 1½ and 2½ times, as the cost increases 5 times the cost of coal per ton. The effect of increased size of engine is marked in its reduction of total energy costs chiefly because the fixed charges are smaller per unit for the large ones. A similar reduction of operating cost is likewise the effect of increased size, because oil and labor costs do not vary in proportion with size. Coal costs per hp-hour are dependent only on cost per ton and on the individual load. The strongest factor in every case in fixing energy costs is the load factor, especially where low load factor is the result of low individual engine load.—*School of Mines Quarterly,* April.

Power Plant of Turbine Factory.—O. LASCHE.—Since the turbine factory of the Allgemeine Elektricitäts-Gesellschaft in Berlin was to be enlarged it was decided to erect a special power plant. This is equipped with two turbo-dynamos each rated at 2000 kva. The turbines are of the Curtis type. The steam consumption is 5.35 kg (11.8 lb.) per kw-hour, including excitation and excluding condensation, with 98 per cent vacuum.—*Zeit. d. Ver. Deutscher Ing.,* April 21 and May 1; abstracted in *Elek. und Masch.* (Vienna), June 6.

Air Compressors.—J. HAVLICEK.—Two papers on electrically-driven air compressors. In the first paper the author discusses the variations of the power. He finds that the driving motor should have as high a flywheel effect as is possible with good design. The "coefficient of lack of uniformity of revolution" (Ungleichförmigkeitsgrad) should be 1/100. The motor must have at least 3 per cent slip. In specially difficult cases a slip resistance must be inserted in the rotor circuit to raise the slip to 5 per cent or 6 per cent. The period of the variations of

power must differ from the period of the generators of the power plant. In the second paper, the author deals with the regulation of electrically-driven air compressors, discussing three different methods of regulation.—*Zeit. d. Ver. Deutscher Ing.,* April 10; abstracted in *Elek. und Masch.* (Vienna), June 6.

Steam Turbine.—C. von Groddeck.—An illustrated paper read before the German Association of Electrical Engineers emphasizing the importance of close co-operation between mechanical engineers and electrical engineers in designing and testing turbo-generators. The adaptability of the steam turbine to varying conditions, its use in various industries, and its influence on the design of dynamos were discussed.—*Elek. Zeit.,* June 17.

Lack of Water in Boilers.—M. Geiger.—Lack of water in most cases up to 90 per cent is the cause of boiler explosions. It also causes other troubles. The author discusses the different arrangements which safeguard the presence of sufficient amount of water in boilers.—*Zeit. d. Bayer. Revis. Ver.,* Jan. 31 and Feb. 15; abstracted in *Elek. und Masch.* (Vienna), June 6.

Turbine Regulators.—A. Budau.—An article illustrated by diagrams describing a number of different electric turbine regulators.—*Elek. und Masch.* (Vienna), June 6.

Traction.

Tramway Statistics of England.—The first of the annual tables containing the statistics relating to electric tramways, railways, and power companies of the United Kingdom. The statistics comprise 119 electric tramways, 16 electric railways and 19 power companies. The existing trade depression is strongly felt. The number of tramway undertakings at work has hardly changed, and important extensions of existing tramways are few. As for the power companies, "those that are working are not too prosperous, while those that have not yet succeeded in making a start seem no nearer doing so."—Lond. *Elec. Review,* June 18.

Catenary Suspension.—P. Dawson.—A continuation of his long serial on electric traction on railways. The author gives theoretical considerations of catenary suspension with formulas and curves.—Lond. *Electrician,* June 18.

Installations, Systems and Appliances.

Automatic Switch for Transformers.—A description of an automatic switch devised by L. T. Stone for switching out the primary of a transformer when the load on the secondary falls below a predetermined value. Fig. 3 shows the connection of the switch to an auto-transformer. One terminal of the alternating supply is connected to a coil *A,* the other terminal of which is joined to the lamp *a* and switch *b,* whence a connection runs to the intermediate terminal b_1 of the auto-transformer *B.* The same supply terminal is also connected through a main switch *D* to one terminal b_2 of the auto-transformer. The auxiliary switch *C* is actuated by the coil *A,* and is diagrammatically shown as of the mercury cup type. A second coil *E* in series with switch *C* is connected to the other terminal b_3 of

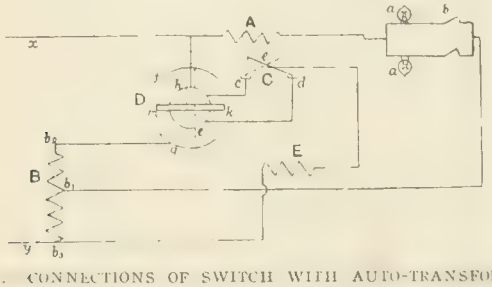


FIG. 3.—CONNECTIONS OF SWITCH WITH AUTO-TRANSFORMER.

the auto-transformer, and to the other supply terminal *y.* The coil *E* actuates the main switch *D,* connecting the lamps across the transformer. Switch *D* consists of six sections, of which *f* is connected to *x* and to *h* (two sections joined together); *g* is connected to the end b_2 of the auto-transformer; *k* to one contact *c* of the switch *C* and *l* to the other contact *d.* The switch arm *e* is joined to the coil *E* and the contact arm *m* makes the required connections between the contacts of switch *D.* The contact arm is operated by a catch on the armature of coil *E,* which engages in turn four pins suitably placed on the switch, moving the arm through an angle of 90 deg. each time *E* is energized. In operation, when one of the switches *b* is closed to light a lamp, current flows from *x* through *A,* the lamp *a* and switch *b,* to the point b_1 of the auto-transformer, and so to

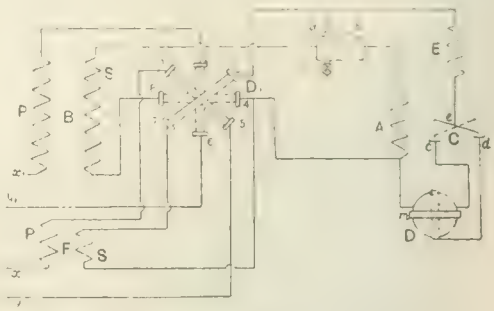


FIG. 4.—CONNECTIONS IN SUBSTATION.

y through a part of the transformer, which acts as an impedance in series with the lamp, so that the current passing is very small. The coil *A* being energized, its armature moves and operates the switch *C,* making contact at *c;* when this happens, current will flow from *x* to *h,* through the arm *m* to *k,* through the auxiliary switch *C* and through *E* to *y.* The armature of *E* moves the contact arm *m* into the dotted position, making the circuit from *x* through *m* to *g* and through the transformer to *y.* The lamp circuit is from *x* through *A* to the lamp and switch, and so to the intermediate terminal b_1 of the transformer, the normal mode of connection. The circuit through *E,* it will be seen, is broken. The contact arm *m* now rests on *l,* in connection with contact *d* of switch *C.* When the lamp *a* is switched off, *C* acts and coil *E* is again energized, moving the switch arm through 90 deg., and thus leaving the switch *D* in its original condition. In Fig. 4 an arrangement is shown, for use in a substation, to cut a transformer out of circuit at times of light load. The action in this case is similar to that above described, but a separate small transformer *F* is used, connected to a separate source of supply. The secondary of *F* is connected to the load through the switch D_1; when a lamp is switched on, coil *A* actuates switch *C,* and this causes coil *E* to actuate switches *D* and D_1, connecting the main transformer *B* to the load and cutting out *F.* The latter may be replaced by low-pressure supply from another substation.—Lond. *Elec. Review,* June 18.

Earthing the Neutral Point of Three-Phase Generators.—G. W. Worrall.—A communication on the practice of Swiss and Italian generating stations with respect to the earthing of the neutral points of three-phase generators. In general the neutral is insulated; in one case, however, considerable disturbances have been experienced and the neutral has been earthed with beneficial results. In another case the neutral has been insulated but permanently connected to one side of an ordinary horn arrester mounted on top of each machine, the other side of the arrester being connected directly to earth. The gap was so adjusted that a spark would pass when the neutral rose above 6000 volts to earth. The tension of the system was 11,000 volts between the lines. Each line was, in addition, protected by lightning arresters in the usual way. It is stated that the apparatus worked well and the generators were in no way disturbed when the neutral flashed over to earth.—Lond. *Electrician,* June 18.

Wires, Wiring and Conduits.

Insulation for Cables.—A note on a recent British patent of E. S. Ali Cohen, P. A. Cramer and W. Geipel (10,535, 1908; June 10, 1909). Paper tape is passed through a bath of paraffin and then coated with a bituminous composition comprising about 63 per cent of purified asphalt, 18.4 per cent of solidified petroleum, and 18.6 per cent of liquid paraffin. The treated paper is wound spirally over the cable, alternately with layers of a similarly impregnated textile tape. An alternative method con-

sists of rendering the bituminous composition elastic, and rolling and cutting the product into tape, without the addition of paper. Such a cable can be vulcanized afterward if sulphur has been added to the composition. To avoid decentralization, layers of textile tape may be wound between the layers.—Lond. *Elec. Eng'ing,* June 17.

Electrophysics and Magnetism.

Electrons and Valency.—J. M. NELSON AND K. G. FALK.—A paper on the electron conception of valency in organic chemistry. The authors make an attempt to extend J. J. Thomson's views of the linking of atoms with each other by the transfer for a corpuscle to the compounds of organic chemistry, and a number of cases occurring with these compounds are explained in this way. The cases involving geometrical isomerism are considered principally and possible explanations are given without considering special relations at all, by the addition to the ordinary conception of the bond between two atoms the idea that this bond possesses a definite direction.—*School of Mines Quarterly,* April.

Units, Measurements and Instruments.

Ballistic Test for Inductance.—G. KAPP.—Fig. 5 shows a known method for the determination of the inductance of a coil by ballistic galvanometer. The battery *B* supplies current to the

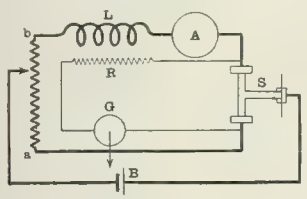
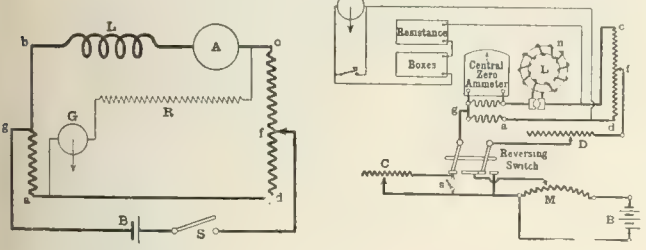


FIG. 5.—BALLISTIC TEST FOR INDUCTANCE

coil *L* to be tested, an ammeter *A*, and a resistance *a b*, with sliding contact, which is so adjusted that the galvanometer *G* shows no deflection as long as the switch *S* remains closed. *R* is a high resistance put into the galvanometer circuit in the usual way. On opening the switch the battery becomes detached and the coil discharges through the galvanometer, the deflection of which is a measure for the flux in *L* that has vanished when the battery circuit was opened. This method is perfect in theory, but very difficult to carry out in practice. It can only give accurate results if the switch *S* breaks both its contacts absolutely at the same moment. In order to avoid an expensive and specially constructed switch, the author has devised the arrangement shown in Fig. 6, and found it to work quite satisfactorily. It has the advantage that no special apparatus is required, the switch *S* being of the usual type. Also in this case a sliding contact *f* is used to supply current to the two halves of the circuit, one-half containing the coil to be tested and an ammeter *A*. The sliding contact is so set that the galvanometer with *S* closed shows no deflection. In this case the points *a* and *c* have the same potential and the whole system forms a Wheatstone bridge in balance, the arms being



FIGS. 6 AND 7.—BALLISTIC TEST FOR INDUCTANCE

a g, g c, c f, and *f d*. If, now, *S* be opened the coil *L* discharges through two parallel circuits—namely, *R G* and *c d*—and the galvanometer shows a deflection which is a measure of the flux that has disappeared in *L*. By a suitable choice of the various resistances, it is possible to obtain the same deflection as with the first method. The second method may be applied with advantage to the determination of the hysteresis loop of laminated iron samples made up in ring form. Fig. 7 shows the arrangement of the test in this case. The author finds it convenient to employ a Siemens milliammeter and to use its own shunt and a spare shunt *ga* to make up the resistance of the branch *agbLAc*. *M* is a main current regulator supplied from a battery and *D* is a rheostat for fine adjustment of the maximum value of the exciting current for each setting of *M*. It is also useful in making sure that the time constant of the circuit is kept sufficiently low for the particular galvanometer used. *C* is another rheostat for taking intermediate points of the loop. The resistances of *M, D* and *C* need not be known. The resistances of *cd* and of the circuit *agc* need only be known approximately to make the correction in *R*. For taking the *H-B* relation the switch *s* remains closed, but for taking the complete hystresis loop, *C* and *s* must be worked in the well-known manner. The galvanometer is provided with a damping key as usual. The measurement includes the inductance of the ammeter, and, to eliminate that, a plug is attached to the coil so that it may be short-circuited and the inductance of the ammeter be determined separately.—Lond, *Electrician,* June 18.

Standards of Magnetic Field Intensities.—R. GANS AND P. GMELIN.—In the exact determination of the field intensity of magnetic fields, considerable, and often unexpected, difficulties are encountered. Nevertheless, if all sources of error are considered, a very high accuracy can be obtained. Gans has, therefore, designed standards of magnetic field intensity in order to facilitate the quantative study of physical phenomena in the magnetic field. These standards were made by a firm of instrument makers in Munich, and calibrated by Gans. The calibration showed that with the aid of these standards magnetic field intensities between 3000 and 7300 gauss can be exactly reproduced at any time. In order to get an idea of the accuracy of the standards, Gans and Gmelin have now designed a "fundamental standard," which they have tested and calibrated by two different methods. This fundamental standard is suitable for currents between 0.8 amp and 1.5 amp, and gives very homogenous field intensities between 5000 gauss and 9000 gauss. It was found that the magnetic field intensity can be determined with the accuracy of 0.2 per cent.—*Ann. der Phys.,* No. 5; abstracted in *Elek. und Masch.* (Vienna), May 20.

Measuring Feeble Currents.—R. ARNO.—An illustrated paper describing an apparatus for the measurement of telephone currents and in general all periodic currents of high frequency and very small intensity. The principle is as follows: Two rotary magnetic fields of the same intensity and frequency, but revolving in opposite directions, act each on one or two little hollow steel cylinders mounted on the same axis of rotation and representing the movable part of the apparatus. One of these two cylinders can be subjected at the same time to the action of a second magnetic field produced by the telephone current to be measured which passes through a special coil surrounding this cylinder. In this case the hysteresis of the cylinder changes and deflection are obtained. The theory and construction of the apparatus are described in detail.—*Bull. de la Soc. Internat. des Elec.,* April; *La Revue Elec.,* June 15.

Radiation Pyrometer.—E. LAUGHLET.—In the former radiation pyrometers of Fery, which measure the total radiation, the radiation is concentrated on a thermo-couple. This thermo-couple has now been replaced by a spiral made of three different metallic strips so as to unroll when heated, acting directly on the needle. The instrument is strong, self-contained and inexpensive, although not quite as exact as the pyrometer with the thermo-couple. In the same issue a thermoelectric calorimeter of Fery is described.—*La Revue Elec.,* June 15.

Meters.—R. KENNEDY.—An article sketching the evolution of mercury motor direct-current electricity meters, making some suggestions as to improvements. The master patents for this class of instruments have all expired in England.—Lond. *Elec. Review,* June 18.

Telegraphy, Telephony and Signals.

Telefunken System.—COUNT ARCO.—The conclusion of his long illustrated paper read before the German Association of

Electrical Engineers on the new system of the Telefunken Company. The principles of the system were described last week in the Digest. It is claimed that it combines the advantages of the spark method and of the arc method without their disadvantages. It has a high efficiency and is almost indifferent to atmospheric and other disturbances.—*Elek. Zeit.*, June 10 and 17.

Telefunken System.—Count Arco.—An illustrated translation in abstract of his recent German paper.—Lond. *Electrician*, June 18.

Lepel System.—von Lepel.—A reply to the article by Count Arco. The author insists that "the new Telefunken system is not an accidental, but an intentional copy of my system," and gives many data on the development of his system, which has been mentioned before in the Digest.—Lond. *Electrician*, June 18.

Lepel System.—J. Erskine-Murray.—A preliminary account of experiments with the Lepel wireless-telegraph system. The author comes to the conclusion that "the Lepel generator acts on the principle of impulsive excitation (Stosserregung) enunciated by Professor Wien; that the damping of the primary circuit is sufficient to attain this result, which is obtained by proper proportioning of the electrical dimensions of the circuit without the insertion of the additional energy-wasting resistance used by the Telefunken Company for this purpose, and that the use of a direct-current supply is in no way incompatible with the efficient production of a high-frequency current by this method."—Lond. *Electrician*, June 18.

German Association of Electrical Engineers.—A report of the proceedings of its recent annual convention, held at Cologne. A committee was appointed to consider higher education for the men who erect machines, install lamps, etc.; also a committee on practical training of students. Th. Koehn reviewed in a paper the large new European hydro-electric plants and their commercial importance. G. von Groddeck discussed the use of large steam turbines in electric stations. E. Rosenberg gave new details of construction of direct-current and alternating-current turbo-generators of the British Westinghouse Company. E. Ziehl discussed the construction of direct-current turbo-dynamos and showed the superiority of completely compensated machines over those equipped only with interpoles. C. Krämer described a new machine of the Felten & Guilleaume-Lahmeyerwerke A. G.; when supplied with constant current it changes the voltage automatically according to the external resistance. It is of normal construction and especially suitable for hoisting, for rolling mills, for charging batteries, for welding installations, etc. K. Fischer described a machine for making condensers by means of a specially prepared paper (pertinax). The new "universal lamp" of the Regina Arc Lamp Company, which operates without regulating mechanism, was exhibited. Bermbach described details of the Conta lamp. A. Libesny gave a review of the development of metallic-filament lamps during the last year. He finds that under present conditions lamps consuming less than 1 watt per candle-power are not economical enough, even with high prices for current, to compete successfully with 1-watt-per-cp lamps. Count Arco described the new wireless telegraph system of the Telefunken Company.—*Elek. Zeit.*, June 17.

BOOK REVIEWS.

Grundgesetze der Allgemeinen Elektrizitätslehre. By Fritz Hoppe. Leipzig: Johann Ambrosius Barth. 114 pages, 118 ills. Price, 4 marks.

This volume, one of a series of electrotechnical publications, is of a very practical nature and forms an elementary text-book for students of electrical engineering. A large number of electric and magnetic principles are discussed in a brief and simple manner. The purpose in view is manifestly to introduce the student to the underlying principles of electrical engineering. The book will be valued by students of electrical engineering in this country who are acquainted with the German language.

Die Uhr, Grundlagen und Technik. By H. Bock. Leipzig: B. G. Teubner. 136 pages, 46 ills. Price, 1 mark, 25.

This is an elementary historical and technical little text-book on the subject of clocks, watches, chronometers and timekeepers generally. The treatment is descriptive with a little arithmetic and elementary algebra. It is suitable for the technical student, not specializing in horology, and for the educated members of the public generally. The style is clear and interesting. We should like to see an English translation produced.

Handbuch für den Bau und die Instandhaltung der Oberleitungsanlagen Elektrischer Bahnen. By Arthur Ertel. Hannover: Dr. Max Janecke. 336 pages, 294 ills. Price, 4 marks, 20.

A very practical and complete handbook for the use and reference of constructing engineers engaged in electric street-railway work. The illustrations are numerous and excellently chosen. The work is restricted to direct-current railroad systems. Within these limits the book is the best on its own subject that we have yet seen in the German language.

Die Theorie der Besselschen Funktionen. By Paul Schafheitlin. Leipzig: B. G. Teubner. 129 pages. Price, 2 marks, 80.

A mathematical text-book on Bessel functions from the German standpoint. Certain inquiries in physics, notably in heat-conduction, sound, and electricity, lead to a particular differential equation which Bessel, a German astronomer, first solved. The functions which solve the equation are usually expressed in the form of infinite series, and are known as Bessel functions. The book is a useful compendium of the more elementary part of the subject discussed, which possesses an extensive literature. It will be valuable to students of mathematics as a German text-book.

Kraft. By. Prof. Dr. E. Reyer. Leipzig: Wilhelm Engelmann. 380 pages, 248 ills.

The author presents in this volume a comparative analysis of natural and acquired resources among the principal civilized nations. The historical development of the various industries receives much attention. The iron and steel industry receives especially full treatment. In general, the countries that are most frequently brought into comparison are England, Germany and the United States. The output of coal, steel and textiles, the importation of foods and the development of power are studied from an economical standpoint in great detail. The curves and diagrams are numerous, but are very poorly executed from the standpoint of the engraver and illustrator. The book will be of interest to the student of international economics.

La Technique de la Houille Blanche. By E. Pacoret. Paris: Dunod & Pinat. 830 pages, 10 plates, 290 ills. Price, 25 francs.

In the domain of engineering, from the snowfall on the mountains to the delivery of hydro-electric power to consumers, there is a wide and diversified field occupied by the hydraulic engineer, the mechanical engineer and the electrical engineer. The subject in its full extent is ordinarily treated separately in books on water-power and dams, books on turbines, and books on electric transmission and distribution. This book, however, endeavors to include the entire field within its covers. It is divided into two main parts, the first dealing with water, water-power, hydraulic measurements, turbines and hydraulic installations. The second part deals with the electric installation. The work has been written by an engineer as an engineering text-book. It is abundantly illustrated with pictures, diagrams and data from actual hydro-electric plants. The book is clearly written and forms an excellent treatise on hydro-electric engineering as practised in the mountainous regions of France, Switzerland and Italy.

NEW APPARATUS AND APPLIANCES

Car Lighting with Opalux.

The introduction of tungsten lamps has given a decided impetus to car lighting and with this has come a demand for new types of reflectors. One of the most serious practical drawbacks to efficient car lighting with reflectors is the inevitable collection of dust or dirt, and, as is well known, the efficiency of the average type of reflectors is seriously impaired by this unavoidable accumulation. With the ordinary type of reflector it is absolutely essential that the lamps be removed, and the reflectors subjected to a thorough washing in order to remove the dust or dirt. This necessitates constant attention, and is frequently costly, in that aside from the actual expense of time and wages of the caretakers, an additional and very heavy expense is introduced due to the breakage of reflectors and tungsten lamps incident to the necessary handling. Realizing the disadvantages under which car lighting is being conducted, the Central Electric Company, of Chicago, Ill., has been experimenting with its "Opalux" reflector, and the results so far are reported as very gratifying. The accompanying illustration shows a dining-car completely equipped with "Opalux" bowl-type reflectors, and experience so far indicates that this new type of reflector will prove a very efficient aid in the proper illumination of railway cars.



CAR LIGHTING WITH OPALUX.

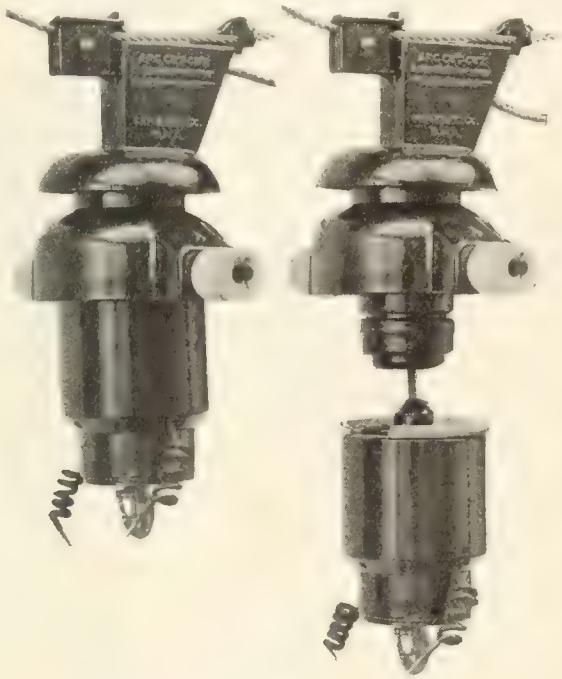
Aside from high efficiency, "Opalux" reflectors have a highly artistic appearance, the reflected light being of a pearly luster, and slightly opalescent. The transmitted light shows a variation of soft-colored tints, and illuminates the ceiling with a warm glow, entirely free from sharp contrasts in intensity. The ornamental detail has been designed to present no sharp corners or deep groves, but an even surface very readily cleaned.

Cut-Outs for Arc-Lighting Service.

The accompanying illustrations show cut-outs designed for both series and multiple arc-lighting circuits in which convenience and safety of lamp trimmers have been well considered. The old style of cut-out made use of a switch for breaking the circuit, whereas the improved form is automatic in action, the lamp being disconnected from the line by simply pulling the supporting rope.

Fig. 1 shows the series cut-out as connected in service. The circuit is closed by means of spring contacts, and a locking device holds the lamp in position. This device is contrived to release the lamp when it is lifted slightly from its normal position. It can then be lowered to the ground, as shown in Fig. 2, and the necessary repairs can be made without the slightest danger to the lineman.

A cut-out of similar design is available for use on multiple arc-lighting circuits. Both the series and multiple cut-outs are manufactured by the General Electric Company, Schenectady, N. Y.



FIGS. 1 AND 2. ARC LIGHT CUT-OUT.

Alba Glass.

With the progress of illuminating engineering the work of the makers of electrical glassware becomes of increasing interest and importance. Considerable attention has been attracted of late by a new semi-translucent glass invented by the Macbeth-Evans Glass Company, of Pittsburgh, and known as "Alba." This is a white glass which lights up most attractively (it has been likened to a lace curtain, but it is a greater protection to the eye than this comparison would imply), and it is said to cause a loss of less light than any other glass with a cased or white coat inside. Further, it does not have the effect, like some white glassware, of making the filament of an incandescent lamp, for instance, appear red when viewed through it.

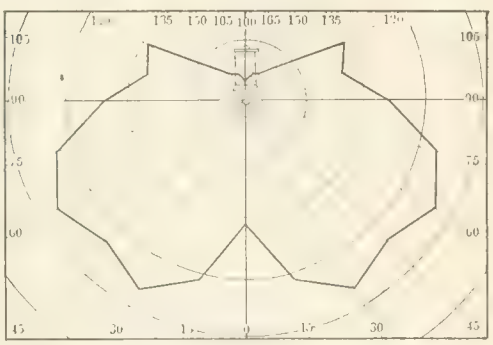


FIG. 1. LIGHT DISTRIBUTION OF ALBA GLASS GLOBE.

Alba glass is the result of researches to produce a satis-

factory "obscured" or semi-opaque glass for outer or inner globes for arc lamps; but it is also used as a shade for incandescent lamps with excellent effect. One good feature is the fine diffusion of the light. The Macbeth-Evans Company



FIG. 2.—HORIZONTAL DISTRIBUTION CURVE FOR ALBA GLASS GLOBE.

thinks that the best combination ever put on an arc light is an Alba outer globe and a "Thermo" clear inner globe, the latter a glass of extremely high melting point and small expansion and contraction.

The accompanying curves of illuminating efficiency of Alba

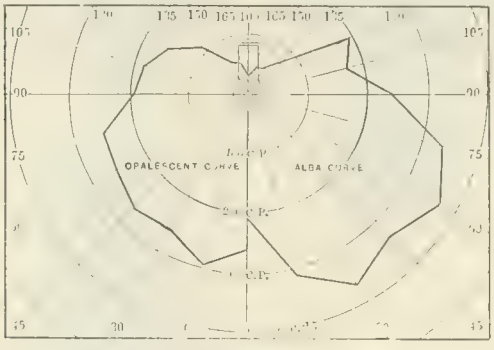


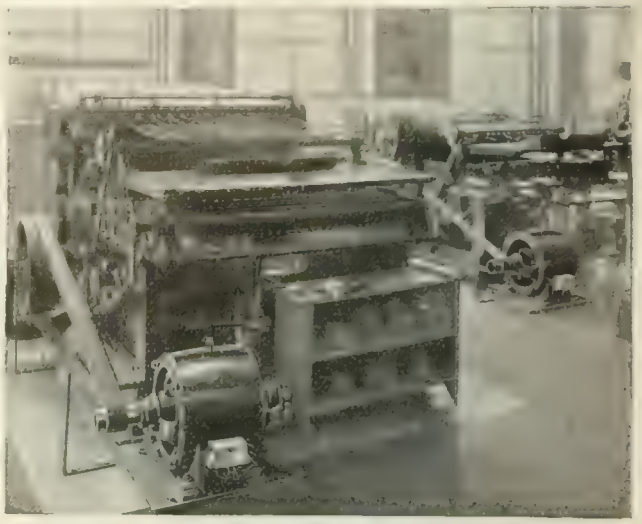
FIG. 3.—LIGHT DISTRIBUTION FROM OPALESCENT AND ALBA GLASS GLOBES.

glass were made, according to the manufacturer, by Prof. H. S Hower, of the photometric laboratory of the Carnegie Institue of Technology. Owing to the variation in candle-power in some directions caused by the shifting of the arc, the curves were determined by from 20 to 80 observations with the same lamp, and the general average taken.

Electric Motors in Printing Establishments.

After 22 years' experience in the printing industry and, therefore, 22 years' experience with steam power, line shafting and belt transmission, the mercantile printing establishment located at 157 William Street, New York City, and operated by Gazley Brothers, has all its machinery driven by electric motors. Altogether they have installed nine motors, varying in horsepower from 1½ hp to 3½ hp. Eight of these motors drive separate machines, while the other motors drive a line shaft from which are operated several small job presses. The cut shows two of these motors, each of 3½ hp, operating two Whitlock cylinder presses. The motors which are installed at this plant are a direct-current, compound-wound type for printing-press use manufactured by the Western Electric Company. Variable speed is obtained by field control, the controller being provided with about 15 forward speeds and several back speeds. The controllers are especially designed for printing-press service and equipped with no-voltage release, overload release and arrangement for push-button stop.

The conditions incident to the former steam drive in the above-mentioned establishment were no worse than in others which have used line shafting for an equal length of time, but they were bad enough: Dust and dirt from sweeping and cleaning collected from time to time on the ceiling and shafting and was being continually fanned down by the fingers which receive the work from the cylinders of the Whitlock presses. Whenever this dirt was swept down a certain amount of it would get into the machines and type cases, thus causing much annoyance, often at times when least welcome. Since the motors have been installed and the line shafting practically all removed, the pressroom has been repainted and the work is now being carried on in a clean and sanitary atmosphere. The clean



MOTOR DRIVEN CYLINDER PRESSES.

white walls, the absence of belting from floor to ceiling and the slapping and flapping of belts in this room make it a striking contrast to its previous condition.

"Exide" Meeting at Dayton, Ohio.

The Dayton Lighting Company extended invitations to an illustrated lecture given under the auspices of the Electric Storage Battery Company, of Philadelphia, on Tuesday, June 22, in the auditorium of the Y. M. C. A. Building, Dayton, Ohio. The meeting was opened by Mr. F. M. Tait, general manager of the Dayton Lighting Company. He spoke of the popularity of the electric vehicle in Cleveland, Buffalo, Chicago and other cities and stated that the object of the meeting was to arouse public interest in this type of vehicle which Dayton, up to this time, had neglected. Mr. H. M. Beck, engineer of the operating department of the Electric Storage Battery Company, delivered the principal address, touching briefly on the history and development of the "Exide" battery and covering very fully and clearly all points regarding the operation of these batteries. The address, illustrated with lantern slides, was greatly appreciated by an audience of about 100, a number of whom took part in the discussion which followed the reading of Mr. Beck's paper. The meeting aroused considerable interest in the electric vehicle and gave a clearer understanding of the subject to the electrical engineers, garage men and vehicle owners who were present than they had hitherto possessed.

Westinghouse Electric Mine Installations.

Among recent installations of electrical machinery by the Westinghouse Electric & Manufacturing Company in the mining territory of several States are the following: Washoe Smelter, of the Anaconda Copper Mining Company, at Anaconda, Mont., four 600-hp motors driving Root blowers and two additional 600-hp slow-speed motors driving high-pressure air compressors for pneumatic-locomotive service. Helena Power Transmission Company, Butte, Mont., a Westinghouse turbine plant, which supplies the local Butte mines in parallel with a 70,000-volt, 85-mile transmission line. Leonard Mine, of the Boston & Montana C. C. & S. M. Company, two 300-hp pairs of 150-hp motors, each direct-connected to Nordberg pumps, and a similar 150-hp motor driving an Aldrich pump. Modoc Mine, of the Anaconda Copper Mining Company, Butte, Mont., a semi-automatic relay-controlled hoist.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Reports of trade conditions for the past week show still further expansion, and the demand for fall and winter goods is larger than it has been at any time within the past two months. Retailers report that business is improving, and the general situation in trade is much more satisfactory. This is largely attributable to the better weather and the better condition of the crops in the Northwest. In the South the improvement of business has been, to some extent, checked by the unfavorable condition of the cotton crop; but, as the price of the staple has rapidly advanced on the Government's crop report, the planters will probably be as well provided with money as if they had raised a larger crop and sold it at cheaper rates. There have been good reports from the many clearance sales throughout the country, and retailers' stocks are being steadily reduced. In industrial lines the gains which have been recorded for the past three months continue to be in evidence, and especially in the iron and steel manufactures the reports are encouraging. Building is as active as heretofore, and the reports from the lumber trade show that it is picking up and feeling the effect of the general awakening. In the textile industries good bookings are being reported for fall deliveries, and the mills are being operated at practically full capacity. Failures have been fewer and liabilities smaller during the past six months than for the same period in 1908, but are larger than in any previous six months for the past 10 years. According to *Bradstreet's* reports, there were 6,149 failures in the first half of 1909, a decrease of 18.6 per cent from the previous year. Liabilities aggregated $880,561,976, a decrease of 55 per cent from the previous year. Failures for the week ended July 1 were 213 against 223 for the previous week; 236 in the same week in 1908, 135 in 1907, 134 in 1906, and 127 in 1905.

THE COPPER MARKET.

Developments in the copper market during the past week were few and unimportant. Trading has been exceedingly dull and for the last few days preceding the holidays reached a condition of absolute stagnation. The general disposition to make no commitments over the holidays was as evident in the metal market as in those which are more active. There is a disinclination on the part of domestic consumers to buy at prevailing prices, due undoubtedly to the popular belief that better bargains can be made later on and to the fact that stocks are now being carried by many manufacturers considerably in excess of immediate needs. The statistical position, both here and abroad, is adverse to higher prices. While the official figures of the Copper Producers' Association will undoubtedly show a decrease in the stocks of marketable copper carried by the producers, the fact will remain obvious that there is more copper unmelted in this country and Europe than ever known before. Production of the domestic mines has been going on at high pressure record, imports have been phenomenally large and consumption has been only moderate. The fact that the ever-growing surplus has largely changed hands, from producers to middle men and consumers, does not make it any the less a surplus. Exports of copper during June amounted to 33,399 tons, the heaviest monthly record since December, 1907. But this copper does not go to the melting pot. Since the first of May stocks in the warehouses of Great Britain have increased 38,000,000 lb. and those on the Continent have been proportionately swelled. In addition to the record breaking production, imports during June were exceptionally heavy. Arrivals at all points are estimated at more than 15,000 tons. Official prices are practically unchanged. On the Metal Exchange July 3 quotations were as given in the table.

Lake	13¼ @ 13⅜
Electrolytic	13 @ 13⅛
Casting	12¾ @ 13

The London prices July 2 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	58 17 6	58 17 6
Standard copper, futures	59 10 0	59 15 0
Market	Quiet.	Steady.
Sales of spot		600 tons
Sales of futures		1,000 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	.....	.....
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

RECENT ORDERS TAKEN BY CROCKER-WHEELER COMPANY.—The Crocker-Wheeler Company has recently received several orders for large alternating current generators. One of these, from De Laval Steam Turbine Company, Trenton, N. J., called for one 1000-kw, 3-phase, 6600-volt turbo-generator. A sale made to the Smith Gas Power Company, Lexington, Ohio, called for one 400-kw, 3-phase, 240-volt alternator, to be used for power and lighting. The A. C. Cheney Piano Action Company, Castleton-on-Hudson, N. Y., placed an order for a 330-kw, 3-phase, 60-cycle generator. Another order was received from the Iowa Dairy Separator Company, Waterloo, Iowa, for one 200-kw, 3-phase engine-type alternator. Among the large orders for direct generators recently booked by this company is one from George A. Fuller Company, Chicago, calling for three 250-volt machines with a total capacity of 500 kw. Many other orders have also been received for smaller equipments, including generators and factory motors, aggregating 1200 kw of the former, and 572 hp of the latter.

PROGRESS OF LIGHTING IN EUROPEAN CITIES.—H. M. Hirschberg, president of the Excello Arc Lamp Company, has recently returned from a trip to Europe, in which he combined business and pleasure. Mr. Hirschberg says that the use of flaming arcs for street lighting is growing very rapidly in European cities, especially in Germany. As he visits Europe at this season every year he has had an opportunity to observe the progress of this development. He says also that the use of tungsten lamps is becoming general for all interior lighting, and that on some of the railroads in Germany small tungsten lamps have been installed. One of the new things which Mr. Hirschberg saw abroad was a new gas lamp, known as the Keith lamp, which is used in some of the German cities for street lighting. This lamp used an inverted mantle, and the gas is mechanically delivered under high pressure. He says that the light is very bright, and that the lamp is recommended as being economical.

OPENING OF THE HUDSON TUNNELS.—Invitations have been issued for the first train to carry passengers through the Hudson & Manhattan Railroad tunnels under the North River, between Cortlandt Street and Jersey City. This train will leave the Manhattan side at 10 o'clock in the morning, July 19. Traffic between Manhattan and Jersey City will be regularly installed in the afternoon of the same day. The builders of the steel cars deny that the delay in opening the tunnel service is due to tardiness on their part. The engineers now say that the delay is due to the fact that the makers of electrical fittings are weeks behind the time set for shipping supplies. This is confirmed by the larger manufacturers of electrical apparatus, who say that most all of the smaller corporations making these fittings were unprepared for the sudden increase in business, and are from one to three months behind their orders.

GROWTH OF NEW YORK TELEPHONE BUSINESS.—The new directory of the New York Telephone and New York & New Jersey Telephone companies will contain the names of about 310,000 subscribers. It is estimated that the edition will amount to 500,000 copies, and will require 1500 tons of paper. The services of 350 men will be needed for its distribution. These figures indicate, to some extent, the growth of the telephone business in the City of New York.

NAVY ELECTRICAL SUPPLIES.—The Bureau of Supplies and Accounts, United States Navy Department, has issued a schedule of miscellaneous electrical supplies and minor apparatus for which bids will be opened July 20.

THREE-PHASE ELECTRIC TRACTION IN THE CASCADE TUNNEL.—Dr. Cary T. Hutchinson left on July 4 for Leavenworth, Wash., to conduct the final train tests of the electrification of the Cascade Mountain tunnel on the Great Northern Railroad. The work of electrification in the tunnels is practically complete, and the power houses will probably be ready for operation by the middle or latter part of this month. While no date has yet been fixed for putting the full electrical service into operation in the tunnels, it is expected that this will be done before the end of August. The present electrification is over a stretch of road about six miles long, including the yards and switches at the ends of the Cascade tunnel, which is almost three miles long. Already several work trains have been operated in the tunnel by means of electric locomotives, but regular service will not be undertaken until the power stations are entirely complete. The hydro-electric plant is expected to develop 6000 kw, of which 4000 kw will be required for pulling one train through the tunnel. If the present installation proves entirely successful, the entire Cascade Mountain division of the Great Northern, which is about 60 miles long, will be electrified. Four additional locomotives have recently been added to the equipment, and it is expected that the entire traffic of that section will eventually be handled by electricity. The locomotives are of the double-truck type, 45 ft. long, the rigid wheel base being only 11 ft., so that they can take curves without difficulty. The weight of each is 115 tons, and the driving wheels are 5 ft. in diameter. The motors are wound for 500 volts, but as the transmission lines are operated at 6600 volts each locomotive is supplied with transformers. These locomotives are of the three-phase type, and the engineers in charge believe that they will operate at constant speed regardless of the grades and loads.

INCREASED DEMAND FOR MOTOR CARS.—Alfred Reeves, general manager of the American Motor Car Manufacturers' Association, has recently returned from a trip to New England and the Middle West, where he has been making a careful collection of figures from the makers of axles, magnetos, frames and other automobile parts. Mr. Reeves says that there is sure to be an increase of 125 per cent in the production of automobiles in the year 1910 over the production of 1909, which is placed at 75,000 cars, and which it is now apparent will be insufficient to supply the demand. He says that 200,000 cars are planned for next year. Of these, 165,000 will be pleasure cars, and 30,000 will be high wheel buggies made by carriage concerns. He estimates that 5000 will be electric carriages and commercial vehicles. Mr. Reeves says that the average price for this large output of automobiles will be between $1,200 and $1,500, as it has been demonstrated that the heaviest demand is for this class of machine. He says that the demand for automobiles has increased so rapidly that the manufacturers are entirely unable to keep up with their orders.

NEW SOUTH CAROLINA POWER PLANT.—Duncan & Lyndon, engineers, at 56 Pine Street, New York, have recently made a report upon a new hydro-electric plant which is projected in South Carolina. The site for the plant is on the Saluda River, about 10 miles from Columbia, S. C., and it is estimated that a plant of about 12,000-kw power can be constructed. The principal market for this energy will be among the cotton mills, which are numerous in that section, although some of it will probably be sold to traction and lighting companies. The same interests that are identified with the project are in control of the Augusta & Aiken Railway Company, which is projecting an extension to Columbia. The same engineers have also made a report upon a small proposition at Clifton, a village near Springfield, Ohio, which is designed to furnish 200 kw. In this connection, there is a new traction line contemplated, to be known as the Springfield, Wilmington & Cincinnati Railroad.

TO BUILD NEW STATION AT JOPLIN, MO.—H. L. Doherty & Company, who recently took over several properties near Joplin, Mo., have organized a new company for the control of these interests, as has been stated in a previous issue. This new company, which has not yet been named, will absorb the Consolidated Light, Power & Ice Company and the Zinc Fields Power & Light Company, together with some interests in other companies. It is now proposed to build a new station six miles west of Joplin, on the Kansas side of the State line. This will be located on Spring River, but will be a steam plant, and will have installed at the start two 5000-kw turbo-generators.

CUBAN INFORMATION BUREAU.—The Secretary of Agriculture, Commerce and Labor of the Republic of Cuba announces that a bureau of information has been established in connection with his department where any person wishing data concerning Cuba, her resources, business opportunities, agricultural and industrial advantages can be accommodated. President Gomez has appointed Leon J. Canova, an American newspaper man, who has resided in Cuba 11 years and has a wide acquaintance with the Island, as director of the bureau. Anyone desiring information should address, Utility and Information Bureau, Department of Agriculture, Commerce and Labor, Havana.

LARGE ISOLATED PLANT FOR CHICAGO.—A large new building is to be built for the department store of Rothschild & Company, Chicago, on State Street, extending from Van Buren to Jackson Street on the east side of the street, replacing the present building. The architects, who are Holabird & Roche, of Chicago, are now working on plans for this structure. This firm will also have charge of the engineering for the building. An isolated plant will probably be installed to produce electric light and power, and the lighting installation of the building will probably include 25,000 or 30,000 incandescent lamps.

STANDARD UNDERGROUND CABLE COMPANY.—The directors of the Standard Underground Cable Company met June 26 in Pittsburgh and elected Joseph W. Marsh, president and general manager, to succeed the late M. W. Watson. Mr. Marsh had previously been vice-president and general manager. W. A. Marsh, general superintendent, was elected first vice-president, and P. W. H. Smith, general manager of sales, was elected second vice-president. F. A. Rinehart, secretary and treasurer of the company, was made a director.

WESTINGHOUSE TURBINES FOR LIGHTING PENNSYLVANIA TUNNELS.—The Pennsylvania Tunnel & Terminal Company, operating the Pennsylvania Railroad tunnels under New York City and the rivers, is installing in its Long Island City power house two 2500-kw Westinghouse turbine-alternator sets for lighting the tunnels and terminals. The reliability required in this service has demanded that every precaution be taken to insure absolute continuity of operation of the generating and distributing systems. The alternators will supply three-phase, 60-cycle current at 440 volts.

COMMONWEALTH EDISON PROFIT SHARING.—The Commonwealth Edison Company, of Chicago, has inaugurated a profit-sharing plan for its employees, whereby an investment can be made of from 3 to 5 per cent of their salaries, to be compounded at 6 per cent semi-annually. At the end of five years the employee is given an option of investing in the company's stock at par. It is expected that the majority of the 2,500 employees will avail themselves of the plan.

ELECTRIC ADVERTISING SIGNS.—A firm of electric-light engineers and contractors in the British Isles has applied to an American consular officer there with the object of securing an agency for the sale of electric-advertising signs. Further information may be obtained from the Bureau of Manufactures, Washington. The file number of the inquiry is 3584.

ELECTRIFICATION OF NEW YORK CENTRAL.—In the expense budget of the New York Central & Hudson River Railroad for the current year, which amounts to $21,488,755, the sum of $8,477,682 is set aside for electrification of the suburban lines and the New York terminals.

ELECTRIFICATION IN THE NORTHWEST.—Robert E. Strahorn, president of the North Coast Railway Company, which is building a line from Spokane, Wash., to the Pacific Coast and Puget Sound, announces that the line will be electrified in the division that crosses the Cascade Mountains.

Financial Intelligence.

THE WEEK IN WALL STREET.

In violation of the almost universal rule, the stock market was not entirely lifeless during the short week that preceded the triple holiday. While the trading was not great, there was much more than had been anticipated. It may be said, however, that the public participated very little in the business. The smaller grade of professional traders were the people in evidence. The tone of the market was strong and general advances were recorded. It was an easy matter for the regulars, as there was an entire absence of selling pressure. The pro-

fessional dealers liquidated a month ago when stocks were at the top. This selling caused a reaction of from 5 to 10 points and when prices were at the lowest they began to load up again. It is not at all likely that another selling movement will begin until prices have again gone to new high levels. In this condition there are more buyers than sellers, which generally means a slow market with advancing prices. In the meantime there are no influences at work to check the upward trend of the market. Industrial and commercial improvement continues; the crop situation—with the exception of cotton—is all that could be desired; the reports of the railroads show vastly improved earnings and the money market remains as easy as ever in spite of the heavy demands made upon the banks to meet the July interest and dividend payments. In addition to these payments there was withdrawn during the week $5,000,000 of gold for export, but the price of money was unaffected. It is a market that advances if let alone and which it requires heavy pounding to depress. Money was quoted on July 2: call 1¾ @ 1⅞, 90-day 2¼ @ 2½ per cent. The quotations in the table are those of the close July 2.

NEW YORK.

	June 28.	July 2.	Shares Sold.		June 28.	July 2.	Shares Sold.
All.-Ch.	15⅛*	15⅛	700	Int.-Met . pfd..	82	49¼	63,482
All.-Ch . pfd...	51½	51¾	500	Mackay Cos...	81*	80½	100
Amal. Cop....	81	82¾	55,050	Mackay Cos., p	74½*	73¾	100
Am. D. T....	29*	29*	——	Man. Elev....	143⅞*	143⅞*	——
Am. Loc.....	59¼	60⅛	5,200	Met. St. Ry...	25⅜*	18	510
Am. Loc., pfd.	117¾*	118¼	800	N.Y. & N.J.Tel	137*	137*	——
Am. Tel & Cbl.	80*	80*	——	Steel, com....	66¼	69¼	382,350
Am. T. & T..	142	140¾	15,295	Steel, pfd.....	124⅜	126⅜	25,867
B. R. T.....	79⅝	79⅜	10,250	W. U. T.....	72	72	1,122
Gen. Elec.....	161½*	164	6,100	West'h, com ..	85	85¼	1,900
Int.-Met. com.	17	16½	23,000	West'h, pfd...	121*	121¼	50

PHILADELPHIA.

	June 28.	July 2.	Shares Sold.		June 28.	July 2.	Shares Sold.
Am. Rys.....	45¼*	45¼*	——	Phila Elec ...	11¾	11⅝	——
Elec. Co. of A.	12¾*	12⅝*	——	Phila R. T....	28	28¼	——
Elec. St. B'ty.	52⅜*	52	——	Phila Trac ...	91*	91	——
E. S. B'ty. pfd	49*	49*	——	Union Trac ..	52¾	53	——

CHICAGO.

	June 28.	July 2.	Shares Sold.		June 28.	July 2.	Shares Sold.
Chi. City Ry..	180*	180*	——	Chi. Tel. Co...	134*	132½	——
Chi. Rs., Ser.1.	107*	112¼	——	Met. El., com.	17½*	17½*	——
Chi. Rs., Ser.2.	37⅛	10½	——	Met. El., pfd.	50*	48	——
Com. Edison..	119½	121¾	——	Natl Carbon..	92	90	——
Chi. Sub'ws...	24*	22	——	Natl C., pfd..	117*	118	——

BOSTON.

	June 28.	July 2.	Shares Sold.		June 28.	July 2.	Shares Sold.
Am. T. & T...	142⅛	140⅞	——	Mex. Tel.....	2¾	2⅞	——
Cum. Tel.....	133½*	133½*	——	Mex. Tel., pfd.	6*	6*	——
Edison E. Ill..	248	250	——	N. E. Tel.....	133½	133¾	——
Gen. Elec.....	161	164	——	W. T. & T....	10½	10½*	——
Mass. E. Ry..	13	13½*	——	W. T. & T., p.	86	85	——
Mass. E. R., p.	69½	70½	——				

*Last price quoted.
Shares sold are for week June 28 to July 2.

DIVIDENDS.

Boston & Northern Street Railway Company, semi-annual dividend 3 per cent, payable Aug. 1.

Brooklyn City Railroad Company, quarterly, 2½ per cent, payable July 15.

Consolidated Power & Light Company, of South Dakota, preferred, quarterly, payable July 1.

Gamewell Fire Alarm Telegraph Company, quarterly, 1¼ per cent, payable July 1.

Manchester (N. H.) Traction, Light & Power Company, quarterly, 2 per cent, payable July 15.

New England Telephone & Telegraph Company, quarterly, 1½ per cent, payable July 15.

Oklahoma Gas & Electric Company, quarterly 1¾ per cent, payable July 15.

Old Colony Street Railway, semi-annual, 3 per cent, payable Aug. 1.

Pacific Coast Power Company, 2 per cent, payable July 16.

Philadelphia City Passenger Railway Company, semi-annual, 7½ per cent, payable July 10.

Philadelphia & Grays Ferry Passenger Railway Company, semi-annual, 4 per cent, payable July 7.

Quincy (Ill.) Gas, Electric & Heating Company, 1 per cent, payable July 20.

San Diego (Cal.) Consolidated Gas & Electric Company, quarterly, 1¾ per cent, payable July 15.

Standard Underground Cable Company, quarterly, 3 per cent, payable July 10.

Twin City Rapid Transit Company, common, quarterly, 1¼ per cent, payable Aug. 16.

United Metals Selling Company, quarterly, 5 per cent, payable July 1.

Union Switch & Signal Company, common and preferred, 3 per cent, payable July 10.

PURCHASE OF THE WILMINGTON GAS & ELECTRIC COMPANY.—C. H. Geist, of Philadelphia, has purchased from Lawrence McCormick and K. L. Ames their interests in the Wilmington (Del.) Gas & Electric Company. These three financiers recently bought the property from John and James Dobson, of Philadelphia, as stated in last week's issue, but now Mr. Geist has made the transaction a personal affair. He owns all of the common and preferred stock and bonds of the company, and the transfer involved about $2,500,000. The property will be taken over some time in August, and changes will then be made in the board of directors and in the management of the company. Mr. Geist will operate this plant along with a number of other smaller companies which he now controls. These include the Northern Alabama Gas Company, at Florence, Ala.; Michigan City (Ind.) Gas & Electric Company; the Lansing (Mich.) Fuel & Gas Company, and the Plymouth (Ind.) Light Company. It is his intention to increase the company's business in Wilmington by the adoption of the most modern methods, and he believes that the output will be doubled within the next three years. One of the first improvements will be the erection of a new 1,000,000-ft. holding tank, and the present plant will be enlarged at once.

ELECTRIC VEHICLE COMPANY REORGANIZATION.—Details of the plan for the reorganization of the Electric Vehicle Company have been finally given out. The holders of the common stock, which amounts to $20,000,000, will be compelled to pay an assessment of $1 per share for the privilege of exchanging 20 shares of their old stock for one share of the stock of the reorganized company. The preferred shares under the reorganization plan are entitled to new stock at the rate of 20 of the old for one share of the new common stock without the necessity of paying the assessment. The new company is capitalized at $2,000,000 preferred stock, compared with $9,000,000 in the old company, and $1,000,000 of common stock, as against $11,000,000 in the old company. Holders of the company's $1,521,000 of bonds are to be given $620 in new preferred stock for every $1,000 bond. The new officers are: Herbert Lloyd, of Philadelphia, president; H. W. Nuckols, Hartford, treasurer and general manager; directors: W. G. Henderson, Philadelphia; W. H. Atwood, New Haven, and K. D. Schley, New York.

CINCINNATI LIGHTING COMPANY DEAL.—Stockholders of the Union Gas & Electric Company, of Cincinnati, have received circular letters from the underwriting syndicate of that company, suggesting a plan whereby the business may be turned over to the Columbia Gas & Electric Company, together with the lease of the property of the old Cincinnati Gas & Electric Company. It states that an offer has been made for the stock of the Columbia Gas & Electric Company and that negotiations have long been under way. Some time ago A. S. White secured about 50 per cent of the holdings, it is said, and they are now in possession of the Columbia Company.

DELAWARE COUNTY (PA.) ELECTRIC COMPANY.—The Delaware County (Pa.) Electric Company, which was recently incorporated to own and control four electric light properties in that locality, has made a contract with the Philadelphia Electric Company for its energy. There will be an issue of $300,000 first mortgage bonds, which will be used for extensions and improvements. The new company will be controlled by the Associated Gas & Electric Company of New York, a concern which is now operating 14 gas and electric light properties in New York, Pennsylvania and Ohio.

KINGS COUNTY LIGHTING COMPANY.—In its report to the Public Service Commission, in connection with its application for permission to issue $450,000 of bonds, of which $200,000 are to be used for a new plant, the Kings County Lighting Company gives its total assets as $5,279,413: this includes franchises, lands and all other property. The liabilities are set down as funded debt, $2,603,000; current liabilities, $120,790; stock, $2,000,000, and corporate surplus, $518,754. The application has not yet been decided.

LACLEDE GAS LIGHT COMPANY DEAL.—It is now stated that the price received by the North American Company for the 77,000 shares of stock of the Laclede Gas Light Company of St. Louis, which were recently sold to bankers representing a syndicate of St. Louis capitalists, was 97½ to the bankers and 98½ to the syndicate, giving the bankers 1 per cent commission. The stock is now selling at about 101.

UNION RAILWAY, GAS & ELECTRIC COMPANY.—Although no official announcement has been made of the interests to be taken over by the newly incorporated Union Railway, Gas & Electric Company—an $18,000,000 corporation—it is understood that it will be a holding company for the interests of E. W. Clark & Company, of Philadelphia, and Hodenpyl, Walbridge & Company, of New York. Among the properties in which these firms are interested are: the East St. Louis & Suburban Company, capitalized at $14,000,000, and owning a number of lighting and traction concerns in Southwestern Illinois; the St. Joseph, Mo., Railway, Light, Heat & Power Company, capitalized at $5,060,000; the Peoria, Ill., Railway & Light Company, capitalized at $3,500,000; the Springfield, Ill., Railway & Light Company, capitalized at $3,000,000; Columbus, Ohio, Railway & Light Company, capitalized at $5,000,000; the Grand Rapids, Mich., Railway Company, capitalized at $3,500,000; the Saginaw, Bay City Railway & Light Company, capitalized at $3,000,000, and the Saginaw Gas Company with capital of $400,000.

CLEVELAND RAILWAY COMPANY'S MORTGAGE.—A mortgage for $3,179,000 has been filed in the county recorder's office here by the Cleveland Railway Company in favor of the Citizens' Savings & Trust Company and Allan B. Forbes, of New York. The mortgage covers all the property of the company including the lines formerly owned by the Forest City and Low Fare Railway Companies. Arrangements have been made to sell the bonds to N. W. Harris & Company, of New York, and this house is represented in the mortgage by Mr. Forbes. This money will be used to retire the $2,026,000 Cleveland City Cable Company bonds, due July 1, and the $1,000,000 East Cleveland Railway bonds, due March 1, 1910. Provision is made in the mortgage for leasing, conveying or transferring any of the lines.

PROTEST AGAINST THIRD AVENUE PLAN.—Various stockholders of the Third Avenue Railroad Company have entered a protest with the Public Service Commission against the adoption of the reorganization plan proposed by the bondholders' committee. A protest has also been entered by the tort creditors' committee. The stockholders and these creditors assert that under the proposed plan they are not given a fair interest in the reorganized property. The bondholders' committee has intimated that if the Public Service Commission fails to approve its reorganization plan, the bondholders may bid in the road at the foreclosure sale, and thus entirely wipe out the existing stock. The commission has not yet had any hearing upon the plan.

LONG ISLAND ELECTRIC RAILWAY.—The Public Service Commission has received an application from the Long Island Electric Railway Company asking permission to reduce its capital stock from $2,100,000 to $600,000. This company was originally incorporated with an authorized capital of $600,000, and subsequently consolidated with the New York & North Shore Railway Company, which had an authorized capital of $1,000,000. The consolidation agreement of these companies puts down the North Shore stock as $1,500,000, and the consolidated company now states that it does not know for what purpose the additional $500,000 was authorized or issued. It desires to return to its original capitalization.

KEYSTONE TELEPHONE COMPANY BONDS.—Newburger, Henderson & Loeb and Fisk & Robinson are offering to the public $1,000,000 of first mortgage 5 per cent bonds of the Keystone Telephone Company, of Philadelphia; the price is 92½ and interest. Formal announcement is also made that $600,000 of three-year 6 per cent collateral notes, due March 1, 1919, have been called for redemption Sept. 1, 1909. The bankers mentioned will accept these notes in exchange for the bonds at the price at which the latter are offered to the public.

NATIONAL CARBON COMPANY DIVIDEND.—It is unofficially announced by interests closely allied with the National Carbon Company, that the dividend on the common stock will be increased some time during the present year. The common stock for some time has been paying 4 per cent annually, and it is expected that the rate will be increased to 5 per cent and possibly 6. The company's earnings are said to be very satisfactory, and the outlook for business is described as the best since the organization of the corporation.

CLEVELAND & ZANESVILLE RAILWAY BONDS.—A mortgage has been filed in Cleveland for $6,000,000 on the property of the Cleveland, Barberton, Coshocton & Zanesville Railway Company to secure a bond issue of that amount. With the proceeds of this issue a new railway line of 190 miles will be constructed. Except 12 miles the entire line will be built on private right of way. The officers of the new company are: J. J. Breitinger, president; W. E. Brooks, vice-president; J. Harry Knisely, secretary, and B. E. Ottman, treasurer.

MASSACHUSETTS LIGHTING COMPANIES.—The May report of the Massachusetts Lighting Companies shows gross earnings of $54,866, which is an increase of $9,297 over May of the previous year. This makes a total increase of $40,244 for the first five months of the present year. The regular quarterly dividend of 1½ per cent was not only declared at the recent meeting of the directors, but an extra dividend of one-quarter of 1 per cent was also declared. This is the second extra dividend that has been declared this year.

INTERBOROUGH'S BONDS SOLD.—J. P. Morgan & Company have purchased the $10,000,000 of 5 per cent bonds of the Interborough Rapid Transit Company which are just being issued. The Public Service Commission dismissed the application of the company for the issuance of these bonds on the grounds that its permission was not necessary, as the bonds were a part of the $55,000,000 issue which was approved by the commission on April 24, 1908.

NEW YORK STATE GAS COMPANY SALE.—The Public Service Commission of the Second District has announced the sale of the properties and rights of the Mutual Gas Company, Ltd., of Wellsville and Andover, N. Y., to the Mutual Gas & Fuel Company, Ltd. The price paid was $222,363, and it is stated that the properties will be improved and put in first-class condition.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Dallas (Tex.) Electric Corporation:					
April, 1909	$100,963	$61,678	$39,285	$28,831	$10,453
April, 1908	91,616	60,745	30,870	30,062	808
Detroit United Railway Company:					
May 1909	664,506	389,178	287,997	154,932	133,065
May, 1908	599,643	365,375	238,232	135,661	102,571
Electric Properties Company:					
Year ended April 30, 1909	231,188	55,327	175,861	135,669	40,192
Year ended April 30, 1908	280,671	87,200	193,471	179,344	14,127
Galveston-Houston Electric Company:					
April, 1909	93,720	55,245	38,475	21,258	17,215
April, 1908	83,446	48,573	34,873	20,582	14,290
Kansas City Railway & Light Company:					
April, 1909	542,376	300,783	241,593	153,846	87,746
April, 1908	492,472	267,657	224,814	151,016	73,798
Lowell (Mass.) Electric Light Corporation:					
April, 1909	27,981	17,395	10,585	4,184	6,401
April, 1908	27,304	15,525	11,839	4,822	7,016
Milwaukee Electric Railway & Light Company:					
May 1909	346,907	161,685	185,224	105,793	79,431
May, 1908	326,376	165,716	160,659	92,901	67,758
Milwaukee Light, Heat & Traction Company:					
May 1909	115,924	29,541	86,382	63,319	23,063
May, 1908	111,768	29,194	82,573	59,848	22,724
Northern Texas Electric Company:					
April, 1909	97,836	56,532	41,304	17,189	24,115
April, 1908	79,381	45,466	33,888	15,050	18,835
Rochester & Eastern Rapid Transit Railway Company:					
Quarter ended March 31, 1909	50,424	39,543	10,881	3,417	7,463
Quarter ended March 31, 1908	54,191	49,592	4,598	3,241	1,356
St. Joseph (Mo.) Railway, Light, Heat & Power Company:					
May 1909	77,187	42,621	34,566	21,537	13,029
May, 1908	72,447	40,232	32,215	20,597	11,618

GENERAL NEWS

Construction News.

PHOENIX, ARIZ.—John W. Sharpe has petitioned the City Council for a franchise to construct and operate an electric light system and gas plant in Phoenix.

COLFAX, CAL.—W. S. Fletcher, of Forest Hill, Cal., is contemplating the construction of an electric railway between Colfax and Forest Hill for both freight and passenger service. It is said that work will commence on construction of the road within 30 days.

LOS ANGELES, CAL.—Captain Amos A. Fries, of the United States Engineer Office, has under consideration the application of the Edison Electric Company to construct a high-span transmission line over the channel between Wilmington and Long Beach harbors, near the plant of the San Pedro Salt Company.

OAKLAND, CAL.—Work will soon commence on the construction of the proposed new power plant of the Oakland Light & Power Company at the corner of First and Alice Streets. It is said that the plant will have an output of 25,000 hp. The company is capitalized at $1,250,000.

SACRAMENTO, CAL.—The Central Traction Company has awarded the contract for the construction of an electric railway from Fifth and J Streets to the Agricultural Park, a distance of about 3½ miles, to Harry J. Gray, of Sacramento. Bids will be asked for in about two months for the construction of an electric railway from the terminus of the line at Agricultural Park to connect with the company's line at Lodi. George W. Pelter is vice-president of the company.

CANON CITY, COL.—The Royal George Power Company, recently incorporated, it is said will develop the water rights filed on by the Webster Park Canal & Power Company and the Grape Creek Pipe Line & Power System, which provide for a reservoir to hold 2,150,000,000 cu. ft. of water, to be located 1000 ft. higher than the Royal Gorge at the railroad grade. The dam, with intake canal and outlet, will cost about $5,000,000 and will be located in Webster Park, south of the gorge. It is proposed to take 12,000 cu. ft. of water per second from the Arkansas River at Texas Creek and conduct it through a canal 10 ft. deep, 16 ft. wide at the bottom and 36 ft. wide at the top and 13 miles in length. The power will be utilized to generate electricity, which will be transmitted to El Paso and Pueblo counties, where stations will be erected for pumping the underflow from the eastern slope of the range. The cost of the Grape Creek project is estimated at $1,600,000. G. A. Taft, R. E. Ellison and others are interested.

CONEJOS, COL.—The streets of the towns of Conejos and Antonito are in darkness, owing to the Conejos Flour Mill having been destroyed by fire. The power plant in the mill furnished electricity in both towns for lamps and motors. It is understood that the mill and power plant will be rebuilt at an early date.

MONTE VISTA, COL.—The Monte Vista Electric & Gas Light Company is contemplating the installation of new and larger boilers. N. H. Chapman is manager.

DANBURY, CONN.—Arrangements are being made to erect a large hat factory in Danbury, contracts for the construction of which have been awarded to Tracy Brothers Company, of Waterbury, Conn. The factories of the Lee Hat Manufacturing Company, the Lee Soft Hat Company, McLachlen & Company and the S. A. G. Hat Company will be consolidated into one plant. A complete electric plant will be installed.

DURHAM, CONN.—The question of lighting the town by electricity is under consideration, the service to be furnished from the plant of the Middletown Electric Light Company.

WATERBURY, CONN.—The Connecticut Company has made application to the Board of Aldermen for permission to erect a dam on the Naugatuck River in this city, near the present distributing plant of the company.

WASHINGTON, D. C.—Bids will be received until July 13 by the Bureau of Supplies and Accounts, Navy Department, for furnishing at the various navy yards and naval stations the following supplies: Brooklyn, N. Y., Schedule 1391—four ash-hoisting engines. Annapolis, Md., Schedule 1392—one generating set erected in place. Bids will also be received until July 20 for the following: Naval Training Station, Newport, R. I., Schedule 1393—furnishing and installing a boiler, stoker, stack and connecting flues and constructing foundation for boiler; also all piping and accessories and for removing portions of dry room wall and roof. Proposals will also be received until August 2 as follows: Mare Island, Cal., Schedule 1394—two electric jib cranes.

FORT PIERCE, FLA.—The St. Lucie Ice Company, which was recently granted a franchise in this city, is planning to install an electric plant at a cost of about $8,000, work on which will commence about Oct. 1. R. White is president and general manager.

PANACEA, FLA.—Plans are being considered for the construction of an electric railway from Thomasville to Panacea, via Thomasville, for which surveys will soon be made.

ST. PETERSBURG, FLA.—The St. Petersburg Electric Light & Power Company is reported to be interested in a project to establish an electric light system in Bayboro.

ATLANTA, GA.—The Council Committee on Electricity has voted favorably on the application of the Central Georgia Power Company for a franchise to sell power for lights and manufacturing purposes in Atlanta. It is stated by W. J. Masse, president of the Central Georgia company, that in the neighborhood of $1,500,000 is available for the construction work planned by the company.

BREMEN, GA.—At an election held recently the citizens voted to issue $8,000 in bonds for the construction of an electric light plant.

ELBERTON, GA.—The City Council is said to be considering plans to increase the output of the municipal electric light plant, for which $5,000 in bonds were recently voted. It is stated that additional power may be developed at Beaver Dam Creek and a steam plant installed as an auxiliary to the water power plant. Park A. Dallis, of Atlanta, Ga., is engineer.

WAYCROSS, GA.—At an election to be held July 28 the citizens will vote on the proposition to issue $35,000 in bonds for the construction of an electric light plant. The city voted against the proposition at the election held June 19.

CHAMPAIGN, ILL.—The capital stock of the Home Telephone Company of Champaign County has been increased from $200,000 to $250,000.

KANKAKEE, ILL.—The City Council has granted the Chicago-Champaign & Kankakee Interurban Company a 50-year franchise to construct an interurban railway on Schuyler Avenue and River Streets.

INDIANAPOLIS, IND.—The contract for the installation of the electrical work in the new city hall building has been awarded to the Hatfield Electric Company, its bid being $8,151, exclusive of fixtures.

NOBLESVILLE, IND.—It is the intention of the Noblesville Heat, Light & Power Company to extend and improve its plant, for which purpose it has increased its capital stock from $50,000 to $75,000. T. C. Reynolds is president of the company and A. C. Holliday, secretary.

WARSAW, IND.—Bids are being asked by the Commercial Telephone Company of this city for the installation of a new toll board.

CEDAR RAPIDS, IA.—The Cedar Rapids & Iowa City Railway & Light Company contemplates enlarging its plant and making improvements in boiler room at a cost of $125,000. Isaac B. Smith is secretary.

INDEPENDENCE, IA.—Plans have been prepared by the Arnold Company, of Chicago, Ill., consulting engineers, for rebuilding the municipal electric light plant, the cost of which is estimated at $8,350. It is proposed to change the system from 133-cycle to 60-cycle, 2-phase system.

FRANKFORT, KY.—The Frankfort Home Telephone Company purchased at auction recently a franchise to operate a telephone system in Frankfort. The amount paid for the franchise was $150.

FRANKFORT, KY.—Bids will be received by the Kentucky State Board of Control for Charitable Institutions, Frankfort, Ky., until July 12, for material and labor required for the erection of boiler and engine house, smokestack and tunnel; also for two water-tube boilers, mechanical stokers and feed-water heater, engine and generator on the premises of the Feeble Minded Institute in Frankfort, Ky. Plans and specifications are on file in the office of the Kentucky State Board of Control for Charitable Institutions in Frankfort, Ky., and in the office of D. X. Murphy & Brother, architects, Louisville, Ky. Albert Scott is president of the board.

PEAK'S MILL (P. O. FRANKFORT), KY.—The City Council has passed an ordinance providing for the construction of an electric light plant and water works system, to cost $40,000.

TALLULAH, LA.—Plans are being made by the city to establish an electric light plant, the equipment of which will include a 75-hp compound engine, direct connected to a 60-kw, 3-phase, 60-cycle, 2300-volt, alternating-current generator, and for which bids will be opened about July 10. J. E. Craig is city engineer.

AUGUSTA, ME.—The Lewiston, Monmouth & Greene Telephone Company has purchased the pole rights on Lakeview Avenue from the Maine Telephone Company. It is said that the company will rebuild the line as far as Sear's Corner.

WALKERSVILLE, MD.—The City Council is considering the question of establishing an electric light plant.

BEVERLY, MASS.—The Beverly Gas & Electric Company has applied to the State Board of Gas and Electric Light Commissioners, asking for permission to do business in Topsfield, under a special act of the Legislature passed this year.

FALMOUTH, MASS.—The Buzzards Bay Electric Company has awarded the contract for the construction of its power house to T. C. Bourne, of Falmouth.

PEABODY, MASS.—The committee on remodeling the municipal electric light plant has awarded the contract for the new switchboard at the power station to the Condit Electric Company, of Boston, Mass., for $5,000.

PITTSFIELD, MASS.—Preparations are being made by the Pittsfield Electric Company to remove its substation from the present location on Carson Avenue, a short distance south of where it now stands.

SOUTHBRIDGE, MASS.—The Selectmen are considering a proposition to substitute tungsten lamps for street lighting. The contract with the Webster & Southbridge Gas & Electric Company for street lighting expired June 1. It is said that the contemplated change may save the town from $800 to $900 per year.

SPRINGFIELD, MASS.—Important changes are being made by the United Electric Light Company at its Indian Orchard and State Street stations. An 800-hp Corliss engine is being removed from the State Street station to make room for the street lighting apparatus, which will be brought from the station at Indian Orchard, and will enable the company to control the entire street lighting system from the downtown station and to be independent of the water power plant. The alternating-current generator which was driven by the Corliss engine will be removed to the Indian Orchard station and operated by water power. The direct-current generator, which was also driven by the engine, is being removed. The company is gradually discarding its direct-current apparatus, and it is hoped to have the entire system changed over within a year. The present changes will make it possible for the removal of the high-tension transmission lines between Indian Orchard and Springfield.

MT. PLEASANT, MICH.—The Chippewa River Power Company has applied to the City Council for a franchise to erect transmission lines and other apparatus in Mt. Pleasant for the distribution of electricity for lamps, motors, etc., for a term of 30 years.

ONAWAY, MICH.—The capital stock of the Onaway Telephone Company has been increased from $4,000 to $5,000.

ANOKA, MINN.—At a special election, held June 26, the citizens voted to issue $60,000 in bonds, of which $40,000 will be used for the purchase of the local light and water plant and $20,000 for improvements.

BEMIDJI, MINN.—The Plantagenet Telephone Company has decided to extend its telephone line during this summer from Lake Plantagenet to Lake George, a distance of 20 miles. A. H. Jester is president.

JACKSON, MISS.—Plans are being made by the Cumberland Telephone & Telegraph Company to install a central energy switchboard with a capacity of 5000 lines.

ELDORADO SPRINGS, MO.—It is reported that B. F. Proctor is planning to construct an electric light plant in Eldorado Springs, machinery for which has already been purchased.

LYONS, NEB.—Arrangements are being made for the construction of a new independent telephone line in Lyons. As soon as the lines are completed in the town, the system will be extended into farming districts.

VALENTINE, NEB.—A. M. Morrisey, village clerk, writes that bids will probably be received about Aug. 1, 1909, for the construction of the proposed municipal electric light plant and water works system, for which bonds to the amount of $40,000 were recently voted.

FRANKLIN, N. H.—The property of the Pemigewasset Electric Company, of Boston, including the mill and dam across the Pemigewasset River at Eastman Falls, in this city, has been purchased by Alvah W. Sulloway. The plant has a minimum output of 1500 hp, of which only a small part is used at present by the Pemigewasset Electric Company, which has an excelsior mill on the west shore. Julian D. Este, of Salem, Mass., is president of the company.

ASBURY PARK, N. J.—The plant and holdings of the New Jersey Consolidated Water & Light Company, in South Elberon, were sold at auction June 23 by John S. Applegate, Jr., of Red Bank, N. J., acting as special master in chancery in a suit brought by John Shepherd. The plant was purchased by F. Bailey, of Jersey City, N. J., who, it is understood, represented the large stockholders in the company for $150,000. It is said that the plant will continue to operate under the same management that has controlled it for some time. C. Conover is manager of the company.

DOVER, N. J.—Work has commenced on the foundation to the new power house of the Morris County Traction Company in Dover, which will be equipped with generators of 1000 hp, to supplement the power now obtained from the plant of the Dover Electric Light Company.

CLOVIS, N. M.—The City Council has awarded the contract for the construction of an electric light plant and water works system to Marshall Brothers, of Las Animas, Col., for $55,000.

ALBANY, N. Y.—The contract for rewiring the executive mansion in Albany was awarded by the State architect to Frost & Sheldon for $6,000.

BROOKLYN, N. Y.—It has been decided to light Fort Greene Park with electricity. The Edison Electric Illuminating Company of Brooklyn has been instructed to place 90 tungsten lamps in the park.

BROOKLYN, N. Y.—The South Flatbush Railway Company has withdrawn its application, filed on June 11, for permission to construct a rectangular railway from Avenue Q station of the Brighton Beach elevated line to Flatbush Avenue, the reason being given that the company is to be reorganized, and later an amended application will be filed with the Public Service Commission.

BUFFALO, N. Y.—Sealed proposals will be received at the office of the Department of Public Works until July 10 for furnishing and installing underground cables for the Police and Fire departments in connection with the placing of all overhead wires in underground conduits within certain districts in the city. Francis G. Ward is commissioner.

DELMAR, N. Y.—The Town Board is considering the question of entering into a contract with the Albany Illuminating Company for furnishing electricity for lighting the town. It is expected the transmission lines of the company will be extended out on the Delaware road in a short time. Many of the residents along the line of Normansville, Elsmere, Delmar and Slingerlands have agreed to take electrical service.

FULTON, N. Y.—The City Council, at a special session June 21, offered for sale a franchise for the distribution of electricity for light, heat, power, etc., for which no bids were made.

MALONE, N. Y.—The Public Service Commission, Second District, has authorized the Malone Light & Power Company to mortgage its property and franchise to secure an issue of $40,000 in bonds, which have been authorized by the commission.

NEW YORK, N. Y.—The Board of Estimate and Apportionment has approved the form of contract and specifications for work and materials for the installation of an electric light and power plant in the New York Public Library, Borough of Manhattan.

NEW YORK, N. Y.—Bids will be received until July 20 at the office of the Board of Water Supply, 299 Broadway, New York, N. Y., for furnishing and installing two 12,500,000-gallon steam turbo-turbine pumps; two 25-hp water-tube boilers and all accessories at the Jerome Avenue pumping station, Borough of Bronx. Plans and specifications, with forms of proposal and contract, can be obtained at Room 1515 at the above address. L. Waldo Smith is chief engineer.

NEW YORK, N. Y.—The Board of Aldermen has approved an ordinance appropriating the sum of $100,000 for the preparation of detail plans and specifications for a new fire alarm system in the Borough of Manhattan, the plans to include the location and character of the ducts required, such subways as the city must build for itself, and also for the entire instrumental equipment and central substations required.

TAPPAN, N. Y.—Plans are being prepared by the Rockland Trolley Company for the construction of an electric railway from Tappan to Suffern, and from Stony Point to Nyack, about 30 miles in length. The cost of the railway is estimated at $2,500,000. The company has been organized with the following named officers: B. A. Hegeman, Jr., president; Charles J. Hardy, secretary; Stafford S. Delano, treasurer; A. C. Miller, second vice-president and general manager, and W. H. Coverdale, chief engineer.

MONROE, N. C.—The Icemorlee Cotton Mills Company has awarded contracts for the construction of its No. 2 mill, which will have a 5000-spindle equipment. The plant will be operated by electricity, which will be furnished by the Monroe transmission system of the Southern Power Company, of Charlotte, N. C.

STATESVILLE, N. C.—Arrangements are being made by the Iredell Telephone & Telegraph Company for the construction of a telephone exchange, to cost $3,000.

PIQUA, OHIO.—Contracts have been awarded by the Orr Felt & Blanket Company for the construction of a new mill, which, with equipment, will cost about $200,000. The plant will be equipped for electric motor drive, electricity for which will be furnished by the company's own plant, to be installed. The company manufactures army blankets.

RANDOLPH, OHIO.—It is reported that a number of residents of Randolph are interested in a project for the construction of an electric railway to connect several villages north of this city. The plan includes the building of a railway connecting Dayton, Covington and Piqua Traction Company and the Dayton & Northern Traction Company. The cost of the railway is estimated at $150,000. Vernon Ewing is said to be promoting an organization to act in cooperation with the Dayton Chamber of Commerce.

ZANESVILLE, OHIO.—The Muskingum & Morgan Railway, Light & Power Company, recently incorporated, proposes to construct a power house in Zanesville and to furnish electricity in this city and to the towns and villages between Zanesville and McConnellsville. The company has been organized with the following named officers: Andrew McDonald, president; John J. Adams, vice-president; W. H. Pierpont, secretary, and R. C. Burton, secretary.

ARDMORE, OKLA.—Oscar Ayres and associates are contemplating the construction of a hydro-electric power plant on the Washita River in connection with a proposed railway. M. T. Forsythe, of West Chester, Pa., is engineer.

CORDELL, OKLA.—It is reported that the proposition to issue $10,000 in bonds for the construction of an electric light plant will be submitted to a vote.

MANGNUM, OKLA.—The question of issuing $80,000 in bonds for the construction of a municipal electric light plant is reported to be under consideration.

RYAN, OKLA.—At a recent election the citizens voted to issue bonds to the amount of $60,000, of which $5,000 will be utilized for electric lighting.

WETUMKA, OKLA.—The Franklin Construction Company, of St. Louis, Mo., is reported to have submitted a proposition to the town officials in connection with the installation of an electric light plant.

MILTON, ORE.—A new 200-kw generator has been installed in the municipal electric light plant, and a Leffel water wheel is now being placed. Thomas Taylor is superintendent.

PORTLAND, ORE.—The City Executive Board has awarded the contract for furnishing electricity for lighting the streets and public buildings to the Portland Railway, Light & Power Company for a period of five years. Under the terms of the new contract the company is to supply arc lamps fed from aerial wires at $56 each per year, a reduction of $7.60 per lamp from which the city paid under the former contract. For arc lamps, supplied from underground wires, $75 each per year; electricity for incandescent lamps at 2¼ cents per kw-hour; the lowest previous bid was 3½ cents per kw-hour. Under the new contract the city will save $15,000 a year over the previous tenders submitted by the company.

ALLEGHENY, PA.—Alexander Gray, superintendent of the municipal electric light plant, writes that 16 mercury arc rectifiers, 75 lighting units, have just been installed in the municipal electric light plant, replacing 12 60-lamp Western Electric arc machines and 600 Brush double carbon lamps.

ALLENTOWN, PA.—The County Commissioners have rejected all bids submitted for installing an electric light and power plant at the County Home, at Wescoesville, as none of them came within the amount estimated by the engineers, which was $9,900. The Commissioners will again call for bids.

BELLE VERNON, PA.—The Independent Telephone Company has been granted a franchise to construct and operate a telephone system in Belle Vernon.

COLUMBUS, PA.—The Columbus, New Albany & Johnstown Traction Company has awarded the contract for the construction of an extension of its railway from Gaharna, the present terminus, to Johnstown, to the Dominion Construction Company, of Pittsburgh, Pa.

MIFFLIN, PA.—The West Penn Railway Company has applied to the Township Commissioners for a right-of-way for an electric railway from Dravosburg to Coal Valley.

NORTHUMBERLAND, PA.—Contracts have been awarded by the Pennsylvania Railroad Company for the classification yard to be built at Northumberland at a cost of about $3,000,000, which will be divided with the Northern Central Railway Company. The work will include the construction of a 36-stall roundhouse, a power house, machine, transfer shed and other buildings and about 70 miles of trackage.

PIERRE, S. D.—The Black Hills Traction Company has applied for water rights on Coxey Lake, to be utilized for a water-power development.

NASHVILLE, TENN.—Arrangements are being made by the Belmont College for the erection of a heating, electric lighting and power plant in the campus to be connected by conduits with other buildings.

SPARTA, TENN.—The A. & T. Power Company, recently incorporated, proposes to develop a water power at a cost of about $25,000, which will include the construction of a concrete race and dam. About 400 hp will be developed. J. R. Tubbs is president, and O. H. Anderson is general manager.

STANTON, TENN.—A company has been organized to establish a telephone system in Stanton. The officers of the company are: W. B. Douglass, president; W. S. Mahon, vice-president; F. C. Rawlins, secretary and treasurer, and P. O. Wilkerson, manager.

AMARILLO, TEX.—Plans are being considered by the Amarillo Water, Light & Power Company for extensive improvements to its systems at a cost of about $100,000, and will include the installation of new machinery, extension of mains and sinking four or more new wells, etc.

CHEROKEE, TEX.—Extensive improvements are being made to the Pioneer Telephone Company's ssytem, which will involve an expenditure of about $10,000.

EL PASO, TEX.—The City Council has granted a franchise to R. V. Borden to construct and maintain a telephone system in El Paso.

EL PASO, TEX.—A franchise has been given by the City Council to Richard Caples and W. B. Latta, representing the El Paso & Fort Hancock Interurban Railway Company to construct and operate an electric railway on certain streets in this city.

GREENVILLE, TEX.—The citizens have voted to issue bonds to the amount of $50,000 for improvements to the municipal electric light plant.

KINGSVILLE, TEX.—The Kingsville Power Company is reported to have awarded the contract for the installation equipment for an electric light plant and water works system, including a 150-hp vertical type three-cylinder gas engine to replace the present system to Rathburn Engineering Company, of Toledo, Ohio.

MOUNT PLEASANT, TEX.—The Mount Pleasant & Red Springs Railway will soon be put in operation. The railway will cover the principal districts of the city and extend to Red Springs, one mile distant. The company expects to extend the line to Pittsburgh, 12 miles south, by next summer.

PRICE, UTAH.—The Town Board is considering the question of establishing a municipal electric light plant in Price.

MONTPELIER, VT.—Announcement has been made that the Vermont Telephone Company will make improvements and extensions to its systems in Barre and Montpelier which will involve an expenditure of about $60,000. The common battery system will be installed.

EMPORIA, VA.—The Home Telephone & Telegraph Company, of Henderson, N. C., which recently secured a franchise in Emporia, has commenced work on the installation of a telephone system in this city, to cost $25,000.

EMPORIA, VA.—Work is progressing on the construction of the hydro-electric power plant of the Emporia Hydro-Electric Corporation, for which contract for construction was awarded to Stamper Brothers & Ragland and E. T. D. Myers, of Richmond, Va. The plant will develop 2800 hp, which will be transmitted by electricity to Emporia, one and one-half miles distant. The dam is of concrete, 40 ft. high and 600 ft. long. Contracts for the generators have been awarded to the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., and to S. Morgan Smith, of York, Pa., for water wheels. The Ashby Cotton Mill and the Emporia Manufacturing Company (planing mill and box factory) have made arrangements for electrical energy from the plant. The terms of the contract require the completion of the plant by Sept. 1. The Emporia Hydro-Electric Corporation controls the Emporia Light & Power Company, which is reconstructing its plant and installing new equipment to be operated by power from the hydro-electric development. C. P. E. Burgwyn, of Richmond, Va., is engineer in charge of the work.

NORTON, VA.—J. B. Sterrett, of Norton, has purchased the electric light franchise, recently sold by the city, for $3,000.

RICHMOND, VA.—Announcement has been made that the reorganization of the Gould street railway interests would result in the construction of a direct line from Richmond to Washington, by the way of Ashland, to which place the railway has already been built. It is said that work will begin early in the fall at Fredericksburg and Ashland, and will involve an expenditure of several million dollars.

RICHMOND, VA.—The committee on electricity is reported to have rejected all bids for the equipment of the proposed municipal electric light and power plant on the site of the old pump house, and new bids will be received until July 14. Bids were opened for this work on April 27 by E. D. Richardson, chairman of committee on electricity. E. W. Trafford is engineer.

ELLENSBURG, WASH.—Plans have been completed by the City Council for extensions and improvements to the municipal electric light system, which will include the installation of a 250-hp steam engine and a 500-kw generator. Bids will be asked on a new turbine and other equipment. W. B. Leverich is manager.

MOUNT KISCO, WASH.—Bids will be received by John H. O'Brien, Commissioner, Department of Water Supply, Gas and Electricity, 21 Park Row, New York, N. Y., until July 14 for furnishing material and labor for constructing and installing two direct-connected, electrically-driven, vertical pumping units, complete with appurtenances, including electric lighting equipment in the pumping station to be erected at the sewage disposal plant at the village of Mount Kisco, N. Y. Plans and specifications may be seen at the office of the chief engineer, where blank form of proposal may be obtained.

WENATCHEE, WASH.—The City Council has awarded the contract for furnishing power to operate the new city pumping plant to the Entait Power Company for a period of five years. The company not being in a position to furnish the service direct at the present time, it has made arrangements with the Wenatchee Canning Company to connect the station with the plant of the Wenatchee company.

FAYETTEVILLE, W. VA.—The City Council has granted R. H. Dickinson a franchise to erect an electric lighting system in Fayetteville. It is said that electricity for operating the plant will be secured from the Stuart Colliery Company, from which transmission lines will be erected to Fayetteville and Oak Hill. P. Davis is engineer and will have charge of construction. A company will be incorporated to operate the system.

BAYFIELD, WIS.—Plans are being considered for extensive improvements to the municipal electric light plant, which will include the installation of a new boiler and changing the system from single-phase, 133 cycles, 1100-volt to three-phase, 2300-volt, 60 cycles; also, replacing the present street lighting system with magnetite arc lamps and series tungsten lamps, and the installation of a new switchboard. F. M. Herrick, Jr., is manager.

CRANDON, WIS.—The capital stock of the Crandon Telephone Company has been increased from $3,000 to $7,500.

JANESVILLE, WIS.—It is reported that the Wisconsin Telephone Company has decided to erect a new exchange building in Janesville.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has purchased a site in West Allis, on which a telephone exchange building will be erected. The company is planning to have telephone exchanges in all larger suburbs, including Wauwatosa, North Milwaukee, Cudahy and South Milwaukee.

LACOMBE, ALTA., CAN.—The Blindman River Electric Power Company is considering the question of constructing a transmission line to Red Deer, Alta. E. J. Tett is secretary and general manager.

KAMLOOPS, B. C., CAN.—Contracts for additional steam and electrical equipment for the municipal electric light plant, to cost about $13,000, have been awarded as follows: To the Canadian Westinghouse Company, Montreal, Que., for engine and generators, and the Canadian Fairbanks Company, Montreal, Que., for boilers and condensers.

MEXICO CITY, MEX.—The cost of making repairs to the hydro-electric system of the Mexican Light & Power Company, at Mecaxa, about 90 miles from this city, caused by a cave-in of one of the dams, is estimated at $2,000,000. The output of the plant will be increased from 30,000 to 50,000 hp.

Company Elections.

NORFOLK, VA.—The following directors have been elected by the Newport News & Old Point Railway & Electric Company: C. C. Dickinson, John Alvin Young, of New York; John Hertzler, Lancaster, Pa.; John G. Powell, Philadelphia; Austin McLanahan, Baltimore; W. J. Payne, Richmond; Geo. A. Schmelz and W. B. Vest, Newport News.

MOUNT WASHINGTON, MD.—At a recent meeting of the Mount Washington Electric Light & Power Company the following officers and directors were elected: President and general manager, Thomas W. Offutt; secretary and treasurer, Harry J. McIntyre; directors, Thomas W. Offutt, Charles M. Cohn, S. Davies Warfield, Walter K. Townsend and Richard A. Bevan.

New Industrial Companies.

THE TESLA INTERNATIONAL PROPULSION COMPANY, of New York, N. Y., has been incorporated with a capital stock of $1,000,000 by H. C. Quinby, J. F. Valient and J. F. Egan, of New York, N. Y.

THE LUBERTZY BRAKE WORKS, of Portland, Maine, has been chartered with a capital stock of $5,000,000 to manufacture and sell engines and motors. A. H. Peavey is president, and G. E. Burnham is treasurer, both of Kittery, Maine.

THE BLAXSTAFF ENGINEERING COMPANY has filed articles of incorporation with the Secretary of State at Wilmington, Del., with a capital stock of $350,000. The incorporators are: W. F. Donovan, J. M. West and E. E. McWhiney, of Philadelphia, Pa.

THE THOMAS CARBORATOR COMPANY, of Middleburgh, N. Y., has been incorporated with a capital stock of $500,000 by D. D. Frisbee, G. N. Frisbee, of Middleburgh, N. Y.; T. E. Finnegan and G. Lawyer, of Albany, N. Y. The company proposes to manufacture carborators and supplies.

New Incorporations.

NEVADA CITY, CAL.—The Middle Yuba Hydro-Electric Power Company has filed articles of incorporation, with a capital stock of $400,000. The company proposes to construct an electric power plant on the Middle Yuba River, above Graniteville, to supply electricity to the mines in that district, Allegheny and other Nevada and Sierra County mining towns. The directors are: A. D. Foote, C. M. Wilson, W. H. Martin, L. M. Hancock, L. N. Wagner, C. T. Jones and Dr. A. H. Trickell.

PUEBLO, COL.—Articles of incorporation have been filed for the Royal Gorge Power Company, with a capital stock of $2,000,000. The company proposes to operate in Fremont, Pueblo, Teller and El Paso counties. The incorporators are: G. A. Taft, F. M. McMahon, R. E. Ellison, K. Schuyler and C. Spiess.

GAINESVILLE, GA.—The Gainesville Railway & Power Company has been incorporated with a capital stock of $150,000 by A. G. Sharp, of Atlanta, Ga.; W. A. Carlisle, W. H. Slack, H. H. Dean, J. W. Smith and Z. T. Castleberry, all of Gainesville. The company recently bought the property of the Gainesville Electric Railway Company, which consists of eight miles of track. The company is capitalized at $150,000.

WORDEN, ILL.—The Worden Telephone Company has been chartered, with a capital stock of $2,500, by John C. Mueller, Charles W. Piper, L. Dornself, F. W. Stocker and Christ Meyer.

AURORA, IND.—The Cincinnati, Louisville & Indianapolis Electric Railroad Company has been incorporated to construct and operate street and interurban railways between Greendale, Lawrenceburg, Aurora, Rising Sun, Patriot, Florence, Markland, Vevay, Madison and Scottsburg. The company is capitalized at $100,000. The directors are: Amos B. Shuts, John C. Hooven, Clinton E. Hooven, William B. Mayo and Wilbur Hargitt.

RUSHVILLE, IND.—Articles of incorporation have been filed by the Rushville Gas, Heat, Light & Water Company. It has an authorized capital stock of $100,000, and Fred. C. Carroll has been named as president.

VINCENNES, IND.—The Vincennes Western Electric Railroad Company has filed articles of incorporation for the purpose of constructing an electric railway from Vincennes to Bridgeport, Ill., a distance of 14 miles. It is stated that William Sontag, of Evansville, has secured the contract for financing and constructing the proposed railway. The company also proposes to furnish electricity for lighting. Robert V. Stinson is president and J. D. Lacroix, secretary, both of Vincennes.

WICKLIFFE, IND.—The Potako Telephone Company has been incorporated to construct and operate a telephone system and exchange in Wickliffe and throughout Crawford and adjoining counties by Jacob Partenhenew, J. F. Zimmerman and Thomas Smith.

HARDINSBURG, KY.—Articles of incorporation have been filed for the Codyville Telephone Company by Branson M. Elkins, J. W. Tabor, N. H. Adlington, T. Allen, Alonzo G. Allen, Overton Basham and J. Cody.

PROVIDENCE, KY.—The Kentucky Electric Railway Company has been incorporated with a capital stock of $25,000 by B. Sisk, of Silver Run; B. H. Roney, J. T. Edwards, M. E. Edwards, S. Hicks, W. G. Roney and M. G. Roney. The company proposes to construct an electric railway from Dawson Springs to Providence, a distance of 20 miles.

PORT SANILAC, MICH.—The Thumb Telephone Company has filed articles of incorporation, with a capital stock of $10,000.

WELCOME, MINN.—Articles of incorporation have been filed by the Welcome-Triumph Telephone Company, of Welcome. Its capital is given at $50,000, and the incorporators are John Janss, C. E. Bagley, H. A. Miller and others.

TRENTON, N. J.—The Union Railway, Gas & Electric Company has been incorporated with a capital stock of $18,000,000. The company proposes to construct and operate electric railways; also electric and gas lighting and heating plants. The incorporators are: F. R. Hansell, John A. MacPeak and James E. Cotter.

Personal.

MR. E. F. PECK, general manager of the Schenectady, N. Y., electric railway system, has been elected president of the New York State Street Railway Association, which held its annual convention at Bluff Point, Lake Champlain, last week. Mr. Peck is a veteran in the electrical field, but first came into prominence in electric lighting. He had charge of the Thomson-Houston exhibit at the Philadelphia Electrical Exhibition of 1884—the first held in this country—and then had charge of the exhibit immediately following at New Orleans. In 1885 he became general manager of the Citizens' Electric Illuminating Company, of Brooklyn, N. Y., continuing there until 1897. He then started an engineering business as the Peck Electrical Company, of New York, but in 1899 became general manager of the Kings County Electric Light & Power Company, of Brooklyn. He stayed there until 1902, when he was appointed to the position he has ever since held at Schenectady, where he is also president of the Electric Express Company. Mr. Peck is a member of the American Institute of Electrical Engineers and also of the Engineers' Club, of New York. He is widely known in the art and is very popular. Mr. Peck is a brother-in-law of Prof. Elihu Thomson.



E. F. PECK.

PROF. JOHN W. DORSEY has resigned from the faculty of the North Carolina College of Agriculture and Mechanics Arts to assume the chair of Electrical Engineering at the Clarkson School of Technology, Potsdam, N. Y.

MR. F. JNO. BELL, of Montreal, has been appointed general manager of the Mines Power Limited, Cobalt, Ont. The company is building a 10,000-hp hydro-electric plant for supplying power to the various mines in the Cobalt camp.

MR. ELIOT WADSWORTH has been made a partner in the firm of Stone & Webster, of Boston. Mr. Wadsworth has been connected with Stone & Webster for a number of years, and has been an officer in the Stone & Webster Corporation. At present he is in charge of the New York office.

MR. FRANCIS RAYMOND, of Chicago, well known to electrical men, but now connected with the Sheldon School of that city, has been laid up with an attack of typhoid-pneumonia for several weeks. Mr. Raymond's friends will be pleased to learn that he is making satisfactory progress toward recovery.

MR. W. A. REICHERT, for the past three years advertising manager for the Fort Wayne Electric Works, Fort Wayne, Ind., has resigned to accept a similar position with The Power and Illuminating Engineering Company of Alliance, Ohio. This company is a commercial organization, cooperating with central stations to increase the day load on their plants.

MR. F. H. TUBBS has retired from the service of the Western Union Telegraph Company after a period of telegraph service extending over many years. For nearly 30 years Mr. Tubbs has been superintendent of the first district of the western division of the company, with headquarters at Chicago, and he now retires to enjoy a rest that has been well earned, with the best wishes of all his fellow officers in the company which he has served so long and faithfully.

MR. WILLIAM M. SMITH, for a number of years secretary and treasurer of the Chicago Insulated Wire Company, and well known to electrical men in the West, has resigned that position and is now sales manager of the American Insulated Wire & Cable Company, of Chicago, manufacturer of weatherproof electric wires, of which Mr. Nathan T. Brenner is president. Mr. Smith has had a wide experience in the electrical field, previous to which he was engaged in the banking business.

MR. W. H. PALMER, JR., secretary and treasurer of the New York Transportation Company, was badly hurt last week while in his automobile on Eleventh Avenue, New York, through the carelessness of an express wagon driver who was on the wrong side of the street and who sidewiped his car. Mr. Palmer received serious internal injuries and was taken to the New York Hospital. Mr. Palmer is a member of the

American Institute of Electrical Engineers and well known in electrical circles.

MR. C. E. GROESBECK has been elected vice-president of H. M. Byllesby & Company, of Chicago, and will have charge of the company's interests on the Pacific Coast hereafter. Mr. Groesbeck's headquarters will be at Tacoma, Wash., where the company has recently purchased the property of the Tacoma Gas Light Company. Mr. Groesbeck has been with the Byllesby interests for some time, and was formerly in charge of the company's work at Mobile, Ala. Before that he was connected with the selling department of the General Electric Company.

MR. W. J. LLOYD, for a number of years assistant district superintendent for the Western Union Telegraph Company at Chicago, has been promoted to be superintendent of the district, having headquarters in Chicago, succeeding Mr. F. H. Tubbs. Mr. Lloyd is one of the best known of the telegraph officials of Chicago, and has worked his way up from the bottom of the ladder, beginning as a messenger boy in Dubuque, Ia. He later became an operator, and about 20 years ago he came to Chicago, where he has served successively as operator, division chief, wire chief, chief operator, manager of the Board of Trade office, assistant district superintendent, and now superintendent. In handling unusual demands for telegraphic facilities, as in the case of great national conventions and the like, Mr. Lloyd has been conspicuously successful, and has won the admiration of large users of the telegraph, such as the Board of Trade and the daily press, as well as of his associates in the company.

Obituary.

JOHN H. MILLER, general manager of the Springfield Railway Company, Springfield, Ohio, died on the afternoon of June 29, as the result of illness caused by a stroke of paralysis in January of this year. Serious complications set in recently. Mr. Miller had been manager of the company continuously for 19 years.

Trade Publications.

LOW AND MIXED PRESSURE TURBINES.—The various types of Curtis steam turbines for low pressure and mixed pressure are illustrated in Bulletin No. 4669, issued by the General Electric Company. The bulletin also contains curves showing tests of an engine in combination with a low-pressure Curtis machine and a chart showing the power output and costs which indicate the increased capacity and economy secured by installing such sets.

DIAMOND H SWITCHES.—The Hart Manufacturing Company, Hartford, Conn., has issued a handsome catalog devoted to its line of Diamond H switches, which includes push-button, rotary flush and rotary surface switches, and automatic door switches. Owing to the excellent illustrations showing mechanisms and methods of operation, and the clearness of the accompanying descriptions, the pamphlet, in addition to its commercial object, serves the purpose of a concise treatise on house electrical switching service.

GASKETS AND BELL MOUTHS.—Bulletin No. 4670 of the General Electric Company, Schenectady, N. Y., covers gaskets and bell mouths for conduit wiring, marine railway car equipments and underground circuits. The illustrations in the bulletin consists of dimension diagrams of the soft rubber gaskets and metallic bell mouths, and a complete set of tables enables the customer to determine the size of bell mouths required for any particular service, and to ascertain readily the gasket which should be used with it.

Business Notes.

MEAD-MORRISON MANUFACTURING COMPANY announces that it has taken over the business of George W. McCaslin and John A. Mead & Company, giving it the absolute control of the McCaslin Overlapping Gravity Bucket Conveyor. The New York address of the company is 11 Broadway.

ROTH BROS. & COMPANY, Chicago, have secured a contract for eleven motors for use in the new plant of the Sanitary Laundry Company, Chicago. Some of the motors are for direct connection to mangles and other machines, and some are for belt driving through shafting. Postel & Linn were the engineers for the Sanitary Laundry Company.

THE HARVARD ELECTRIC COMPANY, of New York and Chicago, is notifying the trade of alleged infringements of the Harvard "hook type" sectional switch boxes. The Harvard Company states that it is the sole owner of patents issued and patents pending, covering the construction of sectional boxes that "hook" together, identical with the illustrations in the Harvard catalog.

HIGH-VOLTAGE TRANSFORMERS.—The Central Electric Company, Chicago, Ill., has issued a new bulletin descriptive of high-voltage transformers for use in serving consumers directly from high-tension lines. A considerable amount of data is given as to construction of these transformers, and attention is particularly called to the special bushings, which are claimed to give an insulation strength much greater than has heretofore been secured. The same company has also just issued a price list of electrical supplies, comprising 30 pages.

MR. JOSEPH H. WILLIAMSON, for 18 years business manager of the Manufacturers' Advertising Agency of New York, and for 7 years the business manager of the Viennot Advertising Agency of Philadelphia, but who resigned from the Viennot Agency October, 1907, and since then to April 1, 1909, had charge of the New York business on a salary basis, has opened an office at 719 Temple Court, New York, as a representative of trade journals. Mr. Williamson is favorably known by publishers of trade papers throughout the United States.

NEW NERNST LAMPS.—The instantaneous lighting Westinghouse-Nernst lamps exhibited at the Atlantic City Convention of the National Electric Light Association mark another important step in the development of the glower system. The desirable feature of lighting instantaneously is accomplished by the substitution of a new form of heater for the old platinum heater. This heater becomes luminous immediately upon the passing of the current, and in addition to producing light instantaneously is so constructed that it causes the glower itself to light in ten seconds. The Nernst Company announces that on and after July 1 it will be prepared to deliver 88,110 and 132 watt, 220-volt type alternating-current and direct-current lamps equipped with the instantaneous lighting burners.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JUNE 29, 1909.

[Conducted by Wm. F. Bissing, Pat. Law, 2 Rector Street, N. Y. City.]

926,088. ELECTRIC CURRENT COLLECTOR; A. H. Angle and L. R. Hecker, Philadelphia, Pa. App. filed July 13, 1907. For underground systems in which the collector is provided with two wheels which swivel and cushion with relation to the oscillating portion of the carrying device.

926,098. APPARATUS FOR INDICATING THE PASSAGE OF A TRAIN AT DEFINITE POINTS OF A TRACK; J. E. Colas, Paris, France. App. filed Feb. 7, 1908. Arranged upon the locomotive or track so that by the contact of a movable abutment the device is actuated. A permanent magnet and a double commanding lever, controlled by returning springs, are used.

926,128. ELECTROLYTE CONDENSER; I. Moscicki, Gambach, near Fribourg, Switzerland. App. filed Oct. 29, 1907. An aluminum electrolyte condenser having aluminum electrodes immersed in the electrolyte supplied with alternating current and means for causing one directional current to flow through the electrodes.

926,148. MOLDING BRANCH BLOCK; E. Sullivan, New York, N. Y. App. filed April 17, 1906. Two adjacent ends of the molding are provided with a capping and a branch block having grooves for the mains and branches interposed, the engagement between the capping and shoulders on the block forming the sole means of support of the block.

926,154. PANEL BOARD; H. S. Walker and H. L. Van Valkenburg, Philadelphia, Pa. App. filed July 17, 1908. The panel board and the linings are secured vertically in alignment with the exterior woodwork surrounding the opening in the partition of the board.

926,162. TRANSMITTING DEVICE FOR TELEGRAPH OPERATORS; W. C. Achgill, Oklahoma, Okla. App. filed Nov. 30, 1908. The body portion of a cabinet has its lower rear edge hinged and is provided with two finger keys, one to make the dot and the other the dashes.

926,164. CIRCUIT CONTROLLER; W. L. Bliss, New York, N. Y. App. filed Aug. 4, 1904. Permits current to flow in one direction and prevents its flow in the opposite direction by means of an electrolytic valve and a switch operated automatically to remove the valve from operative relation with the circuit when the current flows.

926,165. LIGHTING SYSTEM; W. L. Bliss, New York, N. Y. App. filed June 22, 1904. Car lighting system in which the generator is regulated to maintain constant battery current at constant speed irrespective of the amount of current consumed by the translating devices.

926,175. SWITCHING APPARATUS; M. S. Conner, Rochester, N. Y. App. filed May 19, 1904. Party line selective system having a plurality of actuating buttons, switch springs therefor, and a latch frame for the buttons which lock the buttons in their depressed position.

926,185. ELECTRIC WATER HEATER; W. E. Hayes, Omaha, Neb. App. filed March 2, 1909. Employs a core and screw plug of small compact form to carry a resistance coil immersed in the water to be heated.

926,188. HEATING DEVICE; J. R. Holley, Bristol, and E. D. Holley, Forestville, Conn. App. filed Sept. 8, 1908. A flat face carries the heating device, the face being formed of a thin layer of mica and the wire being in the form of a flat ribbon.

926,192. DYNAMO-ELECTRIC MACHINE; L. J. Hunt, Rhyl, England. App. filed June 22, 1906. An induction motor having a stator with a compound winding supplying two or more parallel paths through which the current flows to produce a multipolar field. Equipotential points in the winding are joined, thus producing a field of another number of poles. Two separate windings are employed on the rotor and the connections thereon may be reversed; thus obtains speeds corresponding to the numbers of poles, to the difference of the numbers and to the sum of the numbers.

926,199. TOLL APPARATUS FOR TELEPHONE EXCHANGES; S. J. Larned, Chicago, Ill. App. filed July 7, 1902. The toll device of the substation is controlled by a switch at the central office and one

or both of the manual keys at the central office is dispensed with, the toll device being actuated by the opening of the operator's connection switch.

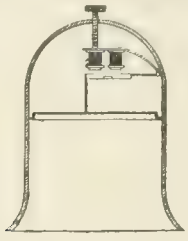
926,225. DYNAMO-ELECTRIC MACHINE; J. A. Williams, Cleveland, Ohio. App. filed Sept. 13, 1906. For explosive engines in which the armature has a core provided with a plurality of wings which co-operate with the pole pieces to increase the number of alternations of flow of magnetic lines for each revolution.

926,236. ELECTRIC FURNACE; J. Bouneau, Paris, France. App. filed July 17, 1907. An electric furnace having a reaction chamber, a passage above the same with a sloping floor, an uptake therefrom and carriages carrying electrodes in the chamber, the electrodes being supplied with current through the rails on which the carriage is run.

926,243. SYSTEM OF ELECTRIC CIRCUIT CONTROL; F. W. Clary, Pittsburgh, Pa. App. filed Sept. 9, 1907. A polyphase supply circuit, a receiving circuit and a plurality of transformers interposed there between with a pair of double-throw switches for varying the voltage applied to the receiving circuit.

926,246. ELECTRIC OUTLET BOX; C. J. Dorff, Chicago, Ill. App. filed April 6, 1908. An outlet box having two sections screwed together by means of screws and slotted lugs.

926,248. DYNAMO-ELECTRIC MACHINE; R. S. Feight, Pittsburgh, Pa. App. filed Oct. 5, 1907. An improved magnetizable wedge



926,284.—Electrical Apparatus for Producing Sound Signals.

located near the top of the slots which contain the coils so as to obtain the advantages of partially closed core slots.

926,254. RHEOSTAT; H. D. James, Pittsburgh, Pa. App. filed July 17, 1905. Rheostats controlling electric motors having two groups of resistance grids and a motor to which the groups are permanently connected with means for varying the number of grids included in the motor circuit.

926,258. TROLLEY WIRE HANGER; W. H. Kempton, Hartford, Conn. App. filed Dec. 12, 1908. A hanger which mechanically grips the trolley wire, consisting of toggle blocks and toggle links with a nut to force them together.

926,262. FIELD MAGNET WINDING FOR DYNAMO-ELECTRIC MACHINES; F. R. Kunkel, Edgewood Park, Pa. App. filed Sept. 8, 1908. A polar projection with a small body and a large end and a winding therefor having a plurality of loops.

926,278. METHOD OF MAKING BATTERY PLATES; G. J. Miller, Toledo, Ohio. App. filed Aug. 27, 1906. The plates have a plurality of ribs and are scored across the ribs.

926,284. ELECTRICAL APPARATUS FOR PRODUCING SOUND SIGNALS; C. H. O'Brien, Augusta, Maine. App. filed Dec. 11, 1905. A sound-producing body, a diaphragm and vibrating armature connected centrally of the diaphragm with an electromagnet for vibrating the armature.

926,312. METER RELAY; H. S. Baker, Wilkinsburg, Pa. App. filed April 4, 1906. A pair of stationary contact members, a moving member having three magnetizable blocks and a stationary magnet.

926,368. MAGNETO-ELECTRIC MACHINE; E. Troike, Sandusky, Ohio. App. filed Nov. 30, 1908. Bipolar magneto making use of an oscillating armature.

926,369. MAGNETIC MOTOR; W. H. Von Tish, Montclair, N. J. App. filed Sept. 16, 1907. Has a laminated yoke carrying two magnets, an armature located between the poles with means for passing the current around the magnets in one direction and breaking the current when the armature poles lie in horizontal alignment with the magnet poles.

926,372. PANEL BOARD; J. J. Wesley, Hackensack, N. J. App. filed April 7, 1909. A panel board including a box and a door, the door having an interior door which can be opened to uncover a part of the board, and a pan overlying the switches when the inner door is open.

926,385. SAFETY-SCREEN FOR SAFES AND STRONG ROOMS; E. Branly and H. Laurent, Paris, France. App. filed July 9, 1908. Safety screen for safes in which compressed air fills the hollow space between the plates so that when the plates are perforated air escapes which closes an electric circuit.

926,386. ELECTRIC PRODUCTION CONTROLLING DEVICE FOR FACTORIES; W. H. Chappell, Chicago, Ill. App. filed Oct. 31, 1908. Keeps track of workmen's time by means of a signal board containing signaling devices in rows and columns which correspond to the departments of the factory.

926,391. THERMOSTAT DAMPER REGULATOR; R. E. Dewey, Grand Rapids, Mich. App. filed Feb. 13, 1909. An electric circuit for opening the dampers; another for closing them, and a pair of thermostats for controlling them.

926,413. PROCESS FOR OXIDIZING ATMOSPHERIC NITROGEN BY ELECTRICITY; D. Helbig, Rome, Italy. App. filed Jan. 7, 1908. An electric high pressure flame arc is blown by air so as to oxidize the nitrogen.

926,443. ELECTRIC FUSE BOX; T. E. Murray, New York, N. Y. App. filed Jan. 21, 1908. A box has parallel partition with metallic clips on opposite sides of the partitions and an upwardly swinging arm pivoted between them and connected to the fuse cases.

926,437. AUTOMATIC BLOCK SIGNAL FOR TROLLEY SYSTEMS; P. N. Pecci, Paterson, N. J. App. filed June 4, 1908. A signal apparatus connecting a motor with means for causing it to move first in one direction and then in the other so as to show danger or safety.

926,451. CONNECTION TERMINAL FOR ELECTRIC CONDUCTORS; H. G. Addie, Gresco, Ia. App. filed April 26, 1906. A terminal which does away with screw or pin fastenings, having a hollow portion through which the conductor extends and to which it is soldered, the solder sealing up the hollow portion and serving as a rivet.

926,463. COMPOSITION OF MATTER; F. D. Borland and P. G. Haney, McKeesport, Pa. App. filed Oct. 5, 1908. For coating insulators, consisting of linseed oil, gum arabic, turpentine and Japan drier.

926,492. ORE-REDUCING APPARATUS; W. V. Jean, Minneapolis, Minn. App. filed Oct. 10, 1907. Includes a tank, a screen dividing the tank into two concentric compartments, in which the terminals are located, and agitators.

926,493. ORE-SEPARATING MACHINE; W. V. Jean, Minneapolis, Minn. App. filed April 20, 1908. Includes a tank containing a liquid solution of the finely ground ore, a magnetic separator therein, a hollow shaft therein provided with radiating tubes and supplied with compressed air.

926,498. FARM AND GARDEN TILLING MACHINE; F. H. Kerr, Chicago, Ill. App. filed Dec. 30, 1907. A plow or lawn mower is supplied with current from a trolley.

926,507. ELECTRICALLY OPERATED POINT-SHIFTING MECHANISM; A. Oesterreicher, Vienna, Austria-Hungary. App. filed April 21, 1908. For shifting switchpoints of railroads by means of an electric motor and suitable connections.

926,510. PARTY LINE TELEPHONE SYSTEM; H. J. Roberts, Evanston, Ill.; C. A. Soans and A. H. Graves, Chicago, Ill. App. filed Jan. 8, 1907. Party line telephone system with a selective lock out of the bridging type in which ringers responsive to differentiated current are effective to control the talking connections.

926,518. LIGHTING SYSTEM; W. I. Thomson, Newark, N. J. App. filed April 15, 1903. Power axle lighting system having a carbon resistance regulator.

926,521. METHOD OF PROTECTING BUILDINGS FROM LIGHTNING; R. C. Totten, Pittsburgh, Pa. App. filed July 27, 1908. A method of protecting buildings from lightning which consists in keeping the roofs cool by agitating the air above the buildings.

926,536. THERMO-EXPANSION METER; C. D. Babcock, New York, N. Y. App. filed May 21, 1908. Hot wire current meter having a plurality of expansion elements and a switch adapted to close a circuit through one of said elements or through another, together with a pointer and scale for each of the circuits, with which the pointer co-acts.

926,595. TROLLEY GUARD; A. Hons and S. E. Martz, Berwick, Pa. App. filed June 18, 1908. A trolley guard consisting of two yieldingly mounted arms which lie above the wire.

926,584. ELECTRICAL SWITCH AND THE LIKE; D. K. Morris and G. A. Lister, Coventry, England. App. filed Sept. 22, 1908. An automatic cutout on overload or failure of current, a movable arm and a laterally deflectable conducting strip connected to the contacts on the arm.

926,605. ELECTRIC BRAKE; F. B. Rae, Detroit, Mich. App. filed Jan. 10, 1906. Electrically controlled means for operating the pressure, thus avoiding train pipe connections between the several cars of a multiple unit system.

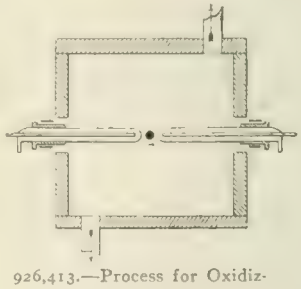
926,622. PENDANT ELECTRIC SWITCH; G. B. Thomas, Bridgeport, Conn. App. filed March 23, 1906. A push-button pendant switch, with two buttons and an insulating cup-shaped body open at the top for the insertion of the switch mechanism.

926,630. STORAGE BATTERY; W. Gardiner and J. Stirlen, St. Louis, Mo. App. filed Feb. 11, 1909. A box-shaped receptacle, a removable cover for one side thereof, ribs in the bottom and battery members resting on the ribs.

926,663. TELEGRAPH REPEATER; E. Longoria, Monterey, Mexico. App. filed Feb. 5, 1909. An automatic repeater which avoids the use of compensating rheostats or differential relays. A local circuit operates each repeater, which is opened and closed by the corresponding transmitter.

926,669. INCUBATOR ALARM; P. S. Martin, Broadway, Va. App. filed Feb. 17, 1909. For use in notifying the attendant in case the temperature of the egg rises or falls too greatly. Details.

926,680. DEVICE FOR MAKING AN ELECTRICAL CIRCUIT OR CIRCUITS; W. S. Ryan, Indianapolis, Ind. App. filed March 4,



926,413.—Process for Oxidizing Atmospheric Nitrogen by Electricity.



926,521.—Method of Protecting Buildings from Lightning.

1907. A fluid electrical conductor contained in a movable switch member is the medium of connection between the terminals.

926,681. CIRCUIT-CONTROLLING SWITCH; W. S. Ryan, Indianapolis, Ind. App. filed Dec. 2, 1907. An electric switch, a receptacle, a float therein, a movable member normally resting on the float and depressing it, and an electro-responsive device for moving the member to release the float.

926,687. ELECTRIC RAILWAY SIGNAL SYSTEM; Y. Burgess, Washington, D. C. App. filed Nov. 5, 1908. An electrically operated railway signal system having section stations along the line with normally closed charged circuits and alternately crossing sectional line conductors, together with a constantly closed train carried circuit which is included in those section station circuits the continuity of which is intact.

926,710. BIFUNCTIONAL STORAGE BATTERY PLATE; A. O. Tate, Toronto, Ontario. App. filed Feb 18, 1909. Improvement on prior patents in which interleaved anodes and cathodes are separated by porous materials of special construction.

926,714. ELECTRIC TOASTER; H. E. Bradley, Appomaug, R. I. App. filed Feb. 25, 1909. A portable toaster in which the casing is provided with a removable cover and contains a heating element formed of resistance wire wound around a bread-receiving rack so as to heat both sides of the bread simultaneously and so that the crumbs will not fall on the wire.

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Corporation Tax Laws.

The proposed law to tax corporation profits does not appear to be making much headway in Congress or in popular favor. It is said that there is now a plan to cut the tax rate down from 2 per cent to 1 per cent. Leading accountants have meantime indicated publicly certain features of impracticability in the measure, as noted elsewhere in these pages. One of the newer points is the proposal to tax the profits of holding companies. It is contended, however, that this is double taxation, as the same profits have already been taxed against the company held. It may be further urged that in many instances the taxation of the same profits would even be triple or quadruple. The Bell telephone system is an example. The parent company does not operate, but holds companies, which in turn hold others. The Consolidated Gas Company of New York, again, is a local institution of a holding character, owning the New York Edison, for instance, which again holds other companies. Such legislation may be intentional, but obviously it militates against the "holding" idea, which has not been found without utility. The House of Representatives has now adopted the income tax by a vote of 317 to 14, so matters are radically unsettled again at the present moment of writing.

Electrolytic Condensers for Large Capacities.

It has been known for some years that condensers can be obtained from aluminum-electrode electrolytic cells, the plates being formed by the steady application of a direct current. The capacities of these electrolytic condensers are enormous in relation to the surface areas involved; or, to state the facts in another way, the apparent thickness of the dielectric layer in these electrolytic condensers is extremely small. There is formed an insulating layer on the anode plates which has the properties of a dielectric, provided that the voltage applied to the condenser is kept within certain limits. A principal objection to the use of these electrolytic condensers in industrial alternating-current practice is that they waste a good deal of power and get hot. An interesting article on these condensers, by Herr Günther Schulze, has recently appeared in *Elektrotechnik und Maschinenbau.* According to measurements therein described, one microfarad of apparent capacity is obtainable at 100 volts of impressed alternating e.m.f., with an active surface of about 12 sq. cm on each electrode. The power factor of the condensers was about 10 per cent at 112 volts, with 40 microfarads at ordinary room temperature. The lowest power-factor stated was 5 per cent at 60 volts. The insulation resistance of the condenser to the forming current after the conclusion of the forming process was 700 megohms to the square centimeter of active electrode surface.

The treatment and behavior of these condensers are different from those developed in electrolytic rectifiers. In the latter the insulating film is arranged to be pierced and broken down

at each impulse of voltage in one direction, while during the intervening opposite impulses, the film is sealed up and restored. In the electrolytic condenser, the impressed voltage must not be sufficient to break down the film, so that there is very little transfer of current by conduction. A curious result brought out by the tests is that the capacity of an electrolytic condenser is approximately inversely proportional to the voltage employed in forming it. This may be interpreted to mean that when the forming voltage is doubled, the film which is finally developed on the anode is doubled in thickness, and so the capacity is halved. On the other hand, the higher the voltage of formation the higher is the working alternating-current voltage that may be safely impressed upon the condenser without breaking it down, so that the apparent power that an electrolytic condenser can safely absorb, at a given frequency, becomes independent of the forming voltage, to a first approximation. Such electrolytic condensers are useful devices in the experimental alternating-current laboratory, but it remains to be seen whether they can be developed practically to the point at which they can be utilized with alternating-current machinery on consumers' premises.

The Harmonic Analysis of Alternating-Current Waves.

When first approximation analysis of alternating-current phenomena is attempted, all voltages and currents are assumed to be sinusoidal, just as in first approximation geodesy the earth is assumed to be a perfect sphere. In more refined geodetic analysis, however, the deviations of the earth's form from the spherical have to be considered. Similarly, in more refined alternating-current analysis the deviations of voltage and current wave-form from the sinusoidal have to be considered. This means that when accurate work is attempted in alternating-current analysis, the form of the voltage and current waves must be tested for sinusoidal purity, and when, as usually happens, harmonics are present in appreciable numbers and magnitudes, their values must be determined, at least, with a certain degree of precision. In order to ascertain and record the wave form, either a curve-tracer or an oscillograph is required. These instruments enable the observer to obtain a record of the wave forms in the circuit under test. The next step is to analyze the wave forms, and to ascertain the respective magnitudes and phases of the successive harmonics. There are a number of methods for effecting this analysis First of all come mechanical analyzers, in which a pointer on the machine is made, by hand, to trace over the wave form, and in so doing to reel off the amplitude of each harmonic. Such machines are rare and beautiful pieces of mechanism, too expensive to be very generally available. Next come various planimeter methods, in which the amplitudes are obtained by running a planimeter over certain portions of the wave forms, or over certain secondary diagrams deduced from the wave forms. Then there are certain arithmetical methods, in which the ordinates of the wave forms are measured up at regular intervals, and these ordinates are put through a sort of computative sausage machine, the formulas absorbing the ordinates as the raw material, and delivering the harmonic amplitudes as finished products.

A fourth method of analyzing the wave-form is presented by Prof. Charles S. Slichter in an article on page 146 of this number. This method requires the wave-form to be plotted afresh on specially prepared co-ordinate paper, once for each harmonic, and the area enclosed by the curve to be measured by planimeter. Professor Slichter's method has the advantages of being easily followed, requiring but little practice, hardly any arithmetical labor, and of readily attaining a considerable degree of precision. The lower harmonics, say, the third, fifth and seventh, are very quickly and conveniently worked out by this method. The higher harmonics involve much more trouble and time. When precision is aimed at, however, and the wave-forms to be analyzed possess sufficient precision, we think this method is well worth study and trial by engineers. It can probably only be beaten in accuracy by the highest class of mechanical wave-analyzers.

When no record of the wave form is available, it is still possible to obtain experimental evidence as to the degree of purity of the voltage wave-form, in a manner akin to that used by Pupin. Such a method is described in Mr. P. G. Agnew's article, also in this number. Mr. Agnew holds the voltage of the circuit constant, by voltmeter, and also holds the current strength constant in a branch circuit, by ammeter, while he inserts three different capacities (one being infinite or with short-circuited condenser) in this branch. The impedance of the branch has, therefore, to be kept uniform under these three different conditions by the use of adjustable resistance. The resistance and inductance of the alternating-current ammeter have to be known and taken into account. From the values of resistance, inductance and capacity residing in the branch-circuit in each of the three measurements of equal impedance the magnitude of the third and fifth harmonics may be individually computed with a reasonable degree of precision. The advantages of this method are that it uses ordinary alternating-current instruments and dispenses with an oscillograph. The disadvantages are that it takes a good deal of computation, is ordinarily not susceptible of much accuracy, and gives no information as to relative phases between the harmonics. It also calls for more information concerning resistance and inductance of the ammeter used than is usually forthcoming. Nevertheless, there are times when such a method has great utility. It is just the sort of method that should be kept on file in the electrical engineer's pocketbook for use when its necessity arrives. The electrical connections are very simple and easily remembered, but the formulas are not easy to recall or to recompute, so that they have to be kept in pocketbook form.

Color and Visual Acuity.

The interesting article by Mr. J. S. Dow on "Color and Visual Acuity," printed elsewhere in our columns, brings out with exceptional clearness the difficulties which are encountered in any attempt to separate, as it were, the visual effects due to color from those probably chargeable to various physiological peculiarities of the eye involving color as such only indirectly. Acuity, properly speaking, deals with the power of the eye to reveal detail assuming strong contrast. It is totally distinct from what one may call shade perception, which depends upon the value of Fechner's coefficient. It is well known at the present time that both these qualities are most strongly developed in the cone of the retina, and for practical purposes are phenomena of cone vision. In the peripheral retina and at

illuminations of very low order, say, a few tenths or hundredths of a meter-candle, both shade perception and acuity fall to a very low value. At 10 or 20 meter-candle illumination, they have risen well into their working range of action. When investigating the properties of the eye, even with so-called white light, it is not easy to devise experiments which will completely separate these two phenomena at very low values of illumination. These difficulties are multiplied a hundredfold when one deals with colored lights, and hence it is natural enough to find great discrepancies in the results obtained by various experimenters. For instance, one may test the eye upon a paper target marked with certain characters. With white light the ability to read these characters is a fairly distinct matter, and one therefore tries to pass from it to a similar experiment when the target is illuminated with colored light. The usual attempt is to produce the same apparent brightness of the field with one colored light as another, or with white light. This does not, however, insure the same absolute degree of contrast between the characters and the background with all the various colors of light, and consequently the tendency is to obtain a measurement of a compound of acuity and shade perception in which the two factors enter to an unknown degree. The absorption in the yellow spot in which the image of the target must fall in order to get good vision is also a strong disturbing factor, tending to affect unfavorably the blue end of the spectrum and it is a well-known fact that this absorption varies materially in individuals, and particularly in individuals of different ages. If, for example, a youth and a man well in middle age were to get exactly the same results in such a test, one could say with almost certainty that the conditions of the experiment were faulty, for the elder man in practically every case would be observing the objects through a tinted screen due chiefly to color in the lens of the eye and different condition of the yellow spot. It is well known that the old eye loses sensitiveness in the violet for this reason.

Beyond this there is a disturbing factor in all such measurements to which Mr. Dow has directed attention, and this is the difference in the accommodation required for various colors. Each color as it falls upon the eye from a source at a given distance has its own particular image plane within the eye. The red image plane lies farthest to the rear and the violet image plane nearest the front. Now few eyes are strictly emmetropic, by far the largest number being normally a little "near-sighted" or a little "far-sighted." Whether these faults are congenital or acquired makes no difference; in either case the eye will find it easier to accommodate for one of these image planes than for another. The short-sighted eye would naturally pick up the red image plane with the greatest ease, while a congenitally far-sighted eye with retina abnormally far forward would find it easier to pick up the violet image plane. The old eye, in which the power of accommodation is much reduced, will have its own set of difficulties added to these. It is therefore to be expected and has been found that the results obtained in acuity tests are somewhat various because the difficulty of focusing is added in the experiment to whatever difference between the various colors as regards acuity may exist independently. Moreover, as Mr. Dow has long ago very ingeniously shown, the difficulties of focusing depend upon the distance of the object. As an object draws near the eye, the rear conjugate focus, and with it the whole system of image planes or rather surfaces, is shifted backward, and a new series of difficulties in focusing is thus encountered. Experiments, therefore, in which the eye is not at a constant distance from the objects serving as tests, introduce this factor in a manner that is apt to be very serious. To get anything like constant results one would find it necessary to work with eyes as nearly normal as could be found, as the eyes of comparative youth, which are able easily to accommodate. These conditions have rarely been fulfilled. In addition, accommodation is to a considerable extent dependent on practice, so that some persons find it much easier than others to focus precisely upon the various image surfaces with which they are dealing. At low intensities the Purkinje effect comes in as a very prominent disturbing factor, the effect of which varies with the color and with the amount of illumination, with the extent of the test object.

It is small wonder, therefore, that results obtained in this difficult field have been discordant. Still another troublesome factor in all such measurements is the state of adaptation of the eye. This is strongly influenced by the conditions of the experiment and in several annoying ways. In the first place it takes a long time under ordinary circumstances for the eye to settle down to a state of adaptation for observation of dim objects of any kind. Something like 20 minutes are required to get the ordinary eye into first-class working trim after it has been exposed to even moderately bright light, and even this period of rest does not qualify it in point of sensitiveness where colored lights have been under observation. There seems to be clear evidence that the effect of strongly colored stimulation may take hours to wear off and put the eye into condition where it can accurately judge regarding illumination of some other color. Burch, in a profoundly interesting paper before the Royal Society four years ago, called attention to the slow acquisition of enhanced color vision by long periods of rest, and found the after-images of objects seen prior to rest in darkness to persist sometimes even several hours, at the end of which time the eye appeared to acquire new and somewhat extraordinary powers of color perception. With all these things in view, the wonder is not that experiments on the variations of acuity of color disagree, but that they do not disagree even more radically than is the case. To a certain extent the question is a physiological one of somewhat academic character rather than a practical one, because it seems to be pretty well determined that in strong illumination, such as is usual for practical purposes, the eye works about equally well over a quite wide range of color, assuming that the general brightness remains approximately the same. Generally speaking, a light of an unwonted color seems "trying," possibly because one has to alter one's habits of accommodation. It is probable too that strongly colored light of any kind is a good thing to avoid, since it may affect in time the normal condition of color vision and so be harmful. In very weak lights all sorts of discordant results have been and are likely to be obtained owing to the causes which here set forth. The moral for the investigator is, we think, that these disturbing factors should be taken into account as far as possible in any experiment on the subject, and in any series of experiments the condition should be accurately set forth so that the inevitable residual errors can be in a measure located in comparison with those of any similar investigation.

Merging Independent Telephone Companies.

A meeting was held last week at Parkersburg, W. Va., under the auspices of the West Virginia Western Telephone Company, having for its object the merging of the independent telephone companies of the United States into a proposed National Telephone Corporation, with a capital stock of $100,000,000. The meeting was adjourned until August for the purpose, it is announced, of clearing up minor details prior to the completion of merger. It is reported that the recent merging of the Ohio Valley telephone companies and the Pittsburgh & Allegheny Telephone Company are first steps toward a national independent system.

Taxation of Corporation Profits.

With regard to the proposed taxation of corporation profits at the rate of 2 per cent on all profits above $5,000, 12 of the leading firms of accountants in New York have addressed an open letter to those interested in Congress, pointing out that aside from the intrinsic merits or demerits of the scheme, there are provisions in the corporation tax bill that render it practically impossible of execution as it stands. One clause provides that the tax shall apply for each year ending Dec. 31, whereas, it is pointed out there are a great many corporations whose fiscal year begins and ends at other annual periods, and that for various business reasons a change cannot be made.

It is also pointed out that there is confusion in the proposed law as to "gross income" and "net income" and that the proper deductions are expenses actually incurred, losses actually ascertained, and interest actually accrued, within any given year. There is also a confusion between income and income received "which can only lead to endless complication." The letter suggests such changes in the bill as will avoid such confusion and as will base returns on the last completed fiscal year.

Winnipeg Electrolysis Report.

Electrical interests in the Canadian Northwest are considerably interested in the report Prof. L. A. Herdt, of McGill University, Montreal, has submitted on the electrolysis conditions in Winnipeg, Man. The report, on the whole, favors the railway company, as the streets named by him, where conditions are satisfying, comprise about one-half the company's trackage and cover all the extensions and betterments made in the past 12 months. The recommendations made have already been accepted and work on the construction of the power substations suggested has actually commenced. The agitation in Winnipeg on the subject of electrolysis resulted from a charge by the City Electrician that a fire had been caused in one of the principal blocks on Main Street by stray currents from the electric railway. While electrical experts ridiculed the idea the City Council instituted the investigation conducted by Professor Herdt and his report effectually disposes of the above charge.

Professor Herdt makes the following recommendations among others:

"The cure for the electrolysis trouble should come from the electric railway company, as the city cannot do anything to protect its piping system from stray currents.

"Remedial means are mainly those which I have already stated in my preliminary report, dated April 1, and addressed to your secretary, namely:

"1—Installation of substations at different points of the system—this with a view of diminishing the amount of current to be returned through the rails in the center of the city.

"2—Proper rebonding of all tracks that show defect.

"3—Special bonding and cross bonding work at intersections.

"4—A system of inspection of track returns by the railway company.

"A substation system of power distribution will do away with the electrolytic trouble. At present the whole current for the railway service being fed from one station gives rise to a concentration of current in the tracks situated in the heart of the city.

"The current density in the rail returns must be kept low. The soil in Winnipeg shows a very low resistance, and only a very small difference of potential in rail returns can be allowed. This must be assisted by a rebonding of the tracks which show defects—that is, which indicate excessive drop. All bonds showing a reading of more than 4.5—that is, whose resistance is greater than 4.5 ft. of rail, should receive attention and be made good. Track intersections should also receive careful attention. Ground plates at sides of bridges to carry return currents from one side of river bank to the other must be done away with and insulated feeders placed instead."

In conclusion Professor Herdt says the railway company should maintain its plant in a high state of efficiency through a rigid inspection of the track returns, and this should be enforced. The track returns should be under test at all times, in order to remedy at once any faulty bonds as they appear. Accurate records of the drop of potential at different points of the railway system should be kept by the railway company and be open to inspection of the city electrician.

Self-Soldering Thermal Cut-Out Litigation.

The Court of Appeals of the District of Columbia has rendered a decision in an interference case involving the priority of invention of self-soldering thermal cut-outs automatically operated by heat produced by an abnormal current in the circuit containing the cut-out, the device being generally known as a self-soldering heat-coil protector. Originally there were eight different interference suits, which finally were reduced to one on appeal, in which the inventors claiming priority were Rolfe, Kaisling and Leeper. The decision of the court was in favor of Leeper, on the following grounds: First, that the mere construction, without test, of an electrical circuit protector comprising means operable upon an excessive current for protecting the circuit, and having provisions whereby it is automatically reset and resoldered in reset condition, constitutes a reduction to practice in view of the condition of the prior art. Second, in the absence of evidence showing actual abandonment of an invention, the mere failure to file an application for a patent for about four years is not an estoppel by concealment within the meaning of the law. Third, where the party to an interference (Leeper) testifies that he described to the opposing party certain experiments which he had made involving the invention at issue, and it appears that such party at the time of such disclosure was highly skilled in the art, and that prior thereto he was not in possession of the invention, the failure of such party (Rolfe) to testify in his own behalf justifies the conclusion that the testimony is true.

Electrical Decorations at the Champlain Celebration.

A notable feature of the recent celebration of the Tercentenary of the Lake Champlain region was the extensive use of decorative electric lighting in connection with the displays of flags and bunting which turned many of the towns into holiday centers. Both incandescents and flaming arcs were employed in a variety of applications, ranging from street illumination to the lighting of watercourses and grand stands, from which parades and races were reviewed. One of the most typical displays was at Plattsburg, where, in honor of the Tercentenary and the visit of President Taft, Ambassadors Bryce and Jusserand, Senator Root, Governors Hughes, Prouty and other distinguished visitors, the streets were festooned with double rows of 16-cp incandescents run in multiple circuits, with the units 3 ft. apart. Special grouping of lights was introduced to focus attention upon flags and bunting at prominent points, and the railroad station and steamship wharf were provided with decorations particularly pleasing under electric illumination.

Committees of the Underwriters' National Electric Association.

The secretary of the Underwriters' National Electric Association announces the appointment of the various sub-committees usually constituted at this time by the electrical committee of that association. The name of the committee, its chairman and his address follow: Committee on Signs and Outline Lighting, Mr. Dana Pierce, 382 Ohio Street, Chicago, Ill.; Committee on Rule 64, Signaling System, Mr. F. E. Cabot, 55 Kilby Street, Boston, Mass.; Committee on Rule 2-a, Mr. C. E. Bruen, 135 William Street, New York; Committee on Switches and Cut-outs, Mr. H. O. Lacount, 31 Milk Street, Boston, Mass.; Committee on Variable-Speed Motors, Mr. H. O. Lacount, 31 Milk Street, Boston, Mass.; Committee on Approval of Laboratory Reports, Mr. G. E. Bruen, 135 William Street, New York; Committee on Fixtures and Fixture Wiring, Mr. Dana Pierce, 382 Ohio Street, Chicago, Ill.; Committee on Auto-Starters, Mr. C. H. Hill, 316 Walnut Street, Philadelphia; Committee on Recodification of Code, Mr. C. M. Goddard, 141 Milk Street, Boston, Mass.; Committee on Cut-out Cabinets, Mr. A. R. Small, 382 Ohio Street, Chicago, Ill.; Committee on Rule 13-a, Mr. C. M. Goddard, 141 Milk Street, Boston, Mass.; Committee on Rheostats, Mr. G. E. Bruen, 135 William Street, New York; Committee on Induction Motors and Wiring, Mr. G. S. Lawler, 31 Milk Street, Boston, Mass.; Committee on Circuit-Breakers, Mr. A. M. Schoen, 339 Equitable Building, Atlanta, Ga.; Committee on Theater Wiring, Mr. J. E. Cole, 11 Wareham Street, Boston, Mass.; Committee on Block Distribution, Mr. W. Devereux, 131 South Fourth Street, Philadelphia; Committee on Theft of Electricity, Mr. J. C. Forsythe, 34 Nassau Street, New York; Committee on Wireless Telegraphy, Mr. F. E. Cabot, 55 Kilby Street, Boston, Mass.; Committee on Rule 41-45, Mr. Dana Pierce, 382 Ohio Street, Chicago, Ill.; Committee on Rule 1-d, Mr. W. S. Boyd, 125 Monroe Street, Chicago, Ill.; Committee on Junction Boxes, Mr. F. E. Cabot, 55 Kilby Street, Boston, Mass.; Committee on Street Railway Property, Mr. R. Sweetland, 141 Milk Street, Boston, Mass.

Extensions to the Portland (Ore.) System.

The Portland (Ore.) Railway, Light & Power Company is planning and making extensive additions to its already large hydro-electric system. A 6000-kw steam relay plant that will use sawdust as fuel is being planned for Portland. The sawdust, which costs about 45 cents per 1000 cu. ft. at the mills, will evaporate about 5000 lb. of water per 1000 cu. ft. burned.



PHOTOGRAPH OF MODEL OF PROPOSED PLANT ON CLACKAMAS RIVER NEAR CAZADERO.

On this basis, the sawdust fuel is much cheaper than coal and equally as satisfactory as oil, which the company uses in its Front Street steam station in conjunction with sawdust.

The company recently placed in service a rotary-converter substation, known as Substation E. At Substation A the building is being entirely remodeled so as to be transformed from a two-story brick structure into a nine-story reinforced concrete building, five floors of which will be used as offices for the company. For the present frequency-changer sets in Substation A there will be substituted motor-generator sets for delivering the energy to an Edison three-wire, underground conduit system, which will replace the present overhead 60-cycle system in the business district of Portland. A storage battery will be installed in connection with the Edison system. The generators of the frequency-changers, which are 2300-volt, 60-cycle, three-phase machines, will be transferred to the Cazadero generating station, where three of them will be mounted on a common shaft and driven as a single generator by a 5000-hp water turbine which is now being installed.

About two miles above the present plant at Cazadero, on the Clackamas River, 33 miles from Portland, the company is planning to erect a hydro-electric generating station to contain six 3300-kw, 60-cycle, three-phase alternators. The consulting engineers for this plant are Sellers & Rippey, of Philadelphia. The older equipment of the company was described in these columns April 11, 18 and 25, 1908.

Massachusetts Commission Allows Connecticut River Transmission Company to Sell Power in Fitchburg.

The Massachusetts Gas and Electric Light Commission has issued a decision allowing the Connecticut River Transmission Company to sell electric power to large consumers in the city of Fitchburg, thereby concluding the matter of the appeal of the Fitchburg Gas & Electric Light Company, which has been before the board for many months, and the various stages of which have been reported in these columns. This case has attracted wide attention in central station and power circles, since it is the first of its character to occur in Massachusetts, and the issues involved the recognition by the board of the rights of an established company doing business in a community thoroughly satisfied with the quality of its service, as well as the economic benefits resulting from the introduction of cheap hydro-electric power into an industrial section of the State. In brief, the case is that of the appeal of the Fitchburg company from franchise rights granted to the Transmission Company about a year ago, on the ground that it should not undertake to supply power to the smaller consumers.

The Connecticut River Transmission Company is controlled by the same interests which own the Connecticut River Power Company, which has built a dam and power house on the Connecticut River at Vernon, Vt., a few miles north of the Massachusetts State line. The enterprise plans to do a general power business on a large scale in the district centering about northern Worcester County, and the generating plant at the dam is now practically ready for operation. The appeal presented to the commission an entirely new question as to whether the public interest may require the admission of a second company for the supply of electric power only into the territory in consideration. In dealing with the case the board states its recognition of the broad principles involved, and after discussing the bearing of recent legislation upon the situation, particularly with reference to the encouragement of cheap power available to manufacturers under specified restrictions, reviews the growth of the power business of the Fitchburg Gas & Electric Light Company, which has developed most rapidly during the past six years. In the year ending June 30, 1908, the Fitchburg company's income from the sale of power equaled that from electric lighting and was more than 36 per cent of its entire earnings. The average power load for that year was nearly one-half of its maximum station load. No complaint was made at the hearings of the quality of service. Of its 62 power customers, with a total connected load of nearly 2000 hp, two are using over 100 hp and one over 300 hp.

The board considers that there are important differences between the two companies, stating in part that "The public character of the Fitchburg company's business is unquestioned. It cannot select its own customers or fix permanently its own prices. The public character of the Transmission Company is not so clearly established. It has sought locations for its lines

primarily to reach only a certain class of power customers, and its willingness to serve others is merely incidental to accomplishing this primary purpose. No express power is vested in this board or in any other public authority to fix rates for its service or to compel it to supply persons desiring its service. If it were to attempt to supply throughout the city all who might desire, the added investment necessary to construct its lines and the cost of their maintenance would probably materially increase the price which it would be necessary to charge for power. Such a duplication of electric lines in the public streets of a thickly settled community would be a serious inconvenience and a burden not to be tolerated without some distinct assurance of a definite and permanent advantage to the public generally. All previous experience demonstrates the futility of any attempt to secure such advantage in that way. Such a course has ordinarily led to unnecessary waste of capital and ultimately imposed needless burdens upon the community. Every effort should be made to secure the supply of power at the lowest possible rates without the evils incident to unrestricted competition and the inconvenience and dangers incident to the extensive multiplication of electric lines in the public streets.

"It is obvious that electric power cannot be sold to power users at a price much, if any, in excess of what it would cost them to produce their own power. Electric light companies, intended primarily for the supply of light, have generally been able, without substantially increasing their investment, to increase their output and make their business more profitable by the supply of electric power. To do this, however, companies have been compelled to make the prices for this service low enough to be attractive to power users, yielding usually considerably less per unit than the average price required to make its business profitable. To what extent it may be advisable for such companies to make the necessary investment expressly for the supply of large users of power is a question not yet solved by experience and dependent probably for a correct answer very largely upon local conditions. With companies organized exclusively for the supply of electric power, like the transmission company in this case, the conditions are distinctly different. Its investment for the development of water-power makes available a large amount of fluctuating 'primary' and 'secondary' power, for all of which it needs a stable and continuous market to make its business profitable. It will be greatly aided by the ability to select as many large customers as possible, so as to reduce to a minimum all charges for distribution investment and operation. If the transmission company must, in addition to developing its water-power and building its lines, construct and maintain distribution systems in every community which its lines reach so as to enable it to supply all persons who may desire to use power, it either must make a price, presumably too high to attract large users of power or its prices to small users will not be appreciably less than the prices at which the Fitchburg company can afford to sell its power."

The board concludes that "under present conditions the two companies interested in the decision are not natural competitors for every class of power business in Fitchburg; that it is doubtful if the Fitchburg company is in a position to undertake profitably to supply large power users, and that it is equally doubtful whether the transmission company can undertake to supply both small and large users of power. As the hearings progressed a recognition of these important facts by the transmission company was developed. With its investment for distribution already made and ample for the purpose, and with only a minimum of its distribution costs necessarily incident to the power supply, the Fitchburg company has every facility for distributing power at a minimum cost. For this reason, and in the interests of the small user, the transmission company should be willing to sell to the Fitchburg company, which in turn should be willing to buy, all the power which the former may have available for the purpose, and be willing to sell at a less price than the latter company can make it. In the opinion of the board, both companies, serving respectively the large and small users of power under conditions stimulating to each, but not disastrous, and operating independently in other respects may reasonably be required, upon terms and conditions advantageous to the public, to avoid the disadvantages necessarily incident to duplicate systems of transmission and to combine their wires into a single line for the purpose of the distribution and sale of current. Details of the arrangements necessary to carry out these suggestions may be made the subject of a contract between the companies, each reserving to itself those things which it can most efficiently perform."

The board states that no hard and fast line can be drawn for the separation of large and small users of power, and experience alone will indicate the proper limits and conditions under which the supply shall be made, in the public interest. In the charter granted by the Legislature of 1908 to the French King Rapids Power Company, affiliated with the Connecticut River Transmission interests, a limit of 300 hp in connected machinery and an annual consumption of at least 450,000-hp hours per year were imposed as the requirements of a permissible supply of power to users in general. The French King Rapids Company has not yet been organized, but the board accepts these limits as pertinent to the case in hand, and rules that the Connecticut River Transmission Company may supply electricity to the Fitchburg Gas & Electric Light Company, electric railroads and railways, but that it shall not, directly or indirectly, supply electricity to any other customer whose motors and apparatus connected for service shall be of an aggregate rated capacity of less than 300 electrical hp, and whose annual consumption shall be less than 450,000 hp-hours Customers are not to resell their power derived from the transmission company. A number of incidental restrictions are included in the permission granted; but the decision in the main establishes a dividing line between the large and the small power fields, and at the same time leaves the way open for the further logical development of each company along the lines in which it is most fitted to operate successfully, giving the public the advantages of cheap power in so far as is consistent with the cost of supplying it.

Some Recent Decisions of the Supreme Court of Canada in Favor of Public Service Corporations.

The following notes of certain recent decisions of the Canadian Supreme Court in favor of public service corporations have been prepared in the belief that they may be suggestive to central-station, railway and power companies concerned with similar matters before State commissioners or judicial tribunals elsewhere. Care has been taken to present the points as briefly as possible, leaving full details to managers and counsel who desire to consult the original reports. No attempt has been made to review all the public service cases of recent interest, space permitting reference to certain representative cases only.

Case of Montreal Light, Heat & Power Company vs. Lawrence, appeal by the company from the adverse judgment of the lower courts. C. S. C. Reports, Vol. 39, p. 327.—The husband of the plaintiff obtained a supply of energy for the electric lighting of his residence only, and signed a contract with the company whereby he agreed to use the supply for that purpose only, to make no new connections without permission and to provide and maintain the house wiring and appliances "in efficient condition, with proper protective devices, the whole according to Fire Underwriters' requirements." He surreptitiously connected wires with the house wiring and carried the current into an adjacent building for the purpose of lighting other premises by means of a portable electric lamp. On one occasion, while attempting to use this portable lamp, he sustained an electric shock which caused his death. In an action by his widow to recover damages from the company for negligently allowing dangerous currents of electricity to escape from a defective transformer through which the current was passed into the dwelling, it was held that, reversing the judgment ap-

pealed from, there was no duty owing by the company toward the deceased in respect of the installation so made by him without their knowledge and in breach of his contract, and that, as the accident occurred through contact with the wiring which he had so connected without their permission, the company could not be held liable in damages. In this case the opinions of the individual justices emphasized the illegal connection of the wiring through which the victim met his death. One justice stated that had the wires been properly installed it is probable that the accident could not have happened, as it did not occur in the deceased's residence and 15 other places supplied by the same transformer. The company could not be bound beyond what it knew it was doing in its contract.

Case of Davidson vs. Stuart, C. S. C. Reports, Vol. 34, p. 215.—This was an appeal from the judgment of a lower court refusing to allow damages to the heirs of an electrician who was killed in a power plant which he was remodeling or putting into first-class condition, in Selkirk, Manitoba. About three months after he had been placed in charge of the plant he was killed by coming in contact with an incandescent lamp socket in the power house, which had been there during the whole of the time he was in charge, but, at the time of the accident, was apparently insufficiently insulated. The court held that there was no breach of duty on the part of the company toward the deceased, who had undertaken to remedy the very defects which caused his death, and who was therefore responsible for the conditions. The lamp was hung from a wooden grating over a damp pump pit, and although it was not of the most approved kind for use in damp locations, the electrician had allowed it to remain in service. An ordinary lantern had been provided by the company for the use of any person having to examine the machinery in the pit. A short time after the accident the power-house lights went out gradually, and it was afterward discovered that the transformer had burned out. A careful electrician should always assume a possible failure of the insulation.

Case of Montreal Street Railway Company, appealing from the award of damages by a lower court to A. Boudreau and others for alleged injuries to real estate and residential property resulting from the erection and operation of a power plant in the city of Montreal. Can. S. C. Rep., Vol. 36, p. 329.—It was held by a majority of the court that the permanent character of the damages so caused could not be assumed from the manner in which the plant had been constructed, and, as the nuisance might at any time be abated by the improvement of the system of operation or the discontinuance of the negligent acts complained of, prospective damages ought not to be allowed, nor could the assessment in a lump sum of damages—past, present and future, in order to prevent successive litigation—be justified upon grounds of equity or of public interest. The appeal was sustained.

Case of O'Connor vs. Halifax Tramway Company, Can. S. C. Rep., Vol. 37, p. 523.—The plaintiff wished to proceed to a certain part of Halifax, and, when a car came along labeled as going in the required direction, boarded a trailer attached to it, which, however, was not so labeled. There was an unusual amount of travel on the street cars that day, and when the car containing the plaintiff had proceeded a certain distance it was stopped and the passengers informed that it would not go farther in that direction. The plaintiff insisted, it being a stormy day, on his right to be carried to his destination in that car; refused a transfer and hired a cab. The courts below held that there was no obligation on the company's part to carry the plaintiff to his destination on that particular car, and that it was his duty to inquire where the car was going. The company was sustained by the dismissal of the appeal.

Case of Willet vs. Chambly Manufacturing Company, C. S. C. Rep., Vol. 34, p. 502.—Owing to the condition of the locality and the character of certain improvements made for the purpose of increasing the water-power development at Chambly Rapids, in the Richelieu River, the parties entered into an agreement respecting the construction of dams and other works, whereby the plaintiff could recover damages for flooding caused by the construction undertaken. The court held that under the agreement Willet could recover only such damages as he might suffer from time to time in consequence of the floods at certain seasons being aggravated by the construction in the stream. The lower courts ordered the company to construct a protective dam estimated to cost $20,993—a large and difficult piece of work. The Supreme Court held that the lower court erred in ordering this construction, since the company was entitled to take the risks on payment of the indemnity as provided in the contract.

Case of Guardian Fire & Life Assurance Company vs. Quebec Railway, Light & Power Company, C. S. C. Rep., Vol. 37, p. 676.—This was an action to recover the amount of a policy of fire insurance paid by the plaintiffs upon the destruction of the premises insured by fire caused, as alleged, through the defective condition of a transformer operating at 2200 volts, whereby a dangerous current was allowed to enter the building. The evidence failed to show conclusively that the transformer was out of order previous to the occurrence of the fire, and at the same time it appeared that the wiring of the building may have been defective. It was held that the burden of proof was upon the insurance company, and that it could not recover.

Planning the Future Chicago.

What may prove an epoch in the civic advancement of the City of Chicago was the recent presentation of the "Plan of Chicago," prepared under the direction of the Commercial Club of that city during the last three years by Mr. Daniel H. Burnham and Mr. Edward H. Bennett, architects, and edited by Mr. Charles Moore, corresponding member of the American Institute of Architects. The plan proposed is most elaborate, and it was worked out by a committee of the Commercial Club, of which Mr. Charles D. Norton, now assistant secretary and treasurer, was chairman. It proposes something akin to the transformation of the City of Paris under Baron Haussmann, only more far-reaching and comprehensive. Inasmuch as no important plan of city beautification can be worked out in these days without a great extension in the use of electricity, it is believed that the readers of these pages will take an intelligent interest in the contents of this monumental report, a very brief summary of which is given herewith.

In the great plan proposed there are six main items:

1. Improvement of the Lake Front.
2. Creation of a system of highways outside the city.
3. Improvement of railway terminals and the development of a complete traction system for both freight and passenger service.
4. Acquisition of an outer park system and of parkway circuits.
5. Systematic arrangement of streets and avenues within the city in order to facilitate movement to and from the business district.
6. Development of centers of intellectual life and of civic administration, so related as to give coherence and unity to the city.

The plan is set forth in a beautiful volume of 180 large pages, finely printed and freely illustrated, containing many colored pictures reproduced from original paintings executed by Mr. Jules Guerin and other artists for the Commercial Club. There are eight chapters, an appendix and an index. The titles of these chapters will give an idea of the character of the work: "Origin of the Plan of Chicago," "City Planning in Ancient and Modern Times," "Chicago, the Metropolis of the Middle West," "Chicago Park System," "Transportation," "Streets Within the City," "The Heart of Chicago," "Plan of Chicago." The appendix is devoted to "Legal Aspects of the Plan of Chicago."

It is pointed out that practical men of affairs are turning their attention to working out means whereby the city may be made an efficient instrument for providing all its people with the best possible conditions of living. Chicago, in common with

other great cities, realizes that the time has come to bring order out of chaos incident to rapid growth, and especially to the influx of people of many nationalities without common traditions or habits of life. The changes proposed cannot possibly be realized immediately. The aim has been to anticipate the needs of the future as well as to provide for the necessities of the present; in short, to direct the development of the city toward an end that must seem ideal, but is practical. The origin of the plan can be traced directly to the World's Columbian Exposition of 1893, which gave to Chicago its great demonstration of the value of order and beauty.

The work is planned on a large scale and for the future. No estimate is ventured of the population of the city 50 years hence. If conditions continue as in the past, with the same rate of growth, the population of Chicago may be 13,250,000 in 1952. It is considered that the area of a partial circle around the end of Lake Michigan, having the heart of Chicago for its center and a radius of 60 miles, has a definite relation to the city, and this area is covered by the plan, with radiating and encircling highways. In this region there are numerous railway stations and electric light and power stations, and these buildings are spoken of as semi-public structures which should be treated in such a manner as to present a smiling face to the public. "A well-arranged grass plot, a few shrubs and a little regular attention," says the report, "will give to the plainest building a setting that, like a soft answer, will often turn away wrath from a public service corporation."

On the suburban aspect of the problem this is said: "The electric railroads, with their frequent cars passing one's very door, have done a vast deal to bind the outlying towns to the central city. More than this, they have promoted neighborliness among people of adjoining towns, and have broken up the isolation of farm life." As in the case of the steam lines, the electric railway station should be in good taste architecturally, with well-kept lawn and shrubbery and a sheltered, commodious platform, well lighted at night. These accessories go a long way toward mitigating the nerve strain which every business man feels. A comprehensive park scheme is recommended for the metropolitan area.

In the chapter on "Transportation" it is said that Chicago has been made largely by the railroads, and its future prosperity is dependent upon them. Twenty-two trunk lines enter Chicago and the problems of transportation have been considered entirely from the viewpoint of the paramount interests of Chicago as a commercial city. The time has come, it is said, to develop one common system for the handling of freight—a traffic clearing house. The subject is perplexing and intensely intricate. "The fine arts of traffic management should be studied no less than the fine arts of parks and boulevards, for unless Chicago keeps ahead of her rivals in commercial matters the parks will become pastures and the boulevards will be deserted." To meet the situation it is proposed to create a central clearing and warehousing yard, a North Harbor at the mouth of the Chicago River, a South Harbor at the mouth of the Calumet River and freight railways, probably underground, interconnecting the city freight houses, the central yard and the two harbors. These connecting lines should be operated electrically.

Much attention is paid to the transportation problem. One suggestion is this: "At the present time much of the nearby farm stuff for housekeepers, hotels and restaurants is brought into the city on wagons which load late in the afternoon and travel at night, reaching the general market at South Water Street or West Market at dawn. Much, if not all, of this freightage can be done cheaper to the truck farmers and more satisfactorily to the consumer by cars run at night on the trolley and elevated lines."

Coincident with the handling of the transportation problem a proposed street plan is worked out, based on a system of circuits and radials. The civic center of the city, it is planned, shall be at the junction of Halsted and Congress Streets. Two railroad terminals are proposed—one on Twelfth Street between State Street and the Chicago River, which will be straightened, and the other between Canal and Clinton Streets and between Lake and Twelfth Streets. Elevated railways, surface lines and subways are planned to be a part of the grand system proposed.

The report says that the noise of surface and elevated railways "is often excruciating." This evil can be largely mitigated.

Of particular interest to central-station men is the following paragraph: "The general trend of improvement is in the direction of central plants for heating, lighting and power; because such plants are found to do the work more economically than separate stations. The individual buildings would, in such a case, cost less initially by leaving out much of the mechanical work now installed, and also there would be a saving by greater cleanliness due to improved atmospheric conditions. It stands to reason that the abolition of a large majority of the smokestacks in the downtown district would improve the air we breathe and relieve us of much of the cost of cleaning buildings, inside and out, and of protecting goods."

Grant Park, on the Lake Front, is to be developed as an intellectual center according to the plan. Here is the present Art Institute, and the new Field Museum and Crerar Library are also to be built in this location. The plan contemplates the beautiful and dignified development of this park with an outer harbor. As it is proposed to group in Grant Park the buildings pertaining to art, literature and science, so it is planned to create on the axis of Congress Street a composition representing the dignity and importance of the city from the administrative point of view. Where Congress Street intersects Halsted Street a civic center should be established. The buildings in the civic center will fall into three divisions represented by the City of Chicago, Cook County and the Federal Government.

So elaborate and extensive is the proposed plan, and so beautiful is it, that its complete realization seems almost like an unattainable dream at the present time. Very likely the plan will never be carried out in its entirety. On the other hand, it is more than probable that many of the suggestions will be adopted. The example of Paris is cited. That beautiful city had half a million people when the municipality adopted a plan something like the present one, calling for the expenditure of $265,000,000. No estimate is made of the cost of the plan of Chicago; it would undoubtedly run into hundreds of millions of dollars.

It is asserted in the report that "Conditions in Chicago are such as to repel outsiders and drive away those who are free to go. The cream of our own earnings should be spent here, while the city should become a magnet, drawing to us those who wish to enjoy life." Mayor Busse is known to be heartily in favor of the plan, or, at least, of some parts of it, and he has recommended that the City Council appoint a commission to take the matter under serious advisement.

In the appendix to the report Mr. Walter L. Fisher, of the Chicago bar, considers the legal aspects of the plan. He finds that many of the recommendations could be carried out under existing laws, and that the Legislature has ample power to grant authority necessary to carry out all of the recommendations.

New York Public Service Commission News.

During the past week the Public Service Commission has held almost daily hearings upon the proposed plan of reorganizing the finances of the Third Avenue Railroad Company. The receiver of the road, F. W. Whitridge, explained the condition of the property and gave his idea as to its earning capacity when properly equipped. He advocated the reorganization plan as proposed by the bondholders' committee and expressed the opinion that this plan gave as much return to the present security holders as any that could be devised. The majority of the time at the hearings, however, was taken up by listening to the objections of the stockholders. Under the proposed plan the stockholders must pay an assessment of $25 per share in order to secure any representation in the new company. The stockholders protest that the present plan gives the bondholders an undue advantage, and expressed the belief that

a better plan could be devised which would result in a very much smaller capitalization for the reorganized company. The commission has not yet made any ruling, but it is anticipated that it will not approve the reorganization plan as offered.

A formal complaint has been lodged with the Public Service Commission by a resident of South Brooklyn, protesting against the ruling that the Brooklyn & Coney Island Railroad Company be permitted to charge a 10-cent fare on Sundays and holidays and 5 cents on other days. In the meantime, the railroad company has declined to accept the ruling of the commission, and announces its intention of continuing to charge a 10-cent fare all the time. This brings the matter to an issue, and the commission will at once make a formal order to the traction company to reduce its fare. Failure to obey this order will result in the prosecution of the company in court.

In order to meet the wishes of the property owners on Lexington Avenue, the Public Service Commission has modified its original plan for a four-track subway on the same level and has adopted a plan for a double-deck structure. The engineers of the commission reported in favor of this construction from Houston Street to 103d Street and from 113th Street to Harlem River.

The commission sent to the Board of Estimate and Apportionment last week a letter asking that a special committee be named to consider the moving platform plan offered by E. P. Ripley, president of the Atchison, Topeka & Santa Fé Railroad, and Max E. Schmidt, president of the Continuous Transit Securities Company. This plan provided for a moving platform subway to run from Tenth Street to Forty-Second Street.

At a hearing before Commissioner Milo R. Maltbie, in a continuation of the investigation into the franchises of the electric light and power companies on June 29, these witnesses were heard in explanation of the claims of their various companies: H. J. Hemmens, for the United Electric Light & Power Company; Adrian H. Larkin, for the Richmond Light & Railroad Company; Eugene D. Hawkins, for the Queensboro Gas & Electric Company, and W. W. Freeman, for the Edison Electric Illuminating Company of Brooklyn. The franchise maps which had been prepared by Delos F. Wilcox, chief of the franchise bureau of the commission, were compared and corrected according to the records of the electric companies. The various steps by which these companies secured their franchises and rights, the various mergings and combinations and the various contracts with highway commissioner and village trustees were all gone over and explained. It is the purpose of the commission to have an absolutely perfect and accurate record of all the franchises and rights owned by the electric companies of this district.

In the case of the Public Service Telephone Company before Supreme Court Justice Erlanger an argument was heard last week for a peremptory writ of mandamus to compel the Empire City Subway Company to accord in its subway conduits space for the placing of the electrical conductors of the Telephone Company, extending from the proposed station and exchange at 46 Wall Street along Wall, William, Broad and New Streets The city has asked permission to intervene in the suit in opposition to the issuance of the mandamus. The assistant corporation counsel says that the matter is one of vital importance to the city, as the Public Service Telephone Company claims to have a lease of a franchise for 999 years, whereas a recent act passed limits the existence of a city franchise to 25 years, and he said that unless the city was permitted to intervene serious injury might occur to the municipality. The counsel for the subway company says that the Public Service Telephone Company was only incorporated two months ago, and that its amendatory certificate was not filed until June 24. He claimed that as the company did not as yet have an instrument or an office staff there was no hurry about securing space in the conduits. The Public Service Telephone Company professes to own its franchise by the purchase of a lease from the Long Acre Light & Power Company. It is claimed by the attorneys for the city that the Long Acre Company, under the present law had no right to transfer its franchise without the sanction of the Public Service Commission. The Long Acre Company, which is controlled by John C. Sheehan and others, has a few electric light wires running through the theatrical district, and some months ago it applied to the Public Service Commission for permission to issue $10,000,000 of preferred stock and $50,000,000 of bonds to establish its lighting system. This application was denied, and after a rehearing the matter was carried into the courts.

Wisconsin Rate Commission News.

The Mazomanie and Black Earth Telephone companies have applied to the commission to have the order for a metallic circuit between the two cities modified, and be permitted to install a grounded circuit instead. This has been objected to by the former petitioners, and the case will be heard this week.

A program for the improvement of transportation in the city of Milwaukee, designed to relieve the present congestion and looking toward permanent future convenience and facility in passenger traffic, has been outlined by the engineering department of the Railroad Commission under the direction of Professor Pence and Mr. Harris. The program suggests means for improvement of the service, both by act of the company and by co-operative steps on the part of the company and public in general, involving changes in routing, additional cars, building new lines, various adjustments of incidents of operation, etc. This matter has been incorporated in a report which has been submitted to the commission by the commission's engineer and is the result of one of the most exhaustive studies of street-railway operation that has thus far been conducted in this country.

This investigation grew indirectly out of the complaint of the city of Milwaukee against the Milwaukee Electric Railway & Light Company relative to service and rates. In the formal hearings before the commission conflicting evidence upon certain matters of a very technical nature rendered it practically impossible for the commission to reach an intelligent decision, hence the necessity for the independent field observations, which resulted in the above-mentioned report. These observations were conducted with the utmost secrecy under the belief that an open investigation might, in some measure, affect the normal operating conditions. They were carried out by a party of five men and covered a period of approximately six months. As a result, a number of distinct contributions to knowledge concerning street-railway operation have been made and the report will undoubtedly attract wide attention among street-railway operating officials when published, as it probably will be in detail. The report itself comprises 350 pages, including some 300 maps, charts and tabulated data.

Two matters of technical importance, which have not heretofore been treated in such investigations, are those covering the determination of "comfortable load" and the promptness or alacrity of passengers in boarding cars. The latter matter was of such importance that corresponding observations were made in a number of other cities, including Minneapolis, St. Paul, Duluth, St. Louis and Indianapolis.

With reference to the determination of "comfortable load," elaborate compilations covering observations of some 9000 cars at all hours of the day and at all important points of the traction system brought the engineers to the conclusion that the presence of "standing passengers" did not necessarily indicate overloading or an insufficient number of cars. It was demonstrated that a considerable number of passengers voluntarily stood up even when empty seats were available. Some interesting statistics on this point are given. The seating capacity of the ordinary car was 42 passengers. The results show that when the car contained from 5 to 14 passengers, 2 preferred to stand; 30 to 40 passengers, 6 stood; 35 to 39 passengers, 7 stood, and from 40 to 42 passengers, 8 preferred to stand. Thus, since the observations very clearly showed that eight persons preferred to stand when the car contained 42 passengers—that is, when every one could have had a seat—

the comfortable load per car was fixed at 50 passengers, and this schedule was used throughout the program.

The observations in regard to the second subject—that of promptness—disclosed the fact that there is a certain sluggishness about the movement of traffic in Milwaukee that apparently might be corrected. Comparisons between Milwaukee and the other cities previously mentioned indicate that the passengers do not board cars in Milwaukee as quickly as they do in other cities, as is shown by the following table. This is due, in part, to the fact that Milwaukee cars have no definite stopping place.

TIME IN SECONDS PER PASSENGER REQUIRED TO BOARD A CAR, WITH DIFFERENT NUMBER OF PASSENGERS BOARDING CAR AT SAME TIME.

	2	5	10	15	20	25
Indianapolis	1.75	1.25	1.00	0.95	0.91	0.90
St. Paul	2.20	1.56	1.15	1.05	0.97	0.98
St. Louis	2.60	1.58	1.15	1.00	0.96	0.97
St. Louis*	2.60	1.58	1.33	1.37	1.42	1.50
Minneapolis	3.20	1.75	1.25	1.05	1.00	0.98
Milwaukee	3.20	2.00	1.47	1.27	1.25	1.25
Duluth	4.00	2.00	1.54	1.10	1.00	1.00

*St. Louis refers to the "pay-as-you-enter" car.

The table shows that if more than 10 people board a car at once the time required is at present greater in the case of the "pay-as-you-enter" car than it is with the ordinary car, and this difference steadily increases with the number boarding the car.

An average of a large number of observations taken at the principal junction points in the city of Milwaukee shows that a car is liable to be held up nine seconds, due to a variety of causes. These causes have been discussed in detail and the data taken for each cause separately and the weighted average found to be nine seconds, as above. This, together with the time required to stop a car on signal, led the engineers to the conclusion that a 20-second headway was the fastest that could be maintained and have the cars run on schedule. The calculations involved are quite technical and will, no doubt, be of considerable interest to street-railway officials in general.

Convention of Society for the Promotion of Engineering Education.

The seventeenth annual convention of the Society for the Promotion of Engineering Education was held in New York City on June 24, 25 and 26, 1909. The several sessions were held at Columbia University, Pratt Institute, Brooklyn, and at the United Engineering Societies Building on Thirty-ninth Street. The registration and attendance at the meetings were larger than those of any previous year, and throughout the program that the committee had arranged was of unusual interest, and the social events that it had planned were thoroughly enjoyable.

The first general session was held on Thursday afternoon, June 24, in Earl Hall, Columbia University, and was called to order by President Frederick E. Turneaure, dean of the College of Engineering of the University of Wisconsin. The meeting was opened by an address by William Barclay Parsons, who, as representative of the board of trustees of Columbia University, and also as an eminent representative of the engineering profession of New York City, welcomed the members of the society to Columbia University and to New York, and described in terms of highest praise the work that the teachers of engineering in America were doing. Mr. Parsons' address was immediately followed by the report of the treasurer, Mr. William O. Wiley, who showed that the funds of the society were in a most satisfactory condition, and that the total income during the past year exceeded by a liberal margin the expenses for the corresponding period. The secretary, Prof Arthur L. Williston, then presented a report which also showed that the society was in an exceedingly flourishing condition. The increase in the membership reported was most gratifying. At the Ithaca meeting three years ago the secretary reported but 415 members, while the following volume of the *Proceedings* showed 503 names on the list. Last year there were 184 new applicants elected to membership and this year up to the meeting there were received 100 more new applications.

The first regular number on the program was the report of the committee on technical books for libraries, which was followed by an interesting discussion in which Mr. Edward F Stevens, in charge of the Applied Science Reference Room of Pratt Institute Free Library, and a number of other members took part. The report was referred to the committee for certain additions and corrections, after which it was ordered to be printed for general distribution. The second number on the program was a symposium on "Mathematics for Engineering Students," which was opened with an address by Prof. Edward V. Huntington, of Harvard University. Professor Huntington described the work which the joint committee, of which he is chairman, and which represents the American Mathematical Society, two sections of the American Association for the Advancement of Science, and also the Society for the Promotion of Engineering Education, has been doing in devising ways in which the teaching of mathematics to engineering students could be very much improved and simplified His report advocated the elimination of a great many of the more technical phases of the subjects now usually included in the courses of instruction, in order that the time might be concentrated on the essentials and a clearer idea obtained of the basic laws and principles, and described a plan that the committee was working out of formulating a list or outline of those mathematical ideas or conceptions that were regarded as of fundamental importance for engineering students, to serve as a guide to those who were teaching mathematics to engineers. The placing of more emphasis on the practical application of mathematical principles to the solution of engineering problems was also strongly advocated in the discussion which followed Professor Huntington's presentation of the subject, in which many of the members of the society took part.

Thursday evening the session was again held in Earl Hall Columbia University, and was opened by the annual address of the president, Dean Frederick E. Turneaure, on "Present Tendencies in Technical Education."

ENGINEERING VS. TECHNICAL EDUCATION.

In a most interesting address the president spoke of the reasons why the present was an especially significant period in technical education and expressed the belief that the development of the next decade will be along somewhat different lines from the development of the one that has just passed. There appear to be many reasons, he said, why there will be a less strenuous growth in numbers, and also in material equipment, in the engineering schools in the immediate future. In both of these directions the growth in the past 10 or 15 years has been almost phenomenal in both this country and in Europe. It is probably within the truth to say that the total number of engineering students in American schools has trebled during the past 10 years, and that at the present time more than half of the students in those institutions in which engineering instruction is well developed are enrolled in the technical courses. This growth in technical education in America, also, is well reflected by the increase in membership in this society, which has grown from less than 200 members in 1898 to 760 at the present time. In Europe the rapid growth in numbers began somewhat earlier, but has been equally great. The attendance in 10 schools of the first rank in Germany and Switzerland increased from a total of about 7600 in 1893 to 18,700 in 1903.

The general causes underlying the great development in technical education are well known. A great demand has existed for technically trained men, and the schools have been busy in meeting this demand as best they could. But, in the speaker's opinion, they have at last reached the point where the supply of young engineers in the industrial world is at least equal to the demand; and, consequently, a condition of stability has been reached which will permit growth along other lines.

The standard courses of instruction have been improved somewhat during the past 10 years and greatly strengthened

through the splendid improvements in the material equipment, but, on the whole, the changes have not been so great as might be supposed. The cause for this apparent stability is not far to find. The entrance examination requirements have remained substantially fixed during this period in most institutions. The essential fact is that the large majority of technical schools now require, and have required, a full four-year high-school course for entrance. So long as this remains stationary, the curriculum of the engineering school cannot be materially altered. Relatively high entrance requirements, especially in mathematics, have been put in force in a few institutions, but the experience in such places leads to the conclusions that results thus obtained are not altogether satisfactory, even from the standpoint of the engineering school. And the belief is now prevalent that it is better to emphasize language and literature in the high-school course, rather than mathematics beyond a certain reasonable minimum.

With the length of the regular course stationary, with the entrance examinations substantially so, and with the rapidly growing faculties endeavoring to cope with the problem of constantly increasing numbers of students, no great or fundamental changes could be expected in the engineering curriculum. Some progress has been made, it is true, in broadening the courses of instruction by adding more training in sciences allied to the major subjects, and also, in some places, by introducing certain general subjects, such as languages, economics, history, etc.; and there has been a marked development in the field of applied chemistry, or chemical engineering, for which there appears to be a real and permanent demand. But more recently there have been appearing certain new developments of other kinds that are indicative of important changes for the future. These point to changes in at least four directions:

First.—Enginering is commonly, and with truth, called a "profession." For many technically trained men it is a profession, but for others—and much greater numbers—it can scarcely be said to be such. The technical requirements requisite for various callings vary between wide limits. Innumerable vocations require a greater or less amount of technical training, some of which might fall within the class generally considered as engineering, while others would not. On the one hand, no training can be too thorough, no culture too broad, for the real professional engineer; while, on the other hand, it is unquestionably true that large numbers of young men who could not possibly afford a long course of study can be greatly benefited by technical instruction extending over a short period. Up to the present time engineering instruction in America has been confined almost entirely to the standard four-year course and the curriculum has been arranged primarily with a view to giving the best possible instruction to those students who expected to remain four years and no longer. Dean Turneaure expressed it as his belief that the present courses were not well adjusted for those who wished to secure a more thorough preparation for truly professional work, but stated that within the past two years there has been an encouraging development toward providing, through longer courses, opportunities for the important group of young men, though comparatively limited in numbers, who seek in the technical college the thoroughness of training and the breadth of view that must be ultimately secured by successful professional men.

Second.—Closely related with the development of the longer courses of study is the recent growth of research in applied science and engineering. In at least two institutions, he said, engineering experiment stations have been organized whose special function it is to carry on research in the engineering sciences, particularly in those directions which must better the industries of the state. Such research has also been greatly developed in other institutions where the work is being carried as a part of the regular duties of the several departments. And the experience has shown that fruitful research is of great value in cultivating helpful relations between the schools and the engineering profession. More and more the latter is utilizing the results of the latest experiments in its line, and is depending more and more on the engineering school for practical assistance.

Third.—Another phase of the new educational development has to do with the courses and methods of instruction adapted to those who can complete only a short curriculum. The present four-year courses do not meet adequately the great variety of needs of this class of students. The young man who wishes to get some technical training to assist him in his chosen vocation, but who is not able to stay four years, is not well provided for, and in but few places have his needs been recognized at all. There is no reason why a large and profitable amount of technical instruction cannot be given without a long preparatory training; and schools or courses of instruction of secondary grade are needed in every large industrial center. Up to the present time the state, in general, has not extended its support to schools of this grade. There is no fundamental reason, however, why this should not be done, and in at least three States legislation has already been enacted leading in this direction. In these States trades schools and secondary schools are now being supported by taxation. Such opportunities should be, and will be, the speaker predicted, more adequately offered in the near future.

Fourth.—Correspondence instruction, supported by public taxation, has been established in at least one State, and has there been placed upon a sound financial basis. The demand for such instruction has come about through the lack of secondary schools in the large industrial centers. It is a notable development and meets a real demand, and is certain to be extended in some form or other.

Following the presidential address was a paper on "Highway Engineering," by Mr. L. W. Page, director of the Office of Public Roads, United States Department of Agriculture, Washington, D. C. Mr. Page described the rapid growth and the enormous extent of the industry of highway building in the United States, and the great difficulty of obtaining competent highway engineers who were familiar with the present exacting requirements, especially in the department of building dustless roads. He urged upon the technical schools and colleges of engineering of the country the serious consideration of the subject, believing that it was a matter to which they should give more serious attention in order that they might graduate both a sufficient number of men and men whose training should be abreast of the requirements of the times.

At the close of the program an informal reception and "smoker," with refreshments, was tendered the members of the society by Columbia University on the campus surrounding the Faculty Club. The grounds were decorated with Japanese lanterns, and refreshments were served at small tables, which gave attractive opportunities for reunions and discussions among small groups of men who were interested in similar subjects.

Friday morning, June 25, the meeting was held at Pratt Institute, Brooklyn, N. Y. The session was opened by an address of welcome by Mr. Frederic B. Pratt, the executive officer of Pratt Institute, with a brief description of the work and the purposes of the institute, and outlining the history of its organization and development.

INDUSTRIAL EDUCATION.

Mr. Charles Buxton Going, editor of the *Engineering Magazine*, then presented a paper on the relation of engineering education to industry. Mr. Going, in a thoughtful paper, briefly traced the history of the development of engineering education and the forces which had been at work influencing its character. The older objective of the well-read scholar, he said, has given place to the newer one of the scholarly worker, and education has been brought back into closer touch with the vital interests of the spirit of the times. But the inherent tendency of all human systems, whether they be of religion, art, letters or science, is to crystallize, and though the American engineering schools are so splendid in their achievements that criticism is ungrateful, he felt that if it must be offered it would seem to be that they in their turn were growing

academic. One criticism is that theoretical standards of construction and theoretical figures of performance are too much idealized by the school, and these ideals are not sufficiently balanced by a knowledge and appreciation of costs, and of the fact that there is always a point, varying, of course, in every case, beyond which further refinement spends more than it saves and becomes a professional mistake. Again, the design of a piece of machinery may require a sound, scientific knowledge of mechanics and kinematics, a careful mathematical calculation of stresses and weights, and a high degree of skill at the drawing board. But if cost of construction is important—and it usually is very essential—it requires also attention to economy in the use of material and especially of the labor involved in manufacture; the selection of stock sizes; the standdardization of gears, arbors, bores, tapers, bolts and screws; the avoidance of difficult problems in pattern making and molding, and minimization of labor in machining and assembling of parts. There is also an absence of any adequate attempt to supply systematic training for the newest of the engineering occupations—manufacturing. The factory is a vast, co-ordinated manufacturing machine, demanding a personnel instructed not merely in dynamic engineering, but in executive organization and management, economical works design and construction, stores-keeping, wage systems, time records, shop discipline and transportation and handling appliances, toolroom practice, sanitation, and by no means least, cost analysis and study.

Mr. Going said that the times have changed and the difficulty is not that the schools did not go far enough, but they were headed in a wrong direction. The theoretical training of the courses leans too strongly toward pure sciences, the shop training leans too far toward the handicrafts. The aim, he said—to illustrate by an intentional exaggeration—seems to be to turn out a composite of the natural philosopher and the mechanic—"a sort of scientist in overalls."

In conclusion Mr. Going made the plea that the general educational scheme might be brought closer to the plane of practical work—nearer to the life that the graduate must follow. He also urged that every opportunity be given in our schools of applied science for a closer fellowship between the engineering departments and the surrounding industries, and that the teachers and professors be encouraged to maintain close touch with active professional work. He advised that more opportunity be given the alumni to be heard in the university councils and to bring back within university bounds the fresh spirit and suggestion of the constantly changing world.

Mr. Going's paper was followed by an interesting address by Mr. Fred W. Taylor, ex-president of the American Society of Mechanical Engineers, on "The Preparation of Technical Graduates for Industries." Mr. Taylor believes that the college graduate did not, and as at present trained, apparently could not, adjust himself readily to the requirements of industry after leaving school and was of very little service to his employer. This, he believed, was due to three serious defects in their training: First, that for 22 years, on an average, the young men who come out of college have never been subjected to anything that even remotely resembles the kind of discipline that they must be subjected to when they enter practical work. The so-called mental discipline which a college training offers is, he believes, no substitute for the discipline that business conditions require. Second, Mr. Taylor believed that the habit which young men formed during their entire period of schooling of *absorbing* rather than *producing*—of being "sponges" instead of "giving out," of looking at things from a selfish point of view, expressed by such phrases as, "What can I learn?" and "How can I get experience for myself?" instead of from the point of view of one who instinctively feels "How can I make myself more useful to my employer?" was primarily responsible for the critical attitude of so many graduates, and added to the difficulty with which they adjusted themselves to the needs and requirements of their employers. And, thirdly, Mr. Taylor spoke of the minute care with which all of the leading colleges of engineering gave instructions in the physical properties and materials with which the engineer must deal, and yet, he said, they omitted almost absolutely to give any instruction or experience in the handling of men. The raw material with which engineers must deal more largely than any other is labor. It enters as the largest factor into most fields of production, and he attributed a large part of the present difficulty with young technical graduates to an absolute ignorance on their part of men and human nature.

As a remedy for these three defects Mr. Taylor urged that as a positive requirement for all young men who wished to study engineering, at least one year of practical experience as an apprentice in the machine shop, working under the ordinary conditions of shop service side by side with the practical mechanics, in order that the boy might learn, while his character was still in its formative period, what real discipline was, what real service to one's employer was, and those things in human nature that can only be learned by working shoulder to shoulder with one's fellow men. And lastly he urged that the colleges place less emphasis upon purely intellectual attainments and that they learn to measure their students by the same standards that the world will measure them, by the standards of, first, character; second, common sense, and, last, and least important in his judgment, their intellectual attainments.

Both the papers of Mr. Charles B. Going and of Mr. Fred W. Taylor were discussed in a most animated way and at considerable length. Many members took part and it was interesting to observe how cordially the members of the society welcomed the frank criticism of their schools and of their product. Many of them differed from the speakers in a number of details, but in the main it was somewhat surprising to see how general was the agreement with the main points at issue in the criticisms that had been offered by both the speakers.

The discussion of Mr. Taylor's paper was followed by a brief description with lantern-slide illustrations of a few typical features of the work done in the shops and laboratories of the School of Science and Technology at Pratt Institute by Dr. Allen Rogers, instructor in industrial chemistry, who described the five chemical plants of the institute—the soap factory, the paint works, the tannery, the dye works and the chemical works; and by Mr. William H. Timbie, instructor in physics, who described the laboratory methods of instruction in practical mechanics. This short description of the work of the institute was followed by a visit to the shops and laboratories, and by a reception and luncheon in the large drawing-room on the first floor of the Chemistry Building, which was tendered by the trustees of Pratt Institute to the members of the society.

The session on Friday afternoon, June 25, was held in the United Engineering Societies Building, in New York City The first number on the program was the report of the joint committee on engineering education, by Prof. Dugald C. Jackson, of the Massachusetts Institute of Technology, who outlined the progress that the committee was making and described the data which were being collected through the co-operation of the Carnegie Foundation. The committee will make its full report to the society in June, 1910.

The greater part of the afternoon was devoted to the discussion of five-year and six-year courses in engineering schools, and three papers were presented on this subject, the first by Prof. Charles Derleth, Jr., of the University of California, the second by Prof. Robert Fletcher, of Dartmouth College, and the third by Prof. William T. Magruder, of the Ohio State University. In these three papers, and in the discussion which followed, attention was called to the ways in which in various institutions provision was being made for those groups of students—usually comparatively small in numbers—who desired a more thorough education and professional training than could be obtained in the regular four-year course. In some places the lengthening of the courses was primarily to afford opportunity to introduce into the curriculum more opportunity for the study of language, literature, history, economics and other general subjects, and in other places the main purpose was to furnish time for further specialization and advanced

work of strictly professional character. In the discussion which followed the presentation of the papers it was clearly pointed out that this demand for these longer courses did not diminish the need for the present four-year course, but, on the contrary, that the increased number of callings, requiring a greater or less amount of technical training, was increasing rather than diminishing the number of young men who wish to get a technical training to help them in their chosen vocations, but who cannot wisely devote more than four years to their education after graduating from high school.

The program was concluded with a paper on "Employer's Requisites of Technical Graduates," by Prof. Hugo Diemer, of the Pennsylvania State College.

At the conclusion of the afternoon program the society adjourned to the Engineers Club, where a delightful banquet was served in the main dining hall. After the coffee and cigars, and in the place of the usual after-dinner speaking, the society adjourned to the roof garden of the New York Theater and witnessed the production of the "Follies of 1909."

Saturday morning was largely devoted to a business session and to the election of officers. The following officers were chosen for the ensuing year: President, Prof. Henry S. Monroe, Columbia University; vice-presidents, Prof. Henry P. Talbot, Massachusetts Institute of Technology, and Prof. Arthur L. Williston, Pratt Institute; secretary, Prof. H. H. Norris, Cornell University; treasurer, Mr. William O. Wiley, John Wiley & Sons, New York. The following members were elected to serve on the council for three years: Prof. F. H. Constant, University of Minnesota; Dean Frederick A. Goetz, Columbia University; Prof. H. Wade Hibbard, University of Missouri; Dean John H. Leete, Carnegie Technical Schools; Prof. Edward R. Maurer, University of Wisconsin; Prof. John C. Ostrup, Stevens Institute of Technology; Prof. Charles R. Richards, Cooper Union for the Advancement of Science.

After the business meeting and the introduction of the newly elected president, the society listened to the report of the committee on graduation, presented by Prof. John J. Flather, of the University of Minnesota. Dean Mortimer E. Cooley, of the University of Michigan, gave a most interesting account, with charts of figures and statistics, descriptive of the careers of the engineering graduates of the University of Michigan. Prof. W. K. Hart, of Purdue University, presented a paper on "Methods of Diminishing Dishonesty in College Examinations," and Prof. Charles Derleth, Jr., a paper on "A Summer School in Surveying." The last paper on the program was presented by Prof. Oliver B. Zimmerman, of Charles City, Ia., on "The Requisite Qualifications of an Engineering College Instructor," at the close of which the society adjourned.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY AT PAN-AMERICAN CONGRESS.—Among the subjects on the program of the fourth Pan-American Congress, to be held at Buenos Ayres in July, 1910, is the international regulation of wireless telegraphy.

INSTITUTION OF MINING ELECTRICAL ENGINEERS.—A new electrical society has been formed recently in Great Britain, known as the Institution of Mining Electrical Engineers. Local sections have already been formed at Newcastle and for the Glasgow district of Scotland. The first general meeting of the body will be held in September.

BRITISH I. E. E. STUDENTS VISIT GERMANY.—Student members of the British Institution of Electrical Engineers have just made an eight-day tour of electrical inspection in Germany. The works of the leading German electrical manufacturers were visited, and also the engineering department of the Charlottenburg technical school and the laboratory of the Reichsanstalt, Berlin. The tour was conducted by Cook at a cost of $45 per person, which included hotel accommodation with luncheon excepted.

BRUSSELS INTERNATIONAL EXHIBITION.—Details as to exhibits at the International Exhibition to be held next year in Brussels have been issued. Concessions have been secured from the Belgian railways as to freight rates, and some of the charges usually payable by exhibitors will be assumed by the Royal Commission. Electrical applications will be made a feature, and an electrical meeting will probably be held in connection with the exhibition.

BALLOON CONTROL BY WIRELESS.—According to the New York *Herald,* Mark O. Anthony, an electrical engineer, last week succeeded in sending a small dirigible balloon, controlled by wireless, out over the ocean from Sandy Hook a distance of one mile and a quarter, directing its movements by manipulation of a keyboard on the beach. The inventor refused to give any particulars of his experiment beyond stating that the balloon unreeled about 7000 ft. of cord, which was attached in order to haul it back in case anything happened to the mechanism.

WATER-POWER OF THE FRENCH ALPS.—The third volume has appeared of a monumental work published under the auspices of the French Government, containing the results of an investigation of the water-powers available for development in the region of the French Alps. The present volume treats of the part of the Alps between the Rhone and Italian frontier, and the Durance basin and Lake Geneva. The illustrations include numerous charts in colors, engineering profiles, etc. The work should offer many suggestions for hydraulic explorations in this country.

KING EDWARD ADVOCATES TECHNICAL EDUCATION.—At the ceremonies attending the laying of the corner-stone of the new buildings for the Imperial College of Science and Technology at South Kensington, London, of which institution former Dean Bovey, of McGill University, is rector, King Edward emphasized the "supreme importance" of the highest specialized instruction in science and added: "I feel more and more convinced as time goes on that prosperity, and even the very safety and existence of our country, depends on the quality of scientific technical training of those who are to guide and control our industries. With the present rapid growth of knowledge, specialism of a high order is necessary to success."

MINIMUM LIGHTING RATE UPHELD.—The Supreme Court of Arkansas has reversed a lower court decision, which held that a minimum monthly charge for electric service was illegal. In its opinion the upper court states that "a regulation of the charges for such service should be just to the company as well as to the patrons, so as to allow compensation to the former and reasonable, uniform rates to the latter, according to the amount of the commodity consumed. One class of patrons should not be favored at the expense of another. And we do not hold that a regulation of charges, based exclusively on the number of units of the commodity consumed, and confined to a fixed charge for each given number of units consumed, would not be sustained if found to be just to the company and all its patrons."

A SIMPLE EXPLANATION.—The Montreal *Standard* says that the explanation of the method of determining the location of a break in a telegraph circuit is simple, and then gives the following description of the method: "It requires, as everyone knows, considerable force to send electricity through a wire. The longer the wire, the greater, of course, must be the force required. This force is measured in units called by electricians 'ohms.' Let us suppose that wire between a Montreal office and a point 150 miles away has broken somewhere. The telegrapher knows that when the wire was intact there were required, say, 2100 ohms to facilitate the current, or 14 ohms to the mile. He now finds that he can send a current with only 700 ohms. Dividing 700 by 14, he finds that the break in the wire is 50 miles from his end."

VITIATION OF AIR BY GAS.—In a recent elaborate investigation in the Laboratory of Engineering Chemistry, Boston, by Mr. Arthur D. Little, it was found that in a fairly well-ventilated room the presence of a man caused an increase in the carbon dioxide content of 2 to 2½ parts, while the combustion of gas raised the amount of carbon dioxide 3½ or 4 parts.

MARINE STREET LAMPS.—A prominent American scientist is quoted as saying that as the light efficiency of luminous sea animalculæ is roughly about 14 times better than the efficiency of the best electric light when measured in heat units, he believed that if a sufficient amount of money were put behind biologists in the next 20 years, they might so improve and develop the breed of such animalculæ that every street lamp would in fact be an aquarium.

PHYSICAL NOTATION.—At the recent meeting in London of the International Congress of Applied Chemistry, a system of physical notation, presented jointly by the Faraday Society and Bunsen Gesellschaft, was adopted. Prof. Charles Marié, of the Sorbonne, Paris, also presented a report from the Société de Chemie Physique on physical constants and numerical values, and upon motion an international committee was appointed to consider the definite formulation of such data.

NATIONAL DAYLIGHT ASSOCIATION.—The National Daylight Association of Cincinnati, O., has started a press campaign to interest the country generally in legislation for "More Daylight." The movement for setting back clocks for one hour between May 1 and Oct. 1 originated in England last year, and recently an ordinance was passed to give it effect in Cincinnati. The object of the present association is stated to be "the saving of one hour of daylight each day for five summer months—May 1 to Oct. 1—of each year to all the people of the United States."

ELECTRICITY IN GAS WORKS.—Mr. Caryl D. Haskins in a recent address, and in illustrating the widespread uses of electricity, remarked that any gas authority will say, if he is questioned very closely, that no modern gas works should be without electric service. The most modern gas plants, built, say, in the last two or three years, use an average of about 1 kw-hour for every 1000 ft. of gas produced. The tar pumps, the water pumps, and the coal conveyors, the blowers, all heretofore extravagantly operated by wasteful steam lines and more wasteful engines, have gone, and as one gas man said recently, "Of course we don't advertise it, but electricity is really the only safe thing to light a gas works with."

RIGHT OF SUBSCRIBERS TO TELEPHONE SERVICE.—By a recent decision of the Iowa Supreme Court an interesting legal point in relation to the use of the telephone was settled in that State. A subscriber to the Marcy Mutual Telephone Company, of Boone, was alleged to have listened over the line and to have used profane and abusive language. The company took out the man's telephone. Later the subscriber promised to amend his ways, but the company refused to replace the instrument. The man brought suit against the telephone company to have service, and the court ordered the telephone put in. The company appealed to the Supreme Court, where the decision of the lower court has now been upheld.

CHICAGO ELECTRIC CLUB OUTING.—As chairman of the entertainment committee, Mr. J. J. Schayer reported at the meeting of the Electric Club, of Chicago, on July 7, that arrangements were well under way for the outing of the club at Michigan City on Saturday, July 17. It is expected that a party of about 300, including ladies, will board the steamer *Theodore Roosevelt* at the Clark Street bridge, Chicago, at 10 a. m. on that day, proceeding to Michigan City, where a midday dinner will be served. In the afternoon there will be various races, games and athletic contests, including a baseball match. Returning, the members of the club will leave either at 4 p. m. or at 7:45 p. m. Tickets are sold at $1.50 each, and this includes the dinner at Michigan City.

BUFFALO LINE-WIRE THIEVES.—The Buffalo & Lake Erie Traction Company and other concerns in southern Erie and Chautauqua counties, have lately been troubled by wire thieves. Early Thursday moning the arrest of one of the gang was accomplished, and he was held to await the action of the grand jury. The accused was caught while engaged in cutting the cable at the top of a pole near the Portland substation, he having already stripped six poles. Four men and a horse and wagon were found nearby. The prisoner proved to be a former lineman of the traction company. The damage has been estimated at $500, besides that due to the stopping of the cars running directly from Buffalo to Westfield for about a week.

EARLY CENTRAL-STATION PRACTICE.—In an interesting address recently delivered at the first annual convention of the Brooklyn Company N. E. L. A. Section, Mr. Caryl D. Haskins recalled some experiences of 21 years ago when he was on the staff of the London Grosvenor Gallery central station. The station had no heavy-current ammeters, and the deficiency was supplied as follows: A slot-like trough was cut in a block of wood, and terminals attached at either end of the slot, with a body of mercury connecting the terminals. This crude apparatus was calibrated against a Kelvin balance using an ordinary glass-bulb thermometer immersed in the mercury, and in routine use the current passing through the "instrument" was determined by a reading of the same thermometer. In the same plant knife-blade switches were used to handle the 2200-volt circuits, and for use in switching there were provided pieces of 2-in. belting about 2 ft. long, each with a wooden handle. The rule was to take the switch firmly in the right hand and the piece of belting firmly in the other, pull out the switch, and then "swat" the arc with the belting. Referring to early power service in this country, Mr. Haskins quoted the following rule established by a central station for testing recording meters on power service: "Examine the installation. Estimate the work being done by the motor in horse-powers. Multiply by 746. Test the meter by the customary formula. If meter checks within 10 per cent, correct. If not, estimate the horse-power again."

BOOMING GAS.—A London contemporary gives the following account of enterprise on the part of an English gas company, which story carries a lesson for the wide-awake central-station man: In one of the better-class London suburbs, the gas company arranged with a local builder to pipe, free of all cost, any houses which he erected. When several of the residences had been completed the company prevailed upon the builder to finish one completely ready for occupation, and it fitted up this house with every gas-consuming device likely to be adopted by a tenant. The appliances installed include gas fires, a gas-heated copper, gas cooker, geyser in the bathroom, hot-water circulator, and attractive pendants and brackets in all the rooms. These can be shown in operation to any caller. A tenant taking one of the neighbors of the sample house is invited to have any or all of the fittings exhibited, and to pay for them outright at a substantial discount from the list prices, or to use them under a hire-purchase, or rental scheme, no charge being made for the cost of installation or for the original piping. Bills are printed by the company advertising the property, and in return for this publicity of his houses, the builder is asked to use them under a hire-purchase, or rental scheme, with no charge to conduct victims through the place. Our contemporary adds that such enterprise is worthy of a better cause, and that it now devolves upon central stations to take a leaf out of the gas companies' book and adopt similar methods for promoting the introduction of electricity into small and medium-sized residential property. Having suitable fittings in position, with lamps running and everything in readiness for use, is by far the surest means of obtaining a consumer.

Electrical Installation of a Publishing Company.

ONE of the most completely equipped, electrically operated industrial plants of the East is the installation of the Phelps Publishing Company, of Springfield, Mass., which is the home of the magazines *Good Housekeeping, Orange Judd Farmer, Current Events, American Agriculturalist, New England Homestead, Farm and Home, Popular Fashions* and the *Woman's Home Journal.* The Phelps company is an organization of long standing in Springfield, but about two years ago the original plant of the company was destroyed by fire, and it was decided to rebuild on substantially the same site, equipping the plant with the electric drive and illumination. Under the general management of Mr. Herbert Myrick the work was pushed through to completion, the engineering plans and plant construction being prepared and superintended by Mr. George T. Gilbert, consulting engineer of the company.

The Phelps Building is an eight-story reinforced-concrete structure, 280 ft. long by 105 ft. wide, with basement and a roof photo-engraving department. The plant is located on a lot bounded by Worthington, Broadway and Bridge Streets, near the business center of the city. The reinforced-concrete work was done by the Turner Construction Company, of New York. The electrical equipment is of particular interest because every machine is driven by a motor, and the illumination is almost

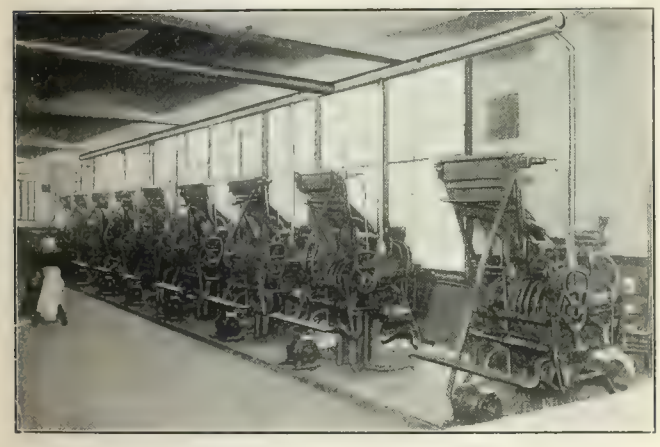


FIG. 1.—MOTOR-DRIVEN LINOTYPES.

entirely accomplished with tungsten lamps. The company has a power plant with a normal rating of 585 kw in the basement. The wiring is carried in iron conduit, and flexible control is effected by a 30-panel switchboard 60 ft. length located in the engine-room.

The generating equipment is steam driven. A coal pocket of reinforced concrete, holding 300 tons, is located beneath the street level so that the fuel can be delivered by gravity from wagons. Draft is provided by a concrete-steel stack 174 ft. high and 6 ft. in inside diameter. On the top of this stack are 64 display lamps of 2-cp each, mounted on a ring and supplied with electricity through a roller contact which enables any lamp to be replaced with ease. On the summit of the flagpole, 175 ft. above the street, are mounted 12 lamps of 16 cp each for advertising purposes.

There are one 440-hp Babcock & Wilcox and two 250-hp Atlas water-tube boilers in the plant, built for 200 lb. pressure and operated at a pressure of 150 lb. The boilers are equipped with Murphy automatic stokers located 7 ft. 6 in. above the floor, and coal is handled from the storage pocket by a 1-ton Sprague electric hoist running on a suspended I-beam having a minimum radius of 12 ft. The hoist runway forms a complete loop, and the trolley is composed of two 2-in. x 2-in. I-beams bonded together and attached about 18 ft. above the floor. The bucket used in the coal-handling system has a capacity of 300 lb., and provision is made for the removal of ashes from the ash pits by a runway located 7 ft. above the floor and connecting with a freight elevator leading to the street level. The motor operating the hoist is a direct-current, 240-volt machine. There are two Warren & Deane feed pumps for boiler service The stokers are steam-driven, and a 500-hp National feed-water heater is in service, a smaller heater of the same type being available for domestic hot-water supply. A 12-in. main and a 10-in. main lead into the engine-room from the boiler-room, branches being taken off for the different generating units. An 8-in. auxiliary main is also run through the plant The exhaust steam is carried to the feed-water heaters in a 12-in. line, there also being an 18-in. connection to the atmosphere for free exhaust.

The generating units comprise four direct-connected sets, three rated at 35 kw, 100 kw and 150 kw, consisting of Westinghouse three-wire, compound-wound, 240-volt, direct-current generators driven by American Ball horizontal, single-cylinder,

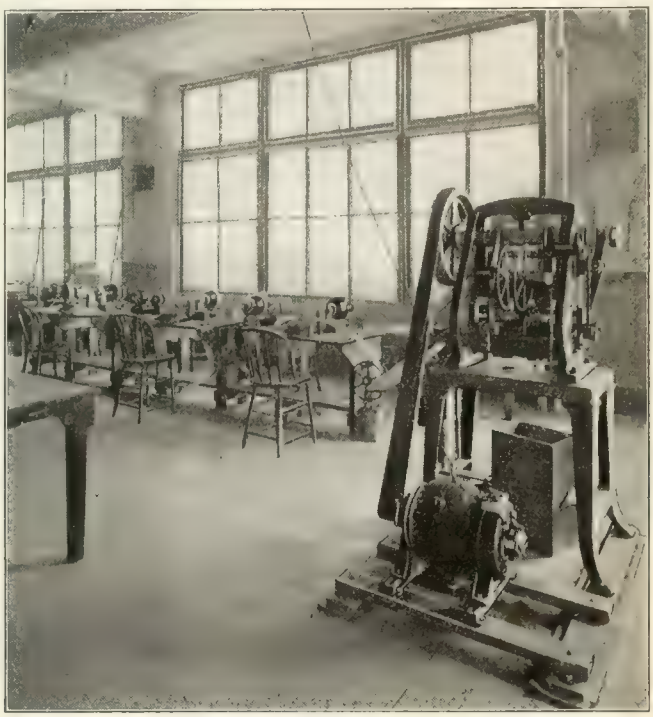


FIG. 2.—MOTOR-DRIVEN RELIEFOGRAPHS AND PUNCH PRESS.

high-speed, non-condensing engines. The largest unit (300 kw) is driven by a Hewes & Phillips compound engine. There are also in service a 40-kw, 240/120-volt balancer set and a 75-kw, 260-volt, compound-wound booster, direct-connected to a 105-hp, 240-volt direct-current motor. The first machine takes care of a positive or negative variation of 10 per cent on the lighting load, which is supplied from the same generators that handle the motor requirements of the installation. The booster is installed for the purpose of supplying power to a number of 500-volt direct-current motors of the company which survived the fire, and it is connected in series with the 240-volt busbars so that both 500-volt and 240-volt service, as well as 120-volt lighting service are available in different portions of the plant. The switchboard is of black slate and was designed and built by the Trumbull Electric Manufacturing Company, of Plainville, Conn. It consists of nine three-wire direct-current feeder panels for lighting service; one three-wire balancer and bus circuit-breaker panel; four direct-current generator panels; two blank generator panels; six 240-volt, direct-current motor feeder panels; one ammeter panel; four 500-volt, direct-current motor feeder panels; one direct-current motor panel, and one direct-current booster panel. In case of an accident to the booster, two generators may be electrically connected together in series. A differential relay is connected across the lighting busbars of the board and arranged to trip a circuit-breaker in one outside bus in case of a dangerous unbalancing of the voltage in the three-wire system. With the board are provided two



FIG. 3.—SWITCHBOARD.

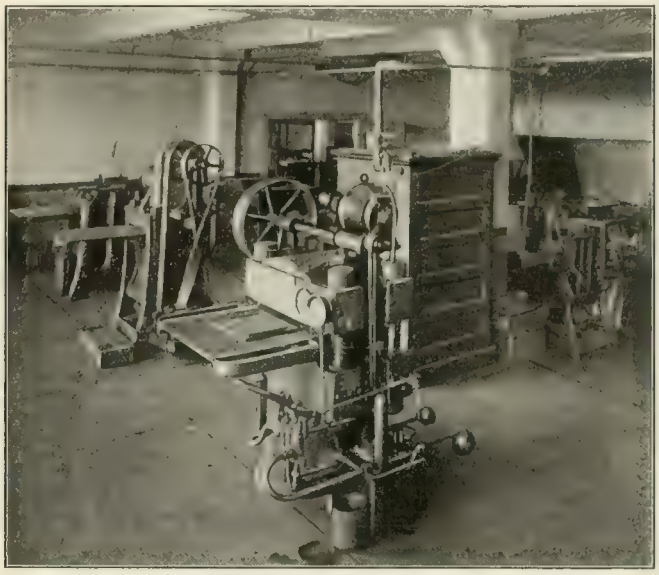


FIG. 4.—MOTOR DRIVEN MOLDING-PRESS IN TYPE FOUNDRY.

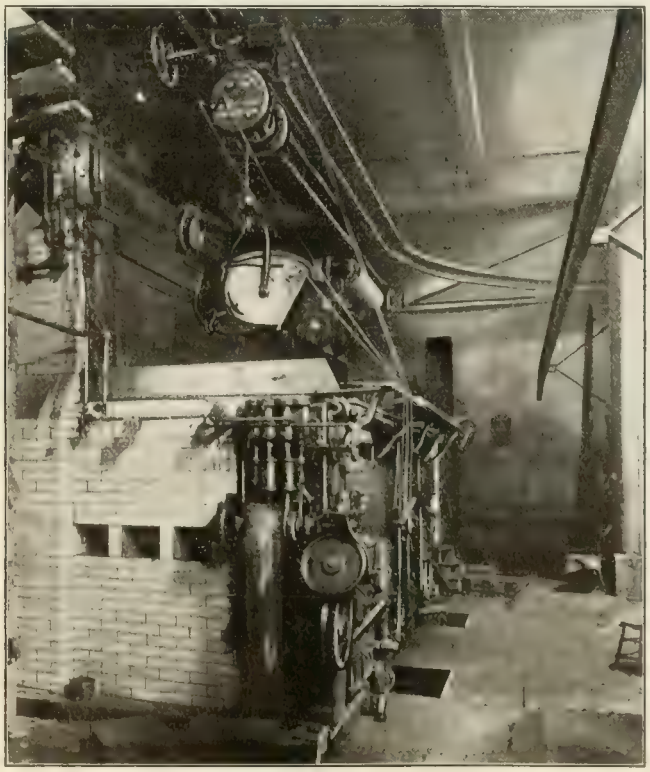


FIG. 5.—ELECTRIC COAL CONVEYOR, SPRAGUE HOIST, IN BOILER ROOM.



FIG. 6.—ENGINE ROOM.



FIG. 7.—PLATING-ROOM.



FIG. 8.—MOTOR-DRIVEN METAL SAWS AND ROUTERS.

ELECTRICAL INSTALLATION OF A PUBLISHING COMPANY.

voltmeters, one to indicate voltage on either side of the balancer, of any generator and of the booster, by means of suitable receptacles located on the machine panels, and the other being connected to indicate the potential across the 500-volt busbars through a receptacle on the booster panel, and the ground voltage to the 120-volt, 240-volt and 500-volt busbars through receptacles on the ground-detector panel. Each motor feeder circuit contains an ammeter shunt with leads running to the ammeter panel, a plug switch being used to throw any circuit upon the proper instrument. When shunting a motor feeder circuit through the ammeter for a reading, the circuit-breaker attached to that circuit is opened, each circuit being provided with an automatic circuit-breaker manufactured by S. B. Condit, Jr., & Company, Boston. No fuses were used on the motor panels of the switchboard. The circuit-breaker located on the bus circuit panel between the motor and the lighting divisions of the switchboard is of 4000 amp capacity at 240 volts.

In general, the feeder conduits for motor and lamp circuits are of 1.5-in. pipe, and the building is divided into two equal parts with separate wells for the risers feeding each half of the establishment. One lamp and one motor distribution box are located between each floor in the shaft, and from these boxes short runs of distributing feeders are made to the floor levels, where the conduits are carried horizontally across and through the floor structure in such a way that the riser shaft boxes supply adjoining floors. That is, the lighting feeders from a riser box in the shaft between the fifth and sixth floors serve, for example, the ceiling of the fifth floor, while the motor feeders branching from the corresponding motor distribution box between the fifth and sixth floors run downward to a horizontal fanning out at the fifth floor. The building is divided into a large number of bays 20 ft. square, there being 70 bays per floor. Each bay is provided with an average of one motor and two lamp outlets, the former being in the floor and the latter in the ceiling. To enable the connections to be made with ease when they are wanted, there were left in the concrete construction of the ceilings and floors over 7000 tin-sleeved wooden plugs 1⅜ in. in diameter, three being allowed per bay for the running of flexible wires where needed.

Tungsten lamps with prismatic glass shades are used extensively on the different floors except where special conditions enabled other types of lamps to be employed. In general, each corridor landing is lighted by one 40-watt tungsten lamp, and in long corridors one such lamp is allowed to each 20-ft. bay. The general offices are lighted with 25 4-lamp tungsten fixtures, 60-watt units being used in each socket. Prismatic glass shades are hung 11 ft. above the floor, and the office area is about 400 sq. ft. In the mailing-room the company uses a Cooper Hewitt mercury-vapor lamp in each 20-ft. bay. In the composing-room each 20-ft. bay is equipped with a Cooper Hewitt new curved-tube lamp, operated in series with a 2-amp, 120-volt tungsten lamp, with prismatic glass bowl 11 ft. above the floor. The pressroom is equipped in general after the manner of the main offices, the fixtures having gun-metal finish. In the photo-engraving department two sets of Cooper Hewitt lamps are used for photographic work, and there are eight 40-amp arc lamps for printing negatives. There are eight dark rooms, each provided with a sliding-screen window of yellow or red glass, an ordinary 16-cp carbon-incandescent lamp being hung outside. The main pressroom has 12 120-volt enclosed arc lamps of the portable type, and the press frames are wired on all landings for incandescent lamp connections. All the lighting panel boards are provided with terminals for the attachment of meters in case the company rents any floor or office section to other parties. A number of tenants are now served in this way.

The variety of uses to which the motors are put and the sizes of motors required cover an extended range. It is the company's intention to gradually weed out the 500-volt motors as they become worn out and replace them with 240-volt machines. Ultimately the plant will be equipped for straight 240-volt and 120-volt service. The following data on motors include the machine equipment of all departments of the Phelps Company:

PHOTO-ENGRAVING DEPARTMENT.

One ¾-hp Sprague, shunt, 2100 r.p.m.—one Royle router, 10,000 r.p.m.
One ½-hp Sprague, shunt, 1320 r.p.m.—one beveler.
One ¾-hp Sprague, shunt 2000 r.p.m.—one Royle router, 2000 r.p.m.
One ¼-hp Sprague, shunt, 1400 r.p.m.—one combination jig saw and drill press.
One ½-hp Sprague, shunt, 1320 r.p.m.—one Royle trimmer.
One ¾-hp Sprague, shunt, 2150 r.p.m.—one Royle circular saw, glass eye-protector.
One ¾-hp Sprague, shunt, 2130 r.p.m.—one Royle circular saw, glass eye-protector.
One 1/20-hp Emerson, shunt, 1750 r.p.m.—polisher and buffer.

PHOTOGRAPHIC GALLERY.

One roof fan motor, Sprague, vertical shaft, shunt, 1500 r.p.m.
One 1-hp fan, diameter 24 in., to extract fumes from dark room.

GENERAL OFFICES.

Three Burroughs adding machines, approximately 1/20-hp motor, each direct driven.
One Burroughs computing machine, approximately 1/20 hp motor, each direct driven.

MAILING LIST DEPARTMENT.

Eight Sprague motors, ⅛-hp shunt, 1650 r.p.m., each driving a reliefo-graph.
Three Sprague shunt motors, ½-hp, 1300 r.p.m., each driving a Dick mailer.
One 1-hp Sprague shunt motor, 600 r.p.m., driving Pollard-Alling punch press.
One ½-hp Sprague motor, shunt, 1350 r.p.m., driving dotting machine.
Two ½-hp Sprague motors, shunt, 700 r.p.m., driving two wrapper presses.

LINOTYPE DEPARTMENT.

Nine ¼-hp Sprague, shunt, 340 r.p.m., each driving a linotype machine.

ELECTROTYPE FOUNDRY.

One 1-hp Sprague, shunt, 1400 r.p.m.—one trimmer.
One 1-hp Sprague, shunt, 1400 r.p.m.—one saw.
One 1-hp Sprague, shunt, 1400 r.p.m.—one end plate trimmer.
One 1-hp Sprague, shunt, 1400 r.p.m.—one tail trimmer.
One 3-hp Sprague, shunt, 1140 r.p.m.—One curved router.
One 2-hp Sprague, shunt, 1160 r.p.m.—one curved router.
One 2-hp. Sprague, shunt, 1300 r.p.m.—one curved router.
One 1-hp Sprague, shunt, 700 r.p.m.—one bender.
One 1-hp Sprague, shunt, 700 r.p.m.—one bender.
One 1-hp Sprague, shunt, 1400 r.p.m.—one small shaver.
One 2-hp Sprague, shunt, 1250 r.p.m.—one rougher.
One 2-hp Sprague, shunt, 1250 r.p.m.—one large shaver.
One 2-hp Sprague, shunt, 1300 r.p.m.—one rougher.
One 2-hp Sprague, shunt, 1300 r.p.m.—one metal saw.
One 1-hp Sprague, shunt, 1350 r.p.m.—one metal saw.
One 1-hp Sprague, shunt, 1450 r.p.m.—one trimmer.
One ½-hp Sprague, shunt, 1550 r.p.m.—one flat bed router.
One ½-hp Sprague, shunt, 1500 r.p.m.—one jig saw and combination drill.
One 2-hp Sprague, shunt, 1160 r.p.m.—one wax shaver.
One 4-hp Sprague, compound, 800 r.p.m.—one United molding press.
One 5-hp Sprague, shunt, 1100 r.p.m.—one Hoe molding press.
One 3-hp Sprague, shunt, 1300 r.p.m.—one Hoe hydraulic molding press.
One 1-hp Sprague, shunt, 1350 r.p.m.—one electrolytic pump.

ELECTROPLATING COPPER-ROOM.

Equipment:
Three electrolytic tanks, each 6 ft. by 30 in. by 33 in.
Three 5-volt, 1000-amp, bipolar generators.
Motors:
Two 10-hp Sprague, shunt, each direct connected to a 1000-amp generator.
One 10-hp Sprague, shunt, each direct connected to a 1000-amp generator.
One 3-hp Sprague, shunt, driving 20-in. fan for fume extraction.

PRESSROOM, FIFTH FLOOR OF BUILDING

One 2-hp Sprague, shunt, 1400 r.p.m.—one paper cutter, 34 in.
One 25-hp Sprague, shunt, 800 r.p.m.—one Hoe press.
One 10-hp Sprague, compound, 600 r.p.m.—one Cottrell press, G. E. controller.
One 15-hp Sprague, compound, 1150 r.p.m.—one four-color Cottrell press.
One ½-hp Sprague, shunt, 1350 r.p.m.—one rewinder.
One 6-hp. Sprague, compound, 600 r.p.m.—one No. 9 Scott press.
One 5-hp Sprague, compound, 800 r.p.m.—one Compbell press.
One 5-hp Sprague, compound, 800 r.p.m.—one Optimist press.
One 5-hp Sprague, compound, 600 r.p.m.—one No. 7 Scott press.
One 8-hp Sprague, compound, 850 r.p.m.—one No. 10 Scott press.
One 3-hp Sprague, shunt, 1200 r.p.m.—one White cutter.
One 2¾-hp Sprague, shunt, 600 r.p.m.—one Cottrell folder.
One 2¼-hp Sprague, shunt, 650 r.p.m.—one Cottrell folder.
One 3-hp Sprague, shunt, 1200 r.p.m.—one Hercules book press.
One ½-hp Sprague, shunt, 1400 r.p.m.—four Universal stitching machines.
Two 4-hp Sprague, compound, 800 r.p.m.—(total) two Miehle presses.
Two 2-hp Sprague, shunt, 1300 r.p.m.—each drives one covering machine.
One 4-hp Sprague, shunt, 950 r.p.m.—one gathering machine.
Five 1-hp Sprague, shunt, 1200 r.p.m.—each drives one job press.
One ½-hp Sprague, shunt, 1450 r.p.m.—one American press.

PRESSROOM IN BASEMENT.

One 25-hp Sprague, compound, 800 r.p.m.—one Scott magazine press.
One 50-hp Sprague, compound, driving one Cottrell four-color newspaper press, with 10-hp teazer motor for slow speed work, operated by motor-control panel switches; also one 7.5-hp motor for partial operation at slow speed.
One 50-hp Bullock, compound, 650 r.p.m.—driving one Hoe newspaper press; also one 10-hp Bullock for slow speed operation. Bullock control.
Two 1-ton paper hoists, Sprague.
One ½-ton paper hoist, Sprague.
Note on control:
Scott magazine press equipped with Kohler single-motor control.
Cutler-Hammer controllers used in part in press room on fifth floor.

CARPENTER SHOP.

One 10-hp Sprague, shunt motor, drives 1/16-in. circular saw, one mortising machine and one grindstone.

Mr. Thomas Walling is chief electrician of the Phelps Company's plant.

Experimental Method for the Analysis of E.m.f. Waves.

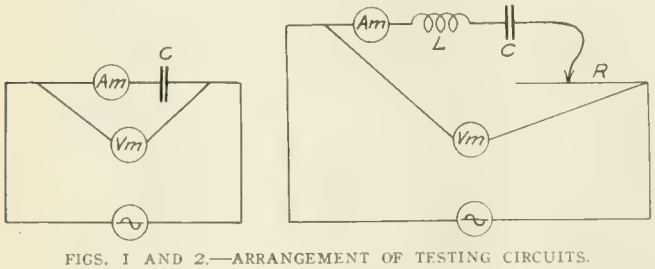
By P. G. Agnew.

It is often of importance, both in physical and in engineering work, to obtain a knowledge of the harmonics present in the e.m.f. wave of a generator. While several types of apparatus are commercially obtainable, notably oscillographs and curve tracers, which trace the wave with various degrees of accuracy, most of such apparatus is elaborate and expensive. After the curves are obtained the ordinates at a specified number of points are accurately measured and from the results the amplitudes of the various harmonics are calculated. The arithmetical computation of these Fourier coefficients has been greatly simplified within the last few years by methods developed by a number of different investigators. In some forms of apparatus the curve is not obtained automatically, but the ordinates are given directly by point-to-point methods. Of some 20 methods summarized by Orlich[1] all but one, the method of resonance due to Dr. M. I. Pupin, require highly specialized apparatus.

Dr. Pupin[2] passed the current to be analyzed through a non-inductive resistor, around the terminals of which he connected a tuning circuit, consisting of a condenser and an inductor of adjustable inductance. By adjusting for resonance with any desired harmonic, and by observing the rise of potential across the condenser by means of an electrostatic voltmeter, it is possible to calculate the amplitude of the harmonic. But even in his case it is necessary to have at hand inductors of a relatively wide range of adjustable self-inductance and electrostatic voltmeters with a considerable range of sensitiveness.

The experiments here described were undertaken to determine whether it is possible to get an approximate value of the first and second harmonics present in an e.m.f. wave by means of ordinary portable instruments and calibrated condensers.

A distorted e.m.f. wave will pass more current into a condenser than a pure sine wave having the same effective value. One ought, then, to be able to use this fact to determine the amplitudes of the harmonics to which the distortion is due. For simplicity, suppose the third harmonic only to be present, and let E be the reading of the voltmeter and I that of the ammeter (Fig. 1). If E_1 and E_n represent the e.m.fs. of the fundamental and harmonic, then one may consider that they cause the respective currents i_1 and i_n to flow in the condenser.



FIGS. 1 AND 2.—ARRANGEMENT OF TESTING CIRCUITS.

If C is the capacity and ω is 2π times the frequency of the fundamental, and if the resistance of the ammeter be neglected

$$E^2 = E_1^2 + E_n^2; \qquad i_1 = E_1\omega C$$
$$I^2 = i_1^2 + i_n^2; \qquad i_n = E_n n\omega C$$

Thus there are obtained four equations connecting E_1, E_n, i_1, i_n, from which these four quantities may be calculated. This process is the inverse of that sometimes employed in correcting for wave form, for example, in the three-voltmeter method of measuring inductance. Theoretically it could be extended to any number of harmonics. Preliminary experiments on waves, obtained by combining e.m.fs. of different frequencies in known proportions, indicated that the method was limited by the unavoidable errors to the determination of one harmonic, and that it did not give good results even then. Of course, account must be taken of the resistance and inductance of the ammeter. It is evident that it is extremely difficult to obtain indicating instruments whose error is, for example, not greater than 0.1 per cent, under the conditions of frequency and wave form implied.

[1] Orlich, "Aufnahme und Analyse von Wechselstromkurven," Braunschweig; 1906.
[2] *Am. Journal of Science*, 48; pp. 379, 473, 1894.

METHOD EMPLOYED.

The necessity of knowing the absolute values of the current and voltage may be avoided by substituting a resistor in place of the condenser and adjusting the resistance to give the same settings on the ammeter and the voltmeter as were observed with the condenser. This is really making the ultimate measurement that of an impedance rather than that of an e.m.f., as will be seen by developing the formula for the ratio of the harmonic to the fundamental e.m.f. Suppose that the third and the fifth harmonics are present. Let L be the total inductance, and R the total resistance of the circuit, shown in Fig. 2. Then the three components of current are

$$i_1 = \frac{E}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$$

$$i_3 = \frac{E_3}{\sqrt{R^2 + \left(3\omega L - \frac{1}{3\omega C}\right)^2}}$$

$$i_5 = \frac{E_5}{\sqrt{R^2 + \left(5\omega L - \frac{1}{5\omega C}\right)^2}}$$

These three currents, being of different frequencies, combine

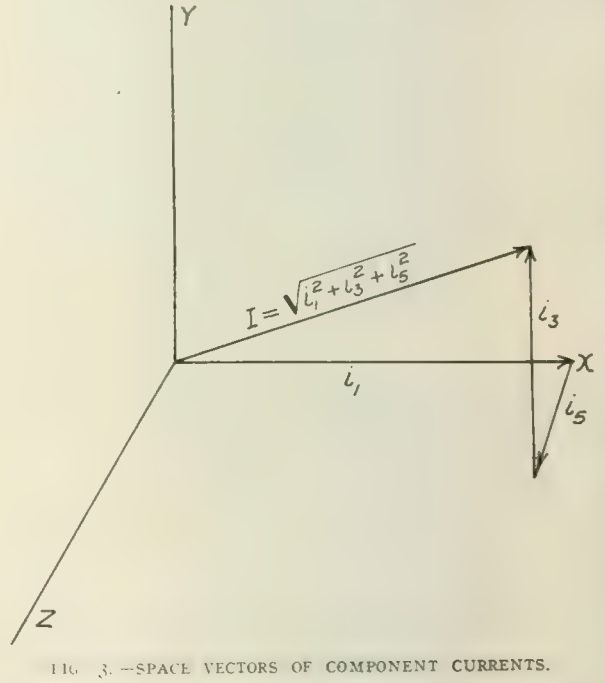


FIG. 3.—SPACE VECTORS OF COMPONENT CURRENTS.

to give a resultant as though they were mutually in electrical time-quadrature with each other. The resultant current is, therefore,

$$I = \sqrt{i_1^2 + i_3^2 + i_5^2}.$$

It is evident that a certain value of the current I can be made up of any number of combinations of i_1, i_3 and i_5, and that a knowledge of the actual values of R, L and C for each adjustment can be used for determining the relative values of E_1, E_3 and E_5.

Let us choose a value of C such as to make R small, and denote by a_1, a_3, a_5 the squares of the impedances for the three components of e.m.f., or the expressions under the radical signs in the denominators above; now choose a second value of C and adjust R for the same readings of total current and total e.m.f., I and E, calling the new values of the squares of the impedances a_4, a_5, a_6. Finally, short-circuit the condenser,

again adjusting R for the same readings of I and E, giving, correspondingly, a_1, a_3, a_5. Then if we put

$$m_1 = \frac{1}{a_2} - \frac{1}{a_4}; \quad m_4 = \frac{1}{a_3} - \frac{1}{a_5}$$

$$m_2 = \frac{1}{a_3} - \frac{1}{a_5}; \quad m_5 = \frac{1}{a_6} - \frac{1}{a_8}$$

$$m_3 = \frac{1}{a_1} - \frac{1}{a_7}; \quad m_6 = \frac{1}{a_4} - \frac{1}{a_7}$$

it may easily be shown that

$$\frac{E_3}{E_1} = \sqrt{\frac{m_1m_5 - m_2m_6}{m_2m_4 - m_1m_5}}$$

$$\frac{E_5}{E_1} = \sqrt{\frac{m_1m_6 - m_3m_4}{m_2m_4 - m_1m_5}}$$

The relations between the several component currents are clearly shown in the diagram of Fig. 3.

The fundamental current is represented by the x co-ordinate of a system of space vectors, i_3 by the y and i_5 by the z co-ordinate. The resultant vector, I, then represents the combined current. The relative magnitudes of the component currents are next changed by altering the constants of the circuit. The vector I remains of the same length, but rotates to a new position. The constants of the circuit being again changed, the end of the vector I again changes to a third position on a sphere of radius I. The solution of the spherical triangle determined by the three positions of the end of the vector I, when the several component vectors are changed by known percentages, allows one to assign definite values to each vector, as desired.

This graphical representation shows that the analysis of a much distorted wave will give values which are not only relatively, but absolutely, more accurate than that of a wave which is nearly sinusoidal. A determination is made of the sines of small angles by the changes in the cosines of the angle, and thus the method cannot be expected to yield reliable values of harmonics which are present to the extent of only a per cent or so. Accordingly, if in a numerical calculation a component comes out as a small imaginary quantity of *the above order of magnitude*, it should be taken to be zero so far as the accuracy of the method indicates.

EXPERIMENTAL CONDITIONS FOR GREATEST ACCURACY.

The quantities which enter into the calculation are resistance, inductance and capacity, which depend directly on bridge measurements, together with the frequency. It is to be noted that the only thing required of the voltmeter is sensibility, as, in each case, it is set at the same point and is working on the same frequency and wave form. The same is true of the ammeter with respect to scale errors and the effect of frequency on its readings, but the wave form of the current changes slightly between readings. However, if the ammeter is affected by change in wave form, the error enters only differentially.

Two values of capacity are required for the determination of two harmonics. It has been found by experiment that the ratios of the two values of capacity employed may conveniently lie between 1.5 and 2, for the cases of nearly sinusoidal and much distorted waves, respectively. With such a ratio, and when R_1 (the first value of the resistance) is kept as low as possible, R_2 (the second value) will be, roughly, half of R_3 (the third value), thus giving good spacing. As shown below, the use of good paper condensers and soft-iron ammeters will give fairly accurate results on badly distorted waves, but for good waves it is better to use standard mica condensers with a dynamometer-ammeter, and the accuracy may be still further increased if an approximate value of the phase angle of the condensers is known. In case an alternating-current mil-ammeter is not available, the multiplier of an alternating-current voltmeter, preferably of the dynamometer type, may be short-circuited, thereby affording a mil-ammeter which requires from 0.05 amp to 0.1 amp for full-scale deflection. The recently introduced type of thermo-ammeter has the advantage of having a negligible inductance and extremely low resistance, but the needle is so slow in assuming its final position that the supply must be very steady to get consistent readings. Yet some inductance is of advantage in that it may be used to neutralize the reactance of the condenser, and also to reduce the effect of the residual higher harmonics of which the formulas do not take account. It is necessary in analyzing very good waves that either the inductance of the circuit be made negligible, or that it be made of such a magnitude that its frequency of resonance with the capacity used shall be at least as low as the highest harmonic of which the formulas used take account. If this is not done, resonance may occur in the case of some neglected higher harmonic, bringing it out strongly in comparison with the lower ones of which the formula does take account, even though its amplitude in the e.m.f. wave may be negligibly small. It is usually easy and convenient in practice to bring the resonance point between the two harmonics of which account is taken, or even, roughly, to approach the conditions of resonance for both C_1 and C_2, the first and second values of the capacity,

$$9\omega^2C_1L = 1$$
$$25\omega^2C_2L = 1$$

with a single value of L. This is the ideal condition for accuracy, although for other practical considerations it is better to take C_1 and C_2 rather closer together than this condition requires. In fact, nothing is gained by attempting to make the tuning close.

By making settings on the ammeter and voltmeter well up on the scale, and allowing them to stand some little time with current on, so as to ensure steady conditions, the impedance settings may be made to 0.1 per cent, or slightly better under favorable conditions. Hence, the calculations should be carried to at least as great an accuracy.

A few other details will be considered in connection with some actual analyses.

In the first case, a badly distorted wave was obtained by connecting in series three machines from a harmonic alternator set, in which all of the machines are rigidly connected to the same shaft. The actual ratios of harmonics could be determined separately. The values given are corrected for slight impurities known to be present in the fundamental. Paper condensers, and an ammeter of the soft-iron type giving full scale for 0.5 amp, were used in this case. In the accompanying table of the data of the experiment, the harmonics are expressed in per cent of the fundamental.

$C_1 = 10.00$ microfarads. $R_1 = 10.2$ ohms.
$C_2 = 19.32$ " $R_2 = 85.0$ "
$L = 10.6$ millihenrys. $R_3 = 140.6$ "
Freq. $= 61.2$ cycles per second. $E = 33$ volts.
$i = 0.235$ amp.

	E_3	E_5
Calculated	33.6 per cent.	17.1 per cent.
Actual	32.2 "	16.7 "

With the same instrument and the same type of condenser the method was tried with a machine giving a wave approximately sinusoidal. When computed without allowing for the phase angle of the condensers, which averaged 14 minutes at 60 cycles, E_3 came out a fairly large imaginary quantity, and E_5 about 5 per cent. When computed, allowing for the phase angle of the condensers by adding to R the equivalent series resistance, $r = \tan\theta/\omega C$, due to the dielectric loss, better results were obtained. Here, as in the cases which follow, they are compared with the results of careful analyses, by Dr. M. G. Lloyd, some of which were obtained with a Rosa curve tracer, and others by means of a special rotating commutator designed by Dr. Lloyd and Mr. J. V. S. Fisher.

	E_3	E_5
Calculated values....	6.6 per cent	(small imaginary)
Curve tracer values..	7.0 "	2.0 per cent.

The phase angle of the condensers used was determined for

60 cycles. The same correction for phase was applied for each of the harmonics.

The following case is that of a combination wave from a three-machine motor-generator set, the third harmonic being the only one added:

$C_1 = 1.0037$ microfarads. $R_1 = 161$ ohms.
$L = 61.2$ millihenrys. $R_2 = 2082$ ohms.
$E = 198$ volts. $I = 0.08$ amp.
Frequency = 61.2 cycles per second.

E_3 (calculated)	24.6 per cent.
E_3 (actual)	22.5 "

The condenser was a mica standard, having a phase angle of 4 minutes at 60 cycles. The calculated value of E_3 is not changed by allowing for the phase angle of the condenser. The mil-ammeter used was of the dynamometer type, full scale reading 0.1 amp, resistance 160 ohms, inductance 61.2 millihenrys.

When used on a machine giving a good e.m.f. wave, 200 millihenrys were added to the circuit containing this mil-ammeter and the mica condensers, in order to suppress the residual higher harmonics, as explained above.

	E_3	E_5
Calculated values	7.2 per cent.	0 per cent.
Curve tracer values	5.5 "	1 "

Allowance for dielectric loss was necessary.

A still more rigorous test of the method was made by attempting to analyze the e.m.f. of a machine in which the third harmonic is practically negligible.

	E_3	E_5	E_7
Values by rotating commutator	0.6 per cent.	1.6 per cent.	1.0 per cent.
Calculated for third and fifth	(small imag.)	(small imag.)	
Calculated for third only	4.8 per cent.		
Calculated for fifth only		2.1 per cent.	

Evidently the most the method is capable of in the case of so good a wave is to indicate that the harmonics are extremely small. However, in a large number of engineering problems this result is all that is required. As explained above, the small imaginary quantities indicate that the wave is so nearly sinusoidal that a separation into three components is beyond the accuracy of the method. Either of the above values, rough though they are, namely, 4.8 per cent for the case where all the residuals are lumped together and computed as the third, or 2.1 per cent similarly obtained for the fifth, really gives a more adequate description of the wave than to call it exactly sinusoidal. At first sight it seems strange that an equally good or an even better result should be obtained by solving for only one harmonic than by trying to take account of two, but it is to be noticed that in the case of one harmonic only, the result depends on only two readings, in one of which the condenser is short-circuited, while in the other the current is so nearly in quadrature that a small change in the resistance component of the impedance is negligible. Similar instances, where an analysis for one harmonic only gives better results than one including two harmonics, may occur in machines of higher frequency.

The following refers to a 180-cycle machine:

	THIRD.	FIFTH.	SEVENTH.
Curve tracer values.	4.0 per cent.	0.4 per cent.	0.4 per cent.
Calculated for third and fifth	4.6 per cent.	(Imaginary)	
Calculated for third only	4.3 per cent.		

In this, as in the other cases of very good wave form, calculation for one harmonic only has the advantage of being nearly independent of the power loss in the condenser, the latter making in this particular case a difference of only 0.1 per cent.

For still higher frequencies where small values of capacity can be used, it would be advisable to employ an air condenser in order to avoid the uncertainty of correcting for the capacity and phase angle with frequency. In all other cases the condenser should be calibrated at the frequency used.

CONCLUSION.

From the foregoing it may be said that the accuracy of the method is intermediate between that of the curve tracer and that of the oscillograph; the error may be taken as not over 3 per cent of the fundamental.

It has the disadvantage of giving no idea of the phase relations, and hence of the form factor, and of not lending itself to the analysis of current waves, unless a considerable amount of power is available.

Its chief advantages are that no special apparatus is required and that the calculations are relatively simple. In case it is desired to know only whether or not the wave is nearly free from upper harmonics, all of the harmonics may be lumped together and computed as if the third alone were present, thus still further simplifying the observations and computations. In special cases a fairly complete knowledge of the impurities may be gained—for example, in the case of a star-connected, three-phase generator. If the wave be analyzed for the fifth and seventh, the first four odd harmonics are taken account of, since the third and ninth are automatically eliminated by the star connection. However, for the accuracy necessary in commercial work engineers have usually found that the third and the fifth are the only harmonics large enough to be of importance.

Another advantage of the method is that neither direct access to the generator nor the use of a synchronous motor is necessary so that observations may be taken at a distance from the machine.

The writer is indebted to Messrs. F. W. Grover and H. L. Curtis for the determination of the inductances, and the capacity and phase-angle of the condensers used, and to Mr. Louis Cohen for many valuable suggestions. In fact, the method was suggested by an investigation by Mr. Cohen of the differential damping out of harmonics in an alternating magnetic field by a copper slab placed in it.[5]

An Electrical Device for Solving Equations.

A paper has recently been presented by Messrs. Alexander Russel and Arthur Wright to the Physical Society of London on an interesting electrical device which can solve equations of the nth degree, evaluating each and all of the roots, successively, to a certain degree of precision, besides being capable of performing other mathematical accomplishments. The device consists of a set of resistance-coil slide-rules, whose conductances may be summed automatically by a specially designed Wheatstone bridge. When the galvanometer in the Wheatstone bridge shows that electrical balance has been obtained, it follows that all the conductances have been equated, and since each term in the equation to be solved is represented by its approximate conductance, the balance struck between them represents one particular solution of the equation, and, therefore, one root of the same.

If we consider the slide-wire Wheatstone bridge arrangement shown in Fig. 1, let PQ be the resistance wire, and let the slider O be clamped at the middle point. A certain conductance in mhos A_1B_1 is connected on the left-hand side, and two other such conductances a_2B_2 and a_3B_3 are connected on the right-hand side. It is evident that the galvanometer G will indicate a zero balance if the mhos on the two sides are equal; that is, if the sum of the mhos in a_2B_2 and a_3B_3 are equal to the mhos in a_1B_1. This addition of conductances required to produce a balance is the fundamental principle of the machine.

[5] A more detailed statement of the method will soon appear in the *Bulletin* of the Bureau of Standards.

Now consider a particular equation that the machine might be called upon to solve; let it be the cubic equation:

$$x^3 + a_2x^2 - a_1x + a_0 = 0,$$

where x is unknown quantity, and a_0, a_1, a_2 are given positive numbers. There are four terms in this equation: three coefficients being positive and one negative. We require then to use four conductances in the Wheatstone bridge, three on one side and one on the other, and to make these conductances balance

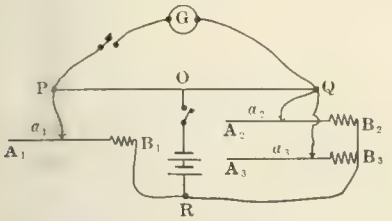


FIG. 1.—SLIDE-WIRE WHEATSTONE BRIDGE ARRANGEMENT.

electrically. Moreover, the individual conductances must be such that the first shall involve the cube of the unknown quantity, the second must involve a_2 times its square, the third a_1 times the quantity, while the fourth is constant at a_0.

A template of thin insulating material is cut in the specially calculated form *OSCY*, Fig. 2, and is then wound parallel to *OY* with thin insulated manganin wire, the turns lying parallel closely together, side by side, in a single layer. The insulation is scraped off the wire along the edge *OS* in such a manner that

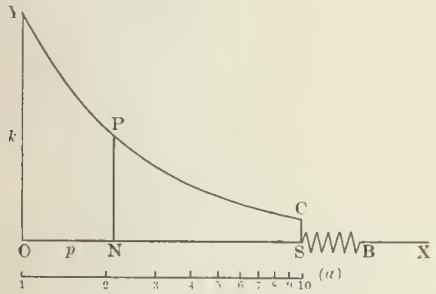


FIG. 2.—FORM OF INSULATING MATERIAL.

a rubbing contact slider can move along this edge. A fixed manganin resistance *SB*, of the proper value, is also added at *S*. Under these conditions the conductance in mhos between the traveling contact and *B* can be brought into conformity with the scale (*a*), which is also a logarithmic scale, or the scale of an ordinary logarithmic slide-rule. Thus, with the traveling contact at *S*, there will be 10 mhos between this contact and the terminal *B*, whereas, with the traveling contact at *O*, there will be only one mho between *O* and *B*.

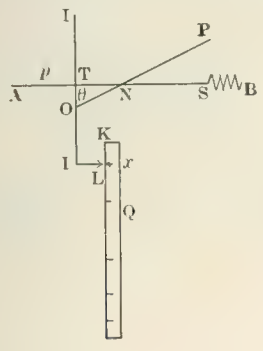


FIG. 3.—DIAGRAM OF CONTACT FINGER.

In order to work out the cubic equation given above, four such logarithmically scaled resistance templates are mounted side by side in a box, with their contact edges parallel. A set of contact fingers is then brought into communication with these contact edges. A contact finger is indicated diagrammatically in Fig. 3. *AS* is the contact edge of the template resistance, *OP* is the contact finger, which is a straight metal wire pivoted about the center *O*, in such a manner as to connect the point *O* with the edge of the template resistance at the point of contact *N*. The conductance in this template coil will then be the mhos between *N* and *B*, as per scale (*a*) Fig. 2. But the angle Θ which the contact finger *OP* makes with the initial line *LΓ'* is adjustable, and the finger can be clamped at any desired angle Θ, within required limits. In the case indicated by Fig. 3, let Θ be such that its tangent is, say, 2; then $TN = 2\,OT$ always. If we call OT x, then $TN = 2x$, and the distance AN is $p + 2x$. But on a slide rule this distance would correspond to a reading Px^2. If then we slide the bar II' in the direction II' or KL, so as to carry the sliding contact from T through N, the mhos between O and B through this contact will be px^2, up to the point when N runs off the contact edge at S. The value of x at any point in this journey will be indicated by the pointer L along the logarithm scale KQ. Consequently, if we read off x from scale KQ, the conductance automatically maintained between O and B through the traveling contact will be px^2 mhos as long as the contact finger keeps on the edge TS.

The full electric connections for solving the above stated cubic equation are shown at Fig. 4. Template A_3B_3 presents the first term x^3, the template A_2B_2 the second term a_2x^2, template A_1B the third term $-a_1x_1$, and template AB the fourth term a_0. The angle Θ of template A_3B_3 is, therefore, set to the antitangent of 3, the angle Θ of A_2B_2 to the antitangent of 2, that of A_1B_1 to the antitangent of 1, or 45 deg., and that of AB to the antitangent of O, or 0 deg. Moreover, the template

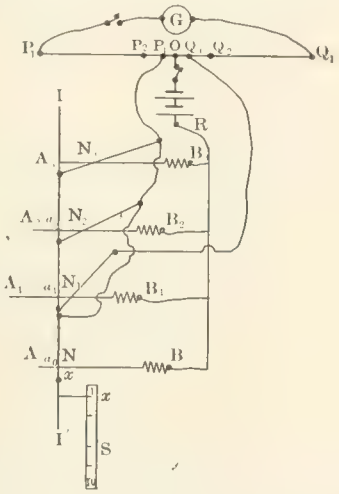


FIG. 4.—CONNECTIONS FOR SOLVING CUBIC EQUATION.

A_3B_3 is set with its mark 1 under the slide bar $IΓ'$, A_2B_2 is set at $p = a_2$ on its scale, A_1B_1 at $p = a_1$, and AB at a_0. Now, if the slide-bar pointer is set to any point $x = r$ on scale S, the mhos in A_3B_3 will necessarily be x^3, the mhos in A_2B_2 will be a_2x^2, the mhos in A_1B_1 will be a_1x_1, and the mhos in AB will be a_0. The templates A_3B_3, A_2B_2 and A_1B_1, respectively, the positive terms in the equation, are connected to the P side of the Wheatstone bridge; while the template A_1B_1, representing a negative term, is conected to the Q side. The bridge is then manipulated, and the slide bar $IΓ'$ slid along until balance is secured by the evidence of no current in the galvanometer. The distance x, on the scale S, is then one solution of the cubic equation.

If any of the contact fingers run off their contact edges during the travel of the slide bar to the balance point, that particular contact finger is reset, and its connecting wire is changed from P_3 to P_2 to P_1 or from Q_3 to Q_2 to Q_1 by decimal shifting distances on the slide-wire P_1Q_1. It will be found that this satisfies the numerical theory.

The instrument, which is stated to be the invention of Mr. Arthur Wright, is described as having a precision of about 1 per cent in the particular embodiment displayed with the paper. This precision, while adequate for many practical purposes, is capable of being increased by magnifying the scales and sizes of the parts.

From an electrical standpoint, since seven sliders and tem-

plates are illustrated as capable of being operated simultaneously for equations of the sixth degree, it is evidently important that the traveling contacts are all very clean and bright, otherwise erratic conductances and solutions might be expected.

The instrument ought not to be extremely expensive, and has many possible mathematical applications. For a more ample and detailed descriptions of its capabilities, the reader is referred to the original paper. It would seem likely that the instrument would be very useful in teaching the theory of equations, as well as in actually solving equations in practice.

Graphical Computation of Fourier's Constants for Alternating-Current Waves.

By Charles S. Slichter.

The harmonic analysis of alternating-current curves by the algebraic methods usually given in the books is tedious and leaves much to be desired. A number of harmonic analyzers have been devised to do this work mechanically, such as the Henrici planimeter and the Michelson and Stratton harmonic analyzer, both of which are very valuable for difficult work. However, the usual alternating-current curves are of so simple

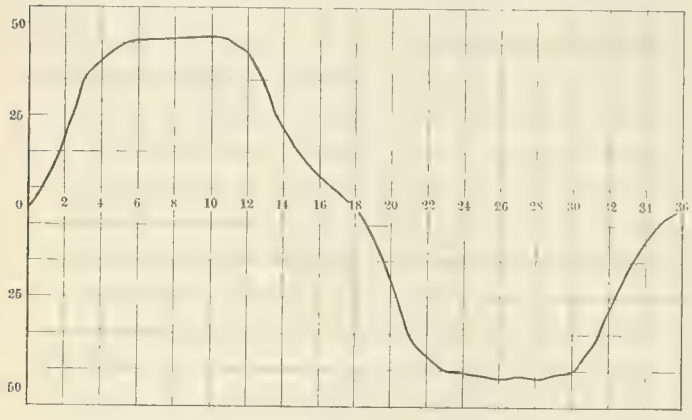


FIG. 1.—E.M.F. WAVE.

a type that it is quite possible to dispense with the more elaborate methods. In the first place, the alternating-current curves are usually built up of the odd harmonics only, and, in addition to this, it seldom happens that harmonics above the fifth, or at most the eleventh, need be determined. This simplification opens up a number of possible numerical ways of performing the work. Prof. John Perry described methods in the London *Electrician*.[1] Several years ago the writer prepared a special form of rectangular co-ordinate paper for use in computing the Fourier constants. The paper described herewith is a newer form with modifications suggested by the use of the earlier plate.

The computation of the constants is based upon the following simple principles: Suppose that a function, say, $f(x)$ has been expanded into a Fourier series, so that

$$f(x) = a_1 \sin x + a_2 \sin 2x + a_3 \sin 3x + \ldots$$
$$+ \tfrac{1}{2} b_0 + b_1 \cos x + b_2 \cos 2x + b_3 \cos 3x + \ldots$$

where

$$a_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \sin nx \, dx$$

and

$$b_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \cos nx \, dx.$$

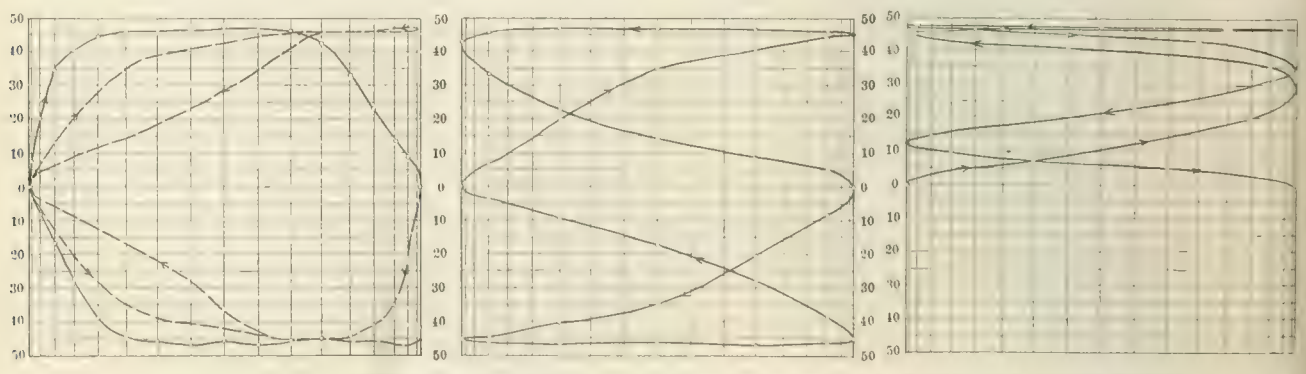
Now if a_n be written the form

$$a_n = -\frac{1}{n\pi} \int_{-\pi}^{\pi} f(x) \, d(\cos nx)$$

and if rectangular co-ordinate paper be prepared upon which the small divisions or increments in the x direction are not proportional to dx, but proportional to $d(\cos x)$ (hence also proportional to $d(\cos nx)$, the value of a_n may be regarded as the area included between the curve $y = f(x)$, plotted upon the special paper, and the x-axis, and the two ordinates corresponding to the limits of the definite integral. Figs. 2 to 9 show paper prepared in this way.

The manner of using the paper is best illustrated by a particular example. Fig. 1 is an alternating-pressure curve plotted from the ondograph record upon ordinary rectangular co-ordinate paper. It is convenient to divide the complete wave-length into 36, 48 or 72 parts. The values of the ordinates of the given curve at these points can be read directly from the curve, or they can be placed in a numerical table. To compute the coefficient a_1 lay off on the vertical lines of the special paper the values of the ordinates of the given curve at each of the 36 points and sketch a curve through the points thus located. The result is the continuous line of Fig. 2.* The area, in square inches, bounded by this curve is the value of a_1. The determination of the area is, of course, made by a planimeter. To compute a_2, or the coefficient of sin $2x$, the same ordinates just used are to be laid off, but they are to be placed on *every alternate* vertical line of the paper. The area bounded by the resulting curve is determined by the planimeter, and when divided by 2 gives the coefficient of sin $2x$. In the present case it is obvious that the area is zero and must be zero for each of the even harmonics.

To compute a_3 the 36 ordinates previously used are laid off on every third vertical line of the paper, and the area of the resulting curve is taken by the planimeter. The result must be divided by 3. It is usually more convenient to lay off the ordinates (18 in this case) of only the first half of the curve and take the area between the x-axis and the resulting curve.



FIGS. 2, 3 AND 4.—CURVES FOR DETERMINING THE COEFFICIENTS OF SIN X, SIN 2X, SIN 3X AND SIN 5X.

[1] Lond. *Elect.* Vol. XXV, p. 285, and Vol. XXVIII, p. 362.

*In order to reduce the diagrams to small space, only one out of ten of the vertical lines of the original have been reproduced in the small diagrams. The original paper measures 7.44 by 8.54 in. Those that use the paper should note that the 36 values mentioned above are to be laid off on the heavily-drawn vertical lines of the paper.

This can always be done when only the odd harmonics are present, but, of course, the planimeter reading is only one-half of the true area.

The computation of the coefficients of cos x, cos $3x$, etc., are made in the same way, except that the 36 or 18 ordinates

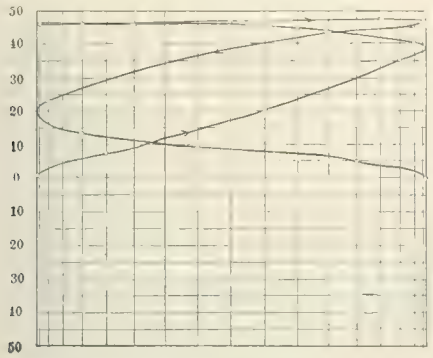


FIG. 5.—CURVE FOR DETERMINING COEFFICIENT OF SIN 7X.

are laid off on the heavy vertical lines, *beginning at the central line of the paper*, and using every heavy line, every alternate line, or every third line, etc., as the case may be. The curves (upper halves only) for the present problem are given in

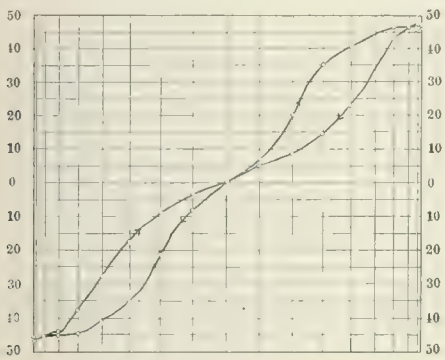


FIG. 6.—CURVE FOR DETERMINING COEFFICIENT OF COS X.

Figs. 6, 7, 8 and 9. The areas given by the planimeter for cos nx must be divided by n in order to obtain the value of b_n. The result must be doubled if the planimeter is run over only half of the complete curve, as drawn for example in Figs. 7, 8 and 9. Care must be taken in reading the planimeter to note whether the area is positive or negative, as this determination is necessary to obtain the signs of the coefficients.

The following table gives the actual planimeter readings in the present case:

Term.	Area.	Coefficient.
sin x	+ 48.0	+ 48.0
sin $3x$	+ 2.0	+ 0.65
sin $5x$	— 12.1	— 2.4
sin $7x$	— 0.6	— 0.1
cos x	+ 5.45	+ 5.45
cos $3x$	— 2.4	— 0.77
cos $5x$	— 18.0	— 3.59
cos $7x$	— 7.0	— 1.0

The required series is then

$$48.0 \sin x + 0.65 \sin 3x - 2.4 \sin 5x - 0.1 \sin 7x$$
$$+ 5.45 \cos x - 0.77 \cos 3x - 3.59 \cos 5x - 1.0 \cos 7x$$

It requires less than one hour's work to perform an analysis of this sort. It is to be noted that the same 36 values are used each time, and that the planimeter performs all of the required calculations except dividing by 2, 3, 4, 5, etc. The size of the plate from which the paper is printed is so designed that division by π is not required.

If there be any doubt about the form of any curve near the edge of the paper, it can be determined by obtaining additional ordinates by interpolation and locating the additional points on the curve. It is sufficient to sketch the curves lightly in pencil. The labor increases very materially with the higher harmonics. To check the accuracy of the method, I have developed into a sine series the broken straight line $y = 90x/\pi$ from $x = 0$ to $x = \pi/3$, $y = 45 - 45x/\pi$ from $x = \pi/3$ to $x = \pi$, both by the theoretical method and by the use of the special paper. The following results permit comparison:

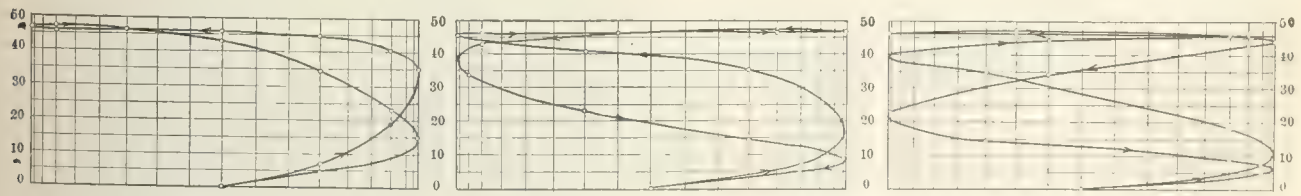
Terms of series.	Sin x	Sin $2x$	Sin $3x$	Sin $4x$	Sin $5x$
Coefficients by planimeter	23.76	5.96	0	— 1.48	— 0.96
Theoretical coefficients	23.69	5.92	0	— 1.48	— 0.95

These results are as accurate as those obtained on a Michelson harmonic analyzer of 80 elements.

Parallel Operation of Widely Separated Hydro-Electric Stations in Utah and Idaho.

In addition to its well-known hydro-electric installation in Colorado, centering around the place from which its name has been taken, the Telluride Power Company operates a physically separate installation, an interconnected system of 44,000-volt lines receiving energy from five hydro-electric stations in Utah and Idaho. The energy distribution from the latter system being confined to the former State, the system is known as the Utah department to distinguish it from the earlier Colorado department.

The accompanying map shows the relative locations of the five hydro-electric stations and five main substations of the Utah-Idaho system for the interconnection of which use is made of about 500 miles of 44,000-volt, three-phase circuits. The Grace generating station, which is located in Idaho about 130 miles north of Salt Lake City, contains two 9000-hp units operating under an effective head of 440 ft. Two 1500-hp units operating under a head of 210 ft. comprise the generating equipment at the Logan station, about 75 miles north of Salt Lake City. At the Jordan Narrows station, about 20 miles south of Salt Lake City, there are two 1600-hp units utilizing a 75-ft. fall. The Battle Creek station contains a single unit capable of using 6500 hp under an 1800-ft. fall. The Olmsted station contains three 3600-hp units operating under a 330-ft. fall. Of the five



FIGS. 7, 8 AND 9.—CURVES FOR DETERMINING THE COEFFICIENTS OF COS 3X, COS 5X AND COS 7X.

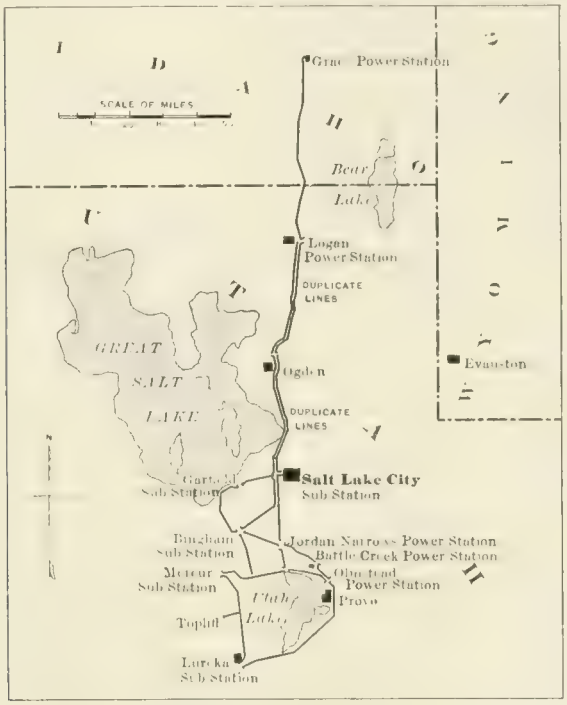
substations that at Salt Lake City uses 4000 kw, Garfield 3500 kw, Bingham 6000 kw, Mercur 700 kw and Eureka 2500 kw. In addition there are substations in the main stations at Logan and Olmsted; each of these distributes about 450 kw.

Under normal conditions all of the generating stations are joined in parallel to feed energy to the various substations. It will be noted that with the exception of the Grace station—between which station and Logan a second line is now being constructed—there are at least two separate lines from each station and not less than two lines to each substation. This arrangement insures continuity of service when any one line is being repaired or altered.

In order to appreciate the methods employed in operating the stations it is necessary to know the local laws relating to the use of the water. Almost all of the water of the streams—and in some cases more water than the streams afford—has been claimed for irrigation purposes, and the water thus claimed can-

not be diverted from the irrigation ditches. Moreover, the flow to the ditches must be kept constant as shown by weir measurements, so that fluctuations in load on the electrical system must not involve changes in the flow of water for irrigation. In spite of these limitations, the company has acquired water rights that will permit it to handle both daily fluctuations and seasonal changes in the loads on its system.

The substation in Salt Lake City supplies energy to the network of the Utah Light & Railway Company, which also re-



MAP OF TRANSMISSION LINES IN UTAH AND IDAHO

ceives energy from this company's local steam plant. Energy is supplied to this company at the rate of about 4000 kw, and the fact that the hydro-electric system is operating in parallel with the steam-generating system renders it necessary for all of the hydro-electric plants to be governed in speed to correspond to the speed of the steam plant at Salt Lake City. It is evident that the amount of energy delivered to this plant does not depend upon the e.m.f. of transmission. The voltage of the system is so regulated as to deliver a constant e.m.f. at the Bingham substation, where an appreciable lighting load is carried. The momentary fluctuations in the load on the whole system are handled at the Logan station, which alone operates with automatic governors on the water-wheels. At the other stations the governors are set by hand to deliver to the system energy at the rate specified from time to time over telephone by the superintendent of operation at Olmsted.

Of the several stations the one best able to carry a heavy peak load for a short time is the Battle Creek, where only a limited amount of storage is available, but violent fluctuations in the flow of the tailrace water are not objectionable. The plant at Grace possesses ideal facilities for seasonable storage in that Bear Lake, near which flows the stream supplying water to the wheels at Grace, is a natural reservoir in which the flood waters can be retained for release during the dry season. It will be seen, therefore, that the combined interconnected hydro-electric stations as a whole possess characteristics far more desirable than shown by any one station considered alone.

The constancy of demand for water for irrigation is not wholly unwelcome to the transmission company, because some of its best customers are those using motors for driving pumps for elevating the water above land lying below the normal gravity irrigation ditches. The pump loads, together with the mining and industrial loads, cause the total load on the system to be much more nearly constant than would be true of a purely lighting load.

The whole system, with its 500 miles of transmission lines, operates at the high frequency of 60 cycles and the low e.m.f. of 44,000 volts. The frequency, which was set initially by the lighting load, has not proved disadvantageous for motors and has not affected the line regulation appreciably. The low e.m.f. possesses both advantages and disadvantages. It has permitted the use of porcelain insulators on wooden pins. At this e.m.f. the pins do not exhibit "digestion" which is found when a higher voltage is employed. Moreover, the conditions of operation have been such as not to require an excessive amount of copper for maintaining the proper voltage at the point of distribution. In explanation of the last statement it should be recalled that the more distant stations carry constant loads, and that the e.m.f. along any transmission line is determined largely by the field excitation of the synchronous apparatus in the immediate neighborhood of the point considered. For example, the voltage at the substations depends almost exclusively upon the excitation of the generators in the Jordan Narrows, Battle Creek and Olmsted stations, and is unaffected by the e.m.f. at the Grace and Logan stations. A change in the excitation of the generators at the last two stations alters only the wattless current taken from or supplied by these stations to the whole system. However, economy in transmission would dictate a higher e.m.f., and the newer lines of the company are being planned and installed with a view to increasing the voltage in the near future.

As intimated above, the actual loads carried by the individual stations are specified over telephone by the operator at Olmsted. The company is arranging to transfer all of its important executive offices in Olmsted, where the surroundings are those of a well-kept city park rather than of a suburban factory, as is most frequently the case with generating stations. It is here that the Telluride Institute, with its corps of instructors, dormitories and excellent general and technical library, has been established by the general manager of the company, Mr. L. L. Nunn, for the training of ambitious young men. Here also are the headquarters of Mr. L. L. Nunn and of Major Cooper Anderson, the superintendent of the Utah division of the Telluride Power Company.

Army Electrolytic Hydrogen Plant at Fort Omaha, Neb.

A very interesting plant for the production of hydrogen gas for balloon purposes by electrolytic process has been installed at Fort Omaha, Neb. A balloon-house has been erected at this fort for the experiments of the U. S. Army Signal Corps.



ELECTROLYTIC HYDROGEN GAS PLANT

Alongside this house is a building containing the hydrogen generating plant. Electrical energy for the operation of this plant is obtained from the Omaha Electric Light & Power Company. A 200-kw motor-generator set has been installed, which consists of an induction motor direct-connected to a direct-current generator wound to give a voltage of from 66

to 110 volts. The hydrogen is generated by electrolysis in cast-iron cells containing caustic potash electrolyte. There are 30 of these cast-iron electrolytic cells, all connected in series. The voltage required varies according to the temperature of the cells, hence the wide range of voltage for which the generator is designed. The operating voltage when the cells are warmed up is 85 volts for the 30 cells, or 2.8 volts per cell. The cells are rated at 1500 amp. The output of hydrogen at 1500 amp is about 23 cu. ft. of gas per hour, or 690 cu. ft. for the 30 cells. Both of the electrodes are of iron. The iron case of the cell forms the negative electrode from which the hydrogen is obtained. The positive electrode, which gives off oxygen, is in the shape of an iron cylinder in the cell. Hydrogen gas, which collects above the negative electrode, is piped to a 50,000-cu.-ft. gas holder. The oxygen, which might easily be sold commercially to cover much of the cost of operating the plant, is allowed to escape into the air because Congress has seen fit not to authorize the United States Army to sell this by-product. Besides generating hydrogen for use in the balloon trials from Fort Omaha, preparations are being made to bottle the hydrogen generated here for shipment to other points where the signal corps of the army may wish it for balloon purposes. The bottles used are of steel, capable of withstanding 3000 lb. pressure to the square inch. The compressors for compressing the hydrogen and testing the steel bottles are motor-driven. The commanding officer of Fort Omaha is Lieut.-Col. W. A. Glassford, and the officer in immediate charge of the plant described is Capt. C. D. F. Chandler.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Banishing the Small Central Station.

In an address before the recent convention of the Brooklyn Company N. E. L. A. Section, Mr. Caryl D. Haskins, in referring to the probable future development in the electrical field, said that the work which lies ahead is so gigantic as compared with what has been done, that it dwarfs the past and present. Probably the first great work in the central-station field will be the banishing of the small central station. At present there are 3200 central stations operating independently in communities of 2000 people or less. In one location in the Middle West which he had in mind there are 13 central stations within a radius of seven miles, and these eventually must be coalesced in one system, and these larger systems spreading out will overlap, and some day there will be a very few great networks covering the entire country. Good engineering and good banking both dictate this, and in this way service can also be given not to half of the population as at present, but to 80 per cent of all the people, including the farmer.

In the course of the same address, Mr. Haskins said that recently in talking to an engineer from California who operates a transmission system 100 miles long, he asked how small a community he would supply over a given distance from the line. The engineer almost failed to understand the question, and finally said that not a single farm "got by him" if it was within two or three miles from the line.

Marketing Electrical Energy in Bulk at Duluth, Minn.

The Great Northern Power Company, of Duluth, Minn., has a water-power plant on the St. Louis River 14 miles south of Duluth, from which energy is transmitted over a steel-tower line to a substation in Duluth. The generating station contains three 7500-kw units, and the transmission line is built for a tension of either 30,000 volts or 60,000 volts. The company supplies practically all of the electricity used for motors in the city of Duluth and surroundings.

This is sold at wholesale to the Duluth Street Railway and the Duluth Edison Electric Company, which latter does all the retailing to small consumers. The Great Northern Power Company, however, sells at wholesale to various large consumers. One large installation is at the Duluth water-works, which was described in the *Electrical World* of Oct. 10, 1908.

Other large motor installations are on the coal docks. Duluth being at the head of the lakes and favored with a magnificent harbor, receives an immense tonnage of coal from Buffalo and other points on Lake Erie, brought by vessels, which carry grain and iron ore on their eastern voyage. The operation of a modern coal dock for the rapid unloading of vessels calls for power in wholesale quantities.

For a typical 1000-kw substation as erected on a large coal dock, the following is the standard equipment used: Three three-phase, 25-cycle transformers stepping down from 13,000 volts to 440 volts; lightning arresters for 13,000 volts; one 13,000-volt, three-phase oil switch manually operated; one standard switchboard panel, illustrated in Figs. 1 and 3, containing switch-operating handle, overload relay, watt-hour meter, ammeter and voltmeter. On the low-tension side there is a

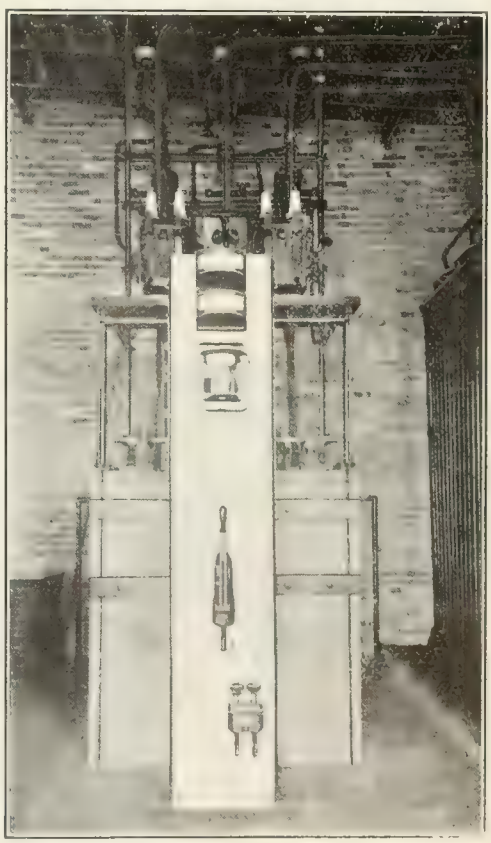


FIG. 1.—HIGH TENSION CONTROL SUBSTATION EQUIPMENT.

440-volt switchboard with panels for the various feeders according to the requirements of the customer. Fig. 2 shows one of these switchboards on a large coal dock. The three motor feeders are on the three panels at the left. The panels on the right are for the lighting feeders. The entire substation is built and maintained by the consumer.

A notable feature in Dutluth practice is the use of alternating-current motors throughout for the hoisting machinery on a coal dock instead of direct-current machines. Fluctuations in cur-

rent with induction motors in the extremely severe hoisting service on a dock are considerably greater than with direct current, but the simplicity and low first cost of the substation as compared with a direct-current substation has caused alternating-current motors to be selected. Their operation has proved very satisfactory.

On the dock of the Berwind Fuel Company, which has three rigs for the handling of buckets, a cargo was unloaded at the

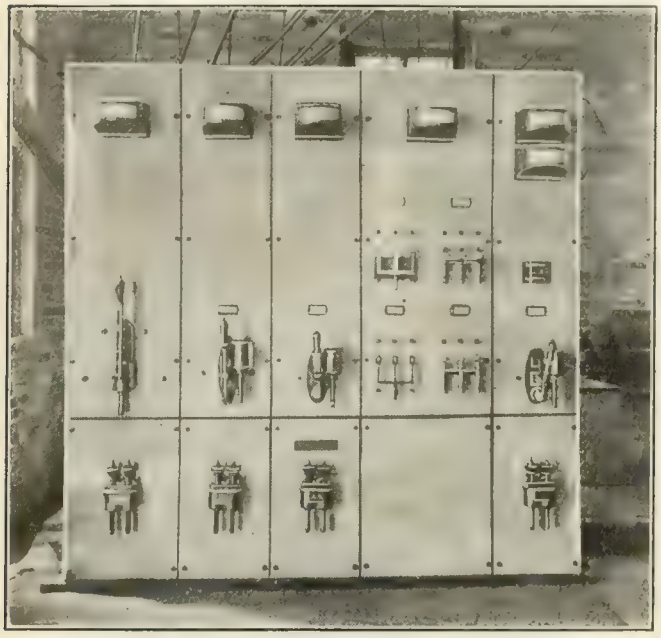


FIG. 2.—440-VOLT SWITCHBOARD.

time of the acceptance test at the average rate of 193 tons per hour for each rig. The fuel was on a steamer having a cargo of 8100 tons and more than 65 complete trips per hour must have been made by each bucket, the buckets having a carrying capacity of three tons each. The fluctuations in current demand caused by the operation of coal docks do not seem to be serious on a load as large as that carried by the Great Northern Power

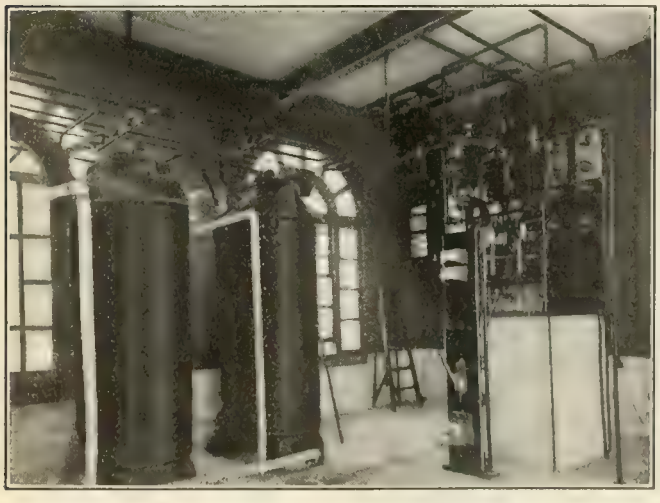


FIG. 3.—STANDARD WHOLESALE POWER STATION EQUIPMENT.

Company. The peaks of the demand of such docks are very brief, lasting about one or two seconds.

The cost of a 1000-kw substation for a coal dock is about $12,000 for electrical apparatus and $2,000 for a building. If a substation were to be built for an equal output with rotary converters or motor-generator sets, the cost is estimated to be $50,000, to say nothing of the extra space occupied on the dock. The cost of attendance and the fixed losses would be greater with the direct-current substation. This difference in cost is so great that the power company has not seen fit to require the installation of a direct-current substation for the purpose of reducing the fluctuation in demand. All substations or transformer houses are of brick and concrete.

Under the Great Northern Power Company's agreement with the Duluth Edison Electric Company, the former makes contracts with consumers where 50 hp or more is involved. Smaller installations are handled by the Duluth Edison Electric Company. The Great Northern Power Company distributes from its Duluth substation at 13,000 volts. The consumer under the wholesale power contract builds the transformer house and furnishes all the apparatus except the series and shunt transformers for the instruments, these transformers being necessary for the company's watt-hour meter.

The rates for wholesale energy in installations of 50 hp to 500 hp, after discounts for prompt payment are deducted, are as follows: A fixed charge of $1 per month per kilowatt of maximum demand, plus 1.25 cents per kw-hour up to the point where the load factor or average load reaches 10 per cent (70 hours' use per month of the maximum). For all energy over that amount the charge is 0.6 cents per kw-hour. The maximum demand is determined as maximum load obtained by any one of the following methods, at the option of the company: (A) By maximum-demand meters; (B) by the maximum on second peak, less 50 per cent; (C) by the maximum one-minute peak, less 50 per cent; (D) by the maximum three-minute peak, less 33 1/3 per cent; (E) by the maximum five-minute peak. Discounts on intermediate peaks are interpolated by proportion.

On contracts of over 500 hp the same rules apply and the same readiness-to-serve or reservation charge, but the kw-hour charge is slightly lower, being 1.1 cent per kw-hour up to 70 hours' use per month of the maximum rating and 0.5 cent per kw-hour for additional energy used. The fixed charge, which is usually known as the readiness-to-serve charge, is entitled in the company's contract, a charge for reservation of machinery, apparatus and lines.

New Wholesale Rate Schedules in Chicago.

After a careful consideration of the subject extending over a long period of time, the Commonwealth Edison Company, of Chicago, has prepared new schedules of rates for the consumption of electricity, applying more particularly to power users. A wholesale system of charging for electricity has been established, and it is divided into three classes. The first of these relates to alternating current not transformed to be delivered at 9000 or 11,000 volts, 60 cycles, to the customers' premises. If the customer desires to change this energy to other voltages or frequencies he does so at his own expense.

The second class of service is for alternating current transformed, or low-tension alternating current, supplied at 110, 220 and 440 volts, 60 cycles.

Direct current at 110 and 220 volts constitutes the third class of wholesale service.

Wholesale schedules for these three classes of service have been very carefully worked out in the form of tables, and two of these elaborate tables relating respectively to alternating current at low-tension and to direct current are reproduced herewith. The net costs per kw-hour are given for various maxima and also for various daily hours' use of the maxima. The primary charge is given, also the secondary charge, as well as the total rate per kw-hour, for installations running from 5 kw to 5000 kw and also for load factors ranging from 4.1 per cent to 100 per cent. The figures in the tables are printed in black and red ink—a distinction which it is impracticable to reproduce in the illustrations given herewith. The kw-hour consumption for 30 days' use of the maximum is given in black figures. The secondary rate per kw-hour is given in red figures (in the original) at the left and immediately below the kw-hour consumption. The total rate per kw-hour is given in red (in the original) at the right and immediately below the kw-hour consumption. The primary

rate per kw-hour may be obtained by subtracting the secondary rate from the total rate per kw-hour.

The primary charge (which includes the various items entering into fixed charges) is figured on a monthly basis or a yearly basis. For the first 20 kw, in the case of the alternating-current, low-tension schedule, this charge is $3.20 per kilowatt per month. For the next 30 kw the primary charge is $2.20 per kilowatt per month. For over 50 kw this charge is $2 per kilowatt per month. On the yearly basis the primary charge for the first 200 kw is $26 per kilowatt per year. For installations in excess of 200 kw the primary charge is $21.50 per kilowatt per year.

The secondary charge covers operating expenses and profit. In the case of the alternating-current, low-tension schedule it is as follows: First 2000 kw-hours per month, 6 cents per kw-hour; next 3000 kw-hours per month, 3 cents per kw-hour; next 25,000 kw-hours per month, 1.1 cent per kw-hour; excess over 30,000 kw-hours per month, 0.9 cent per kw-hour. A discount of 10 per cent from the secondary portion of the bill is allowed for payment within 10 days.

For direct current the wholesale schedule of rates works out slightly higher. The primary charge on the monthly basis for the first 20 kw is $3.20 per kilowatt per month, as in the case of alternating current, but the next 30 kw is $2.50 per kilowatt per month, while the excess over 50 kw is $2.20 per kilowatt per month. On the yearly basis the first 200 kw

WHOLESALE SCHEDULE—ALTERNATING CURRENT LOW TENSION—LIGHT AND POWER

NET COSTS PER KILOWATT HOUR FOR VARIOUS MAXIMA AND VARIOUS DAILY HOURS' USE OF MAXIMA

PRIMARY CHARGE

MONTHLY BASIS
FIRST 20 K. W. @ $3.20 PER K. W. PER MONTH.
NEXT 30 " 2.20 " " " "
EXCESS OVER 50 " 2.00 " " " "
YEARLY BASIS
FIRST 200 " 26.00 " " PER YEAR.
EXCESS OVER 200 " 21.50 " "

SECONDARY CHARGE

FIRST 2,000 K. W. H. PER MONTH @ 6.00 PER K. W. H.
NEXT 3,000 " " 3.00 " "
" 25,000 " " 1.10 " "
EXCESS OVER 30,000 " " .90 " "

A DISCOUNT OF 10% FROM THE SECONDARY PORTION OF THE BILL WILL BE ALLOWED FOR PAYMENT WITHIN 10 DAYS.

THE K. W. H. CONSUMPTION FOR 30 DAYS' USE OF THE MAXIMUM IS GIVEN IN BLACK.
THE SECONDARY RATE PER K. W. H. IS GIVEN IN RED THE LEFT IMMEDIATELY BELOW THE K. W. H. CONSUMPTION.
THE TOTAL RATE PER K. W. H. IS GIVEN IN RED TO THE RIGHT IMMEDIATELY BELOW THE K. W. H. CONSUMPTION.
TO OBTAIN THE PRIMARY RATE PER K. W. H. SUBTRACT THE SECONDARY RATE FROM THE TOTAL RATE PER K. W. H.

MAXIMUM KILOWATTS	EQUIVALENT MAXIMUM HORSE POWER	EQUIVALENT HOURS' USE OF MAXIMUM PER DAY																			
		1	1.2	2	2 4	3	3.6	4	4 8	5	6	7	7 2	8	8 4	9 6	10	12	15	18	24
PRIMARY RATE PER K. W.		LOAD FACTOR																			
		4.1%	5%	8 3%	10%	12 4%	15%	16.7%	20%	20 8%	25%	29 1%	30%	33⅓%	35%	40%	41.5%	50%	62 5%	75%	100%
5	6.7	150	180	300	360	450	540	600	720	750	900	1,050	1,080	1,200	1,260	1,440	1,500	1,800	2,250	2,700	3,600
$3.20 per month																			5.10	5.81	4.70	5.29	4.20	4.64
6	8.1	180	216	360	432	540	648	720	864	900	1,080	1,260	1,296	1,440	1,512	1,728	1,800	2,160	2,700	3,240	4,320
3.20 "																			5.20	6.09	4.70	5.41	4.37	4.96	3.95	4.38
7	9.4	210	252	420	504	630	756	840	1,008	1,050	1,260	1,470	1,512	1,680	1,764	2,016	2,100	2,520	3,150	3,780	5,040
3.20 "																5.39	6.50	5.27	6.34	4.84	5.73	4.41	5.12	4.13	4.72	3.76	4.20
8	10.7	240	288	480	576	720	864	960	1,152	1,200	1,440	1,680	1,728	1,920	2,016	2,304	2,400	2,880	3,600	4,320	5,760
3.20 "															5.39	6.66	5.05	6.16	4.95	5.02	4.58	5.47	4.20	4.91	3.95	4.54	3.41	3.85
9	12.0	270	324	540	648	810	972	1,080	1,296	1,350	1,620	1,890	1,944	2,160	2,268	2,592	2,700	3,240	4,050	4,860	6,480
3.20 "															5.20	6.53	5.10	6.37	4.79	5.90	4.70	5.77	4.37	5.26	4.03	4.74	3.81	4.40	3.14	3.58
10	13.4	300	360	600	720	900	1,080	1,200	1,440	1,500	1,800	2,100	2,160	2,400	2,520	2,880	3,000	3,600	4,500	5,400	7,200
3.20 "												5.27	6.79	5.20	6.68	4.95	6.28	4.84	6.11	4.58	5.69	4.50	5.57	4.20	5.09	3.90	4.61	3.57	4.16	2.93	3.37
12	16.0	360	432	720	864	1,080	1,296	1,440	1,728	1,800	2,160	2,520	2,592	2,880	3,024	3,456	3,600	4,320	5,400	6,480	8,640
3.20 "											5.20	6.98	4.84	6.36	4.79	6.27	4.58	5.91	4.49	5.76	4.28	5.39	4.20	5.27	3.95	4.84	3.57	4.28	3.14	3.73	2.60	3.04
15	20.1	450	540	900	1,080	1,350	1,620	1,800	2,160	2,250	2,700	3,150	3,240	3,600	3,780	4,320	4,500	5,400	6,750	8,100	10,800
3.20 "											5.20	7.42	5.10	7.23	4.70	6.48	4.41	5.93	4.37	5.88	4.20	5.53	4.13	5.40	3.95	5.06	3.90	4.97	3.57	4.46	3.06	3.77	2.71	3.30	2.28	2.72
18	24.1	540	648	1,080	1,296	1,620	1,944	2,160	2,592	2,700	3,240	3,780	3,888	4,320	4,536	5,184	5,400	6,480	8,100	9,720	12,960
3.20 "								5.20	7.87	4.79	7.01	4.70	6.83	4.37	6.15	4.13	5.65	4.10	5.58	3.95	5.23	3.90	5.17	3.68	4.79	3.57	4.64	3.14	4.03	2.71	3.42	2.43	3.02	2.07	2.61
20	26.8	600	720	1,200	1,440	1,800	2,160	2,400	2,880	3,000	3,600	4,200	4,320	4,800	5,040	5,760	6,000	7,200	9,000	10,800	14,400
3.20 "							5.20	8.16	4.95	7.62	4.58	6.80	4.50	6.63	4.20	5.98	3.99	5.51	3.95	5.43	3.83	5.16	3.76	5.03	3.41	4.52	3.32	4.39	2.93	3.82	2.54	3.25	2.28	2.87	1.96	2.40
25	33.5	750	900	1,500	1,800	2,250	2,700	3,000	3,600	3,750	4,500	5,250	5,400	6,000	6,300	7,200	7,500	9,000	11,250	13,500	18,000
3.00 "						5.10	8.43	4.70	7.48	4.50	7.00	4.20	6.28	4.14	6.14	3.90	5.57	3.65	5.08	3.57	4.96	3.32	4.57	3.22	4.41	2.93	3.97	2.85	3.85	2.54	3.37	2.23	2.90	2.02	2.58	1.77	2.19
30	40.3	900	1,080	1,800	2,160	2,700	3,240	3,600	4,320	4,500	5,400	6,300	6,480	7,200	7,560	8,640	9,000	10,800	13,500	16,200	21,600
2.87 "					5.20	9.19	4.70	7.89	4.37	7.03	4.20	6.59	3.95	5.94	3.90	5.81	3.57	5.16	3.22	4.59	3.14	4.47	2.93	4.13	2.84	3.98	2.60	3.60	2.54	3.50	2.28	3.08	2.02	2.66	1.85	2.38	1.64	2.04
35	46.9	1,050	1,260	2,100	2,520	3,150	3,780	4,200	5,040	5,250	6,300	7,350	7,560	8,400	8,820	10,080	10,500	12,600	15,750	18,900	25,200
2.77 "				5.27	9.89	4.84	8.69	4.41	7.49	4.13	6.89	3.99	6.30	3.76	5.68	3.65	5.50	3.22	4.76	2.89	4.21	2.84	4.12	2.65	3.80	2.57	3.67	2.37	3.33	2.32	3.24	2.10	2.87	1.88	2.50	1.73	2.24	1.54	1.92
40	53 6	1,200	1,440	2,400	2,880	3,600	4,320	4,800	5,760	6,000	7,200	8,400	8,640	9,600	10,080	11,520	12,000	14,400	18,000	21,600	28,800
2.70 "				4.95	9.45	4.58	8.33	4.20	7.20	3.95	6.45	3.83	6.08	3.41	5.28	3.32	5.12	2.93	4.43	2.65	3.94	2.60	3.85	2.44	3.57	2.37	3.44	2.20	3.14	2.15	3.05	1.96	2.71	1.77	2.37	1.64	2.14	1.47	1.85
45	60.3	1,350	1,620	2,700	3,240	4,050	4,860	5,400	6,480	6,750	8,100	9,450	9,720	10,800	11,340	12,960	13,500	16,200	20,250	24,300	32,400
2.64 "				4.70	9.10	4.37	8.04	4.03	6.96	3.81	6.25	3.57	5.77	3.14	4.97	3.06	4.82	2.71	4.18	2.47	3.73	2.43	3.65	2.28	3.38	2.22	3.27	2.07	2.99	2.02	2.90	1.85	2.58	1.68	2.27	1.56	2.05	1.41	1.78
50	62.0	1,500	1,800	3,000	3,600	4,500	5,400	6,000	7,200	7,500	9,000	10,500	10,800	12,000	12,600	14,400	15,000	18,000	22,500	27,000	36,000
2.60 "				4.50	8.83	4.20	7.81	3.90	6.79	3.57	5.98	3.32	5.49	2.93	4.74	2.85	4.58	2.54	3.98	2.32	3.56	2.28	3.48	2.15	3.23	2.10	3.13	1.96	2.86	1.92	2.79	1.77	2.49	1.61	2.19	1.51	1.99	1.35	1.71
60	80 5	1,800	2,160	3,600	4,320	5,400	6,480	7,200	8,640	9,000	10,800	12,600	12,960	14,400	15,120	17,280	18,000	21,600	27,000	32,400	43,200
2.50 "				4.20	8.37	3.95	7.42	3.57	6.35	3.14	5.45	2.93	5.01	2.60	4.34	2.54	4.21	2.25	3.67	2.10	3.29	2.07	3.23	1.96	3.00	1.91	2.90	1.80	2.67	1.77	2.60	1.64	2.33	1.51	2.07	1.41	1.87	1.26	1.61
70	95.0	2,100	2,520	4,200	5,040	6,300	7,560	8,400	10,080	10,500	12,600	14,700	15,120	16,800	17,640	20,160	21,000	25,200	31,500	37,800	50,400
2.43 "				5.27	13.37	4.84	11.59	3.99	8.04	3.76	7.14	3.22	5.92	2.84	5.09	2.65	4.67	2.37	4.06	2.32	3.94	2.10	3.45	1.94	3.10	1.91	3.04	1.82	2.83	1.75	2.74	1.69	2.53	1.65	2.46	1.54	2.22	1.42	1.96	1.32	1.77	1.19	1.53
75	100.5	2,250	2,700	4,500	5,400	6,750	8,100	9,000	10,800	11,250	13,500	15,750	16,200	18,000	18,900	21,600	22,500	27,000	33,750	40,500	54,000
2.40 "				5.10	13.10	4.70	11.37	3.90	7.90	3.57	6.90	3.06	5.73	2.71	4.93	2.54	4.54	2.28	3.95	2.23	3.83	2.02	3.35	1.88	3.02	1.85	2.96	1.77	2.77	1.73	2.68	1.64	2.47	1.61	2.41	1.51	2.18	1.39	1.92	1.29	1.73	1.17	1.50
80	107.1	2,400	2,880	4,800	5,760	7,200	8,640	9,600	11,520	12,000	14,400	16,800	17,280	19,200	20,160	23,040	24,000	28,800	36,000	43,200	57,600
2.38 "				4.95	12.87	4.58	11.19	3.83	7.80	3.41	6.72	2.93	5.57	2.60	4.80	2.44	4.42	2.20	3.56	2.15	3.74	1.96	3.28	1.82	2.96	1.80	2.90	1.72	2.71	1.69	2.63	1.60	2.43	1.57	2.36	1.47	2.13	1.35	1.88	1.26	1.70	1.15	1.48
90	120.5	2,700	3,240	5,400	6,480	8,100	9,720	10,800	12,960	13,500	16,200	18,900	19,440	21,600	22,680	25,920	27,000	32,400	40,500	48,600	64,800
2.33 "				4.70	12.48	4.37	10.84	3.57	7.46	3.14	6.38	2.71	5.30	2.43	4.59	2.28	4.22	2.07	3.69	2.02	3.57	1.85	3.15	1.73	2.84	1.71	2.79	1.64	2.61	1.61	2.53	1.53	2.34	1.51	2.29	1.41	2.06	1.29	1.81	1.21	1.64	1.11	1.43
100	134.0	3,000	3,600	6,000	7,200	9,000	10,800	12,000	14,400	15,000	18,000	21,000	21,600	24,000	25,200	28,800	30,000	36,000	45 000	54,000	72,000
2.30 "				4.50	12.17	4.20	10.59	3.32	7.15	2.99	6.12	2.54	5.10	2.28	4.41	2.16	4.07	1.96	3.56	1.92	3.46	1.77	3.05	1.65	2.75	1.64	2.70	1.57	2.53	1.54	2.45	1.47	2.27	1.46	2.23	1.35	1.99	1.24	1.75	1.17	1.60	1.08	1.40
110	147.1	3,300	3,960	6,600	7,920	9,700	11,880	13,200	15,840	16,500	19,800	23,100	23,760	26,400	27,720	31,680	33,000	39,600	49,500	59,400	79,200
2.27 "				4.34	11.92	4.06	10.37	3.10	6.88	2.75	5.90	2.40	4.92	2.16	4.26	2.05	3.94	1.87	3.45	1.84	3.35	1.70	2.96	1.59	2.67	1.58	2.63	1.52	2.47	1.49	2.39	1.42	2.21	1.40	2.16	1.29	1.92	1.20	1.70	1.13	1.55	1.05	1.37
120	161.0	3,600	4,320	7,200	8,640	10,800	12,960	14,400	17,280	18,000	21,600	25,200	25,920	28,800	30,240	34,560	36,000	43,200	54,000	64,800	86,400
2.25 "				4.20	11.70	3.95	10.20	2.93	6.68	2.60	5.73	2.28	4.78	2.07	4.15	1.96	3.83	1.80	3.36	1.77	3.27	1.64	2.89	1.54	2.61	1.53	2.57	1.47	2.41	1.45	2.34	1.37	2.15	1.35	2.10	1.26	1.89	1.17	1.67	1.11	1.53	1.03	1.34
130	174.0	3,900	4,680	7,800	9,360	11,700	14,040	15,600	18,720	19,500	23,400	27,300	28,080	31,200	32,760	37,440	39,000	46,800	58,500	70,200	93,600
2.23 "				4.09	11.53	3.85	10.04	2.78	6.50	2.45	5.58	2.18	4.66	1.98	4.04	1.88	3.74	1.73	3.28	1.71	3.20	1.59	2.83	1.50	2.56	1.49	2.52	1.43	2.36	1.40	2.28	1.33	2.10	1.31	2.05	1.22	1.84	1.14	1.64	1.09	1.50	1.02	1.33
140	187.5	4,200	5,040	8,400	10,080	12,600	15,120	16,800	20,160	21,000	25,200	29,400	30,240	33,600	35,280	40,320	42,000	50,400	63,000	75,600	100,800
2.21 "				3.99	11.37	3.76	9.90	2.65	6.33	2.37	5.44	2.10	4.56	1.91	3.96	1.82	3.66	1.69	3.22	1.65	3.12	1.54	2.77	1.46	2.51	1.45	2.47	1.39	2.31	1.36	2.24	1.29	2.06	1.27	2.01	1.19	1.80	1.12	1.61	1.07	1.48	1.00	1.31
150	201 0	4,500	5,400	9,000	10,800	13,500	16,200	18,000	21,600	22,500	27,000	31,500	32,400	36,000	37,800	43,200	45,000	54,000	67,500	81,000	108,000
2.20 "				3.90	11.23	3.57	9.68	2.54	6.21	2.28	5.34	2.02	4.46	1.85	3.89	1.77	3.60	1.64	3.17	1.61	3.08	1.51	2.73	1.40	2.47	1.41	2.43	1.35	2.27	1.32	2.19	1.26	2.02	1.24	1.97	1.17	1.78	1.10	1.59	1.05	1.46	.99	1.30
175	234.0	5,250	6,300	10,500	12,600	15,750	18,900	21,000	25,200	26,250	31,500	36,750	37,800	42,000	44,100	50,400	52,500	63,000	78,750	94,500	126 000
2.17 "				3.65	10.88	3.22	9.25	2.32	5.94	2.10	5.11	1.88	4.29	1.73	3.74	1.65	3.46	1.54	3.05	1.52	2.97	1.42	2.63	1.34	2.37	1.32	2.32	1.27	2.17	1.25	2.11	1.19	1.94	1.15	1.90	1.12	1.72	1.06	1.54	1.02	1.42	.96	1.26
200	268 0	6,000	7,200	12,000	14,400	18,000	21,600	24,000	28,800	30,000	36,000	42,000	43,200	48,000	50,400	57,600	60,000	72,000	90,000	108 000	144,000
2.15 "				3.32	10.49	2.93	8.90	2.15	5.73	1.96	4.95	1.77	4.16	1.64	3.63	1.57	3.36	1.47	2.96	1.46	2.89	1.35	2.54	1.27	2.29	1.26	2.26	1.21	2.11	1.19	2.04	1.15	1.90	1.13	1.85	1.08	1.68	1.03	1.51	.99	1.39	.94	1.24
225	301.6	6,750	8,100	13,500	16,200	20,250	24,300	27,000	32,400	33,750	40,500	47,250	48,600	54,000	56,700	64,800	67,500	81,000	101,250	121,500	162,000
25.50 per year				3.06	10.14	2.71	8.61	2.02	5.58	1.85	4.80	1.68	4.04	1.56	3.53	1.51	3.28	1.41	2.89	1.39	2.81	1.29	2.47	1.22	2.23	1.21	2.19	1.17	2.06	1.15	1.99	1.11	1.85	1.10	1.81	1.05	1.64	1.00	1.47	.97	1.36	.93	1.33
250	335.0	7,500	9,000	15,000	18,000	22,500	27,000	30,000	36,000	37,500	45,000	52,500	54,000	60,000	63,000	72,000	75,000	90,000	112,500	125,000	180,000
25.10 "				2.85	9.82	2.54	8.35	1.92	5.41	1.77	4.68	1.61	3.93	1.51	3.45	1.46	3.20	1.35	2.80	1.33	2.72	1.24	2.40	1.18	2.18	1.17	2.14	1.13	2.00	1.12	1.95	1.08	1.81	1.07	1.77	1.03	1.61	.98	1.44	.97	1.36	.92	1.21
300	402 0	9,000	10,800	18,000	21,600	27,000	32,400	36,000	43,200	45,000	54,000	63,000	64,800	72,000	75,600	86,400	90,000	108,000	135,000	162,000	216,000
24.50 "				2.66	9.48	2.28	7.85	1.77	5.17	1.64	4.45	1.51	3.78	1.41	3.30	1.35	3.05	1.26	2.68	1.24	2.60	1.17	2.30	1.12	2.09	1.11	2.06	1.08	1.93	1.07	1.88	1.03	1.74	1.03	1.71	.99	1.56	.95	1.40	.93	1.31	.90	1.18
350	469.0	10,500	12,600	21,000	25,200	31,500	37,800	42,000	50,400	52,500	63,000	73,500	75,600	84,000	88,200	100,800	105,000	126,000	157,500	189,000	252,000
24.07 "				2.32	9.01	2.10	7.67	1.65	4.99	1.54	4.33	1.42	3.65	1.32	3.18	1.27	2.94	1.19	2.58	1.18	2.52	1.12	2.23	1.07	2.03	1.07	2.00	1.04	1.88	1.03	1.83	1.00	1.70	.99	1.66	.96	1.52	.93	1.38	.91	1.27	.88	1.17
400	536.1	12,000	14,400	24,000	28,800	36,000	43,200	48,000	57,600	60,000	72,000	84,000	86,400	96,000	100,800	115,200	120,000	144,000	180,000	216,000	288,000
23.75 "				2.15	8.75	1.96	7.46	1.57	4.87	1.47	4.22	1.35	3.55	1.26	3.09	1.21	2.86	1.15	2.52	1.13	2.45	1.08	2.18	1.04	1.98	1.03	1.95	1.01	1.83	1.00	1.79	.98	1.67	.97	1.63	.94	1.49	.92	1.36	.90	1.27	.88	1.15
450	603.0	13,500	16,200	27,000	32,400	40,500	48,600	54,000	64,800	67,500	81,000	94,500	97,200	108,000	113,400	129,600	135 000	162 000	202,500	243,000	324,000
23.50 "				2.02	8.55	1.85	7.29	1.51	4.77	1.41	4.13	1.29	3.47	1.21	3.02	1.17	2.80	1.11	2.47	1.10	2.41	1.05	2.14	1.02	1.95	1.00	1.91	.99	1.81	.98	1.76	.96	1.64	.95	1.60	.93	1.47	.91	1.35	.89	1.25	.87	1.14
600	670.0	15,000	18,000	30,000	36,000	45,000	54,000	60,000	72,000	75,000	90,000	105,000	108,000	120,000	126,000	144,000	150,000	180,000	225,000	270,000	360,000
23.30 "				1.92	8.39	1.77	7.16	1.46	4.70	1.35	4.05	1.24	3.40	1.17	2.97	1.13	2.75	1.08	2.43	1.07	2.36	1.03	2.11	.99	1.91	.99	1.89	.97	1.78	.96	1.73	.94	1.61	.94	1.59	.92	1.46	.90	1.33	.88	1.24	.86	1.13
800	804.0	18,000	21,600	36,000	43,200	54,000	64,800	72,000	86,400	90,000	108,000	126,000	129,600	144,000	151,200	172,800	180,000	216,000	270,000	324,000	432,000
23.00 "				1.77	8.16	1.64	6.96	1.35	4.54	1.28	3.92	1.17	3.30	1.11	2.88	1.08	2.68	1.03	2.36	1.03	2.31	.99	2.05	.98	1.87	.96	1.85	.94	1.74	.94	1.70	.92	1.58	.92	1.56	.90	1.43	.88	1.31	.87	1.22	.86	1.13
700	940.0	21,000	25,200	42,000	50,400	63,000	75,600	84,000	100,800	105,000	126,000	147,000	151,200	168,000	176,400	201,600	210,000	252,000	315,000	378,000	504 000
22.79 "				1.65	7.98	1.51	6.82	1.27	4.44	1.19	3.83	1.12	3.23	1.07	2.83	1.04	2.62	1.00	2.32	.99	2.26	.96	2.02	.94	1.84	.94	1.82	.93	1.72	.92	1.67	.91	1.57	.90	1.53	.89	1.42	.87	1.29	.86	1.21	.84	1.11
800	1,070.0	24,000	28,800	48,000	57,600	72,000	86,400	96,000	115,200	120,000	144,000	168,000	172,800	192,000	201,600	230,400	240,000	288,000	360,000	432,000	576,000
22.63 "				1.67	7.86	1.47	6.71	1.21	4.35	1.15	3.77	1.08	3.18	1.03	2.78	1.01	2.58	.98	2.29	.97	2.23	.94	1.99	.93	1.83	.92	1.79	.91	1.70	.91	1.66	.90	1.55	.89	1.52	.88	1.40	.86	1.28	.86	1.21	.84	1.10
900	1,206.4	27,000	32,400	54,000	64,800	81,000	97,200	108,000	129,600	135,000	162,000	189,000	194,400	216,000	226,800	259,200	270,000	324,000	405,000	486 000	648,000
22.50 "				1.51	7.76	1.41	6.62	1.17	4.30	1.11	3.71	1.05	3.13	1.00	2.74	.99	2.55	.96	2.26	.95	2.20	.93	1.97	.91	1.80	.91	1.78	.90	1.68	.90	1.65	.89	1.54	.88	1.51	.87	1.39	.86	1.28	.85	1.20	.84	1.10
1,000	1,340.0	30,000	36,000	60,000	72,000	90,000	108,000	120,000	144,000	150,000	180,000	210,000	216,000	240,000	252,000	288,000	300,000	360,000	450 000	540 000	720,000
22.40 "				1.46	7.68	1.35	6.64	1.13	4.23	1.08	3.67	1.03	3.10	.99	2.72	.97	2.53	.94	2.24	.94	2.18	.92	1.96	.90	1.79	.90	1.76	.89	1.67	.89	1.63	.88	1.53	.87	1.49	.86	1.35	.85	1.26	.85	1.20	.84	1.10
1,200	1,608.0	36,000	43,200	72,000	86,400	108,000	129,600	144,000	172,800	180,000	216,000	252,000	259,200	288,000	302,400	345,600	360 000	432,000	540,000	648,000	864,000
22.25 "				1.35	7.53	1.29	6.41	1.08	4.17	1.03	3.61	.99	3.05	.96	2.68	.94	2.49	.92	2.21	.92	2.16	.90	1.93	.89	1.77	.89	1.73	.88	1.65	.88	1.62	.87

is scheduled at $28 per kilowatt per year, while in installations of over 200 kw the primary charge is $25 per kilowatt per year.

The secondary charge in the wholesale direct-current schedule is as follows: First 2000 kw-hours per month, 6 cents per kw-hour; next 3000 kw-hours per month, 3 cents per kw-hour; excess over 5000 kw-hours per month, 1.4 cents per kw-hour.

There is a difference in the selling price of electrical energy in the three classes of service mentioned at the beginning of

Theoretically, the charging for electricity on one primary charge representing the fixed charges and one secondary charge representing the operating charges plus the profit seems to be, so far as ascertained at the present time, the correct system of making rates for the consumption of electrical energy. Practically, however, it is difficult to establish a system of rates based on one primary and one secondary charge because of the fact that it costs more proportionately to serve a small cus-

WHOLESALE SCHEDULE—DIRECT CURRENT—LIGHT AND POWER

NET COSTS PER KILOWATT HOUR FOR VARIOUS MAXIMA AND VARIOUS DAILY HOURS' USE OF MAXIMA

PRIMARY CHARGE

MONTHLY BASIS
FIRST 20 K. W. @ $3.20 PER K. W. PER MONTH.
NEXT 30 " 2.60 " " "
EXCESS OVER 50 " 2.30 " " "

YEARLY BASIS
FIRST 200 " 28.00 " " PER YEAR.
EXCESS OVER 200 " 25.00 " "

SECONDARY CHARGE

FIRST 2,000 K. W. H. PER MONTH @ 6.00 PER K. W. H.
NEXT 3,000 " " 3.00 " "
EXCESS OVER 5,000 " " 1.40 " "

A DISCOUNT OF 10% FROM THE SECONDARY PORTION OF THE BILL WILL BE ALLOWED FOR PAYMENT WITHIN 10 DAYS.

THE K. W. H. CONSUMPTION FOR 30 DAYS' USE OF THE MAXIMUM IS GIVEN IN BLACK.

THE SECONDARY RATE PER K. W. H. IS GIVEN IN RED TO THE LEFT IMMEDIATELY BELOW THE K. W. H. CONSUMPTION.

THE TOTAL RATE PER K. W. H. IS GIVEN IN RED TO THE RIGHT IMMEDIATELY BELOW THE K. W. H. CONSUMPTION.

TO OBTAIN THE PRIMARY RATE PER K. W. H. SUBTRACT THE SECONDARY RATE FROM THE TOTAL RATE PER K. W. H.

MAXIMUM KILOWATTS	EQUIVALENT MAXIMUM HORSE POWER	EQUIVALENT HOURS' USE OF MAXIMUM PER DAY																		
		1	1.2	2	2.4	3	3.6	4	4.8	5	6	7	7.2	8	8.4	9.6	10	12	15	18	24
PRIMARY RATE PER K. W.		LOAD FACTOR																		
		4.1%	5%	8.3%	10%	12½%	15%	16.7%	20%	20.8%	25%	29.1%	30%	33⅓%	35%	40%	41.5%	50%	62.5%	75%	100%
5	6.7	150	180	300	360	450	540	600	720	750	900	1,050	1,080	1,200	1,260	1,440	1,500	1,800	2,250	2,700	3,600
$3.20 per month																			5.10	5.81	4.70	5.29	4.20	4.64
6	8.1	180	216	360	432	540	648	720	864	900	1,080	1,260	1,296	1,440	1,512	1,728	1,800	2,160	2,700	3,240	4,320
3.20 "																			5.20	6.09	4.70	5.41	4.37	4.96	3.95	4.39
7	9.4	210	252	420	504	630	756	840	1,008	1,050	1,260	1,470	1,512	1,680	1,764	2,016	2,100	2,520	3,150	3,780	5,040
3.20 "																	5.27	6.34	4.84	5.73	4.41	5.12	4.13	4.72	3.76	4.26
8	10.7	240	288	480	576	720	864	960	1,152	1,200	1,440	1,680	1,728	1,920	2,016	2,304	2,400	2,880	3,600	4,320	5,760
3.20 "																	5.40	6.67	5.05	6.16	4.95	5.92	4.58	5.47	4.20	4.91	3.95	4.54	3.45	3.89
9	12.0	270	324	540	648	810	972	1,080	1,296	1,350	1,620	1,890	1,944	2,160	2,268	2,592	2,700	3,240	4,050	4,860	6,480
3.20 "																	5.20	6.55	5.10	6.37	4.79	5.80	4.70	5.57	4.37	5.25	4.03	4.74	3.81	4.40	3.20	3.66
10	13.4	300	360	600	720	900	1,080	1,200	1,440	1,500	1,800	2,100	2,160	2,400	2,520	2,880	3,000	3,600	4,500	5,400	7,200
3.20 "																	5.27	6.79	5.20	6.68	4.95	6.28	4.84	6.11	4.58	5.69	4.50	5.57	4.20	5.09	3.90	4.61	3.59	4.18	3.01	3.45
12	16.0	360	432	720	864	1,080	1,296	1,440	1,728	1,800	2,160	2,520	2,592	2,880	3,024	3,456	3,600	4,320	5,400	6,480	8,640
3.20 "																	5.20	6.98	4.84	6.36	4.79	6.27	4.58	5.91	4.49	5.76	4.28	5.39	4.20	5.27	3.95	4.84	3.59	4.30	3.20	3.79	2.72	3.16
15	20.1	450	540	900	1,080	1,350	1,620	1,800	2,160	2,250	2,700	3,150	3,240	3,600	3,780	4,320	4,500	5,400	6,750	8,100	10,800
3.20 "																	5.20	7.42	5.10	7.23	4.70	6.45	4.41	5.93	4.37	5.85	4.20	5.53	4.13	5.40	3.95	5.06	3.90	4.97	3.59	4.48	3.13	3.81	2.82	3.41	2.43	2.96
18	24.1	540	648	1,080	1,296	1,620	1,944	2,160	2,592	2,700	3,240	3,780	3,888	4,320	4,536	5,184	5,400	6,480	8,100	9,720	12,960
3.20 "																	5.20	7.87	4.79	7.01	4.70	6.83	4.37	6.15	4.13	5.65	4.10	5.58	3.95	5.28	3.90	5.17	3.69	4.70	3.59	4.60	3.02	3.66	2.56	3.15	2.23	2.67
20	26.8	600	720	1,200	1,440	1,800	2,160	2,400	2,880	3,000	3,600	4,200	4,320	4,800	5,040	5,760	6,000	7,200	9,000	10,800	14,400
3.20 "																	5.20	8.16	4.95	7.62	4.58	6.80	4.50	6.63	4.20	5.98	3.99	5.51	3.95	5.48	3.83	5.16	3.76	5.03	3.45	4.56	3.36	4.43	3.01	3.90	2.56	3.37	2.43	3.00	2.14	2.58
25	33.5	750	900	1,500	1,800	2,250	2,700	3,000	3,600	3,750	4,500	5,250	5,400	6,000	6,300	7,200	7,500	9,000	11,250	13,500	18,000
3.06 "																	5.10	8.50	4.70	7.53	4.50	7.05	4.20	6.32	4.14	6.18	3.90	5.60	3.66	5.12	3.59	5.01	3.36	4.54	3.26	4.47	3.01	4.07	2.94	3.96	2.66	3.51	2.38	3.06	2.19	2.76	1.96	2.39
30	40.3	900	1,080	1,800	2,160	2,700	3,240	3,600	4,320	4,500	5,400	6,300	6,480	7,200	7,560	8,640	9,000	10,800	13,500	16,200	21,600
2.97 "																	5.20	9.33	4.70	8.00	4.37	7.12	4.20	6.67	3.95	6.01	3.90	5.88	3.59	5.24	3.26	4.67	3.20	4.56	3.01	4.25	2.93	4.11	2.72	3.75	2.66	3.65	2.43	3.26	2.19	2.82	2.04	2.56	1.84	2.25
35	46.9	1,050	1,260	2,100	2,520	3,150	3,780	4,200	5,040	5,250	6,300	7,350	7,560	8,400	8,820	10,080	10,500	12,600	15,750	18,900	25,200
2.90 "																	5.27	10.10	4.84	8.87	4.41	7.63	4.13	6.88	3.99	6.41	3.76	5.77	3.66	5.69	3.28	4.87	3.07	4.35	2.93	4.27	2.76	3.97	2.69	3.84	2.51	3.52	2.46	3.43	2.26	3.07	2.06	2.76	1.84	2.47	1.70	2.16
40	53.6	1,200	1,440	2,400	2,880	3,600	4,320	4,800	5,760	6,000	7,200	8,400	8,640	9,600	10,080	11,520	12,000	14,400	18,000	21,600	28,800
2.85 "																	4.95	9.70	4.58	8.54	4.20	7.37	3.95	6.69	3.83	6.20	3.45	5.43	3.36	5.26	3.01	4.59	2.76	4.12	2.72	4.04	2.57	3.76	2.51	3.64	2.35	3.34	2.31	3.26	2.14	2.85	1.96	2.58	1.84	2.37	1.71	2.10
45	60.3	1,350	1,620	2,700	3,240	4,050	4,860	5,400	6,480	6,750	8,100	9,150	9,720	10,800	11,340	12,960	13,500	16,200	20,250	24,300	32,400
2.81 "																	4.70	9.38	4.37	8.27	4.08	7.16	3.81	6.41	3.59	5.93	3.20	5.16	3.13	5.00	2.82	4.38	2.59	3.93	2.50	3.86	2.43	3.60	2.37	3.49	2.23	3.21	2.19	3.13	2.04	2.83	1.89	2.61	1.78	2.41	1.65	2.06
50	67.0	1,500	1,800	3,000	3,600	4,500	5,400	6,000	7,200	7,500	9,000	10,500	10,800	12,000	12,600	14,400	15,000	18,000	22,500	27,000	36,000
2.78 "																	4.50	9.13	4.20	8.06	3.90	6.99	3.59	6.16	3.36	5.59	3.01	4.94	2.94	4.79	2.66	4.20	2.46	3.78	2.43	3.72	2.31	3.47	2.26	3.36	2.14	3.11	2.10	3.03	1.96	2.73	1.82	2.53	1.72	2.23	1.61	2.00
60	80.5	1,800	2,160	3,600	4,320	5,400	6,480	7,200	8,640	9,000	10,800	12,600	12,960	14,400	15,120	17,280	18,000	21,600	27,000	32,400	43,200
2.68 "																	5.20	12.64	4.20	8.67	3.95	7.67	3.59	6.57	3.20	6.68	3.01	5.24	2.72	4.68	2.66	4.45	2.43	3.92	2.26	3.54	2.23	3.47	2.14	3.26	2.00	3.15	1.99	2.92	1.96	2.85	1.84	2.58	1.72	2.38	1.62	2.15	1.55	1.92
70	95.0	2,100	2,520	4,200	5,040	6,300	7,560	8,400	10,080	10,500	12,600	14,700	15,120	16,800	17,640	20,160	21,000	25,200	31,500	37,800	50,400
2.61 "																	5.27	13.97	4.84	12.09	3.99	8.34	3.76	7.39	3.26	6.16	2.93	5.35	2.76	4.93	2.51	4.32	2.46	4.20	2.28	3.71	2.12	3.36	2.00	3.30	2.01	3.10	1.97	3.01	1.89	2.80	1.86	2.73	1.76	2.49	1.66	2.31	1.59	2.07	1.51	1.87
75	100.5	2,250	2,700	4,500	5,400	6,750	8,100	9,000	10,800	11,250	13,500	15,750	16,200	18,000	18,900	21,600	22,500	27,000	33,750	40,500	54,000
2.58 "																	5.10	13.70	4.70	11.87	3.90	8.20	3.59	7.17	3.13	5.97	2.82	5.21	2.66	4.81	2.43	4.22	2.38	4.10	2.19	3.62	2.06	3.29	2.04	3.23	1.96	3.04	1.93	2.95	1.84	2.74	1.82	2.68	1.72	2.44	1.64	2.21	1.57	2.05	1.49	1.85
80	107.1	2,400	2,880	4,800	5,760	7,200	8,640	9,600	11,520	12,000	14,400	16,800	17,280	19,200	20,160	23,040	24,000	28,800	36,000	43,200	57,600
2.56 "																	4.95	13.48	4.58	11.69	3.83	8.10	3.45	7.01	3.01	5.85	2.72	5.09	2.57	4.70	2.41	4.19	2.31	4.02	2.14	3.56	2.01	3.24	1.99	3.18	1.92	2.99	1.89	2.91	1.81	2.70	1.79	2.64	1.70	2.41	1.61	2.18	1.55	2.00	1.48	1.84
90	120.5	2,700	3,240	5,400	6,480	8,100	9,720	10,800	12,960	13,500	16,200	18,900	19,440	21,600	22,680	25,920	27,000	32,400	40,500	48,600	64,800
2.49 "																	4.70	13.10	4.37	11.37	3.59	7.79	3.20	6.70	2.82	5.62	2.56	4.89	2.43	4.53	2.23	3.98	2.19	3.87	2.04	3.44	1.93	3.13	1.91	3.08	1.84	2.89	1.79	2.83	1.76	2.65	1.70	2.56	1.68	2.51	1.61	2.36	1.54	2.08	1.49	1.90	1.43	1.73
100	134.0	3,000	3,600	6,000	7,200	9,000	10,800	12,000	14,400	15,000	18,000	21,000	21,600	24,000	25,200	28,800	30,000	36,000	45,000	54,000	72,000
2.49 "																	4.50	12.80	4.20	11.12	3.36	7.51	3.01	6.47	2.66	5.43	2.43	4.74	2.31	4.38	2.14	3.87	2.10	3.76	1.96	3.34	1.86	3.05	1.84	2.99	1.79	2.83	1.76	2.75	1.70	2.56	1.68	2.51	1.61	2.36	1.54	2.08	1.49	1.90	1.43	1.73
110	147.1	3,300	3,960	6,600	7,920	9,900	11,880	13,200	15,840	16,500	19,800	23,100	23,760	26,400	27,720	31,680	33,000	39,600	49,500	59,400	79,200
2.46 "																	4.34	12.54	4.06	10.89	3.17	7.27	2.85	6.27	2.53	5.26	2.32	4.60	2.26	4.31	2.06	3.77	2.02	3.66	1.90	3.27	1.81	2.98	1.80	2.94	1.74	2.77	1.72	2.70	1.66	2.51	1.64	2.46	1.58	2.26	1.52	2.07	1.47	1.93	1.42	1.76
120	161.0	3,600	4,320	7,200	8,640	10,800	12,960	14,400	17,280	18,000	21,600	25,200	25,920	28,800	30,240	34,560	36,000	43,200	54,000	64,800	86,400
2.44 "																	4.20	12.33	3.95	10.73	3.01	7.08	2.72	6.11	2.43	5.14	2.23	4.49	2.14	4.17	1.99	3.68	1.96	3.59	1.84	3.20	1.76	2.92	1.75	2.88	1.70	2.72	1.65	2.65	1.63	2.48	1.61	2.42	1.55	2.23	1.49	2.03	1.45	1.90	1.41	1.75
130	174.0	3,900	4,680	7,800	9,360	11,700	14,040	15,600	18,720	19,500	23,400	27,300	28,080	31,200	32,760	37,440	39,000	46,800	58,500	70,200	93,600
2.42 "																	4.08	12.15	3.85	10.57	2.88	6.91	2.61	5.97	2.34	5.03	2.16	4.40	2.07	4.09	1.93	3.61	1.91	3.52	1.80	3.14	1.72	2.87	1.71	2.83	1.66	2.67	1.65	2.61	1.60	2.44	1.58	2.38	1.53	2.20	1.48	2.03	1.44	1.89	1.39	1.73
140	187.5	4,200	5,040	8,400	10,080	12,600	15,120	16,800	20,160	21,000	25,200	29,400	30,240	33,600	35,280	40,320	42,000	50,400	63,000	75,600	100,800
2.41 "																	3.99	12.02	3.76	10.45	2.76	6.78	2.51	5.86	2.26	4.94	2.09	4.32	2.01	4.02	1.89	3.56	1.88	3.47	1.76	3.10	1.69	2.84	1.68	2.80	1.64	2.64	1.62	2.58	1.57	2.41	1.56	2.36	1.51	2.18	1.46	2.00	1.43	1.86	1.38	1.71
150	201.0	4,500	5,400	9,000	10,800	13,500	16,200	18,000	21,600	22,500	27,000	31,500	32,400	36,000	37,800	43,200	45,000	54,000	67,500	81,000	108,000
2.39 "																	3.90	11.87	3.59	10.23	2.66	6.64	2.43	5.75	2.19	4.85	2.04	4.25	1.96	3.95	1.84	3.50	1.82	3.41	1.72	3.05	1.66	2.80	1.65	2.76	1.61	2.61	1.59	2.54	1.55	2.38	1.54	2.34	1.49	2.15	1.45	1.98	1.42	1.86	1.38	1.71
175	234.0	5,250	6,300	10,500	12,600	16,750	18,900	21,000	25,200	26,250	31,500	36,750	37,800	42,000	44,100	50,400	52,500	63,000	78,750	94,500	126,000
2.36 "																	3.66	11.53	3.26	9.82	2.46	6.39	2.26	5.54	2.06	4.68	1.93	4.12	1.86	3.83	1.76	3.34	1.74	3.31	1.66	2.97	1.61	2.73	1.59	2.68	1.56	2.54	1.55	2.49	1.51	2.33	1.50	2.29	1.46	2.11	1.42	1.94	1.39	1.81	1.36	1.69
200	268.0	6,000	7,200	12,000	14,400	18,000	21,600	24,000	28,800	30,000	36,000	42,000	43,200	48,000	50,400	57,600	60,000	72,000	90,000	108,000	144,000
2.34 "																	3.36	11.14	3.01	9.49	2.31	6.20	2.14	5.38	1.96	4.55	1.84	4.00	1.79	3.73	1.70	3.32	1.68	3.24	1.61	2.91	1.56	2.67	1.55	2.63	1.52	2.49	1.51	2.44	1.48	2.28	1.47	2.25	1.43	2.08	1.40	1.92	1.38	1.81	1.35	1.69
225	301.6	6,750	8,100	13,500	16,200	20,250	24,300	27,000	32,400	33,750	40,500	47,250	48,600	54,000	56,700	64,800	67,500	81,000	101,250	121,500	162,000
27.66 per year																	3.13	10.81	2.82	9.22	2.19	6.03	2.04	5.24	1.89	4.45	1.79	3.92	1.72	3.64	1.65	3.25	1.64	3.18	1.57	2.85	1.53	2.63	1.52	2.59	1.49	2.45	1.48	2.40	1.45	2.25	1.45	2.22	1.42	2.06	1.39	1.90	1.36	1.79	1.34	1.66
250	335.0	7,500	9,000	15,000	18,000	22,500	27,000	30,000	36,000	37,500	45,000	52,500	54,000	60,000	63,000	72,000	75,000	90,000	112,500	125,000	180,000
27.40 "																	2.94	10.55	2.66	9.00	2.10	5.91	1.96	5.13	1.82	4.36	1.72	3.83	1.68	3.58	1.61	3.20	1.60	3.12	1.54	2.81	1.50	2.59	1.49	2.55	1.47	2.42	1.46	2.37	1.43	2.22	1.43	2.19	1.40	2.03	1.37	1.88	1.36	1.76	1.33	1.65
300	402.0	9,000	10,800	18,000	21,600	27,000	32,400	36,000	43,200	45,000	54,000	63,000	64,800	72,000	75,600	86,400	90,000	108,000	135,000	162,000	216,000
27.00 "																	2.66	10.16	2.43	8.68	1.96	5.71	1.84	4.97	1.72	4.22	1.65	3.73	1.61	3.48	1.55	3.11	1.54	3.04	1.49	2.74	1.46	2.53	1.45	2.49	1.43	2.37	1.42	2.32	1.41	2.19	1.40	2.15	1.38	2.00	1.35	1.86	1.34	1.76	1.31	1.65
350	469.0	10,500	12,600	21,000	25,200	31,500	37,800	42,000	50,400	52,500	63,000	73,500	75,600	84,000	88,200	100,800	105,000	126,000	157,500	183,000	252,000
26.71 "																	2.46	9.88	2.26	8.44	1.86	5.57	1.76	4.85	1.66	4.13	1.59	3.65	1.56	3.41	1.51	3.06	1.50	2.98	1.46	2.70	1.43	2.49	1.43	2.46	1.41	2.34	1.40	2.28	1.38	2.15	1.38	2.12	1.36	1.98	1.34	1.85	1.33	1.74	1.31	1.63
400	536.1	12,000	14,400	24,000	28,800	36,000	43,200	48,000	57,600	60,000	72,000	84,000	86,400	96,000	100,800	115,200	120,000	144,000	180,000	216,000	288,000
26.50 "																	2.31	9.67	2.14	8.27	1.79	5.47	1.70	4.77	1.61	4.06	1.55	3.59	1.52	3.36	1.48	3.01	1.47	2.94	1.43	2.66	1.41	2.46	1.41	2.43	1.39	2.31	1.38	2.26	1.37	2.14	1.37	2.11	1.35	1.96	1.33	1.83	1.32	1.74	1.30	1.61
450	603.0	13,500	16,200	27,000	32,400	40,500	48,600	54,000	64,800	67,500	81,000	94,500	97,200	108,000	113,400	129,600	135,000	162,000	202,500	243,000	324,000
26.33 "																	2.19	9.50	2.04	8.13	1.72	5.38	1.65	4.70	1.57	4.01	1.52	3.55	1.49	3.32	1.45	2.97	1.45	2.91	1.42	2.64	1.39	2.43	1.39	2.41	1.38	2.29	1.37	2.24	1.36	2.12	1.35	2.08	1.34	1.95	1.32	1.82	1.31	1.73	1.30	1.60
500	670.0	15,000	18,000	30,000	36,000	45,000	54,000	60,000	72,000	75,000	90,000	105,000	108,000	120,000	126,000	144,000	150,000	180,000	225,000	270,000	360,000
26.20 "																	2.10	9.38	1.96	8.02	1.68	5.32	1.61	4.64	1.54	3.97	1.49	3.51	1.47	3.29	1.43	2.95	1.43	2.89	1.40	2.61	1.38	2.42	1.38	2.39	1.37	2.28	1.36	2.23	1.35	2.11	1.34	2.07	1.33	1.94	1.32	1.81	1.31	1.71	1.29	1.59
600	804.0	18,000	21,600	36,000	43,200	54,000	64,800	72,000	86,400	90,000	108,000	126,000	129,600	144,000	151,200	172,800	180,000	216,000	270,000	324,000	432,000
26.00 "																	1.96	9.18	1.84	7.86	1.61	5.22	1.55	4.56	1.49	3.90	1.45	3.46	1.43	3.24	1.41	2.91	1.40	2.84	1.38	2.58	1.36	2.39	1.36	2.36	1.35	2.25	1.34	2.20	1.33	2.08	1.33	2.04	1.32	1.92	1.31	1.81	1.30	1.71	1.28	1.59
700	940.0	21,000	25,200	42,000	50,400	63,000	75,600	84,000	100,800	105,000	126,000	147,000	151,200	168,000	176,400	201,600	210,000	252,000	315,000	378,000	504,000
25.86 "																	1.86	9.04	1.76	7.75	1.56	5.15	1.51	4.50	1.46	3.85	1.43	3.43	1.41	3.21	1.38	2.88	1.38	2.82	1.36	2.56	1.35	2.38	1.34	2.34	1.34	2.24	1.33	2.19	1.33	2.08	1.33	2.05	1.31	1.91	1.30	1.78	1.29	1.69	1.28	1.59
800	1,070.0	24,000	28,800	48,000	57,600	72,000	86,400	96,000	115,200	120,000	144,000	168,000	172,800	192,000	201,600	230,400	240,000	288,000	360,000	432,000	576,000
25.75 "																	1.79	8.94	1.70	7.66	1.52	5.10	1.48	4.46	1.43	3.81	1.41	3.40	1.39	3.18	1.37	2.86	1.37	2.80	1.35	2.54	1.34	2.36	1.33	2.32	1.33	2.22	1.32	2.18	1.32	2.07	1.31	2.03	1.30	1.90	1.29	1.77	1.29	1.69	1.28	1.58
900	1,206.4	27,000	32,400	54,000	64,800	81,000	97,200	108,000	129,600	135,000	162,000	189,000	194,400	216,000	226,800	259,200	270,000	324,000	405,000	486,000	648,000
25.66 "																	1.72	8.85	1.65	7.59	1.49	5.05	1.45	4.42	1.42	3.80	1.39	3.37	1.38	3.16	1.36	2.84	1.35	2.78	1.34	2.53	1.33	2.35	1.33	2.31	1.32	2.21	1.32	2.17	1.31	2.05	1.31	2.01	1.30	1.89	1.29	1.77	1.29	1.69	1.28	1.58
1,000	1,340.0	30,000	36,000	60,000	72,000	90,000	108,000	120,000	144,000	150,000	180,000	210,000	216,000	240,000	252,000	288,000	300,000	360,000	450,000	540,000	720,000
25.60 "																	1.68	8.79	1.61	7.54	1.47	5.03	1.43	4.39	1.40	3.77	1.38	3.36	1.37	3.15	1.35	2.83	1.34	2.76	1.33	2.52	1.33	2.34	1.32	2.30

method. However, it is believed that the tables, which are herewith reproduced, with the rates figured out for 20 different load factors representing varying hours' use of the maximum from 1 to 24, are the most elaborate and useful which have yet been put out by any central-station company. They show at a glance almost any rate for the use of electricity which may be desired, and are the result of much study and investigation on the part of the contract and statistical departments of the Commonwealth Edison Company.

The rates apply both to power and to light, but in the latter case without free-renewal lamps.

INTERIOR WIRING AND ILLUMINATION

Wiring of Bedrooms.

Chief among the arguments for installing electricity in the home is the one of convenience, and yet in the average dwelling employing electricity the convenience to the householder is little more than that of gas. In no room in the house is this more clearly shown than in the bedroom. Here no thought seems to be displayed. As a rule there is a center lamp, with possibly a bracket lamp, and if there is a switch near the door for the center lamp, it measures up to the owner's idea of convenience. Strange as it may seem, there are few homes in which the bedrooms are equipped with two-way switches or base receptacles for portable devices, not to mention reading lamps attached to the bed. Moreover, the outlets are rarely arranged with a view to utility, unless the owner has made provision for the extra ceiling outlets and base receptacles.

It is seldom that one finds a lamp suitably placed with respect to a dressing mirror so that a person's face is lighted and not in shadow. On retiring at night, it is necessary to walk over to a switch near the door, gage the distance between the switch and the bed, turn out the light and grope around in the dark to the bed with occasional stubbing of the toes, etc. With a two-way switch, one at the door and the other attached to the bed through flexible cord, the lamps could be lighted on entering the room and extinguished from the bed on retiring, or relighted from the bed if desired. If base receptacles are provided, it is an easy matter to connect a reading lamp to the bed with a chain pull switch within arm's length. There are on the market numerous bed fixtures by means of which one can recline, propped up by pillows in absolute comfort, and read at night. When tired, it is only necessary to pull the chain near at hand, sink down in the bed and go to sleep without further ado. The same receptacle can be used for attaching a heating pad or any of the numerous other electric devices on the market intended for sleeping rooms. It would appear that the advantages of these outlets would be so self-evident that reference to them would be unnecessary.

In this connection it might be well to call attention to misdirected economy in the use of tungsten lamps in bedrooms The average lamp in bedrooms is used but little, possibly an hour or two at most; certainly not over 10 hours a week Outages in tungsten lamps are chiefly due to breakage of the filament, and if a bedroom tungsten lamp had a life of 1000 hours or remained in service two years without breaking, it would be quite remarkable. If plenty of light is needed, it will be found cheaper in the long run to install 32-cp carbon-filament lamps, unless very marked improvements are made in tungsten-lamp filaments. It is for long-hour burning that the tungsten lamp is best adapted. The wiring of bedrooms might be rearranged at small cost to obtain the advantages noted above. Certainly if convenience is worth anything at all the outlay of a few dollars for extra switches and outlets as outlined above is justifiable.

Color and Visual Acuity.

By J. S. Dow.

The contribution of Professor Ashe in the *Electrical World* of Feb. 25, and the editorial comments upon the suggestions contained in this communication, are of considerable interest at the present moment when physiological problems are coming more and more closely under the notice of the illuminating engineer.

Anyone who has made a serious attempt to grapple with some of the thorny questions of this kind will agree as to the bewildering nature of the many factors involved and the difficulty, in many cases, of drawing definite and satisfactory conclusions from the apparently conflicting results on record. This difficulty is intensified by the fact that these researches are often buried in the transactions of some foreign physiological or purely scientific society, and are frequently well known only to the physiologist or ophthalmist. Hence they are apt to pass unnoticed by present-day observers in somewhat different but yet allied fields of investigation. Moreover, there is a tendency to repeat work that has been already well done, and, as the new experiments are sometimes made under distinctly different conditions, the results may only serve to mystify subsequent observers. It may, however, be said that much of the work of this kind carried out in the past, admirable as it undoubtedly is from the standpoint of the physiologist, is rendered less serviceable to the illuminating engineer because the conclusions are presented from another point of view and information on essential details is sometimes withheld.

One question with which Professor Ashe seeks to deal, and which also received attention from Messrs. Laporte and Broca[1] not long ago, is that of the effect of light of different colors on visual acuity. This is a matter of considerable interest, if only on account of the singularly conflicting statements so frequently made in this connection, and the unjustifiable claims sometimes put forward on behalf of different illuminants. One of the main objects of illumination is to enable one to read, and reading is becoming one of the most general methods of acquiring knowledge. Any small difference, therefore, that may exist in the ease and comfort with which one can read by the aid of different illuminants is well worth study, because the cumulative effect of such differences may be considerable.

Prof. J. A. Fleming in his well-known paper on photometry before the Institution of Electrical Engineers in 1902 drew attention to the desirability of distinguishing between two distinct qualities of illuminants; namely, the "power of creating brightness" and the "power of revealing detail." He also proposed the use of so-called "discrimination-photometers," based on acuteness of vision, in which two lights were compared by their relative ability to enable the eye to distinguish fine detail. More recently Dr. Drysdale[2] has referred to the same method as a possible means of facilitating the comparison of the brightness in different regions of the spectrum.

That some method of comparing the quality of revealing detail on the part of lights of different colors is desirable may be admitted. However, at the same time the author would again suggest, as he has already done,[3] that such a test must be regarded as quite distinct from "photometry" as the term is usually understood, and has only a restricted application. The use of light in order to enable the eye to perceive very fine detail, to read print, for example, though an important function of illumination, is only one among many purposes for which it is intended. Apart from any question of the relative accuracy of the two systems, it seems probable at the present moment that the method of comparing the powers of "creating brightness" of illuminants is the best test of their general value, though, of course, it should always be supplemented by the

[1] *Bull. Soc. Int. des Electriciens*, June, 1908.
[2] *Illuminating Engineer*, Lond., Vol. I., 1908, p. 544.
[3] *Electrical World*, Nov. 30, 1908

judgment of the illuminating engineer and may in the future be supplemented by other tests of *quality*.

In attempting to study the question under consideration it is desirable to form a fairly exact idea as to what is meant by "visual acuity." The generally accepted sense in which this term is used seems to be the ability of the eye to perceive fine detail, such as small print, etc. Occasionally, however, people seem to have used the expression to denote the power of appreciating fine distinctions of light and shade, which is a somewhat different matter, though, of course, it may affect visual acuity.

It may also be pointed out that there is some vagueness about statements to the effect that certain varieties of light are "good for reading." It is meant, for instance, that the type appears exceptionally sharp and distinct to the eye when illuminated by this light, or that we can read a book so illuminated for an unusually long period without fatigue? It seems quite possible that these two conditions may not be identical.

Into the question of fatigue the writer does not wish to enter at present. It is, indeed, a term that seems to be used to describe many different phenomena. It is probable that claims on behalf of the "restful" nature of almost all qualities of light have been put forward recently. For the present, at any rate, the wisest course would seem to be to mistrust the influence of red, yellow, green, or any other peculiar kind of light and to imitate the variety found in nature. In any case it cannot be too strongly emphasized how careful one must be to insure that any test of the quality of the light from different illuminants, as regards visual acuity, is made under exactly fair conditions, from the physiological standpoint.

It is, indeed, well-nigh impossible for an engineer, unaided by someone closely in touch with the latest developments in physiological optics, to avoid his results being vitiated by some physiological effect which is apt to obscure the real point at issue. This point may be stated as follows:

Suppose a white surface on which is inscribed some fine black detail, such as small letters, is illuminated in turn by light from different portions of the spectrum, the light being adjusted in such a manner that it appears equally bright to the eye in each case. Under these conditions, will the detail be clearer and more easily perceived by the eye by light of one particular color, and, if so, which kind of light is best for the purpose?

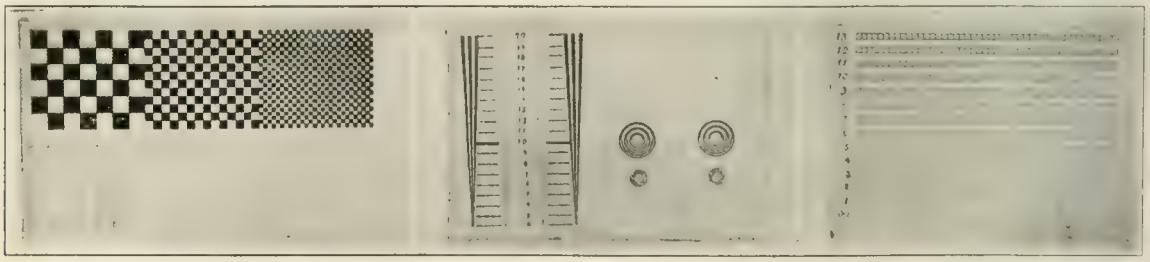
In order to study this question it is essential to treat both kinds of light fairly by insuring that the surface appears to have the same brightness in each case. It is, of course, no easy matter to compare the brightness of two adjacent surfaces, illuminated by lights differing in color, but the experiences of many observers suggest that there is no inherent impossibility in making an approximate judgment. On the other hand, it would seem essential to make sure, *by actual observation*, that the brightness really does seem to be the same in each case, and not to calculate from some assumed law that it is so.

Messrs. Laporte and Broca, in the researches mentioned, utilized a Ritchie wedge complying with this condition, and the writer has recently[1] described some experiments carried out with a very similar form of apparatus, the only distinction being that the detail was photographed on lantern-slides which could be inserted between the eye and the illuminated wedge, and therefore viewed simultaneously by the aid of the different colors. It has at least the merit that one can be sure that he is really comparing the detail-revealing powers of the two qualities of light studied, under approximately equal conditions as regards illumination. It may be added that in the arrangement used by the author provision was made for the distance of the eye from the detail to be maintained at a certain definite value. Professor Ashe appears to have calculated the illumination by which his tests[2] were conducted by the inverse square law, and to have used a flicker-photometer. The writer, however, would venture to suggest that this method is not so satisfactory, partly because it is legitimate to question whether, in a research of this kind, where lights of such different colors are used, readings of a flicker-instrument constitute an entirely satisfactory method of judging "equality of brightness," on the maintenance of which the whole value of the experiment depends; in addition, in his experience, theoretical calculations of illumination are apt to be very misleading in heterochromatic comparisons owing to the "yellow-spot" and Purkinje effects. Many observers have attempted to compare the "visual acuity" for different portions of the spectrum by placing a small object in the eyepiece of a telescope in the spectrometer, and gradually dimming the illumination until it became indistinguishable. Naturally such experiments have not infrequently suggested that greenish-blue light was the best, but probably merely because, at the very low order of illumination necessary to cause the object to appear indistinguishable, this is the region of the spectrum where the luminosity is greatest; therefore, they can hardly be taken as an illustration of the relative detail-revealing powers of different regions, *for the same intensity of illumination*, and at ordinary high illuminations.

Without entering in detail into the many researches that have been obtained apparently introducing this factor, it may be remarked that they lead to very contradictory results. After examining the curves of visual acuity throughout the spectrum as obtained by Langley[3] and many other observers, the author was able to classify them into two groups. The maximum seemed to fall either in the green near 0.52 μ or in the yellow near 0.58 μ, according as the conditions were such as to lead to rod-vision or cone-vision.

Instruments which depend upon the dimming of the existing illumination to very low values seem to the writer to be open to serious objection on the ground that they utilize the illuminants compared under physiological conditions quite different from those prevailing at ordinary working illuminations, and it may be suggested that, as a matter of principle, such measurements should be undertaken at the actual order of illumination which the illuminants will be required to supply.

Another source of uncertainty in making tests of visual acuity by lights of different colors is brought into play by adopting the plan of setting up some type of a given size and then walking backward until it just becomes indistinguishable. Here again the visual angles thus calculated may fail to afford a fair comparison of the acuteness of vision by different qualities of light, because, in walking away from the object, there is brought into play a different region of the retina, which therefore alters not



FIGS. 1, 2 AND 3.—DIAGRAMS FOR THE TESTING OF ACUTENESS OF VISION.

[1] *Illuminating Engineer*, Lond., April, 1909.

[2] *Electrical World*, Feb. 25, 1909.

[3] *Phil. Mag.*, Jan., 1889.

only the visual angle, but also the *apparent brightness of the illumination*. The central region of the retina has been found by many observers to be less sensitive to the blue end of the spectrum than is the surrounding region. Hence, although one may insure that the illumination is the same in the case of the two colors compared at close quarters, this may no longer be the case at a distance. For this reason also the writer prefers an arrangement such as the Ritchie wedge, where the eye is maintained at the same constant distant from the illuminated surfaces during the experiment. The distance of the eye from the surface is also of importance for another reason which will be referred to shortly.

Some researches of Uthoff[1] seem to be open to possible objection on this ground. In addition Helmholtz[2] points out that it is not easy to draw conclusions as to which part of the spectrum is best suited to the revelation of detail because of the uncertainty involved in estimating the relative illumination in each case.

In order to be able to vary the visual angle subtended by the detail studied without altering the distance of the eye, the author has sometimes made use of graduated detail of the variety shown in the chart in Fig. 2. The tapering striped pattern was used as a basis of measurement of visual acuity by noting the exact point at which the eye was unable to detect the transition from the adjacent black stripe to the adjacent white one.

In using the apparatus just described, however, the author first attempted to prepare a discrimination photometer on the lines laid down by Dr. Fleming, using patterns of fine dots, at such a distance from the eye that the dots just fell within the minimum angle of distinct vision about one minute. In a photometer of this type one merely seeks to balance the illumination so that both sets of dots become equally distinct. An artificial pupil-aperture 2 mm in diameter was used, this being sufficient at the order of illumination employed to be well within the minimum value assumed by the author's eye. An artificial arrangement of this kind is generally believed to be necessary in order to eliminate changes in visual acuity owing to the contraction and dilatation of the pupil. It may, however, be questioned whether the effect of this need greatly be feared except at very low illuminations; in the latter case it is the change in apparent illumination so caused, rather than the optical effect of reducing the diameter of the available eye-lens that seems to be most important.

The author's experiments were carried out with incandescent lamps screened with gelatines and solutions of various colors. Naturally the tints thus obtained do not quite correspond to pure spectral colors. There are, however, organic dyes which, in solution, or spread upon gelatines such as a fixed photographic plate, enable a very pure red or green to be obtained, though naturally at the expense of a considerable loss in light. By combinations of gelatines prepared in this way a pure blue can also be obtained, but the absorption is then extremely high. The purity of these colors was ascertained by means of a spectrometric examination, and though not quite equivalent to pure spectrum tints they should probably serve to exhibit the main phenomena examined.

Theoretically, since visual acuity is admittedly connected to some extent with illumination, there would seem some justification for attempting to use this method as a basis of comparison of intensity. Yet no one appears to have devised a photometer on this plan which is regarded as giving results of the same order as those depending on the principles of "contrast" or "equality of brightness" at least for lights of approximately the same color. Personally the writer must admit that his own experiences with many patterns of detail of the kind referred to do not lead him to suppose that detail-revelation is of much assistance even in the case of sources differing considerably in color.

It appeared that there were two distinct criteria of what was to be considered balance. There was, apparently, a distinct difference in sharpness in the case of different colors; this sharpness seemed to be a purely optical effect connected with the accommodation of the eye, and was unaffected by the illumination within wide limits. It was, in fact, possible to secure greater sharpness of the pattern with light of a certain color than another in spite of an obviously lower order of illumination.

On the other hand, another possible criterion of balance was the "contrast" between the pattern and its background; if this be the condition by which judgments are based the instrument could be used as what might be termed a "relief-photometer." In this case it was found that, when linear detail was used, results practically equivalent to those obtained by the "equality of brightness" method were obtained. When patterns consisting of alternate light and dark patches are used, however, the matter becomes more complicated, possibly because the eye no longer judges the brightness of the mass as a whole, but selects the individual bright patches. For instance, to the writer it appeared that, when the "chessboard" pattern (Fig. 1) was superimposed over two patches of, say, red and green of equal apparent brightness, the small red squares invariably appeared brighter than the small green ones, though perhaps somewhat less sharp. This result is what one would naturally expect when it is recalled that the effect of using smaller illuminated surfaces is usually to favor the red end of the spectrum owing to the lack of sensibility of the central portion of the retina to the green end of the spectrum.

In any case it would seem that the effect of superimposing detail of this kind over the illuminated surface is to introduce complications, and the writer's experience is that it tends to cause bewilderment rather than to assist judgment in attempting to balance the photometer.

It may be remarked in passing, however, that this effect seems to offer a possible explanation of the results of several observers of the past who arrived at a conclusion differing from those arrived at both by Professor Ashe and Messrs. Laporte and Broca, and who contended that it was the red end of the spectrum that contributed mainly to assisting visual acuity.

A number of experiments were also carried out with graduated patterns of the type shown in Fig. 2 and others with the object of comparing the visual acuity obtainable with lights of different colors. As a result it seemed that even for more or less pure green or red monochromatic light there was no very distinct difference to be observed in the case of near vision such as one would use in reading. It appeared, however, that there was a small but distinctly better result obtainable by using the green end of the spectrum.

A possible explanation of this effect seems to lie in the want

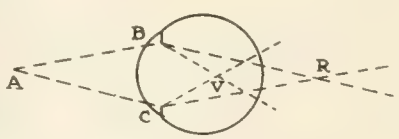


FIG. 4.—DIAGRAM SHOWING WANT OF ACHROMATISM OF THE EYE.

of achromatism of the eye. This quality will be understood from the diagram of Fig. 4, which is similar to that employed in Tscherning's book on "Physiological Optics" and elsewhere. Referring to Fig. 4, let *A* be a luminous point which emits the cone of light *A B C*, penetrating the eye-lens at *B* and *C*. After refraction the violet rays are brought to a focus at *V* while the red rays are brought to a focus on the other side of the retina at *R*. Since sunlight and the light of most artificial illuminants contain mainly rays of a yellowish character, the eye-lens is usually so adjusted that yellow light is brought to a focus on the retina, which is thus in a position intermediate between *V* and *R*.

Now the difficulty experienced by the eye in accommodating for near objects, in the case of white and yellow light, will be

[1] *Graefe's Archiv.*, Bd. XXXII., p. 171; Bd. XXXVI., p. 33.
[2] Phys. Optik, p. 425.

accentuated for the red end of the spectrum because the image of a near object tends to fall behind the retina. On the other hand, it is conceivable that, when a point is reached such that it becomes impossible for the eye to accommodate so as to bring the yellow image on the retina, it may still be possible for it to do so for the violet. It seems possible that in accommodating for a very near object the eye does not as a rule obtain a perfectly sharp image, although by a special effort it may do so.

It is clear under these conditions that a person who finds any difficulty in keeping up the effort of accommodation and therefore finds reading tiresome, might possibly find violet light more "restful," and might also obtain better definition by light of this color. This is the experience of the writer and of almost all of those to whom he has shown these experiments, though, as a rule, the effect is not very marked; it is quite natural that Messrs. Laporte and Broca should have found little perceptible result in the case of practical illuminants. The writer, however, is able to see these effects distinctly by the aid of the mercury-vapor lamp.

There are many experiments designed to exhibit this quality of the eye, some of which have been described by Shelford Bidwell in "Curiosities of Light and Vision" and others. Note, for instance, what happens when a naked incandescent-lamp filament is observed through a cobalt glass, which allows both red and blue light to pass but obscures the intermediate portion of the spectrum. When the eye is only a few inches away there is seen a purplish filament with a distinct red fringe; as the distance of the observer is increased there is seen ultimately a red filament surrounded by a blue ribbon which, at a distance of from 20 ft. to 30 ft., becomes a shapeless haze. The exact nature of the effect and the distance at which it appears, however, are naturally subject to modification according to the optical peculiarities of the eye of the observer.

It is not surprising to find, therefore, that in the case of distant vision there occurs an effect corresponding to that remarked when the eye is close to the detail observed. For the same reason the blue light seems to be less effective for distant vision than does white light, while, on the other hand, red light is somewhat better. It would seem, in fact, that most people find themselves distinctly short-sighted for blue and violet light. In 1907 the writer gave a demonstration of this quality of light before the Physical Society (London). A black-and-white pattern was illuminated by two patches of red and blue-violet light, produced by interposing specially prepared combinations of gelatines in the beam of a lantern. The brightness of the red was intentionally reduced to but a fraction of that of the blue patch. Nevertheless, those at the back of the room were able to see that the detail illuminated by the red patch was incontestably the sharper of the two. Indeed, the detail illuminated by the pure blue-violet appeared a shapeless mass. Naturally the success of such experiments demands very pure colors. The mercury-vapor lamp, which produces vivid lines in the yellow, violet and green, respectively, is very useful for demonstration in connection with suitable gelatines.

On the other hand, it must be confessed that there seems to be individuals who, either through exceptional abilities of accommodation or because their eyes are exceptionally well achromatized, are unable to see these effects distinctly. The writer has known of some cases of this kind and Dr. Louis Bell[1] seems to find no difficulty in accommodating for either red or violet light at will. Experiments of this kind, in order to be conclusive, therefore, should be carried out upon a large number of individuals, and it may be hoped that these remarks may stimulate others to take up the matter more fully than he has been able to do.

From what has been said, however, the writer thinks that it may be conceded that the use of visual acuity, as a means of comparing lights which differ in color, is open to grave objection, even if a very accurate method of applying the principle could be devised.

When it is considered that inability to focus a certain quality of light must mean that the detail illuminated by it is seen imperfectly, however great the illumination, it seems obviously desirable to avoid mixing up this method with the ordinary means of estimating illuminating power. In the same way it seems clear that a method which could lead to identically opposite results, at least in the case of some individuals, according to the distance away of the eye, and one which is so much affected by personal peculiarities of vision, must always be open to grave objection.

There remains one other point in connection with visual acuity which deserves mention, namely, the power of distinguishing small changes in light and shade. This matter is somewhat different from that hitherto discussed and one which has a very intimate bearing on ordinary photometry. Anything that has exactly the same color and the same brightness as found in its surroundings will become indistinguishable from them.

It is of interest, therefore, to inquire whether one is able to perceive a smaller alteration in brightness by the aid of light from one end of the spectrum than from another. The standard researches on this point are probably those of Koenig and Brodhun.[2] Briefly, these observers found that at high illuminations—above 60 lux or so—the minimum change in illumination detectable by the eye was the same for all colors. At very low illuminations, on the other hand, it was found, as the Purkinje effect would lead one to expect, that a given change in stimulus produced a more marked influence in the case of light from the blue end of the spectrum than in the case of the red end. It must be remembered, however, that these observers utilized an artificial pupil-orifice 1 sq. mm in cross-section, which, of course, leads to a nominal illumination of 60 lux, being in reality only a fraction of this value as far as physiological impression of brightness is concerned. It seems reasonable to conclude that at ordinary high illuminations no very marked difference exists.

The author has repeated some of the experiments above mentioned with an ordinary Lummer-Brodhun photometer, but without using an artificial pupil aperture. As a result it appeared that no distinct difference is discernible above about 5 lux; the sharp change in the minimum percentage change in illumination discernible seemed to occur near 0.2 lux, the order of illumination being that at which the change from rod-vision to cone-vision has been found to occur.

To the experiments of Professor Ashe regarding the size of the pupil aperture when the eye is illuminated by light of different colors, the writer can only make brief reference on the present occasion though this, again, is a matter which seems to call for more detailed study. It may be pointed out, however, that great care is needed in studying the effect of color on the diameter of the pupil-aperture to insure that other physiological conditions, such as intrinsic and total brilliancy, are identical in the case of the two sources compared. For instance, in order to draw conclusions from the curves for the lamps with clear and green glass bulbs given by Professor Ashe, one would like to know fuller details regarding the brightness in each case.

The effect of eccentrically placed sources deserves further study. It may be suggested, however, that, if one accepts the correctness of the rod-and-cone theory of vision, one is not justified in assuming, because the rods are believed not to exercise the function of distinguishing color, that therefore they are equally affected by light of any wave-length. On the contrary, the well-known curves of luminosity determined at low orders of illumination would lead one to believe that they are most sensitive to greenish-blue light, near 0.52 μ or 0.53 μ. It seems quite possible, therefore, that the relative effects of different colors might vary in the case of different regions of the retina; very probably, too, the results obtained in the case of the dark-adapted and normal eye, respectively, would be not quite the same.

[1] *Proc. Am. Acad. of Arts and Sciences*, 1907, Vol. XLIII, No. 4.

[2] *Sitz. d. Akad.*, Berlin, July, 1888.

New Telephone Patents.

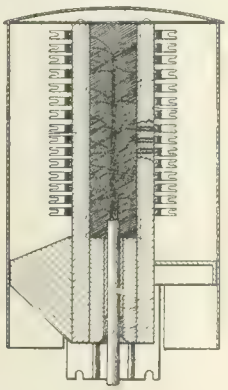
ANTISEPTIC ATTACHMENT.

While the antiseptic attachment for telephone transmitters does not seem to make much headway in commercial use, still inventors are apparently devoting considerable attention to this device. A recent patent in this line describes a mouthpiece made of porous substance of the texture of baked clay. This assumes the usual mouthpiece shape, and is to be enameled or otherwise coated upon its surface, except over one small area. The mouthpiece is soaked in antiseptic solution, fumes from which will be gradually given off from the uncoated surface. This patent has been granted to Messrs. M. S. Hufschmidt, of San Francisco, and C. F. Wagner, of Oakland.

Another type of antiseptic device is described in a patent granted to Mr. E. B. Crosby, of Lockport, N. Y. This consists of a felt-lined metal clip which snaps over the mouthpiece wall. The clip is formed of a narrow strip of metal, say ⅜ in. wide, which is bent to follow the flare of the mouthpiece, from near the grating at its base, to and over the lips, where it clamps itself. The felt lining is saturated with the antiseptic solution, and it keeps a small strip of the mouthpiece wet. By sliding the device around the whole circumference of the mouthpiece lip, the whole inner face of the mouthpiece is traversed by the antiseptic felt, and is thus wiped and cleansed.

CABLE TERMINAL.

Below is shown in section a cable terminal patented by Mr. F. J. Beaucond, New Albany, Ind. The patent was assigned to the Southern Indiana Electrical Company. The terminal not only provides a closed space in which the paper-covered wires of the



BEAUCOND DISTRIBUTING TERMINAL FOR TELEPHONE CABLES.

cable may be fanned out and then filled with waterproof compound, but it provides a sealing sleeve about the cable sheath to avoid the wiping of joints. Furthermore, there are no splices in the wires required, as the paper-covered wire is led out through small fanning holes, which become sealed by the compound.

SWITCHBOARD CORD CIRCUIT.

Mr. J. L. McQuarrie, of Oak Park, Ill., has patented a circuit arrangement for connecting cord pairs, which patent he has assigned to the Western Electric Company. A locking relay controls the operator's listening connection with a cord pair. A push key serves upon momentary operation to pull up and lock the listening relay and display a lamp signal indicating this condition; another push key effects the release of the relay when desired.

SUBSTATION APPARATUS.

For use with multi-party farmer lines, Mr. R. E. Pedigo, of Chariton, Ia., has patented an apparatus comprising a condenser for inclusion in the receiver circuit, and a push key for controlling the local transmitter-battery circuit. The two are combined in a case with terminals designed for ready connection to a telephone set.

Mr. J. A. Birsfield, of Chicago, Ill., has obtained a patent for an improved design of magneto bell, of the harmonic type. The improvements are in the details of construction.

TRUNKING SYSTEM.

Mr. A. H. Dyson, of Chicago, Ill., has obtained a patent based on a system of trunk signals for trunks between two common-battery offices. He arranges his circuits and signals so that when the called subscriber hangs up a clearing-out supervisory signal is displayed, not only in front of the "A" or originating operator, as is usual, but also in front of the "B" or trunk operator. This latter enables the trunk operator to know that the called party has hung up. The trunk operator is also provided with the usual disconnect signal, controlled by the plug of the "A" operator in its association with the trunk jack. Mr. Dyson has assigned his patent to the American Electric Telephone Company.

COMMON BATTERY SYSTEMS.

Mr. E. E. Yaxley, of Chicago, Ill., has patented a special arrangement of substation apparatus for common battery working. In his system the receiver and transmitter are directly in series with the line and its current source. The receiver, however, is double wound, the two windings being in parallel. One of these windings is the usual low-impedance, voice-current winding, upon a soft iron extension pole-piece. The other is a high-impedance magnetizing winding upon the body of the receiver magnet, which serves not only as a low-resistance, high-impedance current-supply shunt, but also serves to augment the magnetism of the receiver.

Messrs. R. D. Harris, J. E. Johnson and H. W. Soest, of Fort Wayne, Ind., have jointly patented a lock-out device for common battery party lines. The lock-out feature is controlled by the relative position of the receiver hooks of the various stations. The hook at each station is itself arranged to receive a manual rotary motion about its longitudinal axis and it thereby serves as a key to an auxiliary switch, by means of which the circuits may be arranged at any one station so that a second station on the line may be allowed to come in when desired. The lock is controlled by a mechanical latch, locked or released, through the operation of a relay.

LETTERS TO THE EDITORS.

The Atlantic Cable of 1858.

To the Editors of Electrical World:

SIRS:—I have lately read Mr. William Maver's article in your issue of Aug. 22, 1908, upon the subject of "The Atlantic Cable of 1858." There are a number of inaccuracies in this article, as I can readily prove from official documents in my possession. The article gives, indeed, internal evidence of no direct contact with the subject, if only from the mis-spelling of names and the repetition of matter from sources that are now known to be inaccurate.

It would take too long to deal with the entire article. I would, however, point out that I hold in my possession, among numerous other official documents, the agreement between John Watkins Brett, my father (Sir Charles Bright) and Cyrus W. Field, signed, in this order, as equal projectors of the first Atlantic cable. Field came over to England after he had secured the Newfoundland landing rights from F. N. Gisborne, but his ideas had all been preceded by Brett and my father over here. Moreover, nearly all the capital was subscribed for in the end on this side of the Atlantic.

Mr. Maver is good enough to tack my father's name last but one in the list of "engineers," whereas he was in reality the engineer-in-chief. In the same list are the names of Whitehouse, an electrician, who was *not* an engineer in any sense, and Thomson (Lord Kelvin), the greatest of electricians, but who was connected with the enterprise as a member of the board and consulting electrician, rather than as an engineer.

Altogether the article is not one at all in accord with the facts. I take particular exception to the following paragraphs:

"But, alas, like the first cable between Great Britain and France, this first Atlantic cable was also doomed to a very short, useful existence. After the transmission of the messages to and from the Queen, the signals over the cable became weaker and weaker until Aug. 31, 1858, when they failed utterly. C. F. Varley, the electrician of the company, was sent to Valen-

tia to ascertain the cause of the non-working of the cable. He made a number of tests and reported that a fault of great magnitude existed at a distance of about 260 miles from Valentia. W. T. Henley, telegraph engineer, and Prof. W. Thomson also carefully tested the cable during the month of September, but without success so far as obtaining readable signals through the cable was concerned.

"It has been thought, and perhaps correctly, that the injury to this cable may have been due to the employment of high-tension currents from induction coils in signaling, and the view has been expressed that had only low-tension currents been employed, their utility for this purpose having been demonstrated by Latimer Clark, the injury to the cable might have been avoided. There is, however, no proof that the fatal faults in the cable were due to these high-tension currents, and it is not difficult to imagine that the inexperience in cable-making at that time, together with the more or less crude methods of paying out the cable on shipboard, may have been sufficient to account for the cause and development of the faults in question. Furthermore, it is to be remembered that at this early period of long-distance submarine working, variable earth currents practically debarred the use of very weak currents for signaling. It probably was not until Varley's interposition of the condenser in the cable circuit, thereby obviating the disturbing effects of the earth currents, that recourse could be had to weaker signaling currents."

In the opinion of practically everybody, Whitehouse, the electrician, was alone responsible for the gradual breaking down of the cable, by the use of a generating power of immense intensity in conjunction with the rest of his apparatus.

Mr. Maver's favorite authority (Cromwell Varley) himself stated that "had a more moderate power been used the cable would still have been capable of transmitting messages," and Professor Thomson (afterward Lord Kelvin), the highest electrical authority, expressed himself still more definitely.

Mr. Maver speaks of the "more or less crude methods of paying out the cable," but he is apparently unaware of the fact that what he is pleased so to term is still in every-day use in all essential particulars!

The subsequent complete electrical (and, therefore, commercial) successes were mainly due to the introduction of Lord Kelvin's delicate receiving apparatus, first employed by my father on the first cable to India, of 1863-4—long before the second and third Atlantic cables of 1865-6—and subsequently on all the lines that followed.

For an accurate resumé of the history of submarine telegraphy, I would venture to draw your attention to the historical section of my "Submarine Telegraphs: Their History, Construction and Working."

London, England. Charles Bright.

Commutation in Direct-Current Machines.

To the Editors of Electrical World:

Sirs:—In issues of your journal in Vol. 51, pages 655, 776, 932, 1380, abstracts are printed of Dr. R. Goldschmidt's discussion with me on the subject of the use of iron for covering open slots. My arguments for the neutrality of the commutation zone (see also *Electrical World,* Vol. 51, page 147) seem not to have produced any impression on your reviewer. Even my challenge at the end of the discussion to prove Dr. Goldschmidt's alleged magnetic saturation of the slot coverings by experiments at my cost was not mentioned, though from the point of view of the usual reversing field commutating theory, my proposition should have led to a confirmation of that theory.

It is in relation to a true insight in commutation which gives to the matter in question its particular importance, because the magnetic saturation can be ascertained by experiments. Therefore, I come now to request your aid in an international prize competition for $1,000, which sum I propose to award for *decisive experimental proofs of the saturation of the iron bridges in the neutral zone.*

In Dr. Goldschmidt's paper in the *Elektrotechnische Zeitschrift,* 1907, page 1166, or the *Electrician* (London), 1908, Vol. LX, page 634, the accompanying Fig. 1 was given as evidence of the alleged saturation.

In refutation to this I present the accompanying Fig. 2, showing that in perfect commutation there are practically *no lines linked only with the short-circuit coils.* This absence of self-induction—not their alleged saturation, which does not exist—explains the absence of a detrimental effect of the iron bridges covering the armature slots. (See my paper, *The Electrician,* 1908, Vol. LX, page 719, and my pamphlet, "Kommutierung, Kompensierung und Wendepole.") This pamphlet, together with my *Electrician* paper as an introduction to it, may be consulted at the library of the American Institute of Electrical Engineers, New York.



FIG. 1.—COMMUTATION IN DIRECT-CURRENT MACHINES.

The papers in the competition must be suitable, by extent and in all other respects, for publication in your columns. They must contain the description of the experiments and their results, which must be discussed with respect to the above-mentioned publications.

The prize-winner shall be the author of that paper which first gives the decisive evidence of the alleged saturation. The competition will be closed on Jan. 1, 1910.

Concerning the award of the prize, I must beg you, Messrs. Editors, kindly to settle this point, as, of course, I cannot interfere in any direct way with it. However, I shall be glad to consider any proposal of yours concerning this or any other phase of the competition.

The decision of award must be unanimous and should eventually be founded upon a repetition of the experiments indicated in the competing papers, for which purpose the competitor shall supply the necessary apparatus and arrangements.

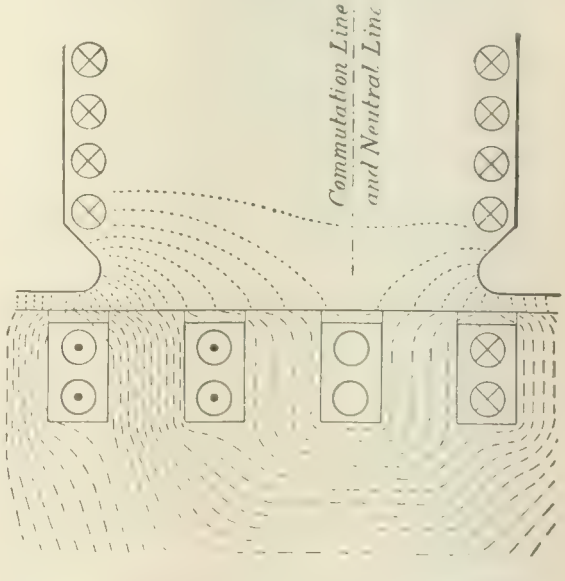


FIG. 2.—COMMUTATION IN DIRECT-CURRENT MACHINES.

The winning paper, indicated by a plain introductory statement as being the prize-winner in this competition, to be published in your columns and in those of the *Electrician,* London. Its author shall also have it translated for publication in *Elektrotechnik und Maschinenbau,* Vienna, in the *Electrotechnische Zeitschrift,* Berlin, and in *La Lumière Electrique,* Paris.

The amount of the prize has been deposited with Messrs. Scheurleer & Sons, bankers, The Hague, Holland, by whom it

will be paid through their New York representative to the person designated by you in accordance with the aforesaid award and after the stipulated publications.

VILLA MAR, C. L. R. E. MENGES.
SCHEVENINGEN, HOLLAND.

[The bankers named by our correspondent inform us that they have on deposit the sum of money named, which is made payable under the conditions of the competition as stated above. We cannot, however, accept the function assigned to us in the proposed competition, as the subject is one that will, in any event, only be settled ultimately by a consensus of scientific opinion and cannot be summarily disposed of by individual judgment. Nevertheless, publicity is given to the challenge, and any of our readers who may become interested in the present phase of the controversy involved can communicate direct on the matter with our correspondent.—EDS.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Fractional Pitch Winding.—F. PUNGA.—The fractional pitch winding has not found as much favor with European designers as in the United States, and the author endeavors to show its advantages for direct-current and three-phase machines and single-phase commutator motors.—*Elek. und Masch.* (Vienna), June 13.

Constant-Current Dynamos.—A. BLOCH.—The author shows how ordinary constant-voltage, direct-current dynamos of standard design can be changed into constant-current machines by providing a separate excitation in connection with the shunt excitation.—*Elek. und Masch.* (Vienna), June 20.

Parallel Running of Direct-Current Generators.—A note on a recent British patent (11,345, 1908; June 17, 1909) of the British Thomson-Houston Company (General Electric Company of this country). Each generator is provided with a Tirrill regulator to the main control magnet of which are added two additional coils. One coil is connected across a resistor in the main generator circuit, and the other across a resistor in the main station circuit. These coils act in opposition, and by suitably proportioning the resistances of the resistors the load is kept equally divided among all the machines. One line resistor acts as the shunt for the "line" coils of all the regulators. With two machines in parallel, the resistance of this resistor is made one-half that of each of the generator circuit resistors and then, with equally divided load, the coils will balance. If one machine takes more than its share of the load, its regulator will decrease its voltage. The load can also be proportioned in any desired manner.—Lond. *Elec. Eng'ing*, June 24.

Polyphase Commutator Motors.—E. ROTH.—In continuation of his long illustrated serial, the author compares the results of his theory with those of tests made in practice.—*La Lumière Elec.*, June 12 and 19.

Lamps and Lighting.

Tungsten Lamp.—R. E. NYSWANDER.—An account of an experimental investigation of the distribution of energy in the spectrum of the tungsten filament at different temperatures.

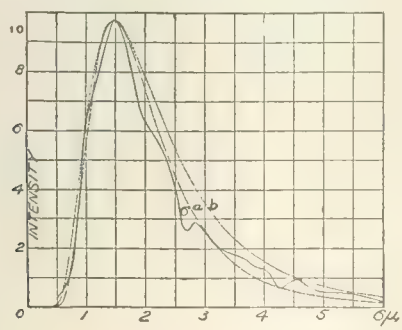


FIG. I.—ENERGY CURVE OF TUNGSTEN FILAMENT.

For the black body absolute temperatures of 1994 deg. corresponding to a maximum wave length of 1.475 μ the curve of energy distributed is as given in Fig. 1 showing the selective radiation exhibited by the tungsten filament. For comparison the curves *a* and *b* are given, *a* referring to the normal radiation curve on the basis of Wien's law using the empirical radiation constant of tungsten, while *b* is the theoretical curve for the black body. Some calculations are also made of luminous efficiencies on the basis of Wien's law.—*Phys. Review*, June.

Metallic-Filament Lamps and Central Stations.—E. E. HOADLEY.—A paper read before the (British) Municipal Electrical Association on the effect of metallic-filament lamps on the income of central stations. At present the alternating-current stations have suffered most by the drop in output, due to the higher efficiency of the lamp, as the consumer can, by employing a transformer, have the same light as hitherto at a less cost. The direct-current, 200-volt stations will, the author thinks, suffer in the near future, when lamps of smaller candle-power are available and the prices are reduced. He recommends them to increase the heating and cooking business, if possible with the aid of free wiring and the hiring out of heating and cooking apparatus if they can obtain permission. The latter part of the paper dealt with the suitability of the new lamps for street lighting, and mentioned the author's experience that these lamps had an average life of 1100 hours, individual lamps lasting from 5000 to 6000 hours.—Lond. *Electrician*, June 25; *Elec. Eng'ing*, June 24.

Flame-Arc Lamps.—GOERGES.—An abstract of a paper read before the Dresden Electrical Society on photometric tests of large Beck arc lamps. He describes the difficulties which were experienced on account of the colored vapors which were evolved in large quantities in the arcs. They may be partly due to the evaporation of the metals, but also consist partly of nitrogen oxides. The vapors filled after a short time the glass globe and the spherical photometer, and then got into the room. The inner surface of the photometer sphere appeared yellow when opened, but in a few seconds it was again white. These vapors caused considerable troubles, such as necessitating redeterminations of the constant of the spherical photometer, etc. The lamp cannot be used in closed spaces, if provision is not made for ventilation so as to remove these vapors. The results of the tests were as follows:

		Mean spherical hefner cp.	Watts per mean spherical hefner cp.
Direct-current lamp, 220 volts, 12.2 amp.	without globe	14,300	0.188
	with globe	8,860	0.303
Alternating-current lamp, 220 volts, 11.8 amp.	without globe	6,340	0.409
	with globe	3,940	0.658

The loss of light due to the globe was in each lamp 38 per cent. The ratio of the mean lower hemispherical candle-power to the mean spherical candle-power is about 1.8, so that the mean hemispherical candle-power of the direct-current lamp without globe is about 25,700 hefner-candles, with a specific consumption of 0.105 watt per mean hemispherical hefner-candle.—*Elek. Zeit.*, June 24.

Volts and Watts per Candle.—H. E. IVES.—A watts-per-candle meter is part of the photometric equipment of the Bureau of Standards. Experiment shows it possible to calculate with considerable accuracy, from the watts per candle at rated voltage (an initial run at rated voltage is part of the regular test), the voltage to give 3.1 watts per candle, by the use of the relation $\left(\frac{V_2}{V_1}\right)^k = \frac{wpc_1}{wpc_2}$ where for the range from 3.6 to 3.1 wcp (watts per candle), for treated carbon filaments,

k has the value 3.5. The results of such a calculation may be used in the form of percentage tables, or the actual volt values may be calculated for each rated voltage encountered and then tabulated. From such a table, for instance, one can read that the e.m.f. of a 110-volt lamp operating at 3.5 watts per candle must be raised to 113.7 volts to operate at 3.1 wpc. Tables thus calculated greatly reduce the work of finding the 3.1 voltage. It seemed desirable, however, to reduce further the number of operations, and this result was accomplished by placing on the specific consumption meter a volt-scale which indicates at once the data of the tables. A possible application of the volt-scale consumption meter is in the rating and sorting of lamps according to watts per candle, the quantity now recognized as of most importance. It is possible by combining a volt-scale on a watt-per-candle meter with proper scales on the photometer to read from one photometer setting, first, the voltage to give a certain specific consumption, and, second, the candle-power or watts at that voltage. In short, the quantities now desired in rating incandescent lamps are obtained at one operation.—*Bull. Bureau of Standards,* Vol. 5, No. 4, May, 1909.

Tungsten Comparison Lamp.—H. E. Ives and L. R. Woodhull.—In the photometry of incandescent lamps the substitution method is commonly used. That is, the lamp photometered is not compared directly with a standard, but with a "comparison lamp" which is carefully calibrated against a candle-power standard or standards at the beginning of a run, and at frequent intervals. The authors have tried as comparison lamps a tungsten lamp operated at voltages to give carbon-lamp colors. The object is to obtain a long-lived lamp and a constant comparison light which at the same time would give perfect color match with all types of carbon lamps. In several months' use the expectations have been fully realized, and after two months' daily running of from four to seven hours, chiefly at colors corresponding to 3.5 and 3.1 wpc, the voltage to give 16 cp has changed less than two-tenths of 1 per cent.—*Bull. Bureau of Standards,* Vol. 5, No. 4, May, 1909.

Generation, Transmission and Distribution.

Turbo-Generators.—E. Rosenberg.—An article describing the special features of the direct-current and alternating-current turbo-generators of the British Westinghouse Company. Attention is called to the contact of the graphite brushes with radially placed parts of the commutator and the subdivision of the voltage between segments, by means of an auxiliary winding. The rotors of the alternating-current turbo-dynamos have throughout cylindrical cores like direct-current armatures, in order to produce a better cooling of the machine. The compensation method of Miles Walker is employed.—*Elek. Zeit.* June 24.

Electric Driving of Rolling Mills.—A note on a recent British patent (11,336, 1908; June 17, 1909) of the Electric Construction Company, Ltd., and W. Buchanan. This is a direct-current load-equalizing system, comprising an auxiliary motor and a flywheel on the main motor. The auxiliary motor is driven from the mains, and is excited by the armature current of the main motor. In series with the shunt winding of the latter is a spring-controlled rheostat, which is operated by a rack and pinion device from the shaft of the auxiliary motor. The torque of the auxiliary motor balances the pull of the spring when the average current required by the work is taken by the main motor. If the load increases the torque of the auxiliary motor increases, and the shunt resistance of the main motor is decreased, so that it drops in speed, and energy is given out by the flywheel. On the other hand, if the load decreases the pull of the spring overcomes the torque of the auxiliary motor, the main motor is accelerated and energy is stored in the flywheel.—Lond. *Elec. Eng'ing,* June 24.

Exhaust Turbines.—An illustrated article on the advantages of exhaust and mixed-pressure turbines, giving the results of some tests at a British colliery with a 750-kw mixed-pressure steam turbine set. The set runs at 3000 r.p.m. and works in connection with a Koerting jet condenser and a Rateau heat accumulator. The tests were principally carried out for the purpose of ascertaining the power available from the exhaust steam. It was found with a few adjustments of the various valves that the steam accumulator would take care of all the exhaust steam and deliver it to the low-pressure stage of the turbine with a pressure difference of 1 lb. in the accumulator. As a vacuum on the intermittently working engines is not permissible, an automatic valve placed in the pipe between the engines and the turbine is arranged to close if the pressure in the accumulator falls below the atmospheric pressure. From the reading of instruments it was found that the load varied from 430 kw to 470 kw on the low-pressure steam alone, exclusive of about 50 kw which was generated and delivered to the condenser pump motors. During the low-pressure test the supply of exhaust steam was at times insufficient for the load being carried by the generator and high-pressure steam was taken in by the turbine automatically and without any hunting tendencies, the speed of the set being very steady. A load of 450 kw was repeatedly thrown off and on the set by opening and closing the main oil switch; the governing under these conditions was satisfactory in every respect. The vacuum registered on a mercury column 28.3 in. at no load, and 27.3 in. with a load of 450 kw, the turbine using exhaust steam only. —Lond. *Elec. Eng'ing,* June 24.

Oil Engines.—An illustrated description of the small generating station of the Chichester Electric Light & Power Company, which is of interest as being the first English generating station to be equipped with Diesel engines of British design and manufacture. At present two 150-hp engines are installed, driving direct-current generators. The only other machine is a 25-kw balancer, but provision is made on the switchboard for a battery should this be added later on.—Lond. *Elec. Eng'ing,* June 24.

Traction.

Gasoline-Electric Automobiles.—J. B. Entz.—A Franklin Institute paper discussing the principal features of the Entz "direct electric transmission system" on automobiles in which the control and transmission system is purely electric, while the gasoline engine is the sole source of power. The field core of an electric generator is bolted directly to the 45-hp engine, taking the place of the ordinary flywheel. The other end of the field core is carried in a large ball bearing. The armature of this revolving-field generator is enclosed within the field core, and its shaft is extended through to the driving bevel in the rear axle housing, which contains the bevel gear drive and the differential, these being the only gears in the machine.—*Jour. Franklin Inst.,* July.

Installations, Systems and Appliances.

British Municipal Electrical Association.—An account of the recent annual meeting of the (British) Incorporated Municipal Electrical Association. The presidential address of S. I. Pearce, city engineer of Manchester, dealt with a large number of topics of current interest, notably with the cost of energy supply and the methods for cheapening house wiring. On the former question he pointed out that the new plant added to the generating station to deal with additional power supply costs now per kilowatt only from one-third to one-half the cost of the existing plant, so he thought it should be equitable to remit a proportion of the fixed charges on capital in the case of new consumers. On the question of wiring, he is of the opinion that the use of flexible supports at a proper height need not lower the standard of safety, and that the number of lamps allowable per circuit might be increased.—Lond. *Elec. Eng'ing,* June 24.—A complete account of the papers read and their discussion in the convention is given in London *Electrician,* June 25.

Cheap Units.—A. Sinclair.—A paper read before the British Municipal Electrical Association on a fair system of charging for electricity supply. The author considers a typical station with an annual output of 2,000,000 kw-hours. He divides the consumers into the following five classes: A—Early-closing shops and offices. B—Late-closing shops, offices, private houses, theaters, hotels, etc. C—Small users of motors. D—Public lighting. E—Large users of motors. He then figures out a

charge for the total cost of each of these classes according to the number of kw-hours consumed, the maximum demand, and the load factor. He finds that for the five above classes a fair selling price per kw-hour, while leaving a margin of profit, would be: A, 9 cents; B, 7 cents; C, 3½ cents; D, 2⅔ cents to 3½ cents; E, 2 cents to 2½ cents. In the discussion which followed a number of speakers criticised the calculation of the charge from the consumer's load-factor. The majority of the speakers objected to varying the price of supply to different consumers except in the case of very large ones. The restricted-hour method was also discussed by A. M. Taylor.—Lond. *Elec. Eng'ing,* June 24.

Wires, Wiring and Conduits.

Cables.—E. M. HOLLINGSWORTH.—A paper read before the (British) Municipal Electrical Association on modern cable systems. The author reviewed generally the various methods of laying cables, noting from experience the technical details to be observed and the dangers to be avoided. A description was also included of the overhead work and the subway at St. Helens, and a table was given showing the relative costs of the "direct-in-ground," "solid," and "draw-in" systems.—Lond. *Elec. Eng'ing,* June 24; *Electrician,* June 25.

Electrophysics and Magnetism.

Magnetic Properties of Soft Iron.—B. O. PEIRCE—The author describes a peculiar experience with a specimen of soft Norway iron, which was found to be unsatisfactory in the construction of a magnet, although it was of extraordinary purity, the tests for nickel, cobalt, manganese, tungsten and for "Groups IV and V" being all negative. There was less than 0.03 per cent of carbon, less than 0.047 per cent of phosphorus, less than 0.03 per cent of silicon, and less than 0.003 per cent of sulphur. It was also found that the magnetic permeability of this iron under strong excitation was extraordinarily high. The failure of the magnet was, therefore, not due to poor material in the core. The explanation was found in the fact that at least 10 consequent poles were created between the ends of the core when it was strongly excited. When the exciting current was reversed these poles changed sign, but in many places outside the exciting coil the direction of the field was always opposed to what it would be if these consequent poles did not exist. This was probably due to unequal heating of the core in the process of annealing.—*Am. Jour. of Science,* July.

Propagation of Electrical Waves Along Wires.—L. COHEN.—A mathematical paper on the coefficient of reflection of electrical waves at the transition point from one conductor to another conductor.—*Bull. Bureau of Standards,* Vol. 5, No. 4, May, 1909.

Electrochemistry and Batteries.

Unit of Candle-Power.—With respect to the new international agreement concerning the unit of candle-power, the German Committee of the International Electrical Commission has sent a reply (signed by Budde and Dettmar) to the International Commission in London, after having held meetings with interested parties. They agree that it would be very desirable to establish an international unit of candle-power, but if this is to be done, the unit should be defined in a single way and it should be possible to reproduce it at any time with sufficient accuracy. These conditions are not fulfilled by the proposition of the British committee. Firstly, they give several definitions, and secondly, the reproducibility of the standard is not guaranteed, since pentane is not an exactly defined chemical compound. According to a recent statement of Janet it has been necessary to change the original definition of the pentane candle in order to get an agreement with the French and the American units, but no description whatever has yet been given of this modified pentane candle. The hefner candle is more easily reproducible, but it has the disadvantages of being too small and too red in color to permit easy and safe comparison. For this reason the Germans think that the international unit candle-power of the future should be established by international co-operation between the different official laboratories. This is thought to be possible within not too long a time and it would be wrong to cut off this development by adopting now a less suitable international unit. If the same unit of candle-power is adopted, there still remains the difference in different countries with respect to meter-candles, foot-candles and yard-candles. If there is to be uniformity in photometry, it should be decided by international agreement also to use the same unit of length in photometry measurements. Until "the real foundations of an international agreement" are found, the Germans adopt provisionally the relation that 1 pentane candle-power = 1 American candle-power = 1 modern bougie decimale = 1.11 hefner candle-power.—*Elek. Zeit.,* June 24.

Standard of Candle-Power.—E. BRODHUN.—The author (a member of the Reichsanstalt) compares the Hefner lamp and the Harcourt pentane lamp. He acknowledges the weak points of the Hefner lamp, especially its red color and comparatively low intensity, but in spite of these he thinks that the Hefner lamp is far superior to the pentane lamp as a primary standard, since it fulfills far better the two chief requirements: that the lamp should be easily reproducible, and that the fuel should be exactly defined so that it can be made up always in the same composition.—*Elec. Zeit.,* June 24.

Incandescent Lamps as Secondary Standards.—E. B. ROSA AND G. W. MIDDLEKAUFF.—In the absence of a satisfactory primary photometric standard which is sufficiently reliable and reproducible as to be generally adopted it is customary in the measurement of the light of electric illuminants, and to some extent in gas flames, to use carbon-filament incandescent electric lamps as secondary standards. The Bureau of Standards has maintained its unit of light substantially constant for six years by this means, and has made frequent intercomparisons with foreign laboratories in this way. In order to increase the precision of photometric measurements it is desirable that standards be used which are substantially of the same color as the light being measured, and this makes it necessary to have standards of different temperatures. For temperature higher than can be attained with carbon lamps, metal-filament lamps may be used in the same way, and recent experiments show that such lamps may be seasoned and used in such a way as to be satisfactory as standards of candle-power. The authors have recently improved their methods of seasoning and testing lamps which are to be used as standards, so as to make them even more reliable and more permanent than heretofore.—*Phys. Review,* June.

Reproductibility of Clark & Weston Cells.—H .L. BRONSON AND A. N. SHAW.—An abstract of an American Physical Society paper. The authors determined with what accuracy they could reproduce Clark & Weston standard cells by following the specifications given by Wolff and Waters. The agreement among the Weston cells seems to be rather better than among the Clark cells. Six Weston cells made by the authors have an average variation from their mean of less than 5 micro-volts, and calculation shows that their mean is only 2 micro-volts higher than the reference cells at the Bureau of Standards and about 6 micro-volts higher than the mean of the three cells from the (Brit.) National Physical Laboratory. In the case of the Clark cell the average variation from their mean is less than 10 micro-volts, while their mean is about 14 micro-volts higher than the reference cells at the Bureau of Standards. As a check upon the accuracy of these values, a direct comparison was made between the Clark and Weston cells. The ratio at 25 deg. C. was found to be 1.394792, which is higher than the value 1.394780 found by Wolff and Waters by an amount which is exactly accounted for by the above-mentioned differences between their cells and those made by them. The above results indicate that both Clark and Weston cells can be readily reproduced with a much greater accuracy than has generally been supposed.—*Phys. Review,* June.

Mechanical Equivalent of Heat.—In an abstract of a Physical Society paper of H. L. Bronson and A. N. Shaw reference is made to the fact that, in 1902, Barnes determined the absolute value of the mechanical equivalent of heat in terms of the international electric units. Taking the value of the true ohm as 1.01358 B. A. units and the value of the Clark cell at 15 deg.

C. as 1.4342 volts, he obtained 4.1888 as the mean value of the joules per calorie for the interval between 5 deg. C. and 95 deg. C. In the meantime the e.m.f. of the Clark cell has been more accurately determined and on the basis of these redeterminations Dr. Barnes has recalculated his value of the mechanical equivalent and has obtained 4.1835 joules per calorie for the interval between 5 deg. C. and 95 deg. C., or 4.1849 joules per calorie between 0 deg. C. and 100 deg. C. The value obtained by Reynolds and Moorby for this same interval would be 4.1836 joules per calorie. The mean value obtained by Rowland, as corrected by Weidner and Mallory, is 4.185 joules per calorie between 5 deg. C. and 35 deg. C., while Dr. Barnes' mean value for the same range is 4.183.—*Phys. Review,* June.

Units, Measurements and Instruments.

Absolute Measurement of Resistances.—E. B. Rosa.—The Bureau of Standards proposes to use a new method for the absolute measurement of resistances in which a revolving coil or two such coils are so disposed in the magnetic field of a

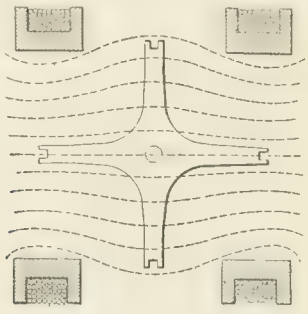


FIG. 2.—REVOLVING COILS AND MAGNETIC FIELDS OF FIXED COILS.

pair of fixed coils as to yield an e.m.f. which can be compared with the fall of potential through a fixed resistance, by means of a differential galvanometer, and so give the absolute value of the resistance. The method is much more sensitive than that of Lorenz. In the apparatus constructed at the Bureau of Standards the two armature coils at right angles to one another (Fig. 2), rotate in a strong magnetic field produced by two stationary coils, set somewhat farther apart, relatively, than the coils of a Helmholtz galvanometer; the whole constituting a kind of two-phase alternator without iron. The theory of the apparatus is given.—*Bull. Bureau of Standards,* Vol. 5, No. 4, May, 1909.

Testing of Transformer Steel.—M. G. Lloyd and J. V. S. Fisher.—An illustrated paper discussing the conditions which should be realized in the measurement of energy losses in sheet iron and steel subjected to alternating magnetization, with a description of a modification of the Epstein method and apparatus, which is believed to better satisfy these conditions and to give an accuracy of 1 per cent with the use of less than 2 kg (4.4 lb.) of material. Results are given showing a wide range in the quality of material in general use, having slight connection with price. Several foreign specimens of ordinary steel and silicon steel are included for comparison with the American product. Silicon steels contain from 3 per cent to 4 per cent silicon, the quality not depending upon the exact percentage of silicon. By making measurements at two frequencies, the eddy current and hysteresis losses have been separated, and the variation of each with the flux density studied. The values of the hysteresis constant and the total loss in watts per pound at 60 cycles and 10,000 gausses are tabulated. The effects of artificial aging are shown to depend upon the flux density selected for test, the hysteresis increasing more for 5000 than for 10,000 gausses. Tests should, therefore, be made at the density to be used. The aging is usually negligible in silicon steels.—*Bull. Bureau of Standards,* Vol. 5, No. 4, May, 1909.

Errors in Shunted Ammeters.—W. Pennell.—The author first emphasizes the possible errors in shunted ammeters and wattmeters due to a difference of temperature of the shunt and of the instrument itself. The shunt temperature may vary from atmospheric to somewhere near 180 deg. Fahr., according to load, while the meter remains at nearly constant temperature, owing to the heat capacity of the case and the large surface exposed. In the case of a wattmeter the volt circuit determines the meter temperature and this is practically constant. If the shunt resistor has a low temperature-resistance coefficient the temperature error is small, even if the instrument resistor is made of copper, which has a high temperature-resistance coefficient, because it remains at a nearly constant temperature. Another and perhaps better method is to make the shunt and the instrument of the same material, say, of copper, and run both at a low-current density, so that their temperature remains atmospheric. The author then refers to considerable errors which may be obtained due to thermo e.m.fs. set up by the different heating of contacts, if one is tight and the other loose. He recommends the following precautions: Plain, bolted contacts should be avoided, or if inevitable, the contact lugs should be far removed from the shunt-strip lugs. A good design would be to make the bolted connection to an extension lug, connected to the shunt-strip lug by a fair length of copper strip of large surface so that local heating due to poor contacts would not reach the shunt strip. If terminals must be near the shunt strip, the contact should be a multiple one, depending upon several screws tapped into the shunt lug. Where cable is connected to the lug, as in shunted supply meters, the grub screws should be equal in diameter to the cable socket, so that a full contact will be made even if the cable is considerably smaller than the socket. Two grub screws per hole should be provided, and, if possible, two holes should be arranged, so that the cable may be split and two separate contacts made.—Lond. *Electrical Review,* June 25.

Adjustable Self-Inductance Standard.—Kollert.—In determining coefficients of self-induction by means of a zero method, it is very convenient to employ self-inductance standards which can be adjusted not step by step, but continuously. The method is indicated in Fig. 3. The resistance of the coils are first so

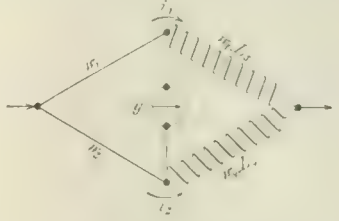


FIG. 3.—DIAGRAM OF CONNECTIONS.

adjusted that the ratio of w_1 to w_2 equals the ratio of w_3 to w_4, with direct current, and it is then observed whether on braking the circuit galvanometer g shows a ballistic deflection. When this is the case the self-inductance of L_2 is slowly varied, until the ballistic deflection of the galvanometer stops. Under this condition $L_3 \div L_4 = w_3 \div w_4$. Instead of observing the ballistic deflection of the galvanometer needle, one may use alternating

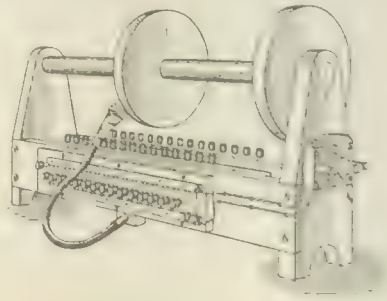


FIG. 4.—ADJUSTABLE SELF-INDUCTANCE.

current with a telephone, etc. A convenient coil of adjustable self-inductance is shown in Fig. 4. It consists of two rather flat coils, the distance between which can be adjusted at will. The two coils have a mean diameter of 20 cm, and one of them can be displaced on a wooden axle so as to remain always parallel to the other coil. The two coils are made of hard rubber; the frame of wood. The coils are connected in series or

in opposition by means of the switch shown at the right. The self-inductance of the two coils together equals $2L_1 \pm M_{12}$, where L_1 is the coefficient of self-induction of each of the two coils, and M_{12} is the coefficient of mutual induction. Fig. 5

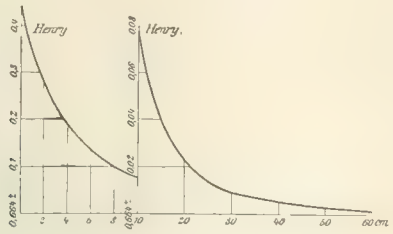


FIG. 5.—INDUCTANCE CURVES.

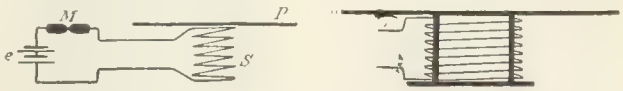
shows the inductance of these two coils as a function of the distance between the two. The abscissas represent the distance in centimeters, the ordinates the value of the inductance in henry, or rather the inductance equals 0.664 henry (the inductance for infinite distance) plus the value of the ordinates given in the curves. In order to extend the scale down to 0.001 henry each coil was constructed in 16 double layers each of 64 windings, which permits, besides the series connection, the connection of the windings of each coil in two groups each of eight, or four groups each of four, or eight groups each of two, or finally 16 groups in parallel, whereby the coefficient of self-inductance is reduced to ¼, 1/16, 1/64 and 1/256.—*Elek. Zeit.*, June 17.

Roentgen Apparatus.—M. HÖCHSTÄDTER.—An illustrated description of an apparatus for generating high-tension direct current for operating Roentgen-ray apparatus from an alternating-current supply network. A transformer is employed and in the secondary high-tension circuit the two half-waves are made of equal sign by means of a synchronous commutator.—*Elek. u. Masch.* (Vienna), June 15 and 20.

Telegraphy, Telephony and Signals.

Telephony.—DEVAUX-CHARBONNEL.—The author has formerly shown that if a sound of the human speech is resolved in a series of sine waves, the fundamental wave and the harmonics are not all of the same importance; some influence the intensity of the sound and others influence the clearness of the sound. Experience shows that only frequencies near 1000 are indispensable to produce a sufficiently clear sound. The author considers telephonic transmission of speech as an ordinary case of power transmission of sine waves with the frequency of 1000. This gives only an approximate theory, but the author claims that he can solve in this way many practical problems which have not been solved before; for instance, the calculation of the line, together with the instruments on it, or the calculation of mixed lines, etc. In the first instalment the author deals with sine currents in general and the propagation of the current over an infinite line.—*La Lumière Elec.*, June 12.

Telephone Receiver.—E. KOSACK.—An ordinary coil can be used as a telephone receiver, the arrangement being shown in Fig. 6, where e is a battery, M a microphone and S the coil. A coil of iron wire is a little bit more effective than a coil of copper wire. The effect seems to be due to the vibration caused by the electrodynamic action between the different windings. But this vibration is very small; even a coil which had been impregnated with a pitch-like mass and thus hardened and stiffened was as effective as an ordinary coil. The effect is considerably increased, however, by bringing the coil S in mechanical contact with the plate P. This plate may be of iron or other metal or wood, and may be relatively thick. A very simple form of telephone receiver based on this principle is shown in



FIGS. 6 AND 7.—TELEPHONE RECEIVER.

Fig. 7. The coil is placed on a brass frame consisting of a short hollow cylinder and two round disks at the ends. A slight increase of the effect can be obtained if a second cell is placed over the other one and supplied with constant direct current.—*Elek. Zeit.*, June 17.

Wireless Telegraphy.—L. COHEN.—A mathematical paper on the theory of coupled circuits in wireless telegraphy; electromagnetically coupled and direct-coupled circuits being considered.—*Bull. Bureau of Standards*, Vol. 5, No. 4, May, 1909.

BOOK REVIEW.

SUBMARINE CABLE LAYING AND REPAIRING. Revised and enlarged. By H. D. Wilkinson. London: *The Electrician* Company. 557 pages, 313 ills. Price, $6.

This well-known work has been considerably enlarged in this new edition and has been revised with care. It is a textbook on the subject of designing, laying, testing and repairing submarine cables. The author has had considerable experience in this branch of electrical industry and many of the illustrations of the work have been obtained from his own camera.

The work is divided into five chapters, headed, respectively: Surveying the route; principles of design and construction; the laying of submarine cables; the cable ship on repairs; the localization of breaks and faults. The discussion of electrical methods of localizing faults is particularly full and the book will certainly be regarded as an authority in this direction. It will be valued by all students of electric telegraphy.

NEW APPARATUS AND APPLIANCES

New Overload Inverse Time Limit Relay.

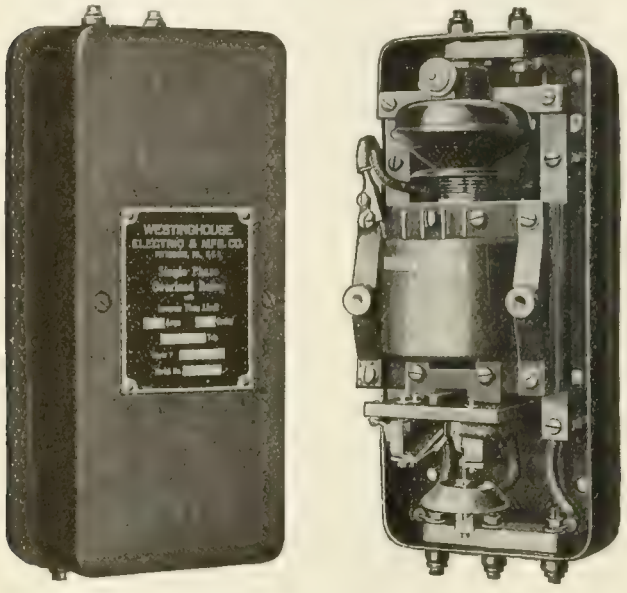
BY HAROLD W. BROWN.

From the standpoint of uninterrupted service, the ideal protection against overload on a heavily loaded power or lighting circuit is one that opens the circuit only after the overload has continued long enough to approach more or less nearly to the danger point. The greater the importance of uninterrupted service, the nearer is it wise to approach the danger point. For such automatic control the protecting apparatus must have a time limit that depends on the amount of overload—being almost instantaneous in case of a short-circuit, but allowing a considerable time element in case of a small overload. It should also be capable of variation so that the time element and the rated full load may be increased or decreased as conditions require.

A new relay having several unique features, and offering exactly the protection just referred to has been designed by the Westinghouse Electric & Manufacturing Company. This relay is successful in overcoming the greatest difficulties experienced heretofore in the operation of overload inverse time-limit relays.

This relay is shown in Fig. 1. The same instrument, with the cover removed, is shown in Fig. 2. It is simple in its construction. The stationary parts consist of a current coil mounted in a laminated iron shell, and a needle valve in the metal framework of the bellows. The moving part consists of a brass rod on which are mounted an iron core inside the coil, a contact cone below, and the bellows above the coil. The relay is enclosed in a dustproof case. The winding of the coil is represented diagrammatically in Fig. 3. One end of the winding connects to one of the binding posts, and leads are brought out from several points. The terminal T is on a flexible cable and

may be connected to any one of the leads from the coil. Thus a part, or all, of the winding may be connected in circuit between the two binding posts of the relay. There are five current settings for 4 amp, 5 amp, 6 amp, 7 amp and 8 amp. The number of turns decreases in proportion as the current rating increases, so that the ampere-turns are the same for any current setting. The size of wire is larger for the larger current



FIGS. 1 AND 2.—OVERLOAD RELAY, ENCASED AND WITHOUT CASE.

capacities, so that the loss in watts at full load due to resistance is approximately the same for any capacity, being 7 watts in case of the 4-amp setting and 11 watts with the 8-amp setting. This watt loss is exceptionally low for an instrument of this kind.

The laminated iron shell around the coil has an ample sectional area, and forms a good magnetic circuit with the core. The shell supports the coil firmly, and is mounted on the base of the relay. The core is very light, but so constructed magnetically that it exerts an ample force for drawing up the moving parts and making the contact.

The bellows leather consists of two thicknesses of a fine quality of light-weight leather, specially treated to render it impervious to air, flexible and durable. The escape valve of the bellows is a needle valve. Each needle is especially ground to allow the right escapement of air. A numbered dial is mounted on the needle to indicate the setting of the valve. This dial renders it possible to set the valve with great accuracy.

This instrument is adjusted at the time of calibration so that the iron core just strikes the iron shell when the moving element is in its highest position. Such an adjustment prevents violent vibration of the moving element. This violent vibration has introduced a serious difficulty of the operation of previous relays of this kind on heavy overloads at low frequency because it prevented their operating properly in the normal time. It was overcome in the original design of this relay, because one of the first conditions imposed was prompt and normal operation on low frequency with very heavy overload. It would be impossible to use this method of damping out the violent vibrations, if the various current settings were obtained by moving the iron core, but inasmuch as the core is in the same position for all settings of the relay its behavior is very satisfactory.

The weight of the moving element is counterbalanced by a spring, so that only a slight magnetic pull is required to make it operate. For this reason, and on account of the small weight of the core and the good magnetic circuit, it is possible to have the resistance and inductance of the relay very low. This has two distinct advantages. First, as to heating: The relay runs cool under all conditions. If the load is heavy enough to heat the relay more than 40 deg. C., it is enough to make it operate and open the circuit, so that it is practically impossible for the relay to heat more than 40 deg. C., but the winding has a special insulation capable of withstanding several times that amount of heating. The second advantage is that of low voltage drop. These relays are ordinarily used with series transformers, and unless the voltage drop is low the accuracy of the transformer ratio is affected. This matter is of considerable importance where measuring instruments are connected to the same series transformers.

This relay is capable of a very wide range of adjustment as illustrated by the curves in Fig. 4. The number on each curve corresponds to a number on the needle-valve dial. All the curves except No. 1 are the same for all relays. There is a small variation of No. 1 on different relays. One of the great advantages that this relay possesses is in the fact that variations may be made in the time setting without affecting the normal full-load rating, and variations may be made in the normal full-load setting without affecting the time of operation at a given percentage in excess of full load. The curves are drawn showing the operation on a basis of percentage overload, assuming that the overload begins as soon as the current exceeds the normal rating, which may be anything from 4 amp to 8 amp. From this it will be seen that the relay has an extremely wide range of adjustment. For example, without changing the current setting the time required for operation at 50 per cent overload may be varied from one to 11 seconds. This range may be still further increased by varying the current settings. It will be noted that the scale divisions indicating the horizontal distances in Fig. 4 are not uniform, but are made on a logarithmic scale. This method of representation is employed because the curve is more compact when drawn in this way. It is thus possible to show clearly the operation of the relay on any load up to 500 per cent of full load.

In some cases two relays are affected by the same overload. For example, one may be on a main feeder, and one on a branch; or one may be at the generator end and the other at the load end of the same feeder. In either of these cases it is essential that if possible only the relay nearer the load end shall operate when the overload occurs. The other relay serves as a protection in case of ground on the line between the generator and the second relay. This selective action may be secured either by adjusting the relay nearer the generator for a longer time element, or by setting it for a larger current. By referring to the time-load curves, this setting may be accomplished with ease because there are wide spaces between the curves, and because the relation between time element and

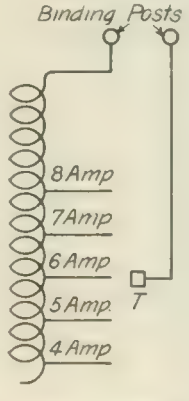


FIG. 3.—DIAGRAM OF COIL WINDING.

percentage of overload is absolutely independent of the current setting on which the rated full load is based.

Another point of excellence of this relay is its "resetting" or returning to its position of rest. The relay must reset promptly whether the overload continues long enough to trip the circuit-breaker or whether it is too short to exceed the time limit. This resetting condition is necessary, because if the relay does

not reset it does not introduce a sufficient time element when the next overload occurs. On the other hand, if the relay resets too quickly it may interfere with the normal operations. This relay resets in the same time as it takes to operate at 20 per cent to 50 per cent overload, and it begins to reset as soon as the load drops to 60 per cent of the load that would make the relay operate. This time for resetting is so short that if the

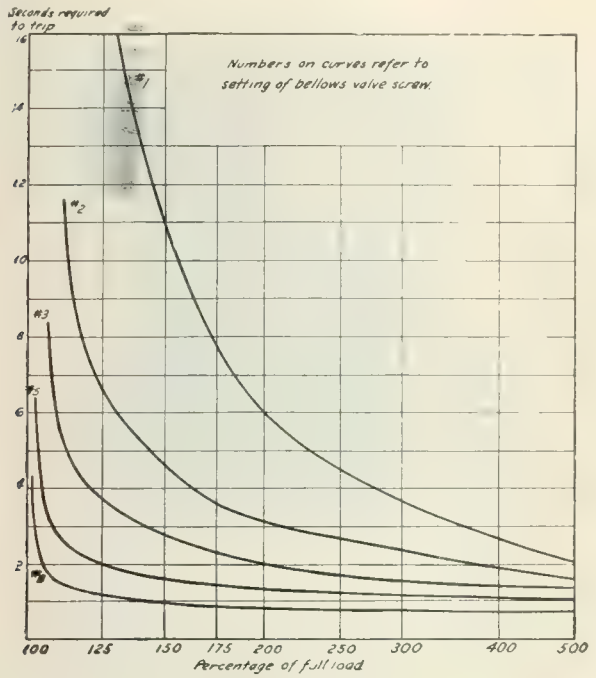


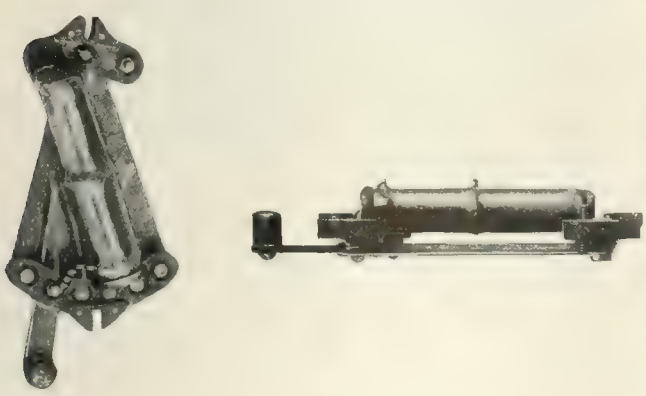
FIG. 4.—CURVES SHOWING RANGE OF ADJUSTMENTS.

circuit-breaker is opened the relay resets before the circuit-breaker is closed, but it is not so short as to interfere with the normal operation of the relay.

The wide range of flexibility in the use of this relay, together with its reliability and durable construction, indicate that it has an important place to fill in the field of switchboard protective apparatus.

Fan Controller.

The accompanying illustrations show a three-speed and open-step fan controller for desk fans, furnished complete ready for mounting in the base of an 8-in., 12-in. or 16-in. desk fan. The



FIGS. 1 AND 2.—FAN CONTROLLER.

resistance consists of Ward Leonard enameled resistance units, the resistance wire being hermetically sealed from the disintegrating effects of the atmosphere. This device, which is claimed to be the first complete rheostat of this kind obtainable, is made by the Ward Leonard Electric Company, Bronxville, N. Y.

Electric "Gathering" Mine Locomotive.

An improved electric mining locomotive of the "gathering type," in which a single powerful motor performs the functions of both propulsion and operation of the gathering reel, has been brought out by the Westinghouse Electric & Manufacturing Company and the Baldwin Locomotive Works, under the patents issued to Mr. J. M. Roan. Mr. Roan, who is general manager of the Clinchfield Coal Corporation, is a practical mine operator, and on this account the gathering locomotive of his invention may be accepted as meeting exactly the requirements demanded by the practical mining man.

In the Roan gathering locomotive the single motor used to

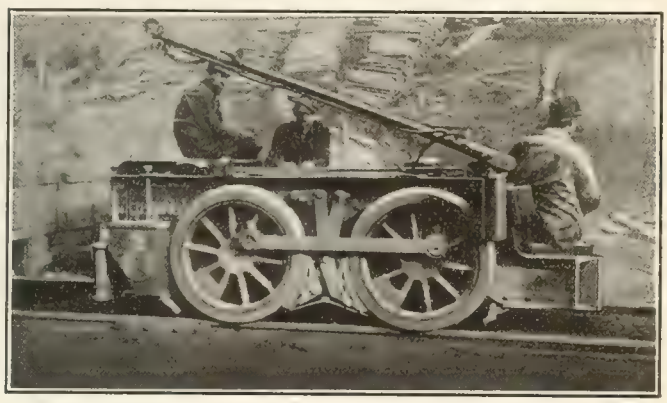


FIG. 1.—"GATHERING" MINE LOCOMOTIVE.

drive the wheels is arranged to be detached and connected to the wire-rope gathering reel. The wheels or the reel may thus be operated either independently, or simultaneously, winding up the rope while the locomotive is moving. This arrangement secures advantages of flexibility, compactness, and reduced amount and cost of electrical apparatus, attained in no other type. The provision of one powerful motor to perform the duties of both gathering and driving motors, cuts in half motor and controller expense, at the same time making the total power of the traction motor available for the gathering reel.

When loaded cars are to be hauled from the working face to the butt heading on which the locomotive stands, the rope is paid out and attached to the cars. The main driving motor is then unclutched from the axle and connected to the reel which winds up the rope, drawing the car toward the locomotive which stands, with its brakes set, on the heading track. The provision

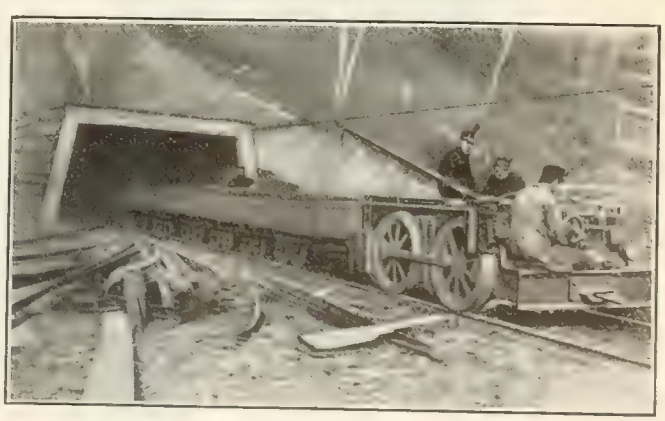


FIG. 2.—ELECTRIC "GATHERING" MINE LOCOMOTIVE.

for propelling the locomotive at the same time the reel is in operation enables the cars to be swung on to the heading without sawing the rope on the rib at the room neck. In service many applications have suggested themselves for the combined tractive and hauling-in actions secured from the motor. Derailed cars may be easily placed on the track, timbers and rails

recovered from under falls of rocks, rails loaded on cars, and in fact the reel can be used for any kind of general hoisting work

The motor transmits its power through a single spur gear directly to one axle. The two axles are connected together by side-rods spaced 90 deg. apart, securing increased tractive effort beyond that of any single-motor or two-motor locomotive. As shown, the wheel base is extrmely short, although the wheels are of full size, and the maximum amount of service is secured by the spring suspension of the frame and motor. The locomotive frame is made up of steel angles and plates, giving maximum strength for a given weight.

Small High-Voltage Transformer.

Companies operating high-voltage transmissions frequently meet with demands for power at various points along their lines. Usually the consumer requires a small amount of power, but if this field is systematically developed it will be found that a considerable revenue may be derived from such consumers. The accompanying illustrations show a transformer made by the Pittsburgh Transformer Company for this service. The features of this new transformer is its unusually substantial mechanical construction and high insulation. The importance of insulation strength will be realized when it is considered that a breakdown in a transformer of this kind is much more costly to remedy than a similar failure with 1100-volt or 2200-volt distributing transformers, and the property or personal safety of the consumer is subject to much greater risks.

These transformers are of the Pittsburgh standard core type design. The cases are cast iron, and are provided with hangers for cross-arm suspension. The high-tension leads issue through very large porcelain bushings which are set in the case at an angle of 30 deg. away from the casing. These bushings are deeply fluted to secure large leakage surface, and the hole through which the lead passes is enlarged at the lower end to produce a dry petticoat effect. The bushing projects well above the cement within the case, thus providing dry glazed porcelain insulation which prevents leakage through the cement. This substantial bushing construction at once does away with the



FIG. 1.—SMALL HIGH-VOLTAGE TRANSFORMER.

usual lead troubles which heretofore have always existed in small transformers for this class of service.

The insulation of these transformers has been most carefully developed. The coils being of core-type construction present only smoothly curved surfaces for the application of insulating materials; that is to say, all insulating material being wound on surfaces which are practically cylindrical is not injured in the process of winding and is, therefore, used in its full effective strength. Between the high-voltage primary and the low-voltage secondary is a heavy shield of built-up mica reinforced with specially treated material, the breakdown strength of which is in excess of the A. I. E. E. rules. This shield extends beyond the high-tension winding at each end of the coil.

The transformers are designed to secure high operating efficiency, combined with substantial construction and perfect in-



FIG. 2.—SMALL HIGH-VOLTAGE TRANSFORMER.

sulation. The windings are thoroughly ventilated by means of oil passages between the core and the windings and between the various sections of the windings themselves, so that the transformer is constantly cooled with currents of freely flowing oil through all parts of the winding. This results in a moderate temperature rise and also maintains the windings at a uniform temperature. Uniform transformer temperature rise is very important on account of the fact that unequal heating produces uneven expansion and contraction, which in time are apt to destroy the insulation and lead to burn-outs.

Storage Battery for Night Load.

The generating equipment of the town lighting plant at Eddyville, Ia., consists of a 55-kw, 220-volt, direct-current generator belted to a Corliss engine. During the year 1908 the load during peak hours reached, and in fact exceeded, the rated equipment of this set, thus necessitating increased capacity. It was felt that if a 24-hour service could be maintained, the number of customers could be materially increased, the 24-hour service being an additional inducement to use electric light and power. An attempt had been made to run a day circuit by operating the generating unit, but the expense was prohibitive.

A battery installation was, therefore, considered, and was placed in service in January, 1909, for the purpose of providing 24-hour service, and supplying the excess peak load. This battery consisted of 130 cells of "Chloride Accumulator," manufactured by the Electric Storage Battery Company, of Philadelphia, with a capacity of 25 amp for 8 hours. It was found that the battery could be charged during the normal run of the steam generating plant, and would then have sufficient capacity to supply the demands for service after 11 p. m., when the plant was shut down. On occasions when the load during the peak is in excess of the generator capacity, the battery is also used to assist the generator. At infrequent intervals, a comparatively heavy demand is made on the plant by the Opera House, lodge halls and churches, and on such occasions the battery is available for supplying the excess demand.

Since the installation of this equipment there has been a material increase in the number of customers, and as this is a municipal plant it is felt that the battery has not only increased the receipts, but has greatly improved the service.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The conditions of trade showed marked improvement for the past week. Future trade continues to be good and growing, and confidence in fall business is absolute. More orders are being received by the wholesalers and jobbers than at any time within recent months, and the reports from retailers throughout the country are very satisfactory, owing to the much more seasonable weather. In industrial lines orders are still extremely numerous, and additional workmen are being employed at all points. The iron and steel business is especially active, and prices have been considerably advanced over the low schedule at which they were marked in the early spring. The best feature of the week, however, was the excellent July crop report which was issued by the Government. This shows that there will be a total wheat crop of 663,000,000 bushels, which is practically equal to that of the previous year. The corn crop promises to be the largest ever grown, and will amount to more than three billion bushels. All of the other principal cereal crops show increases, and, as the range of prices is higher than at any time, the promise of revenue for the farmer is better than ever before in the history of the country. These facts are well known by all manufacturers and leaders in the commercial world, and are responsible for the extremely optimistic sentiment that is prevailing. Collections are somewhat better than heretofore, but are not as yet up to the mark that might be expected from the general revival in trade conditions. Failures for the week ended July 8, as reported by *Bradstreet's*, were 182, compared with 213 for the previous week; 245 for the same week in 1908; 185 in 1907; 143 in 1906, and 166 in 1905.

THE COPPER MARKET.

During the past week the copper market has continued to decline fractionally, and the demand from consumers has been remarkably light. Exports, however, have continued to be fair, although sales for future delivery on the foreign account have been smaller than they were a few weeks ago. The output in the United States continues to steadily increase, and the production in June has been at a record-breaking rate. According to the Copper Producers' Association's figures, the production for the 30 days of June was 116,567,493 lb., or 3,885,583 lb. per day, compared with a daily production in May of 3,817,940. This shows that the ratio of production is steadily increasing, and indicates that a surplus must be piling up in warehouses and in consumers' hands, if not in the hands of producers. The official figures of the Copper Producers' Association, which were made public July 10, show the stock of marketable copper on hand June 1 as 169,848,141 lb.; the production from domestic and foreign sources was 116,567,493 lb., and deliveries of marketable copper for consumption and export 131,557,573 lb. This leaves a surplus on hand the first of July of 154,858,061 lb., showing a decrease of about 15,000,000 lb. in the surplus stock of the month. As the consumption, however, has not kept pace with the production the copper surplus in the hands of consumers must have increased very materially. It is figured that the consumption in this country is running at about the rate of 85 per cent of normal, and as the production is far above any record heretofore made the consumption is, of course, not keeping pace with it. It is contended by the copper producers that there has been a material increase in the demand from electrical concerns, but there has been no evidence of any large sales to this class of manufacturers. Exports so far for the month of July have been 5981 tons. For the first six months of 1909 the deliveries were as follows: For domestic consumption, 313,613,157 lb.; for export, 335,278,657 lb.; total, 648,891,814 lb. On the Metal Exchange July 10 quotations were as given in the table.

Lake	13¼ @ 13⅜
Electrolytic	13¼ @ 13⅜
Casting	12¼ @ 12⅞

The London prices July 9 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	58 0 0	58 2 6
Standard copper, futures	58 16 3	58 17 6
Market	Quiet.	Steady.
Sales of spot		600 tons
Sales of futures		900 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	.....	.....
Lake	14.65	12.55
Electrolytic	14.25	12 12½
Casting	14 12½	12.00
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

WESTINGHOUSE PLANTS MORE FULLY EMPLOYED.—The business of the various Westinghouse companies during the month of June shows the same indications of an improved general condition that has been reported since early this year. A large number of car orders have recently been received by the Westinghouse Air Brake Company. This has also had a similar effect on the friction draft gear department. In addition, the works at Wilmerding have also received quite a number of orders for brake equipment from electric railway companies. The operating forces in the shops have, therefore, been considerably increased, and the factory is running about 80 per cent of its capacity. A correspondingly improved condition of affairs is also reported at the works of the Union Switch & Signal Company, in Swissvale, Pa., which employs at the present time almost twice the number of operatives it did a year ago. The business of the Westinghouse Electric & Manufacturing Company for June showed an improvement of 25 per cent over that of May, and appears to be permanent. In the number of orders the month showed an increase of 15 per cent. During the month of June the company received an order from the New York Terminal Company to furnish to the Pennsylvania Railroad Terminal a large amount of switchboard supplies and auxiliary details, representing approximately a contract for $500,000 worth of apparatus. The Westinghouse Machine Company has received an order from the Philadelphia Rapid Transit Company for two large steam turbine equipments, one of a capacity of 8000 hp and the other of 15,000 hp.

THE GARWOOD ELECTRIC COMPANY, which has acquired the exclusive right to manufacture the dynamos, motors and other appliances formerly manufactured by The C & C Electric Company, has recently taken a number of orders for electrical apparatus, including two 200-kw, one 75-kw and one 50-kw engine-type generators, two switchboards, one 125-hp motor, three 20-hp variable speed motors and four automatic electrical equipments for operating newspaper presses.

WESTCHESTER ROAD.—Work was started on July 12 on the electric line between New York and Port Chester, which will cost about $21,000,000. The start was made at New Rochelle by the Ferguson Contracting Company. The new line will be completed first from New Rochelle into New York, and will take two years to build. It is being built by the New York, Westchester & Boston Railroad, and will serve as a suburban passenger entrance to the subway and elevated lines.

ST. PAUL ELECTRIFICATION PLANS.—The Chicago, Milwaukee & St. Paul Railroad Company has given up for the present the consideration of the electrification of a considerable portion of its Montana mileage. This has been done because it was discovered that the St. Joe River did not have a 12 months volume of water sufficient to give the estimated power required. It was planned to electrify about 110 miles of the main line in Montana, with a power station on the St. Joe River.

AMERICAN EXPOSITION, BERLIN, 1910.—A handsome pamphlet relating to the American Exposition to be held in Berlin in 1910, has been issued from the American headquarters, 50 Church Street, New York. Mr. Max Vilweger is the American manager of the enterprise, which has the endorsement of a long list of leaders in the American industries. The object of the Exposition is to educate Europeans, and particularly Germans, to the excellence of American products.

PROPOSED LARGE NORTH CAROLINA INTERURBAN RAILWAY SYSTEM.—It is announced that an interurban electric line will be built from Winston, N. C., to Salisbury, 40 miles southwest, and to High Point, on the Southern Railway, and along a very heavily traveled part of the steam railway. The chief promoter is T. H. Vanderford, of Salisbury. It is said that the principal rights-of-way have been already secured. A supplemental line, that from Salisbury to High Point, 36 miles in length, paralleling the route of the main line of the Southern Railway, which has been under consideration for some years, is likewise receiving attention, while the Salisbury-Winston cross country line is being promoted. Mr. Vanderford, the leading promoter of the two interurban lines mentioned, has sought an extension of time from the town of Concord, 34 miles southwest of Salisbury, and has put up $1000 forfeiture with the Concord officials to begin work inside of 60 days on a local electric system. Mr. Vanderford declares that work will be begun immediately in Concord. It is stipulated in the franchise held by Mr. Vanderford that three miles of track are to be completed and in use within two years. The High Point (N. C.) Electric Power Company franchise has been purchased by the Public Service Corporation, which has plans in view to have an interurban line operating between High Point and Winston, northwest, and Greensboro, at which latter place the Public Service Corporation, having gained control of the local electric railway system, has made large improvements recently, and will do likewise in Winston, where one mile of track is already laid and work is progressing. The various interurban lines named form a triangle, with Winston at the north corner, Salisbury south and High Point northeast, each leg of the triangle being about 40 miles in length. The Public Service Corporation will probably continue the local High Point electric franchise at Greensboro, some 18 miles northeast, and thence will build through Greensboro, where the company controls the street railway to Winston. At Winston, as stated, the Vanderford interests will build south to Salisbury, and perhaps northeast up the east leg of the triangle to High Point, or at least a part of the way, Greensboro and High Point both being near the east angle of the triangle, which has its base on a line from Greensboro and High Point, northwest to Winston, and the two legs converging at Salisbury. Such a development would constitute the largest interurban electric system now in operation in the Southeastern States with the possible exception of the Aiken-Augusta and allied lines.

EXTENSIVE DEVELOPMENT IN MEXICO.—The hydro-electric plant of the Mexican Light & Power Company, situated at Necaxa, near Mexico City, will be the largest power plant in the world when completed, according to the statement made here by Dr. F. S. Pearson, president of that company. He says that by this time next year the plant will have reached that stage of completion when 100,000 hp will be available. By the construction of additional water reservoirs and the installation of more equipment this horse-power can be increased. The system of storage reservoirs in the mountains which are to furnish the water for operating the hydro-electric plant will hold 100,000,000 cubic meters of water when completed. The first units of this gigantic electric power enterprise have been in operation for some time, the electrical energy thus generated being transmitted to Mexico City, Puebla and El Oro. Other transmission lines will be built when the capacity of the plant is enlarged. The storage reservoirs so far completed have a capacity of 55,000,000 cubic meters of water. This big enterprise already represents an investment of nearly $50,000,000 gold. The stock of the company is held by a few people. Most of the principal stockholders are bankers and other wealthy investors of Montreal, Canada. The same financial interests compose the syndicate which is preparing to install another hydro-electric plant in the northern part of Mexico. This latter plant will be situated upon the Conchos River, near Santa Rosalia, State of Chihuahua, and will furnish lights and power for the cities of Chihuahua, Parral, Santa Rosalia, Jiminez and a number of mining camps of that region. Governor Enrique C. Creel, of Chihuahua, former Mexican Ambasador to the United States, is interested with the Canadian syndicate in this project. He says that $1,000,000, gold, has already been deposited in a bank of Chihuahua to start the work of construction. The expenditure of about $15,000,000, gold, will be required in carrying out the plans of this project.

ALLIS-CHALMERS STEAM TURBINES.—The Allis-Chalmers Company has recently shipped a large number of steam turbines to fill recent contracts, among them being machines of from 500 kw to 3500 kw rating for the Brush Electric Light & Power Company, Galveston, Tex.; Oak Park Power Company, Flint, Mich.; Savannah Electric Company, Savannah, Ga.; Florida Mining Company, Mulberry, Fla.; Glenlyon Dye Works, Phillipsdale, R. I.; Willamette Valley Company, Springfield, Ore.; Pacific Mills, Lawrence, Mass.; Cia Electrica y de Ferrocarriles de Chihuahua, Mex., and Oshkosh Gas Light Company, Oshkosh, Wis. Orders now in the drafting room or shop comprises units as follows: Western United Gas & Electric Co., Aurora, Ill., 1000 kw; Neenah Paper Company, Neenah, Wis., 1000 kw; Cleveland Cliffs Iron Mining Company, Ishpeming, Mich., 2000 kw; Royal Weaving Company, Pawtucket, R. I., 1500 kw; North Adams Gas Light Company, North Adams, Mass., 1000 kw; Merchants' Heat & Light Company, Indianapolis, Ind., 2000 kw; Municipal Light Plant, Anderson, Ind., 500 kw; Clinton Sugar Refining Company, Clinton, Iowa, 750 kw; Anderson & Middleton Lumber Company, Aberdeen, Wash., 300 kw; Kenosha Electric Railway Company, Kenosha, Wis., 300 kw; Fraser River Lumber Company., Fraser Mills, B. C., 750 kw; Northwestern Gas & Electric Company, Walla Walla, Wash., 1000 kw; Wilkes-Barre Gas & Electric Company, Wilkes-Barre, Pa., 1500 kw; Eastern Pennsylvania Railways Company, Pottsville, Pa., 1000 kw; Delaware, Lackawanna & Western Railroad Company, Scranton, Pa., 2000 kw; Colorado Springs Electric Company, Colorado Springs, Colo., 1500 kw; Aldrich Manufacturing Company, Moosup, Conn., 300 kw; Great Southern Lumber Company, Bogalussa, La., 1000 kw.

ELECTRICAL COMPANIES WILL MAKE GOOD REPORTS.—The Westinghouse Electric & Manufacturing Company, it is stated, is now employing in the neighborhood of 7500 workmen in its East Pittsburgh shops. The company is doing a business at a rate which will approximate $25,000,000 a year. The month of July showed a decided improvement over any other month since the first of the year. The Westinghouse company has a much larger capacity than it formerly had, and it is estimated that at the present time it can handle a business of close to $50,000,000 a year. The business of the General Electric Company is also showing a very steady growth. An official of the company is quoted as saying that it is expected that orders for the current year will amount to at least $60,000,000, and it is estimated that business at the present time is running at the rate of between $52,000,000 and $53,000,000 a year. The business of the Western Electric Company continues to show improvement, and it is understood that, especially in switchboards and other telephone apparatus, orders have been as liberal as the company can handle. Quite a number of large installations also have recently been booked by this company. Sales at the present time are running at the rate of $50,000,000 per year. Reports from the Crocker-Wheeler Company are of the same sanguine tenor. Orders have been very plentiful for individual motors for use in factories, and there has also been considerable business in hydro-electric machinery.

REBUILDING STEAM HEATING SYSTEM.—The Ottumwa (Iowa) Railway & Light Company is spending nearly $100,000 in the rebuilding of its district steam heating system. Installed in 1889, this plant was the first in the country to use exhaust steam for district heating. It has proved successful, and as the demand in the territory served has now outgrown the old installation, the company has decided to rebuild the system and at the same time to extend the service. The American District Steam Company, of Lockport, N. Y., is doing the work under the supervision of H. M. Byllesby & Company, consulting engineers, Chicago. The service to be given by the new plant will be metered, the charge to customers being a certain amount per unit of 1000 lb. of water condensed from the steam used for heating. The rebuilding of this system will include the relaying of about four miles of steam mains, and particular attention will be paid to the drainage under the mains. The back pressure will not exceed 3 or 4 lb.

CONTRACT FOR MEXICAN HYDRO-ELECTRIC PLANT.—Gochicoa, Ohlhausen & Company, Toluca, Mexico, have been awarded the contract for the installation of the El Aguila power plant and substations, including two 350-kw generators direct-connected to two 450-hp Pelton-Francis waterwheels.

SOUTHERN POWER COMPANY.—The Southern Power Company, of Charlotte, N. C., will use on its new hydro-electric plant at Ninety-Nine Islands over 700 cars of cement, which is being shipped from Charleston at the rate of two trains of 20 cars each per day.

CENTRAL GEORGIA POWER COMPANY MOVES FROM MACON TO ATLANTA.—Mr. W. Jordan Massee, president of the Central Georgia Power Company, has announced that headquarters of the $3,500,000 Central Georgia Power Company will be removed from Macon to Atlanta. He stated that, while Macon offered large advantages, the company believes that Atlanta will afford a better distributing point, and that likewise a much greater percentage of the power will be used by local manufactories. This company is developing water falls along the Ocmulgee River, and has in view the further building of plants, one on the Oconee River to supply power to Macon, and a third on Flint River to supply power to Southern Georgia. The first site now being completed on the Ocmulgee, near Jackson, includes a dam 1400 ft. long between two solid banks of granite on either side of the river. The dam is built of a mixture of 35 per cent of granite and of cement. The dam completed will be about 100 ft. high and 100 ft. thick at the bottom, 20 ft. at the top and 1400 ft. in length. Steel towers for transmission to Atlanta will bring the entire outlay up to $3,500,000.

TELEGRAPH COMPANIES COMPARED.—A financial newspaper of Boston has recently compared the size and importance of the Western Union Telegraph Company and the Mackay Companies. It shows that the Western Union possesses 1,321,190 miles of land wires, while the Mackay Companies possess only 300,000 miles. Of cable lines the Western Union possesses 8400 miles, while the Mackay Companies have 30,500 miles. These figures indicate that the Mackay Companies have developed very much more extensively their cable business than their land service. At present the Commercial Cable Company has under way work for laying 1700 miles of additional cable. The Mackay Companies' lines on land have been confined to the larger centers of population, and have mostly been developed for the purpose of distributing its cable service rapidly upon its own wires.

WARREN-BICKNELL COMPANY, CLEVELAND.—The Warren-Bicknell Company, of Cleveland, has been incorporated with a capital stock of $10,000, for the purpose of operating electric railway lines. W. E. Davis and Charles S. Thrasher, of the Cleveland Construction Company, H. B. McGraw, John H. Trefel and Thomas P. Kilfoyle are the incorporators. While the company is to operate electric roads, it is said that no Cleveland roads are in mind at this time. The connection between the new company and the Cleveland Construction Company has not been explained, but it would seem that they would make excellent working companions.

USE OF HUDSON TUNNELS BY THE PENNSYLVANIA.—The Hudson tunnels between Jersey City and Cortlandt Street, New York which will be opened to the public on July 19, will be used by the Pennsylvania Railroad to supplement its ferry service, beginning on the date noted. The Pennsylvania tunnels under Bergen Hill and the Hudson River to its station at Seventh Avenue and Thirty-third Street, New York, are now complete and the electric service will be inaugurated next summer. The work of laying the tracks, installing the signal apparatus and electrical equipment will be undertaken at once.

ELECTRIFICATION OF SOUTHERN PACIFIC.—Mr. O. S. Curtis, of the engineering department of the Southern Pacific Railroad, has filed an application with the forest supervisor, Mr. Bigelow, for permits to build generating stations within the Government forest preserves in Sierra County, Nev. Permits for constructing stations along the Rubicon River have already been obtained. These stations will be used for supplying electricity to the mountain division of the Southern Pacific between Auburn and Truchee.

THOUSAND ISLAND ELECTRIC COMPANY.—The Public Service Commission of the Second District of New York has authorized the Thousand Island Electric Light & Power Company to execute a mortgage to secure an issue of $20,000 in bonds, and to issue $20,000 of 5 per cent bonds for the purpose of establishing a new generating plant at Clayton.

NEW YORK CENTRAL'S ELECTRICAL PLANS.—Although the New York Central has not yet made any announcement of its electrical plans for the coming fiscal year, it is known that a part of the work to be done is a new substation at Tuckahoe, in Westchester County, and the electrification of four tracks from Spuyten Duyvil to Croton.

ELECTRIC VEHICLES FOR MAIL SERVICE.—The handling of mail in New York City has been greatly facilitated by the recent substitution of electric for horse-drawn vehicles. There are now being used in the district north of Forty-second Street 14 motor cars, two with a carrying capacity of 4500 lb., four carrying 2500 lb. and eight 1300 lb. These vehicles decrease the time of travel to the Bronx by about 25 min. They are supplied under contract with the Post Office Department by the Motor Delivery Company, which will put on extra cars of similar type during the Christmas season to expedite delivery.

Financial Intelligence.

THE WEEK IN WALL STREET.

During the past week the stock market in Wall Street has been extremely dull, and trading has been little more than professional. Prices, however, have been fairly well maintained, and what losses have been recorded were fractional. The entire tone of the market is strong, and the fact that there have been no advances in view of the many strong bull developments that have occurred shows that the large traders are keeping out. During the past week the Government crop report for July has been published, indicating a larger return to the farmers of this country than ever before known. Reports from the industrials continue to show increased orders, and all conditions of trade have reported improvement. The earnings of the railroads, after remaining comparatively stationary during the late spring, suddenly took a decided upward tendency during June. More cars are being employed, and locomotives that have been long dead are being put into service.

NEW YORK.

	July 2.	July 12.	Shares Sold.		July 2.	July 12.	Shares Sold.
All.-Ch.	15¼	15	——	Int.-Met., pfd.	46¼	48¼	25,999
All.-Ch., pfd..	51¾	51¾*	720	Mackay Cos...	80½	80½*	600
Amal. Cop....	82¾	81⅝	50	Mackay Cos., p.	73¾	73¾*	——
Am. D. T....	20*	20*	48,085	Man. Elev. ...	143⅞*	143⅞*	100
Am. Loc.....	60¼	60¼	——	Met. St. Ry..	18	18*	217
Am. Loc., pfd.	118¼	118¼*	3,500	N.Y. & N.J.Tel.	137*	137*	200
Am. Tel. & Cbl.	80*	80*	400	Steel, com....	60¼	60⅞	268,615
Am. T. & T...	140¼	140	7,200	Steel, pfd.....	126⅛	125¾	11,754
B. R. T.....	79⅝	78	11,780	W. U. T.....	72	71⅜	1,100
Gen. Elec.....	164	164⅛	4,535	West'h. com..	85½	85½*	300
Int.-Met. com..	16½	15½	10,566	West'h. pfd...	121¼	121¼*	100

PHILADELPHIA.

	July 2.	July 12.	Shares Sold.		July 2.	July 12.	Shares Sold.
Am. Rys.....	45¼*	45½	——	Phila. Elec...	11⅞	11⅞	——
Elec. Co. of A.	12⅝*	12⅞	——	Phila. R. T...	28¾	29	——
Elec. St. B'ty.	52	52½	——	Phila. Trac...	91	91	——
E. S. B'ty, pfd.	49*	49*	——	Union Trac...	53	53	——

CHICAGO.

	July 2.	July 12.	Shares Sold.		July 2.	July 12.	Shares Sold.
Chi City Ry..	180*	180*	——	Chi Tel. Co..	132½	132½*	——
Chi Rs., Ser. 1.	112¾	112¾*	——	Met. El., com.	17½*	16½	——
Chi. Rs., Ser. 2.	40½	40½*	——	Met. El., pfd.	48	48	——
Com. Edison...	121¾	121½	——	Nat'l Carbon..	90	92½	——
Chi Sub'ws..	22	..	——	Nat'l C., pfd.	118	120	——

BOSTON.

	July 2.	July 12.	Shares Sold.		July 2.	July 12.	Shares Sold.
Am. T. & T...	140⅞	140¼	——	Mex. Tel.....	2⅞	2⅞*	——
Cum. Tel.....	133½*	133½*	——	Mex. Tel., pfd.	6*	6*	——
Edison E. Ill..	250	250*	——	N. E. Tel.....	133¾	133¾*	——
Gen. Elec....	164	164*	——	W. T. & T....	10½	10½*	——
Mass. E. Ry..	13½*	13¾	——	W. T. & T., p.	85	87	——
Mass. E. R., p.	70½	72½	——				

*Last price quoted.
Shares sold are for week July 2 to July 10.

All of these things should contribute to a strong bull market, and the only reason that can be offered why there has not been a considerable advance all along the line is that traders are taking vacations and are staying out. The public, as has been frequently noted, is taking very little interest in the market. The bond market continues to be the wonder of Wall Street. Any sized issue that is offered is gobbled up by the large banking concerns, and immediately offered to the public and within a few days the announcement is made that it has been oversubscribed. This was true last week with regard to the $10,000,000 of bonds of the Interborough Rapid Transit Company, purchased by J. P. Morgan & Company and others; these were offered to the public about July 6, and within two days the announcement was made that they had been oversubscribed. Other large bond issues are being talked of, and in every instance inquiries are so numerous that it is evident that the competition for them will be sharp. The money market continues to be very easy, and in spite of liberal exports of gold to the Continent and Argentina, rates remain very low. Quotations on July 12 were given as in the table.

DIVIDENDS.

American Locomotive Company, preferred, quarterly, 1¾ per cent, payable July 21.

American Telephone & Telegraph Company, quarterly, 2 per cent, payable July 15.

Electric Bond & Share Company, preferred, quarterly, 1¾ per cent, payable Aug. 1.

International Pneumatic Tube Company, preferred, semi-annual, 3 per cent, payable July 20.

International Steam Pump Company, preferred, quarterly, 1½ per cent, payable Aug. 2.

Manhattan Electric Supply Company, preferred and common, semi-annual, 3 per cent each, payable Aug. 2.

Milwaukee Electric Railway & Light Company, preferred, quarterly, 1½ per cent, payable July 31.

Montreal Street Railway Company, quarterly, 2½ per cent, payable Aug. 2.

National Carbon Company, common, quarterly, 1 per cent, payable July 15.

New Hampshire Electric Railways Company, preferred, semi-annual, 1 per cent, payable July 31.

New York & Queens Electric Light & Power Company, preferred, semi-annual, 2½ per cent, payable Aug. 10.

People's Gas Light & Coke Company, Chicago, quarterly, 1¾ per cent, payable Aug. 25.

J. G. White & Company, preferred, quarterly, 1½ per cent, payable Aug. 1.

TOLEDO RAILWAYS & LIGHT COMPANY.—The bondholders' committee of the Toledo Railways & Light Company has sent a letter to the holders of the first mortgage 4 per cent consolidated bonds, and to the secured creditors, in which it says that the company will not be able to pay the principal and interest on the $4,866,000 bonds maturing July 1, 1909. This makes the third default on interest payments, but the committee asks that no drastic action be taken against the company because of these defaults. The committee is working in harmony with the stockholders' committee and the officers of the company, and it believes that the best interests of the property will be served by giving it time to regain its feet. The stockholders' committee is maturing plans for refunding and bringing about a unification of the secured indebtedness by an issue of collateral trust notes to mature Jan. 1, 1912. It is believed that, with the company's business thus temporarily financed, an agreement can be reached with the city of Toledo for an extension of the franchise, and it is estimated that when this is once accomplished the permanent refinancing of the company will be an easy matter.

ALEXANDRIA (VA.) ELECTRIC COMPANY SOLD.—Baltimore and Washington interests have purchased the Alexandria (Va.) Electric Company and the company's business was taken over on July 1. This plant supplies power to a large number of industries in Alexandria and also supplies light to the city and residents. The present capacity of the plant is 340 kw, but it will be immediately increased by the addition of a 500-kw steam turbine. The order for this turbine has already been placed with the Allis-Chalmers Company. It is the intention of the present management to increase the company's business by the adoption of modern and progressive methods, and by extending the company's lines into the suburbs of Alexandria. The following officers have been elected: President, Thomas C. Coleman, of Cockeysville, Md.; vice-president, J. C. M. Lucas, Baltimore; secretary and treasurer, H. P. Lucas, of Baltimore; general manager, Francis R. Weller, of Washington; resident director, Leo P. Harlow, Alexandria. Mr. Weller will have active charge of the business of the company and will also serve as engineer for all new constructions.

INTERNATIONAL STEAM PUMP COMPANY.—The annual statement of the International Steam Pump Company for the year which ended May 31, 1909, has just been made public. It shows that the total net earnings of the company for the year were $1,984,992, as compared with $2,226,253 in the previous year. The balance applicable to dividends during the year was $1,891,701, and the total surplus of the company is now $2,848,218. Speaking of the year's business, President Benjamin Guggenheim says that, notwithstanding the serious industrial depression and the fact that business was curtailed enormously—approximately 65 per cent—the net profits for the year were equal to 90 per cent of the net profits for the previous year. He also says that the company has taken advantage of the low prices prevailing in the metal market and has made sufficient contracts for pig iron, copper, tin and other metals to carry the concern a full working year. It is understood that the company is contemplating a bond issue of $6,000,000 or $7,000,000. The present funded debt of the company is $4,200,000.

CATARACT POWER & CONDUIT COMPANY.—The annual meeting of the stockholders of the Cataract Power & Conduit Company was held at Buffalo July 6, and the following directors were elected: Edward D. Adams, Charles R. Huntley, W. Paxton Little, D. O. Mills, Victor Morawetz, DeLancey Rankine, Francis Lynde Stetson, George Urban, Jr., and Edward A. Wickes. At the last meeting of the board of directors of this company the officers were authorized to expend in the neighborhood of $150,000 during the present year for extensions and improvements. This money is to be spent as necessity arises. During the present summer there will probably be built some new conduits, and it is planned to install some three-conductor, 22,000-volt, paper-insulated, lead-covered cable.

THE WESTINGHOUSE STORAGE BATTERY COMPANY was incorporated at Albany, N. Y., July 12, with a capital of $1,750,000, including $250,000 in 6 per cent preferred stock. The incorporators were H. H. Westinghouse, Samuel B. Dusenberre, George C. Smith, H. Cool and John G. Greenburgh. Heretofore the Westinghouse storage battery has been an interest of the Westinghouse Machine Company, having been developed in a storage battery department of that concern, and regularly placed on the market about two years ago in types for all classes of storage battery application, from signal service to power station use. The plates are of the Planti type, consisting of thin ribbons attached to the top and bottom of the plate frame or to panel cross-bars.

RECEIVER FOR COMMERCIAL BATTERY ELECTRIC COMPANY.—Following a creditors' petition in involuntary bankruptcy, the United States District Court, on July 9, appointed the American Trust & Savings Bank, of Chicago, receiver for the Commercial Battery Electric Company, of 1451 Michigan Avenue, Chicago. The company named manufactured storage batteries for automobiles. The estimated liabilities are from $30,000 to $35,000, with estimated assets of from $5,000 to $6,000. The petitioning creditors are the Damascus Tool & Steel Company, Kidd Brothers & Burgher Steel Wire Company and another, represented by Herman Frank, attorney.

MILLIKEN BROS. REORGANIZATION.—The creditors of the Milliken Bros. Company have been told by the firm's own special reorganization committee that they would have to wait a long time for their money, and have been advised to deposit their claims before Aug. 1, and assist in carrying on the works. An agreement to defer all claims against the firm, and thus enable the committee to carry on the business under the form of a voting trust, has already been signed by 76 per cent of the creditors, and a prompt response from the remaining creditors will enable the company to resume possession of its property and reorganize the business.

NORTHWESTERN ELEVATED TRAFFIC.—For the year ended June 30, 1909, the Northwestern Elevated Railroad Company, of Chicago, reports the daily average number of passengers carried as 112,208, compared with 102,238 for the preceding year, a gain of 9.74 per cent. In June, 1909, the daily average traffic was 110,988, compared with 109,109 in June, 1908, an increase of 1.72 per cent.

NEW ORLEANS RAILWAY & LIGHT COMPANY BONDS.—The stockholders of the New Orleans Railway & Light Company, at a meeting held June 28, ratified the proposal recently made by the board of directors to isssue $50,000,000 of 5 per cent 40-year first and refunding mortgage bonds, the purpose of this refinancing having heretofore been given.

MASSIE WIRELESS TELEGRAPH COMPANY.—The Massie Wireless Telegraph Company reports that it has prospective contracts aggregating $132,000, and has completed contracts aggregating $60,000, at a profit of $23,000. Of its preferred stock, $28,000 has been sold at par and $200,000 in common stock has been issued.

MEXICAN TELEPHONE & TELEGRAPH COMPANY.—The report of the Mexican Telephone & Telegraph Company for the three months ending May 31 shows gross earnings of $109,864, an increase of $16,669. The net earnings increased almost exactly the same amount.

INDIANA FUEL & LIGHT COMPANY.—The gas and electric light properties developed by the Wayne General Construction Company have been taken over for operation by the Indiana Fuel & Light Company. J. C. Campbell is superintendent.

NEW 90-MILE INTERURBAN RAILWAY IN MISSOURI.—At a meeting of the stockholders and directors of the Hannibal & Northern Missouri Railroad Company at Palmyra, Mo., on July 3, the following directors were elected: Messrs. Frank W. Latimer, Galesburg, Ill.; William B. Chandler, Chicago; Nathaniel Board, Chicago; J. Walter Farrar, Kansas City; Oscar E. Florin, Jr., New York City; Samuel G. Grodson, Chicago; Frank O. Chesney, Kansas City; Henry Funk, Shelby County, Missouri, and Joseph W. Latimer, Chicago. This board of directors elected the following officers: President and treasurer, Mr. Frank W. Latimer; vice-president, Mr. Nathaniel Board; secretary, Mr. Joseph W. Latimer. The organization of the company was perfected, and it is said that the work of making the survey for an interurban electric railway to extend from Hannibal, Marion County, Missouri, to Kirksville, Adair County, in the same State, has been begun. This road will be about 90 miles long. A contract has been entered into between the railroad company and the Roberts & Abbott Company, of Cleveland, by which the latter will have full charge of the engineering work of the railway. The contract also provides for the appointment of a consulting board of five electrical engineers. E. P. Roberts of the engineering firm has been making a personal investigation of the conditions. The Hannibal & Northern Missouri Railroad Company is capitalized at $2,000,000, and it is asserted that the road will be built without doubt. The company was chartered under the laws of Missouri last month and it is said the people of Marion, Shelby, Knox and Adair counties are greatly interested in the project.

ELECTRIC RAILWAY BUSINESS IMPROVING IN MASSACHUSETTS.—The recent holiday patronage of the electric railway lines in Eastern Massachusetts shows a noteworthy improvement over that of the preceding year, indicating a better feeling in regard to the purchase of electric service by the public. The Boston Elevated Railway Company exhibited an increase of about 4 per cent compared with 1908, while the Massachusetts Electric Companies system, comprising about 900 miles of track, showed an average increase of 40,000 passengers per day for the first five days of July as contrasted with 1908. The receipts on the Fourth were $44,500, the largest earnings of that date since the organization of the system. The Boston & Worcester interurban system reported a gain of 17 per cent in gross earnings and the Boston Suburban Electric Companies gained 15 per cent during the triple holiday. The street railways in the vicinity of Boston have been somewhat unfavorably affected by a recent decision of the Railroad Commission ordering the steam lines to sell 12-ride commutation tickets at the same proportional rate as 25-ride tickets.

THE PACIFIC GAS & ELECTRIC COMPANY.—In lieu of the cumulative preferential dividends upon each two shares of its preferred stock for the period between April 1, 1906, and August 1, 1909, the Pacific Gas & Electric Company offers to deliver one fully paid share of its common stock on or before August 15, 1909. The offer, which will be kept open until July 15, has been accepted by the holders of about 72 per cent of the preferential stock. The company's gross revenue for the past three years has been $9,127,083 in 1906, $11,426,992 in 1907, $12,853,817 in 1908. For the year ending Dec. 31, 1908, the net earnings were $2,052,330. The unpaid dividends on the preferred stock since the fire and four months prior thereto, for the payment of which the above plan has been formed, amount to $2,000,000, or $20 per share for 100,000 shares.

STILLWATER (MINN.) ELECTRIC PLANT SOLD.—The properties of the Stillwater (Minn.) Gas & Electric Light Company were sold under foreclosure on June 26. This company was formally controlled through stock ownership by the Western Gas & Investment Company, of Chicago. At the sale the property brought $370,000 which just about covered the $350,000 bond issue and the receivers' expenses. The properties will be taken over by the Washington County Light & Power Company, incorporated by Homer W. McCoy and Joseph H. Roy, of Chicago, and Ernest L. Hospes, of Stillwater. The property acquired includes the plants and franchises of the former owners, together with their rights in the Apple River Power Company, which supplies energy locally and to St. Paul.

NEW HAVEN SELLS ITS MASSACHUSETTS ELECTRIC RAILWAY PROPERTIES.—President Charles S. Mellen, of the New York, New Haven & Hartford Railroad Company, informed the Massachusetts State Board of Railroad Commissioners on July 10 that his company has disposed of its interests in street railways in Massachusetts. This is in effect a report that the company complied with the decree of the Supreme Court of Massachusetts that on or before July 1, 1909, it must part with its holdings in the Worcester & Southbridge, Worcester & Blackstone Valley, Worcester & Webster, Worcester & Dudley, the Berkshire and the Springfield street railway companies, and such other street railway interests as it may hold in Massachusetts.

SYRACUSE LIGHTING COMPANY.—Authorization has been given by the Public Service Commission, Second District, to the Syracuse Lighting Company to execute its mortgage or trust deed for $2,500,000 and to issue at once $143,000 par value bonds. The bonds are to be sold at not less than 95. The company asked permission to issue $207,000 in bonds, but it appeared at the hearing that there remains unexpended $70,388. applicable to additions and betterments under the $1,000,000 debenture issue of May 27, 1907. This amount will be used in addition to the $143,000 just authorized.

ATLANTA-MACON INTERURBAN RAILWAY.—At a recent meeting of the board of directors in Atlanta, President W. Jordan Massee, of the Atlanta, Griffin & Macon Electric Railway, reported that the outlook was bright for securing from New York capitalists the funds for building the line. The entire right-of-way has been secured, and also a franchise from every town on the line of the road. Power will be supplied by the Central Georgia Power Company, of which Mr. Massee is the head. The Georgia Securities Company has been organized as a holding company for the railway.

NATIONAL LIGHT, HEAT & POWER COMPANY.—An issue of $600,000 series "A" collateral trust bonds was made by the National Light, Heat & Power Company Nov. 1, 1908. Of these bonds $150,000 are now outstanding, and last week the company authorized the sale of an additional $500,000 marked series "B." These bonds are secured by bonds of the subsidiary companies amounting to a total par value of 20 per cent in excess of the bonds. It is stated that the earnings of the lighting company amount to more than three times the dividend requirements at the present time.

SPENCER (MASS.) GAS COMPANY BONDS.—The Board of Gas and Electric Light Commissioners has granted the petition of the Spencer Gas Company for permission to issue 550 shares of new stock at the par value of $100, and first mortgage bonds to an amount not exceeding $85,000. The proceeds of the stock are to be applied to the cancellation of promissory notes of the company, while the proceeds of the bonds are to be applied as follows: $59,500 to the cancellation of outstanding bonds and $25,500 to the cancellation of promissory notes.

NATIONAL TELEPHONE CORPORATION.—The merging of the Pittsburgh & Allegheny Telephone Company with the Ohio Valley companies is looked upon as the first link in the formation of an independent long-distance system to extend from Boston to the Rockies. The various companies will be merged into the National Telephone Corporation of New York, with a capitalization of $100,000,000. It is said that the consolidation will be accomplished Aug. 1.

MOLINE LAMP COMPANY.—At the annual meeting of the Moline Lamp Company, Moline Ill., the following officers were re-elected: President, J. M. Dale, vice-presidents, Dr. A. M. Beal and Ed. Coryn; secretary, J. I. Clark. The audited report of the company showed a substantial gain over the preceding year, both in volume of business and profits.

CENTRAL COUNTIES POWER COMPANY.—All of the holdings of the Central Counties Power Company, which was organized by the defunct California Safe Deposit & Trust Company, will be taken over by New York financiers, who will build a generating station in the Clear Lake region of California. The deal, which was consummated at San Francisco, will involve between $7,000,000 and $10,000,000.

FRENCH WESTINGHOUSE COMPANY'S EARNINGS.—The report of the Société Anonyme Westinghouse, of Paris, shows total gross profits of 1,780,764 francs. The total surplus, after paying fixed charges and dividends of 5 per cent on the preferred shares, amounts to 885,089 francs.

PEORIA RAILWAY BONDS OFFERED.—N. W. Halsey & Company are offering to the public at 98 and accrued interest the unsold balance of $1,500,000 of Peoria Railway Company first and refunding 5 per cent gold bonds. These bonds are redeemable at 105 and interest.

REORGANIZATION OF GOULD'S VIRGINIA PROPERTIES.—The proposed rehabilitation of the physical properties of the old Virginia Passenger & Power Company, now known as the Virginia Railway & Power Company, will be an extensive task. Among the extensions under consideration is the completion of the Richmond & Chesapeake Bay line on to Washington, thus affording the first electric railway connection into the capital from the South, excepting the Baltimore line. In Richmond it is proposed to rebuild the system in accordance with the traffic demands of a growing town, curtailing some lines, and building new ones to whatever sections at the present time are wanting in electric railway facilities. It is expected that work will be started at Ashland, the present terminus, and at Fredericksburg also, on the Washington complete line. It is proposed to secure franchises between Broad and Main Streets west of Beech Street. Another issue is that of a bridge across the James River that will carry the weight of the Petersburg cars, 28 miles distant, several sites having been examined, and with the lines to Washington and Petersburg, the Virginia Railway & Electric Company will have perhaps the longest system of lines in the Southeastern States. Application for a charter for the new company has been made. The minimum capital is $9,000,000 and the maximum is $12,500,000, the new company to take charge July 1, with principal offices in this city. Frank Jay Gould, Tarrytown, N. Y., is named as president of the board, in the petition; William Northrop, of Richmond, president; vice-president and general manager, Henry Anderson, Richmond; secretary and treasurer, Guy Phillips, New York. The directors, including the above named officials, and Messrs. C. S. Whelen, Philadelphia; Edward Gould, Dobbs Ferry, N. Y.; Percy M. Chandler, Philadelphia; R. Lancaster Williams, Richmond; Fritz Sitterding, Richmond.

CONNEAUT & ERIE TRACTION COMPANY.—It is announced in Philadelphia that the Conneaut & Erie Traction Company has been successfully reorganized. The road has a trackage of 35 miles, extending from Conneaut, Ohio, to Erie, Pa. It was placed in the hands of a receiver Sept. 5, 1907. On May 12 last the property was sold under foreclosure, and bought by the bondholders' committee, of which R. L. Forrest is chairman. The old company had a capital stock of $800,000, and bond issues of $800,000 first mortgage and $400,000 second mortgage. Under the plan of reorganization the old first mortgage bondholders will receive $500,000 of new first mortgage bonds and $500,000 in 5 per cent income bonds. The holders of the second mortgage bonds will receive $500,000 of new income bonds and the capital stock of the new company, which will be known as the Cleveland & Erie Traction Company.

TOLEDO, BOWLING GREEN & SOUTHERN.—The stockholders of the Toledo, Bowling Green & Southern Traction Company have decided to increase the capital stock to $2,000,000 in order that the property of the Toledo Urban & Interurban Railway Company may be purchased. The amount to be paid is $375,000 preferred stock and $500,000 of 5 per cent bonds. A new plan may be worked out for the old stockholders of the Toledo, Bowling Green & Southern also by which they will receive new stock. The ownership of the two companies is largely the same, but the Toledo Urban & Interurban road has been in the hands of a receiver for some time. As it holds a lease on the Toledo, Bowling Green & Southern, matters have become somewhat complicated.

NEW HAVEN ROAD BUYS TRACTION STOCK.—The New York, New Haven & Hartford Railroad Company, so it is unofficially announced in Boston, has been the principal buyer of the stock of the United Traction & Electric Company, of Providence, R. I. It is also stated that some of the large holders of this stock have been offered by the New Haven Railroad an opportunity to exchange their shares, which pay 5 per cent outright, for New Haven stock, which pays 8 per cent on the basis of five shares of New Haven for eight shares of United Traction. The United Traction stock has recently sold at about 107.

NEW YORK & QUEENS ELECTRIC LIGHT & POWER COMPANY.—The directors of the New York & Queens Electric Light & Power Company proposed to the stockholders in April that a mortgage of $25,000,000 be placed upon the property, and bonds to that amount be authorized for refunding and improvement purposes. The stockholders were to vote on the proposition between that date and July 1. It is now announced that the stockholders have failed to authorize the issue, and the plan will therefore be dropped.

KINGS COUNTY LIGHTING COMPANY BONDS.—The Public Service Commission has granted permission to the Kings County Lighting Company to issue $200,000 of bonds under its $5,000,000 mortgage, to acquire new property and to provide for necessary construction. The betterments are immediately needed, according to the company's engineers, to meet the growing demands of the Bay Ridge and Fort Hamilton section of Brooklyn.

INTERBOROUGH BONDS OFFERED TO THE PUBLIC.—J. P. Morgan & Company and Lee, Higginson & Company are offering to the public at 103¼ and interest the $10,000,000 Interborough Rapid Transit 5 per cent bonds which these firms recently purchased. The announcement is made, in connection with this offer, that the company has paid the special tax due the State, under Section 14, and that these bonds are, therefore, tax exempt.

DENVER GAS & ELECTRIC IMPROVEMENT.—The net earnings of the Denver Gas & Electric Company for June were $72,835, as compared with $59,473 for June a year ago. This is an increase of 22.47 per cent. These figures are especially significant in connection with the fact that arrangements have been recently made for reorganizing all of the properties which involve large additional expenditures and bond issues.

MALONE (N. Y.) LIGHT & POWER COMPANY.—The Public Service Commission of the Second District of New York has authorized the Malone (N. Y.) Light & Power Company to mortgage its property and franchises to secure an isssue of $40,000 of improvement bonds, which were previously sanctioned.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
Central & South American Telegraph Company:					
Quarter ended June 30, 1909 (Est.)	$305,000	$163,000	$202,000	$143,565	$60,935
Quarter ended June 30, 1908	408,000	162,000	246,000	143,565	107,935
El Paso (Tex.) Electric Company:					
April, 1909	46,403	29,304	17,188	7,899	9,288
April, 1908	41,536	32,431	9,104	7,011	2,093
Houghton County (Mich.) Traction Company:					
April, 1909	25,726	14,256	11,470	5,741	5,728
April, 1908	20,670	11,863	8,815	4,735	4,079
Jacksonville (Fla.) Electric Company:					
April, 1909	40,306	23,930	16,376	8,147	8,228
April, 1908	35,880	21,567	14,312	8,519	5,793
Mexican Telephone & Telegraph Company:					
Quarter ended May 31, 1909	109,864	51,983	57,881	....	....
Quarter ended May 31, 1908	93,105	51,483	41,623	....	....
Norfolk & Portsmouth Traction Company:					
May, 1909	151,560	92,651	58,909	....	....
May, 1908	152,175	90,262	61,913	....	....
Pensacola (Fla.) Electric Company:					
April, 1909	18,558	11,468	7,090	4,321	2,769
April, 1908	9,021	9,775	148	4,131	*3,982
Savannah Electric Company:					
April, 1909	47,487	30,801	16,686	15,775	910
April, 1908	47,091	29,211	16,877	14,568	2,308
Scranton (Pa.) Electric Company:					
Year ended April 30, 1909	501,561	254,918	246,643	77,600	168,543
Year ended April 30, 1908	421,559	236,745	184,814	75,000	109,814
Tampa Electric Company:					
April, 1909	46,431	28,634	17,797	4,046	13,750
April, 1908	44,560	30,959	13,601	2,335	11,266
Twin City Rapid Transit Company:					
May, 1909	560,217	260,070	300,147	140,251	167,696
May, 1908	527,303	254,577	272,480	126,972	145,843

*Deficit.

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—To provide adequate facilities for taking care of its increased business between Birmingham and Bessemer, the Southern Bell Telephone & Telegraph Company is planning to expend $10,000 for the construction of new lines. Arrangements are also under consideration for the rebuilding of the toll line between Gadsden and Albertville, and the construction of a line between Albertville and Guntersville.

COLUMBIA, ALA.—It is reported that the A. D. Wood Power Company contemplates the installation of a hydro-electric plant.

LOS ANGELES, CAL.—It is the intention of the Los Angeles Gas & Electric Company to extend its distributing lines to Mount Washington at an early date.

LOS ANGELES, CAL.—The Los Angeles Gas & Electric Corporation, recently incorporated with a capital stock of $30,000,000, is considering the advisability of taking over the plant of the Pasadena Consolidated Gas & Electric Company.

NEWPORT BEACH, CAL.—About five miles of new transmission line are to be erected by the Newport Bay Electric Light & Power Company.

ONTARIO, CAL.—It is reported that the Ontario & San Antonio Heights Railroad is preparing to place a contract for the extension of its electric railway from Upland to Nort Pomona, a distance of six miles.

SACRAMENTO, CAL.—An electric railway from Sacramento to Lake Tahoe, via Orangevale Bluffs, is to be constructed by the Sacramento & Sierra Railway.

SAN FRANCISCO, CAL.—It is reported that a contract has been awarded by the City Electric Company for a large addition to its power plant at North Beach, which will materially increase the capacity of same.

SAN FRANCISCO, CAL.—The Stockton street railway franchise has been sold by the Board of Supervisors to Frank D. Stringham and associates, whose purpose is to organize a company for the construction of street railway lines.

SAN FRANCISCO, CAL.—A deed of trust to guarantee a bond issue of $25,000,000, which hypothecates all of its holdings in Sacramento, Butte and El Dorado counties to the Mercantile Trust Company, of San Francisco, was recently placed on record in that city by the Natomas Consolidated Mining Companies, of California. This bond issue, among other things, is to provide for the development of power properties, it being the company's intention to ultimately supply power to all of the Sacramento Valley towns. The construction of an electric railway between Folsom and Sacramento is also contemplated. W. P. Hammon, F. J. Carolan and Joseph D. Grant are among those interested in the enterprise.

COLORADO SPRINGS, COL.—As a result of the consolidation recently effected in this city between the Grand Junction Street Railway Company and the Grand Junction Electric, Gas & Manufacturing Company, about 20 miles of interurban electric lines will be built in the Grand Valley, Col.

BLOOMFIELD, CONN.—It is understood that electric lights are soon to be installed in a number of residences in this city by the Hartford Electric Light Company, of Hartford, Conn., electricity to be furnished from the company's plant at Spoonville. No decision as to the street lighting proposition has yet been arrived at.

MERIDEN, CONN.—It was voted at a recent meeting of the directors of the Meriden, Middletown & Guilford Railway Company to proceed with the construction of the proposed electric railway from Meriden to Guilford.

NEW HAVEN, CONN.—The United Illuminating Company expects to materially increase the size of its present power plant, for which purpose a large tract of land adjoining its present station has been purchased.

ST. PETERSBURG, FLA.—The St. Petersburg Investment Company, which controls and operates the St. Petersburg & Gulf Electric Railway and the St. Petersburg Electric Light & Power Company, will shortly build one mile of new track and 10,000 ft. of new electric mains. G. B. Gaudy, of Philadelphia, Pa., is president.

AUGUSTA, GA.—The Twin City Power Company has been granted a franchise to enter the city of Augusta.

CUTHBERT, GA.—Plans are being considered for improving the local electric light system, for which purpose a bond issue is contemplated by the city. D. A. McPherson is mayor.

ELLIJAY, GA.—Reports are current that W. M. Scott, of Atlanta, Ga., and Dr. Watkins, of Ellijay, are planning the construction of a hydro-electric plant for the transmission of electricity to Rome, Ellijay and other cities.

HAWKINSVILLE, GA.—It is stated by C. W. Harris, city clerk, that bonds to the amount of $15,000 have been sold, the proceeds to be utilized for the construction of an electric light plant from plans submitted by J. B. McCrary & Company, of Atlanta.

WAYCROSS, GA.—Application for an electric light and gas franchise has been made to the City Council by Burdette Loomis and Nowley Pettibone.

GOODING, IDAHO.—A franchise has been granted by the City Council to W. S. Kuhn to install and maintain wires, conduits, etc., for the transmission of electrical energy in Gooding.

LUCILE, IDAHO.—Plans are under way for the installation of an electric pumping plant at this city. Those interested in the project are M. S. Heart, of Portland, Ore., manager of the company promoting the enterprise; Charles Muckle, of St. Helens, Ore., and Dr. Roming, of Newberry, Ore.

ORFINO, IDAHO.—The Orfino Electric Company is planning to increase its engine equipment from 75-hp to 300-hp. F. J. Engelhorn is manager of the company.

DE KALB, ILL.—A 50-year franchise has been granted to the De Kalb Midland Railway in this city. The company, of which John F. Pearce, of Chicago, is president, is about to construct an electric railway between De Kalb, Elva, Waterman, Somonauk and Sandwich, a distance of about 28 miles.

LEBANON, ILL.—The municipal electric lighting plant, known as the Lebanon City lighting plant, is contemplating the installation of a generator, for which the contract has not yet been let. Mr. Gedney Mayor is president of the company.

OBLONG, ILL.—It is reported that plans have been completed and that contracts will soon be placed for material for the electric railway which the Oil Belt Traction Company is to build between Charleston and Bridgeport. U. L. Upson, of Buffalo, N. Y., will have charge of the construction work. G. E. Groves, of Oblong, is promoter of the enterprise.

SIDELL, ILL.—The Sidell Electric Light & Ice Company has passed into the hands of the Georgetown Electric Company, and arrangements are being made by the new owners to transfer the equipment to Georgetown. The Georgetown Electric Company expects to give a first-class lighting service to Sidell by the extension of its transmission lines from Indianola to that point, right-of-way privileges having been obtained over the greater portion of the distance.

WOODHULL, ILL.—The Woodhull Electric Light Company is planning to substitute series tungsten lamps for the carbon filament lamps now in use in this city. Henry Roselle and Charles W. Roselle are owners and managers of the plant.

BLUFFTON, IND.—The City Council has granted a 50-year franchise to the Bluffton, Geneva & Celina Traction Company to build an electric railway eastward over Washington Street.

CLERMONT, IND.—It is announced by Charlotte Dye, superintendent Indiana School for Girls, that specifications for repairs and installation of pump at the power house will not be ready before Aug. 1.

ELKHART, IND.—A petition has been filed with the City Council by the St. Joseph Valley Traction Company asking for a 90-day extension of time in which to complete its East Jackson Street line.

HARTFORD CITY, IND.—The directors of the Hartford City Lighting Company have decided to erect a central power station in this city, and to transmit electricity for light, heat and power to Union City, Dunkirk, Gas City, Upland, Eaton, Redkey and Ridgeville. It is estimated that the power plant will cost $75,000 exclusive of the equipment.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company has filed a mortgage for $2,000,000 to secure a bond issue, the money to be used in the construction and equipment of a central station plant and the enlargement of its entire system to furnish heat, light and power. The contract for the construction of the power station has been awarded to J. G. White & Company, and work has been commenced.

KENDALVILLE, IND.—The gas and light plant properties developed by the Wayne General Construction Company have passed into the hands of the operating company known as the Indiana Fuel & Light Company. The properties will be connected, and still greater development is contemplated. J. C. Campbell is superintendent.

MITCHELL, IND.—The Mitchell Electric Light Plant intends to install about two miles of additional distributing lines.

OSGOOD, IND.—The Municipal Electric Light Plant, of which F. R. Phillips is superintendent, is planning to establish an all-night service, and is also contemplating the installation of additional turbines.

SOUTH BEND, IND.—The South Bend Home Telephone Company has commenced the work of extending its system, it being its purpose to expend about $50,000 in the betterment of its service.

SOUTH BEND, IND.—It is estimated that the improvements planned by the Central Union Telephone Company in this city, which include the erection of a new exchange and the rehabilitation of its system, will represent an expenditure of about $250,000.

CENTERVILLE, IA.—It is planned by the Centerville Light & Traction Company to construct an electric railway to Mystic, about seven miles distant.

DAVENPORT, IA.—Among the improvements in its system to be made by the Iowa Telephone Company is the erection of 75,000 ft. of aerial cable.

VINTON, IA.—The Bell Telephone Company at this city has acquired the property and equipment of the Vinton & Benton County Telephone Company.

WEBSTER CITY, IA.—The Martin Telephone Plant, which is capitalized at $200,000, is to be sold. It is reported that the company is to be reorganized under the direction of C. P. Holdoegle, of Rockwell City, Ia.

DELPHOS, KAN.—The contract for the material and for the construction of the city water works has been awarded to the Squires Electric Construction Company, of Kansas City. Otto gas engines and Fort Wayne electric equipment will be used. The total cost will be $26,941.

ELK CITY, KAN.—A franchise for the construction and operation of an electric power and light plant to supply Elk City has been granted to the City Council to J. A. Chapman.

HAYS, KAN.—The Hays City Electric Light & Power Company is contemplating the expenditure of $7,000 in the remodeling of its plant. F. I. Rea is general manager.

MINERAL, KAN.—Plans are being formulated by Ira M. Fleming for the installation of an electric lighting plant in Mineral.

MORGANFIELD, KY.—The Morganfield Light & Power Company is planning to supply electricity to a neighboring town at an early date. F. W. Gilbert is president of the company.

NICHOLAS, KY.—The City of Nicholas is figuring on the installation of a new boiler this fall, and it is quite probable that the Nicholas municipal light plant will be combined with the proposed new water works system.

OPELOUSAS, LA.—The Municipal Electric Light & Water Works is planning for the reconstruction of its distributing lines at an early date, and also announces its intention to reconstruct its entire plant in about one year. Armas Durio is superintendent.

PLAQUEMINE, LA.—We are advised that the Plaquemine Electric Light & Power Company, Limited, of which F. E. Hubbard is secretary, contemplates the installation of an entire new plant.

THIBODAUX, LA.—It is reported that the city will install $25,000 worth of additional electric light equipment.

WINNSBORO, LA.—Work has been commenced by the Winnsboro Telephone Company on a line from this city to Rayville. Other improvements arranged for include the installation of new switchboards at Winnsboro and Mangham.

AUGUSTA, MAINE.—As the result of a recent fire in its plant in this city the Kennebec Light & Heat Company has suffered a loss which is conservatively estimated at $2,500. About three weeks will be required to make the necessary repairs upon the water power portion of the plant.

LEWISTON, MAINE.—It is reported that surveys are being made by Walter H. Sawyer, engineer of the Union Water Power Company, for dams for storage and water-power development.

OLDTOWN, MAINE.—It is stated that work is soon to be commenced on a large electric power house at this city, which is to be used as an adjunct to the plant of the Penobscot Chemical Fibre Company at Great Works.

ASHBURNHAM, MASS.—The Ashburnham Municipal Light Company, of which M. E. Gates is superintendent, has decided to change the frequency on its circuits from 133 to 60 cycles. The potential between Gardner and South Ashburnham will be increased from 2300 to 6600 volts.

BELCHERTOWN, MASS.—The Central Massachusetts Electric Company, of Palmer, which supplies electricity for lighting that city, as well as Bondville, Three Rivers, Monson, North Wilbraham, Warren and West Warren, has been awarded the contract for lighting Belchertown.

FITCHBURG, MASS.—The petition of the Connecticut River Transmission Company to erect and maintain poles in the city of Fitchburg for the transmission of electricity has been approved by the Gas and Electric Light Commission.

HAVERHILL, MASS.—A permit to install an underground system of wires in this city has been granted to the Haverhill Electric Company. This permission involves the filing of a $10,000 bond with the city by the Haverhill company, which amount is to be forfeited if the work is not completed within the time specified in the agreement.

HOLYOKE, MASS.—It is stated that the Board of Public Works of this city is contemplating the expenditure of $50,000 for the enlargement of the water works and electric light plant, and the extension of electric wires, gas mains and water mains to Smith's Ferry and Kenilworth.

MALDEN, MASS.—It is announced that the Malden Electric Company, of its own volition, contemplates a reduction to its patrons of 12½ per cent in the present rate for electricity.

PITTSFIELD, MASS.—At a recent meeting of the committee on fuel and street light in this city the substitution of flaming arc lamps for the carbon lamps now in use was considered, and it was voted to recommend to the City Council that an appropriation of $400 be made for a trial installation.

STOUGHTON, MASS.—The Stoughton Gas & Electric Company's plant has passed into the hands of the Edison Illuminating Company, of Brockton. The plant also furnishes light and power for Avon and East Bridgewater.

UPTON, MASS.—A contract has been signed by the Board of Selectmen of this city with the Upton Electric Company whereby the sum of $1,650 per year is to be paid by the city for the lighting of its streets. The contract calls for 100 60-cp lamps, on a moonlight schedule, by Dec. 16. T. Russell Robinson is president of the company.

WAREHAM, MASS.—A special meeting was recently held in this city for the purpose of considering a proposition to light the streets by electricity. Favorable action was taken, it being unanimously voted that the electric lighting committee contract during the present year for such service at a price not to exceed $3,000 per year. James E. Marvelle was elected moderator of the committee.

CADILLAC, MICH.—A consolidation has been effected between the Bell Telephone Company in this city and the Wexford County Independent Telephone Company.

GRAND RAPIDS, MICH.—The municipal electric light plant of this city is planning to combine its lighting system with the pumping station and to rearrange its distribution circuits.

HARBOR SPRINGS, MICH.—The Municipal Electric Light Plant, of which H. L. Metz is general manager, has increased the capacity of its system by the installation of one Allis-Chalmers 350-hp Corliss engine and 275-kw generator.

MOUNT PLEASANT, MICH.—Announcement is made by H. H. Hunter, city clerk, that the franchise to erect transmission lines and other apparatus in Mount Pleasant has been granted to the Chippewa River Power Company.

THOMPSONVILLE, MICH.—It is the intention of the Municipal Light & Water Plant to construct a new dam to take the place of the one destroyed about two months ago. George Morrill is superintendent.

DULUTH, MINN.—It is expected that the Public Service Corporations will soon commence the work of placing their wires in underground conduits.

MINNEAPOLIS, MINN.—A substation, which is to cost $10,000, is being erected in this city by the Twin City Rapid Transit Company.

MINNEOTA, MINN.—It is reported that plans for the construction of a local electric light plant are under consideration by the citizens of Minneota.

OLIVIA, MINN.—The Bird Island Telephone Company has been granted a 20-year franchise and expects to install a modern telephone plant in this city.

PIERZ, MINN.—It is stated that the Little Falls Water Power Company, of Little Falls, Minn., has secured a 25-year franchise to supply energy for electric light and power in Pierz.

ROCHESTER, MINN.—It is stated that the Public Utility Board will advertise for bids on a Corliss or turbine engine and appliances for the electric light plant which it is proposed to install in this city.

STILLWATER, MINN.—At a recent auction the properties of the Stillwater Gas & Electric Company, which have been in the hands of a receiver, were sold to Homer W. McCoy and Joseph H. Roy, of Chicago. It is stated that E. L. Hostes, of Stillwater, will assist in the reorganization of the system, which includes plants at Stillwater and the Apple River power plant and lines.

CLINTON, MO.—It is reported that bids will be received until July 17 by the Board of Public Works, of which J. H. Kyle is chairman, for one year's supply of wattmeters and transformers.

JOPLIN, MO.—It is reported that the preliminary survey for an electric interurban railway, for which W. E. Foran and W. H. Crossland, president and vice-president, respectively, of the Western Surety & Adjustment Company, are fiscal agents, has been completed. The road will extend from Joplin to Bentonville, Ark., and thence to Fayetteville, a distance of 130 miles.

LOUISIANA, MO.—The Louisiana Light, Power & Traction Company expects to install one 400-kw, direct-connected engine unit and a battery of two boilers designed for 150 lb. pressure. Mr. D. Turnbolt is president and manager. In addition to lighting Louisiana and Bowling Green, Mo., the company expects to furnish electricity to the company being organized to light Clarksville, 16 miles distant.

FAIRMOUNT, NEB.—The contract for the supplies that will be used in the installation of the new electric light system in this city has been awarded to the Korsmeyer Company, of Lincoln. T. J. Bender is owner of the system.

LEXINGTON, NEB.—Plans are being made by the Lexington Mill & Elevator Company, of which E. M. F. Leflang is president, for the installation of a 300-kw generator and a 450-hp engine within a year.

PATERSON, N. J.—It is stated that plans are under way for the utilization of the Passaic Falls for the generation of electrical power to operate the mills along the river and raceway. A preliminary sketch of the proposed electric power station has been prepared by John H. Cook, hydraulic engineer, and submitted to Edward L. B. Gardner, president of the Society for Establishing Useful Manufactures, a subsidiary of the East Jersey Water Company, which is said to have obtained a charter which gives it perpetual control over the Passaic River above the falls.

WEST ORANGE, N. J.—The application for a 50-year franchise by the Mountain Railway Company, for the proposed extension of its lines to the South Mountain Reservation, has been approved and a recommendation is to be submitted to the Board that the franchise be granted.

ALBANY, N. Y.—The capital stock of the Oswego County Light & Power Company has been increased from $100,000 to $1,000,000.

ENDICOTT, N. Y.—A contract has been let by the Binghamton Railway Company, of Binghamton, N. Y., which is double tracking some of its lines in this city, to the Endicott-Johnson Company for the installation of 500 incandescent lamps along a portion of its route.

FULTON, N. Y.—The contract for the erection of its new power house in this city has been let, it is reported, by the Fulton Light, Heat & Power Company to John Hendrick, of Oswego, and Joseph Connors, of Fulton.

LANSINGBURG, N. Y.—A franchise for the construction of a street railway line in this city has been granted to Joseph A. Powers, who in turn assigned it to the Trojan Railway Company. This franchise is the result of a decision rendered by the Court of Appeals in the action of the Trojan Railway Company against the United Traction Company and the City of Troy.

NIAGARA FALLS, N. Y.—In consideration of the lower rate to be granted to the city by the Buffalo & Niagara Falls Electric Light & Power Company, the board of public works intends to install a number of new lamps.

RAVENNA, N. Y.—In consequence of an adverse decision of the Public Service Commission, the Upper Hudson Electric Company is removing its street-lighting lines from the poles in this city.

CHARLOTTE, N. C.—A ten-year contract has been agreed upon by the city executive board and the Southern Power Company for the furnishing by the latter of not less than 300 arc lights for the period named, on the following terms: The first 250 lamps at the rate of $56 per lamp per year, and all lamps over 250 to be supplied at $50 per annum. The annual light bill for approximately 350 lamps is $19,000. The city is to have the privilege of purchasing the system at the end of five years, and should it do so, the company reserves the right to charge $60 instead of $56 for the first 250 lamps, and $54 instead of $50 for all over 250.

KINGSTON, N. C.—A 20-year franchise to construct and operate telephone and telegraph lines in this city has just been granted to the Carolina Telephone & Telegraph Company.

SANFORD, N. C.—The Carolina Sanford Cotton Mills of this city are now operated by electricity, the energy being furnished by the Carolina Power & Light Company's plant at Buckhorn Falls.

WASHINGTON, N. C.—It is stated by Mr. Geo. H. Meacham, of the Traction Engineering Company, of New York, that work on the electric railway system in this city is soon to be resumed.

GRAND FORKS, N. D.—The plans of Earl D. Jackson, of Chicago, for the installation of an electric light plant in this city are said to have been approved by the City Council.

ASHLAND, OHIO.—Through a recently consummated deal the Ashland Gas & Electric Light Company, which holds franchises for lighting the streets of Ashland, becomes the property of the American Gas & Electric Company of New Jersey, which controls plants in other cities. It is planned by the new owners of the company, which is to retain its old name, to build a new 1000-hp power plant to cost in the neighborhood of $75,000, and to otherwise improve the system.

CLEVELAND, OHIO.—A reduction is to be made by the Municipal Lighting Company in its charges for electricity, the following schedule of prices having been decided upon: Ten cents for the first 5 kw, 6 cents per kw from 6 to 200 kw and 5 cents for 200 kw and over, plus 10 per cent, which is deducted if bills are paid before the 15th of the month. There will be a minimum charge of 50 cents to all users.

COLUMBUS, OHIO.—Arrangements are being made by the business men on West Goodale Street for the installation of an electric lighting system. Double gooseneck arc lampposts, four at street intersections and three between blocks, are to be employed, the cost of such installation being placed at $1,200.

DAYTON, OHIO.—The Brownell Boiler Company has been awarded the contract for furnishing and installing the engine and generator to be used in connection with the private power station to be established in this city. The engineers who submitted the specifications for bids are H. Thomassen and Lou Weaver.

FREMONT, OHIO.—Application has been made by the Lake Shore Electric Company to the City Council for an extension of its franchise privileges, its object being to make about $25,000 worth of improvements.

GAHANNA, OHIO.—An application has been filed by the Columbus, New Albany & Johnstown Traction Company asking for permission to build a street railway in Gahanna.

LOGAN, OHIO.—The Logan Light & Power Company contemplates the installation of a 230-volt, three-phase, engine-type generator, rated at from 75 to 100 kw. J. R. Rempel is president of the company.

SPRINGFIELD, OHIO.—The Springfield Light, Heat & Power Company has awarded a contract for two direct-current generator sets, one of 330 kw and the other 200 kw. The apparatus is to be installed at the company's new power house, which is to be erected along Buck Creek.

WILMINGTON, OHIO.—A franchise has been granted to the Cincinnati, Milford & Blanchester Electric Railway empowering it to construct an electric railway in Wilmington.

YOUNGSTOWN, OHIO.—A committee has been appointed by Louis E. Geuss, president of the Youngstown Merchants' Association, to confer with the business men in regard to the installation of a lighting system in Youngstown.

OKLAHOMA, OKLA.—Application for a franchise to construct and operate an electric light plant in this city has been made by the Oklahoma Gas & Electric Company.

THOMAS, OKLA.—The Thomas Municipal Electric Light & Water Company is planning the installation of one 150-kw generator, with the necessary boiler equipment and auxiliary apparatus. W. S. Robinson is superintendent.

PORTLAND, ORE.—It is reported that the Portland, Eugene & Eastern Railway Company is contemplating the construction of a power plant this year at Martin's Rapids, about 30 miles east of Eugene, which will furnish power for all its railways as far north as Albany.

KANE, PA.—The Kane Electric Light & Power Company intends to install at an early date at least one 300-hp engine. A. P. Huey is president of the company, and George R. Kempton, general manager. Bids have not been let.

NEW HOLLAND, PA.—A new telephone line between Mohnton and Angelica is one of the extensions being considered by the Enterprise Telephone Company of New Holland.

STROUDSBURG, PA.—Reports state that New York capitalists have purchased a site on the Big Bushkill, which includes the holdings of the East Stroudsburg Power Company, and that a dam 125 ft. high is to be erected. The probable cost of the project is $1,000,000.

WILKES-BARRE, PA.—Permission has been granted to the Wyoming Valley Traction Company to extend its lines. Plans are now being formulated for the construction of a new trolley line to Parsons, Miner's Mills, Hudson and Midvale.

PROVIDENCE, R. I.—The Narragansett Electric Lighting Company is installing four 440-hp B. & W. boilers, with corresponding 6-retort Taylor stokers. These boilers will probably be run at about 1200-hp during the peak load.

EASLEY, S. C.—It is reported that the City of Easley, of which J. M. Jameson is mayor, is contemplating the installation of an electric light system.

ELIZABETHTOWN, TENN.—It is stated that the Doe River Lighting & Power Company expects to develop a 2000-hp water power plant and to install water wheels to develop 1200-hp, as well as other electrical machinery.

FRANKLIN, TENN.—The Harpeth Electric Light & Power Company, which has heretofore given service only at night, will shortly begin to operate throughout the full 24 hours. Jasper Lillie is president of the company.

LA FOLLETTE, TENN.—Among the extensions planned by the La Follette Water, Light & Telephone Company is the construction of 25 miles of telephone lines and two miles of water mains. C. G. Arnold is general manager.

CLEBURNE, TEX.—It is reported that bids will probably be received some time this month for improvements to the plant of the Cleburne Water, Light & Ice Company, the estimated cost of which is $30,000. A. L. Chase, Cleburne, is receiver for the company, and John B. Hawley, Fort Worth, consulting engineer.

CORPUS CHRISTI, TEX.—An application has been filed with the City Council by J. M. King, W. B. Tuttle, of San Antonio, and I. A. Cohen, of St. Louis, requesting permission to build a street railway in Corpus Christi at an estimated cost of $75,000.

ENNIS, TEX.—The Ennis Light & Power Company is increasing the output of its plant by the installation of a 225-hp engine and an alternating-current generator.

GREENVILLE, TEX.—Bids will be received on July 19 on machinery for the improvement of the municipal electric light plant, for which purpose the citizens recently voted to issue bonds to the amount of $50,000. A new power house is to be erected at a cost of $6,000, and the plant is to be operated in connection with the water works. Address W. A. Frazer, city clerk, or J. W. Maxcy Company, engineer, Houston, Tex.

HUBBARD CITY, TEX.—A formal opening of its new plant was recently held by the Union Central Light & Ice Company. The company is now giving a day and night service to the people of Hubbard City.

UVALDE, TEX.—The Uvalde Electric Light & Power Company is making arrangements to increase the capacity of its power plant, and is in the market for one 150-hp boiler, one 100-kw generator and one 150-hp Corliss engine. Frank Hare is superintendent and C. C. Doolin, San Antonio, Tex., is engineer.

WYLIE, TEX.—During a recent fire in this city the Wylie Telephone Company's exchange was destroyed, the loss being placed at $7,000.

BENNINGTON, VT.—An arrangement has been made with the Twin State Gas & Electric Company by the Village Trustees whereby an all-night schedule of lighting in Bennington will be substituted for the present moonlight schedule. The contract, one of the provisions of which is that the city may change any arc lamp now in operation and have

installed in its place three tungsten lamps of 60 cp each, is for five years at a price of $5,640, an advance of only $80 over the old price.

ALEXANDRIA, VA.—Through a recently consummated deal, the plant of the Alexandria Electric Light & Power Company, formerly the property of a Pennsylvania syndicate, has been acquired by Washington and Baltimore parties, and the following new officers have been elected: Thomas C. Coleman, Cockeysville, Md., president; J. C. M. Lucas, Baltimore, vice-president; H. P. Lucas, secretary and treasurer; F. R. Weller, general manager. H. P. Lucas is general manager of the Lucas Electric Construction Company, of Baltimore. It is announced that an order has been placed for a 500-kw steam turbine unit with condenser, switchboard, exciter and other accessories.

BEDFORD CITY, VA.—Arrangements are being made by the Bedford City Light Plant for the installation of a new hydro-electric plant in Bedford City, the estimated cost of which is $100,000. T. C. Dennis is president of the company and C. E. Harris, general manager.

BELLEVUE, WASH.—A franchise has been granted to D. C. Conover and E. P. Moran for the construction of an electric railway from Bellevue to Lake Sammamish.

BELLINGHAM, WASH.—It is reported that the North Coast Mining & Milling Company has filed notice of appropriation of 8000 cu. ft. of water per second from the Skagit River in Whatcom County. A dam is to be erected and the water carried in flume, pipe lines and tunnels to near Red Hill, where a power plant is to be erected.

KELSO, WASH.—At a recent meeting of the Kelso Electric Company it was voted to increase its capital stock to $80,000, to take care of the contemplated improvements.

SPOKANE, WASH.—It is reported that the Washington Water Power Company, of which D. L. Huntington is manager, is considering the advisability of building another power plant on the Spokane River below the plant now under construction at Little Falls.

TACOMA, WASH.—It is stated that H. M. Byllesby & Company, of Chicago, have acquired possession of the plant of the Tacoma Gas Light Company, of Tacoma.

FORT ATKINSON, WIS.—A series tungsten system of lighting will be installed on Main Street in this city by the Fort Atkinson Water & Light Commission. Giles Hibbard is president of the company.

MARATHON, WIS.—The construction of a new telephone line from Little Chicago to Athens is soon to be undertaken by the Marathon-Ziegler Telephone Company.

FERNIE, B. C., CAN.—The city has purchased a site on which to erect a new power house. Address Mayor Tuttle.

VICTORIA, B. C., CAN.—It is reported that Malcolm & Dinsdale have been awarded the contract for the proposed addition to the British Columbia Electric Company's plant on Store Street, the estimated cost of the work being $50,000.

VICTORIA, B. C., CAN.—The British Columbia Electric Street Railway Company has submitted a proposition to the city council to expend $2,000,000 on the erection of a power plant to supply both the city and company with electricity. Address R. H. Sperling, general superintendent, Vancouver, B. C.

WINNIPEG, MAN., CAN.—Tenders will be received until Aug. 2 for hydraulic, electric and auxiliary equipment for the generating station at Point du Bois. For plans, etc., apply to Smith, Kerry & Chase, engineers, Toronto and Winnipeg; William Kennedy, Jr., Y. M. C. A. Building, Montreal, and M. Peterson, secretary Board of Control, Winnipeg.

COLLINGWOOD, ONT., CAN.—A producer-gas unit is to be installed by the Collingwood Electric Light & Water Works for the operation of arc-lighting machines. Thomas Bassett is superintendent.

OTTAWA, ONT., CAN.—The Ottawa Electric Company has increased its equipment by the installation of additional alternators at its No. 2 power house.

MONTREAL, QUE., CAN.—At a recent meeting of the Westmount City Council, in connection with the extension of the electric light plant, the following bids were accepted: Canadian Westinghouse Company, switchboard, $1,285; John McDougall Caledonian Iron Works, cooling tower, $2,900; Darling Brothers, feed-water heater, $700; Canadian Crocker-Wheeler Company, generator and accessories, $4,650; Belliss & Morcom, Birmingham, Eng., Laurie & Lamb, agents, compound condensing engine, etc., $7,000.

MOOSE JAW, SASK., CAN.—Bids will be received up to Monday, July 19, for the following apparatus: One 50-light, constant-current regulator, with 35 arc lamps and suitable switchboard and necessary instruments; also contract for one year's supply of wattmeters and transformers. Address John D. Simpson, city clerk.

Company Elections.

ST. JOHN, N. B., CAN.—At the annual meeting of the St. John Electric Railroad Company the following officers and directors were elected: President, James Ross, Montreal; vice-president and managing director, R. B. Emerson; directors, James Manchester, J. J. Tucker, William Downie, H. B. Robinson and F. E. Sayre, all of St. John.

MORRISTOWN, N. J.—The following officers and directors have been elected by the Morris & Somerset Electric Light Company: Samuel S. Childs, president; F. L. Humphreys, vice-president; Samuel B. Carson, treasurer; Peter V. Stryker, secretary; directors, Clifford Rutan, David P. McClellan, S. H. Gillespie, Eugene S. Burke and John M. Forbes.

New Industrial Companies.

THE JOY WILLSON SALES COMPANY, Peoria, Ill., has been incorporated, with a capital stock of $10,000, for the purpose of manufacturing electrical supplies and implements of all kinds. Robert B. Mitchell is interested in the enterprise.

THE PATENTS EXPLOITATION & OPERATING COMPANY, New York, N. Y., has been incorporated to deal in inventions and patents. It is capitalized at $6,000, and the incorporators are Joseph Steen, John J. Donovan, E. P. Whitaker, New York, N. Y.

THE SERGEANT-MAXWELL COMPANY, Mineola, N. Y., has been incorporated to carry on a general contracting business. It has an authorized capital stock of $20,000, and the incorporators are George Sergeant, Jr., F. S. Maxwell and H. B. Potter, of New York, N. Y.

THE NEW YORK MOTOR BOAT COMPANY, Bronx, N. Y., has filed articles of incorporation, its purpose being to manufacture motors, engines, boats, etc. It has a capital stock of $10,000, and the incorporators are W. F. Wahrenberger, M. Noonan and E. Caron, City Island, N. Y.

THE PANACEA SPRINGS AUTOMOBILE & ELECTRIC TRANSFER COMPANY, of Littleton, N. C., has been chartered with a capital of $125,000 for the purpose of installing a passenger service between Littleton and Panacea Springs. Eugene Johnston is interested in the proposition.

THE NATIONAL CREOSOTING COMPANY, Indianapolis, Ind., has filed articles of incorporation, and proposes to build, equip and operate a plant for the treating of railroad ties and other timber with preservatives. It is capitalized at $200,000, and the directors are Alvin T. Hert, R. V. Look and W. H. Griffith.

New Incorporations.

LAKE CITY, ARK.—The People's Telephone Company, which has an authorized capital stock of $10,000, has been incorporated by P. J. Springer, Fred Roberts and H. C. Beck. It intends to install a telephone system in Lake City.

LITTLE ROCK, ARK.—The Ouachita Power Company has been incorporated, with a capital stock of $50,000, for the purpose of constructing a dam across the Ouachita River in Garland County, and to generate power and supply electricity in Hot Springs, Little Rock and the surrounding territory. The incorporators are Levi Storthz, Joe Storthz, D. L. Phillips and others.

MASCOUTAH, ILL.—Articles of incorporation have been filed by the Belleville & Mascoutah Traction Company, whose intention is to construct an electric railway from Mascoutah to Belleville. The capital stock is given as $150,000, and those interested in the proposition are Emil J. Kohl, Adolph Knobeloch, of Belleville; G. J. Scheve, E. R. Hagist and P. W. Lill, Mascoutah.

SPRINGFIELD, ILL.—Articles of incorporation have been filed by the Springfield, Beardstown & Quincy Railways for the purpose of constructing a trolley line from Springfield to Quincy, via Beardstown. It is capitalized at $25,000, and the incorporators are Henry Colby, Robert Bone, Charles W. Houghton and John Hurle, of Petersburg; John Tolan, of Farmingdale; George Harnsberger, of Springfield, and William T. Gates, of St. Louis.

PLEASANT PLAIN, IA.—Articles of incorporation have been filed by the Pleasant Plain Telephone Company, of East Pleasant Plain, Jefferson County, Ia. It has an authorized capital stock of $15,000, and the incorporators are O. C. Spaulding, J. J. Kyle and Mahlon Roberts.

WALNUT, IA.—Articles of incorporation have been filed by the Iowa & Omaha Short Line Railway, which proposed to construct an electric railway between Des Moines, Council Bluffs and Omaha, a distance of about 140 miles. The capital stock is stated to be $1,000,000, and the following officers have been elected: G. W. Adams, Walnut, president; C. L. Kirkwood, North Branch, vice-president; A. L. Ingram, treasurer, and P. Kathmann, secretary. The headquarters are to be at Pierre, S. D.

RICHTON, MISS.—The Richton Telephone Company has been incorporated, with $10,000 capital stock, by C. H. Stevens, Willis Walley, E. A. Emery and P. M. Anderson.

CARROLLTON, MO.—The Carrollton, Missouri River & Northwestern Railroad Company has been incorporated, with a capital stock of $150,000. Herndon Ely, Lewis Ely, P. L. Trotter, S. J. Jones and W. R. Painter are directors.

MACON, MO.—Articles of incorporation have been filed for the Hannibal & Northern Missouri Railroad Company to construct an electric railway from Hannibal, extending through the counties of Marion, Shelby, Macon and Adair. The railway will be 100 miles long and will take in the towns of Palmyra, Philadelphia, New York, Bethel, Sue City, La Platt and Biggs. Surveys have already been made for the road. Captain F. W. Latimer is president.

LEWISTOWN, MONT.—The Lewistown Coal, Gas & Electric Company has been incorporated, and the following officers elected: President, S. M.

Gebo; vice-president, O. W. Belden; secretary and treasurer, R. S. Stone. J. E. Brayton has been appointed superintendent and purchasing agent.

NEWARK, N. J.—Articles of incorporation have been filed for the New Jersey Water & Light Company, with a capital stock of $125,000, by Samuel Ludlow, Jr., Edgar S. Hill and Conover English.

GOLD HILL, N. C.—Articles of incorporation have been filed by the Gold Hill Telephone Company. Its capital stock is placed at $50,000, and among those interested in the enterprise are R. D. Coleman, A. B. Clements and B. A. Fesperman.

ANADARKO, OKLA.—The Anadarko Southern Telephone Company has been incorporated with a capital stock of $1,500 by J. E. Stadler, W. S. Henry, E. Newhouser, Frank Wideck, Charles Smith, M. F. Gillam and Oliver Richards, all of Anadarko.

FREEDON, OKLA.—The Anderson Creek Telephone Company has been chartered, with a capital stock of $1,000, by J. E. McMoran, R. I. DeGeer and Willis James, of Farry.

GUTHIE, OKLA.—The West Tulsa Belt Railway Company has been incorporated for the purpose of building an electric railway in Guthrie, which, it is stated, will cost in the neighborhood of $20,000. The company is capitalized at $25,000, and the incorporators are W. E. Hawley, C. L. Hoonker, Jr., M. C. Hall, John Haber and Gray Erick.

MENDON, OKLA.—The Mendon Telephone Company has been incorporated with a capital stock of $2,500 by R. F. Wares, A. Beedman and Charles Harris, all of Byron.

REMUS, OKLA.—The Remus Telephone Company has been chartered with a capital stock of $750 by J. A. Main, R. A. Harding, C. R. King, W. E. Varner and M. A. Warehurst, all of Maud.

PORTLAND, ORE.—The Oakland & Tidewater Railway Company has been incorporated with a capital stock of $1,000,000 to construct an electric railway from Oakland to Empire, by C. A. Pengra, H. D. May and W. W. Purdy.

PORTLAND, ORE.—The Coos Bay & Inland Railroad Company, whose headquarters are to be at Portland, has been incorporated to build an electric railway from Coos Bay to Roseburg. It has an authorized capital stock of $1,000,000, and the incorporators are Jacob Haas, George S. Taylor and Charles Ringler.

BUTLER, PA.—The Rochester & Mars Street Railway Company has applied for a charter to construct a street railway from the Baltimore & Ohio Railway depot at Mars to Rochester, a distance of 23 miles. At Mars connection will be made with the Pittsburgh & Butler Street Railway; at Ogle, two miles west of Mars, with the Pittsburgh, Harmony, Butler & New Castle Railway, and at Rochester with the Beaver Valley Traction Company. Surveys have been completed, and it is said that contracts will be awarded for construction of the road soon after the charter is granted. J. H. Barrett is president and engineer; D. R. Torrence, secretary, and W. H. Biggs, treasurer.

CHAMBERSBURG, PA.—The Grindstone Hill Rural Telephone Company has been organized and the following named officers elected: George H. Branthaver, president; Charles Branthaver, secretary, and John Hafer, treasurer.

HALLS, TENN.—The Halls Light, Water & Light Company has been chartered, with a capital stock of $25,000. The new company has purchased the Halls electric light plant, which it proposes to enlarge and improve. It is proposed to install an ice plant and laundry. The overhead system will be rebuilt and the transmission lines extended to Gates, where it is proposed to furnish electricity for lamps and motors.

LANCASTER, TENN.—The Lancaster Telephone Company, which has a capital stock of $2,500, has been incorporated by W. T. Simpson, Robert Heflin, H. C. Lancaster, Jr., J. D. Fisher and others.

UNION CITY, TENN.—The Obion County Telephone Company has been incorporated by W. G. Reynolds, M. T. McMurray, J. P. Adams and others. It has an authorized capital stock of $5,000.

LINCOLN, UTAH.—The Progressive Telephone Company, of this city, has filed articles of incorporation. It has a capital stock of $3,500, and the following officers have been elected: J. W. Whitehead, president; H. W. Sagers, vice-president; H. W. Droubay, treasurer, and Charles Hanson, secretary.

RICHMOND, VA.—The Richmond Railway & Power Company has been chartered with a capital stock of $12,500,000 for the purpose of operating a street railway and power plant in Richmond. The officers are: Frank J. Gould, of Tarrytown, N. Y., chairman of board of directors; William Northrop, of Richmond, Va., president; R. Lancaster Williams, of Richmond; Fritz Sitterding, Douglas Robinson, of New York, N. Y., vice-presidents; Henry W. Anderson, of Richmond, vice-president and general counsel; Guy Phillips, of New York, N. Y., secretary and treasurer.

ROSSLYN, VA.—Articles of incorporation have been filed by the Rosslyn Electric & Gas Company. It has an authorized capital stock of $50,000, and the following officers have been elected: M. E. Church, Falls Church, Va., president; G. H. Rucker, Rosslyn, vice-president; T. J. King, Georgetown, D. C., secretary.

RURAL RETREAT, VA.—Articles of incorporation have been filed by the Cornett Light & Power Company, whose purpose is to install a power plant and electric light system in this city. It has an authorized capital stock of $5,000, and the incorporators are S. M. Cornett, Jr., and E. Brown.

TOLEDO, ONT., CAN.—The Rural Telephone Company, of Kitley, with main office at Toledo, has been incorporated with a capital of $10,000. A. R. Hanton, J. M. Edgar and R. T. Beckett are the provisional directors.

MONTREAL, QUE., CAN.—The Blahgas Company of Canada has been incorporated with a capital stock of $5,000,000 to deal in and develop electrical power. The head office is to be in this city, and the directors of the company are J. A. Jacobs, S. W. Jacobs, A. R. Hall, F. Lewis and A. M. Reaper, all of Montreal.

ALLAN, SASK., CAN.—The Allan Rural Telephone Company has been organized and the following directors elected: W. F. Vauder, N. Lang, F. B. Williams, R. E. Beaver, M. Loran, W. E. Redick, Stanley Bowser and F. B. Doane.

Personal.

MR. C. D. WHEELER has been appointed advertising manager of the Fort Wayne Electric Works.

MR. F. W. BRYANT, of Boston, Mass., has been appointed superintendent of the Thomasville (N. C.) Light & Power Company.

MR. E. W. RICE, JR., vice-president of the General Electric Company, is now in Europe and will stay abroad for some little time.

MR. H. ALMERT has been appointed manager of the Department of Examinations and Reports of H. M. Byllesby & Company, with headquarters at Chicago.

MR. W. R. THOMPSON, late of the Public Service Commission of New York State, and formerly with Westinghouse, Church, Kerr & Co., has been appointed assistant to the chief engineer of H. M. Byllesby & Company, with headquarters at Chicago.

MR. ARTHUR G. SIAS has resigned as superintendent of the Uxbridge and Northbridge Electric Co., Uxbridge, Mass., to accept the position of manager of the Reading (Mass.) Municipal Light and Power Department.

MR. H. H. TAYLOR, formerly of the Gardner Electric Light Company, Gardner, Mass., has assumed the position of superintendent of the Buzzards Bay Electric Light & Power Company, with headquarters at Falmouth, Mass.

MR. J. E. BULLARD has joined the sales department of the Toronto Electric Light Company, Limited. Mr. Bullard was for some time with the Builders' Iron Foundry, of Providence, R. I., and previously he was connected with the Narragansett Electric Lighting Company.

MR. WILLIAM R. WILLCOX, chairman of the Public Service Commission of the First District of New York, sailed for Europe on the *Mauretania* July 14. Mr. Willcox will spend six weeks abroad touring the Continent in an automobile, and is due to return to this country Aug. 30.

MR. W. WECHMANN, chief electrical and mechanical engineer of the Royal Prussian Railroad, has been traveling in this country some weeks and sails for home on July 15. He has made a close study of American electric railway work and went out as far as Los Angeles. He has large plans in hand for the development of Berlin suburban lines.

MR. N. M. ARGABRITE, who for the past five years has filled the positions of superintendent and later general manager of the Winona Railway & Light Company, of Winona, Minn., has resigned, to take effect Aug. 1, in order to accept the position of general manager of the Public Service Operating Company, of Belvidere, Ill. He will assume his new duties on Aug. 1.

MR. H. B. MARSHALL, who has been for many years connected with the Chicago sales office of the Electric Storage Battery Company, has recently been appointed contract agent in charge of the company's office at St. Louis in the Wainwright Building. Mr. Taliaferro Milton, formerly contract agent of the St. Louis office, has been appointed engineer of the Chicago sales office of the Electric Storage Battery Company.

MR. H. G. NICHOLLS, who has for several years been assistant general manager of the Canadian General Electric Company and the Canada Foundry Company, has resigned that position in order to go into business for himself. He has organized a company called "Factory Products Limited," with offices in the Confederation Life Building, Toronto, for the purpose of acting as Canadian selling agent for representative manufacturers.

MR. T. R. BROWN has become associated with the E. Keeler Company, of Williamsport, Pa., as chief engineer, with headquarters at 29 Broadway, New York. Mr. Brown was formerly connected with the Pennsylvania Railroad as master mechanic of the Juniata shops at Altoona; also with the Westinghouse interests, and lately with the American Car & Foundry Company. Mr. Brown will pay particular attention to engineering questions in connection with steam power installations.

MR. DANIEL E. MANSON has resigned as manager of the Boston office of the Westinghouse Electric & Manufacturing Company, to engage in engineering work with a corporation, of which he will be vice-president and manager. A farewell dinner was tendered to Mr. Manson in Boston, July 13, by the officers and associates of the Westinghouse Company, with which he has been connected the past twelve years. Mr. George E. Bates, of the Boston office, will succeed Mr. Manson as head of the Westinghouse sales force for the New England district.

MR. EDWARD G. DEWALD, heretofore manager of the water wheel department of the Platt Iron Works Company, Dayton, Ohio, has become identified with the hydraulic turbine department of Allis-Chalmers Company, as special representative for the Pacific Coast, with headquarters at 599 Mission Street, San Francisco. Mr. Dewald has been with the Platt company for the past 20 years, during five of which he served as manager of its San Francisco office, and he has been identified with many of the largest hydraulic power installations in the country, including the majority of those on the Coast.

Obituary.

MR. THOMAS W. BAKEWELL, a prominent patent attorney of New York and Pittsburgh, and the senior member of the law firm of Bakewell & Byrnes, was taken seriously ill during his argument of the case of the Mississippi Wire Glass Company, of New York, against the Pittsburgh Plate Glass Company, before Judge Buffington in the United States Circuit Court at Pittsburgh on Wednesday, July 7. Mr. Bakewell had argued a case in Chicago the day before, and arrived at court that morning in apparently robust health, and so far as was known was in that condition. He was taken violently ill during his argument and was unable to complete it. On being assisted to the office of Mr. Gamble, the clerk of the Court, he died before the close of the argument of the case. Court was immediately adjourned. His death was attributed to acute indigestion. Mr. Bakewell was the son of William Bakewell, of Pittsburgh, an eminent patent lawyer. He was born Oct. 27, 1861; was a graduate of Rutgers College, studied law at the University of Pennsylvania, and was admitted to the bar in 1885. He was a member of the firm of Bakewell & Kerr, of Pittsburgh, then of W. Bakewell & Sons, and after the death of his father formed the firm of Bakewell & Byrnes. Prior to the death of John R. Bennett, patent attorney for the U. S. Steel Corporation, Mr. Bakewell was associated with Mr. Bennett in the cases of several constituent companies which had been clients of his, and on Mr. Bennett's death he was selected to succeed him as the patent attorney for the corporation. Since then he had resided at Plainfield, N. J., with his main office in New York. Mr. Bakewell was one of the leading patent lawyers of the country, and numbered among his clients not only the Steel Corporation, but the Westinghouse Air Brake Company, the Union Switch & Signal Company, the Westinghouse Electric & Manufacturing Company, the General Electric Company, the Pressed Steel Car Company, the National Malleable Casting Company, the Babcock & Wilcox Company, the Wellsbach Light Company, the Carnegie Steel Company, the Bethlehem Steel Company, and many others. He was an able and successful lawyer, and very acceptable to his brethren of the profession, having the confidence and liking of both bench and bar. He was extremely courteous in his manner, charitable in his judgments, fair minded and just. He leaves a wife, a daughter who has graduated, and a son who is about entering college. His loss has fallen heavily upon his friends and associates, both social and professional. One of his warmest personal friends was President Taft. He was a member of the Baltusrol Golf Club, the Union League, the Railroad and Lawyers' clubs of New York, the Plainfield Country Club, and Westfield Golf Club, the Duquesne, Pittsburgh and Alleghany Country clubs of Pittsburgh, and a consistent and active member of the Presbyterian Church. He was a brother of Col. Allan C. Bakewell, of New York, prominent for many years past in the electrical field. He was also a cousin of Mr. T. B. Kerr, who with him constituted the old well-known firm of Bakewell & Kerr, which was dissolved when Mr. Kerr came to New York to become more actively associated with the Westinghouse interests, from the legal standpoint.

Trade Publications.

METAL MOLDING.—Molding stated to be fireproof, nailproof and rustproof is listed, described and illustrated in a booklet issued by the National Metal Molding Company, Fulton Building, Pittsburgh, Pa.

TUNGSTEN CLUSTER.—The American Arc Lamp Company, of Kalamazoo, Mich., has issued Bulletin No. 42, describing its four-lamp tungsten shop cluster. This is equipped with an 18-in. steel-porcelain shade and a device for absorbing vibrations.

TRANSFORMERS.—In bulletin No. 4666, of the General Electric Company, Schenectady, N. Y., is described an improved form of its transformer, of which there are said to be more than 50,000 in use at the present time. The advantages claimed for the new design are better efficiencies, greater uniformity of impedance, an improved connection board, together with an improved method of supporting the primary and secondary leads, and a new type of suspension hook, as well as a new device for clamping the transformers in the cases. The transformer utilizes a cross-shaped core which permits the use of a cylindrical winding, which presents large cooling surfaces, allowing the oil free access to all parts of the coil and core. The bulletin contains numerous illustrations of the transformer, and shows the methods used in the different processes of manufacture. Tables showing the frequency limits, and a curve indicating the reduction in the core and total losses of the improved transformer over previous designs of the same company are also shown.

AMERICAN BALL ANGLE COMPOUND ENGINE.—The problem of balancing high-speed steam engines is discussed in a pamphlet just issued by the American Engine Company, Bound Brook, N. J. It is pointed out that balancing the ordinary simple engine is an impossibility without the use of "bob-weights," that is, reciprocating weights moving at right angles to the piston; further, that any attempt at balancing in one direction introduces equal unbalancing forces in a direction at right angles. The author then proceeds to show how an engine can be balanced perfectly if two cylinders be suitably arranged, and gives a brief description of the American Ball Angle Compound Engine in which this idea is incorporated. It is pointed out that the perfect balance obtained makes it feasible to install this engine upon upper floors and in other places where vibration would be objectionable; also, that the even turning moment incidentally secured makes it possible to use lighter fly wheels, and results in less pressure upon bearing surfaces besides giving more satisfactory operation of alternating current generators.

Business Notes.

H. M. BYLLESBY & COMPANY, of Chicago, have acquired the Tacoma Gas Light Company's property at Tacoma, Wash.

CLARK & BROWN, of Danville, Ky., contemplate taking up electrical construction work in connection with their plumbing business.

THE KENNY ELECTRICAL MANUFACTURING COMPANY has moved from 140 Nassau Street to 90 West Street. Mr. Paul T. Kenny, the proprietor, sails for Europe on the *Baltic* on July 17 and expects to be abroad for four or five months.

CATALOGS WANTED.—Henry A. Mentz, consulting engineer, Hennen Building, New Orleans, La., wishes to complete his files with a line of catalogs, circulars, etc., descriptive of railway, light, power and industrial apparatus and supplies, and requests manufacturers and dealers to send him their trade publications.

SELF-SOLDERING HEAT COIL PROTECTORS.—Frank B. Cook, Chicago, has obtained a favorable decision on final appeal before the Court of Appeals, Washington, in a case involving priority of invention of the self-soldering heat coil protector. Priority was awarded to E. L. Leeper, whose patent is controlled by Mr. Cook. There were originally eight different interference suits in the matter, involving six inventors and almost an equal number of manufacturers, but the number narrowed until in the final proceedings there was but a single case before the court.

THE GARWOOD ELECTRIC COMPANY announces that it has appointed the International Supply & Export Company, Bank of Commerce Building, St. Louis, Mo., as its sales agent. The International Supply & Export Company is well-known manufacturers' agent in the Middle West and keeps a number of salesmen on the road. The territory in which it represents the Garwood Electric Company includes Missouri, Kansas, Oklahoma, Texas, Louisiana, Arkansas, Mississippi, that portion of Tennessee and Kentucky within 70 miles of the Mississippi River, and all of Illinois within 70 miles of St. Louis. Its large electrical department is under the direct supervision of an electrical engineer.

A QUICK DELIVERY.—The International Acheson Graphite Company, of Niagara Falls, received a telegraphic order on the afternoon of Friday, July 2, between 1 and 2 o'clock, calling for the shipment of a carload of electrodes, 8 in. x 48 in., by express. At 5 p. m. an express car was delivered on the track in front of the Acheson warehouse, and at 5:30 p. m. a locomotive on the Niagara Junction Railroad was pulling away with the loaded car for delivery to the Michigan Central Railway. The car left Niagara Falls about 6 p. m., Buffalo about 8 p. m., and very early on Saturday morning the electrodes were delivered to the consignee in Chicago, Ill. If the business judgment of the Acheson Graphite Company had not been such as to have these very large electrodes in stock, a delay of from 10 to 12 weeks would have resulted.

Weekly Record of Electrical Patents

The budget of electrical patent specifications bearing date of issue of July 6, due at this office on Wednesday of last week, has not come to hand as we go to press (Tuesday noon). Telegraphic inquiry at the Patent Office as to delay in delivery brought the reply "Issue of July 6 not delivered by the contractor." The patents will be duly covered in the RECORD in the issue following receipt of the belated specifications.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Thursday of the same week.

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Electrical Exports.

The figures of electrical exports for May show a slight gain both as to instruments and as to machinery. Whether this marks the turn in a tide that has run the other way for more than a year it is hard to say. We must wait one or two months for later figures before venturing a pronouncement on that point, but are meantime encouraged that the process of gradual diminution should have been checked. Lacking information as to quantities, we might perhaps infer that the lower prices of the past 18 months have had something to do with the total decline in values; but there has evidently been a sharp falling off in gross orders up to this time.

It appears that during May the exports of electrical apparatus and instruments were $539,424 as compared with $464,114 last year. The gains were made in British North America, Brazil, Germany, the Philippines and Mexico chiefly, offset by a further decline of $33,000 in trade with the United Kingdom. In heavy electrical machinery the May shipments were worth $479,951 as compared with $469,088 a year ago. There was a heavy gain in British North America, offset by a corresponding loss in Brazil. Such fluctuations are to be expected, depending upon the receipt of orders that meet all the wants of the moment. It is interesting to note that Japan, whose purchases have lately been very restricted, has increased her imports in this class for the month from $31,277 to $77,209, while Central America jumped from $5,270 to $60,196. The real gains restoring the gross sales to the old totals of 1907 will come when the increases and declines do not cancel out, but all the markets require more from us. In electrical apparatus, the United States has certainly a growing variety of goods to offer, but it takes time and effort to get possible purchasers acquainted with them.

These figures are all in line with those of the general foreign trade of the country, which show the exports to be $200,000,000 less than in 1908, while imports were $100,000,000 less. There is now happily to be noted a marked increase in the importations of raw material, from which it is to be inferred that manufacturing as a whole is getting ready for full resumption of activity.

The Ohio Convention.

The Ohio Electric Light Association Convention last week brought out the usual good attendance and practical program which have characterized this association for many years past. The Ohio Association has recovered from the chronic case of overloaded program with which it was suffering two or three years ago in common with the National Electric Light Association and some other organizations. Unlike some of the latter, however, this association took steps to change this condition as soon as it became annoyingly apparent, whereas in the case

of others the reform is yet to be made. The Ohio programs now consist of comparatively few papers on subjects which are likely to draw out considerable discussion, and plenty of scope is given for discussion, which in every case is as long as time permits. Several matters of special note were taken up. One of these was the question of profitable residence lighting. The figures given from Detroit and vicinity as to the amount of such business secured per block in some localities, and the low ratio of maximum station demand to connected load in this class of business, made its possibilities look more attractive than in the past to some managers who have assumed that there is no profit in residence lighting. A town of 700 population, with 189 consumers, as mentioned in the discussion, is certainly something to set one to thinking.

The matter of supplying all the electric light and power in the various towns of a certain district from a central station in one town has been considerably discussed in the past, but has not been taken hold of as actively as its economic importance demands. It is, in fact, the only salvation for a number of small, unprofitable electric-lighting plants. One interesting feature of the Ohio situation is that several towns are being supplied by companies which are entirely independent of a generating company, and which purchase power from some central station in the district. This suggests the idea that it is not always necessary to wait for the company owning the central station to reach out to the surrounding towns. However, an apparent check to any considerable extension of this plan is that if the central station is not prosperous and progressive enough to reach out for this business itself, it is not likely to have either the apparatus or the inclination to sell power at wholesale at rates low enough to make the proposition feasible for the independent company. Taken altogether, however, to judge from the discussion at this convention as well as from the advice given by prominent central-station operators and financiers at the last National Electric Light convention, there is sure to be a general movement in the direction of consolidation and district supply the next 10 years.

A report was read on the present status of the development of the titanium carbide series arc lamp for street lighting purposes, with which two of our largest electrical manufacturing companies have been experimenting for several years past. It is a lamp of high economy as regards consumption of electrical energy, but this is partially offset by the present high cost of the titanium carbide negative electrodes. Being an alternating-current lamp suited to operation on 60 cycles, it is being looked forward to with considerable interest because of the fact that when operated from alternating-current supply it requires no rectifying set, as do the luminous street arc lamps employing magnetite negative electrodes. The relations of central-station companies to the public, which was the subject of two papers, brought out a marked tendency among progressive central-station companies to constitute every employee of the company an agent for the explanation of the company's policies. There is no logical reason why all of the work of promoting cordial and friendly relations with the public should be left to a "new business" department consisting of a small fraction of the total number of employees. If all the employees are properly taken into the confidence of the management, and if the policies of the company and the reasons therefor are fully explained, these employees are sure to create for the company a better impression on the public than if they are employed merely as machines to do routine work.

Movement of Magnetic Material in a Rotating Field.

There are certain classic experiments with rotatable conductors in a whirling magnetic field which many of our readers know. For example, a copper ball placed in a rotating magnetic field tends to spin about an axis parallel to that of the rotating field. In these experiments, eddy currents are generated in the rotatable conductors, and the magnetic field drags upon these eddies. In fact, the rotating conductors are virtually closed armatures, or act like squirrel-cage secondaries. Professor Boleman describes, in a communication printed elsewhere in this issue, a rather interesting type of motion of iron filings in such a magnetic field. The novelty in the experiment consists in the arrangement of two non-magnetic plates parallel to the plane of magnetic rotation, one above the stator and the other below. By this means iron filings scattered over the plates are acted upon by rotating magnetic forces not in the planes of the plates. The curious fact described is that the filings on the upper plate circulate against the magnetic field, while those on the lower plate circulate with the magnetic field.

It would seem that this remarkable discrepancy in direction of movement may be explained by hysteresis in the iron particles. If there were no hysteresis, the magnetic pull in one direction, as the field approached, would be the same as the magnetic pull in the opposite direction, as the field receded. In the presence of hysteresis, however, the forces during recession must be greater than those during approach. The iron wheels, therefore, roll over in the direction of the receding magnetic field. Each particle of iron in the iron filings tries to behave like a sphere, and to roll along in the direction of the receding forces, which are applied to the upper sides of the filings on the lower plane, and to the under sides of the filings on the upper plane. As pointed out in the communication, an important outcome from the experiment described is that the behavior of iron filings in a magnetic field cannot be blindly accepted as an indication of magnetic direction of rotation, because, on one of the two planes, the iron filings moved around against the direction of rotation of the field. In fact, it should be stated that, contrary to general belief, iron filings are also quite unreliable guides for determining the intensity of a stationary magnetic field. The magnetic pull upon a spherical particle of iron is zero in a uniform magnetic field, no matter how intense the field may be. In a converging magnetic field, the pull upon the spherical particle is exerted in the direction of convergence, so that what filings show and respond to is the product of field intensity and field convergence. It may be said, then, that when accurate deductions are looked for from the grouping or movement of iron filings, the behavior of grains of iron must be taken with a grain of salt.

Color Screens in Color Photometry.

An interesting article by Mr. F. E. Cady, printed elsewhere in the current issue, formulates a scheme for obviating some of the most annoying difficulties of color photometry by means of standardized color screens, acting to reduce the color of the

light under comparison to that of the standard lamp. The project is an old one in principle, dating back to the time of Crova, although its present form is less complete and radical and possibly for this reason easier of adoption. The difficulties of color photometry are obtrusive and notorious. One could write a volume on them without anywhere nearly exhausting the available material. The deeper one goes into the theory of the matter the worse off is he regarding practical remedies, since the phenomena grow more intricate on acquaintance. The methods most in vogue for comparing lights in different colors at the present time are those involving some form of flicker photometer, and those in which the difficulty is attempted to be minimized by the use of working standards of graded color between the extremes to be compared. As regards the flicker photometer in its various forms, great claims have been made for it which, on the whole, have not been substantiated, as Mr. Cady indicates in his paper. The trouble with the flicker photometer is that its advocates have proved too much. When, for example, the statement is gravely made that red and green lights can be compared with the flicker photometer with coincident results, both by persons with normal vision and those who are color blind, it becomes perfectly obvious that something is radically wrong with the instrument, since nothing is more certain than that red and green lights do not have the same apparent luminosity to color-blind persons as to those with normal vision, and the color blind should not under any circumstances be able to obtain the same photometric results as if their vision were normal. With some forms of flicker photometer the color blind and the normal certainly do not obtain the same results, but whether they obtain results which are properly comparable is quite another matter; and finally, as Mr. Cady indicates, it is not yet proved that the substitution of the flicker phenomena for simple comparisons of luminosity leads to the same result. A given observer can obtain constant results at a particular time when comparing lamps of radically different colors by the ordinary photometric methods. Results so obtained, however, do not as a rule check with those of other observers if obtained independently, or with the results of the same observer obtained at another time far enough distant from the first to have a certain amount of independence. A series of graded lights probably reduces the difficulty, but it is by no means clear that the sum of the comparisons made through them is on the whole any more to be trusted than is a direct comparison between the terminal members of the series.

Crova's method has many possibilities. His regular scheme of comparisons, however, was based on too near an approach to monochromatism, and his screens greatly reduced the brilliancy of the illumination, which is sometimes a serious disadvantage. Crova's fundamental theory, however, that for practical purposes the luminosity of two sources is substantially equal when their luminosities are the same in the middle portion of the spectrum, is essentially correct. The luminosities in the red and blue are practically so small that differences between them which may make very material difference in the apparent color of the light do not materially affect the actual illuminations under consideration. Crova, for the purpose of isolating a narrow portion of the spectrum, went to the use of colored solutions rather than colored glasses, and by so doing he obtained a screen which could be very accurately reproduced, but at the cost of some trouble. The color screens suggested by Mr. Cady, following work which he had done in connection with Dr. Hyde at the Bureau of Standards, are simply blue glass such as is used for spectacles. The capacity of such glass for equalizing the colors of ordinary illuminants is remarkably great. With a proper shade of blue it is possible to get a very fair match even between the light of an open arc and that of a 4-watt-per-candle standard lamp. A lighter shade of the same color would equalize such a standard with a tungsten lamp very readily. It should be noted, however, that these blue glasses, particularly in the deeper tints, do not produce uniform absorption but show bands which might lead to serious errors in the comparison of certain illuminants, particularly those which give their light from discontinuous spectra. It has been possible to obtain colored solutions which are free from this objection.

The ultimate success of Mr. Cady's plan depends on obtaining standard sets of color screens and using them under quite uniform conditions. It is undoubtedly possible to fulfill the first requirement; the Bureau of Standards, for example, could without much difficulty supply suitably calibrated sets at moderate expense. In using them, however, interesting questions would arise. In the first place, to obtain uniform absorption it is necessary for the screens to be very carefully cleaned prior to use. Insufficient attention to cleanliness of the surfaces can easily produce errors much larger than those the screens are intended to obviate. There is great difference between a glass surface apparently clean and one really clean. The position of the screen with reference to the lights is also a matter which deserves serious consideration. We do not know of any experiments on the relation of absorption in such screens to their absolute distance from the light which they are intended to modify. No such difference may exist in these colored glasses, but such a difference does exist in some similar cases, particularly in the instance of the photographic wedges, which have been considerably and very successfully employed in stellar photometry. It has been definitely demonstrated in this case that the apparent absorption of a given wedge which has no color selectivity is diminished by bringing the screen nearer to the light. Until such idiosycrasies are proved not to exist in these tinted glasses, it would be wiser to employ them near the lights to be compared and at fixed distances from them, rather than on the photometer head. Such position implies that the surfaces of each screen must be quite nearly plane and parallel. The final usefulness of the screen, as Mr. Cady indicates, is dependent on getting an average coefficient of absorption by a large number of experiments with different observers, and upon the limits of error found with different observers in getting such an average. If it is found that a dozen observers reach practically coincident results, then the matter is left in a very satisfactory state. If, on the other hand, the variations from the mean on the part of various observers reach several per cent, the value of the method as an aid to precision is greatly diminished. This is a question of fact which we hope Mr. Cady will soon be able to determine. If his method can be successfully carried out it will be a great relief to those who have to compare illuminants varying as much in color from each other as do many of those now in commercial use.

Opening of the Jersey City Branch of the Hudson & Manhattan Tunnels.

The twin tunnel tubes of the Hudson & Manhattan Railroad Company, extending from the Hudson Terminal Buildings at Church and Cortlandt Streets, New York, to the Pennsylvania Railroad station in Jersey City, were opened to the public on Monday, July 19. The tunnels are the second pair of tubes under the Hudson River to be put in operation. The connecting land tunnels between the Pennsylvania and Erie stations in Jersey City and the Hoboken station of the Delaware, Lackawanna & Western are scheduled to be opened on Aug. 2, and when this section is put in operation, trains will run through the tunnels completed in 1908 from Twenty-third Street and Sixth Avenue, Manhattan, to Hoboken and Jersey City and thence under the Hudson River again to the downtown terminal at Cortlandt and Church Streets. This will provide uptown and downtown tube connections for three of the five steam railroad passenger stations on the New Jersey side of the river.

The tubes under the river from Jersey City to Manhattan Borough, New York, are a mile long and have been built after the same design as that employed in the new part of the tunnels under the river at Morton Street. They are circular in section, formed by a segmental cast-steel shell bolted together and lined with concrete up to the level of the top of the cable ducts; the top half being unlined. The diameter in the clear is 15 ft. 3 in. The station under the Pennsylvania Railroad terminal is 100 ft. below the level of the concourse of the railroad station and provision is made for carrying passengers up and down from both street and railroad station in hydraulic plunger elevators. After leaving the Jersey City station, the two tubes diverge, the inbound tube runs up under Cortlandt Street, and the outbound tube runs under Fulton Street, two blocks north. Both tubes are connected on the New York side by five-loop tracks in the terminal station.

The terminal occupies three floors below ground in the immense Hudson Terminal Buildings. There are four main entrances and exits from the station concourse. The exits are broad curved inclines leading to the streets. The station platforms are 370 ft. long and permit the operation of eight-car trains. The platform level is lighted with five-lamp ceiling clusters inclosed in ground glass-bowls. The edges of the platform are also illuminated with rows of incandescent lamps. Most of the ceiling clusters are connected to 240-volt, three-wire, direct-current lighting mains, which also supply the offices on the upper floors of the buildings. At frequent intervals, however, a cluster of five incandescent lamps, forming part of the ceiling illumination, is connected to the third-rail circuit. This insures against total darkness in the station in case the lighting circuits to which most of the ceiling fixtures are connected should fail. The lamps on the edges of the platform are also connected to the railway circuits. No automatic switches have been installed to cut in outside sources of energy in case the local supply should fail; but the switchboard in the substation of the building is connected through a hand-operated switch with the mains of the New York Edison Company. A large storage battery which floats on the building lighting circuits affords a supply of electricity for short periods without any interruption to the lighting circuits should the rotaries in the substation or the generators in the power house on the Jersey shore momentarily fail.

After Aug. 2, trains will be run on three routes, and to avoid confusion on the platforms, illuminated train-announcer signs have been installed. There are six on each platform. The sign consists of a narrow box supported from the ceiling near the edge of the platform. Both sides of the box are formed of three panels of ground glass behind which are sheet brass stencils showing the three routes for trains. Mounted between each pair of panels are six incandescent lamps connected in groups of three. The panels are surmounted by a sign with two arrows pointing toward the track and reading: "Train For." The lamp circuits are controlled either from the signal cabin on the baggage platform or from the dispatcher's office. As a train enters the station a switch is closed illuminating the proper route panel in all three signs on the side of the loading platform from which the train departs.

In the basement of the terminal building in New York, below the train platform level, a large substation has been constructed where the high-tension, alternating current is converted into 625-volt current for the railway circuits and to 240 volts for the lighting circuits in the buildings. The substation contains at present two 1500-kw General Electric rotary converters for railway load and four 750-kw rotaries for lighting load. Foundations are provided for two additional 1500-kw units, giving the substation an ultimate output of 9000 kw. Each of the railway units has a separate set of three 750-kw, air-cooled transformers taking 25,000 25-cycle current and delivering 390-volt current at the secondaries. The rotaries deliver 625-volt, direct current to the third-rail feeders. Each of the four lighting units is supplied from three air-cooled transformers. The substation is lighted by Cooper Hewitt mercury-vapor lamps suspended from the ceiling. Cooling air for the transformers is supplied by motor-driven fans taking air from an intake running from the roof.

Proposed Connecticut Public Utilities Commission.

At the last session of the Connecticut Legislature, following the defeat of a measure to authorize a Public Utilities Commission, a special committee was appointed to draft a bill on the subject, and this body has just made public the result of its deliberations. The bill as reported deals with telephone, electric-light and water companies, electric-railway companies not being included for the reason that they are now subject to the jurisdiction of the State Railroad Commission. Three commissioners are provided for, to be appointed for terms of six years by the Governor by and with the advice and consent of the State Senate, each to receive a salary of $3,000 per year. The commissioners are to have power to employ accountants, experts and engineers and to send for persons and papers. All corporations under the jurisdiction of the commission are required to make a sworn report annually on a blank form prepared by the commission. The bill contains provisions designed to do away with stock watering and the issuing of bonds for more than a property is worth. Any customer who shall not receive proper or adequate service may make a complaint in writing to the commissioners; and any person who considers that a corporation does not perform any of the duties imposed upon it under the act may make a similar complaint. Upon investigation the commissioners shall recommend in writing to the corporation the taking of such action as will properly remedy what they find to be justly complained of; and if the corporation does not act upon such recommendations within a reasonable time, the commission may, through the Attorney-General, bring such action in the courts as may be necessary to enforce compliance by the corporation.

Central-Station District Heating Association.

Immediately following the adjournment of the Ohio Electric Association convention at Boody House, Toledo, Ohio, July 15, 1909, a number of gentlemen who are conducting a district steam or hot-water heating business in connection with their electric-light and power plants, met and formed a preliminary organization for the National District Heating Association. It is intended to take in as active members companies and individuals operating district heating systems and as associate members those manufacturing and installing such systems and accessory appliances. The officers are as follows: President, Mr. A. C. Rogers, 752 Euclid Avenue, Toledo, Ohio; vice-president, Mr. A. N. Cope, Springfield Light, Heat & Power Company, Springfield, Ohio; secretary and treasurer, Mr. W. A. Wolls, Columbus Railway & Light Company, Columbus, Ohio. Chairmen of

committees were appointed as follows: Program committee, Mr. D. J. Hard, of Cleveland, Ohio; finance committee, Mr. A. N. Cope, of Springfield, Ohio; executive committee, Mr. E. F. Gwynn, of Delaware Light, Heat & Power Company, Delaware, Ohio. It is planned to have the first convention at Columbus, Ohio, the latter part of November. Members' annual dues have been fixed at $5 and those of associate members at $10.

Steam Power Electrical Transmission from Galena, Ill.

The Power Construction Company is building a plant at Galena, Ill., to transmit power 25 miles north into Wisconsin, of which mention was recently made in these columns. The construction company will turn the plant over to the Interstate Light & Power Company, of Wisconsin, and the Interstate Light & Power Company, of Illinois, for operation. Unlike most transmission plants, the power is supplied by steam-driven units. The initial installation will consist of two Allis-Chalmers reciprocating Corliss engines driving General Electric 2300-volt, 60-cycle, three-phase, alternating-current generators. One of these units will be of 1500-kw rating and the other of 1250 kw. The machine voltage will be raised by means of oil-insulated, self-cooled transformers to a line potential of 33,000 volts. The transmission line will be 25 miles long, and there will be substations at Hazel Green, Benton and Cuba City, with a terminal station at Plattville, Wis. The local distribution will be at 2300 volts, further reduced to 440 volts where necessary. Alternating-current distribution as well as transmission will be used, according to the present plants. Messrs. H. M. Byllesby & Company, of Chicago, are the engineers.

Chicago Electric Club at Michigan City.

The first annual outing of the Electric Club of Chicago at Michigan City, Ind., on July 17, proved a great success. About 115 members and ladies made up the party, which left Chicago on the steamer *Theodore Roosevelt* at 10 a. m. On the way across Lake Michigan several wireless messages were sent, and Mr. C. A. S. Howlett, president of the club, dispatched a message to his home in Chicago while in mid-lake, and received an answer on board 40 minutes later. The afternoon was spent in the beach park at Michigan City, dinner and supper being served on the large veranda of one of the buildings by the ladies of a local church. Mr. John J. Schayer, the chairman of the entertainment committee, made an arrangement by which the visitors received meals superior to the usual summer-resort class, while the ladies netted a considerable sum to apply on the church debt. The weather was delightful, and with a baseball game on the beach, various athletic contests, fine bathing and a homeward sail by starlight, the day's pleasuring was thoroughly enjoyed by all who took part in it.

Cosmopolitan Electric Company, Chicago.

Operating under a 50-year franchise granted in 1895 the Cosmopolitan Electric Company, of Chicago, has been doing quietly and on a small scale a central-station business in Chicago for the last 10 years. It is now making preparations to increase its facilities for furnishing electric service to a considerable extent. The company is erecting a power generating station at the corner of Canal and Grove streets, on the site of its present plant, which is of a rather temporary nature. Two 3500-kw, 12,000-volt generating units will be placed in this station, and the plant will be ready to supply electricity in about three months. Space is left for two other units of equal size. These units consist of Curtis horizontal steam turbines and General Electric alternators. The steam-raising equipment consists of Babcock & Wilcox water-tube boilers, and draft is obtained by means of a steel stack. The principal office of the company is at 115 Dearborn Street, at which address the Ogden Gas Company maintains its offices. When the new building of the People's Gas Light & Coke Company, at Michigan Avenue and Adams Street, is completed it is probable that the Cosmopolitan Electric Company will remove its administrative offices to that building.

The rates offered by the Cosmopolitan company are about the same as those of the Commonwealth Edison Company, possibly a little lower in some schedules. Compared with the rates of the Sanitary District the prices are probably higher than those of that municipal body, which supplies electricity generated at the hydro-electric plant on the Drainage Canal at Lockport, Ill. The Cosmopolitan company has already a number of underground and overhead lines for transmitting its electrical energy from the power plant. It is believed that, although a general central-station service will be given, particular attention will be paid to supplying electricity for power users. Mr. Roger C. Sullivan is the secretary of the Cosmopolitan Electric Company, and has been a prominent figure in the management of its affairs. Mr. H. E. Niesz, until July 15 assistant to the second vice-president of the Commonwealth Edison Company, is now manager of the Cosmopolitan company and he will devote his entire time to his new duties. Mr. C. G. Y. King is constructing engineer, Mr. James Furlong, superintendent; Mr. J. H. Delaney, contracting agent, and Mr. H. E. Wulfing, electrical engineer. It is rumored that the Cosmopolitan company is affiliated with the Commonwealth Edison Company.

Some Boston Electrical Statistics.

The recently published report of Commissioner of Wires James E. Cole to Mayor Hibbard, of Boston, for the fiscal year ending Jan. 31 last throws considerable light upon electrical developments in that city during the past few years. During the past year about 2 miles of streets, carrying 46 miles of overhead wire, were cleared of this construction and added to the underground system. In many cases tungsten lamps have taken the place of the old naphtha street lamps used in Boston on minor thoroughfares. The principal traction, lighting and signaling companies have all extended their underground service during the year. The cables now used vary in size from two-conductor messenger and fire-alarm lines to 200-conductor telegraph and 600-pair telephone cables, and from No. 8 lighting cable to 2,000,000 circ. mil rubber-covered feeders for railway service. There are now about 1,572,100 ft. of conduit installed in Boston, with 9,885,000 ft. of single duct, 12,800,000 ft. of cable, 7143 manholes, 15,862 services, 620 Edison distribution boxes and about 600,000 ft. of Edison three-wire tube. The largest amount of underground work done during the year was by the Boston Edison Company, which installed 17,936 ft. of conduit, carrying 223,776 ft. of cable. The Boston Elevated Railway Company installed 14,977 ft. of conduit, or 73,862 ft. of cable, and the New England Telephone & Telegraph Company, 2860 conduit-feet with 77,409 ft. of cable. All the companies using underground service installed 747 new services in the year, a gain of 43 compared with the previous year. In the past 15 years over 57,000,000 ft. of overhead wire have been removed from the streets of Boston, less than one-fifth of this work having been done by the Wire Department. The total number of poles removed in this period was 2350.

One of the most interesting features of the report is its comparison of the electrical distribution of power in Boston for several years, tabulated in detail for the different companies and totalized isolated plants. Since Jan. 31, 1906, the total boiler capacity in the electrical installations in the city has increased from 115,854 hp to 146,762 hp, and the rated horsepower of engines from 142,931 to 236,400. The number of motors has increased, including the Boston Elevated, from 13,724 to 18,351, and the motor capacity from 192,493 hp to 326,652 hp. The increase in motor horse-power on the Boston Elevated system was from 153,860 hp in 1906 to 271,204 hp in 1909, and on the Edison system the motor capacity increased from 28,030 hp in 1906 to 38,625 hp in 1909. These figures

reflect a most healthy demand for increased electric service on the part of the Boston public, the percentage increase in the traction field being about 80 and in the central station about 35 per cent, as expressed in motor horse-power. The actual traffic of the railway company has, of course, not increased in anything like these proportions, but the enlargement of motor capacity still indicates a growth in the scale upon which service must be rendered, and, as such, is a sign of electrical expansion. About seven times the motor horse-power is now in service in Boston that was installed 11 years ago.

In the generating plant field there are 319 isolated plants now compared with 276 in 1906, an increase of only 15 per cent in this period. The Boston Elevated Railway Company has increased its number of power stations from 8 to 10, and the total number of power stations listed is 348 compared with 303 in 1906. The largest generating unit in New England is a 12,000-kw turbo-alternator in the L Street station of the Boston Edison Company, and two more of these machines are now under contract. In addition to the above, the Edison Company has increased the capacity of two of its substations by the installation in each of 2000-kw motor-generators, and there have been installed four 1000-kw motor-generators at the Atlantic Avenue station to be used for emergency service to reinforce the L Street station in case of accident; and at present a new substation is being built in the North End to be used to distribute direct current to the underground network in the vicinity, as well as a center of distribution for alternating-current service in Charlestown.

During the year many important changes have been made by the Boston Elevated Railway Company at its power stations At Lincoln power station an extensive addition was made, and two 2700-kw units added; a 2700-kw unit was added to Harvard and Charlestown stations, each, and important betterments in the switchboard equipment and station flooring in the line of fireproof construction have been effected. In the interior lighting field, about 60,000 tungsten lamps were installed during the year. The report states that "only a very small proportion of the fires attributed to electric wires by the daily press are found upon investigation to be due to that cause. This is not remarkable, however, as there usually is no opportunity before the matter is printed for either the papers' representatives or the proper authorities to make a correct investigation as to the cause of the fire; and provided the case is not plainly evident, it seems to be the custom to report the cause as electrical for want of better information." Of the 15 accidents to persons that came to the attention of the department but one was fatal, and in this case the death of the victim was due to his climbing upon an iron bridge and making a wilful contact with an overhead lighting circuit. Of the 23 fires found to be electrical in origin, 11 entailed no insurance loss, being very slight. The remainder caused a total insurance loss of about $19,300. The principal causes of the electrical fires were the deterioration of insulation in an oil warehouse, leaky roof, crosses, grounds and short circuits, defective rheostats, lamp in contact with inflammable substances, and hot metal from blown fuse falling upon dry goods. One of the most interesting causes of fires was in a store where the end of a wire which had been cut off and left bare of insulation came in contact with a metal rod lying on the floor. The further end of the rod was in contact with the support of a cash-carrier system, carried by wires run to screw eyes in the ceiling. Current melted off one of these wires and the metal ignited the dry goods below.

Mammoth Electric Organ for Atlanta.

One of the largest electric organs ever built in the United States will shortly be constructed for the Atlanta, Ga., Auditorium Armory by the Austin Organ Company, of Hartford, Conn. The building is capable of seating 8000 persons aside from the main floor or arena. The organ will be placed in a large chamber at one end of the auditorium, with an echo organ at the opposite end in a smaller auditorium, an opening being provided through the wall between the two halls. The main organ will be controlled from a four-manual movable console placed about 65 ft. in front of the instrument. The echo organ will be provided with an independent console, so that it can be used alone in the smaller auditorium when desired. The entire action will be electric, a current of 8 volts being supplied for the service by a specially wound generator. The organ will be blown by a 20-hp motor direct-connected to a series of fans, raising the wind pressure by steps. A universal air chest, supplying the pressure uniformly to all pipes regardless of the demand, is a special feature of this organ, which is now common to this particular company's work. The wind pressures to be used on the organ are 10 in., 15 in., and 50 in. water column. A separate motor and blower will be provided for the echo organ in the small auditorium, which will be voiced on a 5-in. wind pressure. A separate motor and blower will also probably be used for supplying air to the 50-in. wind service, which is the highest pressure ever used in connection with organ pipes. This 50-in. wind is to supply the "tuba magna," a reed producing a smooth tuba tone of large power. The supply of air is automatically controlled by the reservoirs of the instrument.

This organ will consist of a pedal organ, with 576 notes, with pipes from 8 ft. to 64 ft. in combination length; a great organ of 854 pipes, 2 ft. to 16 ft.; a swell organ, having 1181 pipes, from 2 ft. to 16 ft.; orchestral organ, 791 pipes, 2 ft. to 16 ft.; solo organ, 657 pipes and 20 cathedral chimes; and the echo organ, with 499 pipes, 4 ft. to 16 ft. All contacts are of gold and platinum.

Ohio Electric Light Convention.

The Ohio Electric Light Association held its fifteenth annual convention July 13, 14 and 15 at Toledo, Ohio, the meetings and headquarters being at the Boody House. The attendance of central-station men was larger than at any previous convention. After the adjournment of the final session at noon July 15, the convention went by special train over the Lake Shore Railroad to Sandusky, Ohio, and thence to Cedar Point for a banquet and other entertainments.

The first session of the convention opened at 10:15 Tuesday morning. Secretary D. L. Gaskill announced that President C. R. McKay, formerly of the Toledo Railways & Light Company, who has recently gone to Covington, Ky., to take the management of the Union Light, Heat & Power Company, was unable to be present and preside at the meetings. As Mr. J. C. Rothery, of East Liverpool, the vice-president, was unable to be present at the convention until the last session, most of the sessions was presided over by Past-President W. P. Engle, whose efforts two years ago at drawing out good discussions were well remembered by members.

Mr. Albion E. Lang, president of the Toledo Railways & Light Company, and Hon. Brand Whitlock, Mayor of Toledo, gave addresses of welcome. Mr. Lang commented on the number of associations of various kinds in the electrical field, but said that the State association is probably of the greatest practical benefit. Mayor Whitlock called the American city the seventh wonder of the world. There is a constantly increasing tendency for population to crowd together in cities, and electricity will doubtless play an even more important part in the city life of the future than in the past.

Mr. F. M. Tait, chairman of the executive committee, reported 15 applications for membership, which were duly elected. Four more applicants were presented at the closing session and elected. D. L. Gaskill, secretary and treasurer, made his report, showing a balance from 1908 of $237.92 and total receipts, including the balance from last year, of $2,079.50. Expenditures were $1,589.01, leaving a balance July 6 of $490.49. The souvenir program this year was published by the association itself instead of being let out as a concession, as was the case last year. The association was very successful in running

the program itself, the receipts being $2,255 from advertising, giving a profit to the association after paying the expenses of printing and distributing of $1,655. The secretary's report closed with an expression of appreciation of the work done by President C. R. McKay in preparing for this convention before he left the State, and also of the work of Mr. F. M. Tait as chairman of the executive committee. After some announcements as to entertainment features provided for the ladies, the papers were taken up.

Mr. F. T. Mather, of the Edison Illuminating Company, of Detroit, Mich., presented by special invitation a paper on "Residence Lighting," which gave some very interesting figures on residence business in Detroit. This paper was prepared from material presented in a paper to the Association of Edison Illuminating Companies last year, an abstract of which appeared in these columns in the issue of Nov. 7, 1908. This and the discussion which followed brought out the fact that the possibilities as to percentage of houses connected and profits in residence lighting have been frequently underestimated. Some figures were given showing a remarkably high percentage of residences connected in some towns. Discussion of this profitable subject took up the remainder of the morning session.

On Tuesday afternoon Mr. H. E. Hutchings, of the Dayton Lighting Company, and Mr. Claude Smith, of the Bradford & Gettysburg Electric Light & Power Company, each read papers on "The Supply of Electric Current to Other Towns from a Centrally Located Station." This also brought out one of the important discussions of the convention. Mr. Smith is the manager of several companies which do not own central stations, but purchase power to supply small towns from neighboring central stations. All of those discussing the subject favored centralization of power plants in this way, and it would appear that this movement toward centralization, which so far has been most pronounced in Illinois and a few thickly-settled Eastern communities, is destined to spread rapidly through Ohio. Abstracts of these papers and discussions will be given in later issues. The question box was taken up for a short time at the close of this discussion.

After this session special cars were ready to take the convention to the Toledo Casino, north of the city on the Maumee River. After a dinner at the Casino at 6:30 the party enjoyed the river scenery and cool breezes until 8 o'clock, when it attended the Casino Theater in a body.

On Wednesday morning Mr. E. E. F. Creighton, of the General Electric Company, gave a talk with some demonstrations on the subject of the best method of protection from lightning. In these demonstrations he used an induction coil with spark-gap to show the effect of choke coils and other devices in connection with high-frequency lightning discharges. His demonstrations were impressive as to the amount of choking effect offered to high-frequency discharges by even a single turn or loop of wire. The general conclusions of his remarks were that lightning arresters are good for the protection of apparatus, but that it is not commercially practicable to use them for the protection of lines. The multi-gap arrester is the best for distributing circuits, and the aluminum cell arrester the best for high-tension transmission lines.

Mr. C. C. Custer, of Piqua, Ohio, then presented a paper on "Commercial Organization of Electric Lighting Companies and Their Relation to the Public." Another paper on the same subject was read by Mr. W. E. Richards, of the Toledo Railways & Light Company. Mr. N. B. Ayres, of the Dayton Lighting Company, presented a paper on "Boiler-Room Economy" in which he forcibly called attention to the need of devoting thought to the operating and producing end of the business as well as to the selling end, which is now receiving so much attention. This was followed by discussions both of public relations and boiler-room economies.

Mr. F. M. Tait, chairman of the executive committee, reported the appointment of a nominating committee by the executive committee as follows: Messrs. W. J. Hanley, of Cleveland; E. A. Bechstein, of Sandusky, and S. M. Rust, of Greenville. As it was learned that the secretary had expended $150 for miscellaneous items not charged in connection with getting out the souvenir program, which program had netted the association over $1,600, it was voted to appropriate $150 to reimburse the secretary for this expense. The secretary's salary for 1910 was then raised from $600 to $750.

Wednesday afternoon the session was opened with the reading of a paper written by Mr. J. C. Rothery, of East Liverpool, Ohio, on "Plans to be Followed in Supplying Lamps to Consumers." After some discussion on this subject, Mr. S. M. Rust, of Greenville, read a paper on "Factors which Should Be Considered in Making Contracts for Street Lighting." This also drew out considerable discussion, which showed that some companies are not getting anywhere near the prices they should obtain for street lighting. The number of series tungstens in use for street lighting is now very large.

After this session the convention went to Toledo Beach for surf bathing and a frog-leg dinner, followed by dancing in the evening and other impromptu entertainment furnished by various members of the party.

The Thursday morning session opened with Vice-President J. C. Rothery in the chair. The first order of business was the presentation of the report of the nominating committee, in accordance with which report the following officers were elected: President, Mr. J. C. Rothery, East Liverpool; first vice-president, Mr. E. H. Beil, of Youngstown; secretary and treasurer, Mr. D. L. Gaskill, of Greenville. Executive committee: Messrs. F. M. Tait, Dayton; E. A. Bechstein, Sandusky; W. P. Engle, Defiance; Sheldon Rogers, Columbus; W. F. Hubbell, Wauseon. Advisory committee: Messrs Samuel Scovil, Cleveland; F. M. Tait, Dayton; D. L. Gaskill, Greenville. Finance committee: Messrs. J. T. Kermode, Cleveland; T. D. Buckwell, Toledo; W. C. Anderson, Canton. Publicity committee: Messrs. T. H. Jungk, Fremont; E. L. Booth, Bellaire; J. C. Martin, Wilmington. Membership committee: Messrs. W. J. Hanley, Cleveland; E. L. Van Winkle, Cincinnati; P. J. Williams; F. F. Rossman, Cleveland; I. M. Cassell, Cleveland; H. B. Rogers, Columbus; F. C. Caldwell, Cincinnati.



PRESIDENT-ELECT J. C. ROTHERY.

The president-elect, Mr. J. C. Rothery, is general manager of the East Liverpool Traction & Light Company, the Steubenville & East Liverpool Railway & Light Company and the Ohio River Passenger Railway. Mr. Rothery was born 52 years ago in Scotland, where he received an academic education. In his younger days he went to sea and worked up to be master of a vessel. From this he went into the engineering department of the Michigan Central Railroad. He was connected with the erection of the cantilever bridge at Niagara Falls and for a number of years was superintendent of this bridge after its completion. He resigned from this to build and manage the

Niagara Falls Park & River Railway, which follows the Canadian side of the Niagara River from the Falls to the end of the Gorge. He was superintendent of this road until it was absorbed by the International Railway Company, of Buffalo, after which he continued as superintendent of all the lines of that company centering at Niagara Falls, including the Niagara Falls and Buffalo line. In 1906 he went to East Liverpool, Ohio, to assist in rebuilding the East Liverpool Traction & Light Company's system connecting Steubenville and Beaver with Liverpool. He has been a member of the Ohio Electric Light Association ever since he came to the State in 1906 and was vice-president of the association the past year. Following the election of officers an amendment to the constitution was taken up which was presented last year by Mr. M. E. Turner, of Cleveland. This provides that instead of a nominating committee appointed entirely by the executive committee as at present, the nominating committee shall consist of five members, two appointed by the executive committee, two elected by ballot in open meeting of the convention and one appointed by the president. This amendment having been considered for a year by the executive committee, was reported out for discussion. The object of the amendment was explained to be that of making elections a little more democratic and preventing the possibility of control by a clique. Some thought that if this were the object it did not go far enough, because under the proposed amendment three out of the five members of the nominating committee would still be appointed by existing officers. Mr. Turner, who framed the amendment, said that he intentionally made it so that the appointment would not be too democratic in order to avoid the danger that men not familiar with the association's possible work be appointed on the committee. This amendment was finally referred to a committee of three to be redrafted and reported to the association next convention before election. This committee as appointed consists of Messrs. F. M. Tait, of Dayton; M. E. Turner, of Cleveland, and C. V. Hard, of Worcester, Ohio. Resolutions of thanks were passed expressing the appreciation of the association for the work done by the Toledo Railways & Light Company and the supply houses of Toledo in providing for the comfort and entertainment of the convention.

A paper written by President C. R. McKay on the "Titanium Arc Lamp" was then read by Mr. Richards, which was briefly discussed. This was followed by reports on "Tungsten Lamp Experiences" from various companies. Such reports were briefly made by Mr. Booth and Mr. W. E. Richards, of the Toledo Railways & Light Company; Mr. E. H. Beil, of Youngstown; Mr. W. C. Anderson, of Canton; Mr. M. E. Turner, of Cleveland; Mr. A. A. Pointer, of Antwerp; Mr. J. C. Rothery, of East Liverpool, and Mr. Henry Schroeder, of the General Electric Company. Mr. Geo. C. Osborne, of the General Electric Company, read some letters from companies in other States regarding tungsten-lamp work, and Mr. F. M. Tait told of a trial installation of ornamental posts carrying five 100-watt tungsten lamps placed on one of the Dayton downtown streets. The convention then passed resolutions of thanks to Mr. W. P. Engle for his efficient efforts in presiding over the first four sessions.

Abstracts of the papers and discussions will appear in later issues.

Union College Department of Electrical Engineering.

In 1845 the School of Engineering was founded at Union College, Schenectady, N. Y. In 1895 a course in electrical engineering was introduced, which in 1902 was reorganized and made a separate department under the direction of Dr. Chas. P. Steinmetz. A four years' course of study is required for the degree of bachelor of engineering and a one-year resident graduate course leads to the degree of master of electrical engineering.

The four-year course of study offered aims at a thorough and broad scientific education of the prospective engineer, rather than the specific training of the specialist. The instruction consists, therefore, of three classes of studies, the general culture studies furnishing such training as is now considered essential for every educated man, as languages, literature, history, etc. Such instruction extends over a large part of the first two years, and is then followed by a broad and general technical education, giving the student the fundamental principles and their application to all branches of engineering. Then follows specific instruction in electrical engineering, which, while enabling the student, after graduation, to enter the field of electrical engineering practice in the manufacturing or operating company or consulting engineer's office in a subordinate capacity only, has given him all the necessary requirements to gather in a few years' practice the knowledge required for independent work of greater magnitude.

Through the active interest which the General Electric Company takes in technical education, an arrangement has been effected whereby the students in the junior and senior are admitted to the company's works at appointed times, under the direction of their instructor, with the privilege and opportunity of studying and inspecting the plant and operations.

To those students who wish to add to their college training after graduating from the four courses, a graduate course is offered of one-year resident study. Besides instruction in higher branches of electrical engineering, there will be occasion to carry out original investigation under the supervision and with the assistance of specialists prominent in electrical engineering practice on subjects closely connected with the most recent advance of electrical engineering. This course leads to the degree of master of electrical engineering, and is open to graduates of Union College and of other institutions approved by the faculty.

The electrical engineering laboratory, opened for classes in the fall of 1906, is thoroughly up to date, both in construction and equipment. The ground plan of the building is T-shaped, the upper bar of the T having two stories. The lower floor is devoted to three laboratory rooms, the largest of which is 101 ft. x 35 ft. This is the main laboratory and extends from front to rear of the building. The two other rooms, one on each side of the main laboratory in the upper bar of the T, are devoted to thesis work, instruments, the more delicate pieces of apparatus and other special uses. A well-lighted drafting-room occupies the major part of the second floor, being 73 ft. x 27 ft. in dimensions.

In equipping the laboratory special consideration was given to the selection only of such representative types of apparatus as can be handled, operated and tested by the students, and of a size sufficiently large to correspond to modern practice, but not so large as to make the operation under abnormal conditions—that is, under conditions which, as a rule, are specially instructive—unsafe for the apparatus. All such machinery as the student cannot be permitted to handle freely was excluded from the equipment. Power is supplied from a direct-connected unit consisting of a Westinghouse gas engine and a direct-current generator; a motor-generator set consisting of a 17.5-kw, direct-current generator direct-connected to a three-phase, 220-volt induction motor; connection with the 550-volt direct-current trolley circuit of the Schenectady Railway Company, and connection with the three-phase, 2300-volt power circuit of the Schenectady Illuminating Company. In the latter case voltage is reduced by banks of step-down transformers, so that the students can handle the safe, low-tension circuits only. A secondary supply is also secured by means of a group of plate storage batteries charged by a mercury-arc rectifier upon the alternating-current power circuit.

Among the recent additions to the laboratory are an oscillograph and a potentiometer. With the former wave-forms may be traced or photographically recorded and transient phenomena of the electric circuit studied and investigated. The potentiometer is an absolute standard for the calibration of electrical instruments and is similar to that used by the Public Service Commission of New York State.

New York Public Service Commission News.

The Public Service Commission, Second District, has authorized the Hornell Gas Light Company to mortgage its property and franchises to the amount of $250,000 to secure an issue of bonds maturing in 40 years and bearing interest at a rate not less than 5 per cent. It is authorized to set aside and reserve $95,000 in bonds to refund bonds now outsanding. Seventeen thousand dollars of the bonds are authorized to be sold at not less than 90, the proceeds of which are to be used in the discharge of bills payable, for making improvements to the plant and system and the acquisition of property.

The Penn Yan Gas Light Company has been authorized to execute a mortgage to secure an issue of $100,000 5 per cent 40-year bonds. Of this amount $45,000 is to be used in refunding outstanding bonds and $10,000 in bonds to be sold at not less than 90 and the proceeds used to discharge bills payable and to make certain improvements to its plant and distributing system.

The Newark Gas Light & Fuel Company has been empowered to execute a mortgage securing an issue of $100,000 in 40-year 5 per cent bonds of which $30,000 is to be used to retire outstanding bonds and $30,000 in bonds to be sold at not less than 90 to be used for the discharge of bills payable and for improvement to its plant and distributing system.

The commission has authorized the Norwich Gas Light Company to execute a mortgage securing an issue of $250,000 40-year 5 per cent bonds, $85,000 in bonds to be used to retire outstanding bonds and $85,000 in bonds to be sold at not less than 90 and the proceeds used for the discharge of bills payable and improvement of its plant and distributing system. The above companies are controlled by the Associated Gas & Electric Company and are among a number controlled by this corporation in New York State.

The commission has granted the application of the Hoosac River Electric Light & Power Company for permission to exercise franchise in the village of Valley Falls, Rensselaer County. The company in question is a subsidiary company of the Schenectady Power Company and proposes to handle whatever power is distributed to municipalities or individual users along the line of the transmission line. The company expects to furnish light to Johnsonville and to take over the present lighting system in Schaghticoke.

Commissioner Eustis, of the New York City Public Service Commission, has conducted a hearing into the trackage and franchise rights of the Metropolitan Street Railway Company and the Central Park, North & East River Railroad Company, which operate a belt line of horse cars at the South Ferry terminal. The investigation was made at the instance of the Department of Docks and Ferries, which asserts that more roadway is needed for teams and vehicles desiring to enter the ferry. Mr. George W. Linch, manager of the Central Park, North & East River Railroad Company, said that the plan was satisfactory to him. It was brought out that the Metropolitan is now using two of its tracks at the South Ferry terminal without apparently a reason that satisfied him as to their right to do so. There were, he said, horse-car tracks which had been electrified by the Metropolitan for terminal purposes, and gave the Metropolitan the use of five tracks at South Ferry for its roadway on the Sixth and Eighth Avenue lines. Further investigation will be made to determine the Metropolitan's right to the tracks and to find out if it will agree to the plan of the Department of Docks.

As the result of the decision of the Appellate Division of the Supreme Court in ordering the New York City Public Service Commission to grant the South Shore Traction Company a franchise to cross the Queensborough Bridge, which the commission had previously refused, the power of the commission in regard to transportation matters has been questioned. In the amended Travis-Robinson act the power controlled by the commission is as follows:

1. Companies seeking franchises for surface lines make application first to the Board of Estimate; if it is entertained the terms and conditions of the franchise are fixed and the grant made. The company then applies for the approval of the commission.

2. Companies seeking to construct rapid transit lines, subway or elevated, must first apply to the commission; if approved by that body a certificate is prepared, fixing terms, etc., and is then submitted to the Board of Estimate. This applies to lines to be built by private capital.

3. When a subway or other rapid line is to be built as a municipal route, the project also has its initiation with the commission.

4. The commission is empowered by the new law to lay down routes for rapid transit lines, subject to approval by the Board of Estimate.

Massachusetts Commission News.

The Fitchburg Gas & Electric Light Company has petitioned the Massachusetts Gas & Electric Light Commission for authority to issue 3850 shares of new stock at a price of $80 each to pay floating indebtedness already incurred for new construction, extensions and improvements, and to acquire additional plant and property. The par value of the stock is $50, and this is the first case in which the Fitchburg Company has taken advantage of the new law of 1909 which enables the directors of a gas or electric light company to fix a price for new shares of stock to be issued under approval of the board. The total amount of the proposed issue is $308,000.

The Malden & Melrose Gas Light Company has petitioned the Gas and Electric Light Commission for the right to issue 2306 shares of new stock at $140 each, the par value being $100. The money is to be used to meet floating indebtedness and in the purchase of additional plant. The total amount involved is $322,932.

Standards of Electric Service in the State of Wisconsin.

The provisions of the public utilities law relating to standards of service for public utilities operating in Wisconsin read as follows:

"1. The commission shall ascertain and fix adequate and serviceable standards for the measurement of quality, pressure, initial voltage or other conditions pertaining to the supply of the product or service rendered by any public utility and prescribe reasonable regulations for examination and testing of such products or service and for the measurement thereof.

"2. It shall establish reasonable rules, regulations, specifications and standards to secure the accuracy of all meters and appliances for measurements, and every public utility is required to carry into effect all orders issued by the commission relative thereto."

With a view to performing the duties imposed upon the commission by the above laws, the experts of the engineering staff undertook comprehensive laboratory and field investigations. These investigations took the form of a general study of operating conditions, including a study of meter accuracy, variations in pressure, interruptions of service, lamp renewals, gas and electric lighting. In this work the commission had the co-operation of the United States Bureau of Standards and the committee of standards of the American Gas Institute in fixing standards of service tests.

Determinations of the accuracy of gas and electric meters, of the variations in gas and electric pressure, as well as the calorimetric tests of gas, were made in a number of cities throughout the State.

After sufficient progress had been made in different lines of investigation to reflect the general situation in the State, a conference of representatives of gas and electric companies was called for the purpose of arriving at a better understanding of the problems involved in the establishment of standards for

gas and electric service. This conference, as previously reported in these columns, was held at Madison, March 3, and was attended by about 200 representatives of gas and electric companies, as well as by other experts from different parts of the country.

From the results of this conference a set of rules and regulations was formulated, which are now published for the guidance of the managements of the various electric companies in Wisconsin. It is recognized by the commission that certain plants are operated under conditions which make it impracticable or not to the best interests of the public to meet all the requirements of all the rules. In such cases the commission may modify the rules if the evidence in the case warrants it.

The rules and regulations adopted by the commission in reference to electric service are of such a character as to insure adequate service to the majority of consumers with the fewest number of restrictions. It was recognized that the rapidly changing conditions to which the electrical energy supply industry is subjected would make it impracticable to formulate rules at this time which might interfere with the natural growth or progress of the industry.

Adequacy of electric service may be considered under the following classifications: (1) Accuracy of meters; (2) regulation of pressure, and (3) efficiency of devices for utilizing electrical energy.

A meter is considered accurate if it does not register on no-load, and if the error is not in excess of 4 per cent on light load, half load or full load. The commission requires that each central station shall make periodic tests on its meters, according to such methods as the commission shall approve. Each company is required to maintain a record of time, duration and cause of all interruptions of service upon its entire system or major divisions of its system. Also each company "shall adopt and maintain a standard average value of voltage as measured at any consumer's cut-out, which shall remain constant from day to day, and vary during any day by an amount not more than 6 per cent of the minimum value."

A 6 per cent variation is rather excessive and it is probable that a closer regulation will be required in the future. Under the changing conditions at present it appears that a rigid enforcement of this requirement will result in a marked improvement in the quality of service which has hitherto been furnished by the majority of companies in the State.

As has been amply verified by the inspectors on the engineering staff of the commission, much of unsatisfactory electric service comes from neglect on the part of the electric company or from lack of information on the part of the consumer as to some of the characteristics and practical limitations of electric lighting. The foregoing rules will help to remedy the former, while as regards the latter the commission has decreed that, "Each company supplying electrical energy for incandescent illumination shall adopt and maintain some method which will insure periodic inspection of incandescent lamps to which current is supplied, and under which the company will render its consumers assistance in securing incandescent lamps best adapted to the operation of the system. Each company shall submit to the commission the details of such method of procedure as it may adopt." Also, "Each company shall specifically inform each of its consumers as to the conditions under which efficient illuminating service may be secured from its system." As the progress of the art advances many changes and modifications of the definitions of adequate service and of the rules for obtaining the same will undoubtedly be necessary.

Upon an investigation of the Hudson Water Works by the commission it was found that the above concern had ordered every consumer to buy or rent an "Empire" meter. Also that in certain cases consumers who owned "Niagara" meters were ordered to replace them by "Empire" meters or suffer the penalty of having their water turned off. It was brought out at the hearing that the "Niagara" meters were acknowledged by the water board of Hudson to be equal in point of service to the "Empire" meters. The city charged its patrons $1.50 per month rental and charged $11.60 for the "Empire" meter while the "Niagara" meter could be bought for $7.10.

The point at issue was as to whether the water board had the right to compel a consumer to purchase and install a type of meter acceptable to it and to it alone. According to one section of the public utilities law, "It shall be unlawful for any public utility to demand, charge, collect or receive from any person, firm or corporation less compensation for any service rendered or to be rendered by said public utility in consideration of the furnishing by said person, firm or corporation of any part of the facilities incident thereto; provided nothing herein shall be construed as prohibiting any public utility from renting any facilities incident to the production, transmission, delivery or furnishing of heat, light, water or power or the conveyance of telephone messages and paying a reasonable rental therefor." This section of the law has come up many times in connection with telephone companies and it applies equally well to electric companies and all other public utilities. Under this law a city or corporation cannot give a lower rate to a consumer who owns his meter than to another consumer whose meter is owned by the city or corporation. The law contemplates that the divided ownership of parts of the equipment of public utilities shall cease, and that all responsibility for the installation and maintenance of the whole of the equipment shall be centered exclusively in the management. This means that private and municipal plants must acquire by purchase or lease all meters used in connection with their respective works. No utility can compel a consumer to acquire by purchase or lease a meter or any other part of the facilities which the utility is expected to furnish. Consequently it was held that the city of Hudson had no right to compel a consumer to use any kind of a meter, much less a particular type of meter.

On March 24 a hearing was held before the commission to consider the application of the Stoughton Electric Light & Power Company for authority to increase its rates. The company desired a more flexible rate which would enable it to sell more power to factories and large current consumers. The commission made a careful examination of the companies' earnings and expenses in order to determine the unit costs as a basis for rates. Although this is a municipal plant, the commission held that the expenses should be increased by tax, depreciation and interest charges in order to arrive at a reasonably safe basis for rates, although taxes and interest charges may, in a sense, be dispensed with in municipal plants. The commission granted the company authority to increase its rates.

The village of Cashton petitioned the commission for the determination of a just compensation to be paid to the Cashton Light & Power Company by said village, for the purchase of the companies' property actually used and useful for the convenience of the public. The Cashton Light & Power Company operated a pumping plant and flour mill in conjunction with the lighting plant, and it was evident from the testimony that the electric plant, as an independent enterprise, could not be conducted profitably, even if the most rigid economy were practised. In fixing the compensation to be paid the company, the following were some of the points brought out by the commission:

(1) "That in placing a value upon the physical property of a plant, the units of a plant should not be valued as independent entities, but as units of a going concern performing public-utility service.

(2) "That while the law imposes upon the municipality the obligation of purchasing only such property as is both actually used and useful for the convenience of the public, nevertheless just compensation must be provided for any articles of property which, although not of any use to the municipality, would be lessened in value by the removal of the lighting system.

(3) "That the element of 'going value,' created by the investments made in developing the business and in addition to

the cost of the physical structure, must be taken into consideration in fixing value; that, although the franchise of a public utility operating under an indeterminate permit has expired upon the exercise by the municipality of its option to purchase, the plant is to be taken over as a going concern, and just compensation must be awarded for the property taken as a living and operating entity, engaged in serving the public, and not as a mere plant without patrons and without privilege or right to operate and to serve the public, and having but a salvage value."

The compensation fixed by the commission was based largely upon the above facts.

A hearing upon a petition signed by citizens and telephone subscribers of Black Earth, Wis., alleging inadequate service on the part of the Black Earth and Mazomanie telephone companies was held at the office of the commission on May 15. The petition alleges that the toll service between the two cities is very unsatisfactory, the overloading of the present circuit causing great inconvenience and often financial loss to business men from their failure to receive prompt service. The petition further alleges that the Black Earth telephone company has expressed its willingness to construct its share of an additional line, but that the Mazomanie telephone company had refused to coöperate in the same manner. It was stated at the hearing, by the manager of the Mazomanie company, that the present pole line was not strong enough to carry the additional circuit, and that an entirely new pole line would have to be constructed. After investigating the matter the commission issued an order commanding the two companies to construct an additional telephone circuit to connect the two exchanges, the same to be done within a period of 30 days.

In the case of Fullmer vs. Wausaw Street Railway Company the complainant alleged unjust discrimination in the arrangement of fare zones and excessive rates of fare. The petitioner conducts a pleasure resort a short distance outside the city, and the fare charged by the respondent company was 10 cents per trip. This was also the fare charged to the pavilion—a resort owned by the railway company—although the pavilion was nearly two miles farther along the line. The petitioner testified that before the pavilion was operated, his place of business had been very popular, but that now, on account of extensive advertising and low transportation charges, the crowd had been diverted from his pleasure resort to the company's pavilion. It was brought out at the hearing that the published rates of the company called for a 15-cent round trip fare to either of the resorts. But the companies' tariff rates also specify that the 15-cent rate to the companies' pavilion includes a skating privilege. Thus, while the nominal rate of 15 cents applies also to the petitioner's place of business, the company is in reality paying a rebate in the shape of a skating privilege—worth probably 5 cents—at its own amusement park.

The commission recognizes the fact that the fusion of commercial and transportation enterprises is frought with grave dangers, and that it is highly desirable to divorce the railway business absolutely from all pursuits in the domain of competitive industry and to confine itself exclusively to the primary function of transportation. With this end in view and after a careful examination of the companies' receipts and expenditures, the commission ordered that the Wausaw Street Railway Company shall not charge more than 5 cents per trip between any two points on its line. It was further ordered that the company shall cease from publishing any tariff and collecting fares, either single or round trip, which include the charge for the admission of the holder of the ticket to the company's pavilion or other amusement resort operated by it. It is not the policy of the commission to discourage investments in public utilities and if it is evident at the end of six months that the above 5-cent rate will not return a reasonable amount upon the investment, the commission will entertain a request for an increase in rates, provided it can be shown that the above rate is actually too low.

CURRENT NEWS AND NOTES.

NAVAL POST-GRADUATE COURSE IN ELECTRICITY.—It is reported that the Secretary of the Navy is considering the establishment of a post-graduate course in electrical engineering for commissioned naval officers. The present electrical course at Annapolis for midshipmen is a training course which deals more particularly with the routine operation of electrical apparatus and devices.

BALTIMORE METER TESTING ORDINANCE.—A Baltimore ordinance has gone into effect which provides for the compulsory inspection of all electric meters before installation, and a charge of 10 cents for each meter is imposed for this service. On complaint of a patron an inspection will be made at any time, and a charge of $1 is made, to be borne by the company if the error is ascertained to be more than 4 per cent, and by the patron if less.

CHINESE TECHNICAL STUDENTS.—The Chinese Board of Education has under way the establishment of a preparatory school at Pekin to fit students for entry into American colleges. One hundred graduate students from the school will be sent annually to America, 80 of whom will enter technical courses, and 20 will take courses in political science, finance and pedagogy. Until the school begins to turn out graduates the annual quota will be chosen at a special examination in Pekin, the first of which will soon be held.

PHILADELPHIA ELECTRICAL SHOW.—Plans are being perfected for a Philadelphia electrical show, to be held in the First Regiment Armory, Broad and Callowhill streets, Feb. 15 to 27, 1910. An artistic scheme of decoration has been adopted, a feature of which is a representation of Franklin and his kite, the latter being outlined by lamps near the roof and connected by a string of lamps to a statue of the philosopher. The exhibition will be under the management of the Electrical Exhibition Company of America, with present offices at 1522 Chestnut Street.

MAINE ELECTRICAL ASSOCIATION.—The first annual convention of the Maine Electrical Association, which will be held at Portland, July 29 and 30, will have several enjoyable social features. The Portland Electric Light Company will on the first evening of the meeting entertain the members at a dinner, and later at the theater. On the following day there will be an excursion about the harbor in a steamer, followed by a clambake. Twenty central stations have already joined the association, and a convention attendance of 150 to 200 is anticipated. Mr. Fred. D. Gordon, Auburn, is secretary of the association.

BOTTLED ELECTRICITY.—A Baptist clergyman, of Bayonne, N. J., who is described as a scientific student, who has contributed largely to technical magazines, announces that he has discovered a method for the elimination of thunderstorms, and of storing on earth part of the electricity in the clouds. His plan is to construct a huge steel tower reaching to the clouds, down which silently and harmlessly would be conducted the immense quantities of electricity to be there stored. All that would be necessary, he says, would be three city blocks on which to build a solid foundation. "There are 10,000 million volts of electricity in every flash of lightning two miles long. Bottle up this immense energy in storage batteries and sell it and in a year's time you could buy out Rockefeller. The clouds are charged with electricity and the supply is inexhaustible. By the use of such a tower and proper storage facilities thunderstorms in cities would be eliminated. I predict that within the next few years every city in the United States will build one large steel tower in its territory and will run its street cars and large power plants by only that energy drawn from the clouds."

TELEGRAM FILING TIME.—The Postal Telegraph Company is now, in accordance with a decision of the Court of Appeals of Maryland, complying with a law passed in that State requiring the time of filing of messages to be endorsed without charge on all messages delivered.

COLORADO ELECTRICAL ASSOCIATION.—The annual meeting of the Colorado Electric Light, Power and Railway Association will be held in Denver Oct. 7 to 9, coincident with the meeting in that city of the American Street and Interurban Railway Association. Mr. J. C. Lawler, Colorado Springs, is secretary of the association.

WIRELESS TELEGRAPH FOR BOSTON POLICE.—A recent wireless-telegraph installation has been erected by the Boston Police Department on top of the headquarters office of the force in Pemberton Square. The apparatus was constructed by members of the department having a mechanical bent and considerable success has been obtained in picking up night messages. A sending outfit is now in process of installation. This is thought to be the first wireless outfit of the kind in the country.

WIRE-TAPPING SCHEME DISCOVERED IN BOSTON.—Under the investigations of Superintendent John Campbell, of the special service department of the Edison Electric Illuminating Company, a wire-tapping scheme has been brought to light in Boston and the police have made an arrest in the case of an employee of the company, who is charged with unlawfully diverting a current of electricity for the benefit of certain customers. The scheme was the usual one of trying to by-pass the meter. Other arrests are expected.

ONE HUNDRED THOUSAND-VOLT COLORADO TRANSMISSION.—The full 100,000 volts was temporarily thrown on the Denver substation of the Central Colorado Power Company July 10. A secondary was connected for a few minutes to try-out connection with the steam stations of the Denver Gas & Electric Company in Denver, and a portion of the Denver load was carried by the power plant in Shoshone, nearly 200 miles away. This transmission is a portion of a general plan of water-power developments and transmissions being systematically developed.

CITY COMPENSATION FROM COMMONWEALTH EDISON COMPANY.—For the first full year since its formation, the Commonwealth Edison Company has paid into the city treasury of Chicago the sum of $269,752.15 as the compensation required by its ordinance. This is 3 per cent of the gross receipts of the company for the year ended June 1, 1909, and 10 per cent of the rentals of conduit space, the latter, however, being only a small proportion of the total amount paid. The gross receipts of the company for electric service during the year were $8,970,634. An advance payment of $100,000 was made to the city several months ago, on request, so that the check recently forwarded was for the remainder.

BOSTON ELECTRICAL SHOW.—At a meeting held June 29 by a number of gentlemen representing important electrical interests in America, it was decided to form an association along strictly mutual lines for the purpose of holding an annual electrical exposition in Boston. It was decided that to make an exhibition of this character of the greatest interest to the general public, with a consequent business gain to the exhibitors and the electrical trade in general, it should be conducted on a mutual basis insuring co-operation, and a plan to that effect was adopted. It was further decided to hold the first exposition in Mechanics' Building, Boston, on the only available dates, Nov. 15 to 25 (inclusive), 1909. Mr. Chester I. Campbell, 5 Park Square, Boston, is acting secretary.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS.—The executive committee of the Western Association of Electrical Inspectors has selected Oct. 26, 27 and 28 as the date of the 1909 annual convention to be held at Detroit, Mich. The headquarters hotel will be selected later. Addresses arranged for as follows: "Municipal Control of the Electrical Hazard," by Mr. James E. Cole, Wire Commissioner, Boston, Mass.; "Relation of the Manufacturer to Electrical Inspection Work," by Mr. Alexander Henderson, of the American Circular Loom Company; "The Technical Press and Its Relation to Electrical Inspection Work," by Mr. Jas. B. McCarthy, president Electrocraft Publishing Company. The secretary of the association is Mr. Wm. S. Boyd, 152 Monroe Street, Chicago, Ill.

CORPORATION TAX.—Advices from Washington state that an agreement has been reached in regard to the proposed tax on corporation income to be included in the new tariff bill. The chief changes are the reduction of the levy from 2 per cent to 1 per cent of the net earnings of corporations and the elimination of the Clapp amendment, which included holding companies within the scope of the tax. Other modifications are made harmonizing the different exemptions in regard to insurance companies and other ordinary concerns. The amendment will take the place of the House inheritance tax provisions in the formal report of the conference between the House and Senate. The changes have been approved, it is said, by Attorney-General Wickersham after conference with the President.

AMERICAN RAILWAY ASSOCIATION'S COMMITTEE ON ELECTRIFICATION.—The American Railway Association has announced the names of the members of the new committees chosen under the new constitution. The committee on electrical working, which will investigate and report on the progress made in the electrification of steam railroads, is composed of Mr. George Gibbs, chief engineer of electric traction, Long Island Railroad, chairman; Mr. L. C. Fritch, consulting engineer of the Illinois Central; Mr. J. F. Deems, superintendent of motive power of the New York Central Lines; Mr. J. D. Isaacs, consulting engineer, Union and Southern Pacific system; Mr. W. J. Harahan, assistant to president, Erie; Mr. C. S. Sims, second vice-president, Delaware & Hudson, and Mr. E. H. McHenry, vice-president, New York, New Haven & Hartford.

OUTING OF CONTRACT DEPARTMENT OF COMMONWEALTH EDISON COMPANY.—Members of the contract department of the Commonwealth Edison Company, to the number of 130, enjoyed the annual dinner and outing of the department at Riverview Park, Chicago, on the evening of July 13. The party proceeded to the park on special cars and sat down to an excellent dinner. There were no speeches, and after dinner the men were furnished with tickets to the various shows in the amusement park. Members of the party enjoyed themselves heartily and informally and were grateful for the courtesy of the company, which defrayed all the expenses of the entertainment. Mr. E. W. Lloyd, general contract agent of the company, was the chief guardian of the flock, and Mr. Louis A. Ferguson, Mr. John F. Gilchrist and other heads of departments were present as guests of the contract department.

AUDITORS' REPORT IN CHICAGO TRACTION REHABILITATION.—The expert accountants employed by the Mayor of Chicago have made their report after auditing the accounts of the Chicago Railways Company, following the recent controversy in which the Board of Supervising Engineers was involved. The report of the Mayor's auditors in relation to the accounts of the Chicago City Railways Company was made some time ago. The more recent report goes into the subject in detail, and the major portion of the report is taken up with a discussion of interest, principally whether the city is not entitled to interest when the company does not settle its partnership account with the city promptly on the date fixed in the ordinance. In relation to alleged rebates from manufacturers, which aroused so much discussion a few months ago, the present report says that only one instance of such a rebate was found in the case of the Chicago Railways Company, and that was for a comparatively small amount.

Underground Cable System in a Village of Two Thousand Inhabitants.

BY J. FRANZ.

IT is a well-known fact that underground cables are most desirable; and to undertake their installation in connection with a lighting plant in a small summer resort where only a night load is obtainable is a daring proposition. Large summer residences do not furnish as profitable an income to central stations as stores, apartment houses, etc. The installations in the former are large and the consumption comparatively small which means large cost at first for transformers, meters, lamps, etc., and increased core losses. The apparatus could be small enough for the average load were it not for the fact that on special occasions, such as parties and dinners, when the house is filled with guests, the installation is used to its full capacity. In the face of such conditions the Stockbridge Lighting Company, of Stockbridge, Mass., undertook to establish a plant with a capital of $25,000.

Two miles from the town there is a reliable water-power plant which offered to furnish electrical energy at a reasonable price. After due consideration the water-power company proposition was accepted rather than build a power station. A two-phase, 2400-volt, 66-cycle, four-wire, No. 6 transmission line was built, mostly on private right of way, to the nearest available point of the village, and a few consumers were taken on the trunk line. In order to obtain a suitable switch house, the company co-operated with other interests in building a small concrete structure (Fig. 1), one-half of which the Berkshire Street Railway Company uses as a waiting station, the other half being used as a switch house. The floor of this part is 6 ft. x 12 ft., the building being 10 ft. high. In this room is installed a Westinghouse marble switchboard having six outgoing, double-throw, double-pole oil switches, and two busbar switches, all of which are protected by cartridge plug fuses. There are also entrance switches, lightning arresters, and choke coils, all of the Westinghouse make, and a General Electric 8½-kw, constant-current transformer and panel, supplying a street-lighting system. From this center of distribution leave three No. 6 twin-conductor cables carrying 2400 volts, single-phase current to the three principal streets of the village. These cables, made by the National Underground Cable Company, are paper insulated. There is also a No. 6 twin conductor cable, cambric insulated, carrying 1000 volts, made by the Standard Underground Cable Company, to supply the street lamps. Two single-phase pole lines leave the station and feed the remotest houses, and also an overhead line for the street lamps on the outskirts.

The taps of the primary cables are carried direct into the houses to transformer vaults built of brick or concrete, with iron-lined doors. Conduits of fiber were used, being overlaid with a 3-in. covering of concrete. Most of the manholes are blind, being 2 ft. x 3 ft. x 3 ft., built of cement with cast-iron covers. A majority of these manholes are situated in lawns at the road side. Open manholes are only used from the switch house to the main street where five ducts are laid. There are only two ducts through the other streets. Draining the manholes was unnecessary, except in a few places, for the soil is of a gravel or sandy nature and, therefore, allows the water to escape freely. This made a substantial underground system at a minimum expenditure.

Three miles of double duct were laid with only 50 consumers connected, and with a possibility of 50 per cent increase. It is easily seen that secondary distribution was impracticable on account of consumers being too far apart. Where it was possible, more than one house was supplied from the same transformer. Two of the cables are continued overhead on pole lines, the cable ends being protected similarly to those at the switch house. The overhead lines cover about four miles of streets and are built according to standard construction rules; 30-ft., 8-in. top, chestnut poles being used and set at distances not over 100 ft. apart.

This work was completed in the fall of 1907 at a total cost of about $23,000. In the spring of 1908 the company was awarded a contract for public lighting to install 95 32-cp lamps, 51 to be connected with the underground cables, the remaining 44 being strung from the pole lines. Tungsten 5.5 amp lamps are used. The company receives nearly twice as much per year for each street lamp supplied from the underground system as for the lamp supplied from the pole line. A lamp-post is shown in Fig. 2. A No. 10 lead-covered cable tap is carried direct to the head of the post. The sheathing is permanently grounded to the lamp-post. As no loop-lines were possible there is a total of 14 miles of series lines.







FIGS. 1, 2 AND 3.—LIGHTING IN A VILLAGE OF 2000 INHABITANTS.

At three principal street intersections special lamp-posts (Fig. 3) are used. In the base of each are installed test switches. Similar switches are employed on the overhead lines making it much easier to find trouble on the line than if there were no sectional cut-outs. The lamp-posts vary in distance from 200 ft. to 400 ft. apart. While lamps at such distances do not illuminate the street brilliantly, sufficient light for a country town is obtained in marked contrast to the former oil lamps, which were placed at irregular intervals all over the village. The electric service is highly appreciated by all the residents. The cost of installing the underground street-lighting system was less than $8,000, and the 45 overhead lamps cost the company less than $3,000. The management has recently declared a small dividend from first year's earnings, so that the installation evidently pays. The officers of the company are: Mr. Allen T. Treadway, president, and Mr. Charles E. Hull, treasurer and manager. The Rogers Electric Company, of Lenox, Mass., was the contractor and had entire charge of the work.

The Power Plant of the University of Alabama.

By F. H. Sibley,
Professor of Mechanical Engineering.

THE University of Alabama is located at Tuscaloosa, a town of about 10,000 inhabitants, 50 miles southwest of Birmingham, in the heart of the coal and ore regions of the State. The campus covers a tract of about 400 acres, and is situated on the south bank of the Worrior River, a stream upon which the U. S. Government is spending several millions of dollars on the construction of locks in an effort to carry navigation from Birmingham to the Gulf. The location of the university is a fortunate one from both an esthetic and a practical standpoint. The region is high and healthful, the natural beauties of the country are great, and the campus itself, while at present undeveloped, offers some very attractive problems for the landscape engineer. On its practical side, the rapid growth of the Birmingham district, which is assured by the great deposits of ore, coal and limestone, all within easy reach of each other, promises to make this an ideal location for a school for the training of young engineers.

The university has been offering courses in civil engineering for 25 years, and there is a present enrolment of about 50 students. About two years ago a movement was started to develop the engineering department. The State Legislature appropriated $500,000, a considerable portion of which has been used for this work. A two-story building having a ground area of a little over three-quarters of an acre has been erected, and schools of mines, mechanical and electrical engineering have been established. Fig. 2 shows the ground plan of Comer Hall, the new engineering building, which is illustrated in Fig. 1. The middle portion is occupied by the power plant, which was designed to furnish energy for heat and light for the university and for the motors which are in use in the various shops and laboratories.



FIG. 1.—ENGINEERING BUILDING, UNIVERSITY OF ALABAMA.

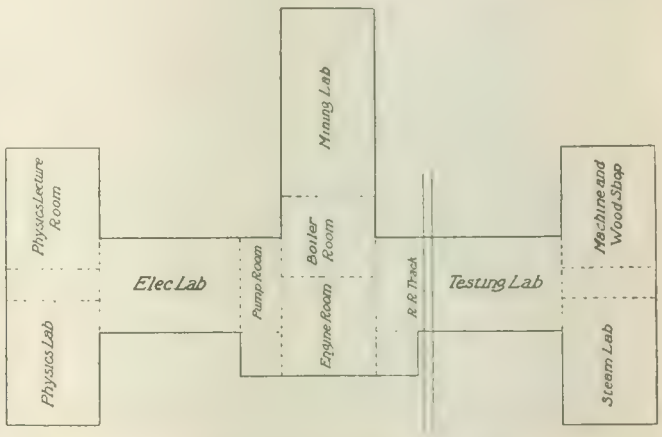


FIG. 2.—FIRST FLOOR PLAN, COMER HALL.

The boiler room contains two 150-hp water-tube boilers. One boiler is of the Erie City type, having the furnace fitted with a Jones underfeed stoker. The other boiler was built by the Walsh & Weidener Company, of Chattanooga, and has a Burke shaking grate stoker of the Dutch oven type. The boilers were built to carry a working pressure of 125 lb. and guaranteed to 200 lb. The steam piping is standard weight, as manufactured by the Crane Company, with medium-weight fittings.

The main generating unit in the engine room is a 160-hp Allis-Corliss engine, directly connected to a 100-kw Bullock generator. The steam and exhaust valves are operated by separate eccentrics, and the engine is designed to run either condensing or non-condensing. The secondary steam unit is a 40-hp high-speed engine belted to a Triumph generator. This unit is large enough to handle the minimum day load of the shops and laboratories when the lamps are not in use.

The generators are wound for an electromotive force of 240 volts. A part of the lamps at the university have been installed on the two-wire system and part on the three-wire system. Both of the generators being of the two-wire type, two small motor-generators, one rated at 10 kw and the other at 3.5 kw, are used to balance the load.

The exhaust steam from the engines is passed through an open heater which is located in the pump room, adjacent to the boiler room, and thence into the heating system. When the supply of exhaust steam is not sufficient to heat all of the buildings, live steam from the boilers is supplied around the heater through a by-pass and a pressure-reducing valve. Steam for the several buildings is supplied through a 6-in. main laid in a concrete conduit. The presssure in the mains is 30 lb., and this is further reduced at the various buildings to about 15 lb. per square inch. The radiation is of the vacuum-return type, the return water being brought back to the heater by a vacuum pump, where it comes in contact with the exhaust steam and is then pumped into the boilers.

The switchboard is designed for three generator panels, two balancer panels and two distributing panels. The instruments are of the Wagner round type and the switches are of the front-fused type. The current is carried through an underground cable to a junction pole, about 200 ft. from the switchboard, from which the leads to the various circuits are taken. Each circuit is controlled by a separate switch in the engine room..

In addition to the generator units already described there has been installed, largely for experimental work, a 35-hp gas producer plant. This plant was built by the Fairbanks-Morse Company, and was designed to handle, at least in an experimental way, any Alabama coal as well as coke and anthracite. The plant is unique and interesting in this particular, because no attempt had previously been made to burn hard and soft coals as well as lignites in the same generator. The special features are a combination of the company's regular anthracite generator with a tar extractor and purifier. The gas generator is larger than is generally furnished with a 35-hp plant, being the one generally installed with a 75-hp plant. When running with soft coals it is planned to use steam from the vaporizer under the grate to keep the temperature of the fire down and prevent clinkering. It will also be necessary when using soft coal to remove the lower magazine to prevent coking in the upper part of the generator. For lignites the generator will run complete as equipped, either with or without the vaporizer. For anthracite and coke the tar extractor is cut out.

The engine furnished with this plant is of the horizontal, straight-line, four-stroke-cycle type, and makes 275 r.p.m. Water for the cylinder jackets is supplied directly from the mains. A 1-hp air compressor is belted to the main shaft, delivering air at 130 lb. pressure to a receiving tank just back of the cylinders. This compressed air is used for starting the engine. The engine is belted to a 30-kw, direct-current generator running at 900 r.p.m.

It is proposed to make exhaustive tests with the gas producer plant in comparison with either the high-speed or low-speed steam unit, under the same conditions and with the same

fuel, and to demonstrate if possible the advantages of the producer, considering cost of operation, maintenance, stand-by losses and fuel. Furthermore, it is proposed to test the Alabama lignites in comparison with other fuels. The State of Alabama has a large available supply of lignite coal as yet practically unused. It has been estimated by Dr. Wm. F. Prouty, assistant State geologist, that the lignite in Alabama represents about 19,500,000,000 tons.

Comer Hall provides quarters for the department of physics and the four departments of civil, mechanical, electrical and mining engineering. The civil engineering department at present includes the work in mechanics and hydraulics. The south end of the building is occupied by this and the physics department. A full line of surveying instruments has been provided, and the equipment in offices and class rooms is suitable for the accommodation of probably 150 students in surveying. The physical testing laboratory was equipped by Tinius Olsen and Purdue University. It includes a 200,000-lb. testing machine, wire, torsion, drop and impact machines. The civil department also has a fairly complete outfit for testing cements and road materials. A spur track enters the building in this laboratory, and a pit is being constructed for locomotive tests.

The hydraulic laboratory and pump station are located on the University Branch of the Worrior River, a small stream having an average daily flow of 400,000 gal. A concrete dam has been built across the creek, giving a head of about 15 ft. and a storage of approximately 3,000,000 gal. The lake so formed will add much to the natural beauty of the campus.

The combined power house and laboratory is of concrete 30 x 40 ft. in dimensions. It contains a 10-hp Trump turbine belted to a 50-gal. triplex pump. A 10-hp motor has also been installed, so that the pump can be operated in dry weather. The water supply for the university is collected by gravity from springs in the hillside and pumped through a 6-in. force main to an 80,000-gal. tank, from which it flows to the distributing mains under a pressure of about 40 lb. per square inch. Under the floor of the pump house are constructed various tanks and movable weirs for measuring and controlling the flow of water for experimental work.

The electric laboratory occupies a room 80 ft. x 50 ft. adjacent to the physics department. The equipment for this laboratory has not yet been purchased, but as projected it will provide facilities for the usual laboratory practice in the testing and operation of motors and generators, lamps, storage batteries, transformers, insulators, etc.

The department of mechanical engineering occupies the north wing of the building. On the second floor are located the offices, draughting and class rooms. On the first floor is a combined steam and transmission laboratory containing an engine for valve setting and apparatus for testing gages, calorimetry and flow of steam. Oil- and belt-testing machines, a traction and absorption dynamometer and various minor equipment are being installed. On the same floor is the machine and wood shop. These will contain lathes, a planer, milling machine, drills, shaper, band and wood saws, trimmer and jointer and all small tools usually found in machine and pattern shops. A small forge shop and a foundry will be fitted up in a building in the rear of Comer Hall. These shops, taken in connection with the equipment proposed for the mining laboratories, will make it possible to illustrate every process in the manufacture of iron and steel from the ore to the finished machine. The shop and laboratory work is so planned that for the immediate future students will be occupied in constructing additional equipment under the supervision of skilled mechanics, and later on some simple machine will be selected and the time of the students in shop practice will be employed in its construction. The mining laboratory occupies the central wing of the building in the rear of the power house. The machinery for this laboratory was furnished by the American Concentrator Company. It is operated by a 70-hp motor and includes crushers, elevators, jigs and screens suitable for handling any of the Alabama mine products on a commercial basis. Smelting and assay furnaces will be added to the equipment in the immediate future. This mining equipment has attracted considerable attention from the manufacturers of the Birmingham district and already the officials of the United States Steel Corporation of the South have signified their intention of co-operating with the university in its further development.

Under normal conditions the demand for technically trained men in the Birmingham section greatly exceeds the supply. With the up-to-date engineering schools provided by the university, free from obsolete and useless equipment, with courses laid out in conformity with the best technical school curricula in the country and with experienced instructors in the shops and laboratories, it is hoped that young men from other parts o fthe South as well as Alabama will be attracted by the opportunities offered.

Electrical Devices for Handling Raw Material and Finished Product of the Indiana Steel Company, Gary, Ind.

One of the most prominent features of the equipment at the Gary plant of the Indiana Steel Company is the apparatus provided for handling the raw material. As shown in Fig. 1, along the slip where the ore is received in vessels, there are five monster ore unloaders and an equal number of bridges. Each unloader is of the grab-bucket type rated at 10 tons per lift, while each bridge is rated at 13 tons and is of the cantilever type. The former is equipped with six motors having a total rating of 435 hp, while the latter has 14 motors, the aggregate rating of which is 618 hp. The object of the bridges is to convey the ore to the point of use from a large concrete trough to which it is carried by the unloaders.



FIG. 1.—GENERAL VIEW OF ORE UNLOADERS AND BRIDGES AT GARY.

The master controller for operating the six motors on each unloader is mounted in a motorman's compartment arranged within the log of the unloader immediately above the bucket, the arrangement being similar to that shown in Fig. 2. Thus

the operators is able at all times to view the performance of the machine from the most advantageous position. No power other than that derived from electricity is used with the unloaders, all hydraulic cylinders, etc., having been dispensed with. Use is made of controlling mechanism which gives to the motors for opening and closing the bucket and for rotating the bucket the operating characteristics of hydraulic cylinders. Automatic



FIG. 2.—ELECTRICALLY OPERATED ORE UNLOADER.

"slow-downs" and "cut-outs" are provided for the trolley motors, so that the speed of the trolley automatically decreases as the bumping blocks are approached. Dynamic braking is employed on both the hoisting motors and the motors for moving the trolley.

In operating the bucket of an unloader it frequently occurs that more ore will be entrained between the jaws of the bucket than the bucket can hold, and as a certain pull cannot be exceeded without injury to the machine, owing to the fact that the bucket is suspended from the end of a steel leg some 40 ft. long, arrangement is made to limit automatically the torque of the motor. At the same time the controller is so arranged that when the load reached a certain predetermined amount the current is not cut off from the motor, but the torque is maintained at a fixed value, and when the load decreases the motor automatically starts up and completes the operation. In closing the bucket the operator simply throws the master controller to the closing position and leaves it there until the bucket is completely closed. In case the bucket grasps more ore than it can hold the operator simply starts the hoist motion, thereby allowing the surplus ore to drop from between the jaws of the bucket, at which time the motor again starts automatically and completes the closing operation. Lifting magnets have proved particularly advantageous for handling both the raw material and the finished product at Gary (Fig. 2). In the open-hearth stockyards, the cranes used for unloading pig iron and scrap from railroad cars are equipped with magnets provided with a controller so arranged as to cause the load to be released with great promptness. Current in a reversed direction is sent through the magnet winding when it is desired to release the load. It is said that the load is released in 0.6 second, while when this arrangement is not used 12 seconds are required for releasing the load. Skull-cracker cranes equipped with lifting magnets are in use at the open hearth and adjacent



FIG. 3.—ELECTROMAGNET LIFTING PIG IRON.

to the pig-casting machine for breaking up of defective castings and the skulls or chilled metal which accumulate on the linings of ladles used in handling molten metal. The cranes are mounted upon runways of exceptional height. Steel balls weighing approximately 12,000 lb. are used for breaking up the scrap and skulls. The material to be broken is unloaded from cars and placed on the ground by means of the magnet. A ball is then



FIG. 4.—ELECTROMAGNET LIFTING 60-FT. RAILS.

lifted by the magnet and hoisted to a suitable height and merely throwing the magnet controller to the "off" position releases the ball, which does the work of breaking the material. The broken metal is then gathered up by the magnet and loaded into boxes for charging into the open-hearth furnaces.

There has recently been put into operation at Gary a pair of lifting magnets for handling the output of the rail mill. The shipping yard of the rail mill is spanned by two special electric cranes, each equipped with double hoisting drums. Fig. 4 illustrates a pair of magnets suspended from one of these cranes lifting 30,000 lb. of rails 60 ft. in length, while Fig. 5 shows the same pair of magnets lifting a double-locked or nested layer of rails 30 ft. in length, 23 rails being handled at each lift. In other words, 10 or 12 tons of rails are handled per lift, depending upon the section of the rail. With these magnets an ordinary car of rails can readily be loaded in from two to three



FIG. 5.—ELECTROMAGNET LIFTING A LAYER OF 30-FT. RAILS.

minutes. In addition to the saving in time and labor which is introduced by these rail-handling magnets a further advantage is gained in that owing to the wide spacing of the magnets the rails are not strained and there is no danger of giving them a permanent set in the process of handling.

For controlling the motors on the above-mentioned cranes, as well as those on the ladle cranes, charging cranes, soaking pit

cranes, stripper cranes, etc., use is made of ventilated grid controllers of the type devised by Mr. A. C. Dinkey when superintendent of the electrical department of the Homestead Steel Works. The controller is operated by a lever having a straight forward and backward motion. When properly connected, the motion of the lever indicates to the operator the direction in which the motor will run. For instance, in the case of a trolley on a crane, when the operator moves the lever from him the trolley moves across the bridge away from him, and when the lever moves toward the operator the trolley moves toward him. This arrangement is found to be very valuable particularly in cases where one operator must operate a number of controllers, and where confusion on the part of the operator might result in serious damage.

The above-described controlling devices and lifting magnets were designed and built by the Electrical Controller & Manufacturing Company, Cleveland, Ohio.

Uniformity in the Photometry of Colored Light Sources.

By F. E. Cady.

In these days of high-efficiency illuminants the accurate determination of their intensity in terms of the standards in ordinary use is a question of considerable uncertainty, due to the difficulty of comparing photometrically lights of different colors. One of the principal objections to the Hefner as a primary standard has been its reddish color. The pentane, while not so bad in this respect, is still far from matching in color the Welsbach mantel. The introduction of the new metallic-filament lamps has only aggravated this difficulty and their rapidly increasing adoption makes it more and more imperative that they should be properly rated. It is highly desirable that the accuracy of photometric measurements in the comparison of light sources of the same color which has been so adequately demonstrated in the case of the carbon-filament secondary standards should be extended to the new types of illuminants.

The so-called "color" error has been a source of uncertainty to photometrists for many years, and the many efforts to obviate it are well known. Among these is the method of Crova, who by the use of colored glasses attempted to compare intensity in certain limited portions of the spectrum only. Many flicker photometers, no one of which has proved to be completely satisfactory, have been proposed in an attempt to solve the problem, using an entirely different principle.

There are two main reasons for the difficulty in photometering light sources of different color. First is the fact that when two contiguous surfaces illuminated by lights of different color value appear to one individual to be equally illuminated they may not appear so to a second individual. Secondly, it is much more difficult for an observer to decide when two such surfaces appear to be equally illuminated. The first condition might be met by averaging the results obtained by a large number of observers and calling this the value corresponding to a normal eye. The second might be met by taking a sufficient number of observations. The flicker photometer meets the second condition fairly well, but it has yet to be satisfactorily proved that the condition of equal illumination indicated by the flicker photometer is the same as that which would be determined by the normal eye working with the ordinary type of photometer.

There is a method which has been used at the Reichsanstalt,[1] and which has also been suggested by others, which may serve to meet both of the above conditions if properly handled. This method consists in the use of a glass color-screen on one side of the photometer so tinted that the illumination on the photometer screen is the same in color value as that produced by the source on the other side of the photometer. The conditions are then reduced to those ordinarily encountered in the photometry of sources of the same color.

If, then, a set of these screens differing in color value by small successive steps were prepared by the National Bureau of Standards and carefully standardized in accordance with the method described in the latter part of this paper, it would be possible for everybody so desiring to obtain accurate copies of these screens and thus eliminate the present lack of uniformity in the photometry of light sources of different color value. And it should be noted that such uniformity is much more important than the determination of the absolute candle-power value of a light source. Thus, it is evident that it is not so important to know whether a certain lamp has a value of, say, 16 cp or whether its value is 17 cp as it is to know that a lamp marked 16 cp by one manufacturer has the same illuminating power as a lamp marked 16 cp by another manufacturer. In other words, it is just as desirable to have uniformity in the rating of the new high-efficiency lamps as it was to have a common unit through which the old lamps have been brought into very good agreement.

It is evident that if such color screens are to be used they should have, among others, the following characteristics: First, the transmission should be uniform throughout; second, the tint should be the same throughout; third, the tint should be permanent and the transmission coefficient should remain constant; fourth, the surfaces of the plates should be very approximately plain and parallel. The last property becomes of especial importance when the screens are to be used under conditions differing somewhat from those under which they were calibrated. Fifth, it is desirable in order to have uniformity in the results obtained by different observers that the spectral absorption of the screen should be such that the color of the transmitted light is as nearly as possible spectrally identical with that of the light to be measured.

The method of using tinted color screens was introduced by Dr. E. P. Hyde at the Bureau of Standards during the incumbency of the author and was found to work very satisfactorily in determining the intensity of high-efficiency sources in terms of the standards of the Bureau.

A preliminary investigation led to the conclusion that it is necessary to subtract only a very small amount of the yellow, which is equivalent to adding a small amount of blue, to make a 4-watt-per-candle carbon lamp match a tungsten lamp in color. Through the courtesy of the American Optical Company, of Southbridge, Mass., a set of glasses combining most, if not all, of the above requirements, was obtained, of definite dimensions and graded in tint from a very light to a dense blue. These samples were marked from 1 to 6. It was then found by experiment that by using these, together with glasses having color values half-way between those given, it was possible to get a set of screens which would give a very fair color match in the photometer between the 4-wpc carbon on the one side and the 3.5-wpc carbon, the 3.1-wpc carbon, the 2.5-wpc Gem, the 2-wpc tantalum, and the 1.25-wpc tungsten on the other side.

Sets of these screens involving three different tints have already been calibrated at the Bureau and have not shown evidence of change over a considerable period of time.

The size of the screens was so chosen that they would fit tightly a brass case which was attached to one side, and always the same side, of the photometer head in such a way that no light could reach the photometer screen on that side without passing through the glass. Each plate was marked in one corner so that it could be placed in the brass case in exactly the same position whenever used.

In calibrating the screens there are several methods available, but that method which most nearly approaches the pure substitution method is undoubtedly the best. Thus, having as a standard a lamp whose voltage for a definite watts per candle is known, find the voltage of another lamp, called the comparison lamp, to be used on the other side of the photometer at which it matches the standard in color. Now place the color screen in position and take a set of readings. Then remove the color

[1] "Praktische Photometrie," Liebenthal, p.

screen and place on the same side of the photometer a sectored disk with an opening such that the intensity on that side is cut down to approximately the same value as that given by the color screen. The determination of the coefficient of absorption of the color screen is then a simple matter.

This method of calibration is as purely substitutional as it is possible to make it. The readings of the photometer come at the same point on the bar, thereby eliminating errors due to distance measurement, inequality in the ways, etc. All the conditions, aside from the use of the sectored disk and the color screen, are exactly the same. On account of the possibility of errors due to the Purkinje effect it would be highly desirable to standardize the color screen at a definite absolute illumination.

The method of calibration may be still further amplified by not attempting to calibrate the given screen directly, but by a step-up process involving one or more screens of colors intermediate between that of the standard and the glass to be calibrated. This method involves the possibility of multiplying errors, but it may be that the result would even then be more accurate than that obtained by the direct measurement.

Up to this point the color difficulty has not been eliminated, for the same sources of errors are present in the determination of the transmission coefficient of the color screen as enter into the measurement of sources of different color value.

But, if an observer makes a large number of different independent observations to obtain the transmission coefficient of a certain screen, he may consider the average to represent the best value which he would obtain for the given screen. If, further, this screen is similarly measured by a large number of different observers, the average of the averages of them all might well be considered as the value which would be obtained by a normal eye. The method, therefore, of using tinted glass color-screens offers a means of overcoming the two principal difficulties which arise in the photometry of light sources of different color.

It would manifestly be very expensive, if not impossible, for each person desiring to use such screens to calibrate them in the above manner. Such a calibration should be carried out at the National Bureau of Standards and a set of standard color-screens should be prepared in the manner outlined above. By virtue of its position, the Bureau, having prepared such a set of screens and made the local calibration, could then send them to different laboratories, both in this country and abroad, for calibration. It would then be possible to obtain international uniformity, which in conjunction with the proposed international agreement on a common candle-power unit would have far-reaching and most beneficial results.

This would result in a set of standard screens from which the Bureau could furnish certified copies to anyone desiring them. It is evident that their reproduction would not involve color errors and, therefore, if copies were used throughout the country there would result a uniformity in color photometry, and consequently in the rating of the present high-efficiency sources which would be very satisfactory.

It would be very interesting, if such a set of screens were thus calibrated at different laboratories throughout this country and Europe, to have them calibrated, also using a flicker photometer. This would give information as to the correctness of the assumption that the flicker photometer gives the true relation between light sources of different color.

It would seem that such screens could be used in all cases where it is desired to photometer light sources of different color, but the accuracy obtainable may not be the same in all cases. It is evident that for the highest accuracy the screens should be used under conditions as nearly as possible like those under which they were calibrated with a certain illumination falling upon them and with light of a certain color value, and the best results would be obtained if these conditions were duplicated in their use in practice.

Since, however, the conditions of use are by no means universally the same, it would be desirable for anyone needing such screens to determine first the conditions under which they are to be used and then specify similar conditions when requesting calibrations of the screens by the Bureau of Standards. In many factories, for instance, the sources under comparison, the test lamp on one side and the comparison on the other, are at a fixed distance from each other, the photometer being movable. Under these circumstances it is evident that unless a sectored disk is used, the illumination on the photometer screen will differ with the difference in intensity of the test lamps. In general, however, the limits of this illumination are known or may be fixed, and in this case it would be desirable to have the color-screen calibrated under two or more intensities of illumination representing the limits above mentioned. If these limits are too broad for the desired accuracy to permit of the use of a single value of the transmission coefficient, then the two values should be used.

If the type of photometer is such that it is not feasible to place the color-screen directly against the side of the photometer it may be placed adjacent to and at a fixed distance from the comparison lamp. Under such circumstances the request for calibration should give, in addition to the efficiency and the intensity of the comparison lamp, a statement as to the distance from the comparison lamp at which it will be used.

The method of using glass color-screens is equally applicable to the photometry of gas, but in this case the calibration of the screens might have to be modified.

The question may be raised as to whether in incandescent lamp photometry it would not be more desirable to standardize lamps of different specific consumption rather than to use the color-screens. There are advantages in this arangement, but there are also some disadvantages. In the first place, it would require a relatively large number of standards, for where one color screen would be used, several of the corresponding standard lamps would be desirable, as it is not safe to trust to a single standard. Furthermore, it would be necessary to change the comparison lamp and restandardize it for every lamp of different specific consumption photometered, and while this might not be objectionable in factories it might be very much so in testing laboratories. Again, the constancy of the high-efficiency lamps as standards has yet to be demonstrated.

Finally, while it is not claimed that the method of using tinted glass color-screens entirely eliminates the error in the photometry of light sources of different color, it would certainly seem feasible by this method to localize this error, if it can be called such. Moreover, there is no apparent reason why differences in the photometric comparison of light sources of different color should not be practically eliminated in the country at large, if not throughout the world, by the adoption of an arbitrary set of color values, through the use of color screens. We have, for the time being, adopted an arbitrary standard of light intensity, and why should we not adopt an arbitrary set of color values? Such action would make it possible to have uniformity in the photometry of light sources of different color value.

The Rouge-Faget Permutator.

In a paper entitled "The Permutator," read before the Armour Institute of Technology branch of the American Institute of Electrical Engineers, Mr. F. C. Zanzig gave a description of the Rouge-Faget permutator or rectifier for changing alternating current to direct current. The machine was defined as a rectifier in the strict sense of the word, consisting of a transformer having a non-inductive rectifier. The transformer action takes place in a hollow cylindrical core having a primary and secondary circuit. The former has a winding similar in every respect to that of an induction motor stator. The latter, however, consists of chord circuits connected to the segments of a fixed commutator about which a set of brushes rotate. These chord circuits are so arranged that when carrying the rectified currents gathered by the synchronously rotating brushes, there is produced in the core the same distribution of ampere-turns as is produced by the primary circuit. Stated mathematically, the distribution furnished by the primary coils

is ($I \sin wt$); by the chord windings it is $I_1(N_1 \sin wt_1)$ where N = number of primary turns; N_1 = number of secondary turns; I = maximum value of alternating current, and I_1 = value of direct current. Thus the inductive action, which corresponds to equivalent transformer action, is balanced.

Within the hollow core a synchronous motor armature rotates about a vertical shaft and drives a set of brushes about the fixed commutator. It is excited by the rectified voltage. The rotating field in the core, having considerable leakage flux interlinked with the windings, furnishes sufficient torque to

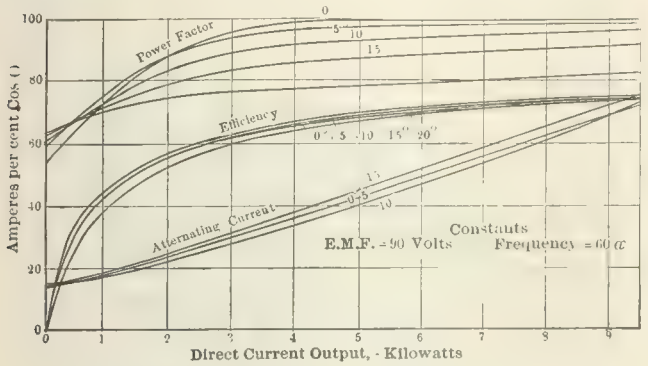


FIG. 1.—EFFECT PRODUCED BY VARYING BRUSH LEAD.

drive the light-moving members. This brush motor starts as an induction motor. At the instant the supply circuit is closed, an alternating current exists on the direct-current side of the machine having a frequency equal to the product of the line frequency, and a slip which decreases as the motor approaches synchronism. The impedance of the armature coils decreases, therefore, becoming negligible near synchronism. This allows sufficient current to circulate in the coils to cause the armature to fall into step with the rotating field and thus operate at

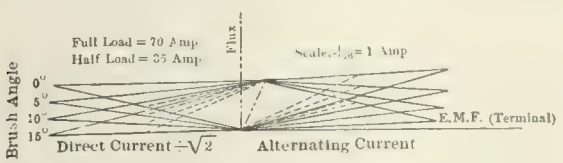


FIG. 2.—VECTOR DIAGRAM.

synchronous speed. The operation takes but a few seconds.

If it is desired to reverse the polarity of the brushes, it is only necessary to open the feeder switch for a few moments and again close it. If the desired result is not obtained, the process is repeated until the desired effect is produced. The brushes may be shifted relatively to the armature, thereby giving an adjustment of the commutating plane to suit conditions within the limits of sparkless operation. Because of the distributed chord circuits, sparkless commutation is obtained even with heavy overloads. The brushes when in the natural plane make contact with those segments of the commutator which are connected to the coils having the maximum induced voltage.

The curves given in Fig. 1 show the effect produced by varying the brush lead for any output. The angles given in this figure refer to the reading on a scale. For 10 deg. the brushes are in the neutral plane, for 5 deg. they lead by an angle of 10 electrical degrees, etc. The vector diagram, Fig. 2, shows vertically the results obtained by making the above adjustments. Thus it is seen, remembering this machine has an output of

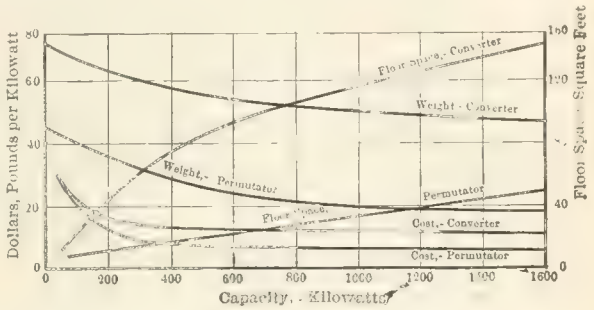


FIG. 3.—CHARACTERISTICS OF MACHINE.

only 9 kw, that the load characteristics compare favorably with a rotary converter—in fact, this is true for all sizes.

However, these results were obtained with a wave having an appreciable fifth harmonic; furthermore, since the excitation of the motor (machine self-excited) depends upon the rectified voltage, which in turn is a function of the brush position, it is evident that many peculiar phenomena may rise under abnormal conditions.

Mr. Zanzig brought out prominently the advantages this machine has over the converter. Some of these have already been mentioned. Briefly stated, the starting action is exceedingly simple and no starting apparatus is necessary. Synchronous speed is attained within a few seconds, and hunting is practically impossible. Hence it follows that the machine requires less attendance, and in fact can be operated remotely; if located in a substation, it can be controlled by the generating-station attendant. Further, transformers are unnecessary and the impressed voltage may have any value whatsoever, the rectified voltage being a function of the secondary voltage only. Since hunting is impossible, the machine may be operated in parallel without difficulty.

Fig. 3 gives some idea of the characteristics of the machine when compared with a converter in regard to weight, floor space and cost. It may be said that the customs duty (for the Rouge-Faget permutator is made in France) is not included in the cost of the permutator, but, on the other hand, the weight and floor space of the transformers which would have to be used with converters are not included. It is apparent that this machine can readily be placed upon an electric locomotive without the drawbacks of a converter under the same conditions.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Ethics in Salesmanship.

Mr. H. P. Albaugh, president of the Albaugh-Dover Company, of Chicago, a mail-order house, made an interesting address at the meeting of the Electric Club in Chicago on July 14, his subject being "Ethics in Salesmanship." The speaker said that salesmanship is a profession, and a noble one, too. It means taking hold of the minds of men and women and controlling them; there is no more important work in the world. The salesman has been accused of many things that are not true, or are true only to a limited extent or in relation to some unworthy members of the craft. Unlike love and war, all things are not fair in selling goods. Sharp, tricky methods sometimes result in a string of orders, and the conscientious man wonders if that plan is not after all the best. But sooner or later all nefarious methods will react on the perpetrator; the trickster is bound to fall by the wayside.

Considering the characteristics of real salesmanship, contrasted with the spurious kind to which he had alluded, Mr. Albaugh mentioned three essentials. The first is knowledge of one's self. Is the salesman fitted to carry the message of this company or that to the world? Efficiency should be built up on right lines. The successful salesman is not a copyist; he turns up things and does not wait for things to turn up. Every good salesman must originate methods. The second characteristic is enthusiasm. The man who sells goods must

have courage and faith. Lukewarm salesmen are worse than useless. The third essential enumerated by the speaker is an intangible, peculiar sort of ability which, for want of a better term, he called power of suggestion. This means the ability to cause men to follow the salesman's reasoning. There must be an appeal that will bring a response—an appeal no less worthy and dignified than that made by the preacher, the lecturer or the advocate at the bar.

Residence Wiring in Chicago.

Since Dec. 1, 1907, the Commonwealth Edison Company of Chicago has wired 945 houses and apartments for electric service. This wiring represents an addition of 26,715 50-watt equivalents to the company's connected load. Consumers are given two years to pay the expense of wiring their premises, which is charged substantially at cost and spread over monthly payments.

An Enterprising Colorado Hotel.

The Stanley, one of the leading summer hotels of Colorado, which has just opened its first season, employs electricity for all heating, cooking, and laundry work, of course, being lighted electrically. It has its own water-power plant with a total capacity of some 300 hp and with transmission at 6600 volts. The village of Estes Park and surrounding hotels are supplied from the same plant with their lighting. Mr. F. O. Stanley is the originator of this project.

Reduction in Rates in Chicago.

In accordance with the provisions of its ordinance, the Commonwealth Edison Company, of Chicago, announces a reduction in rates, effective Aug. 1. On and after that date all lighting bills computed from meter readings will be made out at a net charge of 6 cents a kw-hour for the low-rate portion, allowing 1 cent per kw-hour for payment within 10 days. This is a reduction from 7 cents. The primary charge will remain as before. It is computed that the percentage of reduction on the average total bill will range from 5.3 per cent for two-hour-per-day users to 13.3 per cent for 24-hour-per-day users. The general average reduction is figured at 6½ per cent.

Vacuum Cleaning at Paxton, Ill.

The Paxton Construction Company, which does electrical contracting in the city of Paxton, Ill., operates a vacuum cleaning outfit which was formerly taken from house to house in a wagon and operated with a gasoline engine. The gasoline engine gave trouble and occasionally stopped in the midst of operations, so that now the company uses a ¾-hp Wagner single-phase motor in place of the gasoline engine. A meter is carried on the wagon and the company being in very close relations with the Paxton Electric Company, which is the central-station company, is allowed to tap the 110-volt secondary distribution system at any point where it desires to operate the vacuum cleaning outfit.

Rehabilitation of Public Utilities in Boone, Iowa.

At a meeting of the city council of Boone, Iowa, on July 8, a franchise was granted to Messrs. E. E. Hughes, J. H. McBride and Andrew Stevenson to operate an electric-light plant, heating plant and street-railway system in that city, subject to ratification by the citizens at a special election to be held on August 16. It is reported that the gentlemen named have already secured an option on the properties of the existing Boone Electric Company, of which Mr. John Reynolds is president, and that it is their intention to proceed at once to the rehabilitation of the public utilities of the city. It is also reported that further interurban railway extensions from Boone are in mind, the first objective point being Story City.

The rates provided in the ordinance are favorable to consumers. The schedule for electricity to use for power provides for rates ranging from 9 cents to 3 cents a kw-hour. Consumption of 40 kw-hours or less per month is charged at the 9-cent rate, and there is a series of reductions at the rate of 1 cent a kw-hour until the consumer taking 400 kw-hours or over per month pays only 3 cents per kw-hour. The rates for electricity for lighting range from 13 cents to 6 cents per kw-hour. Consumers taking 20 kw-hours or less per month pay the 13-cent rate, and those taking 160 kw-hours and over secure the 6-cent rate, with various intermediate steps between. A 10 per cent discount is allowed on both light and power rates if paid in 10 days. The minimun charge for power is $1 for the first horse-power and 50 cents for each additional horse power, but no minimum charge for any consumer shall exceed $5 a month. The guarantees agree to furnish power and light in all parts of the city after November, 1910.

According to the system of rates established, each consumer is to pay for the entire quantity used by him at the rate his highest meter reading entitles him to receive. The further provision is included that in case a meter reading indicates a larger total debit than the next graduated quantity would produce, then the lower rate is to apply on the total bill.

In relation to street railways, the grantees have the right to the use of all streets for street car purposes, with a few exceptions. The fare shall be 5 cents, but 24 tickets shall be sold for $1. These tickets are good, however, only between the hours of 6 and 9 a. m. and 4 and 7 p. m. The charges for heating are not to exceed the present rate of 15 cents per foot of radiation annually. Street arc lights of 1200 cp are to be furnished on the moonlight schedule at $52.50 a year. In addition, tungsten incandescent lights are to be used in alleys.

Combined Electric Light and Ice Plants.

Every year sees an increase in the number of artificial ice plants. Many of these are installed in connection with electric lighting and power stations. Artificial ice manufacture was at one time confined almost entirely to the Southern States, but is gradually creeping north, and at the present time many plants are being erected north of the latitude of St. Louis. As the demand for pure ice increases, the zone within which an artificial ice plant can thrive is likely to continue to move gradually north, as it has done for the past 10 years.

In the smaller towns there are in many cases excellent reasons, based on economy, for the operation of electric lighting and ice manufacturing plants together. At the risk of wearying those central-station managers who have been operating ice plants in connection with their central stations for years we will point out some of the fundamental requirements of ice manufacture and the reasons why it fits in so well with central-station operation as conducted in the smaller towns.

A small artificial ice plant first of all requires a sufficient amount of distilled water to supply the tonnage of ice manufactured per day, as the air bubbles in "raw-water" ice are objected to by many classes of buyers. In the case of an independently operated ice plant this distilled water is supplied from the condensed exhaust of the engines which drive the ammonia compressor and pumps. In the case of a small plant equipped with uneconomical engines, this condensed engine exhaust in ordinary practice is about equal to the amount of distilled water required for making ice. In the case of an ice plant operated in connection with an electric light and power plant, which operates 24 hours per day, the exhaust already available from the electric light and power engines will in many cases be sufficient to furnish the necessary water for ice manufacture. In many cases of combined plants, however,

use has not been made of this exhaust, but an independent steam-driven compressor for the ice plant has been installed. In such cases the advantages of combining the ice and central-station business are the saving of a separate set of boilers for the ice plant, the saving of some fixed boiler losses, and the saving of a set of separate engineers and firemen. These savings are important. There is in many cases a chance to make an even more economical combination by driving the ammonia compressors and other pumps of the ice plant by electric motors. If the exhaust from the engines (on account of the other load carried) is more than sufficient to supply distilled water for ice making, the exhaust from a separate engine-driven compressor is not needed and the use of motor-driven pumps is usually more economical because the power supplying them is generated by larger and more economical engines than those with which the independent steam-driven compressor would be supplied. Under the conditions prevailing in many small plants, the addition of the load imposed by the ice plant motors will cause a relatively small addition to the daily coal consumption and will not increase the necessary investment in generating capacity because ice is manufactured only during the summer, and the lighting peak is usually in the winter.

Another ice and electric lighting plant combination is the use of an absorption system of refrigeration in place of the more commonly used compression system. With the absorption system a good-sized ice plant can be operated from the exhaust steam of a small electric lighting plant, by maintaining a small back pressure on the engines. The exhaust steam is used in the ammonia boiler, which takes the place of the compressor used with the ammonia compression system. As regards the use of power or steam, the absorption system is more economical than the compression system. The first cost of the installation, however, conditions being similar in the two cases, is about 25 per cent more than for a compression system and about double the amount of condensing water is required. If all the exhaust steam be used in the ammonia boiler, more ice can be made than there is distilled water to supply. This suggests making some of the ice of undistilled water and selling it at a lower price.

A good supply of cooling or condensing water is necessary in ice manufacture, as the exhaust of the engine must be condensed and cooled and the compressed ammonia must also be cooled. An ice plant with a capacity of 15 tons of ice per day, such as would be installed in many small towns, requires about 960 gal. of cooling water per hour under average conditions.

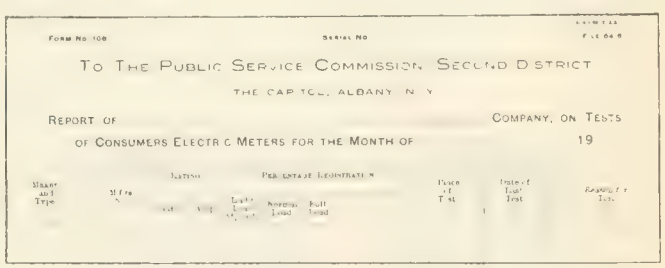
To sum up, the economy of combining ice with electric light and power manufacture consists, in the small station, of (1) the saving in duplicate crews of engineers and firemen (2) a saving in boiler, stack and boiler-house investment, (3) the saving of boiler losses caused by the operation of two boiler plants where one would suffice, and (4) the saving due to the utilization of exhaust steam now going to waste from the electric-lighting engines. These savings in the aggregate should amount to a considerable portion of the operating cost of ice manufacturing. The figures obtainable from some combination ice and central-station plants as to the investment and income from operation indicate that the combination of these industries has a very gratifying effect on the net earnings of both, so that the net earnings on the total investment are considerably better than with a central-station property alone. If a small central station with plenty of exhaust steam is so situated that it can utilize its exhaust steam for ice making in the summer and for steam heating in the winter, it is disposing of its by-products to the best advantage.

Results of Meter Tests.

The accompanying table gives data compiled from the meter-testing reports of companies which are under the jurisdiction of the Public Service Commission of the Second District of New York State. The information is furnished to the commission on a form of which a reproduction of the head is given herewith.

The data cover a period of nine months, from August, 1908, to April, 1909. As will be seen, induction and commutator types of meters are separately reported on, and the tests are classified as to place of test (station or premises) and as to whether the tests were initial, made on complaint or in regular order. As against 24.8 per cent of meters running too slow and therefore entailing loss to the central station, 10.4 per cent registered fast. Moreover, no less than 1087 meters were found not to register at all on one or more load points

Date	Induction Type Meters						Commutator Type Meters						4% or More Slow on Either Light or Full Load or Both		1% or More Fast on Either Light or Full Load or Both		Tested at Plant	Tested on Premises	Regular Tests	Initial Tests	Complaint Tests	Total Meters Tested	Found Not Registering	Companies Reporting Tests	Companies Reporting No Tests Made
	Light Load (5–10% Capacity)			Full Load (100% Capacity)			Light Load (5–10% Capacity)			Full Load (100% Capacity)															
	0–96	96–104	104+	0–96	96–104	104+	0–96	96–104	104+	0–96	96–104	104+	No. Slow	% of Total Slow	No. Fast	% of Total Fast									
Aug., 1908	495	3,210	195	151	3,441	148	1,077	638	200	217	1,503	200	1,605	27.6	616	10.6	1,421	4,473	3,934	1,039	921	5,894	159	84	106
Sept., 1908	554	3,460	156	165	3,854	151	1,103	650	196	243	1,489	217	1,642	26.8	565	9.2	1,869	4,250	4,751	1,225	143	6,119	158	98	83
Oct., 1908	444	3,305	147	175	3,639	82	1,575	1,058	342	457	2,157	301	1,996	29.3	712	10.5	2,138	4,673	4,937	1,593	281	6,811	128	100	85
Nov., 1908	432	2,979	146	174	3,288	87	1,307	1,032	448	431	2,057	299	1,802	28.4	782	12.3	2,066	4,278	4,606	1,358	380	6,344	181	108	80
Dec., 1908	524	3,540	208	181	3,942	141	1,153	746	354	365	1,669	221	1,730	26.4	749	11.3	2,115	4,437	4,607	1,406	539	6,552	131	121	68
Jan., 1909	399	3,515	277	113	3,992	133	933	745	330	276	1,574	169	1,369	22	756	12	1,759	4,507	4,033	1,617	616	6,266	98	125	74
Feb., 1909	516	3,552	225	145	4,038	168	881	841	295	263	1,627	143	1,471	23	661	10.3	1,692	4,714	4,592	1,305	509	6,406	80	112	81
March, 1909	669	4,279	292	214	4,833	177	830	900	265	250	1,567	136	1,539	21	703	9.6	2,497	4,808	5,260	1,703	342	7,305	80	122	72
April, 1909	576	4,571	219	164	5,076	182	836	782	208	198	1,456	122	1,461	20.1	612	8.4	2,257	4,998	5,665	1,395	195	7,255	72	109	86
Totals													14,615		6156		17,814	41,138	42,385	12,641	3,926	58,952	1,087		
Averages...	512	3,601	207	165	4,011	141	1,077	821	294	300	1,678	201		24.8		10.4									


Form No. 108 Serial No. Exhibit File 04-8

To The Public Service Commission, Second District

The Capitol, Albany, N. Y.

Report of Company, on Tests

of Consumers Electric Meters for the Month of 19

Station Per Centage Registration

Maker and Type | Mfr's No. | Test Load | Normal Load | Full Load | Date of Test | Interval Test | Remarks

FORM FOR REPORTS OF METER TESTS.

INTERIOR WIRING AND ILLUMINATION

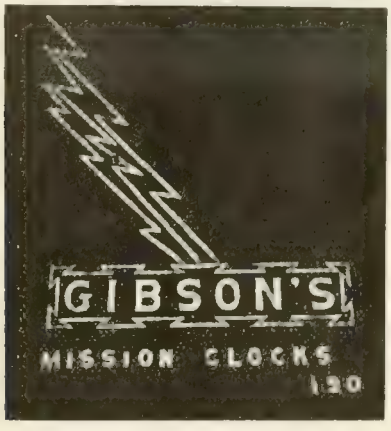
Special Lighting at Waukegan, Ill.

One feature of the recent "home-coming" celebration in Waukegan, Ill., was a special illumination of the streets by festoons of incandescent lamps erected and operated by the North Shore Electric Company. Festoons of light to the number of 15 were strung for a distance of three blocks along the principal street of the city. Each festoon contained 100 lights. The central-station company donated the electricity used in this special street lighting attraction, charging only for the

work of making the installation. The merchants were greatly pleased with the brilliant effect, and have now under consideration the organization of an association to maintain permanently the special decorative street lighting on the principal streets.

Electric Sign in Memphis, Tenn.

The accompanying illustration shows an electric sign recently installed by the Merchants' Power Company, of Memphis, Tenn. The sign is designed to produce a lightning effect and has attached to it a smaller sign, which is changed every week, advertising different sales, novelties, etc. The lightning



ELECTRIC SIGN IN MEMPHIS.

flashes encircle the entire sign, after which the word "Gibson's" appears and then the attraction. The sign extends from the roof of the building across the sidewalk, and has a double face. It burns every night from dusk until midnight, and is connected on a flat-rate basis.

Baseball by Electric Light.

Considerable interest the country over has naturally been manifested in the widely heralded baseball game by electric light, which was played under the auspices of the Grand Rapids Advertisers' Club on the night of July 7 at Grand Rapids Mich. The game was promoted by the club primarily as a means of raising money by attracting a large crowd, and as such was a great success. Forty-five hundred people were present—the largest audience ever seen on the Ramona Park baseball grounds, where the game was played. From the standpoint of the baseball game itself the illumination could hardly be called a success. The players seemed to be afraid to throw a swift ball, although several long flies were caught as far out as the center field.

The problem of illuminating such a field as this is, of course a tremendously difficult one, because of the great height to which balls sometimes go. Unless the illumination is such that the ball can be seen high in the air without the blinding effect of the lamps in line with the ball, baseball playing by artificial light can never be held a success. In the opinion of Mr. H. W. Hillman, sales manager of the Grand Rapids-Muskegon Power Company, the engineers of which company installed the electric lighting on the field, it may be possible some day to play a successful professional baseball game by artificial illumination. He considers three points are essential: First it will require an ample appropriation so as not to be hampered by lack of funds; second, it will require the services of an illuminating engineer to devote considerable attention to the matter in conjunction with those who have been through the experience of this first game and who understands the necessary improvements which could be made. He appreciates that it is a difficult piece of illuminating engineering which will require time and experience and then will be subject to improvements from time to time.

The baseball field for this game was illuminated by 40 lamps, 28 of which were flaming arcs hung high over the field. Two flood lights, following theater practice, were stationed at the ends of the main grandstands. There were 10 searchlights with which an attempt was made to illuminate the upper regions, but with little success. It is interesting to learn the results of this attempt, as it is only upon experimental knowledge gained in this way that future improvements, which may make artificial lighting of this kind successful, can be evolved. On the whole, the illumination must have been rather good for a first attempt, as the score of the seven-innings game was 11 to 10, with 20 hits and 2 errors on one side and 19 hits and 2 errors on the other side.

One spectacular and impressive feature of the evening's program was the sudden turning off of all the flaming-arc lamps and the concentration of the searchlights on "Old Glory" flying in the breeze on the field. At that instant a band struck up the "Star-Spangled Banner." The effect was exhilarating and inspiring and in an instant forced the thousands to their feet to take up the refrain.

Electric Lamps for Automobiles.

By Martin P. Rice.

Electric lamps have two important advantages for automobile lights which ought to insure their universal adoption. The first is safety, and the second is convenience. The increased speed of gasolene-driven vehicles under conditions and upon roads designed for horse traffic involves a sufficient element of danger without introducing the risk of fire from oil or gas lamps. While not perhaps so vitally important as safety, convenience is an advantage not less appreciated by all users of automobiles. Stopping to light up is sometimes annoying, particularly on a windy night, and the regulation of generators, gas tanks, or oil wicks is usually more or less of a nuisance.

All this is avoided by using electric lamps. They eliminate flame and inflammable material. They are lighted and extinguished instantly by a switch within easy reach of the driver. For cleanliness, they are unsurpassed. They produce no soot or smell, and there is no oil to leak or collect dust. There is practically no heat, so that the silvered mirrors cannot be damaged. The interior surfaces of lanterns fitted with electric lamps stay bright and clean. The electric system involves no difficulty in summer or winter—in fact, it is ideal for automobiles.

LAMPS.

The success of the system depends, however, upon the selection of suitable lamps and batteries and upon installing them properly. Carbon-filament lamps, because of their low efficiency,

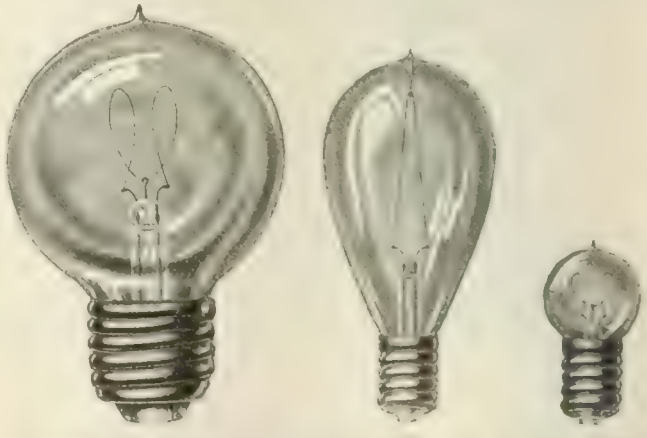


FIG. 1.—HEAD LIGHT. FIG. 2.—SIDE LIGHT. FIG. 3.—TAIL LIGHT.

would require a battery of almost prohibitive size and weight, but tungsten lamps can be operated from batteries of reasonable weight and dimensions.

The filaments of these lamps for low voltages are short and strong enough to resist the jar and vibration incident to auto-

mobile service. No special spring support is necessary and regular sockets can be used. Usually 6-volt lamps are employed, because this is the common voltage of ignition batteries, but 8-volt or 4-volt lamps may be used if preferred. The following equipment of tungsten lamps has been found suitable for a touring car or runabout designed for town and country use: Headlights, two 10 cp to 20 cp; side lights, two 2 cp or 4 cp; tail light, one 2 cp.

The filaments of headlights must be of compact form so



FIG. 4.—ADAPTER FOR CHANGING FROM KEROSENE TO ELECTRICITY.

that the light is concentrated practically at a point which may be adjusted to the focus of the mirrors. If the filament is not compact, light is wasted by scattering. Several leading manufacturers of automobile lamps are now making brass lamps with reflectors and sockets adapted to electricity, but usually they are designed for lamps with miniature base (diameter, ⅜ in.; length, ½ in.), which are entirely unsuitable. The headlights should be fitted with standard Edison screw bases (diameter, 1 in.) and the side and tail lamps with candelabra bases (diameter, 7/16 in.; length ⅝ in.). Some headlights originally designed for acetylene can be modified for electricity,



FIG. 5.—BATTERY FOR LIGHTING AND IGNITION.

but great care must be taken to adjust the position of the electric lamp so that a suitable beam of light will be reflected upon the road. A slight change in the position will make a remarkable difference.

Side and tail lamps designed for electricity may be much simpler in form and construction than lamps for kerosene, and while the latter may be adapted to electricity they include unnecessary parts, such as burner and oil reservoir.

BATTERY.

Tungsten automobile lamps will have satisfactory life at an efficiency of 1 watt per candle. On this basis, the required battery capacity may be readily calculated. Two 16-cp headlights, two 2-cp side lights, and one 2-cp tail light require about 38 watts; or, with a 6-volt battery, the current will be about 6.3 amp. A 100-amp-hour battery will supply all these lamps continuously for 15 hours without recharging. The lamps are so readily turned on or off that motorists will generally not use the headlights except outside of town, and the side lamps can then be extinguished. The number of hours of service with one charge will thus be considerably prolonged.

The battery is also available for engine ignition. It may be

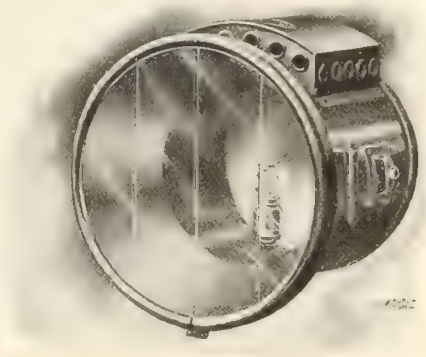


FIG. 6.—HEADLIGHT

recharged on any direct-current system, or from an alternating-current system with a mercury rectifier, or any device used for charging ignition batteries.

An electric system of automobile lighting requires much less weight in battery than is commonly supposed. A 100-amp-hour battery weighs 55½ lb., but it replaces the ignition batteries weighing probably 25 lb., and a gas tank weighing 30 lb.

WIRING.

The lamps should be connected on three separate circuits one including the two headlights, another the two side lamps, and the third the tail light. This arrangement permits the use of headlights and tail light for touring where the side lamps are not required, and in the city the side lights and tail lamp can be used without the headlights. The wire must be heavy enough to carry the current without appreciable drop in voltage and should be connected to the battery through a suitable fuse. Wiremen are liable to overlook the fact that low-voltage lamps are very sensitive to a drop which would be entirely permissible



FIG. 7.—SIDE LIGHT



FIG. 8.—TAIL LIGHT.

with 110-volt lamps. The battery leads and wires leading to the headlights should have a cross-section of not less than 10,000 circ. mils (No. 10). The wire for side lights and tail lamp may be smaller, say, 4000 circ. mils (No. 14). Flexible wire should be used, and on expensive cars it may be enclosed in brass piping so as to eliminate entirely any possibility of damage from short-circuits. A short length of rubber tubing should be used, however, to connect the brass pipe with the headlights, as otherwise the vibration may cause trouble. If a car is carefully wired with well insulated wire it will be perfectly safe without the brass piping, which, of course, adds considerably to the expense. As previously stated, the headlights should be

fitted with standard Edison screw sockets (diameter, 1 in.) and the side and tail lamps with candelabra sockets (diameter, 7/16 in.). The miniature sockets (taking a base 3/8 in. diameter) frequently used for this purpose are entirely too small to carry the current and withstand the vibration. The switch must be adapted for at least three separate circuits and it should be conveniently located on the dash within reach of the driver. Additional circuits are a convenience for a small lamp over the

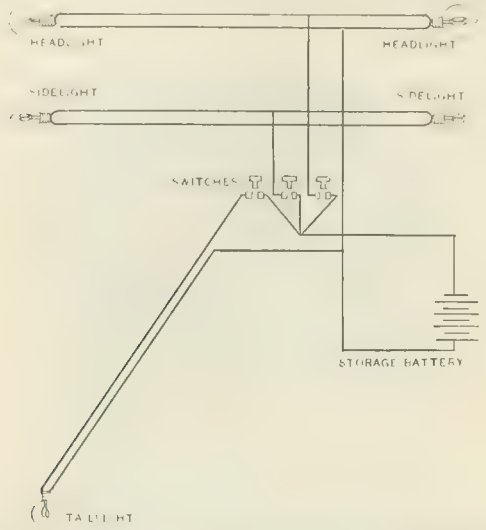


FIG. 9.—DIAGRAM OF AUTOMOBILE LIGHTING CIRCUITS.

speedometer, a portable trouble lamp (4 cp), and a lamp of about 2 cp conveniently located for the inspection of maps or road books. Switches of the type shown in the illustration are made up for various circuits from one to four

COST.

The cost of equipping a car with electric lamps depends, of course, upon the material selected and the charges of the wire man employed. The following will serve as a rough approximation:

One 100 amp-hour, 6 volt battery	$[illegible]
One battery box for running board	5.00
Two 16-cp, 6-volt tungsten lamps	[illegible]
Three 2-cp, 6-volt tungsten lamps	1.50
One 3 or 4-circuit switch	1.50
50-ft. twin conductor	[illegible]
Wireman's time	3.00
Total	$49.50

The cost of brass lamps has not been included in the estimate because it is substantially the same as for gas and oil lamps. The cost of two standard and three candelabra sockets, which will be required if gas or oil lamps are modified for electricity, is about $1.50.

SUPERIORITY.

The small 2-cp tungsten side and tail lamps will give a brilliant light never seen in kerosene lamps even when new; and as there is no soot or heat to damage the glass and reflecting

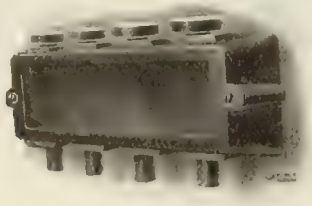


FIG. 10.—FOUR CIRCUIT SWITCH.

surfaces, and no deterioration, the brilliancy will be permanent. Electric lamps cannot blow out. The 20-cp tungsten headlights, when properly adjusted with reference to the mirror, will fully equal the best acetylene lamps.

For safety and convenience, electric automobile lamps are unsurpassed and will speedily be included by manufacturers as part of the standard equipment of all high-grade cars. They are equally advantageous for motor-boat lighting.

Newark Merchants Light Market Street with Flaming Arcs.

By William H. Stuart.

While 150,000 expectant people surged through Market Street at 8 o'clock in the evening of July 14, Mayor Jacob Haussling turned on the switch and transformed the thoroughfare into what may well be considered the most brilliantly lighted street in the world.

As described in the columns of the *Electrical World* of May 27, 1909, the merchants of Market Street, banded together in the Market Street Business Men's Improvement Association, have erected 58 double flaming-arc lamps of 9000 cp each, which extend along Market Street from the Pennsylvania Railroad Station to the Court House, a distance of three-quarters of a mile. This equipment was augmented by strings of incandescent lamps placed at close intervals along the street. The merchants added to the display with large electric signs and illuminated their buildings with outline incandescent lighting. It is estimated that the entire equipment easily reached a total of 2,000,000 cp.

In one window on Market Street an enterprising storekeeper had a novel display. Standing alone was a lighted candle. Beside it was placed a sign reading: "One candle-power." The dim, pale light thrown from the candle was useful as a means of comparison and created considerable attention from the spectators.

The scene at the turning on of the lights was spectacular. At 7:30 p. m. the regular electric signs, which are placed on the front of the Market Street buildings—and it might be added that there are as many of them as on any other street in the country for a similar distance—burst into brilliance. Then the extra outline incandescent lighting on the big buildings sent forth their glow. One large department store had a mammoth shield made up of strings of vari-colored lamps. A few minutes later and the street incandescent circuits were turned on. Finally came the big display, when the 58 flaming-arc lamps were started burning. At this point the merchants set off colored fire and fireworks, and many lighted paper balloons were sent up from the roofs of the buildings.

After the display was started the Merchants' Association held open house at their headquarters. The work, hopes and aims of the association were briefly told by Mayor Haussling, former Mayor W. H. Fiedler, Board of Works Commissioner, and also the chairman of the lighting committee of the city, Mr. Geo. H. Lambert, Mr. W. J. Wakefield, Jr., the president of the association, and other prominent citizens.

Newark has secured widespread notice from this form of street lighting. A number of Western cities have sent committees to inquire into Newark's street lighting, and locally it has not only well advertised that section of the city, but has increased trade fully 25 per cent since the time the illumination has been started.

Mr. W. J. Wakefield, Jr., the president of the Market Street Business Men's Improvement Association, said: "We really had to do something in the way of electric display, since South Broad Street was illuminated by flaming arcs last winter, or be left in the dark figuratively and actually. After our association was formed we worked hard and faithfully to brighten the street and in a few months' time had our scheme in actual operation. Newark has never seen such a demonstration as occurred when our lights were turned on. We had most all of Newark out to see it. Trade conditions have answered wonderfully under the stimulation of this lighting. Every merchant along Market Street is well pleased and encouraged as a result of this undertaking."

North Broad Street will in a short time install a flaming-arc lamp equipment, and the citizens are already talking of the wonderful "Great White Cross." Broad Street crosses Market, and when the plans are put into effect there will be about a mile of flaming-arc lamp lighting on Broad Street and three-quarters of a mile on Market Street, forming a large cross.

New Telephone Patents.

REPEATER DEVICE.

As the repeater problem is largely one of mechanical arrangement and efficiency, inventors are striving to bring out better and more efficient mechanical relation of the repeater parts. A patent granted to Mr. H. R. Stuart, of Wheeling, W. Va., shows, in Fig. 1, a sectional view of the repeating instrument.

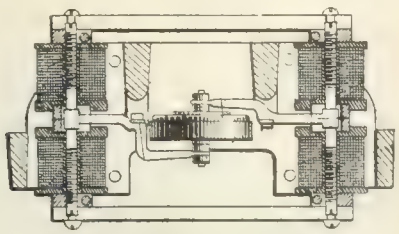


FIG. 1.—STUART MICROPHONE.

Both electrodes of the transmitting element are movable, each attached to a lever the far end of which carries a cylindrical armature. The coils are connected up to have the proper coactive relation.

NEW CIRCUIT ARRANGEMENTS.

In intercommunicating systems of the common-battery type, where the hook switches at the stations entirely control the completion of the battery current circuits, there is a chance for a waste of current and the running down of the battery. To obviate this Mr. W. A. Fricke, of Chicago, Ill., has devised a circuit wherein the home switch at one station in its actuated position must co-operate with the home switch of the connected station in its normal position, before the battery-supply circuit connected. The patent for this system is assigned to the Monarch Telephone Manufacturing Company.

For such long multi-station lines as are used for railroad despatch lines, where the receiving station, so to speak, is always at one end, there is some advantage in regulating all stations, no matter how remote, to the same transmitting volume. To this end he arranges a shunt circuit at each station, adjusted to correspond to its distance. A push button serves to connect the shunt during the transmitting period and thus send a corresponding output of voice current to the receiving despatch station. The transmitter batteries may be correspondingly graded and the receiving efficiency of the stations varied by including graded series condensers in the receiver circuits.

GENERATOR FOR COMMON BATTERY CURRENT SUPPLY.

It has always been found necessary to use a storage battery in connection with the current supply for a common battery telephone system, as such a low resistance shunt is necessary in order to absorb the commutator fluctuations of the usual direct-

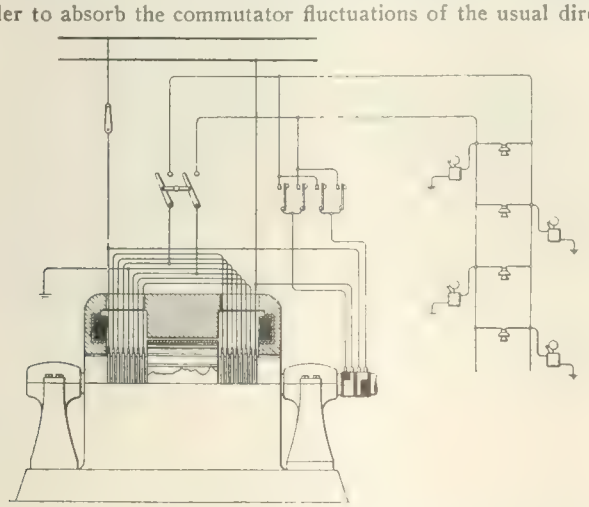


FIG. 2.—HALL SUPPLY SYSTEM FOR TELEPHONE CIRCUITS.

current generator. The unipolar generator has often been suggested as a solution of the problem of direct supply, but thus far there has been no commercial use of the unipolar machine for telephone working; however, inventors are still working on the problem. Mr. J. I. Hall, of Schenectady, N. Y., has recently patented a unipolar machine for this particular purpose, which carries enough of the field-cutting conductors connected in series to generate the desired potential. A commutator is suggested for the shaft of the machine to generate signaling current also. Mr. Hall has assigned his patent to the General Electric Company. A sketch showing the arrangement he has in view is shown in Fig. 2.

MISCELLANEOUS.

Some time ago we noted a patent covering an enclosing case for a portable telephone which was sound-proof. The face of the user closes an opening in the case when his mouth confronts the transmitter mouthpiece, the edge of the aperture being faced with a cushion. Two patents have been recently issued for improvements, both assigned to the Miniature Telephone Booth Company, of New York. One of these, granted to Mr. O. H. Goodrich, of Castleton Corners, N. Y., describes an adjustable linkage, connecting the hook support outside, the box, with the hook switch of the telephone set within. The adjustment provides for varying styles of telephone instruments. The second patent, granted jointly to Messrs. E. F. Hutton and G. A. Ellis, provides an impervious lining inside a felt lining so as to provide means for disinfection. One side is removable so that the instrument may be readily removed for repairs.

As a means of protection, Mr. M. Bowman, of McHenry, Md., has invented a disconnecting device for mounting upon the house wall, which consists of a box-like frame, to terminals upon which the instrument wires are led. The line wires are connected to terminals upon a slide piece, which slides in a vertical plane upon guides attached to the box frame. When this slide is pulled up the line terminals engage spring terminals attached to the box terminals. A rope within the building suffices to raise or lower this slide.

LETTERS TO THE EDITORS.

Value of Classics in Engineering Education.

To the Editors of Electrical World:

SIRS:—I have read with considerable interest Dr. Steinmetz's paper on "The Value of Classics in Engineering Education," and like so many of Dr. Steinmetz's writings, it is certainly a most concise statement of the arguments usually used in favor of requiring students in our colleges to study the ancient languages. There are a few points brought out in his paper, however, which to one not wholly unacquainted with the classics seem open to argument and even doubt.

Dr. Steinmetz states that "the introduction to other branches of human thought are best and quickest given by the study of the classics." It seems to me that an acquaintance with "the world of art and literature of ancient Hellas" can be acquired as advantageously, and certainly more quickly, through translations than through the laborious work required to "dig" it out of the original. I am not denying the value of the discipline acquired by the hard study required to master the 1500 more or less different forms of the Greek verb. That is another phase of the question. The history of the ancient civilizations, their social and political organizations can undoubtedly be acquired through other channels than the ability to read the original.

I am also of the opinion that the utilitarian value of the classics is considerably overrated by Dr. Steinmetz. If the student has had the proper training in English, which should include a good course in etymology, he will be able to get at the fundamental meaning of scientific terms. If very few of "the college students retain even a rudiment of their knowledge of modern languages," of classics the engineering student, I am afraid, would retain nothing.

My main objection to Dr. Steinmetz's advocacy is the enormous waste of time required to acquire an appreciative reading knowledge of the classics in the original.

The most serious objection to the merit of any discussion concerning the relative values of college studies lies in the fact that everyone seems to discuss the question from the viewpoint which has been determined by his early training. Because men

who have been trained in the classics have become eminent in various fields of endeavor does not seem to me conclusive that everyone should follow the same route. Perhaps it will be advisable for us to revise our conception of a liberal education.

Madison, Wis. C. M. Jansky.

Photometric Comparisons.

To the Editors of Electrical World:

Sirs:—In your issue of July 1, on page 53, there is given a cut with a short article, entitled "Device for Photometric Comparisons." Inasmuch as the method therein described is extremely limited in its application and may, in the hands of the untrained, lead to serious mistakes, I would call your attention to the following:

The use of the method as described is limited to one angle, and one only, providing the position and the height of the lamps and reflectors are fixed, as is shown in the illustration. It is evident that the box could not be moved nearer one lamp than the other, and, consequently, the method is correct for only one position. Inasmuch as any photometric device is apt to be extremely misleading when shown for one angle only, it is evident that such a device must be used only with the utmost care, and cannot be used in showing respective merits of two reflectors for the reason that as a rule the value of any reflector is not confined to the light in any one angle, but has to be considered over a considerable range. Moreover, it is evident that the use of such a device would be applicable only with certain types of reflectors. If, for example, a strong concentrated light were wanted directly underneath, as is common practice in window lighting, and the customer were to judge of the effect by any such method as this, he would in all probability get a reflector giving a broad distribution of light, which would be entirely unsuited for this work.

It is, therefore, easy to see that such a method, while applicable for one special angle, is apt to be extremely misleading when shown to a non-technical observer, and should therefore be used with the utmost caution.

New York. V. R. Lansingh.

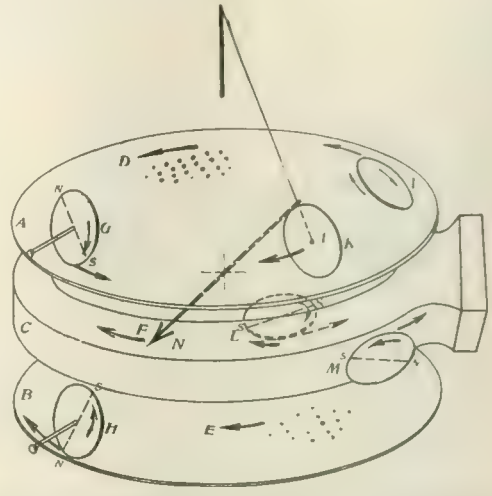
Movement of Magnetic Material in a Rotating Field.

To the Editors of Electrical World:

Sirs:—The following notes relating to observations made by the writer and Messrs. Lénárt and Pfaff serve to draw attention to a peculiar phenomenon of the magnetic field and include an outline of an explanation therefor.

Two plates, *A* and *B*, of non-magnetic material, were placed at some distance above and below the stator (primary) of a polyphase induction motor, the rotor of which had been removed. The front faces of the stator and both of the plates were in horizontal planes. When very fine iron filings of uniform shape were placed on each of the plates and the primary circuit of the motor was closed, it was found that the filings on one plate moved in one direction while those on the other moved in the opposite direction. An exploring magnetic needle *F* showed that the filings on the lower plate *E* moved with the rotating magnetic field, whereas those on the upper plate *D* turned in a direction opposite to the field.

The facts observed are attributable to the circular motion around their center of mass into which the iron filings are thrown by the rotating magnetic field; the approaching field produces in the filings poles of opposite sign and the reciprocal action causes them to turn over. In confirmation of this explanation, an iron button free to revolve around a pin at its center was placed first on the upper plate and then on the lower, at *G* and *H*, respectively. In each case the button assumed a rotating motion, the direction being as indicated in the illustration. When the pin was removed from the button and it was allowed to move freely, a rolling motion was produced, as shown at *I*, the movement being in the direction of the rotating magnetic field when the button was on the lower plate, and in the opposite direction when it was on the upper plate. When the button was suspended from a thread the upper end of which was fixed in the axis of the stator bore, the button



Movement of Magnetic Material in a Rotating Field.

traveled with the rotating field—that is, it moved in a direction opposite to that in which it rolled along the upper plate.

When iron filings were placed directly upon the body of the stator, at either the flat surface *L* or the cylindrical surface *M*, they rotated in a direction opposite to the revolving magnetic field, on account of the rolling motion.

The above-described experiments show that the direction of movement of a revolving magnetic field may be incorrectly judged when iron filings are employed. The only proper method for ascertaining the direction of motion is by means of an exploring magnet placed in or near the center of the stator bore.

Selmeczbánya, Hungary. Gera Boleman.

Location of Vessels by Wireless Telegraphy.

To the Editors of Electrical World:

Sirs:—I was much pleased to read the letter of Mr. L. Espenscheid in your issue of May 13, as it gives me an occasion to make a comparison between the "multi-aerial radiogometer" of Messrs. Bellini and Tosi and my own.

I willingly admit the superiority of the "radiogometer" where

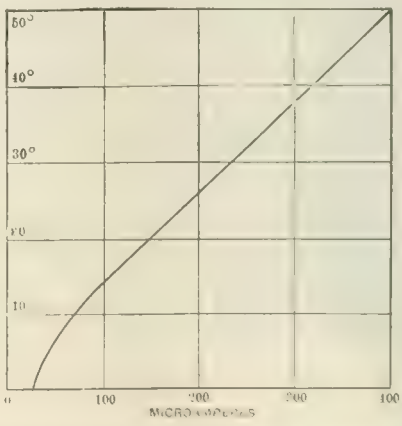


Fig. 1.—Throw of Instrument for Various Currents.

it can be properly applied, and especially when, instead of employing the telephone receiver a barretter-set is used. The telephone receiver is not suitable for any measurements of the kind, and its use by unskilful operators on the high seas, espe-

cially in time of excitement, is impracticable, even in the absence of fog whistles, which hinder all kinds of null methods depending on audibility.

The objections raised by Mr. Espenscheid may be met as follows:

First, the exact measurement requires only the reading of the deflections of the microammeter (pointer galvanometer). This can be done by the crudest operator working near the strongest fog whistle. The whistles do not disturb the deflections; this statement cannot be made of the human ear, which is generally employed with a radiogometer. The reading of the deflections is objective; it can be done by many persons at the same time, so that there is no hallucination, as may be the case when the ear is depended upon.

Second, although the barretter-set measures weak signals, as the curve of Fig. 1 shows, yet it is not delicate, as may be judged from Fig. 2, which shows a portable military set.

Third, the incoming signals really vary in strength, but this fact hinders only the null method of measurement by which the finding of the null point requires from 10 to 20 times as much time as does the reading of the deflection of the microammeter. If 20 readings are taken of the microammeter probably the average will be a good one. The more readings, the better the results. However, one can see at once whether



FIG. 2.—PORTABLE WIRELESS SET.

a reading is extraordinarily devious, and in this case the value will not be applied, and the measurement will be repeated.

Fourth, the interfering signals can be seen also. For instance, when the imperiled ship sends 200 microamperes in the letter *t* and if one receives also the signals of a rescuing ship, say, the letter *i* with 100 microamperes in the first second, the microammeter shows 300, the next second only 200, the third perhaps again 300 microamperes and so on, as the dashes and dots interfere with the ground signals of *t*. The pointer follows momentarily the increase of current strength, and hence, after some experience, the observer cannot be misled by interfering signals. Naturally, it is more convenient to operate when interfering signals are not present, especially from the point of view of the null methods with slower working, since the "radiogometer" cannot be used if waves are emitted simultaneously from several different vessels.

I believe that the chief difficulty exists when the imperiled ship moves in zig-zag lines, but I hope that the excellent graphical method which you have depicted in your editorial note will enable further developments. I should be very glad if the correct graphs for moving ships would attract the attention and interest of someone concerned in these matters.

BUDAPEST, HUNGARY. BÉLA GÁTI.

The International Electrotechnical Commission—Some History-Making for the A. I. E. E.

To the Editors of Electrical World:

SIRS:—In your editorial commentary on the *Transactions* of the International Electrotechnical Commission, in the issue of May 27 (p. 1255), I find the following statement: "In the absence of an official delegate from the A. I. E. E., Mr. C. O. Mailloux, then in London, attended the sessions at the direct invitation of the honorary secretary."

This statement might be taken to imply that I was still some sort of unofficial delegate of the A. I. E. E. on that occasion. I would like to have it understood, distinctly, that such was not the case. The truth is that I had declined, and quite emphatically, to be the delegate of the A. I. E. E., and that, instead of merely happening to be "then in London," I *went* there *on purpose* to attend, on the invitation of the honorary secretary. I had decided on this course before I left America. I accepted that invitation because it was a *real* honor, evincing due appreciation of the services rendered by Dr. F. B. Crocker and myself, in 1906, at the time the commission was formed. The most important work done then—that which was most vital to the organization of the commission—was done by Colonel Crompton, Dr. Crocker and the writer. Without this work—and I must not forget the valuable services of the indefatigable secretary, M. le Maistre—the commission would have been stillborn. Those who are disposed to doubt this statement can find evidence supporting it on almost every page of the printed records of the sessions of 1906. The special vote of thanks given to the writer (the only vote given to a delegate) is of itself sufficient indication of the part played by the delegation of the A. I. E. E. at the time.

Many persons have wondered why I refused the "honor" of being again the delegate of the A. I. E. E. at the last meeting, in October, 1908. It is because I deemed it not an honor but a humiliation and an insult, under the circumstances. We have heard of the person who finally got tired of being "played for a sucker." I admit that I was, and I add that I am still, in that frame of mind, in regard to my participation in gatherings of an international character. I know that this is a strong statement; but I think I am justified in making it. I think I have had at least as much experience as anybody in the A. I. E. E. in gatherings of this kind. I know some interesting incidents—*quorum pars fui*—and a few inside facts and details relative to some history-making in which the A. I. E. E. was more or less deeply concerned; these will suffice as a basis for my statement. I think it worth while to recall some of them.

Let us go back to 1900. In August, of that year, in Paris, at the Electrical Congress, the A. I. E. E. escaped a great set-back or defeat, and won a great victory at the last hour. How was the rout turned into a victory, and by whom? Ask Hering, Pope, Arnold, Crocker, Weaver and others of the A. I. E. E. who were there. To appreciate fully what that victory meant let us see how matters stood just before the "battle." The A. I. E. E. was the sponsor and the advocate for two new units, the "maxwell" and the "gauss." In spite of the heroic efforts of their two formal champions, Kennelly and Hospitalier, and the good work done by them in the special committee appointed to report on these units, the prospects of favorable action had become less and less bright and more discouraging as the end of the congress approached. At the last session of Section A (physics section), on the morning of the last day, the committee report, when presented by Hospitalier, chairman of the committee, had led to a spirited discussion, which had revealed immense and seemingly unsurmountable opposition to these units on the part of men like Mascart, president of the congress; Kohlrausch, of Germany; Ayrton, of England, and many other eminent and influential men. Kennelly had left for America .the day before. Dr. Crocker had also left Paris. Hering, then president of the A. I. E. E., Hospitalier, Weaver, and the writer, were about the only ones

left who had the courage to defend the units. In spite of our protests a course was decided upon—a clever move on the part of Mascart, who presided—to put these on the shelf. They were not to be even proposed for recognition or acceptance as international units. The few who still favored giving these units international sanction instead of burying them alive, got together, after the session of Section A, to hold a sort of caucus during lunch—at "Foyot's." There was, undeniably, a general feeling of despondency and discouragement. Indeed, all except *three* of those present felt that there was nothing more to be done; that the battle had now been fought and lost. Hospitalier, our stanchest friend in this fight, had given up hope, and was in favor of accepting the verdict which had just been rendered in Section A. He feared that the appeal to the "higher court" of the Chamber of Delegates, where Mascart was to preside also, would result in a still more crushing defeat and the total discrediting of the units. There was certainly much wisdom in his advice, based as it was on thorough knowledge of all the circumstances and men against us. The three, and the only three who still stood firm and were disposed to fight *"quand mème"* were: Carl Hering, *president;* W. D. Weaver, *Editor Electrical World*, C. O. Mailloux, *layman delegate*. These three decided that the A. I. E. E. would *not* "give up the ship," but would take up the fight again that afternoon in the Chamber of Delegates. On account of his knowledge of European men, manners and languages the writer was made the "minority leader." It was a "job" that was bound to be "strenuous," like that of Leonidas and the 300. We were entitled to *three* delegates for the United States. I was "made" one of the three for the occasion. As we left Foyot's, Hospitalier said to me that I was about to beard a lion in his den; and that I would be "chewed up" in short order and without ceremony, by the great and influential Mascart and his followers, who were known to be in overwhelming majority. Well, what happened? Mascart did do exactly as Hospitalier had predicted in all respects, except the "chewing up" part. Taking the action of Section A as a basis and an excuse, he proceeded to put our units on the shelf and to argue that "further action was unnecessary." The thing was done so neatly and so quickly that there was no opportunity for discussion until the case was, as he thought, settled and closed. He was mistaken there; the fight was only about to begin. The lion *was* bearded in his den. The fight was long; it lasted more than an hour; it was, at times and by turns, bitter, desperate, and uncertain. But the writer had gone in to tame that lion; and he did tame him, and also some of the other lions in that menagerie, before the "fuss" was over. The final victory was not only complete; it was glorious. At the outset everybody was against us except our honorary member, Sir Wm. H. Preece, and at least one of his colleagues (Dr. S. P. Thompson), who rallied gallantly to our support at a critical moment and helped stem and turn the tide of opposition. At the end there was a veritable stampede "to get on the band wagon"; and Mascart himself was not the last one to get on. The unexpected happened; the final vote was not only *in favor*, but it was *unanimously so*. At the beginning of the fight everybody attacked me; at the end, everybody complimented me. Hospitalier, who was not an official delegate, but had been a spectator, threw his arms around my neck with joy. I sought Mascart at the end of the session, for the purpose of smoothing out any hard feelings; and even he was gracious and complimentary, though he had least cause to be. I will never forget his words: *"Je ne vous en veux pas du tout; au contraire, je sais bien aise de vous féliciter. Vous avez fait preuve de talents extraordinaires. Si j'avais une cause á plaider devant un congres international, je ne voudrais pas un meilleur avocat que vous pour la plaider."*

This was a flattering testimonial from such an eminent man. The most interesting part of the story remains to be told, however. What was my official status in that Chamber of Delegates? I had *none at all*, in reality. I was not an official or Government delegate; not even an "alternate." I was simply *made* a "substitute" for Kennelly, who, as already stated, had left for America. Any person could have had me "unseated," as not being officially accredited by the United States Government. I actually feared it. Having resorted to parliamentary tactics myself and raised *several* "points of order" to gain *my* points, I wondered that somebody did not spring *that* point of order on me. It would, of course, have been a serious one. Fortunately, my statement about my being the substitute and spokesman for another did not cause any comment; and then I felt safer. I said at the time that this should be a lesson to us. We should see to it that our spokesman has proper official credentials. I determined that I would never take any such chances again on any international occasion.

Such is the inside history of the maxwell and the gauss. The official records gave me no credit whatever; Mascart had done it all; he was even credited with having *proposed* the adoption of these units. The official record says that I, and also Preece, made a few "observations." Even my worst enemies would admit that I did good work on that occasion. I got no credit for it officially or otherwise. Nobody connects me with the maxwell and the gauss.

I come now to the International Electrotechnical Commission In 1906, when this commission was formed, I was again played as a substitute. Nobody had thought of making me a place in the delegation until the last moment, when Steinmetz declared he was not going and others were not certain to go. Then the committee was "enlarged"; I was literally "tacked on" to the committee, and to the delegation, *at the last minute*. Though I did not like this, I accepted. I went; I worked, with my colleague, Crocker; and the records are there to show what we did and accomplished. On my return I notified the then president (Sheldon) that I had had enough "substituting" in international affairs and that henceforth I would insist on something more appreciative of my record. The rest of the world expected that Dr. Crocker and myself would be recognized and honored in the formation of the American Committee I did not hesitate to say that I expected it, too, and for both Dr. Crocker and myself. I stated definitely what place I *would* accept and what I would *not* accept. The "slate," I was told, would be made up on a basis acceptable to us both. When the president officially promulgated his appointments, however, I found myself put down a peg or two to make room for somebody else. Dr. Crocker did not fare any better. After he had been notified of his appointment as secretary of the committee, his name was left off the committee altogether and somebody else was put in his place, without a word of warning or notice. I declined the appointment with promptness and emphasis. I have been urged repeatedly in letters from both sides of the Atlantic to take a place on the committee. I have refused and will continue to do so. I have made it very clear that I do not care to be put in the "back-seat" class in international affairs, when the rest of the world gives me a standing much nearer the front seat. Mr. Stott understood this well when he appointed me chairman of the delegation to the Marseilles Congress. I am as proud of my record there, last September, as of my record on the previous international occasions. I can say that I received more than my share of attention and courtesy at Marseilles. I would have received still more if I had been also a "Government" delegate. I would not then have had to give way, on certain official occasions, to the official delegates of even the smallest and least important countries The officers of the congress were more worried about this than I was, however. It was the fault of our Government that it had no official representation. The A. I. E. E. should get an official credential for its delegates on such occasions.

The "last straw" which broke the limit of my patience was when the attempt was made, last August, to play me once more as a "substitute" and again at the last moment, to represent the A. I. E. E. at London in October. Again, it was found that none of the worthy people on the front seats in the committee was going. It was reported that *I was* going abroad. Why not "extend" the committee again, as in 1906, and thus "qualify" me to be a delegate? It was a brilliant idea. Unfortunately, it was "worn out" with me; and it did not work. In the mean-

time I had received intimation that I would be welcome and honored if I "happened" to be in London about the time of the meeting of the International Electrotechnical Commission. I *was* there. I did *not* represent the A. I. E. E. I made no concealment of my having refused to do so and of the reasons why. I was able, nevertheless, to take part in the work of the commission; and there is another vote of thanks placed to my credit; and again I am proud of my record as the printed transactions give it. My European friends were more than good to me, then, as they had been at Marseilles. I was and I am very grateful for their appreciation of me. With that appreciation I do not miss so much the lack of appreciation and consideration shown by the A. I. E. E. in trying to give me "left-over" honors twice.

This is the story of some history-making for the A. I. E. E., and of the way it has been recognized and appreciated here and abroad.

NEW YORK. C. O. MAILLOUX.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Voltage Regulation of Three-Wire Dynamos.—F. NIETHAMMER AND R. CZEPEK.—If in a two-pole, direct-current machine two diametrically opposite points of the armature winding are connected with two slip-rings, this machine (which was first devised by Dolive-Dobrowolsky) can be used to supply direct current to a three-wire network when the neutral wire is connected to the middle point of an inductance coil the ends of which are connected to the two slip-rings. If the inductance coil is subdivided, as shown in Fig. 1, so that the lever H may be connected to any of the points 0 to 6, it is possible to vary the voltage between the terminals K_1 and K_2 within certain limits, although the voltage between K_1 and K_3 remains constant. The theory of this arrangement is given. Apparatus, without self-induction, and without counter e.m.f., like incandescent lamps, may be connected to the terminals K_1 and K_2, while the terminals K_1 and K_3 may be used for motors.—*Elek. und Masch.* (Vienna), June 27.

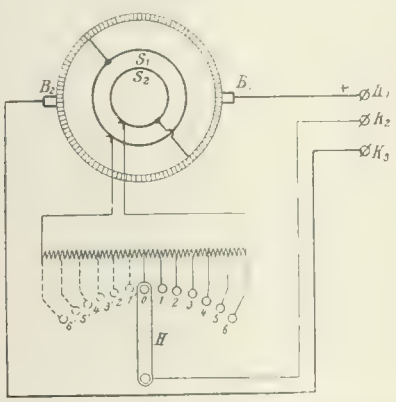


FIG. 1 VOLTAGE REGULATION OF THREE WIRE DYNAMOS

Alternating-Current Generator.—T. R. LYLE.—A long and highly theoretical paper. It has been usual hitherto to ascribe the distortion of the wave-form of the current given by an alternating-current generator to: first, lack of uniformity and pulsation of the magnetic field, causing a distortion of the induced e.m.f. at open circuit as well as under load; second, pulsation of the reactance causing higher harmonics under load; third, pulsation of the resistance causing higher harmonics under load also. Another cause has, however, been generally overlooked, namely, the mutual reaction between the armature and the field m.m.f., which, when the generator is loaded, is at least as important as any of the three foregoing causes. This means that the theory of the simple alternator has not yet been completely worked out. In the present paper this is done for an alternator with a uniform field by means of a new application of the vector method in which all of the harmonics of a periodic function are dealt with simultaneously. The paper shows how to take account of hysteresis and eddy currents, and the theory of the action of dampers in reducing the heating of the field coils and core is also given. The theory of the alternating-current synchronous motor is also dealt with.—*Phil. Mag.*, July.

Currents in Bearings and Axles.—FLEISCHMANN.—In high-speed alternating-current machines of large output, sparks are sometimes observed at the bearings. They are due to currents passing through the bearings and axles. The author gives the theory of these currents.—*Elek. Kraftbet. u. Bahnen,* June 23.

Heating of Dynamos.—E. J. BRUNSWICK.—A discussion of the determination of the temperature of dynamo windings by electric resistance measurements. This method, however, gives only a mean temperature, since the whole winding is assumed to be of uniform temperature. The author discusses the method, the sources of error, and the corrections which can be applied.—*L'Industrie Elec.,* June 25.

Lamps and Lighting.

Carbon Lamps and Tungsten Lamps.—AL. BERNINGER.—An account of an experimental investigation of the characteristic properties of carbon and (Kuzel colloid) tungsten lamps. The relation between the spherical hefner candle-power and the voltage v at the terminals is given by the equation:

$$\text{spherical hefner cp} = Cv^n.$$

The values of the constant C and of the exponent n were experimentally determined:

10-cp carbon lamps:	$C = 16 \times 10^{-13}, n = 6.3$
16-cp carbon lamps:	$C = 80.6 \times 10^{-17}, n = 6.1$
25-cp carbon lamps:	$C = 37.5 \times 10^{-17}, n = 6.31$
32-cp carbon lamps:	$C = 2.89 \times 10^{-13}, n = 6.94$
32-cp 110 volt tungsten lamp:	$C = 2.5 \times 10^{-7}, n = 4.05$

While the candle-power of the tungsten lamp varies with the 4th power of the voltage, that of the carbon lamp varies with the 6th or 7th power of the voltage. This difference has to do with the change of resistance of the filaments with temperature, the temperature coefficient of the carbon filaments being negative, that of tungsten being positive. The author then discusses the variation of candle-power with the power in watts. If i is the current in amperes the equation is

$$\text{spherical hefner cp} = K(vi)^x.$$

The experiments gave the following values for C and n:

32-cp carbon lamp	$K = 1.5 \times 10^{-5}, x = 3.$
32-cp tungsten lamp	$K = 1.1 \times 10^{-3}, x = 2.58$

According to Lucas, the exponent n should be 3.2 for a theoretical black body. The carbon filament behaves, therefore, more like a black body than the tungsten filament. The author then determined the distribution of light from a carbon lamp and a tungsten lamp, both of 32 cp. He finds that the tungsten lamp is greatly superior in giving a more uniform illumination in all directions. The carbon and tungsten lamps were then subjected to a long-time test, during which they were connected to the same alternating-current supply mains. It was found that the exponents n in the above equations remained practically constant, while the coefficients C and K changed gradually. The variation of the resistivity of the tungsten lamp in time is very irregular, while the curves giving the change of resistivity of the carbon lamp in time are always almost straight lines. The above relation between candle-power and voltage permits one to determine the influence of variation of voltage on the spherical candle-power. The author gives curves which show that if the voltage varies 1 per cent upward and 1 per cent downward, a total of 2 per cent, the variations

of candle-power are for a 10-cp carbon lamp, 12.6 per cent; 16-cp carbon lamp, 12.2 per cent; 25-cp carbon lamp, 12.62 per cent; 32-cp carbon lamps, 13.88 per cent; 32-cp tungsten lamp, 8.1 per cent. If a candle-power variation of 10 per cent is permitted the maximum permissible voltage variation for carbon lamps is 1.6 per cent and for tungsten lamps 2.5 per cent.—*Elek. u. Masch.* (Vienna), June 27.

Carbon-Filament Mercury-Vapor Lamp.—A description of the carbon-filament lamp of R. Hopfelt, in which the carbon filament is lighted in a mercury-vapor atmosphere. It is now on the market under the name of "Tuba" lamp. The construction is shown in Fig. 2. The carbon filament, which is especially prepared, is enclosed in a U-shaped tube containing a drop of mercury and some nitrogen at a pressure of about 1 mm When current is switched on, some of the mercury is evaporated by the heat produced by the filament. Owing to the presence of the mixture of mercury-vapor and nitrogen which

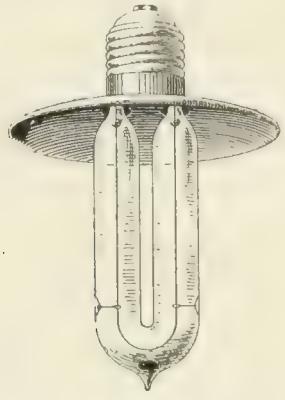


FIG. 2.—"TUBA" CARBON-FILAMENT LAMP.

is formed, the filament can be run at a much higher efficiency than is advisable with the ordinary carbon-filament lamp without any fear of the tube blackening or the filament burning out prematurely. Originally the tube was enclosed in an outer globe, so as to make a stronger lamp and to facilitate the attachment of the cap, but, owing to the higher temperature attained by the tube, this arrangement was found to shorten the life of the filament so much that the outer globe was discarded. When the lamps are new they consume 1.8 watts per hefner candle or 2.5 watts per British candle, but toward the end of their life the consumption decreases to 1.5 watts per hefner candle. The lamps burn in any position, but not satisfactorily when the U-tube is inverted as then the filament is not near enough to the mercury. The candle-power is temporarily increased when the pressure of the mercury-vapor is increased by causing the tube to heat up, but the life of the filament is shortened. The mercury-vapor does not glow itself, but, owing to the high temperature of the filament, a whiter light than that from the ordinary filament lamp is emitted. The life is 500 hours when running continuously, and between 600 and 800 hours when used intermittently. 100-volt to 150-volt lamps are made in two sizes of 25 cp to 40 cp at a price of 38 cents, and the 200-volt to 250-volt 50-cp lamp is sold at 50 cents. A specific consumption of between 1.6 watts and 1.8 watts per candle is guaranteed, and the lamps are suitable for both continuous and alternating current.—Lond. *Elec. Eng'ing*, July 1.

Metallic-Filament Lamps.—A note on a recent (British) patent of H. Kuzel (25,044, 1908; June 24, 1909). When metallic filaments are so held by supports that they are compelled to occupy a certain position, it is sometimes found that the tension in the different legs of the filaments varies considerably, often resulting in the breaking of the filament. According to this invention, the filaments are given a square or polygon-shaped loop with angular corners by hanging a weight from two or more points on the filament during the sintering process. When filaments of this shape are supported loosely at two or more points along the limbs, and not at any portion of the loop, it has been found that unequal tension is avoided.—Lond. *Elec. Eng'ing*, July 1.

Generation, Transmission and Distribution.

Steam Turbines.—A. S. Blackman.—A paper read before the British Municipal Electrical Association on "steam turbines from the user's point of view." The author first relates his experience of the relative advantages of the impulse and reaction types of steam turbines, and discusses the most efficient relation of output and speed. The impulse-type turbine lends itself to a more mechanical-looking construction than the reaction type. The reaction type, as illustrated by the best Parsons machines, is more economical than the impulse type. For speeds of 3000 r.p.m. and below 1000 kw, the impulse type is better than the reaction. For speeds of 1500 r.p.m. and up to 3000 kw the reaction type has proved most satisfactory. For speeds of 1000 r.p.m. and 750 r.p.m. and up to the largest sizes likely to be used, there is absolutely no evidence that the impulse type can compete in reliability or economy with the Parsons type. Concerning the selection of the best speed the author said to choose the size of the unit to suit the highest speed that the frequency will allow, and here the assistance to be obtained from external fan cooling of the generator should not be overlooked, because the higher the speed at which the set is run, the greater the benefits which will be obtained from a turbine installation. He then discussed turbine versus reciprocating engines and summed up the conditions for the turbine installation as follows: (1) 150 lb. per square inch steam pressure—because at higher pressures the volume becomes small and leakage percentages are increased, with only a small gain in heat units available; (2) 150 deg. superheat—because there is no appreciable gain in plant over-all economy above 150 deg. superheat; (3) highest possible speed; (4) best vacuum possible—because it is the strongest feature in turbine working, and it will pay to maintain as high a vacuum as possible. The author finally discussed condensing equipment and exhaust-steam turbines and gave data on the reliability and maintenance of turbines on the experience at Sunderland where the cost of working a turbine plant has been much lower than with reciprocating engines.—Lond. *Electrician*, June 25.

Conservation of Water-Power.—E. R. Taylor.—A paper read before the International Congress of Applied Chemistry in London. The author gives statistical data on the amount of power that could be developed by careful regulation of streams. He remarked that the regulation should not be done by individuals, but the nation should undertake the improvement and control water-powers, prevention of floods, etc.—*Electrochem. and Met. Industry*, July.

Traction.

German Street Railway Statistics.—On March 31, 1908, the number of street railways in existence or in course of erection was 165 in Prussia, 72 in other German States, the total for Germany being, therefore, 237, with 3850.5 km (2387 miles) aggregate track length. Of these there were in operation in Prussia 162 roads with a length of 2652.5 km (1645 miles); in other German States, 72 roads with a length of 1128.5 km (700 miles); total in Germany, 234 roads, with a length of 3781 km (2345 miles). The increase in the number of roads over the year previous is four (two in Prussia and two in other German States). The motive power on street railways in 1907 was as follows:

IN PRUSSIA

Steam locomotives	13 roads, or	7.9 per cent
Electric motors	129 roads, or	78.2 per cent
Horses	15 roads, or	9.1 per cent
Steam locomotives and electric motors	1 road, or	0.6 per cent
Electric motors and horses	3 roads, or	1.8 per cent
Cables	4 roads, or	2.4 per cent

IN OTHER GERMAN STATES.

Electric motors	60 roads, or	83.3 per cent
Horses	7 roads, or	0.7 per cent
Steam locomotives and electric motors	1 road, or	1.4 per cent
Cables	4 roads, or	5.6 per cent

Electric operation is replacing horse or steam traction. While on March 31, 1901, horse traction was used in Prussia on 24 roads, with 163 km length, this is now (1907-8) the case only

on 15 roads, with 68 km length, mostly small roads. The rolling stock in Germany consisted in 1907 of 81 steam locomotives, 57 electric locomotives, 9908 electric motor-cars, 17,263 passenger cars (including motor-cars and trailers), 69 express cars, 937 freight cars, 17 mail cars, and 1124 "special cars." The largest rolling stock is owned by the Grosse Berliner Strassenbahn, which has 2544 cars, with carrying capacity for 85,573 passengers. Hamburg is next with 1269 cars, for 36,693 passengers. Most of the roads are owned by private companies, although municipal ownership is slowly advancing. Ninety-five roads in Prussia (the same number as in 1906) and 42 roads in other German States (against 43 in 1906) were owned by companies, while 61 roads in Prussia (against 57 in 1906) and 24 in other States (against 23 in 1906) were owned by municipalities or counties. Eight German roads are owned by private companies and three roads are owned by the State of Saxony. The gage is 1.435 m (4 2/3 ft.) on 61 roads, 1 m (3 1/3 ft.) on 148 roads, and less on 28 roads. The capital invested in all German street railways was 904,630,453 marks (about $226,000,000), or 239,319 marks (about $60,000 per kilometer; 1 km = 0.62 mil). Of all German roads 22 have not paid expenses at all. The interest earned on the capital invested in 145 Prussian street railways (found by subtracting expenses from receipts, when the expenses include ordinary amortization, but not interest and amortization on the capital borrowed) was nothing in 18 roads; up to 1 per cent in 6 roads; up to 2 per cent in 14 roads; up to 3 per cent in 9 roads; up to 4 per cent in 14 roads; up to 5 per cent in 23 roads; from 5 per cent to 10 per cent in 54 roads; above 10 per cent in 7 roads. Concerning the traffic in the principal German cities the following figures on the length of track and the number of passengers per capita are interesting: For every 10,000 inhabitants there are 5.23 km track length in Hanover-Linden; 2.60 km track length in Dresden; 2.56 km track length in Essen-Ruhr; 2.30 km track length in Leipzig, and so on, and 1.22 km in Berlin. For every 10,000 inhabitants there were carried on street railways 1,972,473 passengers in Cologne; 1,925,462 passengers in Frankfort; 1,873,457 passengers in Leipzig; 1,773,377 passengers in Dresden; 1,715,823 passengers in Hamburg-Altona; 1,667,307 passengers in Berlin; 1,594,308 passengers in Düsseldorf. The average receipt for passengers varied between 7.9 pfennigs (1.97 cents) in Breslau and 11.1 (2.77 cents) in Essen-Ruhr. The total track length of all street railways and interurban light railways in Germany was 12,277 km (7612 miles) in 1907, an increase of 3.7 per cent over the year before. The capital invested in these roads was 1,510,354,116 marks (about $377,588,529) or 115,952 marks (about $28,988) per kilometer. The street railways and interurban light railways are of an essentially different character. While 63.6 per cent of all German street railways carry nothing but passengers, this is the case only for 1.9 per cent of the interurban light railways, while 98.1 per cent carry either passengers and freight or freight only. Further, in the street railways electric traction is replacing horse and steam traction, 78.2 per cent of all street railways being operated electrically, while 91.2 per cent of the interurban light railways are operated by steam.—*Zeit. f. Kleinbahnen*, April.

Hungarian Street Railway Statistics.—W. MAURER.—During 1907 no new electric street railway was opened in Hungary. The number of roads is 14, but the track length has increased from 201 km to 209 km (130 miles). The track length of all electric street railways in Hungary is 68, the balance being operated by horse or cable. The total capital invested in the 14 electric roads is 110,465,634 crowns (about $22,100,000), or 534,632 crowns (about $107,000) per kilometer. The average profit was 8.175 per cent of the invested capital.—*Elek. u. Masch.* (Vienna), June 27.

Energy Transmission Systems and Light Railways.—O. PETRI.—A statistical article on the development of electric street railways and light interurban railways, and the advantages which may be obtained by buying the energy from a transmission plant. It is shown that if the energy is bought at 1.5 cents per kw-hour, light electric railways could be operated more profitably; in this case the possible increase of interest on the capital varies from 0.2 per cent to 4 per cent and averages 1.37 per cent. Close co-operation between energy transmission plants and light railways would also be of advantage to the transmission companies, since the result would be a further extension of the transmission network, whereby electric energy would become available for many other purposes in agriculture.—*Elek. Kraftbet. u. Bahnen*, May 24 and June 4.

New Mountain Railway.—H. MORGENTHALER.—An illustrated description of the Wengernalp railway in Switzerland, which is now being changed from steam to electric operation. Energy is supplied from the new plant of the Jungfrau Railway, which, when completed, will contain four generating sets, each of 1250 hp, and two sets, each of 2500 hp, three-phase current being generated at 7000 volts and 40 cycles. For operating the railway the three-phase current is transformed into direct current.—*Elek. Kraftbet. u. Bahnen*, May 24.

Electric Traction on Main Railways.—R. RINKEL.—The author discusses the prospects of electric operation of main railways, with special reference to the objections raised by army officers. If certain precautions are taken, reliability of operation with respect to the transmission line is thought to be as fully safeguarded as with steam traction. Cables would be preferable, but they are too expensive. With respect to the power plant, it may be advantageous to connect a railway system, especially near the border line, with two plants instead of one. Countries which must import fuel, but have water-powers, should be specially anxious to introduce electric traction, since in case of war the fuel supply could be cut off.—*Elek. Kraftbet. u. Bahnen*, May 24 and June 14.

Installations, Systems and Appliances.

Automatic Reversible Booster.—With reference to recent installations of some large (2000 amp or more) boosters for two British railway plants, the Lancashire automatic reversible booster is described. This machine consists of two essential parts, the motor and the booster, the former of which is supplied from the busbars, its starter being arranged on the "live" side. The motor-breaker, as will be seen from the diagram (Fig. 3), is connected in a special manner with the battery-

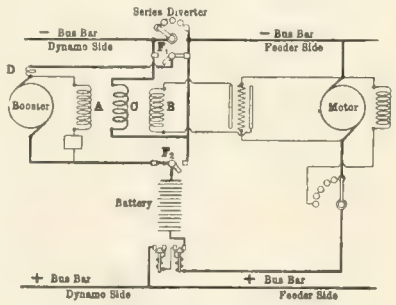


FIG. 3.—DIAGRAM OF CONNECTIONS.

breaker. The effect of this arrangement is that the motor can never be cut off when current is passing through the booster, an accident which would cause the booster to accelerate to a dangerously high speed. As will be seen, when the battery-breaker comes out it leaves the motor running on the battery, although cut off from the busbars; while, if the motor-breaker comes out, the motor is left running on the busbars. The booster has four coils, *A, B, C* and *D*, their functions being as follows: The *A* coil is connected across the booster brushes and is, therefore, energized by the difference of voltage between the busbars. Supposing the battery to have a pressure of 10 volts higher than the busbars, the *A* coil will then cause the booster to oppose the battery voltage by this amount. On the other hand, if the battery volts are lower than the busbar volts, the *A* coil will cause the booster to act in favor of the battery to the same required amount. Hence, in every case, the result will be that the algebraic sum of the battery and booster pressures will be equal to the busbar pressure. The *D* coil consists of a few turns on the booster field cores in series with the booster armature. These turns balance the armature m.m.f.

and cause the booster to act as if there were no voltage drop in it. The action of the *A* and *D* coils then causes the booster to balance all variations of the battery coils. If these coils were only in action, the effect would be to make the booster unstable. It would, in fact, rush off with a charge or discharge at its own will. A controlling force, therefore, is required, and this is supplied by the action of the *B* and *C* coils. The *B* coil is constant in its action, being energized by the busbar volts. It is controlled by a "potentiometer" resistor instead of by an ordinary resistor. When the booster is working in the ordinary way with the generators running, the excitation of this coil is in such a direction as to cause the current from it to charge the battery. It is conveniently connected across the motor brushes, as it then becomes quite dead when the motor is disconnected. The *C* coil is arranged to take the main dynamo current proportion of it, and its adjustment can be arranged by the diverter shown in the diagram. The current passing through *C* coil energizes the booster in such a manner as to take the current out of the battery. Hence, it is opposed to the *B* coil. The action of the *B* and *C* coils is as follows: Assume the boosters to be in operation and running with the generator. If the *B* and *C* coils be adjusted for, say, 100-amp generator current, then at this load they will neutralize each other, and the booster will neither charge nor discharge the battery. If, however, an excess load comes on to the feeders, the generator will give out a little more current, which, passing through *C* coil, will strengthen the latter's action. This will cause the *C* coil to overpower the *B* coil's action, and so draw the excess current needed on the feeders from the battery. When the feeder current is reduced below 100 amp a little less current will be supplied by the generator, and there will be a little less through the *C* coil and its action will become weaker than that of the *B* coil. The superior strength of the *B* coil will cause the excess current to charge the battery, so that the load on the generator will still remain at the standard of 100 amp. The load on the generator can always be adjusted by varying the strength of the *B* coil regulator, and also by adjusting the diverter. It is advisable to adjust the coils at varying periods of the load to get the best possible results from both the booster and the battery. For instance, when the load on the feeders is such that the generators are always working at their full output the action of *C* coil must be increased by reducing the current diverted through the resistor, thus increasing the amount passing through the *C* coil. The strength of the *B* coil must also be increased. The *A* coil should also be run with the resistance of the resistor largely cut out. The diagram shows the arrangement adopted for starting the set with the main generator running. The switches F_1 and F_2 are closed on their right-hand and left-hand sides, respectively, while the series diverter is over on the left. The battery-breaker is closed, thus connecting the motor to the busbars, and the latter is then started in the usual way by means of the motor starter. The *A* rheostat is put in its open position, and the *B* rheostat adjusted until the paralleling voltmeter shows that the battery volts are equal to those on the busbars. The motor-breaker is then closed and the load on the generator and battery is adjusted with the *B* rheostat. The *A* rheostat is placed at its most sensitive position, which can be adjusted by the series diverter. When the arm of the latter is in the extreme left position the booster will act strongly and will keep the load on the main generator steady. On the other hand, when it is on the right-hand side, the battery will do less work and the generator load will vary with the feeder load.—Lond. *Electrician*, June 25.

Large Industrial Load in a British Central Station.—Owing to the great energy with which the electricity department of the city of Bolton, in Lancashire, has pushed electricity supply for industrial purposes, this station has "almost obtained the ideal of being able to make the industrial, rather than the lighting, its staple load." On account of the gradual evolution of the plant, three systems are used: direct current, single-phase current and three-phase current, the latter mainly for industrial purposes. The main part of the three-phase current is used for cotton-spinning work, there being at the present time something like 300,000 spindles driven by energy obtained from the corporation's mains, but in no case is a complete mill driven electrically. Electricity is also used in several engineering and steel works. During the last year the total output from the Bolton station was 10,677,764 kw-hours, of which no less than 64 per cent was for industrial purposes pure and simple, while only 15 per cent was for lighting. The average price obtained per kw-hour from all classes of supply is 2.68 cents, and for industrial purposes only 1.68 cents per kw-hour. When the electricity works first started 10.8 cents per kw-hour was charged, and the price remained well above 6 cents until the present policy was instituted in 1900. Since that date the price has steadily fallen. Although the price is now fairly low for a municipal station of the size of that at Bolton, a gross profit of 9 per cent on the capital has been obtained, and this result could be very well improved if the position of the station as regards the supply of water and cooling facilities were better However, the cost of generating the energy is low. The works costs are 0.944 cent per kw-hour and the total costs 1.166 cent per kw-hour. The cost, including capital charges, is practically 2.4 cents, while in 1895, the first year of complete working of the station, the corresponding figure was 23.68 cents, so that a very substantial reduction has been made. On March 31, 1901 the number of motors on the mains was 27, with an aggregate rating of 148 hp. On the same date in 1909, or eight years afterward, the number of motors was 816, with an aggregate rating of 9219 hp, an average yearly increase of 100 per cent; the increase has been extraordinarily rapid during the latter part of this period.—Lond. *Electrician*, June 25.

Central Stations and Electric Lighting.—E. Schiff.—A contribution to the discussion now going on in this journal on the problem of increasing the popularity of electric lighting. The writer thinks that in general the high cost of electric energy is the greatest obstacle, although not the only one. The high cost is due not alone to the cost of operation of the central station, but to high fixed costs—interest, amortization, business offices, etc. It is, therefore, very important to divide the fixed cost among as many people as possible. To increase the load factor the energy should be sold at times of low load at much lower rates than are employed at present. A distinction should be made between the hours at which the energy is used and not between the purposes for which it is used. It is of great importance to fight isolated plants by lowering the rate for them as low as for traction companies. As a general policy, he advises a large general reduction of the rates, at least for large companies.—*Elek. Zeit.*, June 24.

Wires, Wiring and Conduits.

Insulators.—W. Wiecker.—An illustrated description of a new high-tension insulator equipped with a metallic cover at the top, in order to increase the insulation resistances, by protecting the lower part of the insulator against rain. The metal cover has the advantage of light weight over porcelain.—*Elek. Kraftbet. u. Bahnen*, June 4.

Electrophysics and Magnetism.

Radiation from Black Bodies. W. W. Coblentz.—An abstract from a Physical Society paper. The radiation from the so-called black body was investigated from 8 to 10 years ago, and the results then obtained are somewhat at variance In view of the fact that it seems feasible to replace, or at least to supplement, the present thermo-electric extrapolations, at high temperatures, by means of a temperature scale based upon these radiation laws, it is desirable to make a thorough spectrobolometric investigation of the black body at various temperatures. In previous investigations it was thought that an accuracy of about 3 per cent had been attained. In order to attain a still greater accuracy very elaborate precautions are necessary. Contrary to some of the prevailing notions, the uncertainties in the measurements are located in the bolometric end of the apparatus instead of in the constancy of the temperature of the radiator. Two series of spectral energy-flow curves at various temperatures from 500 deg. C. to 1490 deg. C

have been obtained—in all 33 different curves. The observations extend over a long period in which there were days when the sensibility of the apparatus, the temperature of the room, or the humidity, etc., varied, so that some of the errors due to those causes ought to be minimized in the final resultts. The data are not sufficiently worked out to make a more definite statement than that after a three-hour run it has been possible to repeat the observations in different parts of the spectrum with an accuracy of from 0.10 per cent to 0.5 per cent, and that the $T\lambda_{max}$ constant (in Wien's law) seems to be as high as any value heretofore obtained.—*Phys. Review,* June.

Roentgen Rays.—C. A. SADLER.—An experimental investigation of the transformations of Roentgen rays. The characteristic Roentgen radiation from a substance is found to be identical in character whether it is emitted as a secondary or a tertiary radiation. In each case the radiation is homogeneous, the absorption coefficients of the radiation by other substances are the same, and independent of the penetrating power of the exciting radiation by which these homogeneous beams are produced. The laws governing the emissions of tertiary radiation and the absorption of secondary homogeneous beams were also investigated.—*Phil. Mag.,* July.

Electron Theory.—F. KUNTZE.—Abstracts from old papers and books of Hermann and Robert Grassmann, in which they anticipated the modern electron theory.—*Phys. Zeit.,* June 15.

Electrochemistry and Batteries.

Electric Steel Furnaces.—C. A. KELLER.—A Faraday Society paper on the type of electric steel furnaces in which the current enters the furnace through one electrode at the top—or through several electrodes in parallel—and leaves the furnace through a conducting hearth at the bottom. If the production of steel is carried out in electrode furnaces, fitted with conducting hearths, the material used must not carbonize the metal produced. The various classes of conducting hearths described are: (a) Those made entirely of metal, water cooled; (b) those consisting of one or more metallic poles embedded in non-carbonizing masonry; (c) those consisting of a hearth of refractory material rendered conducting by a carboniferous substance; (d) furnaces with a hearth made up of a mixed conducting material; this is the type devised by the author. The construction and performance of various furnaces erected by the author are also described.—Lond. *Electrician,* July 2.

Caustic Soda and Chlorine.—A number of papers on the subject were presented before the International Congress of Applied Chemistry in London. L. H. Baekeland gave an account of three years' practice of the Townsend cell. It is preferable to operate the cell at a comparatively high current density in order to increase the output, in spite of a diminished efficiency. Although the Townsend cell is commonly described as a diaphragm cell, it may just as well be considered as a cell with a circulating electrolyte, somewhat on the order of the gravity cell. Various other details of operation were described. Aluminum conductors proved very advantageous as they show no evidence of corrosion even after years of constant use in an atmosphere always containing some chlorine. Lepsius discussed especially the Griesheim-Elektron diaphragm cell. R. Taussig described a recent modification of the Castner-Kellner mercury-cathode cell. G. Koller discussed the use of electrolytic chlorine for making chlorine compounds of acetylene, which are non-combustible and non-explosive solvents of oils, fats, etc., with a wide range of boiling points. E. A. Sperry discussed the detinning of tin scrap by means of chlorine.—*Electrochem. and Met. Industry,* July.

Aluminum.—S. A. TUCKER.—A brief description in detail of suitable arrangements for preparing aluminum electrolytically in the laboratory.—*Electrochem. and Met. Industry,* July.

Units, Measurements and Instruments.

International Unit of Candle-Power.—In a paper by C. C. Paterson read before the Physical Society in London, the new international agreement concerning the unit of candle-power was discussed. The paper itself contains nothing that has not been given in our issues. There was, however, an extended discussion. Dr. Fleming said that it was interesting to hear that those chiefly interested had come to an understanding with each other as to the unit of light. It must be remembered, however, that the proposed international unit has no objective existence, and no greater value as a unit of comparison than the Hefner or pentane units, to which it was related by an arbitrary definition. He greatly regretted that the National Physical Laboratory authorities had acquiesced in the adoption of a flame standard of light, with all its difficulties and variabilities. Influenced as they are by atmospheric pressure, moisture, CO_2, height of flame, composition of fuel and number of persons in the photometric room, these flame standards can not possibly be considered as a final solution of the problem of obtaining a primary standard of light. What is really required is the concrete realization of a permanent standard, which can be the standard of reference for secondary standards like the Fleming-Ediswan large-bulb, glow-lamp standards, which the speaker introduced seven years ago. In his paper Mr. Paterson made only a brief reference to Violle's work on the platinum standard, and ignored altogether the careful work of Professor Petavel carried out in 1899 in the Davy-Faraday laboratory. Professor Petavel's conclusions were that with suitable precautions the unit of illumination could be reproduced within 1 per cent by means of the molten-platinum standard. Elaborate experiments to ascertain how many hefners are equal to 1 pentane are not a matter of nearly such importance as the construction of some final constant primary standard of light, and, in Dr. Fleming's opinion, the most satisfactory form for this primary standard of light is to derive it from the light emitted normally by a defined area of some substance in a state of incandescence at a known fixed temperature. Dr. Russell thought that the unit suggested by Waidner and Burgess has many advantages; they propose to adopt as the unit of intensity the radiation from a square centimeter of a black body maintained at the temperature of the fusion of platinum. He referred also to the unit suggested by Steinmetz. Mr. Dow said that the pentane lamp as a standard is not very inferior to the Violle standard. He does not think one can as yet accept as a standard an area of a black body at a high temperature. Dr. Drysdale thought the international agreement arrived at is most welcome. As he understood the paper, however, it is simply an attempt to obtain agreement between existing units rather than standards, and leaves the matter of the best form of standard perfectly open. He thought that everyone having experience with flame standards would thoroughly agree with Professor Fleming's condemnation of them, and there could be no doubt that the primary standard should be an incandescence one. He, however, did not agree with Dr. Fleming's suggestion of reviving the Violle standard. What is wanted in an incandescence standard is a definite area of a definite surface at a definite temperature. When the Violle standard was suggested little knowledge was had of the radiating properties of surfaces, or high-temperature measurements, and, therefore, the only suitable thing was to take a very pure substance, using its melting point as a bench mark of definite, though unknown, temperature. However, everyone who has studied the history of the Violle standard is aware of the great difficulties of setting it up, and it has the disadvantage, according to Petavel, that the surface is dependent on the gas mixture used, that it possesses an extremely short period of constancy and requires a high expense. It is now known that a perfectly black body is easily obtainable and that it has perfectly definite radiating properties; the laws of Stefan and Wien are well established, and optical pyrometry has advanced to a high degree of accuracy. It, therefore, seems decidedly preferable to suggest a unit area of a black body at a definite temperature. Mr. Jolley and he have come to the conclusion that a square centimeter of a black body at a temperature of 2000 deg. C. absolute would perhaps be a good unit, and would probably be of the order of 100 cp. This temperature is probably quite close to that of the ordinary carbon-filament glow lamp, so that there should be no color difficulty and it should not be exceptionally difficult to maintain constant.

A point in favor of the black body is the perfectly definite character of its spectrum, which makes it a standard of color as well as of intensity, and suitable for spectro-photometric comparison. As the surface is that of a solid, it would be unnecessary to maintain it in a horizontal position, as with the Violle standard, and the amount of light can be easily varied by a diaphragm. Paterson replied that his paper dealt with the relations existing between the various units now in use. He agreed with Fleming's observations on the flame standard. With regard to Dr. Drysdale's remarks about the use of a black body, he thought that it would not be possible to keep the temperature sufficiently constant to enable it to be used as a standard.—Lond. *Electrician*, July 2.

Singing Arc.—G. W. Nasmyth.—An abstract of a paper read before the American Physical Society. In the usual form of the Duddell singing arc—the direct-current arc in series with a suitable resistor and choke coil—the oscillation circuit contains capacity and inductance in a shunt across the arc from anode to cathode. In the improved form, two arcs are used in parallel, each with its own resistor and choke coil, and the oscillation circuit is connected between the two anodes, the two cathodes being connected together; the two anodes may be connected together and the inductance and capacity placed between the two cathodes. The diagram of connections for the new form is shown in Fig. 4. The chief advantages of this form of the singing arc are the increased power available in the oscillation circuit, and a greatly increased stability in the oscillation conditions. The power available in the oscillation circuit is approximately twice that obtainable from the usual form of the singing arc. With two arcs connected in this way, the fluctuations

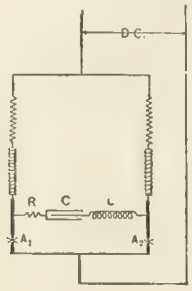


FIG. 4.—DIAGRAM OF CONNECTIONS.

in either arc have a tendency to be neutralized by the other arc and the effect on the oscillations is greatly diminished. If the arcs are surrounded by a hydrogen atmosphere, supplied by alcohol lamps or illuminating gas, the oscillations will be maintained for a time even though one arc goes out, the other arc continuing to send the oscillations through the hydrogen atmosphere. If one arc is short-circuited the connections are changed to the usual form of the singing arc, and the oscillations will continue. With this new form of the singing arc the author has obtained oscillations over a range of frequencies from two per second to 1,000,000 per second. As in the usual form, small currents—from 0.5 amp to 3 amp—give the most power, a water-cooled copper anode is of advantage. For low frequencies the arcs should be as long as possible, but for high frequencies it is necessary to shorten the arcs. The theory of the arrangement is also discussed.—*Phys. Review*, June.

Current Balance.—E. B. Rosa and N. E. Dorsey.—An abstract of a paper read before the American Physical Society on an investigation carried out at the Bureau of Standards on the absolute measurement of current by the new current balance. The Raleigh form of balance has been adopted as affording the possibility of determining the constant of an instrument with extreme precision, and giving a sufficiently large force to be measured accurately. Many improvements have been made over the original balance as used by Lord Raleigh, one of the most important being the use of water cooling to maintain the coils at constant temperature, so that the constant of the instrument and the forces to be measured are unaffected by the heat due to the current. The instrument, which has been in use for more than a year, has been investigated very elaborately for the purpose of obtaining the highest possible precision in the absolute measurement of current. The final results have not yet been obtained, but a report of progress will be made and the results communicated. The difference found between the present legal value of the e.m.f. of standard cells and the value given from the current balance and a resistor of standard resistance is 9 parts in 10,000. Giving the e.m.f. of the Weston normal cell the value 1.0182 volts at 20 deg. C., the corresponding value of the e.m.f. of the Clark standard cell, as at present made, is 1.4324 at 15 deg. C. This is 0.0003 less than that of the older form of the Clark cell.—*Phys. Review*, June.

Maximum Power Meter.—An illustrated description of an instrument intended for use in a system in which the method of charging is based on a fixed charge per year per kilowatt demanded, combined with a flat rate per kw-hour registered on the meter. The instrument is made for single-phase, polyphase, and direct-current circuits. It consists of a disk rotating between magnets against a spring, the amount of torque being proportional to the power. The spindle with its disk is fixed on a float which moves in a vessel containing oil, which not only provides the rotating medium, but also reduces the friction to a minimum by allowing the spindle to be pivoted on a top jeweled bearing. The time lag can be varied, according to the density of the oil, from one minute to one hour or more. The registering is effected by a ratchet fixed to the spindle wheel, which also serves to carry the scale. A very light pawl prevents the ratchet wheel from moving backward, and at the same time allows the scale to revolve to its correct reading.—Lond. *Electrician*, June 25.

Thermo-Elements.—O. Knopp.—A systematic investigation of thermo-elements made from various metals and alloys. The author first discusses the influence of the resistance of the junction on the sensitiveness of the thermo-element. He then gives in a table the constants of a series of thermo-elements made from different metals and alloys. He discusses the effect of the percentage composition on the thermo e.m.f., the effect of the thickness of the wires, and the influence of gas pressure and temperature on sensitiveness.—*Phys. Zeit.*, July 1.

Thermo-Elements.—K. E. F. Schmidt.—The maximum of sensitiveness of thermo-elements is at present represented by a manganin-constantan element, the thickness of the wires being 0.0154 mm and their length each 2 cm. When connected with a mirror galvanometer of medium sensitiveness such thermo-elements permit measuring a current of 0.000089 amp. —*Phys. Zeit.*, July 1.

Telegraphy, Telephony and Signals.

Telephony.—Devaux-Charbonnel.—A continuation of his serial. The author takes up the calculation of the constants of a telephone line of definite length, the determination of these constants and their variation with frequency. He discusses the measurement of these constants by two methods, namely, the galvanometer of Abraham, and the bridge method with a telephone.—*La Lumière Elec.*, June 26.

Semi-Automatic Telephone Exchanges.—F. Lubberger.—The immediate substitution of the automatic telephone exchange for a manual system is often impossible on account of the high first cost. Semi-automatic apparatus permit a slow exchange of the instruments. They permit cheap and easy transformation into completely automatic apparatus. The author describes the apparatus introduced by the Automatic Electric Company in this country, and refers to the differing opinions in Germany. —*Elek. Zeit.*, July.

Miscellaneous.

British Municipal Electric Association.—Extensive reports of the proceedings and of the papers presented. The membership of the association now stands at 390, made up as follows: Committees, 167; chief electrical engineers, 176; honorary members, 3; chief assistants, 36; the total showing an increase of three over last year's total.—Lond. *Electrician*, June 25 and July 2; Lond. *Elec. Eng'ing*, June 24 and July 1.

BOOK REVIEWS.

HANDY COPPER WIRE TABLES AND FORMULAE. By P. B. Down. London: *The Electrician* Company, Ltd., 34 pages. Price, $1.

This little pocket book is, as its name suggests, a handy set of tables and formulas relating to wires and cables of copper and aluminum. The gages of the wires are the standard British and Birmingham, which latter is sometimes known in this country as Stub's. A comparison table of B. & S. gages is appended. Unfortunately, all of the tables are in the chaotic old British system of measures, including the pound, grain, inch, square inch, cubic inch, foot and degree Fahrenheit. The result is, of course, a mass of formulas and cross-references, a large part of which would be unnecessary if the simple metric system were employed. The tables are indeed useful and handy, but the people who have to use such a system deserve sympathy.

HEAVY ELECTRICAL ENGINEERING. By H. M. Hobart. New York: D. Van Nostrand Company. 338 pages, 101 tables, 188 ills. Price, $4.50.

Under the non-committal title assigned to this book the author discusses the over-all efficiency of generating stations and the relation between coal consumption and outgoing electrical energy, the steam-raising plant, piston engines and steam turbines, condensing plant, electric generating plant, the design of generating stations, high-tension transmission lines, the high-tension continuous-current series system, electric traction calculations, traction motors and the electrification of railways. Although design details are omitted, the whole book is arranged for use by the designing engineer, and the various statements made by the author are based on inter-related facts that are outlined.

The book contains a large amount of data presented in the form of tables and curves, the written matter being confined largely to discussions of these data. Throughout the whole book cause and effect are fully explained, and comparisons are freely made between results obtained by different methods. The information is presented in such simple form that the discussion involves the use of no mathematics higher than arithmetic. About one-third of the book is devoted to electric traction, all electrical engineering features of which are fully discussed. In view of the fact that in the preface the author refers to the "flourish of trumpets" with which single-phase traction by commutator motors was heralded by "the very engineers who had previously taken up the position that one of the chief objections to the continuous-current motor is the necessity of employing a commutator," one is not surprised to find that he subsequently mentions the "single-phase monstrosity" as an "ill-omened" system employing a motor that is "a mere apology for a motor at the best," and is seen at its worst during starting and accelerating when it is most needed, in heavy work. The author's statements concerning single-phase traction motors seem to be based on reports made by advocates of other systems rather than upon the performance of the machines in use under steam railroad conditions as recently made public in this country. The treatment throughout is interesting and should prove useful to consulting and constructing electrical engineers.

NEW APPARATUS AND APPLIANCES

A Modern Generating Unit.

BY C. V. KERR.

The Standard Oil Company, of New York City, has recently installed in the Sone & Fleming Works, Kingsland and Meserole Avenues, Brooklyn, a 50-kw Kerr turbo-generator set, shown in the accompanying illustration. The driving power is an 18-in. Kerr steam turbine, which developed during the factory test a maximum of 100 brake-horse-power under the operating conditions of steam pressure at 80 lb. gage with atmospheric exhaust and a speed of 2500 r.p.m.

These turbines are of the nozzle and bucket or impulse type and utilize the principle of the Pelton waterwheel. Each stage of the turbine consists of a set of circular nozzles, and the bucket wheels carry drop forged-steel, double-cup buckets riveted into the rim. As the nozzles lie in a tangent to the plane of the disks with a radial clearance, it is evident that troubles due to change of dimension by expansion in heating are entirely avoided. This radial clearance is greater than the slight swelling of the disks by centrifugal force will amount to and the end-wise motion of the shaft is limited only by the proper position of the disks with respect to the circle of nozzles. In the exhaust end bearing case, locating collars are provided which are adjustable and afford easy means of locating definitely the disks in the plane of the circle of nozzles.

Between the stages in the turbine a floating bronze bushing is provided which seats itself by difference of steam pressure between the stages. A running clearance on the shaft provides an effective steam seal when the turbine is at full speed. These bushings prove to be effective in service, as evidenced by grinding to their seats in the diaphragm casting and polishing the shaft which rotates within them.

As the steam pressure drop from stage to stage is less than that producing maximum flow of steam in most cases, the nozzles are converging in form although providing for expansion of steam through drop in pressure. The design of the nozzles is such that the areas from stage to stage, plotted, form a smoothly diverging nozzle which expands the steam from the highest pressure down to that of the back pressure whether at atmosphere or in vacuum.

The design of the turbine shell is such that the turbine can be taken completely to pieces conveniently in a very short time when it is desirable to do so. The parts, however, requiring adjustment or attention, as the bearings or the governor, are outside and of easy access. The bearing brasses are in halves and so held in the bearing case that by removing the cap both halves may be removed without disturbing the machine otherwise. Adjustment of the governor, which is of the centrifugal

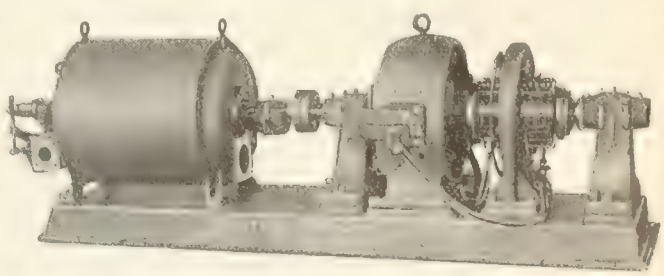


FIG. 1.—18 IN., 100-HP TURBINE COUPLED TO 50-KW GENERATOR.

type and mounted directly on the end of the turbine shaft, is made by increasing or decreasing the governor spring tension by means of lock nuts gripping on the end of the shaft. The bearings are all ring oiling, a 400 deg. Fahr. mineral oil being used on account of the heat transmitted to them by the steam and the friction heat developed as usual by the rotation of the shaft. The disks with their hubs are separately balanced on a steel mandrel and when assembled on the shaft the slight errors left in balancing tend to counteract each other so that the result is a rotor which runs with extreme steadiness.

The generator in this unit is one of a line of specially de-

signed and built generators brought out by the Northern Electric Company, of Madison, Wis., for use with steam turbines. The generator of this unit is a four-pole machine with a rated capacity of 50 kw at 125 volts and 2500 r.p.m. The armature is of the solid drum type with a core built up of laminated sheet steel. The commutator is designed for high velocity and rigidly supported on a spider in such a way as to secure permanent position on the shaft. The segments are of hard-drawn copper bars insulated with mica.

The brush holders are a special design supported on a separate quadrant or ring, as seen in the illustration. The brushes are thin, but broad, and placed in pairs with a slight space between. The effect of this arrangement on commutation was seen in the unusually good behavior when carrying 25 per cent overload. Scarcely a spark even of the pin-head variety could be found.

The efficiency of the generator guaranteed by the builders at different loads and as determined by the builders at the factory tests is as follows:

Load	¼	½	¾	1	1¼
Guaranteed, per cent	77	86	89	90	90
Test, guaranteed, per cent	78	86.1	89	90.2	90.5

These efficiencies were determined by the method of electrical losses in the usual way. The data of the test are plotted in Fig. 2.

The generator was guaranteed on full rated load for 24 hours to have a temperature rise not exceeding 40 deg. C. in

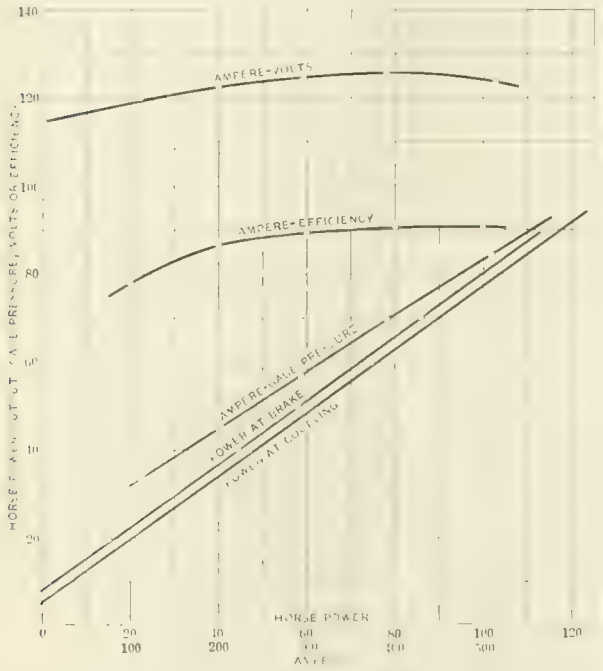


FIG. 2.—CURVES OF GENERATOR EFFICIENCIES.

any part except the commutator and there a rise of 45 deg. C. was allowed. Immediately following such a full-load run the generator was to carry an overload of 25 per cent for two hours, with a temperature rise not exceeding 55 deg. C. in any part. The data from the guarantee test made on the unit at the works before shipment showed an unusual margin to the good. The full load was carried from 8:30 a. m. till 10:45 a. m., followed by a 1¼ load until 11:15 a. m. and full load from 11:15 a. m. to 12 m.

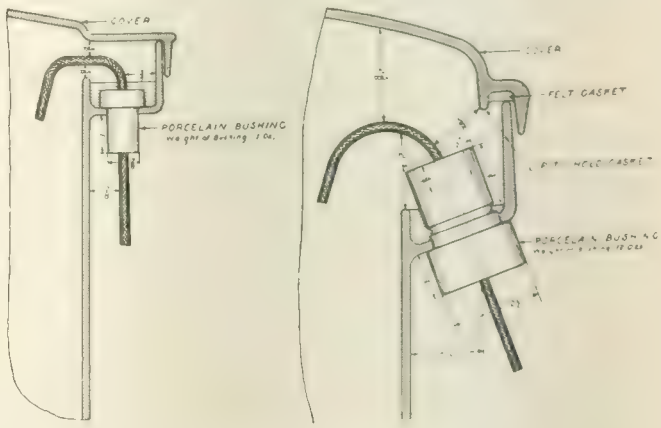
Some interesting tests were made to determine the regulation of the generator and turbine with sudden and extreme changes of load. The field windings on the generator were to be so compounded that the voltage would automatically increase from 110 volts at no load to 125 volts at full load, or any amount between the above limits as desired. The load was thrown on and off the generator by means of a circuit-breaker of large capacity. This gives the most trying condition which the unit could meet. In practice the change of load is small and more or less gradual. The data from tests showed that a 25 per cent overload was in these tests thrown off the generator as quickly as a circuit-breaker could operate. Further a 25 per cent overload was thrown on the generator in the same way. Between ¾ load and the 25 per cent overload there is a steady change in voltage of only one-half a volt. This is believed to be a very creditable performance and the tests show the apparatus to be capable of meeting the most trying conditions of this kind to be made in service.

Transformer Bushings.

By H. W. Young.

It has always been recognized that one of the most vital features of a transformer is its insulation strength, and designers have endeavored to bring this to as high a value as possible by the use of heavy insulation in the coils, the use of oil, etc. It is, however, a strange fact that many designers in the past have left a weak link in the insulation chain by employing porcelain bushings of such design, size and location that a large percentage of the high insulation factor gained in the coils, or by the use of oil, is sacrificed by the low insulation strength at the points where the primary leads pass through the transformer case.

A good example of former practice is shown in Fig. 1, the drawing being made from a commercial type of transformer. It will be noted that the greatest distance between the leads and case is ¾ in., while the minimum distance is ⅜ in. The maximum distance between the leads and the outside of the transformer case is ⅞ in. A large number of transformers insulated in this manner have been in successful operation for years, as the spacing distances shown are sufficient to withstand a break-down test of 2200 volts if these distances are maintained and the conditions are not too severe. As, however,



TRANSFORMER BUSHINGS.

the voltage of electric light and power systems increases, greater strains are brought to bear on apparatus, and if a ground, however slight it may be, starts an arc across surfaces, such as from transformer lead to the case, the line current is very apt to follow. If the generator or line capacity is limited, the arc might readily burn itself out or be suppressed without any great amount of damage; but if the energy is comparatively large there will be sufficient power behind the arc to maintain and increase it, with the usual damage and danger.

It has been found that in locations subject to severe lightning storms a spark will frequently jump from leads to case with the older type bushing, and this will be followed by an arc due to the line current. This is especially liable to happen if the leads are loose and swing in the wind so as to strike the case. Another fact which has developed in practice is that in localities subject to dust or fumes, as in a chemical or steel-mill district, the small bushing soon becomes covered with a film which in wet weather becomes a conducting surface and

causes leakage over the porcelain from the lead to the transformer case.

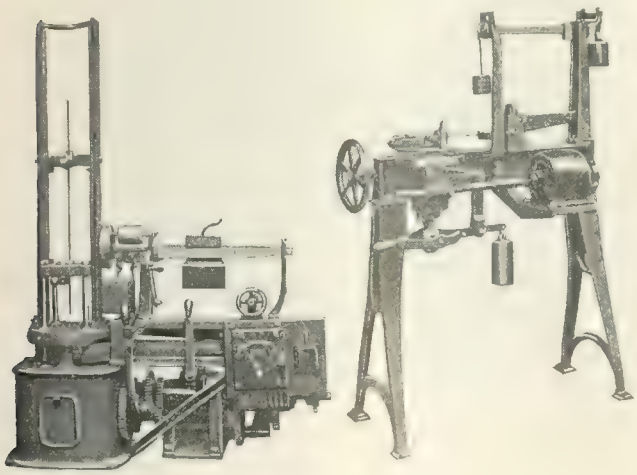
Fig. 2 illustrates an improved bushing which has been adopted for use with the Pittsburgh transformer. A comparison of Figs. 1 and 2 makes evident the greater mechanical strength of the design shown in Fig. 2. Where transformers receive rough handling this increased factor of safety is especially desirable. Electrically, the new bushings are vastly superior to the older types, their use insuring greater creeping distance, resulting in higher insulation and in ultimate strength, which could not possibly be otherwise secured. A comparison of Figs. 1 and 2 will also show that where the older forms had a maximum breaking distance of 3/8 in. and 7/8 in., the new bushings have a maximum break of 1¾ in. and 2 in., respectively. With the construction adopted it is practically impossible for a lineman so to bend the leads inside the case that they can be brought into contact with the iron, whereas with the previous forms a comparatively slight bending of the leads would bring them down onto the case.

In localities subject to heavy storms, rains, snow or sleet grounding of the line leads to the outside of the case frequently occurs, either due to wind blowing the lead up against the case, or to snow and ice packing up between the lead and the case. The danger of grounding is, therefore, always present, especially if the system is star connected, in which case a transformer wound for 2300 volts would have an actual strain to ground of approximately 4000 volts.

With the new type of bushings is secured an increased factor of safety, much desired under normal operating conditions and essential when abnormal conditions occur, such as surges, lightning discharges, etc. Under such conditions a spark will be forced to seek its natural path to earth through the ordinary lightning arresters, rather than jump from the transformer lead to the case.

Motor-Driven Wire-Testing Apparatus.

The latest improved tensile-testing machine for wire tests is that developed by Tinius Olsen & Company, Philadelphia, well-known manufacturers of testing apparatus. The machine, illustrated in an accompanying view, consists virtually of two



WIRE-TESTING APPARATUS.

separate mechanisms, performing straining and weighing functions, respectively. The straining mechanism consists of a cross-head drawn by four screws, providing a steady, straight motion. As the screws do not rotate, all moving parts are enclosed below the base cover. The straining nuts in the base are of comparatively great length to insure a large wearing surface and consequent durability. The cross-head is driven in its vertical travel by a 1/3-hp Westinghouse motor, various speeds being obtained by change-gearing, friction drives and motor regulation. The machine is equipped with a dial vernier screw beam, long column and counterbalance wedge grip for holding the wire. This type of machine is made in sizes up to 20,000 lb., and from 30,000 lb. to 60,000 lb. for strand tests, and 100,000 lb. to 600,000 lb. for rope tests.

The Moore wire tester, shown in the second illustration, is used to apply a bending strain to the wire while under a tensile stress. The wire to be tested is gripped at either end and a stress of 25 per cent the tensile strength of the wire applied; meanwhile one of the pair of grips, connected to a swinging arc, bends the wire backward and forward through an arc of 90 deg. around the bending jaws, which are curved to a radius equal to the diameter of the wire tested. This machine, which has been found especially useful in the tempering shops of wire-cable and rope manufacturers, is motor driven, and applies the bending action until the wire breaks. It is obvious that the wire which will bend the greatest number of times without rupture is the best for rope manufacturing purposes. The motor drive of this machine by a Westinghouse motor provides a great improvement over the hand-operated apparatus, securing convenience and accuracy of a degree not attainable in the hand-driven tester.

New Holophane Clusters.

The Holophane Company, Newark, Ohio, has introduced improvements in the glass equipment of the Holophane "arcs" or clusters whereby a much better distribution of light is se-



FIG. 1.—HOLOPHANE CLUSTER.

cured. The comparative curve here published indicates the improvement in this regard of the new units over the old.

A separable cluster body also is now supplied so that the new arrangement can be taken apart and the glassware cleaned

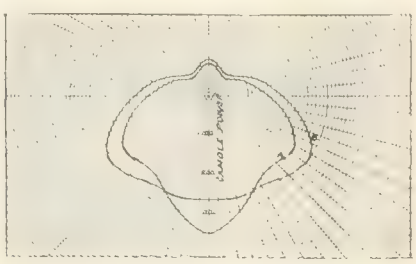
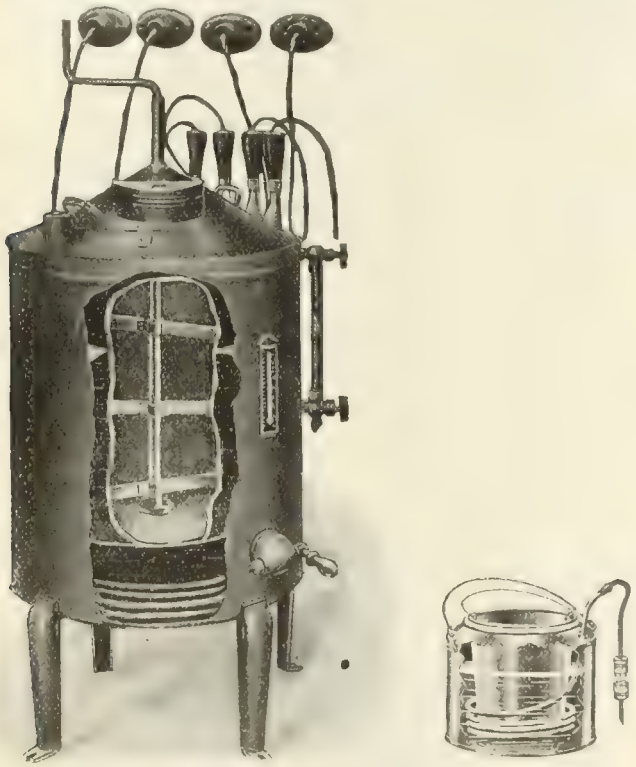


FIG. 2.—LIGHT DISTRIBUTION OF HOLOPHANE CLUSTERS.

without breaking the electrical connection. The standard finish of the clusters in future will be brush brass. Square-linked chain is used for the suspension, and a separable canopy is supplied which does away with the necessity of a long nipple at the ceiling.

Electric Glue Heaters.

The accompanying illustrations show the details of electric glue heaters brought out by the Advance Machinery Company, of Toledo, Ohio. The heater is made entirely of copper and brass, and the construction is such that when the glue is brought to the proper temperature in the morning the heater may be switched out of circuit, as the heat-retaining jacket serves to retard the dissipation of heat for from four to five hours. The glue is first put to soak in soaking buckets, and after it has absorbed all the water necessary and acquired a jelly-like consistency, it is put into the glue receptacle. The latter is cylindrical in form, and is surrounded by a jacket filled with water. This water jacket is surrounded by an additional copper jacket and the wall between the outside jacket and the water jacket is filled with mineral wool. The water in the jacket is heated by means of electric coils, provided with three-



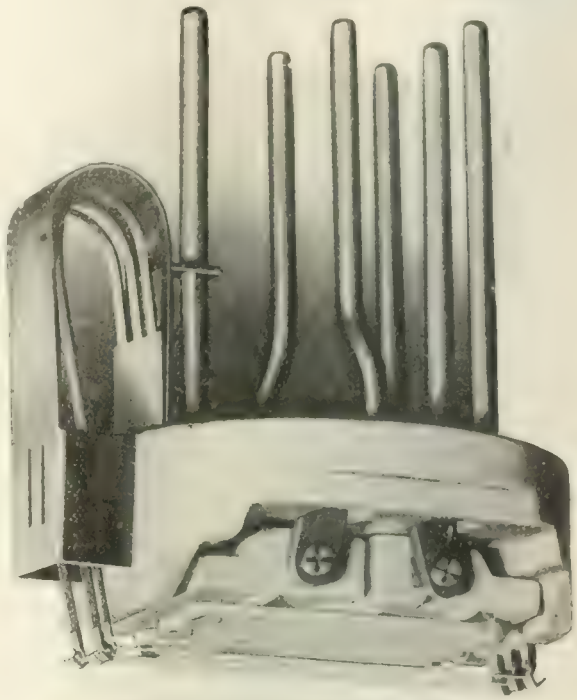
FIGS. 1 AND 2.—ELECTRIC GLUE HEATER.

way switches or several sockets, according to the size of the heater. The heaters are made as small as 1 pint or as large as 100 gal. The manufacturer claims that it is possible to dissolve the glue in 30 minutes in the morning and that the current may be switched off after 45 minutes or reduced, as the operator may desire. If the electricity is shut off entirely, the glue is said to maintain a temperature of about 150 deg. for a number of hours.

New Spring Holder for Nernst Lamps.

Another improvement added to the Westinghouse Nernst system is the new spring holder shown in the accompanying illustration. This holder consists of a one-piece porcelain base the same as that of the old holder and receives the wafer heater in the same manner, but is provided with an entirely new device for holding the glowers. On one side there is attached a metal stamping consisting of a series of springs, one for each glower, covered by a metal guard. A corresponding number of rigid upright supports fit into slots in the opposite side of the porcelain. Small platinum jaws to receive the glowers are welded to the tips of the springs and to the tips of the upright supports.

The glowers are provided with fused beads at the ends of their platinum leads which prevent them from slipping through the jaws of the holder. Replacement consists of the simple operation of inserting the bead of the glower in the jaw on the spring side of the holder and then drawing the spring forward sufficiently to allow the other bead to drop into the corresponding slot on the opposite side of the holder. The spring tension is sufficient to draw the glower into place, which is done automatically without further attention on the part of the operator. Contact is made automatically. The pressure of the



SPRING HOLDER FOR NERNST LAMPS.

spring keeps the glowers in their correct position and does not permit them to assume any other position due to expansion and contraction.

This device makes the replacement of glowers so simple an operation that it can be done by anyone without having had electrical experience, while it greatly reduces the trimmer's time and makes it impossible for him to replace the glowers in any but the proper way.

Storage Battery for Central-Station Night Load.

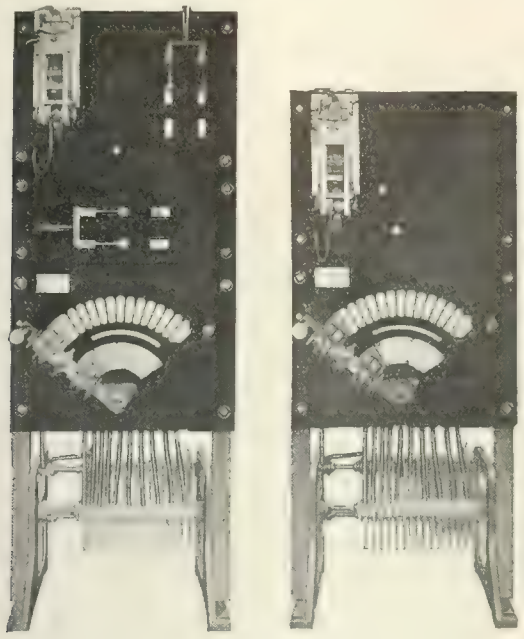
The city of Wilmot, S. D., is operating a municipal lighting plant, and in September, 1907, it installed a battery consisting of 132 cells "Chloride Accumulator," manufactured by the Electric Storage Battery Company, of Philadelphia, with a capacity of 10 amp for eight hours, the jars being sufficiently large to permit increasing the battery capacity later by 150 per cent in order to take care of the natural increase in the day load, the battery having been installed to supply day service during the hours when the steam plant was shut down.

This battery has now been in operation for over 18 months and its installation has resulted in a gross increase in business of from 25 to 30 per cent. The operating expenses of the plant have only increased about 5 per cent and the net receipts for power during the hours when the generating equipment is shut down amount to about 20 per cent of the cost of the battery installation. An additional net revenue has, of course, been secured, due to the increased number of customers, who would not consider electric power unless 24-hour service could be given them.

Consequently, this battery installation has effected a gross return of more than 20 per cent on the battery investment, resulting in a material net return on the battery investment, after allowing for interest and maintenance charges. The battery is valuable as a reserve in case of any temporary derangement of the generating equipment, and has been of assistance in helping out during the peak on frequent occasions when the peak load on the plant exceeded the generator capacity.

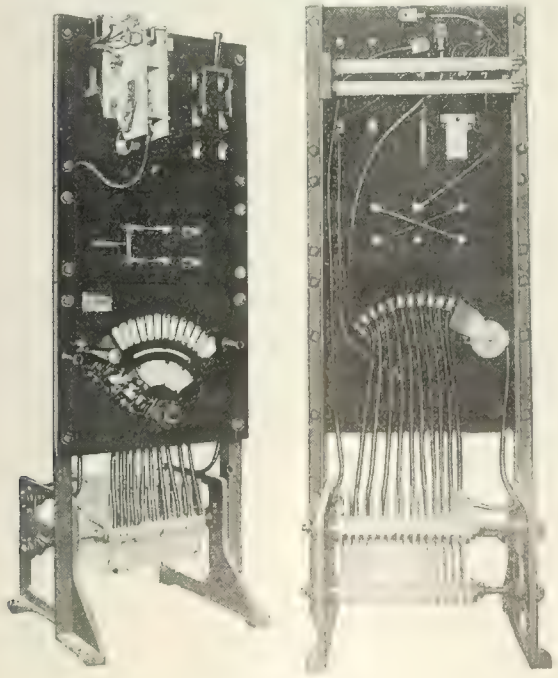
Self-Contained Motor Starters.

The accompanying illustrations show motor starters of rugged construction recently placed on the market by the Electric Controller & Manufacturing Company, of Cleveland, Ohio. The attempt to interpret the severe operating conditions encountered in mill service has necessarily led to the use of some features not found in earlier motor starters. The starters are



FIGS. 1 AND 2.—MILL-TYPE MOTOR STARTERS.

made in panels, have supporting feet, and are completely self-contained. The dimensions of the different forms vary only in height. In width, nothing projects beyond the slates so that adjacent starters may be placed side by side, thus forming a continuous control board. The starters are furnished in several forms, beginning with a very simple form and elaborated on to



FIGS. 3 AND 4.—MILL-TYPE MOTOR STARTERS.

embrace such features as no-voltage release, overload protection for running, and separate and different overload protection for accelerating. In explanation of the last-named feature, this design allows more current to reach the motor during starting than during running. When a motor is connected to a load having large inertia—such as a hot saw or a press with a heavy flywheel—the mere accelerating of the load demands a very considerable expenditure of work. Since such starting is relatively infrequent, the motor will not be injured by employing a starting current in excess of the running current, while the starting time will be materially reduced. There are, in fact, numerous places where it is desirable to allow an accelerating current larger than the running current.

The danger of a broken or weakened spring return arm is absent, because no spring is used. The no-voltage protection is secured entirely by a magnetic switch which opens upon failure of voltage. This same magnetic switch, in connection with an overload coil, is used for securing overload protection. Since the overload feature must withstand the abuse and have the characteristics of a circuit-breaker, the equipment is designed with the arc-breaking ability of a circuit-breaker.

The following features characterize the operation of this type of motor starter:

1. The magnetic switch can be closed only by bringing the arm to the "off" position, thus preventing injurious overloads to the motor upon the return of voltage after voltage failure.

2. The magnetic switch can be held closed to the arm or any accelerating step only by holding in a push button. This arrangement prevents leaving any of the starting resistance permanently in circuit, and thereby burning out the resistor.

3. The magnetic switch will maintain itself closed only when the arm is at the full-on position.

The resistors, fingers, contacts, etc., used in the motor starters are of the same design and kind of material as used in the company's controllers for heavy service.

Exhibits at Ohio Electric Light Convention.

At the Ohio Electric Light Association's convention, held at the Boody House, Toledo, Ohio, July 13, 14 and 15, a number of exhibits were made as usual by manufacturing companies. In the following mention is made only of the new appliances recently brought out which were shown there:

The General Electric Company exhibited a new rectifier for charging two-cell or three-cell storage batteries. This rectifier consists of a small compensator and a polarized vibrating make-and-break which vibrates in synchronism with the supply current and delivers a continuous current. It can be connected for either 7.5 volts or 5 volts direct current with 5 amp maximum current. The battery to be charged is connected across the direct-current terminals and the flow of the current can be regulated by means of a rheostat. The whole apparatus is mounted on a slate base very much like a rheostat with the compensator behind. A small ammeter indicates the current.

The new General Electric water heaters shown are on an entirely different principle from the former water heaters and cookers. The heating element is contained in a brass disk which is connected in the bottom of the stand. The utensil screws in the stand and is held firmly against the heating element by means of a Mason jar thread. This makes the washing of the utensil easier, as it is unscrewed from the stand and free from the weight of the heating element, and is also conducive to better life of the element. The element itself has the new ribbon resistance material which is of such high specific resistance that only one layer is used. This company's new coffee percolator and new flatiron also make use of this new resistance material. In the field of illumination the new G. E. intensified arc was shown. The positive electrode consists of two carbons 3/16 in. in diameter feeding down by gravity to their meeting point. The negative lower carbon is large and burns away slowly. This makes it possible to keep the light-giving crater of the arc in a fixed position between trimmings, which in turn makes the use of an efficient reflector possible. The arc is rated at 5 amp.

The Westinghouse Nernst lamp has recently been improved by the use of a zigzag carbon filament for heating the glower. This makes the lamp begin to give light instantly when the current is turned on, and the glower is heated sufficiently to come into action in a short time. This overcomes the objection

to the slow starting of the Nernst lamp which has sometimes been urged against it.

Among the Westinghouse exhibits was a combination outfit whereby a number of household services can be obtained from one motor of 1/20 hp. This motor had connections for polishing and grinding wheels and a flexible shaft for driving other apparatus. This company has just put out a toaster stove for the preparation of breakfast in 15 minutes. With this stove was also shown the Westinghouse electric irons in model form, with plate glass over the heating elements and an incandescent lamp behind the elements to show the construction. This company also has a new electric range very similar in general construction to gas ranges which have the ovens and broilers on top. The Westinghouse 8-in. fans, which were brought on the market this year, were shown. Low-voltage sign lamps in 5-watt, 10-sizes, operated from a special 10-volt economy coil, were also shown.

The Manhattan Electric Supply Company showed a new line of Wesco electric flatirons and a teapot and stove.

Electric Furnaces.

A novel display of electric furnaces for all classes of chemical work was recently exhibited in the testing rooms of the new plant of the Hoskins Manufacturing Company, Detroit, the occasion being the summer meeting in that city of the American Chemical Society, the visiting members of which made an inspection visit to the Hoskins factory.

Of the many special features of the exhibit the following were of particular interest: A complete connected train of apparatus for determining the carbon content of steel, showing strikingly the advantages of the application of the electric combustion-tube furnace to such steel analyses. The furnace used in this train was run directly from a 110-volt circuit and produced a chamber temperature of 1000 deg. C. (1832 deg. Fahr.) with a current consumption of 6 amp. The ease and accuracy of determining proper temperatures for hardening carbon steels were demonstrated by the Hoskins "Recalescent Outfit," consisting of a standard-voltage, single crucible furnace and a special thermocouple pyrometer. Sample steel specimens, fastened to the couple, were placed in the hot furnace, and on both the heating and cooling of these the "critical" points were readily noted from the pyrometer indicator. A temperature of 1200 deg. C. (2192 deg. Fahr.) was produced and maintained in both crucible and tube furnaces of the heavy-wire wound type. These are for low-voltage operation, with transformer control.

In the furnace-room a permanent installation, with transformer and switchboard, of the Hoskins carbon-plate resistance furnace, was shown. This furnace was in regular operation melting special alloys, being capable of producing a temperature of 2000 deg. C. (3632 deg. Fahr.). In connection with the furnaces a complete installation of Hoskins thermo-electric pyrometers was shown. In each of the operating furnaces was placed a thermocouple, all of these being connected, through a selective switch, to an illuminated dial meter calibrated in Fahrenheit degrees. By turning the switch the temperatures of each of the furnaces were indicated, in quick succession, upon the meter scale.

The inspection of these products, under working conditions, impressed the large number of chemists present from all parts of the country with the increasing importance of the application of electrical energy to all classes of chemical work.

New 200-250-Volt Tungsten Lamps.

The advantages and economy of the tungsten incandescent over the carbon-filament lamp have been practically denied to most circuits operating at 200-250 volts, because the regular multiple tungsten lamps were designed for the standard voltage of 100-125. On these larger voltage circuits—for example 220 volts—in order to use tungsten lamps at all it was necessary to operate two 110-volt lamps in series. Most users of the higher voltages preferred to wait for the advent of the tungsten adapted to their voltage.

In answer to this considerable demand, the General Electric Company has extended its production of tungsten lamps into voltages from 200 to 250. This gives to the users of higher voltages the opportunity for the adoption of the economical high-efficiency lamps for multiple service. The regular 200-260-volt carbon-filament lamps ranged in nominal efficiency from 3.8 watts per candle to 3.1 watts per candle. The new tungsten has the usual tungsten efficiency of 1¼ watts per candle actual. The new lamps are claimed to possess all the excellent qualities of the regular General Electric 100-125-volt tungsten lamps, including the same form of specially anchored filaments which make the 100-125-volt lamps so successful. Tests of the new 200-250-volt tungstens show the average life and performance of these lamps to be fully up to that of the standard multiple lamps. The lamps have ratings of 45, 70, 110 and 180 watts.

Stone & Webster Outing.

The Triskelion Outing, held by the firm of Stone & Webster and its subsidiary corporations on Saturday, July 10, at the Pomham Club, Providence River, was an enjoyable success. The event comprised a round-up of all the Stone & Webster people in the vicinity of Boston to celebrate the official adoption of the "Triskelion," which emblem will hereafter adorn Stone & Webster property throughout the country.

The outing was originated by Mr. Francis J. Hovey, of the Stone & Webster Management Association, who, by the way, is credited with the invention of the "Blue Bell" sign for the Bell Telephone Company. He was ably seconded by Mr. E. F. Flynn, of the management staff, and Engineer Bushnell, of the Engineering Corporation.

The "Triskelion" flag was raised 'mid a vociferous din from the voices of the 300 present, including about 60 lady employees, who were as enthusiastic as the men. Success to the flag was drunk in the form of a Triskelion cocktail especially compounded under the able direction of Mr. Flynn.

Mr. Webster spoke a few words of welcome and set forth the spirit which has always actuated the firm and hoped that the mark of the Triskelion would ever serve to maintain the feeling of loyalty and unity which has formed the foundation of the firm's success. No better evidence of the esteem in which the firm is held by its employees could be shown than the hearty ovation tendered Mr. Webster at the conclusion of his remarks.

Immediately after dinner, athletic exercises were commenced under the guidance of Mr. Edward S. Morse, Chief Engineer Emeritus, the only invited guest, and in spite of his venerable age, the youngest man present. The Japanese tournament run by him bowled over everybody, including at least one dignified member of the firm.

In the senior ball games between the Engineering Corporation and the Securities Department, the former won both games. Vice-President Tripp undertook to umpire, but shouts of "Kill the umpire!" seemed to be about to be heeded and Mr. Tripp's hat was shortly *hors du combat*, whereupon he retired in favor of Equipment Expert Lee Barker. The junior ball game, between the messenger boys and the mailing department, was won by the latter, 5 to 4.

The bowling alley and billiard rooms were well filled, while the ladies divided their time between the dance hall and a steamboat ride on the river.

It was with reluctant steps that the jolly party betook itself to the special train at 5:30 o'clock to return to Boston. Everybody, from Mr. Webster down to the smallest office boy, had had a good time, and the Triskelion Outing of 1909 will fill a large page in the personal history of each. The members of the firm present were: Messrs. Edwin S. Webster, Russell Robb, Henry G. Bradlee and Eliot Wadsworth.

The emblem which gave the name to the outing, and which has recently been adopted by the Stone & Webster Company, consists of a three-arm swastika, called triskelion, within a triangle. The former symbolizes energy and motion and the latter stability.

Electric Lawn Mower.

A new application of the electric motor is to the lawn mower, as shown by the accompanying illustration. The machine illustrated was devised by Mr. Franklin H. Kerr, of 5969 Union Avenue, Chicago, and the picture shows the apparatus in use on the Capitol lawn at Columbus, Ohio. The machine is driven by a ½-hp electric motor. It is now on exhibition at the Electric Shop, in Chicago, and in this case the motor is of the single-phase, 60-cycle type, turning at 1750 r.p.m. and made by the Century Electric Company, of St. Louis. The machine itself bears the name of the Springfield Electric Mower Company. The motor drives on a countershaft in the rear of the machine, from which both the rear traction wheel for propelling the machine and the revolving grass-cutting blade in front are operated by chain drive.

At Columbus the electric mower was operated by means of 500 ft. of No. 12 duplex flexible cable, and it is said that no difficulty was experienced in cutting the grass on 12 acres without the machine becoming entangled in the cable, which is connected at one end, of course, to a suitable source of electricity. For any ordinary requirement Mr. Kerr says that 250 ft. of flexible cable will be ample. The cable is ordinarily carried on a reel at the handles of the machine. It is asserted that with a little practice the operator will be enabled to use the machine nearly as easily as though there were no cable connection.

In turning and backing away from corners a slight pull on the handles will raise the traction wheel sufficiently so that it will not catch on the ground, and therefore there is no necessity for reversing the motor. A friction safety clutch placed on the sprocket driving the cutting blade throws the latter out of engagement on striking a stone or other obstruction without injuring the blade or driving mechanism. The machine weighs about 100 lb. and makes a 40-in. cut, but the inventor is making plans for a smaller machine to make a 20-in. cut and be driven by a ¼-hp motor for city use. The larger machine, however is more economical in consumption of electricity in proportion to the work accomplished. It is said to do the work of six men with ordinary lawn mowers.



ELECTRIC LAWN MOWER.

While the electric mower has been operated successfully on the State Capitol grounds at Columbus, according to Mr. William Miller, the superintendent of grounds, doing close and rapid work around trees and shrubs and over driveways, the inventor thinks that the principle of the machine is capable of much greater development. He is building an improved type of machine for farm and garden tillage to be used to operate plows, harrows, drills, seeders and trucks, as well as mowers, and also provided with emery-wheel attachment for grinding and a pulley by which pumps or other stationary machines may be operated. Mr. Kerr thinks that the trend of agriculture in this country is toward smaller farms and more intensive cultivation. Horse farming tools have increased greatly the tillage acreage; but it is thought that the application of electric power on small farms will double the yield at one-half the expense of maintaining horses, with no stabling or operating expense when the machines are not in use. Furthermore, the electric-power machine will be compact, light and simple, capable of being operated up steep grades and over soft ground and more easy to handle in corners or confined spaces than a machine drawn by horses. To make use of this idea, however, the same machine must be adaptable to the various uses of the farm, and electricity for power must be obtainable at a cheap rate.

Horse Grooming by Electricity.

Mechanical methods for grooming horses have been in use for a number of years, but the electrically operated outfit illustrated herewith is said to represent the latest improvements in this direction. Central-station men will be interested in the machine as indicating a possible method of getting some new business. The apparatus shown is the invention of Mr. John F. Packer, of La Grange, Ill., and is made by the John F. Packer & Sons Company, of the same place, the electric motors used being furnished by the Kimble Electric Company, of Chicago. The motor is flexibly attached to the swinging arm of an overhead crane, as illustrated. To the motor is attached a flexible shaft to which in turn is connected the cleaning brush or clipper knife. A pneumatic attachment is provided so constructed as to utilize the currents of air arising from the rapid rotation of the brush to protect the operator from dust and dirt and to deposit the latter on the floor. The flexible shaft is made of piano wire and is ½ in. in diameter. The cleaning brush is driven by friction so that should the mane or tail of the horse be caught the brush will stop at once without doing damage to the machine.



FIG. 1.—HORSE GROOMING BY ELECTRICITY.

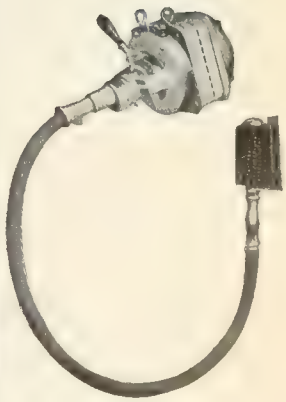


FIG. 2.—MOTOR, FLEXIBLE SHAFT AND BRUSH.

The motors are built particularly for this work. They are of the variable-speed, reversible type, invented by Mr. Austin Kimble and are used on alternating-current or direct-current circuits. If the supply of electricity is direct current, resistance is inserted in the circuit; this is not needed if the current supplied is alternating. The variation in speed is from 100 to

5000 r.p.m. and the operator may stop, start or reverse the machine, run slow or fast, by the use of one lever. The motor is of the four-pole commutator type with commutator control; shifting the brushes controls the speed and power. A full voltage may be impressed in the opposite direction on the motor when it is running at full speed with load. In other words, should the motor be turning at a velocity of 5000 revolutions it will not injure the machine to throw the reverse lever over instantly to full voltage and load in the opposite direction. The frame of these machines and all exposed parts are made of aluminum and brass—a feature of particular value in a livery stable where the ammonia and exhalations will damage anything made of iron or steel.

Many advantages resulting from the use of this horse-grooming outfit are enumerated by the manufacturer. It is said that the machine will clean a horse better than the work can be accomplished in any other way and that anyone accustomed to horses can learn to use the apparatus in a few minutes. The cost of electricity to operate the machine at average rates is said to be about $5 a month for 50 head of horses. The connection to the electric service may be made by means of an incandescent lamp socket. The motors are built to operate on 110-volt or 220-volt circuits. When the machine is in operation it is necessary that one man keep the horse's mane and tail out of the reach of the brush. The danger is not in injuring the machine, but rather of frightening the horse.

First Annual Electrical Show in San Diego.

The enterprise of the electrical contractors of San Diego, Cal., was well illustrated recently when the Electrical Contractors' Association held an educational show to which the public was freely admitted. Daily demonstrations were made by different firms of heating, cooking, electrical machinery, the whole affair being conducted in a spirit of helpful co-operation and friendly rivalry rather than destructive competition. The booths were of uniform size, 12 ft. x 14 ft., and were artistically decorated. It is estimated that during the one week of the show there were 100,000 visitors. The success of the undertaking was such that during next year the second annual show will be held for two weeks. Credit for this result is due largely to Mr. C. H. Heilborn, of the Southern Electrical Company, who was the chief promoter of the show.



FIG. 1.—MEMBERS OF SAN DIEGO ELECTRICAL CONTRACTORS' ASSOCIATION.

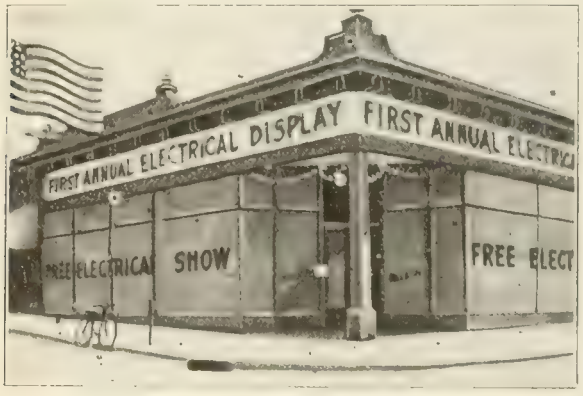


FIG. 2.—ELECTRICAL SHOW BUILDING.

The association is composed of 10 contracting firms: The Hartwell Electric Company, the Southern Electrical Company, the Johnstone Electrical Company, the Woods Electric Company, the Star Electric Company, the Bay City Electric Company, the Clark Electric & Machinery Company, Ayers & Strornton, Shaffer & Moses, C. W. Buker. Among the companies not members of the association but taking part in the show were the General Electric Company, which occupied a booth displaying tungsten lamps; the Thearle Music Company, which furnished music; the Ingersoll Candy Company, which furnished refreshments; the San Diego Street Railway Company, which equipped a rest-room, and the Arnold Vibrator Company, which gave demonstrations with vibrators.

The officers of the Electrical Contractors' Association of San Diego are as follows: President, F. S. Hartwell; vice-president, C. H. Heilborn; treasurer, A. E. Johnstone; secretary, H. C. Ayres.

Two-Piece Fuseless Wooden Molding Rosette.

Pass & Seymour, Inc., of Solvay, N. Y., have brought out a two-piece molding rosette shown in the accompanying engravings; one of which shows the rosette by itself with the cap in position, and the other showing the rosette mounted on a piece of molding with the cap slightly raised. The device is fuseless and is said to have met the approval of the Underwriters' Laboratories. It will be noticed that the small inside piece with the metal parts is intended to be mounted directly on top of the molding. It is not necessary to cut the wire to do this, since the latter may be looped over the terminal plate at the extreme outside point, going under the head of the upper contact screw. There is said to be ample room in the cap for the knot of the cord and the latter is fastened under the two inside screws on the terminal plates. The rosette is attached to the molding by means of two screws passing through holes in the cap. This makes a very neat and finished job which does not necessitate cutting the molding, and which can be completed in remarkably short time.



FIG. 1.—MOLDING ROSETTE.



FIG. 2.—MOLDING ROSETTE.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

A certain portion of the improvement noted in business is being attributed to the progress made in the work of tariff revision, which has reached its final stage—the possibility of the President's veto still remaining, however. Railroad earnings are 6.3 per cent better than in 1908 and only 0.8 per cent under 1907. Foreign commerce at the port of New York during the latest week aggregated $23,695,475, which is $3,052,683 better than in 1908, but $8,856,574 under 1907. Imports were heavy, but exports less than in the two preceding years. Optimism continues to be the characteristic feature of the markets for iron and steel. Steel bars, plates and shapes are firmer, but despite the higher prices orders continue to be received by the mills. New business in steel rails is light. Bar iron shows improvement. Comparatively large sales of Bessemer pig iron have been made, thus advancing prices, and other heavy transactions are looked for. Sales of ore are increasing, and there are indications that the season's shipments may equal those of 1907, the record year. Copper is lower and demand is dull, but the larger sellers do not appear anxious to sell at prices offered by consumers, who for the most part want bargains. Stocks here have been heavily reduced, but oversea the supply shows a large increase, and at the same time domestic production continues of record volume. With the exception of copper, which is still under the influence of oversupply, consumption is rapidly catching up with production capacity, and the problem is becoming that of meeting orders with adequate dispatch. Business failures for the week ending with July 15, as reported in *Bradstreet's*, were 206, against 182 for the previous week, 215 in the corresponding week of 1908, 177 in 1907, 188 in 1906 and 165 in 1905.

THE COPPER MARKET.

Throughout the whole of last week the copper market was dull, there being only a few sales largely by speculators, and in a few instances by weak holders. A slight improvement was noticeable on Monday when a sale of 2,000,000 lb. of electrolytic was reported at 13⅛ cents per pound. In general the demand has been very light and mainly in small lots. The large exports have helped the American producers to dispose of some of their surplus stocks. The shipments to European ports last week were the heaviest recorded, aggregating 12,986 tons, and for the first half of July 18,937 tons, or at the rate of nearly 38,000 tons for the month, which would be record breaking, as the largest monthly exports ever made from this country were during December, 1907, when 37,685 tons were exported. The fact that copper is going largely to swell surplus stocks abroad has a depressing effect, although it is reducing the surplus held by producers in this country. During the last two weeks the increase in British warehouses, where stocks are held against standard contracts, has been 8,000,000 lb.; the total British stocks are now a little less than 158,000,000 lb. On the Metal Exchange July 19 quotations were as given in the table.

Lake	13¼ @ 13⅜
Electrolytic	12⅝ @ 12⅞
Casting	12½ @ 12¾

The London prices, July 9, were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper spot	58 7 0	58 12 6
Standard copper, futures	59 1 3	59 7 6
Market	Steady.	Firm.
Sales of spot		800 tons
Sales of futures		1,400 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	.....	.....
Lake	14 55	12 55
Electrolytic	14 25	12 12½
Casting	14 12½	12 00
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

WESTERN ELECTRIC COMPANY.—The volume of the business of the Western Electric Company is said to be running at the rate of $46,000,000 a year, and while this is far short of the results for 1907, it compares favorably with last year, when it amounted to $33,000,000. In 1907 the volume was $53,000,000. This shows an improvement of 40 per cent in the first case and at the rate of 87 per cent of the 1907 record. An official of the company says: "The present business outlook seems to us good, but without anything to lead us to expect an unusual growth in our business. A sure and steady increase, however, may be confidently looked forward to if business conditions continue along the lines they are doing at present. Gross business for the first quarter of the fiscal year ran at the rate of $42,000,000 per annum, and for the last quarter at the rate of nearly $50,000,000 for the year, an increase of about 19 per cent. While the business for May is usually ahead of the business of the preceding months, the increase of May, 1909, over May, 1908, showed approximately 60 per cent. The month of April, 1909, showed an improvement equivalent to 50 per cent over April, 1908, and if the ratio of improvement of the last two months continues the company will easily attain a $50,000,000 volume. The increase in the machinery sales for the half-year was 40 per cent over the same period a year ago. The volume of the company's orders for the six months increased about 30 per cent over the same period in 1908 and the average value per order increased approximately 10 per cent. The company is putting more copper into consumption at present than for a long time. As is the established policy of the company, however, the metal is purchased only for requirements that can be clearly foreseen."

DELAY IN FILLING EXPORT ORDERS.—In a recent report Consul John H. Grout, of Odessa, Russia, says he finds that much trade is lost in Russia by American firms owing to inattention to the desires of purchasers. He cites the following case which has just come to his notice: Odessa has a well-established and growing telephone system. Some time ago the management sent an order to a certain manufacturing firm in the United States for a lot of instruments. The goods were desired at once in order to meet almost immediate demands. Delay succeeded delay in receiving the goods, and it was six months before they arrived, during which time the management was obliged to order from Germany supplies sufficient to provide the most pressing demands. Owing to this lack of attention on the part of the American firm, the local company has decided henceforth to order its supplies from Berlin and of German make. The consul adds that perhaps this incident may serve as a reminder to American houses desiring foreign trade that if they wish to keep or gain it they should be prompt in filling orders.

CONSOLIDATION IN PENNSYLVANIA.—The Delaware County Electric Company has been formed to take over the following properties operating in the suburbs of Philadelphia: The Media Electric Light Company, the Citizens' Electric Light & Power Company, of Clifton Heights, the Faraday Light Company, of Morton, the Philadelphia Suburban Electric Company, of Lansdowne. These properties were themselves a consolidation of several smaller properties, so that the Delaware County Electric Company will be the merger of some 12 companies. The entire physical property of the Delaware County Electric Company will be reconstructed and in conjunction with the Associated Gas & Electric Company will be controlled and operated by W. S. Barstow & Company, of New York. The territory supplied covers about 64 square miles adjoining the city of Philadelphia to the west, and serves a population of about 50,000. It is expected that the physical reconstruction and consolidation will be completed by Sept. 1.

CROCKER-WHEELER COMPANY.—At the July directors' meeting of the Crocker-Wheeler Company, Ampere, N. J., held at the New York office of the company the following officers were elected for the ensuing year: Vice-president, Mr. Gano Dunn; second vice-president, Mr. A. L. Doremus; chief engineer, Mr. Gano Dunn; secretary, Mr. Rodman Gilder; treasurer, Mr. W. L. Brownell; assistant treasurer, Mr. G. W. Bower. Dr. Schuyler Skaats Wheeler continues to hold the office of president.

THE NORTHERN CALIFORNIA POWER COMPANY is building a 24,000-hp hydro-electric plant in the Battle Creek County and the plant will soon be ready to commence operation with the 6000-hp unit. This station, designated "South," is five miles south of the Volta power plant of the company, where 9000 hp is now generated, and immediately south of Manton. The water to obtain power at "South" is taken from South Battle Creek to North Battle Creek, Mill Creek, and from water owned in Rock and Bailey creeks. At the tail-race near the South station, the water is again picked up and carried down South Battle Creek Canyon to a point near where the Red Bluff-Manton road crosses, and here will be constructed another station, to be known as "Inskip," at the foot of Inskip Butte, where 8000 hp will be obtained. On the line between the intake of the ditches from South Battle Creek and the power house several tunnels are being built, the longest being 4000 ft. The company expects to turn the water into South power house for the generation of energy during the present month; and will then continue the units, until all are completed, when they will have a total equipment of 27,000 hp, which should be in service by Nov. 1 of this year. From this point they will go on to main Battle Creek, where the largest unit of all, 24,000 hp, will be installed. All of these installations will be completed by the end of 1910, making in all in that section available horse-power of 51,000.

SOUTHERN PACIFIC ELECTRIFICATION.—On the division of the Southern Pacific, extending for 140 miles over the Sierra Nevada Mountains from Reno, Nev., to Sacramento, Cal., the limit of haulage has already been reached on the one-track road. Estimates indicate that the cutting of new tunnels, and thereby lowering the grades for steam haulage, would cost from $40,000,000 to $50,000,000 and consume eight years, while a change to electric haulage could be made in two years at a cost of $13,000,000. With electric haulage 75 per cent will be gained in speed, and there will be a 20 per cent reduction in non-profitable tonnage on account of the reduction in the weight of equipment. In commenting upon the report that the road would be electrically equipped on a large scale, the director of maintenance and operation, Mr. Julian Kruttschnitt, said: "We have never contemplated using electricity, except where the Sacramento division crosses the mountains, about 110 miles between sea level on the west and the base of the interior plateau. With a grade of 7000 ft. and six or eight passenger trains a day besides heavy freight trains, that section presents a tremendous problem in transportation. However, our new locomotives have demonstrated a capacity for handling 12 per cent heavier trains with far less fuel than two of our former heaviest locomotives." The company has placed orders for 21 Mallet compound oil-burning locomotives, two of which are now in use on the mountain division.

LARGE HYDRO-ELECTRIC PLANT IN MEXICO.—Reports from Mexico state that the Chapala Power & Irrigation Company, which is being organized to combine the Pimental street railway and electric lighting systems, and the valuable water-power, irrigation and transmission concessions of Manuel Cuesta, will construct a 16-mile canal to carry the water of the Santiago River to a point where a fall of 1800 ft. can be obtained for developing 90,000 hp. The proposed canal would extend from the Juanaca Falls of the Santiago River to Las Juntas, where one of the Pimental power plants is now located. At Juanacatlan the Santiago River enters a barranca, and between that point and Las Juntas drops more than 1800 ft. The canal would follow one side of the barranca until Las Juntas was reached. The estimated cost of the canal is $96,000 per mile. The plans now being formulated in connection with the organization of the new company include the transmission of energy to Aguascalientes, Zacatecas, and other cities and towns, and to a number of mining districts.

SOUTHERN POWER COMPANY'S NINTY-NINE ISLAND PLANT.—The Ninety-nine Island plant of the Southern Power Company will be completed by February next. The site is on Broad River, seven miles from Blacksburg, S. C. B. H. Hardaway has the contract for the construction of the plant. The hydraulic equipment of this plant consists of six 5200-hp Allis-Chalmers horizontal twin turbines, which will be directly connected to Westinghouse 2500-volt three-phase generators. The e.m.f will be stepped up from 2500 to 50,000 volts by three banks of 2000-kw transformers. This plant will tie in at Clover, S. C., with the present 50,000-volt system and will also tie in at Spartanburg, S. C., with a 100,000-volt line to Greenville, S. C. The dam at this plant, which is the largest in the South, is now almost completed. The head developed is 72 ft. and the whole dam will contain 160,000 yd. of concrete masonry. This plant is located in the heart of the Piedmont cotton manufacturing district, and the energy will be largely used by mills of that section.

COST OF NEW YORK CITY LIGHTING IN 1903.—The Appellate Division of the Supreme Court has reversed the lower court and granted the appeal of the city of New York, Boroughs of Manhattan and The Bronx, for an order to inspect the books and papers of the New York Edison Company and the United Electric Light & Power Company to ascertain the cost of electricity for lighting purposes and the price charged against the city in 1903. The electric light companies declared that they were furnishing light upon a contract and at a reasonable rate, but the city authorities denied it and moved to find out what the cost was. Justice McLaughlin, writing the decision, said that if it turns out on the trial that the electric light companies never had a contract the plaintiff can recover only the reasonable and fair market value of the electricity furnished, and the city cannot prepare its case for trial unless it can ascertain what it cost the plaintiff to manufacture and deliver.

ROCKY RIVER (N. C.) HYDRO-ELECTRIC PROJECT.—A. H. Richardson and other leading capitalists of Ansonville, N. C., are promoting a project looking forward to the development of an electrical power site on Rocky River, near Wadesboro, N. C. A dam will be built to cost $400,000 and a power house constructed which will have an initial equipment rated at from 6000 to 7000 hp. The line of the new Southbound Railway passes within one mile of the proposed power plant site, and the promoters expect to see a new town and manufacturing center established. With the cheap power generated at the plant it is believed that large cotton mills can be operated at a good profit. The work now being done is obtaining options and the organization of a company for the purpose of securing the capital needed. It is thought that the entire work can easily be done by the enlistment of local financiers.

USE OF HUDSON TUNNELS BY ERIE.—In addition to the Pennsylvania Railroad, which began to send its passengers through the Hudson tunnels on July 19, the Erie Railroad will make use of the same facilities, beginning on Aug. 2. The schedule for the regular operation of trains calls for six minutes for the trip to Manhattan from Jersey City. The six-minute schedule will chop off about 15 minutes of the time it now takes the commuter to get from Jersey City to Church and Fulton Streets in New York. Arrangements have as yet not been made for the use of the tunnels by the passengers of the Delaware, Lackawanna & Western Railroad or by the Lehigh Valley Railroad.

WESTINGHOUSE LOW-PRESSURE TURBINE IN TEXTILE MILL SERVICE.—At the Bernon Mills of the Manville Company, Georgiaville, R. I., a 300-kw Westinghouse-Parsons low-pressure turbine is being installed to take steam at atmospheric pressure from the exhaust of a Corliss engine, driving a three-phase, 60-cycle, 600-volt alternator to supply additional energy for lamps and motors in the mills. The turbine is operated without superheating and exhausts into a condenser maintaining a vacuum of 27 in. The distribution system supplies energy to a synchronous motor directly connected to a mill line shaft.

BOONE (IOWA) ELECTRIC FRANCHISE.—The City Council of Boone, Iowa, on July 8 granted a franchise to Messrs. E. E. Hughes, J. H. McBride and Andrew Stevenson to operate an electric light plant, heating plant and street railway in that city, subject to ratification by the citizens at a special election to be held Aug. 16. It is stated that the above named have secured an option on the present properties of the Boone Electric Company, of which Mr. John Reynolds is president. It is proposed, should the ordinance be ratified, to overhaul the present plant and extend the electric railway to Story City.

NEW YORK CENTRAL TUNNEL.—The New York Central Railroad Company is planning to construct a 670-ft. tunnel at Spuyten Duyvil, to avoid the sharp curve at this point, and to increase the number of tracks from two to four, which will be arranged for electric motive power. The cost of the tunnel will reach $500,000.

WESTERN TELEPHONE MANUFACTURING COMPANY.—The Western Telephone Manufacturing Company, which recently moved its headquarters from Muskegon, Mich., to its new factory at 9 South Curtis Street, Chicago, was established in Chicago in 1893, and lays claim to being the oldest independent telephone manufacturing company in the United States. It maintained its factory in Chicago until 1904, when it moved to Muskegon, returning now to Chicago. There have been some changes in the personnel of the company. Mr. Charles L. Johnson, treasurer, has retired on account of the rapid growth of the business of the American Electric Fuse Company, of Muskegon, which he represents in Chicago. Mr. Horace E. Anderson, general manager, becomes secretary and treasurer of the company, retaining the management also. The president of the company is Mr. Rolland L. Porter, a retired capitalist from Milwaukee. The general policy of the company will remain unchanged, but bringing the general offices and factory together, with a new factory and the installation of new machinery, will enable the company, it is thought, to become an increasingly active factor in the telephone field.

NEW COLORADO ELECTRIC POWER DEVELOPMENT.—It is reported that the Greeley-Poudre Irrigation Company of Colorado is forming a combination power and irrigation project which will include reservoirs involving an expenditure of several million dollars, the construction of many miles of additional canals and laterals for Weld, Laramie and other counties, the higher reservoirs to be used for large electric power developments. The Denver City Tramways, through W. G. Evans and J. A. Beeler, the general manager, is reported to be specially interested in this power proposition, and is to be connected with the Greeley-Poudre Irrigation Company. Several smaller irrigation companies, including the Cache le Poudre Irrigation Company, controlled by W. G. Evans, of the Denver City Tramways, will probably be absorbed in the proposed merger. The entire project is said to be entirely independent of the present large power developments of Colorado.

OUTLOOK IN THE POLE INDUSTRY.—Mr. W. P. Bowring, secretary of C. H. Worcester & Company, pole dealers, 143 Dearborn Street, Chicago, when asked about the outlook in the pole industry, answered that, whereas business is rather quiet just at present, there were considerable fair-sized orders from large consumers earlier in the year. It is believed that there will be an improvement in the pole business this fall, and Mr. Bowring feels quite confident that by next spring there will be a brisk demand for poles from electrical companies, owing to the demands of new electrical construction. Prices for cedar poles have remained unchanged for some time, and Mr. Bowring thinks that the present is a good time to buy them. Telephone companies take poles of varying sizes, ranging from 16 to 50 ft. in length, but the standard trolley and electric light poles are about 35 ft. long.

NEW YORK INDEPENDENT TELEPHONE COMPANY.—The Appellate Division of the Supreme Court has denied the appeal of the New York Independent Telephone Company for permission to place telephone wires under the streets of the city. The higher court affirmed the decision of the special term of the Supreme Court, which denied the application of the Independent company for a writ of mandamus directed to the commissioner of water supply, gas and electricity to issue a permit to lay wires in the conduits. In refusing the appeal Justice Clarke says the New York Independent Telephone Company merged with the Mercantile Electric Company in 1905, and now asserts its right to lay wires under the franchise of a concern organized for a burglar-alarm business.

A LARGE CENTRAL STATION BOILER.—A single boiler of unusual size, 2274 hp, has been placed in the Delray power station of the Detroit Edison Company. This boiler, a Stirling special, has a 150-in. x 11-ft. grate, and is served with bituminous coal by four Roney stokers installed underneath the one boiler. This exceptional installation is in the first section of the Detroit Edison Company's No. 2 power house at Delray, in the construction of which allowance has been made for extending the outfit with similar units as the station's lighting load increases. Mr. George W. Cate is superintendent of the plant. The engineering design and construction were carried out by Westinghouse, Church, Kerr & Company.

LARGE CENTRAL STATION CONTRACTS IN CHICAGO.—Under its new schedules of reduced wholesale rates, the Commonwealth Edison Company of Chicago has recently closed several contracts of large size. One is to supply all the electricity required by the five factories of the Crane Company, with a connected load of about 7000 hp. Another is for the large department store of Siegel, Cooper & Company, with a maximum demand of about 1200 kw. This establishment was supplied with electricity from its own private plant for many years. Another department store which recently began taking energy from the Edison system is Hillman's, with a maximum demand of about 500 kw.

STEAM TURBINE LITIGATION.—The General Electric Company has brought suit in the United States Circuit Court in Buffalo against the city of Dunkirk for an injunction restraining the city from using an alleged infringement of two of its patents on devices used on two Allis-Chalmers turbo-generators in Dunkirk's new municipal electric and power plant; also for an accounting of profits accruing to the city, and recovery for damages to the General Electric Company, resulting from such alleged use. Devices invented by W. L. R. Emmet and O. Junggren are said to be the subjects of the suit. The Allis-Chalmers Company will defend the suit.

ELECTRICITY FOR COTTON MILLS.—Electrical energy obtained from the plant of the Carolina Power & Light Company, at Buchhorn Falls, is now being used for driving the cotton mills at Sanford, N. C. A total of 11,000 spindles and 400 looms, which were formerly run by a 450-hp engine supplied by steam from four 100-hp boilers, are now driven by electric motors. This is the second manufacturing plant in Sanford to use electric power, the ice factory being the first. It is said that others will follow as soon as wiring can be done, the transmission line having been completed only a few weeks ago.

CURTIS TURBINES ABROAD.—The British Thomson-Houston Company has received repeat orders from the Liverpool municipal station and the London Electric Supply Company's station for Curtis turbines. There are now three Curtis turbines in the former and five in the latter. Fourteen orders for turbines have also been received for turbo-generators for collieries and other industrial plants, ranging from 350 to 1500 kw, with one exception, all for alternating current. Some of these machines will utilize the exhaust of reciprocating engines, and others are for "mixed pressure."

BAD PACKING AND DELAY IN FILLING EXPORT ORDERS.—The United States Consul-General at Capetown, South Africa, in reporting on the canning industry of that country quotes as follows from a letter written by a large canning company: "With regard to a possible demand for American canning and drying machinery in this country, although we have ourselves installed it, we have had to pay heavily for it and have suffered immense delays in the delivery of the goods, which, too, have often received severe handling in transit and have arrived damaged."

MONTANA ELECTRIC ROADS.—It is reported that two electric railways are to be constructed from Missoula to Hamilton, Mont., one on each side of Bitter Root River. The line on the west side will parallel the Northern Pacific, while the east line will traverse nearer the center of the valley, and be used exclusively for passenger business between the valley terminals, the other on the west side will be devoted to freight traffic. The lines are to be built by the Chicago, Milwaukee & Puget Sound Railroad. Ex-Senator W. A. Clark is reported to be interested in these projects.

GENERAL ELECTRIC COMPANY.—Improvements which will necessitate an outlay of about $100,000 have been planned for the factory of the General Electric Company at Schenectady, N. Y. An indication of the extent to which workmen are employed in Schenectady is found in the fact that the company is advertising for help in Rochester, Syracuse, New Haven and other places. The prospects for the immediate future are said to be brighter than for several years.

THE MONTANA MORNING MINE & MILLING COMPANY, Troy, Mont., is erecting a 1000-hp hydro-electric station to supply energy to its mines, to the town and to other mines in the neighborhood. The equipment will be increased as the demand for energy increases. It is stated that a total of 25,000 hp can be developed by utilizing all of the water at the maximum available head.

AMERICAN ELECTRICAL WORKS.—The contract for electrical supplies, including fixtures, fittings, lamps, cable, wire, line material, etc., for which bids were opened June 22 at the office of the Isthmian Canal Commission, Washington, D. C., has been awarded to the American Electrical Works, of New York, for $38,842.

HYDRO-ELECTRIC PLANT FOR BOSTON & MAINE.—The Boston & Maine Railroad has purchased from Mr. Alvah W. Sulloway, of Franklin, N. H., the hydro-electric installation privileges at Eastman Falls on the Pemigewasset River. The transaction includes also undeveloped water-power in the same river in the towns of Bristol Hill, New Hampton and Canborton. Boston & Maine officials say that the railroad company has need of electrical energy, inasmuch as it has large shops in the vicinity and also operates trolley lines.

WESTINGHOUSE ACTIVITY.—It is reported that more orders were received at the East Pittsburgh works of the Westinghouse Electric & Manufacturing Company during June than in any other month in the history of the company, the total value of business during that month amounting to $2,500,000. The present operations are now only slightly behind those of the banner year 1907, when business amounted to $35,000,000.

WESTINGHOUSE ELECTRIC ANNUAL MEETING.—The annual meeting of the stockholders of the Westinghouse Electric & Manufacturing Company will be held at East Pittsburgh, Penn., on July 28, at which time four directors will be elected to serve for four years.

Financial Intelligence.

THE WEEK IN WALL STREET.

As may be inferred from the table below, the United States Steel issues were the center of interest in the stock market. On Thursday the sales of the common stock equalled one-fourth of the total sales made on that date, while on Friday the quotation reached the then high record of 72¾, and rose to 73 on Saturday. It is estimated that the net earnings of the United States Steel Corporation for the quarter ended June 30 will be about $5,000,000 larger than they were for the previous quarter, an increase of about 25 per cent. However, the indications are that the larger transactions in Steel were conducted by banking interests and regular Wall Street traders rather than outsiders. Although most of the stocks are now high, no marked tendencies toward lower prices are in evidence while many facts point toward increases in the stocks that have remained fairly stationary. The securities market as a whole has been strengthened by reason of the satisfactory showing of the steel trade which is regarded in many quarters as a proper barometer of general trade conditions. Railroad earnings continue to increase and bank clearings are gradually enlarging. The total gross earnings of 724 railroads reporting to the Interstate Commerce Commission were 15.37 per cent greater for May, 1909, than for the same month of 1908. Stock quotations on July 19 were as given in the accompanying table.

NEW YORK.

	July 12.	July 19.	Shares sold.		July 12.	July 19.	Shares sold.
All.-Ch.	15	15¼	900	Int.-Met., pfd.	48¾	47½	18,030
All.-Ch., pfd..	51¾	51⅞*	920	Mackay Cos...	80½*	81*	300
Amal. Cop....	81⅝	81⅞	95,800	Mackay Cos.,p.	73¼*	74⅛*	200
Am. D. T....	29*	30*	———	Man. Elev....	143⅞*	147*	1,605
Am. Loc.....	60¾	61¼	4,800	Met. St. Ry..	18*	20*	200
Am. Loc., pfd.	118¼*	119*	100	N.Y. & N.J.Tel	137*	140	1,810
Am. Tel & Cbl.	80*	84	———	Steel, com....	69⅞	71⅞	746,000
Am. T. & T..	140	140⅝	16,250	Steel, pfd....	127¾	127⅝	52,853
B. R. T.....	78	78	7,530	W. U. T.....	71⅜	72¼	2,100
Gen. Elec....	164⅛	166	4,600	West'h. com...	85⅛*	85	6,500
Int-Met., com.	15½	15½	8,791	West'h. pfd...	121¼*	124½*	———

PHILADELPHIA.

	July 12.	July 19.	Shares sold.		July 12.	July 19.	Shares sold.
Am. Rys.....	45½	....	———	Phila. Elec...	11⅞	12	———
Elec. Co. of A.	12⅞	12⅝	———	Phila. R. T...	29	29¼	———
Elec. St. B'ty.	52½	54¼	———	Phila. Trac...	91	90½	———
E. S. B'ty.pfd.	49*	....	———	Union Trac...	53	53½	———

CHICAGO.

	July 12.	July 19.	Shares sold.		July 12.	July 19.	Shares sold.
Chi. City Rv..	180*	180	———	Chi. Tel. Co..	132½*	132½	———
Chi. Rs.,Ser.1.	112¾*	112	———	Met. El., com.	16½	15½	———
Chi. Rs. Ser.2.	40½*	39	———	Met. El., pfd.	48	47	———
Com. Edison..	121½	120½	———	Nat'l Carbon..	92½	90	———
Chi. Sub'ws...	..	20	———	Nat'l C., pfd.	120	118	———

BOSTON.

	July 12.	July 19.	Shares sold.		July 12.	July 19.	Shares sold.
Am. T. & T....	140¼	140⅝	———	Mex. Tel.....	27⅜*	23¼	———
Cum. Tel.....	133½*	137½	———	Mex. Tel., pfd.	6*	....	———
Edison E. Ill..	250*	250*	———	N. E. Tel....	133¼*	133¼	———
Gen. Elec....	164*	164*	———	W. T. & T....	10½*	10⅜	———
Mass. E. Ry...	13¾	13½	———	W. T. & T., p.	87	86	———
Mass. E. R.,p.	72½	74*	———				

*Last price quoted.
Shares sold are for week July 10 to July 17.

DIVIDENDS.

Michigan State Telephone Company, quarterly, 1.5 per cent on common stock, payable Sept. 1; 1.5 per cent on preferred stock, payable Nov. 1.

American Light & Traction Company, quarterly, 15 per cent on preferred stock, payable Aug. 2; 3 per cent on common stock, payable Aug. 2.

Havana Electric Railway Company, 1.5 per cent on preferred stock, payable Aug. 14.

Lowell Electric Light Corporation, quarterly, 2 per cent, payable Aug. 2.

Albany Home Telephone Company, quarterly, 1 per cent, payable Aug. 2.

Columbus Railway Company, quarterly, 1¼ per cent, payable Aug. 2.

Electric Bond & Share Company, initial dividend on common stock, 2 per cent, payable July 15; quarterly on preferred stock, 1¼ per cent, payable Aug. 1.

Minneapolis General Electric Company, semi-annual, 3 per cent on preferred stock and 2 per cent on common stock, payable Aug. 2.

American District Telegraph Company, of New Jersey, quarterly, 1 per cent, payable July 22.

Edison Electric Illuminating Company, of Boston, quarterly, 2.5 per cent and extra dividend of 1 per cent, payable Aug. 2.

Electric Company of America, semi-annual, 3.5 per cent, payable Aug. 3.

Connecticut Railway & Lighting Company, quarterly, 1 per cent on common and 1 per cent on preferred stock, payable Aug. 15.

Commonwealth Edison Company, quarterly, 1.5 per cent on common stock, payable Aug. 2.

Jacksonville Electric Company, semi-annual, 3 per cent on preferred and 3 per cent on common, payable Aug. 2.

AMERICAN TELEPHONE & TELEGRAPH COMPANY—According to a circular which the American Telephone & Telegraph Company has sent to its stockholders, there were, on July 1, 1909, in the United States about 24,000 telephone companies or lines or systems, having 6,500,000 stations. The Bell system proper, comprising the Bell associated operating companies, has 3,215,245 stations and 7,800 connected independent companies, lines or systems, with 1,150,000 stations, making a total of 4,365,245 stations. In another circular it is shown that the total capital obligations of the American Telephone & Telegraph Company and associated companies are $970,030,200 in capital stock, bonds, real estate, mortgages and bills payable, inclusive of $592,475,400 owned by the public, $56,067,100 owned by associated operating, holding and manufacturing companies, and $321,487,700 owned by the American Telephone & Telegraph Company. The total capital obligations of the Bell system on May 1 last, $592,475,400, are $85,356,900 less than the total property owned, including $547,881,500 as the book value of the entire telephone plant. The total capital obligations of the American Telephone & Telegraph Company taken alone are $369,374,500, which is $56,606,200 less than the company's assets in real property, cash and securities. The property of associated operating companies amounts to $583,195,400, which is $37,485,800 more than the combined capital obligations of these associated operating companies. The company has taken an important step in the direction of consolidating the interest of its subsidiary companies by offering to exchange its shares for New York & New Jersey and for Philadelphia Bell. The stock of the New York & New Jersey Company pays 7 per cent, while the American Telephone & Telegraph Company pays 8 per cent, and the Bell Telephone Company of Philadelphia pays 6 per cent. The offer is for a share-for-share exchange with the New York & New Jersey Company and for seven shares for eight Bell shares with the Philadelphia company.

SOUTHERN CALIFORNIA EDISON COMPANY.—Articles of incorporation have been filed at San Bernardino of the Southern California Edison Electric Company, nearly all of the directors of which are officers of the Edison Electric Company, of Los Angeles. They are: James A. Lighthipe, electrical engineer of the Edison; Edward W. Sax, auditor; Addison A. Maxwell, chief clerk; William Dieterle, deputy superintendent; S. M. Kennedy, general agent; O. P. Schoonmaker and John Otto, of Los Angeles; A. E. Murphy, of Ocean Park. The newly formed company will own and operate the Edison Electric Company, of Los Angeles. We are authoritatively informed that there is no intention of merging the Edison company with the Pacific Light & Power Company, as rumored.

RECEIVER FOR McCALL FERRY PROPERTY.—Mr. J. Edward Aldred, president of the Shawinigan Water & Power Company, Montreal, Canada, has been appointed receiver for the McCall Ferry Power Company, of Pennsylvania, the combined capital stock and outstanding bonds of which aggregate $20,000,000. The papers filed in the district court give the Knickerbocker Trust Company, of New York, as the complainant. In the affidavit it is stated that the company has defaulted in the interest on its outstanding bonds, which number 9027, and are of the par value of $9,027,000. Of this amount the reorganization committee holds $7,775,000 as trustee. The committee consists of William H. Barnum, who made the affidavit; A. C. Bedford, S. Reading Bertron, Charles A. Coffin, and Gardner M. Lane, all of New York. The company was incorporated in Maine about five years ago, and had as its project the erection of a concrete dam, 60 ft. high and a half mile in length, over the Susquehanna River near Columbia, Pa., for the purpose of generating and transmitting electricity. With the dam more than two-thirds completed, the company was forced to suspend work for lack of funds. More than $10,000,000 has been expended on the project, and if the dam were completed it would be one of the largest of its kind in the United States. Efforts were made in New York recently to reorganize the company, but the plans fell through, owing to the opposition of the bondholders. The reorganization plans were to form a new company, to be known as the Southern Pennsylvania Power Company, with an authorized issue of $12,500,000 of 5 per cent bonds and $8,500,000 stock. The bondholders were to get 40 per cent in new bonds and 60 per cent in new stock for their holdings.

SALE OF THE ROCKINGHAM POWER COMPANY.—All properties of the Rockingham Power Company, including the hydro-electric plant at Blewett Falls, on the Yadkin River, near Wadesboro, N. C., machinery, etc., were sold at public auction July 14 at Wadesboro, N. C., by order of the United States Court, to D. H. Thomas, representing the bondholders. The purchase price was $1,000,000, the sale being subject to confirmation by the court. This plant was planned for 12,000 hp, with an eventual capacity for 24,000 hp, the power to be transmitted at 60,000 volts to a number of nearby small towns. Hydraulic and electrical machinery were purchased from the S. Morgan Smith Company and the General Electric Company, and $1,500,000 in bonds were issued, which amount has been spent in the development of the power plant. Liens were filed in the Wadesboro Court aggregating $150,000 for unpaid claims against the company. Trouble in this enterprise dates back to the failure of the Knickerbocker Trust Company, which was financing the enterprise, and later differences arose between Hugh McRae & Company, of Wilmington, N. C., and other stockholders which resulted in litigation culminating in the present sale. The ultimate cost of the completed plant is estimated at $3,250,000. The company had an authorized capitalization of $5,000,000. The plant is located in the heart of the North Carolina cotton manufacturing district, and power was to be sold to cotton mills and other manufactories as well as to towns in that section. It is understood that the plant will be completed at once by the purchasers. The main dam is 1475 ft. long and 50 ft. high. The initial power plant installation consists of 3000-kw generators driven by horizontal shaft waterwheels.

PHILADELPHIA RAPID TRANSIT COMPANY.—Preliminary figures on the business of the Philadelphia Rapid Transit Company for the fiscal year ending June 30 show that the various changes made during the fiscal year resulted in producing an average fare of 3.94 cents per passenger, as against 3.57 cents as the average collection from the 512,869,023 passengers carried during the fiscal year 1907-08. Last year 464,364,656 passengers were carried. The present average fare is 4.18 cents. The receipts for the year were $18,306,000, compared with $18,288,763 for the previous year. There was an increase in earnings of $17,000 in the face of a traffic decreased by more than 48,500,000 passengers over the year before. Figures are not yet available for the costs of maintenance of way, of energy and of general expenses, but the transportation expenses were decreased by about $409,000, having been about $4,413,000, against $4,822,472 for the previous year. Owing to the cost incident to changing some 300 cars to the pay-within type, the maintenance of equipment expenses were increased about $20,000, which would bring the item to about $935,000. It is estimated that the company lost $300,000 by reason of the recent strike.

A NEW SPRECKELS (SAN FRANCISCO) COMPANY.—A company, to be known as the Municipal Light & Power Company, has been organized by Messrs. Rudolph and Claus A. Spreckels, and incorporated at San Francisco. The company is capitalized for $1,000,000, of which $500 has been subscribed, $100 by each of the five directors, who are Rudolph Spreckels, Claus A. Spreckels, Percival S. Scales, J. H. Sandford, and Frank Harrold. The object of the company is to acquire, construct, and install gas and electric plants, and to distribute electricity and gas for domestic and manufacturing purposes. An electric light plant, known as the Spreckels plant, has been in operation for some time at Jessie Street, near Third Street.

KIMBLE ELECTRIC COMPANY.—The capital stock of the Kimble Electric Company, of 324 West Washington Boulevard, Chicago, has been increased from $10,000 to $50,000. This company, under the technical direction of Mr. Austin Kimble, the vice-president, manufactures a type of variable-speed, single-phase, reversible motor that has attracted much attention, and the business, although in existence only a year or so, has shown remarkable expansion. Mr. James K. Bass has entered the company as treasurer, and will attend to the office end of the business, relieving Mr. Kimble of that responsibility. Mr. Kimble will devote his entire attention to the factory, supervising the design and production of the motors.

SALE OF ROME (N. Y.) TELEPHONE PROPERTY.—The property of the Rome Telephone Company has been sold by the bondholders at foreclosure sale. The plant was built in 1900 from the proceeds of the sale of $150,000 of 5 per cent mortgage bonds. The property was bid in by James S. Bailey, of Toledo, Ohio, acting for the bondholders, for $20,100. The plant will be rebuilt and an automatic system will be installed.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Dallas (Tex.) Electric Corporation:					
May, 1909	$103,525	$66,183	$37,342	$26,839	$8,503
May, 1908	90,459	64,063	26,396	39,938	*3,542
Galveston-Houston Electric Company:					
May, 1909	103,603	58,731	44,872	21,420	23,452
May, 1908	91,023	54,701	36,322	19,740	16,582
The Minneapolis General Electric Company:					
May, 1909	84,673	37,340	47,333	19,670	17,663
May, 1908	73,677	36,662	37,015	31,222	5,793
Northern Texas Electric Company:					
May, 1909	111,809	57,847	46,052	17,189	29,703
May, 1908	83,807	54,856	28,951	16,553	12,398
Seattle Electric Company:					
May, 1909	457,258	264,459	182,799	103,315	79,484
May, 1908	386,961	215,858	170,103	88,432	82,671
Denver Gas & Electric Company:					
June, 1909	.....	.....	72,836	34,841	37,955
June, 1908	.....	.....	59,473	32,001	27,472
Year ending June 30, 1909	2,299,182	1,300,623	998,559	392,147	606,412
Year ending June 30, 1908	2,062,326	1,210,171	852,155	378,601	473,554
American Light & Traction Company:					
June, 1909	238,171	9,649	228,522	.....	.....
June, 1908	189,835	4,000	185,835	.....	.....
Jan. 1 to June 30, 1909	1,546,979	53,787	1,493,192	.....	.....
Jan. 1 to June 30, 1908	1,217,426	24,000	1,193,426	.....	.....
Year ending June 30, 1909	3,052,616	74,787	2,052,616	.....	.....
Year ending June 30, 1908	2,535,819	36,562	2,499,257	.....	.....
Aurora Elgin & Chicago Railroad Company:					
May, 1909	133,028	71,356	61,672	28,549	33,123
May, 1908	119,648	62,769	56,278	28,422	27,856
Eleven months ending May 31, 1909	1,316,430	724,795	591,634	308,794	282,890
Eleven months ending May 31, 1908	1,275,515	704,279	571,236	306,145	265,091

*Deficit.

GENERAL NEWS

Construction News.

DADEVILLE, ALA.—It is stated that arrangements are being made by Henry J. Jones, of Montgomery, Ala., for the formation of a company, whose purpose will be to construct a hydro-electric plant on the Tallapoosa River, near Dadeville. The construction of a 120-ft. dam and the development of 50,000 hp are contemplated.

DOTHAN, ALA.—The city will vote on Aug. 9 on the issuance of $6,000 of bonds to be used for the extension of the electric light system, the recent election having been declared illegal. J. B. McCrary & Company, Empire Bldg., Atlanta, Ga., have been engaged to prepare plans and supervise the work.

MAMMOTH SPRINGS, ARK.—The Mammoth Springs Electric & Power Company, of which Napoleon Hill, of Memphis, Tenn., is owner, contemplates the construction of a dam and power house a few miles from Mammoth Springs, for the purpose of generating electrical energy for transmission to Koshkonong, West Plains and other towns in southern Missouri, as well as to Salem and Hardy, Ark. The company, which has recently installed an electric light plant at Mammoth Springs, is also considering the construction of an electric railway, connecting that city with Thayer, Mo. and Salem, Ark.

CHICO, CAL.—L. A. McIntosh and T. H. Barnard, of this city, have become interested in the location of power plants on Mill Creek. These gentlemen, it is understood, have recently acquired possession of a valuable site on Mill Creek, which is to be developed at an early date. Associated with them is Leon Bly, of Red Bluff.

CRESCENT CITY, CAL.—The Smith River Electric Company, which has offices at 404-405 Balboa Building, San Francisco, and which was incorporated for the purpose of utilizing the water-power of the Smith River for the generating of electrical energy in Del Norte and Humboldt Counties, is planning the construction of two power plants.

DOWNIEVILLE, CAL.—Reports are current that the Four Hills power house, which was recently leased by J. R. Van Fleet and associates, is soon to be rebuilt, and that an entire rehabilitation of the system is to be effected.

FULLERTON, CAL.—The Sunset Telephone Company is planning to expend about $10,000 in the reconstruction of its system in Fullerton and the surrounding country.

GLENDALE, CAL.—An ordinance providing for the issuance of $60,000 of bonds, to be used for the construction of a new municipal light plant, on which the citizens voted on June 22, has been taken up by the City Council and has passed the first and second reading.

LOS ANGELES, CAL.—It is stated that the Board of Public Works will receive sealed bids up to July 30 for furnishing to the city three 100-hp induction motors.

NEVADA CITY, CAL.—The Middle Yuba Hydro-Electric Power Company has decided to commence work at once on its projected power plant on the Middle Yuba River, and within 80 days will be supplying power to the mines at Allegheny, Forest City, Graniteville and the Washington mining districts. The plant will have a minimum output of 3000 hp and a maximum output of 7500 hp.

OAKLAND, CAL.—The installation of 129 electroliers on Sixteenth Street, from Broadway to the Sixteenth Street Depot, is being urged by the West Oakland Improvement Club.

RED BLUFF, CAL.—Work on the installation of a power plant on Mill Creek is soon to be commenced by the Butte & Tehama County Power Company, which has opened offices in Red Bluff.

REDONDO, CAL.—It is stated that the trustees of this city have recommended a new lighting system in the business section. The recommendation specifies the installation of about 2000 incandescent lamps.

ST. HELENA, CAL.—Information comes to us from G. S. Conner, secretary of the St. Helena Gas & Electric Company, that a transmission line through the Napa Valley is to be constructed. The proposed line will cover a distance of about 18 miles, and will take in the towns of Calistoga, Graniteville, Veterans Home, Rutherford and Oakville. Since June 15 the St. Helena company has been purchasing power from the Snow Mountain Water Power Company.

SAN FRANCISCO, CAL.—It is reported that Eastern capitalists have negotiated for the purchase of all of the holdings and rights of the Central Counties Power Company, the Central Counties Land Company and the Yolo Consolidated Water Company in the Clear Lake region.

SANTA ANA, CAL.—A franchise to erect a line of poles and wires up Santa Ana canyon to the Riverside boundary line, for the transmission of electrical energy, has been sold to the Edison Electric Company, the consideration being $100.

COLORADO SPRINGS, COL.—During a severe electrical storm at this city the power plant of the Colorado Springs & Interurban Company was struck by lightning and one of the generators put out of commission.

LAS ANIMAS, COL.—The Las Animas Electric Light Company has just completed its new combination ice and electric light station.

MONTROSE, COL.—The city is contemplating the installation of an Underwriters' standard centrifugal fire pump of 1000 gal. to 1500 gal. capacity as a reserve and additional source for the general water supply, and especially for assurance of proper fire protection. The plant is to use 2300-volt, 3-phase motor direct.

YUMA, COL.—Application for a franchise to construct an electric railway over the streets of Yuma has been filed by Messrs. Karr, Kester and Speese, the line to be operated in conjunction with their proposed Colorado River Railway.

ANSONIA, CONN.—Plans are being considered for lighting Riverview Park by electricity, petitions requesting such service having been submitted to the Park Commissioners.

SOUTH NORWALK, CONN.—Advices are received from the City of South Norwalk Electric Works, which is a municipal plant, that the enlargement of its generating and distributing system is contemplated, it being highly probable that a storage battery for peak loads will be installed. The officials are also ready to consider preliminary information and data relative to the construction of a tunnel under the Norwalk River for electric cables and pipes, the same to be built ready for service, if possible, this year. A. E. Winchester is general manager and superintendent.

WASHINGTON, D. C.—Application has been made by Elliott Woods, superintendent of the Capitol, to the local authorities for the construction of a pumping station in Garfield Park, in connection with the station which supplies heat and light to the Senate and House office buildings.

WASHINGTON, D. C.—As a result of reports submitted by Electrical Engineer W. C. Allen, the adoption of plans to improve street lighting within the city proper and recommendations to Congress for appropriations to put them into effect are to be urged upon the District Commissioners by Commissioner Macfarland when the annual estimates are in course of preparation.

WASHINGTON, D. C.—The following are the totals of bids opened July 10 at the office of the Bureau of Yards and Docks, Navy Department, for one 1000-kw and two 1500-kw turbo-alternators at the Navy Yards, New York, Philadelphia and Boston (Specification 1644): Westinghouse Machine Company, New York, N. Y., $64,750; General Electric Company, Schenectady, N. Y. (two bids), $77,417 and $76,008; Allis-Chalmers Company, Milwaukee, Wis., $61,736.

ATLANTA, GA.—The Central Georgia Power Company is planning to remove its headquarters from Macon to Atlanta, the reason assigned for this change being the larger field offered for the distribution of its product, it being the company's purpose to suply electricity to the large manufacturing concerns in the latter city. It is stated by President W. Jordan Massee that the proposed water power development on the Ocmulgee River and the erection of transmission lines on steel towers into Atlanta will represent an expenditure of $3,500,000. A franchise has also been granted to the company in Griffin.

ROME, GA.—The Rome Railway & Light Company, of which H. J. Arnold is superintendent, advises that about two additional miles of electric railway are to be constructed.

SAVANNAH, GA.—Many improvements in its Montgomery Street plant are to be made by the Savannah Lighting Company. There is to be installed at an early date one 2000-kw turbine engine, additional boilers and other up-to-date machinery. It is thought that the company is seriously considering the construction of a trolley line between Savannah and White Bluff and other towns south of the city.

VALDOSTA, GA.—Bonds are reported to have been sold to be used as follows: $15,000 for water works improvements and $10,000 for electric light plant.

ELK CITY, IDAHO.—Reports are being circulated to the effect that the Idaho Buster Mining Company is looking for a power site on one of the streams near Elk City with a view to installing a power plant. There is also a rumor that the new power plant will be owned by two companies, the Buster and the Golden Crown, which are closely connected through Philadelphia capitalists.

NAMPA, IDAHO.—Arrangements have been entered into between S. D. Gates, representing the General Electric Company at Portland, and the Dewey Electric Light & Power Company, of Nampa, for an installation of the luminous arc system of lighting in the latter city.

CHICAGO, ILL.—A new $100,000 substation on the North Side of the city is to be erected by the Commonwealth Edison Company, a site for same having been purchased some days ago. The plant, work upon which is to be commenced at once, will supply light and power to the section in which it is located, including the new St. Clair manufacturing district.

ELLIOTT, ILL.—The Dix Telephone Company is considering the advisability of increasing its capital stock to $25,000 for the purpose of installing a new exchange at Gibson City.

FAIRFIELD, ILL.—At a recent meeting of the business men of Fairfield and Burnt Prairie plans were considered for the construction of an electric road from Carmi to Fairfield, through Burnt Prairie, a distance of about 25 miles. It is stated that George Brown, of the Burnt Prairie Bank, is one of the prime movers in the enterprise.

RIVER GROVE, ILL.—The Leyden Light & Power Company, which does an electric light and power business in Franklin Park and River Grove, suburbs of Chicago, has been purchased by the North Shore Electric Company.

ST. ELMO, ILL.—The St. Elmo Light, Ice & Storage Company expects to establish a day service. B. E. Muma is general manager of the company.

KNIGHTSTOWN, IND.—It is understood that the City Council has authorized the trustees of the municipal water and light plant to purchase two additional dynamos and other machinery for the light and power department.

SULLIVAN, IND.—Application has been made by the Terre Haute, Indianapolis & Eastern Traction Company for permission to furnish electric lighting in the city of Sullivan. The applicant promises to make the same rates that the city has been paying to the Sullivan Lighting Company for the past two years.

BOONE, IA.—A franchise is reported to have been granted to E. E. Hughes, J. H. McBride and Andrew Stevenson for the operation of an electric light plant, street car line and heating plant.

COUNCIL BLUFFS, IA.—The Citizens' Gas & Electric Company, of which H. A. Holdredge is general manager, is erecting a new substation.

LEON, IA.—The Leon Electric Company, successors to the Leon Electric Light, Heat & Power Company, advises that it is planning to change its system from direct current to alternating current in the near future. The owners of the plant are Samuel C. Johnson, manager, and J. F Smith, superintendent.

TOPEKA, KAN.—A new telephone line from this city to Lincoln, Neb., is being constructed by the Kansas Telephone & Telegraph Company.

WICHITA, KAN.—Plans are being considered by the Wichita Railroad & Light Company, of which W. R. Morrison is superintendent, for the construction of a new power house. It is believed that several hundred thousand dollars will be expended by the company in the improvements contemplated in its system.

ALEXANDRIA, LA.—It is stated that a vote will be taken Aug. 17 on the issuance of $40,000 of bonds, the proceeds to be used for the extension of the electric light and water plant, and the installation of new machinery in the power house. I. W. Sylvester is city engineer.

TALLULAH, LA.—J. E. Craig, city engineer, advises that contracts for the electric lighting plant machinery (bids opened July 10) have been awarded as follows: Engine, Harrisburg Foundry & Machinery Co., Harrisburg, Pa.; electric equipment, Ft. Wayne Electric Works, Ft. Wayne, Ind., and pumps to Platt Iron Works, Dayton, Ohio.

THIBODAUX, LA.—Preparations are being made by Ellis Braud's Sons for the installation of an up-to-date electric light plant for their three Main Street stores.

EAST ORLAND, MAINE.—The Penobscot Bay Electric Company, which has a power plant at this city, and which is furnishing service at Bucksport, Prospect and Stockton Springs, has petitioned for pole locations in the town of Searsport and the city of Belfast.

ROCKVILLE, MD.—Owing to a disagreement with the Town Council concerning its proposed franchise in this city, the contracts for lighting service which the Potomac Electric Power Company, of Washington, has entered into with the citizens of Rockville are being held in abeyance pending an amicable adjustment of the matter.

BEVERLY, MASS.—Permission, for which it applied recently, to furnish electricity for light, heat and power in Topsfield has been granted to the Beverly Gas & Electric Light Company.

BOSTON, MASS.—It is believed that a sale by A. W. Sulloway, of Franklin, N. H., to the Boston & Maine Railroad of water rights and privileges along the Pemigewasset River points to the electrification of the Bristol, Franklin and Tilton, and the Tilton and Belmont railroads. The transfer to the railroad includes the estate, dam, water wheels and all privileges and easements on the east and west banks of the Pemigewasset River at Eastman Falls in Franklin. There are also conveyed estates with rights of flowage and undeveloped water powers at or near Bristol, and in the towns of New Hampton and Sanbornton; all the water power and mill rights formerly owned by the Pemigewasset Electric Company at Eastman Falls, and the rights of flowage acquired by the Pemigewasset Power Company and conveyed to the Pemigewasset Electric Company.

LAWRENCE, MASS.—In order that it may be able to supply power for an additional mill which is being erected, the capacity of the central power plant of the Arlington Mills at this city is to be doubled. Eight new boilers of an aggregate capacity of 5000 hp are to be installed.

MARLBORO, MASS.—The Marlboro Electric Company is installing 67 tungsten lamps of 40-cp in Southboro.

MIDDLEBORO, MASS.—The Municipal Gas & Electric Plant of this city, of which G. A. Philbrook is superintendent, is considering the recommendation of the residents of Warrentown that electricity be substituted for the present system of lighting at that place.

MOUNT HERMON, MASS.—Work has been commenced on the addition to the central power plant of the Mount Hermon School fo Boys, which will include a new boiler house, dynamo room, etc., and will cost about $20,000. The H. Wales Lines Company, of Meriden, Conn., has the contract.

SPRINGFIELD, MASS.—It is reported that the County Commissioners have received a petition from A. A. Langewald for approval of plans and specifications for two dams to be constructed across the Willimansett Brook, in Chicopee.

WORCESTER, MASS.—The City Council has granted a 28-year franchise to the Connecticut River Transmission Company, limiting its privilege to serving power to firms using 15 or more kilowatts.

NEGAUNEE, MICH.—An ordinance has been passed by the City Council granting to the Cleveland Cliff Iron Company a franchise for the construction and maintenance of an electric transmission line within the city limits.

NORTHFIELD, MINN.—Plans having been completed by Edward P. Burch, engineer, Minneapolis, Minn., for a heating and lighting plant for Carleton College, the estimated cost of which is $30,000; bids will be received until July 28 for the construction of same by Harlan W. Page, secretary, Board of Trustees of the College.

CHARLESTON, MO.—We are advised by the Southeast Missouri Ice, Light & Power Company, of which J. C. Crenshaw is secretary and treasurer, that a transmission line to another town is now in course of construction.

ST. JOSEPH, MO.—Fifty new arc lamps are to be added to the city's street lighting system, the board of public works having recently placed an order for that number.

PLAINS, MONT.—It is understood that the Board of Freeholders has granted an electric light franchise to the Plains Light & Water Company, in which J. M. Keith and S. R. Inch, of Missoula, are interested in the enterprise.

BROKEN BOW, NEB.—Announcement is made that John W. Early, of Columbus, Neb., has been granted a franchise to install an electric light plant at Broken Bow.

COLUMBUS, NEB.—It is reported that all necessary details have been completed to assure the construction of the Loup River power plant at Columbus with an output of 50,000 hp and a secondary plant at Schuyler with an output of 30,000 hp. It has been intimated that W. L. Church, president of the Ambursen Hydraulic Construction Company, of Boston, Mass., will be able to let sub-contracts for the preliminary construction work by Oct. 1.

MALMO, NEB.—A special election is to be held in this city, July 27, for the purpose of voting on a proposition to issue bonds for the establishment of a lighting and heating system.

OMAHA, NEB.—About $25,000 is to be expended by the Omaha Electric Light & Power Company in improvements this year, which will include the establishment of a new substation at South Omaha. S. E. Schweitzer is secretary and treasurer of the company.

PIERCE, NEB.—The Pierce Electric Light Plant, formerly the property of Herbert Craven, has been acquired by S. F. Gilman. The new owner proposes to remove the plant to a mill which he operates at this city, and where sufficient water power is available to operate both the mill and the electric light plant. A larger engine and a new dynamo are to be installed.

RENO, NEV.—An option has been exercised by W. P. Hammon and a party of California capitalists on the complete interests of the Reno Power, Light & Water Company, which operates a trans-Nevada system. Mr. Hammon assumed control on July 1.

WONDER, NEV.—According to J. B. Daniel, of the Nevada Wonder Mine, plans are under consideration for the erection of a 300-hp plant at Fallon to supply electricity for lighting the mines, and power for the operation of the mill which is to be constructed on the company's property at Wonder.

ALBANY, N. Y.—An application has been made by the Hoosic River Electric Light & Power, a subsidiary company of the Schenectady Power Company, to the Second District Public Service Commission for a franchise in Valley Falls, Rensselaer county. The Hoosic River Company, whose intention is to handle whatever power is distributed to municipalities or individual users along the transmission line, expects to furnish light to Johnsonville and to take over the present lighting system in Schaghticoke, James O. Carr, of Schenectady, and George E. Green, of Hoosick Falls, appeared for the applicant.

BATH, N. Y.—A day service in this city is promised by the Bath Electric & Gas Light Company, in anticipation of which many business houses are planning the installation of electric motors.

BINGHAMTON, N. Y.—It is announced that the Binghamton Railway Company will expend about $50,000 for improvements on its State Street power plant, which will include the installation of a turbine, new boilers and new condensing apparatus.

BINGHAMTON, N. Y.—A merger has been effected of the Merchants' Telephone Company, the Tunkhannock & Wyoming Valley Telephone Company and the Montrose Telephone Company. The new concern, which is to be known as the Merchants' Telephone Company, and which is capitalized at $500,000, will control the operation of lines in Wilkes-Barre,

Scranton, Tunkhannock, Binghamton and a number of other cities. Many improvements and extensions in the system are planned.

BUFFALO, N. Y.—The Cataract Power & Conduit Company, it is reported, is having plans prepared by Consulting Engineer E. D. Pith, Niagara Falls, Ont., for a $100,000 brick and steel addition to its power house at Niagara Falls.

BUFFALO, N. Y.—The Buffalo General Electric Company has been granted permission to issue its first refunding 5 per cent gold bonds to the amount of $242,000, the proceeds of which are to be used in placing wires underground and in buying new machinery.

DUNKIRK, N. Y.—The Municipal Electric Light Plant announces a reduction in prices of electrical energy for lamps and motors, the basic rate for the former being 7 cents per kw-hour, and for the latter 2½ cents. The minimum charge on lamp circuits is 50 cents per month, and on motor circuits $1.25. The sliding scale of discounts on lighting circuits ranges from 5 per cent up to 10 kw to 20 per cent over 500 kw. On power circuits the rate for energy over 500 kw is 1¾ cents.

LOWVILLE, N. Y.—The Black River Telephone Company contemplates the construction of toll lines in Lewis, Jefferson, Oswego and Oneida counties, as well as the installation of about 1000 new telephones.

NIAGARA FALLS, N. Y.—The Niagara Falls Electric Light & Power Company has announced that its rate in the future for street lighting in this city will be $65 a year instead of $52.

NICHOLVILLE, N. Y.—The Nicholville Electric Light Plant contemplates the construction of about two miles of transmission line. R. C. Chambers is manager.

OSWEGO, N. Y.—Through a recently consummated deal the Citizens' Lighting Company has passed into the hands of H. C. Warren & Company, of Springfield, Mass., the purchase price being $71,820. A new company is to be formed, and it is understood that John C. Knight, the organizer of the Citizens' Company, is to be vice-president and resident manager of same.

SYRACUSE, N. Y.—The Syracuse Lighting Company has been given authority by the Public Service Commission to execute a trust deed for $2,500,000 and issue bonds to the amount of $143,000, the proceeds of which are to be used for the extension and betterment of its system.

TROY, N. Y.—It is announced at this city that the Schroon River Pulp & Paper Company is soon to commence work on a new dam to replace the old one at its plant on the Schroon River at Burnhamville.

KINSTON, N. C.—It is stated that the city will vote on a $50,000 bond issue, the proceeds to be used for extending the water and electric lighting systems.

SALISBURY, N. C.—It is expected that work will soon be resumed on the $10,000,000 plant of the Whitney Power Company, which for a year past has been in the hands of former Congressman John S. Henderson, of this city, as receiver.

ANSONIA, OHIO.—It is stated that an electric lighting system is soon to be installed at this city, the energy being secured from the Greenville Electric Light & Power Company's plant at Greenville.

BRYAN, OHIO.—The Fort Wayne & Toledo Railway Company, which is planning to construct a line from Fort Wayne, Ind., to Bryan, Ohio, has applied for a franchise in the latter city. R. T. Bastress, of Harlan, is general manager of the company.

CLEVELAND, OHIO.—It is reported that the right-of-way for an electric railway to extend between Cedar Point and Rye Beach, near Huron, which will connect with the main line of the Lake Shore Electric Railway, has been secured by Charles Phelps, former superintendent of the Cleveland Electric Railway Company.

COLUMBUS, OHIO.—It is stated that the officials of the Columbus Railway & Light Company have filed an acceptance of the ordinance recently passed fixing the maximum rate for electric lights at 7 cents net per kw-hour for a period of five years.

LEBANON, OHIO.—A number of 80-cp and 40-cp tungsten lamps are being substituted in certain streets of Lebanon in place of the 16-cp and 32-cp lamps.

ARDMORE, OKLA.—Engineer W. T. Forsythe, of West Chester, Pa., writes that the proposed power plant to be constructed on the Washita River, in connection with the construction of the railway, will cost about $5,000,000. Nothing definite has yet been done. Oscar Ayres is interested in the proposition.

BLACKWELL, OKLA.—Plans are being prepared by Burns & McDonnell, of Kansas City, Mo., for the proposed extensions and improvements to the electric light plant and water works, for which the citizens recently voted an issue of $25,000 of bonds.

DURANT, OKLA.—The Southwestern Engineering Company, of Oklahoma City, is preparing plans for the the city electric light plant, to provide for which an election was recently held in Durant to vote on a $20,000 bond issue. W. S. Shannon is city clerk.

OKEMAH, OKLA.—Bids will be received until Aug. 5 at the office of P. J. Becker, Town Clerk, for furnishing material and installing water works and an electric light plant, as follows: Two tubular boilers, one steam engine, an alternating current dynamo, one motor, two power pumps, tower and tank, pipe line, valves, pole and line wire, street lamps, etc. M. A. Earl & Company, Muskogee, are engineers.

POND CREEK, OKLA.—It is the intention of the Jefferson Power & Improvement Company, recently organized, to utilize the waters of Salt Fork and Pond Creek for the development of electrical energy, which is to be supplied to the manufactories of Pond Creek. A dam is to be constructed and a power station erected at that point. It is estimated that about 2500 hp can be developed.

EUGENE, ORE.—The citizens of Eugene are reported to have voted an amendment to the city charter authorizing the Council to acquire real estate water rights and rights-of-way for water works and an electric light plant.

LEBANON, ORE.—The Lebanon Paper Mills expect shortly to commence work on a large dam just above the falls.

NEW PINECREEK, ORE.—We are advised by the California & Oregon Light, Heat & Power Company that it is its intention to supply day power and a motor service next year. W. H. Shirk is manager of the company.

PORTLAND, ORE.—It is stated that the Wasco County Electric & Water Power Company is soon to commence the construction of an electric railway from Portland through Clackamas to the Doschutos river, where a power plant is to be installed that will develop 60,000 hp.

TOLEDO, ORE.—The City Council has granted a franchise to H. L. Collins, A. C. Smith and J. F. Stewart for the erection and maintenance of an electric light plant in this city. The company will later operate a cold storage plant.

BLUE RIDGE SUMMIT, PA.—Negotiations have been entered into between Charles S. Gardner, of this city, and the officials of the State sanatorium at Sabillasville, whereby the excess energy generated at Sabillasville will be utilized for lighting purposes in Blue Ridge Summit. The Sabillasville authorities have signified their willingness to install adequate machinery to generate any additional supply needed.

HAZLETON, PA.—A consolidation has been effected of the properties of the Consumers' Electric Light & Power Company, the McAdoo Electric Company, the Harwood Electric Power Company, the Nescopeck Township Electric Company, Sugarloaf Township Electric Company, the Black Creek Township Electric Company and the Kline Township Electric Company. The new concern is to be known as the Harwood Electric Company.

LEWISBURG, PA.—It is understood that Messrs. Whittaker and Diehl, of Harrisburg, who are interested in the syndicate which recently acquired control of the Lewisburg, Milton & Watsontown Passenger Railway and the Milton Electric Light & Power Company, also own a franchise for a new electric light plant in Lewisburg. An up-to-date power house is to be built in that city within a year.

OAKMONT, PA.—A contract has been entered into between the Crane-Best Company, which is building a plant at Oakmont, and the Allegheny County Light Company, of Pittsburgh, whereby the latter will furnish 2500 hp for the driving of electric motors, cranes, air compressors and for general lighting purposes at the new plant. Power is to be brought by the light company over a heavy transmission line from the Rankin power station.

WAYNESBORO, PA.—The transmission lines of the Waynesboro Electric Light & Power Company are being extended so as to furnish a lighting service to a number of residences at Pen-Mar.

PROVIDENCE, R. I.—Work has been commenced on the power house on Blackstone Boulevard for the Butler Hospital, of which Dr. G. Alder Blumer is superintendent.

CHESTER, S. C.—Bids will be received at the office of W. A. Latimer, Jr., City Treasurer, until Aug. 3 for turbine pumps, motors, valves and electrical equipment.

COLUMBIA, S. C.—The City Council will, on Sept. 7, pass on a franchise allowing entry into the city of the Southern Power Company. The Columbia Electric Street Railway, Light & Power Company has refused to sell its property at the figure offered by the Duke interests, and will contest the grant of the proposed franchise. Features of the situation are claims made by the Southern Power Company that the odd frequency of the present plant—40 cycles—handicaps motor applications, and that the stock of the local company is owned in the North.

MILBANK, S. D.—It is stated that application for a franchise to construct and maintain an electric light plant in Milbank has been filed with the City Council by Oscar Claussen, of St. Paul, Minn.

KNOXVILLE, TENN.—The East Tennessee Telephone Company is arranging to place its wires in conduits on certain streets of this city.

ORANGE, TENN.—The Orange Telephone Company, whose plant was recently sold for $12,000 under a decree of the court to the bondholders, has been reorganized, with H. M. Shingle as manager.

AMARILLO, TEX.—The Amarillo Water, Light & Power Company, of which F. A. White is secretary and manager, contemplates the installation of one 200-kw producer gas engine and generators.

BROWNWOOD, TEX.—The Brownwood Gas & Electric Company expects to rebuild its light and power plant, the new equipment to include twin internal combustion engines of 400-hp capacity, and an equal steam power plant.

GREENVILLE, TEX.—Bids will be received until July 27 by Jos. F. Nichols, Mayor, for the following equipment for the electric lighting and power plant: Two 300-hp water-tube boilers, horizontal or vertical; one 100-kw and one 200-kw, 2200-volt, three-phase, 60-cycle alternators

with independently driven exciters, switchboard and all equipment, complete; one 14-in. centrifugal pump direct-connected to a 75-hp motor and a 75-kw l.p. direct-connected to a 14-in. pump. F. W. Maxcy Company, Houston, Tex., is the engineer.

AMERICAN FORK, UTAH.—The Utah Light & Power Company, which also gives a lighting service to Lehi and Pleasant Grove, is installing a new power plant in the Alpine canyon under the direction of James O. Bullock.

NORTON, VA.—The City Recorder writes that J. B. Sterrett, of Norton, has secured a franchise for an electric light plant in this city, and is in the market for machinery, etc.

BELLINGHAM, WASH.—A permit to construct a power plant on Thunder Creek, where it flows into the Skagit River, about 40 miles above Marblemount, is reported to have been granted to the Thunder Creek Transportation & Smelting Company by the Forestry Department of the U. S. Government. The purpose in erecting the plant is to secure power with which to develop the mines of the North Coast Mining & Milling Company at the head of Thunder Creek, and to operate a railroad which it is proposed to build, right-of-way for an electric line up Thunder Creek to its source having already been secured. It is expected that work on the plant will be commenced this summer.

HOQUIAM, WASH.—A five-year franchise has been granted to the Pacific States Telephone Company at this city. It will place its wires underground in the business section of the city, the estimated cost of the work being $10,000.

ODESSA, WASH.—It is probable that the Town Council will grant to the Washington Water Power Company, of Spokane, permission to establish a lighting system in Odessa. It is estimated that the cost of constructing the transmission line and installing the lighting system in Odessa will be about $50,000.

PESHASTIN, WASH.—It is stated that the Valley Power Company's plant at this city is to have its capacity doubled, which will furnish the city of Cashmere a voltage of over 16,000, and will also aid in many new pumping projects throughout the southern portion of the county.

TENINO, WASH.—The Tenino Light & Water Company is constructing a new plant, in which is to be installed a 120-kw General Electric generator, so we are informed by G. C. McClellan, of that company.

WAITSBURG, WASH.—Many improvements are being made in the plant of the Waitsburg Electric Light Company, including the installation of a 150-hp Corliss engine.

KINGWOOD, W. VA.—The Bell Telephone Company is planning to install a new exchange in this city, and to construct lines to Terra Alta, Rowlesburg, Tunnelton, Newberg, Independence and a number of other towns. It is expected that about $10,000 will be spent on the proposed work.

MARTINSBURG, W. VA.—It is stated that John W. Dodd, of this city, is planning the erection of a power plant on the South Branch of the Potomac, near Romney, to develop electric power for lighting and for the use of manufacturing plants.

GRAND RAPIDS, WIS.—It is reported that the Electric & Water Company has decided to issue bonds for $30,000, the proceeds to be used in rebuilding the electric light lines and installing new switchboards.

JANESVILLE, WIS.—The Edgerton Electric Light Company, of which T. O. Howe is president and W. T. Pomeroy manager, is now controlled by the Janesville Electric Company, which has been supplying it with electricity for some time. The Edgerton company has surrendered its franchise and taken an indeterminate permit under the Public Utility law.

MILWAUKEE, WIS.—It is reported that the R. J. Preiss Company is soon to let contracts for the two 80-hp boilers, engine and generator for use in the new power plant which is to be installed in the factory building it intends to erect in this city.

MONTELLO, WIS.—The Montello Granite Company, of which Lynn S. Pease is general manager, is planning the improvement of its water power plant, the installation of a larger dynamo and the establishment of an all-night and day service.

PETERBOROUGH, ONT., CAN.—It has been practically decided by the city to offer the Central Ontario Power Company $50,000 for the power privileges at Burleigh Falls. The company is now asking $125,000, and should the above offer not be accepted other negotiations for the disposition of the power will probably be entered into by the company.

PORT ARTHUR, ONT. CAN.—The City Council has decided to buy out all the holdings of the Bell Telephone Company at this place for $3,500, this being the last of the Bell companies in Canada west of the Great Lakes.

WEYBURN, SASK., CAN.—The Weyburn Machine Electric Light Company, of which George V. Reed is manager, contemplates the erection of three miles of transmission lines and the installation of an additional boiler.

NICHOLASVILLE, KY.—The city of Nicholasville is figuring on the installation of a new boiler this fall, and it is quite probable that the Nicholasville municipal light plant will be combined with the proposed water works system. This item appeared incorrectly in our issue of July 15 under date of Nicholas, Ky.

ANTIGO, WIS.—The Antigo Electric Company, which expects to change its system from direct to alternating current, is also planning the erection of a new power station, in which are to be installed new boilers and engines. It is, in fact, the intention of the new owners to practically rebuild the plant, the work involving an expenditure of about $60,000.

Company Elections.

GRASS VALLEY, CAL.—At a recent meeting of the Middle Yuba Hydro-Electric Company the following officers were elected: A. D. Foote, president; W. H. Martin, vice-president; A. H. Tickell, secretary; L. M. Hancock, C. M. Wilson, L. N. Wagner and Dr. Carl P. Jones, directors.

MONMOUTH, ILL.—The following directors have been elected by the Monmouth Telephone Company: A. W. Pattee, Fred Pattee, F. E. Harding, C. C. McClung, J. E. Lanphere, J. E. Watson, R. Lahann, H. B. Smith and W. J. McQuiston.

FITCHBURG, MASS.—The new officers of the Fitchburg Gas & Electric Light Company are: Charles H. Tenney, president; A. B. Tenney, first vice-president; D. E. Manson, second vice-president; H. P. Sands, general manager; Palmer York, treasurer; E. A. Bradley, assistant treasurer; H. A. Gidney, auditor, and Clifton R. Hayes, local manager.

CLAREMONT, N. H.—The following officers and directors have been elected by the Claremont Railway & Lighting Company: W. L. Mauran, of Providence, president; Thomas E. Steere, Providence, treasurer; L. N. Wheelock, manager; directors, W. L. Mauran, H. R. Beckwith, John T. Emerson, Frank H. Foster, Oscar B. Rand and Thomas E. Steere.

WINCHESTER, VA.—The Winchester & Washington City Railway Company has elected the following officers and directors: President, Lewis F. Cooper, Winchester; vice-president, Charles Mullikin, Boyce; secretary and treasurer, Shirley Carter; directors, L. F. Cooper, C. Mullikin, E. V. Weems, W. H. Baker, A. Moore, Harry Warden, S. L. Hoover, R. H. Chew and R. C. Williams.

New Industrial Companies.

THE ATLAS ENGINEERING & CONSTRUCTION COMPANY, Wilmington, Del., has been incorporated, with a capital stock of $10,000, by George G. Steigler, William M. Lupton and Harry A. Pierce, all of Wilmington.

THE FRED NOLTE COMPANY, Catskill, N. Y., has been incorporated to do an electrical contracting business, its capitalization being $5,000. The incorporators are: Julius Nolte, Leopold Fuerther, Anton Weidman, of New York City.

THE HYDRAULIC CLUTCH DRIVE COMPANY, Wilmington, Del., capitalized at $100,000, has filed articles of incorporation. Those interested are: John L. Johnson, William P. Hartley and Milton A. Kettler, of Washington, D. C.

THE GILLIS-STRICKLAND MOTOR COMPANY, Rochester, N. Y., has been incorporated with an authorized capital stock of $25,000. The incorporators are: James W. Gillis, Pittsford, N. Y.; S. M. Havens, Rochester, N. Y., and R. H. Strickland, Rochester, N. Y.

THE IMPERIAL MOTOR VEHICLE COMPANY, New York, N. Y., has been incorporated with a capital stock of $10,000 to manufacture motors, engines, etc. The incorporators are: Charles S. Baeder, Gilbert W. Mead, New York, and H. E. Tunnell, Cranford, N. J.

THE GLOBE AIR LIFT PUMP COMPANY, New York, N. Y., has been incorporated to manufacture air lift pumps, motors, etc. It is capitalized at $500,000, and the incorporators are: J. A. Rose, William Whelpley, New York, N. Y., and Frank E. Griffin, Albany, N. Y.

THE ANDERSON WINDING MACHINE COMPANY, Jersey City, N. J., has been incorporated to manufacture electromagnets, motors, dynamos, electrical machinery, etc. It is capitalized at $50,000. The incorporators are: H. Sutcliffe, W. O'Connor, C. E. Fisk, all of Jersey City.

THE EASTERN MOTOR CAR COMPANY, Portland, Me., capitalized at $500,000, has filed articles of incorporation, and contemplates the manufacture of motors, automobiles, etc. The following officers have been elected: G. L. Weymouth, president; C. L. Breedy, treasurer, and P. J. Larrabee, clerk.

THE AUTO SAFETY SPECIALTY COMPANY, Buffalo, N. Y., whose purpose is to manufacture electrical and mechanical appliances, has filed articles of incorporation. Its capital stock is given as $100,000, and those interested are: C. B. Fish, J. S. Tucker and M. M. Richardson, all of Buffalo.

THE BOGART GAS POWER ENGINEERING COMPANY, Buffalo, N. Y., has been incorporated for the purpose of manufacturing motors, electrical goods, etc. It is capitalized at $25,000, and the incorporators are: S. A. Ginsburg and J. A. Venable, of Buffalo, N. Y., and B. Ginsburg, of Detroit, Mich.

THE TITAN ENGINE COMPANY OF AMERICA, New York, N. Y., has filed articles of incorporation, its purpose being to manufacture motors, engines, etc. It has an authorized capital stock of $3,000. Among the incorporators are: Nathaniel Doyle, G. W. Garland, Jr., both of New York, and J. J. Hogan, Westhaven, Conn.

J. LIVINGSTON & COMPANY, New York, N. Y., have filed articles of incorporation, and intend to engage in the electrical engineering and contracting business. The new concern has a capital stock of $50,000, and the incorporators are J. Livingston, Jr., Howletts, L. I.; J. G. Livingston, Woodmere, L. I., and F. W. Cooper, New Rochelle, N. Y.

New Incorporations.

MARKED TREE, ARK.—Articles of incorporation have been filed by the Marked Tree Telephone Company, and the following officers elected: President, E. Ritter; vice-president, W. L. Pfleger; secretary and treasurer, W. B. Avera.

MONTEREY, CAL.—The Monterey & Del Monte Heights Railway Company has been incorporated, with a capital stock of $100,000, and the following officers elected: H. R. O'Bryan, president; George W. Phelps, vice-president; A. G. Metz, secretary and treasurer, and F. M. Fairchild, San Francisco, general manager.

SAN JOSE, CAL.—Articles of incorporation have been filed by the Peninsular Railway Company, which is the successor to the Peninsular Railroad, San Jose & Los Gatos Interurban Railway and the Santa Clara Interurban Railway. It has a capital stock of $12,000,000, and the incorporators are: J. T. Burke, Paul Shoup, C. B. Seger, P. F. Dunne and F. E. Chapin.

KILLINGLY, CONN.—A new power company has been granted a charter to operate in this city. The company will start business with a capital stock of $5,000, which may later be increased to $10,000. The incorporators are Timothy E. Hopkins, Frederick A. Jacobs and George S. Brown.

COEUR D'ALENE, IDAHO.—Articles of incorporation have been filed by the Coeur d'Alene Current Motor Company, which plans to generate and distribute electrical energy for all purposes. The company is capitalized at $250,000, and among those interested are: J. R. Novers, F. E. Wonnacott and Guy Searles.

CHICAGO, ILL.—The Illinois Lakes Light & Power Company has been incorporated with a capital stock of $2,500 to operate a light, heating and power plant. The incorporators are: Thomas H. Robinson, L. W. Bestel, L. F. Mason. G. A. Ellingson, Chicago, Ill., is also interested in the company.

TAMPICO, ILL.—The Tampico Farmers' Mutual Telephone Company, which is capitalized at $10,000, has filed articles of incorporation. Among the incorporators are E. A. Emmons, Charles W. Foy and L. Lutens.

DECKER, IND.—Articles of incorporation have been filed by the White River Valley Telephone Company. The capital stock is placed at $10,000, and the following directors have been elected: J. F. Breithaupt, D. N. Lane and Richard Ready.

MAYFIELD, KY.—The West Mayfield Telephone Company has been incorporated with a capital stock of $4,000, and contemplates the installation and operation of a telephone system in West Mayfield. W. T. Rozzell, of Pryorsburg, and others are interested in the project.

PORTLAND, ME.—Articles of incorporation have been filed by the Cumberland County Light & Power Company, of Portland. It has an authorized capital stock of $300,000, and the incorporators are: C. E. Mitchell, Oakleigh Thorns, New York; Charles G. Fitts, Brattleboro, Vt.; George A. Goodwin, Newell T. Fogg, F. J. Allen, Sanford.

DETROIT, MICH.—Articles of incorporation have been filed by the Home Telephone Company of Michigan. The new corporation comprises the property of the Home Telephone Company, of Detroit, and the Interstate Telephone Company. The capitalization is placed at $5,000,000, and the incorporators are W. A. Jackson, John M. Dwyer and Fred T. Moran, of Detroit, and Maurice F. Bayard, of St. Louis.

MARENISCO, MICH.—The Marenisco Telephone Company has been organized to construct a telephone line from Wakefield to Dunham and Marenisco. Arrangements for long-distance connections have been made with the Bell Company at Wakefield.

KALISPELL, MONT.—The Home Telephone Company, capitalized at $10,000, has been incorporated by C. J. Bain and others.

VINELAND, N. J.—The Maurice River Electric Company has been incorporated, with a capital stock of $100,000, by M. Fry, R. W. Moffat and W. W. Walls, Vineland, N. J., its intention being to generate and distribute electricity.

BUFFALO, N. Y.—The Niagara & Lake Erie Power Company, of Buffalo, has been organized to develop and distribute electricity for light, heat and power purposes in the towns in Erie, Cattaraugus and Chautauqua counties. It has a capital stock of $100,000, and the following directors have been elected: Charles F. Blair, M. J. Binkley and A. F. Tideswell, all of Buffalo.

JOHNSBURGH, N. Y.—The North Creek Electric Company of this city has been incorporated for the purpose of constructing an electric light, heat and power plant. It has an authorized capital stock of $25,000, and the incorporators are: Charles S. Wood, John H. Wade, Charles S. Wade, all of North Creek.

WILLISTON, N. D.—Articles of incorporation have been filed by the Williams County Farmers' Mutual Telephone. Its capital stock is placed at $10,000, and among those interested are: W. W. Keltner, W. W. Wilde and A. Miller, all of Minot.

ARCADIA, OHIO.—The Arcadia Mutual Telephone Company has been incorporated by A. L. Anderson, Sherman Huffman, G. W. Dick and others.

NEW BURLINGTON, OHIO.—Articles of incorporation have been filed by the New Burlington Mutual Telephone Company of this city. It has authorized capital stock of $5,000, and the incorporators are Walter N. Lackey and others.

STOCKHOLM, OKLA.—The Stockholm & Southwestern Telephone Company of Redout has been incorporated, with a capital stock of $2,000, to construct a telephone line from Stockholm to Cupid and Doby Springs. The incorporators are: J. W. Williams, H. W. Allen, H. P. Omo and G. L. Nesbitt, of Redout; A. Gardener, of Cupid, and J. A. Anderson, Oklahoma.

VINITA, OKLA.—Articles of incorporation have been filed for the Craig County Telephone Company, with a capital stock of $10,000, by E. W. Leforce, Matthew Field, of Estelit; W. J. Hendge, W. H. Klaus and L. M. Smith, of Vinita.

HILLSBORO, ORE.—Articles of incorporation have been filed for the Hillsboro Water, Light & Power Company with a capital stock of $40,000 by A. John Stephenson, Charles E. Lyle and W. G. Hare.

SALEM, ORE.—The Independence, Siletz & Pacific Railway Company has filed articles of incorporation, with a capital stock of $500,000. The company proposes to construct an electric railway from Simpson through Siletz Indian Reservation to the coast. The incorporators are: O. M. Taylor, D. N. Sears and H. Hirschberg.

ASHERTON, PA.—The Asherton & Augustaville Telephone Company has been incorporated with a capital stock of $5,000.

BELLEFONTE, PA.—The Clinton Telephone Company has been chartered with a capital stock of $15,000 and the following directors: N. E. Robb, of Harrisburg, Pa., treasurer; W. D. Zerby, J. J. Bower, S. K. Woodring, all of Bellefonte, Pa.

CLARION, PA.—Application for a charter is to be made by G. F. Arnold, R. M. Werner, T. S. Arnold and others for a new company which is to be known as the Clarion & East Brady Electric Railway Company.

HARRISBURG, PA.—Charters have been issued to three electric companies in Schuylkill County. They are the Blythe Township, Middleport and New Philadelphia Electric Light, Heat & Power Companies, each with a capital stock of $5,000. John Pfeiffer, of Tower City, is treasurer of all three companies.

HARRISBURG, PA.—The application for a charter for the Finleyville Southern Railroad Company has been approved. The company is capitalized at $84,000, and proposes to operate an electric railway in Washington County. The directors of the company are: H. B. Hayden, president; J. E. Hayden and S. C. Wilson, of Monongahela; A. E. Hayden, of Finleyville; T. M. Hayden, of Castle Shannon; A. H. Henderson, of Venetia; George Englert, of Pittsburgh, and J. R. Hayden, of Muncie, Ind.

LOCK HAVEN, PA.—The Clinton Telephone Company has filed articles of incorporation with a capital stock of $15,000.

REEDSVILLE, PA.—The Milroy & Reedsville Telephone Company, which proposes to install a telephone system in Mifflin County, has been incorporated with a capital stock of $10,000, and A. R. Gibbony, of Reedsville, elected president.

SALISBURY, PA.—The Mountainville Telephone Company has filed articles of incorporation for the purpose of operating a telephone system in Salisbury. The incorporators are: Charles H. Stoneback, C. Frank Newcomer, of Coopersburg; George F. Carter, of Emaus; Charles E. Erney and others.

WAYNESBURG, PA.—The Interstate Interurban Railway Company has been chartered to construct an electric railway in West Virginia and Pennsylvania. It has an authorized capital stock of $8,400, and the incorporators are: W. J. Sheldon, McKeesport, Pa.; J. C. Sheldon, Buffalo, N. Y.; T. H. Shannon, R. B. Blair and R. B. Chaleroi, Waynesburg, Pa.

PIERRE, S. D.—The Iowa & Omaha Short Line Railway Company has been formed for the construction of an electric railway from Des Moines to Council Bluffs and Omaha, a distance of 140 miles. The capital stock of the company is placed at $1,000,000. The headquarters of the company will be located in Pierre, S. D., and a business office will be operated at Walnut, Ia. John A. Holmes, of Pierre, S. D., is interested in the enterprise.

CLIFTON, TEX.—Articles of incorporation have been filed by the Clifton Electric Light & Power Company, of this city. It is capitalized at $25,000, and the incorporators are: J. H. Chambers, W. G. Scarff and A. A. Slaughter.

TOYAH, TEX.—Articles of incorporation have been filed by the Toyah Telephone Company. It is capitalized at $7,500, and the organizers are A. G. Van Horn, D. P. Van Horn and J. V. Gage.

VELASCO, TEX.—Articles of incorporation have been filed by the Brazos Telephone Company. It is capitalized at $10,000, and the incorporators are D. A. Todd, C. J. Mackey and L. T. Mackey.

WACO, TEX.—Articles of incorporation have been filed for the Texas Central Telephone Company, with a capital stock of $6,000, by M. H. Lane, G. G. Davidson and W. D. Molear.

HELPER, UTAH.—Articles of incorporation have been filed by the Helper Western Electric Railway Company, its purpose being to construct an electric railway from the Denver & Rio Grande Railroad at a point two miles southeast of Helper, through Carbon County. It is capitalized at $15,000, and the incorporators are T. F. Williamson, Salt Lake City, President; C. L. Crandall, vice-president, H. B. Tyrrall, Provo, secretary and treasurer; G. W. Higgins, Clinton, Ind., and J. A. Thorne, Springfield.

BESSIE, VA.—The Russell-Prater Railway Company has been incorporated and contemplates the construction of an electric railway 12 miles long in Dickenson County. It has an authorized capital stock of $25,000, and the incorporators are: Leon Isaacson, Brooklyn, N. Y., president; C. M. Crawford, Ironton, Ohio, secretary; J. E. Hager, B. E. Whitman and C. F. Hager, Ashland, Ky.

WARWICK, VA.—Articles of incorporation have been filed by the Marlinton & Cloverlick Mutual Telephone Company. It is capitalized at $1,125, and the incorporators are John A. Beverage, Clover Lick; A. N. Barlow and George W. Allen, of Warwick.

VANCOUVER, WASH.—Articles of incorporation have been filed by the Clark County Railway Company. It is capitalized at $150,000, and the incorporators are Bert Yates, J. W. Sifton, O. C. Spencer, James G. Kidwell, Walla Walla; J. H. Murphy, A. Welch, C. E. Moulton and O. C. Spencer.

GREAT CACAPON, W. VA.—The Hydro-Electric Developing Company has been incorporated for the purpose of developing the water-power of the Great Cacapon River. It is capitalized at $100,000, and the incorporators are: Wm. B. Osler and Morris A. Orndorff, both of Great Cacapon; Sam'l R. Boyer, Hanover, Pa., and Wm. F. Disher, Berkeley Springs, W. Va.

PARKERSBURG, W. VA.—The Parkersburg & Pocatiligo Valley Railroad has been chartered, with a capital stock of $5,000. The incorporators are C. P. Craig, E. C. Goodno and Joe Williams, of St. Mary's, and R. E. Bills and John W. Dudley, Jr., of Parkersburg.

ALTO (P. O. WAUPUN), WIS.—The Eastern Alto Telephone Company has been chartered, with a capital stock of $4,000, by William Smits, John Frerick, Garry Wellhouse and R. Kastein.

MICHEL, B. C., CAN.—The Michel Water, Light & Power Company has been incorporated to do business in this town.

FORDWICH, ONT., CAN.—The Springbank Telephone Company has been incorporated with a capital of $10,000. The directors are: J. McLaughlin, R. Ferguson, J. Padfield,, all of Fordwich.

Legal.

LIGHTNING CONVEYED BY TELEPHONE WIRE—NOT NEGLIGENT FOR COMPANY TO FASTEN WIRES TO TREE.—The user of a telephone was struck by lightning and injured while in the act of carrying on a conversation over the line. There was no storm at the place where the accident occurred, but the bolt of lightning was the result of a storm in progress at a considerable distance. A judgment was given for the plaintiff in his action against the telephone company for damages. But, on an appeal, this was reversed and a new trial ordered. It appeared at the trial that, whereas it was customary to make a ground connection with the telephones belonging to the defendant company, in this instance the instrument which the plaintiff was using had no such connection. The wires running from the telephone, instead of being fastened to a pole, were attached to a tree 60 ft. high, standing near the house. There was evidence to show that the lightning struck the tree and traveled over the telephone wire into the house. A witness for the plaintiff, without giving reasons for his opinions, testified that "it was supposed to be dangerous" not to have a ground wire, and that the attaching of a telephone wire to a tree "was not supposed to be the right way." Several witnesses on behalf of the company, one of them being an electrical engineer, testified that it had formerly been the practice to use ground wires in connection with private telephones, but that experience had demonstrated that these ground wires afforded no protection in electrical storms, and their use was discontinued and other safety appliances used. These witnesses also testified that fastening telephone wires to a tree did not increase the danger from lightning, and that an ordinary telephone pole was as liable to be struck by lightning as a tree, and that, when the object to which the wire was attached was struck, the lightning would be carried along the wire to the point of least resistance, wherever that might be. In the opinion of the court the evidence was insufficient to establish negligence on the part of the company, either with respect to the failure to install a ground connection or the fastening of the wire to the tree. For this reason the judgment was reversed. Rural Home Telephone Company vs. Arnold, Court of Appeals of Kentucky, 113 S. W., Rep. 811.

Personal.

MR. D. O. DARNELL has been succeeded in the management of the Golden Electric Lighting Company, of Golden, Col., by a former owner and manager, A. Morrill.

MR. H. THURSTON OWENS will shortly sail for Europe on a short trip, partly for recreation and partly to note the state of development of illuminating engineering abroad.

MR. CHARLES H. WORCESTER, president of C. H. Worcester Company, pole dealer, Chicago, recently operated on for appendicitis, has made a complete recovery, and is again giving his attention to business affairs.

MR. CHARLES E. CANADA, who since his graduation from Yale has been in the General Electric testing department at Schenectady, will take up commercial work with the Hendrie & Bolthoff Manufacturing & Supply Company of Denver, Col.

MR. C. G. TARKINGTON, formerly of the engineering department of Kohler Brothers, Chicago, has joined the engineering staff of the Westinghouse Electric & Manufacturing Company. Mr. Tarkington's specialty is printing-press control.

MR. P. G. GOSSLER, who has recently become associated with A. B. Leach & Company, is now making his headquarters at their offices, 149 Broadway, New York City. A large number of important plants and enterprises are already receiving his attention.

MR. J. BRODIE SMITH, vice-president and general manager of the Manchester (N. H.) Traction, Light & Power Company, and treasurer of the Brodie Electric Company, was married July 14 to Miss Charlotte Dodd Stewartson, M. D., at the summer residence of the former on Uncanoonuc Mountain, N. H.

MR. R. L. THAYER, well known to the electrical men of the West, has been appointed Western representative of Hanlon & Wilson, Wilkinsburg, Pa., with office at Room 201, 275 La Salle Street, Chicago. Hanlon & Wilson manufacture "Vak Klean," a high-class vacuum-cleaning outfit, which, although new, is attracting attention.

MR. A. E. JOSSELYN, who is in charge of the department of information of the Edison Electric Illuminating Company, of Boston, has been visiting other cities to examine methods of central-station administration in the branch in which he is particularly concerned. He was in Chicago recently, and was much interested in the manner in which the bureau of information of the Commonwealth Edison Company is conducted.

MR. M. L. NEWMAN and Mr. Alfonse Kaufman have formed a partnership for practice as consulting and industrial engineers, with offices at 26 Broad Street, New York, under the firm name of M. L. Newman & Company. Mr. Newman, the senior member, has had a long experience in government work at the Brooklyn Navy Yard. Mr. Kaufman recently severed his connection as manager of the Alaska Chemical Company to become associated with Mr. Newman.

SIR CLIFTON ROBINSON has moved his London office to the Hamburg Amerika Building, 15 Cockspur Street, Charing Cross, S. W., as the old quarters have become the site for new government offices. In a recent article, the *War Office Times* praises Sir Clifton warmly for the active and farsighted interest he has taken in the mobilization and handling of large bodies of troops by means of electric roads, and points out the value of his advice in regard to the extension of such a system.

MR. ROBERT W. MARTIN, a famous old war-time telegrapher, and once in charge of the foreign service of the United Press, was stricken with apoplexy some three years ago while employed on the *New York Herald*, and is now critically ill. His friends and admirers are making an effort to raise funds for the benefit of his wife and daughter in this emergency, so as to enable them to make the best of a trying situation. Mr. Walter P. Phillips, of Bridgeport, Conn., has taken the matter up actively. Contributions to the fund can be sent to Mr. John B. Taltavall, *Telegraph Age*, 253 Broadway, New York City, as a member of the committee.

MR. R. F. SCHUCHARDT has been promoted from the position of engineer of electrical construction to that of electrical engineer in the organization of the Commonwealth Edison Company, Chicago, succeeding Mr. Peter Junkersfeld in the latter position. Mr. Schuchardt graduated from the University of Wisconsin in 1897, with the degree of bachelor of science in electrical engineering, and he has made his mark in the electrical industry of Chicago by the value of his work. For a time after graduation he was associated with Mr. F. B. Badt, but in 1898 he entered the service of the Chicago Edison Company, and for a number of years was connected with the testing laboratory of that company. Mr. Schuchardt is a member of the American Institute of Electrical Engineers and other electrical societies, and in 1901 he was president of the old Chicago Electrical Association. He is a man of scientific and literary tastes, and is editor of the *Edison Round Table*, published by the Commonwealth Edison branch of the N. E. L. A.

MR. PETER JUNKERSFELD, until recently electrical engineer of the Commonwealth Edison Company, has been appointed assistant to the second vice-president, succeeding Mr. H. E. Niesz, resigned. Mr. Junkersfeld is a man of high standing in his profession, and his engineering training will make him a valuable assistant to Vice-President Ferguson. He is a graduate of the electrical engineering department of the University of Illinois, class of 1895. Soon after graduation he entered the service of the Chicago Edison Company, and he has had a varied and fruitful experience with that company and its successor, the Commonwealth Edison Company. He has paid particular attention to alternating-current work, being one of the first engineers to employ a four-wire, three-phase system of primary distribution on a large scale. He is a member of the American Institute of Electrical Engineers and a number of other electrical societies, and has made a number of valuable contributions to the literature of the art by papers read before technical societies.

MR. HOMER E. NIESZ has resigned as assistant to the second vice-president of the Commonwealth Edison Company, Chicago, to become

[illegible] been connected with the Commonwealth Company and its predecessor, the [illegible] siderable period assistant superintendent of construction, and in 1899 he was appointed assistant to Mr. [illegible] ent and now second vice-president of the company. Mr. Niesz, who is a graduate of Mount Union College and an associate member of the American Institute of Electrical Engineers, a member of the National Electric Light Association, Illuminating Engineering Society and other electrical organizations, has given his time and effort freely to further general electrical interests. He was editor of the monumental Question Box presented at the Denver convention of the N. E. L. A., in 1905, and was the local committeeman in charge of the exhibits of the same association at the Chicago convention of 1908. In addition, Mr. Niesz has been managing director of the very successful Chicago Electrical Show for several years. He took up his new duties on July 1.

Obituary.

MR. ELWYN G. HOVEY died at his residence in Upper Montclair, N. J., July 8, aged 42 years. Mr. Hovey was graduated from Dartmouth College in 1888, and immediately after entered the employ of the Western Electric Company as an electrical [illegible] capacities, he specialized on the design and construction of telephone central exchanges, and in 1897 was sent to Japan by the company to supervise the construction of several large telephone plants in that country. After he returned to the United States he was transferred to the New York City office of the company, and remained in its service up to the time of his death.

Trade Publications.

STORE AND OFFICE LIGHTING.—The Central Electric Company has issued an attractive folder, entitled "Hints for Inexpensive Lighting of Stores, Offices and Public Buildings." Various fixtures are shown equipped with "Opalux" shades and reflectors of various types.

CIRCUIT AND LINE FITTINGS.—The Harvard Electric Company, of Chicago and New York, has just issued bulletin No. 18, relating to brackets, sectional switch boxes, conduit boxes, telephone fuses, wire joints, etc.. In this bulletin there is given a detailed description of the various Harvard specialties, dimensions, etc.

MODERN PUMPS.—Bulletin No. 10 of the C. H. Wheeler Manufacturing Company, Philadelphia, has for subjects the long line of steam, electric and power-driven pumps, both for pressure and vacuum, made by this firm. It is notable that a large proportion of the more modern forms of pumps are driven by electric motors.

ELECTRIC FURNACES.—The American Electric Furnace Company, 45 Wall Street, New York, is distributing catalogs descriptive of Rochling-Rodenhauser and simple induction electric furnaces of the Kjellin and Colby types. These three furnaces are well illustrated and described, while reports of tests upon the output are given in outline.

TESTING POLYPHASE INDUCTION MOTORS.—The Triumph Electric Company, Cincinnati, has issued a chart [illegible] concise directions for testing polyphase induction motors. The various heads are primary resistance, no-load test, short-circuit test, motor characteristics, service test, insulating tests, puncture and heat tests.

RECEPTACLES FOR DECORATIVE WORK.—Pass & Seymour, Solvay, N. Y., have issued a bulletin (No. 552) devoted to receptacles for decorative work. Prominently mentioned is the type of receptacle which is shipped already connected upon the wire, and which is supplied in any length or streamers a customer may desire, thereby saving time, labor and material.

THE LUMINARIES.—With the title, "The Luminaries," the Tungstolier Company, Cleveland, Ohio, has issued a booklet consisting solely of four strikingly handsome engravings printed in colors. Each occupies a full page, the motives being, respectively, the stars, the moon, the sun and the tungstolier. The design and colors are notably artistic, which is also true of the illuminated title page.

ACHESON PRODUCTS.—The International Acheson Graphite Company, of Niagara Falls, N. Y., has just issued a new folder descriptive of its various products, which include electrodes, dry battery filler, paint pigment, electrotyping leads, graphite for lead pencils, firearms lubrication, general lubrication and graphited greases. The folder is handsomely printed in two colors, and will be appreciated by many as a catalog in miniature.

MOTORS FOR LIGHT MISCELLANEOUS SERVICE.—The Westinghouse Electric & Manufacturing Company has issued a handsomely printed booklet describing the applications of its line of small motors to office, store and shop services. The numerous illustrations scattered through the pages suggest many time and labor saving uses for these efficient little power devices; among these are the motor-driven adding machine, mailing machine, eraser, graphophone, envelope sealer, vacuum cleaner, buffing and polishing wheel, blower, sign-flasher, box-covering machine, hand drill, hack saw, coffee grinder, etc.—applications selected at random from the large number of uses where the [illegible] vides the ideal power.

[illegible] helical spring arranged between the inner ends of oppositely disposed stirrup-like hangers which permit of lateral or oscillating motion in every direction and absorb shocks and vibrations. The device is used chiefly in connection with tungsten lamps and tungsten lamp fixtures and is built by the American Arc Lamp Company, of Kalamazoo, Mich., and described in its Bulletin No. 40.

STONE & WEBSTER SYMBOL.—Stone & Webster, Boston, have issued a handsome pamphlet relating to its recently adopted symbol—a triskelion enclosed by a triangle. The former is symbolic of energy, life, motion and progress, and the latter of stability. The pamphlet gives illustrations of various forms of the triskelion, which is a three-armed swastika, and the text gives a historical account of the symbol and of the various significances which have been attached to it.

DIRECTLY-CONNECTED ENGINE-DRIVEN GENERATORS.—The General Electric Company, Schenectady, N. Y., has issued Bulletin No. 4664, devoted to directly-connected engine-driven railway generators, which embody a number of improvements over previous types. The standard line of these generators range in rating from 100 kw to 2700 kw, and the speeds have been selected to adapt the generators for direct connection to steam engines. They are designed to run at the prevailing full-load railway voltages.

IN MEMORIAM.—The directors of the Shelby Electric Company have issued "A Tribute" to the memory of Mr. J. C. Fish, long the president of that company. It is tastefully but simply printed on heavy paper and is prefaced with an excellent photograph portrait with signature. The body of the text includes a brief delineation of the man as his nine associates knew him in the close intercourse of daily life, and it is signed by all of them at the end, in autograph. The whole thing is admirable in conception and dignified in execution.

VENTILATING FANS AND BLOWERS.—The American Blower Company, Detroit, Mich., has issued three booklets dealing with different aspects of ventilation by fans and blowers. One of these is the "Sirocco" marine fan, which is electrically driven and has been supplied to many warships in our own, European and Japanese navies. Another relates to the fan ventilation of buildings and special dispositions for hotel kitchens, and for laundries, restaurants, etc. The third is a handbook of information on blowers and exhausters for glass factories. All three are handsome specimens of pamphlet work, and particularly the second mentioned.

INVERTED ARC LAMPS.—The Prime Electric Company, of New York, has issued Catalog P, illustrating and describing its miniature arc lamps. In both the inverted and hanging types there is only one moving part and no clutches. The lamp operates on 110 or 220-volt circuits, and consumes 4½ to 5 amp. on 114 volts, with a pressure across the arc of 84 volts. Provision is made to prevent the burning out of carbon holders, and the carbons cannot overlap each other or stick. Standard ½-in. carbons are used. The lamp is made in three sizes, with over-all lengths of 17 in., 19 in. and 22 in. When used for pedestal or newel post lighting the body of the lamp is set on or in the fixture, only the globe being visible.

ELECTRIC POWER FOR DOMESTIC PURPOSES.—The Westinghouse Electric & Manufacturing Company has issued an attractive little folder, entitled "Electric Power for Domestic Purposes," which offers many valuable suggestions for the use of small motors in the home. Among the labor-saving applications of electric power noted are to the sewing machine, vacuum cleaner, washing machine, ice-cream freezer, coffee grinder, meat chopper, ironing machine, silver polisher, dish washer and the motor-driven pump. A novel electric-driven household utility, illustrated in the folder, is the combination of a coffee grinder and meat chopper compactly attached to a small motor.

RAILWAY MOTOR.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 4668, covering its 216-A railway motor. The motor of the box-frame type, equipped with commutating poles and mica insulated brush holders, and the armature shaft is removable. Among the advantages claimed for this type of construction, in addition to the substantial mechanical features, are practically sparkless commutation on even heavy overloads, reduced wear on commutator, together with a marked reduction in commutator heating, increased life for the brushes and increased efficiency and free running capacity, because of lower core in commutator losses. The motors are rated at 50 hp and designed for operation on 600-volt railway circuits.

INDUCTION MOTORS.—Bulletin No. 351 of the Triumph Electric Company, of Cincinnati, Ohio, is devoted to descriptions and applications of the company's induction motors. These are two and three phase machines designed for frequencies of 25, 40 and 60 cycles, and ranging from 1 hp to 75 hp in size. The motors are wound for 110, 220, 440 and 550 volts, and in sizes smaller than 5 hp are started by a special switch which removes the fuses from the circuit when starting and restores them in the running position automatically. Above 5 hp the motors are started by means of an auto transformer suitably encased and provided with a switch. Several different voltage taps permit the motor to be connected for the starting current best suited to its requirements.

MR. RAY D. LILLIBRIDGE has removed his offices in New York to the eleventh floor of 100 Broadway, and in increasing his facilities as an expert in technical publicity has taken into partnership Mr. William L. Rickard. Ten years ago Mr. Lillibridge developed the idea of rendering advertising and publicity service to non-competitive concerns on a

salary to retainer basis, prepare also technical and trade literature and pamphlets for his clients. The business was successful from the first. Mr. Lillibridge secured the accounts of the American Bridge Company, the Electric Storage Battery Company and the Link-Belt Engineering Company. Subsequently the Stanley Electric Manufacturing Company, the Otis Elevator Company, Dodge & Day and the White Sewing Machine Company's automobile department became clients, and there are many others whose names could be added to the list. Mr. William L. Rickard, although a young man, was for 18 years with the Otis Elevator Company, entering the employ of that concern as a boy. For a number of years he occupied a position as assistant to Vice-President Mills in charge of the sales, and later was manager of the foreign department. His experience and work with the Otis Company have eminently qualified him for a business such as technical advertising.

Business Notes.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has removed the sales office formerly located at Tucson, Ariz. to 173 San Francisco Street, El Paso, Texas, where it will be continued as a branch of the Los Angeles office.

THE RAYMOND CONCRETE PILE COMPANY, of New York and Chicago, secured, through its Schenectady representative, G. W. Van Vranken, a contract, just executed, for the concrete piling foundations of the pattern storage warehouse of the General Electric Company at Schenectady.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., reports that it is manufacturing the dimmer plates for the New Theater in New York, which will contain the greatest number of circuits and dimmer plates of probably any theater in the world. Two hundred and sixty dimmer plates are being completed at this time.

THE DIEHL MANUFACTURING COMPANY has moved its New York office, of which Mr. C. C. Remsen is manager, from 561 Broadway, around the corner to 90 Prince Street. The reason for moving was the need of increased space to accommodate growing business.

THE HARVARD ELECTRIC COMPANY, 66 West Van Buren Street, Chicago, Ill., announces that after Sept. 1, 1909, its Chicago office and factory will be located at 523 West Van Buren Street, where, with greater quarters and more adequate facilities, it will be better able to take care of its rapidly increasing business. As before, the Eastern office will remain located at 136 Liberty Street, New York City, in charge of [illegible] Eastern manager.

LIBERTY MANUFACTURING COMPANY.—Mr. Glen M. Porter has succeeded Mr. W. M. Owen as manager of the New York office of the Liberty Manufacturing Company, 90 West Street, and will have full charge of the business in the New York territory on and after this date. Mr. Porter is thoroughly acquainted with all the details of the business and will give the large and growing trade in the New York district his entire attention. He will be assisted by Mr. C. S. Roosa, who is already well known to customers of the company.

MORE LIGHT.—For over 50 years the house of I. P. Frink, 551 Pearl Street, New York, has given expert attention to every detail pertaining to the manufacture of reflectors and lighting specialties. No effort has been spared to make its products reach the highest possible mark of efficiency, economy and beauty. Special reflectors for lighting the squash courts of the University Club, Chicago, were installed by this concern a few months ago, and they proved so satisfactory that it has just finished putting in the reflectors for illuminating the tennis courts also. Bronze reflectors for lighting the desks and screens have been placed in the National Bank of Commerce, St. Louis, Mo., and the fixtures for illuminating the Art Gallery of the Alaska-Yukon-Pacific Exposition were made by this firm, which invites contractors, engineers and central-station managers having lighting problems to consult with it.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 6, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector Street, N. Y. City.]

The following list contains patents that should have appeared in last week's issue, but were not received in time from the Patent Office, owing to the failure of the contractor to supply copies. We are informed by the Patent Office that the patent specifications that should have been issued July 13 will not be received for distribution until the present week.

926,732. ARC LAMP; R. Fleming and C. A. B. Halvorson, Jr., Lynn, Mass. App. filed Nov. 16, 1903. Flaming-arc lamp having a draft tube, and electrode thereon with means for moving electrode in scraping engagement with the walls of slots on the tube.

926,754. SOCKET FOR ELECTRIC LAMPS; W. G. Lindemann, Milwaukee, Wis. App. filed Feb. 20, 1909. Husk chandelier socket in which the cord and lamp may be removed without disengaging the shade, the casing being integrally formed from a single piece of metal.

926,757. PUNCTURE-INDICATING DEVICE FOR TIRES; James L. Marmaud, Worcester, Mass. App. filed Sept. 14, 1908. The pressure within the tire controls an electric circuit so that the puncturing of the tire gives the alarm.

926,792. ELECTRIC ARC LAMP; W. S. Weedon, Schenectady, N. Y. App. filed March 12, 1904. For arc lights using electrodes of titanium carbid which become more or less covered with a film that is non-conducting. Starts the arm from the side of the electrode away from its arcing end and transfers to the end of the electrode.

926,793. ARC LAMP; W. S. Weedon, Schenectady, N. Y. App. filed June 13, 1904. For drawing an arc in the arc light, by means of two electrodes normally in alignment, a stop out of alignment therewith, one of the electrodes being movable into alignment with the stop.

926,818. BLOCK SYSTEM FOR RAILWAYS; G. W. Nistle, E. Inskip and B. W. Brady, North Muskegon and Chicago, Ill. App. filed Nov. 18, 1907. The train is automatically arrested when it reaches a block set at danger, by throwing on the air brakes, from an improved type of track lever.

926,831. TELEPHONE JACK; A. L. Sohm, Whittier, Cal. App. filed Aug. 4, 1908. Avoids removing the entire plate holding the jacks, by providing a bridge strip secured by a locking rod, which latter may be withdrawn to free the parts.

926,857. TERMINAL FOR ELECTRIC CABLES; C. W. Davis, Edgeworth, Pa. App. filed Aug. 3, 1908. For protecting the stripped portion of the cable by means of a thimble secured to the sheath of the cable and a sleeve of insulating material between the thimble and a disk carried by the conductor.

926,874. MOTOR-CONTROLLING DEVICE; L. Janisch, Berlin, Germany. App. filed Oct. 10, 1907. A resistance and switch with means for operating the controlling mechanism and closing the switch in the initial movement thereof, the switch being open at speed.

926,884. AUTOMATIC CARRIER; S. H. Libby, East Orange, N. J. App. filed Aug. 7, 1905. A carrier with a driving motor, a hoisting motor, a current collecting device, a controlling switch and a height limit device.

926,890. ELECTRIC LOCK; T. C. Nixon, Chicago, Ill. App. filed Feb. 19, 1908. Electro-mechanical lock in which the bolt may be retracted by a key or spring and the shooting of the bolt to the locked position is controlled by an electromagnet.

926,900. TRANSMITTING APPARATUS; H. Shoemaker, Jersey City, N. J. App. filed Dec. 10, 1908. For transmitters of wireless telegraphs controlled by a key through which only a small fraction of the entire current passes. Provides an arrangement of differentially arranged inductances, one set being always in circuit while the other is in series with another inductance and is controlled by the key.

926,906. DISTRIBUTING INSULATOR BRACKET; A. L. Stadermann, Terre Haute, Ind. App. filed June 26, 1907. A plurality of independent insulators are strung on a rod carried by a bracket.

926,933. WIRELESS TELEGRAPHY; L. De Forest, New York, N. Y. App. filed March 22, 1905. Spark gap making use of the vapor of a metal, such as mercury, which collects in the bottom of the tube, the tube being provided with an enlarged chamber having a channel containing a liquid electrode with offset pockets.

926,934. WIRELESS TELEGRAPH TUNING DEVICE; L. De Forest, New York, N. Y. App. filed Jan. 20, 1906. A spiral of metallic ribbon and a contact operating transversely across said spiral whereby the capacity and inductance may be varied in a continuous manner.

926,935. WIRELESS TELEGRAPH TRANSMITTER; L. De Forest, New York, N. Y. App. filed Feb. 2, 1906. Spark electrodes are located in a doubled-walled, ventilated muffler and a helix is mounted on the muffler.

926,936. SPACE TELEGRAPHY; L. De Forest, New York, N. Y. App. filed June 20, 1907. A source of practically continuous high-frequency electrical oscillations, a radiating conductor associated therewith, an oscillation circuit associated with said source and controlling it, and a source of vibratory electrical energy associated with the oscillation circuit.

926,937. SPACE TELEPHONY; L. De Forest, New York, N. Y. App. filed June 25, 1907. A plurality of oscillation circuits, transmitting devices therefor, controlling means common to all of the devices and means for converting the energy of the oscillation circuits into radient energy.

926,950. AUTOMATIC RINGING CIRCUIT AND APPARATUS FOR TELEPHONE EXCHANGES; R. H. Manson, Elyria, Ohio. App. filed Feb. 1, 1907. A thermal relay is used for cutting off the ringing circuit and commutators to interrupt the flow of the generator current so as to give intermittent ringing, and a condenser is used in the shunt path for the line current around the relay.

926,951. ELECTRICAL SWITCH; R. H. Manson, Elyria, Ohio. App. filed Feb. 28, 1907. Hook switch for telephone in which the lever may be readily detached.

926,956. ILLUMINATING DEVICE; W. N. McComb, New York, N. Y. App. filed March 25, 1908. An electric display device for producing the kaleidoscope effect by mounting lamps in compartments and arbitrarily selecting the lamps to be flashed in an irregular manner.

926,962. TERMINAL OUT-CUT; F. D. Reynolds and J. Sachs, Hartford, Conn. App. filed Jan. 7, 1908. A fusible conductor for safety fuses whose sectional outline is serrated and large in relation to its sectional area.

926,964. COIL; C. Schrader, Halensee, near Berlin, Germany. App. filed Aug. 4, 1908. A coil consisting of a plurality of superposed broad strips of metal, having holes through the commencing end of the coil passes to the outside.

926,994. TELEPHONE CONNECTING APPARATUS; E. C. Molina, Arlington, Mass. App. filed June 19, 1907. For electro-mechanically making connections at central station, in which switching mechanism provided with a plurality of groups of fixed line contacts is employed and an independent movable contact member co-operating therewith. Telephone lines for one class of service are connected to one group of contacts and for another class are connected to a different group.

927,010. ELECTRIC ARC LAMP; T. Spencer, Philadelphia, Pa. App. filed April 3, 1907. The arc is formed between the two lower ends of carbons which point downwardly. Particularly useful with flaming arcs. Details.

927,014. CONTROLLING DEVICE FOR VEHICLES; R. Werkner, Budapest, Austria-Hungary. App. filed Jan. 14, 1908. Combines a vehicle with a heat engine, an electric generator coupled therewith, a

storage battery, shunt-wound motors connected to the wheels and gearing for connecting the heat engine and the wheels.

927,018. ELECTRIC SIGN; Francis D. Ammen, New York, N. Y. App. filed Feb. 8, 1908. Electric signs in which the units are lighted and extinguished, beginning at opposite points and rapidly approaching a meeting point, producing the effect of a collision of lights followed by a sudden display like an explosion.

927,021. PROCESS OF TREATING ARSENICAL ORES AND SPEISS; Anson Gardner Betts, Troy, N. Y. App. filed Feb. 23, 1909. An electrolytic process for treating arsenical ores.

927,025. CALL DISTRIBUTING TELEPHONE EXCHANGE SYSTEM; S. H. Browne, Pittsburgh, Pa. App. filed Feb. 11, 1905. An automatic switch having a moving testing wiper, a testing relay connected thereto, an armature contact for the relay and a local circuit controlled by the contact which continues the energization of the testing relay independently of the wiper.

927,027. ELECTRIC WATER HEATER; H. W. Denhard, San Francisco, Cal. App. filed June 25, 1908. A reservoir with an electrically heated extension and a feed tube carrying a deflector for the hot water.

927,032. CABLE HANGER; J. E. Feiock, Martin's Ferry, Ohio. App. filed July 7, 1908. An S-shaped strip whose ends lock together, the loops embracing the supporting wire and the cable.

927,041. RAILWAY SAFETY DEVICE; S. H. Harrington, New York, N. Y. App. filed March 29, 1904. A printing device is carried by an arm on the semaphore pole which makes it mark on the passing car if the car should go by when the semaphore is at danger.

927,045. COMBINED INSULATOR AND LIGHTNING ARRESTER; W. F. Hiatt, Danville, Ind. App. filed Aug. 24, 1908. A cylinder with a core of insulating material in sections, adapted to hold a wire.

927,111. ELECTRIC PROTECTION SYSTEM; C. U. Carpenter, New York, N. Y. App. filed Nov. 23, 1908. Electric protection of apartment houses having a main electric protective circuit, an alarm mechanism and a series of key-operated switches, each of which is adapted, when operated, to remove the alarm from the control of a corresponding protected structure.

927,142. ROTARY CONVERTER FOR DIRECT CURRENTS; L. A. Hawkins, Schenectady, N. Y. App. filed March 28, 1908. Substitutes for the two machines of the motor generator, one machine having a commutator and two sets of brushes displaced 90 deg.

927,146. METER LOCK; J. H. Jackson, New York, N. Y. App. filed Nov. 14, 1908. Locks for meters with removable casings to prevent tampering with the meter. Makes use of a seal.

927,173. ELECTRIC HEATER; K. Schluter, Kiel-Gaarden, Germany. App. filed May 20, 1908. An electric heater having its resistance members constructed of nickel tubes.

927,178. MOTOR-CONTROL SYSTEM; J. A. Seede, Schenectady, N. Y. App. filed May 28, 1908. For driving rolling mills in which direct current supplies the motor of a flywheel motor generator set, a second motor is also supplied with current and means operating on the field of the motor generator limits the amount of power.

927,185. TUBULAR INSULATOR; L. Steinberger, New York, N. Y. App. filed June 4, 1906. A high-tension insulating tube comprising a plurality of cylindrical members, concentrically arranged, connected by spacing partitions, one partition being staggered relatively to another.

927,186. HIGH-POTENTIAL STRAIN INSULATOR; L. Steinberger, New York, N. Y. App. filed July 20, 1906. A disk having holes of tapering diameter, insulating sleeves therein, tapering bolts fitting the sleeves with mechanism connected with the bolts for producing a mechanical strain.

927,191. ELECTRICAL MEASURING INSTRUMENT; E. Thomson, Swampscott, Mass. App. filed Nov. 13, 1907. An instrument with a long scale and uniform divisions, abnormally sensitive at certain points. Makes use of a uniform magnetic field and a coil shaped like an isosceles triangle and mounted for bodily edgewise movement.

927,209. ARMATURE FOR ELECTRIC MACHINES; W. J. Bauroth, Columbus, Ohio. App. filed Aug. 23, 1906. Improvement in armatures whose cores are made up of sheet-metal laminæ. Details.

927,218. JUNCTION BOX FOR ELECTRICAL CONDUCTORS; J. F. Burns, Philadelphia, Pa. App. filed Sept. 30, 1908. A junction box having a socket for a conduit with an oblique wall, an insulating bushing and a removable cover.

927,219. JUNCTION BOX FOR ELECTRICAL CONDUCTORS; J. F. Burns, Philadelphia, Pa. App. filed Sept. 30, 1908. A box having sockets for conduits with axes at right angles and removable covers for openings in the box.

927,230. DICTOGRAPH; W. F. H. Germer, New York, N. Y. App. filed July 31, 1908. The manager of the office dictates his letter to any one of his corps of stenographers, without requiring them to leave their desk, by means of a telephone system, a three-wire circuit extending from the manager's station to the stenographers, and a key normally opening one wire in each of the three wires and adapted to open another wire of each three-wire circuit to a non-communicating manager's station when talking circuits are established to any particular station.

927,260.—TRAINING AND FIRING MECHANISM FOR GUNS; J. F. Meigs and S. A. S. Hammar, South Bethlehem, Pa. App. filed Feb. 4, 1907. A sighting device, adjusting means for the gun and electrical means for automatically firing the gun when the adjustment is obtained.

927,274. DYNAMO-ELECTRIC MACHINE; L. A. Pape, Norwood, Ohio. App. filed Aug. 19, 1907. For automatically tightening the current-carrying coils of the rotating member by means of an automatic follow-up wedge acting by centrifugal force.

927,314. CURRENT INDICATOR FOR DETECTOR; C. D. Babcock, New York, N. Y. App. filed Aug. 15, 1908. For wireless telegraphy in which a sensitive conducting element is used containing a chemical salt whose conductivity changes at a critical temperature with great rapidity.

927,318. DYNAMO-ELECTRIC MACHINE; B. A. Behrend, Norwood, Ohio. App. filed May 17, 1908. Alternating-current generators with rotary field of the flywheel type, having a wide spider rim, so that a large volume of air can be caused to circulate through passageways in the stationary core.

927,321. INSULATOR; J. T. Bond, Palatka, Fla. App. filed March 12, 1908. A body portion, an integral base, the body being cylindrical and the base rectangular.

927,344. ADJUSTABLE CASING FOR LAMP SOCKETS; E. H. Freeman, Trenton, N. J. App. filed July 15, 1908. Details in the casing or shell.

927,347. TELEGRAPHIC INSTRUMENT; J. J. Ghegan, Newark, N. J. App. filed Aug. 25, 1908. Improved telegraph transmitting key with a switch lever insulated therefrom which may connect with the contact or with the key, as desired.

927,373. SPRING HINGE FOR ELECTRICAL AND OTHER DEVICES; L. H. Moulthrop, Bridgeport, Conn. App. filed July 31, 1908. For doors of electrical plug receptacles in which the hinge pin consists of a spiral spring.

927,374. PROCESS OF MANUFACTURING INCANDESCENT MANTLES; A. Muller, Furstenwalde-on-the-Spree, Germany. App. filed Oct. 4, 1907. Impregnates the fabric with a colloidal solution of an oxidhydrate of a rare earth.

927,375. ELECTRIC ISOLATION SYSTEM; N. C. McClure, Healdsburg, Cal. App. filed Oct. 18, 1907. For ringing one subscriber on the line and talking, without ringing others. Uses a central-office indicator meter, provided with a coil, springs, a permanent magnet with poles, and a graduated plate indicating the amount of deflection. Each subscriber's instrument is similarly equipped.

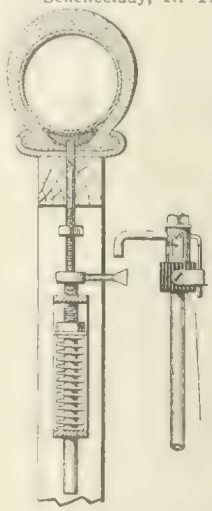
927,377. SIGNALING SYSTEM; J. G. Nolen, Chicago, Ill. App. filed Oct. 4, 1905. Combined fire alarm and watchman's signaling system having a line leading from a central to a series of stations and code teeth at each station.

927,382. CONNECTION BLOCK FOR ELECTRIC SERVICE CIRCUITS; J. G. Swallow and W. E. McCoy, New York, N. Y. App. filed Oct. 12, 1907. For testing meters in service by means of a special connection block having binding posts for service wires, and also for wires to the meter.

927,395. TELEPHONE TRANSMITTER; C. Adams-Randall, New York, N. Y. App. filed April 16, 1907. Obtains increased voltage through the transmitter by supporting on the diaphragm a confined variable resistance conductor of uniform depth and large conducting capacity, under pressure.

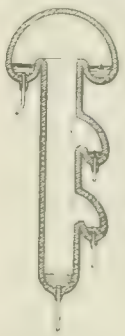
927,397. SINGLE-PHASE MOTOR CONTROL; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Jan. 4, 1908. Control system for repulsion motors with short-circuited armatures for starting and for changing from one running connection to another with an electrically interlocked set of switches whereby the above connections are produced automatically in sequence.

927,398. ALTERNATING-CURRENT MOTOR; E. F. W. Alexanderson, Schenectady, N. Y. App. filed April 17, 1908. Repulsion motor of the commutator type in which the armature is connected in a local closed circuit and short circuited along the line of magnetization of the inducing winding through a central portion of the inducing winding included in the circuit.

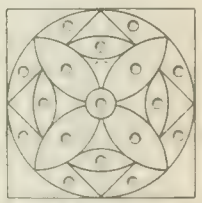


926,757. Puncture Indicating Device for Tires.

927,399. ALTERNATING-CURRENT MOTOR CONTROL; E. F. W. Alexanderson, Schenectady, N. Y. App. filed June 1, 1908. For controlling single-phase motors of the commutator type, particularly repulsion motors in which the armature is short circuited at starting, then opened, and on the return movement of the controller only re-established after the starting or off position of the controller is reached.



926,933. Wireless Telegraphy.



926,938. Illuminating Device.

927,404. BLOCK SIGNAL SYSTEM; A. G. Davis, Schenectady, N. Y. App. filed March 28, 1906. Signal system for electric roads having parallel tracks and a connection from the block to the parallel track adapted to form a path for the power current, two windings inserted respectively between the rails of the block and the connection, a signal for the block and means operative on failure of current in either winding to indicate danger.

927,413. INDUCTION COIL; A. K. Keller, La Fayette, Ind. App. filed Aug. 2, 1908. Telephone switch stand with induction coil which is detachable and comprises a core and windings thereon and a terminal head projecting above the core.

927,414. TELEPHONE SYSTEM; J. M. Latimer, Flushing, N. Y. App. filed Sept. 14, 1908. For transmitting subscribers' messages and other messages so that the two classes can be transmitted simultaneously without interfering with one another. One set of messages consists of local alarms.

927,417. HOIST; S. H. Libby, East Orange, N. J. App. filed May 8, 1907. Motor-driven hoist in which the improvement lies along mechanical lines.

927,428. THIRD-RAIL CONDUIT SYSTEM; P. M. Reynolds, San Francisco, Cal. App. filed Nov. 30, 1908. A housing for the electric conductor having a plurality of sections, the conductor embedded therein and providing a continuous electrical connection.

927,433. TRANSMITTING APPARATUS; Harry Shoemaker, Jersey City, N. J. App. filed July 22, 1908. A transmitter of electro-radiant energy having a plurality of pairs of differentially related inductances associated with the source of energy and a key for cutting in and out an inductance of each pair.

927,455. ELECTRICAL SELECTOR; E. A. Faller, New York, N. Y. App. filed April 8, 1904. Combination with a series of line terminals divided into groups, a series of corresponding normally open local circuits, means controlled by the groups to partially close one circuit and means controlled by one element of the group for completing the local circuit.

927,465. CONTROL APPARATUS; G. H. Hill, Schenectady, N. Y. App. filed April 18, 1908. Means for controlling electric motors from any of a plurality of stations by pressing a button. Details.

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The Electrical Contractors' Convention.

The addresses by Messrs. Jas. R. Strong and F. P. Bissell at the convention of the National Electrical Contractors last week, at Toledo, as well as considerable other talk off the floor of the convention, bring to the surface some of the trade friction of the past few years among manufacturers, jobbers, and local contractors or supply dealers as to the prices given to these various classes. It is erroneous to assume that the electrical trade has had a monopoly on internal friction of this kind, for it has existed more or less in other trades for years, and perhaps always. The fundamental trouble in the electrical business seems to have been due to two causes: First, the willingness of certain jobbers or dealers to do a picayune retail business at wholesale prices; and second, as a result of this, an attempt to establish artificial lines of price demarcation between the manufacturers, jobbers and contractors or dealers. If sound principles of trade had been adhered to in the first place by all concerned, and if prices had been wholly based on quantity purchased rather than on some artificial distinction between classes, the trouble never would have existed. These things are bound in the long run to settle down to the fundamental economic principle in merchandising, that the quantity handled and sold at one time largely governs the cost of selling. It is unreasonable to assume that any association or set of associations can get together and resolve this principle out of existence. There is no reason why one man calling himself a jobber and purchasing 100 articles of a certain kind in a year should receive a lower price from the manufacturer than another man calling himself a contractor and dealer who purchases 10,000 articles of the same kind in a year. Competition among manufacturers will regulate matters otherwise, and it is right that it should.

The original trouble started from the disregard of this principle by manufacturers and large jobbers who sold to small dealers and contractors at the same price that they would sell to considerably larger concerns with larger gross yearly purchases. It would seem to be quite evident to any manufacturer that the cost of selling in small quantities is greater than in large quantities, but the desire to get business, probably coupled with ignorance as to actual selling costs, have made the trouble. As a result of this, various contractors' and jobbers' associations have attempted to define by resolution what should constitute a contractor and what a jobber, and to establish different scales of prices for these two classes. The plan has never worked in practice and the result has been in some cases little short of child's play. The large contractors have in some cases started up jobbing houses under a different name for the sake of getting jobbers' prices, under the association rulings, and doubtless in many cases have done a business in excess of jobbing houses having no connection with the contracting business. On the other hand, if a concern of sufficient size to do a jobbing business happens also to be engaged in the con-

tracting business in the city where it is located, what moral objection can any contractor urge against this proceeding? True, as Mr. Bissell pointed out in his address before the contractors, too many irons in the fire is likely to result in disaster, but that certainly falls more heavily on the man who tries the experiment than on anyone else. As Mr. Strong so forcibly pointed out in his remarks, agreements alone cannot separate classes in the trade. The only line of division possible is the line between wholesale and retail. In the past contractors and jobbers have too often failed to recognize the principle that quantity governs price. If merchandising business is ever to come under the control of a public commission, as have railroads and other public utilities in some States, these commissions would make short work of any distinctions between trade classes, and sales would have to be made, as they are now, by commission-controlled public utility companies, namely, on the basis of relative cost of different classes of service as nearly as those costs can be estimated. Of course, it is not strictly true that in a merchandising business cost is absolutely proportional to quantity sold, but any difference in price must be based on actual differences in cost of selling and handling goods, rather than upon some artificial distinction which soon breaks down under the pressure of competition. The failure of trade agreements in the past to hold on any other basis is ample proof of this.

Beauty and Dividends.

Two men were standing in front of a fine, new electric power station in an Eastern city. Both are engaged in electrical pursuits, and they were inspecting the exterior of the building with the eyes of men familiar with the business represented. The structure conveyed the idea of solidity and permanence, but, in addition, its designers had paid considerable attention to architectural effect. "That's certainly a handsome power house," said one. "Yes," returned the other, "but all that 'gingerbread work' doesn't pay dividends." The sentiment thus expressed is one widely held among practical electrical men; but it appears that the time is at hand when more attention must be paid to the mere appearance of electrical structures, aside from their stability, strength and safety. It is not quite true to say that the money spent in making an electric power house to some extent beautiful is wholly lost in that it pays no dividends. The effect of the building and its grounds on the public must be considered. A handsome building—not frivolous, of course, but one in which the bald, severe, commonplace lines of the old type of power house are replaced by more handsome materials and more stately design—induces a feeling of pride and pleasure among the citizens of the community, and undoubtedly tends in the direction of a sentiment of friendliness toward the builder. In these days of public-service commissions this sentiment, although intangible, is undoubtedly of great value and should be cultivated. The authors of the monumental "Plan of Chicago," recently mentioned in this journal, no doubt spoke the truth when they said that "A well-arranged grass plot, a few shrubs and a little regular attention will give to the plainest building a setting that, like a soft answer, will often turn away wrath from a public-service corporation." If in addition the building itself is dignified and attractive the effect is enhanced. In the earlier days of the art utility was of paramount importance, and, of course, that is the case in many localities at the present time. But as the country progresses in all directions from cruder things to those more in consonance with higher development, material and spiritual, the electrical industry cannot ignore the finer sense of the public. More attention to appearance is demanded, and, within certain sensible limits, ornamentation of electrical structures will be found to pay in eliciting public approval. This applies not only to power houses, substations and the like, but to posts, poles and other structures which support wires, lamps or transformers. The municipal art societies in the various cities give evidence of the effort to beautify these structures, among others common to city streets. The subject must be viewed in a broad light, with minds open to the signs of the times, for there is a sense, and a very real one, in which attractiveness on the part of public-service corporations does pay dividends.

Engineering Education.

In the matter of education required by the engineer, the opinion of Dr. Steinmetz should carry great weight, and we are glad to see that in a recent A. I. E. E. convention address he throws his influence squarely in favor of a broader type of education than has of late been usual for the engineering student. With his opinion that the study of the classics is important and valuable for engineering students, since their avocation in this era of specialists tends to narrowness, we heartily agree. The classics in themselves are not necessarily the only road to broad culture, but there is none which experience has proved to be more practicable. The highly organized ancient languages, with their wealth of literature and philosophy, have shown themselves particularly efficient in training the intelligence and quickening the perceptions. Undoubtedly, as Dr. Steinmetz states, the modern languages are for educational purposes less important since they but open another door to our own world; yet we would hardly follow him in the wish for their elimination from the engineering curriculum. The most important of them from the technical standpoint is Dr. Steinmetz's mother tongue, as it is quite certain that the engineering student needs it in his business. A vast amount of important matter is published in German and never translated at all, or so briefly abstracted as to be of small value for reference. When one considers that so important a treatise as Helmholtz's "Physiological Optics" does not exist in an English translation, the moral is obvious without argument. The engineer who desires to follow up the work of his contemporaries must know at least German, and he will find ample use for French and Italian if he undertakes certain lines of study. Even the modest acquaintance with modern languages gained in college is of material practical value, even if it does not open the door of a broader culture. Modern languages cannot properly be eliminated from the college unless by requiring one or more of them for admission. Engineering as a trade needs them more than it needs the classics. Engineering as a broad profession needs both.

We quite agree with Dr. Steinmetz that the influence of specialized engineering studies at the present time is narrowing, like every form of specialization, not because it is engineering, but because it may become microscopic in its point of view. And this may be the fate even of classical studies. The student who writes an exhaustive thesis on the use of enclitics in Isocrates is in no better case spiritually than he who devotes

his exclusive labors to the seat of the e.m.f. in thermo-electric couples. Both are traveling the path that leads to an intellectual crevasse. What is worse, both are likely to become bores. There is but one corrective to the modern tendency for over-specialization, and that is adequate time taken for education. The day has gone by in which a youth can, like The Admirable Crichton, hang up a defiance offering to debate with all comers concerning any branch of knowledge. The world of learning has widened, and he who hopes to be more than a mere mousing specialist in its byways must take time for intellectual growth. To one who is able, or rather determined, to take this time the study of the classics is the doorway to a new world He needs them not because their intimate study whets his wits to a finer point than any other kinds to keen investigation, but because they are the story of the education of the race. It is a priceless thing for a young man to realize that 25 centuries ago there lived by the Ægean sea a people that knew nothing about electric lights or trolley cars or storage batteries, that would have exiled Graham Bell as a wizard and passed up a cup of hemlock to Marconi, and yet had a deeper and a finer civilization, and a keener intellectual interest and spiritual insight, than any that the world has since disclosed. It is no less a lesson to realize that five centuries later the genius of organization reached in imperial Rome a height beyond the powers of all who have come after, and that the strength and the weakness of the later nations, their laws, their ambitions and their frailties, were there epitomized. It broadens the view to learn that the conceptions and ideals of one's own time are not innate and perpetual, but are a transitory evolution from past sociologic development. It is this broader view, this truer sense of permanent values, that gives to the classics their unique importance in the world's education. It is a pity that in the hurry of the twentieth century more recognition is not given them. But the clash of interests is so fierce that everything has been pushed aside. We shall be calmer and wiser a few generations hence, perhaps, but in the time between let not the lessons of the ages be forgotten.

As to engineering education in general, no discussion of its scope or character can have any finality until the class of engineers to which the discussion actually applies is clearly distinguished. In recent years the term "engineer" has assumed an ambiguity which can be likened to that which 20 or more years ago led to the abandonment of the term "electrician"—previously in dignified repute—to those in the humbler branches of the electrical industry who chose voluntarily to assume it. Until of quite recent date, an engineer, properly speaking, was one whose work was associated with the creative side of human endeavor, whose specific function was to tame and subordinate to the uses of man the forces of nature. He was supposed to be of the class that enrich mankind by making two blades of grass grow where formerly only one had flourished. Under recent extensions of the term to embrace also those engaged in the financial exploitation of engineering, for "blades of grass" we should perhaps read "dollars," and for "mankind" read "employer" as the ultimate as well as immediate beneficiary. Owing to modern specialization of effort, the all-around engineer is becoming a *rara avis*, and of the newer genus one can already enumerate more than a score of species who correspond in a greater or less extent to the old conception of man in communion with the forces of nature in order to betray them to utilitarian use, and whose work, though immediately perhaps only of profit to himself or to his employer, ultimately enriches mankind as a whole. Next comes the class represented in part by the operating engineer, to which class the captured and tamed forces are confided for routine toil in utilitarian service, and whose members, in addition to service to an employer, serve also that part of mankind locally dependent on technical skill for the regular supply of a necessity or convenience. Finally, we have a recent addition, above referred to, whose field is that of commercial exploitation, whose functions have little relation either to engineering creation or engineering operation, and whose service inures entirely to the benefit of the employer. In passing it may be pointed out that salaried return for individual effort in the several classifications appears to be in inverse proportion to the number of those who receive ultimate benefit from such effort. To return to our text, is it possible to discuss profitably engineering education without reference to the specific and often antagonistic educational requirements of the various branches of engineering in which students are to find their careers? Is it possible to frame any general system of engineering education applying equally to the non-specialized engineer and to those who will pass into one of the score or more specialized branches of applied science; a system which will also embrace the operating, the industrial, the workshop engineer, etc., as well as the commercial, the sales, the publicity engineer, etc., and similar additions constantly being made, in name at least, to the engineering profession?

Unsymmetrical Polyphase Voltages and Currents.

The problem of determining the value of the current in a single circuit and its time-phase relation with respect to the voltage is a relatively simple one when the value of the impressed electromotive force and the character of the circuit are known. When, however, one must deal with several interconnected circuits upon which are impressed several separate but mutually dependent electromotive forces, whose values are determined by the character of the circuits, the problem becomes quite complex. In an article printed elsewhere, Mr. Charles H. Porter deals in a manner involving little complexity with the most general form of the problem encountered in three-phase circuits. Using the symbolic method, the author assigns to the e.m.f. impressed on each branch of a circuit a certain definite value and time-phase position, and thereby ascertains the current produced in the circuit of which the constants are known. The only feature of the demonstration liable to cause difficulty to the reader not already familiar with the facts, resides in the use of the symbolic method involving the apparent "factor" j. Although there may be few cases in which it is not preferable to express the relation in the form of algebraic equations involving the square root of the sum of the squares, rather than to employ symbolic equations using the equivalent quadrature-adding symbol j, in the present instance the method employed possesses the advantage of simplicity in distinguishing between condensive and inductive reactance, which are liable to be confused when plain algebraic equations are used. As illustrating the usefulness of the demonstration is the fact, brought forward by the author, that it is necessary to know the cyclic order in which three different impedances are arranged in three-phase star connection in order to determine the currents in the circuits. This relation can be shown by means of plain algebraic equations on graphical diagrams, but the work involved is somewhat greater than that required when the symbolic method is used.

Massachusetts Public Commissions News.

The Worcester Electric Light Company, through its president, Gen. Augustus B. R. Sprague, has appealed to the Massachusetts Gas and Electric Light Commission against a franchise granted by the Worcester Board of Aldermen, on July 14, authorizing the Connecticut River Transmission Company to erect and maintain poles and wires in the city of Worcester for the purpose of transmitting electricity for the use of power consumers. The franchise granted by the Board of Aldermen has a 28-year tenure and provides mainly that the Transmission Company may supply electricity to the Worcester Electric Light Company, electric railways, and to other customers whose motors and apparatus connected for use severally shall be of an aggregate rated capacity of not less than 15 electrical horsepower, and whose annual consumption shall not be less than 22,500 hp-hours. A provision is inserted to the effect that beginning with 1913 the Board of Aldermen may annually order ½ mile of line placed underground. General supervision of the work of the Transmission Company is assigned to the Worcester Commission on Wires and Electrical Appliances.

The above appeal follows close upon the recent important decision of the Board of Gas and Electric Light Commissioners authorizing the Connecticut River Transmission Company to sell electric power in the city of Fitchburg to installations of not less than 300 hp. The Worcester company's appeal follows along lines similar to that of the Fitchburg Gas & Electric Light Company, and appears to be based on substantially the same considerations. In view of the positive stand taken by the commission in the Fitchburg case in favor of limiting the local sale of power by the Transmission Company to 300-hp installations or over, or 20 times the capacity named in the Worcester franchise, it appears extremely probable that the same or similar restrictions will be placed upon the Worcester power market, and there would seem to be little doubt that the appeal of the Worcester company will be sustained, provided nothing of new and important bearing is introduced in the public hearings to be given later. It is understood that the Worcester company is not exercised over the possible sale of Connecticut River power to very large users, but that the appeal is taken to protect the company in that portion of the power field which it can serve most advantageously to the public and itself. No date for a hearing has as yet been set by the commission.

The Plymouth County Gas, Light & Power Company has petitioned the Gas and Electric Light Commission for permission to issue $600,000 of capital stock of the par value of $100 per share, and $400,000 of 5 per cent bonds at a par value of $1,000 each for the purpose of providing funds with which to construct its plant and acquire the necessary property. The company has been created under the laws of Massachusetts for the purpose of making, selling and distributing gas for light and for heating, cooking, chemical and mechanical uses.

For several weeks no street railway fare cases of importance have been brought before the Massachusetts Railroad Commission, but early in August a hearing will be given by the board to the Middlesex & Boston Street Railway Company, which operates lines in the Newtons and elsewhere, on the petition of the company to be allowed to extend the time during which an extra cent may be charged for transfer accommodations. About a year ago the commission approved the imposition of the additional charge for an experimental period of one year, and the company now comes before the commission with the statement that the earnings do not warrant the restoration of the free transfer on the lines formerly operated by the Newton Street Railway Company. General Manager Brush, who is well known as an able executive and close observer of electric traction operating costs and revenue, states that in order to secure, with the least burden upon the public, a proper and just return upon capital actually invested, it is necessary to continue to make the charge of 6 cents where the transfer is involved. It is probable that the hearing will bring out valuable additional information in relation to the expediency and necessity of charging for the transfer under definite conditions. Another fare case to be heard shortly is that of the Peabody-Salem Willows line of the Boston & Northern Street Railway Company. Here the issue is whether the company shall continue to charge 10 cents for a ride of about five miles on a line alleged by the petitioners to be well patronized, although it is questionable how profitable the traffic is during the winter season.

Connecticut Public Utility Bills.

Last week an account was given of the bill recommended by the majority, or nine members, of the committee of the Connecticut State Legislature providing for the establishment of a Public Utilities Commission; the text of a minority bill drawn up by two members of the committee was later published, some of the features of which are noted below.

The minority bill provides for a commission of five members with salaries of $4000 per annum each; the majority bill provided for three commissioners at a salary of $3000 per year each. The minority bill abolishes the Railroad Commission, vesting its power in the new commission, and provides that of the five members of the committee at least one shall be a lawyer, and at least another a civil engineer. Among the provisions of the minority bill are that the commission shall keep itself informed as to the condition of all construction and fixtures in public highways or elsewhere, and of all equipment of every company subject to its supervision, in so far as the safety of the public or the employees of such company may be involved; and it may order such repairs and alterations as are reasonably necessary for public safety or for the safety of employees. The commission is given power to investigate and make orders regarding the voltage at which electricity shall be distributed, and may upon petition cause any electric meter to be inspected. Upon petition that the rates or charges of a company are unreasonable, or the service furnished is inadequate, a hearing shall be held and the commission shall have power to make an examination of the books and financial condition of the company complained of, and of the condition of its plant and equipment. Should the commission after the hearing find that the rates and charges are unreasonable, it shall determine and prescribe what would be an adequate service and just and reasonable maximum rates, and the company thereafter shall not demand or collect any rate or charge for service in excess of that prescribed.

Nine sections of the act cover the issue of stocks and bonds, and five sections relate to appeals from decisions of the commission. A company is given a right to appeal to the Superior Court upon a question of the legality of any order, authorization or decision within 30 days after the filing of the same. The Court may hear the appeal and re-examine the question of legality, and proceed thereon in the same manner as upon complaints for equitable relief, its decision, however, to be subject to review on appeal to the Supreme Court of Errors on questions of law. Every appeal shall halt execution of the order or decision appealed from, unless at intervention of a court, which may at any time order that an appeal shall not so operate if in the opinion of the court it is brought for the purpose of delay, or if justice or equity of public service would be affected.

It is predicted that a situation will arise over the extension of the bill to include railroads which will prevent the passage of any public utility bill at the present session of the Legislature. The Senate is held by the supporters of public utility regulation to be under corporate control, while it is charged that the House is the most radical ever elected in the State, and there is little probability that the two bodies can come to any mutually satisfactory agreement. The question may be taken up in the campaign for the election of a United States Senator, in which case it is believed that Senator Bulkeley, one candidate, would support the minority bill, and that ex-Governor George P. McLean, another candidate, would advocate the majority bill.

Denver Wiring Ordinance.

A new ordinance to go into effect Aug. 1 requires all wiring construction for electric currents in Denver, Col., except electric bell and annunciator wires, to be installed in approved iron conduit. All additions or repairs to existing wiring and all wiring changed to comply with the city electrician's requirements for safety must be installed in iron conduit or, by written permission, in armored cable. In open wiring approved metal molding may be used.

Signs must be of all-metal construction, with all feed wires in conduit. Outlining may be installed in a complete metal casing with detachable front. Exposed telephone wires may be run open if bushed properly at floors and crossings, although all new interior wiring installation in mercantile buildings has been made in conduit for some years.

The advance in construction indicated by this ordinance is very great, as it eliminates entirely cleat wiring and concealed knob and tube. There has been the friendliest attitude on the part of the Denver Gas & Electric Company, the local contractors, the architects and the underwriters toward this improvement. Besides being the "City of Lights," Denver is rapidly gaining a unique position as a city of minimum electrical fire hazard.

Hydro-Electric Developments in California.

Several large hydro-electric developments have been brought to light recently in California, most of them in the central part of the State, and significance is attached to the fact that a great deal of the new work projected will be in the region of the Southern Pacific Company's new track improvements and the large tunnels that will be built through the Sierras to reduce the grade between Sacramento and Reno. It has been denied that there is any intention of electrifying the Southern Pacific Railroad on a large scale, although the company is said to be interested in the hydro-electric developments on the Rubicon and Yuba rivers. It has been known for some time that an electrical commission has been examining the water-power possibilities of the region tributary to the Southern Pacific mountain line, and also has been studying the economical aspects of operating the section by electricity.

The Rubicon project will be near Lake Tahoe, where the locations have been made on the Rubicon River, a tributary of the American River, by the Rubicon Water & Power Company. The preliminary engineering work of the proposition has been completed, and it is stated that the first power station will be built near Hale's Camp, in northern El Dorado County, and the second lower down on the Rubicon. The first will have a head of 1800 ft. and will develop about 30,000 hp.

On the Yuba River locations have recently been filed, which indicate that the water will be carried in flumes and canals from the North Yuba River in Sierra County, at a point below Sierra City, where the intake will be located, to the site of the power house, just below Downieville.

Another important development deal consists of the formation of a large water and power consolidation in the Sierras, which is to be incorporated under the name of the Lake Tahoe Power & Water Company, and in the development of which it is proposed to expend not less than $1,000,000 annually for the next four years. W. P. Hammon, the wealthy mining operator, and a syndicate of English capitalists and New York and Boston bankers are back of the project. It is stated they recently paid $3,000,000 to close the deal. The principal purpose of the syndicate is the development of power from the water of Lake Tahoe, of which it controls the only outlet. Transmission lines will be run on both sides of the mountains, supplying energy to the entire State of Nevada as far east as Ely, and on the California side to Sacramento, and through the valley of the Sacramento River.

At the same time it is announced that Mr. Hammon has reached an agreement with the U. S. Government whereby all of the suits in which the Interior Department had made him a defendant in the Federal courts in seeking to protect the Truckee-Carson irrigation project from the encroachment of Hammon on the waters of Lake Tahoe have been dismissed. The entire output of the plants, now combined, together with that which will be constructed near Lake Tahoe, will be developed to 200,000 hp. The concerns which have been consolidated by the Hammon syndicate are the Truckee River General Electric Company, the control of which Hammon recently purchased from the Fleischbackers; the California-Nevada Electric Power Company, which had been controlled by F. G. Baum and Francis V. Keesling, agents of Hammon, and the Loon Lake Water & Power Company, which has been in the hands of Chickering & Gregory.

It is stated that the Government has agreed, through the Secretary of the Interior, to a joint control of the outlet of Lake Tahoe, so that the Truckee-Carson irrigation project and the power development by the new corporation will be carried out under an agreement by which Hammon will secure the right to use the water under certain regulations by the Government which it is considered will protect the interests of the Federal irrigation project in Nevada.

One of the first parts of the construction work to be undertaken will be the long transmission line to Ely, Nev., where the Hammon corporation is to furnish energy to the smelters. This will not only be one of the longest transmission lines, but it will also carry a load of 10,000 hp.

In addition to furnishing energy to Reno and Sparks, the new corporation, through the California-Nevada Company, is supplying electricity to the mines at Tonopah and Goldfield, and has the control of the market in the entire State. This, together with the transmission line into the Sacramento Valley, will give the company a field from the eastern border of Nevada to Sacramento.

The greatest part of the energy sold in Nevada will be developed from the Carson and Walker rivers, while the engineers have plans for new power stations in the Truckee, where three stations are already in operation.

It is rumored that the Lake Tahoe project consists in driving a tunnel about nine miles in length in a westerly direction, opening on the Rubicon River at Hell Hole, where a drop of 2000 ft. can be obtained. This is near the point of the Rubicon Water & Power Company's developments, and a conflict of rights between the two interests may arise.

The engineering work of all the Hammon plants is in the hands of Frank G. Baum, formerly engineer for the California Gas & Electric Corporation. Mr. Baum has already increased the output of the Truckee River plants by 1000 hp, through changes in the engineering features of the system.

The Bay Cities Water Company is also said to have favored a large water-power proposition on the American River, where $12,000,000 will be expended in developing about 75,000 hp. The engineering work is in the hands of Duryea, Haehl & Gilman.

The management of the Great Western Power Company is in the efficient hands of Mr. H. H. Sinclair, formerly vice-president and manager of the Edison Electric Company, of Los Angeles. The former company has closed a contract with the Southern Pacific Railroad by which it will supply energy to supplement the railway company's new steam plant now building in East Oakland, for the operation of the new electric suburban train service in Alameda, Oakland and Berkeley. Mr. Sinclair says that $2,000,000 will be expended by the Great Western Power Company in the next two years, in addition to the $8,000,000 already invested and that the ultimate improvements planned will represent an outlay of an additional $20,000,000. He stated that the company is building for the future, and within 10 years it will be equipped to supply 500,000 hp, where it is now supplying 60,000 hp.

Considering the above-mentioned power proposition and the many other smaller new schemes and the large improvements to existing properties, it is seen that the power developments now being worked out in the Sierras are of a magnitude that will call for the expenditure of very close to $50,000,000.

Niagara Turbine Disabled.

One of the new 10,000-hp turbines in power house No. 3 of the Niagara Falls Hydraulic Power & Manufacturing Company broke down on Sunday afternoon and two employees were injured. The casing burst, and a piece of metal was hurled across the station, which was partly flooded with the outrush of water. At the time the wheel was moving under about 75-lb. pressure, but has successfully withstood much higher pressure. A defect in the casting is suspected as being responsible for the break.

New York Public Service Commission News.

The question of a 5-cent fare on the Coney Island & Brooklyn Railroad Company is still before the Public Service Commission of the First District. The commission has rendered no decision on the complaint of J. Monheimer, a resident of South Brooklyn, demanding that a 5-cent fare be established for every day in the week, instead of permitting it to be raised to 10 cents on holidays and Sundays. Last week August Kleb, a resident of Brooklyn, applied to the Supreme Court for a peremptory writ of mandamus compelling the commission to issue an order putting into effect a 5-cent rate. The court took the matter under advisement, but said that unless the commission had already decided in favor of such a rate it would be powerless to issue the writ.

The hearings concerning the franchise rights of the electric light and power companies in the metropolitan district of New York have been discontinued temporarily, owing to the absence of Commissioner Milo R. Maltbie. They will be resumed in August.

The New York Public Service Commission of the Second District has made an order requiring the Red Hook Light & Power Company, of Red Hook, Dutchess County, to show cause at Albany on July 28 why it should not provide suitable apparatus for testing electric meters, as required by the commission, and a similar order requiring the Riverhead Electric Light Company to show cause before the commission at Albany on July 28 why it should not immediately put in proper shape to serve the public its plant and distributing system, an inspection of the plant disclosing the fact that it is in such disrepair as to be a constant source of danger and menace to the public. The commission has also served an order upon the Hallet Electric Light & Power Company, of Riverhead, Suffolk County, to show cause before the commission at Albany on July 28 why it should not put its plant and distributing system in proper shape to give satisfactory services to the public. An inspection of the property by a representative of the commission disclosed that it was in a state of disrepair and was a menace to the public.

The Mexico Electric Light Company, of Mexico, Oswego County, has been directed to submit to the commission on or before July 31 a statement showing repairs and improvements made to its distributing system in accordance with the recommendation of the commission, with particular reference to number, size and location of new poles set in the village and elsewhere, and the number, size and location of new cross-arms which have been installed.

The Suffolk Gas & Electric Light Company has been authorized to execute to the Kings County Trust Company, of the Borough of Brooklyn, a mortgage upon all of its property, etc., to secure an issue of 5 per cent gold bonds to the amount of $500,000. The company is authorized to issue at once $200,000 to be used for the refunding of a like amount of bonds maturing May 1, 1918, the bonds to be exchanged par value for par value. The company is further authorized to issue bonds to the amount of $150,000, to be sold at not less than 90, to be used for the installation of new gas apparatus, new buildings, engine, two generators, boilers and a gas holder with a capacity of 350,000 cu. ft., 1½ miles of additional 8-in. main, 4 miles of 6-in. main and 5 miles of 4-in. main.

Mexican Electrical Developments

It is projected to use the rapids of the Balsas River in the State of Guerrero to generate electric power for transmission to Mexico City and a number of towns and industrial centers, particularly mining camps, within a radius of 100 miles of the proposed plant. It is stated that more than $5,000,000 gold will be expended in the installation of the generating and transmission systems. The surveys and estimates which have been made are said to show that more than 60,000-hp can be developed. The Alfredo B. Adams Company, of Mexico City, is financing the project. It is proposed to start the construction work as soon as the rainy season closes. It is expected that this cheap power will cause the opening of many new mines in the territory reached by the transmission lines, as the high cost of fuel in that region makes it unprofitable to work low-grade mines.

The demand for electric power in the city of Pachuca and the many mines and mills of that section is so great that the Compania Electrica y Irrigadora, which already has a hydro-electric plant of 8000 hp in operation at Peublo, is preparing to install an additional plant of 6000 hp at an estimated cost of $2,000,000 Mexican currency. It is stated that orders have already been placed for all this additional power. The new plant will be located at Tetepango, State of Hidalgo. It is planned to have it finished and ready for operation within 12 months.

Mr. W. C. Simmons, of Guadalajara, has finished the surveys for a hydro-electric plant which the Sombrete Mining Company proposes to erect on the Durango River in the State of Zacatecas. It is planned to develop 10,000 hp at this plant and to transmit the electrical energy to the towns and mining camps of Zacatecas, Sombrete, Chilchihuites and Nieves. It is one of the most important electric power projects in Central Mexico and if achieved will mean much for the mining industry of the districts which are to be supplied with the cheap power. Mr. Robert S. Towne, the well-known smelter magnate of Kansas City, Mo., and San Luis Potosi, Mexico, is president of the Sombrete Mining Company. The primary object of the proposed hydro-electric plant is to furnish the mines and reduction mills of the Sombrete Mining Company at Sombrete with electric power, but there will be sufficient surplus to distribute over a wide territory.

The Southern Pacific Railway Company of Mexico has installed a large electric power plant at the town of Empalme, State of Sonora, where its new shops and general offices are situated. The town of Empalme is being built by the railroad, and it is planned to make it a model city in every respect. The electric power plant also furnishes lights for the town.

The Mexican Northern Electric Company has started the construction of the great dam across the Conchos River, near Santa Rosalia, State of Chihuahua, which is to form the basis for operating its proposed hydro-electric plant at that place. A minimum of 24,000 hp will be developed by this plant. The dam will also form a water storage reservoir for the irrigation of about 250,000 acres of valley lands by the company. The survey has been made for an electric railway which will be built from Santa Rosalia to the site of the hydro-electric plant, a distance of 17 miles. The transmission lines will run to the mining districts of Parral, Santa Eulalia, Naica and to the cities of Chihuahua, Jiminez, Santa Rosalia and other places. It is claimed that by the introduction of electric power in mining operations a saving of at least $3 per ton on mining and milling the ore will be obtained.

The Chapala Power & Irrigation Company has had a survey made for the canal that is to be built from the waterfalls of Juanacatlan on the Santiago River to Las Juntas, a distance of about 15 miles, where the water will be made to drop 1800 ft., thereby enabling about 90,000 hp to be developed. The electric power will be transmitted to the city of Guadalajara and to Lake Chapala, where it will be used to operate large irrigation pumps. It is also planned to transmit the electric power from this proposed hydro-electric plant to the cities of Aguascalientes and Zacatecas, more than 200 miles distant.

Street Lighting Experiments by Chicago Park Commissioners.

The South Park Commissioners of Chicago, who have under their jurisdiction Washington Park, Jackson Park, Grant Park and various new parks, with connecting boulevards, are conducting an interesting series of experiments in street lighting on Michigan Boulevard between Randolph Street and Twelfth Street, in the downtown portion of that city. Erected on temporary posts and with temporary wires, in the case of electric lamps, several different types of lamps have been installed to observe the effect of the illumination and to determine how high the lamps should be located, how far apart they should be spaced and other considerations of like nature. The lamps under test or about to be tested are gas lamps with incandescent mantles, enclosed arcs, magnetite arcs, flaming arcs and 100-watt tungsten incandescent lamps. In addition 12 (six on each side of the street) flaming arcs will be installed on Jackson Boulevard, between State and Dearborn Streets. These will be suspended from brackets attached to the buildings and will be about 35 ft. above the street. The Commissioners hope to obtain valuable information by observing the performance of these various lamps, and the results of the tests will be of value in planning the future illumination of the South Side parks and boulevards, with the view of giving Chicago the best obtainable lighting of this character. In the new Grant Park alone it is estimated that 1,000,000 kw-hours per annum will be required for lighting. Mr. John A. Radford is the consulting engineer for the South Park Commissioners.

National Electrical Contractors' Convention.

The National Electric Contractors' Association of the United States held its ninth annual convention at Toledo, Ohio, July 21 to 23. The Boody House was headquarters and the sessions were held in the auditorium of the Chamber of Commerce. The first two days were given over to meetings and the third to an outing trip to Sugar Island. The morning sessions were open to members and guests; the afternoon sessions were executive and for members only. The first morning session was called to order by Mr. M. W. Hensen, president of the Ohio Electrical Contractors' Association, who welcomed the convention on behalf of the State association. He was followed by Mayor Whitlock in an address of welcome from the city. President G. M. Sanborn then took the chair and presided over all of the sessions. There were two addresses at this Wednesday morning session. One was by Mr. W. H. Blood, Jr., of Boston, who spoke on "The National Electric Code and the Relation of the Contractor to the Central Station." Mr. Blood represented the National Electric Light Association, of which he is the insurance expert. Following this address was one by Mr. George C. Nimmons, architect, Chicago, on the relation between the contractor and the architect.

Mr. Nimmons called attention at length to the inherent defects in our present system of letting and carrying out contracts in which the chief aim of each contractor is to put as little money as possible into a job. This evidently struck a responsive chord among the contractors, as it received more discussion than any other address given before the convention. After this discussion a motion of thanks to Messrs. Blood and Nimmons was passed and the session adjourned.

At the Thurday morning session Mr. P. Bissell spoke on "Co-operation Between the Electrical Jobbers and Electrical Contractors" on behalf of the Electrical Supply Jobbers' Association.

Mr. E. Leavenworth Elliott, of New York, spoke on "The Contractor and Illuminating Engineering," calling attention to some practical benefits the contractor could derive by a knowledge of illuminating engineering.

Mr. James R. Strong, of New York, ex-president of the association, read a paper on "The National Electrical Contractors' Association," in which he called attention briefly to some of the things the association had accomplished, but he devoted his paper more particularly to some of the things which the association had not accomplished, and to which it should bend its energies. This finished the business of the second and last open session.

In the executive sessions the association decided to publish a data and sales book which is intended as a guide to retail prices of all electrical supplies. This is to be really what might be called a standard price book, giving the retail and wholesale or quantity prices on all the common devices used and sold by the electrical contractor and dealer. The prices given are to be the common prevailing prices, and are not, of course, to be obligatory on any of the members, as a member may sell at a higher or lower price, as he may desire. The book is intended rather to be a guide as to prevailing reasonable prices, and as such should be of considerable value. This book will be issued by the secretary, Mr. W. H. Morton, of Utica, N. Y. It will be issued only to contractors who are members of the association. The book, the expense of which to revise and publish will be considerable, will be on the loose-leaf plan, so that it can be revised and kept up to date.

A resolution was also adopted recommending to manufacturers and jobbers that catalogs, leaflets and price lists be made a standard 6-in. x 9-in. size, which is the size already adopted by many manufacturers.

The officers elected for the ensuing year are the same as those for the past year, and are as follows:

President, Mr. G. M. Sanborn, Indianapolis, Ind.; first vice-president, Mr. M. L. Barnes, Troy, N. Y.; second vice-president, Mr. Chas. R. Kreider, Chicago, Ill.; third vice-president, Mr H. S. Potter, Boston, Mass.; treasurer, Mr. John R. Galloway, Washington, D. C.; secretary, Mr. W. H. Morton, 41 Martin Building, Utica, N. Y.; sergeant-at-arms, Mr. J. C. Stearns, Buffalo, N. Y.

The directors from the various States for the following year are as follows:

Messrs. J. T. Marron, Rock Island, Ill.; Ernest Freeman, Chicago; F. H. Cheyne, Indianapolis, Ind.; Seth B. Wetherbee, Boston, Mass.; J. J. Thorne, Bay City, Mich.; Wm. Burgess, Duluth, Minn.; Chas. J. Sutter, St. Louis, Mo.; P. N. Thorpe, Passaic, N. J.; James R. Strong, New York City; M. L. Barnes, Troy, N. Y.; James Hilton, Syracuse, N. Y. The next convention of the association is to be held at Atlantic City, July 20 to 21, 1909.

Wednesday evening banquets for both ladies and gentlemen were given at the Boody House. Tuesday evening the Sons of Jove held a rejuvenation. On Friday the entire party went by steamer to Sugar Island, at the mouth of the Detroit River. The weather was not very favorable on account of wind and rain in the morning, but it cleared sufficiently to permit the annual baseball game between the contractors of the East and West in the afternoon. The official score-keeper of this game declared that there were only two errors, although to the spectators it appeared differently. The score stood 3 to 5 in favor of the Western contractors when the players got tired and quit.

Mr. William Burgess, of Duluth, policed the grounds with a big stick and prevented the rooters from annihilating Umpire John R. Galloway, of Washington, D. C. After the official game some of the younger bloods of the convention had a real baseball game for a diversion. From Sugar Island most of the party went back by steamer to Toledo, some going to Detroit.

Registration of members and guests was about 225. The number of members (contractors) registered was 78, which is considerably more than last year, although the total registration was higher last year at Chicago, because it was held in a large city.

THE NATIONAL ELECTRICAL CODE AND THE RELATION OF THE CONTRACTOR TO THE CENTRAL STATION.

Mr. W. H. Blood, Jr., in his address on this subject said that the code, the contractor and the central-station company taken together represent fairly well the entire electric lighting industry. They constitute the triumvirate of the industry. No one of these has unlimited power, but each is a check on the others, and all are automatically controlled by financial limitations. If the company's lighting rates are too high, the consumer turns to gas or oil. If the contractor tries to make undue profit the consumer refuses to use electricity. If the code requirements are unnecessarily severe, it has the same effect.

Previous to 1895, because of the diversity of rules of installation no such thing as uniformity in practice existed. As a result of a general agitation of the subject, a national conference on standard electrical rules met in New York, March 18, 1896, at which a large number of electrical and allied bodies were represented. The N. E. L. A. presented at this conference a large pamphlet prepared by Mr. W. J. Hammer, showing in parallel columns the rules of the N. E. L. A., the National Board of Fire Underwriters, the Associated Factory Mutual Insurance Companies, the Phoenix Fire Company and the English Board of Trade. Following this conference, in 1897 the first edition of the National Electrical Code was sent out This code is published by the National Board of Fire Underwriters and has been regarded as their property. While these are the Underwriters' rules, the code is national in scope as well as in name, and the Underwriters welcome frequent conferences with practical men all over the country who are installing wiring and furnishing electric current. The annual conferences which the underwriters hold in New York, and to which all interested are invited, have been productive of great good to the entire electric lighting industry. The committee has been glad to take advice from the able men of the contractors' association. When such experts as its president, Mr. G. M. Sanborn; its secretary, Mr. W. H. Morton, and Past-Presidents Messrs. E. McCleary and Jas. R. Strong speak, their suggestions are worth listening to. Attendance at these code committee meetings tends to broaden any man, and the individual who comes with the intention of grinding a personal axe or trying to secure the endorsement of some freak idea of his own soon finds that he is out of place, and quickly learns that the conference is too busy determining what is best for the industry as a whole to listen to personal trivialities. The rules of the code have been modified from year to year, and are now like any code of rules which have been frequently revised without being re-codified. The new re-codified edition, which is soon to be published, will relieve this condition of affairs.

Lack of uniform interpretation of the rules has been a serious annoyance to contractors and to electric-lighting companies. The Underwriters are making earnest and effectual efforts to correct mistakes caused by inefficient or prejudiced inspectors. The issuance of supplementary rules by local underwriting boards which render inoperative some of the provisions of the code are discountenanced and even forbidden by the National Board of Fire Underwriters.

Electric-lighting companies cannot afford to have cheap or unsafe work done, nor can they permit the expense of getting ready to use the current to be so great that it will scare off prospective customers. A wiring job which costs $2 per outlet produces as much revenue for the electric-lighting company as one costing $4 or $5 per outlet. It would be short-sighted for the contractor to insist upon expensive work when the cheaper form of installation would be fully as satisfactory. To popularize the use of electricity should be the aim, and no stumbling blocks should be placed in the way by the contractor. There has been in the past too much friction between the company and the contractor, and the question of whether or not the electric lighting company shall do inside wiring is still a mooted one. Few electric-lighting companies of their own volition take up this line of business, unless they are forced into it. It is not infrequent that electric-lighting companies exist in cities which are too small to support a competent wiring contractor, and we frequently find a man in such localities without a reputation and without a conscience who will put in any kind of a job so long as he can get his money for it. If a number of contractors should get together and arbitrarily fix the price of wiring installations at a high rate during a time of active building operations in a given city, one can readily see that permanent injury would be done the lighting company, for the new buildings would go up piped for gas with the electric wiring left out. The electric-lighting company must for its own salvation see that all new buildings are wired, and to do this the price must be reasonable and the work honest. On the other hand, the electric-lighting company sometimes fails to realize that the contractor and his employees constitute a very efficient corps of salesmen for it. There should be the closest co-operation between the central station and the contractor.

RELATION BETWEEN CONTRACTOR AND ARCHITECT.

Mr. George C. Nimmons, of Chicago, in his address on the foregoing subject, said that the electrical work is the youngest of the various trades entering into building construction, but it has come to be very important. He then went into the modern methods of carrying out work through the architect and contractor. Although the architect is an artist, he does not, like the sculptor or painter, execute and carry out the work himself. The architect must depend on the builder and contractor—so that much relies on the contractor.

In ancient Greece there was no distinct line between the contractor and the architect. The architect drew up plans and made estimates on the cost of the building, and was held responsible for the cost. If the actual cost exceeded 25 per cent of the estimated cost the architect had to pay the difference out of his own pocket. If the cost was equal to or less than the estimated cost the architect got his fees and much praise. The aim, however, was to produce high-grade work rather than secure low cost. Under the present system of handling work under which low cost is given the first place, all the ambition to excellence on the part of the contractor is killed.

The aim of the contractor under the modern competitive bidding system is necessarily to put up buildings at as low a cost as possible, or, in other words, to keep as much money out of the building as possible and still bring it under the promise of the contract. This influence goes down through the contractor to the foreman and workman, and the best men under this system are those who can turn out the greatest amount of work of a quality which will pass the architect's superintendent The interests of the owner or architect and those of the contractor and builder are necessarily antagonistic.

Mr. Nimmons also called attention to the great waste of labor in the average building contractor's office in Chicago in making bids and estimates on work which is not secured. This cost of making estimates for competitive bids he figured from apparently reliable sources is from 2 to 3 per cent of the entire cost of building operations in Chicago. In other words, each contractor has to add this expense of maintaining an estimating force. Each contractor secures in Chicago about one job to every seven bid upon, so that six-sevenths of this estimating labor goes to waste and has to be added to the cost of each building.

The owner favors the competitive bidding system and the letting of general contracts to lowest bidders, because the owner under this arrangement takes no risk. The owner may be sure, however, that if he is not willing to take risks, neither is the contractor. Therefore, the contractor will fully protect himself in whatever bids he makes, and will make his bids high enough to cover what he thinks is the maximum first cost of the work Workmanship has a constant tendency to deteriorate under such a system.

A number of plans have been proposed to improve these conditions. It is not likely that any one person will solve the problem, but that the improvement will be the result of many suggestions and ideas. Among the plans which have been suggested are the cost plus a percentage contract; the premium contract, and the cost plus a fixed sum contract. All of these

are efforts in the direction of improvement. If the percentage contract is used, the percentage should also be distributed among sub-contractors as well as to the general contractor, because the sub-contractors have the workmanship directly under their charge. Whatever the plan, the architects' and contractors' aims should be the same—namely, to produce excellence of work instead of the reverse, as at present.

In discussion, Mr. J. R. Strong, of New York, inquired of Mr. Nimmons his opinion as to the effect on the quality of buildings of having a general contractor who sub-contracts. Mr. Strong said that the electrical contractor is one of these sub-contractors who was recently referred to in a contractors' meeting as belonging to one of the insignificant trades, all of which trades are necessary to a general contract. Mr. Nimmons in reply pointed out that the general contractor of necessity becomes skilled in hammering down the bids of various sub-contractors, and getting these sub-contractors to work on the least possible margin. The general contractor cannot be blamed; it is the scheme that is wrong.

Mr. Wm. Burgess, of Duluth, told of one general contract let recently in which the bidder was obliged to specify the names and bids of the various sub-contractors in order that there might be no beating-down process to the detriment of the work after the general contract was let.

Mr. C. R. Kreider, of Chicago, said that his firm will not make estimates for general contractors with the exception of a very few concerns. This is on account of the beating-down process which the general contractor expects to go through after he gets his contract. This concern prefers to deal directly with the owner and architect. He also referred to the practice which is common of specifying a certain make and type of device "or its equal." He recently pointed out to an engineer that this opened the way to considerable annoyance later by the substitution of goods claimed by the contractor to be equal, and that it is much better to specify any one of a certain number of satisfactory brands.

THE NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION, TRADE RELATIONS, ETC.

Mr. James R. Strong, of New York, ex-president of the association, spoke briefly of the work which the association had accomplished since its organization in 1901. Among the troubles which had been partially smoothed out with the aid of the association were the variations in the interpretation of the National Electrical Code in different parts of the country, the competition of central-station companies where there should have been co-operation, and assistance to members in connection with labor troubles. However, he said that he wished to speak more particularly as to things which the association had not done, but which could profitably be considered in the future.

One of these things is the more active interest of a larger percentage of the membership in the routine work of the association and the securing of more new members by present members. The association can also be of considerable assistance to its members by the exchange of information on customers of poor credit.

He then took up the relations of the association with manufacturers and jobbers, giving his personal opinions as to the ultimate solution of many of the troublesome questions which have come up in the contractors', jobbers' and manufacturers' associations in the past few years.

He laid down several principles of trade as fundamental, and as certain to prove true in the long run. One of these principles is that unnecessary profits can never be maintained for any length of time. Another is that agreements and resolutions cannot be made to form artificial division lines between different classes of trade. The only division line possible that can be permanently established, as evidenced by the experience of many years in other trades, is the line between wholesale and retail trade; or, in other words, the basing of prices on quantity. Contractors and others have failed to recognize in the attempts they have made in the past, the principle that quantity must necessarily govern the price, and that any other method of regulating prices is artificial and cannot survive in the natural course of the trade, under the pressure of competition. In other words, he said, "give us all the same price for the same quantity." Natural laws of trade must govern. The middleman will exist only where there is a good economic necessity for his existence.

CO-OPERATION BETWEEN ELECTRICAL JOBBERS AND CONTRACTORS.

Mr. Fred P. Bissell, of Toledo, in his paper on this subject, said that co-operation is much to be desired, and is outlined by the contractors' association resolution which says that "The natural course of merchandise is from manufacturer to jobber, then to the contractor or central-station, and finally to the consumer. Both the jobbers' and contractors' associations are committed to this policy. That it is advantageous to the contractor to buy from the jobber is an old statement growing stronger every day. The jobber makes a depot from which the contractor can draw assorted items on demand; makes a few shipments of many items; relieves the contractor of large investments in merchandise and gives financial favors to the contractor. One of the first troubles is found in the jobber who does a construction business or runs a construction department, and then there are contractors who attempt a jobbing business, yet who retain their construction business. Both of these men are detriments to their respective associations, and have been the cause of the most serious obstacles in the working out of this problem. The contractor points with disgust at the curbstone operator with the proverbial screwdriver and coil of annunciator wire, and is unable to see how the little fellow can get stuff at the big contractors' prices. Yet he fights vigorously and sometimes viciously against a quantity price himself, endeavoring to buy one article at the price of 100. There is not a man in either association who was not once small and who was entitled to and had his chance and the right to prosper if he showed ability, and nothing short of that is thought of to-day; nor will the economies of business regardless of legal objections ever permit anything different.

The price for quantity always has made a difference and doubtless always will, but what can be urged further than that, and what distinctions may be made to conform to divisions of business, no one is prepared to say. The contractor who fights the jobber and the contractor who tries to become a jobber and a contractor at the same time, and the jobber who does contracting are alike equally guilty of being obstacles in the road to co-operation.

Too many irons in the fire is bad practice, and few can keep more than one hot at a time. If many irons be possible, what is to prevent the growth of an octopus which will manufacture, job, retail and construct all over the country, with branches in all important points, big and little? Are we drifting that way?

Along this line of investigation it may be well to ask if the jobber is really a business necessity. It may be well to consider that no one who is useless endures. The progress of events takes him out. From earliest history merchants who bought in bulk and sold in broken lots have been common. Some things to-day go from manufacturer to consumer, but not many. When the jobber ceases to be useful he will vanish. It may be helpful to appreciate that vanishing is not a monopoly.

The store-counter trade in the electrical business is a feature to which much attention can be given. This requires a selling organization consisting largely in promptly answering the telephone, keeping the store new and bright, with reasonably good window and counter displays, cleanliness of store, proprietor and clerks, knowledge of the business, and courteous and reasonable advertising.

Perhaps the greatest enemy to the contractor's success if he is a retailer is the unwise attitude adopted by some central-stations of giving away articles which consume current. It would be more logical for the central station to lower the price of current.

The manufacturer cannot be a jobber, nor a contractor, nor a retailer unless he assumes all the responsibilities, risks and expenses which go with those divisions of the business. When he does assume them the exclusive jobber and the exclusive contractor can always beat him.

Westinghouse Annual Report.

The annual report of the Westinghouse Electric & Manufacturing Company has been issued to stockholders in pamphlet form under date of July 28. The report covers the year ending March 31, 1909. In a statement preceding the financial tables Mr. George Westinghouse, president, states that the affairs of the company were taken out of the hands of the receiver Dec. 5, 1908, the present board elected Nov. 30, 1908, the officers of the company appointed Dec. 7, 1908, and the executive committee elected on Jan. 5, 1909. The board was not permanently organized, however, until the election of Mr. Robert Mather, as chairman, on Jan. 19. The time intervening has been required to complete the adjustments resulting from the receivership, and the readjustments of the debt of the company, and to determine the readjustments to be made with reference to the company's business in America.

The loss from operation of the business during the past business year was, after providing for interest charges and making a fair allowance for depreciation, $918,682. The expenses incurred in connection with the adjustment of the debt which existed Oct. 23, 1907, were $460,490. The compensation and expenses of receiver and attorneys amounted to $265,383 Sundry accounts charged off to reduce the book value of the company's assets, such as discounts and expenses incurred in connection with bond issues of previous years; depreciation of patents; depreciation of various stocks and bonds; provision for possible losses on inactive finished parts and machines on hand at the close of the year, and other minor items of a similar nature, amounted to $1,347,605. The total of the above is $2,992,661, which represents the decrease in the surplus account during the year.

The report states that the loss of $918,682 after providing for interest upon the debt and all expenses is chiefly accounted for by a small volume of business, the utilization of high-priced material, by sales at reduced prices, and by a very considerable extra expense incurred in completing the departmentalizing of the manufacturing operations of the company and the rearranging of machinery, which work was carried on without interruption by the receivers. The result of these important changes in manufacturing methods have been to reduce greatly the amount of material, raw, in process and finished, required to be kept in stock for a given amount of output, and also to greatly increase the space available for manufacturing operations. The amount of material in stock, work in progress, goods on consignment and apparatus with customers, on March 31, 1909, was $9,961,182.32, as compared with $17,740,178.32 on Oct. 23, 1907, when the receivers were appointed.

The company received from stockholders, merchandise and other creditors, subscriptions to capital stock at par amounting to $12,778,825; to 5 per cent convertible bonds at par amounting to $3,586,000; and to four, five, six and fifteen-year notes $1,392,150, making a total of new capital raised at par by the sale of stock and securities of $17,756,975. It is estimated that the plants of the company have an annual output capacity of $50,000,000, and that the cash capital thus provided is ample for conducting a business of that magnitude.

Under the provisions of the convertible bond indenture the company is required to provide a sinking fund of $500,000 annually and to invest the same in its convertible bonds. Since the termination of the receivership the company has turned into the sinking fund $1,500,000, covering the requirements up to the end of the present calendar year. This sum was invested in convertible bonds yielding a profit of $105,478.76.

It is stated that while there has been a decided improvement in the business of the company since the beginning of the year, it has not yet nearly reached normal proportions, although the outlook and inquiries indicate that in the near future the full capacity of the various works will be required to meet the demand.

The general balance sheet and statement of income and profit for the year ended March 31, 1909, are printed herewith.

CONSOLIDATED GENERAL BALANCE SHEET.

ASSETS.

Property and Plant: Factory plants, including real estate, machinery, equipment, etc.		$14,578,389.62
Sinking Fund: With trustee for redemption of convertible sinking fund, 5% gold bonds		48,234.38
Investments: Stocks, bonds, debentures and collateral trust notes of other companies, including affiliated European and Canadian Westinghouse companies		29,844,288.62
Current Assets:		
Cash	$1,267,934.53	
Cash on special deposit	1,535,210.00	
Cash on deposit to pay bond coupons	24,040.00	
Notes receivable	37,988.31	
Accounts receivable	6,951,790.09	
Due from subscribers to capital stock	1,166,280.19	
		23,626,163.90
Working and Trading Assets: Raw materials and supplies, finished parts and machines, work in progress, goods on consignment, and apparatus with customers		9,961,182.32
Other Assets: Charters, franchises, patents, insurance and taxes paid in advance, etc.		6,827,212.10
Total assets		$84,885,470.94

LIABILITIES.

Capital Stock:		
Preferred	$3,998,700.00	
Assenting	36,636,600.00	
Non-assenting	600.00	
		$40,635,300.00
Funded Debt:		
Convertible sinking fund, 5% gold bonds, due Jan. 1, 1931		$20,532,251.75
Debenture certificates, 5%, due July 1, 1913	1,969,000.00	
		22,501,251.75
Collateral Notes:		
Six per cent collateral notes, due Aug. 1, 1910	6,000,000.00	
Five per cent collateral notes, due Oct. 1, 1917	2,702,702.70	
		8,702,702.70
Four, Five, Six and Fifteen-Year, 5% Notes: Issued under readjustment plan.		1,392,150.00
Subscription: To capital stock of Société Electriqué Westinghouse De Russie		347,500.00
Current Liabilities:		
Notes payable	$125,000.00	
Accounts payable	1,168,790.66	
Interest, taxes, wages, and rebates accrued, not due	481,681.93	
		1,775,472.59
Reserve: For inactive materials and supplies, adjustments of production orders and accounts receivable		550,634.21
Profit and Loss: Surplus		8,980,334.69
Total liabilities		$84,885,470.94

CONSOLIDATED STATEMENT OF INCOME AND PROFIT AND LOSS.

Gross Earnings: Shipments billed		$20,606,592.04
Cost of Shipments: Factory cost, including all expenditures for patterns, dies, new small tools, and other betterments and extensions. Also inventory adjustments and all selling, administration, general and development expenses		19,955,808.51
Net Manufacturing Profits		$650,783.53
Other Income:		
Interest and discount	$362,383.85	
Dividends and Interest on sundry stocks and bonds owned	782,315.75	
Miscellaneous..Royalties, etc.	170,775.52	1,315,475.12
Total Income		$1,966,258.65
Deductions from Income:		
Interest on bonds and debentures	$1,056,807.95	
Interest on collateral notes	496,515.19	
Miscellaneous interest	647,448.17	
Property and plant depreciations charged against income	513,316.14	
Miscellaneous	170,854.11	2,884,941.56
Net Income Deficit		$918,682.91
Profit and Loss Credits:		
Profit and loss—surplus, Mar. 31, 1908	$11,972,996.49	
Profit on bonds purchased and retired through sinking fund	105,478.76	
Miscellaneous	27,994.33	12,106,469.58
Gross Surplus		$11,187,786.67
Profit and Loss Charges: Compensation and expenses of receivers and attorneys; expenses in connection with adjustment of debt; depreciation of patents; proportion of discount on bond issues of previous years written off; reserve for possible losses on accounts receivable and inactive machines and parts, and other items appertaining to prior years or of an extraordinary nature		2,207,451.98
Surplus, March 31, 1909, per Balance Sheet		$8,980,334.69

Wisconsin Rate Commission News.

The Wisconsin Railway Commission on Wednesday had a hearing on the petition of F. C. Fullmer, of Scofield, for an order requiring the Wausaw Electric Railway Company to furnish better service and reduce its rates.

The Chippewa Valley Railway, Light & Power Company has granted authority to issue $35,000 in first mortgage 5 per cent gold bonds, to cover cost of plant improvements.

Authority has been granted the Superior Water, Light & Power Company to issue $200,000 in gold bonds, and also to the Waukesha Gas & Electric Company to issue $600,000 in 5 per cent gold bonds.

The accounting department has prepared a standard form of annual report for each of the three classes of telephone utilities, and one for the utility as a whole. The Wisconsin Telephone Company, which operates over 60 exchanges in the State, will, therefore, be required to submit annually over 60 separate and complete reports—one for each exchange and one for the company as a whole. With the completion of the standard report form for the electric railways, every class of utility will have its form of annual report, and the uniform system of accounting necessitated by these reports will enable the commission to compile comparative data concerning the various features of plant management which should be of great assistance in the regulation of rates and quality of service rendered.

Manufacture of Metallic Filaments.

A patent granted July 13 to Werner von Bolton, of Charlottenburg, Germany, describes a process for the manufacture of tantalum, tungsten and other metallic filaments, in which process a ductile metal, such as copper or nickel, initially enters.

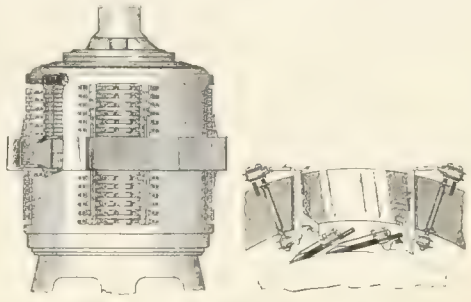
The specifications state that in order to be able to bring metals which in themselves alone can only be molded with difficulty, as, for example, tantalum, tungsten, molybdenum, into the form of filaments for electric incandescent lamps, metal is embedded in a state of fine division in another metal, as, for example, thorium, gold, copper, aluminum and particularly nickel, in such a manner that each of the finest particles of the refractory metal is inclosed by a casing of the other metal. The metallic mass thus obtained is then wrought into the form of filaments mechanically by rolling or drawing, or under certain circumstances by pressing, squirting or the like, whereupon the inclosing metal may be removed by mechanical or chemical means or by vaporization.

One metallic powder can be embedded in another ductile metal in many different ways, as, for example, by the metallic powder being put into a molten mass of the other metal and distributed uniformly in the latter; or by a powder of the one metal being intimately mixed with a powder of the other metal and afterward united by pressure. During the application of pressure to the mixed powder, the ductile metal yields and unites into small plates which cohere and form a covering or casing for the non-ductile metal. The union can also be effected in the latter case by the mixture of metallic powders being subsequently heated in such a manner that the ductile metal, which is supposed to be less refractory, is converted into one cohesive mass by its parts being welded or sintered together, or by its parts being united in a melted state, which cohesive mass envelops the particles of the metallic powder of the highly refractory metal.

When it is desired to remove the enveloping metal, this can be done, if the enveloping metal is not employed in too great excess, by passing through it an electric current by which the filament is heated, so that the enveloping metal is volatilized. The metallic particles which remain behind then sinter together into one filament. If another metal is employed as the enveloping metal which itself possesses a very high melting point, this can remain in the finished filaments. Thorium metal, for example, is such an exceedingly easily ductile metal having a very high melting point and one which can be worked up mechanically in this manner.

Brush Arrangement for Acyclic Generator.

A patent was issued on May 4 to Mr. J. E. Noeggerath for means of supporting a collector brush on an acyclic generator so that it may be easily adjusted and firmly held in place and in contact with the collector surface. The brush holders are mounted on a bracket having a T-shaped slide which is movable in a guide on a support inserted in an opening in the frame of the generator. The whole current-collecting device may be inserted radially inward through the opening and readily adjusted when in position. This arrangement is particularly advantageous for acyclic (unipolar) generators, which require a great number of brushes, pressing on collector rings rotating at high speeds, so that they wear rapidly and must be replaced frequently. The inventor states that he prefers to employ collector rings of metal which does not readily volatilize, such as steel, with brushes composed partly of steel and partly of



FIGS. 1 AND 2.—NOEGGERATH ACYCLIC GENERATOR AND DETAILS OF BRUSH-HOLDER.

copper in laminated form. With such an arrangement a very considerable stray flux passes through the collector rings by way of the brushes. The collector rings shift position in this flux as the armature revolves, and consequently eddy currents are produced in the collector rings and the loss occasioned thereby decreases the efficiency of the machine. According to a second patent issued to the same inventor on the above date, the stray flux may be minimized by counter magnetomotive force, while the eddy current losses may be reduced by placing strips of copper on the collector rings for carrying the eddy currents. In order to equalize the wear on the brushes, which is usually greater at the negative brushes of an acyclic generator, the inventor builds those brushes through which current flows to the collector rings with a greater proportion of steel and a smaller proportion of copper than is used with the brushes of opposite polarity.

CURRENT NEWS AND NOTES.

FARMERS DEMAND ELECTRIC LIGHT.—Farmers in the vicinity of Two Rivers, Wis., have made a proposition to build a line to connect with the central-station system of that town in order to be able to use electricity for light and power, and otherwise will build their own generating plant.

EUROPEAN WATER-POWERS.—It is estimated that in 1905 the water-power utilized in several countries of Europe was as follows: Germany, 294,400; France, 650,000; Italy, 464,000; Switzerland, 380,000. Of the total water-power available, Germany utilizes 20 per cent; France, 11 per cent, and Switzerland, 25 per cent. Of power from steam, Germany utilizes 6,000,000 hp, and France, 3,200,000 hp.

CONSUMPTION OF LINE POLES.—According to a recent bulletin issued by the U. S. Department of Agriculture, about 3,500,000 line poles exceeding 20 ft. in length are used by telegraph, telephone and other electrical companies. Three-fifths of these are cedar, and more than one-fourth are chestnut. Relatively small numbers of pine, cypress and redwood poles are used. The steam and electric railways use 153,000,000 cross-ties annually.

UNITED STATES WATER POWERS.—According to a bulletin issued by the Joint Committee on Conservation the United States has 5,250,000 hp in water-power in use. The undeveloped water-power controlled by the National Government aggregates 1,400,000 hp.

WIRELESS FOR PORTO RICO.—A local Porto Rico wireless telegraph company has been organized subject to control by the Government. The masts and equipment for a 10-kw station have been ordered. There will be at least three stations on the island of Porto Rico and possibly two in the adjoining islands.

HYDRO-ELECTRIC MACHINERY IN PORTUGAL.—It is stated that all of the orders thus far placed for hydraulic and electric machinery for Portugal have been received by Swiss and German manufacturers. The development of water-power is being given considerable attention in Portugal at present and doubtless many additional orders will be placed in the near future.

GAS COMPANIES CUSTOMERS OF CENTRAL STATIONS.—A central station, in some hints to its agents relative to excellent proofs of the real value of electricity for light and power, gives as satisfied consumers of electricity for light and power in their works a list of almost a score of gas companies that might be known, at least by name, to prospective customers for electrical service.

FORTY-FIVE-THOUSAND-VOLT TRANSMISSION FOR NAPLES.—A concession has been granted to a company for the generation of 16,000 hp at Capo-Volturno, for transmission at 45,000 volts to Naples, 56 miles distant. The city of Naples has secured the rights to another waterfall on the Volturno having a capacity of 4000 hp, and it is proposed to transmit the energy over the same line to Naples.

GOVERNMENT TELEPHONE FOR URUGUAY.—The Uruguayan Government has presented a bill to authorize the sum of $1,500,000 for the construction of a State telephone system. There are already two companies working telephone systems in Uruguay, and the present intention of the Government is to compete with these, and not to acquire them. It is proposed to issue a loan for the amount mentioned, bearing interest at 5 per cent.

A TWENTIETH ANNIVERSARY will be celebrated on July 29 by the Massachusetts Electric Lighting Association, of which Mr. C. L. Edgar, of Boston, is president. The meeting and dinner will be held at the Tedesco Club, Swampscott, Mass. Mr. E. W. Burdett has consented to present "A Twenty-Years' Retrospect" of the association and its membership, including a review of the history and development of the electric-lighting industry during the period.

"ALTERNATING CURRENTS."—There was a large attendance at the meeting of the Electric Club of Chicago on July 21, with Vice-President Vose in the chair. The speaker was Mr. Samuel E. Kiser, who conducts a humorous column in the Chicago *Record-Herald* under the heading "Alternating Currents." Mr. Kiser gave a very enjoyable talk, quoting a number of his quietly humorous poems, and his contribution to the entertainment of the club was much appreciated.

ONTARIO ELECTRIC-POWER SCHEME ATTACKED.—The Governor-General of Ontario is receiving petitions from the electric lighting and other companies asking for a disallowance of the recent Ontario act granting sweeping powers to the Hydroelectric Commission. The local electric-lighting companies claim that the act deprives them of their rights, and it is also claimed that the measure will have a baneful effect upon the credit of Canada in the money markets of the world.

SINGLE-PHASE RAILWAY IN BADEN.—A 10,000-volt, single-phase, 15-cycle railway system is being installed by the Baden Government to connect Basle with Schopfheim and Zell. Electric locomotives will replace the steam locomotives now in use. There will be six locomotives, each of which will be equipped with two 400-hp compensated series motors. The motors will be so mounted as to drive the main wheels through cranks and side rods. The equipment will be supplied by the Siemens-Schuckert Company.

ELECTRIFICATION OF BROOKLYN'S LAST CABLE ROAD.—The better service rendered by the electric trains through the East River tunnel having caused the receipts from the operation of the cable railroad along Montague Street to decrease from $200 to $80 per day, the Brooklyn Rapid Transit Company has decided to equip this road—the last cable line in the city—for electrical operation. An overhead trolley will be used. After the changes have been completed passengers will be carried to the Fulton Street ferry without transferring.

ELECTRICAL MACHINERY FOR KOBE.—A report dealing with the trade and navigation of the consular district of Kobe states that in the supply of electrical machinery, equipment, etc., there has been active competition between British, American and German manufacturers. Until recently an American firm had practically a monopoly in this district, but latterly British and German firms have secured contracts. With the opening up of electric railways and the extension of various electric light companies it is probable that large quantities of electrical machinery, etc., will be required during the next few years.

STEAM RAILROAD ELECTRIFICATION IN NORWAY.—As is well known, the subject of the electrification of steam railroads have been the subject of study in detail for some years, including tests of the Ward Leonard and several other systems for heavy traction. Owing to the abundance of water-power in that country, it was surmised that the problem was one not difficult of solution. That this has been the case appears from a recent announcement that the details of the electrification of some lines have been completed, waterfalls have been secured by the Government in various districts, and some foreign firms have been invited to submit tenders.

BRITISH BOARD OF TRADE.—The *Revue Electrique*, of Paris, in printing a long description of the laboratory of the British Board of Trade, finds it necessary to explain in footnotes some of the peculiarities of English nomenclature. It is pointed out that the board corresponds to the French Ministry of Commerce; that while the official address is Richmond Terrace, the actual location is 56 Whitehall; and that while the legend on a sign at the entrance is "Board of Trade, Inspecting Officers of Railways, Electrical Department," in point of fact, electric light and power and electric traction are branches under the jurisdiction of other departments of the Government, and the board has officially no electrical department.

ALLEGED TELEPHONE CONSPIRACY.—An action has been brought at Harrisburg, Pa., before the Attorney-General of the State, charging conspiracy between the Bell and Slate Belt Telephone companies, the latter being an independent company. The latter company has served notice on the Consolidated Telephone Companies of Pennsylvania, an independent concern, terminating a long-distance traffic arrangement with the latter. It is charged that the Slate Belt Company in May entered into a secret agreement with the Bell Company under which it contracted to deliver all of its toll business to the latter. The action brought charges of violation of the anti-trust laws of the State of Pennsylvania, in that the making of a connection between the Slate Belt and the Bell tended toward the destruction of competition to the great injury of the public.

Oil-Engine Generating Station at Chichester, England.

IN this country almost every small town has its electric light station, or is at least supplied with electrical energy. Not so in England, where this state of affairs is far from realized and where the additions to existing generating stations are few and far between. An oil-engine station has recently been placed in operation in Chichester, which, because of its size, equipment and nature of the load, is more than of passing interest. The Diesel oil engine has been chosen as a prime mover, and if the Chichester Electric Light & Power Company, which is responsible for the present undertaking, meets with any degree of success, it is not unlikely that many similar plants will be erected in England and many small towns now without a supply of electricity receive the benefits which are inseparably coupled with that form of energy.

Owing to the adoption of the oil engine, the station building is a very simple structure, comprising merely an engine house. This is of red brick, lined inside with white glazed brick. The floor is finished in white and black terazzo and spanned by a five-ton crane. The station is illustrated in Fig. 1, which shows the generating equipment. This consists of two Diesel oil engines designed and constructed by Mirrlees, Bickerton & Day and direct-coupled to two 100-kw, 500-volt, direct-current generators of General Electric make. Provision has been made on the generators for fitting a compound winding should this be required for traction purposes. The engines run at 250 r.p.m. and are started by means of compressed air stored in suitable receivers, and it is stated that an engine can be brought up to speed and fully loaded in the space of two to three minutes.



FIG. 2.—VIEW OF EXTERIOR OF CHICHESTER STATION

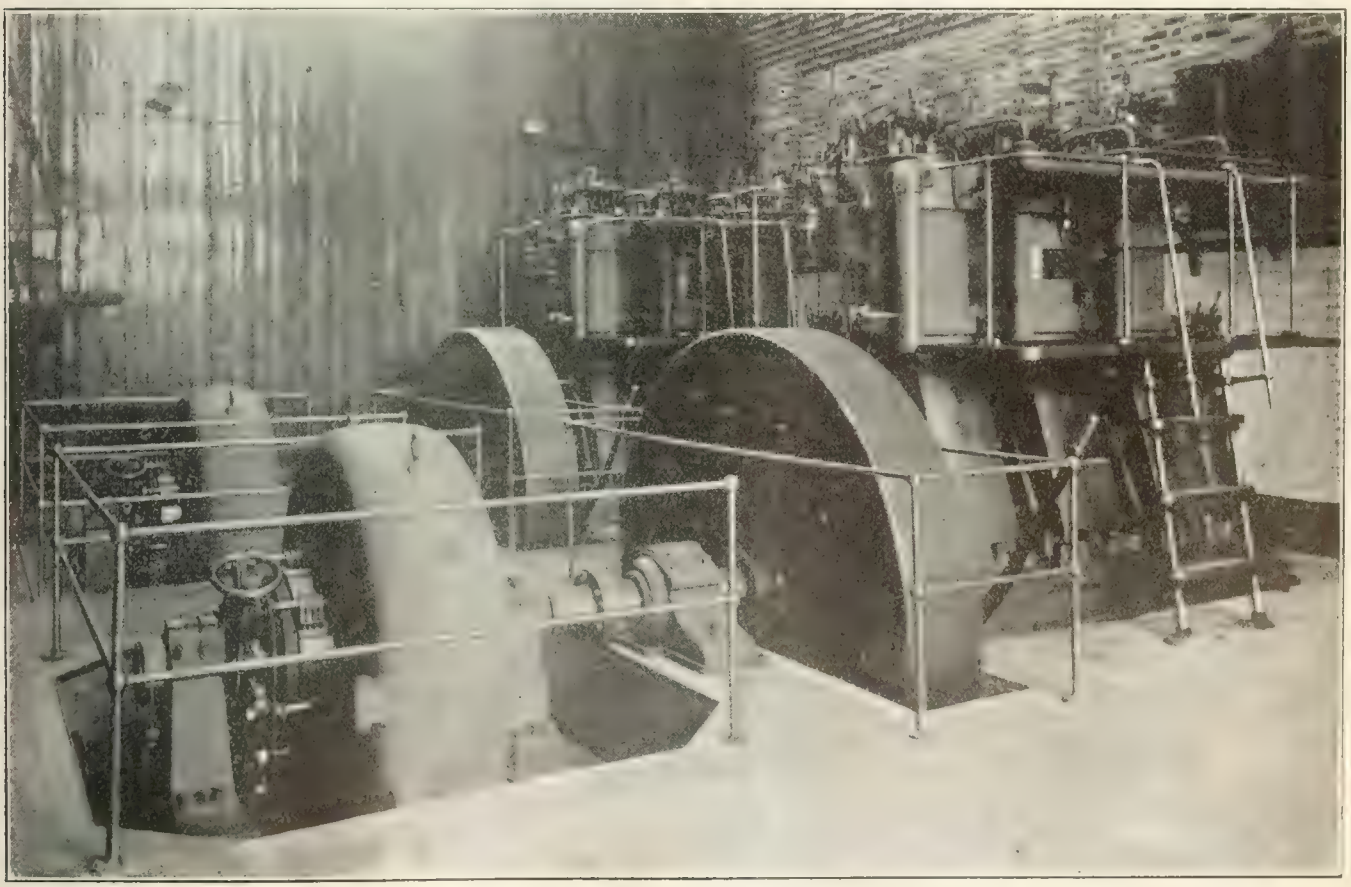


FIG. 1.—ENGINE-ROOM, CHICHESTER STATION

This is an important feature of oil-engine plants from a central-station viewpoint, particularly where, as in the present instance, storage batteries are not installed, for it is well known that internal combustion engines are not particularly adapted for taking overloads.

Water for keeping the cylinders cool is obtained from a canal adjacent to the works, a circulating pump being driven by spur gear from the engine shaft. About 600 gal. of water per hour are passed through the cylinder jackets when the engines are developing full load, and a visible outlet is provided, so as to cause any interruption of the water supply to be quickly observed. Fuel oil is supplied from a circular tank 6 ft. 9 in. x 12 ft. 4 in. situated near the engine house. The tank holds sufficient oil to allow both engines to be run continuously for a week. It is worth noting that when the oil has been delivered to the storage tank no further handling is necessary, so that the labor required is reduced to a minimum.

As a three-wire system of distribution is employed with 440 volts across the outer wires, a balancer has been installed consisting of two 25-kw, shunt-wound machines coupled on the same bedplate. The switchboard, which is shown in Fig. 3, was built by Johnson & Phillips, and is of standard design for a three-wire system. The board is arranged to control three

generators (one panel being provided for extensions), the panels reading from left to right being feeders, middle wire, balancer, battery, motor, dynamo (extension) and two dynamo panels. It will be observed that provision is made for the installation of a storage battery; but one of the features claimed for the installation is that the oil engines are entirely relied upon for maintaining a supply of electrical energy.

Triple concentric, lead-covered cables are used for feeders

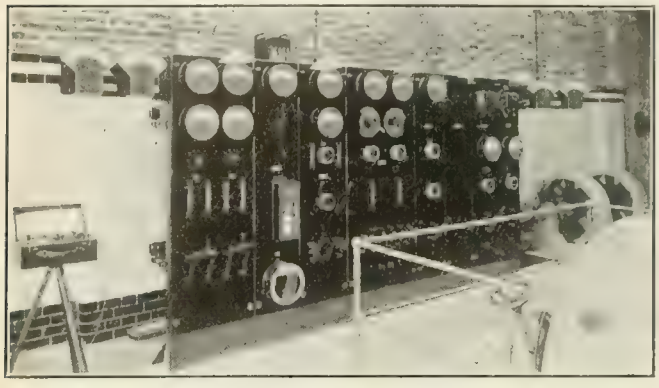


FIG. 3.—SWITCHBOARD, CHICHESTER STATION.

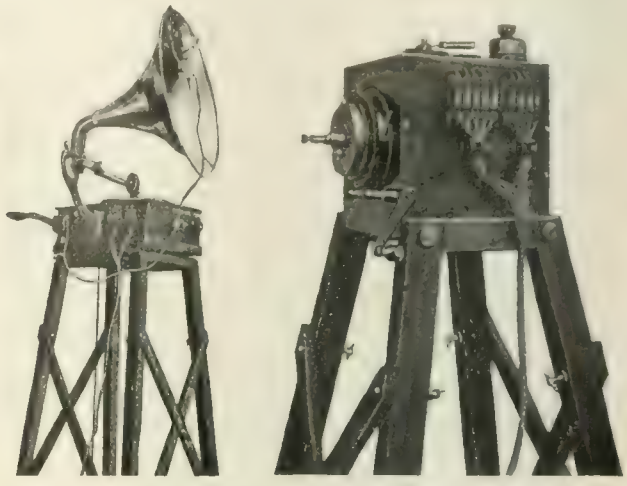
and are drawn into Sykes conduits and three-core cables are used in the distribution network. The latter are armored with steel tape and placed directly in the ground, a board being placed over them to indicate their position when future excavations are made. At present a 0.2 sq. in. feeder cable has been installed and runs to a feeder pillar near the cross, the distributors being fed through fuse switches. For house services concentric-armored cables are used, the service boxes and fuses being of standard type. The prospects of success of the undertaking are said to be very bright and when the supply was commenced over 1200 lamps had been connected. In addition to private lighting, the company hopes to connect quite a motor load, several customers now preparing to install motors.

Three-Phase Device for Driving Phonograph and Moving-Picture Machines.

By Francis M. Weldon.

It has been desired for some time past to secure a device for operating a phonograph together with a moving-picture machine in order to reproduce the image and sounds at the same time. Up to the present, it does not appear that this has been carried out successfully in practice, owing to various difficulties. A solution of the problem seems to have been obtained by Captain Couade, of Paris, who has developed his system at the works of the Pathé Phonograph Company, which is one of the largest in the city and also manufactures moving-picture apparatus.

It would appear that the desired synchronism between the phonograph and the picture machine could readily be obtained by the use of three-phase motors, each instrument having a motor which is connected upon a common circuit. However, for various reasons such a system does not answer the requirements of practice. When working with two such apparatus, the first requirement is to take the records with each instrument, and for this purpose the two apparatus can be coupled together by a connecting shaft so that the phonograph takes the sound record while the picture machine is taking the photographs of the person or persons in question. But for reproduction, the phonograph must be placed near the stage or the point where the screen is located, while the picture machine must be situated at the back part of the hall and is, therefore, at a considerable distance from the phonograph. These two apparatus cannot, therefore, be mechanically connected under such conditions, and an electrical method of connecting must be looked for, using a synchronous system. A brief account of the method which has been adopted in the present case may be of interest. As regards the making of the records in the two apparatus which are mechanically connected together, this is carried out by a person who speaks and makes the appropriate gestures; but as he must speak quite near the phonograph, it is not practicable to make the gestures at the same time. In practice the words are first recorded without the gestures, and then the phonograph is



FIGS. 1 AND 2.—PHONOGRAPH AND MOTOR.

made to repeat the words, music, etc., while the person stands in a convenient position for being photographed by the picture machine. The electrical process does not enter into this part of the work.

In order to reproduce the combined record, it is necessary to drive the phonograph and the picture machine exactly in synchronism, and this is done by an ingenious electrical device. For making the reproduction of the phonograph disk, a weight-driven phonograph is substituted for the electric motor-driven apparatus which was used for taking the record. The mechanism of the phonograph is made to operate at the same time a rotary device in the form of a revolving commutator which receives direct current from a given source and converts this into three-phase current. This latter current is sent into a three-phase motor which is mounted upon a base, usually a folding tripod, and the motor is coupled to the picture machine by means of a universal joint rod. In Fig. 1 will be seen the weight-



FIG. 3.—PHONOGRAPH AND PICTURE MACHINE.

driven phonograph which contains the revolving commutator, and in Fig. 2 the motor, with its regulating apparatus enclosed in a case and designed to be coupled to the picture machine, which is also shown. In this way the phonograph disk and the electric motor of the picture machine are made to work in synchronism.

The rotary commutator is the essential part of the present de-

vice. It is designed to receive direct current at 110 volts from the lighting mains and to convert this into three-phase current so as to operate the synchronous system. The principle which is involved in the rotary device is a somewhat original one, and it will be understood by referring to Fig. 4. A commutator is mounted so as to work in connection with the mechanism of the phonograph. This commutator is provided with a set of

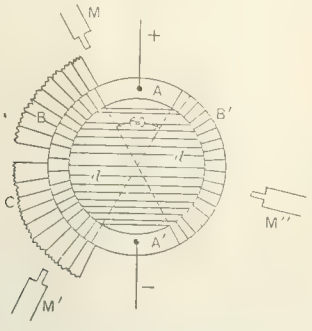


FIG. 4.—DIAGRAM SHOWING PRINCIPLE OF ROTARY DEVICE.

bars, of which there are two bars of large size $A\,A'$, covering 60 deg. of surface. The other bars $B\,B'$ are of smaller size. The commutator is fixed in practice, and the direct-current, 110-volt circuit is connected at $A\,A'$. Between the bars B are mounted the resistance coils C, adjusted to suit the requirements. The bars lying on one side, B', are connected with the set B by means of cross-wires d. Each bar is connected to the corresponding bar on the other side.

Around the fixed commutator there is rotated a set of three brushes M, which are shown here, removed at a distance for the sake of clearness, but in reality they bear upon the surface in the usual way. Captain Couade finds that by properly designing the resistances between the bars and giving them an increasing and decreasing value, he can produce a current from the three brushes which is practically a three-phase current. The theory of the apparatus involves formulas which are too long to be considered at present, but in practice the current in the circuit of the brushes is very near a sine curve, as will be seen in Fig. 5. The dotted line shows a sine curve, and the full line represents the curve obtained from the apparatus. Such current is quite well adapted for operating a three-phase motor. Instead of using a second set of resistance coils between the brushes B', the latter are connected with the bars B by means of equipotential wires, as shown, and this is found to answer the same purpose.

The three-phase current which is thus obtained has a voltage equal to the direct-current voltage, considering the maximum difference of potential between phases, and the frequency is equal to the number of revolutions per second of the apparatus.

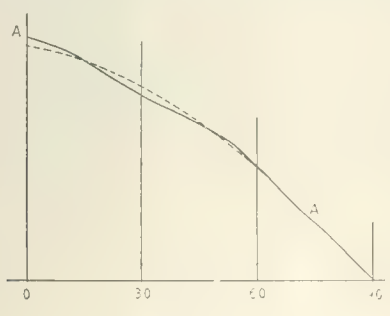


FIG. 5.—CURRENT CURVE.

The resistances are made up of German silver windings in the form of flat coils and are placed beside the commutator, being arranged so as to have a good air cooling. Seeing that the current curve is very nearly sinusoidal, the three-phase motor receiving such current is made to run in a regular manner, and the torque is about a maximum. The commutation takes place with but very little sparking. As to the three-phase motor which is used with the moving-picture machine, it is of a simple kind, being a two-pole motor with shuttle-wound armature. The field is wound like that of a three-phase induction motor, and is connected so as to give two poles. The armature is a soft iron, grooved cylinder which carries an exciting winding. With a larger-sized motor, a simple iron core without any winding can be employed. However, the use of the winding gives a smaller size, and, therefore, a reduced weight to the armature. The speed of the commutator brushes is 360 r.p.m. or six revolutions per second, and this gives a frequency of six cycles. The speed of the three-phase motor is also 6 r.p.m. By the use of a low frequency, the iron in the motor field is reduced to a minimum and the motor is lightened without reducing the torque.

As the voltage of the three-phase motor corresponds at each instant with that of the revolving commutator, it is found that upon starting up the latter the three-phase current gradually rises and reaches its full value in a regular manner. At the start and also at full speed the three-phase motor has sufficient torque for driving the picture machine. As the motor is bipolar, its speed equals the frequency of the current, and therefore the picture machine will start at the same rate as the phonograph and it will arrive at synchronism just as if the two apparatus were mechanically coupled together. This gives the desired coincidence of the phonograph and the picture records. The motor is mounted in a case, which is shown here, and it is small and portable, being mounted on a tripod for convenience. It has power enough to work the machine at the start as well as on regular running.

While the three-phase motor works at 360 r.p.m. it is necessary to rotate the picture machine at one-third this speed, or 120 r.p.m. A gear set for this purpose is mounted on the box, so that by turning the crank on one side the speed of the motor can be increased or decreased while the apparatus is running, and this enables the operator to keep the adjustment in case the two apparatus, phonograph and machine, should accidentally fall out of step, as may happen when the phonograph needle skips over a short distance or where some of the pictures are out of the film.

The Determination of the Current and Voltage Relations in Unsymmetrical Polyphase Systems.

BY CHARLES H. PORTER.

THAT the current and voltage relations in unsymmetrical polyphase systems can be readily determined by the use of complex algebra is a fact less well known than it should be. Some of the text-books take up the special case of an unbalanced load in Y on a three-phase system and show that when the load consists of pure resistance only the voltages and currents can be determined by a method of moments, but none of them gives any method for solving the more difficult cases. This method of moments can probably be developed and generalized, but at best it is in its application to specific problems a method of solution based on mathematically derived formulas the electrical significance of which has been obscured in the process. This may be the reason why it has not come into general use. It is possible that from a purely mathematical standpoint the method to be described below and the method of moments can be shown to be more or less identical, but the application of the present method because of its analogy to familiar direct-current methods is much more obvious.

By the use of simultaneous vector equations exactly analogous to the Kirchoff laws equations for direct-current circuits the most complicated problems can be solved as easily as can the corresponding problems in direct-current work. This statement means simply that the same equations are written as for a direct-current problem with similar data given, but that in the alternating-current problem all of the values must be expressed in complex quantities—that is, in the well-known form, $a + jb$,

for by so doing the time-phase relations of the various quantities are taken care of in the easiest manner.

The method can probably be best brought out by applying it to numerical examples. The notation employed is one based essentially on the use of two subscripts with every symbol or vector representing either current or electromotive force, the subscripts being determined by the lettering of the diagram of

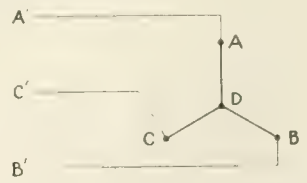


FIG. 1.—CIRCUIT RELATIONS IN THREE-PHASE SYSTEM.

connections. The subscripts indicate that the positive direction of the current is from the first to the second and that the positive direction of the electromotive force is such that the first point is of higher potential than the second. Thus E_{ab} is the electromotive force producing the current I_{ab} in the branch AB and I_{ab} is equal to $-I_{ba}$ or I_{ab} and I_{ba} differ in time-phase by 180 deg. The order of the subscripts therefore is a matter of vital importance.

Consider first the case of three unequal impedances connected in Y between 220-volts, three-phase mains A, B and C. Let the common junction of the impedances be denoted by D and let the three impedances be

$$Z_a = 25 + j\,4$$
$$Z_b = 20 + j\,15$$
$$Z_c = 15 - j\,5$$

If the delta voltages are equal and E_{ab} be assumed as the axis of reference,

$$E_{ab} = +220 + j\,0$$
$$E_{bc} = -110 - j\,190.5$$
$$E_{ca} = -110 + j\,190.5$$

The simultaneous equations for this system are

$$I_{ad} + I_{bd} + I_{cd} = 0$$
$$E_{ad} + E_{dc} = E_{ac}$$
$$E_{bd} + E_{dc} = E_{bc}$$

These last two equations can be written

$$I_{ad} Z_a + I_{dc} Z_c = E_{ac}$$
$$I_{bd} Z_b + I_{dc} Z_c = E_{bc}$$

from which

$$I_{ad} = \frac{E_{ac}}{Z_a} - I_{dc}\frac{Z_c}{Z_a} = \frac{E_{ac}}{Z_a} + I_{cd}\frac{Z_c}{Z_a}$$

and

$$I_{bd} = \frac{E_{bc}}{Z_b} + I_{cd}\frac{Z_c}{Z_b}.$$

Substituting these values of I

$$I_{cd}\left(1 + \frac{Z_c}{Z_a} + \frac{Z_c}{Z_b}\right) + \frac{E_{ac}}{Z_a} + \frac{E_{bc}}{Z_b} = 0$$

With the numerical values this becomes

$$I_{cd}\left(1 + \frac{15 - j\,5}{25 + j\,4} + \frac{15 - j\,5}{20 + j\,15}\right) = \frac{-110 + j\,190.5}{25 + j\,4} + \frac{110 + j\,190.5}{20 + j\,15}$$

$$I_{cd}\,(1 + 0.544 - j\,0.289 + 0.360 - j\,0.520) = -3.10 + j\,8.12 + 8.10 + j\,3.46$$

$$I_{cd}\,(1.914 - j\,0.809) = 5.00 + j\,11.58$$

$$I_{cd} = 0.05 + j\,6.07 = 6.07 \text{ in amp}$$

$$E_{cd} = I_{cd} Z_c = +31.1 + j\,90.9$$

$$E_{ad} = E_{ac} + E_{cd} = +141.1 - j\,99.6$$

$$E_{bd} = E_{bc} + E_{cd} = -78.9 - j\,99.6$$

$$I_{ad} = \frac{E_{ad}}{Z_a} = +4.87 - j\,4.77 = 6.81 \text{ in amp}$$

$$I_{bd} = \frac{E_{bd}}{Z_b} = -4.92 - j\,1.30 = 5.09 \text{ in amp}$$

The voltage between the common junction D of the impedances and the true neutral of the system can now be found. Calling the true neutral O it is evident, since the delta voltages are equal, that

$$E_{ao} = +110 - j\,63.5$$
$$E_{do} = E_{da} + E_{ao} = -141.1 + j\,99.6 + 110 - j\,63.5$$
$$= -31.1 + j\,36.1 = 47.7 \text{ in volts.}$$

The vector diagram, Fig. 2, is plotted with the values computed above. The power in the system if measured by the two-

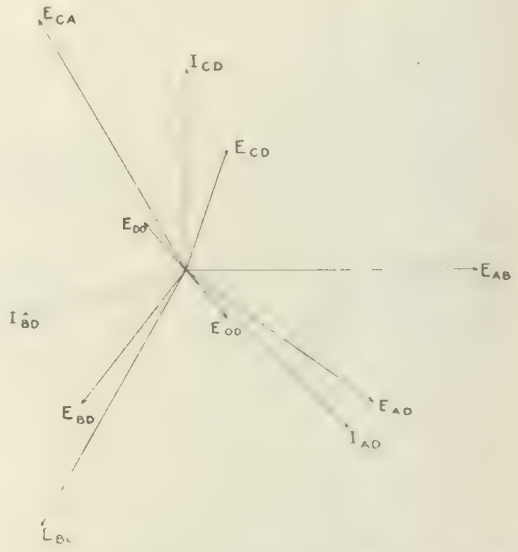


FIG. 2.—TIME-PHASE RELATIONS IN THREE-PHASE SYSTEM.

wattmeter method with the current coils of the instruments in mains A and B would be given by

$$W_a = E_{ac} I_a' \cos\theta_1 = e_1 i_1 + e_1' i_1' = 1446 \text{ in watts}$$
$$W_b = E_{bc} I_b' \cos\theta_2 = e_2 i_2 + e_2' i_2' = 789 \text{ in watts}$$
$$W = W_a + W_b = 2235 \text{ in watts}$$

This total power could have been found equally well as the sum of the I^2r losses for the three impedances.

For any given set of impedances the cyclic order in which they are connected in the three phases makes a difference in the values of the line currents and Y voltages and in the amount of the displacement of their common junction from the true neutral of the system. This fact is frequently overlooked by students.

If in the problem just considered two only of the impedances be interchanged, such as Z_b and Z_c, their cyclic order with

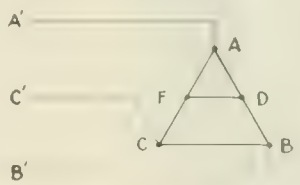


FIG. 3.—CIRCUIT RELATIONS IN INTERCONNECTED SYSTEM.

reference to the impressed voltages will be changed; substituting the new values

$$Z_{a1} = 25 + j\,4$$
$$Z_{b1} = 15 - j\,5$$
$$Z_{c1} = 20 + j\,15$$

in the equations previously derived it will be found that

$$I_{a1d1} = +3.53 - j\,1.60 = 3.88 \text{ in amp}$$
$$I_{b1d1} = -7.00 - j\,4.05 = 8.09 \text{ in amp}$$
$$I_{c1d1} = +3.47 + j\,5.05 = 6.63 \text{ in amp}$$
$$E_{a1d1} = +94.6 - j\,26.0$$
$$E_{b1d1} = -125.4 - j\,26.0$$
$$E_{c1d1} = -15.4 + j\,164.7$$
$$E_{d1o} = +15.4 - j\,37.5 = 40.5 \text{ in volts}$$
$$W = W_{a1} + W_{b1} = 1542 + 693 = 2235 \text{ in watts.}$$

It will be noticed that the values of the currents are quite different from what they were with the first connection and that the unbalancing of the currents is greater, though the displacement of the common junction with reference to the true neutral is slightly less. The total power taken by the system is unaffected by the order of connection, although its distribution among the different impedances is changed.

If the delta voltages had been unequal the complex expressions for them would have been different numerically, but the form of the equations and the method of solution are, of course, independent of the values used; when the values of the delta voltages are known the complex expressions for them can always be found by the solution of the voltage triangle.

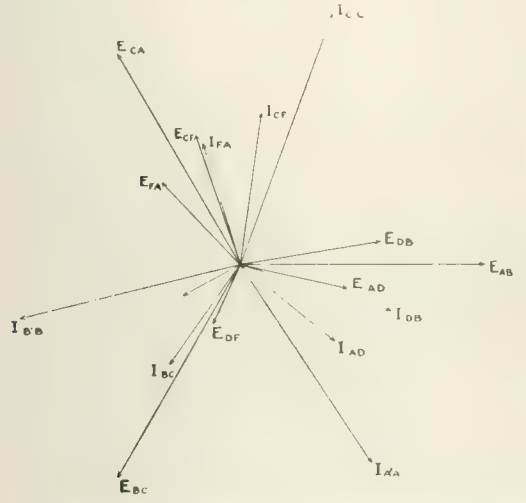


FIG. 4.—TIME-PHASE RELATIONS IN INTERCONNECTED SYSTEM.

Another problem of less practical importance, but which better illustrates the value of this method, is the determination of the current and voltage relations in the following system: Two equal impedances, $Z = 40 + j\,20$, are connected between the mains A and B and the mains A and C of a constant-potential 220-volt, three-phase system. Between the mains B and C is an impedance, $Z = 50 + j\,5$, and a fourth impedance $Z = 20 + j\,15$ is connected between the middle points D and F of the impedances Z_{ab} and Z_{ca}.

If E_{ab} be assumed as axis of reference, the complex expressions for the delta voltages are

$$E_{ab} = +220 + j\,0$$
$$E_{bc} = -110 - j\,190.5$$
$$E_{ca} = -110 + j\,190.5$$

I_{bc} is independent of the rest of the system and its value can be found at once.

$$I_{bc} = \frac{E_{bc}}{Z_{bc}} = -2.56 - j\,3.56.$$

The simultaneous vector equations are

$$E_{ad} + E_{db} = E_{ab}$$
$$E_{af} + E_{fc} = E_{ac}$$
$$E_{af} + E_{fd} = E_{ad}$$
$$I_{af} + I_{cf} = I_{fd}$$
$$I_{da} + I_{db} = I_{fd}$$

The first three equations can be written

$$I_{ad} Z_{ad} + I_{db} Z_{db} = E_{ab}$$
$$I_{af} Z_{af} + I_{fc} Z_{fc} = E_{ac}$$
$$I_{af} Z_{af} + I_{fd} Z_{fd} = I_{ad} Z_{ad}$$

Solving these equations for the five currents, the values in amperes are found to be

$$I_{ad} = +3.37 - j\,2.75 = 4.35$$
$$I_{db} = +5.43 - j\,1.66 = 5.67$$
$$I_{af} = +1.32 - j\,4.36 = 4.56$$
$$I_{fc} = -0.74 - j\,5.45 = 5.51$$
$$I_{df} = -2.06 - j\,1.09 = 2.33$$

The voltages are

$$E_{ad} = +94.9 - j\,21.3 = 97.1$$
$$E_{db} = +125.1 + j\,21.3 = 127.0$$
$$E_{af} = +70.1 - j\,74.1 = 102.0$$
$$E_{fc} = +39.9 - j\,116.5 = 123.0$$
$$E_{df} = -24.8 - j\,52.8 = 58.3$$

The line currents are

$$I_{a'a} = I_{ad} + I_{af} = +4.69 - j\,7.11 = 8.52$$
$$I_{b'b} = -I_{bd} + I_{bc} = -7.99 - j\,1.90 = 8.21$$
$$I_{c'c} = -I_{cb} + I_{cf} = +3.31 + j\,9.01 = 9.60$$

The relation of the various quantities can be better appreciated if plotted as a vector diagram, Fig. 4.

It will be seen that this method bears the same relation to the fundamental equation of alternating currents, $I = \frac{E}{Z}$, where all the values are expressed in complex quantities, that Kirchoff's laws bear to Ohm's law, the fundamental equation of direct currents. If it be remembered that in alternating-current work quantities cannot be considered as known unless they are known as to both magnitude and phase, it is obvious that the method described above can be applied to any problem whatever, however complicated, provided only that the data given are sufficient to make the corresponding problem in direct currents determinate. The application of this method to alternating-current problems is as simple and direct as is the application of Kirchoff's laws to direct-current problems.

Electrical Laboratory Equipment of the College of the City of New York.

BY N. M. SCHOONMAKER.

The College of the City of New York, recently erected at 139th Street and St. Nicholas Terrace, besides being an institution which gives no graduate degrees has further made it an object to keep its work fundamentally practical. Although many students do step directly from it into the graduate courses of universities, the primary aim of this college is to fit young men for the actual work which they will find waiting for them when their college days are over.

When the electrical laboratory was planned, this general aim of the college was followed and the equipment was all designed with the special object of making competent, capable, informed electricians. In the department of physics the students are given a working knowledge of the elements of mechanical and electrical engineering. They are instructed how to design and operate motors, generators, transformers, etc. In the electrical laboratory they become familiar with the simpler types of electrical machinery and learn to operate them.

The Mechanical Arts Building is a three-story structure, 60 ft. x 195 ft. The basement and sub-basement of this building are taken up by the power plant which supplies steam and electric energy to the entire group. Almost all the remainder of the building above the basement floor is devoted to laboratories of the department of physics. The electrical laboratory is located at the south end of the first floor of the building and is approximately 29 ft. x 48 ft. In the main building, in another block, is located a large section of the physics department, where are placed all the arrangements for the minor electrical experiments. The lecture-rooms and laboratories in the main building are provided with both direct- and alternating-current laboratory switchboards, storage batteries cut up into various groups so as to obtain different voltages, and also instruments and rheostats. It is with the main electrical laboratory in the Mechanical Arts Building that this article has to do.

In laying out this laboratory, as well as all the others, an attempt was made to put in as many different types of electrical machinery and appliances as were consistent with the available space and money. This aim renders the system an unusually complicated one. Electricity is generated in the power plant in the basement and sub-basement. The generating equipment

is designed in such a way as to make it possible for students to test it, and in order to familiarize them with different types of appliances, several different kinds of generators were installed. The distribution for lamps and motors for the entire group of buildings is 235-volt, two-wire, direct-current. This voltage was used because so large a percentage of the load is made up of motors, for one reason; and second, in order to decrease the amount of copper in the very long feeder system throughout the group. The alternating current for all the buildings is used only for experimental and electric-furnace equipment and is generated at 250 volts, 60 cycles, three-phase.

There are four 250-kw generators in the main power plant, each driven by a different type of engine—that is, one tandem-compound, one cross-compound, one simple, four-valve and one simple, slide valve. For night use, throughout the whole group, there is a storage battery of 140-amp, eight-hour rate capacity. The switchboard for all these units in the power plant is complicated, yet it is arranged so that students can study it out; but as the principal work is to be done in the laboratory it is here that especial thought has been given to arranging apparatus and circuits for this purpose.

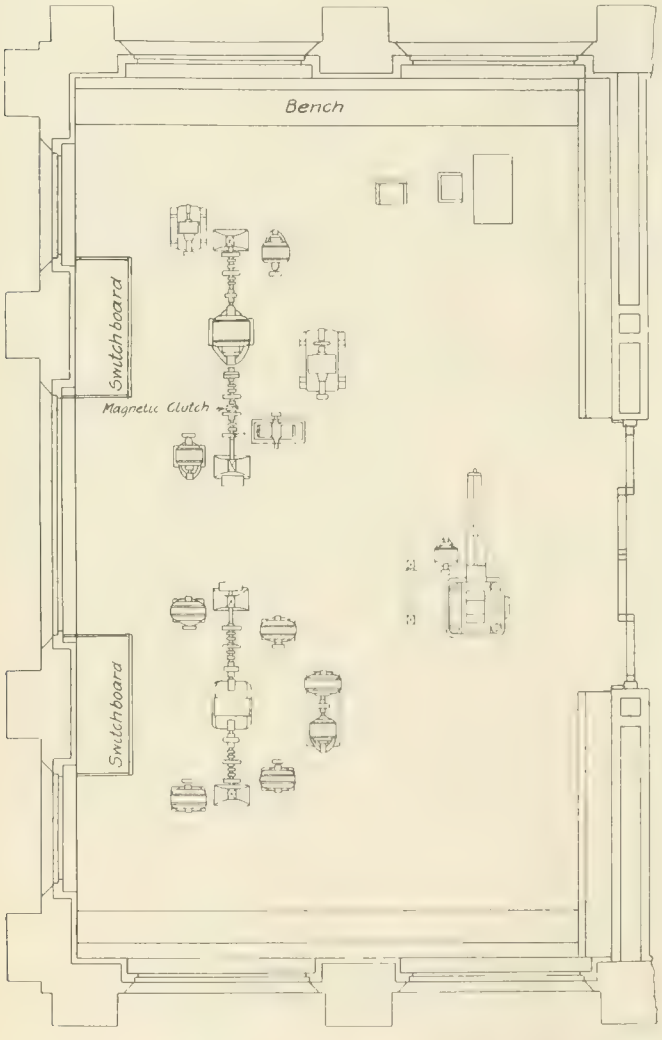


FIG. 1.—ELECTRICAL LABORATORY, COLLEGE CITY OF NEW YORK.

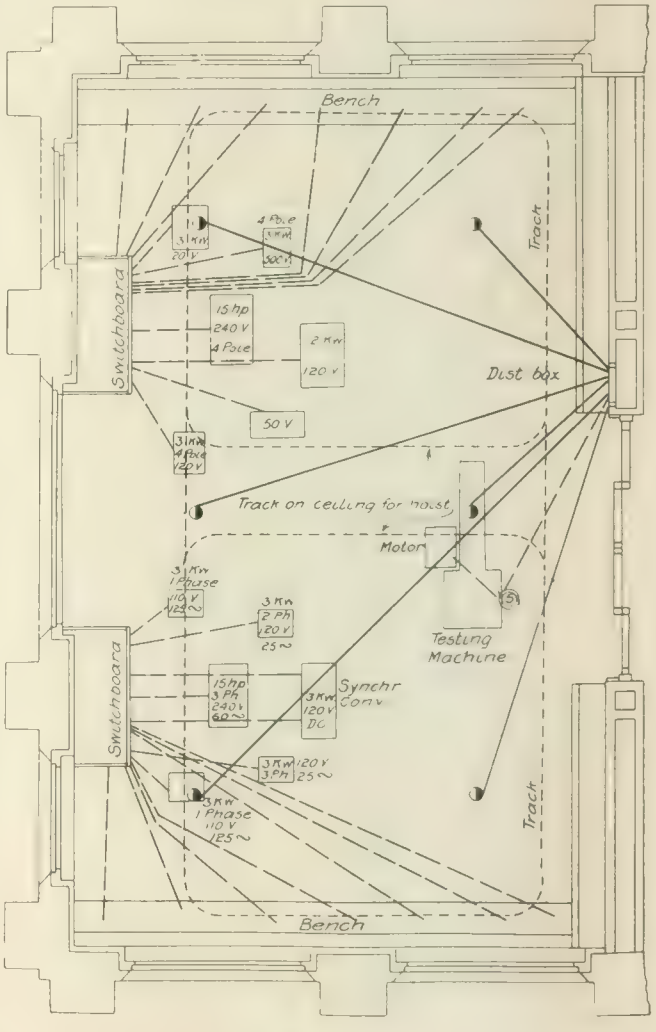


FIG. 2.—CONNECTIONS IN LABORATORY, COLLEGE CITY OF NEW YORK.

The switchboard, motor and generator equipments of the electrical laboratory are divided into two groups; one for direct and one for alternating current. To the buses of the two switchboards direct and alternating current respectively is supplied from the main power plant. There is a motor for each section with an extended shaft from which a number of small generating units are driven, each unit of each section being of a different type. These are all driven by noiseless chain-belts from the motor shaft and are coupled by means of clutches. These clutches are mechanical ones, with the exception of a single electrical one put in to familiarize students with it, and by means of them one or more generators can be used for tests, when the motor is running, without the other generators being called into use. In addition to this arrangement, each motor has a brake pulley on the same shaft, so that a dynamometer test can be run on the motor itself.

The machines of the direct-current group are: One 15-hp, 230-volt motor (the group-driving motor); one 3-kw, four-pole, 120-volt, shunt-wound generator; one 3-kw, bipolar, 120-volt, shunt-wound generator; one 3-kw, four-pole, 500-volt, series-wound generator; one 12-kw, multipolar, 120-volt, compound-wound generator, and one 2-kw, two-pole, 50-volt, shunt-wound generator. Those of the alternating group are: One 15-hp, three-phase, 60-cycle, 250-volt motor (the group-driving motor); two 3-kw, single-phase, 110-volt, 125-cycle generator; one 3-kw, two-phase, 120-volt, 25-cycle generator; one 3-kw, three-phase, 120-volt, 25-cycle generator. In addition to these two groups there is a 3-kw rotary converter, with three-phase, 240-volt, 60-cycle alternator end and 110-volt, direct-current generator, arranged so that either end may be used as generator and the other end as the motor. For detail of this arrangement see Figs. 1 and 2.

The two switchboards are designed as test boards, so constructed and arranged that each of the above machines is a complete power-plant unit in itself. Any two or more of the machines can be used in parallel or in series, and the alternating-current machines may be run in synchronism or out of synchronism. The wiring by which all machines are connected to the switchboards is run in conduit concealed in the floor

construction, and ends in concrete pull-boxes, set in the floor construction, with sides raised above the floor and tops of cast-iron floor plates. These boxes are set immediately behind the switchboards and occupy all the space inside the switchboard inclosures. From the pull-boxes, the wiring is grouped and passes up through conduits to points opposite the switches and instruments on the boards. In order to economize space,

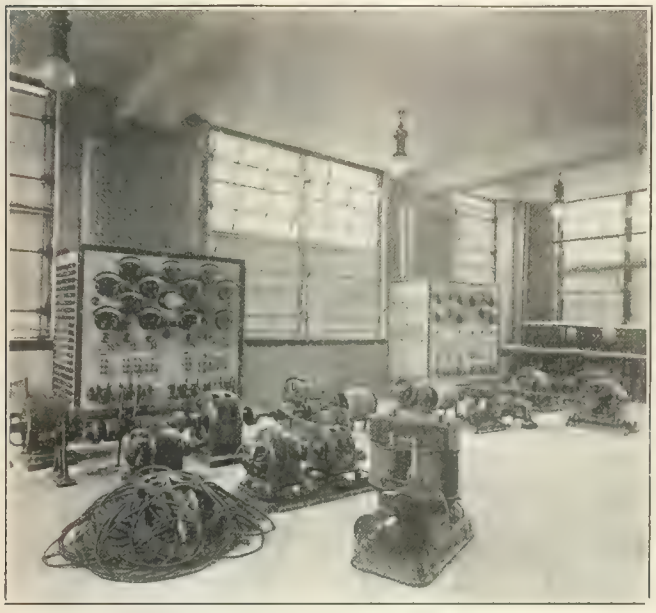


FIG. 3.—VIEW OF ELECTRICAL LABORATORY, SHOWING TESTING BOARD.

both switchboards are built in the form of three sides of a rectangle, with one end of each hinged to provide access to the space behind. These hinged sections are provided with a roller on the pedestal, one on each switchboard, and all connections are made with flexible leads across the hinge ends.

The switchboards are constructed of blue Vermont marble with a polished copper mold extending entirely around each section, and provided with bronze pedestals. On each one of the switchboards is mounted an automatic overload circuit-breaker for each generator, also a main switch, rheostat, illuminated dial, ammeter and voltmeter for each generator. One of the voltmeters on each board is provided with a switch for testing line voltage and grounds on any set of busbars, this voltmeter being marked in ohms as well as volts for the ground tests. On the alternating switchboard there is a synchronizer.

Above each of the two switchboards, mounted on marble slabs against the wall, are banks of lamps for loading the various machines, each bank consisting of 420 16-cp units, some wired in series and some in parallel, so that with 50-volt or

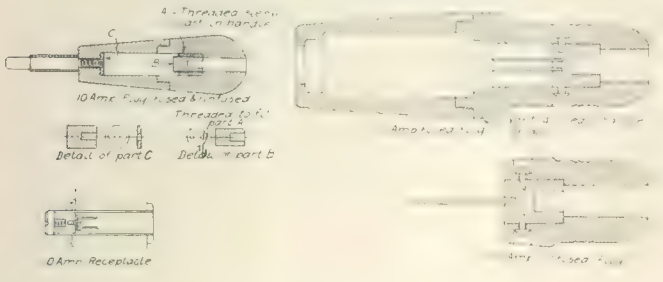


FIG. 4.—DETAILS OF PLUG SWITCH.

110-volt bulbs a load can be had for any machine. Each switchboard is provided with plug and flexible connections from the various busbars to the various loads, so that any load up to maximum can be plugged into the buses of any machine either by means of the lamp banks or apparatus on the students' benches. The lamps in the banks above each of the switchboards are controlled by 42 rotary switches in the connection between the load buses and the lamps. These switches are of 10-amp rating.

This multitude of busbars and connections on the backs of the boards makes them unusually complicated, and it is necessary to use copper cables painted in various colors to enable the students to trace out the various circuits and connections. The plugging receptacles on the boards are of two sizes,

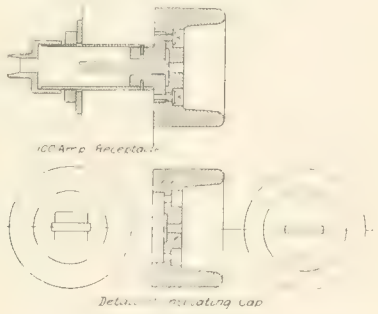


FIG. 5.—DETAIL OF INSULATING CAP.

100 amp and 10 amp resepctively. The 100-amp receptacles are constructed of copper with recessed insulating caps of cast composition, so that short circuits are avoided and the spacing is reduced. (See Fig. 5.) The flexible cables which are used in connection with the switchboards are each constructed with a different type of plug on the ends, one end being fused and the other unfused. The fuses are inserted on account of the liability of students' making improper connections or short circuits, rather than as a protection against ordinary overloads. The ends of these cables are of cast composition, and the fused ends are provided with long sockets to receive an enclosed fuse. Link connectors rated at 100 amp are also provided for bridging from one receptacle to the next nearest. (See Fig. 6.) In addition to the plugs already mentioned, there are 42 permanent connections between the alternating- and direct-current switchboards, each capable of carrying 100 amp, and these are provided with plugs on each board. There are also 10 permanent 100-amp connections with plug-ends extending between the boards and the main switchboard in the Department of Physics in the main building in the next block.

The insulating caps of the plugs on the main switchboard are painted in eight different colors so as to be easily distinguishable, and in addition to this the switchboards are provided with name-plates under each instrument, each switch, and each set of plugs. Students' benches, arranged at opposite ends of the room, one for direct and one for alternating current, are provided with instrument boards on which portable instruments can be mounted and leveled. Each bench is divided into spaces for seven students, and three two-wire, 100-amp circuits run from the switchboards to each student-space. These circuits are provided with receptacles at both ends, those on the benches being somewhat similar to those used on the switchboards.

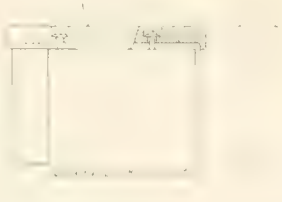


FIG. 6.—DETAIL OF LINK CONNECTOR.

All of the above described plugging provisions make it possible to test any of the machines, either with a lamp load or loads on the students' tables, and either with the switchboard instruments or with instruments located on the students' tables. It also makes possible the testing of motors set on students' benches. In fact, a professor or student may test any one of the machines with loads or instruments in the lecture rooms or

laboratory in the Physics Department of the main building. It will be seen that an almost unlimited number of connections and combinations can be formed. In laying out the plan of the buildings no provision was made in the present group for a testing-room, an omission that necessitated the placing of the testing machine in the electrical laboratory.

As will be seen at once, so extensive and elaborate an arrangement of apparatus required a great amount of thought and care, and for the original design the college is indebted to Mr. C. Howard Parmly, director of the Mechanical Arts Building. Pattison Brothers were the consulting engineers, and the work itself was executed by Hatzel & Buehler, electrical contractors. George B. Post & Sons were architects for the entire group of buildings.

Buying Coal on a Heat-Unit Basis.

Mr. R. T. Gunn, general manager of the Eastern Wisconsin Railway & Light Company, of Fond du Lac, read a paper on the "Purchase of Coal on a Straight-Contract or Heat-Unit Basis" before the Wisconsin Electrical Association at Waupaca, June 29.

He stated that in generating power by steam the cost of coal is about 75 per cent of the entire expense. In most properties the one item of fuel is almost as much as the combined labor payrolls of the entire property. Mr. Gunn, after a year of investigation, feels that it is demonstrated beyond a doubt that the only proper method of making coal purchases is on a heat-unit or pound-Fahrenheit rating. All the larger coal companies, and especially those who handle the best grades of fuel are only too anxious to sell on a guarantee of so many heat units per pound of coal, and are willing to contract and make settlements on analyses at the end of each month, the purchaser paying a bonus where coal exceeds the guarantee and withholding where the coal does not come up to the guarantee.

To go more into detail, he gives an example of how this may be worked out in practice. In his locality Youghiogheny screenings may be bought on a guarantee of 13,000 pound-Fahrenheit units per pound of coal. To determine what the coal will average and obtain a fair test, a small sample is saved from each day's delivery. These samples are mixed thoroughly and at the end of the month analyzed. Care must be taken to keep samples in air-tight jars. The coal may be wet and the analysis should tell the condition of the coal as actually received and not after it has been air-dried.

Local conditions figure more in buying coal than in any other department of the business. Some may find it economy to buy cheap and low grades of fuel, while others may find economy in the best fuel containing the highest number of heat units per pound, although comparatively much higher in price per ton. Two examples illustrate this. In one power plant which is equipped with B. & W. water-tube boilers, one boiler is sufficient to carry the load 18 hours out of the 24, a second being added over the peak load. With low-grade coal containing a large amount of ash this would be impossible, as furnaces would have to be cleaned during the 18-hour period. This plant, therefore, uses the best coal obtainable. When low-grade coals were used three boilers were required to carry the peak load and two boilers at all times. A saving of $10,000 per annum is now being made in this plant by using the higher-grade fuel. These results have been obtained by making heat-unit tests over a period of several months with different kinds of coal. The same company has another plant equipped with Jones underfeed stokers which, when operating on high-grade coal, shows only a slight saving over the cheaper grades of coal.

The human element is one which must have more consideration if the best results are to be obtained. Firemen can lose or save more money for a public utility than any other laborer connected with the organization. This accounts in a great many instances for the fact that the management does not obtain much better results from high-grade than from inferior coals. Purchasing fuel on a heat-unit basis stops the practice of delivering coal from mines other than that called for in the contract, so that the coal is not uniform. The time will soon arrive when all fuel will be purchased on its real value like any other commodity.

Mr. Gunn also emphasized the economy to be obtained by forcing boilers to their maximum capacity. Part of the saving in the plants he referred to is due to this forcing and not allowing boilers to run underloaded.

Mr. C. N. Duffy said that on June 1 the Milwaukee Electric Railway & Light Company entered into a contract for the purchase of coal on the heat-unit basis as a result of investigations. The company is now obtaining coal of a better average heat value than before and at a lower price.

Some questions were raised by members as to the value of continuous flue-gas recorders or indicators as a guide for firemen. One member thought them too expensive for an ordinary plant. Another thought that recording steam-pressure gages did almost as well, because they led to uniform handling of fires Mr. Ernest Gonzenbach, however, criticised the idea that a uniform steam pressure meant proper handling of fires. He told of his experience in the management of a North Carolina plant which presented a beautiful steam chart, but where the coal economy was poor. The firemen were in the habit of loading the furnaces as full of coal as they could be piled and sitting down to play the banjo. By a reform in firing methods the monthly coal bill was cut down from $5,000 to $2,200. In regard to the methods of estimating output for figuring coal consumption per kw-hour, he called attention to the fact that some companies take the total kw-hours generated rather than the total kw-hours sent out of the station. Deducting the current used in the station to assist in the production of energy sometimes made considerable difference. In the Sheboygan plant the consumption averages about 5 lb. of coal per kw-hour actually sent out.

Mr. J. R. Cravath, in answer to a question as to the use of the Venturi meter for measuring the water fed to boilers, told of the practice of the Rockford (Ill.) Electric Company, which keeps a Venturi meter with a recording chart in the feed line of the boilers. This records continuously the rate of boiler feed, and the man in charge of the fireroom is not allowed to start an additional boiler in operation until the meter indicates that the rate of water consumption is considerably in excess of the rated load of the boilers in service. This keeps the boilers well loaded at all times. There is more in heavy loading of the boilers than at first appears. When a boiler is being forced a fireman must of necessity handle his fire so as to get a fair degree of economy from the coal in order to keep up steam, and there is no leeway for the formation of air-holes in the fire.

Mr. R. T. Gunn spoke very favorably of the use of a Williams regulator to keep a constant height of water in the boiler. This prevents water being allowed to get low and other conditions not conducive to economy or safety. Mr. W. B. Voth, chief engineer of the Sheboygan Light, Power & Railway Company, gave an outline of the premium plan which has been in use for four years in the Sheboygan plant with great success. The company inaugurated this plan at a time when it was found that fuel, oil and miscellaneous power-house supplies were costing 1.1 cents per kw-hour. The power-house force is given a premium amounting to 10 per cent of the saving below 1.1 cents per kw-hour. The premium is divided among the men in proportion to their respective salaries. It is really in the nature of a gradual increase of salary, because the larger the output and the better the load factor, the larger the amount available for premium. Mr. Gonzenbach said that he thought it better to pay in this way than by raising salaries. Mr. W. E. Haseltine, of Ripon, reported having used a similar premium plan in the power house successfully. He has a combined water and light plant. The output of the light plant in hp-hours is figured both in electricity and in water pumped. This was determined for each month of the year before the premium plan was begun.

because the relative amounts of electricity and water put out vary from month to month, and the efficiency of pumping is not the same as electric generating. The plan is to give the firemen 20 per cent of the saving in coal per hp-hour by comparison with the same month of the year before the premium plan went into effect.

Electric Energy Directly from the Coal Mine in Colorado.

An electrical transmission system the operation of which is being watched with great interest throughout coal mining regions is that of the Northern Colorado Power Company, whose generating station, between Denver and Boulder, represents the pioneer American installation for the transmission of energy directly from the coal mine. This system, which has been in service since December, 1907, has been increased from time to time, so that it now covers a considerable portion of the best farming district of northeastern Colorado.

In addition to the electrical features, which will be referred to below, the installation operates under conditions which may well be considered unique. The fuel employed is a lignite, possessing 10,800 lb.-Fahr. heat units per pound, which deteriorates rapidly when exposed to the weather. Thus it is unsuited for shipping, but can be used with excellent results at the mine, where it can be purchased at from 75 to 90 cents per ton. The energy obtained from this coal is transmitted, not only for the ordinary village services, but it is used to a large and increasing extent for agricultural purposes, such as driving feed grinders, threshing machines and particularly irrigation pumps. The character of the service is such that during the coming season it is confidently expected that the maximum load will occur during the day at midsummer rather than at night during midwinter.

The generating station, which contains two 2000-hp, 60-cycle, three-phase, 13,000-volt, and two 1000-kw, 25-cycle, single-phase, 11,000-volt Westinghouse-Parsons steam turbo-alternators, is located near the village of Louisville, in the vicinity of which are many of the lignite mines. The station contains transformers for decreasing the 60-cycle e.m.f. from 13,000 to 2400 volts, for distributing energy in the villages of Louisville, Lafayette and Superior, and to 40,000 volts for a 66-mile transmission line for delivering energy to substations located at Longmont, Berthond, Loveland, Fort Collins, Windsor and Greely. Each of these substations is designed for an ultimate equipment of 600-kw in transformers. An additional substation is located at Boulder, to which energy is transmitted over a 10-mile line at the generator e.m.f. of 13,000 volts. This station has been designed for a 1200-kw transformer installation.

The 25-cycle turbo-generators are used for operating the 11,000-volt, single-phase railway which maintains an hourly service between Denver and Boulder, a distance of 28 miles. The rolling stock of this road, which is known as the Denver and Interurban, consists of eight motor cars and four trailers. Each of the former is provided with four 125-hp conductively compensated motors of the Lamme type. These cars operate not only on the 11,000-volt trolley between towns, but they use the 600-volt direct-current trolley in Boulder. In spite of the handicap of the complications incident to the use of both single-phase and direct-current controlling devices, the equipment has proved thoroughly satisfactory.

The local street railways in Boulder and Fort Collins are supplied with direct current from the substations at those points. Through the former substation energy is transmitted over three-phase, 13,000-volt circuits to Salina, and circuits for the same electromotive force are being constructed to Eldorado Springs and Semper. Energy is also delivered from this substation at 2400 volts three-phase to Goldhill. From the Greely substation a 6600-volt, three-phase line extends to Pierce, and a loop line will be erected from this substation to the generating station by way of La Salle, Plattville, Lupton and Brighton. There are in use at the present time about 60 miles of secondary 2400-volt circuits from the various substations used for delivering energy to pumping motors.

For the purpose of providing a storage of water for irrigation and insuring a supply for the steam condenser, a reservoir capable of holding 28,000,000 cu. ft. was formed by constructing a clay dam 30 ft. in height and 2700 ft. long for impounding water over 56 acres near the generating station.

Porcelain insulators held by wrought-iron pins mounted on cedar poles are used on both the 13,000-volt and the 40,000-volt lines. On the former line the spacing of the wires is 26 in., while on the latter it is 48 in.

In the various towns mentioned above there were formerly operated steam-engine driven generating stations for the local service. The service obtained from the transmission system outlined above has proved so satisfactory that the local steam plants have been dismantled.

In view of the very advantageous time-factor of the pumping load it is interesting to note the price obtained by the company for this service. A readiness-to-serve charge of $1 per hp per month is made on each motor installation, and a charge of 3 cents per kw-hour is made for all energy actually consumed. Actual results show that at these rates one acre-foot of water can be elevated 27 ft. for $2.42, which includes 6 per cent interest and 6 per cent maintenance on both the pumps and motors. This price has proved attractive to the farmers and profitable to the company. The rates for lighting are based on a sliding scale, with a maximum of 10 cents per kw-hour, and average about 7.5 cents. For sign and decorative lighting a charge of 5 cents per kw-hour is made.

The president of the Northern Colorado Power Company is Mr. Wm. J. Barker, and the general manager Mr. C. H. Williams. The work of construction was performed by Westinghouse, Church, Kerr & Company. The credit for originating the project noted above is given to Mr. Joseph J. Henry, who was the first vice-president of the Northern Colorado Power Company.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Ohio Question Box.

At the Ohio Electric Light Association, July 13 to 15, during various intervals of the convention as opportunity offered the question box was taken up. The following are some of the questions:

What method should be pursued with consumers having motors when the company wishes to change its service from 125 cycles to 60 cycles?

Mr. W. C. Anderson, of Canton, said that his company made such a change several years ago. The only motors which required changing were fan motors, which involved a relatively small expense. Mr. F. M. Tait, of Dayton, said that in the case of such a change the company should bear the expense. It is unfair to the consumer to require him to buy new apparatus when the advantage of the change is enjoyed mainly by the company. Upon a vote, asked for by the chairman, it appeared that only six stations of those represented are operating 133-cycle service. This, however, does not give an adequate idea of the relative number of plants which still operate at high frequencies, as it is mainly the small plants not represented at conventions which still retain high-efficiency apparatus.

One member asked the question whether there is any benefit in changing from 125 cycles to 60 cycles if there is nothing but

lighting load to be obtained. Mr. F. M. Tait replied that it would be a very peculiar location which would not offer some power business. Assuming that there really was no power business, there would be no advantage in changing to the low frequency.

Another question was as to which is the best combination for a town of 10,000 inhabitants: (a) Three-phase generators and three-phase distribution? (b) Three-phase generators and single-phase distribution? (c) Single-phase generators and single-phase distribution?

Mr. F. M. Tait expressed the opinion that a three-phase generator should by all means be used in a town of this size, the distribution being single-phase or three-phase, as the various local conditions in various parts of the town require. If desired a considerable percentage of the output of a three-phase generator can be obtained from one of the phases, if desired.

Another question was: In stations of 400 kw or less, what method can be used to create interest among the employees in economical operation?

Mr. J. R. Cravath, of Chicago, told of the premium plan in use in some of the Wisconsin plants, most notably the one at Sheboygan, where the power-house force gets a certain percentage of the amount saved per kw-hour below a certain fixed kw-hour cost. Mr. W. C. Anderson, of Canton, said that it is his company's practice to allow a certain amount of coal per kw-hour to give 30 per cent of the saving below this amount to the boiler-room force. Mr. A. A. Pointer, of Antwerp, gives a part of the coal saving to the fireman.

The Commercial Organization of Electric Light Companies and Its Relation to the Public.

Papers on the above subjects were read in the Ohio Electric Light Association convention July 14 by Messrs. W. E. Richards, of Toledo, and C. C. Custer, of Piqua, Ohio.

Mr. Richards said that many of us have come to regard our few solicitors as constituting the entire commercial organization of the company, and perhaps they do. Opportunity and dividends are now often lost by relying upon only 2 or 3 per cent of our forces to promote friendships, sell our products and satisfy our consumers, explain our system, extol our virtues, gloss our faults and preach our doctrines; while the other 98 per cent daily shed their allegiance and their interest when they don their coats and hats, all because we tell them nothing of the company's business outside their own dull daily grind. Numberless chances for substantial benefit and assistance to the company are thus lost. The soliciting and operating forces rarely know the relations of the earnings and expenses to each other. Expenditures or improvements are planned in ignorance of their true desirability, and disgust and disheartenment follow their unexplained curtailment. The clerical force knows little of the difficulties and drudgery of the selling and operating departments. Few of our employees can explain to their friends the company's attitude on the every-day local, commercial or political questions, and can neither justify nor defend it when necessary.

A wider acquaintance with his company's business raises the employee's value and strengthens his influence among others. Every member of the organization unfailingly impresses his personality, ability and character on the composite picture which forms the public opinion regarding the company. Therefore, in reality every member from president to coal-passer is a part of the commercial organization which makes or breaks the company's business. These diverse elements should be brought together frequently for better mutual understanding and instruction. No company is too large or too small to benefit from a policy of broader training for its employees. The best and cheapest commercial organization is a united and interested force of employees who comprehend the general affairs of the concern and the conditions, whether physical, commercial or political which enhance or hinder the prosperity of the business. Communities are not unjust save because of misinformation, and it lies largely in the power of the management to prevent these misapprehensions through the judicious direction and instruction of the employees, who form an active element in the community.

Mr. C. C. Custer in his paper pointed out that large public-utility plants were a necessity to the prosperity and public welfare in any city. The relation between the company and the public should thus be one of mutual benefit. The city must be of sufficient size to offer an attractive field for development. If a town is too small to support a well-built plant, it were better to "hitch your wagon to a star" of greater magnitude by running a transmission line to a larger plant. The public should concede a long-term franchise that the investors may be sure of permanent investment. The generating station, besides being economical so as to furnish service at reasonable rates, should be of neat and modern design so as to be pointed to as one of the city's substantial local industries. It is well that a considerable portion of the stock and bonds of the company be placed locally, in order to strengthen the local standing of the company. While there are some kinds of patronage that will naturally come to the electric light company, there is a much greater amount that is either competitive or needs developing. The company should see that all new buildings that go up are wired for light and power by getting in touch with the owner and architect. The character of load to be most eagerly sought is the daylight or the off-peak load, in order that the load factor or ratio of the average to the peak load may be kept as high as possible. As the only cost factor increased by securing more day load is the fuel bill of the station, it is possible to take on power load on a competitive basis. If a medium-sized town can afford more than one large and efficient power plant the electric generating station becomes a positive power in the community to foster small manufacturing industries. Looking back over a period of 10 years in a town of 15,000 population with natural gas at 25 cents per 1000 cu. ft., he finds an accumulated connected load of 400 hp in motors, a peak load of 800 hp and a total annual income of $4 per capita, but many another plant has put this to shame in certain lines of development. The light and power plant which is most progressive in business-getting methods, and most active in filling and developing its own local field, generally enjoys the most prestige with its patrons and is least harassed by the bugaboo of municipal ownership.

DISCUSSION.

Mr. D. L. Gaskill said that as secretary of the association cases of trouble between Ohio central-station companies and municipalities usually come to his notice, and in 9 out of 10 cases the trouble really started with the company. Wherever a business has no competitor the management is likely to get into a rut.

Mr. F. M. Tait suggested that a convenient way of learning the sentiment in a community regarding the company is to get a stranger to visit a town and talk to various people, who will usually express the true sentiment as they would not to one known to be connected with the company.

Mr. Gaskill said that while this plan was a good one, it was not always feasible in a small town to make a frequent check of this kind, so it was his custom to get some of his friends in the town to perform the same service by reporting to him the sentiment of the community.

Mr. J. C. Martin, of Wilmington, said that a stranger recently investigated the public sentiment in his town regarding his company on behalf of Eastern stockholders. He had found that the most successful way to get new business is to give the service. He had changed his plant from dusk-to-midnight service to all-night service, and then to 24-hour service. One point of interest in connection with his power business which he mentioned was the operation of separate two-phase feeders for power customers. These power feeders are cut out at night, both to stop the core loss on the transformers and to serve as a check on power-users who are under contract not to use power during the hours of the lighting peak.

Care of Electric Automobiles in St. Louis, Mo.

In 1906 there were only 17 electric automobiles in the city of St. Louis. The management of the Union Electric Light & Power Company decided that the only way to foster the electric automobile business and to get a start on a satisfactory basis would be for it to maintain a garage of its own. This was done. A garage was opened on one of the principal streets centrally located with reference to the great western residential district of the city. After starting this garage it was found that it also would be desirable to have agencies for electric automobiles. Consequently the company secured the agency for the Rauch & Lang, Studebaker and Columbia electric vehicles.

A rate was established for the care and maintenance of vehicles. This rate is $30 per month for pleasure vehicles weighing less than 2000 lb. This includes charging, cleaning, renewing of the battery electrolyte and general maintenance. If a customer wishes the vehicle delivered and called for by the garage employees an added charge of $5 per month is made.

As a result of this effort, by the spring of 1909, three years after the garage was started, there were 300 electric vehicles in the city. Of these 74 are being cared for in the company's garage and 52 are being kept regularly at the garage. There are 50 electric trucks operated out of the Anheuser-Busch brewery.

The system of battery maintenance and records at this garage is one of the most complete in the country. There are 64 charg-



FIG. 1.—ELECTRIC AUTOMOBILES.

ing circuits in the garage which start at a central switchboard and terminate in receptacles along the walls and at pillars Each circuit has a single-pole, double-throw switch. When this double-throw switch is thrown one way it connects its charging circuit directly to the regular charging bus. When it is thrown the other way it is connected to a bus that is supplied through an ammeter. In this way the amount of current in any one of the charging circuits can be instantly determined by throwing the circuit on the ammeter bus.

A log sheet covering half a day's operations is kept at the switchboard and the switchboard attendant must take readings every half-hour of the amperes flowing to each battery and the total voltage of the battery. Batteries are fully discharged twice a week. If the owners do not discharge the batteries on the road they are discharged through a lamp bank in the garage This artificial discharge is made at the four-hour rate down to a point where the batteries show 1.7 volts per cell when discharging. A voltage reading is taken of all of the cells in each vehicle about twice a month. For this purpose a monthly folder is kept for every vehicle in the house. On the other side of the folder is the name and address of the owner and a line for each day of the month, together with columns in which to enter the time "in" and "out," a. m. and p. m.; whether the battery was watered; whether the vehicle was washed, oiled, controlled inspected and motor inspected, also odometer reading. The hours charging and maximum temperature of batteries are noted on the daily log sheet. It is, therefore, not necessary to put it on the individual record card. The average life of positive plates is about 18 months; some plates are run 26 months. It is found that the average mileage of vehicles which are in regular service for customers who do a great deal of driving is 45 miles per charge; this is for driving both in the city and the surrounding country.

Vehicles which are not regular "boarders" at the garage, but which are taken care of by the company, are brought in every two weeks. The garage is in alternating-current territory, but is supplied with direct current from a substation in the rear The garage basement is fixed up for battery repairs and here batteries are taken apart and assembled. Motors which need repairs are taken to the company's motor repair department in another part of the city; meters which need repairing are taken to the company's meter department. Thus the garage is prepared to give the best of attention to every kind of repairing. Transients are charged at the rate of 10 cents per kw-hour with $1 minimum for the care and attention required. Private garages are put on the company's regular power rates, which are too elaborate for repetition here. They were given in the *Electrical World* of March 7, 1908.

The manager of the garage makes it a point to teach all customers carefully the proper handling of vehicles. The customers are educated to watch the indicating instruments on the vehicle and in this way battery abuse and neglect are consider-

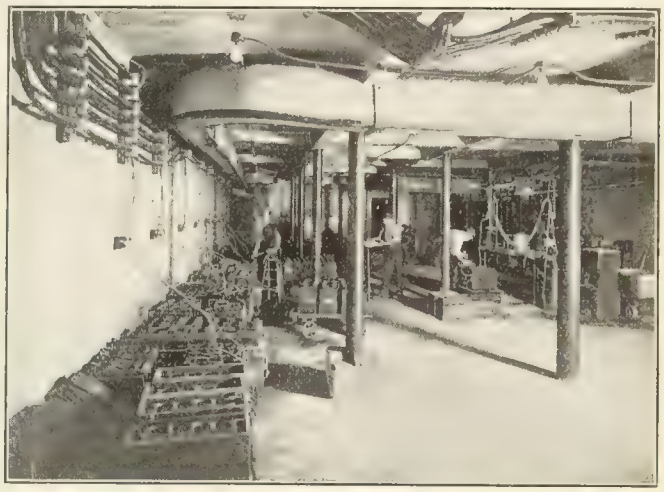


FIG. 2.—CHARGING PLANT.

ably reduced. When an employee from the garage goes to call for a machine he has instructions to examine it carefully before starting to be sure that there is nothing broken. If anything is found defective he must report such defect to the owner at once. This is to avoid any questions as to whether a damaged machine was damaged by the employee sent to bring it to the garage or in some other way. It may happen that the machine was damaged by the owner or that it was run into by some other vehicle while standing in the street before the garage employee called. The automobile department of the company is in charge of Mr. Charles E. Michel, who has built it up to its present state of efficiency.

Factors to Be Considered in Making Street-Lighting Contracts.

Mr. Samuel Rust, in a paper before the Ohio Electric Light Association at Toledo, July 14, gave the following points which should be considered in making a street-lighting contract with a city:

These various factors he groups into length of contract; kind and number of lights; changes in position of lamps; outages; schedule burned; time of payment; cost of service, and manner of contracting.

The length of time that a street-lighting contract should run is a very essential factor to be considered by both parties to the bargain. The statutes of Ohio have fixed the maximum at 10 years. The question is: Should contracts be for any less

period? If the company is a progressive one and keeps abreast of the times in adopting new improvements for its street-lighting service, it should most assuredly not be less, as it can count upon completely changing its street-lighting equipment at least once in every 10 years and this calls for an outlay that shorter-time contracts will not justify. Every street-lighting contract should provide that the company furnishing the lights should have the right to change its system to a newer or better system giving equal or better service during the life of the contract, subject to the approval of the council or board making the contract. Instead of this provision injuring the municipality, the city would profit by getting the benefit of the improvements in electrical service which are appearing so frequently, and it would be an incentive to the company to furnish the city with the best and most up-to-date service.

The proper method of dealing with outages is probably yet to be found. To compel the company to stand the exact price of the lamp when it is extinguished and should be burning is unfair to the company, because of the equipment cost and fixed expenses which always exist; while to excuse the company for continued outage would likewise be unfair to the municipality. A good plan is to agree in the contract just what the outage should be per hour per lamp, and it is suggested that the amount be two-thirds of the price received for the lighting of the lamp.

The kind of lamps to be used in lighting a town or city must depend somewhat upon the size of the municipality. Companies should be careful not to over-light a city in the beginning; as all municipalities grow rapidly and there is a constant increase in the number of lights wanted, the lighting bill may otherwise become too great in comparison to other city expenditures and produce dissatisfaction. While most municipalities do not make any mistake in this regard and are generally under-lighted, there are some that have more lights than the city can well afford to pay for. This is like over-selling a man in goods. He may pay for the goods, but it always results in a dissatisfied customer. In the smaller municipalities it is a question whether the series tungsten will not in time supplant arc lighting entirely. Its economy of consumption and consequently lower price will enable the introduction of a largely increased number and avoid the shadows of foliage which is always dense in the smaller towns.

The number of lights that a municipality can use will determine in some measure the price that should be paid. The price for a street lamp should not be fixed without taking into consideration the fact that the fixed expenses of the plant, sometimes called overhead expenses, will be the same whether 50 or 100 is contracted for.

The schedule that lamps are to be burned must also depend upon the size of the municipality. It is a mistake to furnish all-night and every-night service in towns of less than 5000 inhabitants; for such towns a moonlight schedule is preferable, but every contract should provide that in case the nights are cloudy or stormy, the lights should be burned. Where the town is above 5000 and under 10,000 inhabitants, it is a very good plan to have the contract provide for four nights off in each month, unless they are stormy or cloudy. By doing this the plant is enabled to make repairs to its arc-lighting equipment, without sustaining outages, and plants in cities of this size cannot afford to have so large an equipment as will guarantee continuous service. Cities that are above 10,000 will usually require all-night and every-night service, and usually justify a sufficiently extensive electrical equipment to enable the company to give every-day service on its street-lighting service without inconvenience.

The time at which bills should be paid should always be stated in the contract. It is preferable to make it monthly. To allow bills to grow too large causes the public to murmur at their size.

The manner of contracting in Ohio has been the subject of considerable controversy, but it seems to be the practice to make such contracts without competitive bidding, though a very large proportion of the contracts have been made without such bidding. The revised statutes provide that the Council of any city may authorize a contract with any person, firm or company for lighting the streets, lanes, lands, alleys, squares and public places in the municipal corporation for a period not exceeding 10 years, and the requirement of a certificate that the necessary money is in the treasury shall not apply to such contract.

Many street-lighting contracts are made below actual cost. The following figures are based upon the average cost of a small plant of 100-arc-light capacity, taking into consideration cost of construction, maintenance and operation, and using the standard enclosed-arc system:

It is estimated that each lamp will consume 600 watts per hour, and the time of burning being 4000 hours per year, this gives a total consumption of 2400 kw-hours. Estimating that the average small plant will require 6 lb. of coal per horsepower, the coal consumption for each lamp would be 9.65 tons, which figured at $2.50 per ton in front of the boilers, would be $24.12. The lamp will have to be trimmed about 50 times, and will consume 50 pairs of carbons, costing $2.30. The repairing, time and material would amount to $5; cost of installing about $120 per lamp, and figuring 10 per cent depreciation, would amount to $12 per year. The cost of labor and salaries would aggregate $12 additional, and the interest upon the investment $7.20, or a total cost of $63.62 per year. To show that these figures are certainly low he refers to the report of the commission appointed for St. Louis to investigate the advisability of that city providing its own street-lighting system, in which they found that the cost of operating an arc lamp for a city the size of St. Louis would be approximately near $70 per annum.

DISCUSSION.

Mr. F. M. Tait called attention to the difficulty experienced by nearly every company in making a street-lighting contract from the fact that the prices vary greatly in different cities and a company making a new contract with the city has to make prices to compare favorably with the lowest of those which come under the notice of the City Council without regard to whether the conditions are the same as in the other city under consideration.

Secretary D. L. Gaskill, of Greenville, said that the compilation he had made of prices obtained for street lighting in Ohio had been in great demand not only from Ohio companies, but from all over the world. He is now getting up a new set of figures giving street-lighting rates in Ohio. The situation at New Philadelphia, where the central-station company is trying to renew an old contract of $34 per lamp per year at a higher rate, came in for considerable discussion. This old rate was the result of competition between two companies. Mr. George C. Osborne pointed out that the income per kw-hour received for street lighting varies all the way from 16.6 cents to 3 cents in the State of Ohio.

Mr. F. M. Tait thought it policy to make rates for street lighting to the city as low as possible, both to promote good feeling and remove any temptation to start a municipal plant. In reply to a question as to the number of series tungsten street lamps in use in the United States he replied that from the information which the General Electric Company had there were about 150,000 tungsten street series sockets connected. The rates are from $12 to $48 per year.

Mr. Claude Smith, of the Bradford & Gettysburg Electric Light & Power Company (which purchases power from the Greenville Electric Light & Power Company and transmits it to Bradford and Gettysburg, which are towns too small to support profitable individual plants), reported receiving a rate of $48 per year for a 75-watt series tungsten lamp. While this rate may seem high, Mr. Smith explained that in starting service to such small towns it is necessary to have a street-lighting contract at good prices as a basis upon which to obtain money and to justify the building of the transmission line and distribution system. In connection with this rate, it must also be remembered, he said, that a gasoline street lamp giving an average illumination no better than the 60-cp series tungsten actually cost the town $65 per year before the company started service.

INTERIOR WIRING AND ILLUMINATION

Electric Light Company Presents Monster Sign to Montgomery, Ala.

The accompanying illustration shows the sign presented by the Montgomery Light & Water Company to the city of Montgomery, Ala. The picture was taken just before the sign was completed, and shows the men at work in the framework which holds the letters. The sign, which is lighted by some 2600 lamps, was the outcome of an idea of Mr. George Williams, connected with the Doherty interests. It is 85 ft. long and 75 ft high. The slogan adopted is the outcome of a contest opened to all citizens of Montgomery, the key being the idea of a woman, and the wording, of a local newspaper reporter. In



ELECTRIC SIGN BEFORE COMPLETION.

addition to the words and key shown there is a sky-rocket effect added and the sequence of operation is as follows: A single line of lights comes up like a skyrocket, and at the crest of its long curve breaks into a shower which plays about the key studded with red lamps. Then "Montgomery" in white appears followed by the lower line "your opportunity." The key remains lighted all the while, and the upper and lower lines are flashed on and off alternately. It is said that many hundred thousand persons pass through Montgomery, Ala., yearly, who do not know the name of the place, so that the sign should serve as a good advertisement for the city. The upper row of letters is 10 ft. high and the lower row 6 ft. The sign is erected on the roof of a factory in North Montgomery.

Printing and Illumination.

Within the past year there has been considerable discussion in the technical press regarding the kind of printing which is best from the standpoint of the illuminating engineer. A suggestion has several times been made of late that light letters on a dark background would be far preferable to the method now employed, on the ground chiefly that white letters on a dark ground could be read with less unnecessary stimulation of the eye than dark letters on a light ground. It is an interesting suggestion, although far from a novel one. To the best of our remembrance it has cropped out off and on for the last 30 or 40 years and the earliest suggestions probably go back much further even than this. Since the general use of electric and other brilliant lights, modified forms of printing have a larger significance than before on account of the undoubted over-stimulation that comes at times from working with too brilliant illumination. Save for occasional exhibits of an illustrative nature, very little has been done in a practical way, so that data based on actual use are conspicuous from their absence in the discussion of the problem. To go into the history of the matter, some 35 or 40 years ago the blue-glass cure was a popular fad. Some of our readers have possibly seen windows glazed with alternating panes of clear and of cobalt-blue glass still remaining as the relics of a panacea which in its day had as many alleged cures to its credit as the psychotherapy of later years. If we remember aright, some of the literature circulated by the originator of the blue-glass cure was in white ink on blue paper and later in blue ink on white paper. So far as we know this is the first reduction to practice of the suggestions now under discussion. The dark background in this case was chosen, not with any scientific view of improving contrasts, but merely for the supposed hygienic value of blue radiation.

As regards general facts in the case, it is undeniable that much printing as at present done is exceedingly bad for the eyes. The early printers, using a dead black ink on hand-made matt surface paper, frequently not bleached to a brilliant pure white, certainly obtained results in legibility that have never been surpassed and seldom have been equaled since. In fact, the first printed book—the "Mazarin Bible," dating from 1455—has never since been equaled as an example of the printing art. As time has gone on, chemical bleaching processes have been applied in the manufacture of paper, while the half-tone cut, requiring an extremely smooth surface for its successful reproduction, and cheap quick-drying inks, have come into extensive use, with the result of greatly decreased legibility under ordinary conditions of light. But the fault with modern printing lies not in the use of black letters on white paper, but from the fact that the white paper has generally so smooth a surface that it produces a very strong element of specular reflection, giving a glitter that is altogether distressing. Much of the ink used, too, has a brilliant surface as if varnished, so that it too possesses a considerable power of specular reflection, with the result that the combination inflicts upon the eye an amount of light that is certainly harmful. To these peculiarities rather than anything else is due the complaint of unhygienic properties in modern illuminants. Under these common conditions of printing a change to white letters on a black ground will probably do harm rather than good. It is nearly impossible in printing to produce considerable areas of uniform black, and even a paper colored black or some very dark tint in the web would be far from having a uniform matt surface. If an opaque white ink suitable for printing on such paper could be produced, it would still leave an unsatisfactory background and would probably have, like the present black inks, a surface permitting considerable specular reflection. Moreover, the fact that the white letters would have less area, permitting brilliant reflection, than the background of the printing now has, is not significant. It is not the area that produces trouble, but the over-stimulation of any part of the area. The mischief is done by the too intense light and is great in proportion to the intensity. One could get, therefore, quite as serious results from over-illuminated white letters as from over-illuminated background, inasmuch as the damage to the eye is chiefly done, not by pure exhaustion of the retina, but as the result of the inflammation produced.

The remedy for existing conditions apparently lies in the reduction of extreme contrasts by the simplest possible means, and especially in the use of matt-surfaced papers and dead black inks for all printing designed for close application. Some of the very worst examples are to be found in text-books in which highly calendered paper is employed to facilitate the use of half-tone cuts. All printers are sinners alike in this matter and they probably will continue to sin so long as a good and durable matt surface paper remains high in cost. The cry is for cheap books, which implies the use of cheap paper and cheap inks. When the public is willing to pay a small additional price for well-made and durable books of permanent valve, reform will be easy. An elimination of the extreme

contrasts between background and printing is the vital point in any such reform, and this can readily be secured by using a matt-surfaced cream-colored paper and high-grade inks, using line cuts where illustrations are necessary, except in the case of inserted plates. Slightly larger type than is customarily used in books which have to be comparatively cheap will still further increase legibility. The one vital question is not the use of black letters on a white ground against white letters on a dark ground, but the reduction of contrasts and the elimination of specular reflection. An excellent example of the very bad results which have been produced by white letters on a dark ground may be found in the ordinary school blackboard. In fact, some well-informed oculists have advanced the opinion that conditions would be greatly improved by using a light background and a dark crayon on account particularly of lessened trouble from specular reflection. Even the most careful writing on blackboards is from certain angles of view almost illegible, and anyone familiar with school conditions realizes the trouble which is practically produced in this way. One would hear of relatively few complaints about the trying effect of modern illuminants if people kept the direct light out of their eyes, and carefully avoided direct surface reflection.

Park Lighting at Oklahoma City.

Recently the Oklahoma Gas & Electric Company presented to Oklahoma City the equipment for lighting Stiles Park, one of several small circle parks at intersections of streets with the new 26-mile boulevard. The equipment consisted of eight concrete posts, four carrying three globes and four carrying single globes. The posts are of reinforced concrete, hollow



THREE GLOBE CONCRETE POST AT STILES PARK.

and hexagonal in design, manufactured by the Hollow Concrete Pole Company. They are surmounted by ornamental copper caps which carry the lights.

The lighting of the three-globe posts consists of one upright 100-watt tungsten, and two 60-watt tungstens suspended from 12-in. arms. The single globe posts are lighted with 100-watt tungstens. This lighting supplants one enclosed arc formerly hung from a 60-ft. pole in the center of the park. The popularity of the park has greatly increased since the installation, the present use being more than double the former attendance. The residents of McKinley Avenue have petitioned the council to install 100-watt tungstens on 57 concrete poles now carrying the company's lines along that thoroughfare.

New Telephone Patents.

COIN COLLECTOR.

Pay-station coin collectors are of many different types. In some collectors the coin taps a bell, in others a lever must be pulled. Still others require the deposit of a coin to complete the electrical circuits. Some collectors of the prepayment type are made for returning a coin if the connection for any reason is not carried through. Heretofore the operator has had one key to depress to deposit a coin and another to return a coin to the subscriber. To simplify this operation is the object of an invention of Mr. S. J. Larned, of Chicago, Ill., the patent for which is assigned to the Western Electric Company. In his system the circuits may be so arranged that in case a connection fails, the patron manipulates the return of his coin.

PARTY-LINE LOCK-OUT SYSTEM.

Messrs. H. J. Roberts, of Evanston, Ill., and C. A. Soans and A. H. Graves, both of Chicago, have jointly patented a party-line lock-out system. The system is arranged so that harmonic ringing may be used, and the application of the proper current not only effects a call, but operates the lock-out devices.

The system is upon the bridging basis and the stations are not interdependent. An emergency signal is provided so that one locked out may signal central of this condition.

All circuits are metallic, and the system is adapted to complete common-battery working. The patent is assigned to the Homer Roberts Telephone Company.

Letters to the Editors.

Effect of Seasons on Wireless Transmission.

To the Editors of Electrical World:

Sirs:—While the difference between the range of a wireless station in day and in night has been more or less satisfactorily explained, little seems to be known about the reason for the enormous difference between the carrying power of a station at night in summer and in winter. I submit the following notes, made during the past year, while I was employed as wireless operator on a steamer running to South America, in the hope that they may lead to discussion or investigation which will clear the matter up:

About Oct. 1, 1908, long-distance signals—that is, coming from stations more than 300 miles away—began to be noticed in the evenings about 8 o'clock, but would be too weak to be readable until about 9:30, when, within a space of about 15 minutes, they would increase to about three times their original strength and remain so until daylight. This continued during October, the time at which the signals would become strong, getting gradually earlier, until by the middle of November the time at which they would be readable was about 8 p. m. The greatest distance recorded up to this time was 700 miles. As the winter approached the suddenness of the increase in strength gradually disappeared and signals were heard earlier and earlier until in about the middle of December, distant signals could be heard even before it was quite dark and, a little later in the evening, stations in some cases 1500 miles away could be heard as strongly as a station 100 miles away in the daytime. From the middle of December until the first part of April I was in communication with our stations up to distances of 1200

miles, the communications being reasonably reliable, although at times much trouble was experienced from interference from other stations. The instruments used were a 1-kw set, designed for communication for 200 miles.

As the spring approached the time at which it was possible to work long distances became later and later, and I first noticed the difference which the wave-length made. By the middle of May, short waves—that is, waves shorter than about 800 m, would not be noted until about midnight and then not for distances of more than 500 miles, while longer waves did not seem to be affected at all. Moreover, anywhere south of the latitude 30 deg. N. a heavy "static" discharge, an almost continuous roar, would start about 8 p. m. and continue until daylight. About this time, also, the strength of signals from all short-wave stations would change enormously and very quickly, the change affecting different stations at different times. In 10 seconds the strength of a station's signals would change from strong to nothing, and as quickly back again, making satisfactory communication with a station out of ordinary daytime radius an impossibility.

By the first of June the long-wave stations began to be affected, but not nearly as much as the short-wave stations, and as late as June 10 I heard the South Wellsfleet station, 1200 miles away, although it was impossible to read his messages on account of the "static."

At the present time the distance over which it is possible to transmit from a short-wave station is usually even less at night than in the daytime, as the "static" is worse at night, while the signals seem not to be appreciably stronger. This is particularly the case in the tropics, where, at this time of the year, it is almost impossible for a ship to telegraph over more than 100 miles at night.

Aside from this gradual change there is another change which is noticeable at any time in signals from stations much more than 200 miles away, but is particularly noticeable in the winter. A station's signals will be received strongly and steadily for several hours and then suddenly they will fade away in five seconds or less, and will not be heard again for perhaps an hour. In some cases the change is due to defective insulation at the sending station, but in the greater number of instances it must be due to some change in the absorptive power of the atmosphere between the two stations.

I have been unable to determine any relation between the strength of long-distance signals and local weather conditions. On some nights the signals would be good, while on others they would be poor; but while there might be a 50-mile gale on one good night, the next good one would be clear and calm, with not a cloud in sight, etc. I had no way of measuring either the exact strength or the wave length of the signals, so that my estimates are only approximate. I hope, however, that this letter may be the means of throwing some light on the subject.

ATLANTIC CITY, N. J. AUSTEN M. CURTIS.

Value of Classics in Engineering Education.

To the Editors of Electrical World:

SIRS:—A subject so large as that touched upon in Dr. Steinmetz's Frontenac A. I. E. E. paper—the utility of the classics in engineering—requires, it would seem, to be considered from a number of different standpoints in order to arrive at a proper judgment. The time expended in the study of the classics, the benefits obtained from the time so expended as compared with other studies, and many other questions call for consideration. It is coming clearly to be recognized, however, that it is out of the question for the average boy to study classics, unless in a very superficial way, owing to the pressure of necessity in other directions of study, and of the little time that can be spared in school years for such work. The only remaining question is that affecting classics in the school curriculum of the 1 per cent, or less, of boys who have both the money and the inclination for a college career.

One specific value of classical education peculiar to America is, however, the value incident to a long, steadily maintained, inflexible intellectual discipline, which is particularly needed for the youth of the North American race. Owing to the barrier of the Atlantic Ocean—in early days much greater than at present—the emigrants who elected to pass that barrier were necessarily more enterprising and more restless than those who stayed behind in Europe. By necessity an artificial selection of stock was set up, the accumulated products of which have been retained in this country by inheritance. We have, therefore, in North America a stock that is markedly more enterprising and restless than that of its European parentage. These qualities are good, but they also involve defects. Among such defects appear to be instability of purpose and changeability of design. This tendency should be combated in youth by rigorous discipline, gradually relaxed as adult life approaches. The present educational system of this country lacks the rigor and discipline that are particularly important for the people that have come to inherit the land. In time it is to be hoped that these defects will be realized and minimized. Meanwhile, the rigid intellectual discipline of a classical education should have special vaue in America.

CHICAGO, ILL. J. K. HERMANN.

To the Editors of Electrical World:

SIRS:—The study of the so-called "classics" by an engineering student seems to the writer a sinful waste of time. We are to judge the propriety of a course of study by the reasons advanced for its pursuit; those given by the advocates of dead languages are wholly unconvincing. Dr. Steinmetz's dismissal of the equivalency of the study of modern languages with a rather slighting allusion by no means disposes of them; he should, I think, point out in what particulars there is an essential difference in the study of any two languages as a means of mental discipline. Really to know any language having an extensive literature is a work of a lifetime, though I grant freely enough that the veneer of acquaintance given by a course such as is prescribed in most schools is not to be considered. But just why is not a critical and minute acquaintance with Dr. Steinmetz's vernacular or the French not a work of culture of the same class and difficulty as the translation of Virgil and Horace, at least as they are rendered by the average student?

I feel sure that the most enthusiastic exponent of Latin and Greek will admit that they are quite useless so far as the information which is only to be obtained in those languages is concerned. From Cæsar to Tertullian it has all been done, as the old translators say, into all the tongues of the globe.

The fact is, the study of languages involves only memory, and has no relation to the cultivation of the reasoning powers; it is a fetich, nothing more. In ancient times, when knowledge (especially in the sciences) was recorded in Latin, so as to be available on equal terms to workers in all countries, it was natural enough to preface the real study by drilling the pupil in the vehicle of instruction, but to suppose that it was so done because of any "cultural" effect is to put the cart before the horse. It was thus arranged for exactly the same reasons that move an American student to study German before matriculating at Leipzig or Berlin.

Of course, a knowledge of root-forms is often useful, in any language; but it is acquired at too great cost by giving up hours to the study of the orthoepist. In the end, we must give up something; we people of ordinary abilities cannot, like Herbert Spencer, take all knowledge for our province; we shall not succeed as well as he—even!

For 12 years I spent an hour or more every day reading Latin under a competent master; my regret is that the time was not passed in mastering a modern tongue, colloquially and accurately. I have never gone hungry for lack of Latin; I have for lack of Spanish. If we want pure culture, study quaternions; they have "no base utilitarian purpose."

NEW YORK. THOMAS J. JOHNSTON.

Why Not Advertise the Telegraph?

To the Editors of Electrical World:

Sirs: A Chicago daily newspaper recently called attention to the fact that while electric light and telephone companies, steam-railroad and electric-railway companies direct attention to the service they perform by advertising through various mediums of publicity, the telegraph companies do practically nothing of the kind. This policy is criticised as unwise and old-fashioned and as accounting in large measure for the prevailing idea of the backwardness of the telegraph service in this country compared with other public utilities.

It would seem that the telegraph business of the country could be greatly increased—perhaps doubled or trebled—by judicious advertising, particularly coupled with a reduction in rates for which the increased business would give ample warrant. But this course has never been followed by the great telegraph companies, and it is a matter of curious interest that this is the case. So far as the rates are concerned, they have been increased rather than diminished in recent years, whereas in almost every other line of public service the tendency is in exactly the opposite direction.

What is to prevent the creation of new business for the telegraph companies by well-planned campaigns of publicity? In England the telegraph is much more familiar to the great mass of the people and used to a much greater extent, proportionally, than in the United States. This is not because the telegraph is controlled by the Government in Great Britain and not in this country, but rather because the rates are low and the service reasonably good. Of course, the distances are very much greater in the United States; but nevertheless it is true that the great body of the American people, including the business community, regard the telegraph as something apart, to be used only in case of emergency. It seems to be apparent that there are latent possibilities in the business which have not been fully realized either by those in charge of it or by those who patronize it. Telegrams receive more prompt attention than letters, and, to mention one instance, it would seem that a greatly extended use of the service could be made by business houses in large cities in keeping in touch with country customers, often saving the expense of a visit from a traveling salesman.

Judging by the experience of other electrical utilities, it would seem to be high time for the telegraph companies to realize the merits of advertising and tell the people why they should make a more every-day use of their service. This policy, coupled with a judicious reduction in rates, ought to work wonders in popularizing the use of the telegraph. Should the present *laissez faire* policy of the telegraph companies continue there is little doubt that the Government ownership of telegraphs will some day become a live national issue, and, moreover, will have at least the passive sympathy of large bodies of men not personally in favor of the principle of Government ownership.

Chicago, Ill. Chas. L. Thompson.

The Hysteresis Equation.

To the Editors of Electrical World:

Sirs:—In an article on "Power Characteristics of the Tungsten Lamp," printed in your issue for July 8, 1909, Dr. Steinmetz says:

"This law of hysteresis ($w = \eta B^{1.6}$) is still an empirical law, and all attempts to derive it rationally from theoretical considerations have thus far failed."

In response to this I beg to say that through an analysis of the magnetic loop I have derived rationally from theoretical considerations a formula for the computation of the hysteresis loss. It reads:

$$w = \frac{2}{\pi^2} \times 10^{-7} \eta_0 \times M^2_{max}$$

where

$M = B$ — field strength

and

$$\eta_0 = \frac{\pi}{2 M_{max}} \times \int_0^{M_h} \left\{ \eta_1 \cos \frac{\pi}{2} \frac{M}{M_{max}} - 2\eta_2 \cos 2 \frac{\pi}{2} \frac{M}{M_{max}} + 3\eta_3 \cos 3 \frac{\pi}{2} \frac{M}{M_{max}} - \dots \right\} dM$$

M_h = limit value of magnetic cycle.

That the formula thus obtained is correct is clear from numerical relations as well as from the dimensional test—c.g.s. system. Dr. Steinmetz's formula will not stand the latter test. The law of the 1.6 power seems to be incidental, in so far as a relation seems to exist, between the function to be integrated and the limit M_h of integration.

New York, N. Y. Hans Lippelt.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Compounded Alternator.—An illustrated description of the Parsons compounded alternator in which the method of Stoney and Law is used. The principle made use of is that while an alternating current cannot directly produce a unidirectional magnetic field, it can be made to diminish such a field. If an iron core or "leakage path" of suitable cross-section be laid across the pole pieces of a dynamo and the magnets be powerfully excited, lines of force will be diverted from passing through the armature, and the iron of the leakage path will be saturated. Now, if the core carries a winding through which alternating current is passing, it will be seen that when the current is passing in one direction, it cannot appreciably increase the "leakage flux" through the core, owing to this being already saturated; but when it reverses and flows in the other direction, it will reduce the leakage flux. Fig. 1 shows the arrangement for a three-phase alternator. The "leakage paths," which are of laminated iron, are seen bridging the magnets of the exciter; when load comes on the alternator the leakage flux is choked back and the flux through the exciter armature is increased, thereby raising the voltage of the excitation of the alternator. The action is practically instantaneous, since the load current of the alternator is used directly to effect the regulation, without the intervention of any mechanical apparatus, the action being wholly magnetic. The leakage path windings are placed between the windings of the alternator and its neutral point, which is usually either "earthed," or at a potential differing but little from earth, but in spite of this they are insulated for the full working voltage of the alternator. In a few special cases use is made of series transformers instead of passing the main current round the leakage paths. Fig. 2 shows the characteristic curves of a 1000-kw alternator with and without the leakage-path compounding. The curve marked *A* shows the effect on the voltage when a very inductive load is thrown on; by the time the full-load current of 220 amp is reached the volts have fallen to 2300, so that the load on the

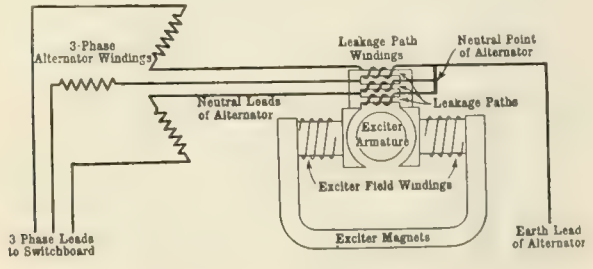


FIG. 1.—COMPOUNDED THREE-PHASE ALTERNATOR.

plant is really only 700 kw. The curve marked *B* shows that when the compounding is in use, the voltage remains practically constant, or if required, a slight increase in voltage can be arranged to compensate for pressure drop in feeders. The curve marked *C* shows the effect when full inductive load is removed, without the compounding arrangement. A further

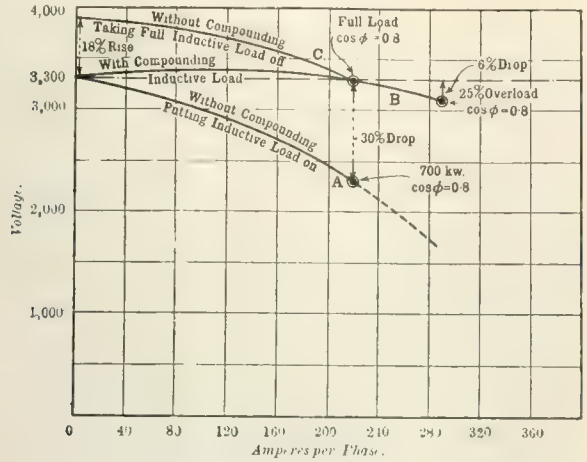


FIG. 2.—CHARACTERISTICS OF 1600-KW ALTERNATOR.

advantage of the system of voltage regulation is that the alternator may be designed for a much smaller short-circuit current. —Lond. *Electrician*, July 2.

Commutation in Direct-Current Generators.—W. E. HIGHFIELD AND R. LIVINGSTONE.—While the reactance voltage is usually regarded as an excellent criterion of the commutating properties, the permissible value of the reactance e.m.f. changes with the size of the machine, from 3 volts in 100-kw, 600-r.p.m. machines to 7.5 volts in 1500-kw, 160-r.p.m. machines. The principal reason for the variation of permissible reactance voltage is the reduction, or increase, of the reactance voltage due to the variation of the number of lines of the main field enclosed by the short-circuited coil. In most cases the cutting of the main field will reduce the reactance voltage, and this corrected reactance can be regarded as a safer criterion of the commutating properties of the machine than reactance voltage alone. The calculation of the reduced reactance voltage is discussed, and it is stated that the corrected reactance ought not to exceed 4.5 volts.—Lond. *Electrician*, July 2.

Polyphase Commutator Motors.—E. ROTH.—The conclusion of his long theoretical serial on polyphase commutator motors. In the concluding parts the author gives numerical examples.—*La Lumière Elec.*, June 26.

Lamps and Lighting.

Electric Lighting.—Two further communications concerning ways and means of making electric lamps more popular. C. Schmidt recommends a convenient and cheap rate for residences since the lamps are lighted in residences generally after the peak load is over. A flat rate, however, has proved very disadvantageous in Russia, as the people there prefer to use cheap lamps of low efficiency and for long hours, which use increases the load at times of the peaks. He recommends the installation of cheap amp-hour meters and the charging of such consumers a certain minimum flat rate, which he has to pay in advance every three or six months. In longer intervals the amp-hours consumed by the party are read, and if they are beyond a certain amount he is charged for the excess. The Officene Elettriche Genovesi in Genoa, Italy, carries out the wiring itself in large apartment and tenement houses. It also allows a certain amount to anybody who installs at least six lamps in six different rooms. In this way the installation of electric lamps in flats of $120 to $400 yearly rent has been greatly facilitated, and the number of consumers of this kind is about 9000. A flat rate is granted to almost all stores, restaurants, etc., which close after 9 o'clock, with the exception of residences, since in this case control would be impossible. The number of consumers who get a flat rate is about 4000. The cost of installation in such cases is paid by the company, but the consumer must make a contract for several years.—*Elek. Zeit.*, July 1.

Economical Lighting.—W. H. F. MURDOCH.—If n is a number of lamps, each taking W watts and running for A hours per year at p cents per kw-hour, and if each lamp costs s cents and has a life of L hours, and if these n lamps are to be replaced by N other lamps each taking w watts having a life l and costing S cents, then no saving will be effected if

$$p = \frac{\frac{NS}{l} - \frac{ns}{L}}{nW - Nw} \times 1000$$

Generally, therefore, the saving E effected is represented by a straight line, or $E = p\,k - k^1$, when k and k^1 are constants depending on the lamps and p the variable cost of electrical energy. The author gives also a more general formula relating to a large building in which there are numbers of different lamps. The above equation shows that the saving is greater, the greater the difference between nW and Nw. If watt per candle be assumed to be the limit likely to be reached, it is clear that no great saving is made in using fewer high-candle-power lamps. There is a direct saving in replacements, since a higher-candle-power lamp generally costs less than its equivalent in lower candle-power, but this can only affect the annual saving slightly. In wiring the building also, there is the advantage of fewer outlets. It seems unlikely that high-candle-power incandescent lamps will be largely used for interior illumination, so long as the cost of electrical energy remains as at present. It is interesting, however, to speculate as to what would happen if the price per kw-hour was sufficiently reduced to make it worth one's while to use high-candle-power incandescents. "From a consideration of the above expressions we see that for some time to come it is unlikely that high-candle-power incandescent lamps will be in such demand."—Lond. *Electrical Review*, July 2.

Daylight Efficiency.—H. E. IVES.—An abstract of a paper read before the Physical Society on the "daylight efficiency" of artificial light sources. This investigation was prompted by the question whether the newer high-efficiency illuminants might not be screened to resemble daylight without prohibitive loss of efficiency. Daylight is assumed to have the spectral relation to acetylene found by Dr. E. L. Nichols' investigations. Two methods are developed. The first, by a discussion of the colored absorbing screens necessary to reduce a continuous spectrum to the daylight spetrum, and the luminosity values of the different colors of the spectrum leads to a quantity—the ratio of intensity of white light obtained by screening source of daylight color to the intensity of unscreened source—called the "white-light efficiency." The second, by considering the amount of white light which, mixed with a single spectrum ray, will match the colored light, leads to a quantity—the ratio of the intensity of white sensation to the intensity of total sensation—called the "white-sensation efficiency." The white-light efficiency depends upon the arbitrary choice of point from which screening starts, and gives zero value to selective sources of the type of the mercury arc. It gives an indication of a source's suitability for use where color values are to be judged. Numerical values indicate that ordinary sources (glow lamps, acetylene, etc.) have from 20 per cent to 50 per cent available light. A 1.25-watt tungsten lamp may be screened to resemble daylight with a resultant specific consumption of about 4 watts per candle or the consumption formerly considered practical in electric lighting. The white-sensation efficiency is applicable to all types of sources, and accurately describes the color of the light or of a white surface illuminated by it. It gives no idea of the source's suitability for color discrimination. It is, however, independent of any choice of screening and scientifically preferable. The white-sensation efficiencies are always higher than the white-light efficiencies. For the most useful comparison of artificial sources the results of the two methods have been combined by a graphical scheme.—*Phys. Review*, June.

Tungsten Lamp.—A note on a tungsten lamp of British make which has just been placed on the market. It is the 16-cp, 200-volt, 25-watt "Leuconium" lamp. The filament, which consists largely of tungsten, is arranged in the 16-cp lamps in nine loops.

its total length being about 40 in., while the specific consumption of the lamp is from 1.5 watts to 1.6 watts per English candle. A bulb of similar shape and approximately the same size as the customary carbon-filament lamp has been adopted. Nothing is yet stated concerning the life, but the filaments are said to be mechanically strong, and to stand a large amount of vibration. The small candle-power of the lamp is rendered possible by an "improved and, at present, secret method of treating the filament after drawing."—Lond. *Electrician,* July 2.

Generation, Transmission and Distribution.

Rolling Mills.—A note on a recent British patent (18,575, 1908; June 24, 1909) of Siemens Brothers Dynamo Works, C. A. Ablett and H. Crowe, for a method of driving reversible rolling mills. The main motor is separately excited, and supplied with energy from a variable generator coupled with a flywheel to a steam turbine. The turbine, which may be of the high, mixed or low-pressure type, is run at a speed about 25 per cent lower than that corresponding to the most economical steam consumption, this reduction facilitating the construction of the flywheel and generator without seriously reducing the efficiency. By-pass valves for short-circuiting one or more stages of blades, or for admitting the steam to different parts, so that the turbine can deal with sudden overloads, are provided. The turbine speed must be arranged to drop with the load automatically by means of a suitable governor, so that the flywheel can give up some of its energy.—Lond. *Elec. Eng'ing,* July 1.

Steam Condensers.—E. Lunn.—A paper read before the British Municipal Electrical Association on steam condensing and water-cooling plants. The author describes the various types of condensers and the advantages and disadvantages of each. After considering the question of pumps, he finally discusses water-cooling plants.—Lond. *Electrician,* July 2.

Traction.

Baden.—An illustrated article on the electrification of the Wiesenthal Railway, hitherto worked by steam, in the State of Baden, in Germany. Energy is taken from one of the stations on the Rhine near Augst-Whylen, which gives a three-phase supply at 6800 volts and 15 cycles. In order to obtain single-phase energy at 10,000 volts and 15 cycles, for the line, a converter substation has been erected at Basel. In this substation there will be installed two converters, each of which comprises a single-phase generator for a continuous output of 2100 kva. Each generator is coupled on one side to a three-phase, non-synchronous motor, which takes energy from the station supply, and on the other side to a direct-current machine connected to a buffer battery. When the output to the railway is greater than the average, the direct-current machine works as a motor and supplies the extra energy for the single-phase generator. When the output is less than the average, the direct-current machine acts as a generator and charges the buffer battery. The battery is able to discharge momentarily at the rate of 2800 kw. Ten single-phase locomotives, both for passenger and freight trains, will be used. The locomotive contains three central driving axles which are connected by coupled rods to two single-phase motors. These motors are of the multipolar, series-wound type, each motor being capable of giving a continuous output of 390 hp, an output of 525 hp for one hour, or a maximum of 800 hp for short periods, at a pressure of 300 volts.—Lond. *Electrician,* July 2.

Contact Surface System.—Some notes on the experience with the "G. B." system at Lincoln. According to the last annual report of this municipal tramway system the working expenses for the year amounted to 11.2 cents per car-mile, a considerable reduction on the figure of 12.2 cents recorded a year ago. The most interesting feature is the reduction in repairs and maintenance from 2.50 cents to 2.24 cents per car-mile. Of the sum of $3,655 appearing under this heading, $2,610 is allocated to cars—that is, a saving of nearly $300 compared with the previous year, notwithstanding an increase of 7 per cent in the number of car-miles run. Most interest, however, will be taken in the cost of repairs to the electrical equipment of the line, and at first sight the increase from $375 last year to $740 in the present accounts appears unfavorable when it is remembered that the "G. B." Company guaranteed the annual cost of upkeep not to exceed $450. The engineer explains in his report, however, that the latter figure has really not been exceeded since the amount stated in the accounts contains the cost of alterations at a railway crossing, also a sum of $75 for improvements, which will give the parts affected longer life, and of $80 for maintaining feeder cables, cleaning feeder, access boxes, conduits, etc., so that only $410 is chargeable to the direct upkeep of the "G. B." system. This value seems to leave a little margin over the guaranteed figure, considering that the guarantee applied to the first 10 years' operation of the system. Moreover, it is explained that several special repairs have been carried out which are not likely to occur again in the near future, while the stud heads throughout the track have been packed up, so that it is expected the estimated five years' life will be realized. Nevertheless the present repairs and maintenance expenses are considerably higher than those of the majority of tramway undertakings, although the total working costs are considerably below the average.—Lond. *Electrician,* June 25.

Electric Locomotives.—Heyden and E. Eichel.—Two articles on electric locomotives. Heyden discusses details of the gearing system, and Eichel describes a new single-phase locomotive of the Prussian-Hessian railways and also American locomotives for a frequency of 15 cycles.—*Elek. Kraftbet. u. Bahnen,* June 4.

Electric Traction on Suburban Lines.—C. Vogel.—On ordinary steam railroads it is advisable to use electric traction on suburban lines in order to run shorter trains at more frequent intervals. The author describes the storage-battery cars used by the railroad department of Mainz, in Germany, for such purposes.—*Elek. Kraftbet. u. Bahnen,* June 23.

Installations, Systems and Appliances.

Regenerative Boosters.—An article describing the new battery-charging station of the garage of the Brighton Automobile Omnibus Company, where the Stevens regenerative battery-charging system has been adopted. In the same article a description is given of the Stevens system of regenerative boosters for automatically maintaining a constant voltage at the ends of three-wire feeders of varying lengths. The main feature of the system is the application of two or more boosters with their armatures directly coupled on the same shaft or series of shafts flexibly connected together by means of couplings so

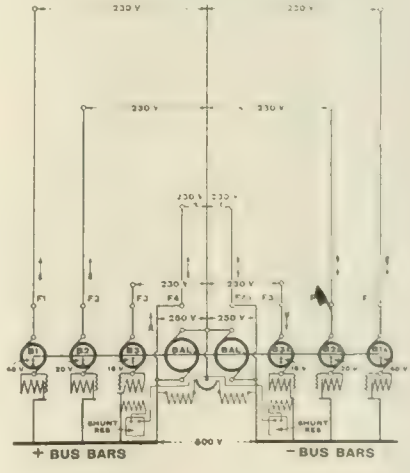


FIG. 3.—MULTIPLE OPERATION OF BOOSTERS.

that all must rotate at the same speed. A line of boosters can be conveniently coupled to each of the outer ends of the balancer shafts, as shown in Fig. 3, so that each feeder, or set of feeders, has a booster armature in series with its positive and negative terminals. Feeders of average length, taking the main load of the station, are not included in the system. The boosters are connected up as shown, those controlling long feeders having their fields series wound, so that the current through the fields raises the voltage across the booster armatures proportionately to the current passing through them; and the volts

across the booster armature can be made equal to the drop in volts in the feeder by adjusting the shunt which is provided with each machine. With this object the fields of the boosters work at a low magnetic density. The voltage across the armature of the booster at no load is zero, and the machine will work automatically throughout all its range, after the shunt is adjusted to the load. As the voltage of the booster is proportional to the current passing through it, it is obvious that the boosters will also act as balancers, as any increase of current demanded on one side of a feeder will be accompanied by an increase of voltage on that side, making up for the increased drop of voltage on the main and in addition providing for the drop in the middle wire for the return current. Boosters which control very short feeders, such as supply energy to the station and immediate surroundings, are provided with a shunt-field winding controlled by a rheostat. The direction of this field is such that the machine runs as a motor and opposes the line pressure, keeping the voltage of supply normal when the station voltage is raised to deal with the drop in the feeders of medium length at peak load. A few turns of series winding acting differentially to the shunt winding will reduce the e.m.f. of the negative boost when the load on the short feeders increases, and the series coils will also tend to balance the load on the short feeders. As an illustration of the action of the system in practice, feeders of varying length are shown in the illustration. Feeder 1 is taken as 3000 yd., 2 as 2000 yd., 4 as 1000 yd., 3 as 200 yd., and the current density at peak is taken for all feeders at 800 amp per square inch; with this density the fall of potential will be approximately 2 volts for each 100 yd. (single) of feeder. On feeder 4, length 1000 yd., representing the average length of main feeders for main supply, the voltage of main busbars, raised at peak load 20 volts on each side of middle wires, will bring the voltage at feeding point to 230. Feeder 3, length 200 yd., will then be lowered by 16 volts, so that the voltage at feeding will be 230. Feeder 2, length 2000 yd., will require a boost of 20 volts on each side in addition to the busbar voltage of 250 to deliver energy at 230 volts to feeding point. Feeder 1, length 3000 yd., will require a boost of 40 volts on each side in addition to the busbar voltage of 250 to supply 230 volts at the feeding point. All boosting with the exception of that on feeder 3 is done automatically.—Lond. *Electrician,* June 25.

Electricity Supply of Berlin.—The various central stations in Berlin sold in January last 655,929 kw-hours less than during the same month of 1908. The company which supplies energy to the suburbs of Berlin, however, increased its output during the month by 372,182 kw-hours. The Berlin central stations, which have usually an average increase in output of 2.6 per cent, thus suffered a reduction in January of 4.1 per cent, and while the company supplying the suburbs has increased its output, it has done so in a much smaller proportion than is usual. The employment of metallic-filament lamps is more extensive in the center of the town, though this latter cause of reduction is only considered temporary. A reduction in the energy supplied to the railways is put down to the fact that the drivers are becoming more skilful and are taking more account of the economical side, for the traffic on these lines is steadily increasing. —Lond. *Electrician,* July 2.

Protection of Three-Phase Feeders.—M. B. FIELD.—When resistors are used in the neutral-earth connection to limit the earth current, they must be constructed to dissipate very large amounts of energy, and when choking coils are employed there is considerable danger of resonance phenomena occurring. The author proposes a method of protecting systems with unearthed neutrals, based on the fact that on a ground connection occurring on any one phase the total capacity current of the cable network will return along the grounded core of the faulty cable. This action causes the cable to have a resultant magnetic effect which is utilized to operate a relay and disconnect the cable without any rush of current.—Lond. *Elec. Eng'ing,* July 1.

Condensers.—K. FISCHER.—An illustrated paper read at the annual meeting of the German Association of Electrical Engineers. The author describes a machine for making condensers of tube form and plate form from tin foil in combination with paper impregnated with resins. Tests of such condensers showed that the watt consumption in the condenser was about 1 per cent of the apparent power. The experiments show that they are sufficiently reliable in operation to make their application for various purposes in practice quite promising.—*Elek. Zeit.,* July 1.

Wires, Wiring and Conduits.

Underground Cables.—J. R. DICK.—An illustrated article on the heating of underground cables, giving diagrams and formulas.—Lond. *Electrician,* June 25.

Insulators.—W. WEICKER.—The first part of an illustrated description of details of construction of suspended insulators.—*Elec. Zeit.,* July 1.

Electrophysics and Magnetism.

Magneto-Optics.—L. R. INGERSOLL.—An account of an experimental investigation concerning the Faraday and Kerr effects for a long range of spectrum; the thickness of the surface layer which gives rise to the Kerr rotation, and the relation between the Kerr rotation and the optical density of the surrounding medium. These problems are studied for the simplest typical case, that of iron in the form of thin films (cathode films). The author describes a bolometric method for measuring rotations, and then deals with rotation dispersion curves for the Faraday and Kerr effects in the infra-red spectrum, and finally with the dependence of the Kerr rotation on the reflective index of the overlying medium.—*Phil. Mag.,* July.

Electron Theory.—J. H. JEANS.—A second paper on the theory of the motion of electrons in solids. The author deals with the radiation of all wave-lengths in a perfectly reflecting enclosure, with natural radiation, and with the dependence of natural radiation on the law of force.—*Phil. Mag.,* July.

Arc Method of Producing Oscillations.—K. W. WAGNER.—The first part of a theoretical paper on the production of alternating current by means of a direct-current arc.—*Elek. Zeit.,* July 1.

Electrochemistry and Batteries.

Fixation of Atmospheric Nitrogen.—Abstracts of a number of papers presented before the International Congress of Applied Chemistry and the Royal Society of London. A. Bernthsen discussed the new electric furnace process of the Badische Company. Two papers by S. Eyde and Professor Birkeland dealt with the Birkeland-Eyde process. N. Caro discussed the calcium cyanamide industry.—*Electrochem. and Met. Industry,* July.

Induction Furnace. —J. HARDEN.—An article discussing in detail the efficiency of induction furnaces, the influence of frequency on the power factor, and the time required for various runs in practice.—*Electrochem. and Met. Industry,* July.

Electrolytic Conductivity and Magnetism.—C. J. REED.—An illustrated description of an observation which appears to show an increase in electrolytic conductivity along lines of magnetic flux.—*Electrochem. and Met. Industry,* July.

Units, Measurements and Instruments.

Vibration Galvanometer.—W. DUDDELL.—During the last few years the use of vibration galvanometers for the measurement of capacities, self-induction and mutual induction has greatly extended, "and in the near future they may be expected to supersede the telephone and possibly the secohmmeter for these purposes." The author describes a new type of vibration galvanometer, in which the mass of the moving parts is reduced to a minimum, the moving coil being reduced to two wires, forming its two sides, similar to a bifilar oscillograph, but with this difference: Whereas the bifilar oscillograph is designed so as to make the damping aperiodic, the bifilar-vibration galvanometer is designed so as to keep the damping as small as possible. The design of the instrument is shown in Fig. 4, in which *a, b, c, d* is a fine bronze wire passing over a pulley *p* and stretched tight by means of a spring the tension on which is capable of variation by a milled head. The wires carry a mirror *M* in the center and are placed in a strong magnetic field between poles *N* and *S* of a magnet. The wires pass over two

bridge pieces, *B, B*, which limit the length of the wires, which are free to vibrate. These two bridge pieces can be moved nearer together or further apart by means of a right-handed and left-handed screw as required. The current to be measured passes up one wire and down the other, causing one wire to tend to move forward and the other back in the magnetic field and so tilts the mirror *M* through a small angle. The

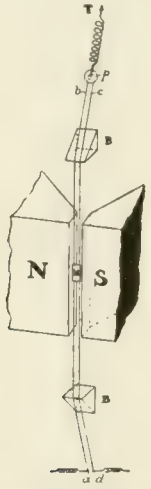


FIG. 4.—VIBRATION GALVANOMETER.

periodic time of the wires depends on their mass, length, tension, as well as upon the moment of inertia of the mirror. In a completed instrument the moment of inertia and the mass of the wires are fixed, but their length and tension can be altered in order to adjust the periodic time. The advantages of the bifilar galvanometer may be summarized as follows: Simplicity, ease in tuning, wide range of frequency for which it can be tuned, high sensibility, negligible self-induction, comparatively small back e.m.f. Its main defect is the small size of mirror that it is necessary to use on the instrument. With a carefully adjusted optical arrangement, and using a small 4-volt metallic-filament lamp, one can work with comfort at a scale distance of a meter in a room which is not too brilliantly lighted.—*Phil. Mag.*, July.

Magnetometer.—J. C. Gray and A. D. Ross.—The authors first discuss the sources of errors found in the ordinary form of magnetometer and then describe a type of instrument in which these sources of errors are eliminated. Its principle is indicated in Fig. 5, where *ns* represents the magnetometer needle provided with a concave mirror, by means of which and a source of light *L* its movements are observed on the scale *SS*. *H* is the magnetizing solenoid placed due east or west of the magnetometer-needle and clamped in a convenient position. C_1 and C_2 are compensating coils placed with their axes approximately in coincidence with that of the solenoid. In adjusting the apparatus the effect of the current in *H* on the needle *ns* is first approximately annulled by means of C_1, which is then clamped in position. The final adjustment of the compensation, so far as the undisturbed position of the needle is concerned, is

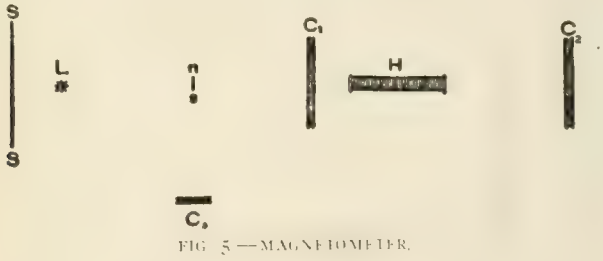


FIG. 5.—MAGNETOMETER.

carried out by means of C_2, which on account of its great distance from the needle contributes only a small fraction of the balancing field, and thus provides an adjustment of great refinement. The position of C_2 necessary for balance having been obtained, it is clamped in position; obviously since the distance of C_2 from the needle is great, any slight movement caused by doing so produces no perceptible effect on the compensation. If the axes of C_1, *H* and C_2 were coincident and passed through the magnetometer needle the adjustment would now be complete. If, however, the needle *ns* is deflected by means of a permanent magnet, and a large current is reversed in the circuit, in general an alteration in the scale-reading on *SS* will be observed. A coil C_3, placed with its axis in the magnetic north and south line passing through the needle, is now included in the circuit. By properly adjusting the direction of the current in C_3, and altering the distance of C_3 from the needle, the compensation can be made perfect for all positions of *ns*. In a magnetometer where *ns*, C_1, *H* and C_2 are all carried on stands moving in one channel in the bedplate, there should be little departure of the axes of the coils from coincidence. Accordingly the resultant magnetic field, due to the coils and solenoid, in the north and south direction will be small. The coil C_3 is, therefore, made of little power, and small change in its position brings about only a very slight alteration in its effect upon the needle. It can, therefore, be clamped without any risk of upsetting the balance.—*Phil. Mag.*, July.

Standard of Wave Length.—J. A. Fleming.—An article on the standard of wave length for the calibration of wave meters. For ordinary laboratory work the simplest method of obtaining a circuit in which oscillations of known frequency can be set up is to combine together a condenser consisting of metallic plates in desiccated paraffin oil, the oil being the dielectric, with a rectangular wire circuit, of which the inductance can be predetermined. Paraffin oil very carefully dried is a dielectric with no sensible leakage and having the same dielectric constant at high frequency as at low. When metallic plates are inserted in this oil one can construct a condenser, the capacity of from 100 mf or 200 mf, by means of a revolving commutator and taken to have that value for high frequency. A circuit can then be constructed for laying one single turn of insulated wire laid in a groove round a rectangular wooden frame and bringing the ends of the wire close together in the center of one side and terminating them in spark balls. The inductance may be calculated by a formula for which a numerical example is given. Lond. *Electrician*, July 2.

Instrument Transformers.—P. G. Agnew and T. T. Fitch.—An abstract of a paper read before the Physical Society on an investigation carried out in the Bureau of Standards on the determination of constants of instrument transformers. The constants to be determined are the ratios and phase angles between primary and secondary. In the case of shunt instrument transformers this is accomplished by drawing from the source of supply a small current through a non-inductive resistor of high resistance and applying the secondary to this resistor in potentiometer fashion, using as detector the moving coil of a dynamometer whose field coil is in the primary circuit. This arrangement makes the ratio depend directly on two bridge values of the resistance. The phase angle is obtained with the same arrangement by applying the small resultant e.m.f. to the moving coil of a dynamometer whose field is excited by a current in time-quadrature. A maximum sensibility of 1/20,000 in ratio and of 0.1 ft. phase angle is obtained. A similar method is used for the ratio and phase angle of series transformers. Measurements on a considerable number of transformers showed that the shunt transformer is a device of high precision, and that the same is true of the series transformer, but to a less degree. It was found that in case the secondary of a series transformer is open-circuited while current is passing through the primary, the constants are changed, due to the permeability of the iron being decreased, but that this effect can be removed by demagnetization. In connection with the work a method was developed for the comparison of extremely low inductances with an accuracy of 1 per cent.—*Phys. Review*, June

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—An illustrated description of the new Telefunken apparatus, giving outside views of the sender variometer, the singing spark-gap, the primary condenser, a 2-kw sender, a complete wave measurer, acoustic receiver for all wave lengths, and a complete military sending apparatus on a truck.—Lond. *Electrician*, July 2.

BOOK REVIEWS.

LE FRODI NEI MISURATORI ELETTRICI. By Lanfranco Mario. Milan: Ulrica Hoepli. 278 pages, 27 ills, 39 plates. Price, 4.50 lire.

This interesting volume is devoted to an analysis of the various errors that can be imported by fraudulent means into the registration of customers' meters whereby the records may be reduced. A very considerable amount of ingenuity seems to have been exerted in developing methods of preventing meters from recording the full amount of electric energy that has passed through them. Corresponding amounts of study and ingenuity have been involved in diagnosing and in remedying such defects in the meters. The work is divided into four parts. The first deals with the nature of fraudulent errors in meters. The second takes up controlling and detecting apparatus for revealing defects in meters. The third part discusses the installation of detectors, and the fourth relates to other types of instruments which may serve as differential detectors. The book is the most complete study yet published on the subject.

THEORIE DER ELEKTRICITÄT. By M. Abraham. Leipzig: B. G. Teubner. Vol. II, second edition. 404 pages, 6 ills. Price, 10 marks.

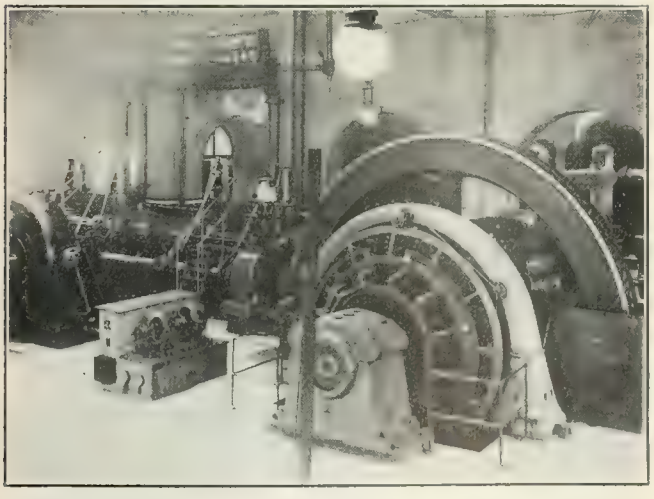
This is the second volume of the theory of electricity by Dr. Abraham and is devoted more particularly to the theory of electromagnetic radiation. It is essentially a mathematical treatise prepared by a mathematician for the use of students of mathematical physics. This is shown by the fact that while there are over 270 principal equations in the book, there are only six illustrations, and these of a very simple geometrical character. The book is useful as formulating the modern theory of electromagnetic radiation in connection with the doctrine of electrons. It is clearly written and eminently worthy of study by advanced students.

NEW APPARATUS AND APPLIANCES

Double-Acting Gas Engines.

In the accompanying illustration is shown an Allis-Chalmers horizontal, double-acting tandem gas engine, of 500 hp, driving a direct-current generator of the same company's build in the power house of the Illinois Steel Company's Bay View Mills, at Milwaukee, Wis. It is stated that during the two years this has been in operation the unit has not cost $50 for repairs, and its record has been such as to demonstrate conclusively the reliability of gas engines, properly designed, for industrial service of the most severe character.

Machines in operation for about the same period of time, or longer, include gas engines and generators of from 300-hp to 5000-hp capacity, which, with others now going into commission, furnish power for iron works, steel mills, clay-products

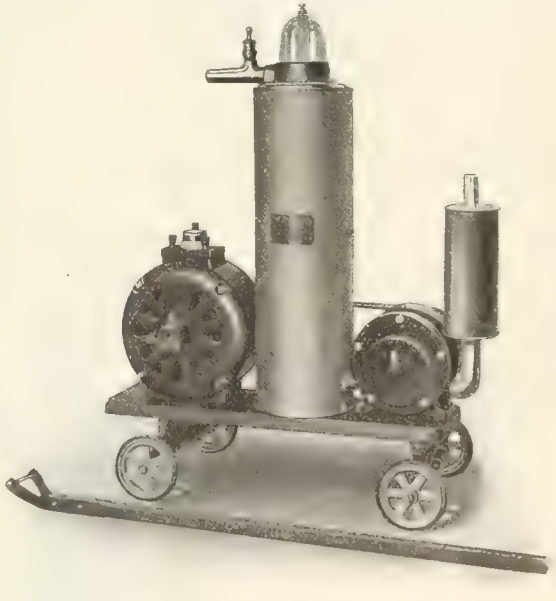


DOUBLE-ACTING TANDEM GAS ENGINE.

plants, cement mills, automobile shops, plate-glass works, tube mills, wire works, central power, lighting and traction stations, phosphate plants, factories and other industrial establishments. In the list are engines operating on producer, natural and furnace gas, and their capacity for continuous service aggregates no less than 210,000 hp. Among the larger users of gas power in the industrial field is the Pittsburgh Plate Glass Company, which was one of the earliest to install the improved type of engine and electric generator built by Allis-Chalmers Company, and has just placed an order for the eleventh of these units.

Vacuum Cleaning Outfit.

A vacuum cleaning set, shown in the accompanying illustration, recently put out by Hanlon & Wilson, of Wilkinsburg, Pa., is said to be an exceptionally well-made and efficient machine. The motor is rated at ½ hp, and may be either alternating or direct current. It is belted to a rotary pump, and the whole machine, which weighs about 140 lb., is simple, compact and durable. The apparatus is known as the Vak Klean machine, and it is mounted on a small truck equipped with rubber-tired wheels. Various attachments are supplied for cleaning carpets, rugs, draperies, mattresses, furniture,



VACUUM CLEANING OUTFIT.

floors and ceilings. They are attached at the end of a flexible tube, and the dirt is drawn out from the parts being cleaned and deposited in a canvas bag inside the dirt separator, shown prominently in the center of the machine. A flexible connection is also provided for attachment to a suitable source of current supply. The Vak Klean machine is made in two sizes. The one designed for use in private dwellings is that illustrated herewith. The larger machine is operated by a 2-hp motor, and is suitable for churches, office buildings, theaters and public buildings. This machine may be made either portable or stationary, as desired.

Portable Electric Breast Drill.

The Willey Machine Company, of Jeffersonville, Ind., has brought out a portable breast drill with a chuck for drills up to ¼ in. in size. The drill spindle has two long bearings, with removable bushings of phosphor bronze, in place of a single short bearing. By simply removing two nuts, the entire machine can be taken apart by any ordinary mechanic for inspection of the enclosed mechanism, no electrical knowledge being necessary. All the electrical connections are attached to the main casting of the machine and are not disturbed when it is taken apart for any purpose. A snap switch is located on the side of the frame convenient for starting and stopping the drill.



BREAST DRILL.

Special attention is said to have been given in designing the tool to the ventilation of the device so as to insure cool running and high-efficiency of the motor. Simplicity in construction is a matter which has received careful consideration by the company in making a machine which would be durable under the rough usage to which tools of this kind are often subjected in service.

Electric Glue Spreader.

The Advance Machinery Company, Toledo, Ohio, has brought out a line of electrically heated glue spreaders which are similar to its regular line of steam-heated spreaders, except they are supplied with electric coils for heating the water in the jacket which surrounds the glue receptacle. The coils are provided with three-way switches which enable the user to maintain his glue at any one of three temperatures—minimum, medium or maximum. The maximum current is required for about 20 minutes in the morning, after which the minimum current will be sufficient to keep the glue at 150 deg. to 160 deg. temperature

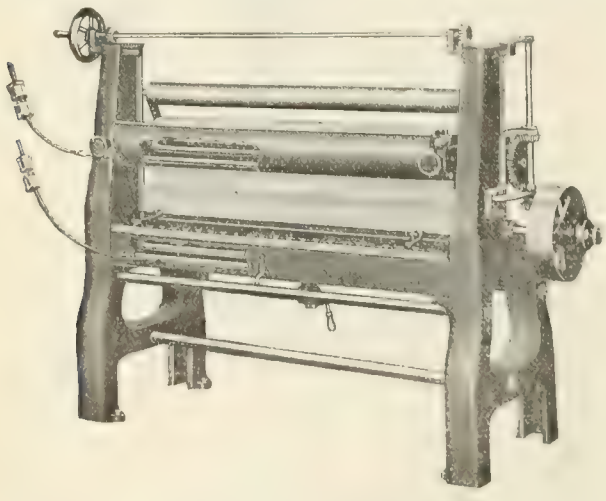


FIG 1.—GLUE SPREADER.

all day long. It is stated that the cost for energy is very little, if any, greater than the cost for steam.

The spreader is also supplied in combination with an electric glue heater, the latter being connected in such a way to the spreader as to supply hot glue through troughs attached to the heater and the spreader. The glue spreaders are provided with copper glue receptacles which not only keeps the glue clean and in good condition, but is stated to reduce the consumption of energy to less than one-half of what it would be if any other metal were used. The spreaders are provided with an automatic "take-up" to compensate for different thicknesses of stock from nothing up to 4 in.—i.e., the upper roll automatically

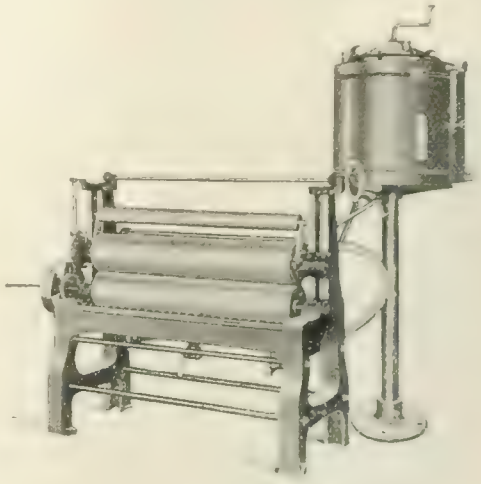
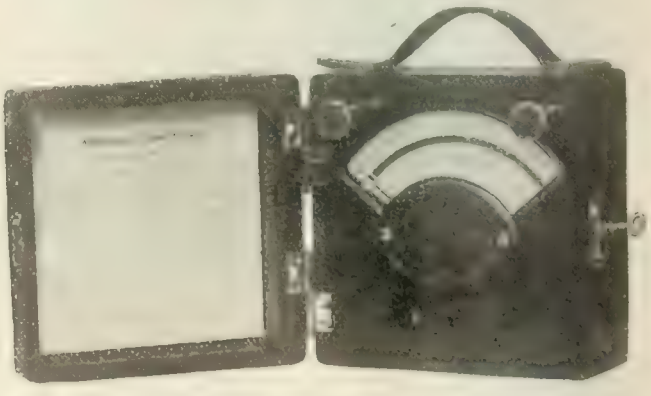


FIG. 2.—GLUE SPREADER.

adjusting itself for the different thicknesses of stock. If the operator is gluing stock 1/16-in. thick, he can run one piece through of this thickness and the next piece of 4-in. thickness, if necessary, without making any adjustments whatever.

Direct-Current Portable Meters.

The Westinghouse Electric & Manufacturing Company is placing on the market a line of direct-current meters known as Type A. Some features embodied in these instruments are their excellent "dead beat" qualities, practically uniform scale, polarity indication, freedom from effects of temperature change or external field, adaptability for use with shunts, and absence of residual errors. These are some of the advantages that follow from the use of the D'Arsonval type which are not found in the "moving-iron" type. The single air-gap construction employed enables the moving coil to be moved without disturbing the magnetic structure by opening the magnetic circuits and thus permanently weakening the magnets. This facilitates the making of repairs by the meter user. The construction is especially suited for portable meters because the coil and pointer balance each other on the moving element. There is ample clearance between the magnet pole-tips for the moving coil, while the reluctance of the single gap is not high. The ammeters are



PORTABLE AMMETER

either self-contained with double range or have separate shunts, the large sizes, of course, having external shunts. These shunts are interchangeable, and are made of a special alloy which has zero temperature coefficient and avoids all error due to the thermoelectric effect of difference in temperature between the alloy and copper terminal junctions. The meters are put up in walnut cases, 6¼ in. x 6¼ in. x 4 in., and weigh about 5 lb. They are made for any current or voltage.

Theater Dimmer.

The Ward Leonard Electric Company, of Bronxville, N. Y., has placed upon the market a new type of theater dimmer which has been designed to occupy a minimum of space. It is similar to the standard enameled, interlocking dimmer plates made by the same company, which have been in service for the past 12

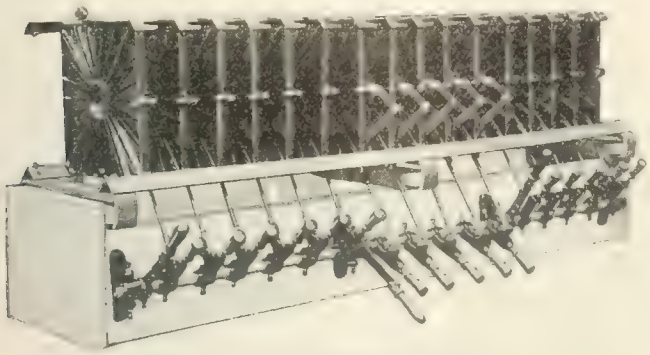


FIG. 1. HAND OPERATED DIMMERS

years or more, but is of a square 14-in. x 14-in. size instead of 15-in. x 24-in. size. It can be placed in any location or position, and controlled from a distance by direct-rod drive, which insures even regulation. The new dimmers are designed principally for circuits of 25 amp or less. The 15-in. x 24-in. dimmers will carry 50 amp per plate maximum.

Fig. 2 shows one of these dimmers arranged for three-wire,

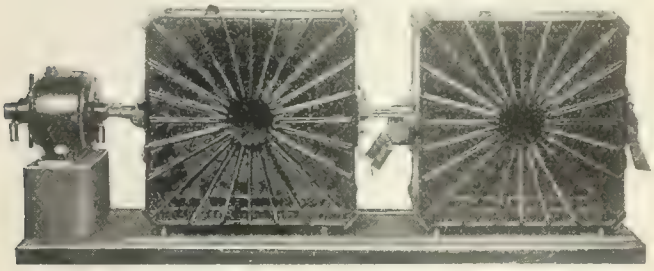


FIG. 2.—PUSH-BUTTON DIMMER.

push-button control. The controlling shoes are driven by a small motor.

Fig. 3 shows a large house dimmer, motor-driven, for a three-wire circuit and having a capacity of 1200 lights. There is an increasing demand for motor-driven dimmers of large capacities, because the rheostat can be mounted in any con-

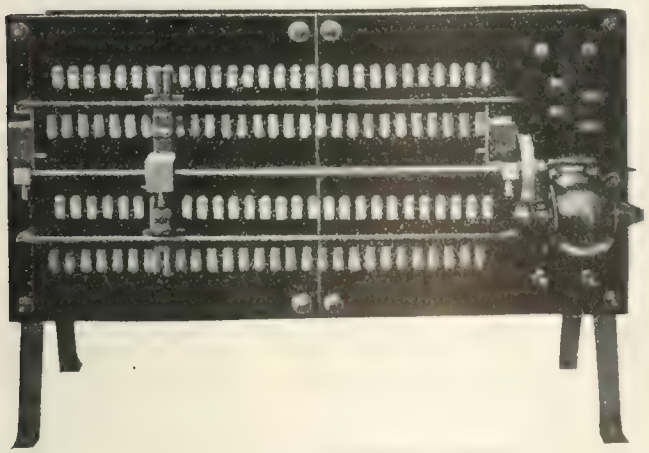


FIG. 3.—LARGE MOTOR-DRIVEN DIMMER

venient place and at any distance from the dimmer board, while the push buttons can be located directly in the dimmer board. The resistance of this large dimmer is made up of standard Ward Leonard strip units. There are no multiple parts and no wire connections, while the resistance is of the zero temperature, non-inductive and non-oxidizing type.

Mercury Type Ammeter.

The problem of measuring large alternating currents with any degree of precision is, from a technical standpoint, a difficult one. All who have had any experience in this class of work agree that there is need for a standardization instrument which can be inserted directly into an alternating-current circuit carrying 500 amp and over which will measure this current with the same degree of precision that small currents may be measured.

As a suggestion toward an instrument which would meet these conditions E. F. Northrup proposed, in 1907, an alternating-current ammeter based on certain forces, and built a crude instrument. Since that time, the Leeds & Northrup Company has steadily perfected this instrument until it has reached a point where, practically speaking, the only limit to accuracy of the instrument is the accuracy to which the ultimate unit of current is known.

The company states that its new instrument, which is designated the "mercury ammeter," is intended for use as a primary standard instrument for large currents, either alternating or



FIG. 1.—MERCURY TYPE AMMETER.

direct. It is intended for the calibration of station instruments and for use in the determination of series-transformer ratios. However, its very small resistance, together with the absence of inductance in the instrument, open to it a number of uses in the alternating-current field which are closed to instruments possessing impedance. The mercury ammeter is intended for use in the measurement of currents of 200 amp and over. The lowest practical range in the present type of instrument has a full scale corresponding to 500 amp, and this instrument on 200 amp may be read to 1/5 per cent accuracy. The standard length of the scale is about 22 in. Tests have been conducted on a number of these instruments, using the potentiometer with direct currents and Kelvin balances with alternating current as calibrating instruments. It has been shown that the mercury ammeter may be read over three-quarters of the scale to an accuracy of 0.1 per cent, this accuracy being totally independent of the kind of current being measured; that is, the same instrument is equally accurate upon direct current and alternating currents of any wave form, and any frequency up to 133 cycles. The scale follows the "square law," and the reading is in terms of the mean square value of the current. Also, the tests have shown that the temperature coefficient of the instrument is negligible when it is used as a standard. A great deal of care was exercised in the determination of the effects of external currents upon the indications of the instrument. The results showed that appreciable errors resulted only when conductors, carrying heavy currents, were placed directly over or directly under the instrument in contact with the base. For instance, when a conductor carrying a current equal to the full scale reading of the meter (2000 amp) was placed over the base of the instrument parallel to its length, and in immediate

contact with it, a 0.3 per cent error resulted. This was the maximum error; when the distance between the conductor and the instrument was increased, the error rapidly diminished.

With regard to the constancy of the mercury ammeter, an instrument built in 1907, embodying all of the essentials of the present instrument, at the present date, is said to show no perceptible change. It has a period of about five seconds; that is, it will pass from 0 to full-scale reading in five seconds. For facility of reading the meter is built to be just short of dead beat. Fig. 1 shows the instrument and Fig. 2 gives various cross-section views, which show very clearly the simplicity of construction and the complete absence of springs, valves, etc.

The operation of the instrument is quite simple. The copper terminals of the instrument are bolted into the circuit without any regard for polarities. The zero of the instrument is roughly adjusted by leveling and finally by turning the thumb-nut at the top of tube. The current is then thrown on and the colored liquid will flow up to a point in the scale corresponding to the current flowing. Current is then read directly from the scale.

A very simple analogy will serve to make clear the essential principle of the instrument. Wires, when carrying current, tend to attract each other so that were they fastened at the ends they would swing together at their center. A liquid conductor may be considered as being made up of an infinite number of elemental conductors, parallel to the directions of flow of the current. With this in mind, in the cross-section views of the ammeter, the right-hand and left-hand sections will be seen to be very similar in construction, and to consist of copper plates alternating with insulating plates, having various holes drilled in each side and closed reservoirs for mercury. Referring to the cross-sections on *EF* and *CD*, the current, for instance, enters through the upper copper leaf. To get to the next copper leaf of the cell it must pass through the mercury-filled space within the ivory ring. (Ivory ring shown dotted in cut.) In passing through the disk of mercury it causes the mercury to tend to flow away from the edges and "bank up" at the center. The force causing this action is exactly the same force that causes solid conductors, carrying current, to tend to attract each other. This attraction toward the center causes mercury to flow through two diagonal tubes, which tubes extend from the circumference of the disk of mercury to the center reservoir of mercury. Thus a force is set up which tends to make the mercury flow through tubes and disks of sections *CD* and *EF* and through the connecting tube in the base of the instrument from *CD* to *EF*. In the meter in question there are four points at which the force is exerted, two being in section *EF* and two in *CD*. This force causes mercury to flow until it is just balanced by the force due to the difference in hydrostatic head between the levels of the liquids in the two sides. The ammeter consumes about 1 watt per inch of scale reading, regardless of the amount of current to which 1 in. of scale corresponds.

The calibration of the instrument is dependent only upon the number and diameter of the disks or cells, the density of the liquid which serves as an indicator and the force of gravity. The liquid is not exposed to evaporation and, due to the fact that the instrument involves only hydrostatic heads, the effect of variations in the diameter of the index tube is eliminated as is also the possibility of error due to "drainage effects." Within wide limits the calibration is also independent of temperature changes.

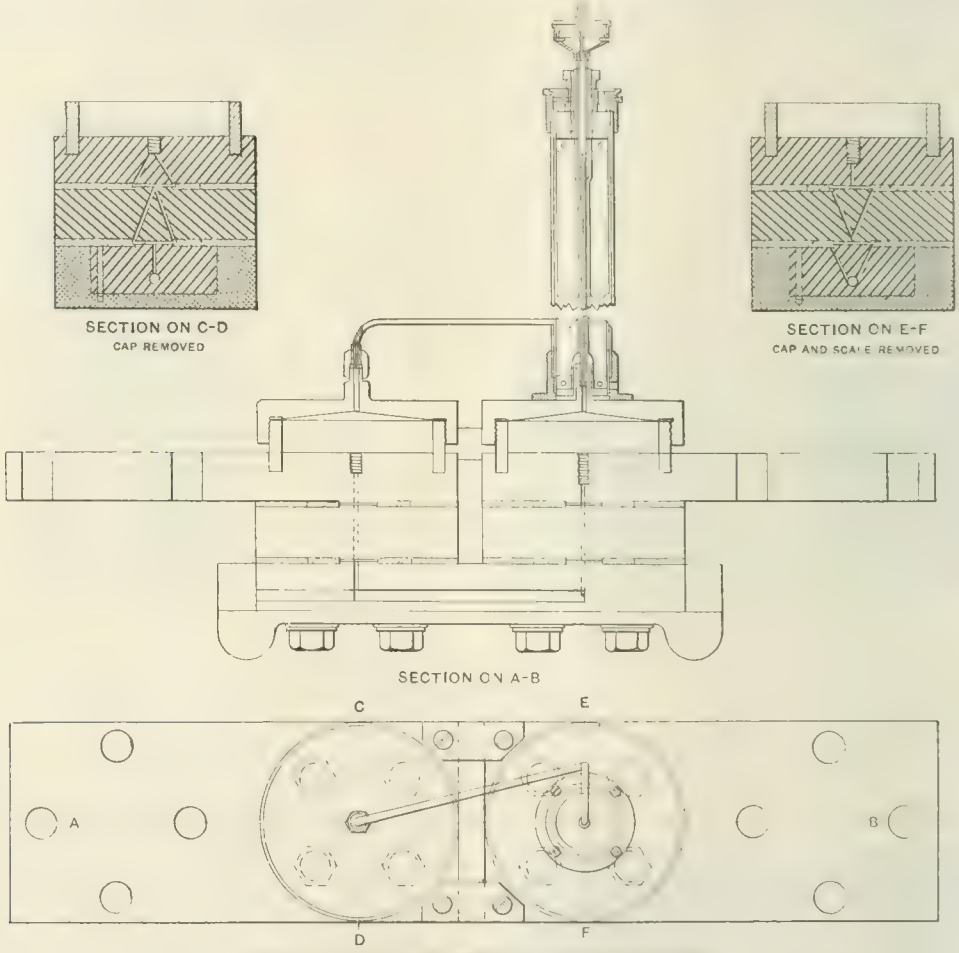


FIG. 2.—DETAILS OF MERCURY TYPE AMMETER

The instrument involves the application of new principles in instrument design. Its development necessitated the satisfactory solution of a large number of incidental structural difficulties of a type totally different from those normally arising in electrical measuring instruments. The accuracy of this completed instrument, its simplicity, together with entire absence of all corrections, are claimed to make it well-nigh ideal considered solely as an instrument, while the fact that it performs a function for which no other tool is at all feasible causes the maker to believe that the mercury ammeter is destined to occupy a position alongside of the potentiometer and the dynamometer as a high-precision standardizing instrument.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

There is no doubt that there has been a distinct improvement in trade conditions during the past week. The improvement in the crop situation has done much to stimulate buying with the result that the retailers report much better results from their midsummer clearance sales and the wholesalers and jobbers are in receipt of more liberal orders. This is especially true in the Central West where the volume of trade has shown a steady increase and the prospects for future business are most encouraging. In Chicago there is a better feeling in the wholesale trade than there has been since the beginning of the term of depression, two years ago. The South and Southwest especially have been buying. In the dry goods and textile lines these purchases have been especially notable. It is the general impression of manufacturers that stocks of merchandise are not large, either in the hands of retailers or at the central distributing points. This belief is encouraging the manufacturers to expand to some extent and more workmen are now employed than at any time within the past two years. In some sections the threats of strikes and the general dissatisfied condition of the wage earners is giving some uneasiness. This condition is undoubtedly due to the upward tendency in the level of commodity prices and the consequent restriction in the purchasing power of the dollar. The iron and steel industry has lost nothing of its activity. Specifications for steel rails, and for all other finished goods, are coming forward in good volume. Structural steel is especially active and many orders are being filed for delivery in the fall and as far ahead as early next year. The equipment companies are unusually busy. Orders for cars, both of steel and wood, and for locomotives are being received in liberal quantity. This, in a measure, is due to the expectation of liberal crops. It is the general opinion of railroad managers that unless the present equipment is largely augmented there will be serious freight congestion early next year. The electrical companies report better business, but they have not enjoyed the rush that has come to the iron and steel industries. Orders for large equipment continue to be scarce, while the volume of small business is much improved. The earnings of the railroads are steadily improving and the number of idle cars is daily growing smaller. Collections continue to be irregular but are somewhat better than a few weeks ago. The forced sales of retailers stocks have done much to help along this condition. Failures for the week ended July 22, as reported by *Bradstreet's*, were 239, as compared with 206 the previous week, 263 in the same week of 1908, 155 in 1907, 171 in 1906 and 197 in 1905.

THE COPPER MARKET.

The most important happening in the copper market since the last report in these columns, is the revolution in the methods of the Metal Exchange, in New York, taken in recognition of the criticisms of the investigating committee appointed by Governor Hughes. The board of managers of the exchange have adopted the recommendations of the reform committee, which provide that quotations of copper—as well as tin, lead and spelter—shall be based only on actual transactions and that the London system of grading copper as "standard" instead of "lake," "electrolytic" and "casting" shall be used. The change goes into effect Aug. 2. The new rule with regard to copper recognizes no grade but "standard," but fixes arbitrary price allowances for various degrees of purity. The rule reads: "Copper dealings shall be confined to standard copper and no other grade of copper shall be quoted. The minimum of contracts for standard copper shall be for 25 tons of 2240 lb. each, and the contract shall be in the form of the London standard warrant contracts. Sellers of copper contracts have the option to deliver as follows: Class A—Refined copper assaying not less than 99 per cent and below 99.30 per cent at contract prices; class B—Refined copper assaying not less than 99.30 per cent and below 99.80 per cent at ⅛ of 1 cent per pound over contract price; class C—Refined copper assaying not less than 99.80 per cent at ¼ cent per pound over contract price; class D—Rough copper subject to a rebate of ⅜ of 1 cent per pound from contract price. For rough copper the standard of produce shall be 97 per cent, but no excess shall be paid for. A pro rata allowance shall be made for deficient produces below 97 per cent down to and including 96 per cent, and a double pro rata allowance on the same basis for deficient produces below 96 per cent down to and including 94 per cent. Produces below 94 per cent shall not be good delivery." Copper stored in warehouses at the port of New York shall be good delivery as also shall be negotiable receipts of the principal refineries in this section. A commission of $1 per ton is provided for each sale and purchase on the floor of the exchange for an outside party. It is believed that these changes will result in making New York the speculative copper market of the world as 55.4 per cent of all the copper produced is mined in this country. Prices for copper during the past week have been uncertain, advancing slightly when there was any disposition to buy and receding when the demand slackened. In London the speculative market has been active and quite a large volume of copper was sold, which, it is said, was largely for the American account. At the close of the week under review prices in this market were a trifle lower. Exports continue to be very liberal and it is probable that the shipments for July will reach 35,000 tons, which will exceed even the high record made in June. Up to and including July 26, the exports for the month were 29,280 tons. Metal Exchange quotations on July 26 were:

Lake	13⅜	@ 13½
Electrolytic	13	@ 13⅛
Casting	12⅞	@ 13

The London prices July 26 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	59 10 3	59 11 0
Standard copper, futures	60 11 3	60 5 0
Market	Easy	Easy.
Sales of spot		900 tons
Sales of futures		1,400 tons

Extreme fluctuations for this year:

	Highest	Lowest.
Standard	.....	.....
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

SHORT-COMINGS OF AMERICAN EXPORTERS.—Vice-Consul Dirk P. De Young, of Santos, Brazil, in a recent report criticises American exporters for lack of knowledge shown in dealing with Brazil trade. There is, he says, no end of trouble caused by the ignorance of American exporters of how to classify their own goods to meet the requirements of the Brazil tariff, and an instance is quoted where this led to duty being assessed 200 per cent over what it would have been under a proper classification. He states that articles are being held in the Santos custom house subject to storage charges in excess of their value because the New York shipper did not send the necessary documents to enable the goods to be cleared. He says further that it is a source of considerable humiliation to those representing American interests that a large percentage of American letters arrive short of postage; if there is only a two-cent stamp, the overdue charge is nine cents.

AMERICAN MONORAIL COMPANY.—Arrangements have been made by the American Monorail Company to construct a line three miles long through Pelham Bay Park and City Island from Bartow Station on the New York, New Haven & Hartford Railroad to Belden's Point at the extreme end of City Island. It is said that work upon this line will begin early in the fall. It is also claimed by interests associated with the Monorail company that plans have been prepared which include the double-decking of both the Second Avenue and the Third Avenue elevated lines for the accommodation of the monorail system. It is intimated that the Interborough Rapid Transit Company is furnishing the capital for the construction of the experimental monorail line. The Interborough company owns control of the City Island Railroad Company and also of the Pelham Park Railroad Company, the two concerns which have

been operating a horse-car line over this route. Recently, the Interborough company transferred its interest in these subsidiary companies to the Monorail Construction Company, which latter is building the experimental line. The two monorail companies some time ago applied to the Public Service Commission for permission to issue $100,000 of bonds, $55,000 of which were to take up outstanding liabilities and $45,000 to be used in constructing the new road. The commission declined to allow the issue until some explanation had been made as to what became of the money realized from the former issue. This explanation has not been given and the monorail experiment had to be financed in some other way.

IMPROVEMENT IN TELEGRAPH BUSINESS.—According to Mr. R. C. Clowry, president of the Western Union Telegraph Company, the business of the company last week was the best ever recorded. He said: "Not since 1907 have matters been so generally encouraging as at present. The business is naturally stimulated through the increased commercial and industrial activity, and we look forward to a season of good earnings. It has been argued that the telegraph has been made to suffer through the popularity of the telephone. This is not stating the matter fairly. There is no doubt that the telephone business has increased enormously and that some of it has been at the expense of the telegraph. But at the same time the two systems work hand in hand. The Western Union has 'phones in every office throughout the country and the number of messages sent in for further transmission is hardly appreciated. Factories and points away from the regular branch offices use the 'phones extensively and this does away with a large number of messengers." On the other hand, the *Wall Street Journal* states that of 80 of the principal railroads of the country that have been sounded with reference to their attitude toward the telephone as a successor to the telegraph, a large majority declare themselves in favor of the change and 50 announce that an extension of their telephone systems already in operation is contemplated. These roads operate 211,681 miles of track and at present have equipped for experimental purposes 11,632 miles along which 1,400 telephone instruments are used.

BRILLIANT ELECTRIC COMPANY'S MIDSUMMER CONFERENCE.—The Brilliant Electric Company, of Cleveland, Ohio, has extended the idea of business staff reunions by adding provisions for the participation of representatives of jobbers in the discussion of questions affecting the latter. At a conference held at Cleveland and Put-in-Bay, July 19-21, besides the home and branch office staff of the Brilliant company, 20 jobbers handling Brilliant lamps were present. During the several days social enjoyment and business discussion were suitably alternated. Papers were read by the members of the staff of the Brilliant company on various subjects related to the incandescent lamp industry, and among guests who presented papers were Messrs. T. J. Creaghead, of Cincinnati; F. W. Loomis, of the Holophane Company, and M. G. Campbell, of Kansas City.

EASTERN COLORADO HYDRO-ELECTRIC DEVELOPMENT.—The new construction in connection with the Eastern Colorado Power Company's power development is attracting a great deal of popular attention through railway excursions arranged to view the progress. The Barker Meadow dam, which is situated just below Nederland, is already about 30 ft. above bedrock, and progressing rapidly. The dam will be of concrete, with a maximum height of 186 ft., impounding about a half billion cubic feet of water. The contract price is $600,000, and it is to be completed in June of next year. The company will commence storing water in the fall of this year, and should be furnishing energy from his plant, which will be run in conjunction with the 100,000-volt development of the Central Colorado Power Company, by the summer of next year.

IMPROVEMENTS IN JOPLIN, MO.—Henry L. Doherty & Company, who control the electric light and power plants in the neighborhood of Joplin, Mo., are about to contract for a new 10,000-kw steam turbine generator. A new power house will be constructed and 3000-hp Stirling boilers have been purchased. The transmission lines, which will extend in all about 60 miles, reaching the various mining camps in that section, will carry a current at 33,000 volts. The energy will be delivered to the customers at 2300 volts and substations with transformers will be located in each of the mining camps. These properties are being put in first-class condition since they were taken over by Mr. Doherty.

COPPER FOR WESTERN ELECTRIC.—One of the largest sales of copper during 1909 was that made recently to the Western Electric Company, when between 25,000,000 and 30,000,000 lb. changed hands, at a price close to 13 cents a pound. It is said that this copper will cover the requirements of the company throughout the balance of the current year. The reason assigned for buying so liberally at present was that the outlook for gross business for the next six months or a year is now so well established that the company can definitely estimate its requirements of raw materials. At the present time the company is doing a gross business running at the rate of $50,000,000 per annum, and with the monthly increases that have been shown since Jan. 1, this rate should advance to at least $60,000,000 by the last of December.

CENTRAL COLORADO POWER COMPANY.—The Central Colorado Power Company is now supplying the Denver Gas & Electric Company with 1500 kw. It is said that the amount will be increased to 4000 kw in the near future. The Denver Gas & Electric Company has recently contracted for two 750-kw generator units to replace the apparatus destroyed by the recent explosion in its power house. Two new boilers have also been installed.

FRANCO-CANADIAN TARIFF AGREEMENT AFFECTS ELECTRICAL MANUFACTURES.—The Franco-Canadian tariff agreement recently ratified is stated to place at a disadvantage the importation into Canada of American machine tools and electrical motors, generators, and fixtures of various types, particularly of the smaller sizes.

ENLARGEMENT OF CANADIAN ACHESON WORKS.—The International Acheson Graphite Company is enlarging the output capacity of its branch works in Niagara Falls, Ontario. A new furnace room providing for a 1000-hp unit is being built, and on completion the new furnace installation will be placed in operation.

STORAGE BATTERY PURCHASES.—The Atchison, Topeka & Santa Fé Railroad has made a large purchase of car-lighting storage batteries from the Electric Storage Battery Company, of Philadelphia.

Financial Intelligence.

THE WEEK IN WALL STREET.

Although trading in the Wall Street stock market during the past week has been very much contracted, the general tone of the market has been strong and a number of issues have made new high records. What trading there has been in the market has been obviously of a professional character and outside participation has been very small. The main interest of the week has been shown in the Western railroads and in a few of the leading industrials, especially United States Steel. The explanation of these preferences is entirely logical. The crop reports indicate that the yield of the fields will be not only the largest, but by far the most valuable in the history of the country, and this, of course, means increased traffic for the Western roads and increased prosperity for the section through which they run. In the case of the industrials the strength is directly attributable to the improved condition of their business. In every line more orders are being booked and the percentage of operation is more nearly approaching normal. In the iron and steel industry the mills are practically running at capacity and prices are being advanced to a point where the operations will be remunerative. Among the rumors that helped stimulate activity during the week were those concerning increased dividends upon Union Pacific and United States Steel common. The result of these rumors was that the Harriman issue reached 199½, its high record mark, and still held comfortably above 70. The return of Mr. Morgan from his annual jaunt abroad, was also used as an argument for advancing prices. His expression was decidedly optimistic for the future of business both in this country and in Europe and it is generally believed that no serious decline in the market will be permitted while he is in this mood. After remaining apathetic on the subject for many months Wall Street has at last awakened to an interest in the tariff. This interest is not, however, so much as to what the new tariff schedule will be, as it is, as to when the rates will be fixed. Wall Street, very rightly, believes that business will adjust itself to any rates that may be adopted, but that the long delay and uncertainty have a paralyzing effect. The tariff uncertainty is being used, too, by those—and their number is not

insignificant—who are seeking lower levels for stocks. There is undoubtedly quite a considerable element in the Street which would like to see prices recede. While these people are timid about making any bear demonstrations, they constantly preach that prices are in excess of values. On July 26, the last day under review, this element succeeded in causing some reaction, but it was of little importance and the volume of trading was light. Money continues to be wonderfully easy and cheap and the demand for bonds is still eager. Quotations on July 26 were call, 1¾ @ 2 per cent; 90 days, 2¼ @ 2½ per cent. The quotations in the table are those of the close July 26.

NEW YORK.

	July 19.	July 26.	Shares sold		July 19.	July 26.	Shares sold
All.-Ch.	15¼	15*	400	Int.-Met., pfd.	47½	45	35,960
All.-Ch., pfd..	51⅞*	53	400	Mackay Cos...	81*	82	1.300
Amal. Cop....	81⅞	82⅞	118,200	Mackay Cos.,p.	74⅛*	73⅞*	300
Am. D. T.....	30*	30*	———	Man. Elev....	147*	145*	600
Am. Loc.....	61¼	62	24,500	Met. St. Ry...	20*	20*	100
Am. Loc. pfd.	119*	120½	815	N.Y. & N.J.Tel	140	139⅝	2,310
Am. Tel. & Cbl.	84	84*	——	Steel, com....	71⅞	70⅛	512,850
Am. T. & T...	140⅝	140¼	12,250	Steel, pfd.....	127⅝	126½	27,550
B. R. T.....	78	77⅛	6,260	W. U. T.....	72¼	73½	3,000
Gen. Elec.....	166	166¾	9,350	West'h, com...	83	84½	9,000
Int.-Met., com.	15½	14¼	18,600	West'h, pfd...	124½*	124½*	———

PHILADELPHIA.

	July 19.	July 26.	Shares sold		July 19.	July 26.	Shares sold
Am. Rys.....	....	45½*	——	Phila. Elec...	12	11⅞	——
Elec. Co. of A.	12⅝	12⅝*	——	Phila. R. T...	29¼	29	——
Elec. St. B'ty.	54¼	56½	——	Phila Trac....	90½	90½*	———
E. S. B'ty,pfd.	....	49*	———	Union Trac...	53½	53½	——

CHICAGO.

	July 19.	July 26.	Shares sold		July 19.	July 26.	Shares sold
Chi. City Ry..	180	180*	——	Chi. Tel. Co...	132½	133	———
Chi. Rs.,Ser.1.	112	119	———	Met. El., com..	15½	16*	——
Chi. Rs.,Ser.2.	39	38	——	Met. El., pfd..	47	47¼*	———
Com. Edison..	120½	120	——	Nat'l Carbon..	90	91*	——
Chi. Sub'ws...	20	20¼	——	Nat'l C., pfd..	118	119*	———

BOSTON.

	July 19.	July 26.	Shares sold		July 19.	July 26.	Shares sold
Am. T. & T...	140⅝	140¼	———	Mex. Tel.....	2¾	2¾*	———
Cum. Tel.....	137½	137½*	——	Mex. Tel., pfd.	....	6*	——
Edison E. Ill..	250*	250	——	N. E. Tel.....	133¾	134	———
Gen. Elec....	164*	167	——	W. T. & T....	10⅜	10¼*	——
Mass. E. Ry..	13½	12		W. T. & T., p.	86	86*	——
Mass E. R.,p.	74*	73¼	——				

*Last price quoted.
Sharles sold are for week July 19 to July 24.

DIVIDENDS.

Guanajuato Power & Electric Company, 1½ per cent on preferred stock, payable Aug. 1.

American Gas & Electric Company, quarterly 1½ per cent on preferred stock, payable Aug. 2.

Western Telephone & Telegraph Company, semi-annual 2½ per cent on preferred stock, payable Aug. 2.

Montreal Light, Heat & Power Company, quarterly, 1¾ per cent, payable Aug. 14.

Butte Electric & Power Company, quarterly, 1¼ per cent on preferred stock, payable Aug. 2.

Helena Light & Railway Company, quarterly, 1¼ per cent on the preferred stock, and 1 per cent on the common stock, payable Aug. 2.

Ohio Traction Company, quarterly, 1¼ per cent on the preferred stock, payable Aug. 1.

Central District Printing & Telegraph Company, quarterly, 2 per cent, payable Aug. 2.

Chicago Railways Company, dividend of 8 per cent on series 1 certificates, payable Aug. 2.

THE UNION RAILWAY GAS & ELECTRIC COMPANY, recently incorporated at Trenton, N. J., with a capital stock of $18,000,000, will be a holding company for the interests of E. W. Clark & Company, Philadelphia, and Hodenpyl, Walbridge & Company, New York. It has for its officers: Anton G. Hodenpyl, president; Clarence M. Clark, vice-president, and George E. Hardy, secretary and treasurer. The company has issued $4,250,000 6 per cent cumulative preferred and $6,000,000 common stock and $4,000,000 5 per cent collateral trust gold bonds, due July 21, 1939. The company was organized with a cash surplus of $500,000 without a floating indebtedness. Included in this organization are the Peoria Light Company, capitalized and outstanding, $3,500.000; bonded debt, $3,500,000; the Evansville Light Company, capitalized at $3,000,000, outstanding $2,500,000, no bonds; the Springfield (Ill.) Railway & Light Company, capitalized at and outstanding, $3,000,000; bonded debt, $2,750,000; and the Rockford & Interurban Railway Company, capitalized at and outstanding, $1,050,000; bonded debt, $1,725,000, the last company being a recent acquisition. These companies operate street railways and interurban lines, gas, electric, power and heating properties in Springfield, Peoria, Rockford, Freeport and Belvidere, Ill.; Beloit and Janesville, Wis., and Evansville, Ind., and serve a total population of 300,000.

ALBANY & HUDSON RAILROAD.—The 37-mile third-rail line of the Albany & Hudson Railroad connecting these two places is now in the hands of its general manager, Mr. R. H. Smith, who has been appointed receiver on application of the Trust Company of America, as trustee under the first mortgage on the property. The receivership proceedings are declared to be a part of a general scheme at extensions of the road, which is a third-track electric line, directly from Albany to Pittsfield. It is proposed to reorganize the company, and ex-Governor Myron T. Herrick of Ohio, Clinton L. Rossiter, vice-president of the Long Island Loan & Trust Company, and R. A. C. Smith, president of the American Mail & Steamship Company, have been named as a reorganization committee for the purpose of establishing the road on a profitable basis. It is said that the reorganized company will also buy the Albany & Greenbush Bridge, which is considered necessary to the completion of any across-the-State system of electric lines which could compete effectively in the future with the steam railroads.

ADDITIONAL BELL TELEPHONE MERGERS.—In addition to acquiring the stock of the New York & New Jersey Telephone Company and the Philadelphia Bell Telephone Company, The American Telephone & Telegraph Company has arranged to obtain possession of the affiliated companies in Buffalo and Pittsburgh. The offer to the stockholders of the Bell Telephone Company of Buffalo is on the basis of one share of American for one and one-half shares of Buffalo Bell. By a deal which it is said will involve about $13,000,000, the American Company has taken over the Central District & Printing Telegraph Company, which operates all of the Bell lines in Western Pennsylvania, Eastern Ohio, and a part of West Virginia—that is, the district centering around Pittsburgh. The exchange is being made on the basis of one share of American for one and one-half shares of the Central.

BANKRUPTCY OF XENIA (O.) LIGHT COMPANY.—The Cincinnati Federal Court has issued an order in the case of the People's Gas & Electric Light Company of Xenia, Ohio, to the effect that failing payment of the principal and interest on the bonds issued in 1902, amounting in all to $195,119.15, the property shall be sold as a unit from the courthouse steps in Xenia, after it has been duly advertised for four weeks. The electric lighting plant is in operation, but the gas plant is now idle. The upset price on the property has been fixed at $20,000. Bidders will be required to deposit certified checks for $2,000 as an evidence of good faith. After the expenses of the receivership have been paid, the proceeds of the sale are to be distributed among the bondholders pro rata.

BELL TELEPHONE MERGER.—In connection with the unanimous vote of the directors of the Central District & Printing Telegraph Company to accept the offer of the American Telephone & Telegraph Company to exchange the stock of the latter for the former, as noted elsewhere in this issue, Mr. M. H. Buehler, general manager of the Bell Telephone Company for Pittsburgh, said: "This is the fourth deal in a movement which will eventually extend over the entire country. The local deal has been pending for some time, and is but a part of a movement on the part of the American Telephone & Telegraph Company to consolidate all the Bell companies in the United States under one head."

SALE OF WESTCHESTER ROAD.—H. R. Barrett, of White Plains, N. Y., has been appointed referee to sell the Tarrytown, White Plains & Mamaroneck Railway Company at foreclosure. The application for the sale was made by the Knickerbocker Trust Company, trustee for the bondholders, to whom the company owes about $300,000. It is now in the hands of J. Addison Young, of New Rochelle, the receiver, who recently purchased 25 "pay-as-you-enter" cars and made other improvements in the effort to make the road meet expenses. It is expected that the road will be sold from the steps of the White Plains courthouse in September or October.

McCALL FERRY COMPANY CONTRACTS.—Since the receivership of the McCall Ferry Power Company there has been some question as to the possible effect on the contracts held in Baltimore for distribution of power. The Consolidated Gas, Electric Light & Power Company holds a contract for the distribution of this power within a radius of 25 miles from the Washington Monument, while the United Railways Company also holds a contract to use this power for its own purposes in Baltimore. This gave to the two companies a practical monopoly. If the reorganization should result in a new company, the question is whether the existing contracts will hold good. The Consolidated Electric Company had large projects in view as soon as this power was available. It was expected to increase the power consumption by large manufacturing plants which have heretofore used steam as the chief motive power. The rates, it is understood, would have been so low as to preclude the installation of isolated plants by large manufacturers. J. Edward Aldred, the receiver named in Pennsylvania, has been appointed by Judge Morris for the property in Maryland. It is understood that the receivership will not interfere with its completion of the work and money will be raised by the issuance of certificates. Word has been received from Washington that the bureau of corporations is investigating the troubles of the McCall company. Mr. Aldred's bond has been fixed at $20,000.

THE B. F. STURTEVANT COMPANY REORGANIZED.—The B. F. Sturtevant Company has been reorganized and its capital increased from $500,000 to $1,250,000 6 per cent cumulative preferred stock and $1,250,000 common stock. The new stock has all been taken by a few of the large owners. John Carr, chairman of the board of directors of the First National Bank, Boston, is president, Eugene N. Foss is treasurer, and E. B. Freeman has been elected general manager. The increased capitalization represents capital expenditures during the past year, largely in the erection of a new plant in Hyde Park which cost over $1,500,000. The B. F. Sturtevant Company has been doing a business of about $3,000,000 a year. Its fan and blower output has increased at such a rate that it was necessary to enlarge the capital to handle the business. Still further additions to the plant will be made next spring.

WESTINGHOUSE ELECTRIC REPORT.—As noted elsewhere in this issue, the Westinghouse Electric & Manufacturing Company has issued a report for the year ended March 31, 1909. It showed the year's gross earnings to have been $20,606,000, as against expenses and other deductions of $21,525,000, there being a resultant deficit of $919,000. There was a decrease in the surplus account during the year of $2,992,000, due to loss from operations of the business; to allowances for depreciation; to expenses incurred in connection with the adjustment of the debt which existed on Oct. 23, 1907, when the company went into receivers' hands; to compensation and expenses of receivers and their attorneys; to sundry amounts charged off to reduce book value of company's assets; to depreciation of patents; depreciation of various stocks and bonds; provision for possible losses on inactive finished parts and machines on hand at the close of the year, and other minor items of similar nature. Mr. George Westinghouse in his presidential report to the stockholders says: "While there has been a decided improvement in the business of the company since the beginning of the year, it has not yet nearly reached normal proportions, although the outlook and inquiries indicate that in the near future the full capacity of your works will be required to meet the demand."

TO TAKE UP MARYLAND TELEPHONE BONDS.—A notice has been issued by Nicholas P. Bond, president of the Baltimore Electric Company, for the redemption of general mortgage bonds of the Maryland Telephone & Telegraph Company, secured by a mortgage from the above company to the Central Trust Company, of Baltimore, dated March 2, 1903. The bonds are to be redeemed and paid off at the next interest date September, 1909, at the office of the trustee, by the payment of interest and principal, with a premium of 5 per cent.

PLYMOUTH COUNTY (MASS.) GAS LIGHT & POWER COMPANY.—A petition has been presented to the Massachusetts Gas and Electric Light Commission, by the Plymouth County Gas, Light & Power Company for permission to issue $600,000 capital stock and $400,000 of 5 per cent bonds. The company has recently been organized for the manufacture and sale of gas.

RIVAL TO BELL TELEPHONE.—The National Telephone & Telegraph Company, which has been incorporated at Harrisburg, Pa., with a nominal capital of $10,000, is said to be the parent of a big corporation intended for national competition with the American Telephone & Telegraph Company. The charter includes every county of Pennsylvania, every State and Territory and Alaska.

TRACTION AND LIGHT PROPERTIES FOR PENNSYLVANIA RAILROAD.—It is reported that interests friendly to the Pennsylvania Railroad are about to take over holdings which control all of the traction and electric light properties between Steubenville, Ohio, and Beaver, Pa.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Montreal Street Railway Company:					
June, 1909	[illegible]	$190,320	$164,598	$48,134	$116,464
June, 1908	331,[illegible]	166,083	165,128	48,992	116,136
Rutland Railway Light & Power Company.					
Year ending June 30, 1909	249,[illegible]	131,692	117,966	81,396	36,570
Year ending June 30, 1908	254,[illegible]	140,444	114,363	.....	.....
Aurora, Elgin & Chicago Railway Company:					
June, 1909	142,[illegible]	71,332	71,236	28,982	42,254
June, 1908	127,[illegible]	62,698	62,894	27,843	35,051
Cumberland Telephone & Telegraph Company:					
June, 1909	536,985	302,279	234,705	41,540	193,165
June, 1908	494,[illegible]	292,200	202,155	35,374	166,781
Chicago Railways Company:					
May, 1909	1,055,100	709,744	345,416	.....	.....
May, 1908	902,482	600,352	302,129	.....	.....
Detroit Street Railway Company:					
June, 1909	698,[illegible]	423,826	274,650	150,007	129,833
June, 1908	638,[illegible]	384,101	251,601	137,179	114,085
Kansas City Home Telephone Company:					
Year ended March 31, 1909	819,786	413,535	406,251	150,260	255,991
Year ended March 31, 1908	766,947	412,971	353,975	150,102	203,873
Kings County (N. Y.) Electric Light & Power Company:					
Six months ended June 30, 1909	1,839,765	874,878	964,887	519,706	450,181
Six months ended June 30, 1908	1,776,723	824,660	952,063	498,[illegible]	453,785
Lexington (Ky.) Interurban Railways Company:					
May, 1909	49,[illegible]	33,403	16,444	..	.....
May, 1908	48,[illegible]	35,[illegible]	13,422	..	.....
Twin City Rapid Transit Company:					
June, 1909	593,[illegible]	260,881	332,220	140,251	191,969
June, 1908	553,[illegible]	270,018	283,482	128,250	155,232
United Railways of St. Louis:					
June, 1909	964,024	600,617	380,407	232,322	131,085
June, 1908	915,339	572,259	343,080	230,883	112,247
Virginia Passenger & Power Company:					
May, 1909	178,[illegible]	101,320	77,430	.....	.....
May, 1908	167,183	108,667	58,716	.....	.....
Rio de Janeiro Tramway Light & Power Company:					
Year ending Dec. 31, 1908	7,138,247	4,407,813	2,730,434	1,860,198	870,236
Year ending Dec. 31, 1907	6,313,706	4,183,385	2,120,321	.....	.....
Northern Ohio Traction & Light Company:					
June, 1909	198,203	107,979	90,227	44,245	45,982
June, 1908	174,114	98,895	75,549	44,120	31,429
Toledo Railways & Light Company:					
June, 1909	216,156	129,075	87,081	70,917	16,164
June, 1908	201,766	107,458	94,308	71,762	22,546

GENERAL NEWS

Construction News.

ALBERTSVILLE, ALA.—Reports are current that it is the intention of the Sand Mountain Electric Company to develop water power on Short Creek and extend its transmission lines to Boaz, five miles distant. Definite details will probably be available later. E. O. McCord is president and general manager of the company.

BIRMINGHAM, ALA.—Newspaper reports state that Mayor O'Brien will recommend to the City Council the installation of an electric light plant.

CULLMAN, ALA.—It is the intention of the Municipal Electric Light Plant to install another 105-kw dynamo, to extend its transmission lines and to replace its 250-hp Erie City engine with a Corliss engine. B. Kiel is superintendent of the company.

NEW DECATUR, ALA.—The terms of the new contract entered into between the Decatur Light, Power & Fuel Company and New Decatur for furnishing lighting for the city are as follows: Thirty arc street lamps, the distribution of which is to be directed by the street committee, are to be supplied by the lighting company at a cost to the city of $2,250 a year. Provision is also made that if the company fails to give proper service the contract may be annulled.

YORK, ALA.—Work is soon to be commenced by the Southern Bell Telephone & Telegraph Company on the construction of a line between this city and Demopolis. Plans are also being considered for the erection of a line to Millville.

WHIPPLE BARRACKS, ARIZ.—Bids will be received until Aug. 2 by J. W. Pope, Ch. Q., M. U. S. A., Denver, Col, for furnishing electric energy at Whipple Barracks for lighting and small motor purposes. The distributing system will be ready about Jan. 1, 1910.

ELDORADO, ARK.—The Eldorado Light & Water Company, so we are advised by W. H. Holmes, vice president and general manager of the company, is doubling the capacity of its plant, and installing a 250-kw, 60-cycle unit.

HELENA, ARK.—The plant of the Southwestern Telegraph & Telephone Company at this city is being entirely rebuilt.

JONESBORO, ARK.—The Home Telephone Company of this city has applied for a franchise in Paragould, it being its purpose to at once commence work on the installation of an up-to-date exchange and telephone system as soon as favorable action on its application has been taken by the City Council.

OSCEOLA, ARK.—We are advised by Abner Driver, owner of the electric light plant at this city, that he contemplates the installation of a 30-kw, alternating-current, 60-cycle, 2200-volt machine for day service.

BAKERSFIELD, CAL.—The West Side Electric Company has requested the Board of Supervisors to advertise for sale a franchise for the stringing of wires for the transmission of electricity to cover the West Side oil fields from Sunset to McKittrick. According to the terms of the advertisement, bids will be received up to Aug. 7, and the successful bidder must commence work within four months after the franchise is granted.

HAMILTON CITY, CAL.—The Northern California Power Company is constructing a power house at this city, and erecting transmission lines between Nord and Hamilton City.

KEELER, CAL.—Plans are being considered by the Four Metals Company for the installation of a power plant to operate its smelter at this city. Definite action, however, will not be taken until the proposition of the Nevada-California Power Company to supply energy to the smelter has been duly considered, the latter company agreeing to supply electricity as cheaply as the Four Metals Company can generate it. Should the Nevada company's offer be accepted, it will at once commence construction work on a 70-mile transmission line from Bishop to Keeler, which will give service to Lone Pine, Big Pine and a number of towns in that vicinity.

LOS ANGELES, CAL.—It is reported that steps toward the establishment of an electric light plant in this city have been taken, the City Council having approved a recommendation of the Board of Public Works that $10,000 be set aside from general taxes for the next two years to pay the cost of preliminary work of establishing power plants along the line of aqueduct.

LOS GATOS, CAL.—It is stated that the Board of Supervisors has awarded to the Los Gatos Ice, Gas & Electric Company a franchise to construct and operate a line of poles and wires for an electric light and power system in Santa Clara County for a period of 50 years, it being the company's intention to give service to practically all of the towns between Los Gatos and Palo Alto. J. D. Farwell is manager of the company.

NEVADA CITY, CAL.—Application has been made to Supervisor Bigelow, of the national forest, by C. C. Curtis, engineer of the Southern Pacific Company, for permission to construct a power plant on the North Yuba river, in Sierra county.

NEVADA CITY, CAL.—It is understood that a well-financed Eastern company has become interested in the Yellow Metal Mine near Bowman's Dam, and that arrangements are being made for the erection of a 10-stamp mill which is to be operated by electric motors.

OAKLAND, CAL.—An ordinance has been introduced in the City Council requiring all wires between Oak and Grove Streets and First and Twentieth Streets to be placed under ground within the next four years. In the ordinance this general district is divided into four smaller ones, underground work in one of which is to be completed each year.

OAKLAND, CAL.—News comes from this city that the Board of Public Works has granted permission to the Great Western Power Company to erect transmission lines from Trestle Glen to its plant at Sessions Bason. This concession by the Board of Works is taken as an indication that the franchise now before the City Council for permission to install overhead and underground wires will soon be granted to the Great Western Company.

PACIFIC GROVE, CAL.—The Monterey County Gas & Electric Company is rebuilding its alternating-current distribution system to meet the rapid growth of the town, and to make the line construction conform to the company's modern specifications. On account of operating conditions, this work is being done a small section at a time. The entire work will cover about nine months, at an estimated cost of $10,000. Mr. F. J. Sutherland is assistant general manager.

REDDING, CAL.—The Sacramento Valley Power Company, which is reported to be a consolidation of the Northern Light & Power Company and the Shasta Power Company, is planning to extend its transmission lines south as far as Chico.

SANTA ROSA, CAL.—A franchise has been granted by the City Council to the Sonoma & Lake County Railroad to construct an electric railway in Santa Rosa. The company's plans include the erection of a line to connect Cloverdale, Preston and Lakeport. A. E. Dickinson, Ukiah, is president.

VALLEJO, CAL.—Newspaper reports state that the Vallejo Electric Light & Power Company, of which K. Casper is general manager, is considering the extension of its transmission lines into the Heights section of the city.

WILMINGTON, CAL.—The board of trustees has granted to the Pacific Electric Railway a 50-year franchise to construct an electric railway on certain streets of Wilmington.

COLORADO SPRINGS, COL.—Credence is given to the reports that the Manitou Electric Company will soon pass into the hands of the Pike's Peak Hydro-Electric Company, the consideration involved in the transfer, it is understood, being about $25,000. It is stated that stock in the Hydro-Electric Company will be offered to the owners of the Manitou company.

DENVER, COLO.—Press reports state that the Greeley-Fouche Irrigation Company, of which D. A. Canfield is president, and the Denver Tramway Company, J. A. Beeler, Denver, president, will soon let contracts for the power plant and irrigation system in northern Colorado. The plans include the enlarging of the Roosevelt reservoir by building a dam 400 ft. high and the construction of transmission lines to conduct the energy to Denver.

GROVER, COLO.—The Grover Telephone Company contemplates the erection of a telephone line from Grover to Cheyenne, via Hartford, Carpenter and Camp Stool.

PALISADES, COL.—The Palisades Light, Heat & Power Company contemplates the erection of ten miles of transmission line. H. L. Davis is manager.

PUTNAM, CONN.—We are advised by the Putnam Light & Power Company, of which R. E. Thurston is general manager, that it has extended its transmission lines from French River to Thompson, and that it is installing 30 32-cp series lamps for street lighting in Pomfret. Mr. Thurston also states that the French River Textile Company, at Mechanicsville, is installing a 150-kw generator to furnish water-power to the Putnam Light & Power Company.

WILLIMANTIC, CONN.—The organization of the Rockville & Willimantic Lighting Company, which has taken over all of the charter rights of the Willimantic & Stafford Springs Street Railway Company, has been completed, and the following officers have been elected: President, Walter Learned, New London; vice-president, H. C. Murray, Willimantic; secretary, treasurer and general manager, A. J. Campbell, New London. The new concern will not attempt to utilize the street railway rights for the present, but will furnish electricity to Willimantic, Rockville, Stafford Springs and a number of towns in Windham and Tolland counties. It is capitalized at $700,000.

JACKSONVILLE, FLA.—The Electric Committee of this city has submitted specifications showing the cost of the addition of 100 new arc lights to the city's circuits to be about $9,054, and has recommended their installation.

LEESBURG, FLA.—A thirty-year franchise for the construction of an electric plant has been granted by the City Council to J. Y. Clark, so it is stated.

MULBERRY, FLA.—The Mulberry Electric Company, so we are informed by R. H. Pratt, president of the company, contemplates the extension of its transmission lines to Kingsford.

ADAIRSVILLE, GA.—It is currently reported that the city is considering the installation of an electric light system. Address the Mayor.

ELLIJAY, GA.—A company, to be known as the Coosawattee & Mountaintown Power Company, of Ellijay, is reported to have been incorporated by W. M. Scott, of Atlanta, and E. W. Watkins & Sons, of Ellijay, for the purpose of constructing a hydro-electric plant, mention of which was made in our issue of July 15. Hall Bros., of Atlanta, have had the surveying in charge, and it is estimated that at least 5000 hp will be developed along the Coosawattee and Mountaintown rivers.

SAVANNAH, GA.—The Savannah Electric Company, of which M. L. Sperry is general manager, is installing a 100-kw Allis-Chalmers alternating-current turbine.

LEWISTON, IDAHO.—The Nez Perces Co-operative Telephone Company is rebuilding its line between this city and Grangeville.

MEADOWS, IDAHO.—A new power plant is being erected on the Little Salmon River by Chisholm & Goodman, of this city.

ST. MARIES, IDAHO.—Permission to install and maintain an electric lighting system in this city has been granted by the Board of Village Trustees to G. H. Jay, of Great Falls, Montana, the other applicants for the franchise being the Washington Water Power Company and C. A. Cochran. It is understood that work is to be commenced at once by Mr. Jay on a $50,000 hydro-electric plant, and that a lighting service from same will be in operation within six months.

SALMON, IDAHO.—The Andrews Light & Power Company, of Salmon, Idaho, which in February purchased the interests of Quarles & Quarles and the Salmon Electric Company, has placed its new station in operation. The equipment consists of a 600-hp water wheel, direct-connected to a 200-kw, 2300-volt, three-phase generator built by the Allis-Chalmers Company. A seven-mile transmission line furnishes 100 hp to the mines of the Copper Queen Mining & Smelting Company. The transmission tension is 11,000 volts stepped down to 440 volts for motor circuits and 110 volts for lamp circuits. The company contemplates the installation of a second larger unit similar to that just put in operation next year.

BEMENT, ILL.—Newspaper reports intimate that the Board of Trustees of this city are considering the installation of a municipal lighting plant.

BURNT PRAIRIE, ILL.—It is officially announced that the Carmi-Fairfield Traction Company, which is not yet chartered, will commence construction work early in September on an electric railway connecting Carmi, Sumpton, Liberty and Fairfield, a distance of about 25 miles. The power station is to be located at Burnt Prairie, and it is the company's intention to furnish energy for lighting also. E. S. Lawrence, St. Louis, Mo., is chief engineer.

CLINTON, ILL.—The National Telephone & Electric Company, which has recently purchased from the Kinloch-Bloomington Company its trunk line between Clinton and the north boundary of DeWitt county, and a line from Farmer City half way to Leroy, expects to rebuild the lines at once.

MACOMB, ILL.—The extensions planned by the Illinois Western Telephone Company in its system include the construction of a line from this city to Galesburg, via Bushnell, and one to Peoria, via Canton.

PEORIA, ILL.—The Railway Terminal Company is considering the purchase of two units and three boilers for its power station.

YORKVILLE, ILL.—It is stated by Hugh Palmer, president and chief engineer of the Yorkville & Morris Railroad, that the company is to be reorganized and work resumed on its proposed electric railway connecting Yorkville, Lisbon and Morris, a distance of 22 miles. The line will later be extended to Ottawa.

HOPE, IND.—The Hope Independent telephone plant, and the plant at Hartsville, recently sold to J. W. Aspy, Joseph Burney and others, will be remodeled and new equipment installed. It is understood that connections have been established with the Bell company at Columbus, but it is claimed that a merger with that company has not been effected.

DES MOINES, IA.—Through a recently consummated deal, the Des Moines Electric Company has passed into the hands of the Illinois Traction Company, the consideration being in the neighborhood of $1,000,000. The purchase will give the McKinley system entrance into a valuable interurban territory in Iowa, and will make a line from Peoria to Des Moines a possibility of the near future.

EARLHAM, IA.—We are advised by J. R. Thomson, Mayor of the Town of Earlham, that bids will be received for the construction of water and light plants up to Aug. 2, 12 o'clock noon. Plans are on file at the Mayor's office and at the Des Moines Bridge & Iron Works, Des Moines, Ia.

WHITESBURG, KY.—The establishment of an electric light plant at this city is being promoted by David C. Mullins.

COLUMBIA, LA.—A new exchange and up-to-date telephone system is being installed in this city by the Home Telephone Company, of Monroe.

ELLSWORTH, ME.—It is stated that Engineer J. A. Leonard, of the Bar Harbor & Union River Power Company, has been working on plans for doubling the equipment of the company's power plant at Ellsworth. The present equipment produces 1500-kw, there being two generators of 1000 kw and 500 kw, respectively, and it is proposed to install two new generators which will add 2000 kw to the rating of the plant.

BOSTON, MASS.—Bids will be received until Aug. 20 by Col. Edward Burr, Corps U. S. A., for electrical cable.

HAVERHILL, MASS.—During a recent electrical storm at this city one of the large power dynamos of the Haverhill Electric Company was burned out, crippling all plants depending on electric power.

HOLYOKE, MASS.—We are informed by the Board of Public Works that the item printed in these columns stating that the board is contemplating the expenditure of $50,000 for the enlargement of the electric lighting plant, etc., is incorrect, inasmuch as the board has not the control of the lighting plant in that city, and that so far as it knows no such amount of money is to be expended.

NEW BEDFORD, MASS.—The contract for lighting the new Registry of Deeds Building in this city has been awarded by the county commissioners to Robert D. Ireland & Co., of Boston, for $5,598.

ORANGE, MASS.—The Orange Electric Light Company expects to commence work at once on the improvements planned at Wendell Depot and the immediate vicinity, which include the construction of a large dam and power house at Wendell Depot as well as the construction of two or more dams in Warwick.

PALMER, MASS.—The Central Massachusetts Electric Company has been granted additional pole locations in Thorndike, Three Rivers and in Palmer Center.

PITTSFIELD, MASS.—One of the dynamos in the power house of the Pittsfield street railway was burned out during a recent electrical storm at this city.

SALEM, MASS.—A committee to investigate rates for street lighting has been appointed by the city of Salem, its contract with the local electric light company having expired this spring.

SOUTHBRIDGE, MASS.—A temporary contract with the Webster & Southbridge Gas & Electric Company has been signed by the selectmen of this city. The contract provides for a reduction in rates and the substitution of tungsten lamps for the present arc lights as fast as the latter need renewing. While the contract calls for a term of five years at the prescribed rates, it is understood that it is subject to alterations by the selectmen.

IRONWOOD, MICH.—Application has been made to the City Council by the Twin City Railway Company for a franchise to extend its lines to Bessemer.

MUSKEGON, MICH.—Information comes from this city that the Interurban Electric Light & Power Company, which has construction rights across Mason and Oscead counties from Hamlin Lake to Shelby and which was organized to furnish electricity to Ludington, Pentwater, Hart, Shelby and smaller places along the right of way, has almost completed work on the lower dam at Hamlin Lake. Wires are being strung from Ludington to Pentwater and arrangements are being made to take over the Pentwater lighting plant. Power rights on the Pere Marquette River capable of developing 30,000 hp are said to have been secured.

ANOKA, MINN.—About $5,000 is to be expended by the Northwestern Telephone Exchange Company in the improvements it intends to make in this city.

BAUDETTE, MINN.—Bids will be received by the Village Clerk until Aug. 6 for the construction of water-works and an electric light plant. Mr. C. R. Middleton is Village Attorney.

MERIDIAN, MISS.—It is currently reported that the Meridian Light & Railway Company, of which A. B. Paterson is general manager, expects to erect an addition to its power house, in which will be installed a 1500-hp engine and a 1000-kw generator. J. N. Eley is credited with being the consulting electrical and mechanical engineer.

KANSAS CITY, MO.—It is reported that the People's Ice Company will rebuild its power house, which was destroyed by fire.

SEDALIA, MO.—The following bid for furnishing lights in the city of Sedalia for the next ten years has been submitted by the Sedalia Light & Traction Company. The company will furnish 150 arc lights, 26 more than are now in use, for $60 per light for one year. Ten cents per kw for residence lights, eight cents per kw business lights and five cents per kw for power were other bids.

SPRINGFIELD, MO.—The citizens are reported to have voted in favor of extending the franchise of the Springfield Gas & Electric Company.

BEAR CREEK, MONT.—Application for a franchise to construct an electric light and water plant at this city has been made, so it is reported, by Chris Yergen.

HAMILTON, MONT.—A statement to the effect that the electric light plant at this city will be entirely remodeled and made modern in every particular is, according to press reports, credited to W. O. Fisk, of Hamilton.

MOORE, MONT.—An electric light franchise, a duplicate of that voted by the City of Lewistown, has been granted to S. W. Gebo, who controls the Lewistown Coal, Gas & Light Company. It is stated that

work on the construction of the company's transmission lines from Lewistown, at which place it has temporary offices in the Bank of Fergus County building, to Moore will be commenced at once, and that a 24-hour service will be operative at an early date.

ROUNDUP, MONTANA.—It is reported that James U. Gridley has made application for an electric light franchise in this city.

HASTINGS, NEB.—Arrangements are being made for the enlargement of the municipal electric light plant at this city.

SWEETWATER, NEV.—It is reported that P. J. Conway has disposed of his ranch and power holdings in this city to Judge Costigan and Dr. Pollard, who, it is understood, represent the Walker River Electric Company. Plans are being prepared by the new owners for the construction of a large power plant, which will supply power to Masonic, Bodie, Aurora and Lucky Boy.

MILTON, N. H.—Work on the construction of a dam across the Salmon Falls River, near the Flume, has been commenced by the Great Falls Manufacturing Company, and it is reported that the company will install an electric plant at that point in the near future.

CRANFORD, N. J.—It is announced that C. Z. Smith, township committeeman, is interested in the establishment of a municipal electric light plant at this city.

FLEMINGTON, N. J.—The subject of a new lighting contract for Flemington is being considered by the Board of Village Trustees, the present one expiring January 1, 1910. It is understood that propositions have been submitted by the Flemington Electric Light, Heat & Power Company and the Flemington Gas Company, and that the new contract contemplates an all-night service in place of the present one, which is operative only until midnight.

IRVINGTON, N. J.—No bids having been received by the Irvington Council for lighting the streets in response to proposals advertised in the regular manner, Mayor Glorieux has suggested that the Lighting Committee be authorized to readvertise, and a motion was passed to that effect.

SANTA FE, N. M.—It is reported that the application of O. M. Lee and J. L. Lawson, of Alamagordo, to appropriate water from the Rio Ruidoso and tributaries on the Mescalero reservation to develop 5000 hp for electric lighting and other purposes in Fort Stanton and other points has been approved in a modified form by Territorial Engineer Sullivan.

ALBEMARLE, N. Y.—Newspaper reports state that the city will vote July 27 on an issuance of bonds a portion of the proceeds of which are to be used for the establishment of an electric light plant. Address the Mayor.

BALDWINSVILLE, N. Y.—At a recent election held in this city favorable action was taken on the proposition to increase the number of arc lamps in use for lighting the city streets from 24 to 65.

BATAVIA, N. Y.—It is understood that the East Batavia Improvement Association will at once ask for estimates and plans for the proposed lighting system, as well as for material and work.

FRANKLIN, N. Y.—The Delaware & Otsego Light & Power Company, of which E. A. Mackey is president and general manager, advises that it contemplates the extension of its transmission lines to Sidney Center for the purpose of furnishing a lighting service at that place.

FULTON, N. Y.—Arrangements have been made by the Fulton Light, Heat & Power Company with the Syracuse, Lake Shore & Northern Railway Company for the purchase of 250 hp from the latter company, in order that there may be no interruption to the Fulton Company's service during the low-water period.

GOUVERNEUR, N. Y.—Press reports state that the Village Trustees will receive bids until Aug. 3 for lighting the streets. The contract held by the Oswegatchie Light & Power Company expires in September.

NEW YORK, N. Y.—The North Shore Traction Company, it is reported, contemplates the erection of a new power house on the McKnight Realty Company's property at the head of Little Neck Bay on Broadway.

POUGHKEEPSIE, N. Y.—It is estimated that about $250,000 will be expended by the Poughkeepsie Light, Heat & Power Company in the improvements which it proposes to make in its plant, and which include the installation of a new 2000-kw steam turbine generator, new exciter set, condenser, boilers, furnaces and auxiliary apparatus. Arrangements have recently been entered into between this company and the Newburgh Light, Heat & Power Company for supplying the latter company with additional electrical energy.

ROME, N. Y.—It is the intention of James S. Brailey and E. L. Cline, of Toledo, the new owners of the Rome Home Telephone Company, to reconstruuct the entire system.

SYRACUSE, N. Y.—It is the intention of the Syracuse Lighting Company, now that it has been authorized by the Public Service Commission to execute an extension and improvement mortgage, and to issue $143,000 for proposed new work this year, to at once commence the installation of additional street lamps in Syracuse. It is stated that 71 new lamps are to be put into service.

CONCORD, N. C.—A franchise to construct electric railway lines in this city has been granted to the Piedmont Carolina Railway. It is stated that the system will also be extended to several nearby towns.

DUNN, N. C.—It is reported that the capacity of the local electric light plant at this city is being doubled by the installation of a new boiler and other machinery.

KINGSTON, N. C.—The date on which a vote will be taken for the issuance of $50,000 of bonds, the proceeds to be used for extending the water and light system, has been set for August 24. W. D. La Roque is Mayor of the city.

THOMASVILLE, N. C.—Energy to operate the Glen Anna Milling Company's plant is to be supplied by the Thomasville Light & Power Company, which intends to install a transmission station on the line recently constructed to Cedar Lodge for the purpose of furnishing electricity for lighting and agricultural purposes at that point.

WADESBORO, N. C.—Plans are reported under way for the construction of a hydro-electric plant at Kendall Ferry, on Rocky River, about 15 miles north of Wadesboro, which will supply power for a number of industrial enterprises. A. H. Richardson, of Ansonville, N. C., and other leading men of Anson County are interested in the project, and are now engaged in securing the necessary options and requisite funds to carry out every detail of their plans. It is estimated that the probable cost of the plant, which is expected to develop between 6000 and 7000 hp, will be about $400,000.

WILSON, N. C.—The Wilson electric light plant is making extensive improvements, including the installation of a new Murray Corliss 450-hp engine.

GRAND FORKS, N. D.—W. H. Alexander, City Auditor, writes that bids will be received about Aug. 9 for the construction of an electric light plant, probable cost $30,000. Engineer, Earle D. Jackson, St. Paul, Minn.

COLUMBUS, OHIO.—Four new branch exchange buildings, the estimated cost of which is $150,000, are to be erected by the Columbus Citizens' Telephone Company.

COLUMBUS, OHIO.—Bids will be received until Aug. 18 by the Board of County Commissioners (John Scott, clerk) for furnishing and installing a complete electrical lighting equipment for the county jail, including all lighting fixtures, electric lamps, conduits, wires, etc.

DEFIANCE, OHIO.—The Northwestern Telephone Company has increased its capital stock from $60,000 to $100,000, and proposes to make improvements in its system.

FAYETTE, OHIO.—It is currently reported that the citizens have voted to issue bonds for the installation of an electric light plant. C. D. Hause is the village clerk.

TOLEDO, OHIO.—The Citizens' Lighting & Heating Company has applied for permission to install underground conduits for the transmission of electricity for light and power purposes in a number of additional streets in Toledo.

HYDRO, OKLA.—It is understood that an election is soon to be held in this city for the purpose of voting on a proposition to issue $25,000 of bonds for water works and an electric light system.

MEDFORD, OKLA.—The City Clerk writes that the city may install an electric light plant, but that nothing definite has as yet been done.

EUGENE, ORE.—It has been decided by the City Council to leave the details of the construction of the city power plant in the hands of a committee of four, consisting of Mayor J. D. Matlock and the committee on fire and water.

JACKSONVILLE, ORE.—A franchise has been granted to the Jackson County Electric Light & Power Company to erect pole lines for the transmission of power and light in this city.

PITTSBURGH, PA.—A new power plant is to be installed at its Aliquippa works by the Jones & Laughlin Steel Company, of Pittsburgh, so it is reported, the additional power to be used exclusively for the operation of a new tin plate plant now being built, and which will have an equipment of 30 tin mills.

READING, PA.—The Metropolitan Electric Company has submitted the following bids for the street lighting of Reading: On a five-year basis: 700 magnetite arc, 320-watt lamps, $76.00 per annum; 500 tungsten incandescent, $19.20 per annum. On a 10-year basis: 700 magnetite arc, 320-watt lamps, $65 per annum, and 500 incandescent tungsten, 75 watts, $19.20 per annum. Lighting public buildings, 12 cents per kw-hour, net, on a five-year basis; on a 10-year basis, 6 cents per kw-hour, net. As showing the comparative costs of electric and gas lighting, it may be interesting to note that the Consumers' Gas Company offered to furnish 500 Welsbach mantle lamps, all night and every night, at $25 per lamp per annum.

SCRANTON, PA.—The Scranton Electric Company, so we are advised by L. H. Conklin, contemplates the installation of two 2400-hp Corliss engines and generators at Scranton.

SEWICKLEY, PA.—Bids will be received until Aug. 3 by the light commission for the municipal lighting and the 100 arc lamps to be installed. For further particulars apply to M. M. Baker, borough engineer, 514 Broad Street.

STROUDSBURG, PA.—It is reported that Meikleham & Dinsmore, 25 Broad Street, New York, N. Y., are among those interested in the construction of a hydro-electric plant on the Big Bushkill River, near Stroudsburg. It is stated that while property rights have been acquired, nothing in the way of construction work will be done until fall. The same interests are planning to build a dam across the Susquehanna River

at Towanda, Pa., to develop about 1500 hp in a hydro-electric plant, preliminary surveys having been made.

WILKES-BARRE, PA.—A seven-year contract for lighting the streets of Wilkes-Barre has been entered into with the Wilkes-Barre Gas & Electric Company by the city.

NEWPORT, R. I.—Orders have been issued for extensive improvements in the electric light plant at Fort Adams. The plans call for a new installation throughout, with service mains from the reservation line, which is taken as an indication that electricity from the Newport power station is to be used.

SPARTANSBURG, S. C.—A franchise to enter this city with its power lines has been granted to the Southern Power Company. It is stated that the company, which proposes to establish branch offices at both Spartanburg and Columbia, intends also to extend its transmission lines to Greenville.

YORKVILLE, S. C.—The Piedmont Telephone Company has secured a franchise at this city, and the installation of considerable modern telephone apparatus is contemplated.

GALVESTON, TEX.—W. D. Masterson, city superintendent of electricity, writes that the contract for the new city arc lighting machinery and lamps was awarded by the Board of City Commissioners on July 13 to the Erie City Iron Works for the engine, generator, condenser and other station apparatus; and to the General Electric Company for the lamps and rectifier outfits. The city is replacing the old 9.6 open arcs by the new 4-amp luminous arc of the General Electric Company, and the old simple non-condensing engines for up-to-date station apparatus.

NACOGDOCHES, TEX.—The Nacogdoches Light & Power Company is planning, so we are advised by O. E. Hubbard, secretary and general manager, to change its system from 125 cycles to 60 cycles, and to install new dynamos and engines. It is estimated that the proposed improvements will represent an expenditure of about $20,000.

NORMANGEE, TEX.—Toll lines from this city to North Zulch, Madisonville and Jewett are being erected by the Central Texas Telephone Company, and plans are being considered for the installation of a new exchange at Normangee.

HUNTSVILLE, UTAH.—The city of Huntsville, it is stated, contemplates the installation of a municipal lighting plant, provision having been made by the council for levying a tax to cover the cost of same. It is estimated that the proposed plant, power for which is to be secured from the Ogden River, will cost in the neighborhood of $15,000.

MURRAY, UTAH.—The Progress Company, of which J. P. Cahoos is manager, is reported to be considering the construction of a power plant in the Big Cottonwood Cañyon.

WOODSTOCK, VT.—The Woodstock Electric Company, which has recently acquired W. H. Brownell's interest in the water privileges at Taftsville, as well as the foundry and sawmill properties on the south and north sides of the river, is planning to enlarge its plant at that place. The present dam is to be replaced, and when the contemplated improvements are completed the company expects to be able to furnish a constant day service.

HIGHLAND PARK (P. O. Richmond) VA.—It is reported that the city has decided to issue $50,000 of bonds, the proceeds of a portion of which are to be used for the extension of the electric lighting system. Address the Mayor.

HUSUM, WASH.—The Husum Power Company is constructing a transmission line two miles north of Husum for the purpose of furnishing electricity in that section. J. T. Thompson is manager of the company.

SEATTLE, WASH.—An ordinance has been passed by the City Council authorizing the installation of lamp clusters on First Avenue from Virginia Street to Denny Way.

TENINO, WASH.—The Tenino Light, Power & Water Company is reported to have filed a claim of water right to 100 cu. ft. of water per second at Skookumchuck Falls, southeast of Tenino, for the purpose of furnishing electricity for lighting, heating and power purposes for Lewis and Thurston counties. It is stated that a dam will be constructed and a flume and power house will be built to divert the power to different points.

WAPATO, WASH.—It is understood that the Yakima Valley Power Company, which is constructing a high-tension power line from its plant near Naches City to Kennewick, will apply for a franchise at Wapato, the citizens of that city having expressed a desire for an electric lighting and power service.

BARBOURSVILLE, W. VA.—It is stated that the city is to vote on the issuance of bonds for the construction of an electric light plant. Address the Mayor.

ASHLAND, WIS.—It is stated that the power plant at White River, which furnishes electricity to the city of Ashland and the State fish hatchery near Bayfield, was practically destroyed as the result of a cloudburst.

CASSVILLE, WIS.—The Farmers' Telephone Company, of this city, is perfecting arrangements for the construction of a new telephone line between Cassville and Bloomington, as well as one between Lancaster and Bloomington.

LINDEN, WIS.—The city of Linden is seriously considering a proposition to light its streets and residences by electricity, current to be secured from Mineral Point, seven miles distant. John Harker is the chief promoter of the new enterprise.

RACINE, WIS.—The plant of the Citizens' Telephone Company at this city has been taken over by the Wisconsin Telephone Company.

CHEYENNE, WYO.—The Cheyenne Electric Railway, connecting Cheyenne and Fort Russell, has operated very successfully during the first half of the year from the standpoint of net income. The electricity so far has been furnished by the Northern Colorado Power Company from a motor generator set in its local station.

SHERIDAN, WYO.—J. J. Henry, of Denver, Colo., president of the Southern Colorado Power & Railway Company, is reported to be interested in the construction of a power plant near Sheridan.

LADYSMITH, B. C.—We are advised by N. A. Morrison that the city of Ladysmith has given the tender for the municipal electric light plant to the Westinghouse (Canadian) Company, Ltd., for a complete installation consisting of a 150-kw, 3-phase, 60-cycle, 2200-volt generator, 10-kw exciter, Robb compound engine Tirill regulator, switchboard, boiler, transformers, street lamps, etc. The plant is to be erected under the direction of George M. Turner, city electrical engineer.

VANCOUVER, B. C.—It is the intention of the British Columbia Electric Railway Company to extend its lines to Huntington.

LONDON, ONT., CAN.—The Bell Telephone Company is planning to place its wires in conduits in this city, the cost of such work being estimated at $50,000.

NORTH COBALT, ONT.—The Nipissing Central Railway, which is to build an electric railway connecting Cobalt Port, Cobalt and Haileybury, expects also to furnish electricity for lighting. The company has an authorized capital stock of $1,000,000, and the officers are: J. W. Fitzpatrick, North Cobalt, president; P. L. Utley, Escanaba, Mich., vice-president; Alfred Jones, Haileybury, secretary; R. G. Stack, treasurer, and Clarence B. Henry, North Cobalt, electrical engineer and general engineer.

VERDUN, QUE., CAN.—The council is considering the advisability of negotiating a loan of $150,000, the proceeds to be used for the installation of an electric light plant.

SASKATOON, SASK., CAN.—Bids were opened June 22 by J. H. Truesdale, city clerk, for one 500-kw, 2200-volt, 60-cycle, 150 r.p.m. two-phase generator, exciter and switchboard installed complete, and a 750 hp, 150 r.p.m. vertical Corliss engine, with necessary condensing apparatus, installed complete, and we are informed that the contract has been awarded to the Allis-Chalmers-Bullock Company, of Montreal, Que., for $6,860.

Company Elections.

ROSEVILLE, ILL.—The Roseville Telephone Company has elected the following officers: President, Henry Kirkpatrick; vice president, Allen Adkisson; secretary and treasurer, W. J. McQuiston; manager, Walter Waugh.

CLINTON, IND.—The following officers and directors were elected by the Clinton Electric Light & Power Company at its annual meeting: David McBeth, president; B. H. Morgan, vice-president; H. C. Dies, treasurer; J. W. Robb, secretary and manager; directors, David McBeth, B. H. Morgan, H. C. Dies, Mark E. Nebeker and J. W. Robb.

LEE, MASS.—At its annual meeting the Lee Electric Light Company elected the following officers and directors: President, B. T. Gale; treasurer and manager, Carl Wurtzbach; directors, B. T. Gale, J. L. Kilbon, J. C. Chaffee, Carl Wurtzbach and E. L. Murphy.

MARLBORO, MASS.—The Marlboro Electric Company has elected the following directors for the ensuing year: W. G. Webber, Edward C. Mason, Lombard Williams, M. B. Webber, George C. French, Louis P. Howe and A. B. Webber. W. G. Webber is president of the company and Edward C. Mason, secretary and treasurer.

DUNDEE, N. Y.—The following directors have been elected by the Dundee Telephone Company: A. J. Price, M. M. Price, H. D. Sproul, E. Sproul, S. A. Price and C. A. Gilbert.

RUTLAND, VT.—At the annual meeting of the stockholders of the Rutland Railway, Light & Power Company the following officers and directors were elected: G. Tracey Rogers, president; Leo H. Wise, vice president; C. H. West, secretary and treasurer; directors, G. Tracey Rogers, L. H. Wise, L. W. Baldwin, R. L. Warner, C. H. West, G. T. Chaffee and G. S. Haley.

New Industrial Companies.

THE CENTRAL INSULATING COMPANY, of Lafayette, Ind., has been incorporated to manufacture insulating material and insulated wire for electrical equipment. The following directors have been elected: W. H. Converse, Paul Clark and Harold Stoud.

THE DE SCHAUM-HORNELL MOTOR COMPANY, Hornell, N. Y., has filed articles of incorporation, and proposes to manufacture automobiles, motor boats, etc. The incorporators are: W. A. De Schaum, H. J. Hopkins and W. C. Paul, all of Buffalo.

THE GARLOCK AUTO SPECIALTY COMPANY, Palmyra, N. Y., has filed articles of incorporation, and intends to manufacture engines, automobiles, etc. It is capitalized at $10,000, and the incorporators are: Olin J. Garlock, H. E. Whiting, S. D. Van Alstine and others, all of Palmyra.

THE LUITWIELER PUMPING ENGINE COMPANY, Rochester, N. Y., has been incorporated to manufacture engines, automobiles, pumps, etc. It is capitalized at $300,000, and the incorporators are: S. W. Luitwieler, W. C. Smith, J. G. Haap and G. W. Rich, all of Rochester.

THE METZ AUTOMOBILE COMPANY, Paterson, N. J., has been incorporated with a capital stock of $25,000 to manufacture engines, motor boats, automobiles, etc. Among those responsible for its formation are: John M. B. Ward, S. F. Holden, Robert Swinley, D. Vanwinkle and others, of Paterson, and J. E. Forgerson, Stockholm, N. J.

THE NATIONAL ANTI-FRICTION ROLLER BEARING COMPANY, Buffalo, N. Y., capitalized at $250,000, has been incorporated by A. T. Killian, F. D. Tracy, J. De Zielinski, all of Buffalo.

THE NATIONAL ELECTRIC WELDING COMPANY, Hoboken, N. J., electric welders of metals, has filed articles of incorporation. It is capitalized at $150,000, and the incorporators are William Moller, Max Smith and Franz Buckel.

THE ROMA CONSTRUCTION & ENGINEERING COMPANY, New York, N. Y., capitalized at $35,000, has been incorporated by G. Marchesini, 585 Washington Street; G. Capone, 402 East 116th Street, and J. Caggiano, 81 East 125th Street.

THE SAUREE MOTOR TRUCKS COMPANY, West Orange, N. J., has filed articles of incorporation, its purpose being to manufacture motors, engines, etc. It is capitalized at $200,000, and the organizers are: William D. Sargent, West Orange, and George M. Judd and E. H. Fallows, 30 Church Street, New York.

THE SCHENECTADY ELECTRIC CLOCK COMPANY, Schenectady, N. Y., has been incorporated to manufacture electric clocks. It is capitalized at $10,000, and the incorporators are: James R. Dyke, Jr., Charles D. Knight, Frank J. Seabolt and E. C. Hall, all of Schenectady.

THE TWENTIETH CENTURY BATTERY COMPANY, Cold Spring, N. Y., has been incorporated and contemplates the manufacture of batteries, electric or otherwise. It has a capital stock of $1,000, and the incorporators are: N. V. Sloat, Carmel, N. Y.; J. Bennett Southard, Cold Spring, N. Y., and William Hofsiss, 191 Covert Street, Brooklyn, N. Y.

THE U. S. BALL BEARING MFG. COMPANY, 112 Clark Street, Chicago, Ill., has been incorporated with a capital of $50,000, to manufacture ball bearing devices. The incorporators are Fritz Henzelman, Carl Rathbert and John W. Utesch.

THE UNIVERSAL ELECTRIC CLOCK COMPANY, of Chicago, has filed articles of incorporation at Springfield, its purpose being to manufacture and deal in electrical apparatus. It has a capital stock of $6,000, and the incorporators are: J. M. Lenz, William L. Dolman and S. W. Bramley.

THE VICTOR ELECTRICAL CONSTRUCTION COMPANY, Columbus, Ohio, has been incorporated with a capital stock of $10,000 by E. L. Morse, Roston Medberg, J. A. Funk, M. A. Culliman and E. B. Taylor.

New Incorporations.

SUTTER CREEK, CAL.—A reorganization has been effected of the Amador Railroad & Electric Light Company and articles of incorporation filed for a new company which is to be known as the Amador Electric Light & Power Company. The capital stock is placed at $90,000 and the following directors have been elected: W. A. Pharis, Provis; J. McGee, B. C. Clark and F. J. Payne.

FREDERICA, DEL.—Articles of incorporation have been filed by the Frederica Telephone Company of this city. It has an authorized capital stock of $5,000, and the incorporators are: John S. Camper, William F. Hoey and G. W. Spurry, all of Frederica.

WILMINGTON, DEL.—News comes from this city of the incorporation of the Twin Falls Oakley Land & Water Company. It is capitalized at $250,000 and the incorporators are: S. E. Robertson, F. M. Shive and Harry W. Davis, Wilmington.

CHICAGO, ILL.—The Advance Power Company, capitalized at $1,000,000, has filed articles of incorporation, the organizers being: C. H. Wilcox, Oak Park, Ill.; W. L. Barnum, W. L. Barnum, Jr., J. E. Harper and F. C. Rutan, of Chicago, Ill.

DOWNS, ILL.—Articles of incorporation have been filed by the Old Town Telephone Company. It is capitalized at $900, and the incorporators are: R. H. Roadman, John McBarnes and George Meiner.

INDIANAPOLIS, IND.—The Indiana Independent Toll Clearing House has been incorporated with a capital stock of $10,000, its object being to establish, maintain and operate telephone lines and telephone exchanges within the State of Indiana, and to conduct a system of toll clearances. The following directors have been elected: Walter J. Uhl, W. J. Coffey, George W. Beers, J. S. Brailey, Jr., and Nelson Hunter.

LANSING, MICH.—The Detroit, Lansing & Grand Rapids Railway Company, capitalized at $25,000, has been incorporated to construct an electric railway between Detroit, Lansing and Grand Rapids. Among those interested in the proposition are Oliver H. Lau and Henry M. Wallace, Detroit.

TRAVERS CITY, MICH.—News comes from this city that the farmers near Kingsley, in Paradise township, Grand Traverse County, have organized a telephone company to be known as the East Paradise Telephone Company, and elected the following officers: President, Edwin Clark; secretary, Bert Smith; treasurer, V. W. Bancroft.

BELLE PLAINE, MINN.—The Belle Plaine Electric Light & Power Company is reported incorporated. Its capital stock is placed at $15,000 and the incorporators are: C. A. Arndt, St. Paul, and F. L. Rauchwater, South Park.

EASTON, MINN.—The Easton Telephone Company has been incorporated with a capital stock of $1,200 by William Sippel, C. Bachtle, W. A. Cusick, W. C. Aschemer, T. Gaffey and B. M. Armstrong.

MOUND CITY, MO.—The Mound City Light & Ice Company has been incorporated with a capital stock of $25,000 by E. M. Miller, R. W. Neill, T. M. McCoy and others.

JERSEY CITY, N. J.—Incorporation papers have been filed in this city by the Joy Construction Company, which proposes to operate a water power system in the towns of Clinton and Madison, Conn., and elsewhere. It is capitalized at $100,000, and the incorporators are: Moses Joy, 827 Whitney Avenue, New Haven, Conn.; David J. Greene, Milford, Conn.; Theodore E. Smith, 54 Hudson Place, Weehawken, N. J.

HORNELL, N. Y.—The Hornell-Bath Railway Company has been incorporated to construct an electric railway from Hornell to Bath, a distance of about 24 miles. It has an authorized capital stock of $250,000 and the following directors have been elected: Charles Adsit, C. H. Armsted, John M. Finch, of Hornell; J. F. Turk, Hammondsport.

McDONOUGH, N. Y.—The Northern German & Pitcher Telephone Company has been incorporated with a capital stock of $400 by C. Yaw, George Hall, S. Beckwith, all of Cincinnatus, N. Y.

CEDAR POINT, OHIO.—Articles of incorporation have been filed by the Cedar Point Railway, whose purpose is to construct an electric railway along the lake shore to connect the Cedar Point resort with the Lake Shore Electric Railway at Sandusky. It has a capital stock of $10,000 and W. C. Phelps is one of the incorporators.

COLUMBUS, O.—News comes from this city of the incorporation of the Northwestern Traction Company, which contemplates the construction of an electric railway from Newark, via Fallsburg, West Carlisle, Cooperdale and Wakatomika, to Coshocton and New Philadelphia. It has a capital stock of $25,000, and the incorporators are: G. W. Oxley, E. S. Crawford, T. S. Sharpless, S. H. Miller and J. M. Magruder.

ARDMORE, OKLA.—The Arbuckle Power Company is reported organized, and it is understood that a dam is to be constructed on the Washita River, the power from which is to be used in operating a glass factory which the company proposes to build near the hydro-electric plant. It is estimated that the construction of the dam will cost about $140,000.

INOLA, OKLA.—The Inola Telephone Company, of this city, has been chartered. It is capitalized at $2,000, and the incorporators are: J. Cameron, J. E. Hathaway, John H. Ross, A. K. Critchen, all of Inola, and W. A. Crockett, of Choteau.

MEDIA, OKLA.—Articles of incorporation have been filed by the Media Telephone Company. It has an authorized capital stock of $2,400, and those interested are: S. L. Sheets, J. I. Horace, F. M. Gibson, all of Fairbanks.

PENDLETON, ORE.—The Holdman Telephone Company has been organized with a capital stock of $5,000 for the purpose of constructing a telephone line from Pendleton to Holdman, a distance of about 20 miles. The organizers and trustees of the company are: J. A. Crosswell, Robert A. Bissinger, F. L. McCrea and Henry Mills.

HARRISBURG, PA.—The National Telephone & Telegraph Company, capitalized at $10,000, has filed articles of incorporation at this city.

PHILIPSBURG, PA.—The Philipsburg Milling, Lighting & Heating Company, capitalized at $15,000, has filed articles of incorporation, the incorporators being: A. Copelin, Duke Copelin, Philipsburg, Pa., and F. G. Copelin, Kane, Pa.

BEAUMONT, TEX.—Articles of incorporation have been filed by the South Beaumont Water & Light Company. It has an authorized capital stock of $10,000, and the incorporators are E. B. Baldwin, E. V. Hayden and F. E. Potts.

LUBBOCK, TEX.—Articles of incorporation have been filed by the Lubbock Light, Ice & Power Company. It has an authorized capital stock of $25,000, and the following officers have been elected: W. D. Benson, president; N. D. Porter, vice-president; Charles A. Rush, secretary; B. O. McWhorter, treasurer.

Personal.

MR. D. W. LOWE, of Alliance, Ohio, will on Aug. 1 assume the duties of manager of the Michigan Power Company, Lansing, Mich.

MR. P. S. DODD has resigned as manager of *The Electrical Review and Western Electrician* and will shortly become connected with the incandescent lamp industry.

MR. DUDLEY T. COOK has resigned as manager of the Ottawa, Kan., telephone exchange to become contract agent of the Lincoln (Neb.) Telephone & Telegraph Company.

MR. JAMES BLAINE WALKER, assistant secretary of the New York Public Service Commission for the First District, delivered an address in Baltimore last week on "Public Utilities Commissions."

MR. B. J. JONES, formerly general manager of the Union Gas & Electric Company, of Cincinnati, Ohio, has been appointed general manager of the Ohio Electric Railway Company, Cincinnati, Ohio.

MR. J. H. McMANUS, for many years connected with the Westchester Lighting Company, in the Port Chester District, has joined the electrical department of the H. W. Johns-Manville Company, New York City.

MR. F. M. DAY, formerly connected with the Ohio Inspection Bureau and more lately with the Rocky Mountain Fire Underwriters' Association, has accepted a position as chief electrician for the American Lumber Company, Albuquerque, N. M.

MR. JAY F. HOOVER, who has been manager of the Cleveland office of the Nernst Lamp Company for the past five years, has been appointed special agent of the company, with headquarters in Pittsburgh. The Cleveland office is now in charge of Mr. J. B. Mitchell.

MR. CHAS. M. HALL, of the Aluminum Company of America, who was taken seriously ill in Southampton, Eng., has returned to this country and gone to Lake Placid, in the Adirondacks, to build up. Dr. W. H. Hodge, of Niagara Falls, went to England to attend on Mr. Hall.

MR. ALFRED G. HEINEMANN has resigned from the staff of George Heinemann & Company, Philadelphia, to become general manager of the Excelsior Electric Light, Power & Gas Company, Sellersville, Pa. The central plant at the latter place supplies Telford, West Telford, Louderton, Reliance, Hatfield, Silverdale and Sellersville.

MR. A. F. HEMINGWAY, formerly connected with the Wellman-Seaver-Morgan Company, of Cleveland, and the General Electric Company, is now looking after the interests of the Terry Steam Turbine Company, of Hartford, Conn., in Chicago, associated with Mr. Charles E. Billin, general agent for that company in Chicago.

PROF. L. P. DICKINSON, of the electrical engineering department of Lafayette College, Easton, Pa., has been appointed professor of electrical engineering at Rhode Island State College, Kingston, R. I., to succeed Prof. Gilbert Tolman, who recently resigned to accept a chair at Colby College, Maine. Prof. Dickinson was graduated from the Massachusetts Institute of Technology in 1896.

MR. W. H. ZIMMERMAN, present manager of the Michigan Power Company, will after Aug. 1 take personal charge of all construction work of the company, both in Lansing and for 18 miles of transmission lines to be constructed between that city and Charlotte. Mr. Zimmerman is also interested in the Construction Electric Company, which will erect local distributing services at Charlotte, Pottersville, Bellevue and Olivet.

MR. W. H. WISSING, recently connected with the Union Electric Light & Power Company, of St. Louis, is now general manager of the Tungstolier Company, of Cleveland, Ohio. Mr. Wissing devotes considerable attention to the development of central-station campaigns for new business, taking the broad view that whatever helps the electric light companies helps his business. His views in relation to methods of selling electrical devices for domestic purposes were set forth in an article on that subject written while he was in the central-station service and published in the issue of July 1.

MR. A. G. CHRISTIE, formerly in the steam-turbine departments of the Westinghouse and Allis-Chalmers companies, has been appointed assistant professor of steam engineering at the University of Wisconsin, and will have charge of the steam and gas engineering laboratories. Prof. Christie is a graduate in mechanical engineering from the University of Toronto, and served a year as instructor at Cornell. He was two and one-half years with the Westinghouse Machine Company, and the same period with the Allis-Chalmers Company, and for one year was chief engineer of the Western Canada Cement & Coal Company.

Obituary.

MR. R. PITCAIRN.—The death occurred at Pittsburgh on July 25 of Mr. Robert Pitcairn at the age of 73, the cause being general breakdown. He had been connected with the Pennsylvania Railroad for 55 years and was not only prominent as a railroad manager, but a leader in many other fields of enterprise. If the facts become known he will probably be found to have been one of the very rich men of the country, as his opportunities for accumulating wealth seemed boundless. Robert Pitcairn was born in Johnstone, near Paisley, Scotland, on May 6, 1836. He came to this country in 1846. Two years later, through the efforts of Andrew Carnegie, who then held a similar position, he became a messenger boy in the Pittsburgh office of the Atlantic & Ohio Telegraph Company. He was rapidly promoted. In 1853 he entered the service of the Pennsylvania Railroad Company as operator and assistant ticket agent at Duncanville, Pa. Mr. Pitcairn rose to be superintendent of the Middle Division, superintendent of transportation, and in 1865 superintendent of the Pittsburgh Division. His responsibilities were considerably increased 10 years later by his appointment as general agent of the Pennsylvania Railroad. Mr. Pitcairn was made assistant to President A. J. Cassatt in 1902, having his offices in Pittsburgh. Mr. Pitcairn was identified with most of the important public and financial interests of Pittsburgh. He was vice-president of the Westinghouse Air Brake Company, the American Surety Company of New York, and the Philadelphia National Gas Company. He was also a director in many other financial institutions. Mr. Pitcairn was Past Grand Commander of the Order of Knights Templar, a member of the Pennsylvania Society and one of the directors of the Carnegie Public Library in Pittsburgh. He married Elizabeth E. Rigg, of Altoona. His surviving children are: Mrs. Omar S. Decker, Mrs. Charles L. Taylor, Miss Susan B. Pitcairn and Robert Pitcairn, Jr. He was a member of the Old-Time Telegraphers' Association and was proud of his early connection with the telegraphic art. When the association visited Pittsburgh some years ago it was chief among its hospitable entertainers.

Trade Publications.

CENTRAL ELECTRIC BULLETINS.—The Central Electric Company, Chicago, Ill., is distributing two new bulletins, one descriptive of Siemens arc-light carbons and the other of Perkins and Bryant socket material. Both bulletins contain a complete list of the latest prices.

MINERAL GREASE.—The Keystone Lubricating Company, in a leaflet just published under the title of "High-Grade Petroleum Grease for Electric Railway Lubrication," sets forth the merits of mineral grease in general, and in particular with respect to its use in electric traction.

ELECTRICAL NECESSITIES.—Bulletin No. 18 of the Harvard Electric Company, Chicago and New York, has the title "Electrical Necessities," and describes and illustrates in detail the lengthy line of Harvard specialties, including channel steel brackets, self-soldering wire joints, section switch boxes, outlet, junction and ceiling boxes, fuse boxes, fuses, etc.

BAROMETRIC CONDENSER.—In a bulletin (No. 1519) just issued the Allis-Chalmers Company describes the Tomlinson barometric condenser, with especail reference to Type AN. No air-pump is required with this condenser, with which 28 in. of vacuum can be maintained. The condenser is claimed to be the most simple and efficient apparatus of this type thus far developed.

DRY BATTERIES.—The Central Electric Company, Chicago, Ill., is distributing several new flyers descriptive of dry batteries. The batteries described are intended for open circuit service, and are claimed to give maximum service with minimum cost, owing to the use of the highest grade of material, best methods of treatment and modern machinery in their manufacture.

PATROL FLASH LIGHT.—The Dean Electric Company, Elyria, Ohio, describes in a pamphlet just issued, with reference in part to illustrations in colors, its patrol flash-light police and fire system. Among the features of the police system is the lighting from headquarters of an incandescent lamp within the patrol box, the light from which passes through powerful red lenses in the front and two sides; the light is also automatically turned on when making a fire alarm.

SHERARDUCT CONDUIT.—An excellent example of a trade publication at its best is furnished by a pamphlet just issued by the National Metal Molding Company, Pittsburgh, describing "Sherarduct" conduit and setting forth its merits. The literary character of the text is such as to create respect for its matter, and the typography is good in design and in execution. The conduit described, which is of mild steel that bends easily, is treated by the Sherard process, by means of which, it is claimed, corrosion is entirely prevented even under the most adverse circumstances.

MOTOR STARTERS, RHEOSTATS, ETC.—The Ward Leonard Electric Company, of Bronxville, N. Y., has issued a new catalog, of which 20 sections are devoted to hand and automatic motor starters, 14 sections to hand-operated armature controllers, 12 sections to generator and motor-field rheostats for several requirements of service, including concentric shaft field rheostats, rheostats for plating generators, with and without potentiometer connections, etc., and a number of sections to enameled resistance units, showing methods of mounting them in lamp sockets, fuse clips, etc. New designs of theater dimmers are shown, both hand and motor-driven. Other sections are devoted to the manufacture of incandescent lamp, projector and searchlight rheostats, photometer rheostats, desk-fan and ceiling-fan controllers, etc.

Business Notes.

THE LORD ELECTRIC COMPANY reports that it has just received a very substantial order for Earll catchers and retrievers as the result of service tests of eight months.

THE BAKER ELECTRIC COMPANY, Chicago, has leased for a term of 10 years a building to be erected for it on a lot 50x160 ft. on Michigan Avenue, near Twenty-third Street, Chicago.

M. L. NEWMAN & CO., consulting and industrial engineers, have established their office at 26 Broad Street, New York, and not at 25 Broad Street, as erroneously stated in these columns last week.

DOSSERT & COMPANY, New York, have concluded an arrangement with the Western Engineering Specialties Company, 1732 Glenarm

Street, Denver, Colo., to act as their agent in the Rocky Mountain Territory. A large stock of connectors will be carried in Denver.

THE D & W FUSE COMPANY, of Providence, announces that it is now manufacturing "Deltabeston" coils wound with Deltabeston magnet wire insulated with pure asbestos material throughout. The new process of treating the coils renders the coils both heat-proof and moisture-proof.

REFRIGERATING PLANTS.—In the past three months the York Manufacturing Company, York, Pa., has supplied 39 ice-making and refrigerating plants ranging in capacity from two to 90 tons of ice daily. Among the purchasers are the Sterling Consolidated Electric Company, Sterling, Col., and the University of Nebraska, each of which purchased a 10-ton plant.

THE VOLKMER ELECTRICAL COMPANY, 585 Hudson Street, New York, announces that its Type No. 3 "Daylight" arc lamp is now ready for the market. This lamp has undergone many improvements since it was first placed on the market a few months ago. The company has made several large installations recently of the new lamps, which are stated to be giving great satisfaction.

THE MINNEAPOLIS STEEL & MACHINERY COMPANY has received from the Huron Light & Power Company, Huron, S. D., a contract for furnishing the new engines for the electric light plant. There will be installed one 100-hp and one 150-hp Muenzel producer-gas engine, together with two 150-hp Muenzel gas producers to replace the present steam equipment. Both of the engines will be belted to altrnating-current generators.

NEW BUILDING FOR FOSTORIA INCANDESCENT LAMP COMPANY.—Plans are being prepared and ground will shortly be broken for the erection of a two-story brick office building for the Fostoria Incandescent Lamp Company, of Fostoria, Ohio. The site is directly across the street from present factory and office. The building will cover an area of 4000 sq. ft. It is expected the structure will be ready for occupancy in November.

TRIUMPH ELECTRIC NEW FACTORY.—The new factory of the Triumph Electric Company at Oakley, near Cincinnati, has been practically completed and the new machinery will be moved from the old plant at Hathaway and Baymiller Streets, Cincinnati, by Aug. 1. The new building contains over 125,000 sq. ft. of floor space and is 140 ft. wide. The heavy machinery will be placed on the ground floor, the medium weight on a first balcony and the light machinery on a second balcony. As there will be a 60-ft. center opening, all heavy material may be handled with cranes or other lifts, instead of trucks.

WATER POWER PLANT.—The Hartford Faience Company, of Hartford, Conn., Mr. F. L. Bishop treasurer, advises us that it knows of a first-class water power at Winsted, Conn., that can be bought at a very reasonable figure; and in regard to which Mr. Bishop will be glad to answer inquiries. The capacity is said to be about 100 hp, never failing. The plant carries with it the entire control of the water power and of the water gate. There is a large brick building 145 ft. x 41 ft. and other buildings on the property, and an electric lighting plant for factory use. A mortgage of $15,000 can remain on this plant, which may interest some of our manufacturing friends.

THE TECHNICAL INDEX, a comprehensive record of current technical literature published in Belgium, announces that hereafter it will be represented in the United States by the Geo. H. Gibson Company, Tribune Building, New York City. The journal appears monthly and gives a systematic descriptive record of all original articles appearing in over 200 engineering and technical journals and reviews, and also indexes the proceedings of technical societies and technical books issued in all countries. Two editions are printed, one upon both sides of the paper and one upon one side only for card index purposes, and for further convenience all items are arranged according to the Dewey decimal system. Clippings or copies or articles, also books, are supplied by the publishers, the price being indicated in each case.

WESTINGHOUSE BALTIMORE SHOWROOM.—The Westinghouse Electric & Manufacturing Company has recently opened a showroom at 121 East Baltimore Street, Baltimore, where it occupies a two-story building devoted to offices and display rooms. Heretofore the company has only had offices and storerooms in the city, and by leasing this store on one of Baltimore's principal streets it places its goods more prominently before electrical contractors, jobbers and visiting central-station men. Mr. M. H. Jones is in charge of this department, known as "General Sales." To fill the position of chief correspondence clerk, formerly held by Mr. Jones, Mr. E. W. Brown, of the erecting department, Pittsburgh, will be appointed. The entire first floor of the building is devoted to an exhibition of electric heating apparatus, arc lamps, portable testing instruments, fans, electric irons and other small apparatus. A large and varied stock of supplies will be carried in the basement and sub-basement, from which jobbers and dealers will be able to draw at all times, thereby obviating the delays incident to a shipment direct from the factories. The second floor is divided into offices for the various departments, consisting of clerical, consultation, Government, railways and lighting, industrial and power, detail and supplies, erection and general manager and correspondence.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 13, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector Street, N. Y. City.]

The following list contains patents that should have appeared in last week's issue, but were not received in time from the Patent Office, owing to the failure of the contractors to supply copies. The patents which should have appeared this week under date of July 22 will be delayed until next week.

927,469. SENDER FOR SELECTIVE SYSTEMS; F. G. Agrell, Stockholm, Sweden. App. filed Aug. 3, 1907. A dial type of switch combined with an arc-shaped series of switch contacts, thus forming two switches at the subscriber's station, one set to correspond to the number desired and another operating in conjunction with a switch hook to send out the impulses.

927,470. TELEPHONE DIVIDED MULTIPLE SWITCHBOARD SYSTEM; W. Aitken, Muswell Hill, England. App. filed Aug. 27, 1900. A central source of current, a plurality of signals located on different divisions of the switchboard, switches at the substation, one for each signal, for selectively operating them, and means for maintaining any of said signals in operative condition after the release of the switches.

927,482. LIGHTING SYSTEM; W. L. Bliss, New York, N. Y. App. filed June 8, 1904. For car and train lighting in which a generator supplies the current and charges the storage battery, having a rheostatic regulator to regulate the generator controlled by a winding supplied with current proportional to the current the generator sends through the storage battery.

927,486. ELECTRIC TIME SWITCH; O. A. Brunn, Copenhagen, Denmark. App. filed March 26, 1907. Closes a circuit when a push-button is pressed for a definite time by means of an air bag or bellows which determines the period of closure, instead of using clockwork.

927,513. LIFTING MAGNET; A. C. Eastwood, Cleveland, Ohio. App. filed June 11, 1906. The lifting coil is embedded in an angular casing with heat-dissipating walls.

927,519. OZONE GENERATOR; T. Friedlander, Chicago, Ill. App. filed July 24, 1908. A pair of concentrically arranged tubes of insulating material, a pair of electrodes consisting of coils of wire wound on the respective tubes, the air space between the electrodes providing the air to be ozonized.

927,541. ELECTROMAGNETIC GOVERNOR FOR INTERNAL COMBUSTION ENGINES; E. Hubbard, Chicago, Ill. App. filed Aug. 24, 1908. A solenoid with a movable core connected to the governor and an annular weight fulcrumed at one side of the solenoid which is disengaged to act on the governor when the solenoid is de-energized, shutting off the supply of fuel.

927,583. ANNUNCIATOR FOR CHECKERS OR SIMILAR GAMES; A. Nelson, St. Paul, Minn. App. filed Sept. 16, 1907. Reproduces upon an illuminated board the movements and positions of the men upon a checker-board.

927,602. SIGNALING SYSTEM; H. O. Rugh, Sandwich, Ill. App. filed June 26, 1908. An improved selector system for railroad telegraph circuits, including polarized relays and a selector mechanism for each relay.

927,611. WIRELESS TELEGRAPHY; J. H. Cuntz, Hobozen, N. J. App. filed March 16, 1903. Separates the waves into groups of low group frequency and places in the receiving circuit a tuning fork tuned to the group frequency.

927,643. TRANSMITTER MOUTHPIECE; W. W. Dean, Elyria, Ohio. App. filed Oct. 8, 1908. A sheet steel metal mouthpiece with perforations in the end wall and an enamel coating.

927,651. SELECTIVE TELEPHONE SYSTEM; H. G. Guyle, Sargent, Neb. App. filed Jan. 25, 1905. Provides a plurality of rotatable disks, one at each station; a plurality of time wheels, one at each station, the disks and wheels being locked or released as desired with means for simultaneously releasing all of the time wheels excepting those at the calling and receiving stations.

927,663. HARMONIC SIGNALING SYSTEM AND MAGNETIC HAND GENERATOR THEREFOR; R. H. Manson, Elyria, Ohio App. filed Feb. 1, 1907. For telephone system in which the annunciator is actuated from a substation without actuating any of the ringers at the subscriber's station by means of a commutator arrangement regulating the current from a hand generator.

927,664. OPERATOR'S KEY; R. H. Manson, Elyria, Ohio. App. filed Aug. 23, 1907. Ringing and listening key having dummy springs so adjusted that they must move a considerable distance before they engage the contact spring to cause disconnection thereof from the normal contact spring and connection with the alternate contact spring, thus permitting the overthrow of the key.

927,675. MEANS FOR UTILIZING ELECTRICAL ENERGY; T. F. Perkins, Atlanta, Tex. App. filed March 1, 1907. The extra current produced by the discharge of the field magnets of the motor is directed into another circuit containing lamps.

927,701. INSULATOR SUPPORT; F. Woodmansee, Chicago, Ill. App. filed Feb. 8, 1904. The base portion is rectangular and carries an upright post, the base being curved to form a water shed.

927,708. TROLLEY POLE GUIDE; J. P. Brennan, Centralia, Pa. App. filed Dec. 26, 1908. The wheel support is provided with pivot arms that rise above the trolley wire and may be operated by a rope.

927,714. ELECTRIC SWITCH INSTRUMENT; C. W. Coleman, Westfield, N. J. App. filed Dec. 22, 1905. A switch instrument for tracks provided with a rocking frame and links connecting the rocking frame with the respective switches.

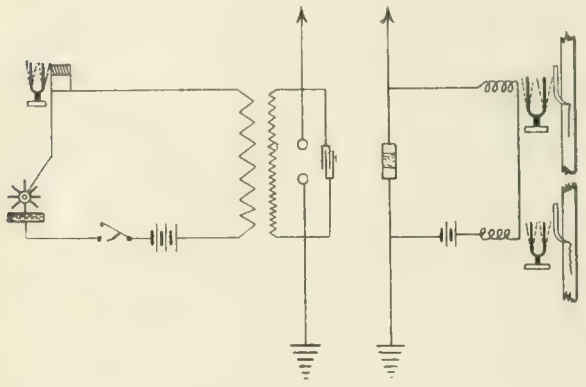
927,733. METHOD OF OPERATING ALTERNATING-CURRENT MERCURY WATTMETERS; R. C. Lanphier, Springfield, Ill. App. filed Feb. 9, 1906. The method of operating consists in bringing the current in the pressure circuit into phase with the impressed electromotive force.

927,739. RELAY; R. H. Manson, Elyria, Ohio. App. filed Aug. 23, 1907. Relay for telephone work of small size carrying an armature rigidly mounted on a core and a contact supported on the core by suitable fastenings.

927,755. ELECTRICALLY HEATED WATER FAUCET; F. A. Robinson, Pittsfield, Mass. App. filed May 29, 1907. Provides the faucet with an electric heater and an electric switch adapted to close the circuit when hot water is desired and to open the circuit when cold water is desired.

927,758. PROCESS OF TREATING SILICATES OF ALUMINUM FOR THE PURPOSE OF OBTAINING VALUABLE PRODUCTS; A. Sinding-Larsen, Christiania, Norway. App. filed Nov. 7, 1907. Process of treating silicates of aluminum by feeding the material to one end of a long electric furnace and a mixture of iron and a reducing agent to the other end and passing an electric current there between.

927,812. BATTERY GRID; J. K. Pumpelly, Indianapolis, Ind. App. filed June 8, 1908. A two-part grid comprising two perforated plates



927,641—Wireless Telegraphy.

having inwardly projecting tapered ribs extending beyond the marginal ribs.

927,817. HYGIENIC ATTACHMENT FOR TELEPHONE TRANSMITTERS; Eliza C. Smith, Washington, D. C. App. filed Sept. 24, 1908. Detachable cup or cone for covering the mouthpiece.

927,907. ELECTRIC APPARATUS FOR DRIVING CLOCK OF SIMILAR MECHANISMS; H. E. Warren, Ashland, Mass. App. filed Oct. 22, 1908. Makes use of a pair of contacts in circuit with the impulse device which are urged toward each other and when released strike together and serve as a make-and-break to continue the movement of the pendulum.

927,917. SWITCH MECHANISM FOR TROLLEY WIRES; F. M. Zimmerman, Aurora, Ill. App. filed Feb. 1, 1908. An arched bridge piece having conductor wire channels and replacable switch mechanism under the wires and bridge piece.

927,935. METHOD OF MANUFACTURING FILAMENTS FOR ELECTRIC LAMPS; W. Von Bolton, Charlottenburg, Germany. App. filed Oct. 22, 1907. Mixes comminuted refractory metals and comminuted ductile metal together, electrically heats the mixture and draws the mass into filaments.

927,959. RESONATOR; P. E. Finlay, New Orleans, La. App. filed Nov. 24, 1908. For increasing the sound of telephone bells by placing a reflecting casing back of the bell covered by a hood.

927,970. ELECTROLYZER; E. Hixon, Chicago, Ill. App. filed Feb. 25, 1909. Tank has a plurality of vertical transverse partitions, some of which have openings at the bottom and the others at the top. Designed for the manufacture of bleaching liquid.

928,004. INTERDEPENDENT SIGNAL AND SWITCH APPARATUS FOR RAILWAYS; F. Prochaska, Berlin, Germany. App. filed April 10, 1906. A single series of supervising devices dependent upon the condition of the switches; selective devices for the routes and means operated by the selective devices for making only the supervising devices belonging to the selective route operative.

928,010. CROSSARM FITTING AND INSULATOR SUPPORT; S. B. Way, St. Louis, Mo. App. filed Jan. 11, 1909. Improved insulator support which clamps the crossarm on all four sides.

928,013. ACCELERATION CONTROLLING DEVICE; V. A. Wolcott, Schenectady, N. Y. App. filed May 16, 1908. For mining locomotives in which the vehicle carries a cable reel, a reel motor connected thereto, with means for automatically increasing the voltage applied to the reel motor during the acceleration thereof.

928,016. TROLLEY HARP MOUNTING; G. L. Adams, Altoona, Pa. App. filed Nov. 21, 1908. The pole has a head with an oblique socket carrying a stem with a port on which the wheel is mounted.

928,021. SIGNAL SYSTEM; E. F. Bliss, Schenectady, N. Y. App. filed May 6, 1909. Block signal system in which a source of alternating current is supplied to the track, and a track relay is thus supplied with current, the relay having a winding and a member adapted to be vibrated by the current in the winding, tuned to a natural period of vibration corresponding to the normal frequency and a signal controlled by the member.

928,028. CONTROLLER FOR ELECTRIC MOTORS; V. E. Chamberlain, Indianapolis, Ind. App. filed April 27, 1907. For controlling automobiles in which a motor has a number of field windings and a controller has contacts arranged to close the circuits with the fields in series, to shunt one of the fields, to throw the fields in parallel, all without breaking the connection.

928,037. DYNAMO-ELECTRIC MACHINE; H. W. Frost, Schenectady, N. Y. App. filed July 25, 1904. High-speed dynamo driven by steam turbine in which the field magnet consists of sets of units, each having a plurality of tongue-receiving notches into which the polar projections enter.

928,049. LIGHTNING ARRESTER; E. M. Hewlett and E. B. Merriam, Schenectady, N. Y. App. filed May 18, 1907. For high potential discharges in which a plurality of conductors are spaced apart to form gaps by mounting them on insulating rings within a tube.

928,068. ELECTRIC SWITCH-CONTROLLING SYSTEM; F. G. Proutt, Memphis, Tenn. App. filed Sept. 13, 1904. For cutting out arc lights in street lighting by means of a shunt circuit connected with the line, a switch between the shunt circuit and the lamp, a solenoid in the shunt circuit controlling the switch and an electromagnet holding the switch in position.

928,074. COATED ARTICLE AND PROCESS OF MAKING SAME; H. Shoemaker and F. W. Midgley, Jersey City, N. J. App. filed Jan. 8, 1909. For making condensers by roughening the surface of the glass, coating it and then grinding off the excess of coating material.

928,082. WATER GAGE; J. Torok, Renovo, Pa. App. filed Feb. 13 1909. A water gage provided with a casing connected to the boiler, the casing containing electrodes through which the circuit is established by a movable float.

928,084. INSULATING STUD; L. E. Underwood, Lynn, Mass. App. filed May 5, 1908. An insulating stud for brush holders comprising a supporting rod, a metal tube thereon and an insulating tube between the rod and the metal tube and extending beyond the rod at one end and beyond the tube at the other end.

928,089. PYRO-ELECTRIC GENERATOR; G. J. Vokel, Philadelphia, Pa. App. filed Jan. 21, 1909. A plurality of series of thermocouples are supported on a frame and bodies of refractory material extend between the adjacent series of couples to form an enclosure, and the heating device, such as a burner, is mounted within the enclosure.

928,096. MICROPHONE; G. Angelini, Rome, Italy. App. filed March 28, 1907. The disk carries a ring of felt next to which is arranged a large flexible disk covered with wadding, the carbon granules being between the disks.

928,104. RELAY; E. R. Brodton, Mobile, Ala. App. filed Aug. 3, 1908. Operates only under a predetermined current so as to selectively operate bells or typewriter keys over a line. The relay controls a plurality of armatures, each controlling a line circuit.

928,119. TROLLEY WHEEL; T. A. Gannoe, Warren, Pa. App. filed Feb. 18, 1908. The trolley wheel is mounted on a series of arc-shaped springs forming the spokes of the wheel.

928,136. CONSTRUCTION OF ELECTROMAGNETS; H. Lacy, Carshalton, England. App. filed Aug. 31, 1906. The magnet contains a core and carries groups of layers of wire, the diameter of the wire diminishing in each group and the number of layers increasing.

928,152. ELECTRIC SWITCH HANDLE; C. D. Platt, Bridgeport, Conn. App. filed Feb. 5, 1909. A turn button having a recess in its under side, a shank thereon and inverted cup sliding on the shank and forced upwardly by a spring.

928,157. TROLLEY WIRE SWITCH; H. O. Shissler, Des Moines, Ia. App. filed April 18, 1907. The movable switch wire is automatically actuated in unison with the switch point in the track below by connections from the switch stand.

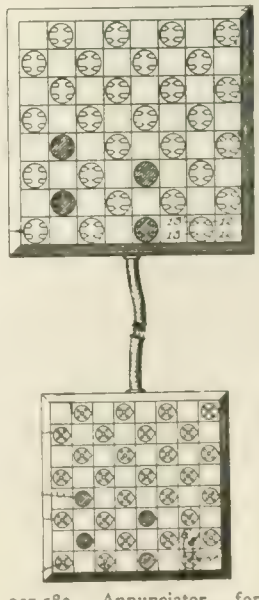
928,161. ARC LAMP; G. E. Stevens, Lynn, Mass. App. filed Aug. 14, 1903. Regulator for arc lamps in which the follower block is guided by posts and is made of insulating, non-combustible material, the block carrying the electrode.

928,171. TELEPHONE SYSTEM; M. Baumer, Nuremberg, Germany. App. filed Nov. 24, 1908. For automatic branch exchanges in which tip relays, each having two coils, are employed to start the automatic switch. Details.

928,189. ARC LAMP; R. Fleming and C. A. B. Halvorson, Jr., Lynn, Mass. App. filed Jan. 16, 1906. Improvement in the electrode feeding mechanism, the support for the electrode being movable parallel to its axis and about another axis parallel to that of the electrode.

928,204. INDUCTION COIL FOR IGNITION SYSTEMS; B. L. Lawton, Meriden, Conn. App. filed Jan. 25, 1909. To avoid the untimely ignition of compressed gas in a cylinder due to magnetic or static induction between the primaries and secondaries of the coils by proving an open circuit shield between adjacent coils to prevent interference.

928,214. MEANS FOR UTILIZING ELECTRICAL ENERGY; T. F. Perkins, Atlanta, Tex. App. filed Aug. 15, 1908. Utilizes the extra



927,583 — Annunciator for Checkers or Similar Games.



928,224 — Electrical Condenser and Process of Making Same.

current which ordinarily produces sparks on the commutator by sending the current through a transformer which lights lamps.

928,219. SYSTEM OF DISTRIBUTION; P. Rose, Berlin, Germany. App. filed Jan. 28, 1909. For automatically distributing a load on two alternating or direct separately excited generators operating in parallel, by making the regulator of each machine sensitive to changes of current in the armature leads of the other machine.

928,224. ELECTRICAL CONDENSER AND PROCESS OF MAKING SAME; H. Shoemaker and F. W. Midgley, Jersey City, N. J. App. filed Jan. 8, 1909. The condenser comprises glass having a roughened surface with a preliminary coating of conducting material and another coating electrically deposited upon the preliminary coating.

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The New Tariff.

There seems reasonable ground for expecting the new tariff bill to become law this week. At any rate, settlement of the subject cannot be deferred much longer, and its removal as a cause of commercial anxiety and disturbance will be welcomed. An article elsewhere in this issue summarizes the situation from the electrical standpoint, and enumerates the various items affecting the electrical industries and the new rates of duties. In a general way the manufacturers should be satisfied, and probably are, as their interests have in the main been conserved, except where perhaps the incidence of a new rate of duty may be found to affect the price on importation of some raw material, as in the case of mica and some of the rarer metals used in incandescent lamp filaments. To this extent also the welfare of the electrical consumer is prejudiced, because any greater element of cost tends to make it harder to give service. The controversy over certain kinds of lighting carbons is a case in point, but the most singular fact in that affair is the absence of complaint from the users. There are about 6000 central stations in this country and probably not less than 50,000 isolated plants furnishing arc lighting; but if any urgent protest has come from this quarter we have failed to learn of it. Indeed, the course of the tariff agitation and of hearings at Washington has been very free from participation by the consumers of electrical goods and apparatus. This may be apathy and indifference, or a feeling that it would do no good anyhow, but the fact remains; and the one thing now left to us is to take the tariff as it stands and make the best of it. In some quarters there appears to be a feeling that prolonged finality is wanting to the present action. That would be rather unfortunate. It may be taken as axiomatic that even a very bad tariff cannot do as much harm to the national welfare as a tariff tinkered every year in the search for perfection.

Central Stations and Automobiles.

In this issue will be found an exhaustive summary of the conditions pertaining to the present relationships between central stations and the electric automobile. As the result of considerable time and expense devoted to a canvass of the central-station industry during the past two months, we have secured returns from over 1500 plants giving data as to what they have or have not done, or what they intend to do in connection with charging electric vehicles. We believe that the data obtained will be surprising and very encouraging to all who feel that here is a most profitable field of business to be developed; and that it will be seen how large the opportunity is. There are some limitations, of course. They were known before. It is not wise to push the use of such machines in regions not adapted for them; but, after all, those regions are restricted in number and extent; and the same remarks would apply to other pieces of electrical apparatus. We make bold to say that under ordinary conditions, the thought and attention now bestowed by an average central station on fans and flat-

irons, if devoted equally to electric vehicles, would bring a large accession of income and profit. It is amazing that so many stations are not yet fully aroused to their opportunity in this respect, yet it will be seen from the article that 10,000 vehicles and an income of $500,000 a year from charging are conservative figures based on authentic statements from all parts of the country.

We are glad to note that the Edison Association at its coming convention will take up the subject; while it is understood that at the time of the New York Electrical Show in October, the National Electric Light Association will again devote attention to it and will hold a special conference for that purpose. The plan must be heartily approved, for it would be hard to find a better means of improving "off the peak" load. Central stations have yet to study this great subject as it deserves, and in particular to learn the infinite possibilities of commercial electrics. There are examples that show not only what they can earn for stations, but what they can earn for their owners. Of course, the question of rates is involved, but here again it is a class of service drawing from the mains at dull hours and tending to even up the load in such a way as to bring a lower range of cost of energy into sight, with larger profit to the plant. In too many instances, hitherto, the business has been discouraged by high rates, examples of which we give; but it is ideally of a class that can be fostered and nourished by a moderate scale.

Another point we would like to emphasize is the necessity for central stations themselves to "get into the game." It is not worthy of a modern, progressive, up-to-date company—it is a contradiction of those terms—to be using horse vehicles when it can use electrics not only as examples, but with actual and notable economy. Any serious investigation will establish that fact, for most of the towns and cities of the country. We trust that our readers will give the matter such study, which they can best do by getting some machines themselves and putting them at once in steady employment on the various classes of work that a station of any size needs to have done regularly and frequently. They will also learn in the same way the features of care and inspection that underlie success, and the absence of which are to blame for much of the ill success of electrics in the past. The mere fact that 5-ton trucks six years old are to-day still doing splendid service daily and earning a known income of $30 to $50 a day, tells the story of what a little care and intelligence will do.

The Blessed Noiselessness of the Electric Automobile.

If the noise of machinery means waste, as engineers contend, the ordinary gasoline automobile must be a wasteful device indeed. In the campaign against the noise of city streets the gasoline car is often a conspicuous offender, and it contrasts most unfavorably with the latest types of electric vehicles, which are almost noiseless. Imagine a darkened upper room in a city house in which a father is anxiously regarding a sick child. The curtains are drawn, but the windows must be left open to admit the summer air. The doctor says that the little sufferer must have rest and quiet, and the parents are doing their best to secure this condition without removing their little one from the comforts of home. There are flowers in the room, and the restful hum of an electric fan is heard. The child has fallen into a troubled sleep, and the father is regarding her anxiously. Suddenly, whir-r-r-r, chug, chug, chug—the distracting noise of a big gasoline automobile is heard outside. It sounds like an explosion and is continued for some time. The patient jumps up with a start; its dearly bought rest has vanished, and slow tears course down the cheeks of the child. The father has an impulse to tear that machine into a thousand fragments if he could get at it. This is no imaginary picture, but fact.

No such charge as this can be brought against the electric machine. "Joy riders" make no use of the electric vehicle. The speed mania does not seize hold of those who manage the safe and sane electric car. The latter does not drip gasoline on the street, neither is it characterized by an offensive odor. Quietly, steadily, but with strength and power, electricity does its work whether in propelling the carriage which a woman or even a child may operate, or driving the attractive delivery wagon or the heavy truck. The opprobrium which attaches to the reckless driving of automobiles is directed almost entirely against the gasoline cars, and rightly so, for very few accidents are to be attributed to the easily controlled machines of the electric type. In a few places in this country automobiles are forbidden the privileges of the street within municipal limits; but it will be well for the exasperated city authorities to make a distinction in favor of the electric vehicle, for it is not that type of car that has brought reproach on automobilism.

Cost of Municipal Street Lighting.

It is gratifying to observe that more scientific and intelligent ideas relating to the cost of street lighting by electric arc lamps are entertained by municipal bodies than has been the case in former years. An illustration is furnished by the report just issued by the Department of Electricity of the City of Chicago, where Mr. William Carroll is city electrician. This report covers the year 1908, and it is conspicuous and interesting from the fact that an effort has been made, apparently, to arrive at the real or actual cost of electric street lamps owned and operated by the municipal corporation. Mr. Carroll places the "average cost of the operation and maintenance" of the 8602 lamps owned and operated by the city at $45.86 per year. He is careful to say, however, that this amount, while it includes all cash paid out for labor and material of all kinds, superintendence and office charges, does not include interest, depreciation, lost taxes, water rates, rent of the office used by the city electrician, rental of poles belonging to other companies nor the cost of work done by other branches of the city government which enter into the electric lighting service. The city electrician refers to the "Arnold and Young report" presented to the Mayor during the year on the cost of Chicago's municipal electric lamps and, without expressing approval or disapproval of this report, he recognizes the great ability, reputation and fairness of the engineers and accountants who made it, and presents a supplementary table in which he adds to the "actual cash cost" charges for water, rentals, office rent, taxes, insurance, depreciation, interest and proportion of other department salaries as being part of the true cost of operating the municipal plant. These various charges amount to a total of $28.26 per lamp. This, added to the "actual cash cost," gives a "grand total" of $74.12 per lamp. It is interesting

to compare this actual cost of municipal street lamps with the average annual rental of lamps obtained from the central-station company, which was $78.75 for the year and is now $75 a year. It will be seen that the city's cost of producing the light for each arc lamp is but a trifle less than that afforded by the central-station company, and it is indeed pleasing to record the fact that, after these many years, municipal lighting authorities have been educated to the point of making public the actual cost of street arc lighting.

In the past similar figures were not given, partly because the municipal authorities wanted to make a favorable showing, but largely because they were not known. Now more intelligent accounting is done by municipal bodies as well as by private concerns; there have been enlightenment and advancement all along the line, and it is evident that the cost to the city of municipal electric lighting was much larger than was strenuously claimed in former years. The point is that the city ought not to make misleading statements about the cost of this lighting, even though these mistaken figures are put forth from ignorance rather than by design. It is to be remarked, however, that central-station companies themselves have learned and are learning a great deal on the intricate subject of electrical accounting while the controversy in relation to municipal ownership has been going on. Both sides to this controversy, or former controversy, now seem to admit that the other has arguments which are entitled to a respectful hearing, and it is pleasing to observe that the old asperities have passed away to a large extent.

Consolidation of Small Central Stations.

The economic advantages to be gained from the consolidation of small central stations under one management, and where possible with one source of supply, are receiving increased recognition from year to year and at the present time are probably receiving more serious consideration by small central-station managers than at any previous period in the history of the industry. At the N. E. L. A. convention in June the point emphasized above all others by no less authorities than Mr. Frank A. Vanderlip and Mr. Samuel Insull was the financial advantage of such consolidation. In a recent talk before the Electric Club at Chicago Mr. Harold Almert referred to the advantages to be obtained by such consolidations of small companies. The disadvantage under which the small company has always labored has been chiefly that the smallness of the enterprise has made it financially unattractive to engineers and business men of ability, who are able to find a more profitable market for their services in larger companies. The influence of this condition has been far-reaching. The management of such companies has frequently been placed in incompetent hands, which has made the profits uncertain, with the result that securities of such companies are not marketable except in the community in which they operate, and sometimes not even there. Mr. Almert also aptly explained the situation when he said that while large central stations are likely to suffer from over-capitalization, small central stations chronically suffer from under-capitalization. The small company usually starts out with enough local capital to build the power plant and take on a limited number of consumers. As the business grows and extensions are attempted which the original capital cannot take care of, the capital is not increased, but legitimate net earnings go back into the plant for extensions and nothing is taken out.

The two particular benefits to be obtained from the consolidation of a number of small central stations are: First, the possibility of attracting good men to manage and carry on the business; second, the favor with which securities of such a consolidation would be received by the general investing public in virtue of the better management and the fact that the investment is not dependent upon any one small community. With a number of consolidated plants it is also possible to put into practice systems of purchasing, bookkeeping and testing not possible in any one small company. As a general rule, both gross and net returns on well-managed plants in towns from 2000 to 10,000 are more than in larger cities. This is not due to low operating expenses, because the operating expenses of such plants are likely to be a higher percentage of the gross receipts than in the large plants. The investment per kilowatt rating for small towns, however, usually averages below that in large cities, which frequently more than compensates for the higher rate of interest and depreciation which must be figured on the small plants. Then, too, much higher and more expensive standards of construction must be maintained in large cities than in small towns, a fact which can only be appreciated by one who is frequently thrown in contact with work in both the large and small towns.

The Conservation of Fuel.

The full utilization of the world's fuel supply implies as one of its most important prerequisites the effective use of the low-grade coals which form so considerable a proportion of the available total. To this end much money and effort have been spent, upon the whole to good purpose, and in particular the process of working up otherwise difficultly usable coal into briquettes has now risen to considerable importance. A recent paper furnishes considerable data upon the subject which are worthy of serious consideration. As a matter of fact, the briquette industry abroad is a large one. Germany has a yearly output of something like 15 million tons of coal briquettes, and even England, with her splendid resources in fuel close at hand, makes one and a half to two million tons of briquettes. In this way very valuable fuel, too small in its natural state to work well in any practicable furnace, is turned to account and by this amount waste of unreplaceable material is spared. Piles of coal briquettes are familiar adjuncts of Continental plants and are found an economical and convenient sort of fuel for use alone or in conjunction with the brown coals that are so prominent a feature in some parts of the Continent. The briquettes have a high thermal value, are easy to transport and to handle, and burn to great advantage.

Technically, the briquette industry involves some nice points, especially in the choice of the binder, which commonly makes up 5 or 6 per cent of the whole. Pitch and resin have proved the most satisfactory binders, upon the whole, especially when combined in the ratio of about three or four parts of the former to one of the latter. On general principles these binders are objectionable on the score of eventually uncertain supply, and perhaps in due season asphaltic residues of some sort may

replace them. But in spite of having to use pitch in the ordinary processes briquettes are not relatively an expensive fuel under favorable circumstances. Figures are given, in the paper referred to, for the cost of briquette making in an English plant of moderate equipment. The total, including everything, even interest and depreciation, figures up to a scant $2.35 per ton at the works. This is an encouraging figure and could doubtless be materially reduced in working on a big scale in this country. Perhaps the time is not quite ripe for the industry here, yet it is well worth considering seriously, especially with respect to some of the coals which do not bear transportation well and show abnormal waste. In addition to such processes the peat supply should be brought into use ere long. Peat has not generally a high thermal value, running even when compressed as low as 6000 lb.-Fahr. units per pound. Its weakest point practically seems to be its admixture as found with earthy material which is hard to separate. Now and then a really rich deposit of peat is found, but it tends to run irregularly, and is therefore very troublesome to manage. Yet in the aggregate the thermal value of the peat supply, like that of the lignite supply, is so huge that it is worthy of very persistent effort. Making briquettes of the waste coals best suited to such use, and working up the lignite and peat supplies, are important steps toward preserving the rapidly waning fuel supply.

The Proposed Corporation Tax.

At present writing it seems highly probable that a tax on the net earnings of corporations is likely to be incorporated in the revenue measures now under consideration. Such a tax, like the income tax, as we have already noted, would be almost certain to prove even more unpopular than most taxes. The revenue of the country has up to the present time been raised chiefly by methods of indirection. The sums required by the recent "billion-dollar Congresses" necessarily fall somewhat heavily upon the whole people of the country, but extracted as they are in small amounts, without the inquisitorial visits of the tax collector, they would hardly be felt were it possible to collect them, not merely at small expense to the Government, but at small expense to the consumer. In point of fact, as has been amply demonstrated during the discussion of the present tariff bill, a very small increase in duties means practically a very large increase in the cost of the commodity to the consumer. A complete disclosure of the devious methods by which a dollar increase in duties becomes $5 increase in price would be extremely interesting and might serve as a corrective of some of the abuses.

The present prosposal to tax the net income of corporations possesses both good and bad features, the bad on the whole predominating. A corporation tax bringing the financial vagaries of some corporate activity within the grip of the Government might perhaps indirectly serve a useful purpose. It would unquestionably be a nuisance for the honestly managed corporations which form the vast majority of the whole. On the other hand, it seems altogether probable that the dishonestly managed minority would succeed, under any form of law likely to be enacted, in dodging a considerable part of their responsibilities and shuffling the burden of taxation off their own shoulders. This was certainly the effect of the late unlamented income tax of a few years ago. In the same way there is every reason to expect that if a corporation tax is passed, net profits, from which alone dividends can properly be declared, might often fall off in a way very shocking to the champions of prosperity. What is worse, they are altogether likely to diminish in such a way as to bear heavily upon the ordinary investor.

Unless the recent lesson of the income tax be forgotten, it is altogether probable that in the case of the very corporations most in need of control the tax will affect dividends most severely, the net income divisible being reduced to the financial advantage of the insiders. Government supervision close enough to avoid this danger would have to be of extremely drastic character, so severe in fact as to be a serious burden to those honestly conducted business organizations that try to live up to the spirit of the law and to deal fairly both with their stockholders and with the Government. Without in the least excusing dishonesty, measures which put a premium upon it are morally objectionable. If corporations, as a revenue measure, must be taxed, some other method than taxation of net income would seem desirable. As has already been demonstrated, corporations as artificial persons have very valuable immunities which offer a valid excuse for a reasonable tax. It would seem, however, that if the Government desires to obtain its revenue simply and cheaply from the taxation of corporations the easiest process would be a small tax upon the nominal assets as represented by the capitalization. As a broad proposition of law, capital stock is supposed to be issued for actual values and theoretically represents the property of the corporation. The effect of such a tax would undoubtedly be salutary in punishing that stock watering which has been the vice of American finance. It would do little harm if many of the corporations in this country were compelled to reduce their stock to a point somewhere nearer its value; and even if the shrinkage were considerable, so that the revenues obtained from this source were greatly reduced, the tax in the long run would work to the benefit of the honest and conservative. But a tax put in such form as to hit merely the net income appears to the casual observer as an incentive to the most reprehensible kind of juggling with the books, and the same objection would apply broadly to an income tax proposition, even supposing that the Supreme Court could find adequate reason for reversing its former decision on the subject.

Standards of Luminous Intensity.

Now that we have safely come into the possession of an international candle-power, decimally connected with the hefner, it becomes of interest to observe the attitude of different countries toward this standard, and the prospects of the maintenance of this valuable international asset. The attitudes of the three countries immediately interested—England, France and the United States—are somewhat different, because England and France have each an official flame standard that, like the vestal virgins of ancient Rome, they have to keep constantly burning on the altars of their respective national laboratories, whereas America has no flame standard of her own. England has the pentane lamp in official recognition, while France has the carcel colza-oil lamp. Either of these flame standards is a comforting device for domestic photometry, so long as no comparisons are made by third parties. If no such invidious comparisons are made, one can pin great faith upon both the constancy and the reproducibility of each standard; but, as soon as these standards are compared photometrically by disinterested observers, in

order to establish a numerical ratio between their luminous intensities, troubles begin in the way of discrepancy. Reports of such comparisons at different laboratories in the photometers of skilled observers have revealed differences frequently of about 1 per cent, and occasionally of several per cent.

Such differences are not of great consequence when the photometric testing of flame lamps is undertaken, because flames vary appreciably in candle-power from hour to hour, with changes of pressure, water-vapor, temperature and carbonic acid in the air of the photometer room; but when incandescent lamps are tested photometrically, such differences become important. Incandescent filaments, operated at constant voltage below their critical brilliancy and below their temperature of rapid evaporation, hold their candle-power steadily for long periods, and can be compared to within a small fraction of 1 per cent. The advantage of a flame standard disappears with its youth. A flame standard is needed as a starting point until some more scientific device shall have been found for measuring luminous intensity than the photometer screen. But the fact that in America there is no flame standard, while nevertheless luminous intensity has been maintained and measured with great precision here for a number of years, shows that no flame needs to be maintained for photometric purposes. It is sufficient to calibrate a sufficiently large number of selected and seasoned incandescent lamps as secondary standards.

The safety of the international candle-power lies, therefore, in batches of intercompared incandescent lamps, and on the constancy of the international volt. We may expect to see the carcel flame subordinated to the secondary standard incandescent lamps in France, and the pentane flame subordinated to the correspondingly calibrated secondary incandescent lamp standards of Great Britain. The attitude of scientific Germany toward the international candle is still that of a bystander watching from afar. Germany has noted the pact between England, France and the United States in their maintaining the international candle, but has made no attempt to adopt or endorse the resolution. If, however, the maintenance of the international candle is as thorough as we anticipate, and with reference to interchanged secondary incandescent lamps we expect that eventually Germany will adopt the plan to the extent of ensuring the decimal relation of the hefner to the international candle, through incandescent lamps likewise. In that event, we should have only two units of luminous intensity in the scientific world, the hefner and the international, in the ratio of 9 to 10; while there would be but one concrete standard maintained everywhere, through the medium of incandescent-lamp interchange, expressible in either of these two units at will.

Some Advances in Producer Gas.

At the recent convention of the National Electric Light Association some extremely interesting reports were given from a form of producer intended for the utilization of cheap coals, particularly of the bituminous variety, and including even lignite. The status of the gas engine as an auxiliary in electric plants would undoubtedly be improved by the possibility of using such coals successfully, inasmuch as at the present time the great problem in economics in the power station is not so much the efficient utilization of high-grade, as a successful working of relatively low-grade fuel which can be obtained for a comparatively very moderate price. The last few years have not seen the increase in the use of gas engines that was to have been anticipated, but many of those who are close in touch with central-station practice have faith that the gas engine will prove itself a most valuable auxiliary. In Mr. Torchio's paper, to which reference has been made in our columns, the author seems to be strongly of the opinion that the gas engine is to see in the next few years greatly increased use in spite of the fact that the last two or three years have been relatively unproductive; and especially in those cases in which the same company produces both gas and electricity it is the gas engine with producer gas to which one must particularly look for valuable results. The tests reported by the committee are particularly significant in that they deal with the utilization of decidedly poor coal, some of it even being peat of as low thermal value as 6400 pound-Fahrenheit per pound. The tests were made on a 175-hp engine under brake load, receiving all its gas from the producer without the use of a gas holder. The results of the tests reported by the committee are altogether striking, particularly so with the poorer fuel. For instance, 24-hour runs were taken with two coals as widely different as Pittsburgh bituminous of over 13,000 pound-Fahrenheit units and a Colorado lignite down to 9500 units. The former showed 1.12 lb. of coal per brake hp-hour, the latter 1.61. The combined efficiency of producer and engine was 17 per cent in the first and 16.6 per cent in the second, showing that even so poor a fuel as lignite could be successfully utilized without any material reduction in efficiency. The gas produced in these tests ran about 115 thermal units, which is all that is desired for the high compression employed in the engine.

Such results as these show clearly that in point of efficiency and economical use of fuel, the producer gas plant is remarkably effective. Great things, too, are claimed for it in the way of low cost of maintenance and general reliability of operation. The use of large gas engines has sometimes been unsatisfactory from the point of reliability, and the cost of plant, including producer, has generally been such as to result in a somewhat high maintenance charge. If these recent improvements overcome the difficulties in question, one may reasonably hope for a very extensive use of producer gas in power production. From the standpoint of the central-station man it would be desirable through giving him the ability to handle part of the load at least at an exceptionally low cost of power production. The great difficulty in central-station operation is inability to store large amounts of energy in any convenient form against the hour of high demand. Improvement in storage-battery service has done much, but it is not the only resource in the matter of storage, and it may be that cheap producer gas stored at comparatively small cost may prove useful in enabling one to throw into service a considerable gas-engine capacity instead of forcing the output of other prime movers for short periods per day. The economy of combined stations other than those using merely steam and water-power has not been properly worked out as yet. We are strongly of the opinion that combined gas and steam plants are likely to play a very important rôle in the future development of electric service, and particularly when it may be possible for the same company to supply on a large scale electric-power and light and fuel gas. We shall not get the smokeless city of our dreams until such combinations are carried out.

Twentieth Annual Meeting of the Massachusetts Electric Lighting Association.

The twentieth annual meeting of the Massachusetts Electric Lighting Association was held at the Tedesco Club, Swampscott, Mass., on Thursday, July 29, about 60 members and guests being present. At a business meeting held in the forenoon the following officers were re-elected for the ensuing year: President, C. L. Edgar, Boston; vice-presidents, A. B. R Sprague, Worcester, and C. F. Pritchard, Lynn; secretary. Everett W. Burdett, Boston.

The executive committee reported that the year had passed without the establishment of any legislation hostile to Massachusetts central stations. The outlook for municipal ownership is constantly growing less attractive, and several undesirable bills of this character were defeated during the past session. The bill sought by the town of Wakefield to permit cities and towns which have acquired plants for the manufacture of gas and electricity to purchase energy from central stations marks a forward step, the experience at Wakefield with municipal ownership being admittedly a failure. The passage of the bill increasing the powers of the Gas and Electric Light Commission so that it now passes upon the price at which new securities are issued represents constructive legislation, since by the terms of this law the directors of gas and electric lighting companies are enabled to fix the price of such securities. The board can veto the action of the directors if they overstep their authority or use improper judgment. Another important measure passed was that permitting electric companies to purchase the electrical business of gas companies under the supervision of the commission. No legislation seriously detrimental to the central station has been passed in Massachusetts for about 20 years. The special committee on uniform contract forms for street lighting reported in favor of standardization along the lines practised by the Hudson Electric Illuminating Company, of Boston, which has adopted a single-sheet standard for use in the 33 cities and towns which lie within its territory. Modifications are readily embodied in the contract when local conditions require them.

After the usual dinner and on account of the anniversary Secretary Burdett, general counsel of the association, presented a most interesting and exhaustive review of the history of the association and its relation to the development of the central-station industry in Massachusetts during the past 20 years. The association was organized in Boston in 1889, with 47 persons, representing 42 companies, present at the initial meeting. The organization was formed for the purpose of withstanding and repulsing serious attacks upon the industry which were then being planned. From 1891 to 1893, inclusive, a large part of the work of the association was devoted to the question of municipal ownership, and it was felt that had the association accomplished nothing but the defeat of the municipal ownership bill of 1890 it would have done a great work for the lighting interests of the State. The general bill which was finally passed in line with the recommendations of the association recognized the popular idea of municipal ownership, but at the same time it was just to invested capital and did not subject it to either effectual confiscation or unfair competition as did the bill of 1890. Mr. Burdett reviewed the case of the Attorney-General vs. Walworth Light & Power Company in 1892, citing the opinion of the Supreme Court of Massachusetts in favor of regarding the business of transmittting electricity through the streets of a city as a regulated monopoly and denominating as impracticable a free competition between as many companies and persons as may be minded to put up wires in the streets and try their luck.

The author discussed the amendments of 1893 to the municipal ownership law, the so-called Whitney Gas Bills of 1896, and the formation of the Massachusetts Gas Companies, with a reference to the part the association played in these events. He also touched upon the recognition as far back as 1900 of the importance of publicity in connection with the shaping of public sentiment in relation to large utility corporations. A large amount of concurrent and co-operative work has since been done, and it has apparently been attended with considerable success, as exemplified in the marked change in the attitude of the general public toward municipal ownership. Continuing the author reviewed the changes which time has wrought in the personnel of the association and referred in high terms to the members who have passed away since it was organized.

The work done at certain specially important meetings, legislative sessions and elsewhere was outlined, including the discussion of "Municipal Lighting in Great Britain," by the general counsel in 1905; "Electrical Charges and Discounts," by Mr. Arthur S. Knight, of Boston, in 1906, and the proceedings before the Gas and Electric Light Commission instituted by the Public Franchise League against the Edison Company of Boston, in 1907. Reference was also made to the general interest of the association in the Knoxville water case and Consolidated gas case of 1908, as decided by the United States Supreme Court. Considerable space was also given to the work of the association in relation to the prevention of legislation requiring the promiscuous burying of underground wires from 1889 to date. A notable feature is that the underground-wire act in Boston has operated to the entire satisfaction of all parties concerned, as evidenced by the fact that the board of appeal from the decisions of the wire commissioner therein provided for has never had a single occasion to exercise its power; whereas, if the original bill of 1893 had been put through without the amendments which were suggested by the city and the companies interested, it would have proved to be a constant source of irritation and perhaps litigation. Since 1894 special underground-wire bills have been passed relating to the cities of Worcester, Springfield, Lowell, Haverhill, Brockton and Somerville and the policy seems firmly established of treating each case upon its merits, putting the law in such shape as will prove reasonably satisfactory to both the public and the private interests concerned.

The 29 companies which composed the original membership of the association had a combined capital of less than $5,000,000. whereas the capital of the 24 companies which at present compose the membership is nearly $26,000,000. In 1890 little if any of the stock was at more and much of it at less than par whereas a large portion of the present capital sells at premiums as high as 100 or 200 per cent. Adding the market premium on the capital of the Boston Edison Company alone to the nominal capital of the present companies, the total investment is carried up to about $45,000,000; and if the premiums on the shares of the other companies were added the total would reach about $60,000,000, or an increase of at least 1000 per cent in 20 years.

No electric lighting business was done in Massachusetts prior to 1881. The Gas and Electric Light Commission was established in 1885. To-day the capital of the Edison Company of Boston represents a market value of nearly $30,000,000, compared with $1,500,000 for the Boston central stations of 1889 The Edison Company's wire length has increased from 3,000,000 to 17,000,000 ft. in 20 years. The lines represent an investment of over $8,000,000 to-day. Twenty years ago the Boston companies burned annually only 21,000 tons of coal, against 102,717 tons last year. Other companies follow the same rates of expansion, Worcester, for example, having gained in wire length in 20 years from 332,000 to 6,000,000 ft., with nearly 50 per cent of the present length underground. This company's annual coal consumption has risen from less than 3000 tons to about 8000 tons, and its boiler equipment from 650 to 3000 hp.

In spite of enormous increases in central-station investment, the quality of the service has been steadily improved and the price decreased. A better and more liberal treatment of the public is coincident with larger earnings and increased dividends. The total dividends paid in 1889 were about $172,000 the rate being 6 1/3 per cent, while in 1908 the dividends were over $2,000,000, at an average rate of 9.65 per cent. Twenty years ago the amounts paid by the companies in taxes did not appear in the reports of the Gas and Electric Light Commission. In 1909 the central stations in the State paid in taxes more

than $700,000, of which the Boston Edison Company alone paid nearly $400,000, or at the rate of 50 cents for every man, woman and child in the area supplied with energy by it. This company alone paid in 1909 2.5 times as much in taxes as was paid in dividends by all the companies of the State in 1889. It thus appears that a large part of the money which the consumer pays for electricity goes back into the public treasury in the form of taxes.

Mr. Burdett then cited the figures below compiled by Mr. T. Commerford Martin, editor of the *Electrical World,* for the United States Census of 1905, showing the increase in the general electrical manufacturing industry of the country between 1890 and 1905.

	1890.	1905.	Increase, per cent.
Capital employed	$18,997,337	$174,066,026	815
Persons employed	9,485	71,085	646
Salaries and wages	$5,366,188	$42,937,406	700
Cost of materials used	$8,819,498	$66,836,926	658
Miscellaneous expenses	$1,154,462	$17,948,708	1,470
Total expenditures	$15,340,148	$127,718,040	753
Value of products	$19,114,714	$159,551,402	718

Regarding municipal ownership, Mr. Burdett said that only 26 out of the 354 municipalities of the State, and including only 3 cities, have established plants of their own, and of these 7, or more than 25 per cent, have distribution plants only and buy energy from private companies. The total investment in municipal plants is only about $4,000,000, or an average of about $156,000 each, while the average of 80 private companies in the State is $375,000. These contrasts seem to illustrate the differences in results to be expected from the encouragement of private as against public enterprise. In Massachusetts there was not in 1908 one town out of the 92 municipalities of over 5000 people without an electrical supply.

The speaker closed with an outline of the developments to be expected in the future, sketching with a bold hand the possible sources of energy, the centralization of plant and concentration of commission control to be anticipated.

President Edgar then called upon Prof. Elihu Thomson, who was the guest of honor at the dinner. Professor Thomson emphasized the importance of cheap energy in the advance of civilization, touched upon the value of the tungsten lamp in decreasing the required generating plant equipment and urged the significance of the distribution problem in the central-station field. It ought to be possible with the tungsten lamp and a single-tube distribution system to secure as a customer every man upon the street. With one wire in an outside grounded copper tube a great deal can be accomplished, at, say, 2300 volts. This main can be extended into houses more easily than a gas pipe; it is absolutely safe and the installation of fittings is an exceedingly simple matter. Such a tube does not deface anything and can be made extremely flexible by screw couplings. Professor Thomson concluded by a short discussion of the importance of conserving the fuel supply, the costliness of battleship fuel consumption even in times of peace, and the probable influence of the recent progress in aviation upon battleship construction and the elimination of war.

Forecasting Public-Service Development.

Under the unusual title "Public Utility Fortune Telling," Mr. Harold Almert, manager of the department of examinations and reports of H. M. Byllesby & Company, of Chicago, addressed the members of the Electric Club of Chicago on July 28. Mr. Almert's talk related to the probable future development of public-service companies, with which his own work is immediately engaged, and he said that despite the "hot-weather" title that he had given it, the subject has a serious side. The electrical utilities of this country have assumed such large proportions that it is a problem of great magnitude to plan and supervise the financial end of the business. In ordinary commercial pursuits statistics show that 97 per cent of all mercantile businesses fail within five years of their establishment. It is therefore necessary, when a public utility, either new or old, is to be financed, to examine carefully into its condition and prospects. The foretelling of the future success of these utilities has been reduced almost to an exact science.

Often small central-station plants are organized by local business men who are not familiar with the business. To this lack of management is often to be added the further fact that small companies are very frequently under-capitalized. In many small plants too much of the earnings have to go into extensions. In the case of large plants failures are sometimes caused by a directly opposite characteristic, that is over-capitalization.

The present-day tendency is toward the combination of smaller stations into a large proposition. In many cases combinations of this sort are advantageous and profitable. Large properties can float bond issues more easily than small ones. On small issues the percentage for brokerage is often excessive and the rate of interest is high. These objections are done away with by issues on a combination of small properties.

In examining properties an engineer is first retained to make an examination and report before the financial house will consider the proposition seriously. Many engineers seem to be pessimistic. One reason is that in a proposition involving a considerable expenditure of money they prefer to err, if at all, on the conservative side. Another reason is that the easy way to handle a proposal of this character is simply to "turn it down" and say there is nothing in it. Nevertheless, Mr. Almert gave it as his opinion that the majority of steam central-station propositions "put up" to financiers have merit. Many things are to be considered, such as the population served, the character of the population, the general business condition of the town or towns, bank deposits and the like. A curve of probable extension of the business that may be expected is plotted as one of the early preparations in the making of the examinations and reports of this charter.

Touching briefly on the municipal ownership agitation of three years ago and its results, the speaker said that, as they are conducted at present, the existence of State public-service commissions is certainly a great benefit to the industry. This method of control is superior to the uncertainties of local control. But there is an element of danger in these commissions owing to the possibility that some time in the future they may pass under the sway of politicians. The management of central-station properties has changed with the development of the art. Formerly it was thought that a man should have legal training to be a manager, and that he might hire technical brains to assist him. Later it was considered that engineers were best qualified for this work, but at present the approved idea seems to be to employ technical men trained also in practical business affairs. Men of this stamp appear to get the best results.

The discussion was opened by Mr. H. E. Niesz, manager of the Cosmopolitan Electric Company, Chicago, who pointed out that it was necessary in the early days to pay a great deal of attention to technical subjects, because the changes in the art were so frequent and of such a revolutionary nature. It was therefore advisable that technical men should be in charge of the companies giving electrical service. Later this side of the business became standardized to a considerable extent, although improvements are still constantly going on. It then became necessary to develop the commercial end of the business; it was of vital importance to enlarge the market. The change in the character of the management of central-station companies has simply kept pace with the development of the art.

Mr. E. A. Bullock, of Norfolk, Neb., former president of the Nebraska Electrical Association, was present as a guest, and he was called on to speak. He corroborated Mr. Almert's statement that the ordinary small plant is under-capitalized, and gave some facts that had fallen under his own observation to prove this statement. Central-station men have found that it will not do simply to build a plant and wait for customers to come in; it is necessary for the men in charge to go out and get the business. Mr. Bullock concluded his brief remarks by saying that the small Western town is worth more per inhabitant to the public-utility corporation than Eastern or Southern towns of equal or even considerably larger size.

Patent Agreement Between Germany and the United States.

According to a reciprocal patent treaty, for which ratifications were exchanged by Secretary of State Knox and the German Ambassador, Count Bernstoff, in Washington, on July 14, American inventors will greatly benefit from the removal of the German restriction under which their patents have hitherto been forfeited if not actually worked in Germany within three years. Under the new treaty an invention reduced to practice in either country is fully protected in both countries when patented in both Germany and the United States. The United States Government, through the State Department, has been taking prompt measures to relieve inventors and the manufacturing and export industries from unjust discriminations in the laws of foreign countries, and last year sent Edward B. Moore, Commissioner of Patents, as a delegate to the International Congress for the Protection of Industrial Property, which met in Stockholm. From Stockholm Mr. Moore proceeded to Berlin, and succeeded in negotiating a tentative reciprocal agreement with the German Government which has resulted in the treaty just established. The agreement is immediately effective, and is to remain in force until the expiration of 12 months following a notice of termination by either Germany or the United States.

It is said that at the next official Congress for the Protection of Industrial Property, which will meet in Washington in 1910, about 30 nations will be represented. An endeavor will be made to harmonize the laws of the various nations relating to the protection of patents and trade-marks.

New York Public Service Commission News.

The Public Service Commission of the First District of New York has appointed Edward G. Connette transportation engineer, a position which pays a salary of $8,000 per year. This office, the head of the transportation department, has never been filled heretofore, although it was provided for in the original plan of organization of the commission. Under this department are the bureau of equipment inspection, until recently headed by A. W. McLimont; the bureau of transit inspection, headed by Daniel L. Turner, and the bureau of accidents and complaints, headed by George F. Daggett.

The Interborough Rapid Transit Company has informed the Public Service Commission that on Aug. 15 it will have ready for service 42 steel cars fitted with side doors for express trains and that by Oct. 15 enough cars will be ready to maintain a 1.5-minute express service in the subway.

The Dock Department of the city of New York has asked the Public Service Commission to order the removal of the loop, used by the Broadway and Sixth Avenue surface lines, at South Ferry. It is alleged that there is no franchise for this loop and that it seriously interferes with trucks boarding and leaving the ferries. The commission will look into the matter of franchise before taking any action.

The Public Service Commission of the Second District has authorized the Nassau & Suffolk Lighting Company to issue its preferred 6 per cent capital stock to the aggregate amount of $420,000, the proceeds to be used for the extension and improvement of its plant and distributing system, for additional working capital to the amount of $25,000, and for the payment of various obligations amounting to $87,500. The company is operating in a rapidly growing territory and it is its intention to increase its facilities.

The commission has authorized the Delaware & Eastern Railway Company to issue its capital stock, par value, of $2,050,000. and its 50-year 5 per cent gold bonds secured by its mortgage dated July 1, 1907, to the Empire Trust Company of New York City, to the amount of $4,570,000 par value. The company is granted permission to sell the bonds at not less than 80 and accrued interest, except that $3,500,000 may be sold at par in accordance with the terms of an underwriting agreement filed with the commission. The capital to be secured by the bonds is to be used for the construction of its proposed road between Schenectady and a point near Hancock, Delaware County, dividing the States of New York and Pennsylvania.

The commission has authorized the Rockland Light & Power Company to issue $100,000 5 per cent bonds, under its mortgage, dated Dec. 7, 1908. The bonds are to be sold at not less than 90, and the proceeds of 50 of the bonds are to be used to discharge the bonds of the Nyack Gaslight & Fuel Company, now merged with the Rockland Light & Power Company, and the remainder for the extension and improvement of the plant and distributing system of the applicant company.

Spectacular Electric Illumination During the Hudson-Fulton Celebration.

For eight nights during the Hudson-Fulton celebration, Sept. 25 to Oct. 9, New York in all its boroughs will be the most brilliantly illuminated city in the world. The illumination will begin each night at 6:30 and continue until 12:30 a. m. Estimates place the number of lamps to be used, in addition to the regular lighting of the city, at between 1,000,000 and 1,500,000 incandescents, 7000 arc lights, 3000 flaming arcs, one battery of 4 searchlights of 100,000 cp each and one battery of 12 searchlights aggregating 1,700,000 cp. This estimate may be greatly increased by electric advertising signs, for which contracts have already been made by electric lighting and display advertising firms. In this estimate no account of the lamps along the New Jersey shore and in other places adjacent to but outside the city limits is taken.

This remarkable illumination is a part of the plan of the Illumination Committee of the Hudson-Fulton Celebration Commission, of which Mr. William Berri is chairman. In addition to the city illumination Mr. Berri's committee has charge of the lighting of the Hudson River Valley on the last night of the celebration, Saturday, Oct. 9, from New York to Troy, a distance of 170 miles, with huge signal fires on mountain tops.

One of the most remarkable features of the illumination in New York will be the probable use of the immense battery of searchlights to be located on Riverside Drive at 110th Street. This searchlight battery will be first put in operation on the night of Saturday, Sept. 25, and continue until the end of the celebration. When brought together in a single beam, as it will be on the night of Oct. 9, it will be visible for 50 miles.

The Hudson-Fulton Celebration Commission will pay the expense of this battery of searchlights and a small battery of four searchlights which will play upon Grant's Tomb and for approximately 170,000 incandescent lamps, while the balance of the display will be made by private citizens, theaters, banks, corporations, office buildings and advertising firms.

The Queensborough Bridge, Brooklyn Bridge, Williamsburgh Bridge and Manhattan Bridge crossing the East River will be outlined from end to end by electric lamps. In Manhattan, the City Hall will be elaborately illuminated, as will be the Memorial Monument at Fourth Street and Fifth Avenue and the entire routes selected for the parades from Fourth Street up to Fifty-ninth Street through to Eighth Avenue to 110th Street will be lined throughout with festoons of electric lamps on the curb line. It was first intended to festoon across the entire streets, but the height of the floats for the historical and carnival parades has made this impossible. These festoons at all the reviewing stands will be made up of floral garlands interspersed with electric lights and producing a very beautiful artistic effect. This entirely original feature was designed by Mr. Charles R. Lamb, chairman of the Committee on Decorations. The Viaduct Bridge on Riverside Drive will be outlined throughout, also the Soldiers and Sailors' Monument at Ninety-second Street and Riverside Drive.

In Richmond the new Borough Hall and in Queensborough the Borough Hall building will be strikingly illuminated. In Brooklyn the Borough Hall, the Soldiers and Sailors' Monument, at Prospect Park, the water tower and the Museum of Arts and Sciences will be electrically outlined. In The Bronx

the Borough Hall will be studded with electric lamps. The building is on a high elevation and will make a fine showing. The Martyrs' Monument at Fort Greene, Brooklyn, will, it is hoped, for the first time have the intention of the late Stanford White, the architect of the monument, carried out by the building of a continuous fire in the enormous urn on the tripod at the top of the shaft. Contracts have been made with the following electric light companies:

The New York Edison, the Edison Electric Illuminating Company of Brooklyn, the United Electric Light & Power Company, the New York & Queens Electric Light & Power Company, and the Richmond Light & Railroad Company.

A large number of contracts have been made for electrical illumination on both sides of the Hudson up to and opposite Spuyten Duyvil. The steamship companies are all becoming active in the matter, as are also most of the other occupants of river-front property.

On the evening of Saturday, Sept. 25, with 30 or 40 foreign and American warships anchored off 110th Street, a grand fireworks display will be given on floats on the New Jersey side of the river in honor of the visiting vessels.

In Manhattan upon the line of parade the great clubs and hotels are arranging for their illumination. The Union League Club will have a most beautiful showing. It will deservedly attract great admiration for its artistic beauty and elaboration.

The line of carnival parade on the night of Saturday, Oct. 2, will be a gorgeous lane. Thousands of dollars' worth of colored fire will also be used during the procession to light the floats.

The illumination committee has practically determined the location for the signal fires up the Hudson River that are to be placed between New York City and Newburgh in connection with the scheme for illuminating the entire river front on Saturday night, Oct. 9, which will be known as illumination night.

Subject to change, the other points selected are as follows: Governor's Island, Fort Lee, Fort Washington, Spuyten Duyvil, Alpina, Hastings' Point, Staten Island, Hook Mountain, High Tor, Stony Point, Dunderburgh, Anthony's Nose, Sugar Loaf Hill, West Point, Constitution Island, Storm King, Bull Hill and Crow's-Nest.

Up the river every town is arranging for displays. This is particularly true of Newburgh, where the plans tentatively adopted give assurance of a magnificent illumination both of the buildings on the river and the mountain peak signal fires.

Probable Short-Time Gas-Lighting Contract in Boston.

On account of a provision recently discovered in the new charter of the city of Boston, which was passed by the Legislature of 1909, it is probable that the municipal authorities will make only a short-time contract for the illumination of thoroughfares of secondary importance by gas lamps. Since the signing of the main street lighting contract last May with the Edison Electric Illuminating Company of Boston, the Street Department has been considering the question of renewing the contract whereby many of the minor streets are lighted by gas, some 12,000 lamps being operated in this service at present by the Rising Sun Street Lighting Company. Bids were asked for and passed upon July 1, and the contract would have been awarded to the so-called Greater Boston Illuminating Company had that organization been able to furnish the necessary bond of $50,000 within the specified time. On July 11, section 16 of the new city charter went into effect, and its wording is such as to forbid the city from making a contract for a later date than the first Monday of February, 1910, when another section of the charter (No. 6) goes into effect providing that a lighting contract extending over a year shall not be valid without the approval of the Mayor and the City Council after a public hearing suitably advertised in the *City Record*. The Finance Commission called the attention of Mayor Hibbard to this situation, with a confirming opinion by Corporation Counsel Thomas M. Babson. As a result the city will have to make the best terms possible for the continuation of the lighting from Sept. 15, when the present Rising Sun contract expires, until the close of the municipal year in February next.

The city will probably have to follow one of the subsequently named courses; the Rising Sun Company may be willing to continue its present system at a fair rate; the lighting may be done in part by municipal employees or sublet; or the Edison Electric Illuminating Company may extend its system by furnishing possibly 5000 60-cp incandescents at the contract rate of $22.31 per lamp per year, leaving the balance of the 12,000 lamps to be supplied by some gas-lighting organization. Under present conditions it is doubtful if the Edison Company would feel itself justified in making the enormous investment necessary to reach the locations of all the present gas lamps on minor thoroughfares, and its contract of May 5 last sets a limit of 400 ft. on extensions to its overhead system and 100 ft. on underground extensions at the request of the municipality for additional lamps. The Edison Company's price is less than that of the Rising Sun Street Lighting Company by about $1.29 per lamp per year, but the feeder investment required to displace the present gas lamps would probably be over $1,000,000. There is a growing sentiment, however, in favor of the tungsten lamp for minor lighting, and it is possible that within a few years developments may occur which will drive the gas lamp from its present position in the subordinate streets of Boston. The Edison Company already operates over 1000 tungsten lamps in this class of service.

Association of Special Libraries.

The Special Libraries Association has been organized for rendering mutual assistance among the special libraries so as to diffuse accurate information as to the authorities on a wide range of subjects, prevent the unnecessary duplication of purchases, and enable the most useful books to be obtained without buying a large number treating the same subject. The following officers have been elected:

President, John Cotton Dana, librarian, Free Public Library, Newark, N. J.; vice-president, Robert H. Whitten, librarian, Public Service Commission, First District, New York; secretary-treasurer, Anna Sears, librarian, The Merchants' Association of New York; executive committee, Herbert O. Brigham, librarian, State Library, Providence, R. I., and George W. Lee, librarian, Stone & Webster, Boston, Mass.

Although only about one month old, the association has a membership of about 50 special libraries. An important feature of its work will be the preparation and publication of bibliographies. Certain special libraries are authorities on finance and taxation, insurance, public utilities, real estate, etc., as they make a point of gathering everything published on the specific subject in which they are especially interested. The librarians in charge of these collections, who qualify as experts on the literature in question, will compile special bibliographies on public utilities, finance and taxation, etc. These bibliographies will be annotated, thereby affording all the necessary information as to the works in the list, and will be circulated among all the members of the Special Libraries Association.

Massachusetts Public Utility Legislation.

In the recently adjourned session of the Massachusetts Legislature of 1909 about 2100 bills were introduced, nearly one-third of which became law. The session was characterized on the whole by a reasonable attitude toward public utility corporations, with a disposition to see fair play in the central station, gas, electric railway and telephone fields. Several measures of more than local interest were taken up, and many proposed laws distinctly hurtful to the companies or destructive of the spirit of conservative regulation by commissions were defeated.

One of the more important measures which became law was a bill relative to the purchase, sale and consolidation of gas and electric light companies (Ch. 316, Acts of 1909). The new law provides that a gas company may, under the approval of the Gas and Electric Light Commission, sell its locations and the

property used in its business of generating and furnishing electricity for light and power to an electric light company whose lines are in the same or a contiguous municipality. In the passage of this act the tendency toward centralizing the generation and distribution of electricity was recognized, and the way opened for gas companies who find themselves more or less burdened with an auxiliary electrical supply business to turn this department of their work over to the central-station interests. The most important application of this law thus far is the pending consolidation of the electrical departments of several suburban gas and electric properties with the Edison Electric Illuminating Company of Boston, which is now before the Gas and Electric Light Commission for approval.

An appropriation of $5,000 was made for the determination of the amount of water-power available on the streams of the State, and for investigating the best methods of utilizing it to further industrial improvement. The Governor is authorized by the act to contract with the director of the United States Geological Survey for this work. A brief report of the work, which it is hoped will be furthered by a like Congressional appropriation, is to be made on Jan. 1, 1910, and a complete and final report a year later (Ch. 359, Acts of 1909).

One of the measures which attracted widespread attention in Massachusetts was the so-called "telegram time-filing law," which became legislation without Governor Draper's signature on April 17. The law provides that every telegraph company shall cause to appear plainly upon the addressee's copy of every intra-State message the hour and minute of the day on which it was filed for transmission and the hour and minute of the day of its receipt at its destination. As soon as the law went into effect the companies instituted a charge for the transmission of this information and within a few days an amendment was passed forbidding the imposition of such charges. (Ch. 402, Acts 1909.)

A law was passed requiring every gaslight company with a capital paid in of $100,000 or more, and others, if required by the Board of Gas and Electric Light Commissioners, and all makers and vendors of meters to set up at some convenient place upon their premises one or more meter provers of a size and type approved by the board, and tested and calibrated by the board. A meter cannot be stamped correct if it varied more than 2 per cent from the standard measures. The board is required to keep a correct record of all meters examined by its inspectors with their proof at the time of inspection, and this record is open at all times for examination by the officers of any gaslight company in the State. Every gaslight company manufacturing or selling more than 15,000,000 cu. ft. of gas per year may be required by the above board to maintain a testing room with an approved disk photometer and equipment at least one-fourth mile from the gas works, open to the inspection division of the board from 8 a. m. to 6 p. m. Illuminating gas of every company of over 50 customers is to be tested at least twice a year, and the board is allowed, within certain specified limits, to establish a standard for the purity of the gas from time to time. A fine is imposed for continued impurities or inferior illuminating power. Provision is also made in the law for the appointment of inspectors and the testing of consumers' meters for fees (Ch. 483, Acts of 1909).

One of the most important laws passed during the session provides that a gas or electric light company shall upon increasing its capital stock (above 4 per cent of the existing capital stock) offer the new shares proportionately to its stockholders at such price, not less than the par value, as shall be determined by its board of directors. The vote of the Gas and Electric Light Commission as to the amount of stock which is reasonably necessary for the purpose for which the increase has been authorized is based on the price as fixed above unless the commission is of the opinion that the price is so low as to be inconsistent with the public interest, in which case the commission may determine the price at which such shares may be issued. If the increase in stock is less than 4 per cent of the existing stock of the company, the directors, without first offering it to the stockholders, may sell the shares by auction or by tender to the highest bidder at not less than the par value. They are also required to sell at public auction any shares remaining unsubscribed by the stockholders authorized to take them, under the supervision of the commission. No shares can be sold for less than the par value paid in cash. This law relaxes somewhat the severity of the Massachusetts statutes bearing upon central-station stock isssues, while safeguarding the public interest as well. It places the gas and electric light companies upon a footing similar to that held by railroads and street railways before the Railroad Commission. (Ch. 477, Acts of 1909.)

A law was passed authorizing municipalities to permit the construction and maintenance of pipes and conduits under the public highways for the transmission of steam or hot water for heating, cooking or mechanical power. (Ch. 103, Acts of 1909.) Another bill was passed which provided that a city or town which has acquired a plant for the manufacture or distribution of gas or electricity may purchase gas or electricity from any other municipality or corporation manufacturing gas or electricity. (Ch. 173, Acts of 1909.) By Chapter 313 of this year theaters are required to install an emergency arc light or its equivalent in the auditorium, and this light, together with exit, corridor and other auxiliary illumination, is required to be fed independently of the stage lighting and controlled from the lobby or front of the house. In specific legislation, the Beverly Gas & Electric Company was authorized to do business in the town of Topsfield (Ch. 438, Acts 1909); the Metropolitan Water and Sewer Board was authorized to sell or lease certain lands for electric power transmission (Ch. 473, Acts 1909); the town of Framingham was authorized to procure electricity for use in pumping sewerage and water (Ch. 479, Acts 1909); there was established an electric light district in the town of Erving (Ch. 496, Acts 1909); the Holyoke Water Power Company was authorized to sell energy to certain mills in Holyoke and to certain existing or prospective municipal plants (Ch. 152, Acts 1909); and Ch. 72, 1909, provides that only one mile of streets shall be the annual requirement for a change from overhead to underground construction in the city of Springfield in 1909.

In the street-railway field perhaps the most important general measure passed was an act to allow companies to issue stock or bonds to supply working capital, under supervision of the Railroad Commission. In connection with the determination of the taxable value of corporate franchises as provided for in existing statutes, an amendment was passed to the effect that "underground conduits, wires and pipes laid in the public streets, and poles, underground conduits and pipes, together with the wires . . . for the purposes of taxation shall, like rails and rights of way, be included in, and not deducted from, the value of the corporate franchises." The burdens of taxation are somewhat relaxed by the inclusion of the poles in the valuation. Special legislation authorizing the New York, New Haven & Hartford Railroad Company to develop the Berkshire Hills district through the purchase of the Berkshire Street Railway system was postponed until next year.

Among the measures which failed to become law this year were bills to reduce the price of gas in Charlestown, East Boston, Fall River and Chelsea; a bill to permit municipalities to establish or acquire lighting plants on a majority vote of each branch of the city council passed in any municipal year and thereafter ratified by a majority of votes at any special or annual city election; a bill to permit gas companies to adopt the tri-partnership system of prices, dividends and wages; a bill to make the price of electricity uniform in rate for all customers without regard to the amount of energy consumed; a bill to require electric companies to instruct their customers in the reading of meters, and a similar measure for gas companies; and bills to prohibit gas companies and central stations from making a meter rental or readiness-to-serve meter charge.

One of the most dramatic incidents of the year was a rebuke by Speaker Walker, of the House, uttered in connection with the bill to reduce the price of gas in East Boston. The bill had almost reached the Governor when the Speaker succeeded in recalling and killing it by a vigorous speech emphasizing the importance of maintaining the State's long-established and successful policy of referring technical questions of this character to its expert commissions.

Latest Aspects of the Tariff Situation.

The new tariff bill, which passed the House of Representatives last week, is the tariff bill which will in all probability be the new law. It is expected to pass the Senate before the end of the present week and it is assured that the President will sign it at once. The vote in the House was very much closer than had been anticipated, and it is generally believed in Washington that if the Democrats and objecting Republicans had been better organized they would have been able at least to have recommitted the bill, if not to have defeated it. At the time that this is written, it is believed that the vote in the Senate will be very close, although there is little fear of failure expressed by the Republican organization.

As far as the electrical trades are concerned, there is not much change in rates from the present scehdules. The only serious contest for lower rates of duty that was made came from the importers of lighting carbons, and these not only failed to secure a reduction, but, it is claimed, will have to pay considerably higher duties.

CARBONS

Section 96 of the new law which deals with the carbon schedule reads: "Carbons for electric lighting, wholly or partly finished, made entirely from petroleum coke, 35 cents per 100 ft.; if composed chiefly of lampblack or retort carbon, 65 cents per 100 ft." Under the Dingley law the rate for all carbons was 90 cents per 100 carbons. The apparent reduction from 90 cents to 65 cents is not, however, a reduction, but is an actual increase, according to the statements of the importers This is brought about by the insertion of the word "feet." The only lighting carbons which have been imported under the present law or which will be imported under the new law, are the high grade goods, such as are used in searchlights, moving-picture machines, flaming-arc and enclosed-arc lamps. More than 90 per cent of all the importations are carbons for enclosed arcs. Under the present law—90 cents per 100 carbons—the importers have been bringing in their goods in 24-in. and 28½-in. lengths and cutting them here. By this means the duty instead of being 90 cents, was less than 45 cents per 100 on carbons of 12-in. length, which is the ordinary length for enclosed arcs. It is easy to see how the introduction of the word "feet" breaks up this system of importation in double lengths and practically advances the rate more than 20 cents per 100. As 24 in. is the most common length for flaming-arc carbons, it is not hard to see that the new law increases the duty on these from 90 cents per 100 to $1.30 per 100.

The clause which fixes the rate for "petroleum coke" carbons—the ordinary cheap carbon used in the open arc—at 35 cents per 100 ft., in reality means nothing to the trade. These carbons are not imported under the present law and will not be imported under the new law. It is likely they would not be imported if they were admitted duty free, as, owing to the greater abundance in this country of the raw material from which they are made they can be produced cheaper here than abroad. These carbons now sell to the consumer at from 60 to 80 cents per 100 in 12-in. lengths, so that a duty of 35 cents per 100 ft. is practically a tax of 50 per cent ad valorem.

Carbon electrodes, brushes, plates and disks, which under the Dingley bill paid a duty of 35 per cent ad valorem, will now pay a duty of 30 per cent; and porous carbon pots for batteries, which formerly were taxed at 20 per cent, come in under the new law at the same rate.

In speaking of the fight on lighting carbons, a Washington representative of the importers who was especially interested in flaming-arc carbons, had this to say: "I do not think there was ever much opportunity to get a reduction on enclosed arc carbons, for the American manufacturers brought too much influence to bear for us to overcome it. If, however, we had been able to work out a descriptive definition that would have covered flaming-arc carbons alone, I believe we might have got a material reduction on these. A number of Senators were willing to listen to the arguments of the flaming-arc importers, and the American manufacturers were not particularly interested in the matter. Several definitions were discussed but the trouble was that none could be found to cover flaming-arc carbons alone which would not be open to a construction that would admit other carbons as well."

MICA

The new schedule covering mica is unchanged from the provision which originally passed the House, April 9, 1909. The new rate is: For unmanufactured mica, or rough trimmed only, 5 cents per pound and 20 per cent ad valorem; for mica cut or trimmed, mica plates or built-up mica and all manufactures of mica, 10 cents per pound and 20 per cent ad valorem Under the Dingley law, uncut mica was 6 cents per pound and 20 per cent ad valorem, and manufactured mica was 12 cents per pound and 20 per cent ad valorem. The new rates are, therefore, a small reduction in the specific duty, but will have very little effect except upon the very cheap grades.

MANUFACTURED GOODS, ETC.

In the original draft of the new law, as it passed the House electrical machinery was specifically named and the duty on it fixed at 30 per cent ad valorem. The Senate, however, eliminated this special reference and the bill as adopted does not mention electrical apparatus or machinery and, therefore, these imports will come under the general provision covering manufactures composed wholly or in part of metal, which must pay a duty of 45 per cent ad valorem. The section covering these goods is exactly the same as that in the Dingley law and the rate is the same.

Steam engines and machine tools under the new law will pay a duty of 45 per cent ad valorem, which is the same as has been paid under the present law. An exception has been made in the new law in the case of nippers and pliers, which will pay a duty of 8 cents per pound and 40 per cent ad valorem.

Incandescent lamps will continue to be admitted at 45 per cent ad valorem under the unenumerated manufactures, in which metal is the component of chief value.

Telegraph, telephone and other wires and cables composed of metal and rubber or of metal, rubber and other materials are expressly taxed in the new law at 45 per cent ad valorem. Under the Dingley act such wire was not named, but paid the 45 per cent rate under the unenumerated clause, while cable, rubber or gutta-percha covered paid 35 per cent.

Poles, telephone, telegraph, trolley or electric light, under the new law will pay a duty of 10 per cent ad valorem. Under the present law they paid a duty of 20 per cent ad valorem.

RAW MATERIALS.

Tungsten, tantalum and wolfram metal are especially named in section 184 of the new law and will pay a duty of 25 per cent ad valorem, when valued at $200 or less per ton, and 20 per cent ad valorem when valued at more than $200 per ton. Under the Dingley law these metals all came in under the unenumerated metals at 20 per cent ad valorem.

Aluminum under the new law will be admitted at 7 cents per pound in its crude shape and in plates, bars and rods at 12 cents per pound; under the present law the rate for the crude is 8 cents and for the plates, etc., 13 cents. Articles manufactured of aluminum, under both the new and the old law, pay 45 per cent ad valorem. The reduction of 1 cent per pound in the metal schedule will have no effect, so it is claimed, upon the price at which aluminum wire is sold.

Lead in bars and pigs pays a duty under the new law of 2⅛ cents per pound, the same as under the Dingley law, while lead in sheets pays 2⅜ cents per pound as compared with 2½ cents at the present time.

Red lead and litharge are taxed under the new law at 2⅝ cents per pound. This is not only a slight reduction, but unifies the rate on the two materials. Under the Dingley law red lead paid a duty of 2⅞ cents per pound and litharge 2¾ cents.

Zinc has had a slight reduction of duty. Under the new law in blocks or pigs the tax will be 1⅜ cents per pound as against 1½ cents under the present law, while zinc in sheets will be 1⅝ cts. per lb. compared with 2 cts. under the present law.

Copper ore, scrap copper, copper in plates, bars, ingots and pigs are admitted free. Brazier's copper, sheets, rods, pipes and copper bottoms pay 2½ cents per pound. These rates are unchanged from the present law.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission has closed the public hearings in the petitions of the Malden & Melrose Gas and the Fitchburg Gas & Electric Light companies for new security issues, and decisions are pending. The board has granted the Beverly Gas & Electric Company permission to extend its service into Topsfield. Other pending matters which have been heard are the petition of the Association of Massachusetts Gas Companies requesting the board to determine the amount of sulphur in gas which may be permitted and setting the quantity at 30 grains per 100 cu. ft.; the petition of certain consumers of the Charlestown Gas & Electric Company for a reduction in the price of gas; the petition of consumers of the Stoughton Gas & Electric Company for a reduction in the rates for electric service; and the petition of the Edison Electric Illuminating Company of Boston for authority to purchase the electric property and business of the Boston Consolidated Gas Company, the Newton & Watertown Gas Light Company, the Lexington Gas & Electric Company, the Waltham Gas Light Company and the Chelsea Gas Light Company. Another pending case is the petition of Joseph Leonard and others to have the meter charge of the Boston Edison Company reduced. As previously noted in our columns the Worcester Electric Light Company has appealed from the franchise granted by the Board of Aldermen to the Connecticut River Transmission Company, but no hearing date has been assigned.

At a hearing recently given in connection with the petition of the Edison Company of Brockton to purchase the Bridgewater Electric Company and to issue $160,000 in stock to pay for the property of the Stoughton Gas & Electric Light Company and also certain floating indebtedness incurred in the construction of new plant, the question of purchasing a plant independently of its franchise came up. Mr. A. Stuart Pratt, of the Stone & Webster organization, the controlling interest and managers of the above properties, stated that the stockholders of the Stoughton company, having sold their physical property, but not their current assets nor cash, intend to liquidate and go out of business. He said that the Stoughton's company's franchise would then cease to become operative, because a new franchise has been secured in the town by the Brockton company. It was supposd that there was no difference between the Edison company acquiring the property of the Stoughton company and the purchase of any kind of supplies from any electric supply company. The stockholders of the Brockton Edison Company had voted unanimously to go into the gas business, and the Stoughton Board of Selectmen had granted the company a franchise to that effect. It was explained to the Selectmen that the Stoughton company would cease to do business and that the Edison would supersede it. Commissioner Schaff asked if the petitioner felt that by changing its title it could go ahead and do a gas business without the consent of the board. Mr. Pratt replied in the affirmative, and General Schaff stated that it was the first instance he recalled of such a construction on the part of an electric light company. He felt that the legal situation ought to be made clearer. Counsel George for the petitioners called attention to the unsatisfactory condition of the earlier and later acts with regard to gas and electric light companies in Massachusetts, saying that the relations between the more modern and the earlier laws are considerably mixed. Every effort had been made to comply with the law. Commissioner Weed stated that in his opinion it was rather a grave question in the light of the recent statutes whether at the present time a gas company, as such, doing an electric-light business, as this Stoughton company, can sell all of its property to an electric-light company. "Such a method," he said, "if employed by men who were not friendly to the interests they were serving, might result in considerable embarrassment." General Schaff concurred in this, but emphasized his belief in the public benefits of the purchase of weak, struggling companies by strong ones. The whole situation is centered, from the engineering point of view, upon the establishment of the new turbine station of the Brockton Edison Company at East Bridgewater and supplying service from it to many neighboring communities, shutting down the inefficient local plants. The Brockton prices are put in force in all the territory, although the public does not realize the loss in the transmission lines. The net rates in Brockton were reduced to 15 cents maximum on July 1. Mr. Pratt stated that to counteract the loss of earnings a soliciting force is hard at work and is meeting much success in increasing business in both the lighting and motor fields. The company has moved to a fine office building in the center of the city and is exhibiting the latest appliances.

Boston Edison Lecture Course for 1909-10.

The Employees' Club of the Boston Edison Company has arranged, through its lecture committee, for a course of lectures this coming winter in continuation of the course carried through last winter. "Steam" and "Alternating Currents" will be the general subjects taken up, 8 lectures to be devoted to the first and 12 to the latter topic, making 20 in all. The lectures will be duplicated in the afternoon and evening of one day each week beginning on Nov. 4. The double lectures will make it possible for employees who work on different shifts to attend. Prof. Sydney W. Ashe, who gave the course last winter, has been engaged to conduct the coming one. He will take up to a considerable extent the points of advanced theory of operating methods.

The attendance for the course last season averaged 26 men at the afternoon lectures and 164 men for the evening lectures making a total attendance for the 20 double lectures of 3808. These courses are conducted under the management of the Employees' Club lecture committee, made up of Messrs. H. W. Moses, chairman; W. E. Cooke, Pierce Kent, D. P. Miner and F. D. Stiles. While the success of last winter's course and the prospective success of the coming lectures should be credited in a general way to the interest of the Boston Edison employees, between 80 and 90 per cent of whom are members of the club, much credit should be given the officers of the Boston Edison Company, who have taken an active interest in the welfare of the club at all times. Several plans for broadening the scope of the club's activity and for the increasing development of studious habits, as well as strengthening the social features, are under consideration.

Property of the Pacific Gas & Electric Company.

It is estimated that the physical valuation of the property of the Pacific Gas & Electric Company is $90,000,000. The electric properties comprise 154,000 developed electrical hp. Of this amount 94,000 hp is generated by water at 11 hydro-electric stations, and 60,000 hp is generated by steam and gas at six stations. The company also owns undeveloped water-power exceeding 100,000 hp, and 31 reservoirs with a storage capacity of approximately 25,000,000,000 gal. of water. The company has 1408 miles of high-tension transmission lines; 950 miles of distributing transmission lines and 167 miles of underground cable in central San Francisco. The company has 16 gas plants, from which the output of gas in 1908 was 5,600,000,000 cu. ft. served through 1400 miles of main and 132,000 meters, supplying the entire city of San Francisco and more than 20 other cities and towns. Also the company owns several domestic water systems, 500 miles of canal for irrigation purposes, and the street railway system of Sacramento. With one small exception, the franchises under which the company operates are either without limitation in point of time or extend from 10 to 15 years beyond the life of the bonds. Many miles of right-of-way of transmission lines are owned outright.

The company's operations extend into 24 counties of central California, with an estimated population of 1,250,000. This is over 60 per cent of the population of California. Over 100 cities and towns are served by the company practically without competition. It is said that the gross earnings of the company have increased since 1906 at the rate of over $1,800,000 annually.

Annual Report of Department of Electricity, Chicago.

Some interesting statistics are contained in the twelfth annual report of the Department of Electricity of the City of Chicago for the year 1908, which has just been made public. The report is submitted by Mr. William Carroll, city electrician, to the Mayor and City Council. It relates to street lighting, fire and police alarms, electrical inspection and electrical construction done by the city. The financial statement shows that the total amount expended by the department in 1908 was $1,922,527. Of this $349,780 was spent for gas lighting, $187,667 for gasoline lighting and $68,833 for electric street lighting supplied from outside sources (principally if not entirely for lamps rented from the Commonwealth Edison Company). The great bulk of expenditure was for the operation and extension of municipal electric lighting for streets. The revenue earned by the department during the year was $171,226, the largest item ($98,855) being fees for electrical inspections. On Dec. 31, 1908, the city was operating from its municipal stations 9500 arc lamps and renting 744 arc lamps from the Commonwealth Edison Company.

It will be interesting to quote Mr. Carroll's exact language in relation to the cost of operating municipal street arc lamps. On this point the report says: "The average cost of the operation and maintenance of the 8602 lamps owned and operated by the city [average number during the year] was $45.86 per lamp per year, including all cash which this department paid out by voucher or payroll during the year 1908 for labor and material of all kinds, superintendence and office charges, but not including interest, depreciation, lost taxes, water rates, rent of office used by the city electrician in the city hall, rental of poles belonging to other companies and used by the city for wires and lamps, nor a portion of the cost of other branches of the city government which do more or less work for the electric lighting service, such as the Department of Finance and the Law Department—which charges, it is claimed, should be included in the cost of the city lights." The average annual cost of rented lamps was $78.75 for the year 1908. The present price of the Commonwealth Company is $75 per lamp per year.

As to the actual cost of the municipally operated street arc lights for 1908, Mr. Carroll gives a table adding to the "actual cash cost" the charges for water, rentals, office rent, taxes, insurance, depreciation, interest and proportion of other department expenses, which should be included to arrive at the true cost. These additional charges he figures at $28.26 per lamp, the largest items being $13.42 for depreciation, $10.73 for interest (at 4 per cent) and $4.03 for taxes. Adding this $28.26 to the "actual cash cost" of $45.86, the total actual cost of operating municipal street lamps is given as $74.12 per lamp per year. Compared with the cost of $78.75 for rented lamps ($75 at present), it is seen that the difference is slight.

The total cost of Sanitary District electrical energy consumed for municipal street lighting during the year was $72,044. Mr. Carroll points out that the improvement in the art and the purchase of power from the Sanitary District has made the old equipment practically valueless. In fact, he says that if the city can raise the money it will pay to put in modern equipment and scrap all the old dynamos and lamps and sell the old engines, boilers, shafting, etc., for what the material will bring.

The most important feature of the work performed by the Department of Electricity during the year has been the completion of the installation of the electrical machinery and apparatus whereby current has been taken from the Sanitary District of Chicago (generated at the hydro-electric power plant on the drainage canal at Lockport, Ill.) and used in place of steam for the operation of the municipal electric lighting system. The change has resulted in a reduction in cost of both operation and installation. Five street-lighting plants were operated by drainage canal electricity during the year and two others have been added since then and are therefore not included in the report.

A considerable amount of street lighting by gas is still carried on; but during the year 1902 gas lamps were discontinued on account of the installation of electric lights and 525 new gas lamps were placed in service. Gasoline lamps to the number of 671 were discontinued on account of electric lighting extensions and 534 new gasoline lamps were installed in outlying districts. The total number of gas street lamps in service on Dec. 1, 1908, was 21,200 and of gasoline lamps 7,013.

The city electrician is held responsible for the operation and maintenance of the fire-alarm telegraph system. During the year 1908 10,811 alarms were transmitted. August had the largest total of any month, with 1217 alarms. The city electrician also manages the police telegraph and telephone system. There are 44 police stations having police-alarm systems and all of these stations are connected to one another with a system of telephone circuits centering in the central station. During the year 77,547 alarms sent over the police telephone service were answered.

An important feature of the work of the department is the inspection of all electrical wiring and electrical equipment within the city. The Bureau of Electrical Inspection reports some interesting facts. One is that a smaller number of motors were inspected than in the preceding year, but that there was an increase in the average horse-power of installations. A large falling off in inspections of arc lamps is reported, which decrease is believed to be due to the number of tungsten clusters used.

The following table shows the number of electric lighting stations and lamps in the city under the jurisdiction of the department:

CHICAGO ELECTRIC LIGHTING STATISTICS.

	Stations.	Arc lamps.	Incandescent lamps.
Commercial companies, central stations	24	18,973	2,322,097
Isolated plants	1,402	16,696	839,540
City plants, street lighting	5	8,602	.....
City plants, isolated, including water works	12	73	2,725
Totals	1,443	44,344	3,164,362

It will be something of a surprise to many to learn that there are 24 electric lighting concerns giving commercial service in Chicago. Of course, by far the most important of these is the Commonwealth Edison Company, the others being mostly what are known as "block lighting plants." One of these, the Gunther plant, is put down as supplying 10,000 incandescents, 300 arcs and 400 hp in motors.

Electric signs reach a total of 4753 and they are equipped with 286,484 incandescent lights.

The report on electric fires investigated by the Bureau of Electrical Inspection shows no appreciable fire loss from electricity. Nearly all of the electrical fires investigated resulted in nominal loss. The report concludes with a number of elaborate tables showing the electrical construction and maintenance work of the year. It makes a volume of 143 pages and is a creditable production.

CURRENT NEWS AND NOTES.

CHICAGO PASSENGER TRAFFIC.—For the year ended June 30 last the system of the Northwestern Elevated Company in Chicago carried 40,955,795 passengers. This is an increase of 3,536,509 over last year's record.

GUNNISON TUNNEL PROJECT.—The newspaper accounts of a hydro-electric development using the water from the Gunnison Tunnel, Colorado, are considerably in advance of any actual project. The best information obtainable states that the Government expects to sell power rights in the canal to the extent of about 1500 hp, but it would be probably much cheaper to erect a station in the canyon of the Gunnison below the tunnel where a large amount of power is available and where sites can be obtained by simply filing on the rights.

MOTOR MANUFACTURERS.—The next meeting of the American Association of Electric Motor Manufacturers will be held at St. Louis, Mo., Nov. 15-18, 1909.

THE PERMANENT MAGNET INVENTED.—A Chicago Sunday paper of recent date prints the rather remarkable statement that "Harriet Hosmer, famed as a sculptor, has invented the permanent magnet as a motive power. This is used in lifting large masses of metal."

CLUBHOUSES FOR TRACTION MEN.—The Interborough Rapid Transit Company has appropriated $50,000 to be used for the building of six clubhouses for its employees at various terminal points throughout Greater New York. It is expected that the houses will be ready for occupancy early in the fall. A subscription of $10,000 has been made by Mr. August Belmont for books, newspapers, etc.

SOCIETY OF AUTOMOBILE ENGINEERS.—The annual convention of the Society of Automobile Engineers will be held in Chicago at the Illinois Athletic Club on Aug. 5, 6 and 7. One of the sessions of the convention will be devoted to matters particularly relating to electric vehicles. Mr. F. J. Newman of the Woods Motor Vehicle Company of Chicago, made the local arrangements for the convention.

CIVIL-SERVICE EXAMINATION, U. S. INSPECTOR OF ELECTRIC LIGHT PLANTS.—The U. S. Civil-Service Commission announces an examination on Aug. 25-26 to fill a vacancy in the position of assistant inspector of electric light plants in the office of the Secretary of the Treasury at $1,800 per annum. A circular on the subject may be obtained by addressing the commission at Washington.

EXTENSION OF BALTIMORE CONDUITS.—The underground conduits for Baltimore are to be extended through a large part of the city and suburbs during the coming year. Mr. Chas. E. Phelps, subway engineer, has announced his intention of including $250,000 in his item of expense for conduit construction. This amount would equal approximately that of the work that was done during the past year. The superintendent of lamps and lighting, Mr. Robert J. McCuen, is most anxious to have the overhead wires placed underground, as it means a yearly revenue of $10 to the city for each arc lamp in use by the lighting company.

TAXES ON ELECTRICAL PROPERTY.—After a fight of a number of years the Consolidated Gas, Electric Light & Power Company has at last given the city of Baltimore a check for $399,475 in settlement of the city and State taxes on easements and structures. This amount covers the taxes which have been the subject of prolonged litigation since the year 1904, when for the first time the Appeal Tax Court entered assessments of this character against all of the public utility corporations. The main bone of contention rested in the valuation of the property which the court has assessed at $5,000,000.

LAW RELATING TO PUTTING TELEPHONE WIRES UNDER GROUND.—The village attorney of Salamanca, N. Y., has given it as his opinion that the municipal corporation cannot force telephone companies to put their wires under ground. He suggests, however, that relief may be obtained by residents of the village by the individual action of the property owners. By a recent decision (Osburn vs. Auburn Telephone Company) the law in New York State seems to be settled that individual owners have the right to prevent the erection of telephone poles upon their premises, notwithstanding any franchise right, unless they receive compensation.

ADVERTISING AN ELEVATED RAILROAD.—It is rather unusual for an elevated railroad company to advertise its service in the daily newspapers, and therefore it is of some interest to observe announcements of this character appearing in the daily papers of Chicago. The Chicago & Oak Park Elevated Railroad Company calls attention by means of display "ads" to the service it offers from the heart of Chicago to Austin, Oak Park and other suburbs. Newly painted stations and cars, a smooth roadbed, new 60-ft., 80-lb. rails and continuous rail joints are some of the attractive features of the road which are advertised.

DOMESTIC ELECTRICITY.—The Indianapolis Heat & Light Company has fitted up on the fourth floor of its office building a fully equipped and beautifully furnished five-room cottage in which is shown how a family can live by electricity. In the reception room there are electric lamps, electric fans, and an electric grate which heats the room. The parlor contains an electric piano which pounds out music when the button is touched. The dining-room contains any amount of electric apparatus, such as chafing dishes, coffee percolators, toasters and similar contrivances. The kitchen is equipped entirely with electrical apparatus for cooking, baking, washing machine, wringers, ice-cream freezer, irons and other devices. The sewing machine in the dining-room is run by electricity. The display is attracting much attention.

SPOT ELECTRICAL WELDING.—A patent relating to electric welding issued on July 20 to Mr. A. F. Rietzel covers the process of making welds electrically in spots for uniting sheets of metals in such a way that the result is similar to riveting. By means of raised portions on the sheets to be united the current and its heating effect are localized and a welding temperature is reached only at the spots desired. The application of mechanical pressure produces distinct spots of electically welded union of the plates separated by well-defined areas in which no union takes place. Advantage over continuous welding is claimed by reason of the saving in electrical energy and the elimination of burning of the metal. The patent, for which the application was filed on Feb. 24, 1905, has been assigned to the Thomson Electric Welding Company.

THE EDISON CONVENTION.—The program has just been issued for the thirtieth convention of the Association of Edison Illuminating Companies at Briarcliff Lodge, Briarcliff Manor-on-the-Hudson, Aug. 31 to Sept. 2. A number of valuable reports will be presented as usual, and a series of papers by well-known authors. The evening of Aug. 31 will be devoted to an address by Mr. Samuel Insull on combination lighting and railroad loads, with discussion. On the evening of Sept. 2 a dinner will be given to Mr. and Mrs. Edison by the association, and it is expected to have as guests also several of Mr. Edison's early associates in the lighting industry. The dinner committee is Messrs. Insull, Edgar and Lieb. This will mark commemoratively the thirtieth anniversary of the Edison incandescent lamp. Mr. W. W. Freeman, of Brooklyn, is president, and Mr D. L. Huntington, of Spokane, secretary.

BALTIMORE SECTION, N. E. L. A.—Since the formation of the Baltimore section of the National Electric Light Association, consisting mainly of employees of the Consolidated Gas, Electric Light & Power Company, much enthusiasm has been shown by the members, which number 115, in the work of the association. The last meeting was held on July 16, with a full attendance. Mr. J. S. Cruikshank addressed the meeting on the subject of "Meters," illustrating his remarks with a number of different kinds of meters, which made the topic extremely interesting. Various points of installation, construction, maintenance, etc., were touched upon in the course of his remarks. The next meeting will be held Friday evening, Aug. 20, at 8 p. m., at the Consolidated Company's offices in the Continental Trust Building and will be addressed by Mr. Dorsey Smith, who will present a paper on "Incandescent Lamps and Lighting." Mr. F. Bonsal has been elected president of the section and Mr. Laurence Jones secretary-treasurer.

Municipal Lighting Plant at Jacksonville, Fla.

By B. H. Clingerman.

FOR almost 15 years the city of Jacksonville has been generating its own electrical energy for street and commercial service. The total cost of the original plant and lines, together with additions and improvements up to Jan. 1, 1908, was $523,567. There is at present no bonded indebtedness directly chargeable to the electric department of the city, the net earnings having been more than sufficient to cover the above amount.



FIG. 1.—JACKSONVILLE ELECTRIC LIGHT AND WATER-WORKS.

The power plant (Fig. 1) is located about a half mile from the center of the city in the residence district. The ground immediately around the power plant and water-works has been converted into a very attractive park and presents a very pleasing appearance. The plant has a rating of 4000 kw in generators as follows: One 1500-kw and two 500-kw Allis-Chalmers steam turbines, one of which is shown during the course of erection in Fig. 2; one 500-kw Curtis turbine (Fig. 4); two 200-kw and one 100-kw DeLaval steam turbines (steam pressure, 200 lb.). There are also one 750-hp Filer & Stowell cross-compound Corliss engine belted to a shaft driving one 250-kw, three-phase generator with belted exciter, one 150-kw, 550-volt generator and three 150-lamp Brush arc machines.

Surface condensers are installed on and beneath the floor of the generator-room and an average vacuum of 27.75 in. is maintained. Centrifugal pumps are used for the circulating water.

The Allis-Chalmers, the Curtis and one of the 200-kw DeLaval units are three-phase, 60-cycle, 2300-volt machines; one 200-kw DeLaval unit is wound for 550 volts, and the 100-kw DeLaval unit is wound for 1150 volts, but the two generators are connected in series and operated at 2300 volts. The Brush arc machines will be shortly removed and the open arc lamps connected to these machines will be replaced with magnetite lamps, supplied with electricity from constant-current transformers and mercury-arc rectifiers. There is also a synchronous motor-generator set, the generator being rated at 275 kw, 550 volts, and the synchronous motor at 300 kw, 2300 volts, three-phase. This set is brought up to speed by an auto-starter.

There are three exciter compound-wound units; one 50-kw, 120-volt Bullock generator, direct-connected to a Ball engine; one 25-kw Curtis turbine unit (operating non-condensing), and one 50-kw Allis-Chalmers induction motor-generator set. Two constant-current transformers are used with the mercury-arc rectifiers and are wound for 2200 volts primary and 4 amp, 4500 volts secondary. Three 42-kw and two 21-kw constant-current transformers are used for 4-amp alternating-current arc lamps.

The boiler capacity of the plant is 3200 hp, made up of two 500-hp Stirling, one 350-hp Aultman & Taylor, two 350-hp, three 250-hp and two 200-hp Babcock & Wilcox boilers. The piping is so arranged that the DeLaval turbines can be operated at 200-lb. steam pressure from one of the 350-hp B. & W. boilers. The plant is normally operated at 150-lb. steam pressure with 70 deg. superheat. Two 750-hp Cochrane feed-water heaters are in use. Three feed-water pumps (Worthington upright duplex, Knowles duplex and Union Steam Company's simple pumps) are connected between the heaters and boilers, but can be used to pump directly from the hot-well. Circulating water is secured from a creek near the plant. Condensation is returned to the boilers from the hot-well.

Changes have about been completed for burning crude oil under the boilers. The bridge wall in each boiler had to be moved back about 2 ft. and the burners were placed on the front face of the bridge wall. The flame is directed forward against a brick wall erected just behind the fire doors. The oil and steam are mixed at pressures of 60 lb. and 40 lb., respectively. A Custodis radial brick stack, 125 ft. high and 10 ft. internal diameter, has been erected to replace two of the stacks shown in Fig. 1.

Cypress poles are used almost entirely on the overhead lines because of their low cost and durability. Although they are porous, the company's linemen make the usual connections on the poles with normal voltage maintained on the wires excepting during a heavy rainstorm. In some cases where the insulation on the wires is subject to abrasion on account of the trees, a rubber-covered wire, protected on the outside by a heavy net-like copper sheath, has been erected.

The system of distribution for lighting is single-phase, the three phases being balanced at the switchboard. The motor circuits are three-phase alternating current and direct current at 550 volts. All new motor load is taken care of by the installation of alternating-current motors. The total rating of motors connected to the lines is 800 hp. The total rating of transformers is 3674 kw. There are in service at the present time 200 magnetite lamps, 325 alternating-current 4-amp arcs and 150 direct-current open-arc lamps. The magnetite lamps have replaced direct-current open-arc lamps for street lighting and the remaining 150 direct-current lamps used for commercial lighting will be removed shortly.

It is interesting to note in this connection that the company has had rectified tubes giving as high as 2700-hours' service, while some tubes broke down shortly after they were installed. The average life, however, is good. In several cases the tubes filled with oil owing to the unequal expansion between the metal and the glass in the terminals while hot, but upon cooling the oil became sealed in the tube. Some trouble was caused by the mercury becoming mirrored upon the glass early in the life of the tube, causing a short-circuit and rendering the tube useless.

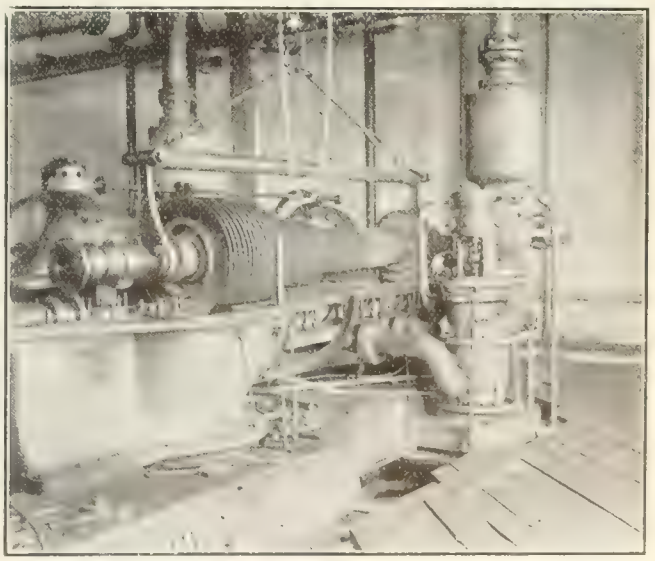


FIG. 2.—HORIZONTAL TURBINE IN COURSE OF ERECTION.

Approximately 166 50-cp series carbon lamps will be replaced

with 75-watt tungsten lamps. Ninety-nine two-lamp ornamental iron posts were recently erected for lighting one of the thoroughfares of the city. The installation was provided by the property owners and the electrical energy furnished by the city. The lamps are 60-watt multiple tungstens. The total

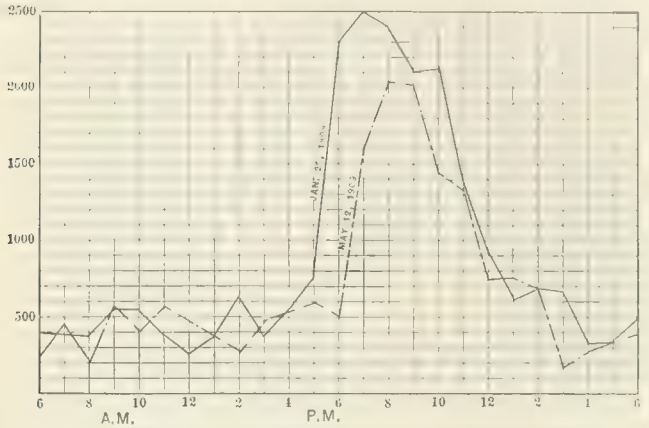


FIG. 3 TYPICAL WINTER AND SUMMER LOAD CURVES.

load for 24 hours in the winter and summer is shown in Fig. 4

The original use of wood was discontinued for a mixture of No. 3 anthracite with 30 per cent bituminous coal. This gave an excessive amount of ash and it was found that No. 2 anthracite and 18 per cent bituminous coal gave better results. For some time West Virginia run-of-mine has been used with a resulting consumption of 4.5 lb. of coal per kw-hour generated. The boilers are being equipped for burning crude oil

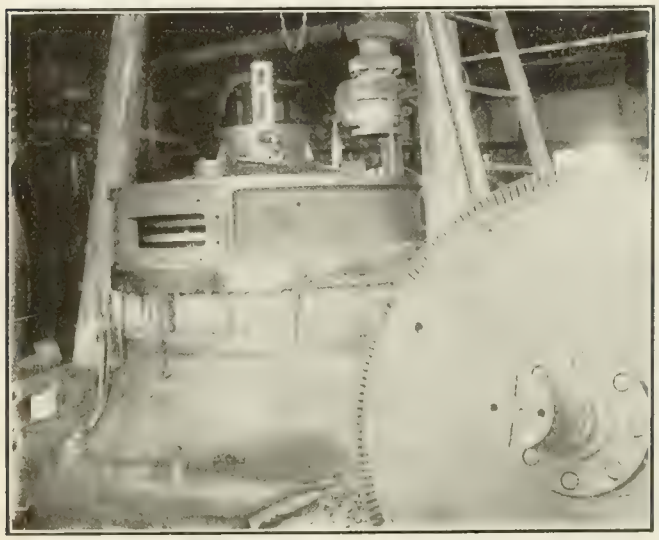


FIG. 4.—VERTICAL TURBINE BEFORE COMPLETION.

(Fig. 5), which gives a better economy than West Virginia run-of-mine at $4.10 per ton, hand-fired.

The following statistics are submitted in advance of the report for 1908:

Gross earnings (including revenue from city for street lighting)	$298,039.90
Operating expenses not including taxes	$179,739.61
Net earnings	$118,300.29
Ratio operating expenses to gross earnings	60 per cent
Gross earnings per capita	$4.60
For additions and extensions	$80,615.80
Turned over to city treasurer	$20,000.00
Total kw-hours generated	6,074,779
Cost of fuel per kw-hour	1.3 cts.
Cost fuel and labor at power plant per kw-hour	1.7 cts.
Operating expenses per kw-hour	3.0 cts.
Gross earnings per kw-hour	4.7 cts.
Load factor for the year	30 per cent
Number of meters in service	4,680

RATES.

Arc lamps, all night	$90
Commercial lighting, per kw-hour	7 cts.
Minimum charge per month	$2
Motor circuits sliding scale per kw-hour	7 to 3 cts.
Minimum charge for elevator motors per month per rated hp	$1

The board of bond trustees exercise a general supervision over the electric department, but the actual management rests with the superintendent, Mr. R. N. Ellis. The length of time during which the officials and heads of departments have been connected with the operation of the plant, seems to substantiate the statements of the employees to the effect that politics does not enter in the management of the property.

Central-Station Development at Lawrenceville, Ill.

The plant of the Lawrenceville Light & Water Company, at Lawrenceville, Ill., furnishes an example of unusually rapid growth due to certain local conditions, and also illustrates the effect of good service and proper engineering in converting a losing central-station property into a paying one.

HISTORY.

The plant of the Lawrenceville Light & Water Company was built in 1898, a 30-year franchise having been granted in 1897. It is a combined electric light and water-works plant. As the population at Lawrenceville according to the 1900 census was only 1300, it will be seen that the changes of profit for such an undertaking were not very great.

The electric part of the plant was built for a direct-current, 220-volt system. There were two 250-volt compound-wound generators direct-connected to high-speed engines, one generator being 30 kw and the other 20 kw. Water for the water-works system and boilers was supplied from two steam deep-well pumps, one drawing from a 200-ft. well inside of the power plant and another from a 250-ft. well outside the power plant, but on the same piece of land. These pumped to a surface

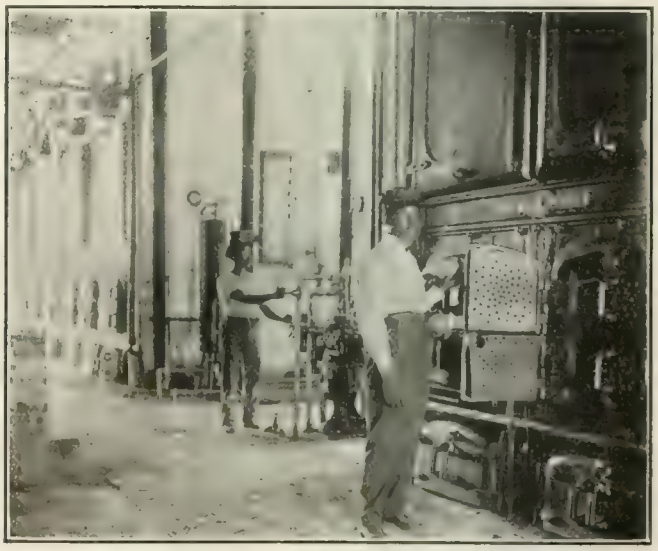


FIG. 5.—BOILERS EQUIPPED FOR BURNING OIL.

reservoir, 50 ft. in diameter by 14 ft. deep, having a capacity of about 74,000 gal. From this surface reservoir the water was forced into the mains and for storage two 1875-cu ft. air-pressure tanks were installed, these tanks being connected to the mains and kept half full of air under pressure to make it possible to discontinue pumping for short periods. A duplex steam fire pump pumped from the reservoir into the mains and pressure tanks. The boiler plant consisted of two 45-hp Erie boilers. Later a motor-driven deep-well pump was placed in a well at some distance from the power plant for the purpose of pumping directly from a deep well into the mains.

The net result of operation for the first 10 years was a considerable loss to the owners. This was caused no doubt during the first part of the period by the fact that the population was insufficient. During the latter part of the period the population was rapidly increasing, but the previous losses on the plant had resulted in its being allowed to run down to a point where reliable service was impossible.

In February, 1908, the control and management of the prop-

erty changed. The new management found a town which was rapidly increasing in population on account of the oil fields which were being opened up in Lawrence County. The oil deposits in Lawrence County are the deepest and richest of any in the State. Natural gas had also been discovered and piped into the new town. Competition with natural gas, retailed at 30 cents per 1000 cu. ft., doubtless had much to do with discouraging the previous owners as to improving the electric light



FIG. 1.—POWER HOUSE AND LAND, LAWRENCEVILLE.

service, and also prevented a number of electric light men who investigated it from taking up the proposition. The new management, however, knew from experience elsewhere that cheap natural gas does not by any means prevent an electric light and power company from prospering if the management is progressive and enterprising. The experience of 18 months has fully demonstrated the correctness of this theory, as gas lighting is very little used, and the only difficulty the company has experienced is in keeping up with the rapidly increasing demand for electric light.

The condition of the plant called for immediate and radical improvements in order to give reliable service and take care of such increase in business as would bring the gross earnings up to a point where the venture would be profitable. The 220-volt direct-connected engines and generators were in such a dilapidated condition that breakdowns were of weekly, and sometimes nightly, accurrence. The copper in the 220-volt, direct-current distributing system was insufficient and a voltage loss of 25

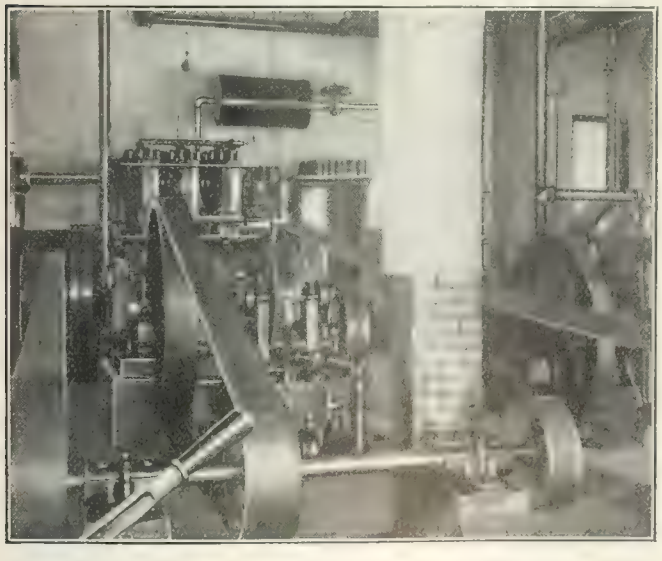


FIG. 2.—GAS ENGINES, PUMPS AND COMPRESSORS

per cent between the power plant and the ends of residence lines existed during peak load.

Electric service was being given only from dusk until midnight—another point which made electric light unpopular. At the same time it was necessary to keep an operating engineer at the plant 24 hours a day on account of the water-works service. One deep-well pump with steam cylinder directly on the pump rod was kept in operation 24 hours a day. The monthly coal consumption was from 90 to 100 tons of coal, costing $2.25 per ton, delivered, resulting in a fuel bill which was absurd, considering the meager service obtained from the coal burned. A test in February, 1908, revealed the fact that out of the 24,000 gal. a day pumped to the water-works reservoir approximately one-third was used in the boilers of the plant itself. At that time one of the two 45-hp Erie boilers had been replaced by a 100-hp horizontal return-flue boiler, and this large boiler was the one ordinarily operated.

RECONSTRUCTION.

It was decided to change the electric lighting system from 220 volts direct current to alternating-current, single-phase, 60-cycle, with 2200-volt primary distribution, feeding into three-wire, 218-volt and 109-volt secondaries. It seemed a very opportune time to make the change, inasmuch as comparatively few meters had been installed and the direct-current generating apparatus was nearly worn out. With the alternating-current system it would be an easy matter to extend the lines to new portions of the town, which before had no service. The management also had in view the building of a single-phase, 10-mile, 10,000-volt transmission line to supply electricity to Bridgeport and Sumner, in the same county. Single-phase distribution was selected because the distribution system is simpler and less expensive than polyphase, which more than counterbalances the extra cost of the single-phase motors.

As to prime movers, in view of the existence of cheap natural gas of excellent quality, it seemed best to install a gas engine to give 24-hour electric service, and to pump most of the water. At the same time it did not seem wise to throw out the existing boiler and steam-pump equipment, which afforded a cheap reserve for peak and other loads. The first change made was to enlarge the building so as to permit the use of belt-driven alternators with 25 ft. to 30 ft. belt centers. For the first unit a gas engine of 85 hp was selected as being the size best fitted to the probable load for 24-hour operation of electric service and water pumping. A three-cylinder Nash engine of this size, running 243 r.p.m., was purchased and belted with a 14-in. belt to a 50-kw, single-phase, 2200-volt Westinghouse alternator running at 900 r.p.m. From the other end of the engine was run an 8-in. belt to a line shaft with a tight and loose pulley on the shaft to permit the shaft to be stopped while the engine is in operation. From this line shaft is belted a triplex pump rated at 76 gal. per minute at 50 r.p.m. This pump is equipped with pulleys of such size that it usually gives the necessary capacity to



FIG. 3.—BELT DRIVEN ALTERNATORS

supply the regular daily needs of the water-works by being operated continuously except during the peak of the electric load. There is also belted to the line shaft a Laidlaw-Dunn-Gordon air compressor, rated for a capacity of 137 cu. ft. of free air per minute at 150 r.p.m. against a working pressure of 100 lb. per square inch. This air compressor was installed for air lift, deep-well pumping, so as to abandon the pumping of

deep wells by means of troublesome deep-well pumps, which were giving frequent trouble on account of the pulling apart of rods or leakage of pump pistons. These rods and pump pistons being located deep in the wells, repairs were expensive and troublesome. Although motor-driven deep-well pumps would probably have been more economical than air-lift pumping, it was considered that with cheap power obtained from a gas engine (which gas engine would be operating in any event to give electric service) it would be almost as economical and more reliable to use air-lift pumping and avoid all moving apparatus in the deep wells. The experience of the year has fully borne out these conclusions.

The 85-hp gas engine is only shut down for regular inspection and cleaning of igniter points once a week. This engine, although of high cost per kilowatt, operates at a very much lower fuel cost than would a steam pump. At the same time, the investment is kept down by utilizing as much as possible of the existing steam plant. The 100-hp boiler and one of the 45-hp boilers were kept in service and piped to use natural gas. The other 45-hp boiler is used as an air-storage reservoir for the deep-well, air lift and for starting of the gas engine. A second-hand steam air compressor was purchased, which furnishes a reserve for air compression. The steam-pressure pump for pumping from the reservoir into the mains and for maintaining extra pressure during fires was unchanged except for a general overhauling.

For an electric reserve and for carrying peak loads a 75-kw, single-phase Fort Wayne alternator belted to a Harrisburg high-speed, four-valve engine was installed. This gives a much lower investment for reserve capacity than if an extra gas-engine unit had been installed.

Two alternators are now regularly operated in parallel during peak load with no difficulty whatever. The compensating winding with which they are equipped, however, is cut out when they are operated in parallel.

It is the intention to use gas engines for future enlargements of the power plant. There is, of course, the possibility that the natural-gas supply will give out in the course of time, but should this occur gas producers can be installed, as space will be left for them adjoining the engine. The power plant is now so arranged that it can be enlarged unit by unit by simply adding a new section to the building without disturbing the machinery already in place. The power plant is shown in Figs. 1, 2 and 3. It is of brick and concrete, with brick and concrete floors and slate roof.

In changing the distribution system the first step was to run the primary mains and connect the primaries of transformers. On account of the large amount of copper in the 220-volt distributing system, it was decided best to install but a few large transformers with their secondaries feeding into the previous 220-volt system. After this change was made a neutral secondary wire was installed and connected to the neutral of the transformer secondaries. Consumers were changed one at a time from 218-volt to 109-volt service, and those desiring to use tungsten lamps, electric flatirons or electric fans were changed first. Most of the 220-volt commutator-type Thomson meters were sold to other companies operating 220-volt, direct-current circuits. All new consumers and all those changed to 109-volt service are supplied through Westinghouse induction watt-hour meters with glass cases. The theory of the management is that glass-case meters are more likely to receive careful treatment at the hands of employees and less likely to present a dilapidated appearance after several years of use.

Along with the change of the secondary distributing system from two-wire to three-wire, considerable copper was taken down between the power plant and the center of the town, a distance of 1200 ft. Some of this copper was installed in other places. The secondary distribution system is divided into sections, each transformer feeding a section. Between sections fuses are inserted, these fuses consisting simply of bare copper wire wrapped around the ends of the adjacent sections, which are dead-ended at the fuse. The idea of these fuses is, of course, to enable one transformer to assist in carrying the load of another in case of a temporary heavy load at one point. If the load on one transformer causes its primary fuses to blow, the secondary section fuses connected to its section will also blow and isolate the trouble without allowing it to spread to other sections. Otherwise the blowing of one transformer fuse would necessitate a complete shut-down of the whole system until all primary fuses could be replaced. The total kw equipment in transformers June 1, 1909, was 73.5, ranging from 20 kw to 3 kw.

The neutral wire is made continuous over the entire system, and the section fuses are inserted only in the outer mains. The neutral is grounded at a number of points to the company's water-pipe system as a precaution against dangerous voltages getting on the secondary circuits.

On a number of streets joint pole construction with the telephone company is used. (Fig. 4.) Under the joint-pole contract the telephone company builds a pole line and the electric light company pays 10 cents per year per wire contact per pole, the maximum being eight contacts per pole, not including branches, and the maximum price is 40 cents per pole. The electric light wires are placed on the top cross-arm so that the breakage of telephone wires in sleet storms will not produce a dangerous condition.

GROWTH.

On Feb. 1, 1908, the company had 86 electric consumers and 100 water consumers; June 16, 1909, it had 251 electric consumers and 333 water consumers. This unusual growth can be ascribed to a number of causes. The plant before reconstruction was too small to carry any more load, and the service was so poor that although many people wanted electricity they were discouraged about putting it in. As soon as the public began to appreciate that the change in management and apparatus meant reliable service, those who had been holding off took electric service. The town in the meantime had been growing rapidly as the result of activity in the oil fields. The population on May 1, 1909, as estimated by school attendance, by post office and by bank transactions as compared to the year 1900 was at least 3500, or about 2.7 times the population in 1900, and to judge from building activity in the town the rate of increase is now more rapid than ever.

Besides good service and growth of population, the existence of a live contractor in the town doubtless had an influence on the growth of the business. The company and this contractor, Mr. A. R. Lewellen, co-operate in every way possible. The company did not enter the contracting field until the winter of 1909, about a year after the present management took hold. The policy is to encourage independent contractors, but to be prepared to give consumers good service in the way of electric wiring and supplies when so requested.

The fan business has been one of the most remarkable features in the growth of this system. The company began to give day service in July, 1908. Before the service was begun, and in expectation of it, 43 fans had been sold. One year later June 15, 1909, there were about 85 fans out. The electric flatiron business during the summer season of 1908 was somewhat interfered with by the fact that part of the residence consumers had not been changed to 109-volt service. However, 20 electric irons were put out the first season, only one of which was returned and that because the consumer was about to move away. Forty electric irons were put out on trial the beginning of the warm weather in 1909, making 60 in use in all. It is expected that but few will be returned, in view of the small percentage on the first lot, and that 100 will be in use by September.

In the lighting of stores three gasoline plants formerly in use have been displaced by tungsten lamps, and the company is doing nearly all the lighting of the business part of the town. Mantle maintenance with natural gas prevented its extensive introduction and in warm weather the heat from gas is further detrimental.

The company's most active efforts for getting new business have been to secure non-peak and day load, as the peak lighting load has come easily. The company's own water pumping gives its plant a good load factor, probably in the neghborhood of 40

per cent. There is not a large amount of steady power business to be obtained in the town. A 7.5-hp electric motor has displaced a 10-hp gasoline engine in a planing mill, and the total connected motor load is only about 15 hp, but small motors for various uses are being gradually connected, and in cases where it seems best will be put in on trial. Only single-phase motors with commutator-type starting devices are allowed over ½ hp to keep down disturbance due to starting current.

RATES.

The rates, which were put into effect June 1, 1908, were considerably below the rates permitted by the company's franchise, which allows a rate of 20 cents per kw-hour. Before the present management took hold the rates had already been reduced to 10 cents per kw-hour. On account of the natural gas competition and also because of the unfavorable sentiment aroused by raising the rates, 10 cents per kw-hour with a minimum bill of $1 per month was allowed to stand as an optional rate on all classes of lighting business. This is termed the company's "single rate."

The consumer is given the option between this and a "multiple rate," which, for lighting, is as follows: 15 cents per kw-hour for electrical energy used equivalent to one hour's use per day, or 30 hours' use per month, of a consumer's maximum demand, the maximum demand being estimated by the rules given later. For electrical energy used in excess of this one hour's use per day and less than two hours' use, the rate is 6 cents per kw-hour. For electrical energy used in excess of two hours' use, the rate is 5 cents per kw-hour. The minimum bill is $1 per month on this rate also.

The rules for estimating the maximum lighting demand are as follows: For stores, offices, depots, etc., where all lamps are lighted during the company's peak-load period (that is, from 5 to 6 p. m. in winter), the maximum demand shall be counted as the full connected number of lamps. For residences the maximum demand is counted as 40 watts for each room in the house, irrespective of the connected load, exclusive of bathrooms, basements, porches, stairways, attics, storerooms, small halls, entrances, woodsheds and barns. In effect, this means that the number of rooms counted is multiplied by 1200 watts to give the monthly amount charged at the rate of 15 cents, the next equal amount being charged at 6 cents and the remainder at 5 cents. The maximum demand for churches, public halls and theaters, not usually on during heavy load hours, is taken as one-half the connected load. Hotels and boarding houses are also figured as having a demand of one-half the connected load.

For power the company's single rate is 8 cents per kw-hour with a minimum bill of $1 per horse-power per month. The multiple-rate system for energy for motors is 13 cents per kw-hour for that used equivalent to one hour's use per day of the consumer's maximum demand; 5 cents per kw-hour for energy used in excess of that, and up to the equivalent of two hours' use per day of the maximum demand. The remainder is billed at 4 cents per kw-hour. Fifty per cent discount is given on those portions of these multiple-rate power bills in excess of $50 per month. There is a minimum bill of $1 per horse-power of motor rating per month. The maximum-power demand on this rate is assumed to be 1 kw per horse-power rating of motor, except where a motor is much underloaded and the consumer desires a test. In such a case the company will make a test for such period as seems best to determine the real maximum demand.

The company has a non-peak rate to consumers who agree not to operate motors between 4:30 and 8 p. m. during November, December, January and February. These consumers are given the multiple rate, with the 13-cent portion reduced to 7 cents. The rates apply to motors of over ½ hp. Smaller motors are put on lighting rates.

As regards store lighting, the rates present nothing novel. In residence lighting, however, the method of reckoning is unusual and believed by the management to be the best adapted to residence lighting conditions in small towns of any system yet devised. The principle of charging a high rate for the first portion of a consumer's use of electricity in order to cover the fixed charge on the investment needed to serve a consumer is now generally recognized and has been put in practice by most of the larger and many of the smaller companies. In applying this principle to residences it has been customary to base the amount of the primary or higher charge on the actual connected load in lamps. This company believes that there are some serious drawbacks to this plan, because every socket which a consumer has in his residence, no matter how infrequently used or how little influence it has on the actual maximum demand, is counted against the consumer in the shape of higher rate. It is believed that estimating maximum demand according to the principal occupied rooms of a house comes fully as near to distributing charges equitably among the different consumers as a plan based on the number connected. Under the plan of counting according to the rooms, the consumer can put in as many lamps as he wishes in various convenient places without affecting his rate, and this has the effect of increasing the monthly kw-hour consumption per consumer. One of the advantages of the multiple rate is that it gives the users of flatirons, fans and heating appliances a low rate on these devices without the installation of a special meter. Flatirons and other appliances which are seldom turned on during peak load are not counted in making



FIG. 4.—JOINT POLE CONSTRUCTION, LAWRENCEVILLE, ILL.

up the consumer's maximum demand, so that the energy used by these devices is billed at the low rates of 6 and 5 cents.

The company recommends to the consumer whichever rates it considers will be the most economical for the customer. At the time the change to the new rate was made, since it was impossible to explain to every customer the two systems, all consumers were billed the first month at the straight 10-cent rate and were gradually changed to the multiple rate, as it appeared to the manager that it would be desirable for them to do so, or as requests were made. On Feb. 1, 1909, about three-fifths of the residence and three-fifths of the commercial consumers were on the multiple rate.

Another advantage of the multiple rate is that it tends to equalize the consumers' bills from month to month. In other words, the consumer pays a higher average rate per kw-hour in summer than in winter, which has a tendency to reduce complaints about high bills which come during the fall and winter months.

STREET LIGHTING.

The town was formerly lighted with 32-cp, 220-volt incandescent lamps. As additional street lighting was wanted about the time the present management took hold, it was recommended to the city that series tungsten lamps be used as being best suited to the lighting of a town of this kind where an arc lamp on every corner is out of the question. As local sentiment seemed to be so strongly in favor of arc lamps at that time, the company finally accepted an order for 15 6.6-amp, enclosed, alternating-current series arcs at $65 per year, all-night, every-night schedule. For additions to the street-lighting system which are to be made in the immediate future, it has been decided to use 55 100-watt, 80-cp series tungsten lamps. With the infrequent spacing which is necessary in a town of

this kind, the series tungsten can be made to give far better results, as was shown by a practical demonstration made by the company on one of the streets where one of these 100-watt lamps was placed on every corner for a distance of three blocks, the blocks being 300 ft. in length. The illumination thus secured was far better than the average in towns of this size.

FINANCES.

The liabilities of the company May 1, 1909, were as follows:

Capital stock (common)	$32,000.00
Six per cent. first mortgage bonds	1,000,000
Floating debt, notes issued account construction	30,340
	$1,062,340

The capital is being increased to take care of the rapid growth of both public and private service which is demanded. To illustrate the immediate results of the reconstruction two equal periods of seven months before and after Sept. 1, 1908, show operating figures as follows:

Seven months, Feb. 1, 1908, to Sept. 1, 1908:	
Collected earnings from operation	$2,862.65
Operating expenses and bond interest	3,504.98
Deficit for period	$642.33
Seven months, Sept. 1, 1908, to April 1, 1909:	
Collected earnings from operation and supplies	$6,836.56
Operating expenses, bond interest and supplies	4,124.06
Net earnings for period	$2,712.50

No depreciation is included in these figures. The fuel bill after reconstruction was considerably less than it was under the old arrangement with half the volume of business.

The property is managed jointly by Mr. J. R. Cravath, of Chicago, president, and Mr. Cale R. Gough, secretary and manager, who has had immediate supervision of construction and operation.

The Selection of Towers for High-Tension Transmission Lines.

By N. J. Neall.

In an article which appeared in the first issue of the *Electrical World* in July, 1909, an outline was given of the conditions encountered by towers in high-tension transmission lines. A study of these conditions permits one to assign the general dimensions to towers and to select the proper towers for specific installations.

Assuming that the telephone wires are to be carried on the same tower as the transmission wires and remembering that under the various weather conditions assumed, the respective deflections of the copper cable and the telephone conductors will not be identical, no less than 9 ft. at the tower between the telephone conductors and the nearest line wire is possible if a minimum clearance of 3 ft. is to be preserved between these groups of conductors at any point of the span for the worst condition—that is, maximum temperature with maximum wind. Assume further that the telephone conductors are strung in parallel on 2-ft. centers and are transposed at every tower. This arrangement will require a tower approximately 49 ft. from the ground to the lowest main conductors.

The main conductors are to be arranged in the form of an equilateral triangle with the apex upward 7 ft. on a side. Above these are to be suspended, in the same horizontal plane, two overhead grounded wires so arranged as to extend at least 2 ft. above the plane of the top wire and approximately 1 ft. outside the plane of the two lower line conductors. The overall height, exclusive of any lightning rods that might be employed, would be approximately 57 ft.

Two classes of towers are to be selected: a dead-end form and one of considerably lesser strength. In the former, provision will be made to hold the respective conductors so that they cannot slip, while in the latter only so much friction will be required of the tie wire at insulators as to keep the main wire in place. It will be expected that with any failure in the main transmission wire which causes it to rupture, successive spans will automatically lengthen out sufficiently to take up the new strain. If the wire should touch the ground, the added friction will be very helpful; however, the chances for fusing away the conductor on testing the short-circuit may require great care in operation.

The respective maximum dead-end loads thus imposed on a tower by a standard span are as follows:

Two 2050-lb. telephone wires	4,100 lb.
Three 3000-lb. main conductors	9,000 lb.
Two 2610-lb. overhead grounded wires	5,220 lb.
Total	18,320 lb.

In the ordinary construction to-day no such loads as those just listed could be taken care of, however strong might be the tower, unless the insulators and their supports are adjusted accordingly.

The effective working strength of an "extra heavy" steel-pipe insulator pin suitable for a 14-in. x 14-in. insulator for 60,000 volts may be taken as 1500 lb.; while tests on insulators with solid-steel pins give a shearing or crushing strength of the insulator at approximately three times this value, yet the moment a metal pin begins to bend the insulator is destroyed. It will thus become apparent that for dead-end tower work or for support resistance against any unbalanced span, there must be as many pins in tandem as the respective conditions of span strain and individual-pin strength may require. It will be obvious that the mere accommodation of these extra pins, with the accompanying insulator clearances, calls for extra spacings and additional material and thus considerably increases the cost of the tower. Fortunately, once a line is erected, the pins in general have only the wind loads and dead weights to take care of, for the adjacent spans being nearly identical the strains balance each other at the point of support. Where adjacent spans are of unequal length or where two adjacent spans are at an angle with one another, the unbalanced forces require the same consideration as in dead-end spans. The insulator pin is thus the weakest point in the tower elements requiring assemblage, and must be so recognized to secure a satisfactory tower.

The usual form of tie used in transmission work consists of a comparatively small wire of the same material as the main conductor. In the present case it will be soft copper. The very best workmanship can probably not create a friction hold between the insulator, cable and tie wire that will prevent the cable slipping at, say, a maximum of 1000 lb., and the average will doubtless be much below this value. For this reason, where dead-end holds are required, use must be made of some other form of tie, such as plates or clamps tightened together with bolts and nuts, etc.

The kind of tests to be required on the respective towers can now be differentiated.

Dead-End Tower.—This tower must withstand, without failure of any sort, simultaneously and correctly imposed by each of the conductors as to angular position, etc., the maximum strains to which they may subject it. At the same time the tower itself must withstand such wind strains on the structure as are contemplated in the attending circumstances and have a factor of safety of at least 1.5; that is, each of the strains could be increased 50 per cent without failure of the tower.

In practical work this requirement would necessitate a comparatively heavy tower, so that in the major part of the line layout the following change could probably be made satisfactorily without any serious decrease in effectiveness. The overhead grounded wires have a much greater ultimate strength and have likewise a much higher elastic limit than have either the main conductors or the telephone wires. For this reason they may be provided with such firm fastenings to the towers as to furnish what is in effect an overhead anchorage. This fact immediately enables the other conductors to be assembled with less rigidity, certainly with a lighter tower to perform the same service.

Supporting Towers.—This tower differs from the modification last mentioned only in the degree of tie strength, and it may in general be considered as a single-insulator-group-tie-wire form. If the overhead grounded wire were not used, the difference between the two on this account would be much greater.

Having thus considered the fundamental features involved in a case for straight runaway requirements, specifications may be

arranged for estimates by tower builders. The following points should be noted therein:

Details as to proposed span; size of wire; proposed arrangement of conductors; insulation clearance requirements; number of towers per mile; general nature and topography of country through which line is to run; character of soil; facilities for shipment and distribution; and accessibility of materials for concrete.

Type of Tower.—Single-circuit or multi-circuit type; width of prospective right-of-way and permissible maximum dimension for tower base; general shape of tower desired.

Type of Anchorage Proposed.

Conductor Strains.—These consist of (1) those estimated for dead-end work; (2) those estimated for support only; (3) the maximum wind pressure assumed, and (4) the two extremes of service to be met, namely, sleet with moderate wind, cable only with maximum wind, the wind being in a direction perpendicular to the line.

Materials.—Care should be exercised here to obtain the best quality of material, because of the light sections generally used and the sudden shocks which the structure must withstand. This means that there should be not only acceptance tests on tensile strength, etc., but also chemical analyses. The amount of rust should be carefully noted, and if rust started considerably before the machining begins, the material should be discarded. There will probably be more attention paid in the future to the now recognized inherent tendency of certain types of steel to rust easily, and this attention, with proper cleansing before either galvanizing or painting, will have much to do with the increased life of the tower material.

Defects in rolling, etc., are easily recognized and a good inspector will not pass them.

All pin material should be given a bending test, on selected samples, particularly if use is made of pipe formed into pins by the hot process. All parts should be interchangeable. In the event of galvanized finish all machining must be performed first. If painted, the number of coats to be furnished at the factory should be specified.

Weight.—This is a figure dependent very largely upon the individual designer, but a limit can soon be ascertained. This value is, of course, considerably affected by the customer's requirement. In general, competition, if it does anything, will tend to keep the weights within reasonable bounds. The adequacy of any design can be fully covered by proper test specifications.

Factor of Safety.—This is a troublesome detail and likely to be hazy. In general it might be considered in a two-fold way. In the first case, under severest working conditions, with, say, maximum wind, the tower and cables complete should be able to withstand at least 1.5 times the respective calculated loads applied simultaneously at every point. Secondly, the tower itself merely as a structure for the support of the conductors and resistance against overturning should certainly have a factor of safety of at least 2. The assumption is made in all these requirements that the anchorages are rigid; unless heavy concrete foundations are used, this is not strictly true; in fact, there may be considerable "give," but since the possibility is most remote that the leverage will affect less than two such anchors simultaneously, a considerable tenacity in holding down is obtained. The tower is therefore likely to fail by buckling. If for any reason the ground under a tower should not be firm enough to support the structure, then arrangements must be made accordingly.

Inspection.—Careful inspection of material, workmanship, etc., in the shop is the very best means of assuring a satisfactory tower. No order of importance should be without such consideration.

Tests for Acceptance.—The value of acceptance tests is not so generally understood as one might desire. The general tendency in tower tests is to arrange for the application of given loads at the insulator-pin heads and then only certain groups are tested simultaneously. No test representing wind loads is made simultaneously on the tower itself. Acceptability generally depends on the ability of the structure to remain rigid or at least to deflect from the vertical by only a small amount. When one considers, however, the variety of possible ways in which a tower can be affected, such a test seems but a feeble approach to certain bad actual conditions. The application of a load in this manner may be perhaps taken as approximating broadly to the resultant stress for a given case, but owing to the complicated form of the structure it is clearly far less direct or indicative than a simultaneous application of known constituent loads to the various parts of the tower. Even here certain assumptions as to the points of application of local pressure resultants must be made, but owing to their distribution and number being greater than in the former single application, the degree of reliability is certainly much enhanced.

In addition to the tests noted, there is also the important condition of torsional stress on a tower which is caused by the failure of only a part of the total number of conductors. A tower might be very ably designed for the condition of sleet load with wind, etc., and likewise for the maximum wind conditions, either in a plain support or dead-end form, but if to the latter the above condition of torsional stress is added, the tower may still prove weak. Proposed methods for ascertaining fully all these characteristics are as follows:

The tower may be placed vertically in position on firmly fixed anchorages and to the various insulator-pin head and panel corners, cables, each supplied with a dynamometer, are attached. The cable should then be subjected to tension in the proper direction and amount up to the required number of pounds. While such a test is theoretically feasible and more nearly approaches the real condition, it is difficult and expensive to apply. According to a second test the tower is placed horizontally and held rigidly by appropriate means. Weights are then applied at the proper points as required. This test is a very simple one to make and will determine fully the characteristics of the tower.

Costs.—Scholes* has stated the cost per 100 lb. of certain towers "delivered in the field" as $4.50, or allowing 50 cents per 100 lb. for freightage—$4 per 100 lb. f.o.b. shop. A tower weighing from 1800 lb. to 2000 lb. will have the following general characteristics: Height, 45 ft. to lowest conductor; height over all, 55 ft., approximately; base, 12 ft. x 12 ft.; pyramidal form; conductors, three main, approximately No. 1 B. & S. hard-drawn copper cable 7 ft. on centers triangularly spaced; two telephone conductors spaced parallel on approximately 2-ft. centers. One overhead grounded wire; span, from 500 ft. to 600 ft.; wind, maximum, 80 miles per hour actual; sleet, layer ½ in. or 1 in. increase in effective diameter with low wind; factor of safety under maximum wind stress, 2.

This tower is probably a very light (economical) form for the purpose. Other manufacturers to secure the same results would use more weight and consequently charge more. There might incidentally be a greater strength in the latter towers which would be more of an accidental result of the natural limitations of the structure than a matter of intention.

POLES

Although reinforced-concrete poles have come into notice and consideration, their adoption for high-tension work is hampered by two serious factors. If molded away from the point of erection, cartage and incidental handling alone may make their adoption unduly expensive, while if molded at the point of erection the cartage of supplies, and in some cases of water also, makes their cost too great. Concrete poles can doubtless be built for very heavy work, but it is doubtful whether they will ever be feasible except for short-span requirements for local conditions.

There is, furthermore, an idea probably fixed in many men's minds that a wood-pole line for such voltages as are here discussed is always cheaper than the metal-tower line. This is erroneous to the extent that the proximity of a suitable pole supply is the determining condition; for such potentials as 100,000 volts, however, with suspension type insulators and long spans, the metal tower has obvious advantages. A comparison of cost with wood poles is really not strictly fair

*Transactions A. I. E. E., 1907, Vol. XXVI., Part II., page 1232.

since in the case of a wood-pole line no such mechanical strengths can be stipulated as in the steel towers. The latter thus have an inherent advantage that is very valuable. If, in addition to the foregoing, the depreciation of the respective elements be considered the towers will be found to have a further superiority.

SPECIAL TOWER FORMS.

Thus far only dead-end and ordinary supports have been mentioned. Note should also be made of the following:

Guying.—The application of guys to certain towers in the line to strengthen against curves or possible mechanical surging due to a break in the wires is often taken advantage of. The application and necessity of such a detail need no further discussion.

Angle Towers.—An angle in a transmission line may be turned gradually as a curve or abruptly at one point. In the former case a number of standard towers on shorter span and properly guyed, if necessary, are placed on the curve. In the latter a special tower of dead-end form may be used with proper provision thereon for the change in direction. The latter expedient may sometimes prove desirable since it will permit of longer tangents.

Sectionalizing and Cross-Over Towers.—One of the most important requirements in a long transmission line is the need of securing continuity of service. A double-circuit supply (two adjacent pole lines) is supposed to insure continuity to a great degree. It happens, however, that often only a small portion of one of the lines may be affected, and if some means could be employed for running the remainder of both circuits in multiple, a more satisfactory regulation of the line under such circumstances would be feasible. To this end a transmission line can be subdivided into certain unit lengths as conditions may indicate to be desirable, provision being made at the junction points for cross-connection from one line to another by suitable air-break switches. In this way one can conceive of only a small part of one circuit of a 70-mile line being out of commission, the remainder being tied in multiple through the corresponding good link of equal length. It is clear that by proper methods of operation an interruption to a line could be made very short; in fact, only as long as might be required for the tracing out of the successive sections. The towers for this purpose are, of course, more elaborate than the regular line towers, being perhaps equal to four such towers.

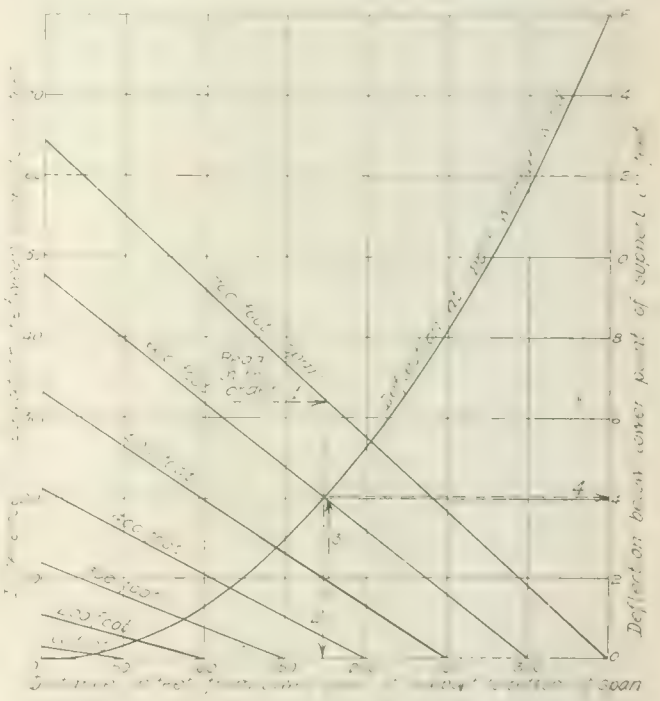
Fortunately, the presence of a substation at such a sectionalizing point enables a tap to be made very conveniently for local supply. By a proper arrangement of knife switches, all of which can be mounted on the tower, a means of quickly clearing the line is supplied.

River Crossing.—Certain rivers are considered by the United States War Department as navigable for only a part of their length and up to this point the consent and approval of the department must be obtained before the transmission line can cross. The critical point, however, is the clearance above the river level and once this is fixed the size of the necessary towers to secure this clearance is easily determined. The towers for this purpose are likely to be very high—at least 100 ft.—and therefore require consideration more as self-supporting structures than as a part of the line, since they are essentially of the dead-end form. This statement, of course, needs modification when applied in special cases, like the Straits of Carquinez, in California, but the principle holds good, nevertheless, particularly for the usual inland crossing encountered by the majority of transmission lines.

Foreign Wire Crossings.—So thoroughly ramified throughout our country are the telephone and telegraph lines that it is scarcely possible for a long-distance transmission line to escape crossing them many times. For this condition no standard practice has evolved itself to date; the nearest approach to anything like a standard form of crossing is embodied, first, in the well-known cradle protection, which is a grounded screen hung between the two circuits requiring insulation; and, second, in the principle of such comparatively short spans with towers of appropriate height as to preclude the contact of the high-tension wire and the telephone circuit in the event of failure to the former.

It is clear that either of these methods in the case of long-span work may become very expensive, perhaps financially impossible, and resort must be had to other means. In general, the transmission-line company is in possession of full information as to the various telephone and other foreign wire circuits which it will cross just as soon as the right-of-way has been settled on. It is obviously in the best interest of all concerned that the transmission company confer with the various interests and obtain suitable and reasonable agreements as to the protection required. In some cases the screen may be feasible, in others special spans may be necessary.

Profile.—Where the standard spans are only 100 ft. or so the adjustment to changes in profile can easily be made. The late Dr. Perrine indicated a method whereby poles of differing lengths can be utilized to produce a span many times the width of the standard span, but still of identical inherent characteristics. This method, of course, is not so desirable with standard spans of the magnitude of 700 ft., and here provision must be made for making each span throughout a complete one in itself. The accompanying curve shows the respective differences in elevation possible with a span of 700 ft. as covered in this problem. From this curve it will be evident that in order to secure a satisfactory line a profile of the right-of-way must



CURVE OF DEFLECTION OF MAIN CONDUCTOR WITH SUPPORTS AT DIFFERENT LEVELS.

first be made and the towers must be placed step by step in order to determine their exact location.

Where there is a double right-of-way the profile data should cover the center line of each row of towers, particularly since the hilly part of the line may be on badly sloping side hills where excavation is undesirable or even impossible.

It is obvious from the above that a modern high-voltage line must be carefully located in advance, and any departure from these points may seriously affect the feature of uniform mechanical tension which is by this means maintained throughout the line.

A study of the profile will, therefore, result in discovering the required quantity of towers of special height; for it must be stated that while it is possible to have a number of variations of differences of level of supports for a given span, it is likewise possible to have a greater span of the same inherent tension which may still enable the standard towers to be used although considerable differences of elevation are to be encountered. In addition, by drawing in the span curves for respective spans where there are differences of elevations or a wide departure from level or uniformly sloping ground, an exact adjustment to conditions can be made. In doing so the

variations of length between extreme hot and cold conditions should be borne in mind—the minimum temperature condition, by reason of causing the shortest span length, likewise determines the minimum distance between the lower point of support and the bottom of the sag to which it is safe to go, whereas the maximum temperature and sleet conditions govern the minimum clearance allowable between the line and the ground. In straight-runaway work over comparatively level country the latter condition is the only one requiring consideration.

Electric Lift Magnets.

By Lawrence Whittredge Cady.

ALTHOUGH the electric lift magnet is by no means a recent discovery, there are many uses discovered for it every day. In fact, it is revolutionizing the method of handling masses of iron and steel, such as pigs, crop ends, blooms, forgings, scrap, and other forms of iron which have formerly required much handling by human labor. At first electrical apparatus was looked at askance by people who had charge of heavy machinery and cheap help. Thanks to the new style of "fool-proof" motors, this prejudice is being removed and these people are eagerly adopting any electrical device that will save them time and money.

The electric magnet when used as a conveyor met with scant approval even among electrical engineers until recently. They had always known about magnets and this new application seemed amateurish and impractical. Therefore, contrary to precedent, it was developed and advocated by practical people who wanted results, and had more faith than electrical theory. The electrical profession has at last awakened and much careful study has been focused on this problem, with the result of placing on the market some very efficient apparatus.

A lift magnet is a much finer engineering conception than is commonly considered. There is probably no kind of electrical apparatus which has to stand so much abuse and yet continue to work with unvarying accuracy. It is used in all kinds of weather and under varying conditions of heat and cold; to lift material from wet places where the magnet is partly immersed in water, and to transport red-hot forgings.

As it is required to displace cheap labor it is often operated by the same kind. Therefore, it is frequently dropped on steel scrap and cast iron from a height of many feet and treated more like a "skull cracker" than a machine. The magnet must not only be very strong, but it must have great lifting power as compared to its weight. Then the lifting power must be obtained with a comparatively small expenditure of electricity. This latter condition is required not only for economy of operation, but to maintain constant lifting power. One can see that a large I^2R loss would cause heating and thus lower the ampere-turns, which in turn would cause the magnet to lift less material per load at the end of the day's run than at the start. Although there are many shapes of lift magnets, the round shallow type is being recognized as the one to be preferred in most cases.

This style of magnet is provided with ribs and flanges which help dissipate the heat absorbed from contact with hot material. The bottom plates of these magnets are made from a very hard non-magnetic steel alloy which protects them from the abrasion due to the pounding of the material lifted. Although several magnets have been designed to operate with alternating current, thus far direct current has been almost exclusively used.

Lifting magnets are mostly used either on cranes traveling on runways, or on locomotive cranes. These latter have the advantage of a wide scope of action. The locomotive cranes are self-contained, as they are equipped with a small direct-connected engine and generator, the engine being supplied with steam from the boiler which feeds the crane engines. These outfits are being extensively used by scrap-iron dealers, ship yards, railroad supply and repair yards, boiler works, iron and steel mills, and iron foundries.

Magnets operated by traveling cranes are used for many kinds of purposes. Their ability to handle red-hot forgings makes them valuable in forge shops and other places where the material to be conveyed is very hot. They are valuable conveyors in foundries and machine shops, where it is necessary to handle large quantities of small castings very quickly and cheaply without breakage. In fact, the secure manner in which a magnet will handle castings, varying in weight from a few pounds to 20 to 30 tons, is one of its chief characteristics. After a magnet once lifts its load free, nothing will ever cause it to drop except an interruption of its supply of electricity.

The amount of material lifted per trip by a magnet depends on its chemical composition, shape and arrangement. Material having the highest permeability is the easiest lifted. Certain steel alloys are so nearly non-magnetic that they cannot be thus lifted. In regard to shape, it is obvious that the more completely the magnetic field is occupied by the load, the greater will the capacity of the magnet be utilized. This explains why a magnet will lift heavy forgings, or castings such as "skull-crackers," which weigh several tons, and yet be able to lift only a few hundred pounds of turnings or other loose scrap. Much depends on arrangement to secure maximum loads. A skillful operator will take pains to place the magnet where it will get the most material per lift. He shows the same care in unloading, and when handling steel plates can unload them one at a time from a lift of five or six. In this way they can be distributed. This is done by a rapid manipulation of the switch, which thus takes advantage of the magnetic "lag" of the plates. As one would naturally suppose, hard steel possesses this property to the greatest extent. The writer has seen very hard steel billets weighing several tons cling to a magnet for three or four seconds after the electric circuit was broken.

Lift magnets, being highly inductive, are provided with different devices to overcome the destructive effect on the winding caused by the high voltage generated when the circuit is broken. The windings of some makes of magnets are protected by having a resistance shunted across the terminals just before the circuit is broken. One make uses a carbon controller switch for this purpose which has a non-inductive resistance and is arranged to reduce gradually the current and voltage to a low value before the circuit is broken.

Care should be taken to have separate service wires for the magnet circuits, as every precaution should be taken to guard them against chance interruption. The blowing of a fuse or opening of a circuit-breaker may result in damage of property or perhaps loss of life. When possible, magnets should be arranged to have their own right of way. There has been a much less number of cases where magnets have dropped their load prematurely than of loads falling from the breaking of chains, ropes, or insecure tying, while their ability to automatically load and unload makes it unnecessary for the presence of human labor in their vicinity. Companies handling large quantities of iron and steel have found that a locomotive crane equipped with a magnet will do work which formerly required 20 or 30 men.

Magnets are used by divers to assist them in recovering material from wrecks. They have long been used in removing loose pieces of iron from other metals. In fact, magnets are destined to take an important part in the future handling of iron in its various forms, from rough sand cast pigs to highly finished machinery.

Repairing High-Voltage Lines While in Service.

By J. S. Jenks and W. H. Acker.

REALIZING the necessity of reducing line interruptions to a minimum, some years ago the writers made experiments on the high-voltage lines of the West Penn Railways Company and found that work could be safely accomplished on 25,000-volt lines while the latter were in service by grounding the line wire on which the work was to be done. Insulators and tie wires could be replaced; but work could only be done on one wire at a time. Means have been devised since then for working on ungrounded lines in service and the facts are embodied in the present article.

Material and tools for doing repair work are placed at many

points over the system where they will be most accessible. A wooden case with glass front containing tools, etc., for use in case of emergency is permanently mounted on the wall in the power station, each substation and office. This case contains climbers, safety belt, connectors, come-a-long, test set, etc., an acetylene gas lamp with a supply of carbide, a combination saw and hammer, emergency pole, insulator, screw clamp, hand screw and Narragansett emergency outfit. The climbers, safety belt, connectors and come-a-long are standard tools as ordinarily used by linemen. The small telephone test set was designed and built by the company and weighs about 3 lb. and 13 oz. This set is so designed that the drops in the stations are released by battery rather than magneto current. The acetylene gas lamp is a Solar bicycle lamp with special bale handle so that it can be carried more readily. The combination saw and hammer consists of a machinist's hammer with a saw blade attached by bolts to the end of the hammer-handle, thus forming an insulated handle for the saw. The emergency pole is of wood about 2 in. in diameter and 10 ft. long, threaded at one end for an emergency insulator of porcelain, designed to protect the emergency pole and under petticoat of the insulator from a driving rain, even though it might have to be put up at a considerable angle from the vertical. These insulators are fitted with a wire clamp for attaching the line wire to the insulator. The screw clamp is made of iron, having a ring at one end, which can be turned at any angle and which is just large enough to allow the emergency pole to go through nicely. The hand screw has a very sharp-pointed thread and lever handle so that it can be screwed into the main pole very easily. The Narragansett outfit contains a hypodermic syringe and tablets, distilled water, brandy, and instructions for use in resuscitating persons who have received an accidental shock.

From time to time additions have been made to these emergency cases in the shape of oil lanterns, a supply of carbon oil, a small rope and set of blocks.

About the same time repair arms fitted with pins and insulators were put up on the lines at intervals of about ¼ to ½ mile. These arms were attached to poles two or three sections back from each road crossing, the idea being to place repair material at points along the line and at the same time to hide them from malicious persons passing along the highway. Along the private telephone line at various intervals test stations are cut in so that linemen when out hunting transmission or telephone troubles can open the telephone line at these test stations and ascertain by listening the direction in which trouble is located.

With this equipment temporary repairs were made to the lines while they were in service, the temporary work being left on the line until several such repairs had been made when an interruption would be arranged for at some time when least objectionable to the customers, and all temporary work removed and permanent repairs made. This enabled interruptions to be forestalled and gave almost absolute control of the time at which such interrutions would occur and their duration The work consisted principally in removing damaged insulators from the line, the greater portion of the trouble being due to broken insulators. When such a case of trouble is found by a patrolman it is reported by telephone and men are sent out immediately to clear it up. Very often trouble occurs on double-arm poles, in which case, provided only one insulator is defective, the pin supporting defective insulator is sawed off at two points, between the bottom of the insulator and top of the cross-arm, leaving an air-gap of about 3 in. between the pin and the cross-arm, or the pin is sawed off and the top of the pin screwed out of the insulator by canting it to one side. In cases where the defective insulator is on a single arm some support for the line wire must be provided before the pin can be sawed off. This is accomplished by using an emergency pole, a screw clamp and an emergency insulator. The screw clamp with ring is first fastened securely to the cross-arm just under the defective insulator, the emergency pole is then run through the ring on the clamp and the emergency insulator is threaded on the emergency pole, the pole and insulator being pushed up until the wire clamp on the insulator engages the line. The pin is then sawed off and the line slightly raised by means of the emergency pole until it clears the stub of the pin. The bottom end of the emergency pole is then made fast to the main pole or a lower cross-arm by means of the hand screw. In some cases a rope sling is used to support the top of the emergency pole from the main pole in place of the screw clamp, the bottom of the emergency pole being fastened by the hand screw. The sling cannot be used universally and is not as secure as the screw clamp with ring, as it leaves a possibility of the line wire being blown in against the structure or against another wire should the wind be blowing the right direction.

Temporary repairs have been made in this manner in cases where the trouble was due to defective insulators; also where the pins, cross-arms, braces, or all had been burned off due to broken insulators, or the line wire getting in contact with the pins or structure. About one year ago a systematic and thorough inspection of poles, cross-arms, braces, etc., was inaugurated on all old lines. This inspection revealed the fact that a considerable number of top and bottom cross-arms and braces were either rotten or defective from other causes; also that there were a number of pins on which insulators were loose, due to "digestive action" or shrinkage. In order to carry on the work of replacing the bad cross-arms, braces and pins without interrupting the service, special tools and material were necessary. These were designed and made up after some experimental work. These tools consisted of a number of the above

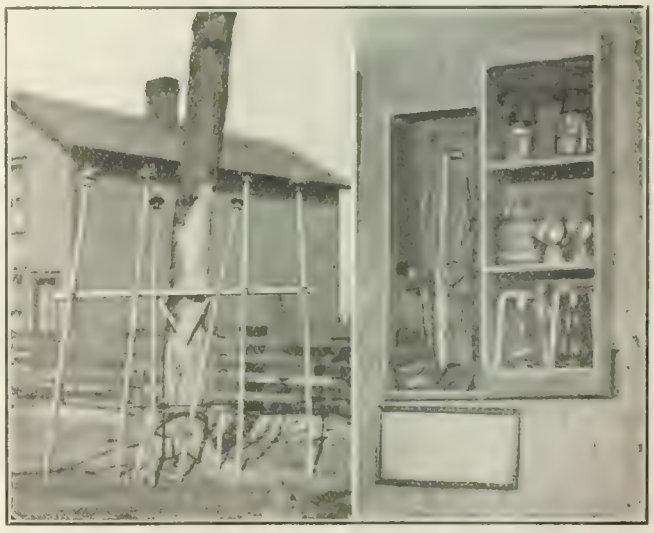


FIG. 1.—EMERGENCY EQUIPMENT.

mentioned emergency poles, some of them being extra long; a light weight reinforced hickory cross-arm with metal braces and cleat for lagging to the pole, several adjustable clamp rings for properly spacing the emergency poles, a pair of light metal cross-arms arranged to support the emergency poles at the proper height. Defective bottom arms were replaced first on account of the additional safety afforded when working on top arms, by having the bottom arms in good condition and also in order that the information and experience gained on this work would be of aid in handling the more dangerous work, as ordinary linemen had to be trained for this purpose. The men have become quite proficient at this work and have inaugurated a system of proper names for the tools with an idea of facilitating the work and preventing error.

About 350 to 400 bottom arms have been replaced without experiencing any trouble whatever, the work having been done under varying and difficult conditions. The time required to replace a two-pin arm varies from 15 to 30 minutes, the average time being about 25 minutes.

When the work of replacing defective top arms was taken up the method of handling and supporting the line wires had to be elaborated and additional tools designed. Fig. 2 gives a series of photographs showing this work in progress. The first is a view of the pole which has a defective top arm just previous to starting work on it. Next is a view of the

same pole after driving the pins out of the bottom arm, both lines having been moved to a safe distance and supported on ordinary emergency poles and insulators by the iron fixture on the main pole, and having been dropped out by means of the rope slings attached to the top of the emergency poles and fastened to the main pole. The third view shows the same pole after work has progressed a little further. The four top wires have been removed from the cross-arm by driving out the two pole pins and sawing off the two outside pins, which in this case were so tight that they could not be driven out, new pins having been screwed into the insulators. The wires are supported at a safe distance above the cross-arm by the emergency poles, which are held in place by the small hickory cross-arm fastened near the top of the pole and the iron fixture lower down the pole. The defective top arm being off the pole, a pulley is fastened on top of the main pole for pulling up the new cross-arm, which is shown in place and ready for the line wires to be put on. The pins are then inserted and nailed in the new top arm as shown, the old pins being used again in all cases where it is advisable. The emergency poles and attachments supporting these wires are then removed. The lower wires are now placed in their previous position on the arm and the pins are nailed, the completed job with all the supports and poles removed being shown in the last view.

In this manner the company has thus far replaced over 200 four-pin top arms; the time necessary to replace a four-pin arm varying from 30 minutes to one hour, the average time being 50 minutes. The average cost of replacing a two-pin arm is $2, including all labor and material. The average cost of replacing a four-pin arm is about $3.50, including all labor and material. Four men are sufficient to carry on the work satisfactorily.

The authors wish to call attention to the fact that damaged insulators have been replaced with new ones, tieing the new insulators in without cutting the current off the line, using the company's standard method of tieing in and thus permanently repairing the line while it was in service, putting the line in just as good shape and making the repair just as secure as it would be had it been made with the line dead.



FIG. 2.—VIEWS SHOWING METHOD OF REPLACING DEFECTIVE CROSS-ARMS ON LIVE HIGH-TENSION LINES.

The most difficult portion of this repair is removing the old tie wire and tieing the line wire to the new insulator. The line wire is taken care of in the same manner as previously described. The damaged insulator is shattered with a few blows with an insulated hammer and falls to the ground, leaving the tie wire attached to the line wire. A pair of wire cutters with long insulating handles are used to cut the tie wires and to untie them. A new insulator and pin are now put in place and the line wire is put in the groove of the insulator. The new tie wire, about 30 in. long, is now bent into a U shape, one leg about 3 in. longer than the other, and the legs about 2 in. apart. Gripping the tire wire with the cutters about the center of the bend, the longer leg is laid over the top of the insulator from the pole side crossing the line wire, the other leg passing under the line wire and partially around the head of the insulator in the side groove. A perfectly dry treated wooden stick about 1¼ in. in diameter and 36 in. long, having a short ferrule at the center with a hole through the ferrule just large enough to let the tie wire enter, is slipped as far as possible over the longer leg by a man on the opposite side of the insulator and then manipulated so as to pull the tie tight over the top of the insulator, then under the line wire and partially around the head of the insulator, going back on the pole side to the man who is holding the tie with the wire cutters. This man removes the wire cutters and after slipping all the slack

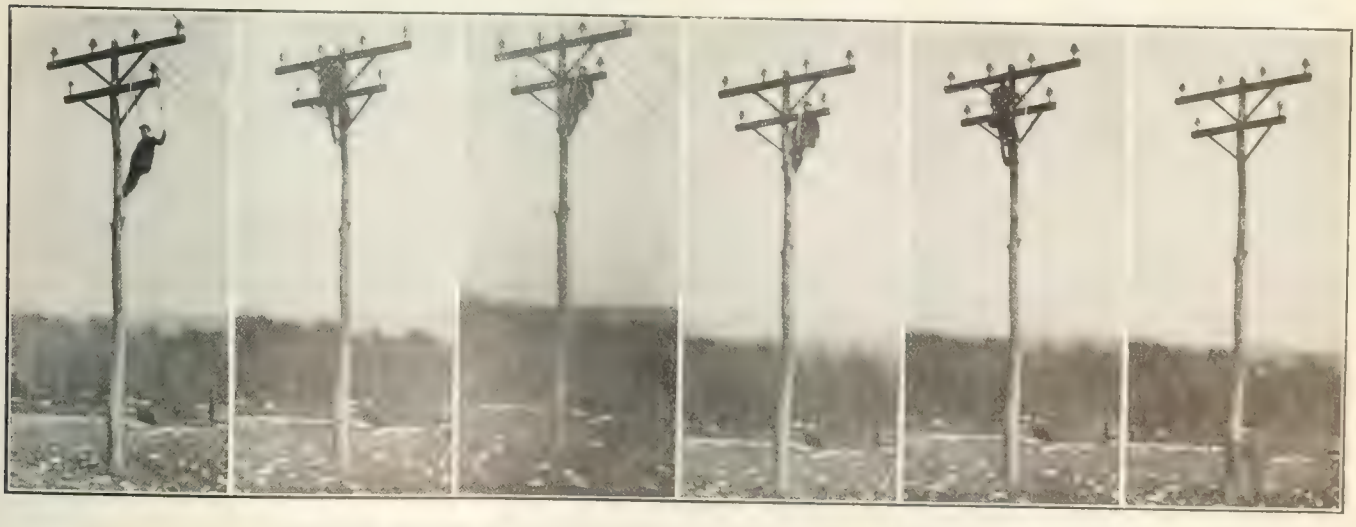


FIG. 3.—VIEWS ILLUSTRATING THE USE OF CLAMP AND TOOLS IN REPLACING INSULATORS ON LIVE HIGH TENSION WIRES.

possible out of the tie into the shorter leg by hitting it with an insulated wooden mallet he holds the stick passed to him, while a similar stick is slipped over the shorter end of the tie which is on the outside of the insulator. The second stick is then handled so that the tie is pulled tight around the head of the insulator in the side groove, thence under and around the line wire until the tire has been pig-tailed out some six or eight turns. The long end of the tie is now pulled tight around the pole side of the insulator, slack being taken out as before, then passed under and around the line wire and pig-tailed out as was done with the other end. The sticks are then removed and the surplus tie wire at each end is clipped off close up to the line wire. This tie is very much tighter than one put on by hand with the line dead, due to the leverage of about 15 to 18 in., which is obtained by use of the sticks. When it is necessary to replace an outside insulator U-shaped sticks, such as are ordinarily used for backs of chairs, are substituted for the straight sticks, so that they can be more readily handled from one side of the insulator. On the average it takes two men about 15 minutes to replace a defective insulator with a new one and to tie in the line.

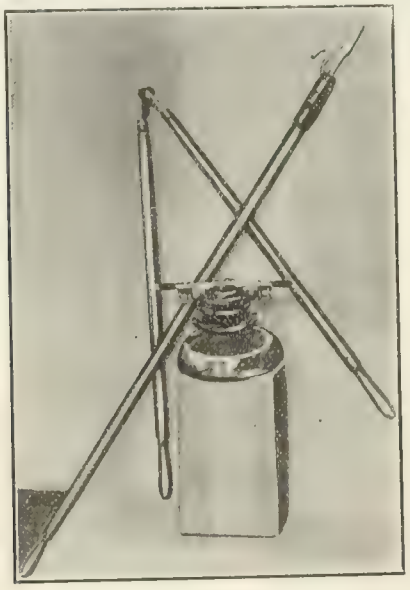


FIG. 4.—INSULATOR CLAMP, SCREWDRIVER AND WIRE CUTTERS.

A safer and quicker method for making such live line repairs is to use a clamp in place of the tie wire, as a repair can be made much quicker by one man and with much more safety. A clamp has been designed which fulfills all conditions, though the details must be modified to a certain extent in order to adopt it for use with the various sizes and shapes of insulators. Special tools are necessary in connection with the use of this clamp, but these tools are very simple and inexpensive. An ordinary steel screw-driver blade and a hook provided with a long insulated handle; a pair of wire cutters, also provided with long insulating handles, previously mentioned, would be sufficient. In Fig. 4 is shown the clamp, also an insulated screwdriver with a hook and a pair of insulated wire cutters. In using the clamp for replacing an insulator the line is taken care of and the insulator and the tie wire removed, as previously described. The brass clamp is fastened to the head of a new insulator with the jaws in line with the top groove and the insulator is put in place on the pin, the jaws for clamping the line wire being loose; the wire is then placed between the jaws of the clamp and fastened securely by means of the small screws which tighten the jaws. Fig. 3 illustrates the use of the clamp and tools. The first view shows a glass insulator with bottom petticoat broken entirely off, supported on a good pin and tied in on a No. 0 copper line. The second shows a dry hand line which has been passed over the upper arm and fastened to the line wire to prevent its falling when the tie is removed, also the lineman removing the tie wire with the insulated wire cutters. The next is a view with the tie wire removed and shows the line wire pulled up by the hand line. The defective insulator is replaced with the new insulator, having clamp attached as shown, and the line is lowered into the jaws of the clamp, being guided by the insulated hook. The jaws are then tightened by the insulated screw-driver. The completed job, the wire being securely held by the clamp, is shown in the last view.

The cost of these clamps is considerably in excess of the cost of a tie wire, but this is insignificant when compared with a loss which the interruption to the service means even on lines transmitting a comparatively small amount of energy. Brass clamps are used on all copper lines, while aluminum or aluminum lined clamps are necessary for aluminum lines.

New poles have been set with the line working by simply taking care that the pole does not come in contact with the line wires, after which the cross-arms and insulators are put on as above described. Several lines have been moved without interrupting the service by simply digging trenches and moving the poles bodily.

Live high-voltage work has not been limited to the lines only, but has been carried on inside the stations. The most important repair made on inside wiring was reconnecting a lead from an air stick breaker to the busbars. This lead burned off about 4 in. from the bus at a time when an interruption was especially undesirable. The repair was made in the following manner: The air-breaker was removed, allowing the line to work by the two other wires and around the hoop; a small brass wing nut clamp resembling a hand vise was then connected to the end of the broken lead which was dead. A piece of asbestos lumber was placed so as to prevent the flame from short-circuiting the buses, while the insulation on the short piece of wire which was attached to the live bus was burned off with a blow torch fastened to the end of a good dry stick. After the insulation was burned off the wire was cleaned by a piece of sandpaper attached to the end of a stick. As the clamp would not close on the small wire attached to the bus, a tube made of gauze was used to bush up the clamp, which was then shoved on the small wire and the wing nut was set up by means of a stick with a slot in the end. This made a very good contact and the stick-breaker was replaced, re-establishing service over this wire. The connection has been working perfectly ever since. In a somewhat similar manner taps have frequently been made to the transmission lines in order to supply electricity at some point where the company had not previously possessed a substation.

No definite figures can be given on the value of this work, but the cost of maintaining the transmission lines has been greatly reduced, as all repair work has been done in the daytime, and much quicker than it could be done at night. The items of livery hire and extra time have been practically eliminated. A large amount of revenue which would have been lost during the time the line was off is also saved, as the territory which would have been without electricity in case interruptions had been necessary is very large as at the time this work was done the West Penn system was not looped. A large but indeterminate amount has been added to the selling value of the output, due to increased reliability of service, which has an average time efficiency of 99.96 per cent.

The safety of men engaged on this work should in all cases be given first consideration, and all tools, apparatus, etc., to be used in making live line repairs should have a large factor of safety, both as regards insulating qualities and mechanical strength. In the above the authors have attempted to outline what has been accomplished in the way of live repairs on the West Penn transmission system, where there are wooden supporting structures throughout, and have touched on almost every phase of live high-voltage repair work except the splicing of the live wire. Provided the supporting structure and insulation of a line are kept in first-class condition, the liability of interruptions due to the line breaking or burning off will be greatly reduced, as such trouble in most cases is the result of a failure of some other part of the construction.

Titanium-Carbide Arc Lamp.

Mr. C. R. McKay, formerly of the Toledo Railways & Light Company, and now of the Union Light, Heat & Power Company, Covington, Ky., communicated a report on the titanium-carbide arc lamp at the Ohio Electric Light Association convention on July 15. He called attention to the rapid advance made in arc lighting in the past 10 years. The magnetite or metallic oxide flame lamp now produced by two of the leading electrical manufacturing companies uses a solid metal positive electrode, generally of copper, and a negative composed chiefly of powdered magnetic oxide of iron with oxides of titanium and chromium in small quantities, the mixture being contained in a thin soft iron tube. In this mixture each oxide appears to perform a distinct function, the iron furnishing the required conductivity, the chromium the essential life and the titanium the majority of the brilliant light of the arc. Both types of this lamp owe their illuminating superiority chiefly to the titanium contained in the negative electrode. They operate with direct current and necessitate some rectifying apparatus when only alternating current is available.

There has recently been developed a system of arc lighting with alternating current in which use is made of lamps with

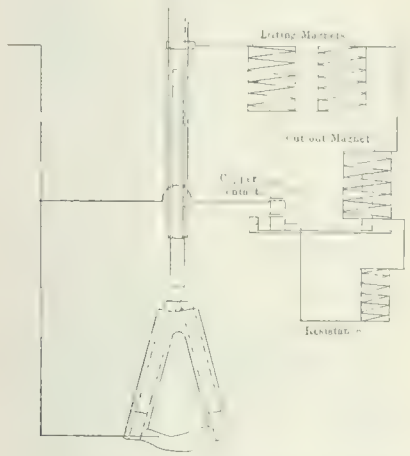


FIG. 1.—CONNECTIONS FOR SERIES LUMINOUS ARC LAMP.

electrodes composed largely of titanium carbide, thereby avoiding current rectification and obtaining increased lighting efficiency.

Experimental circuits of such lamps have been maintained for considerable periods by both the Westinghouse and the General Electric company, and while neither company has thus far commercially standardized, or placed such a system on the general market, several important equipments are in commercial service with a view to demonstrating their possibilities.

Their characteristics are as follows:

The luminous efficiency is high, the specific consumption approaching 0.33 watt per mean horizontal candle-power. Value is about 25 per cent less than that of the 4-amp magnetite arc. The cost of electrode materials at present is high (about 20 cents per trim), and constitutes the principal item in the operating cost of the system. The light possesses a yellow tinge, which is objectionable. The arc is unsteady and the slag condensed from the vapor of the arc may occasion difficulty by fusing into the globe. It is difficult to secure a power factor higher than 55 per cent from the system, because of the reactance required in the circuit to steady the arc. There are in operation three installations of titanium-carbide lamps, respectively, at Rochester, N. Y., 150 lamps; Schenectady, N. Y., 100 lamps, and Haverhill, Mass., 250 lamps.

The system as now operated consists of a plain series lamp without shunt winding, an oil switch in series in the circuit, automatically opened and closed by a clock control relay at suitable feeding intervals, and finally a constant-current transformer. Fig. 1 is a diagram of the lamp connections and arrangements.

The lamp mechanism consists of two series magnets which, through clutch, raise the upper electrode to the proper arc length, where it is held, while the arc burns until the station relay momentarily opens the oil switch, interrupting the current through the entire series circuit, and allowing the upper elec-

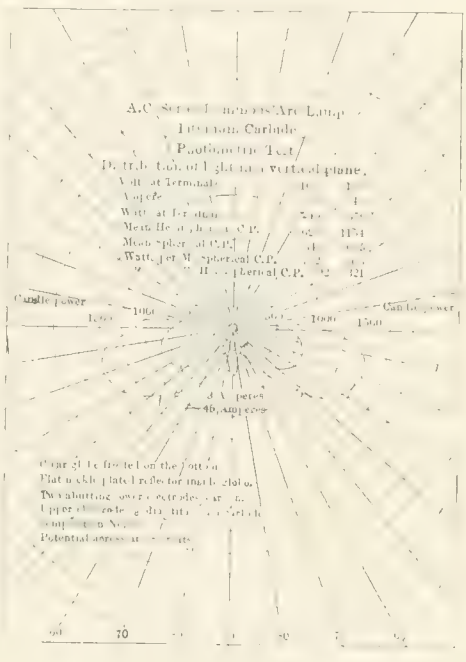


FIG. 2.—CURVE OF CANDLE-POWER DISTRIBUTION.

trodes to drop; the oil switch then closes, immediately completing the circuit to the lamps and again drawing the arcs.

The lamp has three electrodes, the upper being a round stick composed chiefly of titanium carbide, approximately 12 in. long and 0.4 in. in diameter. Each of the two lower carbon electrodes is 6 in. long and 0.4 in. in diameter, of half round section, and held in an inverted "V" position so that their upper tips abut, thereby presenting a circular flat surface toward the upper electrode. The upper tips of the lower electrodes are maintained in contact by a metal finger pressing upward beneath the electrodes as the latter burn away. This lamp arrangement preserves a focusing arc without the complication of a feeding mechanism therein.

The insulation of the lamp is protected against excess potential by shunting the lamp with a suitable spark-gap in series with a resistance and a cut-out magnet, which short circuits the gap. Thus, when the potential across the lamp exceeds the breakdown point of the spark-gap, electricity flows across the gap through the resistance and the cut-out magnet, whose core, linked to one terminal of the gap, rises, thereby short circuiting

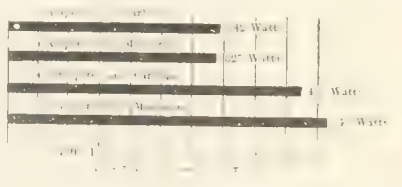


FIG. 3.—COMPARATIVE LUMINOMETER DISTANCES.

the gap through the resistance and dropping the potential across the lamp terminals.

With this type of lamp, as with all the metallic vapor arcs, the fumes and condensed vapor must be carried away by suitable ventilating arrangements. A single clear globe with a perforated base is used with the existing style of lamp.

The existing systems operate at 2.5 amp, but there are in production lamps of 3 amp and 4.5 amp respectively.

The characteristics of these lamps are as follows:

Amperes	3	4.5
Volts at terminals	105	105
Power factor	78.80	78.80
Watts	245	370
Mean horizontal candle-power	624	1154
Watts per mean horizontal candle-power	0.392	0.321
Mean spherical candle-power	349	655
Watts per mean spherical candle-power	0.702	0.565

Polar candle-power distribution curves of these lamps are shown in Fig. 2.

The electrode life of the upper and lower sets approximates 75 and 50 hours for the two sizes of lamps respectively.

The relative luminometer distances for the several sizes of magnetite, and the titanium-carbide lamps respectively are shown in Fig. 3.

The efficiency of the system is given as from 95 to 97 per cent, and the power factor from 50 to 60 per cent, at full load, on 60 cycles.

The following figures on operating cost of the alternating-current, titanium-carbide lamp as compared with the direct-current magnetite lamp are given by the manufacturer:

	3 amp. a.c. Lum.	4 amp. d.c. Lum. Rectifier.	4.5 amp. a.c. Lum.	6 amp. d.c. Lum. Rectifier.
Energy at switchboard at 1 ct. per kw-hour.	$11.28	$14.08	$17.00	$21.48
Electrodes	10.80	1.70	16.00	3.75
Trimming	2.40	1.00	3.50	2.30
Repairs	.75	.50	.75	.60
Globes	.50	.50	.50	.50
Rectifier tubes		2.00		3.00
Total	$25.73	$19.78	$37.75	$31.63

The constant-current transformer is similar in all respects to the familiar type developed for the series-alternating enclosed arc system, the 100-lamp unit being arranged for two series circuits.

The oil switch, which instantaneously and periodically breaks the lamp circuit, thereby performing the function ordinarily performed by individual lamp feeding mechanism, is operated by a 110-volt alternating relay circuit, opened and closed at proper intervals by a time clock. The relay device embodies an induction motor element actuating a contact finger corresponding to each relay circuit, there being one such relay circuit and oil switch for every separate equipment installed.

The titanium-carbide system has not been developed with the intent or expectation of displacing the magnetite or metallic flame systems, but rather to supplement them, and in some cases to afford the advantages due to the use of alternating current in the arc lamp circuits. The author expressed the opinion that until it shall be commercially practicable to produce satisfactory arc lighting from unrectified alternating current at 25 cycles, the magnetite systems will remain the preferable and most efficient means of arc lighting from low-frequency supply, while much remains to be accomplished toward reduced operating and maintenance expense before the titanium-carbide system will, even at higher frequencies, prove its superiority.

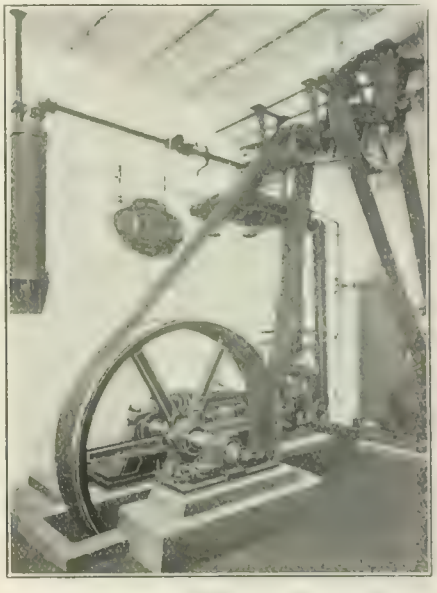
Electrical Refrigeration for Butcher Shops.

By R. L. Lloyd.

Of the trades requiring artificial refrigeration, one of the first to become interested in the subject was that large and widely dispersed class handling meat. Including the small retailers of this perishable food supply, their number is legion and the comparatively high cost of installation is the only bar to the universal adoption by them of the refrigerating machine. For the purpose of this article a moderately large installation for a shop in which the butcher doing his own slaughtering and retailing may be cited. The accompanying illustration shows the machine and motor. The machine is a 7-in. x 14-in. Heutteman & Cramer compressor, with a 72-in. flywheel, running at 72 r.p.m. Under this speed the machine develops about seven tons of refrigeration. At a higher speed it is capable of eight tons. The motor is a 15-hp Westinghouse machine.

Two boxes are cooled by direct expansion. Both have brine tanks for storage and auxiliary cooling. In the store where the cuts are kept for retailing, the box is 10 ft. x 10 ft. x 8 ft. high, and the brine tank 20 in. x 24 in. and 9 ft. 6 in. long, containing about 200 gal. of brine which is maintained at a temperature of nearly 40 deg. The refrigerating pipes are controlled by an individual valve which allows a wide range of regulation; but too low a temperature is not desired. Fruit and vegetables are also stored in the refrigerator.

A larger box in the rear, near the slaughter house, is 10 ft. x 11 ft. x 20 ft. The high ceiling is necessary to keep the hanging beeves clear of the floor. There are two brine tanks here ranged one above the other on one side. They are each 18 in. x 24 in. x 11 ft. and hold 205 gal. of brine. The temperature in the box is maintained at from 30 deg. to 32 deg., which is sufficient to keep the meat in prime condition. There are usually 8 or 10 beeves and 10 or 12 mutton hanging. Killing is done two or three times a week, depending on the season and the meat supply. Seven or eight cattle and 20 sheep or lambs is the average weekly work. If an opportunity is offered to make a profitable purchase of cattle it is a very easy matter to get the whole lot quickly hung up in cold storage. Under former conditions this was not feasible and the cattle had to be kept on the hoof and fed; a method which inevitably resulted in a



EIGHT-TON REFRIGERATING MACHINE.

shrinkage of weight. To maintain the above-mentioned temperature the refrigerating machine is operated only a small portion of the day, as shown by the following record:

May	70 hours	July	111 hours	September	90 hours
June	80 "	August	118 "	October	85 "

The kw-hours consumed during these six months totaled 7251, while for the other six months of the year only 2058 kw-hours were used. The consumption during February was one-tenth that during August. City water is used for condensing and this helps to account for this wide difference in the two months.

Besides the greatly improved hygienic conditions and better keeping of his product, the result of this investment is decidedly advantageous. Before the installation of the refrigerating machine and larger box, the yearly expenses were as follows:

Ice	$400.00
Feed for cattle [illegible] per week	260.00
Shrinkage in weight at $10 per week	520.00
Total	$1,180.00

The change represents an investment of $3,500.

Electrical energy	$518.70
Int. at 5 per cent, depreciation at 6 per cent.	385.00
Ammonia and repairs	75.00
Total	$978.70

a clear gain of about $17 per month, or nearly 6 per cent more on the investment.

A smaller installation in a purely retail meat shop may also be cited. The plant consists of a "baby" Larsen-Baker com-

pressor and is operated by a 3-hp motor. The machine is set up in the basement under the meat box, which is on the floor above. This box is 9 ft. x 6 ft. x 11 ft. high, and holds at times as much as six sides of beef, four or five calves and a dozen lambs, a total of a ton and a half of meat. A direct expansion system is used with a brine tank auxiliary for storage. This tank takes the place of the ice bunker in an ordinary meat box and will hold the temperature down low during the non-operative hours of the machine. With a temperature of 34 deg. when shutting off at night, a rise of only 4 deg. will be experienced by morning. In addition to the main box, the counter cases in the store and a corned-beef tank are also cooled.

In the cold months of the year, four hours' operation of the compressor per day is sufficient. In summer it is necessary to run the refrigerating machine about nine hours, while during January and February the machine is not used at all unless an unusually hot spell occurs. When ice was used, the yearly bill was $425. The bill for electricity for the first year was $250 and for the second $207. The installation cost less than $1,000. Adding interest and depreciation charges at 11 per cent to the bill for electricity makes the total operating cost $320 per year, a saving of 24 per cent, to say nothing of the added advantages of a lower and drier temperature more constantly supplied, and an improved display counter.

Engine-Room Management.

Mr. C. R. Brosius, of the Columbus Railway & Light Company, read a paper on "Engine-Room Management" before the Ohio Electric Light Association convention at Toledo, July 14. The man in charge of the power station, he said, should have a practical knowledge of his plant, should be informed on the practical possibilities of steam appliances and machinery and be able to search intelligently after sources of loss and chances for improvement, and should be a judge of material to know what is best for his requirements. He should never become attached personally to any of the men in his employ, otherwise he is not in a position to judge the value of their ability.

The two essential factors that he should maintain are discipline and system. It is a comparatively easy matter to enforce discipline where system is properly maintained. There is more to gain in an intelligent and economical use of engines and boilers than in any immediate improvement in the machine itself.

While designers and professors are discussing 2 or 3 per cent savings the customers are buying engines so proportioned to their work and so little adapted to their requirements that many times 2 per cent are wasted continually. The way to get the most work out of a steam plant is to find first in what particular the plant is lacking and then bring that part up to the standard. Find separately the efficiency of boilers and engines. If the boilers are inefficient it may be because the rate of combustion is too high or too low for the amount of heating surface. The setting may be faulty, the fireman wasteful, or any one or more of a dozen causes. The engine may be underloaded or overloaded, badly set or leaky. Find the trouble and then go systematically to work to remedy it.

Every engineer, no matter how small his station, should have organized a testing force and have piping arranged to determine what each unit is doing. Elaborate tests are not necessary. Engine tests should be simple, showing the water rate per kw-hour with indicator cards. After the water rate is obtained and found to be high, analyzing the indicator diagrams will tell where the trouble is likely to be.

At 7 per cent CO_2 in the flue gases enough unnecessary excess air is heated to keep a duplicate of the furnace plant going, and at 5 per cent CO_2 the excess would almost keep two additional plants running.

Few concerns would think of putting as much money into any kind of business as is invested in the average power station without having a clerk or bookkeeper, or a number of them, to keep an intelligent record of all transactions. The auditing department takes care of the financial end, but that does not help the engineer keep track of operating figures. In the majority of plants to-day it is the common practice to depend largely on memory for records of the repairs made on station apparatus. The author then outlines a system of keeping track of repairs in large power stations in such a way that the chief engineer will be continuously informed as to what is going on, and records kept.

The clerical force can make money for the power station in various ways. For example, it usually costs from $105 to $125 to renew a furnace arch for a 350-hp boiler. There are fire brick of various grades, and while records are kept of when the arches are renewed, it requires time to follow up records and compare results obtained by the use of different brick. If brick could be found (and they can) which would last twice as long as a poor grade, more than half the expense for renewals of arches would be saved. The same thing applies to packing and other supplies. Every power station should have a set of rules and regulations for its employees.

Boiler-Room Economies.

Mr. N. B. Ayres read a paper on "Boiler-Room Economies" before the Ohio Electric Light Association, at Toledo, July 14, from which the following points are taken:

Of the average switchboard cost, 60 to 80 per cent is spent in the boiler-room. How many boiler plants are delivering 70 per cent of the energy supplied to them? How many are delivering even 50 per cent? How many managers know what per cent of the energy purchased in coal their boilers are delivering? How many even know how much energy they are receiving in the fuel they purchase? Steam lines are carefully covered to prevent transmission of heat through the pipe. Why, then, cover the boiler tubes with scale on one side and soot on the other and expect the same transmission?

The scale, like the poor, we have always with us, but the development in chemical and mechanical treatment has robbed it of its former terrors. The average office is safeguarded against draughts by storm windows and weather strips, with a difference of temperature of perhaps 30 deg. on the two sides of the wall, while the leakage of air through the average boiler setting is neglected, although the difference in temperature is 20 or 30 times as great. The importance of this point is illustrated by a series of tests made on the 650-hp B. & W. boiler, first with plain brick setting, and then with a 0.5-in. coating of cement over the brick. The increase in efficiency in the latter case was sufficient to justify the engineers in recommending an air-tight sheet steel casing outside the brick work.

In a word, the first step toward economies is perfect condition of apparatus, not type of apparatus, because, in the first place we already have the apparatus—have inherited it—and must make the most of it; and, in the second place, there is not a great difference in the efficiencies of the various types of boilers, furnaces and heaters now on the market and in use.

As most coal contracts are made in the early summer, this must be considered. A low-grade fuel in a plant of limited capacity might be cheap in June and prohibitive in December, because of inability to carry the load with it. A point of considerable interest in figuring on coal on a guaranteed b.t.u. basis is the difference in values between run-of-mine coal and slack, or nut and slack. In this system the guarantee is to deliver so many net b.t.u. for 1 cent, and in the majority of cases it will be found that the purchaser is paying an exorbitant price for the privilege of having his fireman break up the lumps. Economy in the boiler-room is entirely a question of the man in charge. Mr. Ayres says man rather than men because it is a question of one man. It is impossible to retain firemen who have the ability to economically operate a boiler-room. If they are bright, intelligent men they graduate to the engine-room, leaving behind the young and inexperienced and the old and unintelligent. Any plant of any size can afford one good man in the boiler-room. He should rank with or above the engineers both in ability and wages. Boilers, like engines, have efficiency

curves, although the boiler curves are very flat and the average boiler will operate at a remarkable overload without decrease in efficiency. The character of this efficiency curve should be determined and the boilers operated at the highest possible point. This information is important in determining to what overload the boilers should be operated on the peak and the point at which it becomes uneconomical to cut in another boiler. Frequently boilers can be operated at or near 200 per cent of rating for a few hours, with a remarkable gain over the cost of firing up another boiler, but the increase in maintenance may overbalance the saving in fuel.

In general, the tendency is toward high furnace temperatures, high rates of combustion and high per cent of overload, and the results indicate that this tendency is in the right direction. A fire-box temperature of 2800 deg. is not uncommon. The burning of 40 lb. of bituminous coal per square foot of grate per hour is an every-day occurrence, and boilers are operated continuously at 200 per cent of the builder's rating, developing 1 hp per 5 sq. ft. of heating surface.

Discussion

Mr. F. L. Duncan, of New Libson, pointed out that insufficient boiler capacity may in some cases prevent the use of the cheapest fuel. For example, a certain slack with a high percentage of ash might cause the lowest coal bill, but it might be impossible to keep up steam during heavy load or it might require more labor.

Mr. J. C. Martin, of Wilmington, gave some experience with boiler feed water. At one time his company had wells in gravel the water from which caused a great deal of boiler scale. A dry year they were forced to go deeper for water and found a new water 200 ft. down that when first used in the boilers caused falling off of the scale already on them, but in time this formed a different scale. This drove them to the process of softening the water before it enters the boiler by means of lime and soda ash. The company happened to have a tank 12 ft. high x 16 ft. in diameter on hand, and used this for the settling tank after treating the water with lime and soda ash to precipitate the scale-forming solids. This system had worked very well. Mr. Martin is now putting in coal scales and water meters so as to keep a more accurate record of the water used.

Mr. D. L. Gaskill reported having had 13 years' experience with a water-softening plant at Greenville. Two tanks are employed, one supplying the boilers while the settling is taking place in the other. In six years there had only been $6.50 repairs on the boilers, except grate repairs, which showed how effectively the scale had been taken care of.

In answer to a question from a member as to the shrinkage in coal weight experienced between the mines and the plant in transit, Mr. A. A. Pointer, of Antwerp, said that he found that he had to charge off 10 cents per ton for shrinkage for short weight as an average the year around. This varies according to the season, and is as high as 25 per cent in winter with coal which has lumps which can be easily thrown off. Some members suggested that sometimes shrinkage could be saved by so routing cars from mine to plant that they do not have to stand in railroad yards a great length of time. Most of the coal stealing is done around such terminal yards. There are plenty of families around such yards which are never known to buy coal.

The Prevention and Removal of Boiler Scale—III.

By W. H. Wakeman.

UNDER the exact conditions described in the previous article no economy can be expected of a boiler compound so far as the consumption of fuel is concerned (although its removal is desirable on other accounts), and as these conditions are approached in other cases the resulting economy decreases. Under the following conditions the use of a suitable boiler compound will save much fuel. Suppose that the shell and tubes are covered with hard scale, say, from 1/16 in. to ½ in. thick, and the load is so heavy that gases escape to the stack at a temperature of 600 deg. Fahr., while the temperature of the steam is 338 deg. Practically all of the scale is removed and the removal of this obstruction allows heat to pass through the iron so rapidly that the final temperature of the products of combustion is reduced to 400 deg. Fahr. In other words, much heat that formerly went into the chimney now goes into the water, hence less coal is used. The foregoing descriptions

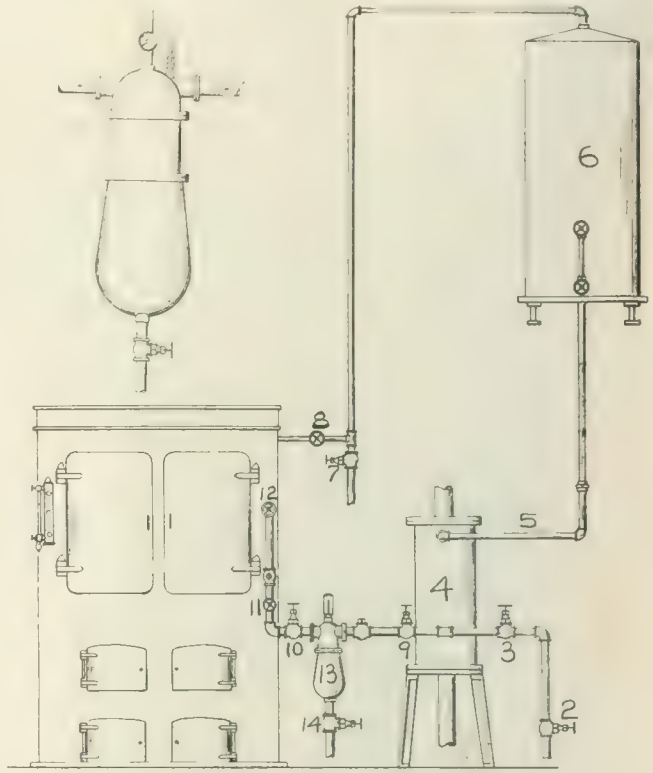


FIG. 1.—FEED-WATER PURIFIER CONNECTIONS AND DETAIL.

show why the same results are not secured in all cases from the removal of scale from boilers.

Fig. 1 represents a feed-water purifier which is used in connection with a gravity boiler feeder and an exhaust steam heater. Cold water is admitted through the valve 2 and passing through valve 3 enters the heater 4 where its temperature is raised to nearly the boiling point, provided the heater is large enough to heat it as fast as it flows through the coils or tubes against a light pressure. The exhaust steam from an engine will heat more than five times the weight of water required to make live steam for the engine, but it is possible to force cold water into some of the heaters in use faster than this admits, therefore it is not very hot when it comes out.

Passing through the pipe 5 the water enters the tank 6 and is allowed to flow in until the tank is full. During this time air is expelled through the upper pipe shown and the valve 7, which is left open for this purpose. As the tank is full of hot water the supply is shut off at valve 2, then valve 7 is closed and valve 8 opened to admit live steam to the surface of this water in order to equalize the pressure in all parts of the tank 6. When this is accomplished the valves 9, 10, 11 and 12 are opened and water gravitates from the tank 6 through valve 5 and heater 4, where it is reheated, passing thence into the boiler. A glass water gage is located near the bottom of tank 6 and when this indicates that nearly all of the water has run out the process is repeated, but it is not necessary to close valves 11 and 12 unless the check valve between them requires attention. Boiler compound is not used in connection with this device, but the water flows through the purifier 13, which retains a large proportion of the scale-forming impurities, whence they can be blown out through valve 14 to the sewer.

An enlarged view of this purifier is presented in the upper corner of the engraving which carries a thermometer at the top to show the temperature of the feed water. It is necessary for

the temperature to be kept high in order to precipitate the impurities that will not settle at a low temperature, or, in other words, below the boiling point. Carbonate of lime can be thrown down by this treatment, as the heat of exhaust steam is sufficient for the purpose. However, a higher temperature is required to precipitate sulphate of lime, which forms a troublesome and dangerous scale. If steam is carried at 100 lb. pressure or more, and the feed water is allowed to remain in the tank shown in Fig. 1 long enough to become as hot as the steam which goes into the top, much of this objectionable ingredient can be disposed of. If this is not sufficient, a higher temperature can be secured by utilizing the heat in the gases after they have left the boiler and before they pass through the chimney. As this foreign matter is precipitated and caught in the purifier it becomes necessary to blow it out several times each day, in order to prevent a large quantity from collecting at this point and being carried through the purifier into the boiler.

When feed water is analyzed great importance is attached to the amount of solid matter found in it per gallon, because some of this solid matter is objectionable. For instance, a certain sample of water contains 50 grains of carbonate of soda per gallon. This can easily be disposed of by frequently changing the water and by blowing down the boiler while it is in use, say, once in 10 hours. On the other hand, the presence of an equal weight of salts of lime would render the water unfit for use unless special precautions were taken to purify it.

In some plants it is practicable to use either of two kinds of water, one of which leaves scale in the boilers, while the other does not. For illustration, a certain plant was supplied with water from the street service, and there was a large cistern into which rain water from the shop roofs collected. The former contained more or less objectionable matter, but the latter was pure, except for a small amount of dirt. As the local company supplied this plant on a flat-rate basis, there was no special object in saving the water thus secured, but the engineer used

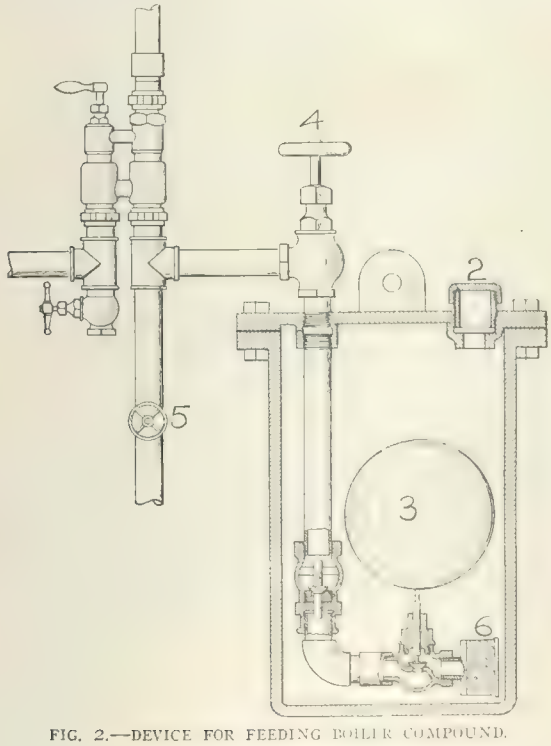


FIG. 2.—DEVICE FOR FEEDING BOILER COMPOUND.

water from the cistern at regular intervals, because he believed that it assisted in dislodging the old scale and did not form new scale to be removed by other means.

From extended observation it is but natural to infer that impurities in the feed water will pass out with the steam. The fact that more is not found in boilers demonstrates that some portion does go through the steam pipe, especially if more or less moisture goes into the engine and pump cylinders.

Fig. 2 illustrates an ingenious device for supplying crude petroleum, soda ash dissolved in hot water, or any other boiler compound, at intervals. The body is filled with the liquid through the plug 2, which causes the float 3 to rise and open the valve below it. Assuming that the inspirator is not working, the angle valve 4 must be closed, because the first water drawn by an inspirator (or any other form of injector) goes to waste. After the inspirator has been started and water comes through

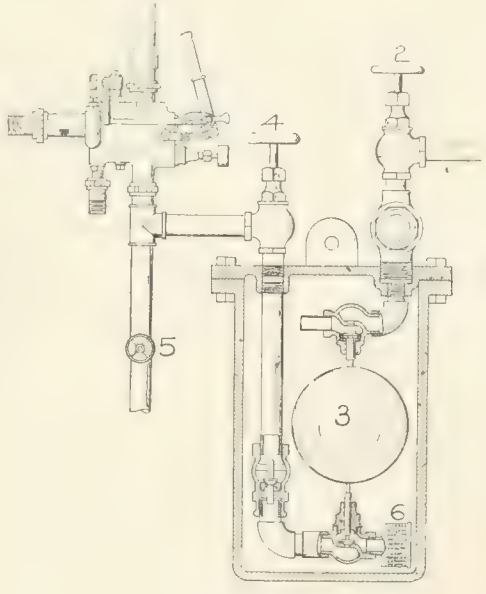


FIG. 3.—BOILER COMPOUND FEEDER.

the suction valve 5, valve 4 should be opened slowly: If the supply of water is lower than the compound feeder, the scale resolvent will be drawn in rapidly, therefore, valve 4 should be nearly closed, because, as a general rule, boiler compounds will not condense steam as fast as water, hence the inspirator will "break" and cease feeding if given too large a dose. Where water comes to valve 5 under pressure it is necessary to close it slowly until a part of the supply is drawn through valve 4. Water cannot be forced back into the compound feeder because there is a vertical check valve in the suction pipe. When about three-quarters of the compound has been drawn out the float 3 falls and the valve below it is closed, thus preventing air from entering through the strainer. When the required quantity of compound has been put into the feeder and enough drawn out to close the valve below 3, several gallons of water ought to be passed through the feeder until all of the compound is taken out. The reason for this is that the capacity of this feeder is 1 gal., and there are many cases where this quantity is considered sufficient for one boiler, but if precaution is not taken to remove all of it, the boiler will receive only 75 per cent of what was intended to go into it.

Fig. 3 illustrates a device similar to the preceding one, but designed for feeding a compound continuously, without interfering with the operation of the injector. Instead of the plug an angle valve 2 is used to admit the compound from an elevated tank, and it passes through a sight feed below the valve. When sufficient compound has run into the feeder to raise the float 3 it closes the inverted valve above it, and thus shuts off the supply. At the same time the lower valve is opened and the compound is drawn through valve 4 into the injector and thence goes into the boiler. The valve 5 in the main suction pipe is not used on a high or medium lift, but if water comes under pressure, valve 5 must be used to throttle the supply. As soon as enough of the compound has been drawn out to lower float 3 the valve above it is opened and more is admitted from the tank. It is thus possible to maintain a nearly constant quantity of compound in the feeder until it is all drawn out of the tank, when the suction valve is closed by the action of float 3, and air cannot be drawn in through strainer 6. In both cases the internal devices are fastened to the cover, hence when that is removed they all come out with it, thus making it possible to adjust or renew any part with little trouble.

The Relations Between Central Stations and the Electric Automobile

SCOPE OF INVESTIGATION.

WITH the object of determining as nearly and closely as possible the present relations between the central stations and the electric automobile as a consumer of electrical energy, the *Electrical World* sent out last May a circular of inquiry to some 4000 stations in this country, with a stamped envelope for reply, addressed to the editors. The object was to stimulate interest in the subject, hitherto neglected by many managers, and to elicit information as to the extent to which effort had been made to secure and develop this new "load." The request was made that all central-station managers receiving the form of census would reply to as many of the questions as possible and offer such comment as the situation might seem to demand. The "returns" are still straggling in, but as enough have already been received to furnish data of great value and usefulness, it has been decided by the editors to collate and digest those in hand, with the idea that others received later from important places can be treated separately, if they contain new data of any significance. As a matter of fact, very nearly 1500 returns have come in from stations which represent the great bulk of the industry as to capital invested and output of current, and this fact alone stamps the inquiry as a great success, worthy of the time, expense and effort devoted to it.

As would be expected by those who know the condition of affairs, a great many of the stations have done nothing at all in this new field and have given it little, if any, attention. A common and characteristic form of response is that of writing across the schedule, "Nothing doing," without any attempt to explain the reasons or justify the absence of electric automobiles from the given territory. In many instances these are from districts where one would suppose that the electric vehicle had a good fighting chance, but, of course, if those who should be its best friends treat it with absolute indifference or ride around in gasolines it will be some time before it can come into its own, as it has begun to do elsewhere. An inquiry of this kind simply shows the tremendous inertia that has to be overcome before any great advance or improvement can take place. Before taking up the actual work done, or exhibiting the real active interest shown in the subject, it will be worth while to canvass briefly some of the remarks made on the negative side. They are not all evidences of apathy, and some of them bring out sharply the points of weakness in the electric automobile of to-day.

REASONS AGAINST ELECTRIC AUTOMOBILES.

There are 44 of the schedules that are answered in the negative sense, with a definite reason why; and all of these reasons relate to the nature of the country. It is stated that the country is too mountainous or too hilly, that there is too much sand, or that the roads are too bad. No fewer than 21 of the companies report adverse hilly conditions, in 14 different States. Asheville, N. C., says that "The hills of western North Carolina are, or seem to be, almost too heavy for the electric automobile. There have been a few at different times, but they have not proved good." The Northern Westchester Lighting Company, of Ossining, N. Y., remarks: "On account of hills, no electric automobiles in territory. This company had an electric truck which was not satisfactory." Winchendon, Mass., says: "There have been first and last three electric automobiles brought into this town. They have all proved a failure on account of the country being somewhat hilly. While we have a great many automobiles in town, the electrical machine is not even considered." Staten Island, N. Y., does not admit that its steep grades are altogether prohibitive, but notes "Very few electrics used on Staten Island. Country very hilly." Ithaca, N. Y., is more positive to the effect: "Too many hills in this country for electric autos," while Eureka Springs, Ark., admits explanatorily: "There are no automobiles in this city, as it is all mountainous; not a hundred square feet of level ground here."

The roughness of the country is also alleged in several instances, although this would appear to be a superficial objection incident to the condition of the roads rather than the state of the pastures and woodlands. Thus Biddeford, Me.: "Electric automobiles have not been sold in this town. The surrounding country is very rough." In like manner Bedford, Ia., says: "No electric cars in this country; too rough." Sebewaing, Mich., and Colville, Wash., concur, using the same language. Others are very frank, however, as to the state of the streets and roads. A typical example is Nacogdoches, Tex., the company saying: "We have no autos of any kind. Our streets are all deep sand and it is impossible to operate machines of any kind. If we ever have our streets paved, we may have some machines." Del Rio, Tex., where there is a power circuit, says: "Our roads and streets are such that no one has attempted to run an electric automobile." Russellville, Ark., says that its roads were so bad that all the automobiles in the place were sold some time ago, including the gasolines. There are several other sad commentaries on American city thoroughfares, and some on rural roads. Henderson, Tex., allows: "This country is not at all suitable for automobiles. Deep sand, and hilly and rough." The Southern Colorado Power & Railway Company, of Trinidad, says: "There were three electrics here at one time, all owned by parties interested in the electrical business, but conditions are not favorable, so they were changed for gasolines." The Northern Light Electric Company, Wahpeton, N. D., remarks: "No electric automobiles here. Wahpeton has no paved streets, and automobiles are required to make long trips into the country; therefore, electrics are not well adapted for use here." But the limit of unavailability seems to be reached in one section of Arkansas, of which the Harrison Electric Light & Ice Company reports: "This country is not adapted to autos—no autos at all—not a bridge in five counties." Under such circumstances, the management does well to boom ice making in preference to charging autos. The Danville (Ky.) Light, Power & Traction Company is very pessimistic in its point of view: "We are located in an extremely hilly country, and have not faith in the electric ourselves"; but one can be more cheerful with the Watauga Electric Company, of Johnson City, Tenn.: "Have no electric autos in town; roads too bad. Hope for better things soon."

VARIOUS ANTAGONISTIC CONDITIONS.

Another large batch of answers to the schedule may be put into a general group of "Objections, Doubts and Inquiries." Of these there are no fewer than 64 of a very miscellaneous character. It is stated by the Citizens' Gas, Electric & Power Company, of Nantucket, Mass., that there are no electrics for the reason that all automobiles are barred from the island from May 1 to Oct. 1 of each year by law. Bar Harbor, Me., reports: "There are no automobiles here of any kind. We have a law prohibiting their use." A strenuous comment of the same kind comes from the Gardiner (Mont.) Electric Light & Water Company: "We live on the edge of the Yellowstone Park, and until it is opened to autos nothing will be done. Why don't the auto builders demand that it be opened to all alike? Get after your Senators and have it done." These statements one can understand, but it is rather difficult to follow the objection made in several instances, on the ground that "this town is too small." Thus, the manager of a company in Connecticut writes: "They hardly seem practical to me in a small town for private use." Of the same tenor is one from Illinois: "This is a very small town, and while there are quite a number

of automobiles here, the people are very prejudiced against the electric vehicle." A writer in Wilbur, Wash., is more explicit, but does not throw much light on the basis of this objection, which is apparently less real than imaginary: "There are no electrics in use in our territory. The town is perhaps too small for this kind of machine, only having a population of 1500. Those who have use for automobiles desire machines that can run several hundred miles; consequently the gasoline machine is all the go." Difficulties of securing gasoline suggest themselves, however, almost as much as the lack of charging stations, when it comes to long-distance travel.

Various other remarks betray apathy and indifference that seem a little remarkable; and a readiness to take it for granted that the electric has no chance. Thus, for instance: "No call for electric machines." "Twenty-eight automobiles in Hammondsport, N. Y., and not one electric. No one here would have one." "At the present moment all cars in use are gasoline machines, the electric not having proven its adaptability to country conditions." "We have nothing to do with outside issues. We light the streets." "There are no electrics here at present, as they are so much more expensive than gasoline cars. We have never made any rates for them." "There is not an electric auto in this city. People do not seem to want them on account of their limited mileage." "There are no electric vehicles in this section. The initial cost is too much for our people to invest in." "Have no electric automobiles. There seems to be a lack of confidence in them." "No electrics in town; have had a sample machine, but could not sell it."

ON THE INQUIRERS' BENCH.

It is obvious that the preceding objections and criticisms are made in good faith, but one would hardly choose their authors as leaders of forlorn hopes or as comrades in a search for the North Pole. Even so practical a matter as the improvement of the load factor requires some courage, something adventurous in spirit; hence it is encouraging to note that just two score of the schedules indicate a desire for information, a willingness to investigate, a readiness to lend a hand for the common good. These cheering evidences of a feeling that the electric automobile has some merits come from widely scattered points in Arizona, California, Colorado, Georgia, Idaho, Indiana, Illinois, Iowa, Kansas, Maine, Massachusetts, Mississippi, Montana, Missouri, Nebraska, New Mexico, New York, Ohio, Oklahoma, South Dakota, Texas and Virginia. Many of the writers are not merely willing to "help the movement along," or "are interested in establishing this department," but are desirous of taking agencies for the sale of automobiles. This opens up a large question, but as 50 per cent of the central stations in the country handle supplies and sell apparatus there seems no good reason, from their standpoint, why they should not do this, just as they would install motors or fix up a big sign. The attitude of the automobile manufacturer to this proposition is another matter. One correspondent says: "Send me address of some responsible company that manufactures electric machines that sell at moderate price, and who would probably desire a selling agent at this place. We have ample facilities for charging batteries." This is typical of many others, waiting for help. Some go out and get what they want. "I have written to a number of builders of electrics for catalogues, etc., with a view of seeing what can be done in our city with them. Would be glad to have any information I can get concerning their use." Or this: "The manager of the company has the agency for an electric automobile and hopes to sell some cars this season." Such a position brings up the question, of course, whether the manager will sell a machine that is best for the customer, or primarily best for the manager to sell; and, next, whether the most helpful policy is that of working up a "prospect" and then getting him or advising him how to get just what he needs. Another company says: "We are endeavoring to sell electric machines and will handle supplies if we can do any business." A further example of broad gage policy is this: "We are preparing to equip our plant with charging apparatus, and will be glad to have the co-operation of all interested in furthering the industry." From Oklahoma comes this: "Would like literature as to rates, cost, etc., of maintenance of electrics, and would like to become agents for some good electric machines." A practical inquiry from Ohio runs thus: "We have an inquiry from our local automobile garage asking as to the cost of an equipment for the purpose of charging electric automobiles. They claim that they have some five to ten prospective customers, provided a charging outfit be installed, and are very desirous that we shall install one, as the community is not large enough for more than one charging set." Then follow details of the system. Another station in New York State remarks: "This company desires information and expects to install equipment and sell electric vehicles, through its commercial department." Out in Nebraska, a local company says: "A dozen electrics could be sold in this city." Why not sell them? A company in Mississippi shows the right spirit when it says: "We have been thinking of buying one for our own use in order to introduce them here." If each company did that, it would make a market for nearly 5000 machines during the next year and bring the price down very appreciably. Another company in Illinois has the same feeling: "We have thought of getting an electric auto, together with the agency, and rig up for charging the same." And this is also excellent: "There are no electric automobiles here, but we have plans under way which we expect will result in the use of quite a number." Similarly, from Illinois, comes this: "We are anxious to do what we can to help this branch of our business. As there has been no local demand for such a service, we have not prepared for it, but we believe there is a good future, and shall be glad to work with other central stations to develop it. Shall be pleased to receive your suggestions." A third Illinois comment is kindred: "Not in the electric yet, but talking it up; expect it to develop later." Out in Idaho, a station says: "No electric automobiles in this city, but this company is contemplating the purchase of one or more." A significant evidence of interest is that given by the Athens (Ga.) Electric Railway Company, which says: "We will appreciate any information that will assist us in building up this field."

CHARGING IGNITION BATTERIES.

Before passing on to consider the data obtained relative to the electrics themselves, the fact must be noted that several central stations while doing nothing as to such business state that they do derive some revenue from the charging of batteries for ignition in gasoline machines. Returns to this effect were received from no fewer than 61 companies. With some of them it is still merely incidental; with others it has become a specific, if small, source of income. At Hillsboro, N. H.: "Occasionally our electrician charges a storage battery for which he may receive a tip, or charge for his services; no income to company." At Alliance, Ohio: "We have no electric automobiles in this city, and the only charging is done for storage batteries for spark coil. Although we have facilities for doing same, it does not amount to more than $5 or $10 a year." The Kenmare, N. D., station puts its receipts from this source at about $100 a year. On the other hand, the Telluride (Col.) Power Company says: "We have charged two or three ignition batteries for stragglers who have entered too far into the mountains, but have rendered no bill." At Rumford, Me.: "We are looking for more business, and last year arranged for charging ignition batteries." Lockhart, Tex., reports receipts of $18 a year from this source, and does it by putting the batteries in series with lamps, which does not sound profitable, though it may accommodate friends, as one of the officers of the company sells gasoline automobiles. At Plymouth, Ind.: "We charge a great many batteries for ignition and do it on the exciter." The income at Albert Lea for ignition battery charging is $75, the work being done through a rheostat. One company reports about 250 gasolines in its city, and that it earns $50 a month charging the batteries with a small rectifier. At Lyons, Kan., 50 batteries per month are charged. At Grundy Center, Ia., there are 40 gasoline cars, of which 20 have batteries charged by the local plant, at a rate of 7 cents per kw-hour. It is stated from one place in Montana.

by the local company, that the sparking storage batteries are charged by the telephone company.

A variety of prices are paid to the stations for this work, which may be briefly noted as follows: Phillipsburg, Kan., $1 per battery; Salinas, Cal., $1 per charge; Cory, Pa., 50 cents per battery for storage batteries of three cells; Albert Lea, Minn., 75 cents per charge; Ottawa, Ohio, $1; Mineral Point, Wis., $1 for a three-cell battery; Victor, Mont., $1 a charge; Humboldt, Neb., 75 cents each; Taylor, Tex., $1 per charge; Oakland, Ill., 50 cents, 60 amp-hours; Rangeley, Me., 25 cents per cell; Vinita, Okla., 50 cents each; Mt. Carmel, Ill., "getting about 12 cents for charge of current"; Waterford, Pa., 50 cents per three-cell battery; Richmond, Ohio, 50 cents per battery; Kent, Ohio, 50 cents per charge; Ellenville, N. Y., 50 cents apiece; Calvert, Minn., 50 cents. These differences seem to be quite arbitrary, and not to have any particular relation to the cost of current or amount of business.

USE OF RECTIFIERS.

In view of the fact that so many central stations employ alternating-current dynamos only, it was recognized that they could not very well undertake to handle electric automobiles, and that many of them had already introduced the modern arc rectifier as a means of solving the problem. Hence one of the questions in the schedule of inquiries related to this class of apparatus, in connection with electric automobile work. It is not altogether certain that the inquiry was accepted or understood in the spirit in which it was put forward, as many of the stations responding appear to regard it as applying to all purposes for which this new and ingenious apparatus can be utilized. The answers, while all proffered in good faith, must not, therefore, be considered as strictly relevant in every case to the general purpose of this census. The question would have been clearer if instead of merely asking whether the company installed and sold rectifiers, the words had been added, "for automobile charging purposes." But, subject to this possible revision, the figures may be accepted as interesting and significant. Outside of the companies which report themselves as actually interested in automobile work, no fewer than 66 reply that they have taken up the introduction of rectifiers or are ready and willing to do so. Some of them state specifically that this adoption of the rectifier is for the purpose of charging storage batteries. Others say: "We are endeavoring to get into this line"; "We will if we can interest any one to make the installations." "Expect to soon"; "Will if demand can be created"; "Would sell and install if we had a chance"; "Have had inquiries but no sales as yet"; "We are preparing to do so"; "Some may be interested this season." A good deal of business in this line would seem to be latent, not far from the surface and waiting development. The responses to this inquiry are of general and widespread origin, and come from Arkansas, California, Connecticut, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Massachusetts, Michigan, Minnesota, Montana, Missouri, Nebraska, New Hampshire, New Jersey, New York, Oklahoma, Ohio, Oregon, Pennsylvania, South Dakota, Texas, Vermont, Washington, Wisconsin. Of the returns, 27 quote prices for electrical energy, but this subject will be taken up under another head.

One of the most interesting examples of the introduction of rectifiers is furnished by Toledo, Ohio, where at one time only direct current was available with rheostats, but where the extension of alternating circuits has rendered it possible to use the new device. The Railway & Light Company has already installed 25 in private garages, and a large number in public ones—as many as eight in a single instance, with two more to be added. The company sells a 20-amp rectifier for $230 and a 30-amp for $250. A reduction of $20 is made from the price if the purchaser undertakes to install the rectifier himself.

THE NATURE OF THE INQUIRIES.

The form of census blank used by the *Electrical World* in this investigation included 18 questions which were as follows: (1) Name of Company and Location; (2) Number of Public Electric Garages in City; (3) Number of Garage Electrics Cared for; (4) Number of Public Garages on Company's Circuits; (5) Number of Private or Isolated Electric Automobiles Charged by Company; (6) Number of Automobiles Not Charged by Company and How Charged; (7) Rates to Public Garages for Current; (8) Rates to Private Automobile Owners; (9) Gross Amount of Company's Income; (10) Number and Capacity of Company's Own Electrics; (11) Number of Electric Automobile Dealers in City; (12) What Makes of Automobiles and Batteries Are Used?; (13) What Rates Do Garages Charge?; (14) Does Company Handle Automobiles or Supplies for Automobiles?; (15) Have You Any Special Automobile Official?; What Are His Duties?; (16) How Are Batteries Cared For?; (17) How Is the Current Supplied? What Is the Garage Equipment?; (18) Do You Sell and Install Rectifiers? The company was also asked to send in any literature, advertising or published automobile charging rates. These questions were prepared with considerable care, and submitted to experts before adoption, but it was not expected in some instances to elicit much definite data, though it was thought, and has happened, that the very fact of asking the question would set local companies thinking on the subject. Two of the questions have caused confusion in the minds of many, though one of them is quite definite. It was asked, as above, how many electric garages there were in the city, and next, how many were on the company's circuits. In several instances the answers to these questions include not simply electric garages, but every garage connected to a given company's mains if it happens to be a customer for current. Now in some instances this patronage is quite heavy, worth getting, and might well lead on to the inclusion of electric automobile service. Thus the Queens Borough Gas & Electric Company, of Far Rockaway, Long Island, reports connection with 13 garages in its territory, but says: "All the garages are almost entirely engaged with automobiles of the gasoline type, the electrical being the exception. Our power is used for charging sets, and for motors used for the general repair work and for elevators; also for lighting." In many ways this may be regarded as a typical case, but it will be seen that such answers tend to vitiate the accuracy of any statement as to the number of electric garages, conducted as such.

Over 250 of the companies addressed sent in data as to work of their own, work done in their vicinity, rates, and other points of interest, these being additional to those already enumerated except a few of those already discussed as to rectifiers, the inquiry with regard to which was given a broader meaning than intended. It seems best for the purpose of summarizing the data to take up the answers to each question as a whole, and to close this analysis with a few general remarks. Before doing this it may be stated that in addition to the 250 returns now to be considered, the Electric Storage Battery Company of America reports 154 additional names, as the result of special inquiries of its own, these being companies that have manifested a distinct interest in the new work. It will be seen, therefore, that, one way and another, nearly 500 central station companies are aroused as to the possibilities, and many of them are building up a new "load." Unfortunately a few of the larger cities have failed to reply, although written to more than once on the subject because of their known activity in the field: but it is a familiar fact that in many instances the traditional policy of never disclosing information about a company's affairs still prevails, an attitude that inquisitorial legislation has done something to encourage. The returns dissected below originate as follows: Alabama, 1; California, 8; Colorado, 6; Connecticut, 6; Delaware, 1; District of Columbia, 1; Georgia, 2; Illinois, 22; Indiana, 13; Iowa, 9; Louisiana, 2; Kansas, 7; Maine, 1; Maryland, 2; Massachusetts, 21; Michigan, 12; Minnesota, 3; Missouri, 6; Montana, 1; Nebraska, 4; New Hampshire, 3; New Jersey, 7; New Mexico, 1; New York, 32; North Carolina, 5; Ohio, 16; Oklahoma, 3; Pennsylvania, 18; Oregon 1; Rhode Island, 1; Porto Rico, 2; South Carolina, 1; South Dakota, 3; Tennessee, 3; Texas, 8; Utah, 1; Virginia, 3; Washington, 3; Vermont, 3; Wisconsin, 8, and Wyoming, 1. We

thus have no fewer than 41 of the States and Territories represented in the returns, making the contemporaneous picture a very comprehensive one.

NUMBER OF PUBLIC ELECTRIC GARAGES.

Note has been made above as to the slight misapprehension arising in regard to this question, and the tendency to consider a garage electric if it receives any kind of electric service. But the internal evidence of the data is helpful in such cases. The Los Angeles (Cal.) Gas & Electric Company reports 5 on its circuits giving electric service, and notes that there are two other companies in the city. At Sacramento, Cal., there is one. The Denver Gas & Electric Company reports 13. The Potomac Electric Power Company, of Washington, D. C., reports 17; Savannah, Ga., 3; the Commonwealth Edison Company, of Chicago, 30; North Shore Electric Company, Chicago, 9; Rockford, Ill., 6; Peoria, Ill., 2. Freeport, Ill., says: "There are three electric machines in Freeport, of which two are charged in our power house, and one by an individual rectifier." Kewanee, Ill., 2; Paxton, Ill., 1; La Harpe, Ill., 2; Evansville, Ind., 3; Lafayette, Ind., 2; Vincennes, Ind. "Four public garages in the city, none of them strictly electric; two carry electrics." Marion, Ind., 2; La Porte, Ind., 1; Burlington, Ia., 1; Davenport, Ia., 4; Des Moines, Ia., 5; Osceola, Ia., 1; Waterloo, Ia., 3; New Orleans, La., 10; Peabody, Kan., 1, "party is putting in a small dynamo and gas engine"; Wichita, Kan., 2; Baltimore, Md., 3; Boston, Mass., 15, "in addition most ordinary garages take electric cars as well, but are not fitted for looking after batteries"; Brockton, Mass., 5; Fall River, Mass., 2; Gloucester, Mass., 2; Haverhill, Mass., 2; Lynn, Mass., 8, "none that are wholly electric; a number care for electric machines; in three instances have supplied motor generator sets to garages to use in charging"; Manchester, Mass., 2; New Bedford, Mass., 8; Newton, Mass., 3; Springfield, Mass., 5; Salem, Mass., 2; Adrian, Mich., 1; Ann Arbor, Mich., 1; Battle Creek, Mich., 4; Detroit, Mich., 35, "fifteen use our service for charging, every garage in town has service from our lines for light and power"; Port Huron, Mich., 2; Sheboygan, Mich., 2; Duluth, Minn., 3; Minneapolis, Minn., 6; St. Paul, Minn., 8; St. Louis, 6; "has also large public garage of its own"; Kansas City, Mo., 2; Beatrice, Neb., 1; New Jersey: "We have very few of these charging outfits, and I doubt if there are more than 25 in the entire State. These are placed back of the meter and charged for at regular rates." Atlantic City, N. J., 1; Lakewood, N. J., 3; Ridgewood, N. J., 1; Camden, N. J., 1; Brooklyn, N. Y., 16; Ellenville, N. Y., 1; Niagara Falls, N. Y., 8, "combination"; Fillmore, N. Y., 1; Buffalo, N. Y., 3; Far Rockaway, N. Y. (Queens Borough system; New York City, 8; Nassau County, 5; see reference above); Gloversville, N. Y., 1; Geneva, N. Y., 1; Hudson, N. Y., 2; New York City, 30; Patchogue, N. Y., 1; Rochester, N. Y., 14; Rome, N. Y., 1; Watertown, N. Y., 1; Charlotte, N. C., 1; Durham, N. C., 2; Raleigh, N. C., 1; Bucyrus, Ohio, 1; Cincinnati, Ohio, 7; Dayton, Ohio, 4; Elyria, Ohio, 3; Lorain, Ohio, 3; Marion, Ohio, 2; Massillon, Ohio, 2; Piqua, Ohio, 2; Springfield, Ohio, 2; Warren, Ohio, 1; Youngstown, Ohio, 2, "on a very small scale; do not charge more than 3 or 4 cars each"; Oklahoma City, Okla., 8; Harrisburg, Pa., 1; Hazleton, Pa., 2; Johnstown, Pa., 3, "all garages care for gasoline and electric machines together"; Pittsburgh, Pa., 6; Lancaster, Pa., 4; Sunbury, Pa., 1; Philadelphia, 10; Scranton, Pa., 1; Warren, Pa., 1; Waynesboro, Pa., 2; West Chester, Pa., 1; Portland, Ore., 2; Ponce, Porto Rico, 1; Providence, R. I., 2; Aberdeen, S. D., 3; Memphis, Tenn., 4; Nashville, Tenn., 1; Beaumont, Tex., 2; Galveston, Tex., 2; Granberry, Tex., 2; Houston, Tex., 1; San Antonio, Tex., 2; Victoria, Tex., 1; Salt Lake City, Utah, 5; Norfolk, Va., 2; Roanoke, Va., 3; Richmond, Va., 1; Seattle, Wash., 2; La Crosse, Wis., 3; Kenosha, Wis., 1; Oshkosh, Wis., 2; Oronto, Wis., 2; Cheyenne, Wyo., 1.

It is not quite clear from the returns that all of these are distinctively electric garages, although the great majority undoubtedly are. An attempt to distinguish garages where electric connection exists with central station circuits so that automobiles could be charged if desired gives an interesting group of 83 garages in addition to those above, located as follows: Selma, Ala., 1; San Bernardino, Cal., 1; Salinas and Monterey, Cal., 3, "for ignition"; Oxnard, Cal., 1; Pueblo, Col., 1; Bridgeport, Conn., 9; Laurel, Del., 1; Brunswick, Ga., 1; Farmington, Ill., 1, "ignition"; Beardstown, Ill., 1; Belleville, Ill., 1; Boswell, Ind., 1; Kokomo, Ind., 5; Crawfordsville, Ind., 4; Muncie, Ind., 2; Clarinda, Ia., 2; Clinton, Ia., 5; Minneapolis, Kan., 2; Arkansas City, Ark., 2; Sanford, Me., 2; Everett, Mass., 7; Newburyport, Mass., 3; Anaconda, Mont., 2; Grand Island, Neb., 2; Portsmouth, N. H., 4; Morristown, N. J., 6; Glen Cove, N. Y., 1; Wilmington, N. C., 3; Kenton, Ohio, 2; Chester, Pa., 1; Spokane, Wash. "The electric automobile business has not had much attention in Spokane. There are a few automobiles in use, the number of which I do not know. There are no exclusive electric garages. I hope within another year to be able to make a better report." Superior, Wis., makes a statement that is interesting: "One garage in city; handles no electrics. One electric automobile owned by the superintendent, electric department, this company; charged from an isolated electric plant at no cost to owner."

In addition to all the facilities for charging thus afforded, note must here be made of some described recently in the *Electrical World* and belonging properly in this census. It appears from this additional data that at Orange, N. J., there are 10 garages, four of which have charging arrangements. There are three at Elizabeth, N. J., and at least one at Newark, N.J., as well as one at Englewood, N. J. It is stated that at Hartford, Conn., one of the great centers of the automobile industry, there are about 12 commercial garages all equipped with charging facilities, while "the facilities in the surrounding country are also good." Several of the garages in Indianapolis are on central station circuit, having charging facilities, but the number is not given. Toledo, Ohio, reports 9 public garages which charge and care for electric vehicles. Cleveland, Ohio, a notable "home of the auto," has a large number of garages where charging can be done, but no exact figures are obtainable

AUTOMOBILES CHARGED BY GARAGES.

It is natural that the information in the possession of the central station companies should be very vague as to the number of automobiles charged in the garages on their circuits. Still, it was thought worth while to ask the question if only as a means of stimulating interest in the matter. The 250 schedules now under consideration do not all of them contain answers to it, but the 87 that do reply give a total of not less than 2827 machines. Hartford, Indianapolis, Cleveland and Toledo are not included in these totals, as the number of automobiles in each place charged by the garages is not quite distinct. At Hartford, Conn., there are upward of 100 electrics for pleasure service charged from the mains of the local company. The number charged by the garages, also, is not given, but it should be considerable. At Pasadena, Cal., there are about 200 electrics, but here again no division is made. Toledo, Ohio, has between 400 and 500 electrics, and as there are 85 private garages it would not be unfair to credit 400 vehicles to the garages. There are about 160 electrics in Indianapolis, but no distinction has been made. The number of electrics in Cleveland is definitely stated to be in excess of 1000 and may be 1200, but no division can be reached, although it is said that there are at least 300 private garages in the city and suburbs.

Meantime, it is encouraging to find as many as 2827 vehicles in the public garages of 87 towns and cities, especially as Washington, D. C., Denver, Col., and Philadelphia, Pa., are not included, for the reason that the numbers do not appear to be ascertainable. Under the circumstances, therefore, it becomes difficult to determine the total number of electrics in any place and the ratio or proportion to the population. This is certainly an interesting point. Thus Rockford, Ill., claims a total of 130, or 2.6 in 1000 population, of 50,000 to the city, while Pasadena, Cal., with a population of 15,000, claims about 200 electric vehicles, or 13 per 1000 at least.

It may be added that in the total of 2827 public garage electrics thus brought to account, 453 are credited to Chicago and district; 650 to New York City (Manhattan Island); 300 to

Rochester, N. Y.; 200 to Detroit, Mich.; 100 to Minneapolis, Minn.; 50 to St. Paul, Minn.; 80 to Boston, Mass.; 40 to Des Moines, Ia.; 25 to Springfield, Mass.; 30 to Galveston, Tex.; 80 to St. Louis (the company's own garage); 53 to Kansas City, Mo.; 180 to Buffalo, N. Y., and 100 to Pittsburgh, Pa. These constitute a large percentage, but on the other hand 16 of the garages reported elsewhere charged only 1 vehicle each off station circuits. It should be noted that there are no data from San Francisco, but that is the only very large city absent from the returns, as the others not included in the total of 2827 are able to give information as to the private charging, which will be considered next.

CHARGING OF PRIVATE AUTOMOBILES.

The inquiry with regard to the number of automobiles charged by the companies for private parties elicited considerable data, and more than was expected; while the amount of information furnished as to electrics "not charged by companies" is also unexpectedly full. A very large number of vehicles are brought to account in a manner which shows deep interest in the subject and a close study of its possibilities. Only one unsatisfactory note is struck as to absence of development, and that is in the case of Charleston, S. C. At one time there were three public garages in the city where charging could be done. Now there are not any, although the company charges two private vehicles. The extraordinary reason given is this: "Up to some months ago about 25 electrics were in use in the city, when a number of comparatively new second-hand gasolines were brought to the city by trading agents, who exchanged gasoline cars for electrics, taking in all the electrics but two." It may be hoped that the near future will see a rally from this curious blow, as Charleston, with 4-cent current, would seem to be a place where the electric can certainly hold its own.

In the case of many of the companies replying to these two questions a confusion existed as to how to separate them; and in several instances if a rectifier was used the company reported that machine as not charged by itself; whereas the object of the distinction in the inquiries was obviously intended to bring out the number charged by isolated plants. No fewer than 175 stations answered one or both questions, showing the remarkable total of 3490 machines, outside of public garages. Of these, apparently 953 were not charged by the companies, but the real number of "isolated" machines was much less, chiefly for the reason just noted, the answer in various instances being "automobile charged by private rectifier." In the case of Chicago, it is stated definitely that 105 private electrics are charged by the company, and 197 by isolated plants where gas or gasoline engines are used. In the case of Rockford, Ill., only 82 of the 130 in town are accounted for as being on the company's circuits, but as there are 55 private garages in the city, the difference is at once accounted for. St. Louis, Mo., reports definitely that about 60 machines there are charged from private plants, but both Boston and Philadelphia decline to make any statement or estimate, owing to the difficulty of knowing what is actually connected "back of the meter," and of eliciting the real facts in regard to what is done at isolated plants in the territory covered—in the case of the Boston system a large part of Massachusetts, owing to the extensive suburban consolidations. Detroit, Mich., on the other hand, has definite information on the subject and reports 90 as charged by itself and 200 as cared for by the garages, with none from isolated plants, although it does not seem unlikely that there may be some in the city. Kansas City, Mo., reports approximately 60 auto lines, with rectifiers, but states there are no others, except those in garages. It is not impossible that such reports overlook isolated instances, especially automobiles of the industrial type, many of which are charged from isolated plants in breweries, factories, large dry goods stores and are duly listed from time to time as such by the manufacturers. The case becomes particularly difficult in a place like Greater New York, where many vehicles of this type might easily exist unknown to the local companies, unless an expensive investigation were made at every isolated plant. The number for New York City of pure "isolated" electrics is given as 200 and for Brooklyn, 12. At Schenectady the 10 "isolated" of which note is made are all those of the General Electric Works. Cincinnati, Ohio, states that it does not know the number outside garages. It charges 25 directly and estimates the isolated ones as possibly "about 15, mostly motor trucks owned by manufacturers and charged from private plants." At Providence, R. I., the schedule reports 50 as not charged by the company, and none charged by itself, outside garages. At Buffalo as many as 125 are in large garages with isolated plants, but there are 535 machines in the city.

In addition to the vehicles enumerated above, there must be added at least 45 for Hartford, Conn., on the company's mains; 200 in Toledo, outside garages; 800 to 1000 in Cleveland; at least 100 in the New Jersey territory of the Public Service Corporation. In short, the data for 250 cities in the United States would indicate about 5000 electric automobiles, outside of those in the garages, which are counted separately; and would also indicate that in these places perhaps 750 are charged from isolated plants—i.e, not less than 10 per cent, and possibly somewhat more.

CENTRAL-STATION INCOME AND RATES.

Most of the 250 companies give their rates; very few name their income from charging. The returns enumerated above disclose not less than 8000 machines, all told, which at $50 a year per machine, as an average, would yield $400,000 for current. It is certainly safe to assume not less than 10,000 machines for the whole country, which at the same average would yield $500,000. Taking Rockford, Ill., as an average case, the return was $60 per year, but the private electrics did not yield more than $42.50. Denver, Col., reports that the machines on its circuits average $60 a year. Washington, D. C., reports its known income from this source—the Potomac Electric Power Company—as $28,000. The Chicago Commonwealth Edison Company reports $24,000. Savannah, Ga., reports an income of $300 a month. Des Moines, Ia., gives $1,682 for 1908. Baltimore, Md., like many other companies, cannot well go "back of the meter." "Our contracts being based on the installation or demand, which takes in all meters on the customers' premises, it is impossible for us to state the amount of income derived from electric machines." Boston has "no record" and offers no estimate, while Brockton, Mass., knows it to a cent—$985.73. At Salem, Mass., the specific income already averages about $900 a year, and at Springfield, Mass., about $2,500. Detroit, Mich., reports "approximately $10,000 and growing." Minneapolis, Minn., says: "Approximately $12,000 a year," and St. Paul, $2,400. One of the most striking reports is from St. Louis, Mo., which reports "about $79,000 per year, including repairs on automobiles and also receipts for current from private and public garages." Kansas City, Mo., reports $8,000 a year. The Brooklyn (N. Y.) Edison Company reports a gross automobile income of $25,000 a year, but the other systems in New York State that they cannot estimate it or that it is not segregated. It may certainly be put at not less than $100,000 a year, assuming about 1400 machines at only $75 a year—a low average where so many of the vehicles are in constant use. Rochester, N. Y., puts its automobile income for 1908 at $19,796, which would indicate there about $40 per machine. Youngstown, Ohio, averages approximately $160 per month; Harrisburg, Pa., $200; Portland, Ore., $60. The income at Providence, R. I., is placed at $1,500 a year. Savannah, Ga., places its income from this source at $300 per month, and Galveston, Tex., between $300 and $400. Salt Lake City computes it at approximately $125 per month. Norfolk, Va., $60 per month. It would appear from the reports that in many instances an income of $100 per machine per year can be earned. The average bill of one customer in Jersey City for energy consumption, over 12 months in 1908-9, was $8.31, and other data show a like average elsewhere. It all depends on the price for current and steadiness of use.

That leads up to the question of rates. Out of the 250 schedules of companies directly interested, 192 gave data as to rates, some of them very fully. Several state that the rates are the same as the regular power rates or lighting rates, but do not quote those rates. The range of price is very wide, and

is governed, of course, more or less, by the terms of discount. The following is a summary of 103 mentioning a flat price for charging, but not quoting any discount in connection therewith: 1 at 2 cents; 3 at 3 cents; 1 at 3½ cents; 7 at 4 cents; 2 at 4½ cents; 31 at 5 cents; 1 at 5½ cents; 12 at 6 cents; 7 at 7 cents; 1 at 7½ cents; 10 at 8 cents; 1 at 9 cents; 23 at 10 cents; 1 at 12 cents; 3 at 15 cents; 1 at 16⅔ cents, and 1 at 20 cents in New Mexico.

Sliding scales and discounts are reported from 21 places. In one instance the rate of 7 cents per kw-hour is subject to 10 per cent discount for prompt payment; and 5 cents in another. One rate slides from 15 cents to 7 cents; another from 15 cents to 10 cents. Nine of the rates range downward from 10 cents to 2 cents. One 9-cent rate falls to 6 cents and another to 2 cents. One 8-cent rate scales down to 4 cents, and one 7-cent rate to 3 cents. The lowest of the sliding scales is that in which the range is 5 cents to 1¾ cents. Buffalo quotes 6 to 2 cents. There are some time limitations.

The above rates show abundant variety, but 68 cities and towns report other rates, some of which are very elaborate as applied to a relatively simple proposition. Thus, in Denver for public garages the rate is 4 cents; or $25 per year per horse-power connected, plus 3 cents per kilowatt, less 10 per cent discount. It is also 4 cents for the more "simple life" private consumer, but the minimum monthly bill must not be less than $5 net. In Washington, D. C., under a guaranty of $25 per month the rate ranges for public garages from 5 cents for the first 1000 kw-hours monthly down to 3 cents for all above 2000 kw-hours. The private owner guarantees $2.50 per month for each meter installed, 10 cents per kw-hour up to $4.95 per month and 5 cents for the excess. Savannah, Ga., gives public garages 2 cents net and private owners a sliding scale of 7 cents to 3 cents. In Chicago, the public garage is on the regular Wright demand 10-5-3 contract with a guaranteed maximum rate of 5 cents if the customer agrees not to charge batteries between 4 p. m. and 6 p. m.—lighting peak. The Commonwealth Edison offers also its low wholesale power contract to large garages using long-hour service. Private owners are on the same 10-5-3 basis of contract, the minimum bill not to be less than 66⅔ cents for each kilowatt of maximum demand, and no bill to be less than $1.50. The adjacent North Shore Electric Company charges public garages 4½ cents per kw-hour, and private owners 10-8-6 4-3 cents sliding scale, with 85 per cent rated capacity of rectifiers as maximum demand. In Rockford, Ill., public garages get a 4-cent-off-the-peak-charging clause, and private owners 6 cents. At Clinton, Ia., the regular lighting rate is charged, beginning at 12 cents per kw-hour, with scale of discounts. Davenport, Ia., gives public garages 5 cents to 3 cents and private owners 6 cents. New Orleans makes it 4½ cents and 6 cents; Wichita, Kan., 10 cents and 8 cents, with a sliding scale to 4 cents and 3½ cents. In Baltimore, Md., standard rates are charged: "being 10 cents per kw-hour for the first 50 hours' use of the connected installation or demand and 5 cents for all in excess of that, subject to discounts provided in schedule, in steps of 1/10th of a cent, according to the size of the installation." In Boston, Mass., the rate runs from 12 cents down to 2 cents for public garages under a commercial schedule of rates, and private owners get the same, but on account of small use it usually runs with them from 12 cents to 8 cents. At Lynn, Mass., the general charge for both classes is 8 cents for alternating current supplied to rectifiers and 10 cents for direct current supplied from rectifiers. The Malden, Mass., company charges public and private garages 15 cents, but the public can get it for 6 cents between 9 p. m. and 5 p. m.—or off peak. Manchester, Mass., "soaks" private customers 25 cents per kw-hour for less than six months and 15 cents if they are customers over six months; while the rate to public garages is 15 cents. Springfield, Mass., makes it 3 cents to public garages and 6 cents to private, while Detroit, Mich., makes it 3 cents and 5 cents. On the other hand, Sheboygan, Mich., reports that it makes the rate 6 cents to private owners and 10 cents to public garages, which if correct implies a desire to get the business directly. Duluth, Minn., makes it 3 cents to public and 6 cents to private, with a minimum in the latter case of $5 per month. Minneapolis, Minn., gives all alike its regular power rates of 7½ cents for the first 52 hours and 2½ cents above, with 5 per cent to 25 per cent discounts for quantity. Bowling Green, Mo., quotes 5 cents per kw-hour, 12:30 a. m. to 4 p. m., on a time switch. At St. Louis, Mo., the rates are variable for public garages, from 5 cents to 3 cents and for private from 10 cents to 6 cents. Kansas City, Mo., makes it 3 cents and 5 cents, with a minimum for the private owners of $5 per month. At Atlantic City, N. J., the public garage gets "various rates according to consumption and demand," while the private owner pays from 16 cents to 8 cents. In Brooklyn, N. Y., the average rate earned from public garages under the discount scale employed is 6½ cents; with private owners it averages 8 cents. "Large consumers for commercial purposes earn a 4½-cent rate." The round rate at Niagara Falls, N. Y., is 3 cents. The Queens Borough (N. Y.) Gas & Electric Company makes an all-around automobile rate of 6 cents; its lighting rate is 15 cents. The New York Edison Company has a special automobile and storage battery contract with rate beginning at 6 cents with a minimum monthly charge of $50 per installation, and with a liberal scale of discounts. The automobile rate of the United Electric Light Company is about the same. If the consumption does not warrant it, the customer can fall back on the 10-cent regular rate, with its discounts. The automobile scale discounts go up to 50 per cent—3 cents—with a consumption of 50,000 kw-hours monthly. There are provided time limits in November, December, January and February. Rochester, N. Y., charges private owners 6.3 cents net and asks a guaranty of $2 per month. The public garage is subject to a guaranty of $12 per month. According to quantity the price for day charging is 3½ cents to 7 cents and for night charging 2 cents to 4 cents. Cincinnati makes a rate under its power schedule—namely, $12 per consumer per year plus $24 per horse-power, plus 3 cents per kw-hour for energy used, with a discount of 50 per cent on all in excess of $100 per month, and 5 per cent additional for prompt payment. At Dayton, Ohio, the public garage rate is $4 per kilowatt of demand; up to and including 110 hours' use, 4.2 cents per kw-hour, rate decreasing with increased use; 240 hours and above, 3 cents; with intermediate rates. Private garages, the minimum monthly charge is $5, with rheostat or rectifier, and the rate is 6.6 cents up to 100 kw-hours; 6.35 cents for 101 to 285 kw-hours, and 6.15 cents for 286 to 715 kw-hours, with a 5 per cent discount. Philadelphia, Pa., has three classes of rates for public garages. One has a minimum of $5 per charging set per month, and a 6-cent rate, customer agreeing to stay off between 4 p. m. and 7 p. m. from Oct. 15 to March 15. Another scale is $3 monthly minimum up to and including 3 hp and $1 per horse-power for each additional; with a rate of 10 cents, subject to a varying discount from 10 per cent at two hours' use to 45 per cent at eight hours. The third rate is the wholesale power on 11 hp and over with a load factor of two hours per day; minimum, $4.57 per kilowatt per month; rates varying from 9 cents net at two hours' use to 3⅞ cents at 10 hours. The private owner can come in under the first two rates or in the case of residences using lights, there can be a joint charge under the contract which provides for a minimum of $1 per month and a rate of 10 cents, subject to a scale of discounts; all bills between $10 and $15, such a discount as will make the net bill $10, and upon all bills of $15 and over per month, a discount of 33⅓ per cent if paid within 10 days.

It is hardly necessary to pursue this subject further, although other variations and interesting methods could be cited. Many of the rates are obviously on such a basis as to encourage automobile use; some would seem to be in the nature of restriction and discouragement.

RATES CHARGED BY GARAGES.

One of the most interesting inquiries made is that as to the rates charged by garages to their electrical customers. There is not a great deal of information in reply to that question, but some of it is very significant. In Denver, it is stated to be $30 per month for charging, cleaning and delivering. At Washington, D. C., "the regular garage rate is $35 per month. This

includes the washing, cleaning, oiling, charging, and the delivery of the car in the morning and calling for it in the evening." At Savannah, Ga., it is $25 per month for cleaning and charging. In Chicago it is $30 to $32 for equivalent service. At Rockford, Ill., garages are charged 4 cents for current and make it 6 cents to their customers. At Peoria, Ill., the rate to garages averages 5 cents and they charge 15 cents. At Paxton, Ill., they charge $4 to $5 a week for inclusive service, and at Crawfordsville, Ind., the rate is from $12 to $15 per month; while at Richmond, Ind., it is $20. The rate at Des Moines, Ia., is not given, but it is "usually a flat rate per month, which includes one charge per day, storage, and any small repairs." In New Orleans "different garages charge different rates according to the size and use of the car." In Baltimore the rate is $1 per day per machine, and this rate is quoted at other places without explanation as to whether it includes more than current. Such a rate for current alone would be prohibitive in a great many instances. Boston, Mass., reports a rate of 7 cents to 10 cents per kw-hour for energy, and about $35 per month for storage, washing, polishing, minor repairs and charging." The garages ought to do very well on such a basis. At Springfield, Mass., the garages get energy for 3 cents and charge 6 cents. At Detroit, Mich., the garage rate is $30 per month for pleasure vehicles. At Duluth, Minn., the garage rate is $20 per month, and at Minneapolis it is $35, including care and delivery, while at St. Paul it is $30 per month for a car of 30 cells, including calling for car and delivery, housing and charging. Several returns quote a rate of 75 cents, or $1 per cell, for charging, per month. At St. Louis the garage rate for ordinary coupés and stanhopes is $35 per month for charging, washing, oiling, calling, delivery and inspection. For large broughams it is $40. In Kansas City, Mo., the rate is $30 to $35 per month. At Atlantic City, N. J., a flat rate is charged averaging about $30 per month, and it is the same at Lakewood, N. J. In Brooklyn, N. Y., the garage rate is about $15 per month for charging. At Niagara Falls, N. Y., the garage rate is $25, including delivery, while at Buffalo it is $30. In New York City, the public garage rate for washing, oiling and charging per month is stated to be for runabouts, $32.50; for pleasure vehicles, $55; for business wagons, $45; for 2-ton truck, $50; 3-ton truck, $55; 4 tons and upward, $60. These correspond closely to the rates also of the New York Transportation Company. The garage rate at Rochester, N. Y., is 75 cents per charge, or $25 per month for charging, washing, calling for car and delivery. At Cincinnati, Ohio, the costs of charging, storage, cleaning and minor repairs are "generally lumped in a flat rate of about $20 per month." At Youngstown, Ohio, the rate at garages is 75 cents per charge, all being small cars. At Harrisburg, Pa., the garage rate is $25 per month inclusive of charging, daily washing and one delivery; while at Johnstown, Pa., the garage rate is 20 cents per kw-hour, which might mean anything, the company rate being 6 cents net. In Philadelphia, Pa., the garage rate for energy varies from 6 cents to 10 cents. "Where machines are stored, charged, etc., the cost of energy is contained in a flat total charge per month." At Portland, Ore., the garage rate is $25 per month for charging and cleaning, while Ponce, Porto Rico, reports a garage charge of 3 cents per mile run by the car. In Salt Lake City the inclusive rate for charging, cleaning, etc., and one delivery per day is $25 per month. At Toledo, Ohio, one garage rate for charging, washing and delivering a coupé is $22.50 per month "It is obvious that too frequent washing of a vehicle is hard on the finish." In Cleveland, Ohio, public garage "boarding" rates are quoted at $25 per month, including two deliveries a day. Some garages are wise enough to grade their rates as described in the April 22 issue of this journal. In New Jersey a rate of $25 per month seems to prevail. In Pittsburgh, Pa., garages charge $6 per week. "This includes washing, charging, general care of machine, also delivery of car to customer and calling for same."

USE OF AUTOMOBILES BY CENTRAL STATIONS

The data as to electric automobiles in use by central stations are scarce and would be discouraging if it were not for the new interest shown in the subject. A great many central-station officials have gasoline cars for private use or for managerial service, but very few of them have electrics, though why they should not patronize the form of power on which their business itself depends is not known and is hardly explainable. Some of them think it amusing to point out the gas companies that use electricity in their offices or works, but this seems analogous. A number of central stations have gasoline automobiles for general work, but it is hoped that when new ones are bought, they will be electrics. The indications are that they will. Some objections are made as to cost, though electrical automobile manufacturers contend that they can easily "meet the market" in competition with gasolines.

The Washington, D. C., company reports that it uses 1 electric; the Comonwealth Edison of Chicago has 1 electric runabout, 15 trucks of 1½ tons capacity and 1 5-ton truck. Rockford, Ill., has a 24-cell runabout; Pontiac, Ill., the same. Des Moines, Ia., has a 2000-lb. truck and is increasing its service. Osceola, Ia., has 1 machine, and Van Horne, Ia., 1. Boston, Mass., reports 3 1000-lb. trucks and 1 2000-lb. delivery wagon; Brockton, Mass., has a runabout; Newton, Mass., has a 1-ton truck; Plymouth, Mass., has a runabout; Salem, Mass., has a 3-hp machine. Battle Creek, Mich., reports 1 machine, and Detroit, 2 runabouts. St. Paul, Minn., has a machine of 5 hp. but Minneapolis reports it has none. St. Louis, Mo., has 6 pleasure or office vehicles and 4 trucks. Atlantic City, N. J., has a runabout and a 2000-lb. truck. The Edison Brooklyn, N. Y., company has a 2000-lb. truck and a Victoria phæton. Buffalo, N. Y., has a light delivery wagon of 400-lb. capacity. The New York Edison Company reports 12 passenger vehicles and has recently added 2 new landaulettes; 18 delivery wagons of 1000-lb. capacity; 18 of 2000-lb. capacity; 1 5000-lb. truck, 2 of 6000 lb. and 5 of 10,000 lb., making a total of 58 machines in service. The United Electric Light & Power Company of New York also reports 4 electric delivery wagons, 2 2-ton trucks, 1 5-ton truck, 1 runabout and 2 surreys. At Rochester, N. Y., there are in use a truck and 4 runabouts. Schenectady, N. Y., has a 1000-lb. delivery wagon and a 2-ton truck. Syracuse, N. Y., has a runabout. Harrisburg, Pa., has 2 runabouts. Philadelphia, Pa., has 3 runabouts, 11 1-ton trucks, 3 5-ton trucks and 1 of 1000 lb.—10 machines in all. Providence, R. I., has 4 machines of 3 hp each. Electric wagons have also been put in service recently by the New York & Queens Electric Light Company and by the Chattanooga Electric Company There are two or three thousand electric wagons and trucks in use in the country, but not many of them, it will be seen, in the service of the companies, where as large a field as anywhere else exists for missionary effort.

SPECIAL AUTOMOBILE OFFICIALS

Very few of the companies reporting have special officials whose duty it is either to "drum up trade" in electric automobiles or attend to the technical side of the subject for the public. In many instances, this class of business is in the hands of the power department. St. Louis, Mo., has a regular official "superintendent of the auto department" in charge of garage, salesrooms and battery-rooms. Galveston, Tex., has an "agent." At Salt Lake City "power representative handles inquiries." Boston, Mass., has two special automobile officials, one for its own cars, and a "special electric-vehicle agent who promotes the sale of vehicles and all current to garages." At Salem, Mass., it is the duty of one official "to interest prospective customers and make inspection of the outfit at stated intervals." At Chicago, the Commonwealth Edison Company has a special agent to look after this business, and the battery expert for its own vehicles "gives customers advice on request." At Rochester, N. Y., the company has established an electric-vehicle department in charge of a competent engineer to look after all vehicles charged from its circuits. It has also taken an agency for vehicles, to sell at a price including all maintenance for one year. The New York Edison Company, outside its own vehicle staff, has an automobile engineer to promote this branch and represent the company in all automobile relationships with the public. In some places, the lighting superintendent or the electrical inspector "takes care of this branch in case of trouble."

LETTERS ON PRACTICAL SUBJECTS

AN ELECTRICALLY DRIVEN BLAST FAN

A brief account of a recent installation of a No. 7 Sturtevant blast fan in a large blacksmith shop may be of interest to some readers. The fan is suspended inverted from two I-beams 18 ft. above the ground, and supplies air blast to 15 oil furnaces having a total of 23 burners. The pressure is 9.6 oz. in the main pipe and 4 oz. 100 ft. away. The motive power is a shunt-wound enclosed motor, rated at 15 hp, four-pole, 230 volts, 58 amp, 850 r.p.m., and belted to a countershaft so as to speed up the fan to 2000 r.p.m.

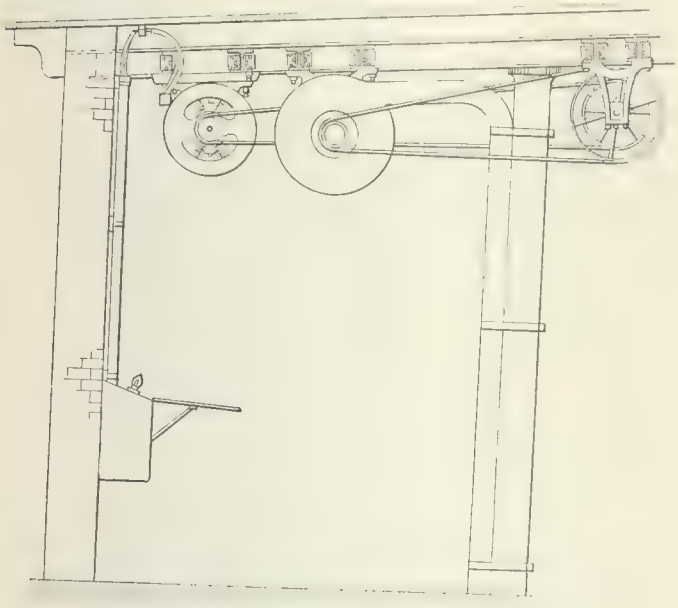


FIG. 1.—MOTOR, BLAST FAN AND SHAFTING

The motor is suspended from two I-beams and has two heavy slotted rails. As the weight is 1500 lb., the matter of a safe suspension could not be overlooked. Four ¾-in. x 4-in. hand made bolts hold each rail in place. Each bolt has a head 1½ in. square by 1 in. thick, and is provided with two heavy nuts, a washer and a cotter 1½ in. long. The rail bolts also were specially made, being ¾ in. diameter by 4 in. long, with two nuts, cotter and washer. The lock nuts prevent the bolts loosening from the constant vibration of the motor, while the cotters allow the motor to be dropped from the rails about ⅛ in. and shifted backward to tighten the belt without any fear of the nuts dropping to the ground. All this is done without removing the cotters. The double 6-in. belt on this motor has been tightened in 10 minutes without stopping the fan. The rails are placed so that one belt screw is in front of the motor at the pulley end, and the other is behind the motor at the commutator end, thus only a wrench is needed to make a shift in either direction. The motor is placed in relation to the fan so that the top side of the belt sags, thus closing around the pulleys the more it stretches. The wiring is all slow-burning weatherproof, which does not readily collect dust like rubber covered.

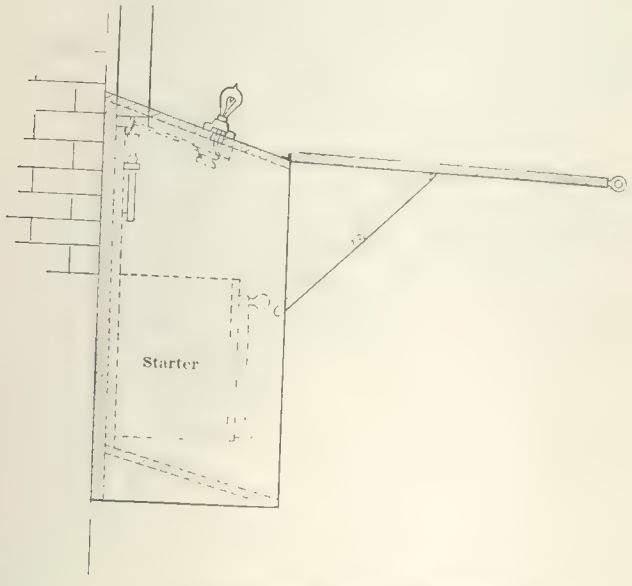


FIG. 2.—STARTING BOX ENCLOSED IN CABINET

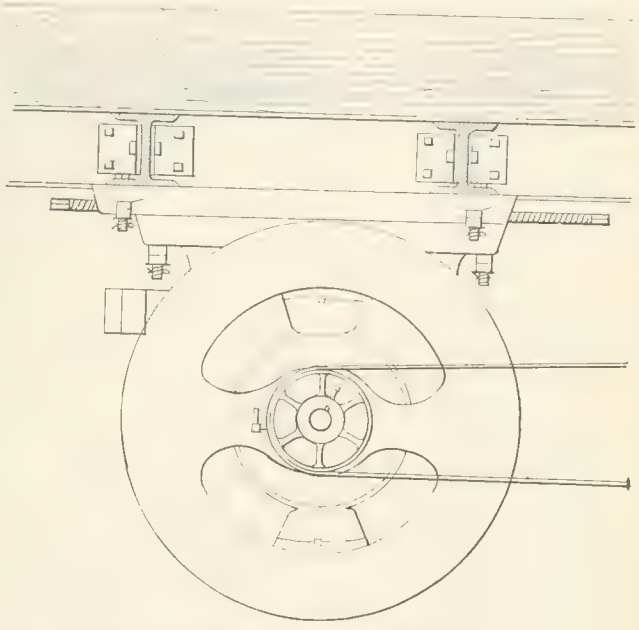


FIG. 3.—DETAIL OF SUSPENSION

Open wiring is employed overhead, but down the side wall the wiring is enclosed in flexduct and run through plain iron pipes. The pipe is carried up to the ceiling to protect the lines from any ladders or long bars that might be leaned against the wall. A 4-cp lamp is connected across the feed line to the switch and indicates when the circuit is alive or dead. A single pole cut-out and fuse are provided for the pilot lamp. The starting apparatus is mounted on a slate panel and enclosed by a dust tight cabinet having the whole front made as a door to open upward and held open by a hinge. A door made this way cannot be left open usually, without being in the way of something, and when down it is completely shut. The top section is made slanting to shed the dust, and the bottom section is made slanting to prevent tools being placed inside so as to prevent the operation of the starter or overload release. When installed, the air pressure was not sufficient with the fan going at 1800 r.p.m., driven by a 10-hp motor. The proper changes were determined as follows, which may be found of value to others.

The previous pressure was 8 oz. in the main pipe, and the motor current was 40 amp at steady load. It was proposed to raise the pressure to 9.6 oz., making the ratio of increase 1 to 1.2. The increased amperes equals $1.2^2 \times 40 = 57.6$ amp. Thus the 10-hp motor had to be replaced by a 15-hp machine rated at 58 amp. The square root of $1.2 =$ close to 1.1, giving the ratio of increase speed required at the fan to raise the pressure to 9.6 oz., which meant a change from 1800 r.p.m. to 2000 r.p.m. This was easiest made by increasing the speed of the countershaft 1.1 times the previous speed by decreasing the size of the motor-driven pulley.

POUGHKEEPSIE, N. Y. H. S. RICH.

TROLLEY WIRING A PUBLIC SQUARE.

There are a few criticisms which may be made on the layout shown by James Francis in the last issue. The old central ring plan is employed; that is, a bull ring in the center from which all pull-off wires run. For ease of construction and stability the scheme answers very well; but for appearance and

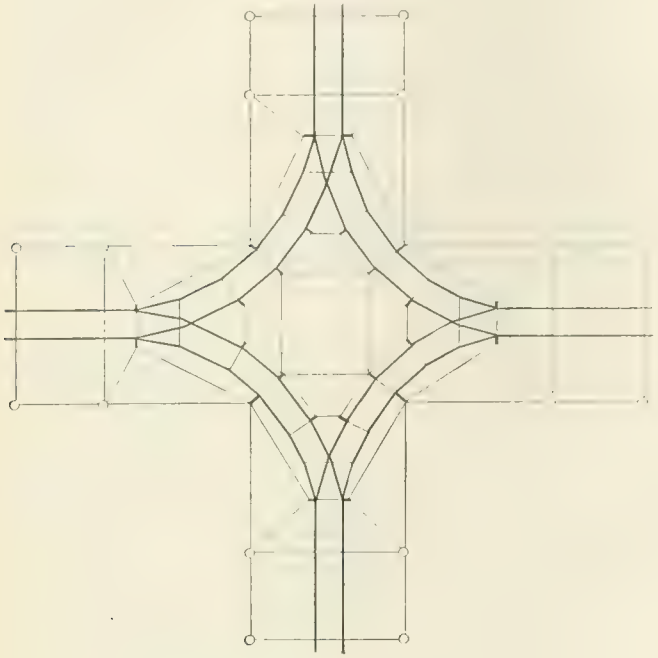


FIG. 1.—PULL-OFF WIRES AT RIGHT ANGLES TO TROLLEY WIRES.

wear, it is not as good as the plan shown herewith. For example, some of the pull-off wires form very acute angles with the trolley and a trolley pole coming off the wire on the curve would be very apt to become entangled. By not pulling more at right angles to the curve, more strain is thrown on the trolley, and so there is a tendency to throw slack in the wire. From the sketch it will be noted that all pull-off wires are at right angles to the trolley. Should a hanger break, the other curves are not affected, the curves being supported by the spans and

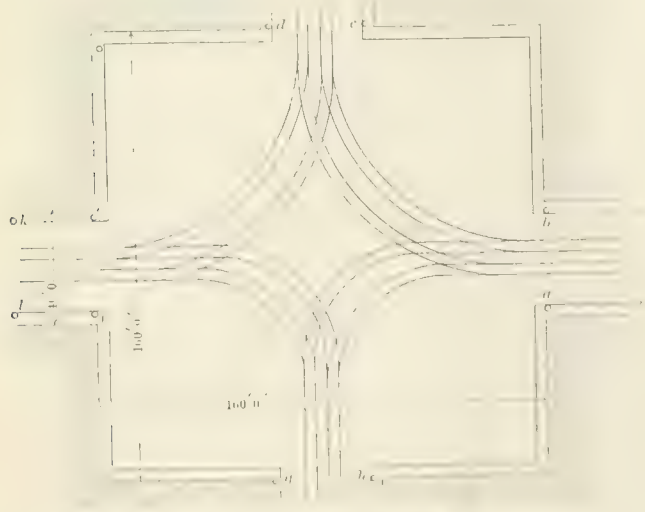


FIG. 2.—SQUARE TO BE WIRED.

the girdling wires outside. The strain of the trolley wire in the curves is taken up by the four central pull-offs, and thus no central support is needed.

CHICAGO, ILL. MILLARD GILMORE.

The last issue contained a description of the wiring layout for supporting trolley lines in a public square (Fig. 2), the sides of which were each 160 ft. long, with intersecting streets 40 ft. wide. The writer has had occasion to lay out similar installations, and offers a plan which he has used with much success in keeping trolley special work in line, reducing wear on service wire to a minimum and as nearly as possible eliminating accidents due to trolley wheels leaving the wire and damaging overhead construction. Three requirements are to be considered: (1) proper location of trolley wire to prevent

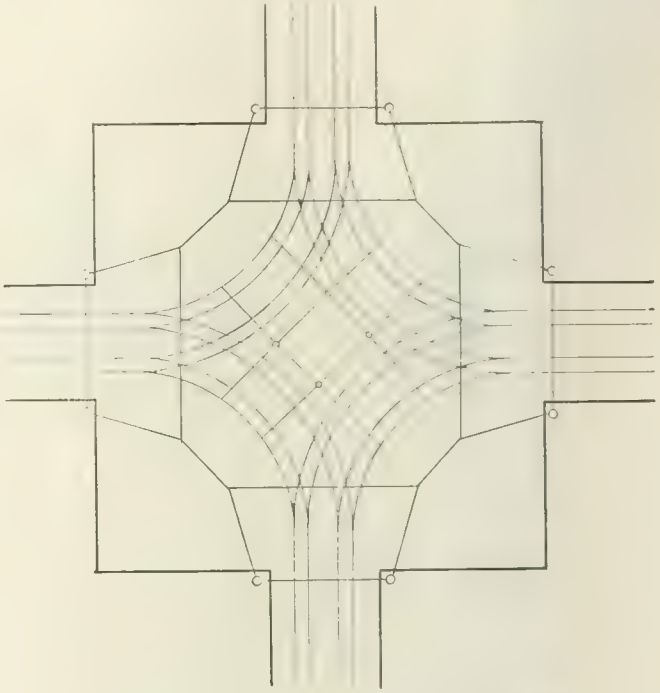


FIG. 3.—ARRANGEMENT OF SPAN AND STRAIN WIRES.

undue wear, (2) pull-off and span wires to pull from and across trolley at right angles at the intersecting points, (3) pull-offs to be "strapped" together with galvanized iron wire of suitable size to prevent same from dropping to street should an ear become detached. In the layout in question, the tension on the four double curves can be equalized, each being made to support the other, thereby relieving somewhat the strain on poles. The guys to poles as shown maintain the trolley at its proper height from track, and also supply additional strength and stiffness. Fig. 3 shows the proposed layout; the shaded lines represent trolley wires and light lines the arrangement of guys and pull-offs. Wood strain insulators should be used in connection with double and single curve hangers in order to give proper distance between trolley wire and wire used in tying pull-offs together.

CHATTANOOGA, TENN. J. CLINT DONALD.

TELEPHONE LUBRICATION TESTS.

The writer has had for a long time an idea that the telephone receiver could be made to tell some very interesting stories about what was going on in the lubricants which might be interposed between two rubbing or bearing surfaces. This is, however, a matter which may be very easily tested and by attaching a telephone receiver and a cell of dry battery to a pair of shaft hangers, as shown by Fig. 1, considerable light can be obtained regarding the behavior of the bearings under various stages of lubrication. In this experiment the cell *a*, receiver *d*, and two journal bearings are simply connected in series, and the observer listens to whatever sounds may be heard in the receiver. In this case the instruments are affected by whatever takes place inside both of the bearings, and if the lubricant perfectly insulates the shaft from either or both bearings, no sound will be heard in the receiver. Likewise silence will be the result if the oil-film does not occasionally at least separate the shaft from one of the bearings. That is, if the bearing is running solid, metal to metal, with no oil between, then there will be a solid connection between the two and no sound will be heard in the receiver. It was soon found that having two bearings in circuit at the same time was a great disadvantage,

and accordingly means were sought for some way of isolating them so they could be tested separately. To this end connections were finally made, as shown by Fig. 2, the collar *a* being substituted for one of the bearings, the other connections remaining the same. Not caring to trust to a brush for connecting directly with the shaft, the device *a* was arranged, as shown in detail by Fig. 3. The disk *a* was cut from thin sheet metal. Tin will answer for short experiments—while the tank shown by the succeeding engraving may be made from a portion of a tin can. It is better to use thin sheet copper for these contacts, if they are to be used for any considerable length of time, because the solution used in the tank attacks the tin very readily and then begins on the plate underneath the tin. If copper is used, the contacts may be made permanent parts of the arrangement, and the bearings tested day by day with the

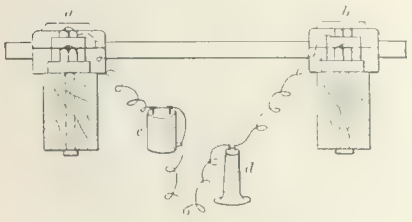


FIG. 1.—TEST OF LUBRICATION.

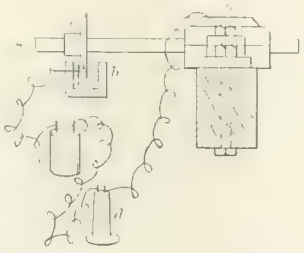


FIG. 2.—TEST OF SINGLE BEARING.

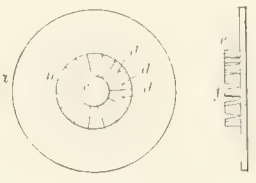


FIG. 3.—CONTACT COLLAR.

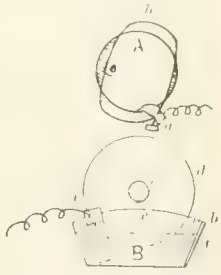


FIG. 4.—CONTACT TANK.

probability of hearing some very interesting things concerning lubrication within the bearings thus electrically connected. The contact shown by Fig. 3 may be made very readily by describing the circle *a* with a pair of dividers, making the circle as large as will comfortably go into the tank shown by Fig. 4. Next describe the circle *b*, Fig. 3, equal to the diameter of the shaft upon which the collar is to be placed. Describe another and smaller circle, *c*, and cut the metal along this circle, leaving a hole. Next cut the radial slashes *d*, *d*, *d*, etc., accurately to the circle *b*, and turn these pieces of metal outward, as shown at *e* and *f*. This may be readily effected by placing the disk in a vise with the jaws even with line *b*, then bend one of the sections, *d*, *d*, down to the vise jaw, then revolve the disk in the vise and bend another section. Continue until all have been bent out at right angles, as shown at *e*, *f*. Next, slide the collar upon the shaft, as shown at *a*, Fig. 2, and bind the turned-out sections, *e*, *f*, Fig. 3, firmly against the shaft by means of a strip of adhesive tape wound tightly around the shaft over the sections. The collar should be trued up as accurately as convenient in order that it may pass through the liquid in the tank with as little agitation as possible. The tank, Fig. 4, may be made of copper, or it may consist of a part of a tin can. The writer has made several of these vessels from the lower portion of molasses cans, which are not as prone to rust as tomato cans. In fact, a good tank for permanent use can be made from a tin can as above described, provided that the metal be well coated with paraffin or asphaltum, and that the copper contact plate, *a*, be clamped to the side of the tank, as shown by sketches *a* and *b*. The tank *b* is now filled with a saturated solution of copper sulphate and secured underneath shaft *e* in such a manner that the disk *d* will dip into the solution in the tank. The solution had better be kept concentrated by means of crystals of copper sulphate in the bottom of the tank. As long as such crystals are there, and the solution does not fall below the bottom of disk *d*, the electrical connection through the solution will be first class and very continuous. The writer has not revolved a contact of this kind more than 500 r.p.m., but the receiver has not been able to detect any breaks in contact continuity when tests were made at the speed mentioned. Some very interesting facts have been observed when a tin collar was in use in a tin tank. Chemical action commenced immediately between the solution, the disk and the tank, the latter being corroded until the tin was removed, then a deposit of copper appeared on portions of the tank adjacent to the plate *a*, which in this instance was brass instead of copper. The most interesting action was observed at the disk, which was quickly blackened where it dipped into the solution, then a loose copper deposit soon appeared along the edge of the disk. Flakes of metallic copper also soon appeared upon the surface of the solution, and continued to float there until the surface of the solution looked as though it had been thickly covered with fragments of gold leaf. Before detailing further observations in the directions of bearings, it may be in order to describe some experiments which were made before the running bearings had been connected. Upon becoming interested in the possible behavior of two metallic surfaces separated by an oil film, in the hope that the telephone receiver might give a clue to the condition of the surfaces and the quality of the oil-film, the writer tried the little experiment illustrated by Fig. 5. Here a bit of smooth metal, *a*, was soldered to a wire which in turn was connected to the receiver *d*, in series with dry cell *c*, and the wire was then soldered to the bit of tin *e*, which was punched out and formed to the shape of a watch glass by a single stroke of a hammer. The tin was placed upon solid end-wood and a hollow punch about 1 in. in diameter concaved the small disk to exactly the right shape by sinking the edges of the tin into the hard wood before the hollow punch had passed through the tin plate. A spot of oil, *b*, was placed upon the plate *a* and disk *e* lowered upon the oil and rubbed about by the finger while the receiver *d* was held to the ear of the experimenter. Ordinary heavy tin was used in the experiment, and it was quickly discovered that the surfaces were not smooth enough. With ordinary engine oil at *b* the receiver never gave a sound as *e* was rubbed back and forth. When castor lubricating oil was substituted for the engine oil, intermittent noise was heard in the receiver as disk *e* was rubbed

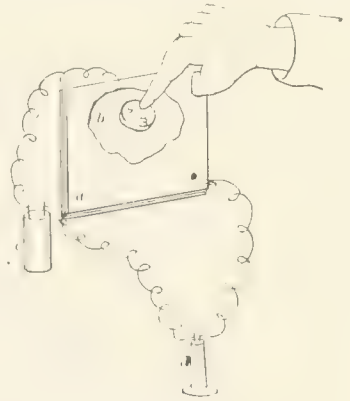


FIG. 5.—TESTING GREASE SPOT.

back and forth. It became apparent almost instantly that the metal surfaces between which the oil was interposed were not smooth enough. Accordingly both *a* and *e* were treated with fine emery cloth and rubbed until a quite smooth surface was obtained on each. Then the emery was removed and the rubbing continued with other and finer abrading material until a fairly smooth and even surface had been obtained on both *a* and *e*. With the smooth surfaces it was quickly found that a different sound was given when sperm oil was between the rubbing metals from that given when crude oil was used. In order to distinguish more readily between the sounds made when different oils were between the plates, several disks were smoothed and soldered to flexible wires, as shown by *a*, *b*, *c*, *d*, etc., Fig. 6. The wires from the several disks were all soldered

together at *c*, and the free end of wire *f* connected to the battery. By means of this arrangement, several oils of various kinds may be placed upon the smooth plate (a surface plate is much better than a sheet of tin) at the same time and tested one after the other by bringing down into each oil-spot its respective disk. In this way the test of each oil may be repeated at will, and may be compared with that of each other sample of oil on the sheet as often as desired. Even with smoothed-up

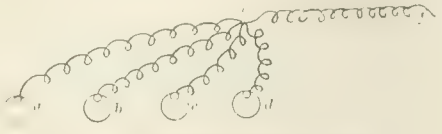


FIG. 6.—MULTIPLE TEST OF DISKS.

pieces of tin for surface plate and test disks, the writer was able to distinguish readily between sperm oil and "harvester" oil, black oil and many other lubricants. The method here described reveals many interesting and valuable points to the investigator, be he engineer, electrician or manager. With a wire connected by liquid contact with the line shaft, branch wires may be run to each bearing upon that shaft and brought to a switchboard where each wire may be plugged or switched at will into the telephone circuit, and the behavior of the lubricant and the condition of each bearing may be studied. The lubrication in any particular journal will be found to give a different sound in the receiver from any other journal on that shaft, and the condition of the bearing, from the time it was oiled to the time it is oiled again, becomes plainly apparent by listening at the receiver from time to time. When a bearing is going dry, it gives a never failing warning to the receiver which, if needed by the attendant, would result in the dryness being detected and relieved before it did damage to the soft metal lining or to the shaft bearing. There is, in the above described method of acquiring information, one time when the observer will fail completely and regularly. That is when graphite has been used as, or in, the lubricant. When the journal bearing has become filled with or coated with graphite. the insulating qualities of the oil have disappeared and there will be a dead ground between the shaft and the bearing.

WILLOUGHBY, OHIO. JAMES F. HOBART

LOCATING AND CURING TELEPHONE EVILS.

The following experience is not given as being new or novel, for doubtless in the experience of telephone experts the troubles noted have been met with many times and the remedies have been used as frequently. But to the laymen in telephone handling, a knowledge of some of the ills and their remedies and how to find the one and apply the other certainly comes in very acceptably, and for this purpose the experience is given, although it may be ancient history to the expert telephone electrician. A certain telephone line was fitted with three series instruments and extended two miles or more from the central station into the country. Whenever the weather was damp trouble was experienced by two of the subscribers both in ringing and in talking with central, though they had no trouble whatever in ringing or in talking with each other. The line was strange to the management, and after tracing it out a sketch was made which is reproduced as Fig. 1 herewith, which shows plainly the cause of the trouble. The instrument A, instead of being in series with the other instruments, is bridged across the line, short-circuiting the central station and rendering that usually necessary proposition useless to all but the first station, *A*, which was at all times in perfect touch with central, also with the other two stations. It had become the custom of the subscribers at *B* and *C* to call up *A* when they wanted central, and then have that station call central and repeat the conversation both to and from the subscriber. This was necessary in very damp weather only, for when the insulation was good, speech could be fairly heard in all the receivers at *B*, *C* and central A lineman was sent out with instructions to cut instrument *A* into the line in series with the other instruments The man departed, but after trouble hunting again the severed instruments were found to be connected as shown by Fig. 2. It is now evident that instruments *A* and *B* are in touch with central, while instrument *C* is still isolated from central and from instrument *A*.

When *C* wishes to call central, he must now call station *B*, who in turn rings up central, or who can ring station *A* if *C* desires to talk with that one. Instrument *B* has now become a substation to do the work for central—or to

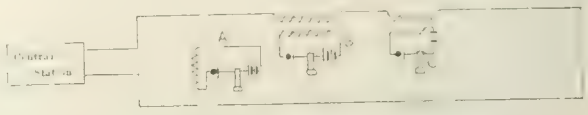


FIG. 1—DEFECTIVE SERIES TELEPHONE LINE.

do that portion which relates to calling either of the instruments on the party line. The next trip of the lineman resulted in all the instruments, *A*, *B* and *C*, being cut into the upper side of the line, as indicated in the diagrams. But then a new source of trouble developed and the line became noisy and picked up considerable cross talk from toll lines upon the same poles. Another trip by the lineman and the instrument *A* was cut into the lower wire, leaving the instruments *B* and *C* in the upper wire, as shown by Fig. 1. This resulted in very nearly

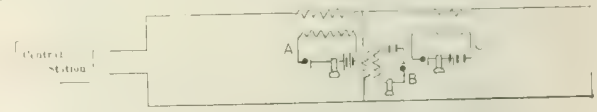


FIG. 2.—SERIES TELEPHONE LINE AFTER CHANGE.

balancing the work on the line, and most of the noise disappeared. Finally a transposition was made in the line between *B* and *C*, and it then became one of the best-behaved series lines the writer ever talked over.

Another line which gave considerable trouble by picking up cross-talk from neighboring toll lines was arranged, as shown by Fig. 3. About two miles of line was necessary to reach the house *B*, which was fitted with two instruments, both series connected to the same pair of drops which left the line

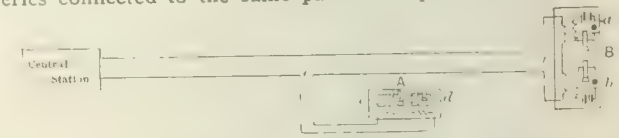


FIG. 3.—TELEPHONE TROUBLED WITH CROSS-TALK.

at *f*. Another house, *A*, about midway of the line, was fitted with another pair of instruments, which were likewise series-connected to the single pair of drops, *e*.

It was found to be very hard work to talk over this line when the neighboring toll lines were very busy. When toll-talk was light, conversation could be carried on quite comfortably over the line, excepting that it was quite noisy. The first attempt at improving matters was by disconnecting instrument *d*, Fig. 3, and connecting it into the opposite side of

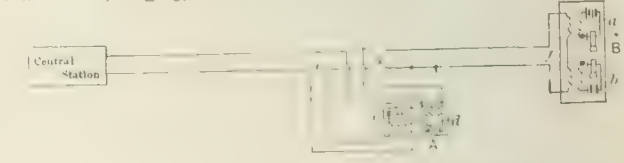


FIG. 4.—FINAL CONNECTION OF TELEPHONES.

the line through the new pair of drops *e* which were cut in for that purpose. This operation, as shown by Fig. 4, resulted in much better conditions in the line, much of the noise being eliminated, but the cross-talk still continued to be heard as badly as ever. Balancing the line, or the instruments in the line had proved beneficial, but it was evident that something was needed to stop the cross-talk, therefore a transposition was made in the line at *h*, and being about in the middle of the portion affected by toll-line induction, it proved to be a cure.

NEW YORK. JAMES FRANCIS.

QUESTIONS AND ANSWERS

In calibrating commutator-type meters on light road, we usually succeed in getting the meter up to speed; but find it impossible to keep it there very long. Can this be remedied? T. I. S.

Ordinarily it is best to adjust the meter to normal conditions by having the brushes just right, even if it is necessary to leave the meter a trifle slow on light load. If the brush tension is excessive, friction causes trouble and if it is too slight, sparking results at full load, causing roughness on the commutator. The general result will be that the meter will not operate on light load and will invariably be slow on full load.

Why does a shunt-wound motor increase in speed with decrease in field strength or with change of brush setting? F. W.

You will find these questions fully covered in almost all works on electricity. When the field strength of a shunt-wound motor is decreased the counter e.m.f. is decreased and a sudden increase in armature current results. This produces more torque than is necessary to carry the load so the motor speeds up. The speed of a shunt-wound motor is a minimum when the brushes have zero lead. Any movement of the brushes from this setting will increase the speed because the counter e.m.f. is thereby reduced.

When should dry cells be discarded? W. E.

The available energy from a dry cell decreases as soon as it is put in service, but just so long as a cell contributes e.m.f. to the circuit in which the current exists, there is no reason why it should be discarded. If the potential drops it will be necessary to increase the number of cells so as to maintain the required e.m.f. On the service conditions will depend the point at which the cells should be removed. Cells should not be left in circuit until their e.m.f. is nil, since they then act as resistances; nor should the number added to the series to increase the e.m.f. be very large. Best results are obtained by discarding the cells after the e.m.f. has dropped below a certain value.

In a railway substation should not the secondary of the transformers be grounded to lessen the life hazard? J. B. B.

In railway substations the negative pole of the rotary is usually directly connected to the negative bus and ground without any switch, so that the secondary of the transformer is permanently grounded through the rotary converter and forms a safeguard in case the high-tension winding of the transformer should break down on the secondary. This arrangement is used in order to simplify the switchboard, the equalizer switch being mounted on or near the rotary and the equalizer bus and negative bus being placed in close proximity to the machines, usually below them in a pit, leaving only the positive single-pole switch and bus to be placed on the switchboard proper. To place another ground on the transformer would be to short-circuit it.

In a medium-sized central station feeding a mixed load what is the best arrangement of busbars to use? H. A.

In the arrangement of busbars, simplicity as far as it is compatible with reliability of supply is essential. With a mixed system this can be obtained by using one set of buses for lighting and another for motor load if the latter is large enough to warrant separate circuits. Each feeder and each machine should be provided with double-throw switches so that they can be connected up to either set of busbars. Means should also be provided for coupling both sets of buses together. In the case of a system in which the lighting load is the greater and where motors may be fed from the same lines by the arrangement of duplicate buses any generator may be used to supply any feeder so that better regulation can be secured, the circuits on which motors form the greater part of the load being isolated from those feeding only lamps. The use of a second set of buses has always been found advisable and invaluable in testing any faulty feeder or machine, as it permits of such work being done during the hours of ordinary supply. The little extra capital involved is offset by increased reliability and efficiency of working.

I am in want of information in regard to the behavior of electrical resistance material under different varying conditions and temperatures. Is there an alloy or metal that has an extremely high positive-resistance temperature coefficient many times that of iron and which is yet a fairly good conductor at ordinary temperature? Are there any metals having a high negative-resistance temperature coefficient and which have fair conductivity at ordinary temperatures? C. F. T.

Among the conducting materials having a negative-resistance temperature coefficient, the most promising ones for commercial purposes are carbon, tetroxide of iron (known as "magnetite") and a mixture of magnetite and chromate of iron. The last named has a higher initial resistance than magnetite; but is equally conductive at high temperatures. When magnetite is at a red heat, its resistance is about 1 per cent of that at ordinary temperatures. Of the materials exhibiting a positive-resistance temperature coefficient there are many; but iron is the best that has come to our notice.

How much electricity is now being generated annually in the United States by water-power? What is the largest amount of power being developed in any one locality? How far is electricity from Niagara Falls transmitted? J. A. L.

The approximate water-power development in the United States is 3,500,000 hp. Of this 1,600,000 hp is used to generate electricity in lighting and railway plants and 1,900,000 is utilized by industrial concerns. Much of the latter is converted into electrical energy; but how large a percentage it would be difficult to say. The combined output of all the stations at Niagara Falls (N. Y. and Ontario) is approximately 300,000 hp. The public utility companies in New York City generate about 500,000 hp by steam. Electrical energy from Niagara Falls is transmitted as far as Syracuse, N. Y., a distance of 160 miles

If the name plate is missing from an induction motor frame having three terminals on the connection board, how may it be ascertained whether it is a three-phase motor or a single-phase motor that is started by a split-phase box exterior to the motor? Can a motor of the latter type be operated as a three-phase motor by connecting the lines direct to the terminal board and cutting out the split-phase box? G. J. R.

It would be rather difficult for you to determine whether the motor in question is a three-phase or a single-phase machine, since many of the single-phase motors on the market are in reality three-phase machines. If the motor has a clutch on the rotor shaft it is a single-phase machine. The best method to pursue in ascertaining the identity of the motor is to have someone who is thoroughly conversant with the motors on the market look at it, and determine from its appearance whose make it is; you may then take the serial number stamped on the machine, and address the manufacturers, who will give you the necessary information. If, as intimated above, the motor is a three-phase machine operated as a single-phase motor, it can, of course, be run as a three-phase machine by connecting the lines as suggested.

Two single-phase transformers, 2200-100 volts, are connected, one to phase "A" and the other to phase "B" of a 2200-volt, two-phase system. The secondary coils are wound for 100 volts each and are connected in series giving as a resultant a single e.m.f. equal to $100 \times \sqrt{2}$, or 141.4 volts. The current rating of the secondary coil of each transformer is 10 amp, and the current rating of the series coil is also 10 amp. From this it is seen that the joint output of the two transformers feeding the single circuit referred to is less than if they were operated separately on independent circuits. Why is there a reduction in the permissible output? H. M.

The two component secondary e.m.fs. are out of time-phase with each other by 90 deg., while the resultant e.m.f. is ahead of one e.m.f. by 45 time-degrees and behind the other by an equal amount. With a non-inductive load the secondary current would be in time-phase with the resultant e.m.f. and hence 45 time-degrees out of phase with each of the other e.m.fs. It may be said, therefore, that even with a non-inductive load, each transformer acts as though the power factor were only 70.7 per cent. That is to say, the permissible output of the two transformers connected as indicated is only 70.7 per cent of the total output when the transformers are used separately. However, by using a third wire at the junction point between the two transformers and connecting the receivers between this wire and the outer two, the full rated output can be obtained from each transformer.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Wood-Burning Central-Station Plant.

Albuquerque, N. M., a city of some 20,000 population, up to two seasons ago was operating a steam-driven electric light plant with somewhat inadequate machinery, and with such poor financial results that upon a reorganization about that time it was decided that something must be done to decrease operating expenses. The entire plant was thereupon removed to a new steel-frame, ironclad building erected within the yard enclosure of the American Lumber Company.

The American Lumber Company's plant occupies a yard enclosure of about 1 sq. mile, northeast of the city, and its annual lumber cut is enormous. It has two power plants with slab and sawdust-burning equipments, but the excess of waste cuttings is very large, and an arrangement was entered into by which the electric lighting company utilizes this additional waste.

The lighting plant is situated some 400 ft. from any portion of the yards or wood-working buildings, and consists of three banks of boilers, wood-burning, with automatic feeds from a continuous chain conveyor, depositing the surplus in bins beyond the power plant. The tram carrying conveyor is about 500 ft. from the sawmill, and together with a 1000-ft. sawdust blowpipe from the wood-working buildings, is led direct to a digester driven by two induction motors. In this digester, which is situated some 30 ft. from the boiler house, all the slabs are chopped to a uniform size, mixed with sawdust, and led by conveyor over the boilers to valved traps controlled by the stoker. The chain arrangement through the boiler-room is so arranged that in event of the shutting down temporarily, for any reason, of the main conveyor from the woodworkers and sawmill, the return chain will carry back chopped wood refuse from the bins beyond the boiler-room and feed the boilers in that manner.

The engine equipment is completely modern, consisting of three-phase, slow-speed alternators, which, however, are belt driven so as to utilize the compound engines from the old plant. Two belted railway generators of 100 kw each, with separate switchboard, supply an electric railway of some 12 miles of single track. The railway has given good financial returns, in spite of the fact that the usual small-town railway is not self-supporting.

The entire lighting of the town is supplied from this plant, the old lighting plant at present being used as a booster substation for regulating the feeder voltage. No reserve is kept at the old plant, but an attendant is maintained there to attend to the voltage regulation, all regulators being under his control. The machine for series-arc lighting is also situated at the substation.

Besides supplying the city, some 200 arcs and some 3000 incandescent lamps are supplied to the mills and yards of the American Lumber Company. Some idea of the extent of this company may be gained from the fact that of three lumber storage yards within the main enclosure, the largest has an area for 20-ft. to 30-ft. piles of over 20 acres.

The main power station is constructed entirely of noncombustible materials, and has, in addition, a complete standpipe and hose equipment, together with sand pails and chemical extinguishers. The water is furnished at present from the private system of the American Lumber Company, comprising some four miles of mains, mostly 6-in. and 8-in., the pump supply being from a detached brick, metal-roof pumping station; the only source of steam supply for the pumps at present is from the brick boiler house of the sawmill through 150 ft. of underground steam pipe. An auxiliary feed for pump supply is contemplated to operate two 75-hp, 2300-volt induction motors driving centrifugal fire pumps located in the above fireproof pumping station.

The entire arrangement is unique and the development of the American Lumber Company is sufficient to warrant the expectation that the plant will be of sufficient capacity for Albuquerque for the next 10 years at least.

Maintenance of Tungsten Lamps at Rochester, N. Y.

In line with its policy of giving its patrons all the advantages to be derived from the use of more efficient units, the Rochester Railway & Light Company has for many months past placed tungsten lamps at the disposal of its customers for a fixed first cost, after which, if desired, the company will renew the lamp on a maintenance contract. The contract applies only to lamps connected up solidly and permanently on keyless sockets. The prices charged for the lamps are as follows: 25-watt, 70 cents; 40-watt, 90 cents; 60-watt, $1; 100-watt, $1.10; 250-watt, $2.20. The maintenance charge on the 25-, 40-, 60- and 100-watt lamps is 8 cents per lamp per month and for the 250-watt lamp the charge per month is 10 cents.

The energy used is charged for at schedule rates. In order that it might have some basis for costs, the company took the account of the customer and calculated as nearly as possible the average hours' use of installation. In October there was 189 kw of tungstens connected on maintenance apportioned as follows: 77 40-watt lamps; 1176 60-watt lamps; 1104 100-watt lamps, and 59 250-watt lamps. The maintenance cost for the month was $530.67 and the breakage cost $205.90, or a total of $736.57. The energy consumed approximated 35,269 kw-hours and the income from maintenance amounted to $199.08. The cost per kw-hour for maintenance on the assumptions made was 1.52 cents. In November there were 121 40-watt lamps, 1298 60-watt lamps, 1105 100-watt lamps and 109 250-watt lamps connected on maintenance, or about 221 kw. The estimated consumption of energy was 39,260 kw-hours, the cost of maintenance $561.85, breakage $145.14, or a total cost of $706.99 against which was a maintenance charge of $218.34. The cost of maintenance was 1.24 cents per kw-hour on the basis assumed.

Inasmuch as the company has followed the same lines for the past six months, it will be of interest to note that its report for June, 1909, one of the lightest months of the year, shows a large increase on the connected load and an exceptionally large addition in the number of 250-watt lamps installed. The report also shows a very material decrease in the cost per kw-hour. In June there were 27 25-watt lamps, 966 40-watt lamps, 2505 60-watt lamps, 2351 100-watt lamps and 391 250-watt lamps connected on maintenance, or about 523 kw. The estimated consumption of energy was 109,862 kw-hours; the cost of maintenance $801.12; breakage, $182.90, or a total of $984.02, against which was a maintenance charge of $504.17. The cost of maintenance for the month of June per kw-hour was, therefore, $0.004 figured on the same basis.

With improvements in manufacture the cost of maintenance has decreased, and the business is now carried with profit. The records show that the tendency is to keep up the kw-hour consumption, and in many cases to increase it, and the enthusiasm aroused by the company among its patrons is of inestimable value. In order that installations do not suffer from careless treatment and also that the best results may be obtained, an employee of the company inspects each installation regularly, renewing all burned-out and blackened lamps, and also washing and cleaning the shades at regular intervals. In this way the consumer gets the full lighting efficiency, and is impressed with the painstaking care that the company is showing toward giving him the most satisfactory service possible.

Reports on Tungsten Installations.

At the convention of the Ohio Electric Light Association, July 15, a feature of the program was the reports from various companies on experience with tungsten lamp installations. One member reported a large number of such installations in stores, replacing all other illuminants. The only objection he found was that it was rendering the company's multiple-arc lamps scrap.

Mr. W. E. Richards, of Toledo, reported that the tungsten lamp is superseding both Nernst and arc lamps. Mr. E H. Beil, of Youngstown, said that in some cases the income from large installations had been reduced 40 or 50 per cent, but the general increase in business was more than enough to make up for this. Mr. W. C. Anderson, of Canton, reported having begun the use of 10-volt tungsten lamps, 11 in series, on 110-volt circuits for electric signs. His experience was not sufficiently extended to justify any statement as to their life. His company has put out about 3,000 ordinary multiple tungsten lamps, and has 1,000 more under contract. Results with 250-watt tungstens have been gratifying.

Mr. M. E. Turner said that in Cleveland the lamp companies are making tungsten lamp sales. These companies have arranged for selling these lamps in durg stores. The lamp companies and the central station are working in close harmony. All advertisements of the tungsten lamp read, "Two and one-half times the light for the same money," rather than the same light for less money.

Mr. A. A. Pointer, of Antwerp, Ohio, said that he bought the Antwerp plant last November with 68 consumers. There are now 120 consumers and 400 tungsten lamps.

Mr. J. C. Rothery, of East Liverpool, has a street-lighting contract under which the company agreed to furnish 50-cp carbon-filament lamps. These have been changed to 60-cp tungsten series lamps, which have been in use one year, or about 4,000 hours, and less than six have been renewed. In Chester, W. Va., 35 80-cp series lamps have been in service with two or three renewals since Jan. 1, 1909. These have been competing with two-mantle natural gas arcs, and Mr. Rothery expects on the whole to displace gas lighting with these lamps. As a result of the introduction of tungsten lamps in stores, his company is accumulating a "fine stock" of second-hand multiple arc lamps.

Mr. Henry Schroeder, of the General Electric Company, explained the methods of using the new 11-volt tungsten sign lamps. On alternating-current circuits they can either be connected to a transformer with an 11-volt secondary, or on a compensator. On direct-current circuits they are connected in multiple series. At a rate of 10 cents per kw-hour the tungsten sign lamp costs one-third as much as a carbon sign lamp, and at 5 cents per kw-hour one-half as much. This means that a sign business is now within reach which never could be obtained before.

Mr. W. C. Anderson reported that in store-lighting practice in Canton one 250-watt tungsten lamp replaces a gas arc. Long life of 250-watt tungsten lamps was reported from both Canton and Dayton.

Mr. George C. Osborne said that the experience at Detroit was that the tungsten lamp sales decreased central-station earnings 25 per cent from existing arc and carbon lamp installations which they displaced, but inside of six months the same consumers would add enough tungsten lamps to bring the consumption up to the original figures. In Kansas City the tungsten lamp is competing with natural gas at 25 cents. It is notable that the sales of lamps by the manufacturers to contractors and supply dealers are mainly in the small sizes, while those to the central-station companies are in the larger sizes.

Mr. Henry Schroeder called attention to the fact that in some cases the carbon series street arc lamp is likely to be displaced by series tungsten lamps because of the efficiency of the tungsten lamp and the expense of trimming and repairing arc lamps.

Mr. F. M. Tait, of Dayton, gave some particulars of a trial installation for special lighting of downtown streets which has been placed on one of the streets of Dayton. Ornamental iron posts 75 to 80 ft. apart carry five 100-watt tungsten lamps. The scheme was fostered by the Chamber of Commerce of Dayton. The intention is to ask the storekeepers along the street to pay for the installation and the city to pay for the cost of operation and maintenance. The principal streets of Dayton are 110 ft. wide from curb to curb, and are level, so that it is believed a very fine effect can be produced with posts 75 to 80 ft. apart. It is expected that about 300 posts will be installed in the downtown district of Dayton.

Residence Lighting.

Mr. F. T. Mather, of the Edison Illuminating Company, Detroit, Mich., presented a paper at the Ohio Electric Light Association Convention, July 15, 1909, which gave valuable data about residence lighting in Detroit. This paper is largely quoted from a paper presented at the 1908 meeting of the Association of Edison Illuminating Companies, which paper covered a careful study of the conditions of residence lighting in Detroit for the past 10 years. It was published in the *Electrical World* of Nov. 7, 1908, to which the reader is referred for more complete figures than appear in this abstract.

Detroit, with a population of about 360,000, has 13,000 homes lighted with electricity. Electricity has no competitor in the high-class residences, little in the moderate-priced homes, and considerable business is secured among the owners of small cottages. Few homes are now built without electric wires. The proportion of old houses wired for electricity is increasing every year.

The rapid growth of this class of business dates from 1898, when the present Detroit residence rate was adopted. Its peculiarity lies in the method used in determining the amount to be charged monthly to each consumer at the primary rate, which is 14 cents per kw-hour. The amount so charged is 2 kw-hours per month for each room counted. Unfinished attics, storerooms, laundries, closets, bathrooms, stairways, halls, servants rooms, kitchens, pantries, porches and vestibules are not counted. Before adopting this method the Detroit company ascertained by observation that the number of lamps likely to be burned at the hour of the district maximum was actually very closely proportional to the number of these living rooms which are taken as the basis of primary charge. The secondary charge for electrical energy used in excess of 2 kw-hours per room counted is 4 cents, and fans, flatirons, disk-stoves and cooking devices are not counted on the demand charge, thus giving the customer the advantage of this low secondary rate for such devices.

The occupants of modest homes are desirous of electricity not only for lighting, but for the labor-saving devices operated with electricity. One concern selling washing machines has placed 450, mostly in houses where the laundry work is done by members of the family. Between 7,000 and 8,000 flatirons are in use on the company's lines. The average monthly revenue from a flatiron is estimated at about 50 cents. In the higher class of houses the vacuum cleaner is coming into general use.

The owner of a building is usually quick to appreciate the saving on decorations and furnishings when electric light is used. Some of the Detroit real estate dealers with large rental lists are inserting a clause in their leases providing for the exclusive use of electric lighting in their rented residences. This action on the part of the landlords was not solicited by the Detroit electric light companies. A display room in connection with the company's main office is in charge of competent clerks, who explain to visitors the uses of electrical appliances that may be employed in the home. Sales of this merchandise amount to about $10,000 a year.

From a central-station standpoint the company considers residence business very desirable. It has been found by studying several groups of residences at different periods that the ratio

of connected load to the district demand is more than 4 to 1. The company finds this ratio increasing as the practice of adding lamps for conveniences in halls, basements, closets, etc., becomes more common. The daily maximum demand of this class of business is fairly constant from the middle of October until the end of June. The maximum does not change much throughout the year. Demand indicators installed in 100 residence circuits showed a reduction of the demand in June, July and August, and the lowest summer maximum reading is 75 per cent of the winter maximum. Energy consumption is considerably less during the summer months.

The maximum demand of a residence district comes about 15 minutes previous to the time of the evening meal, and continues until 8 p. m., then falls slowly until 10:30. The residence district demand comes later than the business district demand, and is falling at the time the demand due to theaters and other places of entertainment is rising. The December sales in a middle class residence district are 3 or 4 per cent of the annual sales for the year, while the monthly midsummer sales may be 4 or 5 per cent of the annual sales. The annual load factor of residence lighting is approximately 1,000 hours' use of the maximum demand of the district. This figure was arrived at by analysis of the annual use of electricity in 905 residences in one group, and is based strictly on the district demand and not on the demand of the individual residence. Residence business is very stable and to a large extent self-propagating. This is especially true of the labor-saving devices.

Discussion.

Mr. W. P. Engle, who presided, said that there had been a general feeling that residence lighting was not very profitable in small towns, and that Mr. Mather's paper would open up an interesting field for discussion. Mr. J. Gilmartin, of Toledo, brought up the question of high investment per kw-demand for meters in residence lighting which he quoted from another authority as being about $40. This cost is considerably more than for generators. Mr. Mather said that it was the practice of his company to use the 10-amp Fort Wayne meter for all residence customers. One member pointed out that a 10-amp meter is more likely to run slow on light loads common in residences than a 5-amp meter.

Mr. Gilmartin said that the 10-amp meter costs but 15 to 20 per cent more than the 5-amp meter, so that the difference in cost is small. Some of the older commutator-type meters require frequent attention, but the alternating-current induction meters now used will give good results over a period of several years.

Mr. Mather said that his company tests meters when received from the factory before they are put in service and every six months thereafter. The minimum monthly bill under the Detroit residence rate is 50 cents. In answer to a question as to the Detroit practice in running three-wire services into residences, Mr. Mather replied that in congested territory three-wire secondary mains are used, but it is seldom that three wires are taken into a residence. Most of the services are two-wire. A deposit is required from customers who do not own the building or else a guarantee from the owner of the building. The deposit required is $5, upon which the company pays bank interest.

Mr. Mather told of a suburban town of 700 inhabitants near Detroit having 189 electric light customers. Most of these customers heretofore used kerosene and gasoline, as there was no gas in the town. There are 204 residences in that place. He said that the reduction of the minimum monthly bill from $1 to 50 cents is a big help in getting residence business among the smaller consumers. It is the policy of the Detroit company to make consumers' bills as low as possible for the service rendered and that can only be done by encouraging the use of the tungsten lamp. Mr. Mather says in soliciting residence business that on going into a house he remarks, "electric light will not cost you a cent." That is enough to arouse the interest of anyone, and he follows it up by showing how the saving in decorations and other items will make electric light free as compared with other lighting.

Mr. J. S. Kermode, of Cleveland, said that the introduction of natural gas in Cleveland instead of having a detrimental effect on electric lighting residence business, increased such business. He gave as the reason for this that the natural gas is used for cooking and results in such a reduction of the householder's bills that more money is available for the luxury of electric light.

Courtesy as a Commercial Asset.

By S. M. Kennedy.

THE two greatest factors in the success of any central-station business undoubtedly are courtesy and enthusiasm. These attributes must not be solely possessed by the president or manager, but must prevail in all departments, and in all ranks. It is true that your business may be the only one of its kind in your community and that the public must come to you if it wants service. Did you ever stop to consider that that very reason does not make the public less critical? If consumers are treated with consideration it is particularly pleasing to them, but if with discourtesy, it rankles through and through, because of the fact that they have no recourse, but must continue to do business with you. It should always be borne in mind that some men have short memories for favors, but all men have long memories for injuries. It is a regrettable fact that, as a rule, there does not seem to be a proper sympathy between the public and the electric company. It is hard to get them to understand each other. The public is very liable to think it is being overcharged or otherwise imposed upon, and the employees of a company to think the public "kicks" too easily and too frequently. But it would be well for the employee sometimes to put himself in the customer's place and understand that it is a reasonable thing for a man to ask questions about what he does not comprehend, particularly when he is paying out his money. No electric company can afford to be independent of the public. It is the public that buys from it, the public whom it must please and look to for its existence—the public that does not forget to remember. No matter how big the corporation, it is vulnerable—its very greatness sometimes making it a bigger and better target; and as for independence, the man who runs a peanut stand on a push-cart and has only a five-dollar capital invested in his business is a thousand times more independent than the corporation with its millions. If business leaves his corner, he can push his cart along to another location, but the public-utility corporation puts its money in the ground and cannot take it out, no matter what conditions may arise.

It seems reasonable to consider the subject of courtesy from two standpoints. The first is the kind which is desirable in the intercourse between the employees of a central station and the public, and which might be termed *conventional courtesy*. The second is the kind that reaches out, beyond the actual points of personal contact, and follows people to their homes. This, perhaps, may best be described as *aggressive courtesy*.

Now, it so happens that there are few businesses which give so many opportunities for the display of conventional courtesy as that connected with the central station. The public appreciates and enjoys considerate treatment. Why, then, should it be treated with hauteur, indifference and brusqueness by inconsiderate employees? Each and every man connected with a central station can do something daily to help his company's business. By careless inattention he can also do something that will produce great injury to its interests. The public does not judge a company by its president, officers and directors. They may be excellent men, with high standing in the community, but they are usually known to only a few of the company's customers. The men who are known are the clerks, solicitors, collectors, meter readers, and trouble men; these are the men who see the customers in the office, or meet them in their homes, who represent the company in its intercourse with the public, and it is by the words and actions of these men that the public praises or condemns their company.

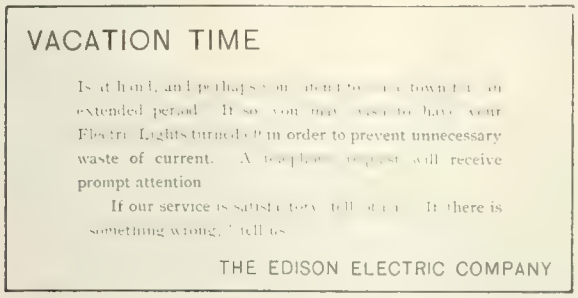
A central-station business is not confined to any one class;

all classes must be dealt with, but there should be no distinctions between the big and the little, the great and the small, the rich and the poor, in the matter of treatment.

The importance of the complaint department of a central station cannot be too highly estimated. Upon the manner in which this end of the business is handled largely depends the friendship of the company's customers and the permanent growth and prosperity of the company itself. The proper treatment of complaints from existing consumers is much more important than the management of the "New Business" department, which is organized and operated to reach out after new customers. It should not be forgotten that satisfied consumers become active agents for the advancement of your company's business. Who, then, can estimate how much the growth of your business is retarded by customers who are dissatisfied through want of proper attention and courteous treatment? The more people you can get to think favorably of your business, the faster it will grow. And as a man thinks, so will he talk, and a pleased public means that you will have many people working overtime for you whose names do not appear on the payroll.

One of the best plans a central-station manager can adopt as a means of educating employees along proper lines, is occasionally to have demonstrations, showing what should be said and done under certain conditions of a more or less difficult character. Once a month employees who come in contact with the public should be gotten together. Several of them should represent complaining customers, who come to tell their grievances. Then let other employees receive these complaints and handle them as they think they should be handled. Let there be plenty of criticism and discussion, and it will be found that much benefit will accrue. Employees should be shown the importance of patience and self-control. It cannot be denied that some consumers may be utterly unreasonable, and even insulting, in making their complaints, and sometimes what is said is liable to put the average employee in a fighting mood. However, although a man may store up an awful tempest within himself, it won't break loose if he keeps his tongue tied down, and under such conditions a tied tongue is safer than a loose one.

If a man has a complaint rankling in his breast, get it out. Every complaint made is an opportunity given to make a new friend, and friends made in this manner are the sort which will put themselves out of their way to help you. You may have done little or much in your endeavors to please and satisfy a complainant, but the main thing is that you heard what he had to say, with attentive consideration; that you made him feel you were interested in his trouble, and determined to do what you could to make matters right. What you may have given him in the way of an allowance, or what you promised to do to improve his service, was only of secondary consideration. It is not unreasonable to assert that a complaint from a customer may even be welcomed, because of the opportunity it gives to strengthen the list of satisfied customers. It is not going too far to state that no adverse criticism should be permitted to go unchallenged. See the man who complains, and endeavor to get him satisfied. He won't be any worse as the result of a tactful interview, and the strong chances are that he will feel better toward you and your business.


VACATION TIME

Is it [illegible] and perhaps [illegible] extended period. If so you may wish to have your Electric Lights turned off in order to prevent unnecessary waste of current. A [illegible] request will receive prompt attention.

If our service is satisfactory, tell others. If there is something wrong, tell us.

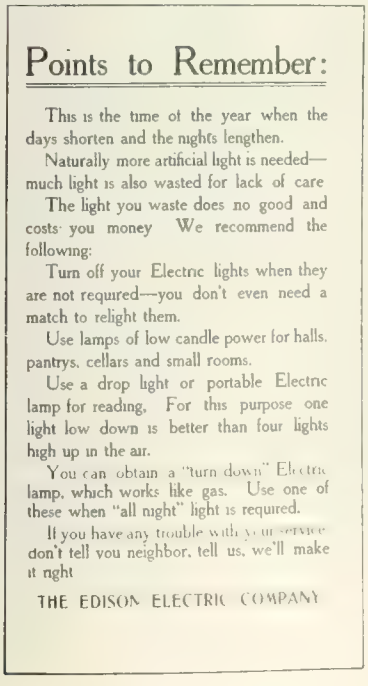
THE EDISON ELECTRIC COMPANY


EDISON BUILDING
120 E. FOURTH ST.

WE HAVE PLEASURE IN ACKNOWLEDGING YOUR REMITTANCE, AND HEREWITH HAND YOU RECEIPT FOR SAME——IF OUR SERVICE IS SATISFACTORY, TELL OTHERS, IF NOT, TELL US.

THE EDISON ELECTRIC COMPANY

FIGS. 1 AND 2.—SPECIMEN FORMS SENT OUT BY LOS ANGELES EDISON COMPANY.


Points to Remember:

This is the time of the year when the days shorten and the nights lengthen.

Naturally more artificial light is needed—much light is also wasted for lack of care.

The light you waste does no good and costs you money. We recommend the following:

Turn off your Electric lights when they are not required—you don't even need a match to relight them.

Use lamps of low candle power for halls, pantrys, cellars and small rooms.

Use a drop light or portable Electric lamp for reading. For this purpose one light low down is better than four lights high up in the air.

You can obtain a "turn down" Electric lamp, which works like gas. Use one of these when "all night" light is required.

If you have any trouble with your service don't tell you neighbor, tell us, we'll make it right.

THE EDISON ELECTRIC COMPANY

FIG. 3.—NOTICE SENT TO CUSTOMERS.

The form of courtesy which may be termed "aggressive" is often evidenced along educational and publicity lines. This policy is one which points the way for consumers to remove the causes for trouble by displaying the proper care in the use of their service, and frequently invites consumers to bring in their complaints, sometimes even before the consumers themselves have realized that they might have occasion to complain. Every possible means should be used for convincing consumers that they are getting all they are paying for; that there is in reality no mystery about the electrical business, and that electric current can be accurately measured and correctly charged. This helps to establish confidence, and if confidence is maintained it means that more current will be consumed.

There is one company in the West (the Edison Electric Company, of Los Angeles) which covers a large territory and has many business offices frequented by the general public. In each office is a printed notice, neatly framed, and hung in a conspicuous place, where all may see it. The notice is signed by the company's president, and reads as follows:

"To Officers and Employees:—The Edison Electric Company desires to have the confidence and respect of the public, with which it deals. Officers, agents and other employees should, in every reasonable way, endeavor to increase that confidence and respect by doing everything in their power to make the name of the Edison Electric Company synonymous in the mind of the public for good service, square dealing and courteous treatment. The public gains its impression of the company through contact with its representatives, and employees will, therefore, be held responsible, in every instance, for the carrying out of the well-established policy of the company."

Along the lines of aggressive courtesy this same company works at all times to convince the people that it is also operat-

ing in their interests and is willing and anxious to do everything possible to make the relations between the company and its customers agreeable, satisfactory and profitable to all concerned.

The accompanying specimen forms and notices give some idea of the means adopted to educate the public and help consumers to help themselves, or if they cannot readily help themselves, to apply for assistance in the proper quarter.

Courtesy does not mean palaver, bowing and scraping, but common, ordinary, every-day politeness—the kind that shows a desire to please, the kind that can give back a smile for a frown and that says "thank you" when the opportunity occurs. This sort of courtesy is a fine art, and when practised will spread sunshine in places that would otherwise be gloomy.

Beyond all doubt, courtesy is an asset of incomparable value in the building up of a central-station business. It represents the easy way to get along—costs absolutely nothing, yet never fails to secure handsome returns.

INTERIOR WIRING AND ILLUMINATION

Street Lighting in Denver.

Sixteenth and Fifteenth streets, in Denver, Col., have been provided with ornamental trolley and lamp poles lining either side of the street, spaced about 100 ft. apart, and extending for nearly a mile along these streets. The effect is said to be handsome and dignified, and moreover involves a minimum of wires on these streets. Seventeenth Street is now to have a similar system of lights. The new poles have been designed, and will be in place Oct. 1, in time for the Street Railway Convention. A single arc light with 15-in. globe will be employed, and the idea of setting off the arc light with a small colored incandescent a couple of feet below will be omitted, although found very effective on Fifteenth Street. The Denver City Tramway has ordered the sectional poles, the ornamentation of which will consist of a base bracket and flanges.

Latest British Wiring Rules.

Unlike the United States, Great Britain does not possess an underwriters' wiring code that is applicable to all cities in the kingdom, or equivalent to the National Electrical Code of this country. The Phœnix rules are the most widely used, however, and approach more nearly those used here. These rules have just been revised and the main points of interest in them are given herewith so that a comparison with American rules may be made. The latter rules are used extensively in Canada. In some instances the Phœnix rules are at variance with the wiring rules of the Institution of Electrical Engineers. Warning is given in the introductory note in regard to the necessity of exercising care in accepting a tender for wiring, and intending users are recommended to retain advising engineers to design and supervise the erection of an installation.

The conductivity of copper conductors must not be below 98 per cent of that of pure copper, as defined by the Engineering Standards Committee (instead of 100 per cent, according to Matthiessen's standard). Current density is still to be taken as 1000 amp per square inch, up to currents of 100 amp, and no change is made in the minimum size of conductors. The standard of insulation for conductors to be used in damp places or in new buildings, and also for pressures between 250 and 500 volts, is to be 2500 megohms per mile (formerly 2000 megohms).

Additional regulations on conduit work are as follows: All piping should be erected before any conductors are drawn in. All joints in piping should be treated with aluminum paint. The use of T-pieces and elbows is not recommended; plain junction boxes should be used throughout. No single pipe must contain more than four wires. Open seam piping with socket connections is not recommended, and is only allowed for surface work and where the pressure does not exceed 250 volts.

Wood casing will be allowed in dry positions only. Wiring joints are only allowed in casing where unavoidable (in the old regulations permission was necessary).

Lead-covered wiring is now allowed, but it must be protected where it is liable to mechanical injury or chemical action. The lead covering must be grounded, and where alternating currents are used both lead and return conductors must be in the same lead tube or covering. Systems with unguarded return are now allowed after permission has been obtained.

Flexible wires and cords must not be joined to hard wiring, except by means of screw connections in a fireproof junction box. The insulation of flexible cords must consist of two coats (minimum thickness of each 10 mils) of pure Para rubber of high quality, or of one coat of pure Para rubber of high quality next the copper and two coats of vulcanizing rubber (the minimum radial thickness of rubber must be a total of 40 mils). Flexible cords not provided with an efficient flameproof outer covering must not be used in shop windows containing inflammable goods.

Surface systems of flexible twin wiring will only be allowed in situations where the wires will not be liable to mechanical injury or damp, chemical action, etc. The systems must be carried out to the approval of the Fire Office.

Ground wire must never be of less section than No. 14 S.W.G. (No. 12 B & S). It is recommended that one end of the grounding wire should be soldered to an approved ground connection and the other end attached to the case of the main switchboard or other iron-cased apparatus by means of a detachable screw lug.

Cotton mills and certain other mills are now included with hazardous risks as situations where, if arc lamps are allowed to be used, they must (unless of inverted type) have two globes, each completely and independently surrounding the arc, and the lamps should be of such design and make that the arc cannot be sustained unless the inner globe remains intact. The inlet holes for wires of portable lamps must be bushed. Flexible twin wires used in connection must be substantially insulated. The use of switch lampholders is not recommended. Where allowed they should be grouped and switch-controlled.

Where main switchboards are in connection with a system of iron or steel conduit it should be enclosed in a cast-iron case and glazed front. Where it is in connection with a wood casing or unprotected system, enclosing cases made of hard wood will be allowed. Distribution fuseboards must be of the same general construction as for main switchboards, and must be enclosed as for main boards. (This would imply a cast-iron case where tubing systems are employed.)

Lamp switches, two-way switches, etc., must be of approved type, and of not less than 5-amp capacity, and enclosed in fireproof boxes, the covers of which must be insulated.

The term "fuses" has replaced that of "cut-outs." A 50 per cent overload (except under certain circumstances when a larger amount is allowed) is still specified for fuses, but the minimum break is now 2 in. (1 in. was formerly allowed for 100 volts pressure). The distributing circuits from fuseboards must not carry more than 8 amp at 25 volts, 6 amp at 50 volts, 5 amp at 100 volts and 3 amp at 200 to 250 volts. Magnetic cut-outs and circuit-breakers must be of approved type.

The rules on dynamos and motors have been entirely rewritten. The maximum temperature of the dynamo at full load must not exceed 70 deg. Fahr. above the surrounding atmosphere. The rules for motors are:

Motors must be enclosed in substantial metal cases, which may form part of the construction of the motor; any openings in the case for ventilating purposes must be covered with metal grids. Slip rings of induction motors must be totally enclosed in metal cases, wherever they are exposed to the liability of mechanical injury or access of dust or damp, etc. Motors must not be placed in positions where they may be exposed to

mechanical injury, extreme damp or dust, unless suitably enclosed to prevent mechanical injury, ingress of dust or fluff or possibility of injury from access of damp. In risks where inflammable dust or vapor is present the motor must be enclosed in a substantial metal case without ventilating apertures, the pulley being external to the case. The case may be connected by suitably enclosed ducts or pipes to the outside air. All adjacent woodwork, both vertical and horizontal, must be efficiently protected with fireproof material. Wood floors on which motors are fixed must be lined with a sheet of metal.

Each motor must be protected by a switch and a fuse, or its equivalent, in each connecting lead. In specially exempted cases, such as a traveling crane, or a tool with one or two motors, then one switch to control the whole will be allowed. Each motor should be on a separate circuit. Each motor should be furnished with an approved automatic no-voltage and overload release. The frames of motors and all metal piping and metal-cased apparatus in connection must be efficiently connected to earth.

The temperature rise of motors under normal working conditions must not exceed 70 deg. Fahr. above the surrounding atmosphere as measured by a thermometer, provided the total temperature does not exceed 140 deg. Fahr. The terminals of motors should be so constructed as to insure that they are efficiently protected by metal covers or an equivalent device. In positions where motors are liable to collect dust, etc., and a totally enclosed motor is not required, the motor should be cleaned periodically by means of a small compressor or hand bellows. Excessive depreciation and trouble are found to occur through neglect in keeping the interior of the motors clean and free from dust.

Auto-transformers must be of sufficient capacity to stand an overload of 25 per cent for short periods. The transformers must be totally enclosed in strong cast-iron cases with removable lids. Terminals to be within the iron cases and the leading-in holes for cables fitted with bushes, except when metal pipes are screwed direct into the case. The metal cases and frames of transformers must be grounded.

The transformer rules have now been reduced to only a small fraction of their former length.

Supply mains should be carried in iron conduit and the apparatus in connection should be enclosed in substantial iron cases.

No telephone wire should be of less section than No. 20 S.W.G. (No. 19 B & S), and the insulation of the circuit inside a building should never drop below 1 megohm. A high-voltage fuse also must be placed upon each telephone wire.

All electric radiators should be fixed to, or stand upon, approved fireproof insulators. A wire guard should protect the radiator lamps. Every floor socket should be so constructed that the contacts are automatically covered when the plug is removed. Electrically heated flatirons and smaller apparatus should each have double fuses and a switch, and be independently grounded.

Street Lighting at Mishawaka, Ind.

Until recently the streets of Mishawaka, Ind., were lighted by arc lamps hanging from ropes suspended high above the street. These, scattered along from square to square, gave light at the crossings, but left the intervening spaces not only without appropriate illumination, but plunged in shadow. Early in the year the Mishawaka Business Men's Association decided that if the city could have plenty of power—it is locally known as "The City of Power"—it ought to have light in keeping. Immediately plans were made for a revolution in the city lighting system. Many suggestions were made for improving the old arrangement, but finally a column about 15 ft. long with curved lamp arms at the top was decided upon.

The execution of the plans was placed with the Dodge Manufacturing Company, of Mishawaka, and in short order the new posts complete were delivered and placed in position. Four to six were installed for each square and one or two thrown in for good measure where needed. Only the business section was covered, but as this represents a considerable area, a large number were required.

The posts are a combination of cast and wrought iron resting on a base 16 in. square. They were made in three sections, the first two being of 3-in. and 4-in. pipe and joined by cast-iron fittings. Two arms drop over from the side posts while four are used for the corners. These are made of 1½-in. pipe with ornamental scroll supports. The distance between the post and the arms is 20 in. The side posts have two drop tungsten lamps with one at the top, while the corner posts have five tungsten 40-watt lamps in opalescent globes. The posts are white.



FIG. 1.—LAMP STANDARDS AT MISHAWAKA, IND.



FIG. 2.—NIGHT VIEW OF MISHAWAKA STREET.

The new system makes a brilliant light flooding every nook and cranny of the shopping center. Mishawaka has a population of about 12,000 and claims to be the only city of its size in the country supporting a lighting system of this kind.

Letters to the Editors.

The Buckingham Printing Telegraph System.

To the Editors of Electrical World:

Sirs:—I have read with deep interest in your issue of July 1, 1909, the tributes paid by your correspondents to the memory of the late Mr. C. L. Buckingham. It was my good fortune to have an acquaintance with Mr. Buckingham that reached over nearly a quarter of a century, during which time I received many marks of his friendship. My acquaintance with Mr. Buckingham began while I was serving as an expert on the

opposite side of a case to the one on which he was engaged, and I can bear testimony to his uniform courtesy and gentlemanliness, both at that time and subsequently, under conditions that easily might have, but did not, provoke impatient action or remark by or from him. It was also my good fortune to be requested several years ago by Mr. Buckingham to undertake a study of his printing telegraph system for a certain purpose. In the course of this study I had numerous consultations with Mr. Buckingham on the subject and, like others of your correspondents, was often struck by the extent and ingenuity of his work along lines ordinarily so divergent from those of the legal profession. Having thus become familiar with Mr. Buckingham's printer, and being familiar also with the long-distance printer that is now in use on the circuits of the Western Union Telegraph Company, I read with some surprise the remark of your correspondent C. H. S., that while the Buckingham perforator is in constant use by the said company, his "printer has, it is understood, been set aside."

From information that has reached me I should be inclined to think that perhaps the Buckingham perforator may have undergone changes of recent years. The perforator, it may be said, is an admirable mechanical contrivance for preparing messages for automatic transmission and is susceptible of many variations in the hands of skilful mechanics. The highly ingenious essential features of the Buckingham printer, however, are not easily variable, but fixed, and they exist to-day in the modified Buckingham long-distance printer practically as they did when operated under the supervision of Mr. Buckingham. The essential difference between the Buckingham printer and the said long-distance printer as now operated consists in the displacement of the Buckingham type-wheel and cylindrical paper carrier by the typewheel and horizontal paper carrier of a typewriter for the printing of the message. The Buckingham alphabet, his main line relay, separator relay, escapement magnet, sunflower arrangement, unison magnet and wheel and his distributing of selecting relays all remain. These devices were all covered by United States patents which long ago were assigned by Mr. Buckingham to the company named. That much at least, especially in view of the years of labor devoted to this invention and the fortune expended in its completion by Mr. Buckingham, should be said in justice to his memory and merits as an inventor; and it can be said without detracting from any credit due elsewhere for the successful application of the principles of his printer to the printing of telegraph messages by a typewriting machine

NEW YORK. WILLIAM MAVER, JR.

The Electrical Engineer of Low Salary Defended.

To the Editors of Electrical World:

SIRS:—During the recent Frontenac convention of the American Institute of Electrical Engineers a speaker, in advocating a broader education for engineers in order to enable them better to take an active interest in public questions related to their profession—a subject which has recently received much high-flown treatment in articles and addresses—remarked that there is no need of "intellectual mechanics." I do not find, however, that any enlightenment was offered by the speaker as to what constituted an "intellectual mechanic" beyond the statement that such engineers can be hired at a small salary in any numbers. Since, however, this type is by implication an undesirable one, and as the American Institute of Electrical Engineers has for its object the promotion and maintenance of a high professional standard among its members, would it not, in the interests of the profession it fosters, be desirable for that body to proceed to scrutinize carefully its membership roll to the end that any of this useless class found thereon may be summarily eliminated?

As the number of engineers who may be hired at low salaries is vastly in excess of those who enjoy large pecuniary rewards for their abilities—services—the speaker should have been more specific in his condemnation; furthermore, the present and prospective student should have plain warning on the subject in order that he may avoid being numbered with the reprehensible class, and technical schools should have a caution in order that they may desist from training "intellectual mechanics."

To look at the other side of the question, would the electrical engineering profession and industry be really benefited by the elimination of the "intellectual mechanic" if we assume that this term may fairly be applied to those whose work involves an absorption in detail, such as is necessitated in the designing branch of engineering works, in the detail department of engineers' offices, etc.? In point of fact, I believe that every engineer who has attained technical (though not necessarily high-salaried) eminence in his profession was at some period of his career an "intellectual mechanic."

It may be desirable to have a few electrical engineers who can talk eloquently to the public on the conservation of forests and dilate in statistical terms on the fact that when we use up the available coal supply none will remain for future power generation; but is there not in this country also hope of employment otherwise than humiliating for the "intellectual mechanic" who deals with technical detail, without which there can be no real engineering accomplishment—for the man who remains sufficiently old-fashioned in professional ideals to receive without bitter feeling the low compensation which appears incident to this class of work? If not, then this country may as well resign itself to a future perhaps of profitable electrical engineering exploitation—to quote a term from your own columns—but one barren as to technical originality; and also be content to depend absolutely on continental Europe for originative technical thought, inventive skill and the supply of works and office "intellectual mechanics."

NEW YORK. HERMANN L. JACOBUS.

Softening of Illumination Effect.

To the Editors of Electrical World:

SIRS:—Would it not be well to suggest to the manufacturers of artificial luminants, especially such luminants as tantalum and tungsten lamps and incandescent gas lamps, that in some cases where conditions would seemingly permit, such as in residences and similar places requiring a soft quality of light, that the glassware used, such as bulbs, chimneys, cylinders, etc., be of a slightly tinted shade of amber instead of clear glass; and that where parts of bulbs, chimneys, cylinders, etc., come within ordinary line of vision, they be ground or acid treated in order to assist in diffusing the light?

I feel that such usage would materially assist in popularizing luminants somewhat approaching the so-called white light, the quality of which is "hard" and does not assist in obtaining the "softness" of light which is so necessary in certain classes of service.

NEW YORK. A. J. MARSHALL.

Resuscitation from Electric Shock.

To the Editors of Electrical World:

SIRS:—The writer's work takes him to a great many electrical plants, and while he has noted that in most of these the chart issued by the *Electrical World* giving instructions for resuscitation from electric shock is posted, he finds very few men who have any adequate knowledge of how actually to proceed in case of an accident of this kind. If, however, employers and managers were to have a regular drill of their men in the application of the instructions, they would soon become proficient in their use. Unfortunately, so far as the writer has been able to learn, managers and superintendents go no further than to see that the instructions are posted in their plants.

The writer has had this matter very forcibly and painfully brought to his attention by the recent death of a friend from

electric shock, and in this case he is satisfied the man would be alive and well to-day had there been some one present at the time of the accident who understood how to apply the methods of resuscitation.

We all know there is a tendency on the part of any class of men to neglect the careful study of instructions of the kind above mentioned. And, again, it is well known that the study of printed instructions, no matter how well they are got up, is in nowise equal to personal drill under an instructor actually going through the motions, thus instilling the directions in the most lasting way. None of us would be willing to entrust our lives to a surgeon who had never witnessed or assisted in an operation, and for this same reason no employer who cares for the welfare of his men should be willing to have their lives dependent on ignorant fellow-workmen when such a condition can be so easily avoided.

In the opinion of the writer, this is a matter that might most appropriately be taken up by the National Electric Light Association and the American Street & Interurban Railway Association with a view to the appointment of a committee in each case to consider the advisability of the employment of competent men to make regular trips to power houses, car houses, etc., there to instruct the men as to the methods for resuscitation from electric shock. This work could be done in classes, but each man should be required actually to go through the various motions, using another man as a subject. For men of ordinary intelligence one or two lessons would be sufficient. It might be desirable to have an instructor visit each plant once a year, as the personnel of the plant often changes very much in that period. I feel sure that the trifling expense attached to this plan would be cheerfully borne by the different electrical companies if the matter were properly brought to their attention.

It is generally conceded by those who have made this subject a study that there are very few cases of electric shock necessarily fatal, yet we know that death by electric shock is becoming quite common.

Hickman, Ky. F. J. Foote.

[We heartily agree with the suggestion of our correspondent. The usual effect of an electric shock is to suspend animation, and this can in most cases be restored by proper treatment. It may be added that in a case brought to our attention shortly after the issue of the instructions referred to in 1895, the patient was revived only after a treatment of two hours, thus indicating the desirability of forcibly impressing on men the value of the method of resuscitation and the necessity of carrying out the instructions to the letter.—Eds.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Auto-Converter.—An illustrated description of the "C. M. B." auto-converter made by a British company. It is a rotary converter with automatic regulation of the secondary voltage, by means of an auxiliary set of short-circuited brushes. In its simplest form, the machine consists of a ring-wound armature with a single commutator, and a two-pole field system divided into two parts as shown in the diagram of Fig. 1, where *a* is the main positive and *b* the main negative brush, and these are connected to the supply mains through an ordinary motor-

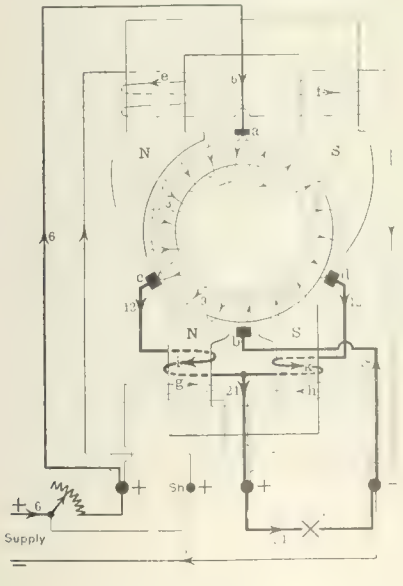


FIG. 1.—DIAGRAM OF AUTO-CONVERTER CONNECTIONS.

starter. The auxiliary brushes are represented by *c* and *d*, their position on the commutator being determined by the ratio of transformation required. If *a* is the positive brush, and the shunt windings *e f* are connected as shown, the armature will rotate in a right-handed direction, and the motoring parts of the armature will be those between the brushes *a* and *c*, and *a* and *d*. The generating portions of the armature are those between the main brush *b* and the auxiliary brushes. In order that the potential of the two auxiliary brushes shall remain the same at all loads, it is essential that the potential curve around the commutator should remain symmetrical. To reduce the distortion of the curve by armature reaction, and the consequent variation in the pressure at the auxiliary brushes the poles are divided as shown, with the result that there is very high reluctance to the armature cross-flux. By this diversion of the poles the motoring and generating fluxes are entirely separated and either side of the machine can be compounded so as to give any desired characteristic. The sectional areas of the poles are in proportion to the ratio of the transformation. The division of the poles also flattens the potential curve at the points where the auxiliary brushes are placed, and this tends to prevent sparking. The figures inserted in Fig. 1 represent the relative intensities of the current in the different parts for an assumed voltage ratio of 4 to 1, neglecting the shunt current and assuming an efficiency of 100 per cent. The machine acts as a true auto-transformer, the current in the generator portion being the difference between the load current and that supplied from the mains to the motor part. The diagram of Fig. 1 shows the connections for a machine wound to give a drooping characteristic—that is, a characteristic half-way between that of the ordinary shunt-wound and that of a differentially wound machine. Such a machine will automatically maintain a constant secondary current over a wide range of voltage and is especially suitable for supplying energy to arc lamps, as the latter can then be run without any steadying resistance. The currents from the two auxiliary brushes are first carried through the series windings *i* and *k* of the generating poles, the m.m.fs. of which are in opposition to that of the shunt windings. This arrangement has the effect of correcting the inevitable departure from symmetry in the potential curves, as well as giving the required drooping characteristic, because if the potentials of the two auxiliary brushes are not the same, a circulating current will be superposed on the load current. This circulating current will magnetize one pole and demagnetize the other and thus correct the dissymmetry. To transform from alternating current to direct current the armature is provided with slip-rings connected to the proper points of the armature, and the machine is run as a synchronous motor. Other applications of the machine are for reduction of the voltage for metallic-filament lamps or for a battery charge, also for use as a three-wire balancer, its advantages over the ordinary balancer being higher efficiency, lower cost, and smaller floor area. Fig. 2 shows the connections of the machine as

a three-wire balancer.—Lond. *Electrician*, July 9; Lond. *Elec. Eng'ing*, July 8. A long special article, by J. C. Macfarlane and H. Burge, describing the different steps in the gradual evolution of this machine, in Lond. *Electrican*, July 9.

Direct-Current Machine for Converting from Constant Pressure to Constant Current.—A note on a recent British patent of Brown, Boveri & Company (13,092, 1908; July 1, 1909). In this converter there are two direct-current machines coupled together; the exciting windings of each machine are in series with the armature of the other machine, and the fields are at

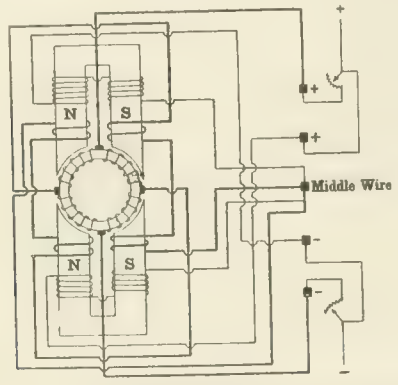


FIG. 2.—AUTO-CONVERTER USED AS BALANCER.

right angles. If a constant pressure is applied to one side of the combination, a constant current will be supplied from the other side. In a modified form of the invention, the excitation of the field system is effected by the armature currents; for a two-pole machine, four-pole pieces are provided, not connected by any yoke of magnetic material, but the adjacent poles of the two armatures are connected so that a flux flows parallel to the shaft. The fluxes produced by the two armatures are at right angles.—Lond. *Elec. Eng'ing*, July 15.

Cooling of Commutators.—A note on a recent British patent of Siemens Brothers Dynamo Works and F. F. O'Hagan (10,067, 1909; July 1, 1909). In turbo-generators in which a series of clamping rings are shrunk onto the commutator, it has been found that a blanket of warm air is trapped in the intermediate spaces between the rings, thus checking proper ventilation. To avoid this result, the present invention provides for suitably shaped draught-producing passages and recesses in the shrink-rings, which draw out the air or force it in more or less radially from or into the spaces between the rings, which thus act as centrifugal blowers.—Lond. *Elec. Eng'ing*, July 8.

Speed Regulation of Polyphase Induction Motors.—A note on a recent British patent of M. Stern (12,326, 1908; July 1, 1909). A method of winding the stator to obtain two speeds by running the motor first as an eight-pole, three-phase motor and then as a six-pole, two-phase motor is described. All the elements of the winding are used in each case. The method is applicable only to motors with eight poles or any multiple of eight.—Lond. *Elec. Eng'ing*, July 8.

Lamps and Lighting.

Reflector Lamp for Show-Windows.—An illustrated description of a new reflector lamp, comprising a low-voltage tungsten lamp enclosed in a flattened globe silvered on one side. Special nickeled flexible conduit for use with these lamps in shop windows and showcases has also been designed.—Lond. *Elec. Eng'ing*, July 8.

Generation and Transmission.

Turbo-Alternator.—An illustrated description of the new 3000-kw, three-phase turbo-alternator at the Pinkston power station of the Glasgow tramways, which comprises a steam turbine of the Parsons type, and a two-pole, 6600-volt alternator. The speed of the set is 1500 r.p.m. Interesting features of the turbine are the special means for fixing the shaft end in the drum at the high-pressure end of the rotor, and the automatic steam-operated by-pass arrangement. Features of the alternator are the careful arrangements for thorough ventilation of all parts of the machine, and the method of supporting the end connections of the stator windings. The rotor is built up of annular steel plates, and gun-metal end covers are provided to hold the end windings rigid against the centrifugal forces. Tests made on the set recently showed a steam consumption on full load of 14.66 lb. per kw-hour, at 146 lb. steam pressure, 93.3 per cent vacuum, and a superheat to 575 deg. Fahr.—Lond. *Elec. Eng'ing*, July 8.

Gas Producers for Low-Grade Fuels.—O. K. Zwingenberger.—A paper on the utilization of low-grade fuels, like lignite and peat in this country. The author thinks that the recovery of by-products would not pay, and recommends the conversion of these fuels completely into gas in a gas producer. The special features of a gas producer for this purpose are discussed and illustrated.—*Electrochem. and Met. Industry*, August.

Traction.

Choice of Frequency for Single-Phase Railways.—F. Eichberg.—A paper read before the Berlin Electrical Society on 25 versus 15 cycles for single-phase railways. The author discusses the effect of the choice of frequency on the weight and cost of generators, transformers, conductors, and motors. The conclusions of the author are strongly in favor of 25 cycles. The lower frequency permits some saving in line copper for long distances, but the first cost of all other parts of the system becomes higher with the lower frequency, and the possibility of taking energy from the railway line in towns in the neighborhood must be taken into consideration; this point is in favor of 25 cycles.—*Elek. Zeit.*, July 8.—The paper of Eichberg brought out a very extended discussion in which various speakers favored 15 cycles, with reference to various examples of American practice. Richter agreed with Eichberg concerning several advantages of 25 cycles, but stated that 15 cycles is more advantageous for the motor, especially for the series motor. Whether to choose 25 cycles or 15 cycles will depend on the question whether the other advantages of 25 cycles are considered more important than the greater reliability of the 15-cycle motors in operation. Reichel also discussed the advantages of 15 cycles, while Fleischmann agreed with Eichberg concerning the higher frequency. Richter pointed out that the choice depends greatly on the type of motor built by the company, which the engineer represents. Richter (series motor) favors 15 cycles; Eichberg (Winter-Eichberg motor) favors 25 cycles.—*Elek. Zeit.*, July 15.

Current Collectors for Railways.—P. Dawson.—In his long illustrated serial on electric traction on railways the author begins to discuss collectors for overhead conductors—namely the trolley wheel and the sliding bow. For railway work the choice and design of the collector depend on the line voltage (which, in a given case, determines the current to be collected) and the speed. The author considers that for main-line railway working with high-pressure currents some form of bow collector, preferably operated by compressed air, is indispensable. He then describes the three types thus far employed—namely, the pantograph or scissors type, the ordinary bow type, and the rod collector of the Oerlikon type.—Lond. *Electrician*, July 9.

Electric Haulage on Canals.—G. Meyer.—An illustrated translation in abstract of his recent very extended German article in *Elek. Kraftb. und Bahnen.*—Lond. *Electrical Review* July 9.

Installations, Systems and Appliances.

Central Stations and Electric Lighting.—Some further communications with respect to the problem of making electric lamps more popular with the general public. B. Leitgebel emphasizes the necessity of facilitating the wiring of buildings. The electricity supply company should carry out the wiring and the owner of the building (not the tenant) should pay for it on the installment plan. The cost of the energy itself is less important, especially with high-efficiency osram lamps. The writer does not favor a flat rate, but recommends measuring the energy by meter. B. Goldenberg also emphasized the necessity of facilitating new installations; electricity supply com-

panies should be anxious not to make unnecessary and troublesome regulations.—*Elek. Zeit.*, July 8.

Bonding and Earthing.—W. J. U. SOWTER.—An article in which the author deals with the trouble which may arise through not bonding the lead and junction boxes of a high-tension system, and concludes with a plea for absolutely concentric systems and the abolition of tail boxes between concentric cables and transformers or switches. The following example shows the danger of neglecting the frequent inspection and testing of earth connections applied to transformers, etc.: A transformer in an outlying district was feeding energy to

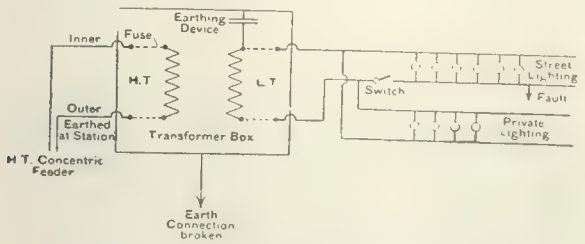


FIG. 3.—LOCAL TRANSFORMER LIGHTING CIRCUIT.

a few private consumers and a circuit of street incandescent lamps, as shown in Fig. 3. A short circuit was noticed on the high-tension feeder supplying energy to this and other transformers, which soon cleared itself. An examination revealed the fact that the transformer fuse had blown, due to the breakdown of a load inside the transformer case which happened to be protected by the fuse. It was also discovered that the whole of the street lamps had evidently been subjected to a very high pressure, as all of the lamps were blown to pieces, and the Cardew earthing device had operated. The transformer was tested for insulation, and found to be in order. The earth connection was examined, and it was found that the earth-wire was corroded away and broken where it entered the pit. There was also an earth on the switch wire of the street-lighting circuit, and the switch was open at the time. The inner when it broke down, evidently charged the case to full potential, and the high-tension current traversed the Cardew earthing device and passed to earth through the street lamps, by way of the fault on the switch wire. Where a concentric system is in use it should be concentric throughout. "For instance, concentric cables are often taken into substations or transformer pits, divided up, and rubber tails are extended to the transformers. It is surprising the number of distributing centers which are dealt with in this manner, and very few manufacturers of transformers appear to arrange their standard patterns for concentric lead-covered cables. In the former case it is obvious that, should earth connection of the case of the transformer fail, dangerous conditions may arise without warning; but a proper concentric system entails the occurrence of a short circuit if there has been any failure of insulation, and at the same time, if the lead sheathing is properly bonded at all joint boxes and at each transformer box, and connected to earth at several points, there is obtained a system which may be regarded as absolutely safe."—Lond. *Elec. Eng'ing*, July 15.

Melbourne.—J. H. DAVIES.—An illustrated description of the Melbourne Works of the Melbourne Electric Supply Company. The single-phase system is used, energy being generated at from 4000 to 4400 volts. The total full-load generator rating is 3925 kw. Four steam engines and steam turbines are used as prime movers. In order to supply energy to 1696 consumers at present connected, there are in use 46.7 miles of high-tension underground mains and 240 miles of overhead bare copper cable. The energy is available along 80 miles of streets. At the present time the equivalent of 157,934 lamps of 8 cp is connected to the mains, of which 2174 hp is represented in motors. The output for the past year has been 2,300,000 kw-hours, and this is increasing rapidly from year to year. The number of arc lamps which is daily attended to by the company, either under its public lighting contracts or under its system of rental, is 860. Almost without exception these lamps are of the flame type, supplied with energy through small pressure-reducing transformers.—Lond. *Elec. Review*, July 9.

Wires, Wiring and Conduits.

Cable Papers.—C. BEAVER.—An article on the composition and durability of cable papers with critical remarks supplementary to the recent article by Beadle and Stevens. Concerning so-called manila papers it is said that the cable manufacturer is flooded week after week with samples of alleged insulating papers which have not the remotest chance of ever being used for insulation. "These come largely from America and Germany, and it is a curious fact that while few samples from America contain anything but ligneous fibers of one kind or another, the best and most largely used American paper cables are insulated with pure manila paper. On the other hand, German cables are mostly insulated with paper either containing wood pulp in large proportions or made exclusively from it. In fact, some German firm states openly that wood pulp papers are better than manila papers, though justification for such statement from electrical or physical points of view has neither been offered in support of the statement nor demonstrated in practice." The author is convinced that paper made of pure manila hemp or flax, or even mixtures of them, will always be superior as regards durability and electrical and physical properties to those made from ligneous fibers. As to the detrimental effect of mineral matter in cable papers the author says that in papers containing only the natural amount of mineral matter, which for manila paper is usually between 1.3 per cent and 3.2 per cent, a considerable variation in insulation resistance and capacity occurs for 0.5 per cent variation in mineral matter. Again, insulation and capacity are affected when the character of the mineral matter varies. The relation between longitudinal and transverse strength is important, because it has a direct bearing on the structure of the paper—that is, the felting of the fibers. The average ratio over several hundred tons of satisfactory insulating paper recorded by the writer has been 2.02. As a further check on the structure of the paper the percentage elongation in both directions gives a useful indication. The average figures are 2.2 per cent for the longitudinal direction and 4.4 per cent for the transverse direction, giving a ratio of 0.5. The same issue contains a long editorial summarizing the results of the papers by Beadle and Stevens and by Beaver, which discuss the subject from the standpoints of the chemist and the electrician respectively.—Lond. *Electrician*, July 9.

Insulators.—W. WEICKER.—The conclusion of a long illustrated article in which the author gives a summary of the different types of suspended insulators, their development and construction, with general notes concerning the difficulties of construction, mechanical strength, electric perforation strength, and the occurrence of discharges over the brim in case of rain. He also gives comparative price and weight curves for suspended insulators and pin insulators, especially for higher voltages. Finally various forms of construction of insulators of the Hermsdorf porcelain factory are described, with figures for mechanical and electrical strength, weight, perforation voltage, and losses.—*Elek. Zeit.*, July 8.

Electrophysics and Magnetism.

Transient Phenomena in Circuits Containing No Capacity.—A. SCHWAIGER.—A theoretical paper on the transient phenomena which occur on closing or opening a circuit containing no capacity. After a general introduction, the author discusses the phenomena in direct-current circuits and in alternating-current circuits free of iron or containing iron, and also gives some comparisons with experimental results. As far as comparison of theory with experiments is possible, the graphical method described by the author enables one to solve even the more complicated cases.—*Elek. und Masch.* (Vienna), July 4 and 11.

Electrochemistry and Batteries.

Electrode Losses in Electric Furnaces.—C. A. HANSEN.—An account of an experimental investigation in which the author studied the best dimensions of electrodes for electric furnaces

in order to reduce as much as possible the heat lost through the electrodes. With graphite electrodes the efficiency of the electrode increases rapidly with increasing current density; but a limit is set by the fact that with increasing temperature of the electrode, the life of the surrounding furnace walls is reduced. The efficiency of the graphite electrode also increases within certain limits with the length of the electrode.—*Electrochem. and Met. Industry*, August.

Units, Measurements and Instruments.

A Source of Error in Needle Instruments.—J. F. Van Lonkhuyzen.—A note on a peculiar source of error in a needle instrument, due to an electric charge of the cover glass produced by friction. The phenomenon depends especially on the humidity in the atmosphere, and on the material with which the glass is rubbed, and on the kind of glass; it depends very little on the insulation of the needle from earth. The instrument is more liable to show this source of error, the smaller the directing force of the needle and the longer the needle and the shorter the distance between needle and glass. By one single rub with leather, the author has produced deflections of the needle by 5 per cent with different standards as well as switchboard instruments. In a heated room it was not difficult to produce with a dry hand deflections of the needle of from 10 per cent to 20 per cent from the correct value. The needle gradually assumes again its corrected position, but this may take from 10 minutes to an hour, and at any rate often sufficient time to result in a wrong reading. Static charges may also lead to errors if an instrument is connected to the secondary winding of a measuring transformer insulated from earth. It may then easily happen that the winding of the system assumes a static potential quite different from that of the frame, and curious errors may result. For this reason it is desirable always to earth the instrument and the secondary winding of the measuring transformer.—*Elek. Zeit.*, July 8.

Telegraphy, Telephony and Signals.

Telephone Lines.—Devaux-Charbonnel.—Continuations of his long serial on a study of telephone lines. The author continues the discussion of instruments for the determination of the constants of a line. He describes the bridge method with telephone, and describes small alternators suitable for such tests. He finds that the constants of lines are practically independent of the frequency. With respect to insulation resistance, he finds that even in the worst cases it is always of the order of several hundred thousand ohms. He then discusses the damping constants of a line. For distortionless circuits it is independent of the frequency, while for commercial lines the damping is greater for higher frequencies. In practice it is necessary to take into consideration the insulation of telephone lines to judge their quality for telephonic transmission. The poorer the insulation, the greater the damping effect. With respect to underground cables their insulation is practically infinitely great. As to the loading of telephone lines with Pupin coils, he finds that this has a very good effect for conductors of small diameter, while for cables of a certain diameter it is thought to be less advantageous than might be expected.—*La Lumière Elec.*, July 3 and 10.

Arc System of Producing Electric Oscillations.—K. W. Wagner.—The conclusion of his paper in which he investigates in general why and under which conditions a direct-current arc is able to produce alternating-current oscillations in a capacity circuit in parallel. The author gives a general review of the results of the more important investigations of this subject, and shows how they can be classified with the aid of Simon's "dynamics of the arc." The author describes some new experiments with arcs between metallic electrodes. Until recently such arcs were considered to be unsuitable for the production of oscillations, while from Simon's theory one would expect especially good results with them. Success has now been obtained, indeed. The lack of success of former experiments was due to the unsuitable choice of the condition of the experiments. With proper arangements simple metallic arcs in free air yield much higher frequencies than other systems, like the Poulsen lamp or the Telefunken lamp. An upper limit for the frequency which can be obtained has not been found. Especially for the highest frequencies the nature of the metal used as the cathode is of importance, while the nature of the anode metal seems not to have any influence.—*Elek. Zeit.*, July 8.

Electrolytic Detectors.—G. W. Pierce.—An investigation of the electrolytic detector with the aid of a Braun cathode-tube oscillograph. The author finds that the whole phenomenon of the rectification of small alternating currents by an electrolytic detector seems to be explicable in terms of the theory of electrolytic polarization. The polarization capacity of the small platinum electrode is not entirely negligible, even with currents making only 60 cycles per second. The polarization capacity may, however, aid in producing rectified current as well as oppose this effect, and, apart from the effect of the capacity on the tuning of the circuit, need not detract from the utility of the rectifier as a detector for electric waves. The present conclusion in regard to the action of the detector is entirely in accord with Pupin's original brief description of the phenomenon. There is a certain analogy between the electrolytic detector and crystal rectifiers, but the author has not yet reached a definite conclusion concerning the action of crystal rectifiers.—*Phys. Review*, July.

Miscellaneous.

New York Metropolitan District.—C. F. McKenna.—A paper presented before the American Institute of Chemical Engineers on the centering of great industries in the New York Metropolitan District, comprising besides Greater New York and suburbs, also Jersey City and Newark and suburbs. The author gives many statistical data and states that the developments of this district as technical centers for production of staples would be more rapid if certain extensive improvements could be made in which the advantages of separate State control by New York and New Jersey could be eliminated. A universal project for water supply is the most important of these improvements. Reclamation of large sunken areas adjacent to deep water to adapt them to normal uses of land is the next important improvement. Introduction of electric energy from the nearest large hydraulic works in both States is an improvement which gives promise of most extraordinary advantages, particularly for electrochemical and electrometallurgical development similar to that at Niagara Falls.—*Electrochem. and Met. Industry*, August.

BOOK REVIEW.

High-Speed Dynamo-Electric Machinery. By H. M. Hobart and A. G. Ellis. New York: John Wiley & Sons. 526 pages, 355 ills. Price, $6.

The major portion of this book is devoted to descriptions of high-speed generators that have actually been built, and the remainder deals with methods of design applicable to such machines. It may well be considered as a reference book for the designer of electric machinery. Much information is given relating to the thermal and mechanical limits encountered in design. The extra problems of providing insulation and mechanical strength when the speed is increased are fully discussed, while solutions that have proved satisfactory are outlined. The chief value of the treatise resides in the well-selected examples taken from present-day practice. The machines discussed are alternating-current generators, and continuous-current generators. Particular attention is paid to the voltage regulation of the former and the commutation of the latter. The commutatorless homopolar direct-current generator, which is useful only as a high-speed machine, is briefly described. The authors discuss an interesting original proposal to employ high-speed alternators in connection with synchronous converters for obtaining direct-current energy from steam turbines. The mechanical and thermal features of commutator construction are discussed in detail. The book will be welcomed as an addition to the reference library of the electrical machine designer.

NEW APPARATUS AND APPLIANCES

Interior Telephonic Communication on Battleships.

BY D. H. BRAYMER

On every United States battleship at the present time there are installed three independent systems for transmitting speech from one part of the ship to some other part. These are: the fire-control system, speaking-tube system, and the general telephone system which is generally known as the ship's circuit,



FIG. 1.—DYNAMO ROOM, U. S. "RHODE ISLAND."

with central-energy switchboard and operator. The first-named system is used exclusively for battle action and will not be treated in this article since the apparatus is special and its application does not figure in the general system of communication throughout the ship. The second needs no description.

The communicating service by telephone on shipboard is confined to the central-energy switchboard and its branches which connect all the important official positions with other portions of the ship for communication. Through the courtesy of the



FIG. 2.—ADMIRAL'S AFTER CABIN, U. S. "RHODE ISLAND."

United States Naval authorities the writer obtained photographs of the telephone apparatus on board the battleship *Rhode Island*, reproduced herewith.

The central-energy switchboard in use on the battleship *Rhode Island* is known as the marine type, manufactured by the Western Electric Company. Although its design was made applicable especially to battleship service, the principle upon which the board was built is the same as that embodied in the cordless private branch exchange switchboard, originally built for the Bell Telephone Company. The special features which make it applicable to battleship use are its proof against dampness, its compact arrangement, and the rapidity and positiveness of its action. The board has connections for 50 substation lines, five connecting circuits and one trunk line. As at present operated, however, there are only 40 stations connected, the trunk line being connected only when the battleship is in port. This connection enables the board to be connected with any long-distance line and operated as a private branch exchange.

The central station in which the switchboard is mounted is located near the dynamo room and is separated from it by sound-proof partitions. The board is mounted in a brass case which sets flush with the compartment wall, and so constructed that when closed the containing case is practically watertight. All the apparatus necessary in connection with the board itself is mounted in a very compact manner on the inside of the metal case, and although this case is moisture-proof, the key sections are hinged and so arranged that all parts are readily accessible for inspection and maintenance repairs.

Energy for talking and operating the signals is supplied from a small motor-generator set which is operated from the electric supply circuit. The motor-generator is of special design, the generator delivering energy to the busbars through a choke coil and from there to the connecting circuits through retardation coils. For the ringing circuit, a second motor-generator delivers direct current. For emergency, a battery equipment is used which may be either storage, dry or Le Clanché cells. The substations are equipped with direct-current vibrating bells. At the left of the switchboard is the low-voltage distributing board, which controls the battery circuits, bell circuits and telephone circuits.

At the switchboard, each substation line and the trunk line ends in a line key and line signal. Magnetic visual signals are used for both the line and supervisory signals. The key levers are arranged so that they can be thrown over a considerable angle, so that the position of any one key is at once apparent

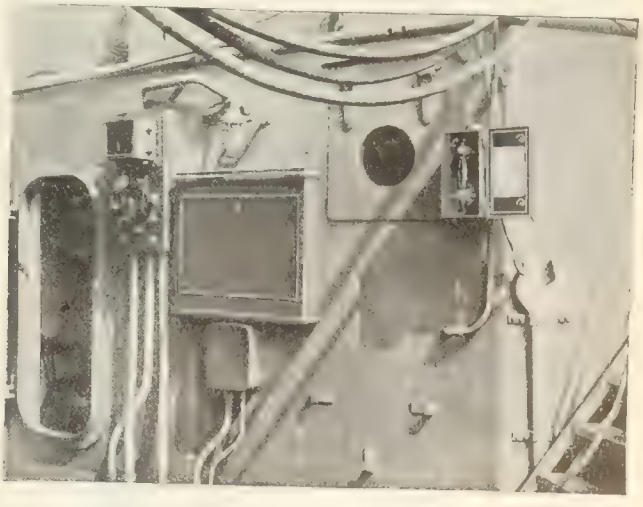


FIG. 3.—QUARTER-DECK, U. S. "RHODE ISLAND."

to the eye of the operator. The board is divided into two key sections; the first key section takes care of 25 substations, the second of 15—that is, the first section consists of 25 keys with three cam levers and the second of 15 keys, also with three cam levers. This arrangement is due to the fact that the space allotted for the installation of the board was not sufficient to accommodate the keys when arranged in one section. On account of the two-key sections there are at the left of these sections two sets of connecting circuit signals which are numbered 1-5; correspondingly numbered signals in the two sets

act in unison. The keys are placed with the axis vertical side by side in the case, giving three horizontal rows of 25 cams each in the first section, and three horizontal rows of 15 cams each in the second section. Each cam has two positions besides the normal or middle position and each key has six sets of operating springs, or three pairs of two sets each. Each one of these pairs is controlled by one of the corresponding cams.

Of the six sets of springs in each key, the upper five of these only, however, are used for connecting circuits; the sixth or lowest set of springs of the extension line keys is a ringing key for calling the extension station, the cam provided being arranged to restore automatically on being released, as is customary with ringing keys. At the right-hand end of the first section is the listening-in or operator's key. Above this there is no signal. Above each line key throughout the remainder of the board is a line signal of suitable type which is actuated by the hook switch at the extension station.

The operation of this board is as follows: On removing a receiver from the hook or taking a hand set from its containing case the corresponding line signal will show, say, No. 10; the operator then throws the lever of the corresponding line key up or down, as the case may be, on one of the five connecting circuits which is not busy and also throws the lever of the operator's key on the same connecting circuit and in the same direction. This puts the operator in connection with the party calling at No. 10 and enables him to find out the party desired. If he desires No. 1 the lever of No. 1 extension line key on the connecting circuit used is thrown in the same direction as the other two, thereby connecting the calling party at No. 10, the operator and the desired line at No. 1. The operator then rings the bell at No. 1 by depressing the lowest lever of the No. 1 line key. When the two parties at No. 10 and No. 1 begin to talk the operator throws his key lever back to normal position. When the key lever of the calling line is thrown the corresponding connecting circuit signals are displayed and the line signal is restored. Also when the conversation is finished and both instruments are hung up, at the substation, the connecting circuit signals will disappear.

In a similar manner all five connecting circuits may be used and five separate conversations carried on at one time; the operator observing the condition of the line called for and of the connecting circuits as to whether busy or not. The five connecting circuits are represented by the five locking positions of the line key levers. Disconnection is made by restoring the levers to normal position.

In connection with the line and connecting circuit signals there is what is known as the "night bell." This bell is thrown in or out of circuit by means of a special key. The night bell is a feature which enables the operator to leave the switchboard and also warns him whenever there is a change in the line or connecting circuit signals.

The operation of the board with the bell connected in circuit is the same as that given above with the following exceptions: When the receiver is removed from the hook at a substation, the corresponding line signal is displayed and the night bell also rings. If this bell is not cut out by the key it will ring until the operator answers the call or until the receiver is replaced on the hook at the calling substation. When the conversation is through and both the instruments are hung up at the substations, the connecting circuit signals disappear and the bell will ring until cut out of circuit. This calls the operator's attention to the fact that the key levers corresponding to the two lines which have been in use should be returned to their normal positions.

Two types of substation sets are used in connection with this installation, a watertight set and a non-watertight set. The watertight set is shown in Figs. 1, 2 and 3, and contains besides the necessary apparatus a hand set consisting of receiver and transmitter mounted so as to be conveniently operated when held in one hand. When not in use this hand set is placed in the metal box, the bottom or transmitter end resting in a cradle and the upper or receiver end held by a spring hook which operates the same as an ordinary receiver switchhook of the central-energy telephone subscriber's set. This box contains all the necessary apparatus of the set and has its direct-current watertight bell mounted on the top. All frame work is of brass and the exposed parts, including the bell, have the standard navy black finish. When closed the lid is held watertight against a rubber gasket in the case by two clamp levers. The connection for the bell and conduit at the bottom are also made in such a way that when the set is closed it is as watertight as possible. These sets are used on all the gun decks and at all places except in the officers' quarters.

Fig. 1 shows the watertight set installed in the dynamo room. The lid of the containing case is open and the hand set is in place. The lid is so constructed that when open it is held by a hook so that the motion of the ship will not cause it to swing or close while the set is being used. On the inside of the lid is seen a directory which includes the 40 substations, a list of which is given elsewhere. Fig. 2 shows a watertight set in the admiral's after cabin. When the ship is stripped for action

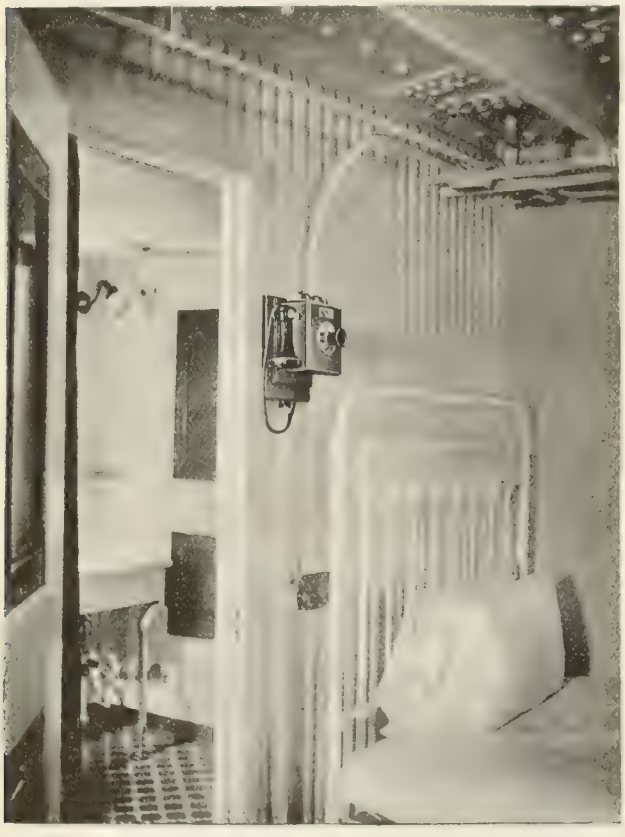


FIG. 4.—ADMIRAL'S CABIN, U. S. "RHODE ISLAND."



FIG. 5.—DISPENSARY, U. S. "RHODE ISLAND."

this compartment forms one of the 3-in .gun stations, and to clean this station and put it in order water is used freely. A waterproof telephone set is, therefore, necessary in such a case.

Fig. 3 shows a similar set as installed on the quarter deck, just in front of the after 12 in. turret. This set is exposed to the weather at all times, yet its operating features are not affected on account of its damp-proof containing case.

The type of set used in the officers' quarters consists of a compact central energy telephone set enclosed in an oak case. A designation plate marks the substation name and also the line number. Fig. 4 shows the non-watertight set as installed in the admiral's stateroom, and Fig. 5 shows a similar set in the dispensary or "sick bay." This telephone station is a very important and essential one and plays a very prominent part in the medical service, not only when engaged in battle, but at all other times.

At the central station is a duplicate of all instruments for transmitting orders that are installed in the conning tower The conning tower, which is heavily armored and immediately under the pilot house, is the station into which the commanding officer can retire during battle, and while watching through sight holes can transmit orders to any part of the ship. In case the pilot house and conning tower are destroyed while the ship is engaged in battle the commanding officer and pilot are accommodated in the central station. Here the commanding officer can give all orders to any part of the ship, and here also are provided all necessary means for steering.

Impulse Type Steam Turbine.

The E. W. Bliss Company, of Brooklyn, N. Y., has placed upon the market a steam turbine on which it has been experimenting for several years past, and which is shown clearly in the accompanying engravings. Structural strength has been a point most eagerly sought for. The turbine is being manufactured in all sizes from 10 kw to 1000 kw, and the designs include machines for both condensing and non-condensing service, and also for utilizing the exhaust steam from reciprocating engines. The exhaust steam turbine is especially adapted to manufacturing plants running at present through direct drive from a steam engine where plant extensions are contemplated. The exhaust steam machines are built in sizes from 75 kw up to 1000 kw.

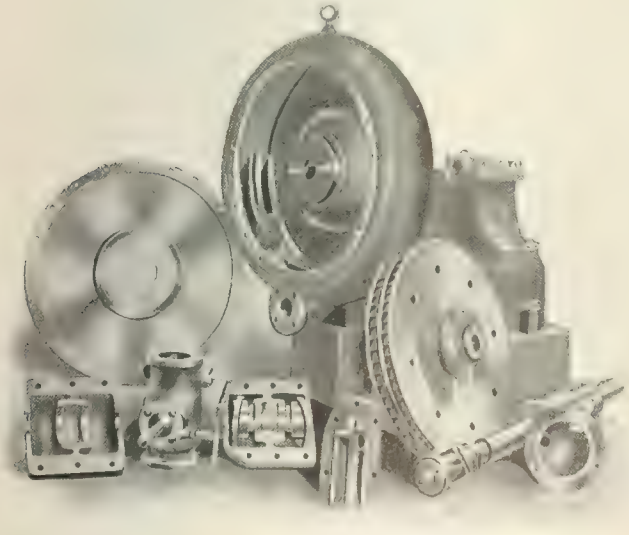


FIG. 1.—STEAM TURBINE DISASSEMBLED

The general construction of the turbine is shown very clearly in the engravings. The casing is of cast iron having the steam chest carried concentrically around its outside and delivering the steam radially inward to each of the nozzles. An even temperature is maintained around the circumference, which does away with the necessity of having to bring any of the steam outside of the casing and then back into it again. This is a very important point in the successful operation of the machine, as it is sometimes desired to look inside of the machine, and if it is necessary to break several steam joints much trouble and annoyance are caused.

The rotor or turbine wheel is made of one solid piece of open hearth steel, which has the bucket seats milled into the periphery. The buckets are separated from each other by sheets

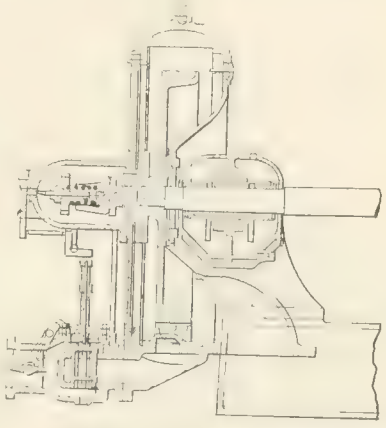


FIG. 2.—CROSS-SECTIONAL VIEW OF TURBINE

of a special anti-corrosive metal, which are held in place by three steel bands shrunk on over the periphery. This method of construction makes a solid unbroken surface on the periphery of the wheel with no projecting parts, yet the wheel is as indestructible as if no separating pieces were used, and has not the disadvantage of requiring a new wheel in case of any trivial accident like the damaging of a single bucket in transportation or handling The running clearance is 1/16 in., so that the machine cannot be considered delicate in this particular, and the construction is such that if by any combination of circumstances the turbine wheel should touch the casing, it would be a case of two smooth surfaces rubbing, like a brake shoe on a car wheel, and would cause no damage.

The steam is expanded completely in the nozzles, so that there is no difference in pressure between the buckets in the wheel and the reversing chamber, and consequently no loss from leakage. The reversing chamber is common for all reversals, so that the steam runs on a film of steam instead of on metal, which greatly reduces the frictional losses, as the relative difference in velocity of each layer of steam with respect to the next is very small, whereas with separate reversing chambers the steam velocity relative to the metal is exceedingly high and therefore causes large frictional losses, as the friction is very nearly proportional to the square of the relative velocities. The number of times which the steam is used on the wheel depends upon the steam pressure and the speed of the buckets, and in this nozzle the steam continues to strike the wheel as long as there is any energy in it.

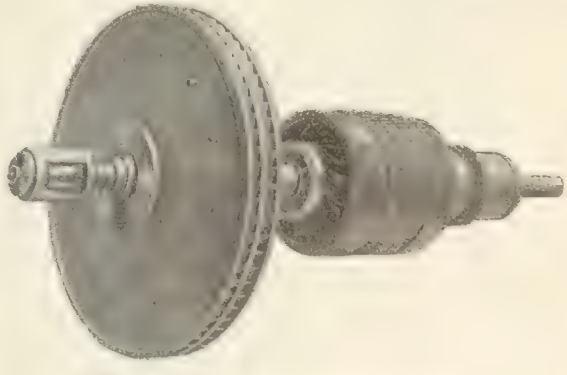


FIG. 3.—TURBINE ROTOR AND ARMATURE

In most designs the rotor is overhung, primarily in order to make a two-bearing unit for fan, pump and generating sets;

but four bearing units are built when desired by the customer and on all large machines. The center of gravity of the rotor is inside of the edge of the bearing, which is of the spherical type, and very generously proportioned.

As the only parts of the turbine requiring lubrication are the shaft bearings, it is absolutely impossible for any oil to become mixed with the exhaust steam. The method of oiling the bearings is by a ring oiler, which gives a positive feed lubrication without the use of an external pump. The oil is held in a rapidly revolving channel-shaped ring by centrifugal force, and is positively diverted to the bottom of the bearings by means of a scoop. This produces a positive oil pressure in the bearing at all times, whereas in the ordinary ring oiler most of the oil flies off from the ring, and very little is actually forced to the bottom of the bearings, where the greatest pressure and need of lubrication exist. Around the shaft is a steel labyrinth packing in which there is no contact between the stationary and rotating rings of the labyrinth. The packing prevents excessive frictional losses and does away with the trouble attendant with carbon packings or stuffing-box packings around a high speed shaft.

The governor is of the centrifugal type, and consists of two revolving weights supported upon hardened steel knife edges, and controlling a balanced governor valve through knife-edge connections. In addition to the main governor there is an emergency governor entirely independent and operating a separate valve. This emergency governor is set at a predetermined speed above normal, and in case of any possible overspeed of the turbine for any reason whatever, the emergency valve will be closed and the machine stopped.

Under the same conditions of steam pressure, back pressure and speed, the primary losses in efficiency in any turbine are caused by steam friction and leakage. In the "Bliss" turbine as the steam is expanded down to the back pressure in the nozzle, there is no difference in pressure between any part of the wheel and the reversing chambers, which makes it possible to run with a very large clearance, and still have no loss.

Electrically Operated Cash Registers.

Among the latest applications of electricity is the utilizing of a small motor to operate cash registers, in place of turning a crank handle, and a system of incandescent lamps to illuminate the upper part of the register where the amount of the sale is displayed, and attract the customer's attention. The National Cash Register Company, of Dayton, Ohio, has developed for this purpose a small and efficient motor of approximately ⅛ hp. which is capable of operating on any electric-light circuit with voltages from 40 to 250 on direct current; and from 75 volts to 250 volts, with 10 cycles to 140 cycles on alternating current, by simply changing the field coil windings to suit the required conditions.

The register with motor and lamps attached is shown in Fig. 1, the hood which covers the motor being removed to expose it to view. The motor is not a continuous running machine, but only runs when the register is operated. The action of the device is as follows: When a purchase has been made the proper amount keys are depressed and the clerks' key is then pushed, which by means of a cam automatically puts the motor in circuit and lights the lamps on the register. The motor carries the register through its operation and is thrown out of action, the whole time required being about two-thirds of a second. The lamps continue to burn for a few seconds, the exact time of illumination being predetermined by the adjustment of a small dash-pot controlled time-limit switch, which is capable of holding the lamps in circuit for a period varying from one-half second to one minute, as desired. This switch with its dash-pot, will be plainly seen in both Fig. 1 and Fig. 2. It will be noticed that the switch is of the spring contact type, making a straight up-and-down contact instead of having a wiping action. These springs are fitted with contact points or buttons of a special non-arcing alloy and are free of sparking during both making and breaking the circuit. A 1 m.f. can-type condenser (shown in Fig. 2), made especially for this purpose, is cut across the switch at the motor end and serves to prevent the arcing.

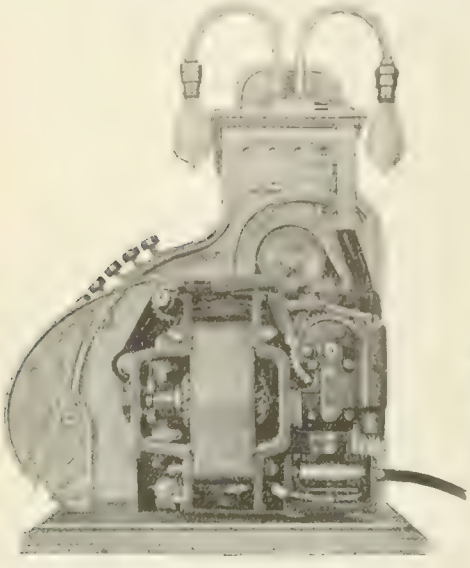


FIG. 1.—MOTOR-OPERATED CASH REGISTER.

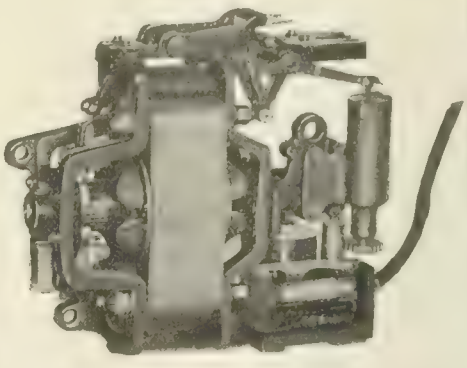


FIG. 2.—DETAILS OF OPERATING MECHANISM.

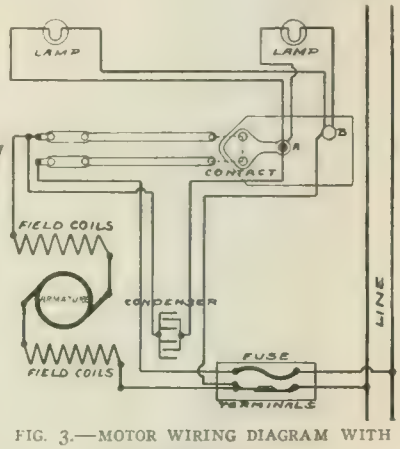


FIG. 3.—MOTOR WIRING DIAGRAM WITH ILLUMINATED INDICATOR.

The motor is a series-wound machine, with a field of the double magnetic type, and is of the usual laminated construction to enable it to operate efficiently on either alternating or direct current. The insulation in this motor is high, as the conditions of operation are such that high-grade insulation is absolutely essential. The motors are tested at 1000 volts, applied both steadily and intermittently several times during construction, and also after assembling upon the cash register. All field coils and armatures are vacuum impregnated and only the highest grade materials enter into the construction of the entire machine. A standard motor has been run continuously for over two weeks entirely submerged in a tank of water without a breakdown.

The connection to the lighting circuit is made with a length of New Code show-window cord and a Benjamin plug, which may be screwed into any lamp-socket. The other end of the cable is connected to the hard-rubber terminal and fuse block shown in both cuts, and from this point a wiring form conducts the current to the switch and condenser. The terminal block is equipped with spring clips for standard cartridge fuses, and is usually fused for 3 amp except on high frequencies, where 4-amp fuse is used. The torque and commutation of this motor when running upon alternating current is exceptionally good, as will be realized when it is considered that the motor starts from a state of rest, accelerating to full speed and completes the register operation in two-thirds of a second. Fig. 3 shows diagram of both the motor and lamp connections, and the location of the condenser in the circuit can be plainly seen.

Motor-Starting Rheostat.

The Ward Leonard Electric Company has standardized a motor-starting rheostat equipped with a device effectually short-circuiting the series field of a compound-wound motor when the motor has been accelerated to full speed. It is used in

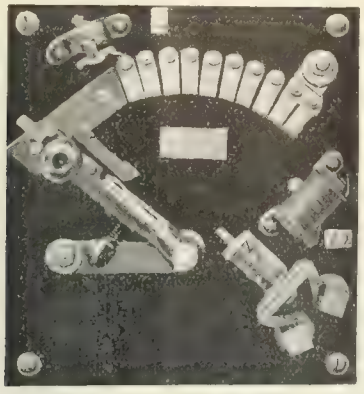


FIG. 1.—RHEOSTAT WITH DEVICE FOR SHORT-CIRCUITING SERIES FIELD COILS.

starting motors which have been designed to obtain a high torque during the period of starting only, it being desired to obtain a constant speed under varying loads after the motor has been brought to normal speed. It has also standardized a

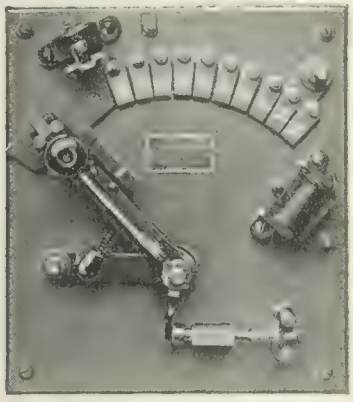


FIG. 2.—RHEOSTAT WITH DISTANCE CONTROL RELEASE.

no-voltage release motor starter equipped with a dynamic break and push-button release for use in starting motors and in enabling the operator to stop the motor at any desired point by the operation of a push-button or other type of switch.

Steel Tie and Splicing Wrench.

The purpose of the wrench shown herewith, and marketed by Mathias Klein & Sons, of Chicago, Ill., is to "tie in" a line wire to the insulator. In practical use the tie wire, already bent in the customary U-shape, is slipped over the insulator with the open end of the U resting on the line wire; then one of the



STEEL TIE AND SPLICING WRENCH.

ends of the U is put through the hole in the eye, and the tool is shoved back against the line wire. By a rotary movement of the wrench around the line wire the tie wire is curved around it in the form of a spiral. The other end of the U is likewise treated, and the line is permanently fastened to the insulator. It is customary for linemen to do this work with pliers, but the wrench is said to be a time saver, and to enable a clean job to be performed without danger of nicking the line wire. The splicing end is intended for use with the splicing clamp. The ends of the wire to be connected are held with the latter, and the projecting end is caught with the shoulder of the wrench, whence by turning the wrench around continuously the wire is coiled tightly and evenly on the line wire, making an effective splice. The device is made for tying-in wires from No. 7 to No. 11, and for splicing Nos. 4, 6, 8, 9, 10 and 12 iron wire or Nos. 2, 4, 6, 8, 10 and 12 copper wire. The wrench measures 7 in. over all.

Bituminous Gas Producer.

The bituminous gas producer shown in the accompanying illustrations combines the principles of the down and the updraft types. It is mechanically fed by dividing the generator into two sections and rotating the lower portion. The generator is both mechanically stoked and mechanically fed. The fuel is admitted on one side of a dividing wall built through the producer, and by the admission of air and steam at both top and bottom the gases are driven down through the fuel bed under the dividing wall, thereby converting the tar and other heavy hydrocarbon into fixed gases.

As the generator is divided in the center of the fuel zone an incandescent body of coke is always maintained on the outlet side, and the gas in passing through this incandescent fuel zone is filtered free of dust and soot, so that in leaving the generator it does not, it is stated, contain more than 31/1000 grain of tar, soot or other impurities per cubic foot.

Another improvement in this type of generator is in the con-

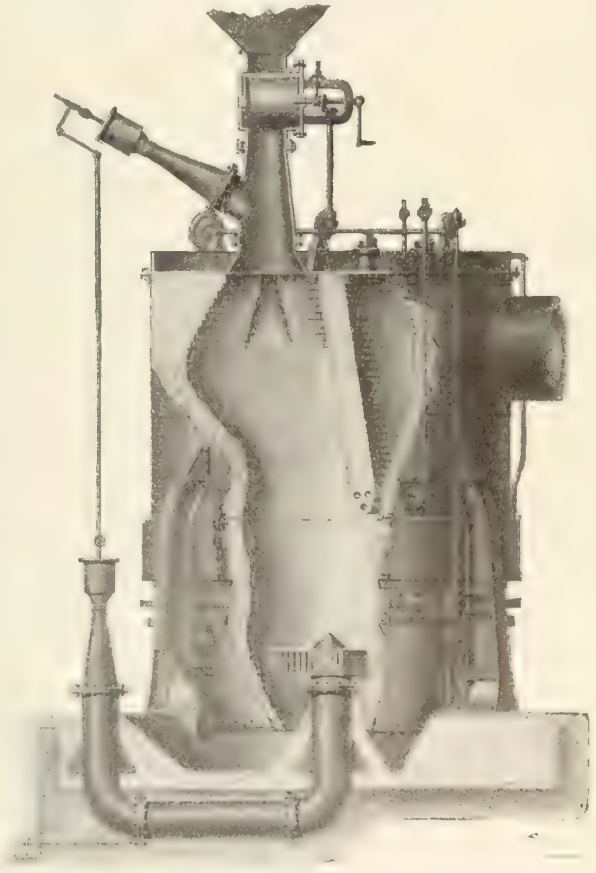


FIG. 1.—BITUMINOUS GAS PRODUCER.

struction of the lower tuyere, which is stationary and around which the bottom section of the producer rotates. This tuyere consists of four cast-iron arms, triangular in shape, with openings on the back through which the air and steam are admitted to the generator. Owing to the triangular shape of these arms and the lower section rotating against them, caking or clinker-

ing is prevented; or should any clinkers form from any undue cause they are broken up, and with the ashes are forced downward through the water seal.

The gas from the producer is conducted through a "Down-Comer" into a cast-iron box and by raising the water height this box acts as a hydraulic valve, cutting off the producer from the plant. The purge stack is connected to the top of the "Down-Comer," and the gases at night, or when the plant is not in operation, can pass either to the atmosphere or through a duct to the boiler for making steam.

The scrubber consists of a circular steel tank provided with a canopy over the gas inlet and a number of water sprinklers at the top. The gas is admitted into the bottom of the cooler and is taken off at the top. The cooler is set in a water-sealed pit, the bottom of which is provided with a sloping side for the collection of tar.

The washer is of the vertical three-stage water-sealed type. The gas is admitted to the center of the washer, and the water is sprayed on the first series of wheels by centrifugal force; the gas is then drawn through the first series of wheels and forced against a number of deflecting rings, on which water is sprayed and where the gas and water intermingle. In the second stage the gas is rotated at a high speed and passes through a mist of water, coming in contact with three series of stationary baffle rings. In the third stage gas is also rotated at a high speed and leaves the washer under pressure of from 6 in. to 12 in. water gage.

The washer is driven by a steam turbine mounted directly over it, and the speed of the turbine is governed by a gasometer which acts directly upon the turbine governor. The exhaust steam is used in the producer for making gas.

The gas is made in direct proportion to the demands upon the plant. As the load is increased, the pressure tends to decrease, which allows the gasometer to fall, which, in turn, acts on the turbine governor, speeding up the turbine to maintain constant pressure. Increase of load on the turbine tends to increase the pressure and amount of exhaust steam, which, in turn, increases the steam pressure and air pressure on the generator; and as the generator is driven by the same turbine which operates the washer, any increase in the turbine speed tends to increase the speed at which the lower section of the generator revolves, as well as to increase the amount of coal fed through the mechanically operated hopper.

The gas from the washer is passed through a dry cleaner, which consists of a steel tank with a water-sealed top, and provided with two baffle plates for holding excelsior, through which the gas must pass. This excelsior is treated with oil, so that the gas passing through it and the oil filters out any soot or dust which may have been carried through the washer. The tar storage tank is provided with heating coils, and by closing the valve at the top and admitting live steam the tar is forced from the storage tank to the collecting tank on top of the boiler and fed by gravity to the tar burner, where, by the admission of steam, the tar is atomized and burned under the boiler for making gas.

These generators are stated to be capable of gasifying slack bituminous coal, lignite or peat. The design permits the admission of air and steam at both top and bottom, where moist fuels are used. Anthracite screenings or low-grade fuels which would stop up the ordinary type producer can, it is stated, be successfully gasified in this type.

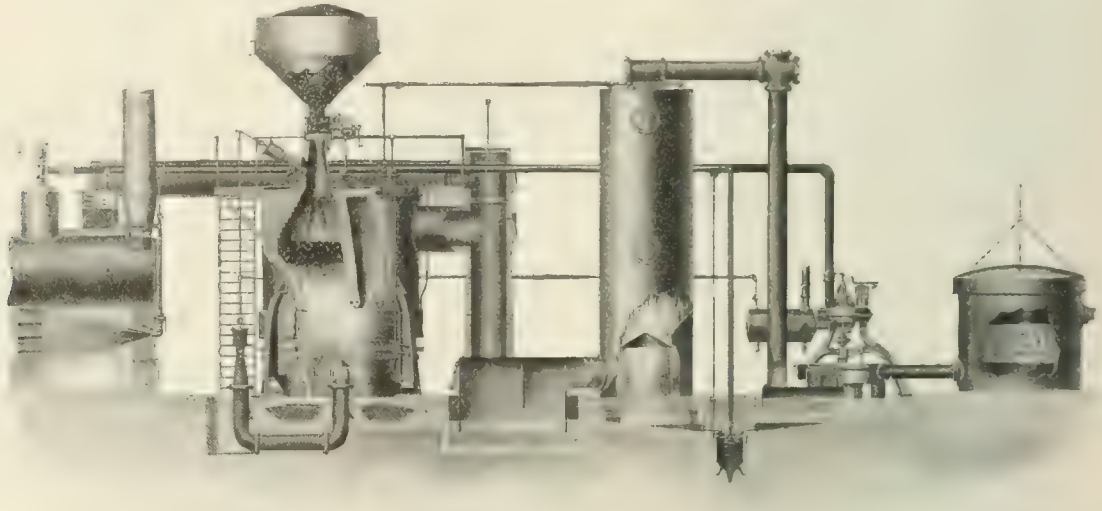
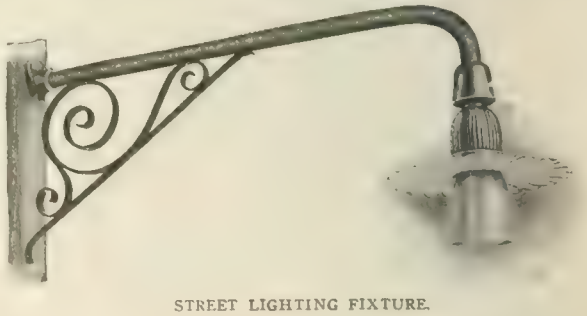


FIG. 2.—PRODUCER GAS PLANT CONNECTIONS.

This producer is stated to have an efficiency of 80 per cent at full load and to be capable of being operated continuously. It is manufactured in sizes from 200 hp up; in large sizes two or more generators are furnished, but usually one cooler and scrubbing apparatus is all that is required. This apparatus is manufactured by the Hill-Hupfel Engineering Company, 30 Church Street, New York City.

Street-Lighting Fixture.

The illustration herewith shows a street fixture brought out by the Wheeler Reflector Company, of Boston, for use with a prismatic street lighting reflector. The fixture consists of a 4-ft. bracket of 1-in. iron pipe (large enough to conceal heavily insulated cable) supported by a wrought-iron scroll, a high-tension mica insulating joint, a cast canopy which acts as a housing for the socket and support for the shade. A 16-in. porcelain enameled steel reflector fits above the prismatic glass reflector and intercepting the light which passes upward through the glass reflector, diverts it to a useful direction, adding over 10 per cent to the light radiated at an angle 15 per cent below the horizontal by the prismatic reflector.



STREET LIGHTING FIXTURE.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Conditions of trade continue to improve in general, without there being very much in the way of specific betterment that can be pointed out. There are more buyers in the leading jobbing centers and fall trade seems to be getting under headway with more vigor than was anticipated. The settlement of the tariff question—which early last week the merchants accepted as a fact—has done much to stimulate trade. Trade has been held largely in abeyance pending the adoption of a definite basis upon which business could be transacted. Just as soon as the schedules of the conference committee were reported it was accepted that these would be the final rates and the rush to market began. Every other condition is an inducement to the retailer to buy. The crop situation is almost uniformly favorable. There will be bumper yields of spring wheat and corn, winter wheat has turned out better than was anticipated some time ago, barley, oats and hay are all good, and even though there will be some reduction in the size of the cotton crop the advance in prices promises a better return to the planters. All of these things indicate that the producing sections of the country will have plenty of money to spend during the coming fall and winter and as retailers' stocks have been considerably depleted the necessity for liberal purchases is apparent. In industrial sections the outlook is equally encouraging. In almost all lines of manufacture increased orders have brought about the employment of additional operations and the buying capacity of industrial communities is rapidly increasing. Just at the present time retail trade in all parts of the country is largely of a clearance-sale character, and this in itself is doing much to clear the shelves of carry-over stock. Railway traffic is enlarging and the heavy wheat movement which is just beginning is doing much to decrease the numbers of idle cars. The equipment companies, especially the car builders, report that very satisfactory orders are being received from the railroads. Business in structural materials and other finished steel products continues in good proportions and prices are gradually being advanced all along the line. Plain wire, rods and rails were marked up $2 per ton last week, thus recording an advance of $4 per ton since May 1. The electrical companies all show steady growth in orders although the reports as yet are that the main volume of business continues to be for small equipment, rather than for heavy apparatus. Collections are somewhat improved, but are not as yet up to what might be expected from the general revival of commercial trade. Business troubles are not serious and few heavy failures are recorded. Failures for the week ended July 29, as reported by *Bradstreet's*, were 223, as against 239 the week previous, 275 in the same week of 1908, 142 in 1907, 170 in 1906 and 178 in 1905.

THE COPPER MARKET.

The new method of trading in copper was inaugurated on the New York Metal Exchange Aug. 2. For the first time actual sales of copper were made, and the quotations given out by the exchange were the result of bona fide transactions. The total sales for the day amounted to 225 tons in single carload lots—that is, 25-ton lots—at prices which ranged at from 12¾ cents for spot to 13 cents for October delivery. These prices indicate a quotation that under the old system would be about 13 @ 13¼ cents for electrolytic. During the past week the course of the copper market has been the reverse of the week previous. Instead of an advance upon manipulation in London, prices during the past week have receded ¼ cent per pound, brought about by the liquidating of speculative holdings abroad and by a reduction in the asking prices of the Amalgamated interests. The takings by domestic consumers continue to be very light, and it is the general impression that the stocks in the hands of the manufacturers are ample for all immediate needs. The output continues to be at the maximum, and it is estimated at the present time to be running at the rate of almost 4,000,000 lb. per day. Exports for July were particularly heavy, amounting for the month to 35,046 tons, which is 1,647 tons in advance of the June exports, and nearly up to the record mark made in December, 1907. Imports continue to be quite liberal, and during July will amount to something like 13,000 tons. At the close of the market Aug. 2 a stronger tone seemed to have developed, and a number of inquiries were reported from large exporters for 1000-ton lots of electrolytic. It is said that these inquiries named 12⅞ cents as the purchasing price. The daily call at 12:30 on the Metal Exchange for standard copper on Aug. 2 was as follows:

Standard Copper— Cents per lb.	Bid.	Asked.	Settling Price.
Spot	12.60	12.80	.....
August	12.75	12.85	12.80
September	12.80	12.90	12.85
October	12.95	13.05	13.00

The London prices July 31 (Aug. 2 was a holiday) were as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	58 7 6	Closed until next Tuesday.
Standard copper, futures	59 5 0	
Market	Easy	
Sales of spot	600 tons	
Sales of futures	500 tons	

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	.....	.....
Lake	14.35	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

THIRD AVENUE SALE POSTPONED.—Judge Lacombe, of the United States Circuit Court, has entered an order postponing the foreclosure sale of the Third Avenue Railroad Company's property from Sept. 2 to Oct. 27. The order also postpones until Sept. 27 the filing of the inventory of the property that is being made by the special master. The postponement of the sale was made at the request of the Central Trust Company, which procured the decree of foreclosure.

THE DENVER GAS & ELECTRIC COMPANY has secured a long lease for its office home in a new 10-story fireproof building, at Curtis and Fifteenth Streets, Denver. Excavation is proceeding rapidly. The building will have its architectural features effectively outlined with various exterior light arrangements. J. Fischer is the illuminating engineer. It is proposed to make the building at night the most attractive in Denver.

MILFORD (MASS.) ELECTRIC LIGHT & POWER COMPANY.—The Milford Electric Light & Power Company, which has plants in both Milford and Hopedale, Mass., has executed a mortgage on its property for $200,000 to secure an issue of 5 per cent gold bonds, payable June 1, 1929. The proceeds of these bonds will be used for extending the distributing lines of the company and taking up outstanding obligations.

GENERAL ELECTRIC COMPANY SELLS AIRBRAKES.—The receivers of the Metropolitan Street Railway Company have purchased from the General Electric Company 250 airbrake equipments, which will be installed upon old cars which are now being converted into pay-as-you-enter type. The Metropolitan intends to have every car in its service eventually equipped with airbrakes.

A TRAINLOAD OF MOTORS.—Buying electric motors by the trainload is an unusual transaction, but such a deal was recently consummated by the Gregory Electric Company, of Chicago. The purchase was made from the Union Electric Light & Power Company, of St. Louis, and consists of new National motors, the shipment of which will require 16 freight cars.

WESTINGHOUSE TURBO-GENERATORS.—The Torrington (Conn.) Electric Light Company is adding a 500-kw Westinghouse turbo-generator to its station equipment, and the Sea View Railroad Company has installed in its power house at Hamilton, R. I., two 400-kw Westinghouse turbines and alternators.

ELECTRICAL BUSINESS SLOWLY EXPANDING.—It is stated that the General Electric Company at the present time is employing about 25,000 workmen. This is an increase of about 1500 since Feb. 1. The increase has been gradual, keeping pace with the slow but constant improvement in sales. The present employment of labor is about midway between the high and low records. In the boom times of 1907, the company had about 31,000 workmen, and in the most depressed times of the panic it employed only 19,000. The Western Electric Company reports a continuous increase in sales. During the first seven months of the company's fiscal year, which ended with June 30, the greatest gains were shown in the Middle-West section, while the Pacific coast was next greatest in the matter of improvement. The Eastern coast section has shown comparatively small improvements. Of late the export business has shown much greater activity. For the first six months the returns ran about neck and neck with those of a year ago, but the June increase of almost twice the exports of the preceding June brought the seven months to about 10 per cent ahead of the corresponding seven months record in 1908. Of the gains reported by the Western Electric the largest percentage of increase is the gain in the cable business. The other two branches which show the most important gains are the telephone branch and the power apparatus branch of the company's operations.

MEXICAN ELECTRIC PASSENGER & FREIGHT RAILWAY.—The ancient town of Ysleta is to soon be connected with El Paso by an electric interurban railway. The El Paso & Fort Hancock Railroad Company has been organized to build an electric railway down the Rio Grande Valley from Fort Bliss to old Fort Hancock, passing through the towns of El Paso and Ysleta. The proposed line will be about 60 miles long and will do both a passenger and freight business. A great impetus to the agricultural development of the valley region both below and above El Paso has been given by the assurance of the early completion of the great Elephant Butte dam and irrigation project, which is a part of the United States reclamation work. The first irrigation in the Southwest was done upon lands adjacent to Ysleta by the Pueblo Indians in the days of Cortez and other early Spanish explorers. The proposed electric line will handle the products of the irrigated farms and afford transportation service to the many people who have taken up homes in the valley. It is stated that the road has been amply financed. Contracts for construction materials and supplies will soon be let.

PROPOSED CORPORATION TAX.—The Chicago *Daily Tribune* publishes a table showing what the proposed corporation tax of 1 per cent of net earnings will mean to a number of Chicago corporations in the shape of annual payments to the United States Treasury. In the case of the Commonwealth Edison Company, for instance, taking the latest report of net earnings, the tax would amount to $12,419. Other electrical or allied companies would be taxed about as follows: Automatic Electric Company, $4,581; Chicago Railways Company, $33,111; Chicago City Railway Company, $25,649; Chicago Telephone Company, $20,733; Metropolitan West Side Elevated Railway Company, $2,614; Northwestern Elevated Railroad Company, $3,508; People's Gas Light & Coke Company, $27,556; Pullman Company, $87,889; South Side Elevated Railroad Company, $2,340. The railroads centering in Chicago would be, of course, large contributors to this tax. The largest would be the Chicago & Northwestern Railroad, which on the basis of the latest report would pay $136,386.

ISTHMIAN CANAL BIDS FOR ELECTRICAL SUPPLIES.—Bids will be opened in Washington on Aug. 10 by the Isthmian Canal Commission for various electrical apparatus. These supplies include bells, switches, push-buttons, plugs, fuses, porcelain tubes and insulators, lightning arresters, conduits, brackets and fixtures, contactors, trolley bases and wheels, batteries, motor brushes, bare and insulated wire and telephones. The proposals ask for bids on almost all sizes and kinds of electrical equipment. In another circular the commission invites bids, to be opened Aug. 18, for the following materials: two turbine pumps, 3-stage horizontal shaft, each arranged for direct connection to a 25-cycle, 440-volt induction motor, each pump to be capable of handling 1400 gal. of pure water against a friction and gravity head of 300 ft.; two induction motors to operate on a 3-phase, 440-volt, 25-cycle circuit and a combined three-panel switchboard, two panels for electrical instruments and controllers, the third for pump gages.

ELECTRICALLY EQUIPPED GRAIN ELEVATOR.—The large fireproof grain elevator of Mueller & Young, at Fifty-fifth Street and the Pennsylvania railroad tracks in Chicago, has been operated by steam engines with rope drive, but by a contract just concluded with the Commonwealth Edison Company it is to be equipped for electric drive throughout. Forty three-phase, 220-volt, 60-cycle alternating-current motors ranging in size from ½ hp to 75 hp will be required, and they will have a total rating of 700 hp. The driven machinery consists of elevator legs, conveyors, scouring machines, exhaust fans, hoists, car pullers, dust packers, vacuum cleaners and several other types of equipment found in modern grain elevators. One of the machines is an oat clipper, which requires a 75-hp motor to operate it. This elevator handles about 40 cars of grain daily, and the Commonwealth company has made a five-year contract to supply the energy to operate it.

EXHAUST STEAM TURBINES ORDERED BY THE INTERBOROUGH RAPID TRANSIT COMPANY.—The General Electric Company is building for the Interborough Rapid Transit Company of New York City two 5000-kw, low-pressure turbines, to be operated in connection with reciprocating engines of the same rating in the subway division power house on Fifty-ninth Street and Eleventh Avenue. The order hinges on the satisfactory performance of the 5000-kw unit now installed in the same power house, and which is now undergoing test. The turbines will be vertical machines driving 3-phase, 25-cycle, 11,000-volt induction generators, the leads from which will be connected without switching apparatus to the generators driven by the respective reciprocating engines. The turbines have no governors save for emergency use, and will be equipped with surface condensers.

KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY.—The report of the Kings County Electric Light & Power Company, which includes the Edison Electric Illuminating Company of Brooklyn, for the six months ended June 30, 1909, shows a surplus, after the payment of charges and dividends, of $50,180. This is a decrease of $3,604 from the same period last year, although as a matter of fact the earnings were considerably greater. The difference is due to the fact that the operating expenses of the company were increased from $824,660 to $874,878, due to the system of accounting prescribed by the Public Service Commission.

WESTINGHOUSE INSTALLATION AT WORCESTER, MASS.—The Spencer Wire Company, of Worcester, Mass., has just contracted to duplicate its present installation of a Westinghouse 16-in. x 18-in. vertical gas engine, rated at 200 hp, and a 250-hp Westinghouse suction producer plant, to meet the needs of its factory. The engine will be directly connected to a 135-kw, 3-phase, 440-volt, 60-cycle alternator, similar to that now running. The initial equipment has been in use only a short time, and is representative of the most improved producer-plant practice for a modern output.

DENVER-GREELEY ELECTRIC RAILWAY.—C. H. Pierce, who has been promoting an electric railway to be run from Denver to Greeley and intervening cities, announces that, while the task of financing the proposition is progressing favorably, it has not yet been consummated. This summer is expected to see the completion of the financing and the beginning of actual construction. This will be a road some 56 miles in length, and energy will probably be purchased for its operation from some of the new water-power companies, the Central or the Eastern Colorado Power Company.

TROY STREET SUBSTATION, CHICAGO.—A contract has been closed for the erection of the new Troy Street substation of the Commonwealth Edison Company, Chicago, of which mention was made in the *Electrical World* of April 22, 1909. The building is located on South Troy Street, one block west of Kedzie Avenue and half a block north of West Twenty-second Street. It will house a step-down transformer substation of the usual type, the equipment consisting of two 1500-kw transformers.

ALLIS-CHALMERS 4,000-KW GAS-ENGINE UNITS.—The Allis-Chalmers Company has received a contract covering two 3-phase, 25-cycle, 6600-volt, alternating-current generators, with a combined capacity of 8000 kw, to be direct-coupled to gas engines in the power plant of the Carnegie Steel Company's Carries Furnaces at Rankin, Pa. These are stated to be the largest machines ever built for service of this character.

ELECTRICITY IN GUADALAJARA, MEXICO.—In discussing the effect on American trade of ordering all wires underground in Guadalajara, Consul Samuel E. Magil said that the order was the effect of the union of two strong local corporations, La Compañia de Tranvias, Luz y Fuerza de Guadalajara, with La Empresa Irrigadora y de Producción Electrica de Guadalajara. The former corporation now has a monopoly of the electric service of the city, and the latter corporation has valuable concessions from the State of Jalisco and the Government of Mexico, through which it controls rights to irrigate a large tract of land in the State and to immense water-power in near-by rivers, and also to enter Guadalajara with its wires to compete with the former in selling electricity in the city. This will prevent a possibly dangerous competition and will certainly result in benefit to Guadalajara, although prices will probably be kept up to the present standard. Just what opening this change will offer to American manufacturers is at present uncertain, because, while the Compañia de Tranvias has heretofore purchased American-made electric machinery, the Compañia Irrigadora is said to have made a contract with a large German concern to use German goods exclusively in return for financial aid given by the German company about a year ago, at a time when it was difficult to interest American capitalists in Mexican enterprises. Offerings of materials for the conduits and for the trolley underground addressed to either of the above companies will no doubt receive consideration, and may result in business.

MURALT & COMPANY, 114 Liberty Street, New York, have been awarded the contract for the electrical equipment of a new municipal lighting and pumping plant at Berlin, Md. Two-phase alternators generating at 2200 volts will be driven by gas engines supplied from producers. Distribution will be at 110 volts.

Financial Intelligence.

THE WEEK IN WALL STREET.

The past week in Wall Street has not been one of great importance, although stocks have been strong in tone and prices have generally advanced. Trading during the week was not particularly active, and the majority of the transactions were among the professionals. During the earlier days there was very little doing, but as soon as it became apparent that an end of the tariff uncertainty had been reached traders took heart and began to go into the market more freely. The feature of the week, from a financial point of view, was the report and increase of dividend of the United States Steel Corporation. The figures for the June quarter are considered to be very satisfactory. They show net earnings of $29,340,491, an increase of $6,419,233 over those of the March quarter and an increase of $9,074,735 over those of the same quarter in 1908. While this showing was regarded as satisfactory the report as to unfilled orders was taken to be even more encouraging. This showed that the corporation now had on hand orders for 4,057,939 tons of material, an increase of 515,344 tons over those of March 31 and of 744,063 over those on hand at the end of the June quarter in 1908. The increase in the dividend on the common stock from 2 to 3 per cent had been so long discounted by the ticker that it had no effect upon the price of the stock. The benefits to be derived from such increases are always reserved for the insiders, and when the price of common advanced 10 points within a few weeks without any apparent reason it was because those who knew what was coming were buying. The returns from the railroads continue to show increases in earnings over the same periods in 1908 and 1907. The amount of idle equipment is becoming less and less, and in some sections the roads are already beginning to complain of the difficulty of securing cars and locomotives sufficient for their purposes. This condition means that orders for new equipment must necessarily be forthcoming before long, and it is generally believed that when such orders start they will be quite liberal. Except for cotton, the reports from the crops are entirely favorable. It is now freely predicted that the farm yields throughout the West and Northwest will be considerably greater than the most sanguine estimates heretofore made, and will be by far larger, in volume and value, than any in the history of the country. All of this is taken to mean business for Wall Street. There is still a good demand for bonds, and money continues plentiful and cheap. Quotations on Aug. 2 were: call, 1¾@2 per cent; 90 days, 2¾@3 per cent. The quotations in the table are those of the close Aug. 2.

NEW YORK.

	July 26.	Aug. 2.	Shares sold.		July 26.	Aug. 2.	Shares sold.
All.-Ch.	15*	16¼	2,300	Int.-Met., pfd.	45	48	32,045
All.-Ch., pfd...	53	57	5,930	Mackay Cos...	82	84⅛	3,100
Amal. Cop....	82⅞	84¾	150,500	Mackay Cos.p.	73⅜*	74¼	300
Am. D. T.....	30*	30*	———	Man. Elev....	140*	141½	205
Am. Loc.....	62	67¼	17,400	Met. St. Ry...	20*	20*	300
Am. Loc., pfd.	120½	120¼	400	N.Y. & N.J.Tel	139⅛	142	2,390
Am. Tel.&Cbl..	84*	84*	———	Steel, com....	70⅛	74¼	487,175
Am. T. & T...	140¼	143¼	42,350	Steel, pfd....	126½	128½	22,650
B. R. T.....	77⅜	80½	25,570	W. U. T.....	73½	76	11,076
Gen. Elec.....	166¼	170	7,725	West'h, com...	84½	86	6,000
Int.-Met., com.	14¼	15½	10,711	West'h, pfd....	124½	124½*	100

PHILADELPHIA.

	July 26.	Aug. 2.	Shares sold.		July 26.	Aug. 2.	Shares sold.
Am. Rys.....	45½*	46	———	Phila. Elec....	11⅝	12⅜	———
Elec. Co. of A.	12⅝*	12¼*	———	Phila. R. T...	29	32⅛	———
Elec. St. B'ty.	56½	62	———	Phila. Trac...	90½*	90⅞	———
E. S. B'ty,pfd.	49*	49*	———	Union Trac...	53½	53⅞	———

CHICAGO.

	July 26.	Aug. 2.	Shares sold.		July 26.	Aug. 2.	Shares sold.
Chi. City Ry..	180*	180*	———	Chi. Tel. Co..	133	134	———
Chi. Rs.,Ser.1.	119	119½*	———	Met. El., com..	16*	16*	———
Chi. Rs.,Ser.2.	38	39*	———	Met. El., pfd..	47¼*	47½*	———
Com. Edison...	120	120	———	Nat'l Carbon...	91*	92½	———
Chi. Sub'ws...	20¼	19½	———	Nat'l C., pfd..	110*	110*	———

BOSTON.

	July 26.	Aug. 2.	Shares sold.		July 26.	Aug. 2.	Shares sold.
Am. T. & T...	140¼	143¼	———	Mex. Tel ..	2¾*	2¾	———
Cum. Tel.....	137½*	145½*	———	Mex. Tel., pfd.	6*	6*	———
Edison E. Ill..	250	254*	———	N. E. Tel....	134	131	———
Gen. Elec.....	167	170	———	W. T. & T....	11¾*	12	———
Mass. E. Ry..	12	12⅝	———	W. T. & T., p.	80*	90	———
Mass. E. R., p.	73¼	72	———				

*Last price quoted.
Shares sold are for week July 26 to July 31.

DIVIDENDS.

Boston Elevated Railway Company, semi-annual, 3 per cent, payable Aug. 16.

Consolidated Gas Company, New York, quarterly, 1 per cent, payable, Sept. 15.

Lawrence (Mass.) Gas Company, semi-annual, 4 per cent, payable Aug. 2.

Northwestern Elevated Railroad Company, preferred, 1 per cent, payable Oct. 18.

Ohio Traction Company, Cincinnati, preferred, quarterly, 1¼ per cent, payable Aug. 1.

Pressed Steel Car Company, preferred, quarterly, 1¾ per cent, payable Aug. 25.

Susquehanna Railway, Light & Power Company, preferred, quarterly, 2½ per cent, payable Sept. 1.

POTOMAC ELECTRIC POWER COMPANY.—The annual report of the Potomac Electric Power Company, of Washington, for the year ended June 30 shows gross earnings from operations of $1,352,888 and total expenses, including maintenance, renewals and new construction, of $965,945. During the year the company issued bonds to the amount of $1,500,000, and paid in interest, sinking fund and taxes, $757,543, and in repayment of loans, $650,000. The balance on hand at the end of the year was $519,907.

CARS ON THE MANHATTAN BRIDGE.—The receivers of the Metropolitan Street Railway Company have been granted until Sept. 1 to file an amended petition for the right to run tracks over the new Manhattan Bridge. The company only wanted to run its tracks across the bridge, but Acting Mayor McGowan has ruled that they must be run all the way to Flatbush Avenue and Fulton Street or not at all. The delay was granted for the company to consider this situation.

CONSOLIDATED GAS COMPANY SELLS NOTES.—N. W. Harris & Company, of New York, have just purchased from the Consolidated Gas Company an issue of $5,000,000, 4 per cent, collateral trust notes due Aug. 10, 1910. The proceeds of these notes will be used to take up a like amount of 5 per cent notes due Aug. 10, 1909. The notes are secured by a deposit of $6,250,000 stock of the New York Edison Company.

WESTINGHOUSE RE-ELECTS DIRECTORS.—At the annual meeting of the stockholders of the Westinghouse Electric & Manufacturing Company, which was held in Pittsburgh July 28, the following directors were re-elected: Richard Delafield, E. C. Converse, Anthony N. Brady and J. D. Callery. The report was presented at this meeting, but only routine business was transacted.

AMERICAN TELEPHONE & TELEGRAPH CONSOLIDATION.—In connection with the movement to consolidate all the Bell operating companies into one big corporation, a bulletin has been issued from the Boston office of the American Telephone & Telegraph Company which says that the plan is too big to be disposed of within a few months' time and that it is a broad movement which in its complete unfolding will spread over a number of years. It is announced that no further exchange of American shares for the shares of local companies will be attempted until the results of the four offers already made have been worked out. The circular then says: "The first step was taken two years ago when the Bell of Philadelphia, the Pennsylvania, the Chesapeake and Potomac, the Delaware and Atlantic and the Diamond State companies, occupying adjoining territory, were consolidated. This consolidation was not completed until the end of 1908. The next step was bringing under a common management the large New York companies and the making of a practical consolidation of the companies operating in central New York. This step was completed this year. Although hampered by artificial boundaries the results of consolidations thus effected from both the economical and practical standpoints have been so great that a step further was decided upon in order that the maximum advantages could be obtained. That the closely interrelated territory of the New York & New Jersey, Bell of Philadelphia, Bell of Buffalo and Central District and Printing Telegraph Company of Pittsburgh might be more effectually rearranged the American Telephone & Telegraph Company offered an exchange of its shares for the outstanding local shares." The basis of exchange with the Bell Company of Buffalo was not one for one and a half, as announced, but was 15 shares of American for 16 shares of the local company.

ELECTRIC RAILWAY BUSINESS IN MASSACHUSETTS.—Returns from the Massachusetts Electric Companies for the quarter ending June 30 show an increase of about $47,000 in gross earnings as compared with the same period last year, representing a gain in traffic of about $50 per mile of track operated on these lines, which extend from Boston to Nashua, N. H., on the north and to Newport, R. I., on the south. A large part of this traffic originates in the less thickly settled districts, and as this system is peculiarly sensitive to the prosperity of the communities through which its cars are operated, the gain in earnings for the three months represents steady improvement in local business conditions. The warm weather has also undoubtedly induced extra travel by trolley. For the nine months ending June 30 the gross earnings increased $100,504. The management expended about $200,000 more upon maintenance in this period than in the corresponding one of last year, and the physical condition of the property is much improved. The dividend rate of 3 per cent upon the preferred stock remains unimpaired, and it is expected that the estimated increase of $100,000 in gross earnings for the present quarter may enable the dividend rate to be raised to 4 per cent next January.

TELLURIDE POWER COMPANY EXPANDING.—It has recently been made known that the Telluride Power Company, a concern which has hydro-electric plants at Telluride, Col., and Provo and Logan, Utah, is in reality the owner of the Beaver River Power Company. This company owns the water rights of the Beaver River in Utah, and recently completed and put in operation the first units of a power plant which will ultimately cost $900,000. The ownership by the Telluride company was disclosed through the sale by the Beaver River company, a couple of weeks ago, of $400,000 worth of bonds for completing its work. These bonds were purchased by the American Trust & Savings Bank and Cutting, Waller & Mayer, of Chicago. L. L. Nunn, president of the Telluride company, is also president of the Beaver River company, and the boards of directors of the two corporations are made up of the same men.

INTERBOROUGH RAPID TRANSIT EARNINGS.—Preliminary figures of the earnings of the Interborough Rapid Transit Company for the fiscal year which ended June 30, 1909, show a gross of $25,775,392 as compared with $24,059,299 in the previous year. The returns derived from the operations of the subway and the elevated lines after paying all charges were equal to 13.11 per cent on the $35,000,000 stock of the Rapid Transit Company. The net income for the year after all fixed charges have been paid amounts to $8,789,823. To these earnings the subway contributed $11,917,313, an increase of $1,896,774 over the previous year, and the net for the subway was $7,369,692, a gain of $1,772,468. The Manhattan Elevated lines earned the full amount of the 7 per cent guarantee which the Interborough has to pay.

WESTERN UNION TELEGRAPH EXPANDING.—In spite of the fact that the telephone as a method of communication has been cutting into the business of the telegraph companies, the Western Union considers that its particular field is open to further development, and the management is at the present time expending large sums on extensions and improvements. President Clowry has recently made the statement that July, up to date, had been better than any similar period in the history of the company. There is now available for dividends a balance of $5,447,663, or $3,766,917 more than was available at the same time in 1908. The total balance of the company at the present time is $17,102,075, which is $2,708,219 more than one year ago.

SOUTHERN COLORADO POWER & RAILWAY COMPANY.—The stock holdings of J. J. Henry, amounting to $36,000, in the Southern Colorado Power & Railway Company have been offered for sale on account of some hitch in the arrangement by which he controlled the company. In this connection it is announced that Mr. Mosely, who was formerly connected in an engineering capacity with the Central Colorado Power Company has been placed in charge of construction of the interurban line in the Grand Valley through Grand Junction. The Southern Colorado Power & Railway Company recently suffered a severe loss by fire in its power station at Trinidad, Colo.

TOLEDO RAILWAYS & LIGHT COMPANY.—Another appeal has been sent out by the secretary of the stockholders' protective committee of the Toledo Railways & Light Company, urging the shareholders to deposit their holdings with the committee. H. F. Swift, the secretary of the committee, says that while a majority of the stock has been deposited the work of the committee is being retarded by a number of small stockholders who are holding back. It is intimated that those stockholders who do not come in run a risk of losing their holdings.

GENERAL ELECTRIC ACTIVITY.—The prospects are that the orders of the General Electric Company for the current fiscal year will run in excess of $60,000,000. Earnings are also showing improvement, one reason being the low prices that prevail for copper. Moreover, the operating costs will probably show a sharp reduction. The increased business that has developed during the last several months is reflected in the stock quotation, which has exhibited a steady upward movement.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Atlanta Water, Light & Railroad Company:					
Quarter ended March 31, 1909	$51,477	$37,954	$13,523	....	.....
Quarter ended March 31, 1908	53,501	40,100	13,401	....	.....
Ann Arbor Electric Railway Company:					
June, 1909	95,815	48,784	47,041	$34,478	$12,562
June, 1908	90,662	51,561	39,100	31,267	7,832
Manufacturers' Light & Heat Company, Pittsburgh:					
Six months ended June 30, 1909	2,802,699	942,868	1,859,831	492,541	1,367,290
Six months ended June 30, 1908	2,492,552	964,298	1,528,254	546,483	981,771
Massachusetts Electric Companies:					
Quarter ended June 30, 1909	2,040,177	1,322,978	717,199	458,477	258,721
Quarter ended June 30, 1908	1,993,216	1,212,081	781,135	466,191	314,943
Norfolk & Portsmouth Traction Company:					
June, 1909	164,511	97,269	67,242	.....	.....
June, 1908	164,526	98,622	65,904	....	.....
United Railways of San Francisco:					
June, 1909	597,484	344,800	252,684	....	.....
June, 1908	551,193	347,037	204,156	....	.....

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—It is understood that the Tennessee Coal, Iron & Railroad Company, of this city, in connection with the other improvements it contemplates, is planning the construction of a generating plant, the cost of which will be several thousand dollars.

CITRONNELLE, ALA.—It is understood that a company is to be formed at this city for the purpose of establishing an electric-light plant. E. E. Nichols is reported to be the prime mover in the new enterprise, the plans for which indicate that the installation will be effected within ninety days.

PHOENIX, ARIZ.—The Consolidated Telephone Company is arranging for the installation of considerable new equipment in its exchange at this city.

CORNING, CAL.—A large pumping station, which will in all probability be operated by electricity, is to be established in the Maywood Colony by George Hoag, of Corning.

DORRIS, CAL.—A proposition has been made to the city of Dorris by Moore Bros., Klamath Falls, represented by Frank Rose, to furnish electricity for lighting and industrial purposes. It is planned by Moore Bros., who have applied for a 50-year franchise in Butte Valley to erect a $75,000 power plant on the Klamath River, and to construct transmission lines to Dorris, Macdoel and Mt. Hebron. It is believed that the carrying out of this project will mean the substitution of electric motors at all pumping stations throughout the Valley for gasolene engines which are now being used.

ESCONDIDO, CAL.—It is reported that an application for an electric-service franchise was recently filed with the City Council by Seth Hartley, of Colton, and that the sale of the franchise is set for September 14. In the interim, it is the intention of Mr. Hartley, so he states, to endeavor to secure three-year contracts from the people in Escondido to patronize his system exclusively, the immediate construction of the plant being contingent upon his success in this direction.

FLORENCE, CAL.—It is announced that the Board of Supervisors has passed a resolution calling for a meeting in this city on August 10, the purpose of such meeting being to vote on the establishment of a lighting district. Similar action is to be taken in East Hollywood.

JACKSON, CAL.—It is said that the Crystal Water Company, a new concern of which nothing definite is known in Jackson, has purchased all of the rights of the Oleta Canal & Power Company, including the Purington and Eagle ditches and other water rights in Dry Creek and Cosumnes River.

LODI, CAL.—The City Clerk, J. McMahon, writes that bids will be received until Aug. 14 for the purchase of bonds for waterworks, an electric light plant and a sewer system. H. Henderson, of Stockton, is engineer.

MERCED, CAL.—The South Fork Mining & Power Company, which owns the Peach Tree and Panoche group of mining claims, is preparing to construct a generating plant for its own use, it is said. As the plant is to be located in the forest reserve, it will be necessary for the company to make a detailed map of its proposed work for filing with the U. S. Government. Smith & Arnold, of Boston, are said to have charge of the property for the company.

SANTA CRUZ, CAL.—The Coast Counties Electric Light & Power Company is installing a 450-kw motor-generator with a rating of 535-hp. This new apparatus is being added to supply power for the Union Traction Company, and is expected to double the equipment of the latter company's plant.

COLORADO SPRINGS, COL.—H. F. Avery, Mayor, is reported to be in favor of constructing an electric-light plant to utilize the water power now going to waste on Pike's Peak.

RIFLE, COL.—The town is installing an electric-lighting plant, which should be in operation by the last of the year.

HARTFORD, CONN.—The Hartford Electric Light Company has declared its regular quarterly dividend of 2 per cent, and an extra ½ per cent.

MIDDLETOWN, CONN.—Arrangements are under way for a betterment of the street lighting in Middletown, the improvement involving the substitution of tungsten lamps for arc lamps wherever possible.

TORRINGTON, CONN.—A 500-kw Westinghouse-Parsons turbine generator set is being added by the Torrington Electric Light Company to its station equipment. The station supplies a lighting and industrial service with 60-cycle, three-phase current at 2300 volts.

WASHINGTON, D. C.—Separate bids will be received until Aug. 11 by Bernard R. Green, superintendent of buildings and grounds, for furnishing and delivering the distributing switchboard and feeder panel, conduit and fittings, automatic time switches and wire for the electric system of illumination in the court book stack of the building for the library of Congress.

FORT PIERCE, FLA.—We are advised by the St. Lucie Ice Company that it has refused the franchise recently granted by the City Council on account of a 10-year clause.

JACKSONVILLE, FLA.—A meeting has been called for August 16 by the Jacksonville Electric Company, of which Clement R. Ford is secretary, for the purpose of voting on a $400,000 increase in its capital stock.

LEESBURG, FLA.—It is announced that J. Y. Clark, manager of the Leesburg Ice Company, who was recently granted a franchise for an electric-light system and waterworks at this city, has placed a contract with the Chicago Bridge & Iron works, Chicago, for an 80,000-gallon tank, and ordered a generator and engine from the Skinner Engine Company, Erie, Pa.

PENSACOLA, FLA.—The Board of Public Works has decided to install electric lamps on Palafox Street from Gonzales Street north to the city limits, a distance of about twenty blocks, and the Pensacola Electric Company has been authorized to proceed with the work.

BREMEN, GA.—It is stated that the City has engaged W. J. Radcliffe, Tallapoosa, Ga., to superintend the construction of the electric-light plant to be installed at Bremen, for which purpose the citizens recently voted to issue $8000 in bonds.

ELBERTON, GA.—The report of Park A. Dallis, engineer, of Atlanta, Ga., for increasing the equipment of the municipal electric-lighting plant having been approved by the City, it will install a 300-hp generator, increase water power by lowering tailrace, remove and install present generator at pumping station, where it will be connected with engines used for pumping water, and construct a practically new line from the electric plant to the city. A bond issue of $5,000 was recently authorized to carry on this work.

MOUNTAIN HOME, IDAHO.—It is reported that the Crane Falls Power & Irrigation Company, a Canadian and Cleveland corporation, is planning to construct west of Mountain Home a power plant the estimated cost of which is $15,000. R. P. Chatton, of this city, is interested in the proposition.

AURORA, ALL.—A franchise has been granted by the City Council to the Aurora, Elgin & Chicago Railroad to construct an electric railway through Aurora.

CARPENTERVILLE, ILL.—The City Council has granted to the Elgin, Woodstock & Lake Geneva Railroad a 50-year franchise to operate a street railway through Carpenterville, the provisions of which are that the company shall complete the railway within a year, and file a bond of $10,000 within 60 days after the passing of the ordinance. J. A. Kirkland, of Elgin, is among those interested in the company.

CHENOA, ILL.—The Joliet & Southern Traction Company, of which Lee Fisher is electrical and chief engineer, has applied to the City Council for permission to enter Chenoa.

CHENOA, ILL.—C. C. McDonald, owner of the present electric-light plant, is said to have secured a 10-year franchise, and is planning to construct a new plant on the west side of Block 25, Hamilton addition, to install new lamps and make the system generally as perfect as possible.

GALESBURG, ILL.—A 25-year franchise to construct and operate an electric railway in this city has been granted to the Peoria & Galesburg Railway, of which S. F. Atwood is secretary.

GENOA, ILL.—A 50-year franchise to construct a street railway in Genoa has been granted by the City Council to the Woodstock & Sycamore Traction Company.

KANKAKEE, ILL.—The Kankakee Electric Railway has been granted a 20-year franchise to extend its electric railway lines on certain streets of Kankakee.

OREGON, ILL.—The capital stock of the Oregon Power Company has been increased from $150,000 to $300,000.

QUINCY, ILL.—Contracts for the construction of an electric light and power plant for the Illinois Soldiers and Sailors' Home, bids for which were opened July 23, have been awarded as follows: To the Ball Engine Company, of Erie, Pa., for engines; alternators to the Electric Machine Company, of Minneapolis, Minn.; boilers (Stirling) to Stack & Kellogg; piping and covering to E. Best, of Quincy, Ill., and Kohler Brothers, of Chicago, Ill.

ANDREWS, IND.—It is the intention of the Andrews Electric Light Company to remodel and enlarge its power station, and to add considerable new machinery and equipment. For this purpose it will be necessary for the company to discontinue its service for several weeks, due notice having been given to its customers.

AURORA, IND.—The City Council has granted the Engineering & Equipment Company a franchise to build, own and operate a freight and passenger railway in this place and to connect with Rising Sun, Ind., The company will purchase oil engines, generators, storage batteries and railway supplies in the near future.

HARTFORD CITY, IND.—The Hartford City Lighting Company, which is controlled by the Trowbridge & Niver Company, a Chicago bond

Forest, is applying for an extension of its franchise from 15 to 25 years. As stated before, other plans are under consideration, pending this extension, which contemplate the consolidation of the electric lighting and industrial supply in several towns in the vicinity, and the erection of a large plant at Hartford to supply energy to these towns.

INDIANAPOLIS, IND.—A proposition to light all the downtown streets without cost to the city has been made by the Peacock-Wooley Lighting Company, a Chicago concern. The company reserves the right to place advertising matter on the glass panels of the lamp posts, out of which it will derive its revenue. The city officials claim that the scheme will effect a saving of $10,000 a year, and a test installation is to be put in operation in a few days.

MISHAWAKA, IND.—The City Council has passed an ordinance requiring the new Electric Light Company and the Bell Telephone Company to place their wires underground at once. The Home Telephone Company has already installed a conduit system.

PORTLAND, IND.—The City Council is reported to have awarded the Ames Iron Company, of Cleveland, the contract for furnishing a complete new equipment for the municipal electric light and power plant.

SOUTH BEND, IND.—It is the intention of the Indiana & Michigan Electric Company, of which F. A. Bryan is manager, to install a new system of electric lighting in the business section of the city, for which purpose tungsten lamps in clusters will be employed.

ESTHERVILLE, IA.—We are advised by G. C. French, superintendent of the Municipal Electric Light Plant at this city, that a day service is about to be inaugurated in Estherville, two new Fort Wayne three-phase, 60-cycle alternators having just been installed to take the place of the old Fort Wayne single-phase, high frequency machines. The company is starting with seven motors, ranging from 1 hp to 15 hp.

GRINNELL, IA.—Reports are current that it is the intention of the Grinnell Electric & Heating Company to expend about $7,000 in the improvement of its plant at this city.

PETERSON, IA.—The citizens of this place have voted to install an electric-light plant, and plans are under way for the formation of a company which will eventually render a lighting service to Sutherland as well as to Peterson. Mr. Sitz, of the latter city, is the prime mover in the new enterprise.

CHERRYVALE, KAN.—It is reported that the Cherryvale Electric Light & Power Company contemplates increasing the equipment of its plant.

DODGE CITY, KAN.—The Midland Water, Light & Ice Company, so we are informed by W. Watson, secretary and superintendent of the company, expects to install a gas producer and engine.

PITTSBURGH, KAN.—It is reported that the Pittsburgh & Kansas City Railway Company expects to erect a power station near Franklin, Mo.

TOPEKA, KAN.—It is confidently expected that the municipal lighting plant will be able to resume its lighting service at an early date. The system has been thoroughly overhauled and new equipment has been installed, and it is understood that the equipment of the plant has been practically doubled. In anticipation of the increased facilities, petitions for additional lamps in the various wards of the city are being filed by the respective councilmen of such wards.

WAKEENEY, KAN.—The citizens on July 26 voted to issue $30,000 in bonds for the construction of a water works system and $10,000 for an electric light plant. George P. Taylor, of Stockton, Kan., is engineer.

MADISONVILLE, KY.—All the bids recently received for machinery for the municipal electric-light plant are reported to have been rejected and new bids will be received; probable cost, $7,000.

NEWPORT, KY.—A twenty-year franchise has been granted by the City Council to the Citizens' Telephone Company, which will at once commence work on the installation of its conduit system.

WEST PEMBROKE, MAINE.—A 100-lamp electric plant has been installed by the Sunset Packing Company in its factory at this city.

BERLIN, MD.—It is announced that Muralt & Company, engineers of New York City, have been awarded the contract for furnishing and installing the electrical equipment of the new municipal lighting and pumping plant. Energy will be generated and transmitted throughout the city by means of a 2200-volt, two-phase alternating current system. Step-down transformers, reducing the potential to 110 volts, will be provided at the centers of distribution, from which the city lighting circuits will be fed.

THURMONT, MD.—Mayor Freeze, of Thurmont, Md., and L. R. Walsche are interested in a project for the installation of a lighting plant for the city of Thurmont. It is understood that rights-of-way have been secured along Hunting Creek near Thurmont for a pipe line, which is planned to be part of a water-power system for the operation of this plant. Estimates are being secured for the work, and it is the idea of those interested to have the plant large enough not only to furnish electricity for lighting the city streets and the residences, but also to supply energy for the operation of manufacturing plants as well.

CHARTLEY, MASS.—The Norton Electric Light & Power Company, of this city, has applied for permission to extend its transmission lines to Norton.

WILLIMANSETT, MASS.—The city of Willimansett is considering the advisability of installing an electric-lighting system.

MASON, MICH.—The Mason Electric Light & Water Works, of which F. J. Rapp is superintendent, advises that it expects to install a new dynamo and other machinery.

HAWLEY, MINN.—Bids will be received until Aug. 13 by the village clerk for the construction of an electric light plant and water works system, to include brick or concrete buildings, a 50,000-gal. steel tank and tower or air compressor tank and concrete reservoir, distributing pipe-line system, dynamo, switchboard and pole line wiring; also pumping plant. Oscar Claussen, of St. Paul, Minn., is engineer.

MINNEAPOLIS, MINN.—It is stated that the city authorities are willing to grant to the Northern Heating & Lighting Company the franchise for which it has made application, provided it will deposit a cash surety to the amount of $25,000 that it will carry out all the agreements it makes.

PARK RAPIDS, MINN.—The Power Engineering Company, Corn Exchange Building, Minneapolis, Minn., secured the contract from L. H. Rice, of St. Paul Rapids, for the construction of a complete new hydro-electric plant, consisting of a reinforced concrete flume, head race and power house.

CLINTON, MISS.—It is stated that the Business Men's League of this city is interested in a proposition to construct an electric railway between Clinton and Jackson. R. H. Henry is chairman.

CLARKSVILLE, MO.—Reports are in circulation to the effect that a company is to be organized at this city for the purpose of installing an electric-light plant. E. N. Moody is secretary of the committee in charge.

KANSAS CITY, MO.—The Southern Wyoming Power Company has signed contracts for the building of a dam, transmission line and power station at a point on the Laramie River about thirty miles southeast of Laramie. The company, whose headquarters are at Kansas City, Mo., is capitalized at $500,000, and about 1000 hp will be developed. The immediate market will be in the City of Laramie in competition with an old and inefficient steam plant located within the city limits. The possible development is very much greater than this, and the field will probably be extended later. The voltage is not yet determined and the machinery is not yet specified. Work on the dam and transmission line will be rushed, as the company is planning to furnish electricity for light to Laramie by Nov. 1.

MONETTE, MO.—Specifications are on file (for reference only) at the office of the Electrical World, 239 W. 39th Street, New York, N. Y., for furnishing material and machinery necessary for an electric-light plant at Monette, Mo., bids for which will be received by D. S. Breece, city clerk, until Sept. 1, 1909. The material required is as follows: Corliss engine, directly connected to alternating-current generator, with high-speed automatic engine, directly connected to alternating-current generator, each complete with independent exciters and controlling apparatus, switchboard, arc regulators, arc lamps, poles, wire, tungsten lamps complete, three tubular boilers, feed pump and feed-water heaters.

SEDALIA, MO.—The City Council has approved the bids for lighting Sedalia, recently submitted by the Sedalia Light & Traction Company, and an ordinance has been passed awarding that company a 10-year contract

CENTRAL CITY, NEB.—C. F. Neumeyer, city clerk, advises that the citizens voted on July 20 to issue $18.000 in bonds for the construction of a lighting plant.

FAIRBURY, NEB.—The Fairbury Telephone Company has decided to combine with the Lincoln Telephone Company in the construction of three copper circuits between Fairbury and Beatrice, and also to build an additional line between Fairbury and Lincoln. It is estimated that the proposed extensions will represent an expenditure of about $10,000, which amount is to be equally divided between the two companies.

NEWARK, N. J.—The Clark Thread Company, of this city, is planning the substitution of electricity for steam in the operation of its plant. In connection with this change, it is understood that the company will arrange its motive power so that each mill can be run independently, enabling it to shut down one section of its plant in case of accident without interfering with the other mills.

ARTESIA, N. M.—Press reports state that the Farmers' Electric Light and Power Company has awarded the contract to install an electric light and irrigation plant on the edge of the artesian belt in Pecos Valley, near Artesia, to the Buckeye Engine Company, Salem, O.

FT. WINGATE, N. M.—Bids will be received by the Construction Quartermaster, U. S. A., until Aug. 18, for electric wiring the post exchange and gymnasium.

ALBANY, N. Y.—The Hoosic River Electric Light & Power Company has been granted the franchise for which it recently filed an application with the Second District Public Service Commission permitting it to operate in the village of Valley Falls. As stated previously, it will furnish electricity for lighting to Johnsonville and take over the present lighting system in Schaghticoke.

ALBION, N. Y.—It is stated that the contract for furnishing electricity for the buildings and grounds of the Western New York House of Refuge for Women at this city has been awarded to the A. L. Swett Light & Power Company, of Medina, that company having extended its transmission lines to the western boundary of the city.

FALCONER, N. Y.—The Falconer Electric Light Plant, of which W. E. Cowden is owner, is now erecting additional wires throughout the village, and is about to furnish 24-hour service from its station

GLENS FALLS, N. Y.—Plans are being considered by the Commercial Association of this city looking toward the installation of flaming arc lamps in front of every store on the main business thoroughfares.

HUDSON, N. Y.—Bids will be received by Charles H. Strong, president of the board of managers of the New York State Training School for Girls, Hudson, N. Y., until Aug. 14 for construction of a new power house and trunk conduit.

MINEOLA, L. I., N. Y.—The Public Service Commission at Albany has authorized the Nassau & Suffolk Lighting Company to issue its preferred 6 per cent capital stock to the amount of $430,000, the proceeds to be used for extensions and improvements of its plant and distributing system. E. H. Mather is general manager.

MOHAWK, N. Y.—Newspaper reports state that a resolution has been adopted to appoint a committee, which shall consist of the Municipal Commission and two citizen members to investigate the cost of installing a municipal electric-light plant in Mohawk.

ALBERMARLE, N. C.—We are informed that the citizens voted July 27 to issue bonds to construct water works, electric light plant and sewer system. As yet no engineer has been selected. I. B. Miller is mayor.

CHARLOTTE, N. C.—It is the intention of the Decotah, Nokomis & Winonah Cotton Mills, of Lexington, to substitute electricity for steam in the operation of its plants, and with this end in view a contract has been entered into with the Southern Power Company, of Charlotte, for, approximately, 2000 hp.

COLUMBUS, OHIO.—A new exchange building is being erected in Columbus by the Cuyahoga Telephone Company, in which much new equipment is to be installed.

COLUMBUS, OHIO.—A new condenser for its Mound street plant and a new engine and generator for the North Side plant are to be installed by the Columbus Railway & Light Company.

FAYETTE, OHIO.—C. D. Hause, village clerk, writes that bids will be received until August 28 for an electric-light plant. He also states that the village will contract to furnish not less than twenty 2000-cp street lamps.

TIFFIN, OHIO.—The plant of the Tiffin Home Telephone Company has been sold by Receiver J. C. Royer to E. Bruce Myers, of this city, the consideration being $30,000.

WAGONER, OKLA.—It is stated that the City will vote in August on the issuance of $200,000 of bonds, the proceeds of a portion of which will be used for a municipal electric-light plant and waterworks. Address the Mayor.

BAKER CITY, OREGON.—The City Council has granted a franchise for a street railway in Baker City to Anthony Mohr.

LEBANON, OREGON.—A new dynamo is to be installed at the plant of the Lebanon Electric Light & Water Company, which will enable it to furnish a day service in this city.

TILLAMOOK, OREGON.—It is understood that the Tillamook Lumber Manufacturing Company is planning to furnish a lighting service to the business houses on the principal streets of this city.

PANAMA.—Bids will be received until August 10 by Capt. F. C. Boggs, Corps Engineer, U. S. A. Isthmian Canal Commission, Washington, D. C., for furnishing electrical material, including fixtures, fittings, batteries, cable, wire, line material, conduit, etc., as per Specification No. 526.

McKEESPORT, PA.—It is stated that construction work is soon to be commenced on the proposed street railway between McKeesport and Port Vue. The Realty Company, of McKeesport, is promoting the project, and it is planned eventually to extend the line to Clairton and Elizabeth. The officers of the company are: James F. Woodward, president; Israel A. Simon, secretary and treasurer; Thomas W. White, engineer.

MERCER, PA.—It is reported that Owsley & Baucherle, of Youngstown, Ohio, have been selected to prepare plans for a generating station which the County Commissioners will erect at Mercer, at a probable cost of $14,000.

PITTSBURGH, PA.—It is understood that the City Council has passed an ordinance providing for the construction of an electric light plant at the South Side Pumping Station, the estimated cost of the work being $4,000. Bids will be received by A. B. Sheppard, director Bureau of Water, Municipal Bldg., between August 1 and 15.

PITTSBURGH, PA.—The Duquesne & Dravosburg Railway Company, with headquarters at Pittsburgh, expects to commence construction work on its double-track electric railway from Duquesne to Dravosburg within a few weeks. The company is capitalized at $50,000, and the officers are: Fred W. Scott, 1351 Annex, Pittsburg, president; J. C. Cato, Aliquippa, vice-president; A. J. Krill, Aliquippa, treasurer. Douglas & McKnight, Union Bank Building, Pittsburgh, are the engineers.

CANONCHET, R. I.—It is the intention of L. Edwards, who is erecting a new building at this city in which is to be installed a dynamo, to light his factory by electricity.

HAMILTON, R. I.—The Sea View Railroad Company has installed in its power station at this city two 400-kw Westinghouse-Parsons turbines driving three-phase, 60-cycle, 360-volt alternators. This addition to the company's present equipment was installed for the purpose of supplying additional power to railway lines, and for furnishing electricity to light several adjoining towns, including Narragansett Pier and Wickford, R. I.

NORTH SMITHFIELD, R. I.—At a meeting of the citizens, for the purpose of voting on the installation of an electric-lighting system in North Smithfield, it was decided to instruct the town council to make a one-year contract with the Woonsocket Electric Machine and Power Company to light the streets of the town. An appropriation of $12,000 was voted.

PROVIDENCE, R. I.—It is understood that plans are being considered for the installation of new magnetite open arc lamps in the principal squares of the city. A saving of something like $9,000 having been effected under the new schedule of rates recently put into effect by the Narragansett Electric Lighting Company, such a system of lighting will be made possible without the necessity of asking for an extra appropriation.

BINGHAMTON, TENN.—The Binghamton Light & Power Company W. M. Tucker, manager, notice of whose intention to increase the equipment of its plant was recently published, expects to install a 150 or 200-kw generator, with boiler and engine, early in September.

LEXINGTON, TENN.—It is stated that the city is considering the construction of an electric-light plant and waterworks at a cost not to exceed $15,000, and that detailed information concerning the proposition may be obtained by addressing H. E. Graper.

ALVORD, TEX.—It is reported that E. E. Gose, of Decatur, Tex., is considering the installation of an electric-light plant at Alvord.

LUBBOCK, TEX.—The Lubbock Light, Ice & Power Company, notice of whose incorporation we published recently, expects to erect a $2,000 brick building in which will be installed a 75-kw alternating-current, 1100-volt, single-phase unit. R. B. Ellis is general manager of the company.

RANDOLPH, VT.—It is understood that competitive bids for a lighting and industrial service in this city will be considered by a committee to be appointed to investigate the subject of rates, quality of service, the White River Electric Company at the present time furnishing electricity for lighting the city, and it is probable that the Consolidated Lighting Company will be a competitor, as that concern has been asked to make a proposition to furnish energy to Randolph.

RUTLAND, VT.—A franchise to operate in this city having been granted by the City Council to the Home Telephone Company, work on the installation of its system is expected to be commenced at an early date.

BESSIE, VA.—It is stated by C. M. Crawford, Ironton, O., secretary of the Russell-Prater Railway Company, notice of whose incorporation was recently given, that its proposed lines are to be operated by steam and not by electricity, as previously stated.

BIG STONE GAP, VA.—Plans are being considered by capitalists represented by Alexander McD. Allenton, Toronto, Ont., Can., for the construction of an electric railway connecting the agricultural districts of Lee County with the Wise coal fields, energy to be furnished from the Powell River at a point near Jonesville.

RICHMOND, VA.—The Council Commission on Electricity recommended on July 27 to the Council for adoption the award of contract for electrical machinery for the municipal plant to Hotchkiss & Gordon, local agents of the General Electric Company, the only bid received on July 21; cost, about $96,000.

ROSLYN, WASH.—Final surveys are being made by the Cle Elum-Roslyn Railway & Power Company for its proposed electric railway line from Roslyn to Cle Elum, via Jonesville, a distance of about 17 miles.

CHARLESTON, W. VA.—Work is to be commenced at once by the Southern Bell Telephone Company on a long-distance line between this city and Madison.

GRAFTON, W. VA.—The Winding Gulf Colliery Company, of Cincinnati, which owns 3,300 acres of land on the Winding Gulf creek, is planning for the construction of a large power plant at that place, to be used in connection with the development of its mines.

MASONTOWN, W. VA.—The Tri-State Telephone Company's exchange at this place has been destroyed by fire.

WHEELING, W. VA.—The Wheeling Rapid Transit Company, of which A. M. Schenk is president, has applied to the Board of Commissioners for permission to operate an electric railway through Ohio County.

WHEELING, W. VA.—It is understood that arrangements have been concluded, although the agreement has not yet been signed, whereby the National Telephone Company, of this city, will take over the properties of the Youngstown Telephone Company and the Columbiana County Telephone Company. The new owners contemplate the expenditure of $350,000 in the extension and improvement of the two plants.

SHERIDAN, WYO.—Plans are being considered by the Rocky Mountain Bell Telephone Company for the construction of a new toll line from Sheridan to Basin, a distance of about 106 miles.

VANCOUVER, B. C., CAN.—The British Columbia Electric Street Railway Company has applied for 30,000 miner's inches from Indian River, and proposes to build an auxiliary power plant on Burrard inlet. Address R. H. Sperling, Vancouver, B. C.

WINNIPEG, MAN., CAN.—M. Peterson, secretary of the civic board of control, will receive sealed tenders until 11 a. m. Aug. 11 for the following supplies: 20,000 ½ by 12 in. carbons; 50 alternating-current series enclosed arc lamps; 50 absolute cut-outs.

WINNIPEG, MAN., CAN.—It is understood that the time in which bids will be received for the hydraulic, electric and auxiliary equipment required for the generating station at Point du Bois will be extended

until August 16. For plans, etc., apply to Smith, Kerry & Chase, engineers, Winnipeg; William Kennedy, Jr., Y. M. C. A. Bldg., Montreal, or M. Peterson, secretary, Board of Control, Winnipeg.

DUNDAS, ONT., CAN.—During a recent electrical storm at this city the transformer station of the Hamilton Cataract Power, Light and Traction Company was struck by lightning, completely destroying a good part of the apparatus. It is estimated that the company's loss will be in the neighborhood of $10,000.

DUNDAS, ONT., CAN.—The County Council has granted permission to the Hamilton Cataract Power, Light and Traction Company, of which W. C. Hawkins is general manager, to erect a transmission line on the highway from Horning Mountain to Dundas, in order to supply energy in that city.

NIAGARA FALLS, ONT., CAN.—The Cataract Power & Conduit Company, Buffalo, N. Y., of which De Lancy Rankine, 718 Fidelity Trust Bldg., is secretary and treasurer, expects to build a station at Niagara Falls, Ont., the estimated cost of which is $100,000.

TORONTO, ONT., CAN.—On account of failure to comply with the conditions imposed, seven leases of water-power rights have been cancelled by the Government. They are as follows: Mississaga River at Grand Portage, held by Joseph Allan Powers; the Seine River above Sturgeon Falls, Rainy River District, held by L. A. Demainville and G. H. Hillyer; Canal Rapids in the Magnetawan River, leased by the McKenzie Power & Development Co.; Deux Rivieres on the Ottawa River, leased to Joseph Kilgour, Willard Woodruff and others; a franchise granted to the Town of Webbwood, at Birch Falls on Birch Creek; Steep Rock Falls on the Seine River, leased to W. H. Upham and others, and a power on Long Lake River, leased to Frederick Bolton.

MONTREAL, QUE., CAN.—It is stated that the Montreal Light, Heat & Power Company is preparing to abolish the system of primary and secondary charges for electric lighting, which has proved so unsatisfactory, and to substitute a flat rate at a figure somewhat lower than in the past.

QUEBEC, CAN.—The Quebec Railway, Light & Power Company, of which E. A. Evans is general manager, is installing a 1000-kw motor generator.

WESTMOUNT, QUE.—Bids will be received until September 1 for $435,000 of bonds, a portion of which is to be used for the extension of the electric light plant.

MEXICO, MEXICO.—The Compania Electria y Irrigadora, of the State of Hidalgo, is preparing to install a generating station at Tetepango costing $2,000,000, which is to be finished in about one year.

New Industrial Companies.

THE BLISS-HEINKE MANUFACTURING COMPANY, New York, has been incorporated, among other things, for the purpose of dealing in patents and patent rights. It has a capital stock of $10,000, and the incorporators are: Frederick W. Bliss, East Orange, N. J.; Frederick Kopper, Jr., No. 10 Wall Street, New York, and Charl S. Brown, 36 Park Row, New York.

THE CAMPBELL ELECTRIC COMPANY, Lynn, Mass., has filed articles of incorporation and expects to manufacture and sell electric motors, dynamos and other electric machinery. It has an authorized capital stock of $20,000, and the following officers have been elected: President, Charles E. Campbell, 74 Jefferson Street; secretary, F. R. Campbell, same address; clerk, A. M. Rich, 276 Chatham Street, all of Lynn.

THE DAYTON ENGINEERING LABORATORIES COMPANY, Dayton, O., has been incorporated, with a capital stock of $150,000, by George W. Shroyer, Ellis P. Legler, Charles R. Nevin, H. H. McGrew and B. F. McCann. The purpose of the organization is to manufacture electrical and mechanical appliances.

THE EASTERN STORAGE BATTERY COMPANY, Chelsea, Mass., capitalized at $50,000, has filed articles of incorporation. Those interested in the new concern are: George H. Buck, president; David C. Buck, treasurer, both of 57 Nicholas Street, Chelsea; Franklin S. Evans, Chelsea, and Charles F. Rowley, 25 Pemberton Square, Boston.

THE ELECTRICAL INSTALLATION COMPANY, of New York, N. Y., has been incorporated to engage in electrical work of all kinds. It has an authorized capital stock of $20,000, and the incorporators are: William C. Pratt, 30 Pine Street; Arthur J. Pares, 51 W. 106th Street, and P. J. Eder, 80 William Street, all of New York.

THE FINKBEINER TURNEY COMPANY, Freeport, Ill., has been incorporated with a capital stock of $25,000 for the purpose of manufacturing engines and electrical supplies. The incorporators are: J. C. Finkbeiner, F. L. Turner and E. J. Kane.

THE INTERNATIONAL BURNER COMPANY, Brooklyn, N. Y., which has an authorized capital stock of $50,000, has been incorporated for the purpose of manufacturing machinery, tools and supplies relating to electricity, gas or steam. Those interested in the enterprise are: Henry Niemann, 163 Ralph Street; Anthony J. Ibert, 405 Evergreen Avenue, and John S. Averill, 449 Evergreen Avenue, all of Brooklyn.

THE McKEEVER ELECTRIC COMPANY, of Columbus, Ohio, which is a reorganization of the McKeever Electric Company, has filed articles of incorporation. It is capitalized at $50,000, and the following officers have been elected: Charles E. Munson, president; George McKeever, vice-president and general manager; Clarence F. Metcalf, secretary; Robert J. Wheaton, treasurer.

THE NATIONAL ELECTRIC SPECIALTY COMPANY, Toledo, Ohio, has been incorporated, with a capital stock of $15,000, to manufacture electrical supplies. The incorporators are: Chris. F. Wall, L. L. D. Chapman, E. B. Marshall, Samuel Kohn and William C. Cole.

THE RELIANCE AUTO-PARTS COMPANY, New York, N. Y., has been incorporated, with a capital stock of $20,000, by Herman L. Wilkens and J. H. Wilkens, 211 W. 40th Street, and W. R. Schaut, 38 W. 18th Street, all of New York. It contemplates, among other things, the manufacture of engines, motors, etc.

THE SHARPE TIRE-PROTECTION COMPANY, Brooklyn, N. Y., has been incorporated to control and grant licenses to patents of G. W. Sharpe relating to automobiles, etc., and to manufacture motor-boats, automobiles, etc. It has an authorized capital stock of $150,000, and the incorporators are: George W. Sharpe, 862 Sterling Place; William S. Hurley, 16 Court Street, and S. S. Whitehouse, 164 Montague Street, all of Brooklyn.

THE STANDARD TRUCK MANUFACTURING COMPANY, 419 Market St., Camden, N. J., has been incorporated, with a capital stock of $250,000 by F. R. Hensell, G. H. E. Martin and John A. MacPeak, all of Camden, N. J. It is the intention of the new concern to conduct a mechanical and electrical engineering business.

THE STEVENS-SOWERS MOTOR-CAR COMPANY, Boston, Mass., has filed articles of incorporation, its purpose being to manufacture and sell motors of all kinds. The capital stock is placed at $12,000, and those responsible for its formation are: James W. Stevens, who is president and treasurer, and Wheaton Kittredge, both of 18 Tremont Street, Boston.

Company Elections.

FRANKLIN, MASS.—The Franklin Electric Company has elected the following directors: J. F. Bartlett, C. W. Hazleton, Porter Farwell, E. I. Cassidy and C. W. Schuler.

LYONS, N. Y.—The following directors have been elected by the Wayne County Electric Company: C. D. Beebe, Henry D. Brewster, C. A. Lux, F. C. Eddy and N. C. Beatty, all of Lyons.

LYONS, N. Y.—At the annual meeting of the stockholders of the Wayne-Monroe Telephone Company the following officers were elected: President, Charles A. Lux; vice-president, George F. Waters; secretary and treasurer, Charles H. Towlerton.

LACONIA, N. H.—At a meeting held at this city the following officers and directors were elected by the Winnipesaukee Telephone Company: President, Jasper N. Keller; vice-president, F. W. Storey; treasurer, E. S. Willard; directors, J. N. Keller, F. W. Storey, F. S. Houston, J. B. Morrill, C. W. Vaughn, W. F. Knight, N. B. Jones, C. W. Adams and C. T. Keller.

PATERSON, N. J.—The following officers and directors were elected by the Paterson, Passaic & Suburban Telephone Company at its annual meeting: H. R. Schwartz, Trenton, treasurer; J. W. Lindsay, Paterson, secretary; Wayne Dumont, Paterson, counsel; directors, George A. Post, J. W. Lindsay, Wayne Dumont; B. G. Hamill, R. P. Wilson, B. Gummere, W. S. Hancock, E. C. Stokes, H. R. Schwartz, C. W. Rice, R. C. Chanmerlin, F. R. Demarest and R. Morrell.

TRENTON, N. J.—The following officers have been elected by the Union Railway, Gas & Electric Company, which recently filed incorporation papers at this city: Anton G. Hodenpyle, president; Clarence M. Clark, vice president, and George E. Hardy, secretary and treasurer.

TROY, N. Y.—At its annual meeting, held at this city, the Commercial Union Telephone Company elected the following officers: President, James H. Caldwell; first vice-president, Wm. Connors; second vice-president, Irving H. Griswold; secretary and general manager, E. L. Grauel; treasurer, Peter McCarthy.

HARRISBURG, PA.—At a meeting held at this city the West Shore Telephone Company elected the following officers: Ellis L. Orvis, Bellefonte, president; Jacob Reiff, New Cumberland, vice-president; E. H. Greenwood, Camp Hill, secretary and treasurer.

New Incorporations.

BIRMINGHAM, ALA.—The organization of the Birmingham & Edgewood Electric Railway Company, of this city, has been perfected by the election of the following officers: Stephen Smith, president; George H. Harris, first vice-president and general manager; M. A. Miller, second vice-president; G. T. Brazelton, secretary and treasurer. The purpose of the new concern is to construct an electric railway from the South Highlands line to Red Mountain.

MERIDEN, CONN.—The Meriden, Middletown & Guilford Railway Company, which contemplates the construction of an electric railway from Meriden to Guilford, a distance of 20 miles, has been organized and the following officers elected: Francis Atwater, Meriden, president; Joseph Merriam, Middletown, vice-president; Eugene F. Hall, Meriden, secretary, and Charles E. Jackson, Middletown, treasurer.

GIBSON CITY, ILL.—Articles of incorporation have been filed by the Drummer Telephone Company, of this city. It has an authorized

capital stock of $5,000, and among those interested are: D. A. Taylor, W. S. Day and W. E. Crone, all of Gibson City.

BLUFFTON, IND.—The Wells Construction Company has been incorporated to construct and equip an interurban electric railway from Bluffton to Geneva, and the following directors have been elected: H. C. Arnold, L. A. Williamson, L. C. Justus and S. Bauder.

Legal.

CONTRACT TO PERMIT TELEPHONE COMPANY TO TRIM TREES ALONG ITS LINE.—A landowner entered into a contract with a telephone company, permitting the company to trim the trees on his property in a certain county so as to clear the wires of the company 18 in. The agreement was written as follows: "In consideration of the sum of ($5.00) five dollars I, Peter Nachand, do hereby grant to the Cumberland Telephone & Telegraph Company, Incorporated, its successors and assigns, the right to erect, maintain and operate a line of poles and wires, and to do the necessary trimming of trees to clear wires eighteen (18) inches on and along my property in Jefferson County, State of Kentucky, and on road between Lakeland, Kentucky, and St. Mathews. Dated at St. Mathews this 16th day of August, 1909. Peter Nachand. Witness, John Lynch, Jr." After the company had trimmed the trees according to its idea of what its rights were under the agreement, the landowner brought suit for $1,000, claiming that the contract referred only to the land on which he resided, and did not include land owned by him and occupied by others. It was held that the contract could not be so construed. Under it the company had the right to trim trees on Nachand's property in Jefferson County, whether occupied by him or not. Nachand vs. Cumberland Telephone & Telegraph Company, Court of Appeals of Kentucky, 120 S. W., 319.

RIGHT TO TELEPHONE SERVICE.—Telephone companies are, to a limited extent, and yet in a strict sense, common carriers of intelligence and news, and are bound to afford equal facilities to all in like situations. They must supply all alike who are alike, and cannot discriminate against any one. Though a patron may have been delinquent, this will furnish no excuse for not restoring the service if he shall pay the amount for which he is delinquent and tender the price of service, with compliance with the reasonable rules and regulations of the company; and in a recent case it was held that, where further service was refused to a patron because he had been in the habit of annoying other patrons by interrupting their conversations and using profane language, the service should be restored upon its being shown that the patron had ceased abusing his privileges upon being warned by the company. The court summed up the rights and duties of the parties as follows: "Such a line, when used in common, enters many family circles, and the proprietor is warranted in assuming, at least until the contrary occurs, that its patrons will have regard for the ordinary amenities of life, and observe the courtesies common to civilized society. Upon discovery that in this it has been mistaken as to any subscriber, and that, notwithstanding being duly warned, he persists in the use of improper language over the line, or purposely interferes in conversations between other patrons of the system in order to annoy or interrupt their conversations, or force them to yield the line for his own convenience, and this is persisted in after being duly warned to desist therefrom, there would seem to be but one adequate remedy, and that is to withdraw the service from such person. (Jones on Teleg. & Telep., Sub. 250.) Otherwise the efficiency of the enterprise would be impaired or destroyed, and the proprietor fail in furnishing the character of service impliedly promised. The very nature of the service undertaken exacts control to this extent, for without the power to withdraw it under the circumstances mentioned, there could be no assurance of its character or efficiency. A single patron by meddling and discourtesy might deprive his neighbors of the benefits of a convenient invention and destroy the value of the property devoted to the public service. This power to regulate is essential in order to enable the defendant to perform such service, and is clearly to be implied from the nature of the enterprise. But it ought never to be arbitrarily exercised. Reasonable caution must be taken lest injustice be done. Some allowance is to be made for the infirmities of human nature. When rules to guide patrons have not been promulgated in advance, it is not unreasonable that any patron misusing his privileges be duly warned thereof by the telephone company, and given an opportunity to mend his ways before being finally deprived of this most convenient means of business and social communication." Huffman vs. Marcy Mutual Telephone Company, Supreme Court of Iowa, 121 N. W. Rep., 1033.

Personal.

MR. AVERY P. ECKERT has been appointed to the position of sales manager of the wire department of the National India Rubber Company, New York.

MR. D. B. RUSHMORE, manager of the power and mining department of the General Electric Company at Schenectady, N. Y., sailed last week for a two months' vacation in Europe, most of the time to be spent in Germany.

MR. ALFRED E. SEELIG, formerly of the electrical engineering department of Columbia University, New York, has been appointed general inspector of the Connecticut River Transmission Company, with headquarters at Fitchburg, Mass.

PROF. V. KARAPETOFF, of the electrical engineering department of Cornell University, is now connected with the Westinghouse Electric & Manufacturing Company, at East Pittsburgh, Pa., but will return to the university in the fall.

MR. FREDERICK SARGENT, of Sargent & Lundy, consulting engineers, Chicago, is in Europe, where he is studying foreign practice in the construction of electric power stations—a branch of engineering to which the firm pays particular attention.

MR. J. W. CALLAHAN has been promoted to be general manager of the Illinois Tunnel Company, Chicago, succeeding Mr. W. J. C. Kenyon, resigned. Mr. Callahan is an experienced and successful railroad man, coming from the Chicago & Western Indiana Railroad Company to the tunnel company, for which he has been successively superintendent, general superintendent and now general manager. He is highly esteemed by all who have business to do with the electric freight railways of "Underground Chicago."

MR. H. D. CRITCHFIELD has resumed his relations with the Automatic Electric Company, Chicago, acting in a general advisory capacity and also having charge of the contract department. Mr. Critchfield, who is a lawyer by training, has been a prominent figure in independent telephone development. He resigned as general counsel for the International Independent Telephone Association to return to the Automatic company, with which he was formerly connected. He says that he is firmly convinced that the use of automatic apparatus will contribute more than any other cause to the final success of independent telephony.

MR. SPENCER TRASK.—It is a matter of deep regret to the many electrical friends and acquaintances of Mr. Spencer Trask, the New York banker, to note that he has lost an eye owing to a recent automobile accident in Boston. Mr. Trask is at his summer home on Lake George, and the injured eye has been removed in order to save the sight of the other one. The accident occurred while Mr. Trask was leaving the Harvard Stadium in an automobile, which was struck by a trolley car. He was thrown forward against the glass wind screen, cutting his face and breaking his eyeglasses, and at first it was not thought that any of the injuries would be serious.

MR. WILLIAM J. C. KENYON, vice-president and general manager of the Illinois Tunnel Company, which operates the extensive system of narrow-gage electric tunnel railways underlying the central business portion of Chicago, has resigned to engage in other pursuits. Mr. Kenyon has paid especial attention to the electrical train signalling system in use in the tunnels, where the conditions are particularly difficult, owing to dampness in the concrete construction. With the co-operation of Mr. S. S. Stolp, he has devised the "Stolken" automatic electric signaling system, which is used in the tunnels with entire success. Mr. Kenyon has been with the tunnel company two years, and retired on Aug. 1.

MR. E. G. CONNETTE, who has been appointed transportation engineer by the New York Public Service Commission, is at present general manager of electric railways covering about 270 miles of track, owned by the Worcester (Mass.) Railway & Investment Company and the New England Investment & Security Company. Formerly he was general manager of the Syracuse Rapid Transit Railway Company, and was connected for a time with the Nashville Street Railway. He was born in Austin, Ind., in 1863, and has been engaged in street railway work since 1890. Mr. Connette has been active in the affairs of the American Street & Interurban Railway Association, and has contributed a number of articles to the technical press.

Obituary.

MR. WILLIAM D. McFARLAND, the well-known choral and oratorio singer, of Washington, D. C., and a brother of Mr. Walter M. McFarland, acting vice-president of the Westinghouse Electric & Manufacturing Company, died at his home in the capital July 22, following a recent serious operation at the Johns-Hopkins Hospital in Baltimore.

MR. WILLIAM WARREN LYON, JR., of New York, N. Y., an electrical engineer of the Public Service Commission, died July 30, at the home of his parents, 157 West Ninety-second Street, New York, N. Y. He graduated from Columbia University in 1906. He was a member of the Theta Xi fraternity and the American Institute of Electrical Engineers.

Trade Publications.

METAL MOLDING so flexible that it can easily be bent by hand is outlined in a folder issued by the National Metal Molding Company, Pittsburgh, Pa.

TELEPHONES.—Pamphlet No. 18 of the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., is devoted to five-line combination switching telephones and two-line switching devices.

VACUUM CLEANERS.—A folder issued by the Hydro-Vacuum Machine Company, 220 E. Fouth Street, Cincinnati, Ohio, deals with motor-driven and hand-operated suction cleaners of the double-acting type.

METAL MOLDING.—A mailing card of the folder type, provided with a red paper cover of striking design, is being distributed by the National Molding Company for calling attention to its non-rusting, non-corroding metal molding.

Business Notes.

M. L. NEWMAN & COMPANY have opened offices in the Broad Exchange Building, 25 Broad Street, New York, and not at 26 Broad Street, as stated in earlier issues of this paper.

THE AUTOMATIC MANUFACTURING COMPANY, of 1945 Park Avenue, New York, has opened an attractive booth in the new Hudson Terminal station at Cortlandt Street, New York. In this are displayed the many applications of its small motors to domestic service in the kitchen.

CUTLER-HAMMER PHILADELPHIA OFFICE.—The Cutler-Hammer Manufacturing Company, Milwaukee, announces the opening of a Philadelphia office, Room 1207 Commonwealth Building, and an engineer specially qualified to advise regarding the control of electric motors will be in charge of the new office.

H. M. BYLLESBY & COMPANY, of Chicago, have moved from the American Trust Building to temporary quarters in the banking rooms at the corner of Dearborn and Monroe Streets previously occupied by the Commercial National Bank. The removal was made necessary by one of Chicago's recent bank mergers, the bank people requiring the additional space in the American Trust Building.

COAL & IRON NATIONAL BANK has been elected a full member of the New York Clearing House Association. The bank is in a most prosperous condition, and on July 15 an extra dividend of 15 per cent was declared to stockholders, who at the same time were given the privilege of subscribing to $500,000 additional capital stock at par. Every dollar of the subscription was taken. The deposits of the institution are now more than $6,000,000.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Lloyd Lyon, Mobile, Ala.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, St. Louis, Nov. 15-18, 1909.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City.

American Electro-Chemical Society. Secretary, Prof. J. W Richards, Lehigh University, South Bethlehem, Pa. Next meeting, New York City, 1909.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, 557 Frick Building Annex, Pittsburgh, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia. Next meeting, Denver, Col., Oct., 1909.

American Street & Interurban Railway Engineering Association. Secretary, John W. Corning, Boston Elevated Railway Company, Boston. Next meeting, Denver, Col., Oct. 4-8, 1909.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York. Next meeting, Denver, Col., Oct. 4-8, 1909.

Association of Car Lighting Engineers. Secretary, G. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next meeting, Chicago, Oct. 5, 6, 7 and 8, 1909.

Association of Edison Illuminating Companies. Secretary, D. L. Huntington, Spokane, Wash. Next meeting, Briarcliff Manor, N. Y., Aug. 31, Sept 2, 1909.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Boston Electrical Show. Acting Secretary, Chester I. Campbell, 5 Park Square, Boston. Mechanics' Building, Nov. 15-25, 1909.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Colo. Next meeting, Denver, Oct. 7-9, 1909.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland and Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle and Central Station Association. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

Electric Club, Chicago. Secretary, W. S. Taussig, 204 Dearborn St., Chicago. Meets every Wednesday noon at Chicago Automobile Club.

Electric Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

Electrical Contractors' Association of State of Missouri. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, Nov. 4, 1909.

Electric Trades Association of Philadelphia. Secretary, E. A. Symmes, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York. Next meeting, New York City, October, 1909.

Florida Electric Light and Power Association. Secretary, G. F. Doig, Gainesville, Fla. Next meeting, Tampa, Fla., April 21, 1910.

Illinois State Electric Association. Secretary, H. E. Chubbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Light Association. Secretary, Fred. Leslie, Muncie, Ind. Next meeting, French Lick Springs, Ind., Aug. 18 and 19, 1909.

Internal Combination Engine Association. Secretary, Walter I. Sittig, 61 Ward St., Chicago.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., Sept 14, 15 and 16, 1909.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

International Independent Telephone Association. Secretary, A. C. Davis.

Iowa Electric Association. Secretary, W. N. Keiser, Des Moines, Ia.

Iowa Independent Telephone Association. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting second Wednesday in March each year.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Sioux City, April, 1910.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Wichita, Kan., Sept. 22 and 23, 1909.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

Maine Electrical Association. Secretary, Fred. D. Gordon, Auburn, Maine.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. C. Marshall, Port Huron, Mich. Next meeting, Detroit, Aug. 17, 18 and 19, 1909.

Minnesota Electrical Association. Secretary, B. W. Cowperthwait, Faribault, Minn. Next meeting, St. Paul, third week in March, 1910.

Mississippi Electric Association. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, Jefferson City, Mo., April 14, 15 and 16, 1910.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, John F. Gilchrist, 139 Adams St., Chicago. Headquarters, 33 West 39th St., New York.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRICAL TRADES' ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings second and fourth Tuesday of each month.

NEW YORK ELECTRICAL SHOW. Madison Square Garden, Oct. 11-21, 1909.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash. Next meeting, Seattle, Sept. 7, 8 and 9, 1909.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, John S. Allen, Lake Geneva, Wis. Next meeting, Milwaukee, January, 1910.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, David Gaehr, Schofield Building, Cleveland, Ohio. Next meeting, Lima, Ohio, Nov. 19 and 20, 1909.

OKLAHOMA PUBLIC UTILITIES ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla. Next meeting, Sapulpa, Okla., 1910.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, F. J. Scherrer, 195 Broadway, New York. Next meeting, Pittsburg, Pa., Aug. 17, 18 and 19, 1909.

PACIFIC COAST ELECTRIC AUTOMOBILE ASSOCIATION. Secretary, J. T. Halloran, 604 Mission St., San Francisco, Cal. Next Meeting, Oakland, Cal., February, 1910.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. L. Smith, Towanda, Pa. Next meeting, Eagles Mere, Pa., Sept. 8, 9 and 10, 1909.

PENNSYLVANIA STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PHILADELPHIA ELECTRICAL SHOW. First Regiment Armory, Broad and Callowhill Sts., Feb. 15-27, 1910.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, C. E. Russell, Boston, Mass. Monthly meeting, fourth Monday of each month.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D. Next meeting, Jan. 11 and 12, 1910.

SOUTHWESTERN ELECTRIC & GAS ASSOCIATION. Secretary, E. T. Moore, Dallas, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, care of J. G. White & Co., New York.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRIC ASSOCIATION. Secretary, A. B. Marsden, Manchester, Vt.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Detroit, Mich., Oct. 26, 27 and 28, 1909.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WIRELESS INSTITUTE. Secretary, Sidney L. Williams, 42 Broadway, New York.

WISCONSIN ELECTRIC & INTERURBAN RAILWAY ASSOCIATION. Secretary, Dudley Montgomery, Madison, Wis.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JULY 20, 1909.

[Conducted by W. F. Bissings, Patent Law, 2 Rector Street, N. Y. City.]

The patents issued July 27 were received too late for appearance in the present issue.

928,245. ELECTRICALLY CONTROLLED METER SYSTEM; H. P. Clausen, Chicago, Ill. App. filed Nov. 25, 1904. For controlling a call meter in an automatic exchange. The calling subscriber is compelled to record upon his own meter before conversing.

928,251. ELECTRIC OUTLET BOX; C. J. Dorff, Chicago, Ill. App. filed Dec. 24, 1908. The box is made in sections and is provided with two recesses in a wall to contain a lug.

928,252. CIGAR LIGHTER; C. S. Drake, Milwaukee, Wis. App. filed Jan. 23, 1909. A torch member with a reservoir of alcohol fed by a wick. An induction coil produces the spark.

928,272. SWITCH LOCKING SYSTEM FOR RAILWAYS; C. W. Nistle, North Muskegon, Mich., and Bernard W. Brady and Edward Inskip, Chicago, Ill. App. filed Jan. 2, 1908. Automatic mechanism for locking and unlocking switches at predetermined positions of the train by means of contact levers struck by the train.

928,273. BLOCK SYSTEM FOR RAILWAYS; G. W. Nistle, Muskegon, Wis., E. Inskip and B. W. Brady, Chicago, Ill. App. filed Jan. 2, 1908. Block system for railway bridges having a set of train-actuated levers associated with the track beyond each end of the bridge.

928,282. WEATHERPROOF ELECTRICAL RECEPTACLE; F. J. Russell, New York, N. Y. App. filed Aug. 20, 1908. Plug holder for lamps with a plug-receiving socket, a center plug contact in the socket and a narrow band of sheet metal within the socket secured to the wall thereof.

928,285. CONDUIT FOR ELECTRICAL WIRES; H. N. Speer, New York, N. Y. App. filed July 12, 1907. A two-ply inner tube made of one piece of material folded into two sections, each secured intermediately to the other and folded on itself.

928,287. DEVICE FOR STEADYING CURRENTS; P. H. Thomas, Montclair, N. J. App. filed Sept. 27, 1905. For securing a steady current for telautographs by means of a vapor apparatus, such as a mercury-vapor lamp, having two main electrodes and an additional positive electrode.

928,300. CABLE-OPERATED CARRIER FOR CONDUITS; W. W. Alexander and M. J. Appel, Kansas City, Mo. App. filed Jan. 18, 1906. For drawing cable through conduits. Improvement in mechanical details.

928,306. TROLLEY POLE CONTROLLING MEANS; C. E. Cozzens, Toledo, O. App. filed Dec. 16, 1908. Pneumatic control for the trolley pole.

928,307. GAS LIGHTING APPLIANCE; F. F. Dier, Manitoba, Canada. App. filed Nov. 20, 1908. Avoids matches by using a spark coil, as indicated.

928,345. ELECTRORESPONSIVE DEVICE; E. A. Terpening, Geneseo, Ill. App. filed Feb. 15, 1908. For telephone relay with horse-shoe magnets arranged about a center between which a coil is suspended.

928,360. ELECTRICAL RELAY; E. E. Clement, Washington, District of Columbia. App. filed Aug. 22, 1906. Telephone relay for exchanges for making and breaking a plurality of contacts, the latter being self adjusting.

928,371. SIGNALING BY ELECTROMAGNETIC WAVES; R. A. Fessenden, Washington, D. C. App. filed May 4, 1906. Interference preventer, with an inductive connection having a variable primary, a condenser, a detector connected with the secondary of the inductive connection, a condenser shunting with the primary, a variable inductance and antenna.

928,394. RHEOSTAT; C. R. Meston and H. I. Finch, St. Louis, Mo. App. filed April 23, 1909. A rheostat having a recess in its base with resistance wire wound on movable perforated plates, the latter in the recess.

928,396. BLOCK SIGNALING SYSTEM; D. J. McCarthy, Wilkinsburg, Pa. App. filed Jan. 29, 1909. Signaling means for indicating the condition of two blocks with a three-position relay for controlling a signaling means. The device is energized by alternating current.

928,402. CONTROLLING MEANS FOR ELECTRIC HEATERS; E. H. Richardson, Ontarion F. Booth, Alhambra, and W. Meredith, San Francisco, Cal. App. filed April 16, 1908. For electric laundry irons. Automatically moves a connection plug out of contact with the terminals to prevent excessive heating.

928,428. CABLE TERMINAL; F. B. Cook, Chicago, Ill. App. filed March 1, 1909. A base, sheet-metal sides on the base and a channel iron located between the sides to accommodate the cable conductors.

928,431. GUARD FOR TELEGRAPH AND TELEPHONE WIRES; C. J. Elliott, Oxnard, Cal. App. filed June 4, 1908. For high-tension wires to keep them from coming into contact with telegraph wires by means of a guard frame supporting the wire away from the pole, the frame being rounded.

928,438. SINGLE-PHASE COMMUTATOR MOTOR; V. A. Fynn, Blackheath, London, England. App. filed March 3, 1906. A single-phase commutator motor having a main winding on the inducing member consisting of two parts connecting in series, an auxiliary winding thereon; an induced member, an auxiliary e.m.f introduced therein with means for short circuiting the induced member along one axis.

928,442. TROLLEY BASE; C. E. Gierding, Newark, N. J. App. filed Aug. 14, 1908. A trolley base with a cushion stop. Details.

928,464. ARC LAMP; D. S. Knapp and I. S. Schlesinger, Philadelphia, Pa. App. filed July 17, 1907. Improvement in the construction of the top carbon holder for a flaming arc lamp.

928,474. ADAPTER; H. S. Salt, New York, N. Y. App. filed April 14, 1908. For use with tungsten lamps which have to be supported vertically in a fixture where the lamps ordinarily project horizontally.

928,476. PROCESS OF MANUFACTURING SILICON NITRID; A. Sinding-Larsen, Christiana, Norway. App. filed May 17, 1909. Produces vapors of silicon by heating a silcid and causing the same to be acted upon by gaseous nitrogen in heated condition.

928,482. CLUTCH FOR WINDING DRUMS OF HOISTING MACHINERY; C. P. Turner, Harrisburg, Pa. App. filed Feb. 1, 1908. Improvement in the mechanical parts of electrically driven hoisting drum.

928,483. PORTABLE BANK; B. S. Wakeman, Scranton, Pa. App. filed Sept. 22, 1908. Savings bank in which access to the bank is prevented by an electromagnet whose armature controls the locking bolt; operated by a magnet from the outside, which magnet is kept at the bank.

928,505. GAS-LIGHTING APPLIANCE; F. F. Dier and M. Primeau, Winnipeg, Canada. App. filed Jan. 9, 1909. A battery and helix with a hand instrument including two extending members to close the circuit.

928,510. LIFTING MAGNET; A. C. Eastwood, Cleveland, Ohio. App. filed Aug. 10, 1908. Has an annular winding space, a unit for the space comprising a bottom plate for closing it and a winding clamped to the upper side of the bottom plate.

928,516. ELECTROMAGNETICALLY OPERATED APPARATUS; R. E. Hellmund, Hinsdale, Ill. App. filed April 4, 1906. An S-shaped armature for an electromagnet.

928,521. ELECTRIC METER; D. C. Jackson, Madison, Wis. App. filed Sept. 14, 1904. Mercury type watt-hour meter in which the self inductance of the pressure coil is neutralized.

928,531. FREQUENCY RELAY; D. J. McCarthy, Wilkinsburg, Pa. App. filed April 24, 1907. For use with two or more alternating currents of different frequency, having two windings of substantially equal inductance, a movable element subjected to their combined influences, one of the windings being resonant at a predetermined frequency.

928,532. ELECTRIC IRON; D. W. McClay, Pittsfield, Mass. App. filed April 10, 1908. An iron provided with a multiple coil, single heating unit, the coils in series, and having a core to allow for expansion.

928,547. ELECTRIC STARTING DEVICE; J. L. Schureman, Chicago, Ill. App. filed Sept. 20, 1907. For controlling the current through an electric motor by means of a series of switches and cams on a rotatable shaft arranged to engage successively the switches and close them.

928,570. SELECTIVE SIGNALING DEVICE FOR RAILWAYS; S. R. Wright, Rochester, N. Y. App. filed Aug. 24, 1908. A line wire with instruments in series connected therein, a controlling selector at the operating station, provided with a variable contact which may be positioned at will by the operator.

928,571. RAILWAY SELECTIVE APPARATUS; S. R. Wright and C. L. Diehle, Rochester, N. Y. App. filed Aug. 24, 1908. The master selector comprises a motor and a movable switch actuated thereby when the condition of the electromagnet changes. A series of local selectors driven by a motor are controlled by the master selector.

928,572. ADVERTISING SHADE FOR INCANDESCENT LAMPS; John D. Yongh, New York, N. Y. App. filed March 26, 1906. A shade for advertising, consisting of thin, flexible material provided with a projection detachably clamped between a screw-threaded projection of the lamp and its socket.

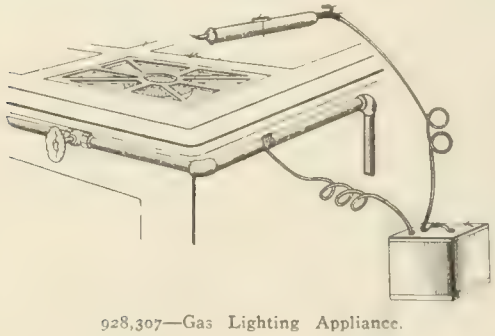
928,580. PROCESS FOR PRODUCING INCANDESCENT MANTLES; G. Byhlmann, Gross-Lichterfelde, Germany. App. filed March 8, 1907. Dissolves a rare earth metal salt, add ammonia, dissolves the precipitate, forms a saturated solution and dips the mantle therein.

928,581. TELEGRAPHIC TYPEWRITER; E. Burlingame, La Porte, Ind. App. filed April 26, 1906. A plurality of sliding bars, a plurality of armatures, one for each character, a magnet for actuating them, and a relay for releasing the magnet after printing.

928,582. POLARIZED MAGNET; E. A. Burlingame, San Francisco, Cal. App. filed May 11, 1908. A permanent horseshoe magnet with a magnet coil between the shoes, an armature located between the core and the poles and arms pivotally connecting the armature with the base.

928,583. METHOD OF UNIDIRECTING ELECTRIC CURRENTS; E. A. Burlingame, San Francisco, Cal. App. filed Nov. 11, 1908. Polarized relay, secondary circuits connected with the main line circuit by the action of the relay and magnets connected across the parallel secondary circuits.

928,589. INTENSIFIER FOR TELEGRAPH SOUNDERS; R. W. Crawford, Jr.; R. H. Beck and L. W. Davies, Lamar, Col. App. filed



928,307—Gas Lighting Appliance.

Nov. 3, 1908. For telegraph relays. Provides the relay with a sound box, a stylus arm engaging a diaphragm and a horn.

928,592. MACHINE FOR APPLYING TAPE TO ARMATURE COILS; J. S. Downs, Easton, Pa. App. filed Aug. 26, 1908. For winding armatures by means of annular tape-carrier having a gate permitting access to the interior of the carrier.

928,597. MUTIPLE PENDANT SWITCH; C. D. Gervin, New York, N. Y. App. filed Jan. 17, 1908. An insulating base, plungers movable therethrough to engage a terminal, spring clips holding the plungers and a release button to displace the clips.

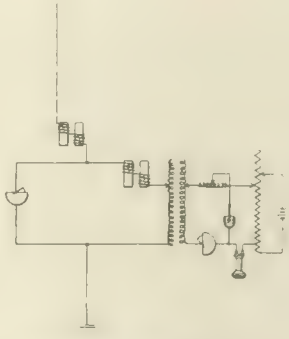
928,651. SOUND-PRODUCING INSTRUMENT; F. Gottschalk, New York, N. Y. App. filed Dec. 23, 1907. A telephone transmitter having a casing with an aperture, a diaphragm therein and a receiver cup extending from the diaphragm to the aperture.

928,652. RESISTANCE CUP; F. Gottschalk, New York, N. Y. App. filed June 3, 1908. A carbon-receiving cup for telephones having a series of partitions of insulating material separating the granules.

928,668. TROLLEY; F. Kompe, Berlin, Germany. App. filed Oct. 10, 1908. A screw-shaped groove is provided on the trolley roller to assist in finding the wire.

928,680. TELEPHONE SYSTEM; D. W. May, Kansas City, Mo. App. filed May 18, 1908. Common battery system in which a line selecting switch is adapted for intermittent operation and is actuated by the removal of the telephone receiver. Central may also effect the operation of the switch.

928,701. UNITING THE COMPONENT PARTS OF COMPOSITE SHEET-METAL STRUCTURES; A. F. Rietzel, Lynn, Mass. App.



928,371—Signaling by Electromagnetic Waves.



928,572—Advertising Shade for Incandescent Lamps.

filed Feb. 24, 1905. Electrically welds the metal at spots by the application of pressure and heating current localized in the spots.

928,707. CONTROLLER; H. Smith, Suffern, N. Y. App. filed Aug. 8, 1908. A revoluble drum carries resistance windings which dip into a body of mercury.

928,709. INSULATOR FOR THIRD RAILS; Louis Steinberger, New York, N. Y. App. filed Feb. 2, 1909. The bearing member is supported by the base and locked thereto, and a body of insulation on the bearing member carries the rail.

928,734. PROCESS FOR ELECTROLYSIS OF ALKALI CHLORIDS; J. Billitzer, Vienna, Austria-Hungary. App. filed Jan. 22, 1907. Forms a thin layer about the cathode and constantly removes it as formed.

928,763. INSULATING JOINT; C. A. Jaynes, East Orange, N. J. App. filed May 8, 1908. For gas pipes having insulated members riveted together and a socket member to which the insulating members are secured.

928,771. DYNAMO-ELECTRIC MACHINE; F. R. Kunkel, Edgewood Park, Pa. App. filed Jan. 10, 1908. Spherical bearing sleeves for the armature and a sheet-metal casing for the machine, having hemispherical sockets for the bearings.

928,772. PIVOTAL CONNECTION; F. R. Kunkel, Edgewood Park, Pa. App. filed Jan. 10, 1908. For fan motors in which a number of space projections are embraced by a plurality of nested U-shaped clips clamped together.

928,799. DYNAMO-ELECTRIC MACHINE; H. M. Schiebe, Wilkinsburg, Pa. App. filed Jan. 10, 1908. The machine may readily be taken apart and has terminal devices, an end bracket and brush holders carried thereby.

928,824. CIRCUIT CLOSER; O. M. Tustison, Bainbridge, Ind. App. filed June 30, 1908. A circuit closer for automobiles which can be operated only by the owner's key.

928,826. UNDERGROUND CONDUIT; S. B. Way and E. C. Freeze, St. Louis, Mo. App. filed Aug. 19, 1907. Concrete conduit made in sections.

928,839. TROLLEY SWITCH PLATE; E. Bell, Dunbar, Pa. App. filed Dec. 26, 1908. A trolley switch having inverted V-shaped converging grooves and V-shaped conductors in the apex of the grooves.

928,844. MANUFACTURE, CONCENTRATION AND SIMULTANEOUS PURIFICATION OF SUFURIC ACID; G. C. DeBriailles, Paris, France. App. filed Oct. 30, 1908. Makes sulfuric acid by oxidizing sulfurous acid through electrolysis.

928,857. ELECTRIC ARC LAMP; S. E. Donnelly, Shreveport, La. App. filed Jan. 16, 1909. For fixing an electrode to the holder body by means of a special clamp so that expansion by heat will not loosen the electrode.

928,862. TELEPHONIC APPARATUS; E. A. Graham, Brockley, London, England. App. filed Oct. 7, 1907. Comprises a casing, a watertight door with circuit-controlling switch operated from the outside of the casing and an agitating device for shaking the carbon granules, also operated from the outside of the casing.

928,879. TROLLEY POLE FOR ELECTRIC RAILWAY CARS; T. Oliver, dec'd, Chicago, Ill. App. filed June 30, 1908. The pivoted trolley pole is automatically dropped when the pole rises above its normal range of movement by means of an arrangement of spring and detent.

928,888. PROCESS FOR EXAMINING MATTER OR OBJECTS IN QUANTITIES; J. I. Solomon, New York, N. Y. App. filed Nov. 25, 1907. Particularly for examining pearl oysters without injuring them by supporting them on a tray and subjecting them to X-rays.

928,901. AUTOMATIC CIRCUIT BREAKER; H. W. Cheney, Norwood, Ohio. App. filed Oct. 22, 1906. An oil switch for any number of phases having a rotary switch member or drum, a weight on the drum for opening the switch and an operating handle for closing it.

928,918. COMMUTATOR FOR ELECTRICAL MACHINES; F. R. Kunkel, Edgewood Park, Pa. App. filed Oct. 7, 1908. Conducting segments with dove-tailed projections, insulating collars embracing them, reinforcing disks for the collars and a supporting sleeve for the parts.

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NEW YORK, THURSDAY, AUGUST 12, 1909.

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Improvement in Export Trade.

The bettered conditions in export trade that were noticeable in May are again seen in the electrical figures for June. The value of electrical instruments and apparatus was $421,732 in 1908, but had risen to $595,044 for June of the current year. The export of heavy electrical machinery was $667,453 as compared with $659,497 a year ago. The items added together show a gain of $181,268, or not very far short of 20 per cent. Such a rate of gain if maintained would soon restore the high-notch figures of 1906-7.

We have with the figures for June the totals of the 12 months, which may be cited. The total for electrical instruments was $6,074,865, or about $700,000 less than the preceding year. The total for electrical machinery was $6,449,526, or very nearly $2,000,000 less. The respective figures for the three fiscal years come out as follows, adding together electrical instruments and machinery:

	Instruments.	Machinery.	Total.
1906-7	$8,262,640	$9,005,766	$17,268,406
1907-8	6,754,217	8,495,219	15,249,436
1908-9	6,074,865	6,449,526	12,524,391
	$21,091,722	$23,950,511	$45,042,233

This is an interesting table in many respects. The two classes of apparatus are seen to be divided pretty evenly over the whole period, while it brings out the sharpness of the decline in gross since 1906 up to the time of the present rally. The total of $45,000,000 is quite respectable, but we hope that the next three years will average even better than $15,000,000 a year.

Our best customer for electrical instruments by long odds in all three years was British North America, averaging about $1,400,000 a year. In 1906-7 the United Kingdom took $1,580,615, but in the last fiscal year that amount was cut to $583,374. Brazil has been a good steady customer, averaging nearly $1,000,000 a year, while Mexico has averaged $700,000. Japan was a large customer once, but last year took only $254,928. In the line of heavy electrical machinery, the conditions change somewhat, and Japan proves to be our "best buyer" with an average of $1,300,000 a year, while British North America took about $1,100,000 each year, and Mexico just a shade less. For the last year Japan took $1,175,208, or $400,000 more than Mexico, which came next. The demand from the United Kingdom declined in the three years from $1,139,165 to $608,146. There are evidently many opportunities for a marked rally as well as for an increase everywhere and the improvement in world trade will help bring this about. But more will depend on the attitude of the manufacturer and exporter and his enterprise in seeking a market for many lines of goods not now known or placed abroad.

Avoiding Electrical Accidents.

An extremely interesting article is published in the present issue from Mr. Robert J. Young, the safety inspector of the Illinois Steel Company, on electrical accidents around machinery and their prevention. The increasing use of electrical energy on a large scale around industrial establishments renders necessary the adoption of numerous precautionary measures, and it is greatly to the credit of the steel corporations of this country that not only do they recognize this fact, but employ special officials to give effect to the rules and regulations that have been adopted. We desire to call attention in particular to the devices illustrated in Mr. Young's pithy article, and to the polyglot signs that are employed for purposes of warning.

These are highly useful in a country where so much of the lower grade of labor is of foreign origin and where the immigrant heads of large families are often unable to speak or understand English. President Crawford, of the Tennessee Coal, Iron & Railroad Company, has also sent us some data of similar work done by his corporation, to which we propose to call attention later. The aroused interest in this subject is another proof that already the aims and efforts of the Museum of Safety, which thus seeks to safeguard labor, are not in vain, and these excellent examples strengthen its hands in the propaganda for protecting human life and limb. Incidentally we would suggest that such work in industrial plants is especially worthy of study by managers of electric light, power and railway systems.

Recognition of the Electric Vehicle.

Perhaps significant of the fact that the electric vehicle is no longer considered the Cinderella of the automobile family is the circumstance that about half of the papers read at last week's summer convention of the Society of Automobile Engineers in Chicago related to electrical subjects. Of the six papers presented two related to storage batteries, one to a test of a gasoline motor, one to energy consumption of commercial vehicles, one to an electric dynamometer for testing gas engines and one to lubricating oils. It will thus be seen that electrical subjects attracted a moiety and perhaps a preponderance of the attention of the convention. The liveliest discussion of the meeting centered around the use of the new mercury type of ampere-hour meter on electric vehicles, and the practice of installing this instrument came in for both praise and blame.

As a class automobile engineers have paid comparatively little attention to electrical problems, and it is an encouraging indication of the manner in which the electric vehicle is gradually coming into its own when the professional society of the great automobile industry—and a high-grade society it is, too, fairly comparable in the quality of its work to the associations maintained in other branches of engineering—gives so large a proportion of one of its conventions to subjects related to the unobtrusive but attractive, reliable and serviceable electric automobile. The society is young, and it is perhaps not strange that it has hitherto devoted its predominant efforts to the showy gasoline car, which looms so large in the public eye. But now that some of the electrical members have brought about a wider outlook on the part of the society, it is to be hoped that this breadth of vision characteristic of true engineering will continue in the future history of the organization. The advantages of this policy will be reciprocal, for both the electric-vehicle industry and the Society of Automobile Engineers will benefit by it. A brief report of the convention as it interests electrical readers appears elsewhere in this issue.

The Rio de Janeiro Power Plant.

Rio de Janeiro is, we believe, the first of the world's capital cities to be adequately supplied with transmitted water-power, save for the City of Mexico; and the capital of Brazil is by far the larger of the two. Few North Americans realize the splendid probabilities of the great republic of Brazil, with an area near that of the United States and natural resources probably greater. Brazil lies enough nearer the equator to have a climate ranging from tropical to temperate, instead of from temperate to sub-Arctic as with us, and lacks the arid stretches that make so much of our own Western country a region fertile only when irrigated. For this reason and because of its magnificent harbor Rio de Janeiro is a city destined for greatness in years to come, and it is most fortunate in having an adequate power supply within easy reach. As we have noted in a description of the Rio plant published earlier, it is distinguished for a very fine and capacious storage basin, large enough to equalize the flow of the stream for very long periods and deep enough to escape serious loss from evaporation, which in the tropics is no slight matter.

The voltage of transmission is high even from our standpoint, being 88,000 volts, and the distance is but 51 miles. The lines are in duplicate, each being of steel towers varying in height from 45 ft. to 60 ft. and in a small number of standard forms so that spare parts can be easily kept in stock. It is interesting to note that, as in many tropical regions, the annual variation of temperature is but small, far smaller than in the United States, so that a long span construction is easily carried out, with no fear of sleet and but little of high winds. The present article deals mainly with the matter of distribution of the transmitted energy and the methods adopted are of decided interest. The topography of the city enabled the company to secure a private right of way fairly into the city for the receiving station. Here the step-down transformers reduce the pressure from 80,000 volts to 6300 volts, three-phase, at which pressure the general feeders for lamps and motors are operated. A 23,000-volt circuit is also provided for suburban service. The general distribution is by means of a four-wire, three-phase system worked at 120 volts between outside wires and neutral, a system which possesses great advantages but has hitherto been used only in plants of rather moderate size. The secondary distribution is by armored cables with the transformers in vaults, where the 6300-volt cables are led. These latter are lead covered and paper insulated. There are 15 distributing stations with the circuit-breakers controlling the transformer capable of remote control from a single point, since the secondaries are all tied into a common network. This system of distribution has many of the characteristics of the direct-current Edison system in common use here, with the additional advantage of high-voltage feeders. It is quite as

flexible and convenient as a direct-current system and is probably considerably more efficient, especially when compared with a direct-current system worked via motor generators or their equivalent. From the standpoint of engineering progress it is very gratifying to see the four-wire, three-phase system worked on so large a scale and with a fair chance for being worked out on an adequate scale. It is quite as economical of copper as an ordinary three-wire, direct-current system, can work a combined lighting and industrial service quite as readily, and is particularly well adapted for big central-station operation. It might be a good idea for some of our central-station men to take a winter run down to Rio de Janeiro when everything is in full operation and see how the thing can be done when one is not tied down by precedents and really has a fair chance to make a fresh start at distribution on a large scale. It is gratifying that the work, even if not in our own country, is still done by Yankee enterprise and by Yankee engineers.

National and International Electrical Engineering Symbols.

The early medieval name for an engineer was *mathematikos,* or the man who could work according to definitely computed estimate. Ever since engineering has been recognized as a business, it has contained and stood for practical mathematical formulas. Probably as long as engineers and engineering shall last, engineering formulas will also last. Each branch of engineering has its own particular formulas which belong to the lares and penates of the guild. In electrical engineering, there are certain elementary and fundamental formulas, such, for example, as Ohm's law, that are of the first practical importance. These formulas are to be found in nearly every good text-book of electrical engineering. It is expedient and desirable that these fundamental formulas should be clothed in essentially the same garb, so as to be recognizable instantly. This requires that the algebraic symbols for the fundamental electromagnetic quantities should be everywhere the same. Nevertheless, there is danger in carrying this principle too far. It is hopeless to standardize, at present, the symbol for every physical quantity in engineering. There are too many quantities all told, too many branches of engineering and not enough alphabetical symbols. There is a just medium to be sought for. If we do not standardize engineering symbology at all, we have a horrid medley, and unnecessary confusion in literature. If we attempt to standardize too much, the labor and artificialty of the effort will surely make it abortive. The right air is then to take electrical engineering alone, and deal only with the most frequently used quantities, standardizing internationally in the direction of least resistance and commencing very modestly.

The comparative table of electrical engineering text-book symbology prepared by Dr. Kennelly and printed on page 374 presents the essential facts in a convenient form for examination and deduction. It is remarkable to find how much uniformity already exists, considering that no serious effort has yet been made internationally by electrical engineers to arrive at a uniform set of symbols. We hope that this research may receive the attention of the International Electrotechnical Commission. It should certainly assist that body to reach a preliminary understanding and resolution in the direction of international electrical engineering symbology. It appears that there are already half-a-dozen electric, magnetic or electromagnetic quantities ripe for international adoption as a nucleus, without calling for any appreciable change or national sacrifice, and not to speak of half-a-dozen more auxiliary and subsidiary quantities that are also practically ripe. If the commission would start with the adoption of an international list of these dozen quantities, a great step would be made, and a great international advantage secured. The remaining discrepant symbols could then be brought into line gradually, and without haste. The important thing is to make a start.

It is doubtful how far the representatives of different countries in the International Electrotechnical Commission could go in accepting modifications of symbology. It is one thing to agree to a change in committee, for the sake of international uniformity, and another thing to effect the change in literature and cold type. That is why we must expect the movement toward uniformity to be slow. Nevertheless, the movement will be sure if it is loyally fostered by the technical press in each country. Without arrogating to ourselves any immoderate praise, we freely admit that this journal has had its share in changing the symbol of electric current from C to I, in order to conform to international usage. Prior to the Chicago Congress, everyone in the United States used C for current in engineering literature. Now I is almost invariably used. This fact shows that such changes can be made.

Vector Diagrams.

An article entitled "The Use of Arrow-Heads in Alternating-Current Vector Diagrams" by Prof. A. S. Langsdorf in this issue calls attention to a feature of vector representation that is frequently overlooked, namely, the fact that each vector shows merely the time-phase relation of some one alternating quantity with respect to some alternating quantity chosen for reference as to time-phase displacement. That is to say, in polyphase systems it is necessary to consider the interconnections of the circuits as well as the time-phase relations of the individual currents and e.m.fs. in determining the resultant amperes and volts. To the error commonly made in assuming that the vector diagram of currents and e.m.fs. represents the interconnections of the circuits may be attributed the great confusion produced in the mind of one unfamiliar with the true conditions when he attempts to place arrows on a diagram used in demonstrating the measurement of three-phase power with two wattmeters.

In a balanced three-phase system the currents in the three conductors are displaced in time by 120 deg., as are also the e.m.fs. between adjacent conductors. As ordinarily, and correctly, represented, the arrows on the delta e.m.f. vectors follow around the diagram, while those on the star current vectors point outward. At first glance it would seem that when measuring power at zero angle of lag a wattmeter with its series coil in one conductor would reverse its reading when its shunt coil was connected first across between one and then the other remaining conductors. However, no reversal takes place, because simultaneously with the time-phase reversal of the e.m.f. to be impressed across the shunt coil there is a relative reversal of the connection of the shunt coil in circuit, and there is no change in the indication of the wattmeter.

Depreciation of English Electric Lighting Undertakings.

The English Board of Internal Revenue has agreed to arrangements proposed by the Tramways & Light Railways Association in regard to the proper allowances for depreciation of certain undertakings, including electric lighting.

According to the agreement which will be the basis for the income-tax assessment, in addition to repairs, allowance for depreciation of cables may be granted at the rate of 3 per cent per annum on the "written down" value—meaning the original prime cost, plus subsequent additions, less all allowances actually granted by the board in respect of wear and tear. On all plant and machinery, exclusive of loose tools, meters and office furniture, depreciation may be allowed at the rate of 5 per cent per annum on the written down value, in addition to the cost of repairs. No allowance is to be made for depreciation of conduits, meters, loose tools and office furniture, but the annual expenditure on repairs and renewals may be allowed as working expenses, as and when incurred.

The above proposals are to be treated as having been in effect during the year 1908.

Chicago Railway Contract for Electrical Energy.

On July 30, after negotiations extending over a considerable period of time, the Chicago Railways Company, which operates the surface street railways on the North Side and West Side of Chicago, entered into contract with the Commonwealth Edison Company for a large portion of the electrical energy needed to operate its cars. The contract calls for not less than 30,000 kw and will cover a period of about six years. The rate is $15 per kilowatt of maximum demand per year with an additional energy-consumption charge of 0.415 cent per kw-hour until Jan. 31, 1910. After that date the energy-consumption charge will be 0.4 cent per kw-hour for the remainder of the period. In its provisions the contract is substantially the same as the one previously entered into by the Chicago City Railway Company and the Commonwealth Edison Company for a similar service and for about the same amount of electrical energy. As is well known, the Commonwealth Edison Company does a remarkably large business in the way of supplying electrical energy at wholesale rates to electric railway companies in and near Chicago. Under existing contracts at the time of maximum demand next winter the Commonwealth Edison Company will be supplying about 80,000 kw to customers of this character—a record significant of the modern expansion of the business of supplying electricity.

Convention of Michigan Electric Association.

The Michigan Electric Association will hold its 1909 convention at the Hotel Tuller, Park Street and Adams Avenue, Detroit, Aug. 17, 18 and 19. The first session will be called to order Tuesday evening, Aug. 17, at 8 o'clock. It will be devoted to papers and discussions on light and illumination. The second session, which will be held at 10 o'clock Wednesday morning, Aug. 18, will be devoted to motor and industrial business. The third session will be held Thursday morning at 10 o'clock, and will be devoted to electric heating. The afternoons and one evening will be taken up with various entertainments which have been arranged for. One of these will be a boat ride on an excursion steamer followed by a dinner at Bois Blanc Island. The entertainment committee urges all members to bring the ladies, as special arrangements will be made for them during the convention sessions in addition to the entertainments which are provided for the entire membership. There will be only three sessions, Tuesday evening, Wednesday morning and Thursday morning, devoted to the three general divisions of the industry—light, power and heat. The secretary of the association is Mr. A. C. Marshall, Port Huron, Mich.

Electrification of Canadian Main Lines.

Hitherto the proposals to electrify main lines of railroad in Canada have been limited chiefly to the Western sections of the Dominion where large water-powers are abundant. U. S. Deputy Consul C. A. Steeves, at Moncton, now reports that the electrification of the Grand Trunk Pacific, or National Transcontinental Railway, from the St. Lawrence River to Moncton, is now under the serious consideration of the railway company, the Dominion Government and the New Brunswick cabinet. Electrical engineers who have given the subject consideration declare the conditions to be entirely favorable. The distance between the St. Lawrence and Moncton is about 460 miles, and for a considerable part of the distance the road passes through dense forests of spruce and fir in lower Quebec and northern New Brunswick, as well as through the rich farming country along the upper St. John Valley. What has given impulse to the new plan is that at Grand Falls on the St. John River, 170 miles from the St. Lawrence and 160 miles from Moncton, is located water-power sufficient to develop energy enough for the working of the whole road. At this point the river has a natural fall of about 130 ft. and a flow that electrical experts estimate will be sufficient to furnish from 100,000 to 125,000 hp continuously by the utilization of comparatively inexpensive means of storage and conservation. As the requirements of the road are estimated at not more than 40,000 hp, there is every reason to believe that the supply will be more than equal to the needs.

Mascart.

The issue for July 15 of *La Revue Générale des Sciences* contains a long paper by Prof. Paul Janet entitled "La Vie et les Œuvres de E. Mascart," which, in addition to giving an appreciative review of the personal career of the great savant and a scholarly analysis of his work, contains an account in detail of the circumstances attending the adoption of the volt ohm, ampere, coulomb and farad at the International Electrical Congress of 1881. Professor Janet, who enjoyed the intimacy of the subject of his contribution, brings out clearly the traits of character which charmed all who came into contact with Mascart. The attraction exercised by Mascart was peculiar in that it did not proceed from a spirit of bonhommie, for he never entirely laid aside the dignity of the savant nor by his manner invited familiarity from any source. It is related how Thiers came under his spell, and for several years during a period of great political activity preceding the Franco-Prussian War, stole away at every opportunity to Mascart's laboratory, where under his tutelage he indulged in experimental study covering a wide range of sciences.

The account Professor Janet gives of the adoption of the practical electrical units in 1881 is apparently based on information derived directly from Mascart, and previously unpublished. During the first stages of the discussion on the adoption of the units, differences of opinion arose, both with respect to expediency and nationality, which appeared to Dumas, president of the congress, and others, to indicate the impossibility of arriving at any international agreement. However, at a dinner at which Mascart, Kelvin, Helmholtz and Werner von Siemens, among others, were present, an agreement was reached which secured the adoption of the ohm and the volt, but left the matter of other proposed units in the previous unsatisfactory state Finally, several days later at a luncheon in a small restaurant near the meeting-place of the congress, Mascart, Helmholtz and Kelvin came to an agreement which resulted in the addition of the ampere, coulomb and farad to the list of electrical units. It is interesting to note that a meeting of the committee on units at which the proposition would have been presented for discussion was not held owing to an order issued suspending routine work of the congress on account of the death of President Garfield. The proposition was therefore brought direct before the congress at its concluding meeting, to the surprise of some members of the committee whom it had not been possible in advance to enlighten as to the circumstances.

Telephone Development of Brazil.

Some very interesting facts are furnished by United States Consul-General George E. Anderson, of Rio de Janeiro, on telephones in Brazil and the demand for apparatus. An American company which is constructing a system for the State of Rio de Janeiro secured its concession about three months ago, and already has the construction well under way. One of the chief objects of the enterprise is to afford communication by telephone between Rio de Janeiro and the country surrounding it, including Petropolis, the summer capital; Nictheroy, the capital of the State of Campos, and other important points.

There is great need in Brazil of telephone service in many parts of the country not reached by the Government telegraph system, or in which the telegraph system does not meet the requirements of business. Although Brazil has 20 States and a territory substantially the same as that of the continental United States, it has no interstate telephone line and, by reason of the interstate restriction, it has few telephone lines serving rural districts within the several States themselves.

According to official returns, there exists in Brazil a total of thirty-nine telephone systems, ranging from 22 to 2503 subscribers, of which, at the time the statistics were prepared, last year, 15 were Berliner, 9 Kellogg, 3 Bell, and 4 "American." The total number of subscribers in all the systems is 9200. Of these companies only five have more than 500 subscribers, viz., Bahia, Rio de Janeiro, Pernambuco, Pelotas and Sao Paulo.

The concern in Rio de Janeiro, the largest in Brazil, is now owned by the American syndicate which has purchased all the public utilities of the city. Since the present owners took charge it has been reëstablished upon a modern basis with American instruments and underground wires. The system has 2676 connections and about 21,000 miles of wire.

The system in Bahia also has recently been purchased by a new concern, which is introducing a modern American system. At the time the statistics were secured it had 554 instruments and about 1400 miles of wire. The Bell system is in use. In Pernambuco the system is Norwegian and German. It has 631 instruments, about 1000 miles of wire, and about as many subscribers as instruments. The system at Pelotas, in Rio Grande do Sul, has instruments of diverse makes to the number of 1479. It has about 2400 miles of wire, and a capital of $180,000.

Mexican Hydro-Electric Developments.

The construction of another large hydro-electric plant, making three in all, will be started by the Guanajuato (Mexico) Power & Electric Company in a few weeks. When completed this plant will give the company about 21,000 available horsepower. The company is composed of Americans who several years ago secured concessions from the Government for the use of the water of certain rivers in the State of Michoacan with which to generate electrical energy. The first of the hydro-electric plants was erected at Zamora. This plant, capable of delivering 8000 hp, was inaugurated in October, 1903, since which time the company, seeing still further need for increasing its equipment to meet the demands of the mining, agricultural and manufacturing interests, has had men in the field securing addition power concessions.

The second plant of the company was built at El Sabino. Concessions for developments on waterfalls of the Angulo River were secured. On the first concession of the company for the use of waterfalls on this river was erected the hydro-electric plant known as the Brunel, which has a head of 50 m, with 7 cu. m of water per second available. A big storage reservoir of 1,000,000 cu. m has been erected at that point. The power houses are built of iron and masonry.

The transmission of the electric energy from the plants to Guanajuato, 102 miles, is unique in that this company was the first to carry its lines on steel towers with long spans, making a decided advance in methods of transmission at high voltage The energy is carried into Guanajuato at 60,000 volts.

The company has a well-equipped substation at Guanajuato. From here the energy is distributed at 15,000 volts to the surrounding districts, more than 50 miles of distributing circuits being necessary to reach the customers of the plant. Steps are now being taken to construct 30 additional miles of circuits. The company is constantly adding improvements to its great electric transmission system. A different form of tower and longer spans than the ones originally erected are now used. Lightning arresters have also been installed.

The site chosen for the third plant which the company is preparing to erect is seven miles above the Brunel plant. The new hydro-electric plant will have a rating of 10,000 hp, and will be connected with the Brunel plant by a tie line.

The cheap electric energy furnished by the company has been the cause of a remarkable industrial awakening in that part of Mexico. It has led to the development of many mines in the Guanajuato district and has been of great benefit to agricultural and manufacturing enterprises. The energy is used to operate irrigation pumps in the vicinity of La Barca, Leon, Celaya, Irapuato and other places within a radius of 150 miles of the hydro-electric plants.

Electrical Machinery in Australasia.

The important market which Australasia affords for all kinds of electrical machinery is shown by the fact that in 1907 the value of imports into Australia reached the total of $2,051,000. New Zealand imports representing a value of $1,250,000. To the Australian total the British contribution was $975,000; the United States share amounted to $587,000; that of Germany to $136,000, and Sweden $272,500. The competition for the New Zealand market is fierce, and a large share of the business is secured by American and German houses. These are official figures, but there is a probability that some portion of the trade returned as British really represents foreign goods. The new tariff will encourage the local industry in the manufacture of generators and motors, and a new factory has been started to manufacture carbon-filament lamps.

Numerous lighting schemes are in progress and under contemplation in the various States, and there is a good deal of business to be done by American firms in motors and generators, providing they go about the business in the right way. This is peculiarly a business that needs a special representative, with a technical as well as a business training.

The Electric Lighting Committee of Sydney is about to purchase a plant of the total value of $415,000, for which the city electrical engineer has submitted the following estimate: Two 4000-kw generators at $11,000; one 400-kw generator, $13,750; one 400-kw transformer, $2,250; switch gear (at power house). $12,500; crane, $4,250; boilers with superheaters and stokers, five, at $13,000 each; pipe-work valves, feed pumps, economizers, tanks, etc., $36,150; coal and ash conveyor, $5,000; substation switchgear, $5,750. The town of Sunbury, in Victoria, is also about to purchase an electric lighting plant, and one is also about to be installed in Adelaide in connection with a refuse destructor.

There is a good trade being done in electric elevators, and American firms are having it almost their own way save for some competition on the part of Germany. Over 60 were installed in 1907 in Sydney alone. The business to be done in telephones and switchboards is considerable. Here again the bulk of the trade is in American and Swedish hands.

At Auckland harbor, electric capstans are to be installed on some of the wharves, and the facilities for rapid discharge of vessels and handling of cargo will be further increased by the supply of electric cranes, and an 80-ton floating crane of modern type, for which tenders were invited at the end of July last. Wharves and sheds are at present adequately lit with gas, and provision is being made for electric light installation. The wharves at Dunedin also are being equipped

with electric cranes to lift up to 10 tons. With the introduction into Australia of the metallic-filament lamp a fine opportunity is presented for the exploitation of small gas and oil engine sets for electric lighting.

There are various important hydro-electric schemes in the commonwealth, and one of the most interesting, according to Mr. Ben H. Morgan, who recently spent five months in the Antipodes as special commissioner of the Manufacturers' Association of Great Britain, is the Waipori (New Zealand) hydro-electric power transmission scheme, from which energy is obtained to operate the tramway system of Dunedin, and for lighting and general power purposes in that city. Mr. Morgan, in his report, gives some details of the power station as supplied to him by the consulting engineer, Mr. W. G. T. Goodman, now consulting engineer to the Adelaide Tramways Trust. The total value of electrical plant used in the installation is $121,255, of which $41,865 is General Electric Company of America, and $79,360 Westinghouse Company. "It is to be regretted," says Mr. Morgan, "that the large orders involved in this plant should have been placed almost entirely with foreign firms. It should be mentioned, however, that the cables used are chiefly British. The Dunedin City Council has decided to carry out an extension of this scheme that will provide an additional 2000 kw. The estimated cost is $100,000, and manufacturers of electrical and other machinery will do well to place themselves, through their agents, in touch with the city electrical engineer." The evil of the shipping "rings" is emphasized by Mr. Morgan, who says: "The proportional growth of German and American trade as compared with British trade in recent years has been most striking, and the evidence which I have collected . . . shows that this is largely due to the excessive charges and arbitrary conditions of the Shipping Conference."

A Parliamentary Commission, which has been sitting since 1906, has only just issued its report as a blue book, and no doubt a means will be found whereby in the future British exporters will obtain fairer treatment. The difference in rates from Germany or America to Australia as compared with those from Great Britain to Australia is in many lines a profit in itself. On one class of goods Mr. Morgan found a difference of $10 per ton. This, he explains, was exceptional, but it must be remembered that on many lines of goods one-third of this sum will decide the Australian buyer to place his order outside of Great Britain—other conditions being equal.

Electrical Engineers in South America.

Recent consular reports contain some interesting data as to electrical engineers in some of the countries of South America. U. S. Consul-General R. M. Bartleman, of Buenos Ayres, reports as follows concerning the opportunities in the Argentine Republic for the employment of American electrical engineers: "In the installation of tramways, city lighting plants, telephones, etc., the standard of the practising electrical engineer in this country is a high one. Installations of the higher order of engineering, such as first-class elevators, motors in modern offices and hotels, etc., are in their infancy. There certainly is an opening for first-class electrical engineers, as well as structural engineers, and they will be successful if they conform with the customs of the country to a certain extent, but they must remember that electrical and other engineers in Argentina are paid fully 20 per cent less than the usual pay of engineers in New York. The principal difficulty to be encountered by American engineers in getting a foothold in the important constructions lies in the fact that these constructions are almost wholly financed by English, German or French capital, and naturally the important posts fall to the engineers of the countries furnishing the capital."

From Uruguay U. S. Consul Frederic W. Goding, of Montevideo, reports as follows concerning electric systems and plants in Uruguay and the opportunity for American electrical supplies and engineers: "There are three tram systems in Montevideo, two having electricity for motor power, viz.: Sociedad Comercial and Sociedad Transatlántica, and one, Tramvía y Ferrocarril del Norte (horse traction within the city and steam beyond), owned partly by the Uruguayan Government and partly by private parties. In Montevideo there are about 15 electric light plants and several small power plants used in printing establishments. In the outskirts there are several electric light plants, not used in the winter, while there are small electric light plants in half a dozen cities in the interior and about 15 connected with slaughtering establishments. The immense plant used in supplying light to Montevideo, owned by the Uruguayan Government, has recently been very much enlarged, so that now the power generated is sufficient for lighting the city and suburbs, including private lighting, besides furnishing power to all those now using private plants. As the price of the current on Jan. 1, 1909, was reduced from about 26 cents American to 12½ cents per kw-hour, the small plants may go out of use. In the country districts the prices vary from 21 to nearly 26 cents per kw-hour.

"The chief electrical engineer of the Government, an Italian, who is under contract for a term of years and whose position will ultimately be filled by an Uruguayan, receives $620 per month. The resident engineer for the Sociedad Comercial, a Canadian, receives about $350, and the chief engineer for the Sociedad Transatlántica about the same. All the other positions are filled by Uruguayans, with salaries ranging from $50 to $80 per month. The policy of the Uruguayan Government is to send young men to Europe to be trained for electrical engineering, who, on returning to this country, are placed in Government positions. Hence, the opportunities for young men from the United States are limited to times when new works are being erected, as only then are skilled foreigners employed. Such positions have been available, but are now closed, as the new works are practically completed. It is the intention to change the horse tram line to an electric system, and the port authorities eventually will erect electric cranes and install an electric light service along the wharves.

"The general use of electricity as a motive power, as promised by the enlargement of the Government plant, and the great reduction in the price of energy, will lead to the sale of a large number of small electric motors and a vast quantity of electrical supplies. In such a field there appears to be an opportunity for the establishment of supply houses through which a large and permanent business may be built up. It is in that direction that the efforts of electrical engineers from the United States will be most successful."

American Telegraph Systems.

The extent and variety of American telegraph systems is brought out in an advance bulletin summarizing the figures of 1907, just issued by the Bureau of the Census in Washington. A few of these statistics have already been made public. The first table relates to the telegraph systems and is a summary, by class. The total number of systems is given as 1813, of which 25 are commercial land line and ocean cable, 6 wireless, and 625 railroad telegraph systems, the remainder not being involved in the topics treated of herein. The 25 commercial land line and ocean cable systems operated 1,577,961 miles of single wire, employed an average of 28,034 persons, paid $17,808,249 in salaries and wages, expended $41,879,613, earned $51,583,868, and sent 103,794,076 messages. The 625 railroad telegraph systems operated 860,342 miles of single wire, employed an average of 68,197 telegraph operators and dispatchers, expended $37,242,479 (income not stated, as there is no direct financial income from their own use of the service), sent 264,512,816 messages, of which 5,923,483 were of a commercial nature, the income being reported by the commercial systems.

The grand total of ocean cable was 46,301 nautical miles, all controlled by the commercial telegraph systems.

Comparing the telegraph with the telephone system, the grand total of salaried officials, clerks, etc., was 29,470, of whom 25,298 were employed by the telephone systems and 4172 by the commercial telegraph. The telephone officials, etc., received in

salaries $19,298,423 and the telegraph clerks $2,794,937. The total of 142,733 wage-earners is divided, 118,871 belonging to the telephone systems and receiving in wages $48,980,704, while the 23,862 telegraph wage-earners were paid $15,013,312.

The grand total of capital stock and bonds outstanding, par value, was $1,034,909,579, of which $814,616,004 were credited to telephone systems and $220,293,575 to telegraph companies.

The grand total income was $236,045,615, of which the telephone concerns earned $184,461,747, expending $140,802,305, and the telegraph system earned $51,583,868, expending $41,879,613. Of the whole number of systems in operation, the telephone formed 99.9 per cent.

In taking up consideration of the joint subject of commercial telegraphs and ocean cable systems, the bulletin points out the impossibility of segregating the statistics. A comparative summary is given of the three census periods 1880, 1902, and 1907, and it is explained that in 1880 there were 77 companies reported, but that number decreased later by consolidations among themselves. In 1902 there were 25 companies considered. The same number was found for 1907. Taking the details for the last census period, it is shown that 1,577,961 miles of single wire were operated; 46,301 nautical miles of ocean cable; 103,794,076 messages transmitted, which include 5,869,317 cable messages; 29,110 telegraph offices operated; total income, $51,583,868, of which $45,255,187 was from telegraph traffic, and $6,328,681 from all other sources. The total expense was $41,879,613, including $34,057,298 for operation and maintenance, salaries, wages, and legal expenses. The capitalization in the form of capital stock was, authorized, par value, $161,603,900, of which there was outstanding, par value, $155,089,575. Dividends on stock amounted to $7,477,083. The average total number of employees is given as 28,034, and salaries and wages, $17,808,249.

The bulletin notes the decrease since 1880 in the number of separate companies and adds that, on the other hand, there has been a very large increase in business and equipment. The increase in the number of salaried employees and wage-earners in 1907 as compared with 1902 was but 407, or 1.5 per cent. As compared with 1880, the number was 13,106, or 87.8 per cent increase. In 1907 the amount paid in salaries and wages was 18.4 per cent greater than in 1902, and 264.5 per cent greater than the 1880 figure.

The commercial telegraph systems controlled ocean cables having a length of 46,301 nautical miles in 1907, as compared with 16,677 in 1902, an increase of 29,624 nautical miles, or 177.6 per cent. It is pointed out that this large increase is largely due to the fact that the Pacific cable and the New York-Havana cable were laid during the interval between the two censuses.

There were six commercial wireless telegraph systems, having 122 tower stations in 1907, situated at most of the large ports on the Atlantic and Pacific oceans, the Gulf of Mexico, the Great Lakes, and in Hawaii. Wireless messages to the number of 163,617 were sent between these ports in 1907. These six companies had an authorized capitalization in the form of stock with a par value of $39,450,000, of which $32,726,242 was the value of outstanding stock. The year's income was $122,154, and the expenses $169,782, of which $87,571 was expended in the salaries and wages of 182 employees.

It is pointed out that the Federal Government has realized the value of wireless telegraphy, and the Bureau of Equipment in the Navy Department, at the end of the fiscal year 1907, had installed wireless telegraph apparatus on 73 naval vessels and at 44 shore stations. During that period the shore stations sent 26,933 messages, containing 541,919 words, and received 34,073 messages, amounting to 675,607 words.

In 1907 the railroad systems in the United States operated 807,824 miles of telegraph wire, 52,518 miles of telephone wire, and employed 68,197 telegraph operators and dispatchers, who received $37,242,479 in salaries and wages. These systems reported 33,441 telegraph offices and 30,115 telephones; transmitted 5,923,483 commercial messages and 258,589,333 messages in connection with the dispatching of trains and other railroad business.

Industrial Electrical Installations at Cobalt, Ontario.

In all commercial enterprises one of the most important questions to be taken into consideration is that of motive power, and any means that can be used to cheapen the cost are eagerly taken up by the consumers. This is particularly true of the Cobalt district, where several companies have been formed to supply air and electricity on a large scale to the mines at a price that will mean an immense saving to the consumers. An exhaustive series of tests were made at the different power plants at the mines, and it was found that the average cost was about $175 a hp-year. The most economical plant produced power for $125, and there were found cases where the cost ran up to nearly $400 per year. This high cost is largely due to the price of coal, which will average about $5.50 a ton on the cars at Cobalt, and as all the coal has to be hauled in carts from the cars, the average price at the mines is well above $6 a ton.

Of the companies installing the large power plants none is creating more interest than the Mines Power, Limited. This company has been financed by Montreal capitalists, and as all the money has been raised by the promoters themselves there is no stock or bonds on the market. The president is Mr. E. A. Wallberg, and Mr. F. John Bell is the general manager. The company is capitalized at $3,000,000.

The plant is being installed on the Matakichewan River, close to Lake Temiskaming, and about 25 miles from Cobalt, where there is a large water-power available. The Government has also granted the company the right to dam up the waters of the lakes, drained by the river, thus enabling the company to provide sufficient storage-capacity in case the water in the river should fail.

The main dam above the power house is being constructed throughout of solid concrete and it will be 800 ft. long and 45 ft. high when completed. Two 5-ft. steel penstocks will be used to conduct the water to the wheels. The working head is 312 ft. and it is estimated that a total of 15,000 hp can be developed.

The power house, which will also be built of concrete, is 40 ft. x 90 ft., and will be fitted with traveling cranes to facilitate handling the heavy pieces of machinery. Four separate generating units are being installed, but ample provision has been made for extensions to the power house equipment. It is expected that this equipment will be sufficient for the present requirements of the camp. Each generator is rated at 1875 kw with a large overload range and is a three-phase, 60-cycle, 2300-volt machine. The wheels are Swiss-type, spiral case turbines with a rating of 2750 hp. These will be directly connected to the generators. There are to be two exciter units each of 100-kw rating and directly connected to a waterwheel. High-power governors are being put in to insure perfect regulation. The step-up transformers will increase the pressure from 2300 volts to 44,000 volts, and there will be four in continual use, while another one will be on hand to be used in case of an accident.

Two separate transmission lines are being built, each having a separate circuit. These are placed 25 ft. apart, and although they will both be in continuous service, the whole of the power can be carried over either line in case of an accident. Aluminum is being used for conductors and these will be supported by high-tension porcelain insulators. The right of way through the bush is being cut 100 ft. wide and to further insure the safety of the wires, all high trees have been cut on both sides in close proximity.

For the delivery of energy to the mines, three substations will be built; one in South Lorraine, with an equipment of 1000 hp, one in the Kerr Lake district of 2500 hp, while the remaining output of the plant will be used in the station at Cobalt. The station equipments will consist of three-phase, step-down transformers, with the usual lightning arrester and switchboard equipment. The distributing e.m.f. will be 2200

volts. At the Kerr Lake and Cobalt stations there will be central plants for the distribution of compressed air. At Cobalt this will consist of three directly connected, motor-driven, three-stage air compressors, each having a rated capacity of 4200 cu. ft. of free air per minute. The compressors will have extra large inter-coolers and after-coolers. The air will be delivered at 100 lb. pressure and approximately atmospheric temperature, through radiating pipe lines from the central station to the surrounding mines, and will be sold to the consumer on a meter basis.

The work on the plant is being vigorously pushed, and it is expected that the company will be in a position to supply electricity by the end of September and air a month later. The dams are being built on the upper lakes, and 400 men are engaged in the construction of the power house and concrete dam. Three separate gangs of men are at work cutting the right of way and erecting the transmission lines. The plant as a whole consists of practically duplicate units, and the management is taking every precaution to insure a continuous delivery of energy.

This company also intends to extend its transmission lines into the newer districts of Elk Lake and Gow Ganda. It also has control of the Kakake water-power on the river Quinze, from which can be developed 40,000 hp. This will be held in reserve to be developed as the market extends.

Electrical Problems Discussed by Automobile Engineers.

A distinguishing feature of the summer convention of the Society of Automobile Engineers, held in Chicago on Aug. 5, 6 and 7, was the large proportion of papers presented which were of an electrical nature. The society is five years old and has about 300 members. It occupies a relation to the automobile industry similar to that of the American Institute of Electrical Engineers in the electrical industry. It holds its annual conventions in New York in January of each year during the automobile show and has three or four other meetings annually, including a regular summer convention. These summer conventions have been held in Buffalo, Cleveland and Detroit, and at the one of this year the society paid its first official visit to Chicago. The officers of the society are: President, Mr. Henry Hess, Philadelphia; first vice-president, Mr. Russell Huff, Detroit; second vice-president, Mr. B. D. Gray, Providence, R. I.; treasurer, Mr. A. H. Whiting, New York; secretary, Mr. A. Churchward, New York; managers, Messrs. David Fergusson, of Buffalo; H. G. Chatain, of Schenectady; H. M. Swetland, of New York; F. J. Newman, of Chicago; R. C. Carpenter, of Ithaca, N. Y.; A. L. Riker, of Bridgeport, Conn., and T. J. Fay, of New York. The officers and managers constitute the council. The arrangements for the Chicago convention were in the capable hands of Mr. F. J. Newman, the local member of the council. The attendance was not large, but the papers and discussions were of a high order.

On Thursday, Aug. 5, members of the society and visitors assembled at the Illinois Athletic Club, Chicago. This day was devoted to the hill-climbing contest at Algonquin, Ill., the entire party proceeding to that village in cars loaned by local dealers. The Babcock car won the event for the electrics, beating the Columbus car, which was the other electric entry. The record was lowered by both cars, and both bettered the time made by some of the gasoline cars—a fact that should be of interest to central-station men who are faint-hearted in relation to the use of electric cars in hilly country.

The first business session was held on Friday morning at the Illinois Athletic Club, with President Hess in the chair. After some routine business had been transacted the first paper was presented by Prof. R. C. Carpenter, of Cornell University, who described efficiency tests made on a Pierce six-cylinder, water-cooled gasoline motor. The speaker illustrated his remarks by lantern-slide diagrams. He said that he preferred the electric dynamometer for tests, although it had not been used in the investigation under description. He described the manograph, an instrument used in the tests for making indicator diagrams. This is a photographic instrument, in which use was made of an electric lamp of an improved arc type devised for the tests at Cornell. In concluding his remarks the speaker said that the gasoline motor is an efficient machine and is practically as efficient in the small sizes used on motor cars as in those employed in large stationary practice.

STORAGE-BATTERY PAPERS AND DISCUSSIONS.

Dr. Edward Sokal, a consulting chemical engineer, of Chicago, read the second paper, entitled "Possible Increases of the Weight Efficiency of Storage Batteries." He began by saying that the problem of producing a storage battery to have a greater output per unit of weight is as old as the history of the storage battery itself. He considered the various possibilities of improvement in this direction. In his opinion the possibility of obtaining a practical advantage by using a different chemical material than the lead battery is practically negligible. Dr. Sokal criticized the Edison storage battery. He said that the utmost limit which has been obtained by Mr. Edison, so far, is about 11 watt-hours per pound of element—a figure which can be easily exceeded by the lead storage battery. The attitude of most electrochemists toward storage batteries other than the lead cell is one of great skepticism. There has been no really fundamental progress since the days of Planté and Faure. However, the progress which has been made in the art of manufacturing and operating storage batteries since the principle was discovered has been very considerable; it has been the slow, gradual work of improvement rather than anything like a startling revelation.

Variations of design may have a marked effect on the output per unit weight of the lead storage battery. For instance, while the standard storage-battery cells of this country are kept within 9 to 12 watt-hours per pound of total element, cells are made in Germany which reach an output of 17 watt-hours per pound. The electric-vehicle manufacturers in Germany use exceedingly thin plates which are not considered advisable under the conditions obtaining in this country. Both the porosity and the thickness of storage-battery plates have an appreciable influence on the specific output, but Dr. Sokal did not care to go on record as advising generally the use of thin plates; the manufacturer has in each particular case to form a decision which will necessarily be in the nature of a compromise, as it is obviously impossible to unite all advantages in one type.

Attention was called to one way in which it may be possible to obtain quite an appreciable gain of output for the same weight. In the present vehicle battery the negative electrode has a much greater specific output than the positive, and in the elements the number of negative plates always exceeds the number of positive plates by one. But the speaker contended that, in vehicle batteries, it is usually not the negative but the positive plate which is the weak spot and which fails first. He therefore proposes to build vehicle cells having the positive and negative plates so divided that there will be one more positive than negative. He said that with this arrangement he has constructed elements showing 10 to 15 per cent increase in specific output, but the practicability of the suggestion may be affected by further experiments.

At considerable length the speaker went on to show that lack of electrolyte of suitable concentration in the pores of the active material is really the reason for the poor specific output of the lead storage battery. He concluded by announcing that he had been working on the problem of producing a storage battery in which the concentration of the electrolyte within the pores of the electrodes is kept constant by causing a continuous flow of the electrolyte through the pores of the active material by pressure or similar means. Dr. Sokal said that he has succeeded in overcoming the difficulties in the way of artificial circulation of the electrolyte by constructing shallow or bottle-shaped electrodes, through the walls of which the circulation takes place. In this way, he said, a gain in specific output of from 50 to 100 per cent may be obtained.

Mr. H. M. Beck, of the Chicago office of the Electric Storage

Battery Company, presented the third and concluding paper of Friday's session. The paper is entitled, "Some Points in the Operation and Care of Vehicle Batteries," and it is of practical value. Mr. Beck said there are four points of special importance in caring for a storage battery—namely, the battery must be charged properly, it must not be overcharged, short-circuits between the plates or from sediment under them must be prevented, and the plates must be kept covered with electrolyte and only water of the proper purity used for replacing evaporation. The points to be especially emphasized in connection with charging are that on regular charges keep the rates as low as practicable and cut off the supply promptly; it is preferable to cut off a little too soon rather than to run too long when there is any doubt. Overcharges must be given at stated intervals and continued to a complete maximum. They should be cut off at the proper point; when in doubt it is safer to run too long rather than to cut off too soon.

In relation to the mercury ampere-hour meter to show the charge and discharge of a storage battery, the speaker said that the results obtained thus far with this instrument have been very promising.

One practical suggestion related to the "washing" of batteries for sediment: There have been many complaints of lack of "capacity" from batteries after washing. Almost without exception this accusation is due to lack of a complete charge following the cleaning. When reassembled the plates need a very complete charge, and unless this charge is given the cells will soon give trouble. "Flushing," or replacing evaporation in cells with electrolyte instead of water, is a common mistake. Mr. Beck discussed at some length the treatment required for bringing a "low" cell or battery back into shape.

On Friday afternoon the visitors were taken to Pullman, where they inspected the extensive works of the Pullman Company.

Saturday morning's session concluded the convention. It was held amid the pleasant surroundings of the South Shore Country Club, and, looking up from the tap-room, where they were seated, the delegates could gaze out over Lake Michigan. A large part of the session was devoted to discussion of the two storage-battery papers, and considerable attention was paid to the question of using ampere-hour meters. Mr. Ernest Lunn, of the Commonwealth Edison Company, Chicago, was the first speaker. He said that Dr. Sokal's paper will bear a careful reading, and that some of his predictions may be adopted in the future. The suggestion about an additional positive plate may work out to advantage. Referring to the ampere-hour meter mentioned in Mr. Beck's paper, the speaker said that this instrument is not a cure-all for the ills that batteries are heir to, but it has manifest advantages. It enables the driver to ascertain how much of his battery charge is left; it prevents lazy drivers from misrepresenting the amount of energy left in the battery; it gives the best kind of a check on battery charging, and enables the private owner to determine whether he is getting the full charge he pays for at public garages. Mr. Lunn said, referring to another part of Mr. Beck's paper, that the utmost care should be taken in assembling elements of batteries. Owners of both pleasure vehicles and commercial wagons cannot afford delays in operation.

Mr. A. Churchward, of the General Electric Company, New York, did not agree with Dr. Sokal's criticism of the Edison storage battery. He said that he had used one of these batteries for seven years, and has been obtaining considerably over 11 watt-hours per pound of element out of it. The new Edison cells give over 16 watt-hours per pound of element.

Mr. F. J. Newman, of the Woods Motor Vehicle Company, Chicago, said that electric-vehicle troubles are often caused by drag or lack of axle alignment. In commercial vehicles and others using hard-rubber tires, it can often be determined whether the axles are out of alignment by observing how the tires wear. If the axles are out of alignment, the tires will wear on one side. Referring to the ampere-hour meter, Mr. Newman said that it is an old device. There are two types. One records on discharge, and in the other the discharge travels at a faster rate than the charge and is compensated for. The speaker was afraid that if ampere-hour meters are used, vehicle owners will get into difficulties because the instruments can be tampered with. In commercial service they are unnecessary, for a hydrometer will do the the work. If batteries are not in proper condition the ampere-hour reading will be misleading.

Mr. H. H. Rice, of the Waverly Company, Indianapolis, complimented Mr. Beck's paper. He was especially gratified that the society had two papers on electric storage batteries. The electric vehicle affords very interesting problems. It is simple in its essentials, but in case of trouble it needs attention from somebody who understands it. It is certain that the electric vehicle has a place in the automobile world. It should not be purchased to do gasoline "stunts"; on the other hand, a gasoline machine should not be used if an electric car will give the service desired. The speaker expects to see improvement in the storage battery, but he remarked that the electric car of today has all the mileage it needs for city and suburban purposes.

Mr. Wilton Bentley, of the Universal Electric Storage Battery Company, Chicago, referring to the specific-gravity test of batteries, said that it requires considerable time and space. Mr. Lunn's point about the ampere-hour meter being a check on lazy drivers is an important one. The conscientious driver can increase the mileage of a vehicle by perhaps 100 per cent. No doubt the instrument can be locked in such a manner that it cannot be tampered with. It is not likely that anything except some mechanical defect will reduce the "capacity" of the battery between charges. If a battery has a certain "capacity" one day, it will have about the same the next day. Mr. Bentley believes in the usefulness of the ampere-hour meter.

Mr. Scott Van Etten, of Elkhart, Ind., said that the storage batteries in vehicles are abused and neglected. There is a tendency toward the gradual formation of white sulphate of lead, one of the several sulphates encountered in storage-battery work, and this produces a false specific gravity, which interferes with the usefulness of the hydrometer test. The ampere-hour meter has its limitations, but Mr. Van Etten believes that it will be a valuable adjunct to the electric rig.

Mr. Beck remarked that if the battery falls behind, the fact must show in the specific-gravity test. He should say that, for this purpose, a specific gravity test would be superior to the ampere-hour test.

Mr. J. F. Firestone, of the Columbus Buggy Company, Columbus, Ohio, said that in 9 times out of 10 trouble with electric vehicles is due to shortage of water in the batteries, as Mr. Beck intimated in his paper. At other times all that is needed is a little air in the tires. Many ladies watch the condition of their electric machines very carefully. It is the simple forms of neglect which cause the great majority of common troubles.

Mr. Newman thought that the difference in sulphates to which Mr. Van Etten alluded is probably the difference in crystallization. There can be no false specific gravity. The speaker explained the chemical action of the battery to substantiate this statement. The voltmeter furnishes the only way to show from an external source such mechanical injuries as broken jars, loose terminals, etc. It is not difficult to arrange a pilot cell for the hydrometer test, which is simple and requires little apparatus to complicate matters.

Mr. Van Etten said that when the average garage man gets a low gravity reading, he proceeds to flush his battery, which is usually a bad thing to do.

Mr. Lunn, speaking from practical experience with the ampere-hour meter gained by six months' use on 15 vehicles, said that he had yet to find the first case of trouble with this instrument, which has not proven in any way misleading. With its use vehicles never get stalled for lack of energy. The gravity test must not be neglected, but the ampere-hour meter is very useful.

Mr. Beck, in closing the storage-battery discussion, said that his position in regard to the ampere-hour meter was that of one who holds a middle ground. The instrument is a help, a step in the right direction, but it must not be thought that it

will take the place of everything else. The gravity test in reality is an ampere-hour reading, but the ampere-hour meter gives nearly the same information, and is very convenient. The speaker wanted to emphasize the fact that ammeters and voltmeters must not be taken off electric vehicles because the ampere-hour meter is used. The latter is a good thing, a decided help, but it does not furnish all the help which operators of electric vehicles should have.

OTHER PAPERS AND DISCUSSIONS.

After a brief discussion on Professor Carpenter's paper on the testing of the six-cylinder gasoline engine, Mr. Frank H. Floyd, of Detroit, read a paper on lubricating oils. One of his points of general interest was that large users should purchase their oils under specifications, to be followed by test, just as they do other materials.

"Energy Consumption of Commercial Vehicles" was the title of a short paper read by Mr. Alexander Churchward. This is a practical paper containing data showing that the horse-power required by a vehicle is influenced by a number of factors, the principal ones being tires, controlling apparatus, transmission losses, correct gear ratio, wheel diameter, springs, road resistance, grades, wind resistance, economic speed, stops, and acceleration. In discussing this paper Mr. Lunn said that Mr. Churchward's table of economic speeds is particularly valuable. It is not advisable to attempt to run a commercial vehicle ordinarily above its economic speed; speed mania ought not to influence commercial-vehicle operation. Mr. Newman gave some interesting information about tires, describing their composition and the methods of manufacture. He also spoke of the desirability of calculating a formula of power consumption for automobiles if this could be done. In closing the discussion on this paper, Mr. Churchward noted the comparatively great acceleration of the electric car compared with the gasoline car.

Mr. H. S. Baldwin's paper on "Electric Cradle Dynamometer" was read by Mr. Churchward in the absence of the author. This paper described the electric cradle dynamometer in which an electric generator is used for loading the gasoline engine under test. This dynamometer is of the absorption type, but the load is dissipated in a suitable rheostat at any desired distance from the dynamometer, which reaches only a moderate temperature. The apparatus was described particularly from the viewpoint of testing gasoline engines.

After some other discussion the convention was adjourned. The delegates were entertained at luncheon at the South Shore Country Club by the Woods Motor Vehicle Company and spent the afternoon in playing golf and indulging in other outdoor recreations.

New York Public Service Commission News.

The Public Service Commission of the First District of New York held a public hearing on Aug. 11 upon the application of the receivers of the Metropolitan Street Railway for permission to purchase 500 shares of the capital stock of the Bridge Operating Company from the receiver of the New York City Railway Company. The application set forth, that under the agreement between the city of New York, the Brooklyn surface lines and the New York City Railway, the city should construct the surface tracks across the Williamsburg bridge, that the Manhattan company should operate the northerly part of the tracks for a 5-cent fare, that the Brooklyn companies should operate over the southerly tracks for a 5-cent fare and the Bridge Operating Company should operate local cars for a 3-cent fare. The receiver of the New York City company, being without operating facilities, desires to sell his interest in the local operating company to the Metropolitan, which has equipment. No decision has been rendered as yet upon the question.

An order has been adopted by the Public Service Commission authorizing the Spuyten Duyvil & Port Morris Railroad Company to assume the bonds to be issued by the New York Central to the amount of $2,500,000, bearing interest at 3½ per cent. The commission also approved an application of the Spuyten Duyvil road permitting it to issue a mortgage of $20,000,000 upon its property.

The commission has set a hearing for Sept. 8 upon the question whether extension of the proposed rapid transit line from Buffalo Avenue to New Lotis Avenue on Eastern Parkway, in Brooklyn, shall be constructed under the plan of assessments upon the area benefited as authorized by the Travis-Robinson bill.

The commission has held a public hearing during the past week for the purpose of determining the character, extent and value of the property of the Third Avenue Railroad Company. This hearing is a preliminary step in the consideration of the reorganization plan of the Third Avenue Company which has been proposed by Receiver Whittridge.

Frederick W. Whittridge, receiver for the Third Avenue Railroad Company, has applied to the Public Service Commission for a franchise over the Queensboro Bridge. The route will start from Fifty-seventh Street and Third Avenue and cross the bridge to Jackson Avenue in Long Island City. It is proposed to issue free transfers from the Third Avenue line.

It is announced by the Public Service Commission that plans are being prepared for approval by the Board of Estimate, of an addition to the Broadway-Lexington Avenue subway route which will provide for a west side line to form a connection with the new Pennsylvania Railroad terminal at Thirty-third Street and Seventh Avenue.

The Public Service Commission, Second District, gave a hearing at Albany, Aug. 10, on the application of the Geneva-Seneca Electric Company for authority to execute a mortgage for $500,000 and to issue at present $360,000 in 5 per cent bonds.

On Aug. 11 the commission gave a hearing to the reorganization committee for the approval of a plan for the reorganization of the Albany & Hudson Railway Company, and the issue of stocks and bonds of a company to be formed on this plan.

On Aug. 12 the petition of the Plattsburg Light, Heat & Power Company and the Lozier Light & Power Company for consent to merger and consolidate will be given a hearing.

The commission has authorized the Lewiston & Youngstown Frontier Railway Company to construct an extension of its railroad in Oneida Street in the village of Leiston.

CURRENT NEWS AND NOTES.

RADIUM ON THE FREE LIST.—The new tariff law especially mentions radium as one of the articles placed upon the free list. There was no mention of radium in the Dingley bill, as it was unknown at the time that law was approved.

EMERGENCY LIGHTING AT BARCELONA, SPAIN.—During the recent rioting at Barcelona, the gas and electric lighting plants being out of commission, the city was lighted by means of the search lanterns on the warships in the harbor.

COMPLETION OF NEW TRANSATLANTIC CABLE.—The Commercial Cable Companies has completed the laying of its new cable from St. John's, N. F., to New York. The landing has been made at Manhattan Beach and the line is now in service. The new line to Newfoundland is 1307 miles long and the line across the ocean taps the main line 270 miles east of St. Johns. It is claimed that the new line will vastly increase the speed of transmission.

BALLOONS STOP TROLLEYS.—An item from St. Louis of Aug. 9 says: "The East St. Louis & Suburban Railway Company has declared war on balloons. Several of the company's cars have been tied up because guide ropes trailing to the ground from balloons became entangled with trolley wires and put the cars out of business temporarily. The company will hold the balloonists responsible for damages and time lost when the air craft tie up trolley cars."

A NEW TARIFF.—The Payne tariff bill was agreed to by the United States Senate on Aug. 5, and became law the same day, President Taft signing it and making a brief statement in support of its right to be regarded as "revision downward." A summary of the various portions affecting the electrical industry appeared last week in our Aug. 5 issue.

ELECTRIC VEHICLE EXPERTING.—The Edison Electric Illuminating Company, of Brooklyn, N. Y., has started a new campaign to develop the electric vehicle field and to increase its vehicle "load." It has secured the services of an expert battery and vehicle engineer and letters have been written to every electric vehicle user in Brooklyn offering them his advice free of charge.

PENNSYLVANIA ELECTRIC ASSOCIATION.—The Pennsylvania Electric Association will hold its second annual convention at Eagle's Mere on Sept. 8, 9 and 10. An interesting program is being provided by Mr. J. H. Perkins, chairman of the program committee, who states that a very large attendance is expected.

CONNECTICUT UTILITIES BILL.—The Connecticut House of Representatives has voted against the Chandler Public Utilities Commission bill, which the Senate had rejected in favor of the majority report known as the Barnum bill. The Barnum bill provides for a commission of three to supervise gas, electric and telephone companies, while the Chandler bill calls for supervision of all public-service corporations, including the New York, New Haven & Hartford Railroad.

LOST RADIUM PACKAGE.—Dispatches from Paris state that the city is excited over one of the most curious cases of loss ever known. A gentleman left on a seat in an omnibus a tiny package valued at $5,000. The peculiarity of the package is that it is a tube containing salts of radium. No infernal machine was ever so frantically sought as this tiny tube by the Paris police. All the omnibuses were searched and swept, and urgent warnings were posted in public places.

WIRELESS RATES.—In connection with the recent completion of a wireless telegraph station at the port of Willemstad, Island of Curacao, it has been announced that the following rates will be charged: From 1 to 10 words, 40 cents; for every additional word, 4 cents; delivery of message in Willemstad, 10 cents; delivery on board of a vessel not moored alongside the quay of Willemstad, 20 cents. These charges are collected from the sender or receiver of the message on land while the ship rates charged on board of the vessel are paid by the sender or receiver on board.

ELECTRICALLY OPERATED DRAINAGE CANAL BRIDGES.—The Sanitary District of Chicago will operate by electricity the Western Avenue and eight-track bridges across the main channel of the Drainage Canal near Thirty-first Street. Use will be made of a rotary converter capable of delivering 100-kw, direct current, at 550 volts. The electricity furnished to the alternating-current side of the machine will be 60-cycle, three-phase, at the required voltage. A two-panel marble switchboard, with starting controller, circuit-breaker, rheostat, instruments and switches, will also be installed.

RESTRICTION ON POWER DEVELOPMENT.—Attorney-General Mullen, of Wyoming, has brought suit for the State against the Big Horn Power Company, asking the removal of part of the dam in the Big Horn Canyon. The dam is claimed to exceed the specifications approved by the State engineer, by the erection of a bridge and buttresses above the 35-ft. dam. The Burlington Railroad is the principal complainant on the ground that the additional structure blocks its new construction for three miles along the canyon. An injunction will be sought restraining the power company from closing the gates.

CIVIL SERVICE EXAMINATION FOR POWER PLANT ENGINEER.—The Navy Department announces an examination of applicants at the Federal Building, Chicago, Aug. 24, for the purpose of filling the positions of engineer in charge of power plant, at $5.04 per diem, and assistant engineer, at $4 per diem, at the United States Naval Station, Great Lakes, North Chicago, Ill. Detailed information concerning the examination is contained in Examination Order No. 34, a copy of which can be obtained from the Commandant, Naval Training Station, Great Lakes, North Chicago, Ill.

SOUTH AMERICAN EXPOSITIONS.—The railway exposition at Buenos Ayres in commemoration of the centenary of independence of the Republic will offer, it is said, unusual opportunities for American manufacturers of railway material and machinery of all kinds, and the date for receiving applications has been extended until Sept. 1. The proposed exposition at Santiago, Chile, this year has been postponed until the spring of 1910, and Consul A. A. Winslow, of Valparaiso, writes that it will be of great value to American interests, the field including electrical and industrial apparatus of all kinds.

WIRELESS INSURANCE.—It is reported from Berlin, Germany, that steamship companies using wireless apparatus on their vessels will apply for lower insurance rates. A proposition to this effect will be presented to the international marine insurance congress at Baden-Baden beginning Sept. 8. It will be supported, it is understood, by President Arthur Dunker, head of the North German Marine Insurance Society, and by representatives of various foreign organizations. The adoption of this plan, it is urged, will result in extending the use of the wireless system aboard ship throughout the world and in a consequent reduction of the number of accidents.

THE DINNER TO EDISON.—The annual convention of the Association of Edison Illuminating Companies will be held at Briarcliff, N. Y., Aug. 31 to Sept. 3, inclusive, under the presidency of Mr. W. W. Freeman, of Brooklyn, N. Y. One of the distinguishing features will be a dinner given in honor of Mr. and Mrs. Thomas A. Edison on Thursday evening, Sept. 2. On this occasion the association will entertain the guests of honor, who will meet the members of the association and guests composed mainly of those who were pioneers in the Edison electric-lighting industry in the early eighties. The committee in charge of the arrangements for the Edison dinner consists of Mr. Samuel Insull, of Chicago, chairman; Mr. Charles L. Edgar, of Boston, and Mr. John W. Lieb, Jr., of New York. The convention already promises to be one of the largest ever held by the association, and it is an interesting coincidence that it is alike the thirtieth convention and the thirtieth annivery of the Edison lamp of 1879.

CONSERVATION CONGRESS.—A very large attendance is expected at the first National Conservation Congress, which is to be held at the Seattle Exposition, Aug. 26, 27 and 28. The delegates will include United States Senators and Representatives, Cabinet officers, the Governors of many States, members of 40 State Conservation Commissions, mayors of cities, and delegates from commercial and civic organizations. Delegates are coming from Alaska and the Hawaiian Islands. Prof. Ralph S. Hosmer, of the Hawaiian Conservation Commission and Gov. W. T. Freer are among those who have promised to attend. West Point will be represented by Gen. Marion P. Maus, commanding the Department of the Columbia. Addresses will be made by R. A. Ballinger, Secretary of the Interior; Gifford Pinchot, chairman of the Joint Committee on Conservation Between States and Nation; W. K. Kavanaugh, of the Lakes-to-the-Gulf Deep Waterways Association; James Arbuckle, secretary of the Latin-American and Foreign Trade Association, and Howard Elliott, president of the Northern Pacific Railway Company. The conservation movement will perfect a permanent organization at the Seattle Congress. It will also select representatives to attend the World's Conservation Conference at The Hague.

A ROUNDABOUT ALARM OF FIRE.—An alarm of fire from the northern part of Edwardsville, Ill., was sent over 200 miles recently and returned to a point 10 blocks away in three minutes. A crew in a tower of the Wabash Railroad at Edwardsville Junction reported to the agent at the station that a car of coal had caught fire. There is no telephone in the yard station, so the agent notified the superintendent's office at Decatur, 100 miles away, by wire. The dispatcher called Poag, the nearest station to Edwardsville which has a long-distance telephone. The Poag operator notified the exchange at Edwardsville and the operator there rung the alarm in the engine house. Three minutes from the time the fire was reported the apparatus was on its way.

GASOLINE-ELECTRIC CAR IN CHICAGO.—Considerable attention was attracted on Aug. 2, among railroad and electrical men in Chicago, by a gasoline-electric passenger car of the latest type developed by the General Electric Company. This car was on exhibition at the passenger station of the Chicago, Rock Island & Pacific Railway Company, of Chicago, and has seen actual service on the Southern Railway, between Manassas and Strasburg, Va. These places are 63 miles apart, and for 20 days the car made a round trip daily. The Atchison, Topeka & Sante Fé Railway Company is testing a similar car of the same make. Both cars have made trial trips around Chicago. A complete description of the car and its equipment appeared in the May 27 issue.

ELECTRICITY FOR IRRIGATION.—The United States Sugar & Land Company, of Garden City, Kan., has contracted with the farmers about Portales, Roosevelt County, N. M., to install a steam-engine generating plant at Portales which will furnish energy to centrifugal pumps for irrigation throughout the district. Between 10,000 and 12,000 acres are to be irrigated by pumping from an underflow which is close to the surface. The land is in the artesian belt in the eastern portion of New Mexico, where the artesian level is below the surface of the ground. Hundreds of farmers have signed the contracts, considerably exceeding the minimum area of 6000 acres required by the company before proceeding with the construction. Use will be made of New Mexico coal as a fuel.

THE CLEVELAND TROLLEYS.—By a very decisive vote, the people of Cleveland, headed by a committee of 100 leading citizens, have rejected the Johnson plan under which there would be a 3-cent carfare and a gradual absorption of the franchises of the Cleveland Railway Company. It is now most probable that the plan of Federal Judge Tayler for a careful revaluation of the properties with a 3-cent fare, and 1 cent for a transfer, will be adopted, it being provided that if the dividend or the valuation falls below 6 per cent, the rate of fare may be raised to 25 cents for seven tickets. Before the Johnson-Schmidt scheme, now defeated, was put forward, an attempt was made to pass such a Tayler ordinance, but it failed. There is now more likelihood of success, as the public wants the question settled and taken out of politics.

RENDERING WIRELESS SIGNALS SELECTIVELY AUDIBLE.—A patent granted to Mr. J. H. Cuntz, on July 13, describes a method by which selectivity in wireless telegraphy can be obtained by the use of acoustic instruments. By means of a mechanical interrupter in the sending circuits, with which a tuning-fork is magnetically associated, the high-frequency wireless telegraph current is interrupted throughout each signal period at a definite rate corresponding to the pitch of the tuning-fork. A tuning-fork magnetically associated with the receiving circuits gives forth an audible sound when the wireless signals are interrupted at the rate corresponding to its pitch. Hence, the selectivity depends solely on the vibrational periods of the tuning-forks at the sending and receiving stations, the signals being heard only when the forks at the two stations have equal pitches.

FRENCH LETTER REGISTRY.—The United States Postoffice is considering plans for overcoming the deficiency in the expenses of registering letters. The fee is now 8 cents. Meantime advices from Paris state that the French Government has just introduced into use an ingenious automatic device for registering letters. The letter is dropped into a box, and a nickel piece, purchasable for 5 cents, placed in the slot. The crank is turned, a numbered receipt falls out, and the corresponding number is stamped on the letter. The ingenious feature of the machine is the device for preventing the use of any except the nickel coin. This is accomplished by means of a magnet. The slight attraction of the nickel is neatly calculated, and as the coin falls the attraction is just sufficient to retard it and make it fall into the pocket which operates the mechanism. An iron piece would be strongly attracted, miss the pocket and be ejected. All other coins also are ejected.

SPLIT-PHASE MOTOR.—A method of obtaining two windings of different inductive time-constants for use with a single-phase induction motor as a split-phase machine is described in a patent recently issued to Mr. S. R. Bergman. The stator is arranged with open slots, the main winding being placed in certain of the slots and the starting winding in the remaining slots. Magnetic wedges are employed to close the slots occupied by the main winding, and non-magnetic wedges for the slots containing the starting winding. Since the starting winding is wound with smaller wire than the main winding and is placed in the tops of the slots, the bottoms of the slots being filled with pieces of wood or other non-magnetic material, thereby decreasing the reactance of the starting winding, by this arrangement the main winding is of high reactance and low resistance, while the starting winding is of low reactance and high resistance, and yet the slots of the stator are of uniform size and equally spaced.

MONT BLANC ELECTRIC ROAD.—The electric railway up Mont Blanc was started on Sunday, July 25, and the first section is now open to the public, which is now able to ascend to the Col de Voza, 5495 ft. high. The first train up took an hour to accomplish the journey of about four and one-half miles. There are no tunnels, and the steepest grade is 20 ft. in the 100. Some magnificent views of Alpine scenery can be had from the cars. Having accomplished the first stage of the journey up Mont Blanc, the plan is to continue along the ridge of the Col de Voza, tunneling through first the Aiguille and then the Dôme du Goûter, coming out by the Observatoire Vallot. From there a tunnel will have to be made right underneath the Bosses du Dromadaire, into the heart of Mont Blanc, and then the summit is to be reached, as in the case of the Jungfrau, by means of a lift. This is the plan for the continuation of the line, and it has even been calculated that the cost of the return ticket is to be $20.

OUTING OF CONSTRUCTION DEPARTMENT OF COMMONWEALTH EDISON COMPANY.—About a thousand persons, including women and children, attended the annual outing of the construction department of the Commonwealth Edison Company, of Chicago, at Glenwood Park, Batavia, Ill., on the afternoon of July 31. The merrymakers, who proceeded to the park on the Aurora, Elgin & Chicago Electric Railway, filled 15 large cars. The feature of the afternoon was a baseball game between nines representing the station construction men and the interior wiring force for a prize of $10. This was an exciting game and was won by the station construction players after a seven-inning contest by the score of 11 to 10. The feature of the game was the prowess of Mr. A. C. Jantzen, who made two home runs and a three-base hit for the station construction team. There were foot races for the married ladies, the single ladies, the married men, the single men, the girls and the boys, and in the evening there was dancing in the pavilion. The outing was thoroughly enjoyed. Its success was largely due to the efforts of a committee of arrangements consisting of Messrs. H. C. Patterson, chairman; J. C. Manley, E. H. Lakeman and C. B. Crothers.

The Transmission and Distribution Systems of the Rio de Janeiro Tramway, Light & Power Company.

By L. L. Perry.

THE 51-mile transmission system of the Rio de Janeiro Tramway, Light & Power Company receives three-phase, 50-cycle current at 88,000 volts from the power plant described in the *Electrical World* of May 13. There are two steel-tower lines, each carrying two circuits of a normal capacity of 9000 hp delivered at Rio de Janeiro. Each circuit has an emergency capacity of 18,000 hp. A private right-



FIG. 1.—TERMINAL STATION IN RIO DE JANEIRO.

of-way, usually 328 ft. (100 m) wide, was acquired. This leaves space for additional tower lines when the present supply of energy becomes inadequate, and allows for ample clearing of the tropical forest, which at many points is heavy. This right-of-way begins at the power house in exceedingly rough country, which extends for 10 miles (15 km); then traverses 25 miles (41 km) of very flat country, and approaches Rio de Janeiro through 16 miles (25 km) of granite mountains, where line con-

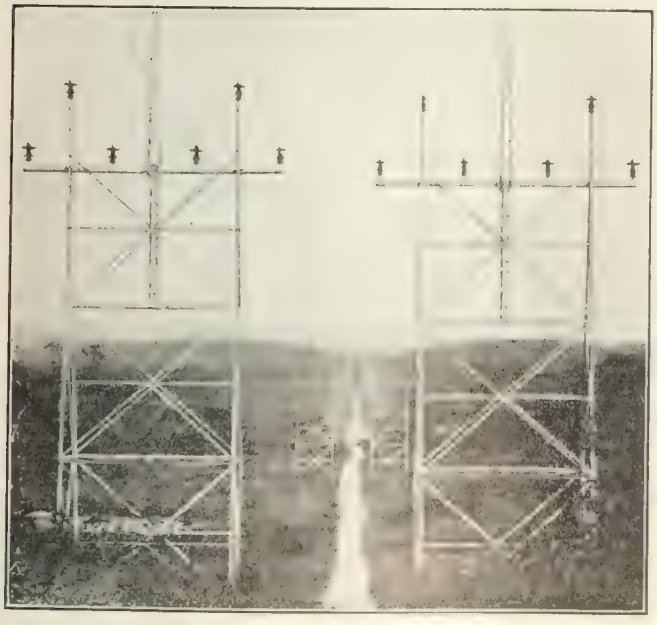


FIG. 2.—TRANSMISSION LINES IN FLAT COUNTRY.

struction is difficult and expensive. In such country tower construction is of great advantage, even though the cost of erection is heavy.

A tower 45 ft. from ground line to lower wire is the standard, with a standard span of 600 ft. (180 m) and a sag of 20 ft. (6.1 m). In view of the long distance from the base of supplies necessitating the placing of orders for tower material long in advance of the final surveys, the following towers were adopted to meet the general conditions:

Style Number.	Height.	Purpose.	Remarks.
1	45 ft.	Standard.	
1a	51 ft.	Standard.	No. 1, with 6-ft. Extension
1b	54 ft.	Standard.	No. 1, with 9-ft. Extension
1c	60 ft.	Standard.	No. 1, with 15-ft. Extension
2	45 ft.	Long span.	
2a	60 ft.	Long span.	No. 2, with 15-ft. Extension
3	45 ft.	Angles 0° to 30°.	
3a	60 ft.	Angles 0° to 30°.	No. 3, with 15-ft. Extension
4	45 ft.	Angles 30° to 60°.	
4a	60 ft.	Angles 30° to 60°.	No. 4, with 15-ft. Extension

Except for the terminal towers practically no towers were designed for special locations.



FIG. 3.—TRANSMISSION LINES IN ROUGH COUNTRY.

A triple-part Thomas porcelain insulator, 17½ in. (445 mm) in diameter and 19¾ in. (504 mm) high is used. This was tested in parts, cemented at the factory and shipped in crates containing two insulators each. The conductor is a stranded-copper cable of six wires on a hemp center, with a copper section equivalent to No. 3-0 B. & S. (85 sq. mm). The longest span is 1935 ft. (590 m). A ⅝-in. galvanized Siemens-Martin steel cable is used as a lightning-arrester wire, and, while not a complete protection to the insulators, appears to be of great value.

There are five sets of switch-towers, making six sections of line, and four patrol houses are maintained, with a patrolling force of one foreman and four patrolmen. There are five complete transposition spirals. While no intermediate lightning-

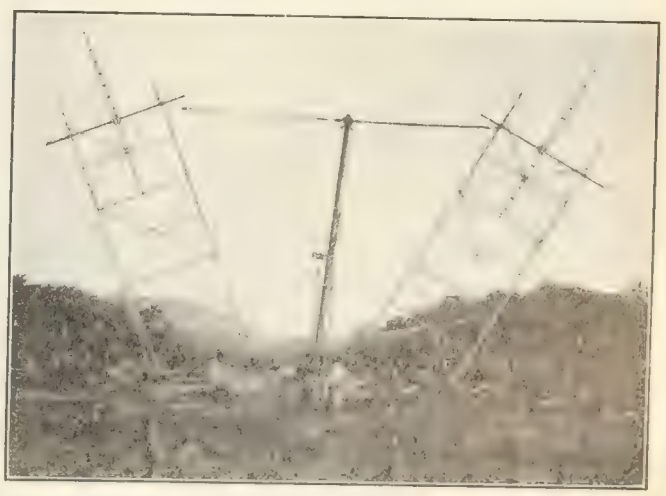


FIG. 4.—METHOD OF RAISING TOWERS FOR TRANSMISSION LINES.

arrester stations were originally planned, experience has shown that they are desirable and they have been installed. In addition to the station arresters, horn arresters have been connected at the power-house end of the line. At the two ends of the route, where the line follows along the side hills with higher

ground projecting above the line, whether rocky or not, there is but slight puncturing of insulators from lightning; but in the flat country, where the line runs for miles just above sea level, the very frequent tropical thunderstorms occasionally give trouble. Often storms of great severity give no trouble.

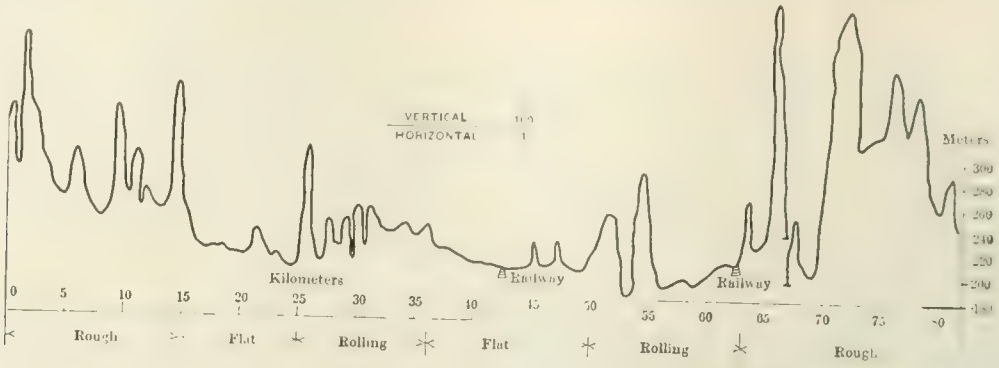


FIG. 5.—PROFILE OF RIO DE JANEIRO TRANSMISSION LINE.

It is to be noted that the climate is particularly adapted to tower construction, for the annual variation in temperature usually does not exceed 40 deg. Fahr. (22 deg. C.), and consequently there is little variation in the sag. There is no sleet and high winds are uncommon.

Two telephone circuits are maintained; one, tapped for the patrol stations, is carried on one tower line; the other is a through line and is carried on light tubular poles. Normally the two lines are as quiet as any 50-mile line, but the one on the tower line is useful in giving prompt notice of any defective insulator on the power circuits. Both lines are of No. 10 B. W. G., BB galvanized iron wire.

TERMINAL STATION.

The transmission system ends at the terminal station, located one mile from the center of Rio de Janeiro. Owing to the high hills surrounding the city it was possible to carry the high-tension lines into the city over a private right-of-way. The terminal station is a steel-frame brick structure on pile foundations. The length over all is 240 ft. (73.2 m), the width is 117 ft. (35.7 m) and the height from basement floor to eaves is 71 ft. (21.7 m). The arrangement of the entering lines, and, indeed, the entire high-tension arrangement of the terminal station, is practically the same as that of the power house. The four lines enter the back of the station; each can be connected to either of two sets of high-tension busbars, and the sectionalizing of the high-tension busbars is carried on in the same manner as in the power house. All the high-tension and low-tension wiring is in masonry compartments.

There are two groups of step-down transformers corresponding to the two groups of step-up transformers in the power house. Each group consists of two banks to step-down from 80,000 volts to 6300 volts, three-phase, and of one bank from 80,000 volts to 23,000 volts, three-phase. Each bank comprises three 1700-kw. single-phase transformers to form a unit of the same size as the generating units of the power house, and the customary oil-insulated, water-cooled transformers are used. The step-down transformers are located in masonry pockets under a crane runway, as in the power house; the low-tension bus structure is located in their rear; above this is the operating floor, and above this the high-tension switches and buses.

This station supplies 6300-volt feeders for general lighting and power work, supplies large energy consumers at 6300 volts, converts current by synchronous motor-generators into 575-volt direct current, and supplies constant-current arc circuits through tub transformers. Current at 23,000 volts can be supplied for suburban service. A gas-engine reserve plant of four 1000-kw alternating-current generators driven by gas engines will be installed in the terminal station. Consequently a flexible bus system was chosen for the 6300-volt cir-

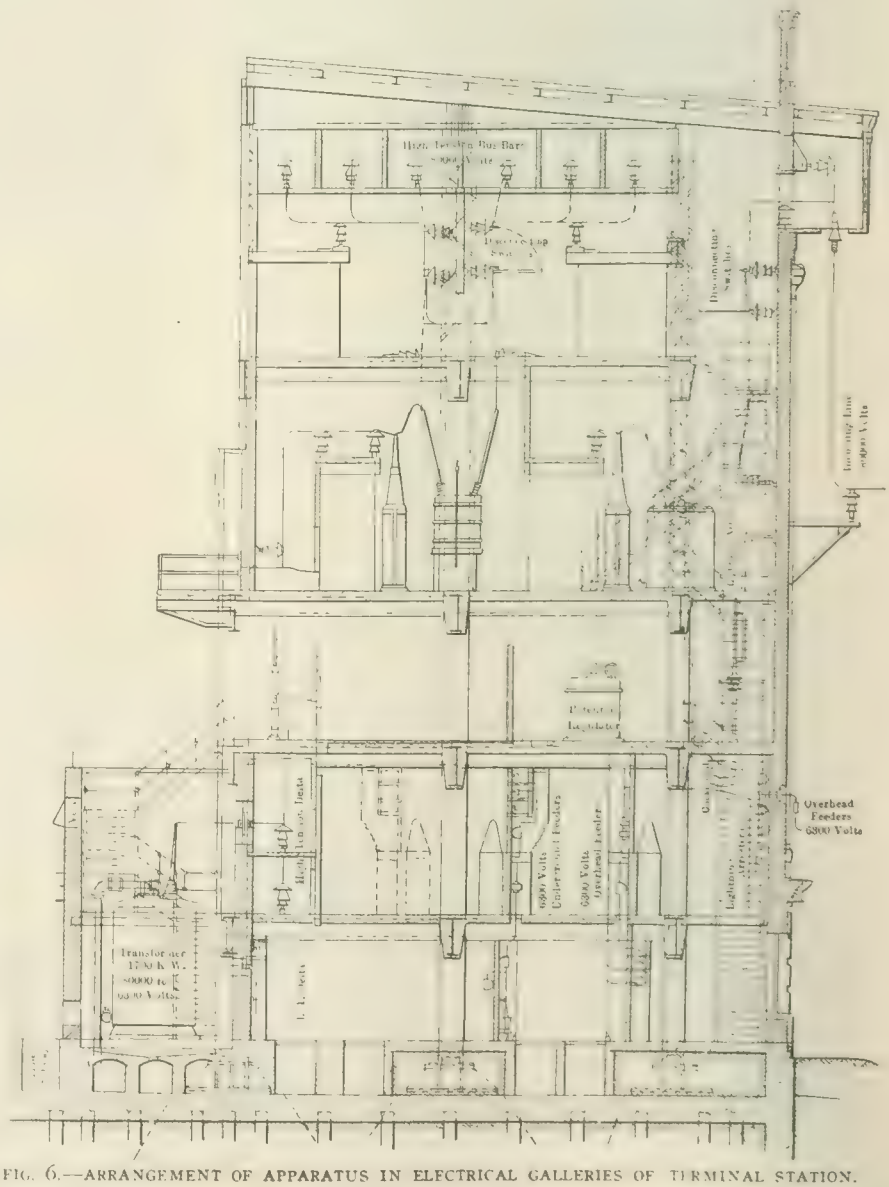


FIG. 6.—ARRANGEMENT OF APPARATUS IN ELECTRICAL GALLERIES OF TERMINAL STATION.

cuits. Duplicate buses are provided throughout, and the important feeders are carried out in two groups, each group from a separate section of the bus.

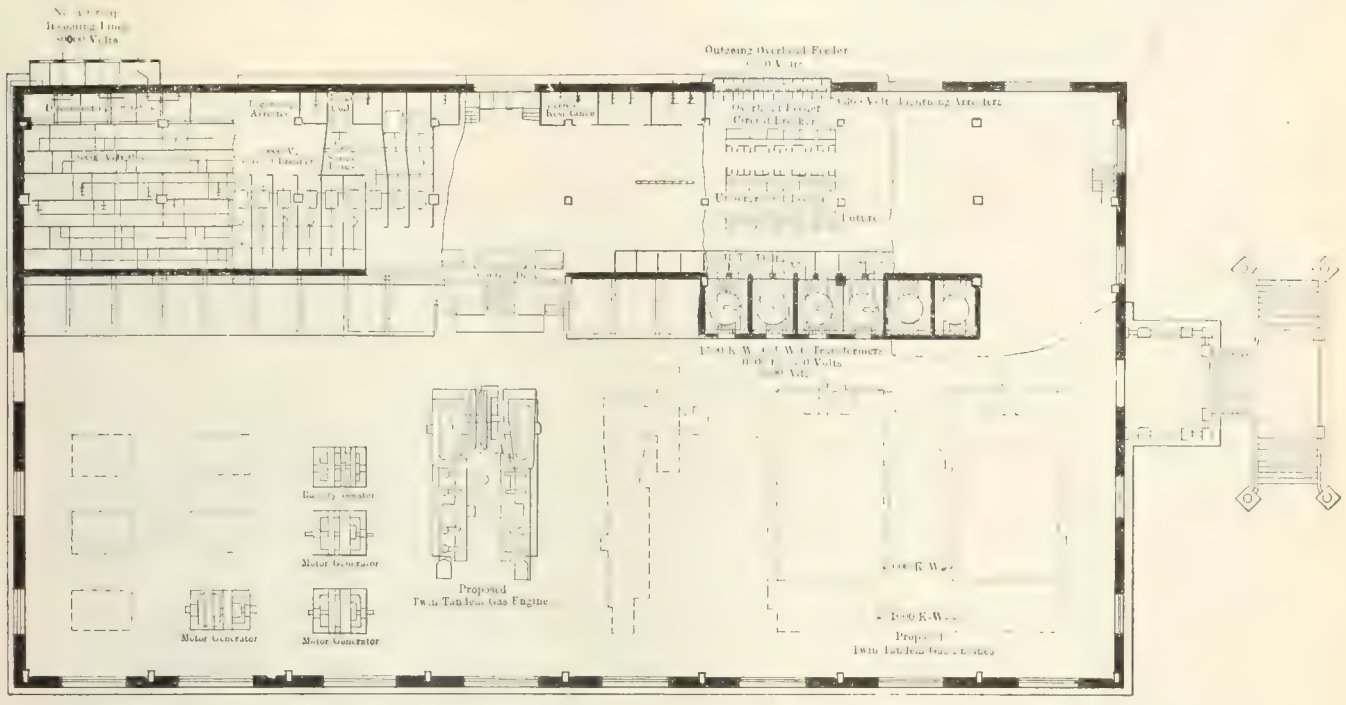


FIG. 7.—PLAN VIEW OF TERMINAL STATION IN RIO DE JANEIRO.

The 6300-volt, three-phase current is converted into 575-volt direct current by five 800-kw synchronous motor-generator sets each consisting of a 1200-hp motor driving an interpolar, compound-wound generator, running at 500 r.p.m. The synchronous motor generators are designed to run at 60 per cent leading power factor in order to bring up the power factor of the entire system. Three of these sets were made by the Westinghouse Electric & Manufacturing Company and two by the General Electric Company. In parallel with the motor generators is a storage battery of the Electric Storage Battery Company's make, with booster and automatic regulation so arranged as to keep the load on the motor generators constant. It has a net discharge capacity of 1000 kw for one hour. It is located in a separate building. The transformers and the entire switchboard except for the battery were supplied by the Westinghouse Electric & Manufacturing Company.

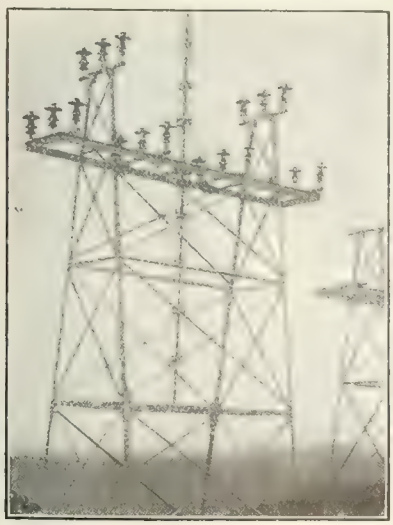


FIG. 8.—TOWER FOR LONG SPANS.

The company now supplies 587 7½-amp, series-enclosed, alternating arc lamps for street illumination. These are fed from 100-light, two-circuit tub transformers, and those on the constant-potential side are connected in pairs through a two-phase-three-phase connection to the three-phase arc buses. A pair of group circuit-breakers on these three-phase arc buses allows the entire arc system to be transferred from one main set of buses to the other.

Both underground and overhead lighting and power service are supplied at 6300 volts. The underground feeders are divided into two groups of six 500-kw feeders, each group having a pair of circuit-breakers permitting the group to be connected to either set of main buses. Inserted in each group connection is a water-cooled, oil-insulated, three-phase, automatic potential regulator, allowing a variation up or down of 5 per cent. As the voltage of these underground feeders is high relative to their length, only a small drop will occur, and the difference between the drops of these feeders is expected to be small. The



FIG. 9.—OVERHEAD CIRCUITS IN RIO DE JANEIRO.

overhead feeders are likewise divided into two groups of six feeders each. The rating of these feeders varies from 1000 kw to 5000 kw, and as their length varies and the drops are relatively high, each overhead feeder has its individual regulator of the automatic type, with a raise or lower of 7½ per cent. The reserve plant will be fed from the lighting mains of the gas department of the company.

Provision is also made for 6300-volt, three-phase feeders to supply power to motor-generator substations now under construction to furnish direct current for distant parts of the trolley system, particularly that of the Jardin Botanico Company, of which control was recently acquired. To supply this last 2000-kw motor-generator sets will be used.

DISTRIBUTION SYSTEM.

The general scheme of distribution comprises a duct system for the 6300-volt, lead-covered, paper-insulated, three-phase primary feeders and mains, and a secondary four-wire, three-phase, armored cable distribution with 120 volts at the lamps and 208 volts across outside wires for motors. The neutral of the secondary circuits is grounded.

Fifteen distributing centers were chosen to which eventually a separate feeder will lead from the terminal station. On account of many narrow streets and other local conditions, it was found best to locate these centers in underground vaults in the streets. The distributing center is also a transformer vault, and from it are carried primary mains to the various subway transformers located in vaults. As there is always a possibility of flooding these vaults at times of tropical rains, all apparatus is waterproof. The illustrations show the arrangement and an interior

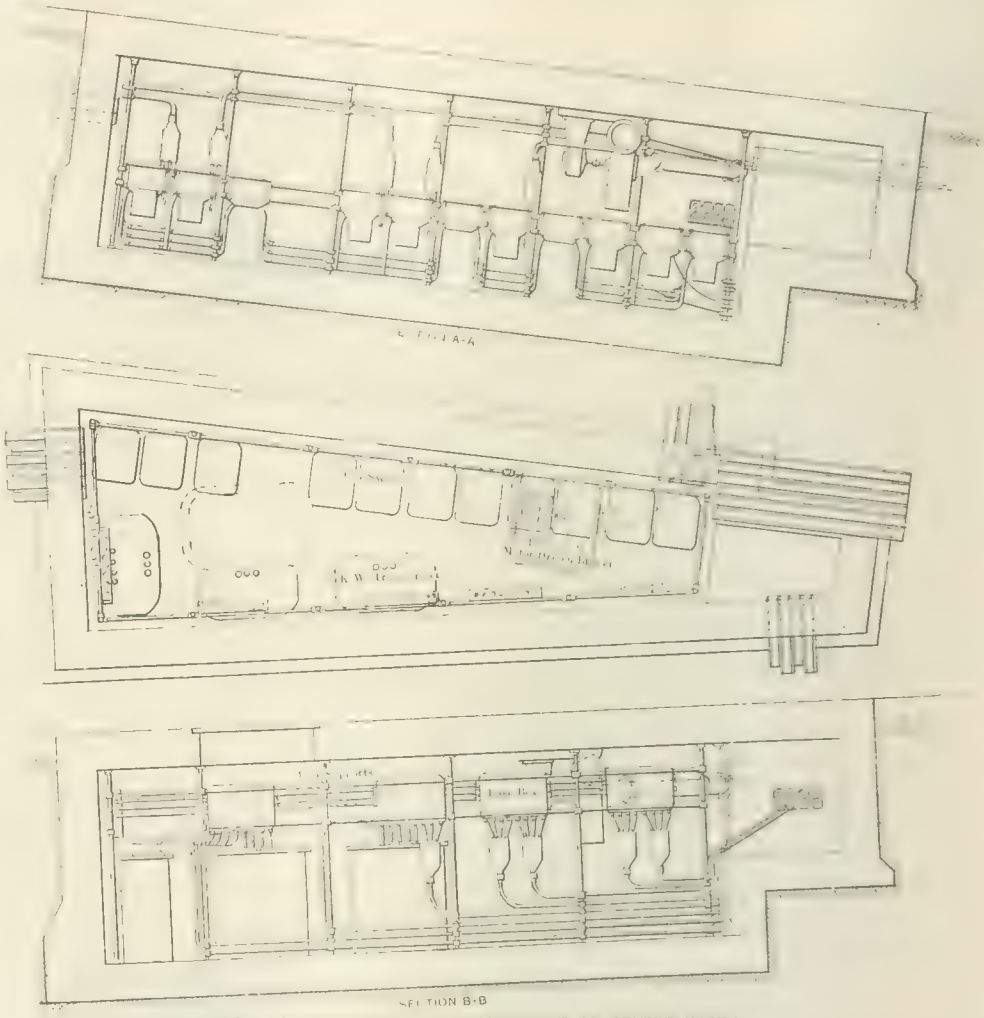


FIG. 10.—ELECTRICAL ARRANGEMENT OF STREET VAULT.



FIG. 11.—APPARATUS IN STREET VAULT.

view of a vault. Three-phase transformers of 40 kw or 80 kw are used, with a 6000-volt primary, and a secondary of 216.5-volt star, 125 volts to neutral. Each transformer is protected by an automatic oil circuit-breaker on the high-tension side and by fuses on the low tension. As all the secondary cables connected to one high-tension feeder are tied into a secondary network, it was considered necessary to provide a ready means of controlling all oil circuit-breakers, those controlling the mains as well as those controlling the transformers; consequently they are made distant control, are actuated through 500-volt solenoids, and can be opened or closed from one central-control point. These circuit-breakers were made by the Westinghouse Electric & Manufacturing Company. All 6300-volt feeders have a section of 97,400 circ. mil (50 sq. mm), and usually the mains are of 48,700 circ. mil (25 sq. mm).

Each transformer is protected on the low-tension side by a water-tight fuse box with cartridge fuses, made by the D & W Fuse Company. Each main is protected by the same type of

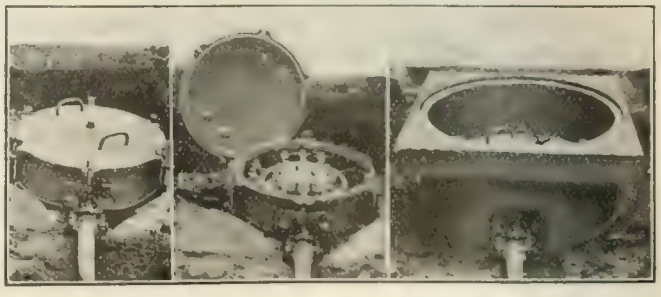


FIG. 12.—LOW-TENSION DISTRIBUTION BOX.

fuses. The low-tension mains are usually strap-armored cable laid in trenches, but in some important streets, where the load conditions are very uncertain, plain cable in ducts has been

used. The sections vary from 69,000 circ. mil (35 sq. mm) to 296,000 circ. mil (150 sq. mm). At street corners the usual type of distribution box is employed. The section of the neutral conductor is one-half that of the outer wires.

Overhead feeders for motor circuits are of 250,000 circ. mil (128 sq. mm). On account of the rapid deterioration and high cost of wood, steel poles and cross-arms are used, with Thomas porcelain insulators and wrought-steel pins. Since one of the existing electric tramways purchased by the company had in use the harp or bow trolley, this has been adopted as standard, especially as grades are, as a rule, light and but few heavy cars will be used. A special section of trolley has been adopted, as shown in the cut. For the track, standard gage, 4 ft. 8½ in. (144 cm), is used, and either 6-in. T-rail on ties or 7-in. girder on ties is used, with continuous or Weber joints.



FIG. 13.—SECTION OF TROLLEY WIRE.

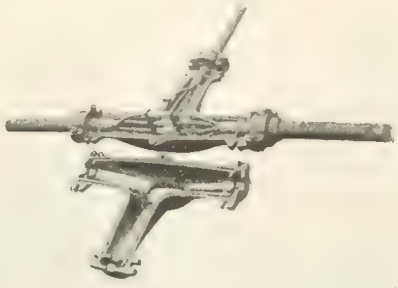


FIG. 14.—LOW-TENSION BRANCH BLOCK.

The transmission, distribution and tramway systems were started under the management of Mr. James Mitchell, and have been built under the management of Mr. F. A. Hountress, with the president of the company, Dr. F. S. Pearson, as consulting engineer.

5000-kw Exhaust-Steam Turbine in Interborough Power House.

The Interborough Rapid Transit Company of New York City has just placed in operation in its subway division power house at Fifty-ninth Street and Eleventh Avenue, a 5000-kw Curtis exhaust-steam turbine on whose performance hinges the immediate installation of two others of the same size and the ultimate doubling of the station output by this means. It is certain from the results already attained by this triple-expansion combination that the highest economy is obtainable and that new life is given to reciprocating engines. It is recognized, and has been for years, that a reciprocating steam engine is only able to take partial advantage of the complete expansion of steam. Multiple expansion engines utilize the steam under good conditions in the high-pressure cylinder, for as these cylinders are relatively small, the friction and radiation losses are low and expansion can be employed up to the carrying capacity of the connecting pipe to the next cylinder. In order to obtain complete expansion in the low-pressure cylinder, however, the dimensions would have to be such as to make the proposition commercially as well as mechanically impossible. A steam turbine, on the other hand, can utilize low-pressure steam to much greater advantage. Thus in the combination of reciprocating engine and low-pressure turbine, each unit is worked at its most efficient range.

The Interborough power house contains at the present time nine Allis-Chalmers combined double-horizontal and vertical engines having a nominal rating of 7500 ihp, and three Westinghouse-Parsons turbines rated at 1250 kw. The low-pressure turbine is located between the first and second engines and the relative size of both units is well shown in the engravings.

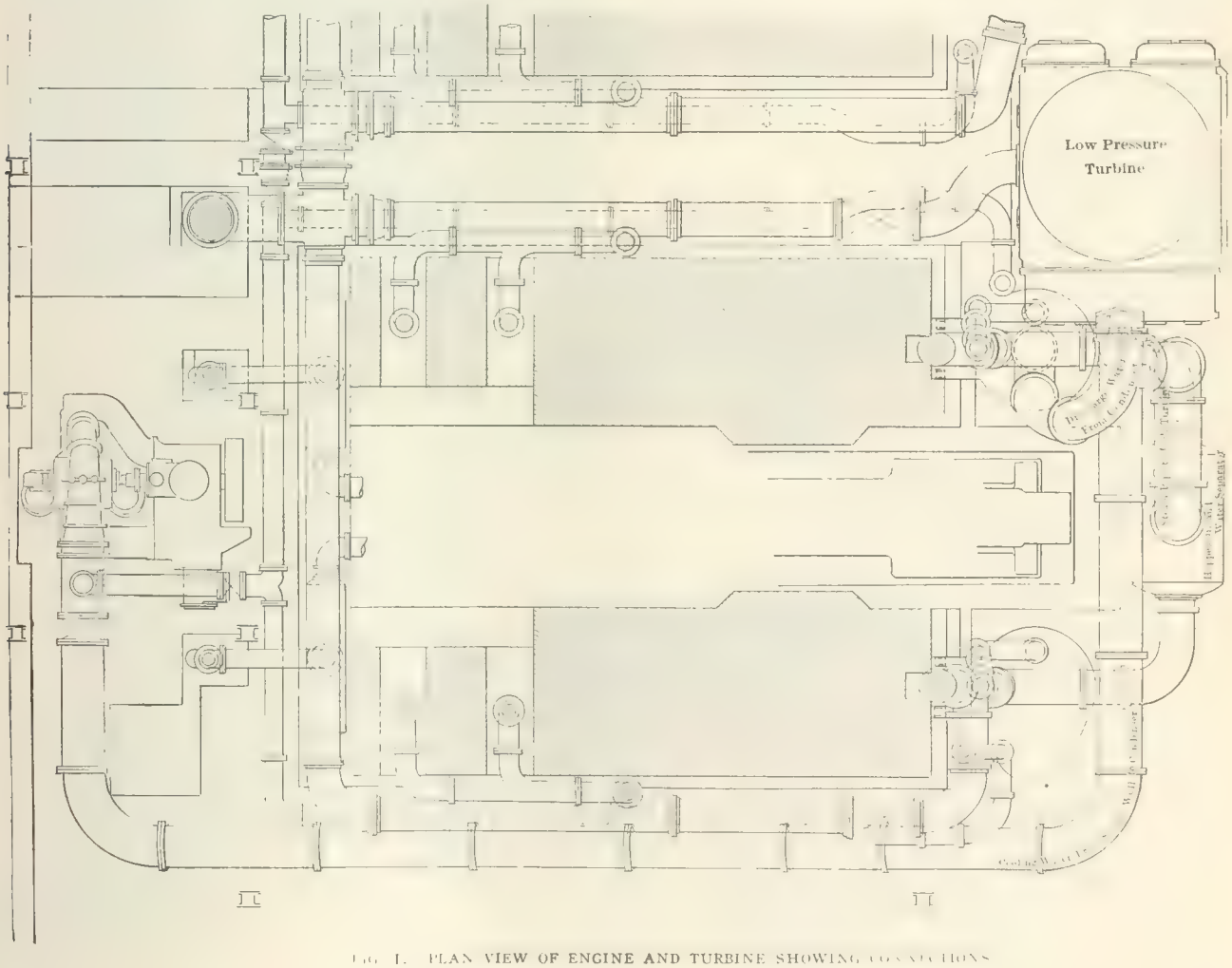


FIG. 1. PLAN VIEW OF ENGINE AND TURBINE SHOWING CONNECTIONS

In the engine the high-pressure cylinders are horizontal and the low-pressure cylinders vertical. The dimensions of the cylinders are 42 in. and 86 in. in diameter by 60-in. stroke and the speed is 75 r.p.m. Both pistons of each side of the engine are connected to one crank pin. Steam enters each high-pressure cylinder at from 175-lb. to 200-lb. pressure through a 14-in. pipe and from there passes into a receiver through a 16-in. pipe whence it passes to the low-pressure cylinder. This receiver is not steam jacketed. The engines have poppet valves on all the high-pressure cylinders to provide for the use of superheated steam; but the usual Corliss valve gear is employed on the low-pressure cylinders. The generators are of the Westinghouse, revolving-field, flywheel type, the field structure being mounted directly on the engine shaft. The generators are rated at 5000 kw, 25 cycles, three-phase, 11,000 volts.

Ordinarily the exhaust piping from the engine starts from the condensers with a 30-in. relief valve. From this valve the pipe, which is 30-in. in diameter, drops through the main operating floor to the basement, where the exhausts from the two units unite into one 40-in. riser, which is carried to the roof. The exhaust piping is of riveted steel and is equipped with both corrugated copper and slip expansion joints. The condensing system for each engine-generator unit consists of two Alberger jet condensers with barometric column discharge, two hot wells of concrete and expanded metal, one dry vacuum pump and one cross-compound circulating pump. Each condenser is supported on specially designed steel work placed in front of the engine and is connected directly to the exhaust outlet of the low-pressure cylinder by means of a single elbow on one side and the relief valve of the atmospheric exhaust line on the other The condenser head or chamber is 50 in. in diameter and terminates at the bottom in a cone-shaped connection to the tail pipe, while the top is provided with a chamber in which the entrained air and vapor collect and to which is connected the air pipe to the dry vacuum pump. On the side 90 deg. from the steam pipe and the exhaust relief valve the circulating water enters, while directly opposite in the vapor chamber is the air-pump connection. The water for use in the condensers is taken from the North River through a concrete tunnel.

The use of the low-pressure turbine has necessitated some changes in the exhaust lines and condensers. The jet condensers are not used on the engine to which the exhaust turbine is connected, the turbine being equipped with a surface condenser instead. The turbine resting directly over the condenser not only makes a better vacuum possible, but by equipping the exhaust pipe between the low-pressure cylinder of the engine and the turbine with an oil separator, the condensation is made available for boiler feed purposes. At present all the boiler feed water is purchased from the city at a large annual expense, and if the condensation from the turbine can be utilized again a saving will result.

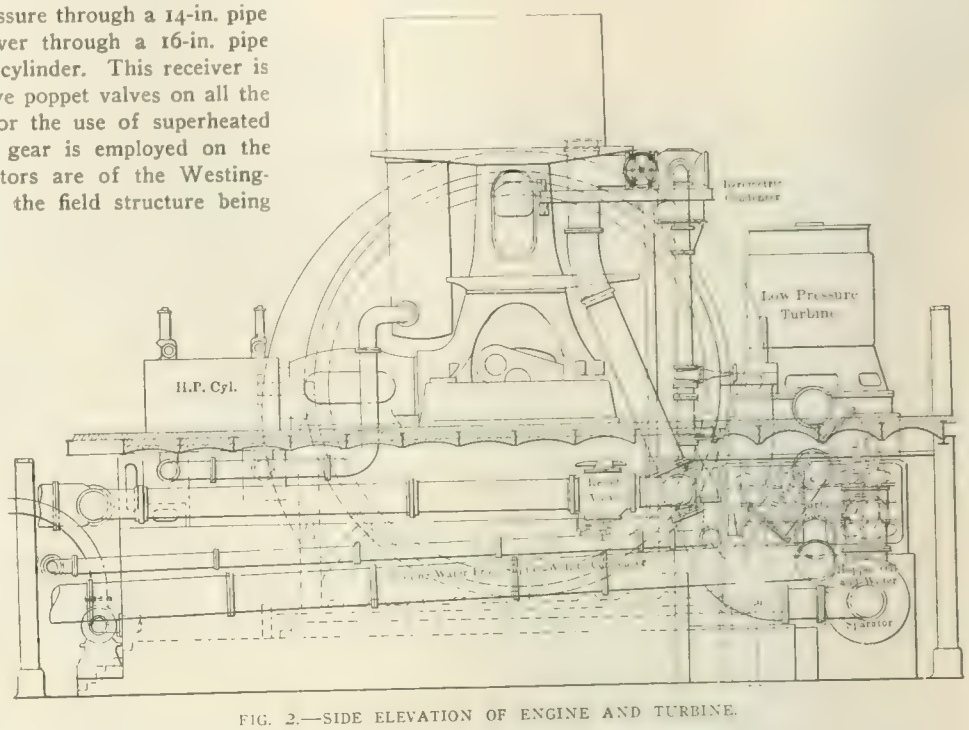


FIG. 2.—SIDE ELEVATION OF ENGINE AND TURBINE.

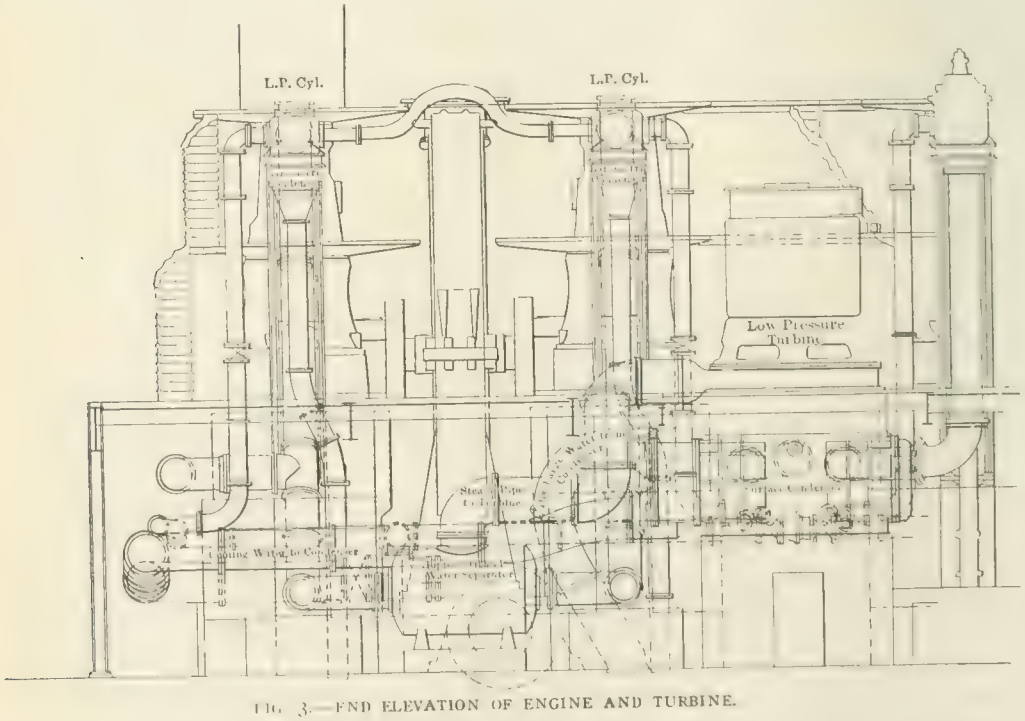


FIG. 3.—END ELEVATION OF ENGINE AND TURBINE.

The low-pressure turbine is directly coupled with an induction generator rated at 5000 kw, three-phase, 25 cycles, 11,000 volts, and the leads are connected to the reciprocating engine generator without switching apparatus. The turbine, which is a three-stage machine, has no governor and is controlled in speed by the engine generators which latter is controlled by the engine governors. On a vacuum of 28 in. and with the low-pressure cylinders exhausting at a back pressure from 12 lb. to 17 lb. absolute, the steam consumption is less than 15 lb. per kw-hour. The combination is still under test, and the results are not at present available for publication, but it may be stated that the output can be doubled by the installation of exhaust steam turbo-generator sets at a cost of about one-third that of the original installation.

The power house occupies the entire square block at Fifty-ninth Street, Eleventh Avenue and the North River, and the structure and site represent the largest item in the investment. Doubling the output does not entail the expenditure of a cent

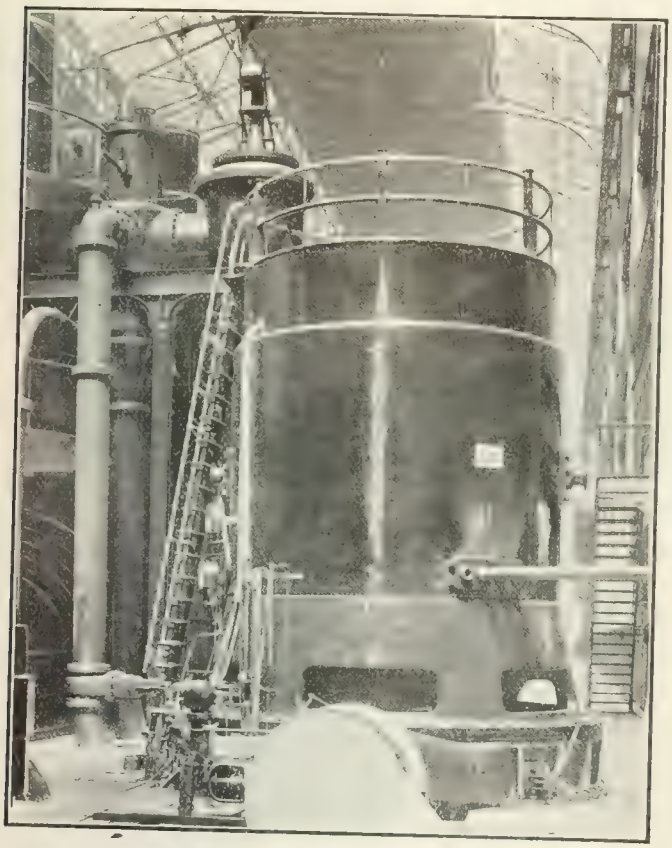


FIG. 4.—5000-KW EXHAUST STEAM TURBINE.

for real estate, it being possible to install the added equipment in the present structure. If reciprocating engines were em ployed another structure of the same size would be required The illustrations show the connections to the engine and also to the low-pressure turbine so that further comment on the layout is not necessary. H. G. Stott, superintendent of motive power, has given serious thought to this work for some time, and it is to him that the credit of installing the largest low-pressure turbine at present in use is due.

English Generating Station with Large Motor Load.

WHEN the Bolton Electricity Works were started 14 years ago, single-phase current at a pressure of 2200 volts and a frequency of 83 cycles was generated and this supply was transformed in substations in the center of the town to a secondary pressure of 200 volts. This arrangement was naturally not suitable for motor loads, and as an interesting sidelight on the way electricity supply was looked upon in those days, it may be mentioned that the undertaking was under the control of the gas committee. The system was continued until 1900, when a direct-current plant had to be installed for supplying railways. The central area of supply was then provided with electricity for lamps and motors by means of low-tension feeders, the substations mentioned above, one of which is shown in Fig. 1, being used as distribution centers. The single-phase network was and still is used for supplying lamps in outlying districts, but the central area is now all supplied with direct current.

In 1906 a three-phase system was installed, the plant consisting of two 6500-volt, 50-cycle, three-phase, slow-speed condensing sets. With the installation of these machines, a very energetic canvas for motor load was made by the Bolton Corporation, three-phase currents being used for this purpose. By lowering the price of energy furnished for motors during the day, the corporation has been able to connect up over 9000 hp in motors and the load is constantly increasing. Three-phase currents are not entirely used for motor circuits, a certain portion of the energy being converted by means of rotaries which feed into the direct-current network at its most distant points, or where the demand is exceptionally heavy. The future policy of the corporation will be to transform the high-tension, three-phase currents in substations, and then either convert them into direct current or supply them direct to customers as three-phase, low-tension currents.

Fig. 2 illustrates the Duncan Street substation of the Bolton Corporation, which now contains three 600-kw rotaries with the necessary transformers and control boards. The central station at Spa-road is also a substation and in it rotaries and motor-generators of about 900-kw rating are installed as shown in Fig. 3. These machines are used not only for taking the light load on the three-phase network at night, but also as a means for converting a certain amount of energy from one system to the other. This enables the machines of either class to be fully loaded, or in the event of a breakdown of one type of steam generator, to enable a steam generator of another type to act as a standby. The present station at Spa-road lacks adequate water supply for condensing purposes and the limited space for cooling towers and reservoirs made it impossible to adopt turbines when the last extensions were made. The facilities for taking in coal are also defective; all the fuel being carted from a railroad siding some distance away from the station. Under these conditions the generating costs at Bolton may not compare favorably with better situated stations.

The greater part of the three-phase currents, other than those converted, is used direct for cotton spinning work, there being at the present time some 300,000 spindles driven from the corporation's mains. In no case, however, is a complete mill driven electrically. The supply is for one, two or three floors only, and electric drive is generally employed for working the mules, which are the most awkward part of the cotton spinning equipment to drive, as the power is very great for a short time and then drops to nothing for an interval, thus imposing an arduous task on the motor. The transformers and necessary switch-

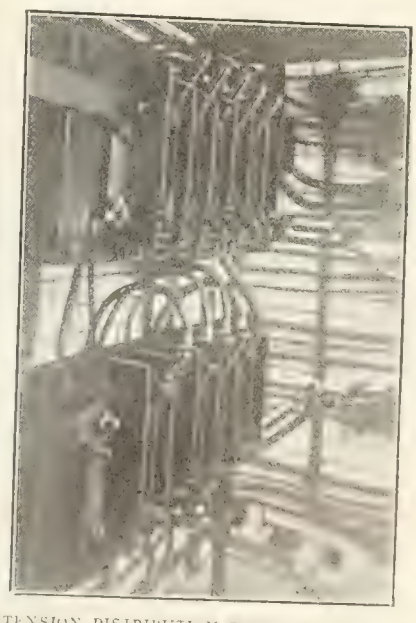


FIG. 1.—LOW TENSION DISTRIBUTION BOARD IN THE BALMORAL SUBSTATION.

board for supplying mules, up to the present are installed in a special substation on the mill premises. The station is, however, kept under the entire charge of the corporation's electricity department. The voltage is in all cases stepped down from 6500 to 400 for use on the mill motors. In some cases the lamps in the mills are supplied with electricity by means of a fourth wire at 230 volts.

The experience obtained in Bolton with this type of motor

drive shows that the results are satisfactory in every way, the only point about which trouble occurs is the price of energy. The usual course adopted by the Bolton corporation in installing electric drive in mills has been to fix a three-phase motor with slip rings direct to the line shafting driving the mule-operating room. The speed of the shafting has generally been increased over that which was used with the steam-driven machines. The

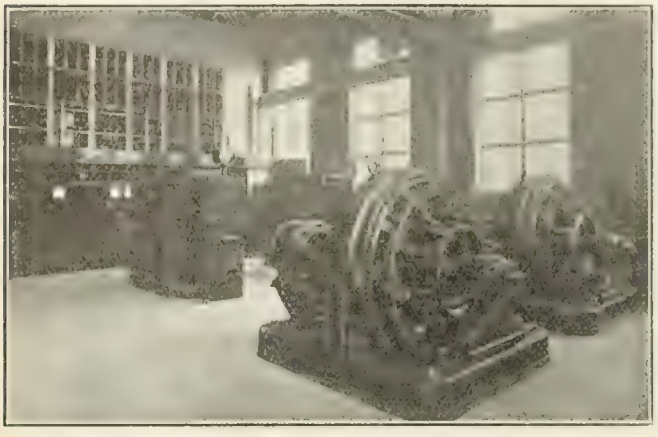


FIG. 2.—EQUIPMENT IN DUNCAN STREET SUBSTATION.

speed of the machine has also been somewhat increased. Although cotton spinning is the industry on which Bolton most relies, there are several engineering works which have installed motors aggregating 1200 hp for driving cranes, tools, conveyors, etc. Three customers on the direct-current mains take over 3,000,000 kw-hours yearly and have installations aggregating 3000 hp. Two of the concerns have a load factor of over 30 per cent.

The recently issued accounts for the year show the total output from the Bolton station to be 10,677,764 kw-hours, of which no less than 46 per cent was for motor circuits entirely and 15 per cent for lighting circuits only. It is essential, of course, that the energy supplied for motors should be at a low rate, for the load which is obtained is of such a steady character and in such large units that consumers would use their own plants

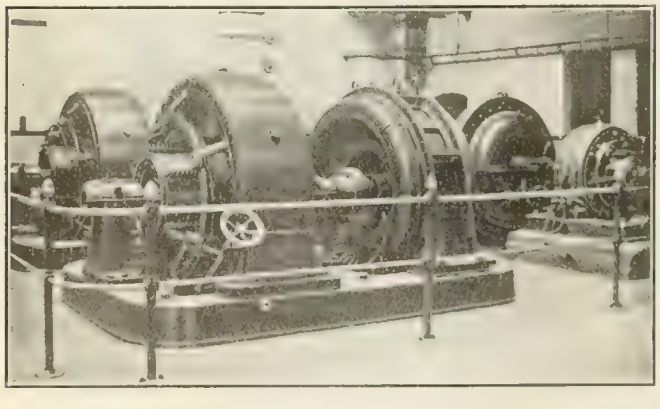


FIG. 3.—MOTOR-GENERATOR SETS IN SPA ROAD GENERATING STATION.

unless the price were reasonable. It appears from the accounts that the average price obtained per kw-hour from all classes of supply is 1.23d (2.46 cents), and for motor circuits, 0.84d (1.68 cents). Although this price may be considered fairly low for a municipal station of the size of that at Bolton, a gross profit of 9 per cent on the capital has been obtained. The works costs with the handicaps previously mentioned are given as 0.472d (0.944 cent) per kw-hour and the total costs, 0.583d (1.166 cents). The inclusive cost, including capital charges, is 1.2d (2.4 cents). In March, 1901, the number of motors on the mains was 27, with an aggregate rating of 148 hp; on the same date in 1909 the number of motors was 816 and their aggregate rating 9219 hp.

A Contribution to the Statistics of International Electrical Engineering Symbology.

By A. E. Kennelly.

In view of the discussion which has of late years been carried on concerning the possibility of adopting an international set of symbols for the principal formulas of electrical engineers, the writer here presents the results of an examination into the notation of recent text-books from countries which have a large and independent electrical engineering literature.

In making the examination, care was taken to avoid forming any theory in advance, or preconceived notions, as to what the results of such an inquiry might be. No comparisons were attempted until the individual records had been completed. Indeed, now that the comparative notations of different countries are presented, no particular line of argument or deduction is invoked. The object is merely to indicate the agreements and differences among the notations in use between different countries.

It was decided to confine the examination to recent literature. Accordingly, with but one exception, the books or documents accepted have all been published since the year 1900. Consequently, these statistics bear upon current notation; or, at least, upon notation that has until very recently been current.

It was also decided to limit the inquiry to electrical-engineering literature. It will be evident that if electro-chemistry, physical chemistry, physics, chemistry and astronomy were included, with their numerous applications to industry, the list of necessary symbols would be very long.

In order to present the results of the inquiry in tabular form, capable of being covered by one view, and yet revealing the individual accordances or discordances, it was decided to limit the number of entries to seven from each country.

Table No. I sets forth five groups of publications, from France, Germany, Great Britain, Italy and the United States, respectively. Seven publications appear for each country. Where possible, the seventh publication in each group is taken from an official or semi-official source. For France, we have the Hospitalier notation; for Germany, a notation suggested by a special committee of the Elektrotechnischer Verein; for Great Britain, a recent volume of the *Journal* of the Institution of Electrical Engineers; for Italy, a paper from the *Journal* of the Associazione Elettrotecnica Italiana; and for the United States, the notation proposed in the Standarization Rules of the American Institute of Electrical Engineers.

The remaining publications have been taken, more or less at random, from a list of representative national text-books, and without any prior reference to the particular notations they contain. It is believed that, although seven examples may not be a satisfactorily large number through which to deduce a national average, yet, taken collectively, they fairly exhibit the current state of electrotechnical notation in the countries represented. If more extensive inquiry should indicate that the actual average usage is not well shown, the discrepancy is to be attributed to the chances of selection, and is entirely accidental.

In Table II the various symbols used in the above-mentioned 35 publications are set down in parallel columns, each under its appropriate number as given in Table I. In many cases, two or more symbols have been used in the same publication for one physical quantity; as L and l for self-inductance, or E and e for e.m.f. In such cases, the variants are included, as far as possible. In many instances the variants run over and occupy an extra line below.

It will be seen that there are 21 electric, magnetic or electromagnetic quantities in the list, and 15 subsidiary fundamental quantities, making a total of 36 entries in all. This is not a long list comparatively. The list of symbols recommended by the Notation Committee of the Chicago Congress (1893), with the additions of the Paris Congress (1900), contains 43 quantities. The list recommended by the Notation Committee of the Elektrotechnischer Verein in 1902 contains 53 quantities (Vorschlagliste, June 5, 1902), and that recommended similarly in 1906 contains 39 quantities. Although "admittance," "sus-

ceptance" and a few other quantities in technical use do not appear in Table II, yet it is believed that the most important electrical engineering quantities will appear therein.

It will be observed that, so far as Table II shows, there is already substantially complete international agreement on the symbols for the following six electric, magnetic or electromagnetic quantities:

for (1) length, (2) volume, (3) time, (4) angle, phase-displacement, (5) velocity, and (6) efficiency. Moreover, in the cases of potential, reactance, impedance and permeability, the agreement is nearly complete. Even among the quantities where there is the most international disagreement, the differences in usage between different publications in the same country are sometimes of the same order of magnitude and frequency as the differences in the usage therein between the different countries.

TABLE I

TABLE OF PUBLICATIONS CONSULTED

Country	No	Title of Publication	Pub. Date	Author	Pages	Publisher
France	1	Essais des Machines a Courant Continu et Alternatif	1907	P. Bourguignon.	299	Ch. Béranger. Paris.
	2	Distribution de l'énergie par Courants Polyphasés.	1903	J. Rodet. (2d Edition)	561	Gauthier-Villars. Paris.
	3	Contrôle des Installations Electriques.	1904	A. Monmerque (2d Edition).	775	Ch. Béranger. Paris.
	4	La Technique de la Houille Blanche.	1908	E. Pacoret.	830	H. Dunod & E. Pinat. Paris.
	5	Phénomènes Fondamentaux et Principales Applications du Courant Alternatif.	1904	R. Swyngedauw.	173	Ch. Dunod. Paris.
	6	Pratique des Essais des Machines Electriques a courant continu et alternatif.	1903	E. Duquesne and U. Rouviere.	362	Ch. Béranger. Paris.
	7	[Hospitalier Notation]		E. Hospitalier.		
Germany	1	Die wissenschaftlichen Grundlagen der Elektrotechnik. 2d Edition	1907	Gustav Benischke.	580	Julius Springer. Berlin.
	2	Elektrische und Magnetische Messungen und Messinstrumente.	1906	H. S. Hallo and H. W. Land	517	Julius Springer. Berlin.
	3	Handbuch der Elektrischen Beleuchtung. 3d Edition.	1907	Joseph Herzog and Clarence Feldmann.	765	Julius Springer. Berlin.
	4	Prinzip und Wirkungsweise der Technischen Messinstrumente für Gleichstrom.	1908	Fritz Hoppe.	64	J. A. Barth. Leipzig.
	5	Elektrotechnische Messkunde. (II Band Grundriss der Elektrotechnik).	1908	Alex. Königswerther	167	Max Janecke. Hannover.
	6	Messungen an Elektrischen Maschinen. 2d Edition.	1907	Rudolf Krause	193	Julius Springer. Berlin.
	7	Elektrotechnischer Verein. Vorschlagsliste A.	1906			*Elek Zeitschrift*, April 19, page 396
Great Britain	1	Handbook for the Electrical Laboratory and Testing Room.	1901	J. A. Fleming	1 538 II 622	*The Electrician* Series. London.
	2	Electric and Magnetic Circuits	1903	Ellis H. Crapper.	379	Edwin Arnold. London.
	3	Submarine Cable Laying and Repairing. Revised Edition.	1908	H. D. Wilkinson.	557	*The Electrician* Series. London.
	4	Dynamo-Electric Machinery. Revised Edition.	1904 1905	Silvanus P. Thompson. " " "	1 984 II 848	E. & F. N. Spon. London. E. & F. N. Spon. London.
	5	Electricity Meters.	1906	Henry G. Solomon	323	C. Griffin & Co. London.
	6	Vectors and Vector-Diagrams.	1909	William Cramp and C. F. Smith.	252	Longmans, Green & Co. London.
	7	*Journal* of Institution of Electrical Engineers. Vol. 41.	1908	Various.	872	The Inst. El. Engrs. London.
Italy	1	La Tecnica delle Correnti Alternate.	1903	Giuseppe Sartori. " "	1 336 II 495	Ulrico Hoepli. Milan. Ulrico Hoepli. Milan.
	2	Le Frodi nei Misuratori Elettrici.	1908	M. Lanfranco	277	Ulrico Hoepli. Milan.
	3	Impianti Elettrici a Correnti Alternate.	1907	Attilio Marro.	338	Ulrico Hoepli. Milan.
	4	Cavi Telegrafici Sottomarini	1896	E. Jona.	338	Ulrico Hoepli. Milan.
	5	Trattato di Telefonia. Parte I.	1905	I. Brunelli and E. Longo.	96	G. Scotti & Co. Rome.
	6	I Metodi Elementari per la Rappresentazione e lo Studio delle Correnti Alternate Sinusoidale	1903	G. Giorgi.	15	L' Elettricista 1903. Rome.
	7	Magnetizzazione del Ferro per Effetto di due Campi Ortogonali.	1909	Giancarlo Vallauri.	35	*Atti* dell' Asso. Elet. Italiana, March, 1909.
United States	1	Testing of Electro-Magnetic Machinery and Other Apparatus. Vol. I.	1904	Bernard Victor Swenson and Budd Frankenfield.	420	The Macmillan Co. New York.
	2	An Introduction to the Study of Electrical Engineering. 1st Edition.	1907	H. H. Norris.	404	John Wiley & Sons. New York.
	3	Theoretical Elements of Electrical Engineering.	1902	Charles Proteus Steinmetz.	330	*Elec. World and Engineer*, New York.
	4	Alternating-Current Machines. 7th Edition.	1908	Samuel Sheldon, Robert Mason and Erich Hausmann.	353	D. Van Nostrand Co. New York.
	5	Dynamo-Electric Machinery.	1908	Francis B. Crocker.	235	American School of Correspondence. Chicago.
	6	Electrical and Magnetic Calculations.	1903	A. A. Atkinson	319	
	7	Standardization Rules of the American Institute of Electrical Engineers.—Recommended Notation.	1907			Am. Inst. El. Engrs. June 1907

Electromotive Force—*E e.*
Electric Quantity—*Q q.*
Magnetic Intensity—some type of capital *H.*
Magnetic Flux Density—some type of capital *B*
Self-Inductance—*L l.*
Mutual Inductance—some type of capital *M.*

Among subsidiary quantities there is also substantially complete international symbolic agreement indicated in the table

While, therefore, it is clear that international agreement on the entire list could not be attained without mutual adjustment, change and compromise between the national notations, it seems that if the actual state of affairs is correctly presented by the table, about one-third of all the quantities given in the list are ready at once for international standardization, without

TABLE II. COMPARATIVE TABLE OF SYMBOLS APPEARING IN ELECTRICAL ENGINEERING TEXT-

	Quantity	Unit	France							Germany							Great Britain							Italy							United States						
			1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
General	Energy or Work	Joule	T		W	W	$T,U,$ W,w	$P,T,$ W	W	A,a	A,W	T				A	E	W,w						w	W	L		L		w	W	W	W	W			
	Power or Activity	Watt	$P,$ W,w	P	P	P,p	P	$P,p,$ W	P	P,p	W	W		$\mathfrak{L}$	A,N W		P	P		$P,$ W,w	P,W				$P,Q,$ I,W		P,W					P	P			W,w	P,W	P
Electric	Electromotive Force	Volt	$E,e,$ $\mathcal{E}$	$\mathcal{E},e$	E	E,e	E,e	$\mathcal{E},E,$ e	E,e	E,e	E,e	E,e	E	E,e	E,e	E	E,e	E,e	E,e	$\mathcal{E},E,$ e	E	E	.		E,e	e	e	.	e	E		E,e	E,e	E	E,e	E,e	E	E,e
	Potential or P. D.	Volt	V,V	U,u V	$U,u,$ V	.	V,v	. . .	U,u	$K,k,$ U	V	V,v		V,k		. .	$U,$ V,v	V,v	P,p	V	V,v	V	V,v P		V,v	V	$V,v,$ u	V,v		V				V			
	Current Strength	Ampere	I,i	$\mathfrak{J},J,$ I,i	I,i	I	I,i,j	I,i	I,i	$\mathfrak{J},J,$ i	J,i	I,J,i	I,J,i	i	$\mathfrak{J}$	I	$A,C,$ I,i	C,c	C	C	$A,C,$ c	C	$A,C,$ c		$I,J,$ i	I,i,j	i	i	I,i	I,i	i	I,i	I,i	I,i	I	I	I,i
	Quantity	Coulomb	Q		Q	.	Q,q	. . .	Q,q	Q,q	Q,q	q		Q	.	Q	Q,q	Q	Q,q			.	. . .		Q,q	.		Q,q					Q,q	Q	Q	Q		Q	
	Capacity	Farad	C	C		C,c	C	. . .	C,c	C	C	C,c	C	C	.	C	C	K	$F,f,$ K,k	K		K	K,k		C	.	C	$C,\Phi,$ ϕ	C	K			C,c	C,c	C	C	C	C,c
	Resistance	Ohm	$R,r,$ ρ	R,r	R,r	R,r	R,r	R,r	R,r	$W,$ w,ρ	$R,r,$ W,w	$R,r,$ w	W	W,w	$R,r,$ g,w	.	R,r	R,r	R,r	R,r	R,r	R,r	R,r		R,r	$R,r,$ ρ	$R,r,$	R	R	R		R,r	R,r	R,r	R	R,r	R,r	R,r
	Reactance	Ohm							X	.	x	. . .	. . .		x	. . .	. . .	. . .		.		x	. . .		x	Λ,λ						X,x	x	X,x	X			x
	Impedance	Ohm		Z					Z	. . .	z	$\mathfrak{R}$	. . . .	. . .	. .		. . .	. . .	. . .			Z			Z	z	Z					Z	z	Z,z	Z	. .		Z,z
	Resistivity	Ohm cm	ρ	ρ	ρ		ρ	. .	ρ	α	.			. . .	c	. . .	. . . .	σ		ρ	. .		. . .		ρ	. . .		ρ				σ		ρ	. .	ρ	K	
	Conductivity	Mho cm	. .		γ	.	c		γ	. . . .	. . .	. . .		. . . .	λ	. . .	. . . .	. . .	. . .	. . .	. .		. .		. . .	. . .		c	. .	.	.	γ			. .			
Magnetic	Magnetomotive Force	Gilbert*		$\mathfrak{F}$	$\mathfrak{F}$	$\mathfrak{F}$	F		$\mathfrak{F}$	$\mathfrak{F},f$	. . .			.				.		X	. .			. .							$\mathfrak{F}$		$\mathfrak{F}$		M		
	Magnetic Intensity	Gilbert/cm	$\mathcal{H}$		$\mathcal{H}$	$\mathcal{H}$	H	$\mathcal{H},H$	$\mathcal{H}$	$\mathfrak{h}$	.	H		H	H	H	$\mathfrak{h}$	. .	$\mathbf{H}$	.	$\mathbf{H}$	$\mathcal{H}$	H,h	. .	$\mathbf{H}$						H	H	$\mathcal{H}$	H	H	H	H
	Magnetic Flux	Maxwell	Φ	Φ,f	Φ	Φ	Φ	Φ	Φ	. .	Φ		Z	Z	Φ		. .	$\mathbf{N}$	.	$\mathbf{N}$	F	F	N		Φ	. .	$\mathfrak{R}$				Φ	Φ	Φ,ϕ	Φ	ϕ	ϕ	Φ
	Flux Density	Gauss	$\mathfrak{B}$	$\mathfrak{B},\mathfrak{f}$	$\mathfrak{B}$	$\mathfrak{B}$	F,B	$\mathfrak{B},B$	$\mathfrak{B}$	$\mathfrak{B}$	B	.	. .	B	B	$\mathfrak{B}$	.	$\mathbf{B}$	$\mathbf{B},\mathfrak{B}$	B	. .	$\mathbf{B}$		$\mathfrak{B},B$	. .	$\mathfrak{B}$					$\mathfrak{B}$	B	$\mathfrak{B}$	$\mathfrak{B}$	B	B	$\mathfrak{B},B$
	Reluctance	Oersted*			$\mathfrak{R}$		.	.	$\mathfrak{R}$	w						.		$\mathfrak{R}$			. .		. .		$\mathfrak{R}$					.	$\mathfrak{R}$	$\mathfrak{R}$	ρ	$\mathfrak{R}$	R	$\mathfrak{R}$	
	Reluctivity	Oersted.cm. . . .			ν		.		ν									$\mathfrak{H}$			.	.	.									ϱ	. .	ρ		$\mathfrak{h}$	.
	Permeability	1/(oersted.cm.)		μ	μ		p		μ	μ	μ	μ	μ	μ		μ	μ	μ	μ	μ		μ	μ		μ		μ	μ				μ	μ	μ	μ	μ	μ	
Electro-magnetic	Inductance Self.	Henry	L,S	L	L	L,l	. .	L	L,l	L,λ	L	L		L	L	L	L			L	.	L,l	L		L	L	$\mathfrak{L}$			L	.	L	L,S	L,l	L	L	L,l
	Inductance Mutual.	Henry.	.	. .			. . . .		.	M				. . . .	. . .	.	M			M		M	..	M	..	$\mathfrak{M}$		.	M	M			M		..		
Fundamental and Subsidiary	Length	Cm., ft., etc.	l	l	L,l	l	l	. . .	L,l	l	l	L,l	l	L,l	l	l	. . .	l	.	l,λ			l	L,l	l	l	l	l	..	L	l	l	l	l	l	l	
	Surface Area	Cm^2., sq. ft., etc.	S	S,σ	S,s	.	s	S	S,s	S	F	. . . .	F	. . . .			. . . . .			A				s	σ	Q,A	S	.		S	A,s	A		A,S	A,s	$A,a,$ s	
	Volume	C.c., c. ft., etc.	.	.	V	V	V	V	V	v	V,v				v	V		.		.					V,v								V	V	v	..	V	
	Mass	G., kg., lb., etc.	..	.	M,P	.	.		M		m	. . .	M	m	m	m		W	.	.	M		M	p	.	G,P	P				M			W		m,W	
	Time	Sec., min.	T	t	T,t	T	T,t	..	T,t	t	t	T	T	t	t	t	T,t	t		T	T,t		T,t	Γ,t,τ	T,t	T	T,t	t			t	t	..	t,τ	t	T,t	
	Angle	Radian, Deg.	α	α,β	α,β	α,θ		α	α,β		α	α,θ	α	α	α	α,β		θ,A		θ	ϕ,Φ	α,θ	θ	$\alpha,\beta,$ δ	γ,δ	α	α	..		α,β	$\alpha,\beta,$ θ	$\theta,\theta,$ ω	α,ω	α	λ,ψ	
	Angle	Phase Diff.	ϕ	ϕ,ψ	ϕ	ϕ		ϕ		.	ϕ	ϕ,ψ	..	ϕ,ψ	ψ	ϕ	.	.		ϕ		ϕ	ϕ	ϕ,ψ	ϕ,ψ	ϕ	ϕ	..	ϕ				ϕ,ν	ϕ		ϕ	
	Temperature	Deg. Ab. or C.	t,θ	.	θ	..		.		.	t	. . .	t	T,t	T,t	T,t,A t,t_C					n°		t	T	t,τ	t	t	..	..			t		..	t	t	t	
	Velocity	Cm./sec.	v		v	V	v	V	v	. .	v			v	v	v	..	v	.	v	..	.	v	.			v,t,u				V,v	v				v	
	Angular Velocity	Radian/sec.	ω	.	ω	ω	ω	ω	ω	ω	ω	ω		ω	ω	ω	p			$\Omega,\omega,$ p	p,ω		$P,p,$ ω	ω	p		. . .		ω				ω	ω		
	Angular Velocity	Rev./sec., Rev/m.	N	N	N	n	. . .	n	.	. .				. .		n	. .		.	n,U	n	n					u,n	. . . .			V	n	z		
	Frequency	1/second	f	n	.	$\sim$	. . .	f	n	ν	c	$z,\sim$	.	ν	ν	.	n	. . . .	. . .	f	n	$\sim$		f	n	f	. . .				V	n	z		f	f	N	f	f
	Force	Dyne, lb.-wt.	$P,p,$ T	.	F,f	F	.	F	F,f	F,f	K		P	f,K	K,P		.	F,f	.	F				F	F	k,T	P,T		.		F,f	F		T	F	$F,$ W,w	
	Acceleration	Velocity/sec.	. . . . .	. . . . .	a,g	. . . .	.	. . .	a	.	g,γ	. . .	. . .	. . .	. . .	g	. . .	a,g	. . . .	g	g	. .	.	ρ	. . . .	g					ρ	. . . .				g	
	Torque	Force perp. cm.	C	$\mathfrak{M}$	C	C_m	C	. .	. . . .	. .	. . .	. . . . .	. . . . .	. . . . .	. . . . .	. .	. . .	. .	. .	T,t	D,T	.	.	. .	. .							T	. .					
	Efficiency	Output/input	. . . . .	. . .	. . .	. . .	. . . .	. . . .	. . . .	. . . .	. . .	. . . .	. . . .	. . . .	. . . .	η	. . . .	. . .	. . .	. . .	. . .	. .	.	. . . .	. . .	η			. .	. .	η	. .	. .		η	. .	. .	

*The names "gilbert" and "oersted" have never received international recognition. They were only provisionally adopted by the American Institute of Electrical Engineers. †Only T for Deg. Abs. and t_C for Deg. Cent.

any change or compromise; while the task of bringing about international agreement among the remaining two-thirds is, perhaps, not much greater than the task would be of bringing about systematic and uniform notation within the limits of several individual countries, without reference to international usage. In other words, since some effort is evidently necessary in order to effect national standardization of symbols, perhaps not much additional effect would be required to effect international standardization.

HISTORICAL OUTLINE OF THE MOVEMENT TOWARD INTERNATIONAL STANDARDIZATION OF ELECTRICAL ENGINEERING SYMBOLS SINCE THE INTERNATIONAL ELECTRICAL CONGRESS IN CHICAGO IN 1893.

The International Electrical Congress of Chicago appointed a committee from the chamber of Government delegates to conside the subjects of nomenclature and notation, with M. Edouard Hospitalier as its chairman. The committee reported in favor of a list of 38 symbols. The chamber voted to print the report as an appendix to the general report of the chamber.[1] The system of notation presented in that list has been called the Hospitalier system of 1893.

Prior to the date of the Chicago congress, the notation current in American electrical engineering literature did not differ noticeably from that simultaneously current in the electrical engineering literature of Great Britain. After the publication of the Hospitalier system, however, in the Chicago congress proceedings, electrical engineering literature in the United States indicated a tendency to diverge from the British notation, and to follow the Hospitalier notation in those symbols wherein these two notations differed. In a considerable measure this influence, regarded as an international approximation, was exerted by the electrochemical press in the United States.

In Germany, electrotechnical notation received much attention from the Elektrotechnischer Verein, whose committee on notation reported in 1902 and 1904, and in 1906. (See bibliography appended.)

Attempts were made in the United States in 1903-04 to have the subject of an international technical notation brought before an international congress at the St. Louis World's Fair in 1904. Joint committees on notation were appointed by the American Physical, Chemical and Electrochemical societies, as well as the American Institute of Electrical Engineers and the Bureau of Standards. A proposed list of 95 symbols was jointly drawn up and was brought before a branch of the International Congress of Arts and Sciences at St. Louis, but no action was taken.

The subject of international electrotechnical symbols was discussed in subcommittee by the council of the International Electrotechnical Commission in London, October, 1908.

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[1] Proceedings of the International Electrical Congress of Chicago, 1893. See inserted table at end of volume.

Repulsion Motor for Railway Work.

There has recently been brought out a single-phase repulsion railway motor of the Deri type, which is a modification of a motor of the same type built by Brown, Boveri & Company, of Baden, Switzerland, for hoists, etc., and in experimental use on the Stansstad Engelberg Railway. A list of the contracts which the manufacturers have closed for this new type of motor is shown in the accompanying tables.

As the Deri type of single-phase motor has not been used in this country to any great extent, a short account of the principles on which it operates will be of interest. The motor consists of a single stationary primary winding and a revolving secondary winding, short-circuited upon itself along certain axes which are stationary with respect to the primary magnetism. It differs from the plain (Thomson) repulsion motor in requiring twice as many brushes on the commutator. These brushes are short-circuited in pairs.

STATISTICS OF DERI REPULSION MOTORS IN USE OR BEING BUILT.

Line.	Number of locomotives or motor cars.	Number of motors per machine.	Power of each motor in hp.	Voltage.	Frequency.	Speed of motor in r.p.m.	Length of line in km.
Baden State Railways, Wiesental	2	2	500	500	15	225	49.1
Seetal Railways, Switzerland	2	2	50	500	25	600	..
Martigny-Orsieres Railway, Switzerland	4	4	80	500	15	450	19
Parma Tramways, Italy	20	2	15	400	25	500	10.5
Buer Mine	1	1	5	150	50	1,000	..
E. W. Mark Switching Service	1	2	40	1,000	50	500	..

A diagram of the motor is given in Fig. 1, which shows the scheme for arranging the brushes and inter-connecting them in a two-pole model. The two brushes in line with the stationary primary coil are held stationary in spacing, while the other two are shifted manually for varying the torque. This produces on each side of the armature a pulsating torque, the net result of which is to tend to turn the armature in a common direction. The value of the torque depends not only upon the current, the magnetism in space-quadrature therewith and

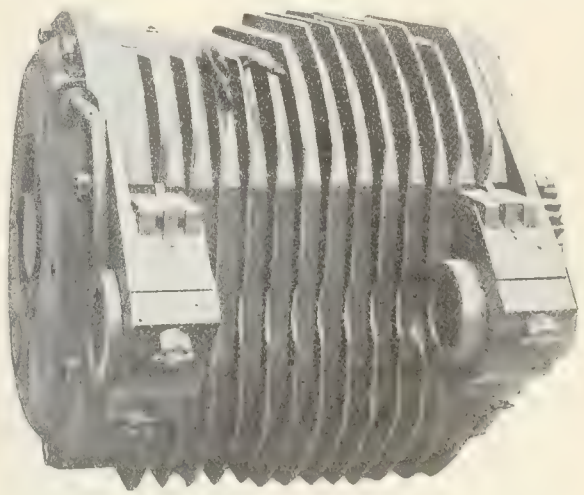
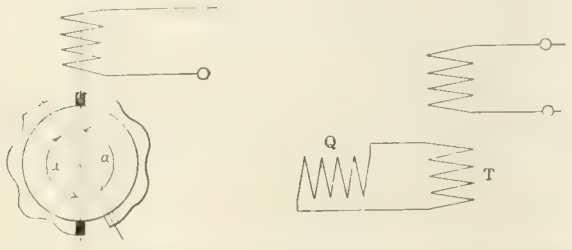


FIG. 1.—DERI TYPE RAILWAY MOTOR.

the cosine of the time-angle between the two, but also upon the space distribution of the coils in which the secondary current is produced.

In dealing quantitatively with the physical relations, it is convenient to consider that the armature winding is divided into two completely superposed armature windings receiving current along two axes separated by an angle equal to the space-angle spanned by the coils actually short-circuited between the brushes. Evidently, the actual condition relating

to the current values will be faithfully represented if each superposed winding is assumed to receive a current equal in value to one-half of the real current in the armature coils. Under the assumed conditions the coils spanned by the brushes will carry the full value of current, while the others will be free from current. One of the assumed superposed armature windings has its axis in line with the primary field magnetism, and hence it may be called the transformer winding. The other superposed winding occupies a position depending upon the adjustment of the brushes, but a certain component of the effect produced by the current in this winding is in space-quadrature with the primary field magnetism—the other component being in direct space-opposition therewith, and hence this winding may be called the quadrature coils.

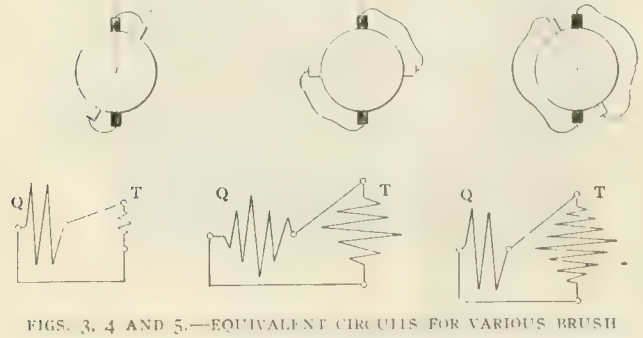


FIGS. 1 AND 2.—CIRCUIT DIAGRAM AND EQUIVALENT TRANSFORMER CIRCUITS.

On the basis of the above assumption the connection of the Deri repulsion motor with two brush axes in space-quadrature can be represented as shown in Fig. 2. Any flux produced by the current in the "quadrature" winding will be in time-phase, with the current in the transformer winding, and will produce accelerating torque at the rotor. The time-place relation between the current in the transformer winding and the flux in space-quadrature therewith will not be altered by any motion of the rotor or change in its speed.

Figs. 3, 4 and 5 indicate three positions of the brush axes and show the equivalent connection for the "transformer" and "quadrature" windings on the motor. With the axes close together, the transformer opposing component of the "quadrature" winding is large, so that the resultant "transformer" winding is small, even in comparison with the fairly small space-quadrature component of the "quadrature" winding. With a wider separation of the axes the "transformer" winding produces a greater effect in comparison with the "quadrature" winding. Both when the axes are together and when they are separated by 180 space degrees the torque is zero. In the former case the transformer effect is zero, while in the latter case there is no quadrature effect.

Under speed condition there are produced two e.m.fs., which affect the value of the secondary current, and therefore alter the torque, which for each position of the brushes varies directly with the square of the current in the armature. One e.m.f. appears at the "transformer" axis and the other at the "quadrature" axis; the former is proportional to the product of the speed and the quadrature flux, and the latter varies directly with the product of the speed and the transformer (primary) flux. In any event, these two e.m.fs. have such values and time-place position as to tend to decrease the armature current with increase of speed.



FIGS. 3, 4 AND 5.—EQUIVALENT CIRCUITS FOR VARIOUS BRUSH ARRANGEMENTS.

It will be seen from the above that the machine possesses the speed-current and speed-torque characteristics of the direct-current series motor. With constant primary e.m.f. and at any set position of the brushes the current decreases with increase of speed, while the torque varies with the square of the current. With the brushes in a constant position at any chosen speed the current varies directly with the e.m.f., but the torque varies only with the square of the current independently of the e.m.f. on the speed at which it may be produced. With constant impressed primary e.m.f. at any given speed the current, the torque and the relation between the current and the torque can be varied throughout a wide range by merely shifting the brushes, as explained above.

Owing to its construction, it is possible to connect the primary winding directly to the high-tension circuit, thus eliminating the necessity for a transformer. Moreover, the regulation of speed, torque and direction of rotation is obtained without the use of a resistance, by the mere movement of the brushes. Thus the machine operates at high efficiency during acceleration, and the acceleration can be made as gradual as desired.

No information has been made public by the manufacturers as to methods for reducing sparking under starting conditions.

Electrical Accidents Around Machinery and Their Prevention.

By Robert J. Young.

THE dangers peculiar to the duties of those engaged in electrical industrial work may be classified under four general heads: (1) Those attributable to shocks; by shocks meaning injury due to the passage of current through the body. (2) Those attributable to burns or injuries caused by burning some portion of the body by contact with an electric arc. (3) Flashes or injuries to the eyes by exposure to the intense light of an arc. (4) Those attributable to falls caused primarily by shocks or burns.

Shocks.—A shock may be received from any electrical circuit provided the body or some portion of it be allowed to form a link in the circuit. No shock can be obtained unless the circuit is completed through the body. This result may follow, however, either by making contact directly to the two sides of a circuit or by allowing the body to form only a part of the connecting circuit from side to side, as, for instance, by standing on the ground and touching one side of a circuit while a ground exists on the other side.

First in order of danger in working on electrical apparatus are the high-voltage transmission circuits carrying power from the generating stations to the works or mills. No work should ever be done upon these circuits or upon any apparatus connected to them unless the men are absolutely certain that the power has been cut off. With such high voltage the ordinary precautions, such as standing on an insulator or wearing insulated gloves, are of no value. Before doing any work on these circuits the switchboard attendant should be notified by the man intending to do the work, giving him his name at the



FIG. 1.—NOTICE TO USE THE PRECAUTIONS AND PROTECTIVE DEVICES.

same time. When advice is received from the attendant that the power has been cut off the wires between the point where the work is to be done and the power station should be grounded and short-circuited with a chain, one end of which should be placed over the wires after the other end has been thoroughly grounded.

The series arc circuits carrying a high voltage are a source of

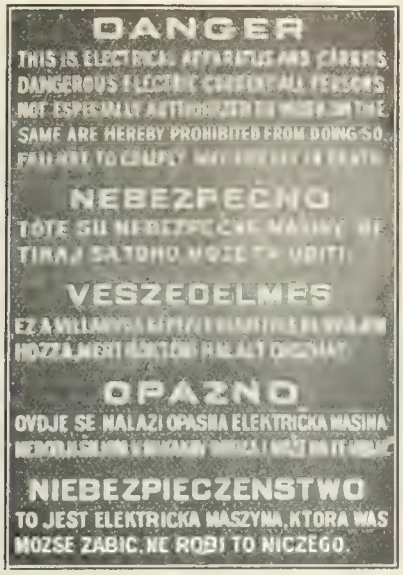


FIG. 2.—WARNINGS TO KEEP AWAY FROM APPARATUS.

grave danger. None but experienced men should attempt to work upon them. The greatest danger arises from a possibility of grounds. The leakage alone from the circuit to ground may cause death. The lamp should be cut off by means of the switch. This does not, however, isolate the lamp from the circuit and it should not be touched unless the attendant is standing on an insulator. Before taking hold with either hand he should touch the parts upon which he intends to work gently with the tips of his fingers to make sure he will receive no shock.

Burns.—This class of injury frequently accompanies injury by shock, though it is possible to receive injury by burn even

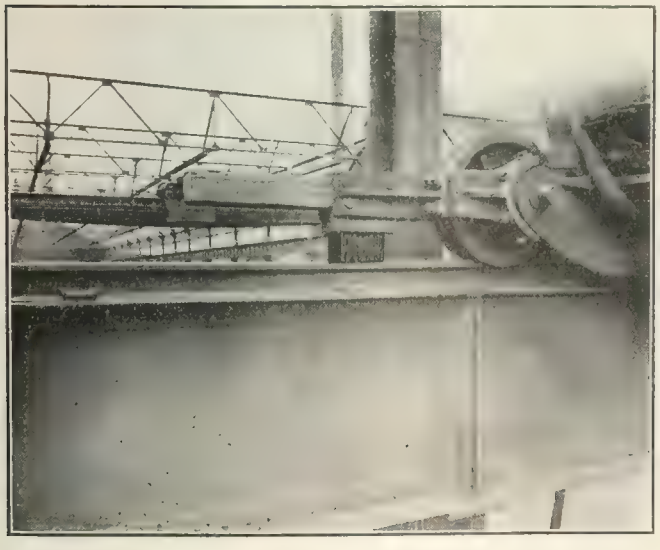


FIG. 3.—SWEEP BRUSHES TO WARN OF APPROACHING CRANE.

where no shock is experienced. Such cases consist in the injured one coming into contact with an electric arc. The most usual cause of an unexpected electric arc is a short-circuit. This may happen in many ways. A lineman may get his pliers across from side to side of the circuit or drop a wire across, or bring two sides of a circuit in contact without knowing that they are of opposite polarities or while thinking they are "dead." The only way to avoid these accidents is to avoid the short circuits. The man working on the circuits should never take any step unless he has full knowledge of what the results may be.

Flashes.—A most annoying, though not deadly, danger exists in the exposure of the delicate nerves of the eye to the intense



FIG. 4.—GUARD AND SIGN PLACED ON SWITCHBOARDS. BACK OF BOARD PROTECTED BY A PLATE. BOARD GROUNDED.

light of an electric arc, but inasmuch as the injury to the eye does not manifest itself for several hours, it is perhaps well to mention it here so that workmen will not underestimate this danger. Heavy blue or black glasses should always be used when watching an intense light.

Falls.—When an electrical worker is engaged at some point where a fall would be dangerous he should be especially careful not to receive even slight shocks. The surprise of a sudden shock, even though the shock itself is slight, may cause an unconscious contraction of the muscles, which may precipitate a man from a position otherwise secure.

Guarding Electrical Apparatus.—A large percentage of employees injured around electrical apparatus are not connected with that particular work. They may come to grief through ignorance of the dangers or because proper safeguards have not been provided.

The following are a few precautions which have been found very effective:



FIG. 5.—CUP PLACED OVER END OF MOTOR SHAFT TO PREVENT CATCHING OF CLOTHES.

All poles and apparatus carrying high voltage and all buildings in which it is generated should bear warning signs calling attention to the dangers. Where there is a large foreign population, such as will be found in most large manufacturing plants, these signs should be printed in the different foreign languages.

Switchboards carrying high voltage and located where work-

men may come into contact with them, should be enclosed to prevent accidental contact and should bear a warning sign printed in several different languages.

Safe disconnecting means should be arranged so that switchboards or switches may be rendered "dead" when necessary to work on them.

The enclosed fuse or automatic overload circuit breaker should be used on all mill motor circuits. There should be insulating mats at all boards.

All motors should be thoroughly grounded. Where the motor is so located that men work around it the armature shaft, if it projects beyond the housing or the brake wheel, should be guarded. A convenient way to do this is to place a cup over the end of the shaft, fastening it to the housing or framework of the motor. It should not be allowed to turn with the shaft. This shaft end has been found to be a prolific cause of accidents.

One of the most productive causes of accidents is the overhead traveling crane.

All overhead cranes should be provided with a railed walk



FIG. 6.—DANGER SIGN IN SIX LANGUAGES.

the entire length of the bridge. It seems strange that manufacturers would build cranes without these walks, but they do. These cranes should also be equipped with foot gongs for the use of the operator; with a box on the bridge in which to keep tools and oil cans, and with limit switches to prevent running the hoist blocks into the drums and probably breaking the cables, allowing the burden to fall onto workmen below.

Each crane should have a switch installed at some point on the bridge which will cut off all power, making it impossible to start the crane from the cab. Many men have been injured while working on the top of a crane by a thoughtless craneman forgetting for the moment that they are there and starting the machinery.

Each man working on a crane should be provided with a "warning sign" bearing his name, which he should attach to the safety switch, warning all not to throw in that switch as he is working on the machinery.

All overhead cranes should be equipped with sweep-brushes extending out from the truck wheels, sweeping the rails, the purpose being to warn a person resting his hand on the rail of the approach of the crane. The number of arms and hands lost by persons working on scaffolds along crane-runways, who thoughtlessly rest against the runway and fail to notice the approach of the crane, is appalling. Four instances have come to my personal knowledge within the past year where these brushes have prevented such accidents.

No man should ever be allowed to go onto an overhead crane runway without permission from his foreman, and then not until the cranemen have been notified and steps taken to protect him from the cranes while he is on the runway.

In going over the reports of State commissioners and factory inspectors it is found that one of the most prolific sources of accidents is electrical apparatus. It is necessarily hazardous in many of its branches, but much can be done to make conditions safer. The foregoing precautions in actual practice have materially reduced the number of these accidents in plants where they have been observed.

The Use of Arrow-Heads in Alternating-Current Vector Diagrams.

By A. S. Langsdorf.

It has been the observation of the writer that students of electrical engineering frequently have trouble in using vector diagrams to interpret the behavior of instruments in interlinked polyphase systems. There is a tendency in analyzing three-phase circuits to use such diagrams as though the vectors represent the space-phase displacements of the circuits involved, whereas they actually represent only the time-phase relations of the quantities themselves. According to the usual convention the vector is supposed to rotate at synchronous speed about one extremity (the unmarked end), so that its projection at any instant upon a fixed axis is the instantaneous value of the quantity represented; the arrowhead simply indicates the "positive," or rotating, end. Whether a given instantaneous value is to be taken as positive or negative will depend upon which *direction* in the circuit is regarded as positive. It is the consistent handling of this underlying assumption, commonly present by implication only, that is essential to a correct solution of the problems referred to. Otherwise stated, the student will find it advantageous to make a particular point of correlating the time relations between the vectors and the physical connections of the circuits in which they act. There is, of course, nothing new in the above statement nor in what follows, but it is thought that the point of view illustrated by a few examples will be found helpful by some students.

If two vectors, E_1 and E_2, Fig. 1, representing two e.m.fs. acting in the same circuit, have between them an angular time-displacement Θ, their resultant is E, according to the ordinary parallelogram law. The physical circuit corresponding to this case may be represented by Fig. 2, G_1 and G_2 being two alternators, or other sources of e.m.f., connected in series. It is well to call attention to the fact that the vector combination of E_1 and E_2 is justified only because these e.m.fs. act in the same circuit.

Suppose that G and M, Fig. 3, represent an alternator and a synchronous motor, respectively. At any instant the generated e.m.fs. of the two machines, with respect to the circuit connecting them, will be nearly opposite, as indicated by the arrows in Fig. 3 and by the vectors in Fig. 4. The resultant e.m.f. in the circuit of the two machines is then e. But suppose now that the two machines of Fig. 3 are alternators in parallel, supplying energy to the line LL, Fig. 5, and that at some general instant the e.m.fs. are physically directed as there indicated. With respect to the circuit LL the vector relation between the e.m.fs. of the two machines must in general be as shown in Fig. 6, e representing, as in Fig. 4, the e.m.f. in the local machine circuit; in Fig. 6, therefore, the parallelogram method of combining vectors (as illustrated in Fig. 1) apparently fails, in the sense that a different signification must be attributed to the arrowheads. Bearing in mind that the physical change from the condition of Fig. 3 to that of Fig. 5 is quite insensible, the difference between Figs. 4 and 6 is due entirely to the fact that the positive space direction in these two figures refers to different circuits. The correct combination of the "time" vectors thus

depends upon a consideration of the physical or space direction of the circuits involved.

Again, consider a three-phase, Y-connected winding, whose vector diagram is shown in Fig. 7. As is well known, the resultant of *Oa* and *Oc* is *ac*, not *Od*. The arrowheads on *a*, *b* and *c* are not to be taken literally, as in Fig. 1, but with due regard to the connections of the phase windings in which the e.m.fs. are generated. It must be remembered that the three vectors *a*, *b* and *c* are supposed to be rotating at synchronous speed about *O* as center, and that their projections on a fixed (vertical) axis are the instantaneous e.m.fs. generated in the three windings; moreover, the positive space directions of the e.m.fs. must be relatively the same in each of the three phases —either from line to neutral or from neutral to line—as demanded by the symmetry of the connections. Thus, if Fig. 8 is a bipolar alternator having three windings displaced from one another by 120 space-degrees, a symmetrical Y-grouping can be obtained only by joining the homologous terminals 1, 2, 3, or 1′, 2′, 3′, the three remaining terminals going to the line. Assuming that terminals 1′, 2′, 3′ are connected at *O*, the circuit from line 1 to line 3 is 1 — 1′ — *O* — 3′ — 3; if the direction from 1 to *O* is considered positive, that from *O* to 3 must be negative. Hence, to combine *Oa* and *Oc* (Fig. 7) one of them must be reversed. Assuming that *Oc* has been so reversed, the arrowhead on *ac* will be directed as shown in Fig. 7; though it might equally well be oppositely directed, corresponding to the reversal of *Oa* instead of *Oc;* but in either case the arrowheads on *ab* and *bc* must follow the same convention—that is, the vectors must be grouped in pairs and *in cyclical order*. This will result in the progressive direction of the arrowheads of the delta, Fig. 7, as must needs be the case from the fact that the sum of the instantaneous values of the line e.m.fs. must always be zero.

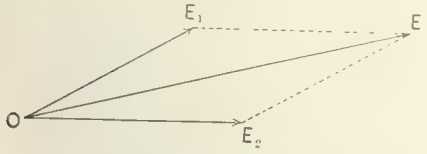


FIG. 1.—ORDINARY VECTOR COMBINATION.

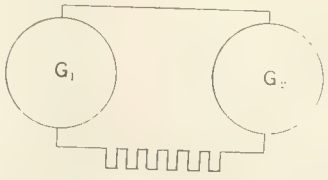


FIG. 2.—ALTERNATORS IN SERIES.

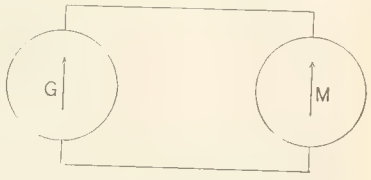


FIG. 3.—ALTERNATOR DRIVING SYNCHRONOUS MOTOR.

An interesting application of these simple principles is afforded in the case of power measurements in a balanced three-phase circuit supplying energy to an inductive load of power factor cos Θ. Let Fig. 9 represent the connections, *W* being an indicating wattmeter with its series coil in one lead and its shunt coil arranged for connection between that lead and each of the two remaining ones; and let Fig. 10 represent the time-phase relations between the various e.m.fs. and currents. Since current i_1 and e.m.f. $e_{1\text{-}3}$ appear in Fig. 10 with their arrowheads in the same general direction—that is, with an acute angle between them; and since i_1 and $e_{1\text{-}2}$ enclose similarly an obtuse angle, it would appear at first glance that the wattmeter would read, respectively, positive and negative with its potential coil across lines 1 — 3 and 1 — 2. Both readings are, however, of the same sign, provided cos Θ is greater than 0.5, which may be understood from the following considerations:

Considering a general instant when the current in line 1 is positive—that is, from left to right (Fig. 9) assume that when switch *S* is down the current in the shunt coil is likewise positive, and that this tends to produce a positive deflection of the instrument. This is equivalent to saying that the direction from line 3 to line 1 is the positive one; therefore, following the lines in cyclical order, the direction from line 1 to line 2 is also positive. But reference to Fig. 9 shows that when *S* is in the up position the direction from line 1 to line 2 through the volt-coil is from right to left, or negative; consequently, if the first reading is

$$W_1 = EI \cos (30 - \Theta),$$

the second will be

$$W_2 = EI \cos (30 + \Theta).$$

Similar methods may be employed in all the various cases that arise in modern switchboard practice in which shunt and series transformers are used in connection with indicating and integrating instruments. It then becomes possible to analyze the behavior of any combination and to design the connections for any desired result.

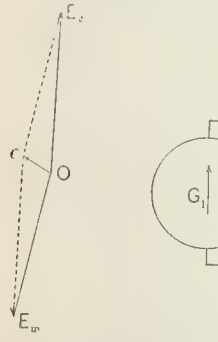


FIG. 4.—E.M.F. VECTORS.

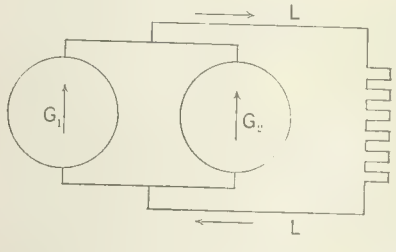
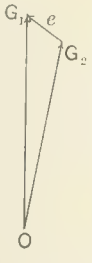
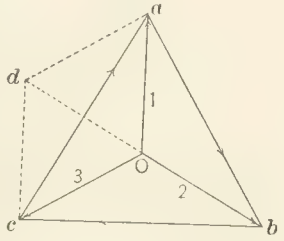


FIG. 5.—ALTERNATORS IN PARALLEL.





FIGS. 6 AND 7.—E.M.F. VECTORS.

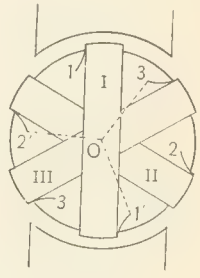


FIG. 8.—Y-CONNECTED ALTERNATOR.

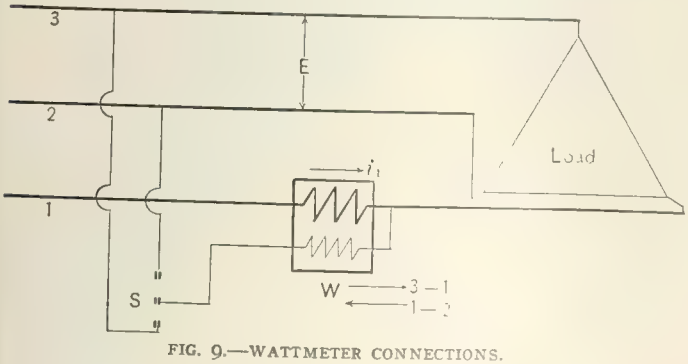


FIG. 9.—WATTMETER CONNECTIONS.

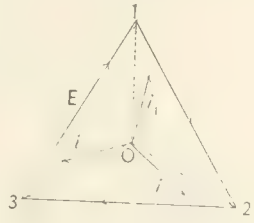


FIG. 10.—TIME-PHASE RELATIONS.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Greenhouse Advertises Itself by Electric Light.

An enterprising florist in Evanston, Ill., calls attention to his business at night by simply illuminating his greenhouse by tungsten lamps and letting the lights burn until 10 p. m., when they are turned out by a private watchman. Sixteen 60-watt lamps are used, and the light shining through the glass makes the building conspicuous and apparently "on the job," to use a slang phrase. There is light enough to readily read the florist's sign.

The greenhouse is not on a main street, but it is on the line of the Chicago & Milwaukee Electric Railway, and passengers on that road cannot fail to see the brightly illuminated glass structure. Attention is thus directed to the proprietor's business and he is well satisfied with the experiment. The North Shore Electric Company supplies the electricity, the rate being 10 cents per kw-hour for this service.

Electric Iron Campaign in Baltimore.

A vigorous campaign is being made by the Consolidated Gas, Electric Light & Power Company, of Baltimore, for the sale of electric heating units, more particularly electric irons. A hustling force of solicitors has been given separate districts covering the company's customers in its endeavors to introduce these irons into the households of the many users of electricity. A house-to-house canvass has been made, the solicitor with the sample iron ready to prove to the "czars of the laundry" what these wonderful units will really do toward making the summer ironing day one "of beauty and a joy forever."

The policy of the company in leaving the irons on a 30-day trial is meeting with favor on all sides, and the price at which the units are ultimately sold is so low as to bring them within the reach of the most humble householder. The most popular is a 6-lb. iron selling for $3, either cash or in three monthly payments, as the purchaser may elect, payments beginning upon rendition of the first bill following the expiration of the 30-day trial; these special prices have been made only for a limited period.

The company has other methods of bringing this sale to the attention of the public, one by its electric bulletin sign, lighted nightly, whereon the cost and merit of this iron are brilliantly set forth; the other through its main office and showroom where the units are on display to all those who may either seek information or desire to pay their monthly bills.

Although much criticism on account of the low price of the irons, which would ordinarily sell for $5, has been heard from jobbers and contractors, who maintain that the selling of supplies should be separate and distinct from the lighting business and should not be encroached upon by the central station, yet the company believes that the irons are not only increasing the daily energy consumption, but are creating a demand for something by which the electrical contractor and jobber will ultimately reap the benefit.

Gas Lighting Superseded by Tungsten Lamps.

A recent addition to the growing list of mercantile establishments where tungsten lamps have supplanted gas light is afforded by Rosenberg's department store in Evanston, Ill. Formerly this establishment was lighted by a variety of lamps, including arc lamps, glower lamps, ordinary incandescents and 76 gas lamps. But the owner has entirely changed his lighting equipment, using tungsten lamps throughout and taking out all other sources of illumination. The store is now lighted by 90 four-light tungsten clusters, the lamps being of the 60-watt size. There are also about 100 60-watt tungsten lamps in the 250 ft. of show windows which form a part of the store. The proprietor redecorated his ceiling to get the best surface for lighting reflection when making the change. He makes his own lamp renewals. He now has no gas bill at all for lighting, and although his bill for electricity has been increased about 50 per cent, he nevertheless is making a saving of about $60 a month in his lighting bills. The North Shore Electric Company supplies the electrical energy, and is also pleased at the change, getting a long-hour customer who uses nothing but electricity. The store is uniformly and brightly lighted by the tungsten lamps.

Protection from Lightning.

At the Ohio Electric Light Association convention, July 14, Prof. E. E. F. Creighton, of the General Electric Company, gave a talk, accompanied with demonstrations, on "Methods of Protecting Apparatus from Lightning." He said that the static charge which accumulates on lines by the passing of hail, rain, fog and dust across the wires is easy to dispose of simply by placing a very high resistance between lines and ground, which is sufficient to drain off the static charge as fast as it accumulates. He mentioned one peculiarity of resistance sticks of graphite. These show a lower resistance the higher the voltages that are applied to them. This is supposed to be because the graphite resistance stick is really a conglomeration of conductors, mixed in with non-conducting material, and when high voltages are applied the current jumps across at more points than with a low-voltage applied.

The apparatus which Professor Creighton had for demonstration consisted of an induction coil capable of giving a 16-in. spark. For the purpose of showing the effect of lightning discharges which are of very high frequency, this coil had its terminals connected to Leyden jars and the other terminals of these jars were connected to the needle points which were used for indicating the discharge voltages during the tests. The frequency of the oscillations in the discharge thus produced, he said, was approximately twice that obtained with lightning discharges. The frequency of lightning discharges is usually considered to be between 500,000 and 1,000,000 vibrations per second.

A small choke coil was connected in shunt with the needle points, and he moved the needles together until a discharge took place. The length of this discharge is a measure of the resistance offered to the passage of the high-frequency discharge.

It was shown that even with one or two turns of a choke coil in shunt with a spark-gap the discharge would jump over a considerable gap rather than round these turns, thus strikingly illustrating the efficacy of choke coils in circuits between apparatus and lightning arresters. These choke coils, although having but little effect on the low-frequency dynamo current, have a very pronounced effect on high-frequency lightning discharges. A spark 0.5 in. long was obtained in shunt with a 7-in. loop of wire, thus showing that the high frequencies employed in this test would jump 0.5 in. before going around a 7-in. loop. Other demonstrations along the same line were given. He explained that in any arrester of the type which depends on sparking between metals there will be a heavy flow of dynamo current if there is sufficient discharge to volatilize much metal.

In answer to questions following his demonstrations, Professor Creighton said that the multi-gap arrester is sensitive to lightning discharges, but not to the surges which take place due to short-circuits. At the present time lightning arresters in

stations are desirable for the protection of apparatus, but it is not commercial to use them all along transmission lines. The multi-gap arrester is the preferable form for low-tension distributing circuits, and the aluminum cell for high-tension transmission lines.

Answering a question as to the effectiveness of the horn spark-gap arrester with the resistance in series to limit the current, he said that if enough resistance is placed in series to prevent the shutting down of the system by the excessive line current following the discharge, the resistance would be so great that it would not allow a sufficient flow to dispose of the discharge of lightning properly. The aluminum cell arrester, on the other hand, is like a safety valve in that it allows no discharge up to a certain voltage, and offers a very low resistance path to the discharge in excess of the predetermined voltage. This prevents an excess of current on the generator, because the only current flowing through the arrester is the excess caused by the lightning discharge.

INTERIOR WIRING AND ILLUMINATION

Special Electric Illumination at Salem, Mass.

Electricity contributed largely to the enjoyment of Old Home Week this year at Salem, Mass. The Salem Electric Lighting Company installed about 3500 extra incandescent lamps in the park and residential districts, notably at Salem Willows and Juniper.

The new U. S. scout cruiser *Salem,* which lay off shore a few hundred feet, was also specially illuminated. A crowd of about 50,000 persons witnessed the special electric lighting, which included a large amount of store-window work. The company made extra preparations to carry the additional load without interruptions, and not the slightest difficulty in this direction was encountered. General Manager S. Fred Smith states that a still larger load could have been handled satisfactorily.

Meter Location.

By G. E. Palmer.

The necessity of maintaining apparatus of a delicate nature on premises not controlled by the operator has contributed largely to the unsatisfactory results attending the use of watt-hour meters, as the successful operation of this class of electrical apparatus is dependent entirely upon frequent and accurate testing.

As the subject of properly metering the use of electricity is at present one of the most important engineering and operating problems confronting the central stations of the country, it appears that a discussion of this subject will be of more than passing interest.

As the purpose of this article is more to comment on the prevailing poor conditions rather than attempt an academic discussion of the subject, it is merely necessary to touch, in a very perfunctory way, on the prime causes of meter inaccuracies.

Briefly considered, there are a number of meters on the market of standard design and manufacture that, when properly installed and regulated, measure the use of electricity with greater accuracy than will be found in any commercial measuring apparatus in general use. That these results do not obtain in ordinary practice is evidenced by the fact that a combined record of all obtainable tests gives an average of 8 per cent loss on all speeds of meters for the entire country—results that show conclusively a lack of frequent and proper testing.

Assuming the cost of the generating equipment to be $12 and of the metering equipment $8 per kw—figures that are practically correct for stations of moderate size—it is a wonder how the foundation or setting for watt-hour meters could have been so generally forgotten when so much ability has been brought to bear on the subject of generator locations. Both devices have rotating elements and depend upon perfect bearings and lubrication and freedom from dampness and dirt to insure their proper operation: both require the most skilful adjustment before they are placed in service and, in addition to these similar characteristics, the watt-hour meter must perform its duty perfectly through all ranges of speed and should be able to perform its regular functions when the generating equipment is not maintaining ideal conditions of potential and frequency.

For a number of years meter locations have been generally improved, but with the exception of a few of the larger companies, the general practice has been to mount the meter on a wooden board supported on a wall or partition of the customer's premises and as nearly as possible to the service entrance. Then it was demanded of the contractor that a loop be left which would enable the station wireman, assited by a blow-torch, two kinds of tape and a few feet of flexible conduit, to complete a job of meter connection that would be a credit to the workman only until after the meter had been subjected to the regular installation and commercial test.

It is quite true that a number of central stations insist that a definite arrangement of meter leads be maintained, but when an open-wire system is in vogue the maintenance of appearance in this wiring adds very materially to the cost of meter inspection.

The meter, placed on wood, is subjected to the strains due to the effect of changes in temperature and the gradual shrinkage of its base; its wires are exposed to illegal manipulation and any attempt to give its connections an orderly appearance simply makes more delay to the operation of testing.

It surely seems that such an expensive piece of apparatus as the electric meter should have a more definite location than is ordinarily accorded it, and it is interesting to note that a number of manufacturers are in the market with devices designed to facilitate the installation, test and replacement of meters. All of the devices examined by the writer are certainly steps in the right direction. The most essential features in an arrangement for this purpose should include terminals for service and house wires that may be approached from any direction without crossing leads, and terminals to which the meter leads may be readily connected or disconnected; a base or location on which it is possible to set any meter within the probable wants of the service without making any changes in the wiring, means for testing without interfering with the wiring or the customer's use of electricity, and an enclosing box that will allow the service wires to be carried in conduit into and out of the meter so that neither the meter nor connecting wires may be altered without breaking the seal.

When the meter is provided with the above surroundings and accessories it is practicable for the meter-testing force to improve greatly the quality of their work and so reduce the cost of meter testing that it is possible to make more frequent tests when they may be found necessary without increasing the cost of the department. Furthermore, meters can be quickly replaced without the use of any tool other than a screw-driver, and as tests may be made without interfering with the customer's lamps in service, the meter-testing force is not compelled to work on a short-hour schedule during the winter months.

It is to be noted also that the subject of energy theft ceases to be a topic of vital interest when all wires on the line side of the meters are protected by a conduit in such a manner that it is possible to obtain unmetered service only by manipulating the seals on the meter itself.

During the coming year a great deal of work will be done in improving the condition of meter location, and the next annual report of the meter committee of the National Electric Light Association in a further elaboration of this very interesting subject will probably contain much valuable information along the lines indicated above.

Wiring for Vacuum Cleaning Apparatus.

There are at present on the market very many portable vacuum cleaners driven by electric motors the energy requirements for which are only vaguely known. In pushing the sale of such devices, the manufacturers place stress on the fact that the apparatus can be connected to any convenient lamp receptacle, and, in the majority of cases, a suitable length of flexible cord and a screw plug form part of the outfit. While there should be no doubt as to the amount of current taken by the motor, the code calling for a statement of current requirements on the name plate, the fact remains that the size of the motor is not taken into consideration at all and the vacuum cleaner is connected to a lighting fixture in whatever room it chances to be placed. Where the ordinary fan motor forms parts of the vacuum cleaner, the apparatus is not likely to consume more current than the standard key socket is designed to carry, and no hazard results. Larger sizes, however, should be provided with separate circuits, or where heating circuits are installed, should be connected to the latter. Where the vacuum cleaning apparatus is installed in a cellar and has pipe lines leading from it to various portions of the dwelling, the contractor is careful to provide sufficient copper in the circuit to carry the load. It is the portable device that sometimes causes trouble because of excess current requirements. Such devices should preferably be fed from base receptacles with stab plugs. With the appearance of innumerable household electrical devices, the need of two circuits in houses becomes more apparent. New dwellings should be equipped with straight lighting circuits and an auxiliary circuit of much heavier wire which will permit of the installation of heating apparatus, vacuum cleaning apparatus, or any other of the numerous motor-driven household devices. By using a stab-plug, instead of a screw plug, rupture of the wires through undue pulling or sudden strain is avoided.

New Telephone Patents.

AUTOMATIC SYSTEMS.

Suitable provision has been made for both direct and party lines, but the problem with the private branch exchange is quite different, in that the whole series of trunks is designated by the call number of the lowest numbered trunk. In order to get the benefit of the choice of trunks it is, of course, necessary that the automatic switchboard shall select any of the group of trunks represented by the private branch exchange number, and Mr. E. C. Molina, of Arlington, Mass., has now patented a system providing for this feature. In his system the circuits may be so arranged that in case of a call for a group of lines represented by one number the connecting apparatus arriving at this number, if this be busy, automatically proceeds to the first non-busy trunk of the group. Mr. Molina has assigned it to the American Telephone & Telegraph Company.

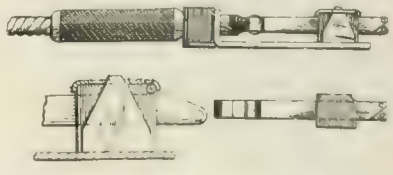
Another patent relating to automatic systems is that granted to Mr. S. H. Brown, of Pittsburgh, this patent being also assigned to the American Telephone & Telegraph Company. This system is of the call distributing type—a form of semi-automatic system. The subscribers' lines terminate in two sets of apparatus—first, a series of jacks such as is common in manual board; and second, an automatic connecting switch. When the subscriber takes his receiver from the hook the automatic switch operates to select a non-busy trunk. These trunks terminate in cords and plugs in front of a manual operator before whom the subscriber's jacks are displayed. The arrival of a call on a trunk is indicated by a calling signal, and the operator, responding and learning the subscriber's desires, completes the connection in the usual way, using the trunk plug. The circuits are so designed as to provide a complete and protecting busy test system. Upon the completion of the call the subscriber's connector restores and sets a disconnect signal.

MISCELLANEOUS CIRCUITS.

As a means of selecting a desired circuit on a multi-party line, Mr. N. S. McClure, of Healdsburg, Cal., has introduced a modification of the usual electric indicating meter. The selecting devices at all stations include the features of the usual volt or ammeter—a moving coil in a permanent magnetic field, driving an indicator over a dial. The indicator in this case carries a contact bar at its point, while on each dial there is mounted two contacts and solenoid, radially disposed. When it is desired to select any line, the current controller at the sending station is adjusted until its indicator shows the desired line. All indicators move freely above their dials, out of contact therewith, and, being connected together and properly adjusted, they work in synchronism with the indicator at the sending station and, therefore, all indicate this same desired station. The solenoid circuit is now energized and this, acting upon the indicator at the desired station (the indicators being of magnetic material) draw it down upon the dial. This connects in the desired station only, each station having its contacts angularly disposed to correspond to the numbering of the dial.

Mr. R. H. Manson, of Elyria, Ohio, has obtained a patent for a control device for automatic central office ringing circuits, and has assigned it to the Dean Electric Company. The control lies in a thermal relay. This relay may be of the hot-wire type, so arranged that the contact is either opened or closed with the heating of the wire. A combination of resistance and retardation coils and a condenser shunt may be included in the circuit in such a way that the hot-wire relay acts with exactly the same time element with either the alternating ringing current during the ringing period or the direct battery current during the silent period. In Mr. Manson's adaptation a revolving commutator alternately feeds to the ringing circuit alternating and direct current, with the result that the subscriber's bell is operated intermittently. The circuit is maintained through an auxiliary locking relay, the lock circuit, in turn, being controlled by the contact of the thermal relay. The rush of current following the removing of the subscriber's hook, whether during the ringing or silent period, causes the thermal relay to operate, unlocking the control relay and restoring the circuits to normal.

A combined fire alarm and telephone system forms the subject of a patent granted to J. M. Latimer, of Flushing, New York, his patent being assigned to the Consolidated Fire Alarm Company. The invention contemplates the parallel use of the two-line limbs of a telephone line for the sending of fire alarm signals while the two limbs are used in series for the ordinary telephone messages. The fire alarm is received on a register through the agency of a differential relay, which relay is differential only for the two-line limbs in series and cumulative when operated in parallel to ground in transmitting the fire-alarm signals. The telephone line is inoperative for conversation at the exact moment of transmission of a fire-alarm signal,



DETAILS OF TELEPHONE JACK.

but the attempted use of the telephone at this instant does not interfere with the proper transmission of the firm-alarm signal.

NEW APPARATUS.

It has usually been customary, where space was an essential feature, to mount switchboard jacks in strips, which plan has necessitated the dismantling of a whole strip of jacks wherever it was necessary to repair one. Mr. A. L. Sohm, of Whittier, Cal., has devised a jack which is readily removable from the jack strip and which is shown in section in Fig. 1. The jack springs are asembled on an insulated mounting, which may be pushed into position between the base plate of the jack strip and a bridge plate. The front edge of the bridge plate is turned down so as to limit accurately the forward motion of the spring elements. Small portions of the back edge of the bridge plate (those portions lying between the jack units) are bent down so that a wire may be slipped longitudinally behind them in a way to lock the jack units securely in position. Mr. Sohm has assigned his patent to the National Electric Works.

Letters to the Editors.

The Value of German in Engineering Education.

To the Editors of Electrical World:

Sirs:—Much has been said of late regarding the education of engineers and some surprising statements were made in discussing Dr. Steinmetz's A. I. E. E. Frontenac paper on "The Value of Classics in Engineering Education," notably a statement by one speaker that scarcely one graduate in 10,000 has any real use for German, and who, furthermore, considered that a knowledge of Spanish is the more important. In regard to the latter statement every one will agree with him that if the only object of engineering education is to transact business in Spanish-speaking countries, the mastering of the Spanish language is the key to at least the commercial side of engineering education. Germany has long recognized and systematically applied this theory for the exploitation of engineering propositions, and we find German engineers to-day the world over, and particularly in South America and Mexico. That German literature and acquaintance with German methods of doing things are of great importance to the engineering profession is evidenced by the fact that several of the foremost hydraulic developments cover the use of machinery originated or built in German-speaking countries; to quote Mead's "Water Power Engineering," "Practical turbine analysis has not been treated except in a most general way in any publication except the various German treatises on the turbine, in which the subject is discussed from the basis of turbine design." Now, if our engineers had proper knowledge of the German literature and theory many of these plants would have been equipped with machinery of American make and manufacturers would not have been forced to make use of German designs and pay high royalties to German talent.

What, it may be asked in passing, would become of the allied branch of chemistry if it were not for German literature? Due to this lack of knowledge on the part of our engineers we remain several years behind German progress, as the translation of German engineering books is only accomplished many years after the original edition is issued. In this connection it must not be lost sight of that much of the matter of these works appears initially in the leading German periodicals which, while they are often seen in this country, cannot be properly digested without a good knowledge of the language. Cases have been known where the use of diagrams and formulas from such sources has been attempted without an understanding of the descriptive matter.

To furnish a very striking example of what the lack of knowledge of German may lead to, the following case is cited: In October, 1907, a paper was discussed before the A. I. E. E. on "The Practicability of Large Generators Wound for 22,000 Volts." During this discussion reference was frequently made to 15,000 and 20,000-volt installations on the Continent of Europe which had actually been in use for five years and over, but the opinion prevailed in the discussion that such high-voltage generators for transmission systems, without transformers, were not practical. At this very time there had already been in successful operation on the Continent of Europe for about a year in connection with a 15-mile transmission system and without the use of transformers four 5200-kw generators of 30,000 volts. It is amusing to note that a British periodical, commenting on this paper, made a statement to the effect that America is about to bring out an innovation in the form of a 22,000-volt generator now building and that great developments are soon to be expected from America.

As an indication that English-speaking engineers need very much to adopt German theories and methods, I may quote a few sentences from a recent speech in the British Parliament: "One of our greatest failures is that less than 1 per cent of our engineers and officers understand the German language; everything that we wish to know of German progress must come to use second-hand in insufficient and delayed translation; to-day we are at a point where Germany is able to build ten ships against our one; we have to learn to imitate Germany."

In the light of these remarks and bearing in mind that England formerly was far ahead of Germany in engineering, it is rather surprising that engineers who ought to lead the profession in bringing about broader education seemingly consider only the direct money question and do not look far enough into the future.

We evidently cannot afford to ignore Germany. Was it not German skill, pure and simple, which recently gave our English cousins "sleepless nights and made whole England shiver?" Germany quietly ignored this talk about the German invasion, but, nevertheless, continues to invade Great Britain and its colonies with its engineering skill and broad methods generally.

Progress in the engineering profession is certainly stimulated by the interchange of American and European ideas and methods and, as Germany leads Europe, German, next to English, is the foremost language to be considered in our engineering education.

New York. Frank Koester.

Location of Vessels by Wireless Telegraphy.

To the Editors of Electrical World:

Sirs:—In your issue of July 22 Mr. B. Gati points out the advantages of his method for determining the location of vessels from other ships, using the variation with distance of the received wave energy.

If a disabled ship knows her own position she will, of course, telegraph it to the rescuer, it being very unlikely that the operator aboard the former should be disabled before his instruments are. In case the crippled vessel is fog-bound all that is necessary is an indication of her bearing aboard the assisting boat, in which case the latter will arrive just as quickly as if she knew the distance to be traversed. I shall uphold my arguments in the order first presented.

First, the exact quantitative measurement is undesirable because of the fineness of the readings required in order to give a reasonably accurate result. Mr. Gati, in his article of April 29, shows that the movement of a vessel from a distance of 50 km. to 47 km. may cause a change of 12.7 microamperes in the received current. This means a change in the meter scale of about 1.6 deg. It is doubtful whether an operator can read such a small increment on a rolling, vibrating ship with sufficient accuracy to enable the correct position to be obtained. In practice the distance between the two ships is apt to be two or three times the above mentioned.

Second, the relative delicacy of an instrument is a function of both the mechanical construction and the conditions under which it is used. A device which has a moving member operating on a fraction of a micro-watt may surely be termed delicate for shipboard use.

Third, regarding the variation of signals Mr. Gati says: "One can see at once whether a reading is extraordinarily devious." There are a number of causes which may change the magnitude of signals, either quickly or slowly, making comparative readings unreliable. For instance, take the *Republic* disaster, where the energy was supplied by ever-weakening storage cells; in this case it would have been impossible to correct for the decline, and repeated measurements would have been almost useless. Also it is well known that the energy emitted in any one direction from a "flat top" aerial varies with the orientation of the vessel; thus a comparison between the successive readings and the movement of the helping ship may lead to an erroneous result, for the effect caused by the turning of the transmitter may either add to or subtract from the effect produced by the rescuer's motion.

Fourth, from the statement that "interfering signals can be seen" on the scale of the meter, it seems probable that Mr.

Gati is not acquainted with conditions existing in a congested wireless zone where there may be a number of sets of signals overlapping at the same time, making the current changes very irregular. Moreover, one cannot assign any definite value to the signals for a short period of time because the combining of the various characteristics of the code results in an ever-changing effective current value. In tropical climates where intense aerial disturbances are almost continuous for about 12 hours out of every day during the summer months, exact measurement during these "Xs" is an absolute impossibility.

If it is desired to find the geographical position of a steamer two other stations could each determine her bearing and the location be found by the intersection of these two lines.

The ability to locate accurately vessels by electric waves is a feat worth striving for, but, although the method of the comparison of relative quantitative measurements is possible, it hardly seems feasible under such uncertain conditions.

Brooklyn, N. Y. L. Espenschied.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the current periodical press of the world

Generators, Motors and Transformers.

Direct-Current Turbo-Dynamos.—E. Ziehl.—A paper read before the German Association of Electrical Engineers. The author explains that not considerations of mechanical strength, but the electric difficulties of getting sparkless commutation, prevent the building of direct-current machines suitable for direct connection with steam turbines when running at the usual high speeds. The tendency of steam-turbine designers should be to reduce as much as possible the speed of their turbines. Fig. 1 shows comparative curves of the cost of

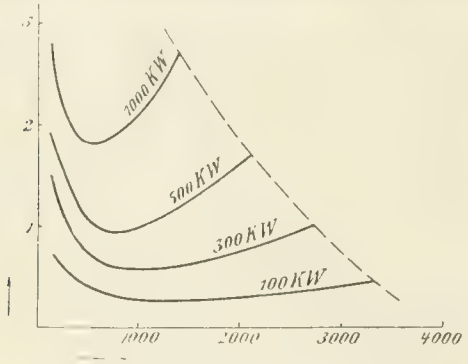


FIG. 1.—COMPARATIVE COST CURVES.

manufacturing direct-current dynamos of 100, 300, 500 and 1000 kw as function of the speed. The abscissas represent the revolutions per minute. The ordinates give relative values of cost of manufacture. The curves all show a distinct minimum for speeds which are far below those usual with steam turbines. The dotted line represents present practice of speed with steam turbines. By building them for lower speeds the cost of the electrical machines can be reduced by 50 or 30 per cent. The author then discusses special arrangements for getting sparkless commutation and compares interpole machines with perfectly compensated machines. His conclusions are in favor of the perfectly compensated machine.—*Elek. Zeit.*, July 15.

Artificial Load for Transformers.—G. Benischke.—An illustrated description of a simple method of self-loading of a transformer, if one of the two windings can be subdivided into two parts. The method is illustrated in Fig. 2, where J_1 is the primary winding and J_2 the secondary winding. The latter can be divided into two parts, *a* and *b*, and these are connected in parallel as shown. If the e.m.fs. in both are exactly equal, no current will pass them. But if one has a larger e.m.f. than the other, a balancing current passes between the two which is directly proportional to the differences of the e.m.fs. and inversely proportional to the apparent resistance consisting of ohmic resistances and reactance. Such a balancing current is produced by adding a few windings as indicated by *c* in the illustration. By properly selecting the number of additional windings the current in J_2 can be made to assume any value. To this secondary current J_2 corresponds a current J_1 in the primary winding, while the required additional e.m.f. equals the short-circuit voltage at the existing current strengths. The power furnished by the primary current consists only of the losses in the transformer and can be measured directly. The power factor depends on this power and on the reactance of the stray fluxes of both windings. To increase it ohmic resistance must be inserted in the secondary conductors *a* and *b*. To diminish it inductance must be added. Of course, some additional windings must be then employed.—*Elek. und Masch.* (Vienna), July 4.

Direct-Current Series Motors.—F. B. Crocker and M. Arendt.—The first part of an illustrated elementary article on direct-current series motors. The authors discuss the speed-current curve, the torque-current curve, the horse-power-current curve, the efficiency-current curve and the speed-tractive effort curve.—*Gen. Elec. Review,* August.

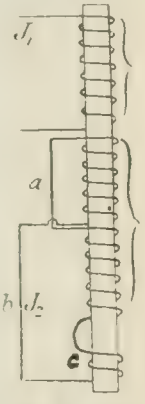


FIG. 2.—ARTIFICIAL LOAD FOR TRANSFORMERS.

Lamps and Lighting.

Metallic-Filament Lamp.—A note on a British-made metallic-filament lamp having the trade name of "Royal Ediswan Metfil." "While the efficiency of the Royal Ediswan Metfil may be taken as being as high as that of any other metallic-filament lamp on the market, the useful life is not less than 1000 hours." The lamp does not blacken even though it may burn for three or four times the normal life. Further, the filaments are not fragile. They are so arranged that they are supported throughout their entire length, so that the lamp may be used in any position. The lamp is made for use on voltages up to 200 or 250.—Lond. *Electrician,* July 9.

Tungsten Lamps.—F. W. Willcox.—An article giving some notes on the manufacture of the tungsten lamp, also comparative tables and diagrams of the behavior of carbon, graphitized carbon, tantalum and tungsten lamps.—*Gen. Elec. Review,* July.

Street Lighting in London.—A deputation appointed by the streets committee of the Corporation of London has visited several towns in continental Europe and has recommended the use of high-pressure inverted gas lamps, centrally hung, with lowering gear, for the lighting of the city of London. The streets committee has not adopted the report, but has merely issued it without offering any opinion on its suggestions. —Lond. *Electrician,* July 16; *Elec. Eng'ing,* July 15.

Generation, Transmission and Distribution.

French Water-Power Station.—A. Soulier.—An illustrated description of the hydro-electric power station of the Vis River which forms part of the extended network of electric transmission systems in Southern France along the Mediterranean coast. A fall of 107 meters of the Vis, which is a tributary of the Herault, is utilized. There are five turbines, each of 1000 hp, and each driving a three-phase, 3000-volt, 50-cycle alternator. The voltage is raised to 30,000 for transmission to a substation at Sommieres, where the voltage is again reduced to 13,500 for distribution to the surrounding districts. This substation is also interconnected with two other generating plants in the neighborhood.—*L'Industrie Elec.*, July 10.

Water-Power Plant in Italy.—Some notes on a new large water-power plant scheme in Northern Italy. Power is obtained from the Rivers Toce and Devero at three points in the vicinity respectively of Foppiano, Goglio and Verampio, in Northern Italy. From these three generating stations energy is taken over high-pressure transmission lines to a transforming and distributing station at Novaro, whence is fed an extensive network in the surrounding neighborhood. The three generating plants will have a capacity of 10,000, 20,000 and 20,000 hp, respectively. The transmission voltage is 50,000, the length of the transmission line to the substation is 68 miles. At the substation the voltage is reduced to 25,000, at which pressure the current is supplied to the distributing network. Adjoining the substation itself is an auxiliary steam station, in which plant to a capacity of 6000 hp is already installed, but foundations are provided to accommodate extensions aggregating 18,000 hp.—Lond. *Elec. Eng'ing,* July 15.

Winding in Mines.—A note on the Iffland system of electric winding employed at the potassium salt mine Friedrichwerke in Germany. The generating station at this place contains two tandem steam engines, one of which has an output of from 900 hp to 1200 hp and the other from 450 hp to 600 hp, when running at 107 r.p.m. Both of these are coupled to three-phase generators, which supply energy at 2200 volts for lighting and other purposes. Another small steam engine, having an output of 150 hp, is also coupled to a three-phase generator. For excitation purposes use is made of three three-phase, continuous-current motor-generators, which are connected to an exciter battery. When the generating machinery is shut down the battery can supply energy to the network through these machines. The depth of the shaft at these mines is 900 ft., and 75 tons have to be drawn up per hour. The winding motor, which is coupled to a Keepe pulley, 20 ft. in diameter, is supplied with energy from a controlling dynamo, whose pressure varies between + 500 and — 500 volts. This dynamo is permanently connected to a booster which can supply 1030 amp at 500 volts in connection with a battery of 236 cells. The whole of these sets, consisting of the controlling dynamo and the booster, can be connected with either of the steam engines. When the load comes on suddenly the booster begins operating, being driven by the battery as a motor, and assists the steam engine in driving the controlling dynamo. When the brakes are put on the booster works as a generator and supplies energy to the battery, so that the steam engine works at a constant load A special transforming arrangement, as used in the Ilgner system, is, therefore, unnecessary. In order that the booster may work in the way stated above, its voltage must be dependent on the load on the winding motor. This is effected by using a second dynamo, which is connected to the field circuit of the booster and is excited in proportion to the load on the winding motor. For bringing the winding motor to rest a compressed air brake with two cylinders is used. The necessary air is supplied by a small compressor worked by a 500-volt, direct-current motor.—Lond. *Electrician,* July 9.

Electricity in Coal Mines.—R. Nelson.—A paper in which the author describes the difficulties experienced in employing electrical apparatus in coal mines and makes suggestions for meeting them. For this purpose he considers separately cables and transmission system, switch gear, motors and transformers, and lighting.—Lond. *Electrician,* July 9.

Water-Power Plant in Asia.—S. Orling.—An illustrated description of the Jhelum water-power installation in Kashmir. The generator plant consists of four three-phase, 25-cycle, six-pole, 1000-kw, 500 r.p.m., 2300-volt, revolving-field generators and two six-pole, 150-kw, 500 r.p.m., 125-volt exciters. For transmission the voltage is stepped up to 60,000 or 30,000 volts. There are two transmission lines, one 20 miles long and the other 50 miles long. An electrically driven dredging plant is supplied with power from the river. The article is to be continued.—*Gen. Elec. Review,* July.

Traction.

London Tramways.—The accounts of the London County Council tramways for the year to March 31 show a net profit of $537,850 after meeting capital charges. The whole of this has been added to renewals account, $93,925 being in respect of the amounts which ought to have been added to this account in past years. The total expenses were 13.48 cents per car-mile and the total receipts 23.6 cents per car-mile.—Lond. *Elec. Eng'ing,* July 22.

Liverpool Tramways.—An illustrated abstract of last year's financial report of the municipal tramways of Liverpool. The total working expenses per car-mile, not including interest and amortization, were 15.72 cents in 1908 (against 15.64 cents in 1907), including all charges. The total expenses, including capital charges, were 20.26 cents in 1908 (against 20.20 cents in 1907). The revenue per car-mile was 22.08 cents (against 22.48 cents in 1907).—Lond. *Electrician,* July 16.

Installations, Systems and Appliances.

Berlin Electricity Works.—A review of the development of the Berlin Electricity Works during the 25 years of their existence. The first Berlin central station was opened in 1885, with 900 hp, while the company now has steam engines of an aggregate capacity of 163,450 hp. The connections (originally only for lighting) have increased from 268 kw to 153,947 kw; the capacity of motors connected to the station from 7.5 kw in 1888 to 86,291 kw in 1908. In the year 1900 the capacity of the motor connections became greater than that of the connections for lighting. The number of kw-hours sold per year has increased by 550 per cent in the last 10 years; 37,080 kw-hours were sold in 1885 and 150,615,704 kw-hours in 1907-8. Two and 37 per cent respectively of these figures were consumed "for industrial purposes." If the consumption of street railways is included, the last-named figure of 37 per cent is raised to 73 per cent. The total number of kw-hours generated during the last 25 years by the Berlin Electricity Works is esimated at 1,316,000,000 kw-hours. At the end of 1907-8 the company had in Berlin and suburbs 22,244 customers with 914,399 incandescent lamps, 38,390 arc lamps, 3998 "apparatus" and 23,664 motors (89,419 hp). The number of employees of the Berlin Electricity Works was 191 in 1888 and 1585 in 1908. The tariff for electrical energy has greatly changed. According to the very first tariff, 1 cent was charged for each 16-cp lamp-hour, while for every installed incandescent lamp (including first cost and renewal) $1.50 was charged a year. On the bill for lamp-hours the company allowed a discount from 5 to 25 per cent, but charged a meter rate of $3.75 to $10 per year. For a mean of 600 lamp-hours per year the cost of the lamp-hour was 1.257 cents; the lamps consumed 5 watts per candle-power at that time. Hence the cost of the kw-hour was almost 16 cents. At that time I km of coal produced 325 watt-hours (average for a year), while the same amount of fuel now produces 965 watt-hours in the latest Berlin central station (Rummelsburg). Beginning with 1890 the company allowed a discount of 10 per cent on the fundamental rate of 1 cent per lamp-hour. Beginning with 1896 the bills were based on the kw-hour with a fundamental rate of 15 cents, which was reduced to 13.75 cents in 1899 (at the same time abolishing the meter rate). The rate was further reduced to 10 cents in 1904. The fundamental charge per lamp installed ($1.50 for each incandescent lamp and $10 for each arc lamp) was also reduced gradually down to 25 cents and $1.75, respectively, in 1895. At the latter time it was entirely abolished. The prices of the kw-hour for power purposes was 5 cents from 1890 to 1895 in the city of Berlin; then it was reduced to 4 cents and in the suburbs (three-phase) to 2.75 cents with underground cables and 2.5 cents for overhead wires. The ratio for the total kw-hours sold per year to maximum load in kilowatts was 1025 hours in 1888 and 2860 hours during the last year.—*Elek. Zeit.,* July 22.

Diversity Factor Among Lighting Consumers.—F. Fernie.—On a particular alternating-current network groups of consumers are supplied from transformers, the network supplied by each transformer being independent of the remainder. The ratio of the total connected kilowatts to the capacity of transformer in kilowatts has been worked out by the author for 60 such transformers. This ratio is plotted against the number

of consumers supplied by each transformer in a diagram. For values of x above 5 the diagram is represented by the formula $y = 2.6 \log x$ is derived, where y is the ratio of the total kilowatts connected to the maximum load and x the number of consumers. If every individual consumer's maximum load was equal to his total possible or connected load, then y would represent the diversity factor. Since, however, each consumer's maximum load is nearly always (for private houses) less than his possible load, y must equal the diversity factor multiplied by some number A. The diversity factor equals therefore 2.6 $\log x$ divided by A. A is the average value of the ratios of the connected kilowatts to the maximum demand of all the consumers and is thus approximately a constant. Taking A to be 1.5, the diversity factor becomes 1.7 $\log x$. The author then shows diagrammatically the reduction in the (general) diversity factor by adding a shop lighting load to a private house lighting load. The private house diversity factor is assumed as 3 and the shop diversity factor as 1. If the shop and private house maximum loads are equal, the diversity factor is half what its value would be if the load consisted of private houses only. The author concludes that the price per unit charged by any supply authority for lighting must depend on what proportion the shop lighting bears to the total lighting. Both on account of diversity factor and load factor shop lighting must be more expensive than private house lighting. The difference in load factor is, of course, allowed for if the maximum demand system of charging is employed.—Lond. *Electrician,* July 16.

Leakage Indicator for Mines.—A note on a recent British patent (17,161, 1908; July 15, 1909) of the Ashington Coal Company and T. McKie for a leakage indicator for mines. In this arangement, which is adapted to three-phase systems, a separate leakage return circuit to the neutral point of the main generator is provided to each main circuit, so that the leakage current flows through a coil which actuates a drop weight for knocking off the main switch or similar releasing device. The leakage current also actuates a tell-tale, or indicator, on each leakage circuit, which closes a relay circuit controlling a lamp indicator in the generating station. A recording ammeter is placed in the main leakage return circuit and also a choking coil and fuse.—Lond. *Elec. Eng'ing,* July 22.

Wires, Wiring and Conduits.

Transmission Line Constants.—The first set of a series of tables of transmission line constants, compiled under the direction of D. B. Rushmore by M. W. Franklin. The present installment contains tables for the self-induction of solid conductors, the capacity of solid conductors, and the inductive reactance of solid conductors for 25, 60 and 100 cycles. The tables are carried to the fourth and fifth place, and the calculation is based on exact formulas.—*Gen. Elec. Review,* July.

Hard-Drawn Copper Wire.—Standard specifications for hard-drawn copper wire, as proposed by a special committee of the American Society for Testing Materials.—*Gen. Elec. Review,* August.

Electrophysics and Magnetism.

Radiations.—W. S. Andrews.—A lecture in which beginning with a general discussion of ethereal waves the author passes to a description of the known waves of greatest length; i.e, the Hertzian waves, having a frequency of the order of millions per second. He then takes up in the order of increasing frequency the infra-red, or heat waves, with an approximate frequency of from 20 to 365 million millions per second; the visual light waves, which have a frequency of from about 365 to 800 million millions; the ultra-violet waves, of from 800 to 3000 million millions; and, finally, the group of waves of exceedingly small wave length and enormously high frequency, to which the X-ray ethereal pulses and probably the gamma rays of radium belong. All these rays cover a total range of possibly 40 octaves or more.—*Gen. Elec. Review,* July.

Selenium.—Louise S. McDowell.—An experimental investigation of the diminution of the resistance of selenium under the action of light, and especially of the recovery curves—that is, the curves which show the rate of return to the normal dark resistance after exposure to the light has ceased. The chief results are as follows: The form of the recovery curve depends on the intensity of the excitation and on the wave-length of the exciting light. In general the time of recovery increases with the intensity of the excitation. Recovery is slower for excitation by infra-red light than by light of the visible spectrum. Individual cells differ in the relative time of recovery for different wave-lengths as well as in the absolute time of recovery for light of the same intensity and wave-length. The effect of increased duration of excitation upon the form of the recovery curve is similar to the effect of increased intensity. Excitation requires time. While from 60 per cent to 80 per cent of the entire increase in conductivity may be produced in the first five minutes, for complete saturation hours are required. The rate of excitation varies with the intensity and the wave-length of the exciting light. The time required for complete saturation may decrease as the intensity of the light diminishes, but the initial rate of excitation increases with the intensity. The variation in the rate of excitation of the individual cells for the different wave-lengths corresponds to the variation in their rate of discovery—for example, those cells which show the most rapid recovery for red light show also the most rapid excitation for red light. The relation between the resistance and e.m.f. is approximately a straight-line relation. The resistance decreases as the e.m.f. increases. Different cells show a variation in the relative sensibility to light of different wave-lengths, but no relation was found between this variation and the variation in the curves of recovery and excitation. Electric oscillations affect the resistance and hence the sensibility of the selenium cell. These effects are of two kinds—immediate and deferred. Both may be in the nature of coherer effects and both depend upon the condition of the cell at the time when the oscillations are applied.—*Phys. Review,* July.

Photoelectricity.—J. Elster and H. Geitel.—An investigation of the emission of electrons from surfaces of alkali metals, as influenced by the condition of polarization of the exciting light. More negative electrodes are emitted by light polarized perpendicularly to the plane of incidence than by light polarized parallel to the plane of incidence. The maximum speeds of the electrons are the same in both cases, but the number of electrons with a certain speed below the maximum is greater in the first case than in the second case.—*Phys. Zeit.,* July 15.

Photoelectricity.—F. K. Richtmyer.—An article on the dependence of the photoelectric current on light intensity. The chief result is that the photoelectric current from a metallic sodium surface at zero potential, under the action of light from an incandescent lamp is strictly proportional to the light intensity for ranges of intensities from (approximately) 0.007 to 0.5 foot-candle.—*Phys. Review,* July.

Electrochemistry and Batteries.

Induction Furnaces.—G. Gin.—An illustrated Faraday Society paper describing "automatically circulating induction furnaces" in which inclined passages for the charge are provided so as to produce an automatic movement of the charge due to the differences of specific gravity.—Lond. *Electrician,* July 9.

Purification of Water by Ozone.—R. Rideal.—A paper read before the Royal Sanitary Institution in London on the successful use of De Frise-Siemens ozonizers for the purification of river water at Paris.—Lond. *Electrician,* July 9.

Units, Measurements and Instruments.

Projection Rheograph.—An illustrated description of the Abraham double-projection rheograph for demonstrating wave forms, etc. It consists of two parts (see Fig. 3), a double galvanometer, G_1 and G_2, and a synchronous motor S. In the standard instrument the two galvanometers are identical and entirely independent of each other. The moving part of the galvanometer consists of a small rectangular frame of aluminum (A in Fig. 4), closed upon itself, about 38 mm long, 6 mm wide and 0.9 mm thick, carrying upon it the comparatively large mirror B of area 48 sq. mm. The aluminum frame is suspended by means of a very thin silver wire W, in the

field of a permanent magnet *C*, the wire being so thin as to exert practically no torsional control. The frame forms the secondary of a small transformer, the primary *D* consisting of several turns of wire, while a laminated core of soft iron *E* carries the flux through the secondary. The two ends of the

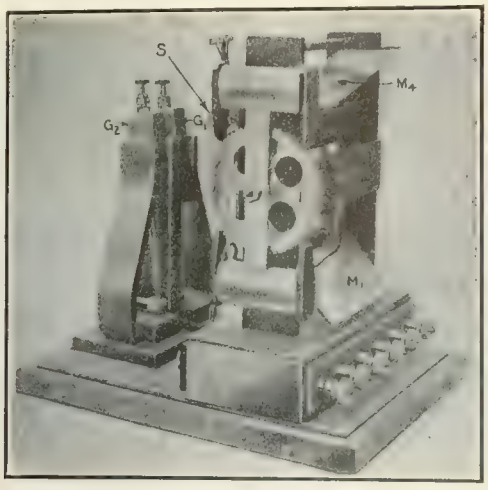


FIG. 3.—PROJECTION RHEOGRAPH.

fixed or primary windings are brought out to the terminals on the front of the instrument. To study the wave form of a given current or potential difference it is necessary to arrange that a current in time and space quadrature with it should be passing through the primary winding of the oscillograph. If the wave form of a potential difference is being studied, then

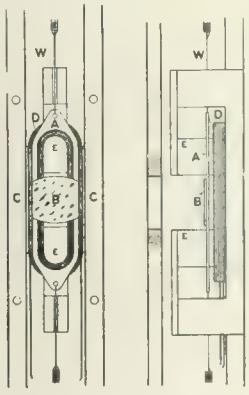


FIG. 4.—DETAILS OF CONSTRUCTION.

a condenser is placed in series with the oscillograph, or if a current curve, then a small series transformer is used; the current under investigation is passed through the primary, the secondary being closed through the oscillograph. The resistance of the secondary of this transformer is purposely made high so that the induced current will be in time quadrature with the main current, and not in opposite phase. The current

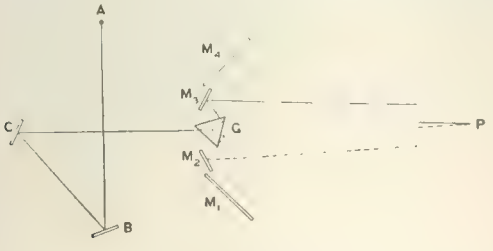


FIG. 5.—REFLECTING SYSTEM.

in the suspended aluminum frame is produced entirely by induction from what is practically a small transformer in the oscillograph itself. This transformer has been so designed that the flux is proportional to the ampere-turns without the hysteresis of the iron exerting any material influence. The current produced in the moving system is proportional to the rate of the change of the current in the primary of the rheograph. With proper design it can be so accomplished that the deflection varies directly as the current. The synchronoscope is a form of synchronous motor used to project vertically upon the screen, and proportionately to the time, the horizontal movements of the beam of light from the mirrors of the two galvanometers. It consists of a equilateral total reflecting prism (see Fig. 5) mounted on a horizontal axis, a simple toothed iron wheel *I* (Fig. 3) forming the rotor of a synchronous motor being mounted on the same axle. The motor operates at frequencies of from 40 to 90 cycles without difficulty, making one rotation per second when the frequency is 36. If the prism alone were used only three reflections per second would be given, and these would not be sufficient to produce an appearance of continuity on the screen. Abraham has, therefore, introduced four mirrors to increase the number of reflections to 12, this number being sufficient to give an appearance of almost perfect continuity. Two of the mirrors are clearly shown in Fig. 3—namely, M_1 and M_4. The beam of light from the arc lamp *A* (Fig. 5) is thrown by the small mirror *B* onto the galvanometer *C*, is reflected from that on the prism *G*, is again reflected onto one of the fixed mirrors *M*, and from that onto the screen at a point *P*. If the prism is rotating in the direction of the hands of a watch, then the beam of light will be reflected from the mirrors M_1, M_2, M_3 M_4 respectively. The diagram shows the beam reflected from the mirrors M_3. The applications of the instrument for studying the curves of an e.m.f., or the curve of a current, or the variation of the flux in a magnetic field, or the use of the instrument as a ballistic galvanometer, are described.—Lond. *Electrician*, July 9.

Reichsanstalt.—An abstract from the annual report for 1908 of the electrical work performed at the German Reichsanstalt. Notes are given on the constancy of manganin coils, the preparation of standard cells, the tests of dry cells, aluminum electrolytic condensers. Of a series of 24 carbon-filament lamps tested on a 234-volt, alternating-current circuit, 15 were still usable after having burned for 2000 hours. In another series of 24 metallic-filament lamps (12 for 110 volts and 12 for 220 volts) half the number of each voltage were tested in a vertical position, the other 12 being at an angle of 45 deg. to the vertical. They were run on alternating current. It was rather surprising that the latter batch showed a longer life than those hanging vertically. A number of tests were carried out on various forms of flicker photometer which could be used on a straight photometer bench, with a view to determining whether the use of the flicker photometer is to be advocated for test purposes. It was found, however, that this form of photometer offered to the skilled operator no advantage over the usual method of measurement as regards rapidity and certainty of adjustment.—Lond. *Elec. Eng'ing*, July 22.

Telegraphy, Telephony and Signals.

Wireless Telephony.—M. Colin and R. Jeance.—An account of experiments on the production of simple undamped oscillations of constant energy for wireless telephony. For this purpose very stable arcs are required and they are obtained by the arrangement of the negative electrodes, which consist of very thin pencils of carbon carried in a support with a large radiating surface. The positive electrodes are large copper cylinders with flat ends, water-cooled from the inside. To produce a simple oscillation the authors make use of an intermediate current.—Lond. *Electrician*, July 9.

Miscellaneous.

Electric Accident.—At the inquest recently held in England upon the death of two men who were killed by electric shock it was elicited that the shock was obtained from an electric coal-cutter working at 550 volts, three-phase. An abrasion in the insulation of this stator winding caused contact to be made with the frame of the machine, and although the trailing cable contained a fourth wire for earthing, the connection between this and the machine was defective.—Lond. *Elec. Eng'ing*, July 22.

BOOK REVIEW.

TRANSFORMERS FOR SINGLE AND MULTIPHASE CURRENTS. A Treatise on Their Theory, Construction and Use. By Gisbert Kapp. Second edition, revised and enlarged. London: Whittaker & Company. 363 pages, 219 ills. Price, $3.

Electrical engineers are glad to welcome the second revised edition of Mr. Kapp's small book on transformers. The first edition of this work appeared in 1895, as the result of a course of lectures delivered by Mr. Kapp in the winter of 1894 on the theory and the design of transformers. The little book grew out of this course of lectures and it is now submitted to us with considerable interesting and valuable additions.

Few engineers of the younger generation realize or appre ciate the remarkable work accomplished by Mr. Kapp in the 15 years from 1880 to 1895. He taught that generation of engineers who developed and perfected alternating-current generators, motors and transformers. He enunciated the principles, explained, expounded and applied the theories of Thomson and Maxwell to dynamo design and engineering practice. Always deeply interested in engineering problems, and profoundly in earnest, nothing could have been more instructive than a colloquial controversy between him and such men as Dolivo Dobrowolsky and Brown. One could not leave such discussions without having been set to thinking and having received the most fertile suggestions.

Mr. Kapp's great work belongs to the first half of the score of years just passed. In this period he taught the use of the characteristic saturation and regulation curves, of direct-current and alternating-current generators. With Swinburne, he showed the effect of armature reaction with lagging and leading currents, and explained, by means of vector diagrams, the use of overexcited synchronous motors as "power-factor rectifiers," as he called them in 1893, now 16 years ago. His earnestness and his unwillingness to accept specious explanations and half knowledge led him to investigate the "Ferranti Phenomenon," 20 years ago, and his contribution to this subject before the Physical Society of London is a classic in our art.

The little book on "Transformers" has grown since 1894. Much new valuable matter has been added, but also much obsolete matter has been retained. For instance, Fig. 20, representing a Westinghouse transformer plate, Figs. 61 and 62, and Figs. 193, 194 and 195, are only of historic interest. In showing electrical designs it is essential to follow closely the development of the times, as designs antiquate soon and are apt to be misleading to beginners and inexperienced engineers.

There are a number of subjects upon which full information would have been welcomed at the hands of the author, whose ability to present complex subjects lucidly is unrivaled. The theory of eddy currents in solid conductors is omitted, although of the greatest importance in the design of modern transformers. The mechanical forces between coils should have been discussed, as they are of growing importance, and the designer has to provide against the effects caused by them. The extra insulation between turns near the terminals of transformers for high potential is another subject of which Mr. Kapp has not treated. Since we are talking of the shortcomings of the book, we call attention to diagram IV, Fig. 113, showing Dr. Behn-Eschenburg's method of measuring the power of a three-phase circuit, which is correct only for balanced and not for unbalanced circuits.

Against these few and unimportant criticisms there stands out a wealth of information, an outline of fundamental principles with application to practical problems, unrivaled in clearness and simplicity. The measurement of alternating-current power, the correction factor of wattmeters, the testing of transformers, the fluxometer, rise of pressure through resonance—these are some of the chapters the study of which will repay both students and engineer. This work of Mr. Kapp is indispensable to the electrical engineering profession.

NEW APPARATUS AND APPLIANCES

New Electric Delivery Wagon of the Commonwealth Edison Company, Chicago.

Favorable attention has been created by the appearance in the Chicago streets of the new type of electric delivery wagon



FIG. 1.—ELECTRIC DELIVERY WAGON.

belonging to the Commonwealth Edison Company and used in the delivery of purchases made at "Electric Shop," the Michigan Avenue salesroom of the company. This wagon, which is illustrated in Fig. 1, is not only of handsome appearance, but it also has a record of great efficiency in operation. The exterior finish is dark green with brass trimmings with plate-glass windows at the sides and in the rear. There are artistic side lamps, as shown in Fig. 1, and an electric search lantern is mounted beneath the dashboard. The vehicle has a carrying capacity of 3000 lb. and its normal speed is 14 miles an hour. The battery consists of 40 eleven-plate cells and it supplies electrical energy to one 4-hp, 80-volt electric motor mounted on the rear axle. The driving gear is of the new type known

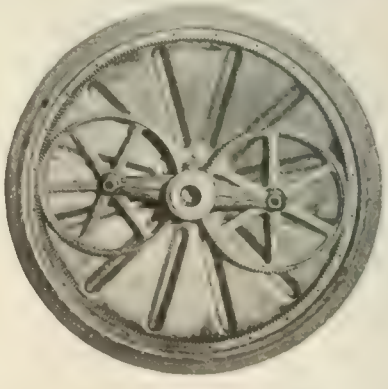


FIG. 2.—REAR DRIVING WHEEL, WITH OUTER DISK REMOVED.

as the Walker balance gear which is made by the Automobile Maintenance & Manufacturing Company, of Chicago. Disk

wheels are used and they are provided with solid tires 42 in. in diameter, 3½ in. wide for the rear wheels and 36 in. in diameter and 3½ in. wide for the front wheels. The wheel base is 88 in. and the gage of the vehicle is 56 in. Four forward and reverse speeds are available and the brakes are of the external-band type, applied on the rear wheels. The steering is accomplishd by a side lever.

Fig. 4 is a view from beneath showing the construction of

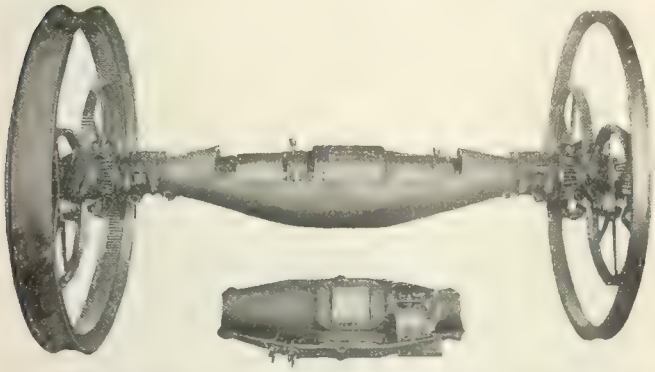


FIG. 3.—BALANCE GEAR AND MOTOR HOUSING, WITH COVERS REMOVED.

the wagon. The absence of complicated driving mechanism is evident. As stated, the driving gear is of the Walker balance gear type and the design and application of this method of gearing may be readily understood by reference to Figs. 2 and 3. This gear is unique in that the motor and rear axle are integral. The diameter of the rear axle motor housing is 11⅝ in. The rear wheels are of the disk type, as previously mentioned, with disks pressed cold out of sheet steel, and the gears are inclosed within the space between the two disks of each wheel, as clearly shown in Figs. 2 and 3. This construction is proving highly efficient both in relation to energy consumption and maintenance cost. All driving gears are of the spur type and run in oil. All bearings are either of the Hess-Bright ball type or the Timken roller type. There is no side thrust on the armature bearings.

As shown in Fig. 3, a portion of the upper half of the motor housing on the rear axle is removable, affording ready access to the armature and differential gear. The ends of the housing are bored out to admit cast-steel yokes, which support the rear-wheel bearings and hold the idler gears, which are placed between the driving pinions and the large internal gears, mounted on the tire channels.

The power transmitted by the driving pinions is equally dis-

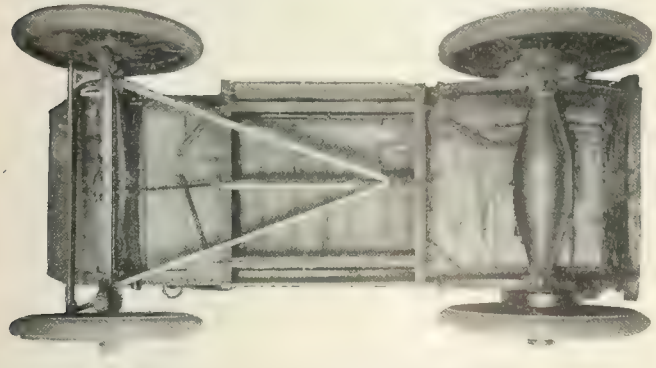


FIG. 4.—UNDERPART OF DELIVERY WAGON.

tributed to the idler gears, which, in turn, distribute it equally to the internal gear of the driving wheel. Power is thus transmitted from the motor armature practically without loss to the rims of the rear wheels and through mechanism entirely encased. It is believed that this construction is particularly favorable to long life as well as to efficiency. The wagon is almost noiseless in operation. It is particularly serviceable in crowded streets, as it can be turned completely around in a circle having a diameter of 25 ft.

In daily operation the wagon is making runs of from 40 to 60 miles on one battery charge. It has been driven 76 miles on one battery charge. The battery is charged only at night at the Commonwealth company's garage at 138 South Morgan Street, where 15 electric wagons are housed, all of about the same size, but not of the same type, as the one illustrated.

Each wagon is equipped with an odometer and a Sangamo amp-hour meter. The application of the latter instrument to electric automobile operation is comparatively new, but it seems to be meeting with favor. The instrument registers the actual number of amp-hours of battery discharge during the day's travel. Thus the driver, knowing the approximate output of his battery, can see at a glance at any time the amount of available energy remaining. He is in no danger, therefore, with ordinary judgment of getting caught on the street without sufficient energy left to carry him back to the garage.

Outlets for Knob and Tube Work.

The accompanying illustrations show applications of an outlet made by the Union Electrical Manufacturing Company, of Akron, Ohio, and approved by the Underwriters. The device is especially useful in knob and tube work and can be quickly

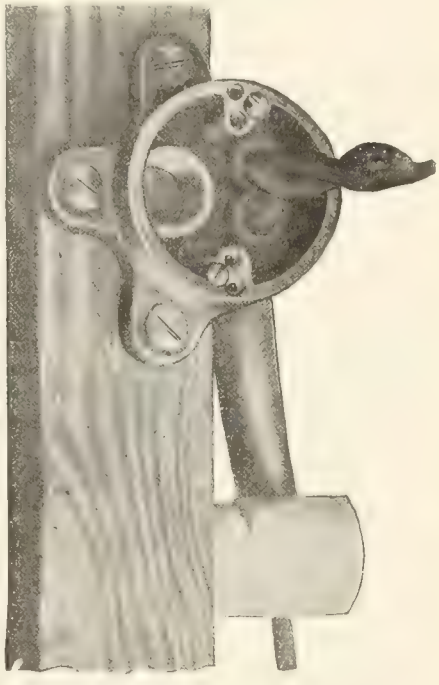


FIG. 1.—OUTLET ATTACHED TO JOIST.

attached directly to the joists and studding where outlets are required for switches and lamps. It is applicable for all standard makes of surface snap switches, wall sockets, rosettes, wall brackets, etc. The arrangement of the holes provide five different sizes corresponding with the screw holes in switches,

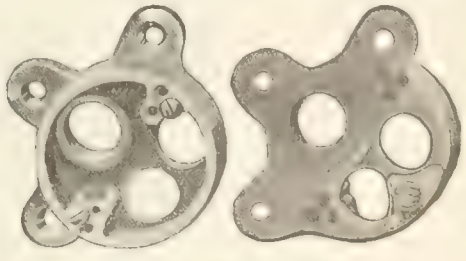
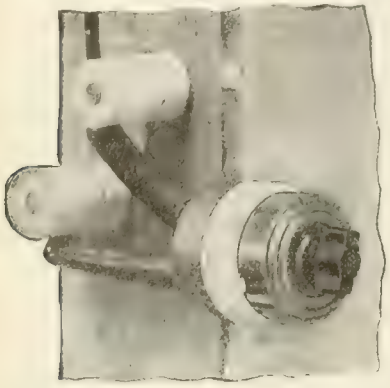


FIG. 2.—VIEWS OF OUTLET.

rosettes and wall sockets. The bracket is provided with a threaded opening from which the smallest to the largest chandeliers can be firmly suspended. The bracket can in most cases be quickly attached directly to the joists and studding, and the

wires can be spread as desired. If it is necessary to use two switches at the same place, one bracket is placed above the other on the same studding. For three-point switches the third wire and tube are entered through the threaded opening.



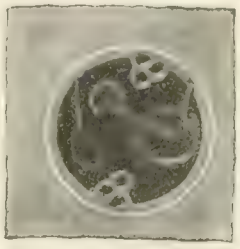


FIG. 3.—OUTLET FOR SURFACE SNAP SWITCH. FIG. 4.—OUTLET WIRED FOR THREE-POINT SWITCH.

It is claimed by the maker that by the use of the "Newhub" outlet bracket, the name by which the device is known, knob and tube work can be installed very rapidly.

Non-Multiple Telephone Switchboards for Central Offices.

In the accompanying illustrations are shown telephone switchboards designed for non-multiple central-office installations, in which compactness, neatness and durability have been given proper consideration, and special attention has been paid to the obtaining of high efficiency of operation and low maintenance expense.

All joints in the woodwork are tongued and grooved, fastened with glue and reinforced with steel angle irons. The key-shelves of the sections are strengthened by steel bars to which the operator's keys are fastened by means of machine screws. This arrangement not only insures a proper alignment for the keys, but permits of their easy removal should occasion require. The key-shelves are hinged by means of a piano-hinge extending the full length of the key-shelf. This arrangement strengthens the key-shelf and plug-shelf and also adds to the appearance of the switchboard. The exterior surface of the sections is given a rich, golden-oak finish. The outer coat of varnish is hand-rubbed and of such a character as not to scratch easily or to show ordinary wear.

The switchboards are arranged in one-position and two-position sections equipped with Bell type of apparatus throughout. Many interesting features will be noted in connection with this apparatus. The combined jack and signal used on the line circuits of the self-restored signal type of switchboard is said to be radically different from any previous design of magneto signal device. The signal is given by means of a revolving steel ball, the visible portion of which changes color when operated. A portion of the surface of this ball projects from the face-plate in such a manner that the signal can be seen from the side as well as from the front. One of the advantages claimed for this type of signal is that there are no projecting surfaces on the face of the board that are liable to injure the operator's hands or tear her clothes. Another feature of this signal is the circular armature that is made use of in order to permit of readily removing the coil from the signal.

By means of the circular armature, none of the line connections is disturbed in any way and no parts of the signal that enter into the adjustment of the same are disturbed when repairs are made. The coil is removed by taking out a single screw. Especial attention has been given to the night alarm attachment. The circuit for the alarm is completed through two platinum-pointed springs that are attached to each of the signals, which springs make contact when the signal device is operated. These springs are located in an accessible position behind the face-plate so that they cannot be injured by the operator. The keys used are equipped with horizontal

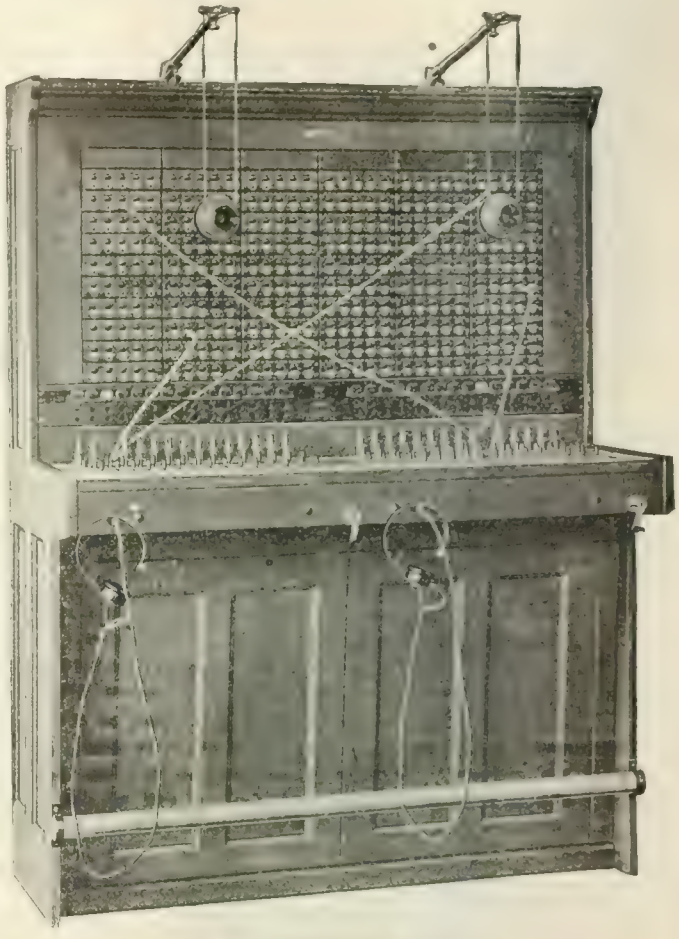


FIG. 1.—TWO-POSITION BOARD.

springs mounted on edge in blocks of hard rubber. The arrangement is such that, upon opening the key-shelf, the trouble-man can ascertain at a glance whether the key-springs are in operating condition, and hence it is seldom necessary to remove the key from the key-shelf.

The variety of conditions that can be met by these switchboards is well illustrated by the fact that there are six different types of equipments for which they are adapted, as follows: Magneto equipment with self-restoring line signals; magneto equipment with manually restored line signal; magneto equipment with electrically restored line signal; magneto equipment

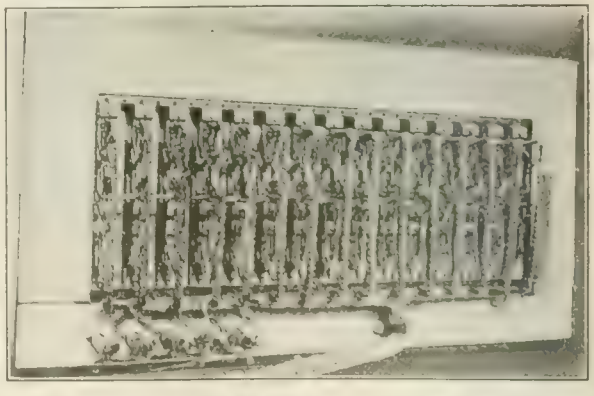


FIG. 2.—REAR VIEW OF BOARD, SHOWING KEY SHELF.

with electrically restored line signal, arranged for conversion to central-battery service; central-battery equipment with magnetic line signal, and central-battery equipment with lamp-line

signal. The magneto switchboards can be additionally equipped with ringers for operation on exceedingly long lines or on lines where audible code signaling is desired, while the central-battery switchboards can be additionally equipped with a combined jack and signal for operation on rural lines.

All of the switchboards can be operated with standard ringing systems, such as one-way, two-way, two-party, four-party pulsating, four-party harmonic, eight-party harmonic, etc. They are also suitable for single or double supervision. The double supervision cord-circuits used in the switchboards are arranged to prevent "ring-through" or "hang-up" difficulties. The switchboards can be equipped with through toll-line circuits (sometimes known as "cut-in stations"), audible code ringing on each of the line circuits, etc.

The above-described apparatus has been placed on the market by the Western Electric Company, which has developed for use with such boards full lines of lightning arresters, cabinets, calculagraph sections, etc.

Reflector for Industrial Establishments.

The reflector illustrated herewith has been developed especially for factory and shop lighting with tungsten lamps. It is of the steel type, the reflecting surface being so designed as to



SHOP TYPE REFLECTOR.

eliminate objectionable shadows. The type of ventilated holder does away with overheating and deterioration of lamps. These reflectors have been placed on the market by the Holophane Company, 227 Fulton Street, New York.

High-Voltage Tantalum Lamps.

The General Electric Company is offering to the trade tantalum lamps designed for use at e.m.fs. of from 200 to 250 volts. The 200-volt lamp is rated at 50 watts and the 250-volt unit at 80 watts. It is claimed that the life of these lamps is fully as great as that of the regular 100-volt and 125-volt tantalum lamps operated at the same specific consumption of 2 watts per candle.

Telefunken Wireless Telegraph System.

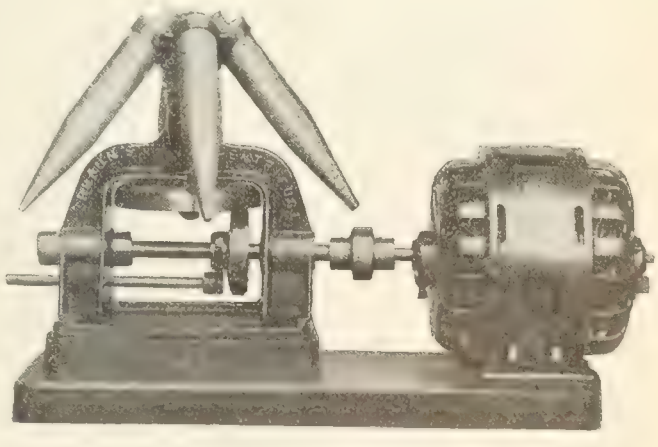
Reports from abroad indicate that excellent results are being obtained with the Telefunken Company's new "Singing" or "Quenched" or "Sounding Spark" system, as it has variously been designated, which was recently described by Count Arco in a paper before the Verband Deutscher Elektrotechniker (German Electrotechnical Society) at Cologne. During preliminary tests upon the completion of a 20-kw station at Pola, on the Adriatic—which is one of three similar stations now being erected for the Austrian Government—it was found that the signals were so strong at both the Norddeich (on the North Sea coast) and the Kopenhagen station that perfect coherer reception—i. e., signals printed on tape—was possible at both stations.

It was also possible to copy everything in Berlin with an ordinary portable set and 25-meter mast, and with another portable set of the 2-kw wagon type and a 25-meter mast, perfect communication both ways was maintained between Vienna and Pola. Still better results were obtained with an 8-kw set installed on the Austrian battleship *Erzherzog Karl*. The tests were made with the vessel at anchor in the harbor at Pola and in this case everything sent was copied at Kiel.

Very interesting results showing the immunity from atmospheric interference with this system were also obtained with three vessels of the Black Sea fleet. These vessels were equipped with 2-kw sets, and while one remained at anchor at Sebastopol the other two steamed out to sea. The transmitters of all three sets were adjusted for the same wave-length but for different tones and although atmospheric effects—always troublesome on the Black Sea—were particularly strong, perfect communication both ways was maintained up to a distance of 600 km. It was also possible to receive two messages simultaneously from the moving vessels at the station in Sebastopol, over the entire range and on one and the same receiver and detector, but with two differently adjusted telephone receivers. The fact was also noted during these tests that the signals from an old type 15-kw station near Sebastopol —which was also used—became absolutely unintelligible on board the moving vessels on account of atmospheric effects long before the effective range of the 2-kw sets had been accomplished.

Motor-Driven Centrifuge.

The motor-driven centrifuge shown herewith, which is designed for rotating a liquid at high speed in order to produce a separating force greater than gravity, consists of pivoted receptacles mounted to rotate about a vertical axis, the speed reaching about 1500 r.p.m. Under these conditions the centrifugal pull is 320 times as effective in separating the mixtures as is the force of gravity. Since, when in use the containers swing out horizontally, the centrifugal force on the material in their extreme tips is about twice that at the center of gravity of the containers. Accordingly, separations can be made with the apparatus in a very short time, while the adjustable-speed friction drive enables the tubes to be started gradually and brought up to any desired speed. The little motor shown, a ¼-hp Westinghouse, is directly connected to the friction-wheel shaft, which communicates its motion to the face wheel, giving a range from 1000 to 2000 r.p.m. The glass container tubes are surrounded by water and inclosed in an aluminum case, furnishing a cushioning surface which prevents breakage. The



MOTOR-DRIVEN CENTRIFUGE.

tubes contain 100 cu. cm and are calibrated to tenths of a cu. cm, so that the results are easily and quickly read off. The motor-driven centrifuge is of recurring use in the laboratory and is a practical necessity in the separation of heavy, thick, viscous liquids, such as crude oils, etc. The above-described centrifuge is manufactured by F. W. Braun, Los Angeles, Cal.

Meter-Testing Rheostat.

In calibrating service watt-hour meters it is the general practice to use an artificial load, and a bank of incandescent lamps is commonly employed for this purpose. The latter is far from satisfactory on account of its size and weight and is uneconomical because of the expense of lamp renewals. The meter-testing rheostat illustrated herewith, a recent product of the

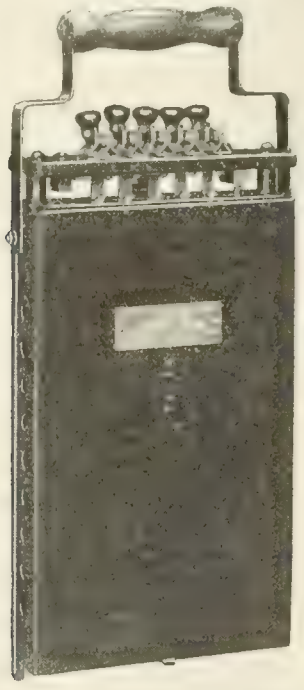


FIG. 1.—METER-TESTING RHEOSTAT.

General Electric Company, is especially adapted for testing service, as it has small dimensions and weighs only 7 lb. Fig. 1 shows the rheostat complete. As may be seen from Fig. 2 a number of resistance units is supported by a sheet metal frame and connections are made to knife switches, mounted on a small terminal board. Each switch is marked with the value of the load which it controls, the steps being arranged to give loads from ½ to 15 amp in ½-amp increments. On the inner side of the terminal board are two binding posts into which the line wires are inserted and fastened by set screws. The sides



FIG. 2.—METER-TESTING RHEOSTAT READY FOR USE.

of the box are hinged and serve as supports when the rheostat is in use.

The resistance metal of the meter-testing rheostat is non-corrosive and has a low temperature coefficient. It is wound on a fireproof body and the complete unit is covered with a protecting compound.

Storage Battery in 24-Hour Service.

In 1907 the Sisseton Mill & Light Company, of Sisseton, S. D., decided that it would be distinctly advantageous to maintain a day service if it could be accomplished without a prohibitive expense. It was believed that the change would not only result in giving better service to the existing customers, but would enable the company to obtain a number of new customers who would not use electricity for lamps and motors unless a 24-hour service could be promised.

It was out of the question to give this service by operating the generating equipment, as the additional cost of fuel and labor would have been excessive. Consequently, in September, 1907, a 134-cell battery with a rating of 25 amp for eight hours was installed. The battery jars were of such a size that the rating of the battery could be increased by 40 per cent at any time by the installation of additional plates, thus providing for the natural growth of the day service. This battery has now been in service nearly two years and the Sisseton Mill & Light Company has had an opportunity of accurately determining the results that have been obtained.

The gross business has increased 25 per cent, this being attributed almost entirely to the 24-hour operation that has been made possible by the battery. The total expenses have increased only 5 per cent. The net receipts of the plant have increased by an amount equal to approximately 25 per cent of the cost of the battery. In other words, the gross return on the battery investment amounts to approximately 25 per cent, leaving an ample profit after deducting the interest and maintenance charges; the additional operating expense, due to the installation of the battery being covered by the 5 per cent increase in expenses referred to above.

The battery is of the "chloride" type manufactured by the Electric Storage Battery Company, Philadelphia.

Artistic Tungsten Fixtures.

The lighting fixture illustrated herewith is one of seven designs developed by the Central Electric Company, Chicago, in conjunction with the Price-McKinlock Company, Boston, for use with Opalux reflectors and tungsten lamps. In designing the fixtures an attempt has been made to obtain correct proportions from the artistic point of view, the proper dimensions for the desired illuminating effect, and the most satisfactory

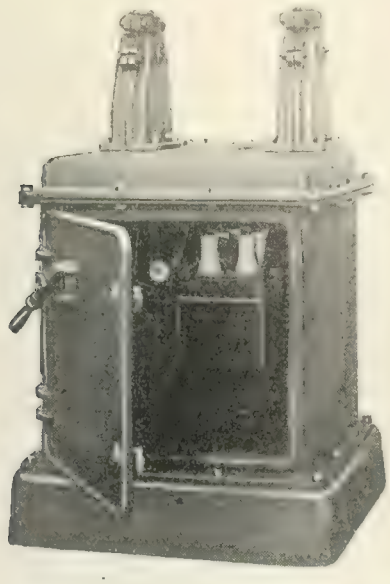


ARTISTIC TUNGSTEN FIXTURE.

arrangement from the standpoint of economy in installation. It is said that the reflectors employed not only transmit sufficient light to prevent deep shadows on the ceiling, but give a distribution free from glare. The reflecting surface is entirely on the inside of the bowl so that any dirt or dust on the outer surface has practically no effect on the efficiency of reflection.

Pillar Switchgear for Mining Work.

One of the standard mining pillars designed by the British Westinghouse Electric & Manufacturing Company, Ltd., of Manchester, England, for collieries, or for use in exposed situations generally, is shown herewith. The switches are completely enclosed in substantial cast-iron pillars, which afford



PILLAR SWITCHGEAR.

complete mechanical and fire-risk protection. A unit type of construction is employed so that the pillars may be utilized singly or in groups. In order to prevent indiscriminate handling, the pillars are rendered fool-proof by interlocking the door, isolators and oil switch in such a manner that the correct sequences must be followed in opening the device for inspection. First, the oil switch must be opened, after which the isolators can be operated and thus disconnect the oil switch terminals from the supply mains or busbars. It is said to be impossible for the door of the pillar to be opened until both these operations have been performed. The interior being accessible through the door at the front, the pillars may be placed against a wall, the cables being run to the leading-in boxes on top of the apparatus. The switchgear is suitable for use on circuits having potentials up to 3300 volts, and may be fitted with either ammeter or voltmeter, or both, together with fuses, oil-immersed switches or knife switches. The latter type of switch is used only for circuits up to 600 volts, each pillar being then fitted for two circuits.

Electricity at the World's Shoe and Leather Exposition.

At the first World's Shoe and Leather Exposition held in Cambridge, Mass., during the month of July electrical methods of illumination and power service were greatly in evidence. The fair was held in a new reinforced concrete structure specially built for permanent exposition service on the west bank of the Charles River between the Harvard and the Longfellow bridges and directly opposite the Back Bay district. The building has a seating capacity of about 20,000 persons and is one-third larger in floor area than Madison Square Garden, New York. All the machinery of the exhibitors was motor driven, and energy for both power and lighting was supplied by the Cambridge Electric Light Company's service.

The illumination of the exposition was strikingly effected by the use of several thousand tungsten lamps for interior service and by the installation of about 50 flaming-arc lamps on the exterior of the structure. The latter gave the building a brilliant appearance at night from all parts of the Back Bay and Cambridgeport. The flaming lamps were hung from poles carried for the most part on the flat roof of the exposition building, a number being used in addition to illuminate the approaches and exits together with the automobile parkway, where motor vehicles were handled to and from the fair. The roof was opened for promenading, with refreshments on sale at the corner towers, and the arcs enabled the utmost freedom of movement to be enjoyed. In the interior tungsten lamps were installed on the under sides of all the ceiling and roof trusses of the building, with a central massing of incandescents under the dome to give maximum brilliancy at the band stand. A large number of concealed lamps were installed in the showcases of the exhibitors, where an investment of $75,000 had been made in plate glass and mahogany fittings.

In the power field the most elaborate exhibit was that of the United Shoe Machinery Company, which consisted of a complete shoe manufacturing plant erected in the main auditorium and in which Goodyear welt shoes were produced by passing through all the stages between the raw material arrival and the packing in cartons for shipment. The machinery was arranged in two rows, each row being group driven by a separate motor, one being a 15-hp and the other a 10-hp Western Electric Company's induction motor. Among the machines driven in this exhibit were equipments for cutting, stamping, punching, sewing, turning, creasing, folding and otherwise manipulating the stock handled. Closely associated with the above exhibit was that of the Singer Sewing Machine Company, which was operated in part by the motors above mentioned as a separate department in the manufacturing process. A 3-hp Western Electric motor of the induction type was also installed for driving about 30 sewing machines of different types. In a gallery above eight 1/7-hp Diehl 220-volt induction motors, each direct-connected to a special sewing machine for shoe work, were installed. The compactness, simplicity and reliability of the individual drive were notably in evidence.

The Stuart-Howland Company, of Boston, had an exhibit space in which the wide range of that organization's electrical supplies was emphasized and a feature made of the Excello flaming-arc lamp. The Newman Manufacturing Company, of Cincinnati, Ohio, showed seven automatons and special moving devices for displaying shows in windows, each driven by a 1/10-hp motor. One of the most novel was an automatic "lady" electrically operated to show the effect of different types of shoes on the foot. The Narrow Fabric Company, of Reading, Pa., exhibited a shoe-lacing machine driven by a ¼-hp Westinghouse motor and the Burroughs Adding Machine Company, Detroit, Mich., showed a full line of electrically operated calculating and checking equipments.

The Puritan Manufacturing Company, Boston, showed five wax-thread sewing machines driven by individual motors of from ⅛ to ¼ hp each and four marking machines driven by 1/10-hp Emerson motors. Thos. W. Gardiner, Lynn, displayed a last-making machine driven by a 3-hp General Electric motor. The Boston Machine Works Company exhibited a cementer, two folders, vamp-folding machine, beader, finisher, top cutter and evener driven in group by a 5-hp motor. The G. W. Baker Machine Company, of Wilmington, Del., showed two roller-staking machines driven together by a 7½-hp motor of Western Electric make. J. E. Nightingale, of Danvers, Mass., showed two measuring machines driven by a Holtzer-Cabot motor of ¼ hp and the Peabody Leather Machinery Company exhibited a shaving machine driven by a 5-hp motor and a measuring machine operated by a ½-hp motor.

The Western Electric Company, Chicago, displayed a full line of intercommunicating telephone equipment for factory service, induction motors up to 7½ hp, direct-connected exhaust and office fan motors, D & W inclosed fuses up to 12-kw capacity, inclosed arc lamps and the Victor flaming arc. A recent feature of the telephone equipment is the use of individual buttons for ringing and listening in place of the separate buttons found in the usual Bell office sets. The company was represented by Messrs. Rounsville, Twitchell, Robinson, Raftery, Damrell and Tiffany. The New England Telephone & Telegraph Company installed special circuits and service for the exposition.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

There has been a notable accession of prosperity in the commercial world since the final settlement of the tariff matter. This has brought out a flood of orders, specifications for which have long been determined upon but which have been held up until the new business basis was finally agreed upon. Retailers have come into market in greater numbers, and their orders bid fair to be unusually liberal. This is especially anticipated because the summer clearance sales have lasted longer and been more generally successful than was expected, clearing the shelves to low-water mark. Another thing which has cheered all business sections is the wonderful report from the growing crops. There is now little doubt that the return to the farmers in money will be the greatest ever known in the history of the country. Even in the South, where the cotton crop promises to be considerably short of original expectations, the rapid advance in the selling price of the staple will more than make up the defficiency in volume. Already there has been a vigorous movement of crops in the West, and there have been healthy shipments of coal, lumber, iron and steel in the Eastern territory. These things are swelling the earnings of the railroads, and will soon make it necessary for them to go into the equipment market with valuable orders. In the steel and iron industries there is a further expansion of production, and prices are constantly strengthening. It is claimed that in the advance movement the independents are leading the United States Steel Corporation, although everywhere rates are much better than they were a few weeks ago. New business in steel rails is not large, but many heavy orders are pending. Structural material continues to be in excellent demand, and there have been many orders for steel cars. One of the features of particular note is the extremely sanguine tone taken by every leader of finance or commerce. Frank A. Vanderlip, president of the National City Bank of New York, voiced the common sentiment when he said, upon his return from a trip through the West last week: "I am a bull on business. In my opinion, we are at the beginning of a long period of most profitable commercial activity. The only check to it can be some most unexpected and unlooked-for occurrence. Of that there is not at the present the faintest indication. Not a cloud is to be seen on the financial horizon, nor is there even the semblance of one." According to *Bradstreet's* report the failures for July were 974, about the same number as in June, but 17.7 per cent less than in July, 1908. The liabilities for the month were $8,299,169, a decrease of 16 per cent from June and of 63 per cent from July a year ago. Failures for the week ending with Aug. 5 were 184, against 223 last week, 205 in the like week of 1908, 157 in 1907, 137 in 1906 and 166 in 1905.

THE COPPER MARKET.

The past week has been one of considerable inaction in the copper market. There has been very little speculative demand from London and the takings of the domestic consumers has apparently been very light. At the time this report is closed the July figures of the Copper Producers' Association has not been made public, but the market was full of interesting rumors foreshadowing the statement. These for the most part indicated that there had been a decrease in producers stocks during the month of something like 44,000,000 lb. If the figures bear out this report it indicates that both at home and abroad the speculators and consumers must have stocked up to a far greater extent than had been generally believed. It is known that during the month of July the stocks in foreign warehouses increased by more than 20,000,000 lb. and it is certain that further piling up has continued in August. In the meantime the betterment of the copper situation by such a decrease in producers stocks is more technical than real. There is every indication that the actual melting of copper is very little greater than it was a few months ago, while the production is at the record mark. The decrease in the producers surplus therefore can mean little beyond a shifting of stocks—a transfer from the smelters' yards to storage warehouses and manufacturers' sheds. Trading in copper on the Metal Exchange has been dull and the tone of the market has been weaker for spot transactions with relatively higher prices for future shipments. Imports continue to be large and exports for the month up to and including Aug. 9 were 6,826 tons. The daily call Aug. 9 at 12:30 o'clock on the Metal Exchange for standard copper was as follows:

	Bid.	Asked.	Settling price.
Spot	12.65	12.80	.....
August	12.60	12.85	12.72½
September	12.65½	12.95	12.80
October	12.65	13.00	12.82½
November	12.75	13.—	12.87½
December	12.75	13.00	12.87½

The London prices on the same date were as follows:

	Opening. £ s d	Close. £ s d
Standard copper, spot	58 13 9	58 15 0
Standard copper, futures	59 12 6	59 13 9
Market	Firm.	Steady.
Sales of spot		400 tons
Sales of futures		900 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	.....	.....
Lake	14.75	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	54 10 0
London, best selected	67 15 0	59 0 0

ELECTRIFICATION OF THE NEW YORK CENTRAL.—In the expense budget of the New York Central & Hudson River Railroad for the year which ends June 30, 1910, there appeared an item of $8,477,682, set aside for the electrification of suburban lines and for a New York terminal. This amount of money indicated rather more electrification than was contemplated. A large portion of this money will be spent in the perfection of the New York terminal; some of it will be spent in adding extra tracks within the electric zone, but only a comparatively small part of it will be spent for electrification proper. One of the engineers of the New York Central, in outlining the plans of the railway for the coming year, said that it is contemplated that the electrical zone will be extended on the Harlem division from Mount Vernon to North White Plains, a distance of about 10 miles. This will be equipped with the third rail, and all of the standard electrical appliances that are used in the other electrical zones of the New York Central. Curves and also grade-crossings will be eliminated, and the road will be put in first-class shape for express service. Two substations are to be constructed, one at Tuckahoe, and another, exactly similar, at White Plains. These substations will contain three 1000-kw rotary converters, similar in design to those that are now in service in the substations of the New York Central. The transmission will be on aerial lines on steel towers, like the other lines of the New York Central, and the entire equipment will be standardized according to the New York Central's ideas. Circuit-breaker houses of the usual form will be established about every two miles of this road. The New York Central contemplates making four tracks on its Hudson division all the way to Yonkers. At the present time there are four tracks to Spuyten Duyvil, but only two to Yonkers.

AUTOMATIC ARMATURE BINDING MACHINES WANTED.—Julius West, 5 Landhausstrasse, Degerloch-Stuttgart, Germany, writes that he desires to receive from manufacturers prices of automatic machines for winding the armatures of small motors.

ELECTRICAL DEVELOPMENT IN URUGUAY.—Consul Frederic W. Goding, of Montevideo, reports that it is under contemplation to electrify the horse street railway in that city and to erect electric cranes and install an electric light service along the wharves.

CHINESE TELEPHONE ORDER FOR WESTERN ELECTRIC.—The export department of the Western Electric Company received last week, from Pekin, China, a cablegram stating that a contract with the Chinese Government to supply a complete common battery telephone plant for the city of Pekin had been signed. The Chinese Government, through the president of the Board of Communications, had ratified the sale, which came as a result of negotiations of a year's standing. This order was secured after strenuous competition, in which the largest telephone manufacturers of the world figured. China is absolutely a new field for telephones, and one giving great promise for future development. Heretofore there have been telephones in only a few of the cities of China, and these are largely in the foreign quarters, which were served by small, out-of-date systems. The two switchboards sold by the Western Electric Company to the Government are the first common battery boards in the entire empire, yet China has an estimated population of over 400,000,000. Our own country, with a population only one-fifth as large, has more than 1000 telephone exchanges larger than the two intended for Pekin, besides fully 15,000 smaller ones in towns. Though only two exchanges so far have been ordered, this is considered as merely the beginning of a system that will eventually be fully developed throughout China. The Board of Communication not long ago formed what was known as the International Chinese Telephone Administration. Last fall F. M. Dresing, foreign advisor of this body, while on an American tour visited the Western Electric Company, and made known the desire of the Chinese Government to buy telephone equipment. Chinese commissioners visited this country, inspected the telephone plants of the large cities and were shown through the shops of the large telephone manufacturers. The Western Electric Company then sent a special emissary to Pekin. The order amounts to about $150,000, and covers a complete plant of modern type, including several hundred thousand feet of lead-covered aerial and underground cable. The contract calls for complete delivery at Tientsin by Feb. 3, 1910. The work of installation will be done under the supervision of one of the Western Electric's engineers.

WESTINGHOUSE STORAGE BATTERY COMPANY.—The Westinghouse Storage Battery Company, which, as announced in our issue of July 15, was incorporated in Albany with a capitalization of $1,750,000, which included $250,000 6 per cent preferred stock, has acquired all of the plants, equipment, patents and business of the storage battery department of the Westinghouse Machine Company and all of the property of the General Storage Battery Company. The equipment at the plant of the Westinghouse Machine Company at East Pittsburgh will be moved to Boonton, N. J., and installed in the works formerly occupied by the General Storage Battery Company at that place, thus giving the new company the greatly increased manufacturing facilities so essential to prompt deliveries. The Westinghouse Storage Battery Company will manufacture both the Westinghouse and Bijur types of battery for such service as each has been shown to be adapted. The new company's staff of engineers is composed of men of long experience, and the laboratories for testing raw materials and finished product are well equipped. The officers of the new company are: H. H. Westinghouse, president; H. T. Herr, vice-president; S. B. Dusinberre, vice-president and general manager; T. L. Brown, treasurer, and T. S. Grubbs, secretary. The general offices of the company will be at Boonton, N. J., with sales offices in the principal cities of the country. The New York office will be located at 165 Broadway.

REORGANIZATION OF CABLE CODES.—The American Cable Companies are determined that there shall be a revision of the codes now in use by commercial houses which will at least restrict the messages to ordinary English words. "The regulations for all cable messages," said George Clapperton, of the Commercial Cable Companies, "are fixed by the International Telegraph Convention. This was established in 1875, and, as you can readily understand that, considering the political condition of Europe, there must be some international agreement to insure the safe passage of messages, say from Paris to St. Petersburg via Berlin. The United States, standing outside of all these diplomatic complications, has had no need to join such a conference, but it is none the less forced to abide by its regulations. Our cables, for example, land in England, and we are obliged to take only such messages as the British Government will forward. In America the use of codes has enormously increased the difficulties of the cable companies. Some of the most impossible words have appeared, and these lead to constant mistakes. Big importing and international houses have spent much money on these codes, and it may produce some hardship to have them changed. The cable company, however, must protect itself and there will be a general simplification."

ELECTRIC PUMPING IN PANAMA.—Authority has been granted for the purchase of a pumping plant to lift water from the reservoir in process of construction near Gatun, to the large tank on the hill in that village. The plant will consist of two three-stage centrifugal pumps directly connected to a three-phase 440-volt induction motor. Each pump will have a capacity of 1400 gal. a minute with a suction lift of 12 ft., and will deliver against a head of 300 ft. The distance from the pumps to the water tank at Gatun will be about 6800 ft., and delivery will be made through a 12-in. main. There will be two suction connections, one with the filtered water sump, and one direct with the reservoir. It is desired to have the pumps operated automatically by a float valve in the tank. A 5-ton hand-operated crane will be installed at the station to assist in making repairs.

ALLIS-CHALMERS COMPANY DOING GOOD BUSINESS.—The Allis-Chalmers Company reports that all of its plants are busy, and that orders are very satisfactory. Among the sales of large electrical apparatus which have recently been made are: from the Merchants' Heat & Light Company, of Indianapolis, for two 1000-kw synchronous motor-generator direct-current sets, and one 200-kw shunt-wound balancing set, consisting of two 125-volt machines on a common cast-iron base; Delaware, Lackawanna & Western Railroad, Hampton power plant, Scranton, Pa., one 1500-kva transformer, and San Francisco Gas & Electric Company, San Francisco, Cal., two 1000-kw synchronous motor-generator sets. Numerous other orders have also been recently booked for transformers and for small apparatus.

HYDRO-ELECTRIC DEVELOPMENT ON THE CHIPPEWA RIVER.—The Chippewa River Power Company, of Port Huron, Mich., has secured lands on the Chippewa River and also most of the necessary township rights for transmission lines and franchises in Mount Pleasant, and expects to obtain additional franchises in Alma, Ithica, Midland and Bay City. These cities will furnish a market for 7500 hp, to develop which the company will erect five dams on the Chippewa River. From the fall in the distance the company expects to develop 125 ft. Wilbur F. Davidson, whose son is president of the Consolidated Lighting Company of Montpelier, Vt., is interested in the project.

COOPER HEWITT ELECTRIC COMPANY.—The Cooper Hewitt Electric Company reports that its business during the month of July has been the best in three years. During that month the Pittsburgh agency alone took contracts for 400 Cooper Hewitt lamps. One hundred of them were placed in the factory of the Canton Stamping & Enameling Company, of Canton, Ohio; an equal number with the Berger Manufacturing Company of the same place, and 90 with the Crosby Company, of Buffalo. The Cooper Hewitt lamp, it is claimed, is becoming constantly more popular with large factory owners and the demand for lamps has never been greater than at present.

DOHERTY IN CONTROL OF ENTIRE JOPLIN FIELD.—At a meeting of the stockholders of the Spring River Power Company, of Joplin, Mo., held recently, the interests of which H. L. Doherty & Company, of New York, are representatives elected nine out of the 15 directors. At a meeting held subsequently the directors elected Mr. Doherty as president of the company. The acquirement of this property practically gives Mr. Doherty control of the Joplin mining district. Interests identified with his firm already dominate the Consolidated Light, Power & Ice Company and also the Missouri Zinc Fields Company.

ELECTRICAL PLANT FOR MANUFACTURE OF STEEL PRODUCTS IN MEXICO.—According to the *Mexican Herald*, a company, to be known as the Mexico Steel & Chemical Company, has been organized, with a capital of about $500,000. The purpose is to manufacture steel and chemical products by means of electricity. A plant will soon be in course of construction. It is intended to manufacture rails, steel castings, shoes and dies for mining mills, and calcium carbide.

WESTINGHOUSE COMPANY MAKES AUTOMOBILE ENGINES.—The Westinghouse Machine Company has added a department to its works at East Pittsburgh for the manufacture of gasoline motors for automobiles. The company has been making preparations to take this step for some time. An order has been secured for 1000 motors from one of the largest automobile manufacturers in this country, and negotiations are pending with other automobile firms which will bring additional orders for about 50,000 of these motors to the company's works within the near future. During the business depression of the last year the company found itself greatly handicapped because, being a manufacturer of only large prime movers, its business was practically at a standstill as the demand for that class of machinery was very small. This condition suggested to the management the idea of entering into the construction of other machinery, and the addition of the automobile motor department has been the result. With the facilities in the East Pittsburgh shops, and the company's extensive experience in the making of gas engines, the works are able to meet the requirements of any of the automobile manufacturers and a large business is expected to be done in this line. It is stated that in the meantime the orders for steam turbines and gas engines have continued to come in constantly in increasing quantities, and the business of the company during July will cause it to be recorded as another heavy month. There are also orders for 75,000 hp Le Blanc condensers in the factory, besides a number of gas engines of various sizes.

WESTINGHOUSE SHOPS KEPT BUSY.—The July business of the Westinghouse Electric & Manufacturing Company was the largest done by the company in a single month during the last two years, the amount representing approximately $3,000,000. All departments at the East Pittsburgh works show considerably increased activity, and it has been necessary to add to the productive force everywhere. The company recently received an order for electric railway material, which for various reasons is particularly noteworthy. This order came from the Chicago Railways Company, and called for the quadruple equipment of motors for 350 cars, making a total of 1,400 railway motors. This is the first time Westinghouse motors have been ordered for the surface lines of the Chicago railways. With this order for motors and the work already on hand in the railway motor department, that section of the factory will be kept very busy for the next six months.

ELECTRICAL SUPPLIES FOR NAVY DEPARTMENT.—The Navy Department in Washington will open bids, on Aug. 17, for 15,000 ft. of cable. On Aug. 24 bids will be opened for cable for portable lamps—cord, lamps, conductors, carbon and other electrical supplies; two electrical hoists; dry batteries; graphite brushes; 1500 arc lamp carbons; 4000 ft. ebonite rod; fans, armatures and desk lamps, and two motors. On Aug. 31 bids will be received for two fire alarm annunciators, 8000 carbons, and for tape fuses and miscellaneous supplies.

WESTINGHOUSE TURBO-GENERATOR FOR SOUTHERN COTTON MILL.—A 2500-kw Westinghouse steam turbo-alternator has been ordered for furnishing service to the Erwin Cotton Mills, at West Durham, N. C. The steam element operates at 175-lb. pressure, and exhausts into a 27-in. vacuum. The energy distribution will be made with three-phase, 60-cycle current at 600 volts. This property is the largest among the cotton-mill interests of the Dukes, of the American Tobacco Company.

AMERICAN ELECTRICAL SIGNS IN EUROPE.—A dealer in electrical apparatus informs an American consul in a European city that he would like to communicate with manufacturers of electrical signs desirous of selling their patent rights in that country. The file number of the inquiry is 3700.

GENERAL ELECTRIC MICA MINES.—The General Electric Company's mica mines at Loughboro, Canada, has an output sufficient to keep engaged 150 girls in the company's trimming factory at Ottawa. The company has also trimming factories at Carleton Place, Smith's Falls, Ontario.

CARTHAGE (N. Y.) WATER POWER COMPANY.—The Carthage (N.Y.) Water Power Company, which recently constructed a hydro-electric plant on the Black River, has recently purchased two 1000-kw generators from the General Electric Company.

THE ILLINOIS TRACTION COMPANY, with headquarters at Peoria, Ill., has ordered 50 40-ton coal cars from the American Car & Foundry Company, for use on its extensive interurban railway system. These new coal cars will supplement about 400 of the same type now in use.

TRAMWAY CONSTRUCTION IN UNITED KINGDOM.—An American Consul writes that a power company in the United Kingdom has determined on the construction of 12 miles of single track electric tramways between towns of importance. The file number of the inquiry is 3715.

Financial Intelligence.

THE WEEK IN WALL STREET.

The stock market continued on its upward course during the past week, with only slight interruptions. New high records were made almost every day, and the temporary set-backs attracted little attention, being due almost entirely to the profit taking of small traders. Both Union Pacific and Steel common, which were practically the leaders of the market, reached new high figures. The latter on Aug. 9 sold up to 78⅛. Union Pacific has been up to 205⅜, and the volume of sales continues to be very large. Reading continues to be phenomenally active and sold as high as 165¼. There seems to be no check to the feeling of optimism that prevails in financial circles. While business has not recovered to the high-water mark of 1907,

NEW YORK.

	Aug. 2.	Aug. 9.	Shares sold.		Aug. 2.	Aug. 9.	Shares sold.
All.-Ch.	16¼	15¾	8,300	Int.-Met., pfd..	48	46½	46,840
All.-Ch., pfd..	57	56¼	11,100	Mackay Cos...	84⅛	83½	400
Amal. Cop....	84¾	85⅜	121,969	Mackay Cos.,p.	74¾	74¾*	230
Am. D. T.....	30*	30*	——	Man. Elev.....	144½	144⅝*	200
Am. Loc.....	67¼	68¼	43,830	Met. St. Ry...	20*	24*	300
Am. Loc., pfd.	120¾	120½	1,100	N.Y. & N.J.Tel	142	142½*	350
Am. Tel.&Cbl..	84*	76*	119	Steel, com....	74¼	77½	558,475
Am. T. & T...	143¼	142½	25,573	Steel, pfd.....	128½	126¾	37,905
B. R. T.....	80½	80½	31,240	W. U. T.....	76	75½	2,270
Gen. Elec.....	170	171¾	9,175	West'h, com..	86	88¾	32,100
Int.-Met., com.	15½	15½	19,000	West'h, pfd...	124½	124½*	100

PHILADELPHIA.

	Aug. 2.	Aug. 9.	Shares sold.		Aug. 2.	Aug. 9.	Shares sold.
Am. Rys.....	46	45⅞	——	Phila. Elec....	12⅛	12⅝	——
Elec. Co. of A.	12¼	12⅜	——	Phila. R. T...	32⅛	31¼	——
Elec. St. B'ty..	62	62	——	Phila. Trac....	90⅞	91	——
E. S. B'ty,pfd.	49*	49*	——	Union Trac...	55⅞	55¼	——

CHICAGO.

	Aug. 2.	Aug. 9.	Shares sold.		Aug. 2.	Aug. 9.	Shares sold.
Chi. City Ry...	180*	180*	——	Chi. Tel. Co..	134	134	——
Chi. Rs.,Ser.1.	119½*	119½*	——	Met. El., com.	16*	16*	——
Chi. Rs.,Ser.2.	39*	37⅞*	——	Met. El., pfd..	47¼*	49	——
Com. Edison...	120	120	——	Nat'l Carbon..	92½	94*	——
Chi. Sub'ws...	19½	23½	——	Nat'l C., pfd..	119*	119*	——

BOSTON.

	Aug. 2.	Aug. 9.	Shares sold.		Aug. 2.	Aug. 9.	Shares sold.
Am. T. & T...	143¼	142¾	—	Mex. Tel.....	2¾	2¾*	——
Cum. Tel.....	145½*	145*	——	Mex. Tel., pfd.	6*	6¼*	——
Edison E. Ill..	254*	254	——	N. E. Tel....	134	137¾	——
Gen. Elec.....	170	172	——	W. T. & T....	12	11¼	——
Mass. E. Ry..	12⅝	13	——	W. T. & T., p.	90	89	——
Mass. E. R., p.	72	74⅜	——				

*Last price quoted.
Shares sold are for week Aug. 2 to Aug. 7.

stocks are much more buoyant and for that matter, in most instances, selling at higher prices than they were during the period of greatest commercial prosperity. This condition has led many conservative observers to feel that the market is entitled to a substantial reaction and that speculation upon the present level of prices is not without danger. There are many others, however, who believe that the market at the present time is more completely in the hands of powerful financial interests than at any time in its history; they believe that these great leaders do not intend to permit a serious slump and that under ordinary circumstances, they will be able to prevent it. Of course under the present condition of more or less inflated prices, any disaster that seriously affected commercial interests might bring about a sharp reaction. Every outside influence is in favor of continued high prices. The crop reports indicate that the farmers will receive more money for their products this year than ever before. This means money for the retailers, for the manufacturers and for the railroads. It means that the big transcontinental lines must soon go into the equipment market for extensive renewals of their depleted rolling stocks. All of these things contribute to the general belief that high prices are here to stay. Of course the immediate upward

movement that occurred during the past week is largely attributable to the settlement of the new tariff schedules. These form the basis upon which business must be done and it is well known that many conservative corporations have been unwilling to expand until the new rates were entirely settled. There continues to be a very healthy demand for bonds and many concerns have taken advantage of this to readjust their finances. Although gold shipments continue to be fairly liberal, especially to Argentina, there seems to be no indication of any contraction in the money market. Rates are still cheap and cash is plentiful. Quotations Aug. 9 were: call, 1⅞ @ 2½ per cent; 90 days, 3 per cent. The quotations in the table are those of the close, Aug. 9.

DIVIDENDS.

American Smelters Securities Company, quarterly, preferred A, 1½ per cent; preferred B, 1¼ per cent, both payable Sept. 1.

American Telegraph & Cable Company, quarterly, 1¼ per cent, payable Sept. 1.

Butte Electric & Power Company, quarterly, preferred, 1¼ per cent, payable Nov. 1; quarterly, common, 1½ per cent, payable Oct. 1.

Kings County Electric Light & Power Company, quarterly, 2 per cent, payable Sept. 1.

Philadelphia Company, preferred, semi-annual, 2½ per cent, payable Sept. 1.

ENGINEERING SECURITIES CORPORATION is the new name of the Engineering & Electrical Securities Corporation, of 43 Exchange Place, New York City, of which J. G. White is president; F. H. Reed, vice-president; R. B. Marchant, secretary and treasurer; T. C. Gillespie, assistant secretary and treasurer, and R. T. Lozier, special representative. The company has in reality been in existence some years, owning securities and taking part occasionally in underwritings or other issues of securities. It deals in high-grade securities of engineering enterprises and aims rather to distribute them through established bankers than to build up a competitive organization for selling securities at retail. The company is now enlarging its sphere of operations and broadening its area of contact and influence.

PUBLIC SERVICE CORPORATION BONDS SOLD.—V. Drexel & Company and J. P. Morgan & Company have purchased $8,000,000 Public Service Corporation, of New Jersey, first mortgage 5 per cent 50-year gold bonds. This is part of the $50,000,000 issue dated May 1, 1908, of which $5,500,000 are outstanding. The proceeds of this issue are to be used to take up outstanding notes and for improvements. There are $7,250,000 5 per cent collateral trust notes, dated Nov. 1, 1904, and due Nov. 1, 1909. Also $6,250,000 5 per cent convertible 5 per cent notes due Nov. 1, 1909, convertible into stock at the option of the holders.

ALBANY & HUDSON REORGANIZATION PLANS.—The reorganization plan proposed for the Albany & Hudson Railroad Company is meeting with strenuous opposition from many of the bondholders. The plan proposes that the owners of the $1,850,000 first mortgage 5 per cent bonds shall exchange these for an equal amount of 5 per cent non-cumulative preferred stock in the new company. This does not seem promising to the stockholders. The new company is to have $1,375,000 of common stock, $2,100,000 of preferred and an issue of $1,500,000 of new 5 per cent bonds.

CONSOLIDATION OF INTERESTS AT CINCINNATI.—A deal has just been completed at Cincinnati through which a syndicate representing the Columbia Gas & Electric Company has purchased the outstanding stock of the Union Gas & Electric Company. Both the preferred and common stock were bought and the Columbia Gas & Electric interests will practically control the entire issue of stock of the amalgamated companies. The negotiations were completed through A. B. Leach, George W. Young and Oscar Gubleman, of New York, as representatives of the syndicate.

SECOND AVENUE RAILROAD CASE.—Judge Lacombe, of the United States Circuit Court, has decided that the custody of the Second Avenue Railroad Company, which is now in the hands of a receiver, properly belongs to the State courts, and not to the United States Court. This decision is based upon the fact that there does not appear to be any stockholders of importance outside of the jurisdiction of the New York courts. The transferring of this case to the State courts will put an entirely different aspect upon the litigation, which it is intended will result in reorganization.

INTERNATIONAL STEAM PUMP COMPANY.—At a special meeting of the stockholders of the International Steam Pump Company, held Aug. 5, action was postponed until Aug. 12 on the proposition as to whether or not the company should authorize an issue of $12,000,000 5 per cent bonds. It is understood that about $8,000,000 of these bonds have already been negotiated for, and that they will be taken by William Solomon & Company, while the balance will be retained in the treasury to meet the requirements of future extensions.

WILLIMANTIC LIGHTING & RAILWAY.—The Rockville-Willimantic (Conn.) Lighting Company, which has taken over all the charter rights of the Willimantic & Stafford Springs Street Railway Company, has elected Walter Learned, of New London president. The company has issued $400,000 of stock, $200,000 being 6 per cent cumulative preferred and $200,000 common shares. It has authority to issue $400,000 preferred stock and $300,000 common.

LA FRANCE COPPER COMPANY.—The stockholders of the La France Copper Company have elected a new board of directors, as follows: W. A. Kidney, R. A. Carnochan, David Gilbert, E. M. Brennan, of Butte, and John T. Williams, of New York. Mr. Williams is an employee of the United Copper Company. It is understood that Mr. Kidney, who is now general manager of the company, will be elected president, to succeed R. S. Walker.

NEW ENGLAND TELEPHONE COMPANY.—The New England Telephone Company for the first six months of the current year has shown an increase in gross earnings of more than 11 per cent compared with the same period of last year. Net profits have been showing up even better, and the increase in the balance for dividends amounted to 23 per cent. The company has planned to spend $2,700,000 for new construction and $3,500,000 for maintenance, in 1909.

UNITED RAILROADS OF SAN FRANCISCO.—The June report for the United Railroads of San Francisco and for the six months which ended June 30 are very encouraging. The gross earnings for the six months are $3,568,905, which is an increase of $227,452 over 1908. It is claimed that the labor troubles which existed earlier in the spring did something to reduce the totals in this report of earnings.

SAN JUAN WATER & POWER COMPANY.—The Animas Power & Water Company, of Silverton, Colo., has been reorganized under the name of the San Juan Water & Power Company. The company still operates on Animas River, at Tacoma, Colo., a station which develops 4500 kw, with distribution lines reaching Silverton and the mining district adjacent.

DURANGO GAS & ELECTRIC COMPANY.—The Standard Light, Power & Water Company has sold its entire property to the Durango Gas & Electric Company, an organization which is building a transmission line from Durango (Colo.) to the power plant of the San Juan Water & Power Company at Tacoma, Colo.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Albany & Hudson Railroad Company:					
Year ended June 30, 1909	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$20,926
Year ended June 30, 1908	345,207	232,891	112,070	114,203	[illegible]
American Gas & Electric Company:					
Quarter ended June 30, 1909	170,844	.....	27,028	[illegible]	[illegible]
Quarter ended June 30, 1908	139,301	.....	29,123	26,175	2,948
Birmingham Railway, Light & Power Company:					
June, 1909	175,189	100,757	74,423	.....	.....
June, 1908	193,707	107,148	86,619	.....	.....
Nashville Railway & Light Company:					
June, 1909	143,644	67,368	76,276	.....	.....
June, 1908	130,191	61,606	68,585	.....	.....
Philadelphia Company:					
Year ended June 30, 1909	8,952,383	4,751,634	4,200,749	.....	.....
Year ended June 30, 1908	8,620,949	5,062,544	3,558,405	.....	.....

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—W. J. Cameron, F. Y. Anderson, George C. Kelly and associates have applied to the City Council for a 30-year franchise to construct an electric railway on certain streets in Birmingham and to use the tracks of the Birmingham Railway, Light & Power Company.

RUSSELLVILLE, ALA.—The City Council has granted a franchise to Thornton & Ames, of Birmingham, Ala., to construct an electric-light plant and water-works system in Russellville.

TROY, ALA.—W. R. White and associates have been granted a franchise by the City Council to construct a street railway in Troy.

ROGERS, ARK.—Bids will be received by the Haefele Lamp Company, of Rogers, Ark., until Sept. 1, for equipment to be installed in its new plant for the manufacture of the Haefele electric lamp, which will include stamping machines, drilling machines, tinners' tools, etc. The machinery will be equipped for electric motor drive. R. S. Willis is president and J. E. Felker treasurer.

BISHOP, CAL.—Benjamin H. Yandell has applied to the Board of County Supervisors for a franchise to construct an electric transmission line in Inyo County to supply electricity for lamps and motors.

BODIE, CAL.—The Walker River Electric Power Company is reported to have secured from J. P. Conway, of Sweetwater, Nev., deeds to his water rights on the East Walker River and certain lands adjacent. It is said that the company will erect a power plant at a cost of $750,000 to supply electricity to mines at Sweetwater, east to Lucky Boy and Hawthorne, west to Aurora and Bodie, and north to Masonic. The East Walker River, from which the power will be generated, has a minimum flow of 6000 cu. in. per second.

FRESNO, CAL.—The San Joaquin Light & Power Company has authorized an expenditure of $500,000 on its plant in the mountains of Fresno County. The work will include the construction of a large dam in Crane Valley, work on which will begin at once. A. G. Wishon is manager.

GLENDALE, CAL.—The Trustees are considering the question of purchasing the entire electric light system owned by L. C. Brand within the city limits of Glendale for $25,000. The city recently voted to erect a municipal electric plant at a cost of $60,000.

LOS ANGELES, CAL.—An election will soon be held to vote on the proposition to establish a lighting district, the cost of which is to be maintained by an assessment against property owners of the district.

MARE ISLAND, CAL.—Sealed proposals will be received by the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Sept. 11 for the construction of a central-power station at the United States Navy Yard, Mare Island, Cal. Plans and specifications can be obtained on application to the above bureau or to the commandant of the navy yard named. R. C. Hollyday is chief of bureau.

MERIDIAN, CAL.—It is reported that the Board of Trustees has decided to enter into a contract with the Pacific Gas & Electric Company to furnish electricity to operate the pumping plant, which has been operated by a gasoline engine. The company will extend its transmission line from Marysville to furnish the service. It is said that E. A. Forbes, of Marysville, will use electrical power to irrigate his ranch north of the town.

MODENA, CAL.—Plans for the construction of the power plant for the Gold Springs Mining & Power Company have been approved. It is said that work on construction of the plant will commence at once.

OAKLAND, CAL.—The City Council has authorized the city clerk to advertise for bids for the sale of the franchise applied for by the Great Western Power Company.

REDDING, CAL.—The Sacramento Valley Power Company has purchased extensive water rights on North Battle Creek, in Shasta County, and proposes to develop the water power and to double the present output of its plant.

SAN DIEGO, CAL.—G. W. Purcell has applied to the City Council for a franchise to operate an electric railway in San Diego. The proposed railway is to connect San Diego, La Mesa, El Cajon, Bostonia, Lakeside, Poway and Escondido. The cost of the road is estimated at about $2,000,000.

TULARE, CAL.—The Mt. Whitney Power Company has purchased a site on Kern Street, on which it will erect a new substation in the near future for the purpose of supplying electricity for lamps and motors in this city.

BOULDER, COL.—The Eastern Colorado Power Company is planning to enlarge its irrigation project, six miles northeast of this city. It is proposed to raise both dams 5 ft., giving the two reservoirs a combined capacity of 744,052,000 cu. ft. of water. The cost of the work is estimated at $250,000.

COLORADO SPRINGS, COLO.—The Royal Gorge Power Company is reported to be contemplating the development of two hydro-electric power projects of approximately 20,000 hp each.

DE BEQUE, COL.—E. A. Swenson, of Colorado Springs, is reported to be interested in the construction of a water-power plant on the Grand River.

FORT LUPTON, COL.—The Lupton Utility Company, headed by D. H. Rich, who is also connected with the Denver Consolidated Engineering Company, is contemplating the erection of a combination water works, light and power and ice plant in the town of Fort Lupton within the next seven months. The town has a population of about 1,500. The plants include water mains, fire pressures, pumps, water tower for ordinary domestic uses, centrifugal pumps being used, driven by 2000-volt motor. The ice machine will also be driven by an induction motor. The generator will be direct connected to compound engine, and will have a rating of 75 kw. Franchises have been granted, and construction work will begin at once.

GRAND JUNCTION, COL.—The Grand Junction Electric, Gas & Manufacturing Company is considering plans for increasing the output of its generating plant.

HOLLY, COL.—The town of Holly has just installed a combination electric light and water works plant, utilizing a rotary pump driven by electric motor for the deep well. The street lighting system will include 25 arc lamps. Burns & McDonald, of Kansas City, Mo., are the engineers.

HOLYOKE, COL.—The town of Holyoke is installing a municipal electric light plant.

MANITOU, COL.—The Manitou & Pike's Peak Railway Company, which operates a cog railroad up Pike's Peak, is contemplating the installation of a third-rail system at a cost of about $750,000. The railway will be widened the entire distance and will use cogs, as on the old system. C. W. Sells, of Manitou, is president and manager.

RIFLE, COL.—The contract for the construction of the power plant for the Rifle Light, Heat & Power Company was awarded to Charles Fravert. The initial development will be 250 hp. E. McLearn, C. L. Todd, W. M. Maley, Dr. W. L. LeRossignol and others are interested in the enterprise. The company is capitalized at $50,000.

BRISTOL, CONN.—Plans are being made by Joseph McCabe, the contractor in charge of the tunnel work west of Bristol, to install an electric generating plant at the tunnel just over the Bristol line to furnish electricity for lamps and for power to carry on the tunnel work.

MERIDEN, CONN.—Francis Atwater, president of the Meriden, Middletown & Guilford Railway Company, has been granted a franchise by the Board of Selectmen to construct an electric railway over the Middletown Road from the tracks of the Connecticut Company to the town limit.

NEW HAVEN, CONN.—Bids will be received by the Boards of Fire and Police Commissioners until Aug. 17 for furnishing the City of New Haven with the following: Nine hundred ft., more or less, 75-wire cable; 1800 ft., more or less, 25-wire cable; wires to be No. 14 B. & S. gage, pure soft drawn copper thoroughly and evenly tinned. Conductors to be insulated to 5-32 in. diameter with a compound containing not less than 20 per cent pure Para rubber. S. J. Metzger is secretary Board of Fire Commissioners, and A. V. Phillips clerk Board of Police Commissioners.

TAFTVILLE, CONN.—Arrangements are being made by the Ponemah Mills Company for a large addition to its plant at Taftville, which will include the erection of a weave shed 670 x 200 ft., one-story high, with basement. The machinery in the new addition will be operated by electricity, which will be furnished by four 250-hp motors.

WILLIMANTIC, CONN.—The Rockville-Willimantic Lighting Company, recently organized, is reported to have made arrangements to secure electricity from the hydro-electric plant of the Uncas Power Company, located 10 miles above Norwich on a tributary of the Thames River, which will save the company about $12,000 on the cost of electrical energy. In a formal statement published by the company it is stated that the company owns and operates under perpetual franchises the entire gas, electric lighting and power business in the cities of Rockville and Willimantic, the electric light and power service in the towns of Stafford and Ellington, and upon completion of its new pole line will control all the electric lighting and power business in the towns of Coventry, Willington and Mansfield. It is said that a saving of $6,000 will be effected by improvements in gas plants and by the concentration of the clerical and executive departments. Walter H. Learned is president and Alexander J. Campbell is general manager of the company.

WASHINGTON, D. C.—The House of Representatives has passed the bill presented by Charles L. Bartlett, of Macon, Ga., granting a franchise for the construction of a dam across the Savannah River between Edgefield County, South Carolina, and Columbia County, Georgia.

MARIETTA, GA.—Captain R. W. Boone, president of the First National Bank, of Marietta, Ga., recently appointed by the creditors of the Georgia Manufacturing & Public Service Company as trustee, has taken charge of the property, which represents an investment of $350,000, and includes an electric light plant, water works system and paper mill. James T. Anderson is receiver.

WAYCROSS, GA.—The proposition to issue $35,000 in bonds for the construction of an electric-light plant was defeated at an election held July 28. The city also voted against the proposition at an election held June 19. It is said that another election will be called.

KENDRICK, IDAHO.—It is reported that work will soon commence on the construction of an electric plant in Kendrick, franchise for which was granted to Richardson Brothers, of Wallace.

CHAMPAIGN, ILL.—Application has been made to the City Council by the Danville, Urbana & Champaign Railway Company for a franchise to extend its electric railway through the city to connect with the tracks of the St. Louis, Decatur & Champaign Railway Company on Neil Street and with the system of the Urbana & Champaign Railway, Gas & Electric Company on Walnut Street.

FREEPORT, ILL.—C. E. Gregory, of Chicago, Ill., who holds a franchise for the construction of a gas and electric plant in Freeport, has been investigating his interests in this city. Mr. Gregory recently secured an extension of time from the city for the construction of the plant.

LA SALLE, ILL.—Plans are being made by the Chicago, Ottawa & Peoria Railway Company to install two boilers of from 400 to 500 hp each in its La Salle station in the near future.

NORTH CHICAGO, ILL.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Aug. 24, for the construction of a system of heating and laying of mains and conduits for the distribution of electricity at the Naval Training Station, North Chicago, Ill. Applications for proposals should refer to Schedule 1483, blank forms for which will be furnished upon application to the navy pay office, Chicago, Ill., or to the above bureau. E. B. Rogers is paymaster-general, U. S. N.

PEORIA, ILL.—The control of the Peoria Gas & Electric Company has been taken over by the Union Railway, Gas & Electric Company, which is a holding corporation for the interests of E. W. Clark & Company, of Philadelphia, Pa., and Hodenpyl, Walbridge & Company, of New York, N. Y. The officers of the Union Railway, Gas & Electric Company are: A. G. Hodenpyl, president; Clarence M. Clark, vice-president, and George E. Hardy, secretary and treasurer.

QUINCY, ILL.—The Trustees of the Soldiers' Home have awarded contracts for equipment for power plant as follows: To the Adams-Bagnall Company, electric lighting system, for $1,086; switchboard, to the General Electric Company, for $1,025; two engines to the Ball Engine Company, for $4,800; Electric Machinery Company, of Minneapolis, Minn., for electrical machinery, for $5,525, and for electric wiring to Kohler Brothers, of St. Louis, Mo., for $5,200.

STREATOR, ILL.—The City Council has granted a 25-year franchise to C. A. King to furnish light, heat and power in Streator.

BLUFFTON, IND.—The Bluffton, Geneva & Celina Traction Company has awarded the contract for the construction of its railway from Bluffton to Geneva to Bears, Brown & Company. Fred Davenport is engineer.

COLUMBIA CITY, IND.—Bids will be received by the Common Council until Aug. 23 for installing two 350-hp vertical water-tube boilers with steel stacks in the municipal water-works and electric-light plant. F. T. Schultz is superintendent.

GOSHEN, IND.—The Goshen municipal electric light system has become antiquated and the City Council has taken steps toward the substitution of a new and up-to-date system. A committee has been appointed to visit other cities where modern plants have been installed and make investigations for the purpose of deciding as to the system to be installed in Goshen.

HARLAN, IND.—Plans are being made by the Fort Wayne & Toledo Electric Railway Company for the construction of its proposed electric railway from Fort Wayne and Maysville, Ind., to Hicksville, Bryan and Toledo, Ohio, a distance of 42 miles, work on the construction of which it is expected will begin about Sept. 15. The Keystone Construction Company, of Indiana, has the contract for building the road. The railway will be operated by the overhead trolley system, electricity for which will be supplied by the Toledo & Indiana Railway Company. E. A. Tennis, of Garden City, Kan., is president of the company, and W. H. Cost, of Harlan, Ind., chief engineer.

INDIANAPOLIS, IND.—The commission appointed to build a State Hospital for tuberculosis patients will receive bids until Aug. 18 at the office of the board, 25 State House, Indianapolis, Ind., for the installation of all the electrical work on the plant in course of construction near Rockville, Ind. I. B. Strouse is secretary.

INDIANAPOLIS, IND.—The proposed plan for lighting the streets of the downtown business district, adopted by the city a few weeks ago, has been abandoned in favor of the scheme offered by the Peacock-Wooley Company, of Chicago, for lighting the streets free of cost, or in consideration of the privilege to conduct an advertising business on the lamps. The change will mean a saving of $10,000 a year to the city. The contract will provide for 10 lamps to the square.

RICHMOND, IND.—Robert Ashe, of this city, has secured a franchise to install an electric light plant at New Paris, Ohio, which is just across the State line. The plan is to transmit the electricity from Richmond to the new plant when completed.

SHELBYVILLE, IND.—The Central Laboratory & Supply Company, of Lafayette, Ind., has secured a contract for the installation of an engine and generator and 848 motors, including the equipment for the Campbell Company's factory in Shelbyville, Ind. J. W. Esterline, of Purdue University, is manager of the Central Laboratory & Supply Company.

SHIRLEY, IND.—The Town Board has engaged George Wallace, of Anderson, to prepare plans for the construction of an electric light plant and water works for this town.

WINGATE, IND.—The Wingate Light Company, organized by C. L. Johnson, of Crawfordsville, Ind., has applied for a 10-year franchise to erect and equip an electric light plant in this city.

RUSSELL, KAN.—At an election held recently the citizens voted to issue $25,000 in bonds for an electric light plant and water-works system.

LOUISVILLE, KY.—Mayor Grinstead on July 26 vetoed the ordinance granting to George G. Fetter the right to extend the boundary line of the territory in which he had been granted a franchise to sell electricity for lighting purposes.

JEANERETTE, LA.—The City Council has granted Henry A. Metz, of New Orleans, La., a franchise to operate a street railway in Jeanerette by electricity or other motive power than steam. Mr. Mentz proposes to construct a railway to connect Jeanerette and other towns of Teche Valley.

AUGUSTA, MAINE.—The Kennebec Light & Heat Company has awarded the contract for the construction of an office and substation at Gardiner to L. E. Bradstreet, of Farmingdale, Maine.

PRESQUE ISLE, MAINE.—Announcement has been made that the Aroostook Valley Railroad Company, which is affiliated with the Canadian Pacific Railway Company, is planning to construct an electric road connecting Presque Isle and Washburn, Maine, with an extension to the St. John River ultimately, a distance of 110 miles. It is stated that a 1200-volt direct-current system will be installed, electricity for which will be furnished by the Maine & New Brunswick Power Company's plant at Aroostook Falls. The proposed railway will carry freight as well as passengers.

ROCKVILLE, MD.—The Town Council has entered into a contract with the Washington Electric Light & Power Company, Washington, D. C., to extend its transmission lines to Rockville and to furnish electricity for lamps for residences and business buildings.

COHASSET, MASS.—The Gas and Electric Light Commissioners have given their approval to the consolidation of the Cohasset Electric Company with the Electric Light & Power Company, of Abington. The last-named company is to pay $18,000 for the property of the former and assume the indebtedness of the Cohasset company.

CONWAY, MASS.—One of the objects of the Boston & Maine Railroad Company in rebuilding the large dam across the South River, where 2000 hp will be developed, is said to be the lighting of the Hoosac Tunnel by electricity. It is also said that the East Deerfield yards will be lighted by electricity; power will also be furnished for the Conway electric lighting and street railway systems as at present.

FITCHBURG, MASS.—The Fitchburg Gas & Electric Light Company has petitioned the Gas and Electric Light Commission for permission to increase its capital stock by $385,000, the proceeds of $275,000 to be used to pay for debts incurred for construction and improvements and $33,000 to be used to complete the work.

NEW BEDFORD, MASS.—The New Bedford Gas & Edison Light Company is handling a well-known make of electric runabouts, which it is advertising on the back of its bill forms for electric service. Charles R. Price is treasurer of the New Bedford Gas & Edison Light Company.

ORANGE, MASS.—The Gas and Electric Light Commission has granted the petition of the Orange Electric Light Company to issue $155,000 additional capital stock, the proceeds to be used to pay outstanding obligations.

SOMERVILLE, MASS.—Mayor John M. Woods has signed a contract with the Edison Electric Illuminating Company for lighting the city for a period of 10 years, under the terms of which the city will save $16,615 per year. Under the new contract the company is to furnish arc lamps at a net rate of $84.08 each per year and incandescent lamps at $18.34 each per annum. The price paid under the previous contract, which expired in 1906, was $105 per year for arc lamps and $30 each for incandescent lamps. In consideration for the new contract the company has agreed to accept a settlement from the city covering the period from the expiration of the old contract to April 30, 1908, at its lowest rate for that period with a 25 per cent discount, and for the remainder of the period until the beginning of the new contract at the same rate as the new contract.

WEST SPRINGFIELD, MASS.—The Board of Selectmen has awarded the contract for lighting the streets and public buildings to the United Electric Light Company, of Springfield, Mass., for a term of five years, under which the company is to furnish 35 arc lamps at the rate of $71.50 each per year and not less than 200 incandescent lamps at $15 per lamp per year. The price for electricity for lighting the public buildings has been reduced from 15 to 7 cents per kw-hour. Under the old contract the city paid $73 for each arc lamp.

WESTFIELD, MASS.—Work has been commenced on the construction of the new engine room of the Westfield Power Company, which will be equipped with a high-speed engine direct connected to an alternating-current generator. The company will supplant the present steam service with electricity.

WORCESTER, MASS.—The Worcester Electric Light Company has filed with the State Gas and Electric Light Commission its appeal from the grant of the Worcester Board of Aldermen to the Connecticut River Power Company.

GRAND RAPIDS, MICH.—The contract for the construction and remodeling the new water-works pumping and municipal electric lighting plant on Canal Street was awarded to Hauser, Owen & Ames, of Grand Rapids, for $89,571.

HOLLAND, MICH.—Equipment, including boilers, electrical apparatus, shafting and other machinery will be purchased in the near future for a new factory to be erected by the Thompson Manufacturing Company.

MANISTEE, MICH.—The Manistee Iron Works Company has completed its new building and most of the machinery has been installed The new equipment will include a motor-driven planer weighing 60 tons.

NEGAUNEE, MICH.—The Cleveland-Cliffs Iron Company is considering the construction of a hydro-electric power plant with a high-potential generating plant and transmission system, near Negaunee, Mich. The company was recently granted a franchise by the City Council for the construction of an electric transmission line in the city.

YALE, MICH.—Plans are being considered to change the municipal electric light system from direct to alternating current in the near future; also to install a new 125-hp Corliss engine. R. G. Green is superintendent.

CHISHOLM, MINN.—Plans are being made by the Range Power Company for the construction of a new power house and the installation of a new engine. The company has submitted a proposition to the Town Councils of Chisholm and Hibbing in regard to supplying water for both towns. A. McMillan is president of the company.

EVELETH, MINN.—The plant and holdings of the Eveleth Electric Company, which supplies electricity for both public and private lighting in Eveleth, has been sold by the Northen Electric Company, of Fargo, for $50,000. It is understood that the property was purchased by local parties.

NORTHFIELD, MINN.—The general contract for the construction of a central heating and lighting plant for Carleton College was awarded to J. G. Robertson, of St. Paul, Minn., for $37,000. Harlan W. Page is secretary of the board of trustees.

NATCHEZ, MISS.—The Southern Light & Traction Company contemplates improving its power-house and installing additional equipment, including a 500-hp engine, generator for street railway service and generator for the commercial lighting system.

WATER VALLEY, MISS.—Plans are being considered to change the municipal electric light plant to a three-phase system and to install a 1,500,000 or 2,000,000 gal. water-driven pump, of either the triplex or centrifugal type, in the water-works system. T. M. Early is superintendent.

CHILLICOTHE, MO.—The contract for installing an electric light plant at the State Industrial Home for Girls has been awarded to F. B. Wheeler, of Chillicothe, Mo., for $4,838. T. J. Hoge is president of board of managers of the institution.

BROKEN BOW, NEB.—John W. Early, of Columbus, Neb., who was recently granted a franchise to operate an electric plant in Broken Bow, is preparing plans for the construction of the plant, the cost of which is estimated at $25,000. A company will be organized under the name of the Broken Bow Electric Company to operate the system.

SALEM, N. H.—The plant of the Salem Light, Heat & Power Company was purchased at auction July 30 by Frank P. Woodbury, for $7,700, who operated the plant for several years previous to the formation of the company. The company has been in the hands of Arthur O. Fuller, of Exeter, as receiver for several months.

ATLANTIC CITY, N. J.—It is reported that the Atlantic City Electric Light Company is planning to erect a new electric light plant at a cost of about $156,000.

COLUMBIA, N. J.—The contract for the construction of a hydro-electric development across Paulin's Kill, Columbia, for the Warren County Power Company has been awarded to Frank B. Gilbreth, 60 Broadway, New York, N. Y. The contract includes the construction of a Ransom hollow dam 30 ft. high and 350 ft. long, and a reinforced-concrete power house, tailrace, etc. Meikleham & Dinsmore are the engineers.

BROOKLYN, N. Y.—Arrangements are being made to change over the Peter Cooper Glue Factory on Maspeth Avenue from belt to motor drive. The company is in the market for a 125-kw generator, several electric motors and other power equipment.

BROOKLYN, N. Y.—The Public Service Commission, First District, has granted the Brooklyn Heights Railroad Company permission to change the motive power on its Montague Street line from cable to overhead electric system. While it was not a specific condition in the order, it was announced by the company that it has consented to maintain a line of cars between the Wall Street and Fulton ferries in return for the privilege granted.

CARTHAGE, N. Y.—The Carthage Water Power Company has placed contracts with the General Electric Company, Schenectady, N. Y., for two 1000-kw generators. M. S. Wilder is interested in the company.

CELORON, N. Y.—The City Council of Jamestown is considering the question of extending the transmission lines of the municipal electric light plant to Celoron for the purpose of supplying electricity for lamps and motors in that town.

CHARLOTTE, N. Y.—Plans are being made by the Rochester Railway Company to carry the large electric cables between Charlotte and Summerville over, instead of under, the Genesee River. A steel tower will be erected on each side of the river, and arrangements are being made for an elaborate electrical illumination, which will provide for lighting both banks of the river.

ELMIRA, N. Y.—The Elmira Water, Light & Railroad Company has petitioned the City Council for a franchise to construct an extension on Maple Avenue from Miller Street south to the city limits.

FULTON, N. Y.—Operations are under way at the local plant of the American Woolen Company for remodeling the headgates and hydraulic canals, to conform with the 6-ft. "raise" which is to be made in the upper dam. It is said that the company is planning to remodel its plant and install generators to furnish electricity to be used in connection with its mills.

JAMESTOWN, N. Y.—The Jamestown Common Council has applied to the Public Service Commission, Second District, for permission to extend the transmission lines of the municipal electric light plant to Celoron for the purpose of supplyng electricity in that town for lamps and motors.

JAMESTOWN, N. Y.—Arrangements are being made by the Jamestown Iron Works for the construction of a hydro-electric plant to furnish electrical power to operate its foundry and machine shop, contracts for which have been awarded as follows: To the Jamestown Boiler Works for 30-in. steel flume, and to the Dayton Globe Iron Works, of Dayton, Ohio, for a 22-in. water turbine.

LYONS, N. Y.—The Rochester, Syracuse & Eastern Railroad Company has decided to increase the output of its local power plant and will install a 5000-hp turbo-generator set. The boiler capacity of the plant will be increased and transformers will be added. The improvements contemplated will increase the output of the plant to 8400 hp.

MAYVILLE, N. Y.—The Mayville Telephone Company has been reorganized. It is said that the company will make extensions to the system, additional funds for which will be secured by issuing treasury stock. The new officers of the company are: V. A. Kent, president; Samuel C. Crandall, vice-president, and Alton H. Appleby, secretary, treasurer and general manager.

MOUNT VERNON, N. Y.—The Common Council has granted the application of the New York, West Chester & Boston Railway Company for an amended franchise which will enable the company to continue the construction of its four-track rapid transit line, which is to connect Mount Vernon, Pelham, New Rochelle and other towns with the subway. The company has spent $700,000 for rights of way in Mount Vernon, and will expend $800,000 more in construction work. Surveys are also being made for a branch line from Mount Vernon to White Plains. It is stated that construction work will begin in the near future. L. S. Miller is president.

NEW YORK, N. Y.—Plans are being made by the Interborough Rapid Transit Company to install two General Electric 5000-kw, low-pressure turbines, to be operated in connection with reciprocating engines of the same rating in the subway division power house on Fifty-ninth Street and Eleventh Avenue. The order hinges on the satisfactory performance of the 5000-kw unit now installed in the same power house, now undergoing test. The turbines will be vertical machines, driving three-phase, 25-cycle, 11,000-volt induction generators, the leads from which will be connected without switching apparatus to the generators driven by the respective reciprocating engines. The turbines have no governor save for emergency use, and will be equipped with surface condensers.

NEW YORK, N. Y.—The Third Avenue Railroad, through the Third Avenue Bridge Company, has applied to the Public Service Commission, First District, for permission to construct and operate a street-car line over the new Queensboro Bridge to the Borough of Queens. The route of the proposed new street car line will be through Fifty-seventh Street from Third Avenue to Second Avenue, up Second Avenue, through Sixtieth Street to the new bridge. The application states that the new company will operate with the Third Avenue Railroad and will finance the construction of the line by the sale of its capital stock. The commission will give a hearing Aug. 13.

NYACK, N. Y.—The Rockland Light & Power Company has been granted permission by the Public Service Commission, Second District, to issue $100,000 in bonds, under its mortgage dated Dec. 7, 1908. The bonds are to be sold at not less than 90, of which $50,000 are to be used to take up the bonds of the Nyack Gas Light & Fuel Company, now merged with the Rockland Light & Power Company, and the remainder for extensions and improvements.

OSWEGO, N. Y.—A. B. Tenney, of Springfield, Mass., head of the syndicate which recently purchased the plants of the People's Gas & Electric Company, has been in this city investigating the property acquired by the company. It is understood that it is proposed to increase the output of both plants.

PORT JERVIS, N. Y.—The City Council has granted a franchise to the Interstate Hydro Electric Company to construct and operate a plant in this city.

RED HOOK, N. Y.—Plans are being considered by the Red Hook Light, Heat & Power Company for the construction of a hydro-electric power plant at Bingham's Mill, 10 miles north of Red Hook. J. H. Sharpe is president of the company.

ROCHESTER, N. Y.—The Rochester Railway & Light Company is receiving bids for the construction of a two-story machine shop, 30 x 60 ft., to be erected at Andrews and Tenth Streets, which will be used

as a repair shop and charging station for electric automobiles. C. L. Hibler is superintendent.

ROCKVILLE CENTRE, N. Y.—Bonds to the amount of $4,500 have been sold by the Village Trustees, the proceeds to be used for improvements to the municipal electric light plant.

APALACHIA, N. C.—The Carolina-Tennessee Power Company, which has acquired water rights for two hydro-electric power plants on the Hiawassee River, has increased its capital stock from $250,000 to $5,000,000. The company proposes to erect two plants six miles apart, one near the North Carolina-Tennessee boundary, near Apalachia, and will develop 30,000 hp for transmission by electricity within a radius of 100 miles, to Ducktown, Tenn., and Rome, Dalton and Athens, Ga. The cost of the plants is estimated at $4,000,000. The executive offices of the company are at 115 Broadway, New York, N. Y. W. L. Church is president and Stanley R. Ketcham secretary and treasurer.

ASHEVILLE, N. C.—The Asheville Electric Company has filed a mortgage deed to the Old Colony Trust Company, trustee, for the $3,500,000 to secure a bond issuue of the same amount, to be issued as needed by the company, payable July 1, 1939.

HENDERSON, N. C.—Machinery is being installed in the Harriet Cotton Mill No. 2, including 10,000 spindles and other machinery. The mill will be completed about Sept. 1, and will be operated by electricity.

LEXINGTON, N. C.—The Southern Power Company has secured an entrance into the town of Lexington, and will supply electrical power for manufacturing and industrial plants in Lexington.

MONROE, N. C.—The No. 2 mill of the Icemorlee Cotton Mills is nearly completed and ready for installation of the machinery, which will be operated by electricity. The mill will be equipped with 5000 spindles.

BUCYRUS, OHIO.—The Board of Public Service has granted F. C. Kingsbury permission to purchase the plant of the Bucyrus Electric Light Company, under the terms of which he will be required to install all new machinery and equipment in the plant. Mr. Kingsbury was granted a franchise last spring by the Board of Public Service, and also a contract for street lighting, under which street arc lamps are to be furnished on an all-night schedule at $74.50 each per year and $69 per lamp per year on a moonlight schedule.

CANAL DOVER, OHIO.—Plans for the construction of the new municipal electric light plant have been approved by the City Council, which has authorized the Service Board to receive bids and enter into contracts for the power house and equipment for same.

CINCINNATI, OHIO.—A deal has been completed whereby the Columbia Gas & Electric Company, of Cincinnati, Ohio, has purchased sufficient stock to practically control the Union Gas & Electric Company, the deal representing between $7,000,000 and $8,000,000. Negotiations were completed in New York by the managers of the syndicate headed by A. B. Leach, George W. Young and Oscar Gubleman, of New York, N. Y.

CLEVELAND, OHIO.—The Board of Public Service will receive bids until Aug. 17 for 350 kv-amp, 2200-volt, three-phase, 60-cycle, alternating-current, synchronous generator, with exciter, switchboard panel, instruments and attachments, to be installed in the municipal electric light plant. A 350-hp, water-tube boiler, superheater, smoke flue and other appliances will be added to the equipment of the municipal electric plant, bids for which were received Aug. 11. E. H. McIntosh is secretary of Board of Public Service.

COLUMBUS, OHIO.—Plans are being considered by the Board of Prison Managers for the construction of the proposed new power plant to be erected at the penitentiary, contracts for which it is expected will soon be awarded. The plant will cost about $250,000 and will furnish electricity for lighting the penitentiary, the Institution for the Feeble-Minded, in West Broad Street, and the State House.

NEW PARIS, OHIO.—Robert Ashe, of Richmond, Ind., has secured a franchise to install an electric light plant in New Paris. Electricity for operating the system will be supplied from Richmond, Ind.

NORWOOD, OHIO.—The Cincinnati Traction Company has applied to the City Council for a franchise to construct a new street railway into West Norwood. W. K. Schoepf is president.

ANTLERS, OKLA.—The city is reported to have voted to grant a franchise for the construction of an electric-light plant.

ERINDALE, ONT.—It is reported that the Erindale Power Company, recently incorporated, contemplates the construction of a hydro-electric power plant with an initial output of 1000 hp. The entire output of the plant has been purchased by the Interurban Electric Company. E. S. Edmondson, of West Toronto, is manager.

GRANITE, OKLA.—It is stated that bids will soon be asked for the construction and equipment of an electric light and water plant in Granite. The cost of the plants is estimated at $45,000.

HARTSHORN, OKLA.—The Freeborn Engineering & Construction Company, of Kansas City, Mo., is reported to have secured the contract for the construction of the 12,000-bbl. Portland cement plant at Hartshorn, Okla., for the Oklahoma City Portland Cement Company, recently incorporated, with a capital stock of $1,200.000. The buildings will be of steel construction and the machinery operated by electricity. The engineering company has not yet decided upon the equipment for the plant.

CONDON, ORE.—The Wasco County Electric & Water Power Company, capitalized at $3,000,000, has issued a trust deed to secure a bond issue not to exceed $15,000,000. The company proposes to take over the property of the Oregon Gold Prospecting & Promotion Company, which includes 30 miles of water rights on the Deschutes River, and proposes to erect a plant at some point on the Deschutes River within its acquired rights capable of developing 60,000 hp, half of which, it is reported, has been contracted for by the Portland, Baker City & Butte Electric Railroad Company.

EUGENE, ORE.—Arrangements are being made by the Willamette Valley Company for the construction of its new plant, work on which will begin in the near future. The plant when completed will furnish electricity for several cities in Willamette Valley and to operate the proposed electric railway between Eugene and Portland. Plans are also being made to commence work on the construction of the Eugene-Portland early this fall. It is planned to extend the railway as far north as Junction City this fall.

KLAMATH FALLS, ORE.—Plans are being made to establish an electric power plant on the Klamath River and extend transmission lines through Butte Valley to supply electricity in the towns of Dorris, Macdoel and Mt. Hebron for lamps and motors, but principally to furnish electricity for various pumping plants through the valley. Moore Brothers, of Klamath Falls, are interested in the enterprise.

OREGON CITY, ORE.—The City Council has granted a 25-year franchise to F. M. Swift, of the Oregon City, Beaver Creek & Molalla Railway Company, to operate a railway through the Mount Pleasant and Green Point sections of the city. Thomas F. Ryan and G. W. Dimmick are also interested in the enterprise.

PENDLETON, ORE.—Extensive improvements are contemplated at Lohman Springs before another season by Mr. McCormack, the new owner, which will include a new hotel, electric lights, etc. A dam will be built on Frazier Creek a short distance below La Grande Road and the water brought down the valley, where the power plant will be erected. Surveys are now being made and work will commence on construction of the plant as soon as the pipe line is established.

CARLISLE, PA.—The Cumberland Railway Company has taken over the property and holdings of the Carlisle & Mount Holly Railway Company and proposes to construct an extension from Carlisle to Newville, a distance of 12 miles, and later to Shippensburg. John Graham, of Newville, is president of the Cumberland Railway Company, and W. F. Pascoe, of Carlisle, general manager.

NEW CASTLE, PA.—The Mahoning & Shenango Railway & Light Company has recently purchased a 600-kw Westinghouse motor generator set and a 200-kw General Electric motor generator set.

PITTSBURGH, PA.—It is reported that the Duquesne Light Company will soon erect another large power plant to take care of its increasing business in the business district of the city.

READING, PA.—The Boyertown & Pottstown Street Railway Company has commenced work on the construction of a substation at its park in Reading. W. J. Hardaker is superintendent.

READING, PA.—A new plant is being erected by the Steiner & Talcott Silk Company on Chestnut Street between Fifth and Sixth Streets, which will double the output of the present factory. The power house will be 33 ft. by 40 ft. and one story high.

WILKES-BARRE, PA.—Negotiations between the city authorities and the Wilkes-Barre Gas & Electric Company for lighting the city for a term of seven years have been completed.

PROVIDENCE, R. I.—The Narragansett Electric Lighting Company has made a proposition to the Board of Contract and Supply relative to installing a turbine at the Hope high-service pumping station and entering into a contract with the company to supply electricity to operate the same, by which, it claims, the city would save $30,000. The city is now considering bids for the installation of a new pumping engine for the station.

SALUDA, S. C.—The plant and holdings of the Saluda Telephone Company have been purchased by A. J. Day, of Trenton, S. C. It is said that the new owner will enlarge the system, install an exchange and construct several rural lines, including one to Higgins Ferry and Coleman.

SPARTANBURG, S. C.—A proposition is under consideration for the building of an interurban electric railway to connect Glenn Springs, 15 miles distant, and Union, 30 miles distant. General Manager F. H. Knox, of the local electric power company; J. B. Lee, president of the Glenn Springs Hotel, and others are interested in the project.

ABERDEEN, S. D.—The Aberdeen Light & Power Company, it is stated, is planning to enlarge its plant at a cost of $30,000. A new building will be erected; a third engine has been ordered and an additional 200-kw generator will be installed.

HILL CITY, S. D.—R. T. Walker, of the Gold Medal Mining Company, is interested in a water-power project. The company has recently been organized and proposes to install electrical machinery and utilize the energy for mining purposes and for lighting the town as soon as the company can secure the necessary funds. It is proposed to develop about 200 hp. Mr. Walker would like to communicate with someone who would finance the company or put up the capital required to build the flume and install the machinery. The cost of the work is estimated at $40,000.

MEMPHIS, TENN.—It is reported that Ford, Bacon & Davis, consulting engineers, are receiving bids through their New Orleans office for an extensive addition to the power plant of the Memphis Street Railway Company, of Memphis, Tenn., which will include the construction of power house and equipment, the cost of which is estimated at about $100,000.

NASHVILLE, TENN.—The City Council has granted the Nashville Railway & Light Company a franchise to extend its system from Sixteenth Street on Broad Street out to Hillsboro Pike.

BRYAN, TEX.—The City Council has granted a franchise to Judge V. B. Hudson to construct an electric railway from Bryan to the Agriculture and Mechanical College, a distance of five miles.

CORPUS CHRISTI, TEX.—The City Council has granted Daniel Hewitt, of Salina, Kan., a franchise to construct and operate an electric railway in Corpus Christi.

GREENVILLE, TEX.—The Allis-Chalmers, of Milwaukee, Wis., has secured the contract for the equipment of the municipal electric light plant. The contract calls for an expenditure of about $38,000, the machinery to be delivered in 90 days. The J. W. Maxey Company, of Houston, Tex., has charge of the engineering work.

MART, TEX.—The Mart Light & Power Company has commenced work on the construction of a new plant to replace the one recently destroyed by fire. Temporary quarters have already been erected.

MEDICINE MOUND, TEX.—W. J. Johnson and associates are interested in a project to construct an electric railway from Quanan to Medicine Mound, a distance of 18 miles. For further information address Mr. Johnson, care of Porter A. Whaley, Quanah, Tex.

RICHFIELD, UTAH.—The Jumbo Plaster Company contemplates installing an electric light plant to enable it to operate night shifts.

SALT LAKE CITY, UTAH.—Application has been filed with the state engineer by Thomas A. Starrh and Wilford Allen, both of Salt Lake City, to appropriate 7 cu. ft. of water per second from North Dry Creek in Salt Lake County. It is proposed to pipe the water a distance of 9150 ft., where it will be utilized to generate 1000 hp, which will be used for lamps and motors three miles northeast of Draper.

WILLARD, UTAH.—The Willard Power Company has completed its transmission line into Weber County, and it is stated that the company will furnish electricity to operate the street-railway system in Ogden from the local plant. Messrs. Browing and Eccles, principal owners, are said to be contemplating the extension of the Hot Springs line through Willard to Brigham, as soon as feasible, electricity for which will be supplied by the Willard plant.

BIG STONE GAP, VA.—Bids will be received by the City of Big Stone Gap until Aug. 12 for franchise, rights, etc., for the establishment of a proposed telephone system. J. S. Wright is town recorder.

BIG STONE GAP, VA.—The Virginia & Tennessee Telephone Company is planning to extend its telephone service to the Wise coal fields, and erect a 60-mile line to Middleboro, Ky., and also to put Bristol and other towns in closer connection with the Southern Bell system.

ST. PETERSBURG, VA.—The St. Petersburg Telephone Company is making extensions into outlying districts.

ENTIAT, WASH.—Active operations have been resumed by the Entiat Light & Power Company on its local power-house and it is expected to have the plant in operation early this fall.

INDEX, WASH.—Plans are being made by J. A. Soderberg and associates, who recently filed water rights on the Skykomish River, in this State, to erect a power plant to furnish electricity for lamps and motors to several towns along the Great Northern Railway.

PESHASTIN, WASH.—The generating equipment of the Valley Power Company's plant in Peshastin will be doubled.

WALLA WALLA, WASH.—Dement Brothers, of Walla Walla, have secured riparian rights on the Salmon River, near its junction with the Columbia River, necessary to construct a power plant.

WALLA WALLA, WASH.—It is reported that the project to develop the water power of the John Day and Deschutes rivers, which was abandoned by the Government several years ago, will be taken up by a private enterprise. A company has been incorporated, with a capital stock of $500,000, which proposes to utilize the water power to generate electricity and for irrigation and power purposes. The incorporators are: Prof. W. D. Lyman, of Whitman College; Y. C. Blalock and W. J. Karinor, of Blalock, Ore.

ANTIGO, WIS.—Plans are being made by the Antigo Electric Company for a new generating system, which include the construction of a large power station to be equipped with tubular boilers, a Corliss engine or steam turbine and alternating-current dynamos, replacing the present direct-current apparatus, for which contracts have been awarded as follows: To the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for electrical apparatus, and for engines, to the Nordberg Manufacturing Company, of Milwaukee, Wis.

APPLETON, WIS.—The Kimberly & Clark Company, it is reported, will construct an electric power house on the site of the old Vulcan mill in the near future.

ASHLAND, WIS.—The Ashland Light & Power Company, it is reported, will purchase electrical equipment for a new substation to be erected in this city.

EDGERTON, WIS.—The plant of the Edgerton Electric Light Company, which has been taken over by the Janesville Electric Company, of Edgerton, Wis., will be changed from a 133-cycle, single-phase system to 60-cycle, three-phase, and the distributing system will also be greatly improved.

MILWAUKEE, WIS.—The contract for installing a small electric generating unit in the North Avenue pumping station has been awarded to George F. Rohn, of Milwaukee.

NEW RICHMOND, WIS.—The plants and holdings of the Apple River Power Company in this city and the two power plants on the Apple River, one located at Somerset and the other in Riverdale, have been taken over by the recently organized Washington County Light & Power Company, of Stillwater, Minn. It is said that extensive improvements to the plants are contemplated. The officers of the Washington County Light & Power Company are: Homer W. McCoy, of Chicago, Ill., president; M. P. McNally, of New Richmond, Ind., vice-president, and E. P. Manwarring, of Stillwater, Minn., secretary and treasurer.

VIOLA, WIS.—E. R. Cushman has fine water-power rights for sale, which local parties have been trying to secure for an electric-light plant, but negotiations have fallen through. Mr. Cushman will be glad to correspond with parties interested in the subject. The village has a population of 1000 and is in need of a lighting service.

WATERLOO, WIS.—Plans are being made to rebuild the plant of the G. B. Lewis Company, which was recently destroyed by fire. It is said that the plant will be equipped for electric motor drive.

WAUKESHA, WIS.—Application has been made to the City Council by the Milwaukee Western Electric Railway Company for a franchise in Waukesha, via North Street.

BRACEBRIDGE, ONT., CAN.—The by-law to raise $65,000 for the purpose of developing additional water power at Wilson's Falls, two miles up the Muskoka River, was carried at an election held Aug. 2. This enterprise will be an addition to the municipal plant already in operation.

LONDON, ONT., CAN.—The Bell Telephone Company of Canada will place its wires underground in this city, at a cost of about $50,000.

TORONTO, ONT., CAN.—Contracts for the construction of the transformer stations at Toronto and London have been awarded by the Hydro-Electric Power Commission. Witchall & Son, of Toronto, secured the contract for the station at Toronto, for $36,500, and Hyatt Brothers, of London, the London station, for $23,500. The contracts for the remaining eight stations, at Woodstock, Paris, Berlin, Stratford, St. Mary's, Preston, St. Thomas and Guelph, will be let soon. John Hayman & Sons, of London, Ont., have submitted a tender for all the stations of $148,000, or $18,500 for each building.

REGINA, SASK., CAN.—The Saskatchewan Government has awarded a contract to J. S. Bartleman, of Regina, Sask., for the construction of the long distance telephone line between Saskatoon and Prince Albert. Connections have also been made at Fillmore between the Government telephone systems of Manitoba and Saskatchewan.

CIENFUEGOS, CUBA.—The Cienfuegos, Palmira & Cruces Electric Railway & Power Company expects to place contracts for the construction of 30 miles of railway between Cienfuegos and Manicaragun, within two months. Contracts for rails have already been placed. Hugh J. Reilly, of Cienfuegos, Cuba, contractor, wishes to purchase two gasoline motors; the company has a concession for the development of water power, and will probably use electricity to operate the railway.

GUANAJUATO, MEX.—Arrangements are being made by the Guanajuato Power & Electric Company for the construction of another large hydro-electric plant, work on which will commence in a few weeks. The plant when completed will have an output of 10,000 hp, and will make the third one erected by the company. The new plant will be located about seven miles above the Brunel plant, and will be connected with it.

MEXICO CITY, MEX.—F. de J. Villareal, of Satillo, Mex., who owns a short line of railroad which runs from Allende, on the Mexican International road, to Zaragoza, has sold the property to a syndicate of Americans, who are preparing to extend the road to Las Vacas, situated on the bank of the Rio Grande opposite Del Rio, Tex. The road will be about 100 miles long when finished, and is to be operated by electricity. It will do both a freight and passenger business, but its primary object is to afford a transportation outlet for the products of the lands.

New Industrial Companies.

THE AZTEC ENGINEERING COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $5,000, and proposes to do a general contracting and building business. The incorporators are Stephen A. Whisten, Thomas J. Buckley and J. Edward Murphy, all of New York, N. Y.

THE BERGEN AUTO COMPANY, of Rutherford, N. J., has been incorporated, with a capital stock of $50,000, to manufacture motors, engines, machine supplies, engineering appliances, etc., by E. Steffens, Jr., and J. F. Steffens, of Rutherford, N. J.

THE DELAWARE RAILROAD CONSTRUCTION COMPANY has filed articles for incorporation with the Secretary of State, Dover, Del., with a capital stock of $100,000. The incorporators are: J. Lord, of Dover, Del.; D. E. Ratten and W. S. Allen, of Philadelphia, Pa.

THE ELECTRIC AMPLIPHONE COMPANY, of Wilmington, Del., has been incorporated, with a capital stock of $250,000, by G. M. Wallace, of Camden, N. J.; P. J. Dougherty, of Philadelphia, Pa., and T. Ritchie, of Wilmington, Del.

THE ENGINEERING & DEVELOPMENT COMPANY has filed articles of incorporation, with a capital stock of $25,000. The incorporators are F. C. Rockafellow, G. F. Coffin and C. Snyder, of Easton, Pa.

THE FREIGHT HANDLING MACHINERY COMPANY, of Jersey City, N. J., has been incorporated by G. H. Stephens, B. W. Tucker, R. D. Steel, H. M. Behren and J. E. Potbury, all of Jersey City. The company is capitalized at $100,000 and proposes to manufacture machinery, cable ways, hoists, etc.

THE HERZOG ELEVATOR SIGNALS COMPANY, of Newark, N. J., has filed articles of incorporation for the purpose of manufacturing elevator signals and appliances. The company is capitalized at $500,000 and the incorporators are: W. J. Connor, T. F. Mulvaney and W. H. Saunders, of Jersey City, N. J.

THE HOLMES CONTRACTING COMPANY, of New York, N. Y., has been incorporated by E. A. Holmes, G. B. Walbridge and F. W. Colwell, of New York, N. Y., as general contractors for the construction of roads, railways, power plants, etc.

THE G. J. HORNUNG CONTRACTING COMPANY, of West New York, N. J., has filed articles of incorporation for the purpose of doing a general contracting business in public and private improvements. The company is capitalized at $50,000 and the incorporators are: C. J. Hornung, J. Burkart and S. Miller, of Guttenberg, N. J.

THE HUSSON MOTOR COMPANY OF AMERICA, of New York, N. Y., has been incorporated, with a capital stock of $12,000, for the purpose of manufacturing gas engines, motors, machines, automobiles, aerial vehicles, motor boats, etc. The incorporators are John Husson, of New York, N. Y.; John J. Hogan, of West Haven, Conn., and William E. Young, of New York, N. Y.

THE NATIONAL BATTERY FAN COMPANY has filed articles of incorporation with the Secretary of State, Dover, Del., with a capital stock of $600,000. The incorporators are: W. I. N. Lofland, W. F. P. Lofland and S. C. Y. Ware, of Dover, Del.

THE NATIONAL APPLIANCE COMPANY, of Chicago, Ill., has been incorporated by Heldman & Street, 1242 Monadnock Block, Chicago, Ill., for the purpose of manufacturing railway appliances. The company is capitalized at $10,000.

THE RAILWAY BUILDING & OPERATING COMPANY, of Camden, N. J., has been incorporated by C. T. Leland, C. W. Rambo and W. B. MacDonald, of Camden, N. J. The company is capitalized at $125,000 and proposes to construct railroads, telephone and telegraph lines, etc.

THE SCIENTIFIC AEROPLANE & AIRSHIP COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $50,000, to manufacture, sell and operate airships. The incorporators are: H. C. Beach, W. A. Haynes and H. C. Evans, of New York, N. Y.

C. F. SPLITDORF, of New York, N. Y., has filed articles of incorporation, with a capital stock of $500,000, for the purpose of manufacturing electrical machinery, ignition apparatus, automobile parts and sundries. The incororators are: C. F. Splitdorf and J. Splitdorf, of New York, N. Y., and P. J. W. Kelly, of Jersey City, N. J.

THE TURBO ENGINEERING COMPANY, of Chicago, Ill., has filed articles of incorporation, with a capital stock of $25,000, and proposes to do a general engineering and contracting business. The incorporators are C. A. S. Howlett, W. L. Stockton and H. Hertz.

Company Elections.

PITTSFIELD, MASS.—At the annual meeting of the Pittsfield Electric Company held July 30 the following-named officers were elected: Alexander Kennedy, president and treasurer; William L. Adam, clerk. Directors were elected as follows: W. L. Adam, S. G. Colt, Alexander Kennedy, James W. Hull, Charles E. Merrill, Henry R. Pierson and A. H. Rice.

NASHUA, N. H.—At the annual meeting of the stockholders of the Nashua Light, Heat & Power Company the following-named directors were elected: F. W. Estabrook, F. E. Anderson, James H. Tolles, George E. Anderdon and Elbert Wheeler. The directors later elected officers as follows: F. W. Estabrook, president; James H. Tolles, clerk; Elbert Wheeler, treasurer; George L. Sadler, superintendent electrical division, and Walter F. Norton, superintendent gas division.

New Incorporations.

FORDYCE, ARK.—The Southern Telephone Company, of Fordyce, has been granted a charter, with a capital stock of $1,000,000, and proposes to construct and operate telephone and telegraph lines throughout the State. The incorporators are: A. B. Banks, president; C. B. Kyle, T. A. Munroe, William Wopfer and Dr. J. H. Middleton.

FORT WAYNE, IND.—Articles of incorporation have been filed by the Fort Wayne & Toledo Electric Railway Company, which intends to construct an electric railway from Fort Wayne to Bryan, Ohio, a distance of 55 miles, with headquarters at the former city. It has an authorized capital stock of $100,000, and the incorporators are E. A. Tennis, Garden City, Kan.; H. C. Baker, Philadelphia, Pa., and R. L. Bastress.

WARRINGTON, IND.—The Warrington Telephone Company has been organized and incorporated for the purpose of constructing, equipping and operating a telephone exchange in this city and extending its lines throughout the north part of Hancock County. The directors, headed by W. J. Kennedy, are in the market for material and equipment.

VICKSBURG, MISS.—The Mississippi Electric Company, capitalized at $10,000, has been incorporated by A. A. Woods, A. M. Paxton and others.

CARTHAGE, N. Y.—The Oswegatchie Hydraulic Power Company, of this city, has been incorporated for the purpose of generating and selling electricity, but not for public purposes. It has an authorized capital stock of $100,000, and the incorporators are: Mark S. Wilder, M. C. Wilder and F. P. Wilder, all of Carthage.

GILBOA, N. Y.—Articles of incorporation have been filed by the Gilboa Electric Light, Heat & Power Company, which is capitalized at $25,000, and the following directors have been elected: E. E. Billings, E. S Persons, Sidney .Rivenburgh, J. M. Case, G. M. Wyckoff, E. Hulbert, N. C. Wyckoff, F. S. Lewis and J. M. Cronk.

GREENSBORO, N. C.—The Southeast Guilford Telephone Company has been chartered, with a capital stock of $25,000, by C. S. Gilmer, of Greensboro, and others.

CLEVELAND, OHIO.—The Cleveland Traction Company has been incorporated to construct an electric railway in this city. It is understood that Herman J. Schmidt, one of the incorporators, intends to transfer his franchise rights in Cleveland to the new organization. Others interested in the new project are: A. F. May, O. F. Leisey, T. G. Fitzsimmons and James Lawrence

PENDLETON, ORE.—Articles of incorporation have been filed for the Farmers' Railway & Navigation Company to construct a railway to be operated by electricity, gasoline or steam to connect Umatilla, Holdman, Helix, Hermiston, Echo and Pendleton. The company is capitalized at $250,000. The officers are: Charles A. Hill, of Pendleton, president; A. A. Cole, of Pendleton, secretary and treasurer, and E. T. Erickson, of Hermiston, Ore., chief engineer.

PENDLETON, ORE.—Articles of incorporation have been filed by the Umatilla Railway & Electric Power Company, whose purpose is to construct an electric railway connecting Pendleton, Pilot Rock, Nye, Alba. Umatilla and other places. It is planned to construct about 200 miles of line in Umatilla County, surveys for which are being made, and to develop power from Camas Creek. The company is capitalized at $100,000, and the incorporators are: C. J. Smith, Pendleton; D. Belts and A. R. Turner.

AMBRIDGE, PA.—Application for a charter has been made by the People's Electric Company, whose intention is to generate and sell electricity for light, heat and industrial purposes. Those interested in the new corporation are: E. H. Jennings, Pittsburgh, Pa.; L. A. Meyram, Pittsburgh; F. A. McVay, of Sewickley, Pa., and others.

HOUSTON, TEX.—Articles of incorporation have been filed by the Westmoreland Railroad Company, those interested in the enterprise being W. W. Baldwin, Max Eggert, A. J. Condit and R. B. Henderson. The new concern has an authorized capital stock of $40,000, and proposes to construct an electric line from Houston to Bellaire, a distance of about miles

MARSHALL, TEX.—The Marshall Traction Company has been incorporated with a capital stock of $25,000 for the purpose of constructing an electric railway within the corporate limits of Marshall. Among those interested in the enterprise are: Marvin Turney, F. H. Prendergast, John Copeland and others.

SAN MARCOS, TEX.—The San Marcos Utlities Company, whose charter includes the privilege of establishing an electric light plant at this city, has been incorporated, with a capital stock of $200,000, by V. L. Brooks and others.

SUFFOLK, VA.—Articles of incorporation have been filed by the Suffolk Gas & Electric Company. It has an authorized capital stock of $15,000, and the following officers have been elected: W. H. Venable, president; W. W. Starke, vice-president, and M. G. Mulvey, secretary and treasurer.

STARBUCK, WASH.—Following the acquisition of the Starbuck Electric Light & Power Company's plant, formerly the property of Dr. Marcel Pietrzycki, of Dayton, by A. E. Bryan, of the Washington State College, articles of incorporation were filed for the Starbuck Electric Company. The new concern is capitalized at $25,000, and others interested are H. Bryan, A. W. Bryan and Thomas Neill. The new company proposes, in addition to supplying power for lighting Starbuck, to construct and operate water works and furnish power for manufacturing purposes.

CHARLESTON, W. VA.—The Kanawha & Ohio Valley Traction Company has been chartered by George S. Couch, F. P. Grosscup and others, of Charleston, to construct an electric railway from Kanawha Falls on the Kanawha River to Point Pleasant, surveys for which are now being made between Charleston and Kanawha Falls.

FAYETTEVILLE, W. VA.—The Fayette Public Service Corporation, which is capitalized at $20,000, has filed articles of incorporation, and taken over the franchise recently granted to R. H. Dickinson for the construction of an electric lighting system at this city. The original plan outlined by Mr. Dickinson, who is one of the incorporators of the company, for securing power from the Stuart Colliery Company's plant and erecting transmission lines therefrom to Fayetteville and Oak Hill, will be adhered to. The officers of the company are: J. P. Davis, Stuart,

W. Va., president and general manager; J. P. Staton, Glen Jean, W. Va., vice-president, and R. J. Stegall, Glen Jean, secretary and treasurer.

WHEELING, W. VA.—Articles of incorporation have been filed by the Warwood Water & Light Company, of Warwood (post office Wheeling, W. Va.). The capital stock is placed at $50,000, and the incorporators are: B. W. Peterson, John A. Moore, James W. Ewing, Edmund P. Hunter and others.

Legal.

DUTY OF ELECTRICAL COMPANIES TOWARD PERSONS USING THE HIGHWAYS.—It has been held in different cases that electric light companies are not insurers of the public using the streets over which their wires are strung on poles, and are therefore not liable for all injuries resulting from contact with their wires, irrespective of the circumstances under which they occur. What they are liable for is the exercise of that degree of care which the law imposes upon them in view of the dangerous character of their wires and the rights of the public in the highways over which they are suspended. In a recent Maryland case it appeared that, while the plaintiff, a boy of eight years old, was passing along a public street of Baltimore he swung himself around a pole standing in the pavement, when he came in contact with a hanging wire charged with electricity and badly burned his head and his hand. The evidence did not show the existence of any sudden or unforescen cause for the falling of the wire, nor show with certainty whether it fell before or at the time of its coming in contact with the boy. It was held that, in view of the exceedingly dangerous character of electric light and power wires, and the peril to which their suspension over the public streets exposes the public who constantly traverse and use the streets, the injury of a person upon the surface of the street by contact with a hanging or fallen wire, in itself, if unexplained, affords sufficient *prima facie* evidence of negligence on the part of the owner of the wire to entitle the plaintiff to go to the jury in an action for damages for the injury. Walter vs. Baltimore Electric Company, Court of Appeals of Maryland, 71 Atl. Rep. 952.

ELECTRIC COMPANY NOT LIABLE FOR FRIGHTENING A HORSE.—An action was brought against a telephone company on the ground that the plaintiff's horse took fright at a reel of pipe being used by the company and ran away. The defendant telephone company had acquired from the proper authority the right to erect and maintain "telephone poles and wires to be placed thereon, together with such supporting and strengthening fixtures and wires as the company might deem requisite." In the erection of its plant the company made use of cables or groups of wires inclosed in lead pipe a little over an inch in diameter and wound on wooden reels so constructed that they could be mounted on axles. The defendant's foreman of construction sent men to string cables on the poles already erected. For this work some of the men under his direction placed one of these reels of lead pipe on the side of the street next the sidewalk and in the line of the poles upon which the cables were to be strung. While the men were at work upon the poles and wires preparing to string the cables and pipe, but before they had begun to unwind the pipe from the reel, the plaintiff, driving his horse along the street, came toward the reel, when the horse became frightened from the appearance of the reel, or of the lead pipe wound around it, and ran away, to the plaintiff's injury. In holding the company free from liability, the Court said: "It is not the law that economic progress is to be arrested or even turned aside whenever a well-broken horse, carefully driven, is frightened or likely to be frightened thereby. To say that well-broken horses, carefully driven, must not be frightened, is to say that no new appliance, however useful, shall be used on or near highways. In this age of economic progress it is the more reasonable and workable, and hence the legal, rule that owners and drivers of horses should recognize that the highways are not exclusively for their use; that other and new instrumentalities for transportation and transmission, and appliances for their construction and maintenance, are often legally allowed upon the highways; and that they should early accustom their horses to whatever new conditions thus arise, and be on their guard against them. In this case it was as much incumbent on the plaintiff as on the defendant to foresee that his horse might be frightened by the reel or the lead pipe, and have taken measures to avoid or prevent the possible consequences. The reel and the lead pipe being otherwise lawfully where and when they were in the street, the mere fact that they were likely to frighten horses unaccustomed to them did not make their presence there unlawful. The consequences of the fright must therefore remain where they fell." Simonds vs. Maine Telephone & Telegraph Company, Supreme Judicial Court of Maine, 72 Atl. Rep. 175.

Personal.

MR. ALTON S. MILLER, formerly vice-president and general manager of the Consolidated Gas, Electric Light & Power Company, of Baltimore, has assumed duties in a similar capacity with the Union Electric Light & Power Company, St. Louis, Mo.

PROF. MORGAN BROOKS, of the electrical engineering department of the University of Illinois, has a year's leave of absence, giving him a rest of which he stands greatly in need. He will take a trip around the world, first spending about three months in Europe.

MR. H. B. HERYFORD has resigned as local manager of the Colusa Gas & Electric Company, Colusa, Cal., to accept the position as manager of the Chico Gas & Electric Company, Chico, Cal. Mr. William H. Henderson, of Sacramento, Cal., has succeeded Mr. Heryford as local manager of the Colusa Gas & Electric Company.

MR. AND MRS. SAMUEL INSULL, SR., and Miss Insull, of London, the father, mother and sister of Mr. Samuel Insull, of Chicago, president of the Commonwealth Edison Company, are spending the summer in this country as the guests of their Chicago relative at Mr. Insull's farm at Libertyville, Ill. The London Insulls will return to England in September.

MR. CHARLES MACLOSKIE, of Brussels, who has been spending a short vacation in New York State, sailed for home on Thursday, Aug. 5. Mr. Macloskie is one of the well-known men of the industry, having been identified with the Bentley-Knight Company, the Thomson-Houston Company and the Allgemeine Elektricitäts Gesellschaft. He was engineer of the intra-mural road at the Chicago World's Fair.

PROFESSOR F. B. CROCKER, of the electrical engineering department of Columbia University, New York City, has leave of absence and, starting in October, will make a trip around the world. He circumnavigated the globe 11 years ago, and was in Manila while things were very warlike. He is interested to study at first hand the tremendous changes that have happened since then in the Far East.

MR. HUGO REISINGER.—At Berlin on Aug. 9, Emperor William conferred the Crown Order of the Second Class on Mr. Hugo Reisinger, the well-known carbon and electrical importer of New York. This honor was in well-deserved recognition of services in helping to organize the splendid exhibit of modern German art at the Metropolitan Museum of Art last January. Mr. Reisinger has shown much public spirit in efforts of this character.

MR. R. W. SEARS, one of the founders of the great mail order business of Sears, Roebuck & Company, has just retired from business at the age of 45 with a fortune of $25,000,000, having sold his holdings in the concern. He was formerly a telegraph operator, and while working at the key developed among his fellow employees the ideas and methods which later laid the foundation of the great enterprise. He began with selling watches by mail. He will now live and work on his model farm in Illinois.

MR. ARTHUR EASTMAN CLIFFORD, second vice-president of the McGraw Publishing Company, New York, was married to Miss Jean Fergus on the evening of Aug. 3 at the residence of the bride's parents, Mr. and Mrs. George H. Fergus, 415 Sheridan Road, Chicago. Mrs. Frank Bartsch, of Omaha, sister of the bride, was matron of honor. There was a large gathering of friends to witness the ceremony, which was performed by Rev. Dr. R. H. F. Gairdner. Mr. and Mrs. Clifford are spending their honeymoon on the Great Lakes and at summer resorts in New York State. They will be at home in New York about Sept. 1.

Obituary.

DR. O. FRÖLICH.—It is with great regret that we note the death of Dr. O. Frölich at Berlin, Germany, at the age of 66. He is fittingly spoken of as one of the pioneers of the modern electrical industry. He was associated with the great firm of Siemens & Halske in its early telegraph days, but as the art expanded he grew and advanced with it. He took up in turn the development of the dynamo-electric machine and gave much time to the perfection of electrical measuring instruments. He was of late years lecturer at the Charlottenburg Technical High School and always maintained a strong interest in pure science and scientific research for its own sake.

Trade Publications.

RECEPTACLES.—A complete price list of receptacles for decorating work, outlining buildings, suspension and festooning is given in bulletin No. 522 of Pass & Seymour, Solway, N. Y.

MOTOR STARTERS.—The Automatic Switch Company, 131 Liberty Street, New York, has issued as additions to its loose-leaf catalog sections Nos. 12 and 25, dealing with magnet switches and automatic starters for electric motors.

MOTOR-DRIVEN PUMPS.—Pumps designed particularly for furnishing water to residences, garages, stables, etc., and arranged for driving electric motors, are illustrated, listed and described in a loose-leaf catalog issued by the Jarvis Engine & Machine Works, Lansing, Mich.

ELECTRIC MEASURING INSTRUMENTS.—The bulletin issued by the Hoyt Electrical Instrument Works, Penacook, N. H., gives much information concerning ammeters, voltmeters and a combined voltmeter and ammeter known as the volt-ammeter. These instruments are intended for direct-current circuits, and are characterized by neatness and compactness.

PUMPS.—Catalog No. 32 of the Du Bois Iron Works, Du Bois, Pa., is a well-prepared 32-page publication relating to pumps arranged for steam, electric and gasoline engine and air-driving. These pumps are designed for all service for which pumps can be used.

SILENT CHAINS.—Silent-running, flexible gearing, involving the use of steel chains, is treated briefly in a well-illustrated bulletin, designated as No. 8, issued by the Morse Chain Company, Ithaca, N. Y. These chains are built for drives ranging from ¼ to 1000 hp.

STORAGE BATTERIES.—A sketch of the development of the Exide and the Hycap-Exide storage batteries is contained in a neatly executed booklet issued by the Electric Storage Battery Company, Philadelphia, Pa. These batteries are used extensively for electric vehicles.

FUEL ECONOMIZERS.—The Green Fuel Economizer Company, Matteawan, N. Y., has issued a booklet, entitled "How to Save Coal," which presents in a convincing manner the advantages to be derived from the use of the so-called fuel economizers, which utilize heat otherwise wasted through gases.

PISTON PUMPS.—The Goulds Manufacturing Company, Seneca Falls, N. Y., is distributing a mailing card for calling attention to its double-acting piston pump, particularly adapted for domestic service. These pumps are provided with wheels, and are well arranged for driving by electric motor.

SPEED INDICATORS AND RECORDERS.—Schuchardt & Schutte, 90 West Street, New York, have issued a booklet entitled "Tachometers and Tachographs," which deals with devices for indicating and recording rotative speed. There is also described and illustrated the so-called cut-meter, which indicates the peripheral speed of a shaft or similar device being turned in a lathe.

HIGH-VOLTAGE DIRECT-CURRENT RAILWAY.—Bulletin No. 4673 issued by the General Electric Company describes the Pittsburgh, Harmony, Butler & New Castle 1200-volt direct-current railway. The bulletin contains numerous illustrations, and gives a more or less detailed description of the road, its equipment and operation, and should be of interest to railway men.

THE PHILADELPHIA BATTERY.—Some excellent literature is issued by the Philadelphia Storage Battery Company, Emerald and Tioga Streets, in regard to its various cells, including those for vehicles, for lighting and for automobile ignition. This battery has been very largely used for electric vehicles, and the reports are most satisfactory from users as to life and endurance, with large capacity steadily sustained. The company keeps in close touch with customers by means of regular reports and issues instructions that are clear and concise and that, if followed, will insure fair and proper treatment of the battery under all conditions of service. Full details are given as to the construction of the battery, and all the parts are illustrated in the descriptive pamphlets. Prices are also given.

ELECTRIC HEATING DEVICES.—The extent to which electricity is now being used for heating purposes will be appreciated from the fact that the latest catalog of the American Electric Heater Company, Detroit, Mich., is a 100-page publication, most all of which is devoted to descriptive matter relating to heating devices. In addition to the material of a purely catalog nature, a certain amount of technical information relating to the cost of operation, etc., is included. The devices described are smoothing-irons, stoves, water-heaters, toasters, coffee-percolators, chafing-dishes, warming-pans, air-heaters, hot-water urns, coffee urns, plate-warmers, foot-warmers, hair-dryers, curling-iron heaters, broilers, griddles, ovens, sterilizers, soldering-irons, glue-pots, wax-heaters, shoe iron tools and branders.

Business Notes.

GENERAL ELECTRIC COMPRESSORS.—The General Electric Company has introduced recently centrifugal air compressors of two kinds. The first is a single stage apparatus, which takes care of pressures from 1 lb. to 3½ lb. The more important development, however, is a compressor for blowing blast furnaces and similar apparatus, where large volumes and pressures of from 10 lb. to 30 lb. are involved.

THE HOLOPHANE COMPANY, 227 Fulton Street, New York, has announced that, beginning on Sept. 1, its steel-reflector department will have several engineers working exclusively upon factory and shop lighting. These engineers will be prepared to undertake any problem in industrial lighting that may be offered, and their services are placed, without charge, at the disposal of central stations, electrical contractors and supply dealers.

THE DICKINSON MANUFACTURING COMPANY, Springfield, Mass., announces that, by the registration of the "Gummon" trade-mark in the United States and in many principal foreign countries, it is legally granted the exclusive right to the use of the name "Gummon" and the symbol thereof in the marketing of all substances for molded electrical insulation based upon qualities claimed for Gummon. This material is said to be capable of withstanding a temperature of 500 deg. Fahr., while retaining its insulating properties.

THE WOODS MOTOR VEHICLE COMPANY.—Owing to the growth of its business, the Woods Motor Vehicle Company, maker of electric pleasure vehicles, is building an addition to its factory at Calumet Avenue and Twenty-fifth Street, Chicago. The new structure, with brick front and of reinforced concrete construction, will consist of four stories and basement, with ground dimensions of 60 ft. x 120 ft., and it will extend through to Cottage Grove Avenue from Calumet Avenue. It will add about 25 per cent to the floor space of the factory. Woodworking operations will be carried on mainly in the new part. There will be two Andrews dry kilns in the basement and various types of woodworking machinery on the other floors. Electric drive is used throughout the factory, and, so far as possible, individual motors are used. Electricity is purchased from the Commonwealth Edison Company. A feature of the addition to the factory will be a large elevator, in which an automobile may be driven from the street and hoisted to any floor above. An exhaust system is installed by which the shavings from the various woodworking departments are conveyed to the basement, where they are burned under boilers which generate steam for heating the dry kilns. The company gives its entire attention to the manufacture of high-grade electric carriages, and it turns out from 500 to 600 cars a year. Its output is sold from three to four months ahead, usually. The officers of the Woods Motor Vehicle Company are: President, L. E. Burr; secretary, Thomas Clements; treasurer, A. G. Becker; works manager and engineer, F. J. Newman; sales manager, C. J. Metzger.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JULY 27, 1909.

[Conducted by W. F. Bissing, Pat. Law, 2 Rector St., N. Y. City.]

927,816. (Issued July 13.) SELECTIVE RINGING AND TALKING DEVICE; C. O. Sisler and L. D. Smiley, Uniontown, Pa. App. filed Oct. 2, 1908. Lock for selective communication between parties on the wires in which a pawl and ratchet operates a switch, the ratchet being worked by a key.

928,373. (Issued July 20.) SANITARY GUARD FOR TELEPHONES; S. E. Florsheim, Chicago, Ill. App. filed April 5, 1909. A cup guard, attached to a mouthpiece made of collapsible material, for shipment.

929,001. RHEOSTAT; R. R. Noble and L. E. Mitchell, Chicago, Ill. App. filed Feb. 5, 1909. The combination of a frame with a plurality of grid resistance supports slidably mounted in the frame and doors engaging with the supports for holding them in position.

929,011. ELECTROMAGNETIC WINDING GEAR FOR CLOCKS AND THE LIKE; K. Puttkammer, Gross-Lichterfelde, near Berlin, F. Orthmann, Charlottenburg and J. Schindler, Berlin, Germany. App. filed Dec. 5, 1907. Details in electromagnetic winding apparatus, making use of a U-shaped armature enclosing the magnet coil.

929,017. METAL-DEPOSITING APPARATUS; J. K. Reynard, East Elmhurst, N. Y. App. filed Feb. 14, 1906. Deposits a gold layer on the wax of phonograph records by mounting the apparatus in a vacuum chamber.

929,025. TELEPHONE STAND; C. R. Schafer, Syracuse, N. Y. App. filed March 24, 1908. A telephone stand carrying an arm and an adjustable bracket having a clamp at one end to support the receiver, leaving the hands free.

929,026. WIRE CLAMP OR SUPPORT; O. F. Scholz, Charleston, W. Va. App. filed Feb. 17, 1909. A cap with parallel flanges, wire clamps engaging, the clamps grasping the wire and having serrated edges.

929,041. CONTROLLER ATTACHMENT; J. Sontag, West New York, N. J. App. filed Oct. 17, 1908. Controller drum with a contact finger whose face is provided with a recess carrying insulating material to prevent burning.

929,094. ILLUMINOUS ELECTRIC HEATER; F. Kuhn, Detroit, Mich. App. filed Dec. 12, 1908. The heater gives light and heat and carries a reflector, including a central standard.

929,095. ELECTRIC HEATER; F. Kuhn, Detroit, Mich. App. filed March 22, 1909. A flat heater having a hot plate, a heating unit on its under side and a casing, including an air chamber.

929,097. OUTLET OR JUNCTION BOX; G. A. Lutz, New York, and C. C. Sibley, Perth Amboy, N. J. App. filed Nov. 29, 1905. The box has socket members provided with walls, which have offset channels adapted to receive extensions or conduits.

929,116. GAS STOPPAGE ALARM; W. E. Apt and E. L. Schott, St. Joseph, Mo. App. filed Nov. 30, 1908. For giving a signal when the flow of natural gas ceases by means of an outer cylinder, an inner cylinder, an alarm bell and a float mounted within the inner cylinder, actuated by gas pressure.

929,118. BATTERY SUPPORTING MECHANISM; T. V. Buckwalter, Altoona, Pa. App. filed Jan. 20, 1909. A cradle for protecting batteries on trucks against vibration by means of elastic hangers, having three points of connection with the frame above the center of gravity.

929,121. STORAGE BATTERY; R. N. Chamberlain, Depew, N. Y. App. filed Oct. 9, 1906. A storage battery cell having a plurality of battery plates, alternately positive and negative, and an outside positive plate of greater capacity than either side of the inside positive plates.

929,123. ELECTRIC METER; T. Duncan, LaFayette, Ind. App. filed Feb. 1, 1909. An integrating watt-meter for large currents having a supplemental pressure field winding normally cut out of the field and manually brought into and out of operating relation with the meter armature to test its speed.

929,132. INSULATOR; E. R. Hill, East Orange, N. J. App. filed May 25, 1908. Makes use of strong metal bonds for securing the wire support to the insulating member and the latter to the supporting base.

929,142. METHOD OF TREATING SLAG, S. B. Ladd, Washington, D. C. App. filed June 2, 1906. For recovering copper from slags by transmitting an electric current through a flowing body of slag in a direction transverse to its line of flow, superheating the slag and permitting the metal to subside.

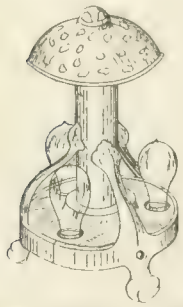
929,185. ALTERNATING DIRECT-CURRENT SYSTEM OF CONTROL; H. L. Beach, Wilkinsburg, Pa. App. filed March 3, 1906. For railway vehicles supplied from a grounded track rail in which the trolley is held out of contact when the motor circuit is open and in contact when the motor circuit is closed.

929,186. SYSTEM OF ELECTRIC MOTOR CONTROL; H. L. Beach, Wilkinsburg, Pa. App. filed Sept. 26, 1907. For electric vehicles containing the combination of a supply conductor, a transformer, and a current collecting device engaging the conductor and electrically connected to the transformer with means depending on the transformer circuit for automatically moving the current collector out of engagement with the supply conductor.

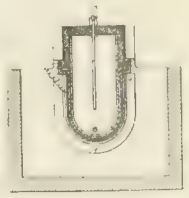
929,187. CONTROL SYSTEM FOR ELECTRIC MOTORS; H. L. Beach, Wilkinsburg, Pa. App. filed Nov. 8, 1907. A plurality of motors are provided with control switches, operating amgnets for the switches, secondary batteries for the magnets and means for charging the batteries from unlike sources of energy with automatic means for selecting one of the charging means.

929,211. POSITION INDICATOR FOR ELEVATORS; R. A. Griswold and J. Zang, Seattle, Wash. App. filed May 26, 1908. Stationary contact members and movable contact members control lights and a switch is provided to change the signaling point relative to the travel of the elevators.

929,214. RAILWAY SIGNAL; S. T. Harvel, Lawrence, Kan. App. filed Feb. 4, 1908. A circular spectacle case supported on a pivot and having a semaphore arm extending from its edge.



929,094—Illuminous Electric Heater.



929,469—Electrolytic Cell

929,219. METHOD OF TREATING ALUMINOUS MATERIALS. Aldus C. Higgins, Worcester, Mass. App. filed May 31, 1907. Fuses aluminous material in an electric furnace at a temperature above quiet fusion and chills the product.

929,256. ELECTROMAGNET; A. E. Sink, New York, N. Y. App. filed Jan. 25, 1909. The coil is provided with a composite wire comprising a plurality of insulated strands intertwined and a variable resistance enclosed circuit with one of the strands.

929,269. ELECTROMAGNET FOR CLOCKS AND MOTORS; C. Arnold, Hamburg, Germany. App. filed May 11, 1908. For small motors in which a resistance takes up the spark, the resistance being in the form of an inductionless double coil wound upon the magnet coil.

929,276. ELECTROLYTIC DIAPHRAGM AND METHOD OF MAKING THE SAME; A. G. Betts, Troy, N. Y. App. filed Jan. 7, 1909. Prepares asbestos board by treating it with powdered sulphur and heats the board to melt the sulphur.

929,280. LAMP; E. C. Broadwell and J. A. Lyons, Chicago, Ill. App. filed March 18, 1905. An incandescent lamp in which the thread consists of metallic chromium with metallic oxides and a mantel of earth oxides encloses the thread, but is out of contact therewith.

929,284. THIRD-RAIL OR OTHER ELECTRICAL CONDUCTOR; W. J. J. Burch, Chicago, Ill. App. filed Jan. 7, 1907. A third-rail with flanges on its under side, the rail receiving contact shoes and being provided with an insulating covering supported by the flanges carrying a supply cable.

929,312. ELECTROPLATING PLANT, W. R. King, Newark, N. J. App. filed Nov. 13, 1908. For plating hoop iron, etc., by passing it in a strip through a series of baths. Details.

929,319. RELAY, F. R. McBerty, New Rochelle, N. Y. App. filed Sept. 5, 1908. A relay having an energizing spool with a projecting core and a contact terminal projecting through the core together with a magnetic yoke.

929,332. ELECTRODE SUPPORT FOR FLAMING ARC LAMPS. R. Scott, Newark, N. J. App. filed July 27, 1907. A stop for the electrode consisting of a button made of equal parts of zinc and aluminum, which has the property or repelling the arc.

929,338. CURRENT-CONTROLLING MECHANISM FOR RAILWAY MOTORS; A. B. Stitzer, Philadelphia, Pa. App. filed Feb. 18, 1909. For four motor cars to avoid a closed loop circuit in which the armature and field of each motor are arranged in series. Provides means controlled by the controller to open and close the circuit at a point in the loop including the several motors.

929,339. CURRENT-CONTROLLING MECHANISM FOR RAILWAY MOTORS; A. B. Stitzer, Philadelphia, Pa. App. filed Feb. 18, 1909. A four-motor car, in which damage to the reverse cylinder is avoided by means controlled by the controller to open and close the circuit at a point including the several motors.

929,349. WIRELESS TELEGRAPH SYSTEM; C. R. Underhill, Providence, R. I. App. filed Aug. 10, 1904. A wireless receiving device in which all the devices are controlled by a high-resistance relay or equivalent device. Details.

929,353. INTERRUPTER; R. H. Wappler, New York, N. Y. App. filed Dec. 9, 1907. A mechanical interrupter for X-ray apparatus by means of which a varying flux is set up in a magnetic circuit for actuating the contacts to make and break the circuit.

929,354. GAS CHAMBER FOR ARC LAMPS, E. P. Warner and C. Wiler, Chicago, Ill. App. filed Sept. 12, 1906. The gas cap has an airtight globe surrounding the arc, the cap including an outer and an inner chamber with a common passageway through which the gases pass, the gases acting as a check to prevent the free entry of air.

929,363. ELECTRIC SIGNAL FOR RAILWAY SWITCHES; F. Zele, Cleveland, Ohio. App. filed March 8, 1909. A switch and signal operated by a track instrument struck by the wheels of trains.

929,371. ASYMMETRIC CELL; W. C. Arsem, Schenectady, N. Y. App. filed March 18, 1909. Includes a metallic, mercury anode and a co-operating electrode and a solution containing a reagent which will interact with the mercury to form an insulating film.

929,393. RELAY; F. B. Corey, Schenectady, N. Y. App. filed March 20, 1909. Relay for railway signaling having a non-fusible contact block and a metallic contact piece normally resting thereon, with a metallic contact relatively movable into and out of engagement with the contact piece.

929,404. TELEPHONE ATTACHMENT; B. E. Detrick, New Albany, Ind. App. filed Feb. 14, 1908. By means of a wire bracket attached to the transmitter's stand the telephone receiver is carried in operative and in inoperative positions, thus leaving both hands free.

929,444. TRACK DEVICE FOR RAILWAY SIGNALS; M. M. Kane, Montgomery, Ala. App. filed Nov. 17, 1908. Controls a signal by a track instrument.

929,469. ELECTROLYTIC CELL; J. McPhail, Carteret, N. J. App. filed Feb. 5, 1909. The vessel is of rectangular form and carries a vessel within it, the inner vessel havnig portions meeting the projections of the outer vessel.

929,473. SOLDERING TOOL; J. L. and O. G. Nilsson, Chicago, Ill. App. filed Jan. 13, 1908. Details in a soldering tool with the coil removably secured to the tip and removable contact ends.

929,487. WIRELESS SIGNALING SYSTEM; V. Poulsen, Copenhagen, Denmark. App. filed Dec. 24, 1906. Supplies an atmosphere of hydrogen to the arc for producing electric waves and varies the supply according to the signals to be transmitted.

929,492. COLLECTOR BRUSH; H. G. Reist and J. E. Noeggerath, Schenectady, N. Y. App. filed July 28, 1904. Includes a box having overhanging portions to form a partially closed slot and a plurality of conducting leaves with their upper portions in the slot.

929,506. FUSE BOX; E. Sherwood, Honesdale, Pa. App. filed May 18, 1908. A fuse holder having means for engaging the conductor, a pin for holding one end of the fuse and a flange for engaging a portion of the fuse adjacent to the part engaged by the pin.

929,517. METHOD OF TREATING ALUMINUM ORES; F. J. Tone, Niagara Falls, N. Y. App. filed March 3, 1909. Works with a mixture of aluminum silicate and emery by placing them in the furnace in which two electrodes dip which are raised as the column of purified product increases.

929,518. PROCESS OF TREATING ALUMINUM-SILICATE ORES; F. J. Tone, Niagara Falls, N. Y. App. filed May 4, 1909. The method of smelting aluminum silicate which consists of subjecting a charge of the silicate base, metalliferous material, and carbon to electrically developed heat, partially reducing the silica, adding further metalliferous material, and completing the reduction of silica.

929,525. RELAY; J. F. Webb, Jr., Denver, Col. App. filed May 12, 1908. A relay having an armature, with operating magnet, a stepped block secured to the armature and a keeper co-operating with the block to lock it in various positions.

929,528. CABLE THREADING HEAD; F. S. Woodward, Brooklyn, N. Y. App. filed May 24, 1905. To facilitate drawing a cable into a conduit. The head has two parts, each having a plurality of perforations, one for each conductor of the cable.

929,531. DEVICE FOR CONVERTING ORDINARY CLOCKS INTO CLOCKS WITH ELECTRIC DRIVING MEANS; August Anders, Charlottenburg, Germany. App. filed June 19, 1908. An ordinary clock is provided with electrical driving means.

929,543. INSULATING APPLIANCE; W. A. Bonnell, Brooklyn, N. Y. App. filed May 3, 1906. A coupling for outlet boxes made in two parts having upper and lower jaws to bind the conduit.

929,578. TREATING METAL FILAMENTS; C. T. Fuller, Schenectady, N. Y. App. filed Aug. 24, 1907. Mixes the compound with a binder, shapes it into wire, fires it in a reducing atmosphere, thus shrinking the residue.

929,582. ELECTRIC CURRENT RECTIFIER; E. Garretson, Buffalo, N. Y. App. filed Sept. 10, 1908. Comprises a body of silver sulphide and a body of metallic oxide in electrical contact therewith.

929,587. ELECTRIC LOCOMOTIVE; M. R. Hanna, Schenectady, N. Y. App. filed Sept. 11, 1906. Circulates cooling air through a conduit extending from the truck motor to the bearing.

929,591. BLOCK SIGNAL SYSTEM; L. A. Hawkins, Schenectady, N. Y. App. filed Sept. 21, 1906. The rails act as a return for power current; one rail is continuous for all the currents and the other is divided into sections to form signaling blocks.

929,602. TRANSMITTER FOR ELECTRIC TELEGRAPHS AND THE LIKE; C. L. Krum, Chicago, Ill. App. filed April 11, 1904. A transmitter for telegraphs having a set of relays operated in order and imparting a succession of impulses to the line at each operation of the set and a series of controlling keys for modifying the impulses.

929,603. TRANSMITTER FOR AUTOMATIC TELEGRAPH; C. L. Krum, Chicago, Ill. App. filed Aug. 31, 1906. For transmitting code impulses in which a series of switches is operated by a series of key controlled type, each switch being actuated by a number of type and each type simultaneously operating a particular combination of switches together with locking means to lock the switches.

929,607. INDUCTION COIL; B. L. Lawton, Meriden, Conn. App. filed Jan. 12, 1909. The coil is wound in sections by simultaneously winding a plurality of adjacent coil sections and simultaneously interposing sheets of insulating material between the sections.

929,609. ELECTRIC CIRCUIT CONTROLLER; H. W. Leonard, Bronxville, N. Y. App. filed Nov. 7, 1907. An automatic release with a mechanical locking device for holding a switch lever in operative position while the circuit remains normal, and released by an electromagnet.

929,635. ELECTRIC SWITCH; N. H. Suren, Needham, Mass. App. filed May 23, 1908. A switch arm having a pivot stud and a spring mounted on the stud, pressing against the arm. Details.

929,643. ARC LAMP; J. Harden, Schenectady, N. Y. App. filed Dec. 26, 1903. Flaming arc having an auxiliary electrode movable into contact with the arcing end of the consuming electrode shortly after current is cut off from the lamp.

12,992. (Reissue.) MANUFACTURE OF SPAR INSULATORS; F. M. Locke, Victor, N. Y. App. filed Dec. 22, 1908. Subjects feldspar to a high temperature, which makes it pliable, then heats it and molds the product.

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The Alleged Water-Power Trust.

Mr. Pinchot, for whose efforts at preserving the forests of the country we have only praise, seems to have become somewhat unnecessarily excited over the water-power situation. He has been misled, apparently, by the fact that two or three large companies furnish nearly all the power transmission apparatus, into thinking that the power plants are actually under their control and that a group of powerful financiers are endeavoring to grab the hydraulic resources of the country. We have been familiar with the development of electrical power transmission in this country from its very beginning, and can assure the worried Mr. Pinchot that he is wasting breath in barking up the wrong tree. The history of power development in this country tells the truth about the situation, and in brief it is substantially as follows: From more than a half century back the chief streams of the East have been under development strictly for local use. The rivers of the New England States in particular have been worked up very carefully in the interest of the textile and lumber trades. The developments are mostly in the hands of old and close corporations as far removed from the speculative grasp of high finance as it is possible to imagine. The same conservative interests are now at work in many parts of the South forestalling in so far as may be the southward drift of textile manufacturing.

When in the early '90s electrical power transmission became practicable, hydraulic properties heretofore unutilizable became useful. Already many had been employed locally for electrical purposes, and the new possibilities of transmission merely extended the list. The early transmission plants for the most part bought and paid for their equipment in the ordinary course of business. As their success was demonstrated, powers more difficult to develop and more distant from a market began to be exploited and their owners often came to the great manufacturing companies for help, since at that time capital in general fought shy of electrical power transmission. Being in business to sell apparatus and having the faith in electrical transmission that is born of intimate knowledge of the facts, the great companies sometimes came to the aid of transmission projects by taking their bonds in part payment for apparatus or lending their influence in helping the placing of securities. This they did to encourage the business on which their own prosperity depended. More often they turned down applicants for such assistance in whose projects they did not feel proper assurance. Those who, from the inside, have tried to get apparently sound propositions through the deadly gantlet of the auditors militant will smile at the idea that the great manufacturing companies have been plotting control of the hydraulic resources of the country. As a joke the accusation is a howling success, but that is all.

After nearly a decade of struggle through hard times, electrical power transmission became a definite and acknowledged success and a legitimate and conservative form of investment.

The capital at last was ready to take up the work of development and larger enterprises began to be set on foot. But this confidence on the part of capital came too late to enable it to grasp the hydraulic resources of the country. We think it is not too much to say that in no industry with a similar total investment is there so little community of ownership and action. Something like 900 electric stations already own and operate their own water-powers and these plants are nearly all independent. The few holding and operating companies that own groups of electric stations actually control a very small part of the whole. It is true that here and there groups of independently developed powers have been physically merged into networks. Such merging, however, is technically very desirable since it enables a fuller and more economical utilization of the forces of nature. Two power plans worked together can generally be made to give a larger output than if worked independently and the full employment of the nation's hydraulic resources demands the linkage of many units into such networks. But there is no sign that the networks now formed are part of a deep-laid plot for general control. On the contrary, they are quite independent and are likely to remain so.

The facts on which Mr. Pinchot's error is based are merely those which apply at large to any attempt at government control of natural resources. Capitalists big and little spontaneously rise in revolt at any action in any sphere that threatens their chance for private gain. Public ownership is the nightmare of high finance under all circumstances and it is fought against with desperate energy. Undoubtedly there is opposition to the reservation of water-powers just as there is to forest preservation, or to public ownership of coal mines and railroads, or to such a parcels-post scheme as the country bitterly needs. We have so long lived under the "Prosperity be dammed" principle that large and small interests alike resent a change such as Mr. Pinchot is trying to bring about. He is up against a hard fight in which we wish him success, but he fights not a "Water Power Trust," but the "Zeit-geist" of our century and people. Everything he wins from it is a gain for posterity though his battle is against desperate odds. He complains that the laws are made by and for the benefit of the "interests." He may be right, but the proper remedy is to unmake the laws, not to break them. The President's long judicial experience inevitably leads him to this view which is not likely to be changed. We hope Mr. Pinchot will do all he can legally to conserve the nation's hydraulic resources and so to preserve them as to ensure their wise and full employment hereafter. He need not fear the opposition of a "Power Trust," which is only a specter of his imagination. Opposition will come vigorously enough from things that really exist. As a matter of fact, the time has now come when water-powers are of increasing value and form sound and profitable investments. For their best use they should be developed on a comprehensive plan and not at haphazard, so that the deliberation ensured by government control would be in the long run a good thing for everybody.

Workmen's Compensation Laws.

In various European countries, notably in Belgium, England, Germany and Austria, industries are so organized that in the event of injury to a workman by any accident, he receives compensation, the amount and duration of which depend upon his wages, and upon the duration as well as on the severity of his injury. The cost of insurance against such injury is added, either directly or indirectly, to the cost of production. In this country there is at present no such legal compensation to the workman, although such legal enactments have been frequently recommended by ex-President Roosevelt in speeches and communications. At the present time, the question is under the consideration of at least one State Legislature, having been referred to a special committee of the Massachusetts Legislature. It is fair and desirable that a workman should be compensated for injuries that disable him. It is also reasonable that the cost of such compensation should be added to the cost of production in each industry. On the other hand, it is very important that the compensation should be given carefully and in order. Above all, it should be contributory, or it may do more harm than good. That is, the insurance fund should be participated in by the workmen collectively in each industry, so that a certain small deduction should be made from each weekly payroll toward the fund and the accounts duly published. In Germany the insurance fund is maintained jointly by the workmen, the employers and the State.

If the injury compensation is equitably made, it is capable of assisting not only the injured workman, but also the entire country, by improving the mutual relations of labor and capital; whereas, if the compensation is either inequitably or carelessly made, it may do much more harm than good. In Great Britain, for example, the Compensation law is open to much criticism. As it stands at present, any hand-worker employed in Great Britain, including domestic servants, receiving any injury, disability, or disease in his or her employment, may demand a compensation of half-wages until recovery. In the event of permanent disablement, the half-wages may be due for life In the event of accidental death, the payment called for from the employer is three years' wages. In Great Britain the practice of insuring regular employees of all kinds is practically universal. Insurance costs from one-fifth of 1 per cent up to 6 per cent of the wages, according to the kind and danger of employment. An average might be about 1 per cent. There are various objections made against the working of the law. One is that the insurance is not apparently contributory, while actually it is. That is to say, discrimination tends to be made against older workmen on account of increased liability to injury. Some go so far as to believe that, in the future, older workmen may have to contract themselves out of compensation in order to secure employment.

The Difficulties of Heterochrome Photometry.

It is well known that when two steady light sources, say, incandescent lamps, are homochrome, or have the same color, their luminous intensities, or candle-powers, may be compared very closely by a good photometrist using a good photometer. The probable error of a single comparison might be half of 1 per cent with a contrast photometer. When, however, the two steady light sources to be compared are heterochrome, or have different colors, then their comparison is not so easy a matter, or, in popular language, is "a horse of another color." For instance, suppose a blue lamp compared against a red lamp. The photometrist has to estimate the relative intensity of two illuminations, namely, a blue illumination and a red illumination. It

is much harder to compare two illuminations if they have different colors than if they have the same color. One and the same observer will evince a much greater probable error of observation in the former case, and two different observers are likely to obtain widely differing mean values. According to the Young-Helmholtz theory of color vision, this increase in the difficulty of comparing heterochrome illuminations is because we have three distinct sets of color-perceiving organs constituting virtually three distinct visual senses of the same general type. When we compare illuminations of the same color, we equalize stimuli on all three color senses. When, however, we compare and seek to equalize a red illumination with a blue illumination, we are trying to compare the stimulus of one color sense with the stimulus of another color sense, something like trying to compare, by feeling, the temperature excess of a hot body with the temperature defect of a cold body. But whatever the correct theory may be, the fact is that differences in color of modern illuminants exist to a marked extent, and that photometric comparisons between them have to be made somehow.

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It was in an attempt to remedy this difficulty that the flicker-photometer was devised. In this instrument the two illuminations to be equalized are not steadily presented to the observer's eye, but are allowed to produce rapidly alternating impressions or flickers on his retina. Viewed in this way, the color difference largely disappears and a photometric balance is obtained with greater ease and definiteness. Not only is the probable error of a single comparison largely reduced, in heterochrome photometry, by the use of a flicker-head, but the discrepancies between the mean results of different observers is also largely reduced. That is to say, different observers are able to agree fairly well, in their heterochrome comparisons, when they use flicker photometer-heads. It has often been questioned whether the flicker photometer gave correct results. It has been admitted that it gave definite results, and reproducible results, on which different observers could agree; but it has been questioned whether it gave a correct illumination balance, such as might be obtained from the mean of a number of observations by a number of different photometrists comparing heterochrome steady illuminations without flicker.

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This question of reliability in the flicker photometer is raised afresh by Mr. Lancelot W. Wild, in a recent article in the London *Electrician*. He describes, and gives the results of, a number of photometric comparisons of a tungsten-filament lamp consuming 1.5 watt per m.h.cp. and a carbon-filament lamp consuming 4.5 watts per m.h.cp. Of course, the former would give the whiter light, and the latter the redder light. These heterochrome comparisons were made with six different photometer-heads, three of which were flicker-heads, and three non-flicker-heads. The three flicker-head results agreed well together, and so did the three non-flicker-head results; but the two sets were about 6 per cent apart. That is, the flicker photometers gave 6 per cent less candle-power to the white tungsten lamp than the non-flicker photometers. Although this result is quite reasonable, and well within expectation, yet it must be regarded with caution, because only one observer was included in the test, and the result should be corroborated by at least one more observer before we accept it. Human eyes differ exceptionally so widely in color preceptions that it is not safe to generalize from a single experience. Assuming, however, that the result is of general rather than of particular significance, it could be accounted for by the fact that we have in the human retina two distinct sets of light-perceiving apparatus; namely, rods and cones. The rods are believed to be possessions handed down from remote ancestors, as far back, perhaps, as fishes; while the cones are of more recent evolution in the history of our ancestors, since they left the waters for the land. Color cannot be perceived by the rods, it is supposed, and can only be perceived by the cones. The rods are capable of responding to very faint stimuli, or very weak illumination; while the cones, with their complex color apparatus, require a stronger light to excite them into action. We all know that we can still see faintly on a dark evening when all colors have faded from view.

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It has been suggested that flickering illumination can excite the rods when the cones have not time to respond. If that suggestion is correct, a flicker-photometer is a rod-perception photometer, and so evades the color difficulty by keeping the color-perception sense out of action. In that case, we might readily produce a balance of visual stimuli on the rods in the retina; but it would not necessarily be the same balance as when both rods and cones were at work. In a similar manner, the sense of taste is largely a conjoint sense of taste and smell. A person might make taste comparisons of teas or of wines after he had deadened his smell-sensation area with cocaine, but his comparisons would then probably differ from those he would make with both senses in activity. The above theory is one consideration, but the facts present another. More observations are first needed on heterochrome comparisons with flicker and non-flicker photometers. Suppose that Mr. Wild's indictment against the flicker-photometer is a true bill, does that mean we must throw that instrument out of court? Mr. Wild seems to think we must do so, at least when tungsten-filament lamps are compared with carbon-filament lamps. We must agree to this so far as concerns the proper establishment of the tungsten-filament candle-power industry. The judgment of a man on wines, with both taste and smell, is to be taken over his judgment with taste alone. The visual judgment of a normal-eyed man who sees the world clearly is to be taken over his visual judgment when he sees it only through blue spectacles. Nevertheless, the value of the flicker-photometer is, we think, too great and too well known to be set aside because it may give a one-sided view. Its view is always definite, and can be accepted subject to its one-sidedness. If, for instance, lamps are specified to be measured by flicker-photometer, the measurements might not be the same as when non-flicker-photometers were used, but they would at least be definite, and fairly capable of agreement. If then further observations should indicate a discrepancy between flicker- and non-flicker-photometers as great as Mr. Wild has reported, it would be encumbent upon photometrists to specify, as "by flicker tests," all measurements made in that way. Perhaps, in time, a table of correcting factors might be arrived at experimentally to bring flicker measurements into conformity with non-flicker measurements. The discrepancy, whatever its magnitude may be, is only another evidence of the difficulties that lie in the path of accurate photometry.

Convention of Illuminating Engineering Society.

The third annual convention of the Illuminating Engineering Society will be held in the Engineering Societies Building, New York, Sept. 27, 28 and 29. One of the features of the meeting will be an exhibition which, besides historical and educational exhibits similar to those shown at the convention last year, will include displays by manufacturers of commercial types of electric and gas lamps, accessories and fixtures, in this respect resembling the national electric light annual trade exhibition. The exhibition will be held in a building at 5 West Thirty-ninth Street, in proximity to the Engineering Building in which the regular sessions of the society will be held. Following is a list of the papers to be presented as thus far arranged, to which additions will probably be made:

Ethics of Illuminating Engineering, by Mr. E. L. Elliott. Some Notes on Illuminating Engineering Practice in Europe, by Mr. H. Thurston Owens. The Importance of Illuminometry in Practical Illuminating Engineering, by Mr. Norman Macbeth. Efficiency of Lighting Installations, by Mr. A. L. Eustice. Shades and Reflectors, by Dr. Louis Bell. The Design of Reflectors, by Mr. A. J. Sweet. Diffusing Mediums, by Mr. A. J. Marshall. Absorption and Diffusion of Various Forms of Glass Surfaces, by Mr. Basset Jones, Jr. Factory and Mill Lighting, by Mr. L. B. Marks. The Photometric Laboratory of the United Gas Improvement Company, by Mr. C. O. Bond. The New Physical Laboratory of the National Electric Lamp Association, by Dr. E. P. Hyde. The Problem of Heterochrome Photometry, by Mr. P. S. Millar. Description of a Demonstration Lighting Installations, by Mr. W. C. Morris. Discussion of the Efficiency of the Moore Light, by Messrs. Hyde, Woodwell, Sharp and Millar.

On Monday evening, Sept. 27, there will be a reception in the assembly rooms of the Engineering Building, followed by a musical program in the auditorium. On Tuesday morning there will be a review from a point of vantage of the historical parade in connection with the Hudson-Fulton celebration.

New York-Canadian Hydro-Electric Plans.

Plans are being drawn for three hydro-electric generating stations to utilize the falls at the Long Sault Rapids, which separate Ontario from New York, near Cornwall. The scheme involves the construction of a dam at the upper end of Barnhart's Island, the building of a lift lock and the straightening out of the course of various channels of the river. It is claimed that fully 100,000 hp can be developed.

The plant will probably be constructed and managed jointly by two companies—the Long Sault Development Company on the New York side and the St. Lawrence Power Company on the Canadian side. The companies are seeking a charter from the Canadian Parliament and the United States Congress.

Meeting of the Indiana Electric Light Association.

Very complete arrangements have been made for the third annual meeting of the Indiana Electric Light Association, to be held in the French Lick Springs Hotel Aug. 18 and 19. The Indiana association was organized three years ago, and the conventions have been well attended.

The executive committee has prepared an excellent program consisting of papers and addresses to be presented by Messrs. P. H. Palmer, of Kokomo; G. S. Merrill, Cleveland; W. H. Schott, Chicago; A. P. Tills, Evansville; H. W. Wells, of the J. G. White Company, New York, and E. E. F. Creighton, Schenectady, N. Y. The following topics for discussion have been placed on the program: Theft of Current; Reading and Care of Meters; Water-Softening Plants; Wood-Working Plants as Power Customers; Day-Load Rates; Relations with the Public. A round of entertainment will be provided for those in attendance and the meeting promises to be the best in the history of the association.

Proposed Protection for Linemen.

A petition signed by a large number of electrical workers of the city of South Bend, Ind., has been filed with the Council of that city asking for the betterment of electric construction and for better protection for the linemen.

The petition asks that all high-tension wires be placed on yellow cross-arms; primary and arc light wire on black cross-arms, and low-voltage wires, such as telephone, telegraph, police and fire alarm, on red cross-arms. Where high and low-voltage wires are on the same poles, the petition asks that a clearance of 6 ft. be made. All cross leads should have a clearance of 4 ft. with proper guards. High-voltage wires should be placed on the tops of the poles and no street railway lines should carry more than 1000 volts on their wires. The petition cites the great number of incidents where electric workmen had been electrocuted and little or nothing done to better conditions. The petitioners ask for due consideration of their requests to the end that their labors may be made less hazardous.

Cascade Tunnel in Operation.

Dr. Cary T. Hutchinson, consulting engineer for the electrification work of the Great Northern Railroad's tunnel through the Cascade Mountains, has concluded exhaustive tests of the electrified section, which is now in successful operation, heavy freight trains being hauled a distance of about four miles from the yard at one end of the tunnel to the yard at the other portal. Four three-phase locomotives, constructed by the General Electric Company, are at present operated. Each of the locomotives weighs 115 tons and the recent tests show that they are fully capable of performing more work than the specifications called for. When very heavy freight trains are hauled through the tunnel, three of the locomotives are used. In addition to the trains, a heavy steam locomotive is at present pushed through in order to take the train at the end of the electric zone. So far as the brief operation of this short stretch of electric road has shown, it is an entire success. Upon the ultimate success of this piece of track depends the electrification of about 60 miles of the Great Northern through the entire Cascade Range.

European Trackless Trolley Cars.

A committee, consisting of two of its members and the general managers of the tramways of the city, has submitted a report to the City Council of Leeds, England, on the trackless trolley cars employed in Europe. They visited the Continent and inspected various railless systems in order to advise as to the adaptability of such means of transit to the needs of English communities. The result of their observations is summarized as follows:

The three systems considered were the Mercedes-Stoll, which is in operation in various parts of Austria and was seen in Vienna; the Filovia, used on six or seven routes in north Italy, and seen in Milan, and the Max Schiemann, which is employed in Germany, especially in the Rhine Valley.

The vehicles operated under each of these systems in general appearance do not differ greatly from the familiar single-deck motor omnibus, except as to the return circuit, which is overhead. It appears that the principal difference among the various systems occurs in regard to the arrangement for keeping the two shoes on the two overhead cables.

The length of the route inspected in Vienna is about 1½ miles, where the road—of a switchback character, having at one stretch of about 100 yd. a gradient of 1 in. 15—is mac-

adamized. On this route there are two pairs of cables, one for going and one for returning cars, though elsewhere one pair is made to suffice, so that when two cars meet one has to stop and remove its connection with the wires until the other has passed. The vehicles carry 12 passengers seated, though when required an additional 12 are allowed to stand, even on the platforms, both front and back. The entrance is at the driver's end, and he attends to all the duties of a conductor as well as driver.

The committee was particularly struck with the smoothness and comfort of riding, the spring base of the truck being very well arranged. Satisfactory assurances were received as to the operation of the cars under the severest winter conditions, though it is noticed that on this particular route the cars have been running only since last October. The motors, which are each 20 hp, form the hubs of the back wheels, and the current is collected from the supply cable by means of a pair of wheels running on the top of the wire—a similar pair of wheels being used for the return. A weighted pendulum slung from a frame carrying these two pairs of wheels keeps them well pressed upon the wires, and the current is conveyed to the motors not by a "fishing rod," but by a pair of cables which allow the car to pass to any part of the road in the avoidance of other traffic. The empty car weighs 2½ tons.

The cost of the chassis of the Mercedes-Stoll is about $2,750, without body. The cost of the overhead construction is about $8,500 per mile, and the working expenses per car-mile, the committee was informed, are: Energy, $0.80; tires (total load 4.2 tons), $2.66; wages (driver only employed), $2.40; depot expenses, $0.52; taxes, management, insurance, $1.60; repairs, renewals, painting cars and equipment, $1.06; total, $9.04.

On the Filovia system the cars will take 30 passengers. A framework carrying two pairs of wheels, one pair in contact with each overhead cable, is employed to maintain the circuit. It is very similar to that used in the Mercedes-Stoll system, except that it is pressed by a "fishing rod" or "boom" against the under sides of the cables. There are two direct-current motors of 10 hp to 12 hp each, and figures supplied by a route similar to that inspected show a working cost per car-mile as follows: Cost of energy used, $0.83; general expenses, $1.188; rubber tires, renewal, $4.32; wages and salaries, $2.80; maintenance of vehicles and line, $1.24; repairs of vehicles, $0.912; total, $11.29.

The route inspected, owned by a private company, is 4½ miles long, and the fare charged is 8 cents. The vehicles are well able to reverse, turn around and maneuver without the trolley being removed, and to take heavy gradients over bad and muddy roads without difficulty, vibration or noise. The cost of overhead construction is estimated at only $3,756 per mile, but only wooden poles were used. They were, however, found to be quite serviceable.

The Max Schiemann system was seen working at Mulhausen. Here the contact with the pair of cables is maintained by means of a "fishing rod," carrying at its extremity a pair of sliding shoes. The overhead construction is similar to that of the systems previously described. The vehicle carries about 15 passengers seated. Only the front wheels have rubber tires, so that there is considerable vibration and noise. The single motor drives onto the front axle, so that the steering is comparatively heavy. The design of this type, however, is stated to be undergoing radical modification. The weight of the present empty car is 5650 lb.

It is stated concerning all of the three systems that very few hitches have been reported, and owing to the comparative lightness of the vehicle the surface of the road suffers less than in the case of a service of cars carrying their own petrol or other engines.

The committee was much impressed with the practicability of each of the various schemes, and considers that by avoiding the heavy expenditure required in the installation of ordinary tramway traction this method of conveyance offers considerable possibilities as general feeders in suburban and interurban districts to tramway systems, and is quite capable of supplying a sufficient service for thinly populated districts on a reasonably economic basis.

Springfield (Mass.) Central-Station Report.

The annual return of the United Electric Light Company, of Springfield, covering the year ending June 30, 1909, has been filed with the Massachusetts Gas and Electric Light Commission. The company shows a gratifying increase in earnings compared with the previous year. In the fiscal year 1909 the company earned $496,437.70, against $465,682.35 in 1908, or a gain of 6.7 per cent. The operating expenses, including manufacture, distribution, office expenses, management and miscellaneous expenses, were $54.3 per cent of the gross earnings, or $269,381.88, compared with $253,471.57 last year. The balance to profit and loss for 1909 is $227,055.82, against $212,210.78 for 1908. The company declared dividends of 8.5 per cent in the fiscal year ending June 30, 1909, or $106,250, compared with 8 per cent dividends, or $84,888, in 1908.

The Springfield company's total energy sales for the latest year were 12,117,048 kw-hours, against 10,421,309 kw-hours sold in 1908, or an increase of 16.3 per cent, indicating that the public received a large part of the increased service at a lower relative cost than in the preceding year. The total energy generated in 1909 was 16,583,186 kw-hours, compared with 16,230,797 for 1908.

The company sold 73 per cent of its total energy in 1909, compared with 64 per cent in 1908, showing considerable improvement in the physical character and administration of the plant. In the following table a few data of engineering and operating interest are given, for the fiscal year 1909:

UNITED ELECTRIC LIGHT COMPANY.

Income from commercial arc lights by contract	$11,563.62
Income from commercial incandescent lights by contract	20,130.64
Income from commercial arc and incandescent lights by meter	277,620.29
Income from public street arc lights	84,371.35
Income from public street incandescent lights	4,972.95
Income from electric power sales	97,778.85
Total, net	$496,437.70

The principal gains for the year were in metered arc and incandescent service, 9.5 per cent, and in power sales, 6.6 per cent.

Cost of manufacture	$132,916.38
Cost of distribution	68,003.01
Cost of office expenses and management	35,062.03
Miscellaneous expenses	33,400.46
Total	$269,381.88

The chief gain was in the cost of manufacture, which was 13.9 per cent greater than in 1908. The company saved about 4 per cent in its distribution expense in 1909. The total number of customers as of June 30, 1909, was 3222. The company's total boiler capacity was 5300 hp, with 7770 hp in steam turbines and 2835 hp in water-wheels.

Massachusetts Commission News.

The Massachusetts Railroad Commission has authorized the Boston & Northern Street Railway Company to issue 5883 shares of preferred stock at $115, and the Old Colony Street Railway Company 4042 shares of preferred stock at $115, the money in each case to be used to supply working capital under the law passed by the Legislature of 1909, which sought to improve the facilities of the electric transportation companies of the State in financing their affairs. The total issue amounts to about $1,140,000 at the market price set by the directors in accordance with the law permitting companies to fix the price of new securities so long as they are not sold at less than par, and subject to the consent of the Railroad Commissioners. This board has also authorized the Worcester Consolidated Street Railway Company to issue $3,182,000 in 20-year 5 per cent bonds, to refund bonds previously issued for taking over the Worcester & Marlboro, Worcester & Clinton, and the Leominster & Clinton companies. The Berkshire Street Railway Company has been authorized to issue bonds to the amount of $190,000 to pay floating indebtedness and the cost of permanent additions to the property.

At the hearing given by the Railroad Commission on Aug. 3, in connection with the continuation of a charge of 1

per cent for each transfer issued by the Middlesex & Boston Street Railway Company, no opposition appeared to the further extension of the present arrangement. This company operates trolley lines in Newton and other suburbs at the west of Boston, and within the past year absorbed the Newton Street Railway Company, which operated its transfer system at a charge of 1 cent extra per passenger transferring, under a year's trial authorized by the commission. Considering the opposition which originally developed in Massachusetts when the 6-cent fare was introduced by certain hard-pressed companies, it is most suggestive that at this latest hearing no objections were pressed against the continuance of the extra charge. The board has made a careful examination of the receipts of the Newton Street Railway Company prior to the consolidation with the Middlesex & Boston, and also of the earnings of the latter company for the month of July, 1909, and has granted in an order dated Aug. 5 the extension of the right to charge an extra cent for a transfer for a period of one year. The board states that on account of the consolidation of the companies the period should be a limited one which suitably conserves the public interest.

This decision and the absence of public opposition to the company's petition show that there is now a more favorable sentiment in Massachusetts on behalf of reasonable returns to street railway companies. Many factors have brought about this result, among them being a disposition on the part of the commission to reduce every fare case to an arithmetical situation, to a general appreciation of at least a 6 per cent dividend as a minimum fair return on the investment, and to straightforward methods of publicity on the part of the companies. Decisions granting the companies the means of maintaining themselves as going and profitable concerns are of general value to the electrical industry as a whole, since they revitalize the purchasing power of each corporation and add to its economic stability in the community which it serves.

Marinette, (Wis.) Rate Decision.

The Wisconsin Rate Commission has issued an inportant decision cutting the rates for electric lighting and changing those for electric power at Marinette, Wis., thus winding up the case of the Menominee and Marinette Light & Traction Company. This company operates the street railway, electric lighting and electric power plants in Menominee, Mich., and Marinette, Wis., and the matter before the commission was as to the rates to be charged in Marinette. The company made application for an equalization of rates and submitted a schedule which the commission refused to allow to be put in force. The city asked for a hearing on the rates, alleging that they were unjust and discriminatory and hearings were held together.

The commission finds that unjustifiably low rates have been charged in some cases to uses of current for power and that the result of discrimination has been that rates too high have been charged for residence lighting, for part of the business lighting and for a part of the current for power purposes.

This case was gone into very thoroughly and carefully, as is shown by the fact that the application was made Jan. 21, 1908, and the decision has just been rendered after months of work on the part of the engineering force, the statistical force and the members of the commission itself. At one time the commission refused to dismiss the application of the city for lower rates. It had been maintained that the company was planning to obtain current generated by water-power, make various additions and put in improvements; but the commission held that because at some time in the future this was planned was no reason why service should not be delivered at reasonable rates at the present time.

In its findings the commission declares that electricity may be considered a service rather than a commodity and this should be taken into account. It cannot be stored up ready for use, but the plant must be ready to furnish it when required. It is declared that depreciation must be prepared for by the company and that money which should properly go into the fund for this purpose should not be paid out to stockholders. It is found that the matter of depreciation has not always been properly treated by the company.

Deterioration, rate of interest on investment and taxes and insurance are all counted as fixed charges, and it is held that they are not affected by the output of an electric plant nor by the extent to which the plant may be used. They are held to affect one consumer just as another. But the variable expenses are a different proposition and are held to increase with the output. The fixed charges are found to be generally the greater. A flat rate is held by the commission to be objectionable. In this case a consumer for a short time is compelled to pay as much as a consumer for a long time. A straight meter rate is held to be satisfactory only where all consumers use electricity in the same way. The commission says it is not fair that a consumer who uses 10 kw for 10 hours should pay as much as one who uses 100 kw-hours, the same amount, but uses it all in one hour. The latter takes too much of the capacity of the plant during the one hour to be allowed to pay as small a rate as the former. The average cost per kw-hour grows smaller as the sales of current under the same maximum demand grows larger.

In making its investigations the commission's statistical force gathered great quantities of data, and the study was a thorough one. The apportionment of the active connected load was taken up in great detail and it was decided that probably one-third of the active connected load should be charged to the residence district, and that the business houses should be charged with about 60 per cent. The capacity expense is declared dependent upon the active load while the output expense is dependent upon the output of the current.

It seems that a rate of 4 cents per kw-hour had been made for users of more than $150 worth of power. The commission declares against this. It says that there is no justification for it for it is less than the output cost and such a rate should not be allowed.

Rates of the company have been as follows: 15 cents per kw-hour for amounts up to 20 kw-hours per month; 13½ cents for the next 40 kw-hours; 12¾ cents for the next 40; 11½ cents for the next 40; 10 cents for the next 40, and 8 cents for consumption of more than 180 kw-hours per month. The commission orders a rate for incandescent lighting of 13 cents per kw-hour for the first 30 hours per month; 8 cents for the next 60 and 4.5 for each additional. It is held in fixing this rate that the active connected load or demand for residences shall be considered as 33 per cent and for business houses of 60 per cent.

An optional rate of 16 cents per month for each 50-watt lamp demanded and 4.5 cents per kw-hour for current consumed is allowed the company. The power rate is made 50 cents per horse-power per month of nominal rated capacity of the motor and 3.5 cents per kw-hour for current consumed. This is a change from a rate of 8 cents per kw-hour for users of 100 kw-hours; 7 cents for 200 kw-hours, down to 3.25 cents for 1000 kw-hours and over.

Much work was necessary on this case on account of the fact that the same company has practically all the gas, power, street railway and light utilities at both Marinette, Wis., and Menominee, Mich.

Wisconsin Rate Commission News.

The petition of the North Milwaukee Light & Power Company for authority to change its rates was granted by the Wisconsin Railroad Commission on Aug. 3. The petition asked for a readjustment of rates in order to meet the demands of power users and to give all consumers a uniform step rate. From a careful analysis of the expense account properly apportioned between station rating and output charges, it is evident that the short-time users—those that use their equipment for one hour or less daily—receive their energy under the new rates for

2.5 cents per kw-hour less than it costs the company to supply it, and that the difference has to be made up by the long-hour users. This condition of affairs exists in practically every case, notwithstanding the lower rates usually paid by the long-hour users, but the apparent benefits to be gained under the new rates seemed to warrant its adoption.

The Chippewa Valley Light & Power Company was granted authority to issue $35,000 of first mortage, 5 per cent gold bonds to cover part of the cost of extension and additions to its railway and lighting plant.

In the case of the city of Marinette vs. the Wisconsin Telephone Company the complainants alleged excessive rates and unlawful increase in rates. The company replied that the several changes in service and rates which it had made were in fact reductions in rates, because old, primitive equipment and inferior service had been displaced by the most costly and modern equipment, giving the best possible service, as evidenced by the change from grounded to metallic circuits and the change from four to two-party lines. This case was the first formal complaint involving a telephone exchange and telephone rates and was made the occasion for an exhaustive study by the commission as necessitating the establishment of precedent.

In the investigation of the cost of service it was shown that the composite depreciation of the Marinette exchange was 8.98 per cent, or 7.32 per cent if the depreciation reserve drew 4 per cent compound interest. It appeared in the case that the Wisconsin Telephone Company charged off 4.1 per cent of its cost value on the entire Wisconsin system in 1907 for repairs and reconstruction and it was also found that the company is writing off about 5 per cent straight for depreciation, which the commission declares is not enough unless the earning rate on the money set aside for depreciation is assumed to be in the neighborhood of 10 per cent.

A point of considerable difficulty in this case as well as in every similar case lies in the proper apportionment of the cost of operation between the local exchange and the long-distance toll business, due to the absence of any system to measure the number and duration of the subscribers' calls. It was shown very clearly in the examination that the multiple party-line subscribers are not ordinarily charged enough for the service they receive, while they are also made the means of rate cutting. This disparity in the case of the Marinette exchange is shown below:

Business.	Ratio of Total Stations.	Per Cent Earnings.
One party	6.7	27.9
Two party	34.2	24.2
Residence.		
One party	19.1	10.1
Two party	52.4	37.6

There seems to be discrimination against the business telephone, but the commission considers that this is not an unjust discrimination, but one that is warrantable and apparently axiomatic in the telephone business.

The commission flatly states that no franchise value can attach to a telephone property for the purpose of fixing rates. The public utilities law considers that utility enterprises in general are monopolistic in character, but this theory is not extended to telephone companies. Therefore, "good will," being an attribute of a competitive business, might be assigned a value in the telephone business, but the commission holds that as the competition is only a possibility in Marinette, not a controlling fact, no "good will" value can be allowed for the purpose of fixing rates.

The theory of the Wisconsin public utilities law is that rates shall be reasonable and shall be not greater than enough to yield a fair return upon the investment. In determining the investment as a preliminary process to the fixing of rates, the commission had to deal with the claims of large "intangible" franchise values as well as "going values" in both the Antigo water case and the Marinette Telephone case. Regarding the former the commission holds that if the municipality required the payment of money or its equivalent, or there was necessary legitimate payment made for the franchise, then the sum which may reasonably be said to have been paid for the franchise may be included in the valuation the same as money necessarily invested in the physical property. But the commission refuses to consider the claims of some experts and corporations that franchises for which no money was paid may have "intangible" values which should be considered in the making of rates.

It has been held by experts that "going values" should be allowed as so much per customer or as a percentage of the receipts, and some have considered it of as great if not greater importance than the physical value of the plant. The commission holds that the actual, reasonably wise expenditure of money toward getting the business of the plant established may be included in the value to be allowed for the purpose of fixing rates. Since no plant pays at the outset and the first years of operation are almost invariably accompanied by losses or necessary deficits, the commission holds that such losses may be said to represent the cost of securing an established or going business and as such may be included in the value or investment upon which the rates for public service shall be fixed. But the converse of the rule also holds—that is, if a plant has in the past earned more than a reasonable return, possibly through the toleration of excessive rates, the excess over reasonable earnings may under certain conditions be subtracted in determining the present value of the plant. That is, a "going value" may be negative. In the case of the Marinette Telephone Company, for example, the commission found upon its investigation of the financial history of the company that through a period of recent years the company had been enjoying a sufficiently high rate of return to write off the early deficits in so far as such deficits might be allowed as going value. The plant earnings have ranged from 2.62 per cent to 13.6 per cent of the inventory investment during the last eight years, but as this shows considerable instability in the telephone business, and as a reduction of 25 cents per month would reduce the revenues to 4.39 per cent, the commission concluded that, all things considered, no present reduction of rates in the Marinette telephone exchange can be ventured without utterly eliminating any margin over the cost of operation, with its attendant serious effects.

Application has just been made to the Wisconsin Rate Commission by the Antigo Electric Company for permission to issue stock to the amount of $125,000. Two applications were made, one being to issue $50,000 worth of stock and the other to issue $75,000 worth. Permission was granted the stock to be issued in shares of $100 each and to be sold only for money consideration, at a rate not below the par value. The concern has been organized to take over the plant at Antigo. Of the $75,000 issue $5,000 is to go to the former owners of the plant and $30,000 is to be used as working capital. The $50,000 issue is authorized for the purpose of allowing the company to make additions and improvements of various kinds.

New York Public Service Commission News.

In compliance with the order of the Public Service Commission, First District, the Interborough Rapid Transit Company has placed in operation in the subway six eight-car trains equipped with side doors. The remainder of the express equipment of the company will be converted into side-door cars as rapidly as possible, and it is expected that all of the express trains will be of this character by Oct. 15.

The commission has held a hearing upon the application of the Central Crosstown Railroad Company for approval of a modification of its lease to the Metropolitan Street Railway Company. It was stated at the hearing that the Metropolitan receivers threaten to cut off the lease entirely unless they can obtain easier terms. This lease has already been modified twice, and it is stated that a deficit still exists in the operation of the crosstown lines even under the modification. The commission has as yet rendered no decision upon the point.

At another hearing, upon the application of the Third Avenue Bridge Company, the new subsidiary of the Third Avenue Railroad, for a franchise to cross the Queensboro Bridge, Receiver Whitridge explained his reasons for organizing the new company. He said that he had been advised by counsel that the

right of the Third Avenue to build extensions while in the hands of a receiver, was questionable. So he picked out a number of officials of the Third Avenue company and formed a new corporation. It was stated at the hearing that $20,000, or 2 per cent of the capital stock of the new company, had already been paid in.

The Economic Power & Construction Company has formally submitted itself to the jurisdiction of the Public Service Commission, Second District, by petitioning the commission for permission to construct and operate an electric plant at Geneva, N. Y., in connection with its steam heating plant. By the terms of its charter granted in 1893 the company was empowered without further authority of law or ordinance to use any street, avenue and public place in the State. This right was contended by the company to be valid until May 4, 1909, when the Court of Appeals held that the grant was unconstitutional and void. The company states that it has heretofore purchased the steam heating plant and capital stock of the Geneva Steam Heating Company, for $44,603, and on Feb. 3, 1908, that company was merged into the Economic Power & Construction Company; that in March, 1908, the company, acting in good faith, entered into a contract with the city of Geneva for lighting the city and gave a surety bond for $20,000 and installed in connection with the steam heating plant an electric power plant costing over $38,000. The company states that immediately after the decision of the Court of Appeals it secured a franchise from the city of Geneva, which it now presented to the commission for approval.

The Public Service Commission of the Second District has approved an agreement between the Syracuse Rapid Transit Railway Company and the Syracuse & Suburban Railway Company for the use of a portion of each other's lines in Syracuse.

The commission has given permission to the Utica & Mohawk Valley Railway Company to exercise franchises granted it by the city of Utica, on Whitesboro Street in that city.

The Public Service Commission, Second District, in denying the application of the Central New England Railway Company for consent to execute a mortgage for $20,000,000 upon its property and for authorization to issue bonds upon the security thereof to the amount of $12,910,000, lays down some principles of interest to all public utility corporations. The application submitted was the financial organization plan of the New York, New Haven & Hartford Railroad Company for this property.

The Central New England Railway Company has in outstanding common stock $4,800,000, prefered stock $3,750,000, total $8,550,000. Of this stock the New York, New Haven & Hartford Railroad Company owns common $4,415,395.38, preferred $3,410,376.50, total $7,825,771.88. The New Haven Company by reason of such stock ownership practically owns and controls the Central New England Company. The Central New England Company has outstanding funded and other indebtedness the principal of which amounts to $12,320,500. Of this indebtedness the New Haven Company holds $9,989,123.29 and third parties $2,331,376.71. Among such indebtedness are certain general mortgage income bonds amounting to $7,250,000, of which the New Haven Company owns $6,329,125.29 and other parties $920,876.71. These bonds have been outstanding 10 years and no interest has ever been paid thereon. Another issue of income bonds for which the Central New England Company is liable and which has been outstanding since 1887 and upon which no interest has ever been paid amounts to $1,164,500, of which the New Haven Company owns $1,164,000 and other parties $500. It is proposed to issue interest-bearing bonds bearing 4 per cent in the place of the income bonds owned by the New Haven Company, except said company proposed not to exchange about $1,000,000 of its income bonds for interest-bearing bonds at this time. Other parties have no right under the proposed mortgage to exchange their income bonds for interest-bearing bonds. Certain of the outstanding bonds which the applicant desires to refund have unpaid interest coupons attached to them amounting to $403,283.33. Interest on these coupons from their due date is claimed to amount to $131,377.54. All of these bonds and attached coupons are owned by the New Haven Company and the applicant asks authorization to issue its interest-bearings bonds for the amount of the unpaid coupons and the interest thereon to the amount of $534,660.87. The proposed mortgage, while ostensibly drawn to refund all the outstanding indebtedness of the applicant, is so drawn that no bonds can be issued by the trustee to refund outstanding bonds unless such outstanding bonds are presented by either the applicant or the New Haven Company. This means the New Haven Company only in practical effect since it wholly controls the applicant. The amount of bonds owned by others which cannot be refunded as of right is $2,331,376.71.

In making its decision the commission in a detailed opinion written by Chairman Stevens held: 1. That the applicant is not legally indebted for the interest upon the unpaid coupons. 2. That no sufficient reason has been shown why unpaid interest should be made a capital obligation of the applicant. 3. That a refunding scheme which embraces the securities held by the only creditor and that creditor in control of the applicant through stock ownership cannot be approved. 4. That under all the circumstances of the case the conversion of the income bonds held by the New Haven Company into fixed rate interest-bearing bonds cannot be approved. The last paragraph of the opinion recites that the commission is willing to consider and approve any reasonable plan for the readjustment of the somewhat complicated financial situation of the applicant, but the one submitted possesses features so peculiar that approval cannot be extended to it.

The Atlantic Cable of 1858.

By William Maver, Jr.

I have read Mr. Charles Bright's letter published in your issue of July 15 relative to my article in your columns on the Atlantic cable of 1858.

I may remark that for reasons not essential to state here, it was necessary to prepare the said article quite hurriedly; in less than four days, in fact, part of which time I was sojourning at the seashore, from which place the manuscript of the article was mailed to the editor, and it was printed within two days thereafter. It is, therefore, apparent that I had not the opportunity to devote as much care to the preparation of the article as I should have desired, nor as I assume Mr. Bright had devoted to his letter, in the writing of which he had allowed himself the best part of a year.

It may be said, however, that this reference to the hasty preparation of the article is chiefly made for reasons that will presently appear. Of course, I recognize that the article in question being limited as to length, and, as I have intimated, to the time of preparation, does not do proper justice to so wide and interesting a subject. There are some features of the article that I myself should now criticise somewhat severely, but in so far as the paragraphs to which Mr. Bright takes particular exception are concerned, they are, in my opinion, well warranted by the facts of the case; and in selecting these paragraphs I think my critic was not happy, as I shall perhaps demonstrate in the course of this reply. It may be interesting to note in passing that one of the aims of the article criticised by Mr. Bright was to point out the important part taken by British engineers and cable manufacturers in the early work of submarine cable laying. No part of the article was intended as an attempt to settle or even to discuss the amount of credit due to the respective engineers concerned in certain parts of that work (a point on which I perceive Mr. Bright is very sensitive), nor to revive the asperities that followed the laying and the immediate utter failure of the Atlantic cable of 1858. But since Mr. Bright has seen fit to reopen the subject, I am quite sure that electrical engineers, and especially telegraph men, of the present generation will read with interest a brief account of some of the salient features connected therewith, and perhaps before I have done there may be occasion to recall the old adage about letting sleeping dogs lie.

Reverting to my critic's letter. Obviously in view of what I have said relative to the haste with which my article went to press, there was no time to submit a proof of it to the writer.

On seeing the article in print, the misspelling of names to which Mr. Bright refers was noticed and occasion was taken to call attention thereto, but the errors were so clearly typographical that it was not deemed worth while to correct them by special notice. The article was, however, subsequently reprinted in *Telegraph Age* (Oct. 16, 1908), and availing of the opportunity afforded thereby, the said typographical errors were corrected in the reprinted article by the writer. As Mr. Bright in his letter called attention to the instances of incorrect spelling of names to show lack of familiarity with my subject, I at first assumed that he had not seen the corrected reprint in *Telegraph Age,* but I now know that he had read the reprinted article and, therefore, I am privileged to assume that Mr. Bright's reference to the incorrect spelling of names as noted was due either to inertness or unfairness. Mr. Bright further states that my article gave evidence of no direct contact with the laying of the Atlantic cable of 1858 on my part. I must plead guilty to that charge, as I was not an infant prodigy; but as Mr. Bright carefully informs us in his writings that his father was knighted by the Lord Lieutenant of Ireland within a few days after the laying of the cable of 1858 when only 26 years of age, it is self-evident that my critic himself could not have had very direct contact with the subject. Such indirect contact as he may have had was, it may easily be supposed, not calculated to make of him an impartial historian or critic relative to more or less disputed questions in which certain persons were concerned, which supposition is well substantiated by Mr. Bright's writings on this subject, some evidence of which I shall produce.

My critic further says in his writings, referring to the honor conferred upon his father for his part in the laying of the cable of 1858: "It was the first title conferred in the telegraph profession, and remained so for many years"; an almost unnecessary sentence, one would think, for at this distance it seems quite evident, in view of the deep mortification following the quick and utter failure of the said cable, that no undue haste would be made subsequently in awarding honors for telegraph work. Possibly it is around this point that the animus of my critic's letter and his treatment of Whitehouse in his writings may be found. It would appear from these writings, especially the later writings, that my critic has set himself the somewhat difficult task of proving that the 1858 cable was practically perfect and fit for lasting operation when laid. Therefore, anything that tends to controvert this view must be frowned upon, to put it mildly, by a self-appointed arbiter. It may be noted that Mr. Whitehouse was the electrician and my critic's honored father was the chief engineer of the Atlantic Telegraph Company of 1857-58.

I said in my article of a year ago that the Atlantic cable of 1858 was to have been laid in 1857, but the attempt to lay it then failed. This led to repeated coiling and uncoiling of the cable from the ships to shore before the cable was laid in 1858, a fact which I omitted to mention in that article. I also omitted to mention the treatment to which the cable was subjected in the process of manufacture in Greenwich, where it was exposed to the heat of the summer sun, "intensified by the tar coating of the cable to 120 deg"; and, as one writer has said, "as might have been foreseen, the gutta percha was melted, so that the conductor which it was desired to insulate was so twisted by the coils that it was left quite bare in numberless places, thus weakening and eventually, when the cable was submerged, destroying the insulation"; nor did I mention the cutting and hacking to which the cable was subjected before its submersion, in the effort to localize and remove defects, evidently without the protest of anyone, and some details of which I shall give when I come to discuss this feature more particularly.

My critic having, as I assume, taken upon himself the task of showing that the cable of 1858 was in operative condition when laid, it appears to have aroused his ire that the present writer should have innocently intimated in his article that possibly the cable of 1858 might have survived the "high tension" of Mr. Whitehouse's induction coils had the cable not been initially defective by reason of the inexperience in cable-making and laying at that time. To refute such a view, Mr. Bright says in his letter: "In the opinion of practically everybody, Whitehouse, the electrician, was alone responsible for the gradual breaking down of the cable by the use of a generating power of immense intensity, in conjunction with the rest of his apparatus." In his "Story of the Atlantic Cable," page 157, my critic says the authorities were unanimous on this point. On page 156 he names Mr. W. T. Henley as one of the authorities. And then he quotes, or rather misquotes, Mr. C. F. Varley as saying unqualifiedly, "Had a more moderate power been used, the cable would still have been capable of transmitting messages." Mr. Varley, however, was not so unfair or so unguarded as to make so unqualified a statement. What he did say in his report on the state of the Atlantic telegraph cable, Sept. 18, 1858, was: *"It is not at all improbable* that the powerful currents from the large induction coils have impaired the insulation, and that had more moderate power," etc. (Italics are mine here and throughout this reply.) This abridged quotation also occurs in my critic's book just mentioned, page 156, hence it is not a slip of the pen.

I may remark here, that after the failure of the Atlantic cable of 1857, a joint committee representing the Board of Trade and the Atlantic Telegraph Company was appointed to inquire into the entire subject of submarine telegraphy. The committee consisted of Messrs. Douglas Galton, C. Wheatstone, William Fairbairn, George P. Bidder, representing the Board of Trade, and of Messrs. Edwin Clark, Cromwell F. Varley, Latimer Clark and George Saward, for the Atlantic Cable Company. This committee continued its sessions for nearly two years and presented a report which has probably never been surpassed for thoroughness and for the value of the information brought out relative to the art of submarine telegraphy. The committee heard the testimony of very nearly all the persons concerned in any way with the Atlantic cable of 1857-58 and inquired particularly into the effect of the Whitehouse induction coils upon the operation of the cable, as subsequent citations herein from the committee's report will show. Mr. Bright in his letter also says that Professor Thomson expressed himself still more strongly than Mr. Varley on the subject of the Whitehouse induction coils. Let us allow Professor Thomson to answer for himself. He was questioned on this point as follows by the Board of Trade committee: "At what distance, in your judgment, did the fault exist, or does it now exist?" "About 300 miles along the cable from the shore end." Question 2551: "Is it your opinion that the electrical state of the cable was made worse by the use of induction coil power or battery power, or either of them?" *"Most probably* it became worse *more rapidly* than it would have done if the fault had been altogether undisturbed. I do not think that the induction coils would produce a worse deteriorating effect on a fault already formed than battery power at 300 miles, for instance." Professor Thomson was also asked, Question 2531: "Then you attribute the failure of the current *immediately after landing* to the defects of insulation which were overcome by the use of more powerful batteries, or more improved means of transmitting the signals either by induction coils or batteries afterwards?" "Yes, and still more by improved means of receiving."

It may be assumed that in his reference to the professor's subsequent statement, Mr. Bright alludes to a qualified remark (in 1860) on this point quoted in Mr. Bright's writings to the effect that Professor Thomson *"had little doubt* that if no induction coil and no battery *power* exceeding 20 Daniell cells had ever been applied to the cable since the landing of its ends, imperfect as it then was, it would now be in full work day and night with no prospect or probability of failure." But it is now obvious that the fearfully imperfect condition of the cable when laid, considered in connection with the history of subsequent events, does not confirm this qualified, optimistic view. For example, in one of his books Mr. Bright says, speaking of the cable of 1865-66 (giant cables as compared with the cable of 1858, and made and laid with all the care that previous sad experience had shown to be necessary). "Unfortunately, both these cables broke down a few months later, and one of them again during the following year. Unlike the 1858 line, however,

these last cables (1865-66) had not been killed electrically, and being worthy of repairs they were maintained for a considerable time." Here, it will be noticed, that in the anxiety to give poor Whitehouse another cut it is unwittingly shown that cables vastly superior in every way to the cable of 1858 could die and did die in a short time without meeting a gradual death by induction coils.

Mr. Bright speaks of the gradual breaking down of the cable in 1858. If breaking down in about three weeks is gradual, so be it. Possibly a remark in Mr. E. B. Bright's "Electric Telegraph," page 120, and another by Mr. Henley, quoted presently, will cast some light on this so-called gradual failure. "As it had been found that the tarry composition coating the outside strand interfered with the speedy detection of faults, by filling up any injury to the gutta percha and by preventing ready penetration of the water in such cases, it was considered better to omit it in the cable of 1866." The 1858 cable was coated with tarred yarn when made and thickly covered with tar when laid.

Mr. Bright, in his writings, I observe, carefully quotes everything that appears favorable to his theory that Whitehouse alone was responsible for the failure of the Atlantic cable of 1858. Quite as carefully, or more so, he hides what practical men have said contrary to that theory. For instance, the writer finds no reference in any of Mr. Bright's writings to the views of Mr. W. T. Henley (one of his authorities), elicited during the Board of Trade investigation. Asked by Mr. Wheatstone if he was of the opinion "that any permanent damage occurred to the cable from employing the very strong induction coils, as some persons think," Mr. Henley replied: "No. It is not my opinion that the induction coils would injure the cable if it was in a sound state." Nor does my critic quote what Mr. Henley said in his report, Sept. 30, 1858, to the chairman and board of directors of the Atlantic Telegraph Company, written from Valentia as a result of Mr. Henley's tests. "In my opinion the fault or faults existed in the cable before it was submerged, and that they would have been detected and made good had the *precaution been observed of having the whole cable* tested in water during its manufacture. Its not showing so bad when first laid is easily accounted for, as it takes some time for the water to soak through the coating of pitch and tar." Neither does my critic quote C. V. Walker, Esq., himself a director of the cable company, I believe, and who had made experiments with Whitehouse at the cable factory and who on being asked, "Do you consider that the cable was injured at all by the strong current sent through by means of the induction coils?" replied, "I have no reason to think so."

It is, by the way, quite singular that notwithstanding his repeated attacks in his writings on Whitehouse, it appears that my critic himself does not really in his heart believe that the 1858 cable was necessarily killed by the Whitehouse induction coils, for in his book, "Submarine Telegraphs," page 54, we find the following rather surprising admission: "It is not improbable that weak joints were the cause of ultimate failure (of the cable of 1858.) A bad metallic joint—i.e., a case of the two ends of the conductor not being properly united—was not a very uncommon occurrence in those days, when no method of joint testing was in vogue. A carelessly effected metallic joint is liable to draw apart on being subjected to a strain during the operation of laying. On the strain being taken off, the ends may join together again temporarily, but under such circumstances the points of contact soon become oxidized and thus all communication gradually ceases. This, together with a gradual percolation of water, is perhaps more likely what took place in the case of the first Atlantic line than any of the explanations for the subsequent cessation of signals. Faults of insulation are scarcely ever of such a character as to account for signals being entirely stopped, and it is never suggested that the cable actually broke."

After this kindly statement by Mr. Bright further pursuit of the subject is almost unnecessary, but it would be a pity to refrain from quoting the verdict of the Board of Trade committee on the failure of the cable of 1858, which is as follows: "We attribute the failure of this enterprise to the original design of the cable having been faulty, owing to the absence of experimental data, to the manufacture having been conducted without proper supervision, and to the *cable not having been handled after manufacture with sufficient care.* We have had before us samples of the bad joints which existed in the cable before it was laid, and we cannot but observe that practical men ought to have known that the cable was defective, and to have been aware of the defects before it was laid." Comment on this finding is unnecessary, except to note that the absence of this verdict verbatim from Mr. Bright's books, so far as I have been able to find, may be considered as very fair testimony that the verdict does not contain anything particularly favorable to his contentions. By the way, my critic's chief witness, Mr. Varley, joined in signing this verdict.

Now, reverting to the Whitehouse induction coils, there is not, it may be remarked, an iota of evidence that the e.m.f. which those coils developed was sufficient to break down the insulation of the gutta-percha insulation of the cable of 1858. At Valentia, Mr. Varley and Mr. Henley both tested samples of gutta-percha insulated wire corresponding, the present writer assumes, to that of the cable, with the Whitehouse induction coils, and in every case the evidence shows it was necessary to prick the gutta-percha with a needle to admit water before the induction coils could force a way through the insulation. Further, Whitehouse used induction coils of high tension in experiments on 2000 miles of underground cable and on the Atlantic cable while it was in process of making, in the presence of and presumably without protest from, the chief, and there is no evidence that, as Whitehouse states, the coils had been found other than harmless. It is noteworthy also that although the members of the Board of Trade committee heard everything that experts concerned had to say unfavorable to the use of the Whitehouse induction coils, they utterly ignored such use as a possible or probable cause of the failure of the cable of 1858. Indeed, all the evidence points to the fact, as the Board of Trade committee's verdict clearly intimates, that the cable of 1858 was in a moribund condition when the Valentia end was handed over to Mr. Whitehouse by the chief engineer. Confirmatory of this, Mr. Saward tells us that he was informed by Captain Kell "that the cable must have been cut into in at least a hundred places at one time or another, and that either from that or some other cause this fearful result has taken place which is exhibited by these four joints which have been cobbled up again," and Captain Kell also in his testimony, on being asked if he thought there might not be faults in the cable when it was laid, other than those he had described, replied, "Yes; quite possible." Mr. Mullaly, who was on the *Niagara,* states, page 267 of his book, that "one part of the cable has been coiled so often that it is bent and twisted to such an extent as to render it difficult to pay it out as fast as the other part, with safety." And more recently, in an article in the Franklin Institute *Journal* (1907), the same gentleman writes: "Hardly, however, had four weeks elapsed before the electrical connections had ceased altogether, the defects which had been the cause of the many delays and difficulties encountered on the different expeditions having not only impaired, but finally destroyed the continuity." Sabine, in his book, says, page 343 (1867): "It (the cable of 1858) was faulty when laid and broke down entirely in three weeks after its submersion." Again, Professor Thomson when testifying before the Board of Trade committee, said (Question 2508): "I had the very strongest misgivings of the cable from the Monday forenoon of the laying," and in an address before the Royal Society of Edinburgh, 1866, said: "And the electrical failure . . . was owing to electric faults existing in the cable before it went to sea." Mr. H. M. Field, in his "Story of the Atlantic Telegraph," page 252 (1866), says: "Take all these things together, and the wonder is not that the cable failed, but that it ever worked at all."

Something of a "consensus of opinion" on the contrary side, it will be observed, and one that rather strongly supports my previous remark as to the moribund condition of the 1858 cable when laid. Somewhat apropos of this the following more or

less analogous incident, which was told to me quite recently by one of the participants, may be related: In some of the hospitals of this country there is an unwritten rule that if the ambulance surgeon brings in a "dead one" to the hospital the penalty is a dinner to the rest of the staff. The efforts made by the ambulance surgeon to avoid this penalty may easily be imagined. Quite recently an ambulance surgeon on responding to a call learned that he had to deal with a bad case of carbolic-acid poisoning. The surgeon found that faint evidence of life still lingered in the patient, hence he was hurriedly placed in the ambulance and the driver urged his horses with all speed toward the hospital, the surgeon meanwhile, as a last resort, vigorously practising artificial respiration on the patient. Reaching the hospital, the moribund body was placed on a bed. The patient gave a gasp. "Did you hear him breathe?" said the surgeon to the nurse. "Certainly, doctor," was the reply, whereupon the surgeon made hurried exit to the corridor to take the elevator to his office down stairs. Unfortunately, the elevator did not come immediately, and while the surgeon was waiting the nurse came forward, saying, "Doctor, you had better return and pronounce him dead." It is within the possibilities that nurse Whitehouse, although he had heard the patient gasp, would have been glad to have made a similar request had the surgeon in the case been accessible.

Mr. Bright also criticises my reference to the more or less crude methods of paying out the Atlantic cable of 1858, which, together with the inexperience in cable-making, I had timidly suggested may have been sufficient to account for the cause and development of the faults. And Mr. Bright inquires if the writer is not aware that the methods of paying out the cable of 1858 are still in every-day use in all essential particulars. Any tyro, of course, knows that the underlying principles of the paying-out apparatus employed on the *Niagara* and *Agememnon* in 1858, as recommended by Messrs. T. Lloyd, Joshua Field and John Penn, Englishmen, and Mr. W. E. Everett, the American engineer, in their joint report on the subject to the cable company (and to which I shall refer at length subsequently), are still followed in cable laying. But not even a tyro should be expected to father the statement that the present methods of laying submarine cables are as crude in all respects as they were in 1858. The writer said "more or less" crude methods. Because of the fair weather enjoyed by the *Niagara* the methods were "less crude" and the paying-out machinery worked beautifully, while no doubt mainly because of the tempestuous weather met with by the gallant *Agamemnon*, the methods were "more crude." The machinery did not work so well on that ship. It stopped at times, and the log teems with items like the following: "Hands stationed helping brake wheels round"; "heavy sea on, men continuously in attendance to turn brake wheels"; "men, as on previous watch, stationed to turn drums," etc.

But we may now hear from some of the engineers concerned and others. For example, relative to this subject, in the hearing before the Board of Trade committee, the chief engineer was asked: "Did you observe any mechanical defects in the paying out?" He replied: "I think the machine should be made a little lighter another time." His assistant, Mr. Canning, was asked: "Have you any observations to offer to the committee upon the paying out of the cable or the brake machinery?" "As far as we saw it, on board the *Agamemnon*, it acted very well certainly; we should now make some alterations or we should not use the same apparatus again." Well might Canning say, "As we saw it on board the *Agamemnon*." In view of the many anxious hours, during which, because of the terrible storms encountered by that ship, it may easily be surmised they probably did not see it at all. And Staff Commander H. A. Moriarty, in the *Journal* of the United Service Commission in 1867, said: "This arrangement (of 1858) of machinery is very powerful for retarding the egress of the cable, and well adapted to a uniform strain, but it has too much inertia to meet the exigencies of strains and speed ever varying. *Manual effort was frequently employed* (1858) when the strain was light (on the *Agamemnon* only, however). The machine employed for the same purpose in 1865 was very different." So much for the more or less crude methods.

But why my critic's gratuitous fling at Mr. C. F. Field, where he says that when Field came over to England "his ideas had all been preceded by Brett and my father?" Because, perhaps, his father, in common with numerous other men in Europe and America, had suggested that transatlantic telegraphy was within the range of possibility. Indeed, it would seem that my critic resents Mr. Field's appearance on the scene as an intrusion that deprived certain other gentlemen of first honors in Atlantic cable telegraphy. But let us have some testimony on this point from a gentleman whose competency to express an opinion on this question of priority will hardly be disputed even by my critic. The reference is to Mr. George Saward, secretary of the Atlantic Telegraph Company, who, asked by the chairman of the Board of Trade committee to kindly describe the origin of the Atlantic Telegraph Company and the arrangements under which the first proceedings took place, replied: "The Atlantic Telegraph Company sprang out of a scheme for shortening the time of communication between the United States and Europe, which was originated in 1851 by a Mr. Tibbetts, of New York, in conjunction with Mr. F. N. Gisborne, an English engineer." This resulted in the formation of the Newfoundland Electric Telegraph Company, which company proposed to establish land and submarine lines of telegraph from St. Johns, N. F., to the Gut of Canso. That company failed financially. In 1853 Mr. Gisborne visited New York and met Mr. Field. "It happened that some time previously to this period the idea of establishing a telegraph across the Atlantic had suggested itself to several individual minds, but it *had assumed no form or substance*, and Mr. Field, though unwilling to apply his private means to propping up the falling fortunes of the Newfoundland Telegraph Company by promoting that scheme as an isolated venture, conceived the notion of obtaining scientific advice upon the subject of a transatlantic telegraph from his distinguished countrymen, Lieutenant Maury and Professor Morse. Their assurances were satisfactory." The result was that a company was formed consisting of six American citizens, and termed the New York, Newfoundland & London Telegraph Company, the object of which was to bring London and New York into continuous electric communication. "This company, established as I have described, having executed its work in the island, turned its attention toward extending the telegraph to Europe. It was found impractical to raise the capital for this part of the undertaking in America, and Mr. C. W. Field, during one of his early visits to England, associated himself with Mr. J. W. Brett with a view to the money being raised in England. Mr. Brett, who was then a good deal occupied with other cables, employed Mr. Whitehouse, whom he knew as an electrical experimenter, to investigate for him some electrical facts in connection with the probabilities of success. Mr. Whitehouse, in the course of these experiments, became acquainted with Sir Charles Bright, and finally these four gentlemen, Messrs. Field, Brett, Whitehouse and Bright, entered into a contract with each other to become joint projectors of a separate company in England to carry out the submarine line between Ireland and Newfoundland," etc.

This statement by Mr. Saward puts the American claims for Mr. C. W. Field's part in transatlantic telegraphy in terse shape. Mr. Field gave *form* and *substance* to what had hitherto been merely a dream. As Mr. Whitehouse said before the Board of Trade committee, Mr. Field was the "active" man, and while there is no doubt that transatlantic telegraphy would eventually have been accomplished had Mr. Field never taken part in the work, the fact remains that it was he who, by his untiring efforts, advanced its accomplishment by many years; and despite the flings of cavilers, the name of Cyrus W. Field will, in the words of Mr. George Saward, "go onward to immortality as long as that of the Atlantic telegraph shall be known to mankind." The fact that Mr. C. T. Bright was one of the four original "projectors" of the Atlantic cable of 1858 is so well known that one wonders what my critic has in mind when he so solemnly assures us that he has in his possession the orig-

inal agreement between the four gentlemen. Of course, no one will question that Mr. Brett had early practical conceptions of the feasibility of transatlantic telegraphy, and even went so far as to *register* in 1846 a scheme for connecting Ireland and Nova Scotia by telegraph, but Mr. Saward's statement as to "form and substance" still stands; and Mr. Brett himself has written in his "Origin and Progress of the Ocean Electric Telegraph" (August, 1858): "To my coadjutor, Mr. Field, too much praise cannot be given; his untiring energy has united and brought about the invaluable co-operation of the United States and Colonial Governments to the support of the enterprise."

I notice also Mr. Bright's allusion to the fact that I did not in my article specifically differentiate between the civil engineers and the electrical engineers engaged in early cable work. In Great Britain and in this country electricians employed in electrical work of a high order are included in the generic term electrical engineers, as evidenced by the names of the electrical engineering institutes in both countries. To term a man an electrician in this country is usually to dub him a dynamo tender or an electrical wire worker. With this explanation, my inclusion of Whitehouse, Latimer Clark, Thomson and Varley as engineers is clear. I had previously referred to Varley as the electrician of the company, and to Henley as the telegraph engineer; and in general the writer may modestly remark that his opportunities to distinguish between the various grades of electrical engineers have very likely equaled, if not exceeded, those enjoyed by his self-appointed critic.

I confess, however, I was somewhat derelict in not taking time in my article of last year to give at least passing notice to the admirable service rendered by the American engineer, Mr. W. E. Everett, under whose supervision the cable-paying-out machinery was made and installed, and who was in *sole and responsible* charge on the *Niagara* of the successful laying of one-half of the cable of 1858. But, in fact, as may plainly be seen by a perusal of the article, there was no intention to make particular mention of or to detract from the credit due to individuals concerned in the enterprise. Still I now find it difficult to excuse the failure to make mention in any way in my article of Mr. Everett's great part in that work and I shall here endeavor to make some small amends. In doing this, I may incidentally also disclose what seems like an attempt on the part of my critic to deprive Mr. Everett of the great credit due him for his participation in this work. Thus I find my critic concurring in saying, as joint author of the "Life of Sir C. T. Bright," on page 204 of that comparatively recent book, and repeating almost verbatim on page 77 of a new edition of that book (1908), revised and abridged exclusively by my critic, as follows: "A committee was arranged to confer with Charles Bright as to the machinery, consisting of Messrs. Lloyd, Penn and J. Field. Mr. W. E. Everett *was also consulted later.* . . . He also joined in approving Charles Bright's suggested alterations. This gentleman had to return to America with his ship, but on again arriving in London on Jan. 18 (1858) he had the satisfaction of attesting to the sterling qualities of *the machine devised, adopted and constructed in his absence,* as well as in *partly superintending* the setting up of it aboard the ships. The above committee reported (Sept. 17, 1857): We consider the paying out *sheaves* require no alteration, except those suggested by Mr. Bright in a memorandum he was good enough to place in our hands. Quite independently, however, Charles Bright had decided that the checking gear or brake should not be left in the power of any person in charge to jam the machine. Subsequently a very opportune invention of Mr. J. G. Appold, F.R.S., was suggested . . . Which is all very interesting, indeed, in view of what appears to be the facts in the case.

Let us first take up the statement relative to the alleged construction of the paying-out machinery in Mr. Everett's absence, apropos of which Mr. Mullaly, who accompanied both expeditions (1857-58) on the *Niagara*, has this to say, on page 172 of his well-known book, published immediately after the events: "Mr. Field and Mr. Everett arrived in London (about Jan. 18, 1858). They found that nothing had yet been done toward making the experiments preliminary to the adoption of the required form of machine for paying out the cable, although it had been explicitly understood before Mr. Everett's departure from England that the experiments would be announced to him on his arrival. Nothing, however, as we have said, had been done, and he was obliged himself to enter upon the experiments, the results of which *were of consequence* . . . working night and day until the apparatus was constructed, whereupon Mr. Everett reported to the directors the results and received the following letter from Mr. Saward, secretary of the company: "London, April 24, 1858. To E. W. Everett, London: Dear Sir—As *you* have now reported to the managing committee that the paying-out machinery for H. M. Ship *Agamemnon* is completed, and that it has been working satisfactorily during the last three days, and that *you* do not consider any alteration necessary to increase its efficiency, and as another set is required for the United States frigate *Niagara,* the managing committee have authorized and instructed me to request that you will immediately give directions to Messrs. Easton and Amos to put another set in hand for that ship; and I am further to request that you *will continue your supervision over the construction of the machinery,* and also undertake to superintend and direct its being properly fixed and fitted on board the *Niagara.* I am further instructed to *request,* that *you* will take charge of the operation of experimenting upon, and subsequently of paying out the cable from that ship; in doing which you will have the co-operation of Messrs. Woodhouse, Follansbee and of such assistant engineers as you may consider it requisite to appropriate to such service. You are also authorized to make such preparations and arrangements as are necessary to enable you to carry out the foregoing instruction."

The following remarks from a letter to the directors of the company from Mr. C. T. Bright, under date of April 24, 1858, is also of some interest in this relation: "Gentlemen—Since the report which I made to you *in conjunction with Mr. Everett,* of the 6th inst. (April, 1858), in regard to the paying-out machinery and the results of the experiments relating thereto, *a complete machine has been erected* at the works of Messrs. Easton and Amos . . ." It will be noted that the quotation cited from the "Life of Sir C. T. Bright" has this machinery all made before Jan. 18, 1858, and only allows Mr. Everett a partial share in the setting up of the machinery aboard the ships.

A few words relative to the committee "arranged to confer with Charles Bright" may now be in order. It will be remembered by the readers of the literature of this subject that Mr. C. W. Field also sailed on the *Niagara* on the unsuccessful expedition of 1857. There Mr. Field had met Mr. Everett, and the former gentleman, with his usual acumen, had no doubt recognized in Mr. Everett a young man of parts. On the failure of the expedition of 1857, Mr. C. W. Field had requested Mr. Everett to undertake the work of devising new paying-out machinery for the next expedition (1858), the machinery devised for the first expedition having proved insufficient, and Mr. Field obtained leave of absence from the United States Government for Mr. Everett to enable him to undertake this work (see Mullaly's book, page 172). Mr. Everett in 1857 obtained the co-operation of Messrs. Lloyd, Penn and J. Field, of London, and with them presented a report (mentioned in the quotation cited from the "Life of Sir C. T. Bright") to the managing directors (Mullaly, page 157), from which report the following brief abstract is here made: "London, September, 1857. Gentlemen—Having examined, agreeably to your request, the apparatus and arrangements on board the *Niagara* for paying out the Atlantic telegraph cable, and given the whole subject our careful consideration, we beg to lay before you the conclusions at which we have arrived. We consider the paying-out sheaves require no alteration except those suggested by Mr Bright in a memorandum which he was good enough to place in our hands, a copy of which we append. (Here follow the suggestions.) The most important consideration, however, to which we have directed our attention is how to guard against the strain being brought on the cable while paying out, greater than it is capable of bearing without risk of damage . . .

The means which we recommend for this purpose are the substitution for the present brakes of two others . . . They should be constructed on the plan patented some years ago by Mr. Appold . . . (Signed) T. Lloyd, Joshua Field, John Penn, W. E. Everett."

It may be observed here that the "subsequent suggestion" of the Appold device mentioned in the quotation from the earlier edition of "The Life of Sir C. T. Bright" occurs in the paragraph of the committee's report immediately following the one relative to sheaves, cited in the same quotation. Notwithstanding that, I am aware my critic has said in one of his books that this subject is treated from the American standpoint by Mr. Mullaly, I am compelled to quote that gentleman for the simple reason that I do not find either the committee's report or the very important letters of Mr. Saward and C. T. Bright in my critic's accurate resumé of the subject, or in any of his other writings. I trust I have not overlooked them. However, the ordinary reader will probably agree that Mr. Mullaly's statement of the facts accords quite nicely with the facts as given in the English letters and report just mentioned, all of which facts tend to show very conclusively Mr. Everett's exceedingly important part in the work of laying the Atlantic cable of 1858, to say nothing of the important bearing of that work on all subsequent submarine cable laying. It is, by the way, noteworthy that no one on Mr. Everett's part has ever deemed it necessary to endeavor to throw the blame of the failure of the cable, in which he bore so prominent a share in laying, on the shoulders of Mr. Whitehouse.

I concede that in the last paragraph of my article I was not perhaps sufficiently discriminating in classing all engineers (civil and electrical) together as worthy of equal credit. I should have differentiated more clearly, for instance, between those engineers who had merely laid or assisted in laying and operating one or more cables, and those, like Thomson and Varley, whose early work made possible the successful operation of all submarine cables for all time.

In closing, I may notice my critic's allusion, in his letter to the *Electrical World*, to his work on "Submarine Telegraphy" as containing an accurate resumé of the history of that art. As my critic thus invites criticism of the accuracy of his statements, I would point out what appears to be a rather important error on his part, unless he can prove from his alleged sources of "exclusive information" that the gentlemen whom I shall quote are themselves in error. Thus, on page 52 of that book, Mr. Bright says: "It (the cable of 1858) had only been subjected to battery currents derived from *about 70 ordinary Daniell cells, by which all* signals were interchanged between the ships." On this point, Professor Thomson testified, in answer to questions 2494 and 2498, before the Board of Trade committee, referring to the nature and power of the battery employed on shipboard, that "The common sand, zinc and copper battery, with sawdust substituted for sand, was the battery which was used . . . During the greater part of the process in laying the cable 20 *twelves* of the battery described was the battery used." And Mr. Mullaly, who, as already stated, was on the *Niagara* on both expeditions, in his book, says, page 252, that 240 pairs of zinc-copper cells were employed on each ship. Quite a discrepancy.

On the whole, I account myself rather fortunate that my impressions concerning the matters under discussion herein were formed long before Mr. Bright's books were written, and from sources quite authentic, although not necessarily "exclusive." I have thus probably been safeguarded from falling into accord with certain views that my critic has striven somewhat assiduously to promulgate in his writings, and some of which I have touched upon in the preceding remarks. I rather regret that time will not permit picking up my critic on the matter of his reference to my "favorite" Varley. That pleasure may be reserved for another occasion.

I trust it will not be hastily concluded that the foregoing statement of facts exhausts the subject; on the contrary, the surface has as yet scarcely been scratched.

CURRENT NEWS AND NOTES.

WIRELESS STANDARDIZATION.—The Wireless Institute has appointed a committee to provide rules for wireless telegraph standardization similar to the standardization rules of the American Institute of Electrical Engineers.

SUBMARINE TELEPHONY.—The British Government has decided to lay a telephone cable equipped with Pupin coils across the English Channel to be connected with the land lines at Dover and Calais in order to improve the communication between London and Paris.

EDUCATION OF EMPLOYEES.—The Dayton (Ohio) Lighting Company has formed a night study class for instructing its employees on electric subjects. Mr. Oscar Reemelin, superintendent of the underground department at the plant, has been elected chairman, and Mr. A. Larney secretary and treasurer. The latest patents and appliances will be taken up and studied.

CONNECTICUT PUBLIC UTILITIES.—The public utilities bills drafted by a special committee of the Connecticut Legislature providing for a public utilities commission have been defeated by a vote in favor of indefinite postponement. The opponents of the bills claimed that the bills as drawn up would make conditions in the State worse under a commission than they are at present with no commission.

MONOPOLY OF UTILITIES.—Mr. E. M. Bassett, of the New York City Public Service Commission, has returned from an inspection of traction systems in Cleveland, Toledo, Buffalo, Niagara Falls, Toronto, Detroit, Chicago, Milwaukee, St. Paul, and Minneapolis, and expresses himself as a result strongly in favor of well-regulated monopolies in city transportation under a system of "indeterminate" franchises. He believes this best for the public welfare and benefit.

TELEPHONIC TRAIN DISPATCHING.—Many of the leading steam railroads are arranging to employ telephones for train dispatching. The Norfolk & Western will equip its entire main line, 710 miles in length, with telephones. The Northern Pacific, which now has in service 470 miles, will install 250 more immediately. When the contemplated installation of 200 miles, in addition to the present equipment of 250 miles, has been made on the Michigan Central, the New York Central will have 1000 miles of its system under telephonic control.

LITIGATION AGAINST ELECTRIC SIGNS.—The prosecuting attorney of South Bend, Ind., has filed action against a number of merchants charging them with violation of the State law in the erection of overhanging electric signs. His charges apply to illuminated arches and all electric devices extending over the sidewalk. As these alleged unlawful electric signs represent an expenditure of thousands of dollars the action of the courts, if unfavorable, will probably have an effect throughout the State.

INDIANA WATER-POWERS.—Mr. W. S. Blatchley, State Geologist, of Indiana, who has been surveying and investigating the water-powers on the various streams of Indiana, says the State of Indiana should assert control over the water-power of the rivers of the State and prevent their ownership by private interests. The Attorney-General has declined to give an opinion as to whether the State has power to assume control of the streams for power purposes, but admits the importance of doing so if possible. Indiana has a number of power-producing streams and their development is only a matter of a short time.

A LAMP IN BED.—An incandescent lamp left on a bed in a residence in Portland, Ind., at a time when the current was off the lines, fired the bed and building when current was later turned on the lines.

WIRELESS INSTITUTE MEETING.—At the next regular meeting of the Wireless Institute, to be held in the Engineering Societies Building, New York, Sept. 1, Mr. Harry Shoemaker will present a paper entitled "The Production of High-Frequency Oscillations."

SIXTY-CENT GAS IN INDIANAPOLIS.—Residents of Indianapolis are supplied with manufactured gas for both illumination and fuel at the low rate of 60 cents per 1000 cu. ft. There are two companies, and the rate is the result of a legislative enactment. The older company declares the rate is confiscatory, and it is not unlikely that the legality of the 60-cent rate will be tested in the courts.

CREOSOTING AS PROTECTION AGAINST BIRDS.—The United States Forest Service has called attention to the damage to telephone, telegraph and electric lamp poles inflicted by birds of the woodpecker family. The Service is investigating the protection afforded by creosoting. It has been observed in Louisiana that poles which had been impregnated with creosote oil were not attacked by the birds, whereas untreated poles under the same conditions were very severely injured.

METAL CORROSION.—The Carnegie Library of Pittsburgh has just issued a second edition of a classified series of references to metal corrosion and protection. The pamphlet was first issued in 1906 and has been in constant demand ever since. The revision has been made by Mr. Walter C. Holmes, of the Technology Department, and comes up to as recent a date as July 1, 1909. The references to electrolysis are very numerous and useful as well as to such subjects as galvanizing and tinning. The pamphlet is published at a price of 10 cents, postage prepaid.

FEDERAL CORPORATE TAXATION.—The third international conference on State and local taxation will be held at Louisville, Ky., Sept. 21 to 24, when several important questions will be brought up, and resolutions will be offered against Federal taxation of corporations. A resolution will also be submitted approving the proposed amendment to the Constitution on the subject of a Federal income tax, applicable to all income. The conference is held under the auspices of the International Tax Association, of which Mr. A. R. Foote, of Columbus, Ohio, is president. A letter of invitation to Governors of States has been sent out by Governor Willson, of Kentucky. At the last conference, in 1908, no fewer than 24 States, 5 Canadian provinces and 18 universities and colleges were represented by delegates.

ELECTRICAL ASSISTANTS.—The United States Civil Service Commission announces an examination on Sept. 29, 1909, to secure eligibles from which to make certification to fill two or more vacancies in the position of electrical assistant in the Signal Service at Large, War Department, at $1,080 per annum. Applicants, who must be thoroughly familiar with the practical side of electricity as applied to telegraph, telephone and cable engineering, and also with the methods of testing and installing electrical instruments used in fire control, such as storage batteries, motor generators, power and telephone switchboards, wireless telegraph apparatus, telegraphs, electric clocks, telephones, etc., should apply at once to the United States Civil Service Commission, Washington, D. C., for application Form 1312.

ELECTRICAL SECTION OF WESTERN SOCIETY OF ENGINEERS.—Among the papers announced for the coming fall and winter season of the Western Society of Engineers, Chicago, are three bearing the following titles: "Economies in Central-Station Management," by Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company; "Depreciation and Reserve Fund for Electric Properties," by Mr. William B. Jackson, consulting engineer, Chicago; "New Illuminants," by Mr. Carl Wiler, Western Electric Company. These papers will probably be read before the electrical section of the society, the first meeting of which, for the season, will be held probably on Oct. 15.

MEXICAN TELEGRAPHS.—All telegraph lines in Mexico are controlled by the Government, and there is a network which covers the Republic. The service is rapid and accurate, and there has been a great improvement in recent years, largely owing to the unceasing efforts of Mr. Camilo A. Gonzales, Director-General of Telegraphs for the Federal Government. The Morse alphabet is used with a few changes to make it conform to the alphabet of the Spanish language, which is slightly different from the English alphabet. The rates are somewhat lower than in the United States, and the operators are nearly all men. Quadruplex and duplex instruments are used on the more important trunk lines, and the Government is considering the installation of printing telegraphs in the larger cities.

STREET-RAILWAY STRIKE IN CHICAGO APPARENTLY AVERTED.—In an effort to secure increased wages the employees of the Chicago Railways Company, Chicago City Railway Company and allied companies, nearly 10,000 in number, voted to strike nearly two weeks ago. But active negotiations were at once begun by representatives of the companies and unions, with the benevolent assistance of Mr. Walter L. Fisher, representing the city, which is actively interested because it receives 55 per cent of the net profits of operation. Happily, an agreement was reached on Aug. 13, which is apparently acceptable to both sides. The men will receive a satisfactory increase in wages, but not in accordance with the schedule of their original demand. A contract will be entered into, under the compromise plan, to run 3½ years from Aug. 1, 1909. To all old men who have served one year at 27 cents an hour—the old maximum scale—it will grant an immediate increase to 28 cents for the first year of the contract, 29 cents for the second year and 30 cents for the last 18 months. Other men will progress to the maximum more slowly.

RECOVERY FROM 15,000-VOLT SHOCK.—Professor Henry G. Gale of the department of physics, University of Chicago, was the victim of a very serious accident on March 19 at Pasadena, Cal., from the effects of which he has not yet entirely recovered. At the time of the accident Professor Gale was working with a 5-kw transformer in the laboratory of the Mt. Wilson Solar Observatory at Pasadena. The transformer was adjusted to give about 15,000 volts in the secondary, with about 20 amp at 110 volts flowing in the primary circuit. The high-potential current was used as a source of spark spectra under pressure, which were under experiment. In some manner Professor Gale, who was alone at the time, came in contact with the 15,000-volt circuit in adjusting some self-induction in that circuit. The shock rendered him unconscious and threw him violently to the floor and some distance away so that his body came in contact with the rheostat in the primary circuit. This rheostat is made of strips of sheet-iron on a wooden frame, and in falling upon it Professor Gale received very severe burns from the hot metal. How long this contact lasted is not known, for when the injured man was discovered by Professor Hale of the observatory, about half an hour after the accident, he had rolled away from the rheostat. For 24 hours after the accident Professor Gale was practically unconscious, and he was delirious for much of that time. He was removed to a hospital in Pasadena, and it was discovered that there were over 20 burns on his body, some of them very deep. He recovered from the electric shock within a few days, but the burns were slow in healing, and it was not until late in June that he was removed to his home in Chicago, and he is still confined to the house.

The Electrical Equipment of the Mutual Benefit Life Building of Newark, N. J.

By N. M. Schoonmaker

ONE of the characteristics of the buildings put up by insurance companies is their perfection and elaborateness of detail. The Mutual Benefit Life Building, of Newark, N. J., is no exception to this rule. It is a building upon which was spared no expense that would add to its beauty or efficiency. Facing on Broad Street, with 100 ft. frontage, it runs back 188 ft. on Clinton Street, with a wing that extends back through to Commerce Street. The main building, seven stories high, is of white marble. A public corridor, the common entrance, divides the first floor, the Clinton Street section being occupied by a bank and the opposite section by the department of insurance.



FIG. 1.—SCREEN LIGHTING IN BANKING OFFICE ON MAIN FLOOR.

In order to give more floor space to the bank, a mezzanine was constructed in the rear of the first floor of the Clinton Street section, which the bank uses for directors' room, etc. The basement beneath this section was also adapted to the bank's requirements. It is shut off from the remainder of the basement, and has but one exit, through a barred door into the rear of the public space of the bank. Inside of the barred grille work, in this section of the basement, which surrounds the vault, is also the coin-lift which exits above inside the paying teller's screen. Outside of this barred space the bank basement is used for storage of books, records, etc.



FIG. 2.—METHOD OF LIGHTING DESKS IN ACTUARIAL DEPARTMENT ON SEVENTH FLOOR.

The basement under the entire remainder of the building is connected, one section being occupied by the heating and ventilating plant, pumps, tanks, etc., for the elevators, and a considerable space being set aside for locker- and toilet-rooms to be used in common by the bank and by the department of insurance. This basement space has two sidewalk lifts. Views of the motor-driven apparatus in this part of the building are shown in Figs. 4 and 11.

The department of insurance occupies the first floor of the section across the public corridor from the bank and also all the upper stories, which latter are used for clerk space, filing-rooms, etc. A book vault, extending from the first floor and constructed with two or three mezzanines to each story height, runs up through all other stories except the sixth. The main burglar-proof vault is on the second floor. The sixth floor, which is used for filing space, has no windows opening upon the street. The sixth and seventh floors of the old Commerce Street wing were remodeled into a kitchen and dining-room for the officers and clerks of the insurance company. The company's old building was on this same site and, as it did not wish to find new quarters elsewhere while the new building was in process of construction, it was decided to put the new building up in sections. The company was crowded into the part of the old building which lay along Clinton Street while the opposite section was erected and made ready for occupancy. They then moved into that, and the Clinton Street section was built. And last of all, the Commerce Street section was remodeled, the lower floors of it being left as they were, except that the boiler-plant and other such equipment were increased.



FIG. 3.—DESK FIXTURES IN FINANCE DEPARTMENT.

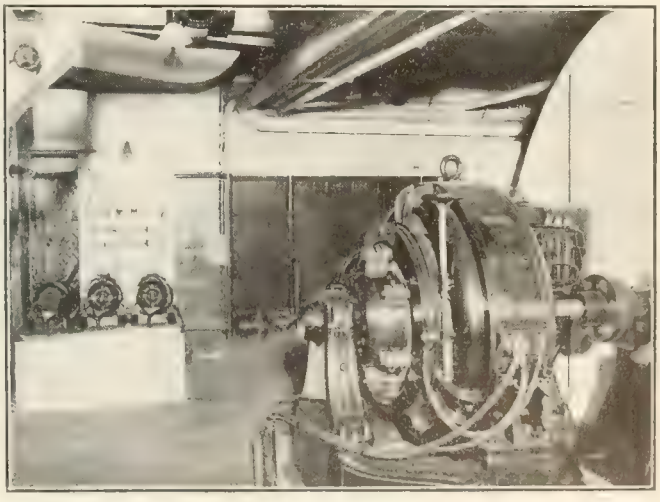


FIG. 4.—MOTOR-DRIVEN VENTILATING FANS AND LOW VOLTAGE SETS FOR RINGING CIRCUITS.

The basement for the entire new building was built before the above-ground work was begun and before any part of the old building was torn down. The supporting columns for the new building were there laid out so as to secure the two sections separately.

All these peculiarities in construction and conditions of construction had, of course, to be taken account of in the plans for the electric wiring of the building. To begin with, a temporary lighting service had to be installed for the section that was built first, this being eventually taken out and replaced by the permanent service. In this temporary system weatherproof wire was used and the work was run exposed.

Many parts of the building required special work. The sixth floor (Fig. 9), in which there are no outside windows, and which is used for filing space, depends entirely upon artificial light. The number of desks in the upper floors of the building, each one of which must be provided with a desk lamp (Fig. 2), also made a great deal of special work necessary. There is an unusually elaborate system of call bells. The wiring in the bank screens is run in specially designed cornices with outlet boxes made to correspond. More than this, there are two kinds of service, the lighting being 230-volt, three-wire, alternating current and the power 525-volt direct current, this voltage necessitating the best of insulation. The permanent service enters the basement from Clinton Street, drops through the floor and runs on the ceiling of the cellar to the switchboard.

Ordinarily the service company will put in the service-board, but desiring to keep the standard of the whole construction up to a very high level, the engineers provided for two special service-boards, to be put in by the electrical contractor. These are set in a service vault at the service entrance, just off the locker-room, with double-throw switches so that in case of a blow-out one side can be fused while the other side is in use. They are constructed like switchboards, with all busbar work on the back, and have the light and power meters mounted on them.

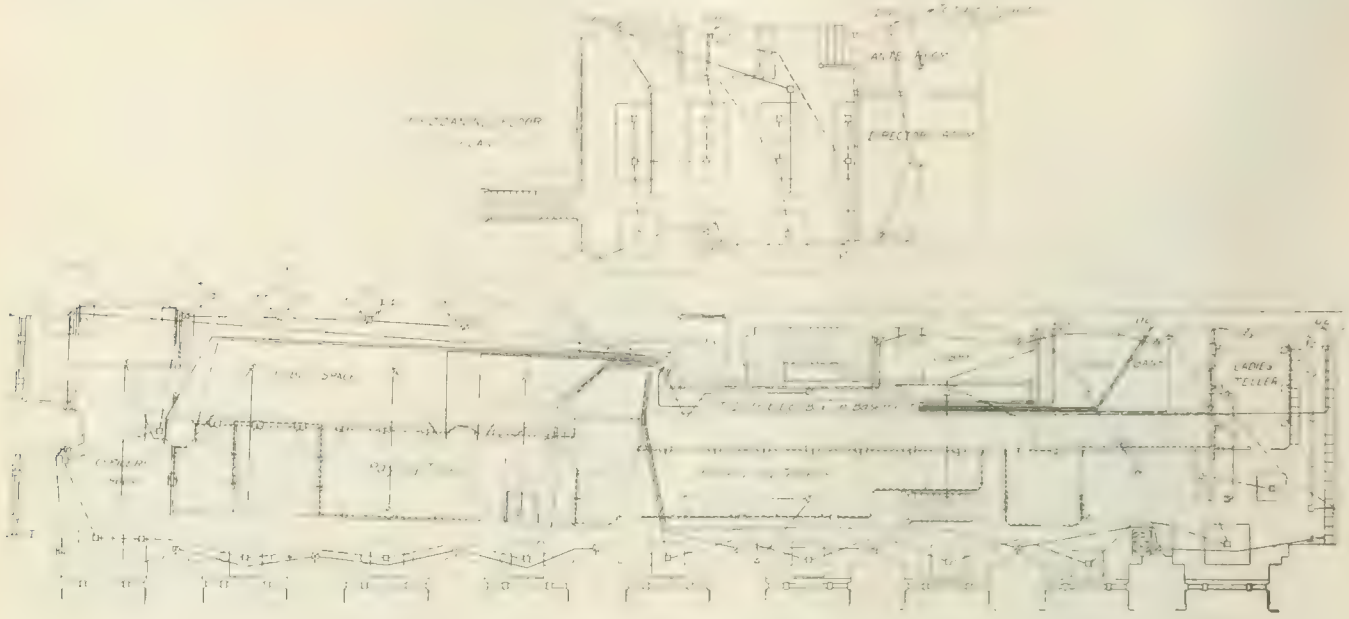


FIG. 5.—ELECTRIC CIRCUITS ON FIRST AND MEZZANINE FLOORS.

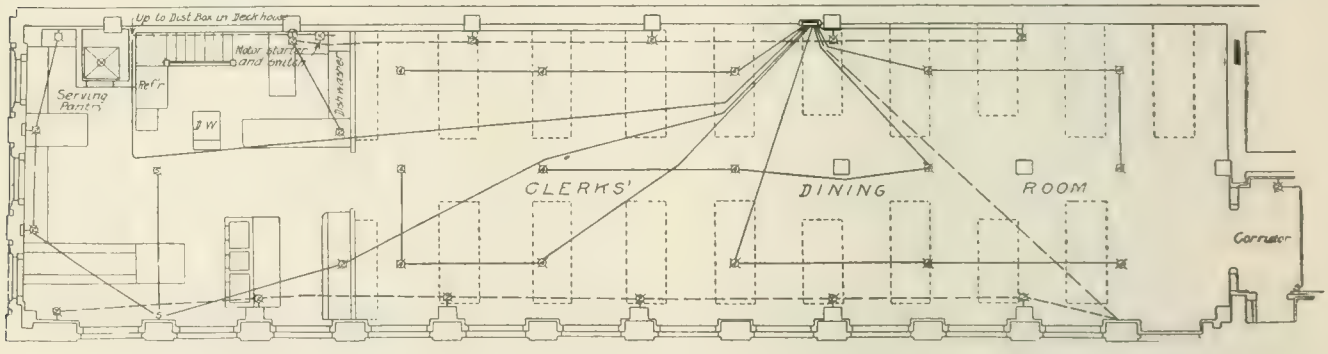


FIG. 6.—CIRCUITS IN GENERAL DINING ROOM ON FIFTH FLOOR.

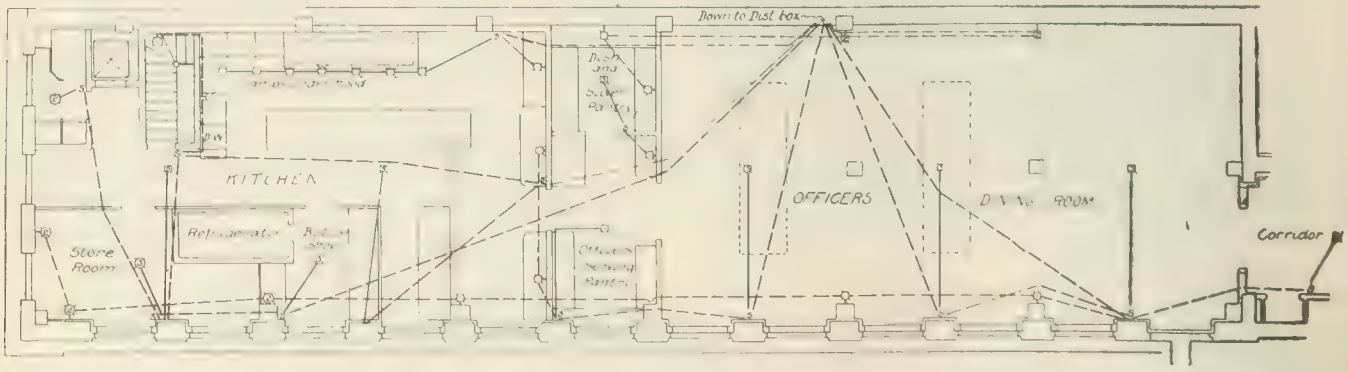


FIG. 7.—OFFICERS' DINING ROOM ON SIXTH FLOOR.

The switchboard is located in the basement. It is 8 ft. long, 6 ft. 6 in. high, of white Vermont marble 1½ in. thick, and is supported on an angle-iron frame resting on bronze pedestals. It is made up in two slabs, one for light and one for power. The front of the board is surrounded by a plain polished-copper molding, the space around the completed board being filled in with bronzed grille work, extending above from the top of the board to the ceiling and at the ends from the board to the wall. The switches, knife pattern with enclosed fuses, are all-copper and the busbar construction on the back of the board is of copper. The large lugs are specified to take a length of cable equal to 2½ times their diameter. The switches are mounted on the power section of the board for each individual motor and each power center of distribution, and on the lighting switchboard for each lighting feeder as indicated by the feeder diagram (Fig. 8).

The feeders run to the bottom of the switchboard in the shape of hard-drawn copper rods covered with neatly fitting circular-loom conduit and supported by porcelain insulators fastened to angle-iron frame. These rods, which are of the same size as the cables, no rod being less than ¼ in. in diameter, are secured to the cables by means of Dossert mechanical couplings.

From the switchboard the feeders run to centers of distribution, to distribution boxes, or to motor outlets. At centers of distribution, the feeders join the mains through knife switches. They are run in exposed conduit on the cellar ceiling to their riser points and thence in chases up to their destinations. The number, size, route, system, etc., are shown by the following tables:

MOTOR FEEDERS.

No.	Location.	Motors.	Horse-Power.	Size.
8	Cellar	Motor Generator.		
9	Basement	Vault Blower.	6	No. 8 B.&S.
10	Basement	Broad St. Blower.	20	No. 2 B.&S.
11	Basement	Engine Room Exhaust.	5	No. 0 B.&S.
12	Basement	Filter Cleaner.	3	No. 10 B.&S.
13	Basement	Engine Room Blower.	20	No. 2 B.&S.
14	Basement	Clinton St. Blower.	12	No. 6 B.&S.
15	Basement	Small Elevator Pump.		No. 0
16	Basement	Elevator Pump.		No. 0000
17	Basement	Elevator Pump.		No. 0000
18	Roof	Roof Power.	62	300,000 circ. mil
19	Basement	Air Compressor.	2	No. 10
20	Basement	Commerce St. Wing Power.		No. 00

LAMP FEEDERS.

No.	Feeds.	Lamps.	Dis. Box.	Size.
1.	Commerce St., Wing Lamps			No. 0000
2.	Basement and Cellar Lamps	146		No. 4
3.	1st, 2d, 3d and 4th Fl. Lts., Shaft No. 1	597	3, 5, 7, 9, 11.	No. 0000
4.	5th, 6th, 7th Fl. Lts., Shaft No. 1	790	13, 15, 17	No. 400,000 circ. mil
5.	Bank Lamps	311	-	No. 2
6.	1st, and 3d and 4th Fl. Lts., Shaft No. 2	932	4, 6, 8, 10.	No. 300,000 circ. mil
7.	5th, 6th, 7th Fl. Lts., Shaft No. 2	986	12, 14, 16.	No. 400,000 circ. mil

Let it be remembered that the plan of the general wiring had always to take into consideration that the building was to be erected in sections. It often happens, for this reason, that an outlet will be nearer another distribution panel than it is to the one from which it is fed.

The entire interior conduit system is concealed, either in the floor construction, through which the fixture hanger extends, or chased in the walls, the lighting feeders and mains being three-wire and all branch circuiting two-wire.

One noteworthy peculiarity in the arrangement of the distribution boxes is that they are, wherever possible, set behind a full-sized door of exactly the same pattern, size, etc., as the other doors in the rooms in which they are found; thus a fine harmony is preserved in all the interior woodwork. Inside of this door is an interior door, opening upon the distribution box. This second door is lined with plate glass covering the diagrams of circuits. The distribution boxes are slate-lined with white marble panel boards provided with double-pole knife-pattern circuit switches and also with a short goose-neck and key socket so that a lamp may be attached if a light is necessary. Two extra switches are set on each panel. The polished copper busbars are arranged on the front of the panels. The centers of distribution are of the same construction as the distribution boxes and are set above them, behind the same large door described above. They are of the same white marble as the panel-boards and have fused main switches. There was no distribution box used on the first floor of the bank. The distribution box for this section is in the basement below and the lamps are controlled by local switches set on the columns.

The wires throughout the building are of sufficient size to supply all lamps simultaneously with a loss of not more than 2 per cent between the switchboard and any lamp. The difference between any two lamps does not exceed 2 volts, the voltage at the lamps being 115.

All motor wiring is done on a two-wire basis with insulation

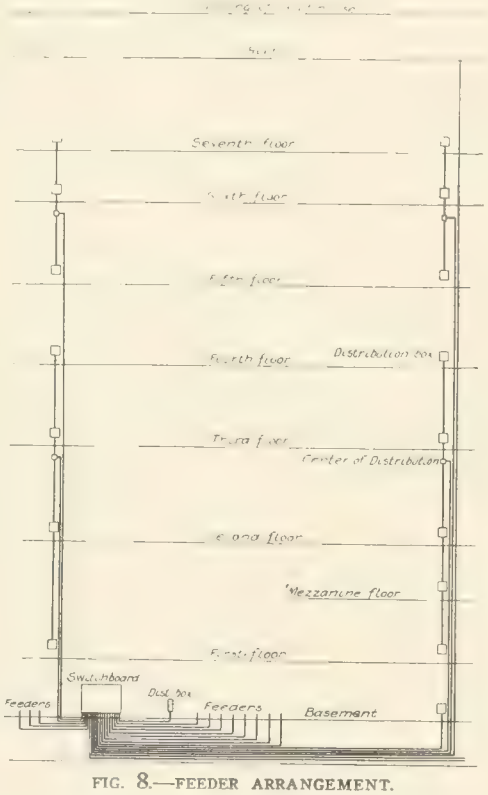


FIG. 8.—FEEDER ARRANGEMENT.

for 500 volts. The switches at each motor outlet are enclosed in slate-lined switch boxes. All motors in the machine-room are wired directly from the switchboard, the controlling rheostat and switch being mounted on brackets on top of the motor frames.

Owing to the number of desks in the building, each to have its own desk lamp, a great number of floor outlets were used, the wiring extending up from the floor to the desk, cases, etc., through brass tubing. As before mentioned, the wiring also extends up into the screens of the bank, being run in conduit along in the cornices which were built specially to accommodate this design and outletting in specially designed outlet boxes set at each fixture.

Neither the bank vault nor the insurance vault was pierced by the electric wiring. This necessitated plug receptacles and switches on both the inside and outside, with flexible connectors. Feed wires run to a floor box at the point where wires are brought through the vault plates. The wiring inside the vaults is run in polished steel conduit, with outlet boxes finished to match the vault. At each outlet in each vault is a five-lamp wireless cluster with an 18-in. white porcelain shade,

and in each vestibule a key receptacle and small prismatic globe. In general, the ceiling outlets throughout the building, except in the public corridors, are controlled by local switches set in gangs on the columns.

The low-potential work throughout the building is, in general, about that of the usual high-class office building. As with the high-potential work, the chief complication arose from the number of clerks' desks to be supplied and interconnected. The conduit and wiring for the public telephone was put in under the electrical contract, all wires being run in concealed conduit and all the necessary interconnecting boxes being installed by the contractor. These boxes have the general construction of distribution boxes, with copper-screw terminals on slate strips. The boxes at the outlets are the same as other electric boxes, but with brass covers bushed for extension to instruments. The central of the system for all working portions of the building is on the sixth floor. From it a 25-pair cable is run to the service entrance, with three twisted wires to each outlet. Besides this cable, five-pair cables are run from the service entrance to the local telephone centers in the bank and in the department of insurance on the first floor. Wherever possible, standard paper-insulated, lead-sheathed telephone cables are used.

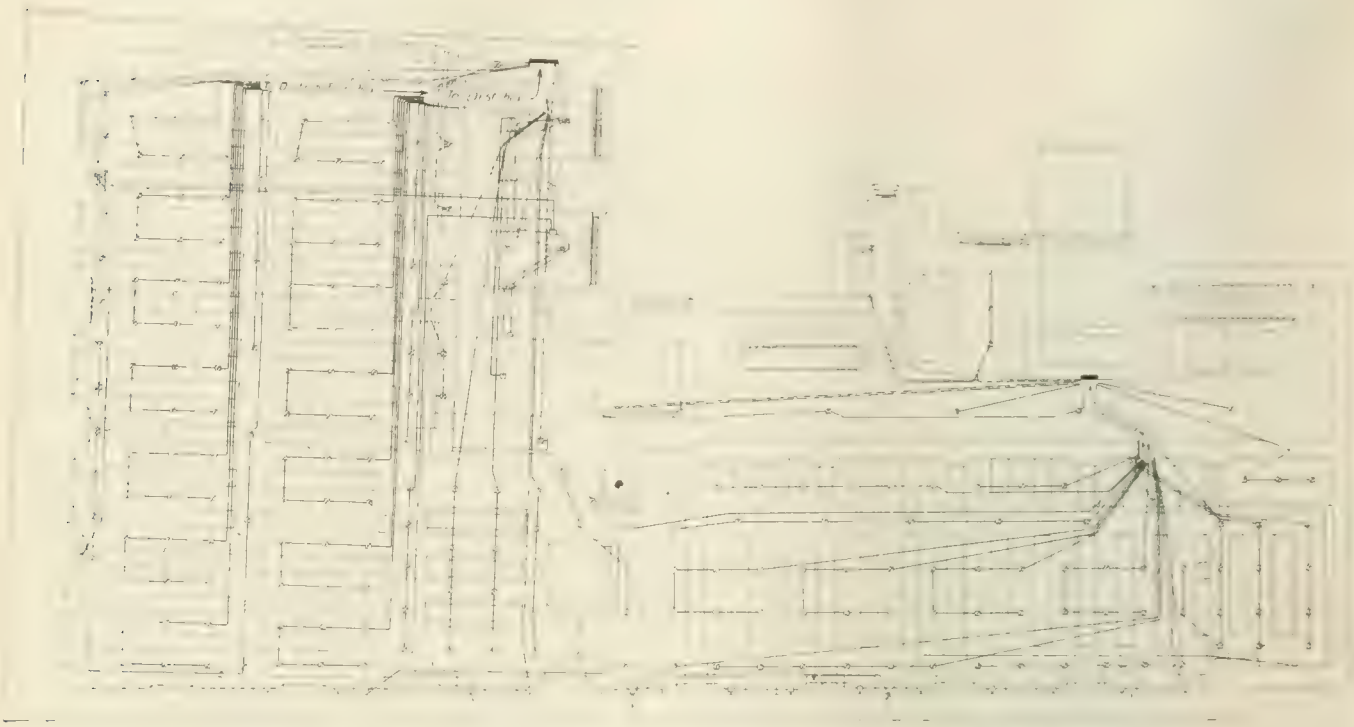


FIG. 9.—FURNITURE LAYOUT AND ELECTRIC LIGHT AND BUZZER CIRCUITS ON SIXTH FLOOR.

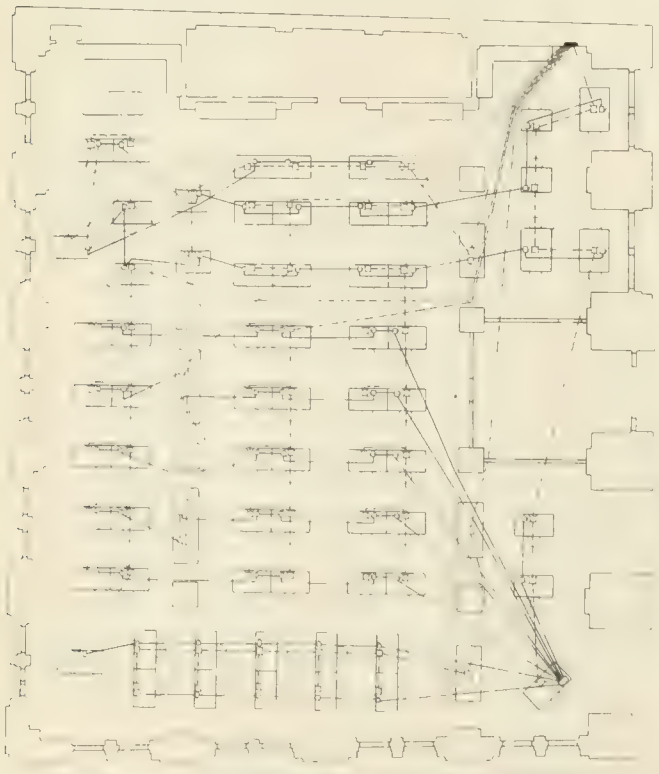


FIG. 10.—LAMP AND BUZZER CIRCUITS ON SEVENTH FLOOR.

In addition to the public-telephone system there was also installed a house-telephone system, with its central also in the telephone-room on the sixth floor. This system is run in the same general way as the public system. The switchboard for this private system is exactly like those which telephone companies furnish, with all the features which an ordinary board

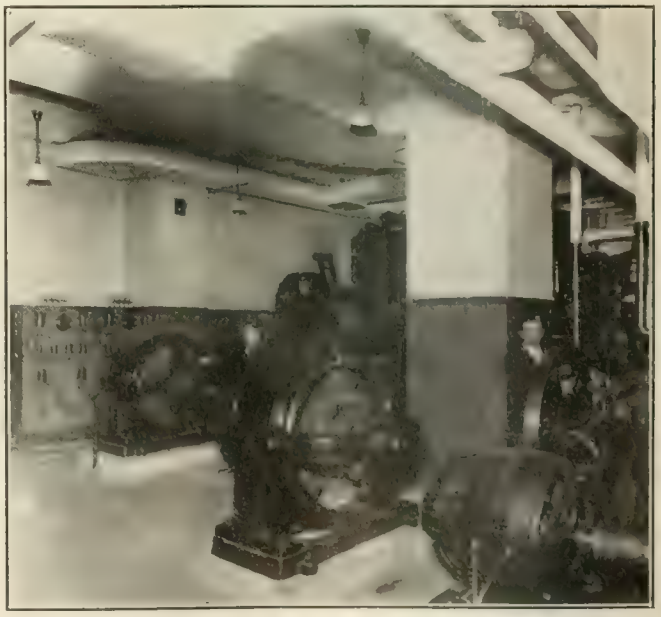


FIG. 11.—MOTOR-DRIVEN HYDRAULIC ELEVATOR AND VACUUM PUMPS.

has. The instruments are of as high a grade as those used by the local telephone company, but of sufficiently different shape to be easily distinguishable. For this house-telephone system, as well as for bells, buzzers and the electric signal system throughout the building, a low-potential generating and storage-battery system was installed. The motor generators, three in number, all arranged for interconnection, are located in the basement machinery-room.

The low-potential switchboard connected with this system (Fig. 4) is constructed like the main high-potential switchboard and is set immediately over and back of the motor generators. It is provided with ammeter and voltmeter and switches for same, also with copper knife switches for distribution, charging the battery and tying the systems together. The rheostats connected with the motor generators are set on the board.

The ringing system of both the house and intercommunicating telephones is connected directly off the busbars, which are always kept alive. A night storage battery, with arrangements for switching it onto busbars, is provided for the use of the ringing service when the low-potential motor generators are not running. But the talking system is taken off the storage batteries, which are charged by motor generators, and of which there are two sets, one for the house system and one for the intercommunicating system. The intercommunicating system referred to above is for the use of the bank and has 15 stations.

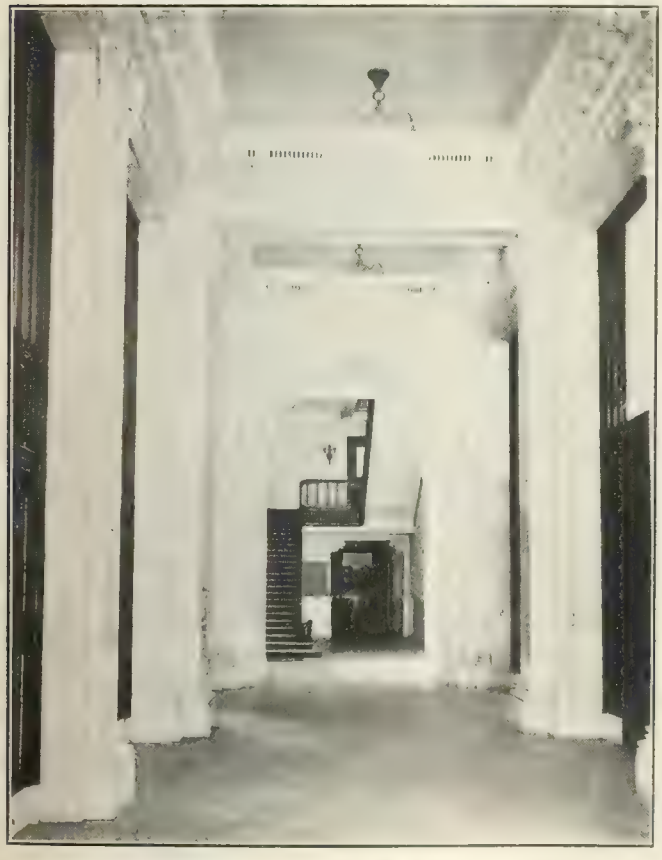


FIG. 12.—MAIN CORRIDOR OF BUILDING.

In planning the call-bell system, the engineers had to lay out special work, as in insurance offices it is necessary to have such connections between the chiefs' rooms and many of the clerks. The grade of wire, the kinds of outlets, the manner of installation, etc., are all the same as those of the high-potential system. The energy for this entire system is supplied through feeders connected to the ringing buses of the low-potential switchboard. The wiring is run up through the desks, the same as in the high-potential system, and flush-type buzzers and annunciators are set in the desks and cases.

The building is provided with two complete systems of watchman's clocks and key stations. One of these systems is for the bank alone, the other has its master recorder in the superintendent's office on the seventh floor. The wiring for these is also the same in grade of wire, conduit, etc., as the high-potential system.

There is also a system of burglar alarms connected with the vaults. These alarms are wired for connection with public burglar-protection service.

The time clocks of the building are electric and are wired from the master clock in the superintendent's office on the seventh floor. The secondary clocks have 12-in. dials, with dust-proof metal cases, and one is provided for each office and each department, besides a specially ornamented one for the public corridor. The wires for these clocks are of the same grade as those used in the lighting work and are run in iron conduit, with an iron outlet box for each clock. The energy for this system is taken from a primary battery at the master clock.

The plan of erecting the building in sections proved, on the whole, an entirely satisfactory one, the architects, Messrs. G. B. Post & Sons, having carefully worked out the details of the construction. The electrical engineers for the building were Messrs. Pattison Brothers, and the contractor was Mr. J. P. Hall, all of New York.

Connections for a Single-Phase Wattmeter on a Three-Phase, Three-Wire System.

By F. Conrad.

ALTHOUGH modern switchboard practice tends more and more toward the use of polyphase wattmeters for three-phase systems, there are still a large number of single-phase meters used, especially to indicate the load on a generator or feeder when the system is practically balanced and when strictly accurate readings are not required. For generators or feeders it is usually sufficient to know roughly the load carried at any particular time. As a rule, the load in either case is changing from time to time, so that there is no advantage gained by using an expensive instrument, as it will be found in practice that the needle of the meter will be swinging constantly, making it impracticable to take precise readings.

There are in general use two methods of connecting a single-phase meter to indicate the load on a three-phase, three-wire system. One requires the use of two series transformers and one shunt transformer and the instrument may be an ordinary single-phase instrument—that is, the scale need not be a special one and if properly connected overload relays may be operated by the same series transformers. This introduces a slight error in the reading of the wattmeter, but not sufficient to be objectionable. The other method requires the use of but one series transformer and two shunt transformers. There is practically no advantage in either method as to cost, because it is customary to use two series transformers in order to connect in overload relays, as well as two shunt transformers, the latter being used in connection with a pilot lamp and synchronoscope as well as the wattmeter. With the second method, a Y resistance box is essential and a special scale for the instrument.

In Fig. 1 are shown the connections for a single-phase wattmeter without a Y-box. The series transformers must be connected as shown. The beginning of one secondary winding, as a^1 is connected to the end of the other at b^3 and a^3 is connected to b^1. A tap from each of these wires is run to the current coil studs E and F of the wattmeter. There must be a non-inductive high resistance connected in series with the potential coils of the meter. This latter is sometimes contained in the instrument case, but may also be in a separate box. In either event it must be in series with the potential coils. The series transformers may be connected in any two lines, but it is customary to install them in the outside lines A and C. The potential coils must then be connected across the phase A-C, or, what is the same thing, to the corresponding secondary wires. The synchronoscope may be connected across A-B, and a

lamp across *B-C*. The wires from the potential studs *c*, *d* must go to the two lines containing the series transformers. If the meter should happen to indicate backward it is necessary to transpose the wires at the potential studs *c*, *d*. If, as in this case, shunt transformers are used, these wires go to the secondary wires, which must correspond to the primary wires connected to *A* and *C*. An ammeter to indicate the current

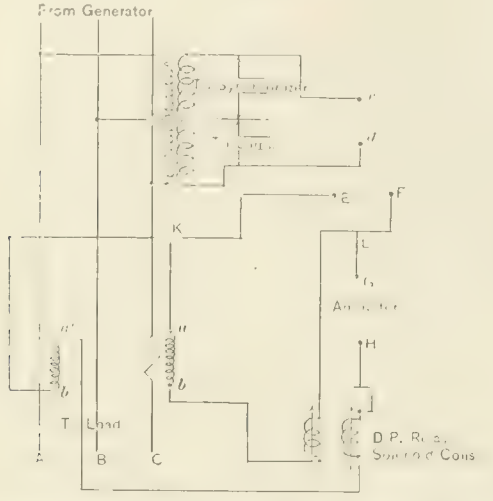


FIG. 1.—SINGLE PHASE WATTMETER, ONE AMMETER AND DOUBLE POLE RELAY ON A 3-PHASE, 3-WIRE CIRCUIT

flowing in one line may be cut in on one secondary circuit between *L* and the series transformer.

It is sometimes desirable to connect in three ammeters to indicate the current in each line, but with this method of connecting the series transformers, it is impossible to operate the three ammeters from the two series transformers, as the current in the common return wire *E K* is, in this case, equal to the resultant of the currents in the two secondary circuits at a phase displacement of 120 deg., and is equal to either current (assuming them to be equal) times 1.732. Hence an ammeter connected in this wire would have an incorrect reading. As the load is necessarily a balanced one, or the use of a single-phase meter would be out of the question, one ammeter is all that is necessary, and if this is cut in wire $L\,b^3$ it will indicate the current flowing in line *C*. If cut in wire $L\,a^1$ it will indicate current in line *A*.

If a relay is to be used, one coil should be cut in wire $L\,b^3$

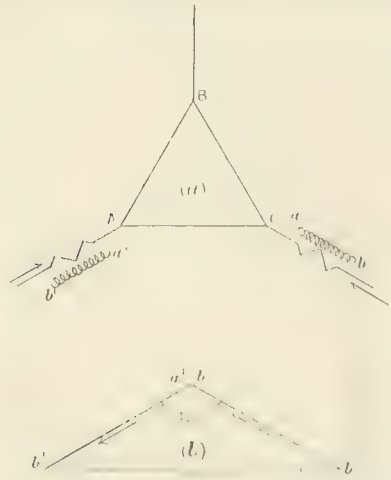


FIG. 2.—PHASE RELATIONS OF CURRENTS FOR FIG. 1.

and the other in wire $L\,a^1$. The relay will then protect the circuit fully against short circuits or overloads. If there are either one or two switches to be opened by the relay, the contacts closing the trip coil circuits should be connected in multiple—that is, either solenoid core will close the trip-coil circuit. Connections for the trip coil when one switch is used are shown in Fig. 5, and when two switches are used, the connections are shown in Fig. 6. In the latter case *a* and *b* are automatic switches on the main switches Nos. 1 and 2 respectively. They close and open with the main switch, so the trip coil is not in circuit when the main switch is open.

The time-phase relations of voltage and current are shown in the vector diagram (Fig. 2); at (*a*) the lines *A B*, *B C* and *A C* represent the voltage of a delta-connected, three-phase system; the lines *A*, *B* and *C* represent in direction the resultant of the currents from two phases respectively—that is, the current in line *A* is the resultant of the currents in phases *A B* and *A C*; likewise the current in any line. The small arrows show the instantaneous direction of the currents; a^1b^1 and a^3b^3 being the secondary windings of the series transformers. At (*b*) (Fig. 2) the lines a^1b^1 and a^3b^3 represent the direction and magnitude of the currents flowing in the secondary windings and the resultant of these two currents, which are displaced 120 deg. from each other, is equal to the line a^3b^1 and, at unity power factor, is directly in phase with the voltage across *A C*, and its value is equal to the current in either a^1b^1 or a^3b^3 times 1.732.

It will be readily seen from the diagram (*a*), Fig. 2, that in this system the line voltage *E* is equal to the phase voltage *e* and the line current *I* is equal to the phase current *i* times 1.732. The connections for the instrument do not differ for a Y-connected system with no neutral, as in that case the phase

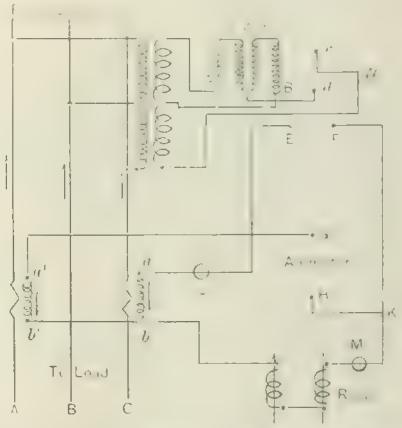


FIG. 3.—SINGLE-PHASE WATTMETER WITH Y-BOX, ONE AMMETER AND DOUBLE POLE TIME RELAY ON A 3 PHASE, 3-WIRE CIRCUIT.

current *i* is equal to the line current *I* and the phase voltage *e* is equal to the phase voltage $e \times 1.732$. In either case the potential and current coils of the instrument must be suitably wound. For example, assume a delta-connected system in which *e* = phase voltage = 2400; *E* = line voltage = 2400; *i* = phase current = 100; *I* = line current = 173.2, and a power factor of unity. The watts in one phase would be $W = E \times i = 2400 \times 100 = 240{,}000$, or 240 kw. Hence, in the three phases the kilowatts would be $3 \times 240 = 720$ or the formula for a three-phase system gives it directly $W = E \times I \times 1.732 = 2400 \times 173.2 \times 1.732 = 740$ kw. As this is a single-phase meter it is, of course, suitable for a single-phase system. Suppose a shunt transformer with a ratio of 20 to 1 is used, there would be impressed on the potential coils of the meter $2400 \div 20 = 120$ volts. A series transformer with a ratio of 60 to 1 would give the current coils $100 \div 60 = 1\frac{2}{3}$ amp, and the instrument would have a scale so calibrated as to read the kilowatts in the system or $2400 \times 100 \div 1000 = 240$ kw. For a three-phase system it must indicate three times that much.

In using the meter on a three-phase system, as assumed above, shunt and series transformers of the same ratio must be used. The potential coils would have 120 volts impressed on them, as in the single-phase system; but it will be noted that the primary of the series transformer carries the line current *I*, which is equal to the phase current $i \times 1.732$ or 173.2 amp. Each series transformer secondary would therefore carry $173.2 \div 60$ or 2.89 amp, as the two secondary circuits are so connected that the meter receives the resultant of these two currents displaced 120 deg. from each other, or the current of

of the secondary times $\sqrt{3}$, or $2.89 \times 1.732 = 5$ amp. Referring to the single-phase assumption, the meter would have 120 volts impressed on its potential coils and 1⅔ amp flowing through its current coils and would indicate 240 kw, or the load on the single-phase system. On the three-phase system, the potential coils would have 120 volts impressed on them, but the current coils would carry 5 amp or exactly three times as much current as in the single-phase system, the phase current i being the same in each case. Hence, the meter will indicate $3 \times 240 = 720$ kw, which would be correct for the three-phase system. Therefore, the scale of the instrument need not be changed when this method of connection is used.

In the foregoing the power factor is not taken into account—that is, unity power factor is assumed. At a lower power factor, the current is, of course, increased for the same load, but the meter indicates the true watts regardless of the power factor. In Fig. 1 if the full-load current in the secondary of the series transformers is 3 amp, the ammeter and relay coils should have 3-amp windings; but the current coils of the wattmeter should be wound for 5 amp. In any case, the instrument windings should be of such size that they will not overheat under full-load conditions.

The second method of connection is shown in Fig. 3. In this case the current coils of the wattmeter are connected to the secondary of one series transformer. Assume that it is the one in line *C*, the primary of the series transformer carries the line current *I* and the meter coils receive *I* divided by the transformer ratio. For the meter to indicate properly, it is necessary for the voltage to be directly in phase with the current at unity power factor, or the potential coils must be connected from line *C* to the neutral point of the system; and since there is no neutral point in a delta-connected system, it is necessary to create one artificially. This is done by connecting one terminal of the potential coils to line *C*. To the other terminal is connected two high non-inductive resistances, the other terminals of which are connected to *A* and *B*, as shown in Fig. 4. As two series transformers are necessary to operate the protective relays, it is customary to connect an ammeter in the secondary circuit of the other transformer. This will indicate the current in line *A*, one terminal of the ammater and wattmeter going to the common return wire at *K*; the relay with its two coils in series being cut in this common wire, and the trip coils connected as shown in Figs. 5 and 6. For duplicate apparatus there will be two main switches on each machine or feeder, and a two-pole relay would be necessary.

As the resistances of the potential coils and Y-box are high, the current flowing is very small, and the voltage across either resistance is equal to the line voltage divided by $\sqrt{3}$, or 58 per cent of the line voltage. Assuming as before the phase current 100 amp, the line current is $100 \times 1.732 = 173.2$ amp; but the voltage impressed on the meter is reduced in the same proportion as the current is increased—that is, 58 per cent of 2400, or 1392 volts. As the shunt transformer has a ratio of 20 to 1, the meter receives 69.6 volts; hence the meter will indicate $1392 \times 173.2 = 240$ kw, which is just one-third the total power in the system, and the meter must have a special scale reading three times normal.

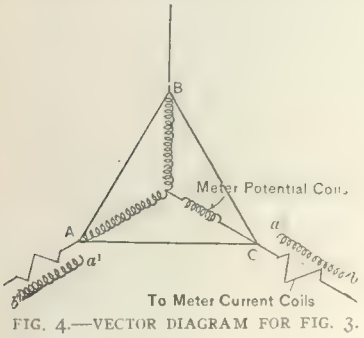


FIG. 4.—VECTOR DIAGRAM FOR FIG. 3.

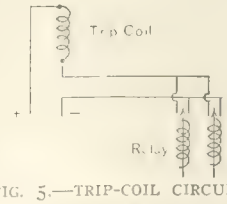


FIG. 5.—TRIP-COIL CIRCUIT FOR ONE SWITCH.

If the instrument should indicate backward, it can be reversed by transposing the wires to the potential studs. Usually a wrong connection will produce a very large error in the indication, and great care should be taken to connect the one potential stud to the line in which the series transformer is cut in, and the other to the center binding post of the Y-box. For a wrong connection, the error will vary with the power factor, and if there is more than one alternator running, an error in the connection may be detected by varying the field excitation and holding the load on the machine as steadily as possible. If the load indicated on the meter varies with the field excitation the connections are wrong. By using the method of connecting the series transformers shown in Fig. 3, two additional ammeters may be cut in at *M* and *L*. Then ammeters *G-H* will indicate the current in line *A*, ammeter *M* the current in line *B* and ammeter *L* the current in line *C*.

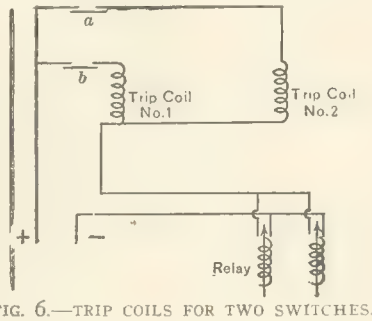


FIG. 6.—TRIP COILS FOR TWO SWITCHES.

Double-Service Electric Railway Signals.

By W. K. Waldron.

IN the Feb. 11 number the writer described a solenoid-operated electric railway signal for a third-rail track circuit. The description referred to applied to roads on which the traffic was always in the same direction, and, consequently, the arrangement of track circuits and wiring connections was of the simplest form. Instances, however, occur in which one track circuit must be used to operate two or more signals controlling trains running in opposite directions on the same track during different hours of each day. The circuits then become somewhat complicated and many problems develop, the solutions of which are very interesting and instructive. Such conditions may be found on railways where two tracks are used for local trains, while a third track is used for express trains, the latter running one direction during the early hours of the day and in the reverse direction during the evening hours. The signal control must, of course, reverse when traffic reverses and possess a simple and yet positive action.

An interesting example of this double service of solenoid-signal circuits may be seen on the elevated railway at 110th Street and Eighth Avenue, New York, where it is used on the center track on which the express trains run southbound in the morning and northbound in the afternoon and evening. At this place are located two curves which are protected by one signal for each curve for each direction, making four signals in all. These four signals are controlled by five block sections, three of which are used by both the north and south bound signals, the remaining two blocks being at the extreme north and south ends of the protected portion of the line and used as release blocks to indicate when a train has passed a sufficient distance beyond the curve to allow the following train to advance; the southern block controlling the southern southbound signal and the northern block controlling the northern northbound signal.

As these articles are intended primarily for the instruction of men engaged in the installation and maintenance of this class of signals, they must of necessity be made clear and concise, each step being carefully described and the purpose of each part in a general way explained, thus making the description somewhat elementary.

The description referred to at the opening of this article applies to this installation, except as to the track relays, which, in

the former case, were less complicated in their arrangement, one track relay controlling each signal, while in this case there are two track relays required for the control of each signal. The semaphore also differs in size and shape, being smaller, and placed centrally on the signal post, as shown in Fig. 1, these signal posts being put between tracks where space is very limited. Only about 5 ft. of the upper portion of the post extends above the track, the machinery case being beneath the track level, all supported on a platform built below the tracks. Each end of the semaphore board being hinged near the post is free to swing in either direction in the event of its being struck by a passing train, thus avoiding frequent breakage.

Fig. 2 is a wiring diagram of the four signals under consideration. The section of line protected extends from about 107th Street north to about 113th Street. The direction of signaling is controlled from a point about 115th Street, where a three-point switch is located, which, as shown, governs the feed for the two sets of signals, the lead being connected with the third-rail at *A*. The switch as set in the diagram is feeding signals for southbound trains. Following this feed wire a branch leads off at *B* connecting with the common rail at *C*. This branch has a 3-amp, 500-volt fuse snap switch and resistance tube of 3000 ohms. At the 1800-ohm point a lead is taken off, which, after passing through the track relays at *D* and *E*, picks up the solenoid relay of the signal at *F* and passes to ground at *H*, thus allowing the current from *G* to operate the signal. Returning to point *B* in the main feed line and continuing to point *J*, there is connected at the latter point a branch similar to that at *B* leading to the common rail at *K*. The lead from the resistance passes through relays *L* and *M*, picking up the solenoid relay of signal *N* and connecting with the common rail at *O* and completing the circuit from the third-rail connection at *P* to the solenoid which operates signal *N*. This description shows sequence of operations when the track is clear and both southbound signals are at "proceed" position; the northbound signals are, of course, "dead" and are at "danger."

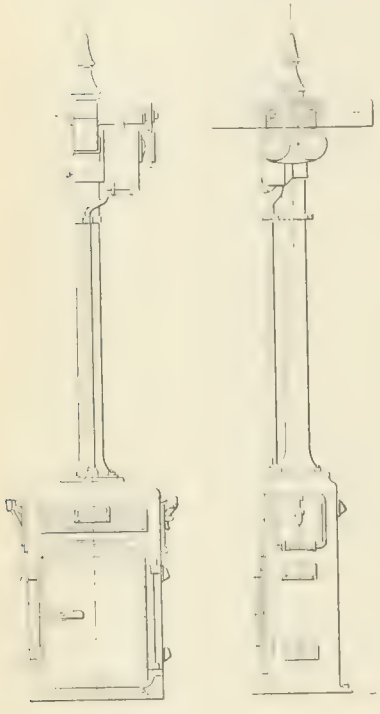


FIG. 1.—SIGNAL POST.

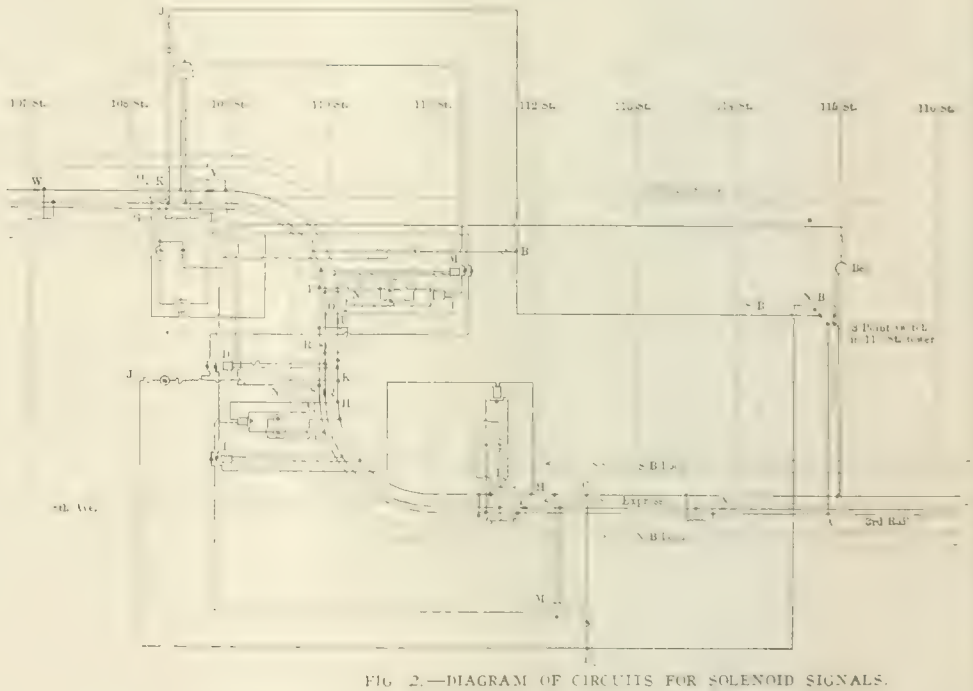


FIG. 2.—DIAGRAM OF CIRCUITS FOR SOLENOID SIGNALS.

The block section *Q R* is also used to indicate to the tower man at 115th Street when a northbound train has reached this section. The indication is given by a bell in the tower, which is rung through back connections on relay *D*, the feed for the bell being connected to the third-rail at *S*.

The action of signals on the passage of a southbound train is as follows: When a train enters the block *T-Q*, relay *E* in northbound signal case drops, thus breaking the circuit *B-D-E-H* and causing the signal *F* to go to "danger." When the train enters block *Q-R*, relay *D* also drops, thus making two breaks in the above-mentioned circuit. The train advancing, enters block *U-V*, causing relay *M* to drop, breaking the circuit *B-J-L-M* and putting signal *N* to "danger." Both signals, *F* and *N*, are now set at "danger" since the distance from *R* to *U* is less than a train's length. After the train passes *R*, signal *F* goes to "proceed" position and when the train enters block *V-W*, the relay *L* drops, making a second break in the circuit *B-J-L-M*. After the train passes joint *V*, relay *M* picks up, but as relay *L* is still "dead" the signal *N* remains set at "danger." When the train passes joint *W*, relay *L* picks up and the signal at *N* goes to "proceed" position. From the above it will be noted that each of the signals at *F* and *N* is controlled by two track relays; also that block *T-X* is not used by southbound trains.

When the northbound train starts the switch at the 115th Street tower is thrown over to feed into northbound signals; the southbound signals are now "dead" and stand at "danger," and the northbound signals go to "proceed" position if the line is clear. Assuming that the switch at the 115th Street tower is thrown over so as to feed into northbound signals, the circuits will be as follows: From switch, following line marked *N, B*, a lead is taken off at *B2* connecting with common rail at *C2*. This branch is similar to *B-C* and *J-K* as described in the southbound system. From tap on resistance the line passes through relay *M2*, then relay *E*, thence through solenoid relay of signal, *N2* passing to ground at *H2*, thus allowing current from third-rail at *P2* to operate signal *N2*. From *B2* the circuit runs to *J2*, where another branch corresponding to *B-C* passes to ground at *K2*. Again from resistance tap the line passes through relay *D*, relay *M* and through solenoid relay of signal *F2*, thence to ground at *O2*, allowing current from the third-rail connection *G2* to operate signal *F2*. It will be observed from this description that relays *E, D* and *M* have each two circuits under control.

When the northbound train enters block *V-U*, the relay *M* drops, breaking the feed circuit to signal *F2*, which goes to "danger." Train entering block *R-Q* causes relay *D* to drop, which by its back connection rings the bell in the tower at 115th Street. Relay *D* in dropping also makes a second break in the feed circuit of signal *F2*. When the train enters the block *Q-T*, relay *E* drops and puts signal *N2* at "danger"; when

the rear end of train passes out of block *T-U*, the relay *M* will pick up, but the signal *F2* will not go to the "proceed" position until relay *D* also picks up, which it cannot do until the rear end of the train has passed out of block *R-Q*. When the train enters block *T-X*, relay *M2* drops, making a second break in the feed circuit of the signal *N2*, and when the rear end of the train passes out of block *Q-T*, relay *E* picks up, and after the train passes out of block *T-X*, relay *M2* picks up, which, completing feed circuit of signal *N2*, allows this signal to go to the "proceed" position. In this case it will be noted that the block *W-V* was not used.

The purpose of the bell in the 115th Street tower is to call the attention of the towerman to the approach of the northbound express. The 116th Street station being between the local tracks, the express train must be switched on to northbound local track and the bell therefore notifies the towerman to hold the approaching northbound local trains. The bell is controlled by a switch in the tower, which is thrown out when the southbound traffic is passing, as there is then no need of it. This bell is wound for 10 ohms and has 100 ohms resistance in circuit. All other details are the same as described in the previous article.

Express trains run only on the Ninth Avenue line, starting at Rector Street and running to 135th Street. In this entire distance no bad curves exist except those at 110th Street, where the line passes from Columbus Avenue to Eighth Avenue. At Fifty-third Street and Ninth Avenue, where the Sixth Avenue southbound trains pass over the express tracks, the towerman is notified by bells, controlled by single-rail blocks; one located at Forty-first Street indicating the approach of northbound express trains, and the other at Fifty-ninth Street indicating the approach of southbound local trains.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Advertising Block Signals Electrically.

The advertisement of automatic block signals is a prominent feature of modern methods of stimulating railroad travel, and many references to this equipment are encountered in transportation publications. One of the latest examples of signal publicity, involving electricity as a motive power, is at present on exhibition in the Boston office of the Union Pacific Railway Company. A reduced size semaphore signal of the Union Switch & Signal Company's make, with a glass case around the mechanism, is installed in the window facing a crowded portion of Washington Street, and operated by two Exide storage cells controlled by a motor-driven switch, supplied with energy from the 110-volt Edison system. The signal is equipped with a 3-ft. blade, motor driven, and incandescent lighting is used behind the spectacle lenses. The operations of the signal many times an hour attract the interest of a large crowd, and inquirers entering the office are given a booklet entitled, "Making Travel Safe," describing the purpose and service of the automatic signals on this company's system.

Making Dresses by Electric Power.

The flexibility of electric power in the operation of machinery for combined productive and advertising purposes was well illustrated recently in a manufacturing exhibit made by the department store of William Filene's Sons, Boston. The installation consisted of a motor-driven shop for the manufacture of machine-made dresses at high productive speed. The raw materials were cut, up to a maximum of 250 thicknesses, by an Eastman electric cloth cutter, capable of doing the work of 20 operators, and supplied with energy from a 110-volt circuit. The installation was provided with a 1.5-hp, 110-volt direct-current motor, driving the following machines in group: One skirt bander, one button-sewing machine, output 3000 per day; one button-hole machine, output 400 per hour, against 40 by hand; one sleeve sewer, one tucking machine, making 3500 stitches per minute; one waist machine, making 1800 stitches per minute; one sleeve machine, and one skirt machine, making 3000 stitches per minute. The individual machines were placed in and out of service by friction clutches operated by treadles. The exhibit was extensively advertised in the Boston press and attracted wide attention.

Combined Ice and Electric Lighting Plant.

The Sterling Consolidated Electric Company, which recently obtained a franchise in Sterling, Col., is remodeling its entire primary and secondary distribution system, and is contemplating the grounding of secondaries, which is being generally recommended by underwriters in that territory.

This company has completed a combination ice and electric-light plant. The building is brick with all-brick partition walls and tar-and-gravel roof on steel supports. The boiler-room has communicating coal-bins arranged for direct dumping from cars. Two 175-hp water-tube boilers are installed, with space for a third, and an electrically driven fan operates an induced draught installation, giving at all times an easily controlled draught. The generator equipment consists of a 150-kw and a 75-kw Bullock generator directly connecting to Ideal engines.

The steam feed pipes from the boiler-room enter one main pipe steam line, which also feeds steam to a 20-ton refrigerating machine made by the York Manufacturing Company and driven by a simple Corliss engine. Space is allowed also for another ice machine of the same rating as well as for another generating unit of the larger rating.

Arc lamps for the city are fed at 2300 volts through a constant-current regulator. The company is installing its own artesian well and uses the exhaust steam for its distilled water supply. The circulating pump, electrically driven, is used for ammonia condensing and steam condensing.

This plant provides electricity for Sterling, a place of 5000 inhabitants, and is the type of plant which is becoming very frequent in that portion of the country. The engineers for the entire system and the equipment are the Mountain Electric Company, of Denver.

Pushing Tungstens in the South.

The tungsten lamp has not been as rapidly introduced in the South as in Northern cities, and about June 1 the Mobile Electric Company, of Mobile, Ala., which is one of the companies controlled by H. M. Byllesby & Company, of Chicago, rented temporarily an average-sized store and equipped it with fans and tungsten lamps. There was very little else in the store save a desk and a few chairs. This fact in itself helped attract attention to the tungsten lamps, which were the one feature which it was desired to bring out prominently. The arrangement of lamps is shown in Figs. 1 and 2. Sixty-watt units with prismatic reflectors were used. A watt-hour meter was also fixed up on a board with the usual arrangement so that various lamps could be turned on and off and the watt-hours recorded.

The principal novelty of this method of pushing the tungsten lamp was the hiring of a special store in which to demonstrate it rather than depending on exhibitions in the company's offices, which are frequently not well suited to such demonstrations. The transparency in the front show window is for the purpose of comparing a 60-watt tungsten with a 112-watt carbon-filament lamp. There were also signs reading as fol-

lows in the show window and on the walls of the room "This brilliant illumination is the result of installing 18 60-watt tungsten lamps in 18 Holophane reflectors and costs for current 7.56 per hour; for renewals, 0.15; total, 7.71 (cents). Let us figure the cost to illuminate your store. Mobile Electric Company." Invitations and personal letters were sent out to nearly 1000 merchants and during the three days that the store was open several thousand business men called between the hours of 2 p. m. and 10 p. m. Since about May 1 the company has been carrying on a very vigorous campaign. As a result the gas company is finding the tungsten lamp a strong competitor.



FIGS. 1 AND 2. TUNGSTEN DEMONSTRATION AT MOBILE, ALA.

Mr. E. L. Callahan has recently taken charge of the new business department of H. M. Byllesby & Company, and it is by his courtesy we are able to reproduce the photographs of this store.

District Electric Supply in Ohio.

The supply of electricity to other towns from a centrally located station was the subject of two papers at the convention of the Ohio Electric Light Association, July 13. One of these was by Mr. Claude Smith, manager of the Bradford & Gettysburg Electric Light & Power Company, of Bradford, Ohio, whose paper gives the following account of this enterprise:

BRADFORD & GETTYSBURG LINES.

The Bradford & Gettysburg Light & Power Company was organized in the fall of 1908 for the purpose of building and operating a transmission line to the towns of Gettysburg and Bradford, Ohio. Ten-year street lighting contracts were obtained with both towns and a contract for energy was entered into with the Greenville Electric Light & Power Company of Greenville, the county seat of Darke County. Gettysburg is a small farming settlement eight miles east of Greenville, while Bradford is strictly a railroad town four miles further east. Gettysburg has a population of about 350, practically all of whom own their own homes. Bradford has a population of about 1600.

The transmission line is built of No. 6 hard drawn copper and designed for a maximum of 60 kw at 6600 volts. Seven miles of the line is built on private right-of-way just outside the railroad property line. The remaining five miles is on a country road. The substation at Greenville is just outside of the city limits and contains the step-up transformers and the meter.

At Gettysburg a 7.5-kw transformer mounted on a pole feeds the three-wire secondary service of 110-220 volts. A small substation contains a 3-kw selective-tap transformer for street lighting with 220-volt primary and a maximum secondary of 600 volts; the selective taps being for 12.5, 25, 37.5, 50, 62.5, 75, 87.5 and 100 per cent. A small series regulator, ammeter, wattmeter and an eight-day time switch complete the street-lighting equipment. Eighteen 75-watt, 60-cp series tungsten lamps are operated on the streets, the service being all night every night from 30 minutes after sundown to 30 minutes before sunrise. The lamps are all permanently hung on 16½-ft. rigid mast-arms 16 ft. above the street.

The street lighting system of Bradford is designed for 150 lamps, 60 being in use at present. Three 15-kw step-down transformers are in use at the Bradford end and are connected in multiple feeding a main secondary system of two No. 4-0 and one No. 3-0 lines, the branches being of two No. 4 and one No. 6, the smallest being two No. 6 and one No. 8, which makes the copper loss on the secondaries of small value. The 15-kw transformers are arranged so that the two at the ends of the secondary mains can be cut out of service during the day, which greatly reduces the core losses and keeps up the regulation. The maximum voltage during the daytime is 118 to 120, the minimum at the peak load is 112 to 114.

The series tungsten street lamps have given excellent service and during the past four months only two lamps have been lost by burn-outs and 45 by defective joints between the filament and leading-in wires. Many of these lamps failed in the first 24 hours of burning.

The lighting company does not handle any supplies or do any wiring, but co-operates with the manager in this matter. Tungsten lighting was pushed from the start. The commercial rates charged for energy are first 30 kw-hours, 12 cents; 30 to 60 kw-hours, 9 cents; 60 to 90 kw-hours, 6 cents, with a 1 cent per kw-hour discount for payment in 15 days. No meter rent is charged, the minimum being $1.

The 60-watt lamp was adopted as the best for fighting gasoline as the operating cost is less and in small towns the financial end is the strongest argument that can be produced. In one instance a 15-light gasoline plant was displaced by 15 60-watt lamps, one 40-watt lamp and several 16-cp lamps for use in the basements and storage rooms. The gasoline had been costing $12 per month, with $2 for the oil lamps in the basements and a night lamp. The first month's energy, February, cost $8.32; March, $6.25; April, $6 In May this firm purchased a power coffee mill, the May bill being only $6. At the present time only three gasoline plants are left and they are less than a year old. The owners are willing to take electricity at the first sign of trouble.

The residence proposition has been very easy as the 24-hour service is of such character as to commend itself to all.

By pushing the 25- and 40-watt lamps a large number are coming in under the $1 minimum charge. This makes the introduction of flatirons and heating appliances very easy. The irons are put out on 30 days' free trial. Nothing but high-grade irons are used and during the past month, 20 irons have been sold. Almost all the wiring has been installed by the manager, who from experience has found that but few people know what they want, and for this reason he has always offered advice as to the proper equipment, and in fact has refused to install work that was not standard. For tungsten lighting in many cases it was necessary to agree to make any desired change if the tungsten service was not satisfactory, hence all tungsten lamps have been installed well out of reach with suitable Holophane ware and independent switches, with the result that the breakage has been very small and service good. Where consumers are timid about trying irons, the outlet is installed free of charge. By actual test the irons put out are more economical than gasoline even at a 11-cent rate. On June 1, 105 meters were in service and 50 applications on file. The aim is to install 300 meters in the two towns and to rent house wiring. The power question has as yet received but little attention. The gasoline machines now in use do not total over 50 hp. A small ½-hp motor is being used to demonstrate coffee mill service. This motor is belted to any old coffee mill that happens to be handy, and after a few days' use the company obtains an order for a direct-connected outfit.

O. H. HUTCHINGS' PAPER

Mr. O. H. Hutchings, superintendent of the Dayton Lighting Company, Dayton, Ohio, gave a paper on the same subject, taking up some of the general principles involved as follows:

Looking at the question from the standpoint of the smaller central station which it is proposed to supply, some, if not all, of the following conditions of operation obtain: (1) Limited hours of operation—no day service; (2) simple, non-condensing prime movers; (3) street lighting operated on the moonlight schedule.

It is very apparent that the actual cost of each unit output of a central station in this class is necessarily high on account of excessive coal consumption per unit output; extremely low "load factor," meaning that the investment is returning revenue a small percentage of the total time. In a general way, the investment in generators, engines, boilers, pumps, piping and buildings necessary to equip a small generating system of this class, compared with its equivalent rating in transforming apparatus, buildings, etc., is approximately in the ratio of 5 to 1. Other important points greatly in favor of purchased energy are: (1) The complete elimination of that portion of labor necessary to operate a generating station; (2) the complete elimination of steam maintenance charges; (3) greatly reduced electrical maintenance charge; (4) the important feature of continuous 24-hour service, permitting taking on what day load may be available without additional expense other than the purchase price of additional units sold.

All of the above items effect a decided reduction in the total running expense of the small central station, and the last item is probably the most important of all. Applying this argument to central stations in cities of 15,000 population, in a general way the demand upon a station would be occasioned by (1) a limited amount of connected industrial power, together with a small demand for daylight lighting, representing the day load; (2) the usual amount of commercial and residence lighting, together with the street lighting, representing the night load.

One would not expect more than one theater in a city of this size, and it giving only an occasional performance during the theatrical season, and there would not be a large amusement park to offer a market for energy during the summer months. The object in itemizing the various classes of service as above is to show the very slight opportunity offered for a diversified load. As it is now generally conceded that the "diversity factor" is a very potent element necessarily considered in determining the true load factor of individual apparatus, or station equipment, it is very evident that the result must be high fixed charges per unit output where diversification of service is lacking.

Unfortunately many smaller central stations are so located that they cannot attain a total production cost sufficiently low to enable them to compete successfully with private power plants; on the other hand, they do not feel justified in increasing their investment to the amount necessary to correct their general condition. Such stations should welcome the first opportunity of purchasing electric service.

A central station designed to supply the service outlined in this paper should be as nearly perfect mechanically and electrically as engineering skill and capital make possible. It must be so arranged that an interruption of the supply of its output is next to impossible. The transmission lines for delivering its output must be designed for absolute continuity of service under all conditions. The transmission voltage may be from 6600 to 60,000 volts (higher, if necessary), depending upon the load and the length of each transmission line; about 1000 volts per mile is considered good engineering practice. In passing through thickly settled rural districts, by installing a lowering transformer at a central, convenient point, it would be possible to supply these districts with, say, 2300 volts, to be further lowered to a normal voltage of secondary distribution at the points of usage.

The location of a generating station whose output is to supply surrounding territory must be very carefully considered. In a general way the location should be near the electrical rather than the geographical center of the territory to be supplied, and preferably near a large manufacturing center where a ready market can be secured for a good portion of its output. This will greatly assist in bringing about that very desirable and important point previously mentioned, "diversification of service," on account of the great variety of business that is obtainable in any large city. For illustration, the following are cited: An endless variety of industrial power; local street railway system; operating city waterworks electrically; charging electric automobiles, both pleasure vehicles and heavy haulage trucks; municipal lighting; special boulevard lighting; several theaters operating nightly; summer amusement parks; sign, outline and decorative lighting; interurban railways.

The above do not represent an ideal condition, impossible to realize; on the contrary, such business is being developed every day by progressive and aggressive organizations. A central station enjoying the diversity factor made possible by the above outlined demand for its output, is in position to produce its output at such a cost that, plus the transmission costs, it can supply all the surrounding territory within a reasonable radius (that is now being supplied from several smaller central stations) on a basis that will remove all doubt from the minds of the managers of the small central stations regarding the advisability of availing themselves of the opportunity of purchasing, rather than generating, their electric energy. As time goes on it will be more and more the best plan for the smaller central stations to purchase their energy from the larger companies within proper distance to supply it economically; and plans for future improvements and enlargements in any central station should be considered with this end in view. It is the spirit of the times to centralize and combine in many lines of effort, and why should it not be equally as good and economical for central stations?

Discussion.

Mr. D. L. Gaskill, of Greenville, president of the company which sells energy to the Bradford & Gettysburg line, told how, when he had been approached to sell electricity to such an enterprise, he had at first been unfavorable to the idea. At last, however, he had been prevailed upon, and now thought the plan an excellent one. His company sells energy at 3.5 cents per kw-hour, measured at the Greenville city limits, before the step-up transformation. Service was begun last December.

Mr. Smith in discussion gave some further points of interest. The first electric light plant at Bradford was built in 1893 to operate with gasoline engines. This was a failure and the

plant was later steam driven. A little later it was abandoned and was idle for seven years. Its history was one of repeated failures with trying to maintain a separate generating plant. Mr. Smith said that he is now constructing a line and distributing system to supply Liberty, Ind., from Richmond, Ind. He gets $48 per year each for 75-watt tungsten lamps lighted all night every night. All consumers are on meters. The average rate for energy is 13 cents per kw-hour. Distribution losses are low because there is only one step-down transformation from 6600 to 220 volts. In Bradford there are three step-down transformers located at secondary centers of distribution. Two of these transformers are cut out by switches placed on the poles and operated by ropes when the load is light, thus keeping down the core loss. The Bradford & Gettysburg Electric Light & Power Company is bonded for $25,000. The present maximum load is about 25 kw. The system is capable of supplying a load of 60 kw.

Mr. F. M. Tait, of Dayton, expressed the opinion that the lighting plants of the small towns would be forced to district supply ultimately because they cannot continue with operating expenses 105 per cent of the gross receipts. Mr. W. C. Anderson, of Canton, told of a 5500-volt transmission line which his company had been operating to a neighboring town for six years. On this line a step-down transformation from 5500 to 230 and 115 volts is made in the town. Mr. Smith said that on the Richmond-Liberty line now building a step-down transformation will be made from 13000 to 110 and 220 volts.

The question came up as to the feasibility of taking electricity for lighting small towns from high-tension transmission lines of electric railway companies and the best method of voltage regulation in such cases. One member reported taking energy off of a 33,000-volt traction line. Mr. Culver suggested that where there is a load of 100 kw or more to be taken from such a transmission line it would pay to put automatic voltage regulators on the station generators. The difficulty of this plan is that the compounding of the regulator may be right to produce a steady voltage with a certain load at a certain point, but if the lighting load is taken from more than one point on the transmission line the compounding cannot be right for all of them. He also spoke of using induction regulators for regulating the voltage of local lighting lines.

Mr. J. R. Cravath called attention to another plan, which is rather an expensive one, but nevertheless very effective; namely, that of using a synchronous motor-generator at the substation from which it is desired to obtain lighting service and placing an automatic voltage regulator on the generator of the set.

Mr. Claude Smith said that the Bradford & Gettysburg line, 12 miles in length, cost $800 per mile, including 60 kw in step-up and step-down transformers. He advised companies to build on private right-of-way as much as possible. The private right-of-way of his company was along the fence line. As to supplying farmers along the line, he has a 1-kw transformer for this purpose on the high-tension line. In this case the farmer builds the necessary pole lines and pays 50 cents per month transformer loss.

INTERIOR WIRING AND ILLUMINATION

Tungsten Arch Lighting at Grand Rapids.

Burton Heights, a suburb of Grand Rapids, has adopted the scheme used on the principal downtown streets of that city for special lighting of its business street. This plan, it will be remembered, consists in hanging tungsten lamps from a span wire in such a way as to give an appearance of an arch at night. The number of lamps can be varied to suit the requirements of the street. The spans are usually about 110 ft. apart. Use is made of series lamps connected across a 220-volt constant-potential circuit.

Suggestions on Home Illumination.

Mr. H. J. Gille, contract agent of the Minneapolis General Electric Company, has recently caused to be issued a 22-page pamphlet, 6 in. x 9 in. in size, entitled "Home Illumination; A Few Suggestions by the Commercial Department, Minneapolis General Electric Company." The first two pages are given to general suggestions as to the advantages of electric light, and especially the tungsten lamp. The pamphlet then takes up in detail plans for the lighting of a six-room house, showing the location of the outlets for lamps, switches and baseboard receptacles. The first and second-floor plans of such a house are shown with the outlets marked thereon. A paragraph of text is given to each room. No definite suggestions are made as to lamps, glassware or fixtures, the idea being mainly to suggest typical outlet and switch arrangements which are most desirable.

The lighting arrangements for typical seven-room and eight-room houses are also treated in the same way. The wiring plans are followed by the company's rates for electric service; selling prices of incandescent electric lamps; an explanation of measurement of electricity; a suggestion as to fixtures and glassware; a directory of electrical contractors, electric fixture dealers, electric elevator dealers and electric sign manufacturers in the city. The pamphlet puts good, standard, sensible suggestions in concrete form for use in such shape as to be of material assistance in planning the wiring of the great majority of houses.

Tests of Flaming-Arc Lamps.

Referring to the test of various lamps for street lighting by the South Park Commissioners of Chicago, as mentioned in



FIG. 1.—TESTS OF FLAMING-ARC LAMPS.

the *Electrical World* of July 29, page 241, Mr. H. Caird, manager of the engineering department of the Excello Arc Lamp



FIG. 2.—TESTS OF FLAMING ARC LAMPS.

Company, in Chicago, furnishes some information about the series flame arc lamps under test. The installation comprises 11 lamps, spaced 100 ft. apart and suspended 25 ft. from the ground. Prismatic inner globes are used, giving a maximum

distribution at 30 deg. from the horizontal. The following figures were submitted to the commissioners by the lamp company to show the relative cost of the cp-year for various illuminants in use. Taking an arbitrary figure of 1 cent a kw-hour for electrical energy, and simply including energy cost and cost of electrodes, the proposition is figured on a basis of equal illumination, as the various lamps now in use vary in candle-power. Summarized, the calculations furnished by Mr. Caird are as follows:

1. 2000-cp. direct-current, 9.61-amp, series flame arc lamp.—Watts (9.6 amp × 47 volts), 451; kw-hours per year (451 × 3.9), 1759; cost of energy, $17.59; cost of electrodes, $37.43; total cost per lamp per year, $57.02; cost per candle-power per year, 2.75 cents.

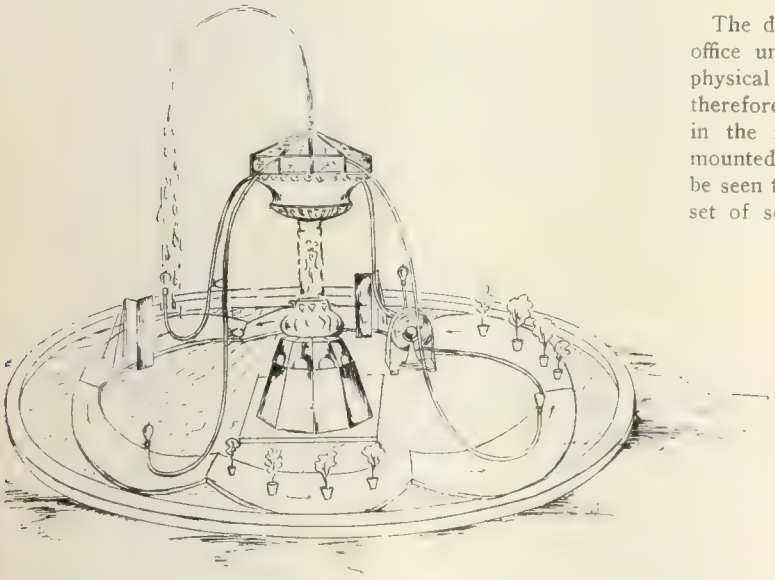
2. 600-cp, direct-current, series open arc lamp.—Watts (9.6 amp × 55 volts), 528; kw-hours per year (528 × 3.9), 2059; cost of energy, $20.59; cost of electrodes, $4.74; total cost, $25.33; cost per candle-power per year, 4.22 cents.

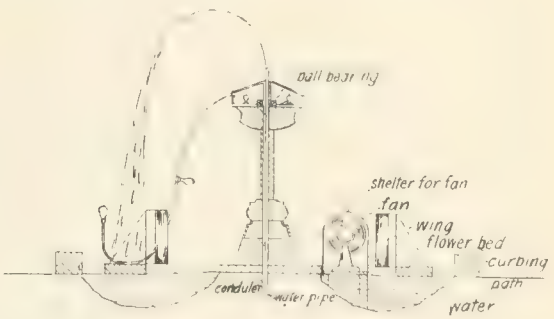
3. 300-cp, alternating-current, series enclosed arc lamp.—Volt-amperes (7.5 amp × 78 volts), 585, or 497 watts at 85 per cent power factor; kw-hours per year (497 × 3.9), 1938; cost of energy, $19.38; cost of electrodes, 86 cents; total cost, $20.24; cost per candle-power per year, 6.75 cents.

4. 1400-cp, alternating-current, series flame arc lamp.—Volt-amperes (7.5 amp × 45 volts), 337.5, or 287 watts at 85 per cent power factor; kw-hours per year (287 × 3.9), 1119; cost of energy, $11.19; cost of electrodes, $33.84; total cost, $45.03; cost per candle-power per year, 3.22 cents.

Floating Garden in a Denver Park.

Fig. 1 is a photograph of a floating garden located in one of the pools at Elitche's Gardens, Denver, Col. The garden





FIGS. 2 AND 3.—DETAILS OF FLOATING GARDEN.

revolves around a central pillar, and is supplied with electric light. The inner construction is shown by Figs. 2 and 3. Power for revolving the foundation is furnished by an 18-in. desk fan, which is placed between the revolving part and the central post or pedestal. At equal intervals on the floating scalloped-shaped flower bed are placed eight wings, which catch the wind from the fan as they pass and cause the bed to revolve. The dome-shaped piece at the top of the post is made of art glass. The long arms leading from the dome to the flower bed are iron conduit terminating in conduits and wired for two lamps. These arms also guide the floating revolving flower bed and keep it in its regular course. The floating part is completely covered with beautiful plants which conceal the boards. The fan is sheltered with a covering of sheet iron. The center post or pedestal is made of cement and iron, and the water pipe and conduit pass through the center of the post. The ball bearing is shown at the base of the dome which carries the weight of the conduit arms. The dome is the only part of the post that revolves. Mr. C. N. Stannard, secretary



FIG. 1.—FLOATING GARDEN.

of the Denver Gas & Electric Company, through whose courtesy we are able to publish this description, says that this is but one of the many electric novelties to be seen at these gardens.

New Telephone Patents.

DIVIDED-MULTIPLE SYSTEM.

The divided-multiple switchboard is used where the central-office unit is so large that the multiple reach is beyond the physical capabilities of the average operator. The multiple is, therefore, divided into enough parts to bring each section within the required space limits and each of these sections is mounted in an individual set of switchboard sections. It will be seen that each subscriber's line must have a signal upon each set of sections and the subscriber must also select his signal for any call upon those sections whose multiple contains the desired number. It is with this feature that the circuits described in a patent granted to Mr. W. Aitken, of Muswell Hill, England, are concerned. He arranges for three sets of sections, and by means of two keys at the substation and two line relays at the office, he controls his three-line signals. One responds to each key and the third responds to the simultaneous operation of the two keys and relays.

SELECTIVE SIGNALING.

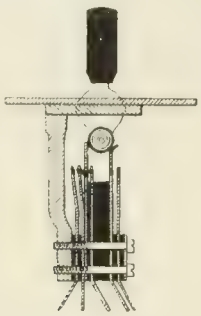
When the harmonic system of selective signaling is attempted in connection with a magnetic exchange, if the ordinary hand magnet be used there arises a difficulty from cross-ringing—that is, as the speed of driving of the hand generator is indefinite it may send out currents of any periodicity. To obviate this Mr. R. H. Manson has invented a hand generator which is

normally an open circuit and is connected to line but an instant during each revolution of the armature. The resulting momentary impulses will not ring the bells. Mr. Manson has assigned his patent to the Dean Electric Company.

Mr. H. G. Guyle, of Sargent, Neb., is the inventor of a lock-out system in which the controlling mechanism is driven by weights. The establishment of a connection between two stations to the exclusion of all other stations is accompanied by the simultaneous release of what are known as "time wheels" at all the other stations. Until these complete one revolution the use of the line is exclusive. Thereafter any station can interrupt. The weights of the clockwork are so arranged that if allowed to run down they cut the station off the line until properly rewound.

IMPROVED APPARATUS.

Below is shown a key, the invention of R. H. Manson, whose patent is assigned to the Dean Electric Company. It will be seen that in this key the left-hand sets of springs are not all contact-making, those bearing on the key-lever roller



MANSON'S KEY.

being actuating springs only. It will thus be seen that to effect the key contacts a considerable movement must be given the actuating spring. The key adjustment is thus given much wider limits, and the key lever is never in a free position.

Another patent assigned to the Dean company is one granted to Mr. W. W. Dean for a pressed-metal transmitter mouthpiece. The contour is standard, except that the walls are of uniform thickness. The mouthpiece is worked up from a single piece of steel, the usual perforated partition being at the end of the threaded extension.

Mr. G. Angelini, of Rome, Italy, has patented a transmitter in which all walls of the microphone button except the actual operating surfaces of the electrodes are protected from the granular carbon by felt or fibrous linings. It is claimed this overcomes the jacking tendency.

An antiseptic device forms the subject of a patent granted to Eliza C. Smith, of Washington, D. C. A metal holder is attached to the transmitter mouthpiece and paper protecting cones may be inserted in the mouthpiece supported by the ring of the holder. The cones come folded, the points being cut off and a tissue diaphragm attached in a manner to close the small end of the cone.

AUTOMATIC EXCHANGES.

A sender for an automatic system has been patented by Mr. F. G. Agrell, of Stockholm, Sweden, which is especially adapted to operate in conjunction with automatic apparatus of his own design. The desired number is set up on a number board by individual digits, and then in connection with the rising of the hook switch the selection is sent in.

Mr. M. Baumer, of Nuremberg, Germany, has patented an automatic sub-exchange system. A number of neighboring subscribers are connected to the sub-exchange, trunk lines connecting this to the central office. Calls are then relayed to and from them automatically.

TRANSMITTER.

Mr. C. Adams-Randall, of New York City, has patented a transmitter especially adapted for carrying currents of much greater magnitude and voltage than those to which a transmitter is usually subjected. His invention consists in using a large section granular button under considerable pressure, so as to do away with any chance of arcing or "frying."

Letter to the Editors.

Self-Induction.

To the Editors of Electrical World:

Sirs:—That self-induction is a subject of certainly no less interest to the electrical engineer than, for instance, the question, "Looping Versus Cutting Theories of Electromagnetic Induction," need not be discussed. It seems, however, that the main point to which I wish to draw attention as being of particular interest to the electrical engineer has not been sufficiently emphasized by me, for it is entirely left out of consideration in your remarks following my letter on page 1599 of your issue for June 24.

The explanation of the inertia of ponderable matter which you bring into the debate may be misunderstood as a contradiction of what I said, while, on the contrary, it fully corroborates it. The electronic theory is not based on "the inertia of moving charges," as is often believed; it does *not* explain electromagnetic phenomena by *means of inertia.* Besides the electrostatic field, it is the electromagnetic field, due to moving charges devoid of inertia, which forms the essence of the theory. The electromagnetic field depends upon the path of the electric current, be it a conduction or a convection current. Inertia depends only upon the speed of every material part of given mass. All experimental investigations of electronic effects have shown that the total result is fully accounted for by means of the magnetic field due to the electrons; there is no part left that can be attributed to inertia of the electrons. Therefore, the electrons must be devoid of inertia. Nevertheless, there is some resemblance to inertia, and this led to the idea (as yet only a plausible supposition) that the inertia of ponderable matter may also be attributable to the magnetic field due to electrons. Should this prove to be true, then the original aim of electric theories will be reversed; electromagnetic phenomena will not be reduced to mechanical causes and means, but mechanics will be explained by means of the magnetic field due to electrons.[1]

Going back to my subject—self-induction—it is seen that the aforesaid perfectly corroborates my explanations, namely, that self-induction consists only in an effect of the magnetic field due to the electric current, but has nothing to do with inertia of electricity. This is certainly of much practical importance to the electrical engineer, for, this point being settled, it is immediately obvious that to avoid the detrimental effect of self-induction (sparks, for instance) one should annul the magnetic field; the self-induction, being due to the magnetic field, is then at the same time annulled, too. The common supposition is, however, that a magnetic field is necessary to counteract the effect of self-induction, while the self-induction remains. If this idea were correct then the additional magnetic field would necessitate an increase in expenditure of electrical energy to maintain it, especially on account of the increase of magnetic saturation. This led to the opinion that the means to counteract the effects of self-induction—compensating windings and commutating poles—would be uneconomical additions to the dynamo, only to be used where they are absolutely necessary to avoid difficulties in commutation. If, however, the matter be considered in connection with the true nature of self-induction, as explained above, it is seen that a compensated machine can be more economical than a common dynamo, as in the former useless or, rather, detrimental magnetic saturation is avoided. I think that this is a result of practical importance. It is also important from the point of view of the manufacturer, for a machine which is more economical in the production of the current will heat less and therefore may give a larger output than a common dynamo; or for the same output the machine may be smaller in size and weight and therefore cheaper to make. If such a result has not yet been obtained

[1] "Ergebnisse und Probleme der Elektronentheorie," a lecture delivered by Prof. H. A. Lorentz, of Leyden, before the Electrotechnical Society in Berlin

generally it is, nevertheless, important to know that it is possible, the problem being only to find the proper arrangements.

Sir Oliver Lodge has said: "Self-induction is not a property of the circuit." This contradiction is quite right. But he added: "It is a property of the current," and this taken alone must be contradicted, too, for self-induction is not a property of either the circuit or the current, it is rather a property of both the circuit and the current, as these together determine the magnetic field, which gives the e.m.f. of self-induction.

SCHEVENINGEN, HOLLAND. C. L. R. E. MENGES.

[The explanations given by our correspondent concerning the physical relations existing between the electromagnetic induction around a circuit carrying a current and the seeming inertia of the moving electric charges constituting the current, are evidently correct. Moreover, it is unnecessary to assign to electric charges any "inertia," because the seeming attempt of the current in an inductive circuit to prevent any change in its value is explainable with reference to well-known electromagnetic phenomena, and the change in the value of the current affects the number of charges moving so that the familiar relations existing in material inertia are not directly attributable to electricity in motion. However, it is sometimes convenient to refer to the "inertia of electric current," as is done by Sir Oliver Lodge in his recent book, "The Ether of Space," where he states that self-induction is electrical inertia. Concerning our correspondent's statement as to the supposition relating to the necessity of a magnetic field for counteracting the effect of self-induction, it seems well to call attention to the fact that convenience frequently dictates the treatment of the fictitious components of a quantity as realities, even when they are in opposition and so neutralize each other that the quantity itself disappears. Thus the mere fact that two equal opposing fluxes produce zero flux as a resultant does not render inaccurate the assumption that both fluxes exist simultaneously, provided the full effect of each flux is properly considered; in many cases the magnetomotive force by which each component flux may be assumed to be produced is a reality and must be treated as such.—EDS.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Speed Control of Induction Motors.—H. C. SPECHT.—An illustrated article on speed control of induction motors by cascade connection. The author discusses the connection of motors in direct concatenation and in differential concatenation. The diagram, Fig. 1, shows the connections of a cascade set in

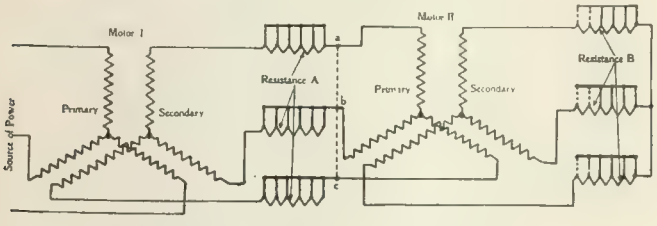


FIG. 1.—DIAGRAM OF CONNECTIONS

which two speeds can be obtained in a very simple manner without opening any of the main circuits. The full lines represent the connections when the motors are operating at low speed—that is, in direct concatenation, with some resistance in the secondary circuit of motor II. When the motor set is to be run at a higher speed the resistor at *B* will be short-circuited; the short-circuiting connections on resistor *A* will be opened step by step; the points *a*, *b* and *c* will be short-circuited, and finally resistor *A* will be short-circuited to the point giving the desired speed. The change from high speed to the low speed is accomplished by reversing the above operation. It is obvious that with this method of control the changing from one speed to another can be done in a very smooth and safe way without opening any of the main circuits. It is possible to obtain a greater number of speeds without adding greatly to the complication of the connections and still keep the main circuits closed throughout. The author finally discusses the torque of all cascade sets, both initial and running.—*Elec. Jour.*, July.

Direct-Current Turbo-Generators.—E. ZIEHL.—A continuation of his long illustrated paper. The author continues the comparison between the completely compensated machine and the interpole machine. He discusses the distortion of the field in the latter. He thinks the completely compensated machine is the superior type, from which further progress in the design of turbo-dynamos must be expected. He then discusses details of the design of armatures, and especially commutators.—*Elek. Zeit.*, July 29.

Direct-Current Generator.—A note on a recent British patent of A. H. Midgley and C. A. Vanderwell (21,936, 1908; July 15, 1909). With the object of reducing weight of the field system, these machines are provided with a second annular-ring armature upon a suitable frame carried by the inner armature shaft, and a single field system, occupying the space between the two armatures.—Lond. *Elec. Eng'ing*, July 22.

Lamps and Lighting.

Different Colors and Visual Acuity.—J. S. DOW.—The conclusion of his paper on the effect of light of different colors on visual acuity. It seems that the blue-green end of the spectrum is somewhat advantageous for very close work, but not so good as red light for the illumination of objects or patterns to be distinguished at a distance. The author thinks that possibly it might be found of advantage to illuminate distant objects —clocks, etc.—with red light, which would also serve the purpose of distinguishing them from surrounding objects and tend to attract attention.—*Illuminating Eng.*, August.

Tungsten Lamp.—A note on a recent British patent of the British Thomson-Houston Company and H. H. Needham (23,726, 1908; July 22, 1909). The filaments are made by a squirting process from powdered tungsten, with a special binding material composed of an amalgam of cadmium, bismuth and mercury in certain proportions, which produce very fine filaments suitable for high-voltage lamps.—Lond. *Elec. Eng'ing*, July 29.

Incandescent Lamp.—G. LEONARD.—The first part of an illustrated German translation of his recent French paper on carbon lamps and metallic-filament lamps. The original paper has already been abstracted in the Digest.—*Zeit. f. Beleucht.*, July 10.

Cut-Outs for Arc Lamps.—P. S. BAILEY.—An illustrated description of automatic series and multiple cut-outs for arc lamps.—*Gen. Elec. Review*, August.

Generation, Transmission and Distribution.

Steam Condensers.—F. HODGKINSON.—The first part of an illustrated article in which the author discusses the different types of condensers and points out the particular applications of each. In an editorial summary of this article by R. A. Smart it is said that, all things considered, the centrifugal jet condenser has, for the average installation, the greatest number of points in its favor. The long exhaust pipe which not infrequently is a necessity with the barometric condenser has disadvantages which must be reckoned with, but which may be guarded against in laying out the plant. The barometric type has the advantage that the circulating pump handles the cooling water on its way to the condenser, and before it is heated by the condensed steam, which is an important factor in reducing the inevitable wear and corrosion of the circulating pump, which in the other case handles hot water, particularly if the pump is of the centrifugal type.—*Elec. Jour.*, July.

Electric Winding in Mines.—H. ARRAGON.—An article illustrated with diagrams describing the difficulties of electric wind-

ing in mines and methods of their solution, and comparing electric and steam winding in favor of the electric system.—*L'Industrie Elec.*, July 25.

Electric Dredging.—S. Orling.—In a continuation of his article on the Jhelum power installation, electric dredging on the Jhelum River, in Kashmir, is described. The dipper range Himalaya is the only range in the world to be electrically operated. It is supplied with energy from two floating substations. Energy is transmitted to induction motors on the dredge at 2300 volts through a three-conductor armored cable, 600 ft. long, supported on rectangular wooden pontoons spaced 18 ft. apart and fastened between the spans by planks placed on swivels.—*Gen. Elec. Review*, August.

Centrifugal Air Compressors.—S. A. Moss.—An illustrated article on the development of centrifugal air compressors and the uses of compressed air. The author discusses the centrifugal compressor characteristics, the measurement of air quantity, and the use of multiple-stage compressors.—*Gen. Elec. Review*, August.

Traction.

Feeders for Railways.—P. Dawson.—A continuation of his long illustrated serial on electric traction on railways. In the new section, which begins in this issue, the author discusses the arrangement and design of the transmission and distribution system. The most economical cross-section of cables, the heating of conductors and voltage drop are considered, as well as the employment of aluminum, both for overhead and underground lines. In conclusion, the use and action of booster transformers are described. The best broad rules to remember about the comparison of aluminum and copper conductors are: for equal volumes aluminum is one-third the weight of copper; for equal conductivity aluminum is half the weight of copper. The use and action of booster transformers are as follows: At various points in the track of a single-phase system are provided substations into which all the high-tension (outgoing) conductors are led. Thus the whole energy taken by the system beyond this point is brought into the substation. The energy is then passed through the primary of a transformer, the secondary of which is connected on one side to the track and on the other to an insulated return cable. The connections are shown

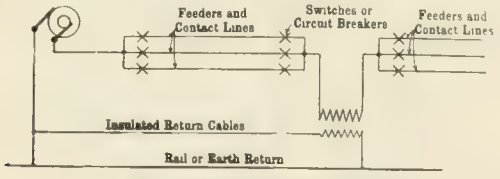


FIG. 2.—FEEDERS FOR RAILWAYS.

in Fig. 2. If the transformer is of one to one ratio, the only difference between the primary and the secondary currents will be the small current supplied from the primary side for magnetizing the booster transformer. Neglecting this, the entire current fed to points beyond the substation will be returned to the power station through the insulated return cable. Another arrangement, due to W. M. Mordey, consists in feeding energy

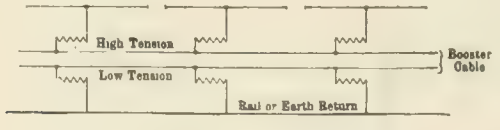


FIG. 3.—FEEDERS FOR RAILWAYS.

to each section separately from a single point, as shown in Fig. 3. In this arrangement, by making the sections equal, each transformer has the same loading. Against this advantage, however, is the fact that the trolley is not used as an auxiliary to the feeding cable, and the capital cost of the installation may thus be greatly increased.—Lond. *Electrician*, July 23.

Single-Phase Traction.—R. M. Deely.—Notes on the results obtained with single-phase working on the Heysham-Morecambe branch of the Midland Railway, in England, during the last 15 months. Figures on test runs are given, the energy consumption per ton-mile being 99.3 watt-hours. The conditions are not typical, however, of suburban service, but figures are given showing that 83.83 watt-hours per ton-mile might be expected under these conditions if the gear ratios and wheel dimensions were altered. The opinion is expressed that the results, if only from the energy point of view, is favorable to single-phase as compared with direct current. As to weight, the single-phase equipment is about one-third heavier than the corresponding direct-current equipment, but when the whole train is taken into consideration the additional weight amounts to only about 7½ per cent. This difference would be considerably reduced if the rolling stock were made for through running.—Lond. *Electrician*, July 30.

Surface-Contact System.—An illustrated article on a recent demonstration of the Suchostawer surface-contact system on an experimental track in London. In this system the switches in the studs are held off by a heavy iron plunger, which is lifted by the car magnet. No springs are used, a long break is secured, and there is no continuous conduit to require ventilation.—Lond. *Elec. Eng'ing*, July 22.

Installations, Systems and Appliances.

British Central-Station Account.—The report and accounts of the Poplar Electricity Works record increased load in all departments except public lighting, where there has been a slight decrease due to the introduction of metallic-filament lamps. The costs per kw-hour sold have also decreased, and are now 2.84 cents per unit or, without capital charges, 1.598 cent.—Lond. *Elec. Eng'ing*, July 22.

Rheostat Control.—A. E. Button.—The first part of an illustrated serial on the fundamental principle of rheostat control. The author deals with starting rheostats for direct-current and alternating-current motors.—*Gen. Elec. Review*, August.

Wires, Wiring and Conduits.

Underground Cables.—De Marchena.—The conclusion of his long Marseilles congress paper. The author discusses the limitations in the use of underground cables and gives a comparison of the cost of underground cables and overhead wires.—*La Houille Blanche*, July.

Aluminum-Copper Cables.—A note on a recent British patent of C. J. Beaver and E. A. Claremont (20,447, 1908; July 22, 1909). They propose the construction of cables with conductors composed partly of copper strands and partly of aluminum strands. The aluminum strands are placed outside in cases where the insulating material is india rubber, as it is found that aluminum has less deteriorating action on india rubber than has copper.—Lond. *Elec. Eng'ing*, July 29.

Transmission-Line Constants.—D. B. Rushmore and M. W. Franklin.—A second set of tables of transmission-line constants, giving the charging current, single-phase, for 25 cycles, 60 cycles and 100 cycles; the inductive reactance, three-phase, for solid conductors for 25 cycles, 60 cycles and 100 cycles.—*Gen. Elec. Review*, August.

Electrophysics and Magnetism.

Electronic Theory of Metals.—E. Riecke.—A paper read before the German Bunsen Society on "the present conceptions of the nature of the metallic state" from the viewpoint of the electronic theory. The author reviews both the accomplishments and the shortcomings of the electronic theory. The different values, obtained by different methods, for the densities of free electrons agree very well together. The same is true for the values found for the diameters of metallic atoms. An interesting result is the periodic character of electronic density and of atomic diameter. These positive results are encouraging, but there are still many discrepancies in the theory.—*Phys. Zeit.*, Aug. 1.

Electrochemistry and Batteries.

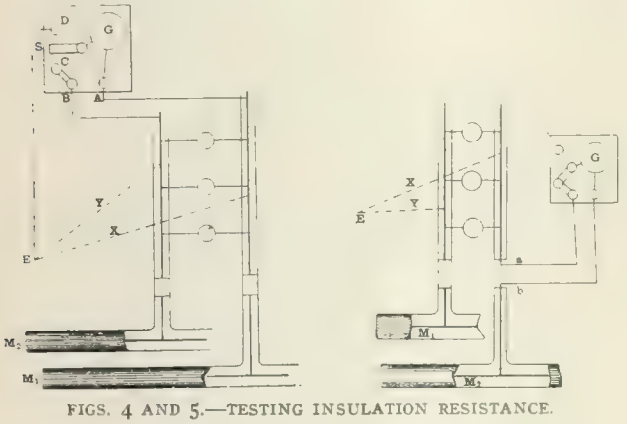
German Bunsen Society.—A review of the proceedings of the last annual convention. Papers by E. Riecke on the electronic theory of metals and by G. Tammann on the constitution of metallic alloys are printed in full. Other papers are reported in abstract. M. Le Blanc recommended the use of nickel wire instead of platinum wire as resistor material in electric laboratory furnaces for temperatures below 1000 deg. C. E. Cohen

described apparatus for making chemical and electrochemical tests at pressures up to 1000 atmospheres, especially for the study of the effect of a change of pressure on the e.m.f. of cells and on the solubility of salts in water. R. Amberg reported on a modification of carborundum, the so-called silundum, which has already been described in this paper; it is used chiefly for electric heating apparatus. M. Seddig described a new bolometer.—*Phys. Zeit.*, Aug. 1.

Electric Steel Furnaces.—W. RODENHAUSER.—A fully illustrated paper on electric steel furnaces, with special reference to the Roechling-Rodenhauser furnace, which is a combined inductive and electrode furnace.—*Metallurgie*, July 22.

Units, Measurements and Instruments.

Testing Insulation Resistance.—R. G. ALLEN.—A paper read before the Dublin Section of the (British) Inst. Elec. Eng. on testing the insulation resistance of live cables on direct-current systems by the Kelvin testing set. The circuit shown in Fig. 4



FIGS. 4 AND 5.—TESTING INSULATION RESISTANCE.

is supposed to be one of the sections fed from the main cables M_1 and M_2. A and B are the ends of the connections from the cables to the two terminals of the testing set ordinarily used for the battery. The terminal D is earthed. The insulation resistances X and Y of the cables are represented by the dotted lines. The test is conducted thus: With G suitably shunted, place S on C and read the deflection. Multiply the latter by the shunt value used and then call this number D_1. Repeat a like operation with S on D and so obtain D_2. Leaving S on D, interchange the positions of the ends A and B, and find D_3 in the same way as the other two values. Then the insulation resistances are given by

$$X^1 = \frac{D_1 - (D_2 + D_3)}{D_3} G \text{ and } Y^1 = \frac{D_1 - (D_2 + D_3)}{D_2} G,$$

where

$$X^1 = \frac{Xx}{X + x} \text{ and } Y^1 = \frac{Yy}{Y + y},$$

x being the insulation resistance of cable M_1 and all the right-hand cables of the other live sections attached to it; y being the similar value for M_2; and y will be found by the method just described after first cutting out the section shown in the diagram, and joining A and B to two connections, one on each of the cables M_1 and M_2. To determine the insulation resistance between the cables, first switch off all the lamps in the section and connect as shown in Fig. 5. The galvanometer G will now act as a sensitive ammeter—reading, if necessary, to a value as low as 1/600 milliampere. X and Y are supposed to have been determined by the previous method. Let S represent $X + Y$, and Z be the insulation resistance between the cables to be determined. Then, if D is the deflection of G suitably shunted,

$$\frac{E}{G + \frac{ZS}{Z + S}} = kD,$$

E being the potential difference between the mains measured by a voltmeter. Now remove the ends a and b and connect them to a few storage cells of voltage E_0. Then, leaving the same shunt on G as before, read the deflection D_0 and $\frac{E_0}{G} = kD_0$.

From these two equations and the values found for X and Y the value of Z can be easily found. The application of the method on two-core cables, concentric cables and for determining the insulation resistance between two conductors of a three-wire system is described.—Lond. *Electrician*, July 16.

Unreliability of the Flicker Photometer.—L. W. WILD.—A note on the photometry of differently colored lights. The author has made comparative tests of tungsten lamps and carbon lamps by means of three flicker photometers and three other photometers. The tests were made by comparing the light from a tungsten-filament lamp taking 1.5 watts per candle against that of a carbon-filament lamp taking about 4.5 watts per candle. The following table gives the maximum, minimum and mean scale readings obtained with all six photometer heads:

	Flickers.			Contrast.	Equality.	
	Wild.	Whitman.	Simmance.	Bunsen.	Prism.	Lummer.
Max. read.....	1.73	1.735	1.735	1.80	2.05	2.00
Min. read.....	1.72	1.715	1.71	1.79	1.72	1.70
Mean read.....	1.725	1.725	1.72	1.825	1.85	1.83

"All three flickers give almost the same mean reading, although they differ as to sensitiveness. The Bunsen, Prism and Lummer heads again agree together exceedingly closely on their mean readings, but the reading is no less than 6 per cent greater than that obtained with the flickers. It would appear from these tests that in spite of the greater sensitiveness of the flicker photometer, it will have to be discarded in favor of the Bunsen disk." . . . "The conclusion from these tests is that for testing tungsten lamps against carbon lamps a flicker head must not be used. Equality-of-brightness photometers, on the other hand, fail on the score of insensitiveness, and contrast photometers of the Bunsen type alone fulfil the required conditions, though it is a pity that the sensitiveness of the flicker type cannot be equaled."—Lond. *Electrician*, July 16.

Measurement of High Inductions and Properties of Iron-Silicon Alloys.—E. GUMLICH.—An abstracted Bunsen Society paper in which the author describes a modification of Ewing's isthmus method, as used in the Reichsanstalt for tests of iron and alloys at high induction. A series of samples of iron-silicon alloys with varying content of silicon (up to 8.3 per cent) were tested; the magnetic saturation values decrease up to about 5 per cent Si in direct proportion to the silicon content; the author concludes that the beneficial effect of silicon on the magnetic properties of iron must be indirect. The specific electric resistance increases up to 5 per cent Si, proportionally to the silicon content, while the temperature coefficient of the resistivity decreases regularly according to a hyperbolic formula. The effect of the carbon content is still to be investigated.—*Phys. Zeit.*, Aug. 1.

Ampere-Hour Standards.—H. S. HATFIELD.—An abstract of a Bunsen Society paper on practical amp-hour standards. In spite of the great practical importance of measuring amp-hours, there do not yet exist standards which could be compared to the manganin resistor or to the standard cell with respect to constancy and ease of calibration. The usual voltameters, like the silver voltameter, have many disadvantages; their application is restricted, since they cannot be calibrated by government bureaus. Mechanical meters are too inaccurate and too complicated and variable for scientific purposes. The author thinks that voltameters, completely enclosed in glass and operating on the principle of electrolytic action, would be suitable practical standards, the volume of the evolved gases being read off directly. The accuracy which can be obtained is not very high—about 0.1 per cent to 0.2 per cent. The author described the new mercury voltameter of Schott & Company, a hydrogen voltameter of Hookham & Holden, and a new bromine voltameter. The mercury voltameter has a sensitiveness of 0.01 amp-hour per millimeter of scale, the bromine voltameter a sensitiveness of 0.00015 amp-hour per millimeter of scale.—*Phys. Zeit.*, Aug. 1.

Meter and Relay Connections.—H. W. BROWN.—The conclusion of his long illustrated serial on meter and relay connections. In this installment the author discusses relays adopted to special uses, and especially protection against short-circuits and grounds, also protection against both overload and short-circuit.—*Elec. Journal*, July

Circuit-Breakers.—An illustrated description of a new time-limit device for circuit-breakers. It consists essentially of a partially toothed quadrant-gearing, with an escapement. The escapement allows the quadrant to move only at a certain speed until it becomes disengaged and releases the breaker, or until the load becomes normal again. The time element is practically constant for any pull. The device is calibrated for four time lags—namely, 3, 5, 10 and 15 seconds.—Lond. *Elec. Eng'ing* July 15.

Pyrometers.—G. K. Burgess.—An account of an investigation carried out at the Bureau of Standards on the estimation of the temperature of the surfaces of molten copper by means of optical pyrometers or radiation pyrometers.—*Electrochem. and Met. Industry,* August.

Telegraphy and Telephony.

Telephone Cables.—B. S. Cohen.—A paper on the most economical combination of capacity and inductance in underground telephone cables. The author criticises severely some results recently obtained by Devaux-Charbonnel, and especially his opinion that if the thickness of the dielectric in an underground paper cable is doubled, thus decreasing the capacity and increasing the inductance, the results would be superior to those obtained by increasing the inductance by means of Pupin coils. The present author concludes that Charbonnel's assumptions as to the increased transmission value of low-capacity cable cannot be upheld. The reduction of cable capacity is also an extremely costly matter, by reason of the increase in diameter of cable per unit number of wires, which not only increases the cost of the cable itself, but also of the duct into which the cable is drawn.—Lond. *Electrician,* July 23.

Telephony.—Devaux-Charbonnel.—A continuation of his long serial. The author discusses some cases of particular practical interest. In an overhead telephone system in a city efficiency of sound transmission depends not so much on the line as on the apparatus. In underground systems this is true only for distances less than 3 km or 4 km (2 miles or 2.5 miles). The author then passes over to a discussion of long lines and the damping coefficient.—*La Lumière Elec.,* July 24.

Telefunken System.—W. H. Eccles.—A critical analysis of the alleged advantages of the new telefunken system of wireless telegraphy. "The genuine improvements contributed to the technology of wireless telegraphy consists of the extreme stranding of the conductors carrying heavy oscillatory currents, and the employment of more frequent sparks than are usually used by the originators of the singing spark. An elevated capacity can emit little-damped waves conveying considerable total energy per second. These improvements, taken by themselves, are amply sufficient to account for the inferiority of the old Telefunken apparatus as compared with the new, without invoking the copper-mica plate spark-gap or any of the numerous devices that might replace it. Finally, it seems inevitable that in the effort to increase the power of emission to greater values the Telefunken Company will be obliged to reinstate the coupled reservoir-circuit which it has lately taken such pains to eliminate, unless it is prepared to erect gigantic antennas."—Lond. *Electrician,* July 30.

BOOK REVIEWS.

Moody's Manual of Railroads and Corporation Securities. Tenth Annual Number. 1909. New York: Moody Manual Company. 3300 pages. Price, $12.

Moody's Manual for 1909 exceeds in volume the former issue by 300 pages, containing in all 3300 pages. Many new corporations are listed, and the data in regard to many others are much fuller than in the previous edition. In addition to the statistical information, the new edition contains a series of signed articles which are in reality analytical criticisms relating to the value of the securities of 100 of the most important railroad systems of the country. These were written by Roger W. Babson, the well-known statistician. The book is well indexed, making it an easy reference work.

Grounded Electric Transmission and Electrolytic Corrosion. By J. Stanley Richmond. Toronto: *The Canadian Engineer.* 69 pages, illus. Price, 50 cents.

This pamphlet is a reprint of articles contributed to *The Canadian Engineer,* in which the subject of the electric railway ground circuit is dealt with under various heads. Considerable of the space is devoted to methods of potential surveys, some of which are elucidated in detail. A section is devoted to rail-joint bonding and another to means for lowering track drops.

Saladature Autogene dei Metalli. By S. Ragno. Milano: Ulrica Hoepli. 129 pages, 18 ills. Price, 2 lire.

This little volume discusses in a simple but technical and impartially scientific manner the subject of autogenous soldering—that is, the soldering of one piece of metal to another of like physical and chemical character, as, for instance, lead to lead, aluminum to aluminum, and so on. The various methods employed industrially for autogenous soldering are discussed and classified. The book is a useful little guide to the processes in general use for soldering and will be of service to engineers.

Atlas der Elektropathologie. By Dr. S. Jellinek. Berlin and Vienna: Urban & Schwarzenberg. 92 pages, 96 plates, 246 ills. Price, 35 marks.

The author, who is a privatdozent at the University of Vienna, divides his work into three sections. The first part is devoted to accidents to human organisms due to electric currents; the second, to damages to circuits or material which introduce a life hazard, and the third, to losses attributed to lightning. The text is not voluminous, being merely a narrative giving the complete history of cases cited, special emphasis being placed on the clinical, forensic and sanitary aspects of each. As Mark Antony showed the Roman populace the wounds of Cæsar and bade them speak for him, so the author shows color plates of wounds, burns and rent wearing apparel and lets them tell the greater part of the story. He is careful to state that electric circuits are so safeguarded that the majority of fatalities are due to carelessness or to non-observance of printed rules; and that the percentage of accidents due to electrical causes is very much less than those due to gas, steam or other forms of energy. The work is doubtless of value to medical libraries, museums and to those interested in safety appliances and measures.

Les Industries Electrochemiques. By Jean Escard. Paris: Librarie Polytechniques, Ch. Beranger. 773 pages, 332 ills. Price, 25 francs.

In the introduction of this work the author lays emphasis on the fact that the work is to be concerned purely with industrial electrolysis. He adheres rather closely to this idea throughout the text, though some question might arise as to the relevancy of the chapters on the production of ozone and nitric acid and such apparatus as frequency indicators. Like many other compilations of this magnitude, a lack of intimate knowledge of many of the processes makes itself evident. In several cases obsolete information is given as to recent practice, and the illustrations of a copper refinery, a nickel-plating plant and various types of electrical machines used in the different branches are mostly out of date. The work is of little value as representing American practice and in cases certainly does not do justice to foreign practice.

The book is divided into 10 chapters, and the bulk is taken up with descriptions of the industrial preparation of salts and the obtaining of metals. Three chapters in particular commend themselves to the reader, the subjects being the production of ozone, nitric acid and applications in the field of organic chemistry. In every way these are modern treatises on their respective subjects and contain much information not found in most works of this character. There is nothing in the work which cannot better be taken from the multitude of special treatises on industrial electrochemistry, but for a summary of all the more important processes and many lesser ones the book should find place in the library of all discerning electrochemists.

Contador de Electricidad. By Victor Mauri. Madrid: José Corrales. 91 pages, illustrated.

This little pocketbook is one of the few treatises on electricity or electrical applications in the Spanish language that come to these shores. It describes an electrolytic meter of electric current (ampere-hours) for direct-current installations, called the Krumer meter. The book is suitable for the use of those who desire to test or to operate meters.

Annuaire Pour L'An 1909. Bureau des Longitudes. Paris: Gauthier-Villars. 710 pages, with appendix. Price, 1 fr. 50.

This annual volume carries its usual welcome message. The great value of the Annuaire is that it is an official publication of the French Government. The Bureau des Longitudes was established by the French Revolutionary Government in 1795 and charged with the duty of studying and perfecting the applications of the sciences of astronomy and geography to navigation and physical geography. The result has been that tables were published by the Bureau at regular intervals in a little annual volume, the Annuaire, which has continued to this day. The Annuaire includes a great variety of subjects and is now divided into two volumes, which appear alternately in successive years. This particular volume relates to the solar system, geography, meteorology, etc. It is one of the most important publications of the French Government.

Electric Furnaces. By Wilhelm Borchers. Translated by H. G. Solomon. London: Longmans, Green & Company. 218 pages, 282 ill. Price, $2.50.

The name of Dr. Borchers coupled with a work on electric furnaces should need no further comment as to its standard, and this book represents the author at his best. It is a careful translation of the second German edition of "Die Elektrischen Ofen," containing as an appendix a description of the Girod and the Rochling-Rodenhauser furnaces, two important types developed since the publication of the German edition. In this work furnaces are divided into four principal types: direct and indirect resistance and arc furnaces, and practically all commercial forms so far devised are described and illustrated. The author's readily convertible laboratory furnace is treated separately. Chapters on the construction and the output of electric furnaces make this book unique in electric furnace literature, enabling it to take place as a work on design. The cuts and the descriptive matter are above criticism and the book will find place as a standard in every establishment having to do with this type of heating appliance.

NEW APPARATUS AND APPLIANCES

Hydro-Electric Equipment of the Reedy River Power Company.

The hydro-electric installation illustrated herewith is situated on the Reedy River in South Carolina. The stream flow is



FIG. 1.—REEDY RIVER POWER STATION.

about 110 cu. ft. per second, all of which is utilized. A reservoir capable of storing 16,500,000 cu. ft. has been created by the erection of a stone dam 38 ft. in height, 618 ft. in width, with



FIG. 2.—INTERIOR VIEW OF REEDY RIVER PLANT.

a thickness of 40 ft. at the bottom and of 12 ft. at the top.

No canal is used in leading the water from the reservoir to the turbines, each of which receives water through an individual flume 125 ft. in length, protected at the intake from floating trees, timbers, and débris by a heavy iron rack. The turbines are of the horizontal type, manufactured by the S. Morgan Smith Company. The generator equipment, which will furnish 2300-volt, 60-cycle, three-phase current, consists of one 300-kva and two 600-kva alternators, which receive their excitation from two 35-kw, 125-volt, direct-current generators.

The transformers used for increasing the e.m.f. to 23,000 volts for transmission are situated in a separate room and are of the oil-insulated, water-cooled type. The water for this purpose is led from a tap in one of the flumes to a settling basin on the side of the hill, and from there to the cooling coils of the transformers. The 2300-volt oil switches are of the remote control type. They are operated by means of bell cranks and levers, mounted on a control board situated in the generator

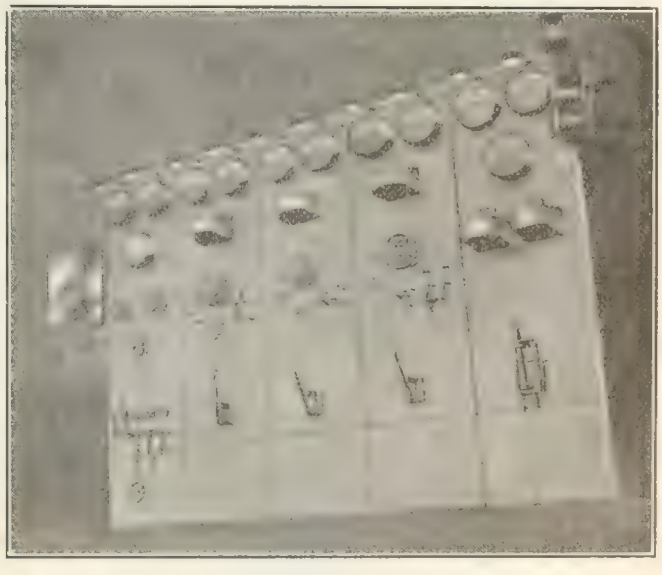


FIG. 3.—SWITCHBOARD, REEDY RIVER PLANT.

room. Here are also situated the field rheostats used for the voltage regulation of the generators. No high-tension wires are brought out here, all instruments being operated through potential and series transformers.

The transmission line, which extends in almost a straight line from the power station to Laurens, is made up of three-stranded aluminum cables, each of which has a conductivity equal to that of a No. 1 copper wire. The danger from lightning has been provided against by three-stranded steel wires stretched above the conductor and grounded at every third pole.

Shortly after the dam had been completed and while the machinery was partially installed, a heavy rain produced a flood which completely inundated the power station. When the water receded it was found that the river had gouged out an entirely new path, leaving the station high and dry at a considerable distance from the river. A long embankment of masonry had to be constructed in order to shift the river back to its original course. Although the machinery was submerged some 18 hours, the plant was in operation within a short time after the flood.

The generators and transformers for the equipment were built by the Crocker-Wheeler Company, Ampere, N. J.

Electrical Equipment of the Loray Textile Mill.

In connection with the textile industry electric transmission and motor drives have of late received considerable attention. On account of some of the peculiar features of this industry

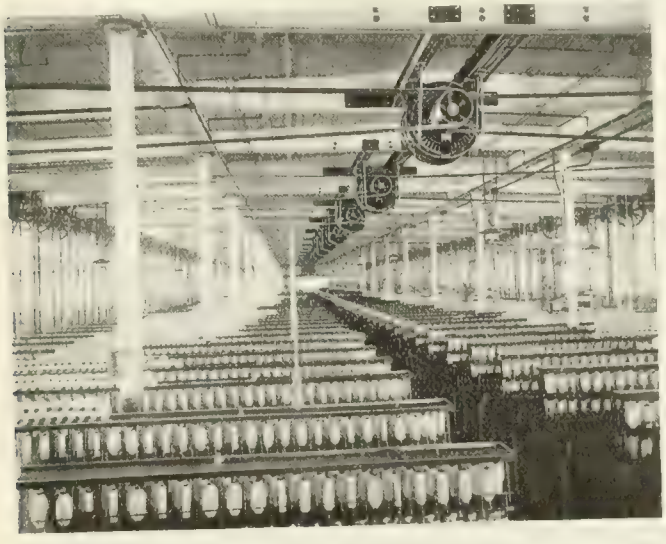


FIG. 1.—SPINNING ROOM, LORAY MILL. 14 75 HP MOTORS.

inherent in the nature of the material handled, the working out of the application of these motors is a matter of interest. One of the largest mills in the South which has made this change is Loray Mill, located at Gostonia, N. C. This mill, which was formerly driven by steam engines with rope transmission in connection with lineshafts, is now operating successfully by electric motors throughout. The Loray Mill has 37 motors in operation with an aggregate rating of 3000 hp. The motors are all three-phase, 60-cycle, 2200-volt Hawthorn induction motors, manufactured by the Western Electric Company, and the Southern Power Company supplies the energy.

It was the experience of the company with rope transmission which caused it to change to electric transmission and motor drive. The principal reason, and the one which is causing rope-driven installations to be replaced by motor-driven equipments, is continuous operation. In large plants shutdowns for repairs of ropes frequently last for from one to two days. The energy consumed must also be kept down to the lowest possible point. Electric motors have come nearest to fulfilling the requirements of continuous operation and low energy consumption. The man standing at the switchboard in the engine-room or at the distributing board is able to tell at once by simply looking at his indicating or recording instrument when the amount of energy is increasing over that required for normal operations. By inserting indicating meters in a motor circuit, checks can be made on each individual operator's work and the processes made a scientific study.

The size of the Loray Mill makes it an excellent example of a motor-driven equipment, since approximately 58,000 spindles and 1650 looms are driven by electrical motors. Fig. 1 shows a view in the spinning-room of this mill. In this section are installed 14 75-hp motors suspended from the ceiling in a row

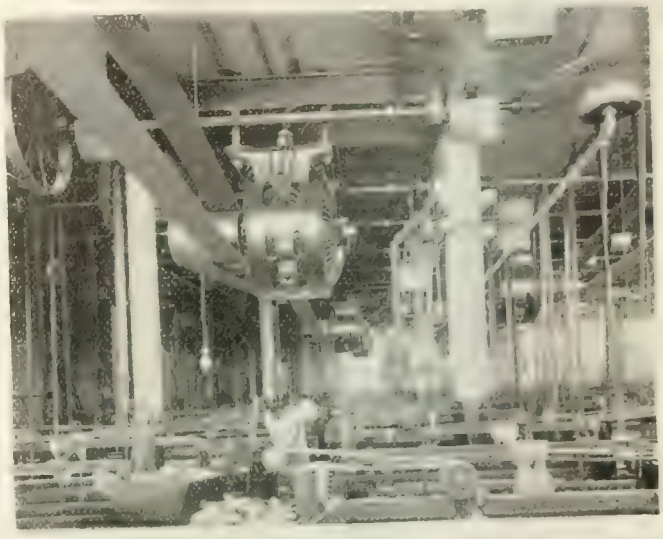


FIG. 2.—WEAVE ROOM, LORAY MILL. 5 125 HP MOTORS.

extending down the center bay of the section. Each of these motors has two pulleys attached from which two belts extend in opposite directions to countershafts extending down each

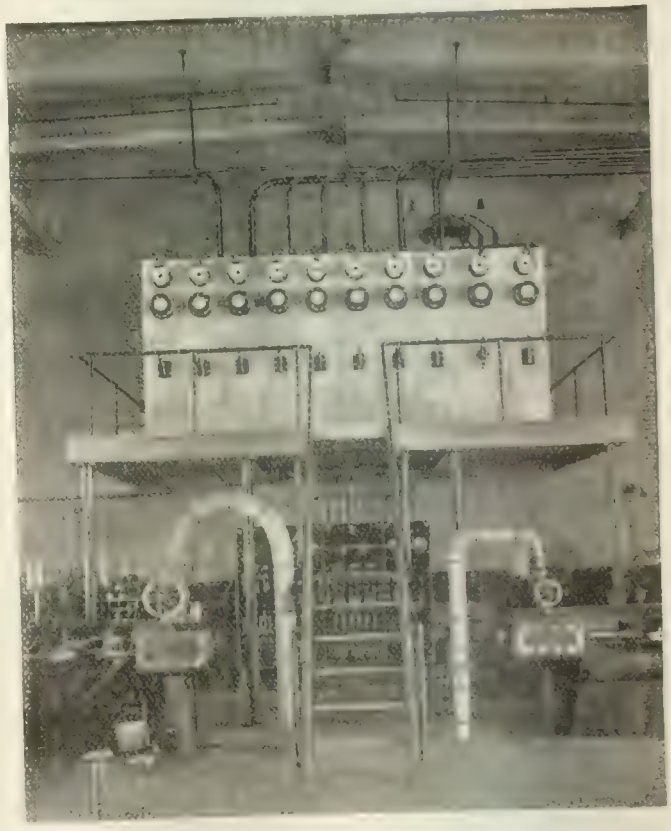


FIG. 3.—SWITCHBOARD, LORAY MILL.

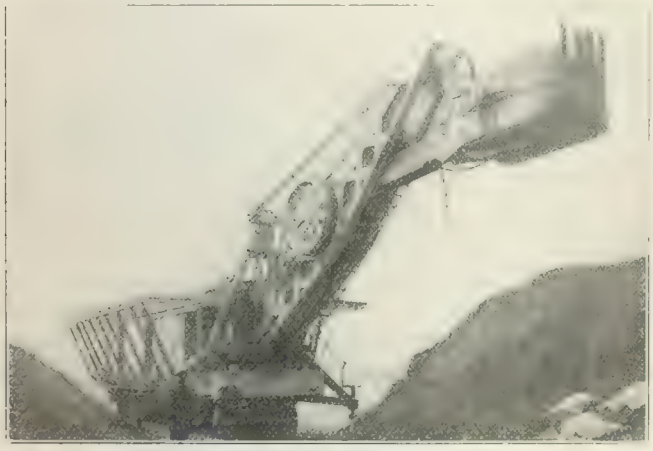
side of the bay at the end of the two rows of spinning frames. As already stated, this mill changed from steam drive and rope transmission to electric drive throughout, so that the shafting and methods of operating by the former equipment remain the same as originally installed. The change, therefore, occasioned a minimum of expense, which consisted principally of the motor equipment, wiring and changes in belting.

The method of drive and the two-pulley attachment are shown somewhat plainer in Fig. 2. In each case the motors are rigidly secured to beams, which are in turn fastened by bolts to the floor beams. This scheme of support is shown in Figs. 1 and 2. In the weave room (Fig. 2) five 125-hp motors are installed, each operating two groups of frames in the same manner as shown in Fig. 1. Mounted on a column at the right of each of these motor installations are the starting and controlling devices. Each motor is equipped with an auto-starter and line panel, the line panel being equipped with a three-pole, single-throw, automatic oil switch.

The 10-panel switchboard used in connection with this motor installation is shown in Fig. 3. Each panel is equipped with the necessary indicating meters and an oil switch. In the foreground may be seen the steam engines connected to direct-current generators. This equipment was formerly used to light the mill, but is now idle since both lamps and motors are supplied with energy from the Southern Power Company's circuits.

Electrically Driven Shovels.

What are said to be the largest electrically operated shovels ever constructed, having buckets holding 4 cu. yd., and equipped with Westinghouse motors and automatic control, have recently been placed in the service of the Dolese & Shepard Company, of Chicago, for mining rock in its limestone quarries. The hoist



ELECTRICALLY DRIVEN SHOVEL.

movement of these two 110-ton machines is actuated by a 200-hp, 220-volt, series-wound, direct-current mill motor running at 415 r.p.m.; the thrust motor, controlling the movement of the dipper handle, is an 80-hp machine of similar type; while the swing boom is operated by an 80-hp motor. Each motor is controlled independently by an automatic magnetic switch controller, which secures the greatest nicety of operation of the heavy bucket. This form of control protects the motors from any heavy overloads which may result from the bucket striking solid rock or other obstructions, by opening switches to introduce resistance into the motor circuit. The control panels and resistances are mounted in the rear of the cab, while the controller handles are conveniently placed under the hand of the operators. The hoist and swing-boom motors are mounted within the car. The thrust motor is placed out on the boom communicating its motion to the bucket staff through reducing gearing connected to a pinion engaging a rack on the staff. The circuit to the shovel is completed through a feed cable, carried on a retractile reel on the shovel cab, and through the rails on which the shovel advances. The shovel may also be fitted with a standard trolley and may then attain a speed of five miles an hour. Compared with the steam shovel, the electrically-driven excavating apparatus has been found to present marked advantages of simplicity, economy and ease of operation. The hauling of water and coal is avoided, fewer operators are required to handle the machine, and a considerable saving of time is noted.

Motor Equipment of Borland Manufacturing Buildings, Chicago.

The new Borland Manufacturing Buildings will be located at 114-142 Federal Street, Chicago, between Harrison and Polk streets. There will be five of these buildings, all 100 ft. x 100 ft. in ground dimensions. The two end buildings will be eight stories high, and the center one nine stories high. The individual buildings are placed 26 ft. apart so that there is space for light and air around them. However, there will be a one-story or two-story building connecting each of the large buildings, so that there will be one continuous building at the street level. Excavation for the three middle buildings has been begun. In the center building will be an 800-kw isolated electric generating plant, which is laid out to provide for the three buildings which are now under way, although space is left for future increase in plant equipment by the addition of two generating units of 400 kw or 500 kw each, as required when the remaining two buildings are erected, or, indeed, before that time if the demands of tenants should make the extension necessary. The buildings are designed for the use of printers, electrotypers and allied crafts, and the plant will furnish the electricity to operate the motors of tenants, as well as to light the building. The initial plant will consist of three units, one of 400 kw, one of 250 kw and one of 150 kw. All will consist of Corliss engines directly connected to 250-volt direct-current generators. The engines will be supplied by the Nordberg Manufacturing Company, of Milwaukee, and will be of the cross-compound type for the large units, with a simple engine for the 150-kw generator. The generators are furnished by the Sprague Electric Company, of New York, and are steel-frame machines. The plant will be equipped with 1600 hp in boilers, there being four 400-hp units, with space for an additional unit when needed. The boilers are supplied by the Edge Moor Iron Company, of Edge Moor, Del. There will be Green chain-grate stokers and a brick stack 185 ft. high and 88 in. in diameter. The building is of reinforced-concrete construction, with brick walls. The feeders from the switchboard will lead upward through vertical shafts, and tenants will make their own wiring connections to them. The plant will be operated day and night, and it is expected that the 150-kw generator and one boiler will, for the present, take care of the night load. Pierce, Richardson & Neiler are the consulting engineers for this interesting isolated industrial plant.

Arc Regulating Rheostat.

In the accompanying illustration is shown a rheostat designed for the regulation of projector and search lanterns by the adjustment of the voltage across the arc. The resistor consists of enameled units in which the wire is sealed from the dis-

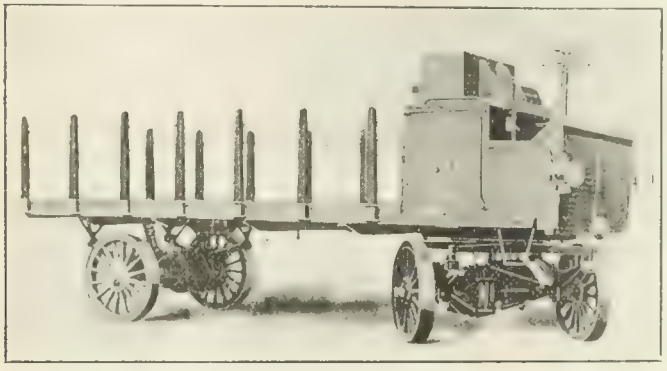


ARC REGULATING RHEOSTAT.

integrating effects of the atmosphere. It is said that these units can be worked at very high temperatures without injury. This type of rheostat has been placed on the market by the Ward Leonard Electric Company, Bronxville, N. Y.

Gasoline-Electric Truck.

The truck shown herewith, and built by the Fuller Power Truck Company, of Delphos, Ohio, is made entirely of steel, even to the tires. A water-cooled gasoline engine direct-connected to an electric generator furnishes the necessary energy for driving four motors, one for each wheel. The operator regulates his power and speed by his control of these motors, as the engine and generator act automatically in response to that control. The engine and dynamo rest on a base fastened to the



GASOLINE-ELECTRIC TRUCK.

platform under the seat of the driver, and every part of the apparatus is accessible.

The truck may be turned completely around in practically its own length. The wheels are of the artillery type, and all bearings are of navy bronze and automatically oiled. The engine and generator take the place of storage cells. The actual rating of each motor is 3.75 hp, but for shorter periods each motor will furnish 2½ times its normal horse-power rating without injury to construction.

The forward end of the vehicle is supported on a fifth wheel or turntable having ball bearings of a size and strength capable of sustaining the heaviest loads under any conditions of the truck's service. On the lower half of this turntable the steering sector is secured, enabling the operator to move the forward axle with its driving power in either direction from a straight line to a degree, allowing the truck to be turned completely around in practically its own length. In this steering movement either the forward-axle electric motors only may be used or the forward and rear-axle motors.

The springs are of the semi-elliptic type tested to sustain a load of 5000 lb. per spring on a 4-in. deflection. These springs, four in number, two in front and two in the rear, on the same deflection maintain a load of 20,000 lb., making them well able to meet the demands of the carrying capacity of the truck.

The axles are of very high grade of steel, and each one of the four wheels forms a point of traction. Should one of the wheels slip, therefore, the remaining three are still in service. By this means of obtaining motion the vehicle is relieved from all detrimental strains, as the working power is more evenly distributed. The control of this truck has been so worked out that the starting torque is not more than the running torque. This is accomplished by a special winding of the generator with its controller. A truck of this kind obviously possesses a number of advantages.

Return Trap System of Boiler Feeding Without Pump or Injector.

As is well known, the return trap is a device which receives the water of condensation from whatever source, and automatically delivers it into the boiler at practically the temperature due to the pressure at which the steam is condensed. The type of trap shown in the accompanying cut, known as the "Detroit" return trap, will, it is claimed, deliver water at a temperature higher than a pump will lift. The pressure is admitted to the surface of the water, and is automatically shut off before the tank is empty. The steam used is only such as is condensed by the latent heat passing from it into the water in the tank, which is all put back into the boiler.

When the steam pressure carried on a heating system is 10 lb. to 15 lb. or more, it is only necessary to employ one

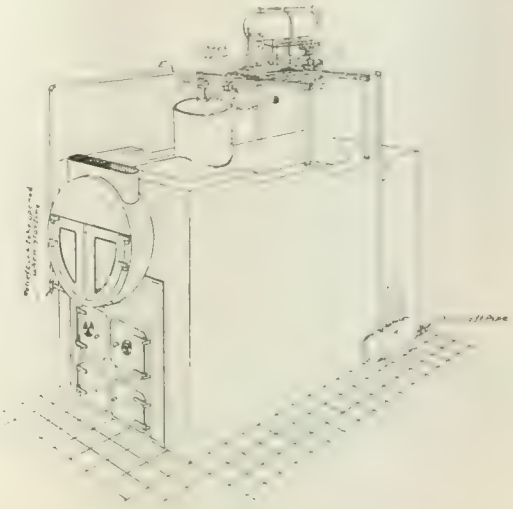


FIG. 1.—RETURN TRAP BOILER FEEDER.

"Detroit" return trap and receiver. All the returns from whatever source are brought into the receiver *A*. For every pound of steam carried on the system, water can be lifted 2 ft. The trap is set perfectly level at any convenient point about 4 ft. above the water level of the boiler and as near to it as possible. The water is raised through the pipe *B* and a check value *C* into the trap tank, which normally stands in a horizontal position. As the tank becomes filled with water, it tilts over, engaging with a lever which automatically admits live steam from the dome of the boiler over the surface of the water in the tank, thereby equalizing the pressure with that within the boiler. The water thereby is allowed to flow directly

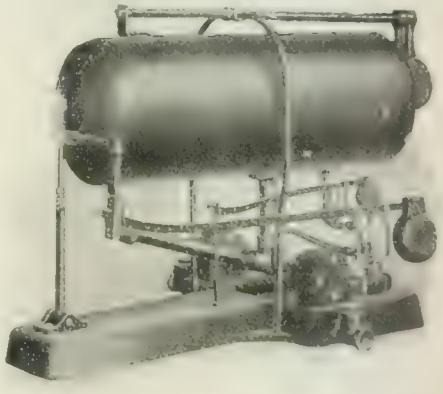


FIG. 2.—RETURN TRAP.

into the boiler by gravity. As the trap tank becomes empty, it is tilted back into its normal position by a weighted arm, and the process of refilling and dumping is repeated.

In manufacturing plants where exhaust steam is used for heating and drying, all the returns can be brought to a receiver and trap located where all the lines will be drained by gravity. The trap below is then employed as a water lift to the trap above the boiler. With this double-trap system no other means of boiler feeding is necessary. This type of trap is also perfectly adapted to the draining of live or exhaust steam headers, and an adaptation is made for systems carrying a vacuum. The trap described is made by the American Blower Company, Detroit, Mich.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Business conditions have rapidly adjusted themselves to the new tariff schedules and the result has been a very apparent increase in commercial transactions. The jobbing houses report a satisfactory number of buyers in the market and say that orders are being placed more liberally than at any time since 1907. The uncertainty as to the rates of duties being removed, retailers are prepared to lay in the heavy stocks that the promised prosperity of the consumers seems to make necessary. The crop reports continue to improve and to indicate that there will be an enormous amount of money distributed among the farmers next fall and winter. This is taken to presage unusual buying and the retailers are preparing for the emergency. In industrial centers the evidence of prosperity is equally alluring. All branches of manufacture, but more especially in iron and steel and in textiles, report largely increased orders and expansion of operations. More men are being put to work every day, and many localities where the buying capacity of the public has been restricted are returning to normal. This encourages the retailer to lay in stocks. The only disturbing element in the situation is the unusually high level of commodity prices. The cost of living is at the present time higher than it has been at any time since the systematic compilation of such statistics was begun. This, of course, restricts the prosperity of the individual, especially of the wage earner. Among the encouraging features of the past week were the large orders for railroad equipment that came to light. Recent car orders amount to 25,000, the larger part of which are to be of steel construction. Collections have improved to some extent, but are naturally slow, as much of the commercial betterment is yet prospective. Failures for the week ended Aug. 12, as reported by *Bradstreet's*, were 219 as against 184 for the previous week, 249 in the same week of 1908, 146 in 1907, 143 in 1906 and 147 in 1905.

THE COPPER MARKET.

During the past week there has been considerable speculative interest in the copper market, and transactions of this character have been quite liberal. The result of this has been a decided advance in selling prices and a material strengthening in tone. Producers and selling agencies have been holding out for higher prices, apparently being of the opinion that the favorable figures given out in the July report of the association would bring about an active demand. This has not been the case, so far as the actual consumers are concerned. During the past week there has been very little demand from melters, either at home or abroad, and the spot sales have mostly resulted in adding to the stocks in warehouses. From the best information obtainable it appears that the actual consumption of copper in this country during July was but little more than 50,000,000 lb. As the domestic deliveries are given as $75,520,083 lb., it is evident that there has been a heavy increase of stocks in consumers' hands. In the meantime it is known that stocks in foreign warehouses increased 22,000,000 lb. during the same month and have continued to increase rapidly during the first half of August. These facts are perfectly well understood by consumers and they cannot, therefore, be demoralized by the surprising statistics given out by the Copper Producers' Association. Actual sales on the Metal Exchange during the week were only fair. Imports continue to be liberal and exports for August, including Aug. 16, have amounted to 11,220 tons. The daily call on the Metal Exchange, Aug. 9, at 12:30 o'clock, quoted standard copper as follows:

	Bid. per lb.	Asked, per lb.	Settling price, per lb.
Spot	12.65	12.90	....
August	12.75	12.90	12.77½
September	12.75	12.90	12.82½
October	12.82½	12.90	12.87½
November	12.85	12.95	12.90
December	12.95	13.00	12.97½

The London prices Aug. 16 were as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	59 17 6	59 15 0
Standard copper, future	60 17 6	60 15 0
Market	Easy	Easy.
Sales of spot		500 tons
Sales of futures		1,400 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.05	12.72½
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

BUTTERINE FACTORY ELECTRICALLY EQUIPPED.—The John F. Jelke Company, of Chicago, butterine manufacturer, is building a large new factory at Washtenaw Avenue and Polk Street in that city. All machinery in this factory will be operated by electric motors, and there will be an isolated 500-kw generating plant. This plant will consist of two 250-kw, 250-volt units of simple Corliss engines made by the Vilter Manufacturing Company, Milwaukee, directly connected to Sprague direct-current generators. There will also be a 50-kw dynamo of the same manufacture directly connected to an Ames high-speed engine, which will be used for night service. Practically all of the electricity generated in this plant will be supplied to electric motors, and the factory will be equipped with between 400 and 500 hp in motors for driving various kinds of machinery as well as electric elevators. Pierce, Richardson & Neiler, of Chicago, are the consulting engineers.

AUTOMATIC ELECTRIC COMPANY.—Announcement has been made by the Automatic Electric Company of Chicago, manufacturer of automatic telephones, that it can accept no further orders for delivery before Jan. 1. It is announced that the business booked for delivery within the next four months includes about 85,000 telephones and switchboards. The Havana installation must be in operation by December, and there are 16 cities in this country where the installations must be in readiness before the end of the year. Among the recent orders received by the company are two for 5,000 telephones each from Los Angeles and San Francisco. The former city now has 33,000 automatic telephones in service and the latter city is using 15,000 similar devices.

DAYTON GLOBE IRON WORKS COMPANY.—Among the recent orders of the Dayton (Ohio) Globe Iron Works are the following: two double-wheel units to Pine City (Minn.) Electric Power Company; single-wheel units to the Orion (Mich.) Light & Power Company, the West Milton (Ohio) Electric Company and the Camden (Ohio) Electric Company; one double and one single-wheel unit to the Osceola Light & Power Company, at Reed City, Mich. This last mentioned apparatus is to take the place of the present equipment of vertical trump wheel on mortise gear.

BALL & WOOD COMPANY ORDERS.—The United Electric Company, Chambersburg, Pa., has contracted with the Ball & Wood Company, Elizabethport, N. J., for two 750-kw Rateau-Smoot high-pressure turbines and 60-cycle three-phase generators, to be installed in its plant at Lemoyne, Pa. The United Electric Company is owned by the Cumberland Valley Railroad Company, and the latter is, in turn, controlled by the Pennsylvania Railroad. The specifications for these units were issued by the motor power department of the Pennsylvania Railroad.

DISTRICT HEATING SYSTEM IN INDIANAPOLIS.—The Indianapolis Light & Heat Company, of which C. C. Perry is vice-president and treasurer, is spending about $150,000 for a new exhaust-steam heating plant. The mains, which are being laid in the central business streets, will have a total length of about 15,000 ft. The American District Steam Company has the contract, secured by the Chicago office, for installing the new system. It is expected that the plant will be ready for service by Nov. 15.

RECENT CROCKER-WHEELER ORDERS.—The Crocker-Wheeler Company has recently booked several large orders for direct-current apparatus. One of these, from the Indiana Steel Company, calls for 70 mill motors, totaling about 2400 hp. This order is an addition to the 11,000 hp employed at the present time. An order from the Gould Paper Company, of Lyons Falls, N. Y., calls for electric drive for a new paper-making machine. A sale has been made to J. M. Kohler Sons Company, Sheboygan, Wis., of one 750-kw, 250-volt direct-current generator. Other sales are to the King Bridge Company, Cleveland, Ohio, one 150-kw, compound-wound, 250-volt generator; to the American Lace Manufacturing Company, Elyria, Ohio, one 100-kw generator; to the Bethlehem Steel Company, a 225-hp, compound-wound motor, to be installed at its Saucon plant; to Beadleston & Woerz, New York City, 187 hp in compound-wound, 115-volt motors and one 150-kw. 125-volt, compound-wound generator. Among orders for induction motors recently received is one from the Roessler & Hasslacher Chemical Company, Perth Amboy, which totals 295 hp in three-phase, 60-cycle, 480-volt motors of the squirrel-cage type.

WHEELER CONDENSER & ENGINEERING COMPANY.—At the recent annual meeting of the stockholders of the Wheeler Condenser & Engineering Company J. J. Brown was elected vice-president and general manager. Mr. Brown entered the condenser field some 15 years ago as Southwestern manager for the Henry R. Worthington Company and later became general sales manager. After the formation of the International Steam Pump Company he became its general Western sales manager with headquarters at Chicago, and resigned that position to take up his present work. The Wheeler Condenser & Engineering Company has recently introduced several important improvements in condensing apparatus, among which are the "dry tube surface condenser," which has shown satisfactory results in high vacuum work. The plant at Carteret, N. J., is being enlarged and improved. Among these improvements is a new power house which will be equipped with several different systems of condensers for exhibition purposes, as well as for supplying the electrical energy for the shop.

CONTRACTS FOR NORTHWESTERN RAILROAD TERMINAL, CHICAGO.—Work is proceeding steadily on the new passenger terminal of the Chicago & Northwestern Railway in Chicago, the electrical features of which were described in the issue of July 8. The contract for the conduit and wiring of this large railroad station has been awarded to Kohler Brothers, of Chicago, and will amount to over $140,000. This is one of the largest wiring contracts ever awarded in Chicago. The Kehm Brothers Company, of Chicago, is the contractor for the heating and ventilating equipment, the contract calling for the expenditure of nearly $275,000. The Link-Belt Company, of Chicago, will supply the coal-handling and ash-handling machinery in the power house at a cost of about $15,000. These contracts have been placed on the recommendation of Pierce, Richardson & Neiler, who are the consulting engineers.

OSBURN ELECTRIC COMPANY.—The Osburn Electric Company has been incorporated under the laws of Illinois, with authorized capital of $100,000, to do a manufacturing business. The factory of the company will be at 66 Fort Street, East, Detroit, Mich., and the Chicago office at 404 Great Northern Building. The company will make ignition apparatus for automobiles as well as small storage batteries and magnetos. It will also place on the market an ingenious electric lighter for gas stoves. The officers of the company are: President, H. G. Osburn; vice-president, J. C. Osburn; treasurer, Ralph G. Hutchins; secretary, F. E. Hutchins. H. G. Osburn, the president, is well known in electrical circles as the founder of the Osburn Flexible Conduit Company, and was formerly engaged in the storage-battery and electrical supply business in Chicago. R. G. Hutchins will have charge of the Chicago office.

COMMERCIAL CABLE COMPANY'S PROTEST.—George Gray Ward, vice-president of the Commercial Cable Company, has written a strong letter of protest to Sir Edward P. Morris, Premier of Newfoundland, against the repudiation by that Government of the contract made between the company and the former administration in the province. It is claimed that the present government in Newfoundland seeks to abrogate the contract with the cable company purely for political reasons, and the cable company, according to one of its officials, does not intend to interfere with its present arrangements without carrying the controversy to the House of Lords, if necessary. The cable company has already spent $1,000,000 under the contract and has made plans to spend as much more. Its officials claim that it is carrying out every feature of its contract.

WHITNEY HYDROELECTRIC COMPANY LITIGATION.—The United States Court in North Carolina has entered a judgment against John S. Henderson and C. W. Smith, receivers for the Whitney Company of Salisbury, for $325,000, in favor of the T. A. Gillespie Company, contractors, who built the large dam across the Yadkin River. This decision holds that the construction lien is prior to the mortgage held by the Bankers' Trust Company of New York, which secured the bond issue. It is understood now that the formal sale of the property will be made at an early date, and the purchasers will no doubt continue the work on which several millions have already been expanded.

WIRELESS ON LAKE SUPERIOR.—Contract has been closed by the United Wireless Telegraph Company with the Calumet & Hecla Mining Company for the erection of a wireless station near Calumet, Mich. The contract includes the erection of two 130-ft. towers on a hill 625 ft. above Lake Superior, enabling the station to command a sweep of the entire lake from Duluth and Port Arthur to Sault Ste. Marie. The contract calls for the exclusive wireless privileges on the peninsula. The Calumet & Hecla Company is contemplating establishing wireless stations at several of its mines, as well as equipping its ore boats.

VIRGINIA ELECTRIC TOOL & MANUFACTURING COMPANY.—In pursuance of a resolution of the board of directors, a meeting of the stockholders of the Virginia Electric Tool & Manufacturing Company has been called for the purpose of considering a plan to dissolve the old company and organize a new one with capital of $1,000,000 to carry on a greatly enlarged business, under the name of the American Electric Tool Company. The stockholders of the old company are to receive a good share of the stock of the new company in exchange for their old stock, provided the program be carried out.

WESTINGHOUSE TURBO-GENERATOR SET FOR BRIDGEPORT, CONN.—The United Illuminating Company, Bridgeport, Conn., is installing a Westinghouse 500-kw turbine for driving a 2400-volt, three-phase, 60-cycle Westinghouse alternator, which is to feed into the distribution system serving the city of Bridgeport and surrounding territory with light and power. The present installation is an addition to the existing equipment of a 300-kw Westinghouse turbine driving a Westinghouse alternator, besides several small belted units.

SOUTHERN POWER COMPANY.—The Southern Power Company is making ready to develop the water-power at Getty's Shoals, on the Catawba River, in North Carolina, 12 miles above Camden, and 25 miles south of Great Falls, where another large development is being finished. The Getty's plant will give 100,000 hp, it is estimated, while the dam will be over 100 ft. high, it is stated, with backwater running 20 miles up the river.

UNITED STATES LIGHT & HEATING COMPANY.—The newly organized United States Light & Heating Company, which was incorporated under the laws of Maine with $17,500,000 capital, reports that during the last month the company received orders to equip 240 cars, of which 88 are for the Western Pacific. The other orders came from the Santa Fé, Denver & Rio Grande, Ann Arbor, Minneapolis & St. Louis, Pennsylvania and Erie.

DEMAND FOR ELECTRIC HEATING APPLIANCES.—The Vulcan Electric Heating Company, of Chicago, reports an especially active demand for industrial electric-heating appliances, such as soldering irons, branding irons and curling irons. Its factory is so busy that, despite the utmost exertion, the company finds it difficult to make deliveries on time.

CATALOGS WANTED.—Smith, Kerry & Chace, consulting engineers, of Toronto and Winnipeg, who have recently opened offices at 68 McDougall Block, Calgary, Alta., in order to deal more conveniently with their business in that section of the West, would be glad to receive catalogs of electrical and engineering supplies at that address.

MOORE ELECTRICAL COMPANY, Newark, N. J., has received an order for three installations of the Moore tube lamp in Berlin, Germany. The necessary apparatus, which has been forwarded, will be installed by James A. Holt, who sailed for Bremen from New York Aug. 5.

Financial Intelligence.

THE WEEK IN WALL STREET.

The week has been one of continued buoyancy in the stock market. There has been practically no cloud on the horizon, and there has been every sort of news to stimulate the buyers. The August crop report indicated even a better state of affairs than the very favorable report of July had promised. There is no longer the slightest doubt that the producers will receive for their labors in 1909 vastly more than ever before in the history of the country. The reports from industrial sections indicate continued activity and such a volume of orders and inquiries that every wheel will be kept turning for months to come. The railroads, too, are showing the effects of the revival of business. Weekly returns are vastly improved, and with economical methods that were adopted during the period of depression, net earnings in many instances are making their best records. All of these things have boomed the market in Wall Street and have carried many stocks to unheard-of levels. The feature of the week was the sudden and spectacular advance in Union Pacific. This stock showed a net gain of more than 14 points on the week and touched the high water mark of 219. This advance was accompanied by well-defined reports that the shareholders were to receive participation certificates in the earnings of other stocks held by the company. The money market has shown some symptoms of growing stronger. There was a better demand from the banks during the past week and rates were considerably stiffer. Quotations Aug. 16 were: Call 2@2½, 90 days 3¼@3½. The quotations in the table are those of the close Aug. 16.

NEW YORK.

	Aug. 9.	Aug. 16.	Shares sold.		Aug. 9.	Aug. 16.	Shares sold.
All.-Ch	15¾	15½	1,000	Int.-Met., pfd..	46½	46	24,100
All.-Ch., pfd...	56¼	53⅞	3,150	Mackay Cos...	83½	83*	2,900
Amal. Cop....	85⅜	85⅜	214,500	Mackay Cos.,p.	74¾*	74*	225
Am. D. T.....	30*	20½	——	Man. Elev....	144⅝*	143¾	500
Am. Loc.....	68¼	65	19,100	Met. St. Ry...	24*	24*	——
Am. Loc., pfd.	120½	120*	600	N.Y. & N.J.Tel	142½*	141	100
Am. Tel. & Cbl.	76*	76*	——	Steel, com.....	77½	79¼	791,140
Am. T. & T....	142½	141¾	18,845	Steel, pfd.....	126¾	125⅞	25,937
B. R. T.....	80½	79	31,080	W. U. T.....	75½	74	3,125
Gen. Elec	171¾	169	5,748	West'h, com...	88¾	86	12,680
Int.-Met., com.	15½	14¼	10,100	West'h, pfd....	124½*	120*	122

PHILADELPHIA.

	Aug. 9.	Aug. 16.	Shares sold.		Aug. 9.	Aug. 16.	Shares sold.
Am. Rys.....	45⅞	45⅞*	——	Phila. Elec...	12⅝	12¼	——
Elec. Co. of A..	12⅜	12⅜	——	Phila. R. T.	31¼	30⅜	——
Elec. St. B'ty..	62	61¾	——	Phila. Trac.	91	91	——
E. S. B'ty,pfd.	49*	49*	——	Union Trac...	55¼	54½	

CHICAGO.

	Aug. 9.	Aug. 16.	Shares sold.		Aug. 9.	Aug. 16.	Shares sold.
Chi. City Ry..	180*	180*	——	Chi. Tel. Co..	134	135	——
Chi. Rs.,Ser.1.	119½*	119½*	——	Met. El., com..	16*	17½	——
Chi. Rs.,Ser.2.	37⅞*	37	——	Met. El., pfd..	49	49*	——
Com. Edison..	120	121*	——	Nat'l Carbon...	94	98	——
Chi. Sub'ws...	23½	20½*	——	Nat'l C., pfd...	119	119*	——

BOSTON.

	Aug. 9.	Aug. 16.	Shares sold.		Aug. 9.	Aug. 16.	Shares sold.
Am. T. & T...	142¾	141⅝	—	Mex. Tel.....	2¼*	2½*	——
Cum. Tel.....	145*	142½*	——	Mex. Tel., pfd.	6¼*	5¼	—
Edison E. Ill...	254	252	——	N. E. Tel....	137¾	137	——
Gen. Elec.....	172	169	——	W. T. & T....	11¼	11⅝	——
Mass. E. Ry..	13	14⅛	——	W. T. & T., p.	86	81	——
Mass. E. R., p.	71⅝	75					

*Last price quoted.
Shares sold are for week Aug. 9 to Aug. 14.

EMPIRE DISTRICT ELECTRIC COMPANY.—The name of the new holding company, organized by the H. L. Doherty & Company interests in the neighborhood of Joplin, Mo., is to be the Empire District Electric Company. As already detailed in these columns, the Doherty interests control the Consolidated Light, Power & Ice Company, the Missouri Zinc Fields Company and the Spring River Power Company. The new company will come into possession and control of these three properties. It is proposed to furnish electric energy, from hydro-electric and steam plants, to the entire Joplin district. This comprises a radius of about 30 miles from Joplin and covers an extremely busy mining district. The new company has been organized with an authorized bond issue of $6,000,000, 5 per cent bonds, and with authorized issues of $3,000,000 preferred and $3,000,000 common stock. It is proposed to offer for sale at once $1,250,000 of these bonds, giving as bonuses to the purchaser $500,000 preferred and $1,600,000 common stock. Full details of this offer will be made public within the next 10 days.

DENVER GAS & ELECTRIC BONDS.—The Denver Gas & Electric Company has sent out notices that it will redeem the entire outstanding balance of the 6 per cent, 5-15 year gold mortgage bonds. These bonds were dated April 1, 1903, and amount to $458,000. The bonds, with interest, will be paid upon presentation at the office of the Bankers' Trust Company, 7 Wall Street, on and after Oct. 1. The redemption of these bonds has nothing to do with the refinancing plans of the company now being matured by H. L. Doherty & Company, further than to clear the decks for action. This plan, which was outlined in the issue of June 3, 1909, contemplates the authorization of a $25,000,000 bond issue, to be placed upon the market as needed. The money for the retirement of the bonds which are now called will not come from this issue but will be drawn entirely from surplus earnings. The reports of the company's earnings are still most flattering.

GEORGIA TRACTION MERGER.—The recent passage by the Legislature of Georgia of the Boyd bill permitting the consolidation of the Atlanta-Macon interurban line, the Macon-Albany interurban line, and the Central Georgia Power Company, means the formation of a $10,000,000 merger of the three concerns named with the Macon electric systems, the source of power being the Central Georgia Power Company. President Jordan W. Massee has announced that he has secured the cooperation of a New York firm to underwrite the bond issue and that the building of the interurban line will be undertaken within a short time. The total cost of this line will be between $2,500,000 and $3,000,000.

NATIONAL MINING & POWER COMPANY.—A new company has recently been organized at Birmingham, Ala., with a capitalization of $2,500,000, called the National Mining & Power Company, which is designed to furnish energy throughout the Alabama mining section. C. F. Wheelock, of Birmingham, is the president of the new company; W. K. Wheelock, vice-president, and M. H. Bone, secretary and treasurer. The company's charter gives it the right to develop, build and operate plans for the production of power, including gas, water, light and sewerage, and the developing of mineral lands, dams, power plants, factories, equipments, etc.

NEW ORLEANS RAILWAY BONDS IN FRANCE.—The New Orleans Railway & Light Company has placed $2,580,000 of its 40-year 5 per cent bonds with the French Finance Corporation. These bonds were placed through Bertron, Griscom & Jenks, of New York. The new mortgage upon which the bonds are secured authorizes an issue of $50,000,000. Of these $30,000,000 will be reserved to retire the company's outstanding bonds. The new money obtained is to be expended in extensions and improvements.

HOLDING COMPANY FOR SAN FRANCISCO PROPERTIES.—The Railroads & Power Development Company has recently been incorporated under the laws of Maine as a holding corporation for the Stanislaus Power Development Company and the San Francisco Electric Railways, the new company which is to acquire and operate the tractions in San Francisco. All of the capital stock of the Railroads & Power Development Company will be held by the United Railways Investment Company.

KEYSTONE TELEPHONE COMPANY.—The annual report of the Keystone Telephone Company, of Philadelphia, which has just been issued, shows that the company has increased the number of its telephones in service in the city and suburbs from 17,000 in 1905 to 30,000 in 1908. The company has 335 miles of ducts in the streets. The total net earnings of the company for the year were $130,145. This was after paying all fixed charges and allowing $100,000 for renewals.

HICKORY (N. C.) HYDRO-ELECTRIC PLANT.—After some delay in perfecting details, it is now announced that all of the capital stock has been taken in the hydro-electric water-power development on the Catawba River, near Hickory, N. C., in which Col. M. E. Thornton is a principal promoter. It is said that a large cotton mill will be erected and will use power from the proposed plant.

ROCKINGHAM (N. C.) POWER COMPANY'S SALE.—Judge Pritchard of the United States Court in North Carolina has made an order setting Aug. 23 as the date for hearing any protests from creditors against the sale of the Rockingham Power Company's property to the reorganization committee for $1,000,000. An order authorizing $17,500 receiver's certificates was also entered.

WESTINGHOUSE DEFERRED DIVIDENDS.—In spite of the fact that the business of the Westinghouse Electric & Manufacturing Company has been extraordinarily good for the past few months, it is announced by officers of the company that no steps have been taken toward paying the accumulated back dividends on the 7 per cent cumulative preferred stock. The dividends on the outstanding $3,998,700 preferred now amount to 12½ per cent, or, in round figures, $500,000. The finances of the company are at present in satisfactory shape, but it is not deemed wise, until after a longer period of successful operation, to make so large a draft upon the existing cash resources.

BROOKLYN RAPID TRANSIT EARNINGS.—There is practically no doubt that as soon as the directors of the Brooklyn Rapid Transit can be gotten together for a meeting they will declare another quarterly dividend of 1 per cent. The earnings of the company, while they have been fair, have not been so heavy as to inspire any hope for an increase in the dividend. Although the figures have not yet been given out, it is understood that the earnings will amount to about 4½ per cent on the capital stock. Within the past year large sums spent upon improvements have been charged into the expense account, thus making the percentage of operation cost appear very high.

PACIFIC GAS & ELECTRIC BONDS.—Offering is being made in New York by N. W. Halsey & Company of the unsold balance of the $2,340,000 issue of Pacific Gas & Electric Company's bonds recently purchased by that firm. These bonds bear 6 per cent and are offered at par. The properties of the company embrace 154,000 developed electric horse-power, distributed through 2525 miles of transmission lines, including 167 miles of underground cable in San Francisco. There is also 100,000 undeveloped horse-power in reserve. In addition to these properties the company has 16 gas plants with 1400 miles of mains and 132,000 meters.

ALBANY & HUDSON REFINANCING NOT OPPOSED.—At the hearing before the Public Service Commission of the Second District on the proposed plan for refinancing the Albany & Hudson Railroad Company, the promised opposition of the present bondholders did not materialize. It was announced at the meeting that the new cash that will be raised by the issue of $1,500,000 5 per cent bonds would be used for the purchase of the Albany & Greenbush Bridge over the Hudson River, between Albany and Rensselaer, and for double tracking the line between the latter place and Electric Park.

AMERICAN TELEPHONE STOCK LISTED IN CHICAGO.—The listing committee of the Chicago Stock Exchange has approved the application of the American Telephone & Telegraph Company to list $239,880,700 of capital stock and $150,000,000 of convertible bonds. The Illinois Trust Company has been named as the Chicago transfer agent and the Northern Trust Company as the registrar.

CLEVELAND ELECTRIC BONDS.—The stockholders of the Cleveland Electric Illuminating Company have just authorized a bond issue of $30,000,000 for future improvements and acquisitions. The details of this refinancing plan have not as yet been given out. It is reported in Cleveland that this large bond issue is the initial step in a plan for merging all of that city's public utilities.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
American Light & Traction Company:					
Six months ended June, 1909	$1,546,980	$53,787	$1,493,192	$1,175,332	$317,860
Six months ended June, 1908	1,207,426	24,000	1,183,426	989,996	203,430
Associated Bell Operation Companies:					
June, 1909	11,393,309	4,681,672	6,621,637	4,172,934	2,448,703
June, 1908	10,464,596	4,942,100	5,972,406	3,690,890	2,281,516
Chautauqua Traction Company:					
Quarter ended June 30, 1909	22,361	17,652	4,708	14,414	10,198
Quarter ended June 30, 1908	16,248	15,655	593	12,970	12,769
Consolidated Gas, Electric Light & Power Company, Baltimore:					
Year ended June 30, 1909	.....	.....	1,228,974	442,440	786,534
Year ended June 30, 1908	.....	.....	1,060,949	442,440	618,509
Dallas Electric Corporation:					
May, 1909	103,525	66,182	37,342	25,506	11,836
May, 1908	90,459	64,063	26,396	26,606	*209
Elmira (N. Y.) Water, Light & Railroad Company:					
Quarter ended June 30, 1909	61,883	42,467	19,416	.....	.....
Quarter ended June 30, 1908	61,031	42,222	18,809	.....	.....
El Paso Electric Company:					
May, 1909	47,509	28,681	18,828	7,899	10,928
May, 1908	42,633	28,479	14,154	7,247	6,906
Fairmont & Clarksburg (W. Va.) Traction Company:					
June, 1909	38,131	12,946	25,184	.....	27,283
June, 1908	33,459	11,698	21,762	.....	23,551
Galveston-Houston Electric Company:					
May, 1909	103,603	58,731	44,872	18,670	26,201
May, 1908	91,023	54,700	36,322	17,131	19,191
Hornellsville (N. Y.) Electric Railway Company:					
Quarter ended June 30, 1909	5,012	3,073	1,939	700	*1,239
Quarter ended June 30, 1908	5,417	6,318	*900	700	*1,600
Kingston (N. Y.) Consolidated Railroad Company:					
Quarter ended June 30, 1909	38,847	21,693	17,154	12,756	3,313
Quarter ended June 30, 1908	38,745	22,152	16,592	9,566	5,535
Keystone Telephone Company:					
Year ended June 30, 1909	1,073,462	531,009	542,453	412,308	130,145
Year ended June 30, 1908	1,051,071	539,123	511,948	413,112	98,836
Lake Superior Corporation:					
Year ended June 30, 1909	566,511	543,516	.....	.....	22,995
Year ended June 30, 1908	566,616	538,747	.....	.....	27,869
Lexington & Interurban Railways Company:					
June, 1909	52,373	38,186	13,186	.....	.....
June, 1908	54,142	34,518	19,624	.....	.....
Minneapolis General Electric Company:					
May, 1909	84,673	37,339	47,333	29,670	17,663
May, 1908	73,677	36,662	37,015	31,221	5,793
Northern Texas Electric Company:					
May, 1909	104,890	57,946	46,952	17,189	29,763
May, 1908	83,807	54,856	28,951	16,553	12,398
Oneida Railway Company:					
Quarter ended June 30, 1909	88,980	51,455	37,524	4,642	29,807
Quarter ended June 30, 1908	73,026	42,198	30,827	5,472	23,480
Savannah Electric Company:					
May, 1909	50,274	32,624	17,650	15,707	1,942
May, 1908	48,097	30,243	17,853	15,336	2,517
Schenectady Railway Company:					
Quarter ended June 30, 1909	240,925	144,735	96,189	22,500	64,542
Quarter ended June 30, 1908	220,110	158,559	61,551	23,170	31,584
Seattle Electric Company:					
May, 1909	457,258	274,459	182,799	91,803	90,995
May, 1908	386,961	216,857	170,103	80,087	90,016
Tampa Electric Company:					
May, 1909	47,820	27,162	20,658	4,008	16,649
May, 1908	45,405	32,254	13,150	2,303	10,847
Utica & Mohawk Valley Railway Company:					
Quarter ended June 30, 1909	309,830	191,314	118,516	56,194	43,830
Quarter ended June 30, 1908	272,979	155,602	117,376	42,052	68,462
Virginia Railway & Power Company:					
June, 1909	159,025	109,206	79,419	.....	.....
June, 1908	174,858	125,151	49,707	.....	.....

*Deficit.

GENERAL NEWS

Construction News.

SELMA, ALA.—The City Council has granted the Selma Street & Suburban Railway Company a franchise to extend its railway on Water Street.

SPEIGNER, ALA.—Work has commenced by the State Convict Bureau on the construction of a dam in connection with a proposed power plant. Edgar B. Kay, of Tuscaloosa, Ala., is engineer in charge of the work; J. Craig Smith is president of the bureau.

TUCSON, ARIZ.—The Sonora Copper Company is planning to install an electric power plant, an aerial tramway and a 100-ton matting furnace in the Caracahui Mountains, about three miles from the Sonora Railroad. A. N. Conrad will have charge of the work.

BENTON, ARK.—The Atkinson Water Power Company, recently organized, proposes to operate a water power plant on Saline River. The officers of the company are: J. F. Lee, president, and J. R. Gibbons, secretary and treasurer.

MURFREESBORO, ARK.—Plans are being prepared by the Pike County Water Power Company, of Little Rock, Ark., to construct a hydro-electric plant on the Little Missouri River, near Murfreesboro. It is proposed to develop 10,000 hp. at a cost of $500,000. The Fuller-Coult Company, of St. Louis, Mo., will have charge of the engineering work.

PRAIRIE GROVE, ARK.—The capital stock of the Prairie Grove Telephone Company has been increased from $6,000 to $12,000.

FOREST HILL, CAL.—It is reported that John A. Britton, general manager of the Pacific Gas & Electric Company, is interested in a project to install a large electric power plant on the Middle Fork of the American River, near Horse Shoe Bar, about three miles from Forest Hill, work on which has already commenced. It is understood that about 750 hp will be developed. The plant, it is said, will furnish electricity for the Cash Rock mine, located two or three miles from Horse Shoe Bar. It is expected that ultimately the plant will be connected with other transmission lines of the company and will furnish electrical energy in Sacramento.

GLENDALE, CAL.—Bids will be received by C. B. Woodbury, city clerk, for the purchase of $40,000 in bonds, the proceeds to be used for establishing a municipal electric light plant.

LONG BEACH, CAL.—The Harbor Electric Light & Power Company, recently incorporated, has secured a site for its proposed power plant, near Daisy Avenue School.

VISALIA, CAL.—The Visalia Electric Railroad Company has completed the grading of the extension of its railroad from Lemon Cove to Woodlake, a distance of 12 miles. It is said that the company is planning for another extension from Exeter to Lindsay and Portersville.

ANTONITO, COL.—The directors of the Conejos Co-operative Mills Manufacturing Company have voted to build a mill at Antonito, replacing the Conejos mill, which was recently burned. The hydro plant at Conejos will be retained and the power will be transmitted electrically to Antonito to furnish the electrical power for the new mill and for lighting the town of Antonito, with which the company has contracted to furnish electricity for lamps.

DENVER, COL.—It is reported that plans have been completed for financing the Colorado Interurban Electric Railroad Company, and that work on construction of the proposed electric railway to connect Denver, Brighton, Fort Lupton, Greeley and other towns in the northern coal district will commence in the near future. C. H. Pierce is general counsel for the company.

GEORGETOWN, COL.—The construction of a power plant on Clear Creek, three miles below Georgetown, is contemplated, investigations for which are being made by W. H. Goodrich, electrical engineer, of Mineral Wells, Tex. It is said that 600 hp can be developed at a small cost. The Golden Glory Tunnel Mining Company, which is backing the project, will utilize 100 hp and the remainder will be sold to adjoining mines.

GREELEY, COL.—It is reported that the Greeley-Pouche Irrigation Company will soon award contracts for the construction of a power plant and irrigation system in northern Colorado, including the building of the Roosevelt reservoir, which is to be enlarged by the construction of a dam 400 ft. high. Lines will be erected to transmit electricity to Denver, which will be used to operate the tramway and interurban railways out of Denver. D. A. Canfield, of Greeley, and J. A. Beeler, president of the Denver Tramway Company, of Denver, are interested in the project.

MONTROSE, COL.—The Colorado Telephone Company is planning extetnsive improvements to its service throughout the State which will involve an expenditure of about $60,000, and will include the construction of a 20-mile line to the Escalante section in Delta County; a 12-mile extension, from Montrose to Bostwick Park, and a 3-mile extension from Olathe to an agricultural community to the northeast. Improvements will be made to the Delta system, which will involve an expenditure of about $8,000.

KILLINGLY, CONN.—The Killingly Power Company, recently incorporated, has acquired four water privileges in East Killingly. It is said that the company proposes to supply electricity for some of the electric railways in the eastern part of Connecticut.

WASHINGTON, D. C.—The electric lighting plant for furnishing electricity for lighting the book shelves, etc., for the Library of Congress will be erected by day labor, the electricians to be employed by Bernard R. Green, superintendent of the building. The cost of the equipment of the plant is estimated at $13,000, bids for which were opened Aug. 11.

TAMPA, FLA.—The Tampa-Sulphur Springs Traction Company, it is reported, is planning to extend its railway along Eighth Avenue to Thirty-sixth Street and on Fifth Avenue to Thirty-second Street. L. Brill is general manager.

ATLANTA, GA.—It is stated that the Central Georgia Power Company, which is erecting a 20,000 hp. power plant on the Ocmulgee River, near Jackson, will make its headquarters in Atlanta, Ga. The company will erect a large transforming station in this city. W. J. Massee is president of the company.

CUTHBERT, GA.—We are informed that an election will be held in October to vote on the proposition to issue bonds for improvements to the electric light plant, water-works and sewerage systems. J. B. McCrary, of Atlanta, Ga., is engineer.

DOUGLASVILLE, GA.—The city has issued $10,000 in bonds for improvements to the municipal electric light plant.

DUBLIN, GA.—P. L. Wade, S. M. Kellam, W. W. Robinson and associates have applied to the City Council for a franchise to construct and operate an electric railway over certain streets in Dublin.

SAVANNAH, GA.—The Twin City Power Company, holding a franchise to build a dam and construct an electric plant on the Savannah River at Augusta, has applied to the City Council for a franchise to sell power in Savannah. It is expected that similar franchises will be asked of other cities and towns in the State of Georgia.

WAYCROSS, GA.—The Waycross Electric Light & Power Company has submitted a proposition to the City Council, offering to dispose of its entire plant and holdings for the sum of $40,000. The company claims that the plant has been valued by an expert at approximately $60,000. The company, in lieu of the above, also offers to continue furnishing electricity to the town at a reduction of from 15 cents per kw-hour to 12 cents per kw-hour, with a special rate of 10 cents to large consumers of electricity for lighting purposes, etc. The company also offers to furnish street arc lamps at $60 instead of $75 per year, the present rate. The matter is still under consideration on the part of the town.

WHITESTONE, GA.—Several hydro-electric projects in this vicinity are being investigated by H. von Schon, consulting engineer, of Detroit, Mich., in the interests of the marble industries.

CALDWELL, IDAHO.—Plans are being considered for watering the proposed Gem Irrigation District. They involve the installation of a pumping plant on the Snake River in connection with the transmission of electricity from the Thousands Springs, a distance of 120 miles, to irrigate 32,000 acres. The cost of the transmission lines is estimated at $240,000.

MOUNTAIN HOME, IDAHO.—It is reported that the Slick Brothers' Construction Company is making preparations to commence work on the construction of a large power plant for the Crane Falls Power & Irrigation Company at Crane Falls. The company proposes to furnish electricity for pumping water for irrigation purposes and to various towns in this vicinity for lamps and motors.

HAGERMAN, IDAHO.—Plans are being prepared by H. A. Stroud and associates, of Hagerman, for the installation of a 75,000-hp electric plant and construction of an electric railway.

SANDPOINT, IDAHO.—The Northern Idaho & Montana Power Company has commenced work on the construction of its transmission line from Sandpoint, Idaho, which, when completed, will furnish electricity to Newport and intervening towns. Work will soon commence on the substation in Newport, which will cost about $20,000. Equipment for the building has already been ordered. The company has recently purchased the power and water plants at Kalispell, where it is planning extensive improvements.

BARRINGTON, ILL.—Negotiations are under way for the sale of the plant and holdings of the Barrington Electric Lighting Company. The system is to be purchased by a company which proposes to furnish electricity to all small towns between Barrington and Chicago. A. L. Robertson is manager of the Barrington Electric Lighting Company.

BENTON, ILL.—A proposition has been submitted to the City Council by F. O. Hamilton, of this city, and C. E. Hamilton, of Carbondale, Ill., proposing to take over the municipal electric light plant and building a new plant to supply the city with electricity for lamps and motors, and also water. The City Council has appointed a special committee, con-

sisting of two members of the Council and F. H. Stamper and W. W. McCreery, to make investigations of plants in other cities and if possible to come to an agreement with the parties in regard to the installation of the plant, and report its decision at the next meeting of the Council.

CHICAGO, ILL.—By the use of electricity generated by the drainage canal instead of by steam power the city has saved $72,542 in the street lighting system during the last year, and it is expected that more than $100,000 will be saved this year. In the annual report, published by William Carroll, city electrician, a saving in operating expenses of $3.69 and in water of $4.73 is shown on each of the 8602 lamps used by the city, and an increase of $3.31 per lamp in investment charges. Six plants and substations operated by energy purchased from the Sanitary District were operated during the first half of 1908, and since that time two new stations have been built. With all of the plants operating during 1909 a still greater reduction is expected in the cost of lighting the city. The net cost per lamp in the last ten years has varied from $60.98 to $52.93 in 1907. In 1908 the cost was reduced to $45.86 per lamp.

CHRISMAN, ILL.—The City Council has granted the Paris & Northern Railway Company, of Danville, Ill., a 50-year franchise to operate its electric railway in Chrisman. The railway will extend from Ridgefarm to Paris, a distance of 26 miles.

GENESEO, ILL.—The capital stock of the Geneseo Telephone Company has been increased from $2,500 to $10,000.

GLEN ELLYN, ILL.—The municipal electric light plant has been purchased by Carl S. Spaulding, with a 20-year franchise, who will make extensive improvements to the plant, including the installation of a 100-hp. Foos suction gas engine and a Smith gas producer to be installed within 30 days.

LA SALLE, ILL.—Plans are being prepared by the Citizens' Lighting Company for improvements and extensions to its plant, which will involve an expenditure of about $42,000, and will include the installation of a 300-kw steam turbine with pumps and condensers, a 200-kw, alternating-current generator and other equipment required for changing the lighting system from direct to alternating current.

MONMOUTH, ILL.—The residents of Aledo have raised a bonus of $10,000, to be given to the Rock Island Southern Railroad in consideration of building a branch road into Mercer County.

MONMOUTH, ILL.—The Monmouth Telephone Company is making arrangements to make extensions to its plant, which will involve an expenditure of about $20,000.

MOUNT MORRIS, ILL.—The electric plant of the Mt. Morris Electric Light & Power Company has been taken over by Kable Brothers Company, publishers. The company is installing a new plant, which will furnish electricity to operate its printing office and for lighting the town. A day service will be established about Nov. 1, 1909. H. J. Kable is secretary and treasurer, and C. H. Thomas, manager.

INDIANAPOLIS, IND.—Both the Central Union Telephone Company and the Indianapolis Telephone Company are erecting new branch exchange buildings at Irvington. The cost of each will be about $12,000.

NEW ALBANY, IND.—The Council has adopted a resolution authorizing the Board of Public Works to advertise for bids for lighting the streets of the city for a term of 10 years, beginning with Sept. 1, 1909.

NEW CARLISLE, IND.—Negotiations have been closed whereby the South Shore & South Bend Railway Company will supply the town of New Carlisle with electrical energy for a term of 25 years. The town has been operating a municipal electric plant, a direct-current, 220-volt system, in connection with the water-works plant. The company will supply alternating current, single phase, 25 cycles, 110-220 volts. It is expected that series tungsten street lamps will be installed. The citizens are anxious to have a day service established.

NOBLESVILLE, IND.—The Noblesville Heat, Light & Power Company has recently placed orders for additional equipment for its power house, which include a 300-kw, Allis-Chalmers turbine, two 200-hp Sterling boilers and auxiliaries. F. T. Holliday, of Indianapolis, Ind., is secretary and treasurer.

ALGONA, IA.—The Western Electric Company is reported to have purchased the controlling interest in the Algona Telephone Company. It is understood that extensive repairs and improvements will be made to the system.

CEDAR RAPIDS, IA.—Contracts have been awarded by the Cedar Rapids & Iowa City Railway & Light Company for improvements to its power house in Cedar Rapids, aggregating $125,000. The output of the plant will be increased to 8000 kw. H. M. Byllesby & Company, of Chicago, Ill., are consulting engineers.

GRINNELL, IA.—The City Council has accepted the proposition of the Grinnell Electric Light & Heating Company to replace the present street arc lamps for tungsten lamps. It is proposed to install 180 tungsten lamps of 80 cp, which will greatly improve the street lighting system without additional cost to the city.

MARSHALLTOWN, IA.—The Mason City & Clear Lake Railway Company is reported to have placed orders for equipment for a new power plant, which includes a 2000-hp turbine engine and a 500-hp motor generator set for a substation at Clear Lake. When the new plant is completed the old power plant at Emery will be abandoned.

MARSHALLTOWN, IA.—H. W. Darling, of Chicago, Ill., is reported to have applied to the City Council for a franchise to install an electric light plant and street railway system.

WATERLOO, IA.—Extensive improvements and extensions are planned by the Waterloo, Cedar Falls & Northern Railway Company which will involve an expenditure of about $500,000 and include an extension from Denver Junction to Waverly, a distance of six miles, the reconstruction and double tracking of its lines between Waterloo and Cedar Falls, the erection of a car house and shops and increasing the output of the power station. C. D. Cass, of Waterloo, is general manager.

COUNCIL GROVE, KAN.—The City Council has granted H. H. Sparks, of Junction City, Kan., a franchise to construct and operate an electric light and pawer plant in Council Grove.

LUCAS, KAN.—The installation of an electric light plant and water works system are under consideration, plans for which are being prepared by the J. S. Worley Company, engineers, of Kansas City, Mo. The cost of the proposed plant is estimated at $30,000.

ST. JOHNS, KAN.—Bids will be received [illegible] September 15 by Burns & McDonnell, Scarritt Building, Kansas City, Mo., for the construction of an electric light plant, water works and sewer systems, for which $40,000 in bonds have been voted.

WICHITA, KAN.—The Arkansas Valley Interurban Railway Company is reported to have completed preliminary surveys for its proposed electric railway from Wichita to Hutchinson, a distance of 50 miles. J. D. Hodgson is constructing engineer.

NEW IBERIA, LA.—The Board of Commissioners of Electric Lights and Water Works has petitioned the City Council for permission to issue $45,000 in bonds, the proceeds to be used to secure the services of a consulting engineer, installation of complete new equipment for electric lighting plant and pumping station for water works, renovating of electric transmission lines, providing meters for entire new system and for extension of both water and lighting systems.

NEW ORLEANS, LA.—Bids will be received until September 7, at the office of the supervising architect, Washington, D. C., for mechanical equipment (excepting elevators), including plumbing, gas fitting, boiler plant, heating and ventilating system, electric generating system, vacuum cleaning system and clock system, for the U. S. post office and court house building at New Orleans, La., in accordance with the drawings and specifications, copies of which may be obtained at the above office, or at the office of Hale & Rogers, architects, 11 East Twenty-fourth street, New York, N. Y. James Knox Taylor is supervising architect.

SPRINGFIELD, LA.—A telephone company is being organized in this place to construct a telephone line to Hammond, via Brakenridge's Mill and Albany, which will probably be extended to Centerville, Clio and the French Settlement.

BELFAST, MAINE.—Permission has been granted to the Penobscot Bay Electric Company to erect its transmission lines from Searsport over the back road to Swan Lake Avenue, thence to Belfast. The company is planning to furnish electricity to operate the works of Coe-Mortimer Company by Nov. 1.

PORTLAND, MAINE.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until August 27, for installing a vacuum cleaning system in the U. S. post court house at Portland, Maine, in accordance with drawings and specifications, copies of which may be secured at the above office, or at the office of the custodian, Portland, Maine. James Knox Taylor is supervising architect.

HAGERSTOWN, MD.—The Hagerstown Railway Company contemplates the purchase of a 1000-hp condenser for its power plant at Hagerstown immediately. H. C. Alvey [illegible] engineer.

UNION BRIDGE, MD.—The Tidewater Portland Cement Company, 115 Broadway, New York, N. Y., has awarded the contract for designing and erecting its new 3000-bbl. cement plant in Union Bridge to the Fuller Engineering Company, of Allentown, Pa. The plant will be operated by electricity throughout. Contracts for machinery will soon be let, specifications for which will be made by the Fuller Engineering Company, which will also receive bids for the equipment, but the purchases will be made by the Tidewater Portland Cement Company. John K. Tener, of Charleroi, Pa., is president of the company and Joseph T. Fanning, of New York, N. Y., vice-president.

ATTLEBORO, MASS.—Work has commenced on the construction of the new plant to be erected by Frank Mossberg Company, of Attleboro, at a cost of $50,000. Power for operating the plant will be furnished by a steam or gas engine direct connected to a generator. Many of the larger machines will be operated by independent motors.

BELCHERTOWN, MASS.—The citizens are considering the question of establishing an electric lighting system in the town. A special town meeting will soon be called to take action on the matter.

WAREHAM, MASS.—The Buzzards Bay Lighting Company has been awarded the contract for installing electric lamps in the Town of Wareham. The company is planning to furnish electricity in all the towns from Wareham to Falmouth. Eugene Carpenter is interested in the company.

WESTFIELD, MASS.—The Western Massachusetts Street Railway Company has applied to the Board of Selectmen for a franchise to extend its railway in Westfield.

WESTFIELD, MASS.—The contract for extensions to the municipal electric power plant has been awarded to the Westinghouse Electric & Manufacturing Company, for $24,322. The output of the plant will be increased by 900 hp and the equipment will include a 750-kw, horizontal

turbine engine, generator, switchboard, meters and Terrill regulators. George Pettibone is manager of the municipal electric plant.

WILLIMANSETT, MASS.—The citizens are contemplating the installation of an electric lighting system, the service to be furnished from the municipal electric light plant at Chicopee, Mass.

WORCESTER, MASS.—A permit has been granted to the Connecticut River Transmission Company to erect a transformer station in Greendale, to cost $10,000. J. G. White & Company, of New York, N. Y., are engineers and Fred T. Ley & Company, contractors.

BEMIDJI, MINN.—The Warfield Electric Company has applied to the City Council for a renewal of its franchise in this city, which will soon expire.

LAKE CITY, MINN.—Plans are being considered for the installation of a 100-kw turbine this year. E. V. Lombard is superintendent.

ROCHESTER, MINN.—The Zumbro Power Company, it is stated, proposes to erect a power plant at Zumbro Fall, 14 miles north of Rochester, to supply electricity for lamps and motors.

BILOXI, MISS.—Plans are being made by the Cumberland Telephone Company for rebuilding the local telephone system, at a cost of about $22,000.

JOPLIN, MO.—It is reported that plans have been perfected by Henry L. Doherty & Co., New York, N. Y., for the construction of a large power plant, the site for which has not yet been definitely announced. The initial installation will cost about $2,000,000, and will have an output of 15,000 hp, with provisions to increase it to 60,000 hp at a cost of $6,000,000. The transmission lines will be extended throughout the entire lead and zinc belt. Work will soon commence on surveying the route for extensions to Carthage, Alba, Neck City, Spring City, Baxter Springs, Granby, Neosho and other towns. It is understood that all transmission lines in Joplin, Webb City and Galena will be rebuilt.

ST. JOSEPH, MO.—The Home Telephone Company has awarded contract for the construction of an exchange building on Tenth Street, to the Selden-Breck Construction Company. The cost of the building is estimated at $80,000. The company has taken over the system of the Andrew County Mutual Telephone Company under a lease for a term of 43 years. The Home Telephone Company will begin work at once on the erection of copper circuits to connect with the lines of Andrews County company.

ST. LOUIS, MO.—Arrangements are being made by the Courtney Shoe Company for enlarging its power plant with a view of supplying electricity for lamps and motors for the entire plant. Proposals will be received by William H. Bryan, 315 Lincoln Trust Building, St. Louis, Mo., consulting engineer for the company, for one 200 hp. high-speed Corliss engine; one 125 kw., three-wire, direct-current generator, and twelve 230-volt motors of various sizes.

STEVENSVILLE, MONT.—It is reported that the Bitter Root Irrigation Company, of Bitter Root, will install an electric light system.

BEATRICE, NEB.—The New Home Telephone Company is planning to extend its rural telephone lines to all parts of Gage County from the Beatrice exchange, and also proposes to establish a direct copper circuit with Barneston, Pawnee City, Liberty, Tecumseh and Fairbury. The cost of the work is estimated at about $25,000.

CRAB ORCHARD, NEB.—The plant and holdings of the Crab Orchard Telephone Company have been purchased by the Nebraska Telephone Company. The price paid for the system is said to have been $19,500.

EDGAR, NEB.—At a special election held Aug. 5 the citizens voted to issue $5,000 in bonds to purchase an electric light plant. The town holds an option of $4,000 on the plant of the Edgar Light & Power Company, which will be paid from the bonds voted, and the remainder will be used to install new equipment in the plant.

FAIRBURY, NEB.—Plans are being made by the Fairbury Telephone Company to improve its service, which will include the erection of three copper metallic circuits to Beatrice, at a cost of $10,000. This will give Fairbury direct communication with St. Joseph, Kansas City and St. Louis.

HASTINGS, NEB.—Preparations are being made for increasing the output of the municipal electric light plant and water works, which will include the installation of a generator direct connected to turbine and condenser. It is stated that bids have been received by the Council for the above equipment.

O'NEIL, NEB.—The citizens are contemplating the installation of an electric lighting system in O'Neil. It is expected to have the plant in operation before the coming winter.

STANTON, NEB.—Plans are being considered for extensions to the municipal electric light plant, which will include the installation of a 75-kw. generator, 50 tungsten street lamps and the erection of three miles of transmission lines. Benjamin Henning is manager.

BERLIN, N. H.—The power house of the Cascade Electric Light & Power Company was destroyed by fire Aug. 8, causing a loss of about $100,000. The company furnished electricity for lighting the streets and for the street railway. Electrical service for the street lamps will be furnished by the generator located in the Burgee mill, but the street railway will be out of commission until arrangements can be made to secure power from the Berlin Electric Company.

MANCHESTER, N. H.—The Manchester & Derry Electric Company has filed an amendment to its charter increasing its capital stock from $200,000 to $240,000.

MILTON, N. H.—Work has been commenced by the Great Falls Manufacturing Company on the development of its water privileges at Milton, N. H., for the purpose of furnishing power for an electric light plant in Milton. It is expected to have the plant completed before the coming winter.

ESPANOLA, N. M.—Preparations are being made by the Espanola Milling & Elevator Company for the construction of a 2,000 hp. electric plant on the Santa Cruz River, north of Espanola. George Bond, of Trinidad, Col., and Frank Bond, of Espanola, are interested in the project.

PORTALES, N. M.—It is reported that bids will be received about September 15 by H. B. Ryther, city clerk, for the construction of an electric light plant and water works system. The cost of the work is estimated at $50,000. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are the engineers.

BALDWINSVILLE, N. Y.—The Seneca River Power Company has commenced work on the construction of a new power plant at Baldwinsville, which will be equipped with three 100-kw generators direct connected to water wheels. The company will also use electricity generated at Niagara Falls and Seneca River water power. In addition to furnishing electricity for lamps the company will furnish electrical energy to industrial plants in Baldwinsville. Plans are being considered to increase the number of street lamps from 28 to 65, for which the company has quoted a price of $75 each per year.

BALLSTON, N. Y.—The Town Board has granted the Schenectady Railway Company a franchise to erect a transmission line across the Ballston Lake Road and the town's half of the town line road between Ballston and Malta. The company proposes to construct a transmission line from its new power station on the Buell farm, south of Ballston Spa, to the power house on the Hudson Valley line at Round Lake. The railway company will eventually receive electrical energy from the Delaware and Hudson station, near Mechanicville, making it independent of the Spier Falls plant.

BERLIN, N. Y.—The Berlin Electric Light, Heat & Power Company has been granted permission by the Public Service Commission, Second District, to issue $5,000 in capital stock for improvements and extension to its plant, and has also approved of the extension of the distributing system from Berlin to Petersburg, N. Y.

FULTON, N. Y.—The Niagara-Oswego Power Company has made a second application to the City Council for a franchise to furnish electricity in this city.

FREWSBURG, N. Y.—The Home Telephone Company of Frewsburg has purchased the plant and holdings of the Ivory Telephone Company, of Ivory, N. Y., and will take possession of the system Oct. 1.

GOUVERNEUR, N. Y.—The Village Board has awarded the contract for lighting the streets of the village for the next five years, commencing next October, to the Oswegatchie Light & Power Company. The company is to furnish arc lamps for $45 each per year with an all-night service, and 32-cp incandescent lamps for $10 per lamp per year. This will result in a saving of $1,000 per year on the present rates.

HILTON, N. Y.—The Village Trustees have awarded a contract to John E. Spencer for the installation of a street lighting system which calls for 43 tungsten lamps, 25 lamps of 40 cp and 18 of 32 cp, at an annual cost of $500 per year, with the privilege of adding any number of lamps at any time at the same rate. The system is to be installed on or before Nov. 1, 1909. Mr. Cooper was recently granted a franchise to erect an electric plant in the town.

SAG HARBOR, N. Y.—The Sag Harbor Electric Light & Power Company contemplates establishing a day service. George Kiernan is owner and manager.

SALEM, N. Y.—Plans are being considered by the Salem Light, Heat & Power Company for the installation of a day service for both lamps and motors; also the installation of an auxiliary gas engine of 150 hp for use in case the water supply gives out, and also to extend the power service to Raleigh, four miles distant. The power station of the company is located about four miles from the village on Battenkill Creek. W. H. Simpson is superintendent.

SIDNEY, N. Y.—Application has been made to the Board of Trustees by E. C. Bennett, of Pulaski, N. Y., for a franchise to construct an electric street railway from Sidney to Treadwell. The proposed railway will connect Sidney and Franklin.

CONCORD, N. C.—Work has been started on the grading of the new local street railway system for this town. J. T. Vanderford, of Salisbury, N. C., is interested in the project. Plans are also being considered for the electrical development of the section north of Concord.

LEXINGTON, N. C.—C. A. Hunt, Jr., manager of the Nokomis Cotton Mills, the Wennonah Cotton Mills and the Dacotah Cotton Mills, is making arrangements to operate the mills by electricity, which will be supplied from the Lexington transmission system of the Southern Power Company, of Charlotte, N. C. Electrical apparatus for changing the machinery to motor drive has been purchased. The plants operate about 34,200 spindles and 1,080 looms, and will require about 2,000 hp. of electrical energy.

WAKE FOREST, N. C.—Contracts have been awarded for construction and equipment of the new municipal electric lighting plant in Wake Forest. It is expected to have the system in operation by the middle of September. All the college buildings have been wired and will be furnished electrical service from the new power station.

CANAL DOVER, OHIO.—The Board of Public Service is asking for bids, to be opened August 21, for the installation of a complete electric lighting system, including a building 30 x 50 ft.; two 250-hp. gas engines; two 150-kw. three-phase, 60-cycles, 2,300-volt generators; 133 arc lamps, together with necessary switchboards, instruments and pole line construction.

CLEVELAND, OHIO.—The stockholders of the Cleveland Electric Illuminating Company have authorized a bond issue of $30,000,000, the proceeds to be used for future improvement and acquisitions.

CLEVES, OHIO.—A 25-year franchise has been granted to P. M. Hans to furnish electricity for light, heat and power in the village of Cleaves; also a contract for street lighting for a term of ten years with 20 or more 2000-cp arc lamps at $60 per lamp per year, on a moonlight schedule. Incandescent lamps will also be used for street lighting, the territory to be determined later. Electricity will be furnished to private consumers at a maximum rate of 10 cents per kw-hour. The company has not yet been organized and the system to be installed has not been decided upon.

COLUMBUS, OHIO.—Bids will be received until Sept. 9 for improvements to the penitentiary, which will include the installation of a power plant. An appropriation of $200,000 has been made for the work. Mariott & Allen, of Columbus, are architects and the Osborne Engineering Company, of Cleveland, Ohio, engineers. George A. Marvin is secretary of board of managers.

DAYTON, OHIO.—The Starbuck Electric Company, recently incorporated, with a capital stock of $25,000, has purchased the plant of the Starbuck Light & Power Company. It is said that the new company will make additions to the system.

IRONTON, OHIO.—William Lenley, representing A. E. Cox and associates, of Huntington, has applied to the County Commissioners for a franchise to construct an electric railway from Gallipolis to Ironton.

IRONTON, OHIO.—Application has been made to the County Commissioners by Thurman Braley, of Proctorville, for a franchise to construct and operate an electric railway from Ironton to Millersport.

NORTH BEND, OHIO.—P. M. Hans has been granted a 25-year franchise to furnish electricity for light, heat and motors in North Bend, and also a 10-year contract to light the streets of the village for a period of 10 years, to include 10 or more 2000-cp arc lamps.

MUSKOGEE, OKLA.—L. H. McHenry has applied to the City Council for a franchise to operate a lighting system in Muskogee.

OKEMAH, OKLA.—The contract for constructing an electric light plant and water works system for the town of Okemah has been awarded to the Squires Electric & Construction Company, of Kansas City, Mo. M. A. Earl & Company, of Muskogee, Okla., are consulting engineers.

RALSTON, OKLA.—At a special election held recently the citizens voted to issue $25,000 in bonds for the construction of an electric light plant and water works.

PORTLAND, ORE.—The Portland Railway, Light & Power Company has purchased a 200-kw, 2300-volt, 60-cycle synchronous motor of the Allis-Chalmers Company, of Milwaukee, Wis. W. H. Phillips is vice-president.

SPRAY, ORE.—D. A. Horron is reported to be making preparations to install a large water wheel to operate a pumping plant next season. If sufficient power can be secured a small electric plant will be erected.

BRISTOL, PA.—The Borough Council has awarded the contract for lighting the streets of the borough to the Bristol Electric Light & Power Company for a term of five years. The company is to furnish 17 arc lamps of 2000 cp at $95 each per year, and not less than 125 incandescent lamps at $20 each per year. Under the present contract the borough is paying $96 per arc lamp per year and $21.60 each for incandescent lamps.

FRANKLIN, PA.—The Petroleum Telephone Company is planning to place a portion of its telephone wires in Franklin underground this year.

HARRISBURG, PA.—The Central Pennsylvania Traction Company has decided to build several extensions in this city and also to rebuild the Third and Sixth Streets lines.

JOHNSTOWN, PA.—The Citizens' Light, Heat & Power Company will soon commence work on the erection of a transmission line which will supply electricity to the residents between Luna Park and Benscreek. The company has also closed a contract with the Valley Coal & Stone Company to furnish electricity to operate its mines; the equipment will include a 40-hp motor, a 150-hp motor-generator set, and two electric locomotives. August Weis is superintendent of the Citizens' company.

NORTHUMBERLAND, PA.—The Northumberland County Railway & Light Company is contemplating the extension of its railway in Northumberland to provide for the $3,000,000 construction work now being done by the Pennsylvania Railroad. The company also contemplates making connections with the electric railway at Lewisburg, Milton and Watsontown, during the present year. G. Parkman is secretary.

ORVISTON, PA.—The Hayes Run Fire Brick Company, of Orviston, it is reported, will erect a new fireproof building to replace the one recently destroyed by fire. The equipment will include a 300-hp engine, a smaller engine and generator, belting, shafting, elevator, conveyor, brick presses, etc. C. W. Keller is manager.

PITTSBURGH, PA.—The Pittsburgh & Lake Erie Railroad Company is considering plans for changing the motive power of its suburban lines between this city and Beaver. It is proposed to use gasoline-electric cars.

SCHUYLKILL HAVEN, PA.—Plans are being considered for the reconstruction of the municipal electric light plant.

SPEERS, PA.—The West Penn Electric Company, it is reported, is planning to erect a generating plant at Speers, opposite Belle Vernon, at an estimated cost of $1,000,000. G. R. Folds, of Connellsville, Pa., is general manager.

WERNERSVILLE, PA.—It is reported that the Wernersville Electric Light, Heat & Water Power Company proposes to enlarge its plant.

PROVIDENCE, R. I.—The Narragansett Electric Lighting Company is planning to install new magnetite open arc lamps on the principal squares in this city.

SUMTER, S. C.—The Sumter Telephone Company is planning to install the common battery system, at a cost of about $12,000.

WOONSOCKET, S. D.—The question of installing an electric lighting system in Woonsocket is under consideration.

HUMBOLDT, TENN.—The Missouri, Tennessee & Georgia Railroad Company has applied to the Board of Aldermen for a 45-year franchise to construct and operate its proposed electric railway over certain streets in Humboldt. The company proposes to construct a railway from Humboldt to Dyersburg, a distance of 35 miles. I. H. Dungan is president and general manager.

CANADIAN, TEX.—The Canadian Long Distance Telephone Company has increased its capital stock from $10,000 to $20,000.

DALLAS, TEX.—The Dallas Telephone Company has applied to the Board of Municipal Commissioners for permission to lay conduits for telephone wires in several streets in the city.

GREENVILLE, TEX.—J. W. Crotty and L. A. Miller, of Dallas, Tex., have applied to the City Council for a franchise to construct an electric railway in Greenville.

HOUSTON, TEX.—L. A. Anderson, representing the Westmoreland Railroad Company, has been granted a franchise by the County Commissioners to build an electric railway from Houston to the Westmoreland Farm, near Bellaire, a distance of seven miles. W. W. Baldwin is interested in the enterprise.

HOUSTON, TEX.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until August 27, for installing a vacuum cleaning system in the U. S. post office and court house building, at Houston, Tex., in accordance with plans and specifications, copies of which may be secured at the above office or of the custodian at Houston, Tex. James Knox Taylor is supervising architect.

PORT ARTHUR, TEX.—The contract for the construction of the Port Arthur Railway has been awarded to H. E. Talbott & Company, of Dayton, Ohio. A charter will soon be applied for by the company, which will be known as the Port Arthur Traction Company. H. J. Myers will be president and general manager. The headquarters of the company are located at 503 Reobold Building, Dayton, Ohio.

SHERMAN, TEX.—Arrangements have been completed by the receiver of the Grayson County Telephone Co. for extensions and improvements to the telephone systems in Denison and Sherman owned by the company. The present plan provides for 300 additional instruments in Sherman and 200 in Denison and also the erection of a telephone line between Sherman and Greenville. C. A. Shock is receiver.

TEXAS CITY, TEX.—The Texas City Terminal Company has contracted with the Westinghouse Electric & Manufacturing Company to erect a large power plant to operate the wharf loading and unloading machinery. The power plant will be located inside of the town and electricity transmitted to the wharves to operate the trams and cranes. The cost of the plant is estimated at more than $100,000.

MODENA, UTAH.—Plans have been approved for the construction of a large power plant for the Gold Springs Mining & Power Company at Modena, work on construction of which will begin as soon as material can be secured. C. A. Short is president of the company.

BRATTLEBORO, VT.—It is reported that an agreement has been made between the Connecticut River Transmission Company and the Fitchburg Gas & Electric Company, of Fitchburg, Mass., whereby the local company will handle all of the electrical energy furnished by the Connecticut company in Fitchburg. Under the franchise of the power company it has the right to furnish electricity in units of 300 kw. to consumers, but has not the privilege of using the streets for either overhead or underground transmission, except to cross certain streets with its lines for the purpose of carrying its lines in and out of the city.

COEBURN, VA.—The Coeburn Light & Power Company is contemplating the installation of an ice plant and water-works system in the near future. T. B. Helliman is owner.

LURAY, VA.—Plans are being considered to replace the dam on the Shenandoah River, owned by the Shenandoah River Light & Power Com-

pony with a concrete structure. The company furnishes electricity for lamps in Luray and the Luray caverns.

RICHMOND, VA.—The Common Council on August 4 confirmed the award made by the committee on electricity to Hotchkiss & Gordon, agents of the General Electric Company, Schenectady, N. Y., for electrical equipment for the new municipal electric light plant. The amount involved in the contract is $96,592, the city reserving a 90-day option on the use of the lamps, transformers, and cut-outs now in use by the Virginia Railway & Power Company, in which event the price is to be reduced to $86,682. E. W. Trafford was engaged as supervising engineer of construction.

BELLINGHAM, WASH.—The Whatcom County Railway & Light Company has petitioned the City Council for a franchise to extend its line on Donovan Avenue.

HANFORD, WASH.—The Hanford Irrigation & Power Company has placed a contract with the Allis-Chalmers Company, of Milwaukee, Wis., for a duplication of the generating system of its plant at Priest Rapids, which will include one 1,000 hp. vertical triplex, open-flume turbine; one oil pressure governor complete; one 900-kw., 60-cycle, 2,200-volt alternator; three 400-kw., oil-filled, water-cooled transformers and switchboard complete. The present equipment of the plant was furnished by the Allis-Chalmers Company.

HOQUIAM, WASH.—Extensive improvements are contemplated by the Pacific States Telephone & Telegraph Company, which will involve an expenditure of $100,000.

ODESSA, WASH.—The Town Council is reported to have granted the Washington Water Power Company, of Spokane, Wash., a franchise to furnish electricity in this city. A transmission line will be extended from the Harrington-Sprague line to Odessa, a distance of about 20 miles. The cost of the transmission line and the distributing system is estimated at $50,000.

SEATTLE, WASH.—The City Council has passed an ordinance requiring all public service corporations to place their wires underground in the business district of the city.

TACOMA, WASH.—Plans for the proposed municipal power plant on the Nisqually River have been changed to develop 30,000 hp instead of 20,000 hp, as originally intended. The plans call for the construction of a dam 45 ft. high and 45 ft. at the base. A station will be erected at South C and Twenty-fifth Streets in this city. The cost of the entire plant is estimated at $2,000,000. Frank C. Kelsey is engineer in charge of the work.

TACOMA, WASH.—Proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until August 31, for installing a vacuum cleaning system in the U. S. post office, court house and custom house, Tacoma, Wash., in accordance with drawings and specifications, copies of which may be obtained at the above office or of the custodian, Tacoma, Wash. James Knox Taylor is supervising architect.

LARSEN, WIS.—The capital stock of the Larsen Telephone Company has been increased from $5,000 to $10,000.

LINDEN, WIS.—A franchise has been granted to the Mineral Point Electric Light Company, of Mineral Point, Wis., to furnish electricity for lamps and motors in Linden. F. C. Ludden, of Mineral Point, is manager.

MELLEN, WIS.—The Mellen Water & Light Company, it is said, will make extensions and improvements to its plant if granted a 15-year contract by the city.

MILWAUKEE, WIS.—It is reported that Mayor D. S. Rose will recommend the installation of electric generating machinery in the garbage incinerating plant to furnish electricity for lighting the suburbs. Rudolph Hering, 110 Broadway, New York, N. Y., is consulting engineer.

CALGARY, ALB., CAN.—Plans have been completed by Smith, Kerry & Chace, of Toronto, Ont., and contracts will soon be awarded for the construction of the main dam, headworks, power house, retaining walls, erection of steel racks, penstocks, sluice gates and other work necessary for the plant of the Calgary Power & Transmission Company, on the Bow River, about 45 miles west of Calgary.

BERLIN, ONT., CAN.—The ratepayers have approved the by-law to raise $10,000 for double tracking a section of the Berlin & Waterloo Street Railway between Berlin and Waterloo.

CORNWALL, ONT., CAN.—Plans are being considered for the construction of a large power plant at the foot of the Long Sault Rapids, near Cornwall, the plant to be built and managed jointly by the Long Sault Development Company, on the American side, and the St. Lawrence River Company, on the Canadian side. The latter company already operates a plant at Mill Roches, which furnishes electricity for lamps and motors at the locks and in Cornwall. Under the present plan it is proposed to utilize the Long Sault Rapids as a head race for three large power houses, and will include the construction of a large dam 4,000 ft. in length, from the lower part of the rapids to the upper end of Barnhart's Island, to bring the waters of the Sault to the power houses, the construction of three power houses, straightening of the course of the river channels and other engineering work, which will involve an expenditure of about $20,000,000. It is estimated that 100,000 hp. can be developed. The companies are trying to secure a charter from the Canadian Parliament and the United States Congress.

TORONTO, ONT., CAN.—Contracts for the construction of eight transformer stations have been awarded by the Hydro-Electric Power Commission. The contract for constructing the stations at St. Mary's, Stratford, Berlin and Guelph was awarded to Edge & Gutteridge, of Seaforth, at a cost of $18,000 each; the buildings at Preston, Paris, Woodstock and St. Thomas will be erected by John Hayman & Son, of London, for $19,850 each.

MONTREAL, QUE., CAN.—Work has commenced on the construction of the electric plant of the Canadian Light, Heat & Power Company at St. Timothee. It is the intention of the company to develop 21,000 hp., which will involve an expenditure of $2,400,000. It is claimed that 72,000 hp. can be obtained by deepening and widening the canal.

New Industrial Companies.

THE AMERICAN ELECTRIC TOOL COMPANY, of Petersburg, Va., will be incorporated, with a capital stock of $1,000,000, and the following-named officers: Louis Paulero, president; W. G. Andrews, vice-president; W. H. Wilcox, secretary and treasurer. The company is a reorganization of the Virginia Electric Tool & Manufacturing Company, which manufactures electric hammers and other appliances, and will take over the assets of the old company and enlarge the plant.

THE BONOM INTERNATIONAL STEAM TURBINE COMPANY has filed articles with the Secretary of State at Dover, Del., with a capital stock of $1,000,000. The incorporators are: G. R. de Montlord, A. T. de Montlord and T. A. Schneider, Jr., of Winslow, N. J.

THE CAPITOL HILL GAS & ELECTRIC MANUFACTURING & SUPPLY COMPANY, of Capitol Hill, Okla., has been incorporated, with a capital stock of $5,000, to manufacture gas and electric supplies. The incorporators are: A. W. Aubrey, W. L. Harmon, of Capitol Hill, and D. F. Sullivan, of Oklahoma City, Okla.

THE DELAWARE CONSTRUCTION COMPANY, of Wilmington, Del., has filed articles of incorporation with a capital stock of $25,000. The incorporators are: J. B. Talley, W. P. Jorde, H. H. Thayer, Jr., and M. S. Molloy, of Wilmington, Del.

THE ELECTRIC CLEANING COMPANY, of Fayetteville, N. C., has been chartered by F. H. Bradley and associates, with a capital of $25,000, to operate electrically driven renovating machines ,etc.

THE ELECTRICAL INDUSTRIES MANUFACTURING COMPANY, of New York, N. Y., has been chartered, with a capital stock of $40,000, by J. S. Leach, E. W. F. Mammen, E. M. Mammen and K. E. Leach, of Brooklyn, N. Y. The company proposes to manufacture electrical, medical, surgical and scientific apparatus, tools, dies and devices.

THE GELBERT VON NAGY ENGINEERING & MANUFACTURING COMPANY, of Brooklyn, N. Y., has filed articles of incorporation with a capital stock of $25,000, as mechanical and electrical engineers, machinists, founders, metal workers, etc. The incorporators are: J. Gelbert, D. von Nagy and N. Waxman, of Brooklyn, N. Y.

THE GEORGE L. FISH ELECTRIC COMPANY, of Lafayette, Ind., has been incorporated with a capital stock of $25,000 for the purpose of manufacturing electrical supplies. The directors are: George L. Fish, John McHugh and W. F. Frey.

THE GRIMM MANUFACTURING COMPANY, of Buffalo, N. Y., has filed articles of incorporation, with a capital stock of $5,000. The incorporators are: John M. Hull, Edward L. Grimm and Morgan P. Jackson, all of Buffalo, N. Y. The company proposes to manufacture motors, engines and wood-working machinery.

THE HALL CAR COMPANY, of New York, N. Y., has been incorporated by T. M. May, B. H. Howell and H. P. Hall. The company is capitalized at $20,000 and proposes to manufacture engines, motors, cars, locomotives and vehicles of all kinds.

THE HARRISON ENGINEERING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $500,000 to manufacture machinery, particularly for heating and ventilation. The incorporators are: P. B. Gibson, H. E. Harris, both of New York, N. Y., and B. S. Harrison, of Brooklyn, N. Y.

THE ILLMER GAS ENGINE COMPANY has filed articles of incorporation with the Secretary of State at Dover, Del. The company is capitalized at $100,000, and the incorporators are: L. Illmer, Jr., W. Bohren, Cincinnati, Ohio, and E. J. Kunze, of Newark, N. J.

THE JACKSON PERFECT METER LOCK COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000, for the purpose of manufacturing meter locks. The incorporators are: E. J. Forhan, H. M. Browne and J. J. Harper, all of New York, N. Y.

THE KELLER-McMANUS COMPANY, of Camden, N. J., has been incorporated by S. Moor, W. R. Watson and F. A. Kuntz, of Camden, N. J. The company proposes to manufacture portable or stationary vacuum dry cleaning machinery, etc.

THE McCARTNEY BOILER COMPANY, of Bessemer, Ala., has been incorporated by James McCartney, of Mobile, Ala.; W. J. Long, G. H. Stevenson, H. E. Bumby, Albert Ross and W. W. Hollinsworth, of Bessemer, Ala. The company is capitalized at $50,000 and proposes to manufacture boilers, engines and other power-plant equipment.

THE PERFECT GAS CONTROLLER & FIXTURE COMPANY, of Chicago, Ill., has been chartered with a capital stock of $30,000, by H.

A. Hill, F. J. Ellis and C. J. L. Anderson. The company proposes to manufacture gas and electric fixtures.

THE P. & W. VACUUM CLEANING COMPANY, of New York, N. Y., has been chartered by Walter Thompson, Jr., D. G. C. Levick, of New York, N. Y., and Manfred S. Uhlfelder, Yonkers, N. Y. The company proposes to manufacture vacuum carpet-cleaning machines.

THE SOUTHERN ENGINEERING COMPANY, of Texarkana, Ark., has been chartered by J. Graham Miller, president; J. M. Walsh, vice-president, and H. M. Barney, secretary and treasurer. The company proposes to act as manufacturers' agents for gas, steam, electrical equipment, supplies, etc. A number of high class agencies have already been secured and the company is prepared to handle any proposition offered.

THE UNITED INVENTIVE COMPANY, of New York, N. Y., has been granted a charter with a capital stock of $50,000, to manufacture "Flaming Beak Ignition" spark plugs, coils and electrical machinery and supplies. The incorporators are: J. W. Ebbs, of Englewood Cliffs, N. J.; H. H. Nieman, of New York, N. Y., and A. A. Kelly of Montclair, N. J.

THE UNIVERSAL CARTRIDGE COMPANY, of New York, N. Y., has been chartered, with a capital stock of $10,000, to manufacture mill supplies, engines, boilers, etc., by Joseph B. Doran, John J. Doran and R. A. Greenblatt, all of Yonkers, N. Y.

THE VIR CONSOLIDATED ENGINEERING COMPANY, of Portland, Maine, has been incorporated with a capital stock of $250,000 for the purpose of manufacturing machinery, engines, etc. C. E. Eaton is president and A. F. Jones treasurer.

THE WARNER ELECTRIC COMPANY, of Muncie, Ind., has been incorporated with a capital stock of $100,000. The object of the corporation is to establish, equip and operate a large plant for the manufacture of electric machinery, devices, supplies, etc. A. L. Johnson, W. E. Hitchcock, R. C. Stone and C. E. Davis are directors.

Company Elections.

MAQUOKETA, IA.—At the annual meeting of the Barnes Electric Light & Power Company the following officers were elected: A. B. Bowen, president; C. Von Schrader, treasurer; E. W. Farr, vice-president; J. F. Barnes, secretary.

GARDNER, MASS.—At the annual meeting of the Gardner Electric Light Company held recently the folowing-named officers were elected: Arthur P. Derby, president; Thatcher B. Dunn, vice-president, and Francis S. Whittemore, treasurer and clerk.

SUPERIOR, WIS.—At the annual meeting of the Superior Water, Light & Power Company the following officers were elected: William R. Merriam, of Washington, D. C., president; Robert R. Dunn, of St. Paul, Minn., vice-president; V. M. Watkins, of St. Paul, Minn., treasurer, and W. H. Winslow, of Superior, secretary and general manager.

New Incorporations.

JONESBORO, ARK.—The People's Telephone Company has been organized with a capital stock of $10,000, to construct and operate telephone lines throughout the eastern part of Craighead County.

SANDPOINT, IDAHO.—The Idaho Power & Concentrating Company has been incorporated by R. C. Reinerston, of Park River, N. D.; Ralph Reinerston and G. H. Hipke, of Sandpoint, Idaho; C. L. Finneseth, of Park River, N. D., and A. K. Erickson, of Story, Ia. The company is capitalized at $500,000 and proposes to develop the water power of Trestle Creek between Sandpoint and Hope, Idaho, and also proposes to erect a concentrating plant on the lake shore near the Northern Pacific Railway tracks east of Sandpoint. It is proposed to develop 1000 hp, which will be used to operate the concentrator plant; also the mining properties on the lake shore. Electricity will also be transmitted to Sandpoint and other places.

BROOKPORT, ILL.—The Ohio Valley Traction Company has been chartered to construct an electric railway from a point near Golconda, via Brookport, to Joppa, Ill. The company is capitalized at $10,000, and the incorporators are: O. H. Margrave, G. W. Tucker, William Pell, H. W. Holifield and William Harrington, of Brookport; Chenault Webb and Robert C. Leeper, of Unionville, and C. L. Robertson, of Paducah, Ky.

WESTFIELD, ILL.—The Westfield Mutual Telephone Company has been incorporated with a capital stock of $2,500 by J. J. Hinkley, E. E. Robbins, John Hornbrook and Jackson Hardin.

AUBURN, KY.—The Auburn Home Telephone Company has been incorporated, with a capital stock of $3,000, by D. B. Williams, V. G. Price, Edgar Harris and others.

AUGUSTA, MAINE.—The Gulf States Telephone Corporation has been incorporated with a capital stock of $2,500,000 to maintain and operate telephone and telegraph lines. M. F. Sheehan is president and treasurer.

FORT FAIRFIELD, MAINE.—Articles of incorporation have been filed for the Maple Grove Electric Company, with a capital stock of $50,000. The officers are: Isaac Conant, president; C. M. Waldron, treasurer, and J. R. Thurlow, clerk, all of Fort Fairfield, Maine.

ROCKLAND, MAINE.—The International Tidal Power Company has been incorporated with a capital stock of $1,500,000 for the purpose of taking over the patent rights of an automatic tidal air compressor invented by William O. Webber, of Boston, Mass. The company does not intend to build plants, but to grant leases to subsidiary companies. The officers are: William O. Webber, of Boston, Mass., president; Edward B. Macallister, of Rockland, Maine, vice-president; F. Ernest Holman, of Rockland, treasurer, and Dudley M. Holman, of Taunton, Mass., secretary.

KALAMAZOO, MICH.—The Michigan & Chicago Westbound Railway Company has been chartered, with a capital stock of $3,000,000, to construct an electric railway between Kalamazoo and Grand Rapids. Alfred H. Brown, of Chicago, Ill., is one of the incorporators.

ROCHESTER, MINN.—Articles of incorporation have been filed for the Zumbro Power Company by Charles H. Armstrong, Henry O. Christensen and John M. Norton. The company is capitalized at $300,000 and proposes to erect a dam across the Zumbro River, about 114 miles above Rochester, where it is estimated that about 600 hp can be developed. L. P. Wolff, of St. Paul, Minn., is engineer.

JACKSON, MISS.—The Jackson Interurban Railroad, Light & Power Company has been incorporated, with a capital stock of $100,000, for the purpose of constructing a railway from Jackson to Clinton, a distance of about 10 miles. The company also proposes to operate gas, electric light and power plants. The incorporators are: R. E. Kennington, W. J. Davis, W. H. Watkins, J. Ehrman, H. L. Hicks and others, of Jackson; J. W. Provine and D. N. McLean, of Clinton.

GREAT FALLS, MONT.—Articles of incorporation have been filed for the Great Falls Telephone Company for the purpose of installing a telephone system in Great Falls. The company is a branch of the Montana Independent Telephone Company and is capitalized at $500,000. F. R. Vandeputte is president; George H. Stanton, vice-president and treasurer, and R. T. Durett, secretary and managing director. The company proposes to erect a building as soon as possible, and expects to have its system in operation by Dec. 1.

GREENSBORO, N. C.—The Southeast Guilford Telephone Company has been chartered with a capital stock of $24,500 by C. S. Gilmer, of Greensboro; J. H. Bowman, of Liberty; C. M. Boobb, of Julian, and others. The company proposes to operate a farmers' exchange and telephone service in Greensboro.

MONROE, N. C.—The Union Telephone Company has been incorporated, with a capital stock of $25,000, by J. M. Fairly, F. E. and F. H. Wolfe. The address of the company is Monroe, Rural Free Delivery No. 5.

JERSEY CITY, N. J.—The Montana, Wyoming & Southern Railroad Company has been granted a certificate of incorporation, with a capital stock of $5,000,000. The company proposes to operate railroads, tramways and terminals. The incorporators are: Frank S. Gannon, William H. Seibert, William C. Langley, Charles W. Fernall and James J. Molley all of New York, N. Y.

NEW YORK, N. Y.—The Trackless Trolley Company, of New York City, has been incorporated, with a capital stock of $150,000, by Charles E. Barrett, of New York, N. Y.; A. Livingston Norman and S. E. Wiener, of Brooklyn, N. Y. Mr. Norman, counsel for the company, states that the company has secured the American rights to a system of transportation which has been used successfully in Germany. By this system an omnibus is run over roads or pavements, power being furnished by an overhead trolley.

ROCHESTER, N. Y.—The Livingston-Niagara Power Company has been incorporated with a capital stock of $100,000 by C. J. Brown, W. S. Riley and W. W. Dake, of Rochester, N. Y., for the purpose of supplying light, heat and power.

COLUMBUS, OHIO.—The Municipal Utilities Company has filed articles of incorporation for the purpose of taking advantage of a law passed some time ago in which municipalities were given authority to lease gas, electric light and power or water plants from private corporations for a term of years with the privilege of purchasing same. The company is capitalized at $25,000.

ALVA, OKLA.—The Valley Telephone Company has filed articles of incorporation with a capital stock of $3,000. The directors are W. D. Anderson, C. J. Funk and Z. B. Anderson.

COWLINGTON, OKLA.—The Cowling Spira Telephone Company has been incorporated with a capital stock of $1,000 by T. L. Tharel, W. E. McGeown, S. D. N. Nelson, J. O. Terrell, R. L. Redwine and H. B. Lowrie, all of Cowlington.

ENID, OKLA.—The Enid Central Traction Company has been incorporated with a capital stock of $1,000,000 by W. H. Stewart, R. W. Whittinghill, C. E. Burkhart, of Enid, Okla.; M. F. Machon and J. W. Smith, of Toledo, Ohio.

BAKER CITY, ORE.—Articles of incorporation have been filed for the Baker Interurban Railway Company by Thomas B. Neuhausen, Anthony Mohr and A. K. Bentley. The company is capitalized at $50,000 and proposes to construct electric railways in the vicinity of Baker City, Ore.

JOHNSTOWN, PA.—A charter has been granted to the Johnstown & Gallitzin Railway Company to construct an electric railway 32 miles in length, to connect Johnstown and Gallitzin and intervening towns. The officers of the company are: Wallace Sherbine, president; Alian Sher-

bine, secretary; H. W. Storey, treasurer, and G. U. G. Holman, general manager and electrical engineer.

DUNCAN, S. C.—The Duncan Telephone Company has been incorporated with a capital stock of $2,000.

PIERRE, S. D.—The Pierre & Southeastern Telephone Company has been chartered with a capital stock of $100,000 for the purpose of doing a long-distance telephone business in the country south and southeast of this city. The incorporators are: Albert Gunderson, Frank B. Rowe, of Pierre, S. D., and Albert Saveland, of Chicago, Ill.

CLINTON, TENN.—The Cook Creek Electric Light & Railway Company has been granted a charter with a capital stock of $25,000 to construct an electric railway in Anderson County. The incorporators are: Charles Loyd, J. P. Stanton, E. M. Beasley, J. S. Stanton and S. B. Faris.

SALT LAKE CITY, UTAH.—The Utach & Idaho Railroad Company has been incorporated with a capital stock of $160,000 to construct a railway to be operated either by steam or electricity from a point on the Ogden & Lucin Railroad at or near Salina, through Kelton Pass to the State line, and with the Minindoka & Southwestern Railroad, near Burley, Idaho, 150 miles in length. The officers are: W. H. Bancroft, president; D. E. Burley, vice-president; G. K. Smith, secretary, and C. H. Jenkinson, treasurer.

FREDERICKS HALL, VA.—The Fredericks Hall Telephone Company, capitalized at $5,000, has been incorporated, and the following officers elected: President, E. A. Ferrell; vice-president, J. H. Crunk; secretary, G. R. Poindexter; treasurer, E. H. Poindexter.

ONANCOCK, VA.—The Onancock Light Company has been incorporated with a capital stock of $5,000 for the purpose of constructing an electric light plant at Onancock. The officers of the company are: H. F. Parks, President; Horace Wiltbank, secretary and treasurer.

DEEP VALLEY, W. VA.—Articles of incorporation have been filed by the Farmers & Merchants' Telephone Company of this city. It is capitalized at $5,000, and Arlington Dotson is one of the incorporators.

GLEN JEAN, W. VA.—Articles of incorporation have been filed for the Fayette Public Service Corporation by R. J. Stegal, J. S. Staton and E. F. Thacker, of Glen Jean; R. H. Dickinson and Ross M. Reigel, of Harrisburg, Pa. The company proposes to install an electric power plant.

MARTINSBURG, W. VA.—Articles of incorporation have been filed for the Preston Power Company by William S. Downs, of Kingwood, W. Va.; Frank E. Carver, of Brandonville, W. Va.; F. W. Sheidenheim and Victor Hammell, of Connellsville, Pa., and Ross M. Reigel, of Harrisburg, Pa. The company proposes to construct a hydro-electric plant on Sandy Run, at an estimated cose of $100,000.

MILAN, W. VA.—The South Fork Mutual Company has been incorporated with a capital stock of $5,000 by N. D. Wilson, N. G. Dasher, G. H. Simon and others.

FOREST JUNCTION, WIS.—Articles of incorporation have been filed by the Calumet Telephone Company. It has a capital stock of $3,500, and William Hacker is one of the incorporators.

IRON RIDGE, WIS.—The Hubbard Farmers' Telephone Company, capitalized at $2,000, has filed articles of incorporation. H. Bilymen and others are interested.

LARSEN, WIS.—Articles of incorporation have been filed by the Larsen Telephone Company. It has a capital stock of $5,000, and the incorporators are Neils Jensen, A. H. Hinman and Louis Sorenson.

MADISON, WIS.—The Yellow River Telephone Company, of Yellow River, Wis., has been incorporated with a capital stock of $3,000 by Arthur Wright and others.

STURGEON BAY, WIS.—The Shifo Telephone Company has been incorporated with a capital stock of $2,000 by G. E. Johnson, C. Olson and Herman Foth.

SUPERIOR, WIS.—Articles of incorporation have been filed for the Superior Traction Company by Richard Russell, P. J. Eckstand and S. L. Perrin. The company is capitalized at $100,000 and proposes to operate an electric railway system in Superior.

COWLEY, ALTA., CAN.—The Farmers' Mutual Telephone Company, with a capital of $5,000, has been organized here. Construction will be started this summer.

EASTON'S CORNERS, ONT., CAN.—The Walford Rural Telephone Company has been incorporated, with W. H. Watts as secretary.

HAWKESTONE, ONT., CAN.—The Oro Telephone Company has been incorporated, with headquarters in this city. For further information address R. W. Metcalf.

ELLISBORO, SASK., CAN.—The Ellisboro Rural Telephone Company has been incorporated for the purpose of building a rural telephone system.

MAPLE CREEK, SASK., CAN.—The Bay Creek Telephone Company, with headquarters in this city, has filed articles of incorporation.

REGINA, SASK., CAN.—The Central Rural Telephone Company has been incorporated for the purpose of building rural lines from here.

REGINA, SASK., CAN.—The Rose Plain Telephone Company has been incorporated to build rural telephone lines in the vicinity of this city.

ROULEAU, SASK., CAN.—The Riverside Rural Telephone Company, which expects to operate in this city, has filed incorporation papers.

Personal.

MR. A. M. CANTRILL, son of Mr. S. Cantrill, superintendent of the Denver City Tramways, who was formerly manager of the Pueblo Gas & Fuel Company, has assumed the management of the Spokane Gas Company.

MR. H. D. FRUEAUFF has been placed in charge of the Pueblo Gas & Fuel Company as manager of that concern. Mr. Frueauff is a brother of Mr. Frank W. Frueauff, general manager of the Denver Gas & Electric Company and president of the National Electric Light Association.

MR. C. E. ALLEN, who has been connected with the General Electric Company at both its Lynn and Schenectady works, has tendered his resignation to take effect during the present month. For the past 10 years Mr. Allen has devoted considerable time and thought to the development and introduction of improved designs of transformers, and was granted patents for the divided core type arrangement, which has been upon the market for about two years.

MR. HENRY B. OTIS, who has been connected with the electrical industry in Chicago for several years, has accepted an appointment with the contract department of the Sanitary District, devoting his attention particularly to the soliciting of electric power business for the Drainage Canal water-power plant. Mr. Otis was formerly the Chicago manager for the Cutter Electrical & Manufacturing Company, of Philadelphia, and before that he was connected with the Western Electric Company for some time.

MR. FRANK F. FOWLE, consulting electrical engineer, Marquette Building, Chicago, has recently made a preliminary examination of the water mains at St. Paul, Minn., to determine the present rate of damage by electrolysis. The matter was first investigated in 1901 and is again being studied by the water board. Mr. Fowle has also been engaged in an investigation as to rates and service at Beloit, Wis., and on a steam and water power development for the Oregon Power Company, of Oregon, Ill.

MR. T. B. GAY, secretary and purchasing agent of the Norfolk & Portsmouth Traction Company, of Norfolk, Va., has tendered his resignation, effective Aug. 15, and will take up the practice of his profession as a lawyer in Richmond, Va., on Oct. 1. Mr. Gay is a graduate from the Law School of the University of Virginia, and was admitted to the Virginia Bar several years ago. As an associate member of Messrs. Munford, Hunton, Williams & Anderson, Mr. Gay enters with exceptional opportunities a leading law firm of the State.

MR. WILLIAM B. HALE, a consulting electrical engineer of the City of Mexico, has been visiting the United States. He was the official delegate from the Mexico section of the American Institute of Electrical Engineers to the recent Frontenac convention, and before returning took occasion to call on his friends in various American cities. Mr. Hale is retained by the Mexican Government as an adviser to the Department of Federal Telegraphs, and is also the Mexican representative of the Weston Electrical Instrument Company and the Bristol Company. He was formerly a resident of Chicago, where he was connected with the Western Electric Company.

Obituary.

MR. JAMES SUGDEN, a prominent electrical contractor of Malden, Mass., died at his home in Malden, Aug. 10. He was 57 years old. He was formerly identified with the General Electric Company, the Edison Company, and the New England Telephone & Telegraph Company, until a few years ago, when he started in business for himself. He is survived by a widow, two sons and three daughters.

CAPTAIN HERMAN P. SCHUYLER, assistant treasurer of the General Electric Company, and one of the best-known credit men in this country, died on Aug. 14 at his home in Albany, aged 67 years. The late Mr. Schuyler enjoyed an acquaintance which extended throughout this country and Europe. He was born in the Schuyler home in Albany County, Sept. 13, 1842, and was a direct descendant of Gen. Philip Schuyler of Revolutionary fame. With the beginning of the Civil War he went West and enlisted in the First Wisconsin Regiment, where he remained until the end of the war, being promoted to first lieutenant. In 1864 he was appointed head of the Ordnance Department of the Army Corps with headquarters at the Watervliet Arsenal. Resigning this position in 1870 he became the head of the sales department of the Troy Steel & Iron Company, of Troy, N. Y. In 1887 Captain Schuyler went to New York City to become private secretary of the late H. H. Rogers of the Standard Oil Company. Three years later he was called to Philadelphia to become head of the sales department of the Wellman Steel & Iron Company at Thurlow, Pa. His marked ability soon after won for him the position of assistant treasurer in charge of credits of the General Electric Company in 1893. The deceased was a member of the Fort Orange Club of Albany, Troy Club of Troy and the Army and Navy Club, the Loyal Legion and the Holland Society of New York City. Captain Schuyler is survived by a daughter, Mrs. R. C. Yates, and a son, Mr. Herman P. Schuyler, Jr., both of Chicago. The funeral was held at the chapel, Rural Cemetery, Albany, Aug. 16.

MR. A. A. KNUDSON.—We record with deep regret the death of Mr. Adolphus A. Knudson, the electrical engineer, at Meadville, Pa.

The occurrence was very sudden and unexpected. Mr. Knudson had gone to Meadville last week from New York on behalf of the city water and light department to investigate some electrolytic conditions in the water mains, and on Friday afternoon, Aug. 13, was at the old pumping station with Superintendent Ellsworth inspecting the plant when he collapsed; and soon after all was over. The physician on arrival was able to do nothing. The day was very warm and oppressive, and Mr. Knudson had complained of feeling unwell, but insisted on going forward with his work. Mr. Knudson was the son of a Norwegian sea captain, and as a youth accompanied his father, but did not like the career, and turned his attention to electricity. He was early connected with the financial ticker interests in New York, and brought out a ticker of his own that was well known. Indeed, he was a man of considerable inventive and mechanical ability and made various improvements in electrical apparatus. He gradually enlarged his sphere of work as the electrical arts grew, and for some years past had given almost his entire time to electrolysis cases as a specialty. Some years ago he organized and conducted a very successful electrical exhibition at St. John, N. B., the first every held in the Maritime Provinces. He was a full member of the American Institute of Electrical Engineers, which he joined in 1887, and also an old member of the New York Electrical Society. He took an active interest in the welfare and progress of both bodies. Mr. Knudson leaves a widow and a wide circle of friends and acquaintances in the electrical field.

Trade Publications.

REFLECTORS.—Bulletin No. 23 of the Holophane Company, 227 Fulton Street, New York, is devoted to reflectors for factory and shop lighting.

BEARINGS.—The Hill Clutch Company, Cleveland, Ohio, has issued as the first of a series of booklets a bulletin devoted to line-shaft bearings. The bearings discussed are of the collar-oiling type.

TURBINE PUMPS.—Centrifugal pumps, arranged for direct connection with induction motors, are briefly described and well illustrated in bulletin H. issued by the Lea Equipment Company, 90 West Street, New York.

STEAM TURBINES.—Much information concerning the constructive features and operating characteristics of small steam turbines is given in a catalog issued by the E. W. Bliss Company, 17 Adams Street, Brooklyn, N. Y.

STEAM TURBINES.—Leaflet No. 2117 of the British Thomson-Houston Company, Ltd., gives a list of Curtis turbines installed or in course of erection. The total rating is 1,378,580 kw, and the aggregate selling price about $32,000,000.

DRILLS.—The Cleveland Twist Drill Company, Cleveland, Ohio, has issued a folder devoted to its high-speed, flat-twist drill, with a Paragon flat-taper shank. It is claimed that this drill is as tough as can possibly be made for use at high speed.

DOMESTIC ENGINEERING.—The H. W. Johns-Manville Company, 100 William Street, New York, is distributing a folder entitled "How to Economize in the Home." This folder deals with the numerous mechanical devices employed in the modern residence.

HIGH-VOLTAGE DISTRIBUTING TRANSFORMERS intended for connection along high-voltage transmission circuits for delivering energy to small consumers are briefly described in Bulletin No. 1093 of the Pittsburgh Transformer Company, Pittsburgh, Pa.

HYDRAULIC WHEEL PRESSES.—Hydraulic presses intended for mounting car wheels and axles are illustrated in a catalog issued by E. R. Caldwell & Company, 34 Hilton Street, Bradford, Pa. The catalog contains an imposing list of companies by whom the presses described are used.

ELECTRICAL SPECIALTIES.—The Thordarson Electric Manufacturing Company, 216 Jefferson Street, Chicago, Ill., has issued a well-illustrated catalog devoted to ignition coils of the jump-spark and make-and-break types, transformers of large and small range and special laboratory equipments.

COAL HANDLING MACHINERY.—Catalog No. 051 of the C. W. Hunt Company, West New Brighton, N. Y., contains much interesting information relating to machinery for handling coal and ore. The information is largely of an engineering nature, and in its presentation effective use is made of photographs and line illustrations.

LIFTING MAGNETS.—The Electric Controller & Manufacturing Company, of Cleveland, Ohio, is distributing a mailing folder containing many well-prepared illustrations showing its lifting magnets in actual service. It is claimed when used in steel mills that each magnet produces a saving of from $10 to $40 per day in handling iron.

ARC LAMPS.—The Regina Arc Lamp Works, Ltd., Cologne-Sulz, Germany, have published in English a catalog giving a good technical description of its Conta lamp, which is of the self-regulating type without clockwork. This lamp can be used with either direct current or alternating current, and is suitable for either flaming electrodes or electrodes of pure carbon.

TRANSFORMERS.—In Bulletin No. 86 of the Wagner Electric Manufacturing Company, St. Louis, Mo., is given a good description of the desirable features in transformer performance, special attention being paid to the magnetizing current, which is referred to as the "leakage current." The bulletin describes particularly single-phase core-type transformers for central-station service.

ELECTRIC DRIVE FOR LARGE PRINTING PRESSES.—The General Electric Company has issued Bulletin No. 4672, entitled "Electric Drive for Large Printing Presses," which deals with a subject of vital importance to the up-to-date printer. The bulletin refers to certain electrical installations used in connection with such work, and describes the most modern method of operation and control of large presses.

LIGHTING FIXTURES.—The Central Electric Company, Chicago, Ill., is distributing an attractive set of plates showing a reproduction of five artistic lighting fixtures. Accompanying the plates is a card bearing the inscription: "A lighting effect must have two inceptions: First, in the designer's thought, made apparent by the use of the pencil. Second, its reproduction in metals by craftsmen of sterling worth. It is the service of such an organization that we offer you."

WIRELESS TELEGRAPH APPARATUS.—The Central Electric Company, Chicago, Ill., is distributing several folders descriptive of wireless telegraph apparatus suitable for experimental and private installations. A complete description is given of the various sizes of receivers, detectors and sending sets. Several new types of spark and tuning coils are described which, together with complete diagrams of connections, should prove of much interest and service to those engaged in wireless telegraph work.

SLIDE RULE.—The Keuffel & Esser Company, Hoboken, N. J., has issued an eight-page folder entitled "Log Log Duplex Slide-Rules." It is stated that with the device described any problem can be solved that can be handled with the ordinary slide-rule, and many others heretofore unattempted in slide-rule work. This slide-rule should prove valuable in the solution of numerous electrical calculations. It will extract any root or raise to any power—integral or fractional. Hyperbolic logarithms are read directly, while sines, tangents and co-tangents are given from one second to 90 deg.

AUTOMOBILE MOTORS.—In its most recent catalog the Woods Motor Vehicle Company, of Chicago, does not give a horse-power rating for the electric motors used on its electric automobiles. In explaining this fact the company makes the following interesting statement: "The motor is not rated as to horse-power. It has been determined that, with automobiles as in railway practice, horse-power rating cannot be satisfactorily stated. The horse-power rating of a motor is dependent upon its temperature, and, inasmuch as heat accumulates, it is very easy to understand that this rating must, therefore, depend upon the number of consecutive hours the motor is intended to run. The Woods motor is designed to run the vehicle longer than the rated capacity of the battery, so that the battery really becomes a safety-valve against dangerous heating of the motor."

Business Notes.

THE BEAVER ELECTRIC CONSTRUCTION COMPANY, of Chicago, which does electric contracting, has increased its capital stock from $10,000 to $15,000, owing to the demands of a growing business.

MR. H. VON SCHON, whose principal office is in Detroit, Mich., following hydro-electric practice as a specialty, has arranged with Mr. Thatcher T. P. Luquer to represent him in New York City with office at 103 Park Avenue.

THE NEW CASTLE (IND.) ELECTRIC SIGN COMPANY has changed its name to the Elmo Electric & Manufacturing Company. The company's plant will be enlarged and a wider range of electric appliances and devices will be made. Philip W. Moore is president.

THE NATIONAL CARBON COMPANY, Cleveland, Ohio, announces that within the next 60 days another reduction will be made on the price of its carbons. This statement is particularly interesting in view of the fact that the tariff upon imported carbons has just been advanced, which caused many people to believe that there would be a corresponding advance in the price of domestic arc light carbons.

EXCELLO ARC LAMPS.—The Excello Arc Lamp Company has received an order for 44 lamps from the Minnesota State Agricultural Society. These are to be used in extending the out-door lighting arrangements which this society began last year, when they purchased 42 lamps from the same company for the illumination of the live-stock department and the lighting of the field upon which was enacted the spectacular reproduction of the Fort Ridgeley massacre.

GARWOOD AGENCIES.—The Garwood Electric Company has appointed the Tucker Electric Company, 970 Old Colony Building, Chicago, as its selling agent for Chicago and as far south in Illinois as a line drawn east and west through Springfield and including Springfield, and as far in Wisconsin as a line drawn east and west through Madison, and including Madison, and that portion of Indiana north of a line drawn east and west through Indianapolis and including Indianapolis. Mr. Tucker is very well known in the electrical field, having formerly been connected with the Western Electric Company, and recently was with the International Cash Register Company. Messrs. Fellows & Fellows, Lawler Building, Toronto, Canada, have been appointed sales agents for the entire Dominion of Canada. This firm is very well known in railway and general engineering lines.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED AUG. 3, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., New York.]

929,708. SERVICE METER SYSTEM; W. Reid, Chicago, Ill. App. filed Dec. 5, 1907. For system of central energy type, having three conductor multiple jacks at central. The meter has differential coils with means for shunting one and using the other to actuate the meter.

929,745. WIRELESS COMMUNICATION; C. D. Babcock, New York, N. Y. App. filed Sept. 25, 1905. A platinum wire terminal whose end is flush with the glass envelope and dips into a conducting liquid, acts as a wireless detector.

929,758. DYNAMO REGULATOR; S. D. Field, Stockbridge, Mass. App. filed Feb. 14, 1908. A voltage regulator for self-excited dynamos having a resiliently mounted armature and differential field windings, with a blade spring actuated by the armature to close the circuit through the windings.

929,763. ELECTROMAGNETIC APPARATUS FOR ACTUATING MECHANISMS; S. H. Hoggson, New York, N. Y. App. filed June 29, 1906. Makes use of a pivoted weighted lever operated by a solenoid to drive a mechanism.

929,773. CURRENT LEAK INDICATOR FOR ELECTRICAL CONDUCTORS; R. S. Masson, Berkeley, Cal. App. filed Aug. 10, 1908. The insulator has its surface coated with white paint, whose color changes when the current leaks through it.

929,812. PANEL BOARD CABINET; F. B. Adam, St. Louis, Mo. App. filed Oct. 19, 1908. A box is set in a wall and carries a panel board mounted on supports adjustable toward and from the wall.

929,844. RELAY; J. Erickson, Chicago, Ill. App. filed Aug. 20, 1906. An annunciator drop relay having a knife bearing carrying an armature with a sheet metal holder secured to the magnet and removably holding the armature on the pivot.

929,854. ELECTRICAL MEASURING INSTRUMENT; D. C. Jackson, Madison, Wis. App. filed June 5, 1905. Phase adjuster. Improvement on prior application.

929,878. INSULATOR; J. W. Ransom, Batavia, Ohio. App. filed July 22, 1908. A shiftable body with a groove for receiving the wire in one position of the body and for bending and interlocking it when shifted.

929,901. ELECTRIC HEATER; C. E. Trewhella and E. D. Holley, Forestville, Conn. App. filed July 17, 1907. A receptacle having a base with a heating unit in the base, a heat distributor therein, and insulation between the base and the unit.

929,918. TROLLEY WHEEL; B. Crow, Findlay, Ohio. App. filed Aug. 8, 1908. The wheel has a core with spaced radial ears integral therewith, with caps and a ball bearing.

929,933. LOW WATER ALARM FOR STEAM BOILERS; C. Brent, Brandon, Manitoba, Canada. App. filed Nov. 5, 1906. A head is filled with hot water and is converted to steam at low water, which in turn actuates a thermostat.

929,934. CONTACT DEVICE; C. Brent, Brandon, Manitoba, Canada. App. filed Nov. 5, 1906. For fire alarms operated thermally and placed in a call-bell circuit. The spring expands and makes the circuit.

929,937. GAS-SUPPLY ALARM; L. C. Bulkley, Benton, La. App. filed Nov. 20, 1908. A pivotic member is included in the electric circuit and is controlled by a thermostat with an open casing surrunding it.

929,963. BATTERY CONTACT; J. H. Gugler, Minneapolis, Minn. App. filed July 25, 1908. Improvement in binding posts for primary batteries in which the carbon electrode carries a metal contact cup, which is electroplated, to the electrode.

929,965. EXTENSION CALL FOR TELEPHONES; A. R. Marcotte, Concordia, Kan. App. filed May 1, 1908. Closes an extension call circuit by spring-pressed slides, which may be placed inside or outside of the telephone box.

929,984. MACHINE TELEGRAPH; G. C. Read, Davenport Station, Ontario, Canada. App. filed March 21, 1908. A number of separate circuits, each controlling one of the keys of a typewriter, are energized in succession by selective mechanism operated from a distance.

929,989. TELEPHONE CABINET; A. Larsson, Buffalo, N. Y. App. filed Aug. 21, 1907. A wall cabinet having a back of sheet metal and its lower part dished rearwardly, with a movable hood therefor.

929,995. SELECTIVE RINGING MAGNETO BELL; B. W. Sweet, Cleveland, Ohio. App. filed Sept. 8, 1905. An exciting electromagnet having a sectional armature, the selections being adjustable to regulate the air-gap.

929,998. ELECTRIC FUSE CASE; T. E. Murray, New York, N. Y. App. filed Sept. 28, 1908. A wrapping of non-combustible fabric surrounds the fuse, which is contained in a body of pulverized material, surrounding the fuse and wrapping.

929,999. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed Dec. 30, 1908. A fuse plug having a base with a cover and a removable plate locked in position to the base and cover.

930,006. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; J. E. Webster, Pittsburgh, Pa. App. filed Sept. 25, 1905. Provides a spring guide which maintains the coils of the spring in concentric relation.

930,007. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; J. E. Webster, Pittsburgh, Pa. App. filed Jan. 3, 1906. For insulating and supporting brushes, having a plurality of supporting arms and insulating sleeves with sealing and protecting caps therefor.

930,022. ELECTRIC POWER HAMMER; T. F. Baily, Alliance, Ohio. App. filed May 19, 1909. Has a head for the ram and spaced flanges connected to the head with a series of transverse copper bars in grooves in the structure, which are short-circuited.

930,023. PROCESS OF STERILIZING FLUIDS; C. B. Bartley, Pittsburgh, Pa. App. filed Aug. 5, 1908. Passes a direct current through the medium to be sterilized and induces a disruptive discharge through the medium and the atmosphere between an immersed terminal and an outer terminal.

930,024. GOVERNOR; N. C. Bassett, Milwaukee, Wis. App. filed Feb. 23, 1907. For controlling a motor actuating a pump by means of a toggle and spring.

930,027. METHOD OF REDUCING ORES; F. M. Becket, Niagara Falls, N. Y. App. filed May 11, 1909. Smelts the ore electrically with a reducing agent containing silicon and boron.

930,028. METHOD OF REDUCING ORES; F. M. Becket, Niagara Falls, N. Y. App. filed May 11, 1909. Electrically smelts a charge containing the ore and a borid.

930,065. ELECTRIC STORAGE BATTERY; B. Ford, Philadelphia, Pa. App. filed Sept. 7, 1908. A battery jar having a top, perforated bottom wall and side and end walls constituting an overflow compartment.

930,067. COMMUTATOR BRUSH; F. W. Garrett, Pittsburgh, Pa. App. filed Jan. 3, 1906. Has an end cavity and slot in one corner with a cap plate having a portion that projects into the slot and a resilient stud that projects into the cavity.

930,068. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; F. W. Garrett, Pittsburgh, Pa. App. filed May 21, 1906. A current collector having a brush and holder, including a loop and a shunt connected with one end attached to the brush, a hook at the other end, and a spring for holding the hook in engagement with the loop.

930,126. DAMPER ACTUATOR; J. W. Barton, Flint, Mich. App. filed June 11, 1908. A temperature controlled damper, controlled by fluid pressure, whose action is in turn controlled by weights and by a magnet brake.

930,141. AUTOMATIC SAFETY DEVICE; F. F. Bourdil, Paris, France. App. filed Sept. 6, 1907. An insulator which can be rotated around its axis when the supporting wire breaks, without displacing the line wire.

930,150. AUTOMATIC CUT-OFF FOR TROLLEY LINES; R. Brown, Windber, Pa. App. filed Sept. 16, 1908. For mining use, operated by the trolley wheel to make and break the circuit so as to render the cut-out section harmless.

930,155. CIRCUIT-BREAKER; H. W. Cheney, Norwood, Ohio. App. filed Oct. 22, 1906. Oil switches or circuit-breakers having a plurality of stationary contacts and oscillatory switch member carrying bridge contacts of special construction.

930,156. OIL SWITCH; H. W. Cheney, Norwood, Ohio. App. filed Oct. 22, 1906. For a circuit of high voltage and large amperage in which the switch can be readily attached to a narrow switchboard panel.

930,171. LIQUID INDICATOR AND LEAK DETECTOR; J. Foley, Birmingham, Ala. App. filed Nov. 4, 1908. A float is actuated by the leak and controls an alarm circuit.

930,177. ELECTROMAGNET; D. J. Hauss, Aurora, Ind. App. filed Sept. 2, 1908. A compact magnet, whose parts may be readily separated and firmly secured together for bell use.

930,203. ELECTRICAL INSTRUMENT FOR PYROGRAVURE AND SURGICAL PURPOSES; L. Mandarelli, Paris, France. App. filed Nov. 28, 1908. The point is electrically heated to incandescence and is made hollow for the circulation of air.

930,212. APPARATUS FOR TREATING GASES BY ELECTRICITY; I. Moscicki, Fribourg-Gambach, Switzerland. App. filed Aug. 28, 1906. For obtaining nitric oxides from mixtures of gases by subjecting them to the action of electric current in a furnace having an annular electrode, through which the gases flow.

930,213. SECONDARY ELECTRIC BATTERY OR ACCUMULATOR; W. Moseley, London, England. App. filed March 29, 1909. An accumulator plate having a series of conical cups receiving the oxide of lead.

930,235. SYSTEM OF DISTRIBUTING ELECTRICAL ENERGY; P. H. Thomas, Pittsburgh, Pa. App. filed Jan. 20, 1903. Delivers a flow of electric current in a given direction in two or more consumption circuits from an alternating-current supply. Permits positive impulses only to flow in one circuit and negative in the other.

930,238. PRODUCTION OF LONG STABLE ELECTRIC ARCS; O. Schönherr and J. Hessberger, Ludwigshafen-on-the-Rhine, Germany. App. filed March 16, 1906. Stretches the discharge by directing a current of fluid parallel with the body of the discharge.

930,275. TROLLEY WHEEL; E. E. Ecker, Kansas City, Mo. App. filed Aug. 18, 1908. The wheel is provided with right and left-hand grooves, which act as a finder.

930,324. ANNUNCIATOR DROP; B. W. Sweet, Cleveland, Ohio. App. filed May 19, 1906. An annunciator drop with a removable armature in which the defective winding may be replaced without disturbing soldered connections.

UNITED STATES PATENTS ISSUED AUG. 10, 1909.

930,336. TROLLEY WHEEL HOLDER; J. Barry, Ocean View, Cal. App. filed Oct. 18, 1907. Has a housing having an independent pivoted movement mounted in a frame work pivoted to the upper end of the trolley pole.

930,337. BRUSH HOLDER; N. C. Bassett, Lynn, Mass. App. filed March 24, 1902. The brush is supported by two surfaces on opposite sides of the same, but not opposite each other. Avoiding rocking and chattering.

930,376. METHOD OF TREATING ALUMINOUS MATERIALS; A. C. Higgins, Worcester, Mass. App. filed May 31, 1907. Fuses an aluminous material in an electric furnace and then roasts it under oxidizing conditions.

930,388. ELECTRIC SIGNALING FIRE ALARM APPARATUS; W. H. Kirnan, Bayonne, N. J. App. filed Nov. 7, 1908. Fire alarm signaling apparatus in which a single thermostat is employed in connection with a single signal box to send a plurality of different signals over a single-transmission circuit.

930,404. AUTOMATIC GAS FEED FOR VACUUM TUBES; D. McF. Moore, New York, N. Y. App. filed May 8, 1906. A gas feed valve with an operating magnet and a thermostat exposed to the direct heat of the gas in the tube and controlling the circuit of the magnet.

930,427. BRUSH HOLDER; L. H. Sparks, Warren, Ohio. App. filed Jan. 16, 1908. A simple and durable brush holder in which the pressure on the carbon is regulated by an adjustable spring.

930,449. SNAP SWITCH; J. W. Wyatt, Philadelphia, Pa. App. filed Feb. 6, 1908. A snap switch operated by a pair of push buttons, including a spring and latch.

930,471. PROCESS OF MANUFACTURING SULPHURIC ACID. W. Hallock, New York, N. Y. App. filed July 15, 1907. Sulphurous acid to the influence of an ironizing agent, such as x-rays in the presence of oxygen.

930,474. CURRENT TESTING DEVICE FOR ELECTRIC BATTERIES. W. C. Heed, Chicago, Ill. App. filed March 2, 1907. Substitute for an ammeter in which metal foil is mounted on an insulating support, the foil being of graduated widths at different points.

930,508. RECEIVER FOR HIGH-FREQUENCY ELECTRICAL OSCILLATIONS. J. S. Vreeland, Montclair, N. J. App. filed June 1905. Two relatively movable coils are arranged in close inductive relation with their coils in parallel.

930,512. TELEPHONE EXCHANGE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Aug. 4, 1904. For central battery systems using a cord connecting apparatus with which a relay is associated having contacts which have two operative positions besides the normal one, controlling the local circuit of the supervisory signal.

930,513. TELEPHONE EXCHANGE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Aug. 4, 1904. A central battery system including a cord connecting apparatus in which for connecting a call at the central office has associated with it a polarized electromagnet having differential windings and controlling by its armature the display or non-display of a supervisory signal.

930,514. TELEPHONE EXCHANGE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Dec. 16, 1904. A central battery system in which the connecting cord at the central has two windings and controls by its armature the display or non-display of a supervisory signal.

930,515. TELEPHONE EXCHANGE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Dec. 4, 1905. A central battery system in which the supervisory signal has associated with it a differentially wound electromagnet with its windings so arranged that one is included in a circuit local to the central office and under the control of the operator while both are included in a circuit controlled by the subscriber.

930,516. TELEPHONE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Dec. 4, 1905. The subscriber and operator may signal each other and the operator may be informed of the operative condition of a connected line. Makes use of a linked circuit for interconnecting the line, the connection of the linked circuit establishing a shunt path under the control of the subscriber's switch hook.

930,517. TELEPHONE EXCHANGE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Jan. 13, 1906. Two-wire telephone systems in which the talking circuit is kept free from separable contacts and the transmission current supplied in bridge of the cord circuit.

930,518. TELEPHONE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Dec. 10, 1906. Each supervisory signal is directly connected in circuit between the source of current and a contact of the corresponding connecting plug of the linked circuit, and a line relay and resistance are so arranged that when the operator inserts a plug the circuit is completed through or around the resistance covered by the operation of the switch hook to control a signal.

930,519. TELEPHONE EXCHANGE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Feb. 23, 1906. There is associated with the line circuit a signal-controlling electromagnet normally under the control of the subscriber whereby a call may be initiated at the central office. The invention relates to the construction of a magnet.

930,520. TELEPHONE SYSTEM; H. G. Webster, Chicago, Ill. App. filed May 4, 1906. Provides a cut-off magnet for the line circuit and switching mechanism which alters the substation control of the calling signal and controls the battery connection of the line limbs.

930,521. TELEPHONE EXCHANGE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Dec. 4, 1907. Testing means common to the cord circuits with means whereby the interconnection of certain terminal contacts automatically disconnect the relay and actuates a signal.

930,547. APPARATUS AND SYSTEM FOR MEASURING TELEPHONE SERVICE; D. S. Hulfish, Chicago, Ill. App. filed April 3, 1905. For automatic or semi-automatic exchanges in which a meter is connected to the selective switch.

930,527. AUTOMATICALLY ADJUSTABLE STRAIN INSULATOR HOUSE FIXTURE; C. S. Burge, Tacoma, Wash. App. filed March 17, 1909. The plate has holes or slots suited for the reception of screws and carries an eye in which a clevis and pin are mounted, the pin carrying the insulator.

930,552. RELAY; J. M. Long, Los Angeles, Cal. App. filed March 4, 1907. A solenoid cell with soft iron core operated in the coil actuating a two-armed lever on a shaft and a two-ended contact piece likewise on the shaft.

930,586. ELECTRIC CURLING IRON; C. W. Wilmot, Redondo, Cal. App. filed June 17, 1908. A tubular handle having a detachable portion with electricity supply means and heating irons electrically connected with the supply means.

930,588. RECEIVING ELECTRIC SYSTEM; C. Wirth and C. Beck, Nuremberg, Germany. App. filed March 18, 1909. A receiving circuit, a distributor controlled thereby, electro-motors, circuits controlled by the distributor, cut-outs and gears connected with the motors to actuate the cut-outs.

930,603. CONTROLLING DEVICE FOR ELECTRIC MOTORS; C. D. Knight, Schenectady, N. Y. App. filed Feb. 21, 1907. Means for controlling electric motor circuits, particularly alternating-current motors of the induction type in which an electromagnet switch varies the resistance in the secondary circuit, and another switch closes the primary circuit when the resistance varying switch occupies a certain position.

930,606. ADAPTABLE TERMINAL CONTACT FOR SAFETY FUSES; V. F. Morgan, Hartford, Conn. App. filed March 7, 1906. Ferrules are mounted on the ends of an insulating tube and have a threaded engagement with terminal contacts.

930,608. INSULATOR; L. McCarthy, Boston, Mass. App. filed Oct. 5, 1908. Metallic connections are secured together with interposed insulation and have a covering of molded composition.

930,609. INSULATOR; M. Neubert and R. P. Jones, Glen Jean, W. Va. App. filed Feb. 24, 1908. A section insulator having spaced end pieces and an insulating strip between the end pieces. Details.

930,638. ELECTRIC SMOOTHING IRON; A. O. Whitmore, Salt Lake City, Utah. App. filed Aug. 7, 1908. Has a cover or top plate provided with an extension, the extension having an upstanding guard and depending wings.

930,644. SURFACE CONTACT ELECTRIC RAILWAY SYSTEM; W. M. Brown, Johnstown, Pa. App. filed Feb. 20, 1905. Auxiliary contact devices or studs are electrically connected with the adjacent boxes and so arranged as to be engaged and spanned by the current collector.

930,666. PROCESS OF TREATING ORES; P. L. T. Héroult, La Praz, France. App. filed April 19, 1906. Ores are treated by air and heats by means of an electric current.

930,674. MANUFACTURE OF RAIL BONDS; G. A. Mead, Mansfield, Ohio. App. filed Nov. 2, 1906. The rail bond comprises a [illegible] body portion with [illegible] and terminal lugs all separate from each other and then united.

930,675. SAFETY FUSE; W. Menzel, Hanover, Germany. App. filed Aug. 3, 1906. The plug has a rib, contact pins and a fuse connecting the pins.

930,698. TROLLEY RETRIEVER; M. D. Self, Bessemer, Ala. App. filed Dec. 30, 1908. Pneumatic trolley retriever in which the air pressure is cut off when the trolley is pulled down by hand.

930,704. PUZZLE TOY OPERATED BY STATIC ELECTRICITY; E. A. Sullivan, Toronto, Canada. App. filed Aug. 18, 1908. When the glass is rubbed the particles assume a definite position forming the counts of the game.

930,723. PROCESS OF FORMING ELECTRIC-INCANDESCENT-LAMP FILAMENTS; W. Von Bolton, Charlottenburg and F. Hartmann, Berlin, Germany. App. filed Feb. 3, 1909. Inserts into a tube of ductile metal, a tube of another ductile metal and then inserts refractory metal powder into the inner tube and works the products into filaments.

930,727. STORAGE BATTERY. R. N. [illegible], Lepsey, N. Y. App. filed April 5, 1905. Each set of plates can be removed without disturbing the other set. Details.

930,728. STORAGE BATTERY; R. N. Chamberlain, H. E. Pratt, New York, N. Y., and A. S. Hubbard, Belleville, N. J. App. filed Dec. 17, 1906. A battery cell and crate having its walls provided with upright air channels adjacent to the cell and having bottom openings for the admission of air to the channels.

930,746. AERIAL CONDUCTOR; S. Eisenstein, Kiew, Russia. App. filed March 27, 1908. A supplementary capacity and a self-induction coil are used, the latter in series between the capacity and the aerial conductor and arranged on the top of the conductor.

930,750. INSULATOR; C. McL. Graham, Malvern, Victoria, Australia. App. filed Aug. 4, 1908. Glass insulators supported by wooden pin to which they are connected by a metal bolt. Details.

930,751. REINFORCED WOODEN SUPPORT FOR INSULATORS; C. McL. Graham, Malvern, Victoria, Australia. App. filed Aug. 4, 1908. Double shed insulator having a metallic central reinforcing member.

930,753. MONTOTELEPHONIC RELAY TRANSFORMER; P. E. Heina, Paris, France. Has a circular plate of magnetizable metal with three supports carrying it, the supports being arranged to correspond with the first harmonic of the plate.

930,754. ELECTRIC CLOCK; R. D. Hickok, Atlanta, Ga. App. filed Nov. 5, 1908. An electric clock having secondary clocks and a master clock, in which the secondary clocks are actuated once a minute, and the master clock at the minimum beat.

930,780. MAGNETIC DETECTOR; J. Murgas, Wilkes-Barre, Pa. App. filed March 17, 1909. Produces a stationary magnet field, in which is mounted a conducting disk of magnet material, to which the oscillations are conducted.

930,788. EXTENSION PLUG OR DEVICE FOR CONNECTING ELECTRIC CONDUCTORS; W. E. O'Neil, Norwich, N. Y. App. filed March 27, 1909. A wedge plug is interposed between the members and expands the plug when the latter is inserted in the socket.

930,815. ELECTROLYTE; A Van Winkle, N. J. App. filed Nov. 20, 1908. Electrolyte for coating iron, comprising a solution containing a fluorin salt of zinc.

930,819. ELECTRIC GENERATOR; E. F. White, Spokane, Wash. App. filed Sept. 12, 1908. Portable, manually operated generator having a metallic arm with bearings integral with the arm. Details.

930,854. TELEPHONE REPEATER; M. R. Gilson, Philadelphia, Pa. App. filed Aug. 8, 1907. Comprises a stationary field magnet and a hollow armature revolving between the inside and outside field magnets, together with means for destroying the residual magnetism of the field magnets.

930,864. BRUSH-HOLDING STUD; T. L. and M. J. Kearney, Carbondale, Pa. App. filed Feb. 10, 1908. The stud is formed of insulation with a flat tongue at one end and a detaching device having a recess into which the tongue is fitted.

930,873. ELECTRIC COUPLING; T. Maijgren, Rochester, N. Y. App. filed July 10, 1908. Means for locking the two members of the coupling against accidental separation by means of a locking notch.

930,896. ARMORED CONDUCTOR; E. D. Speer, New York, N. Y. App. filed June 27, 1908. An armored conductor with a flexible protective covering consisting of two metal strips, both corrugated.

930,902. ELECTROLYZING APPARATUS; E. L. Thorp, Nottingham, England. App. filed Nov. 21, 1905. The plate has active sections on one side alternating with active sections on the other.

930,928. ELECTRIC SWITCH APPARATUS; A. F. Berry, Ealing, England. App. filed April 6, 1906. The electric switch comprises two movable contacts operated by a solenoid magnet.

930,958. ELECTRIC GLOW LAMP; G. K. Hartung, New York, N. Y. App. filed May 27, 1904. Electric glow lamps of the Nernst type, in which a current of a cooling medium is created through the lamp, which is regulated in accordance with variations in the potential of the current supplied.

930,971. FIRE ALARM SIGNAL APPARATUS; W. H. Kirnan, Bayonne, N. J. App. filed Feb. 17, 1909. Improvements in the signal wheel and other parts of a fire alarm signal apparatus.

930,972. THERMOSTATIC CIRCUIT CONTROLLER; W. H. Kirnan, Bayonne, N. J. App. filed Feb. 17, 1909. For fire alarm signals, in which a quick-acting switch and thermostatic couples are employed to cause the switch to make and break the circuit.

930,997. ALTERNATING CURRENT RECTIFYING APPARATUS; C. P. Steinmetz, Schenectady, N. Y. App. filed April 30, 1904. For multiphase currents in which current-generating windings are used for one polarity and counter magnetizing coils for the direct current produced by the rectifier.

931,008. SUBMERGIBLE MOTOR; A. C. Durdin, Jr., Chicago, Ill. App. filed May 18, 1908. The motor has an enclosing wall and an air chamber for cooling it, and can be submerged in water without endangering the motor.

931,013. ELECTRIC HEATER; J. E. Macomber, Albany, N. Y. App. filed April 24, 1909. An electric heater with a semi-cylindrical battery, a plane front plate, an end plate situated within the end of the battery and an auxiliary plate on the end plate.

931,015. INSULATING COMPOSITION; M. McGerry, Kalamazoo, Mich. App. filed Oct. 5, 1908. Consists of asbestos pulp, slippery elm, a vegetable acid, glue, starch and water.

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Indiana's New State Association.

Indiana has about 150 privately owned central-station companies, and of these one-third are embraced in the membership of the recently formed Indiana Electric Light Association, which held its first annual convention at French Lick last week. About 30 stations were represented at the meeting, or 60 per cent of the active membership. This is not a bad showing, considering the proportions of the memberships of other societies which attend annual meetings, but, compared with the whole number of companies in the State, it will be seen that only one-fifth were represented. For a first convention the attendance was creditable. The association is only nine months old, and as it develops it will undoubtedly embrace a large proportion of the existing companies. It would seem that an active-membership list of considerably over 100 companies ought to be comparatively easy of realization, particularly with the moderate dues of the association, ranging from $2.50 a year for the plants in the smallest cities to $20 a year for the companies in the larger cities in the State. The new organization seems to have the germs of vitality in it, and there is no reason why it should not become one of the most flourishing of the State associations.

Representatives of the manufacturers and supply dealers attended the convention in considerably larger number than the central-station men themselves. This is often the case at other conventions. Possibly the plant managers can learn something from the alertness and enterprise of the men who sell electrical apparatus. The supply men turn out without fail because they believe it will be to their advantage individually and also on the broad principle of supporting the industry. The conventions ought really to be of much greater importance to the men selling electricity than to those selling apparatus, to say nothing of the great desirability of united action on the part of public-service companies on questions of public policy. But there are still many central-station men who refuse or neglect to make the comparatively slight effort necessary to give the conventions the support and prestige of their adherence and presence. We hope and believe that with the growing realization of the responsibilities of managers of public-utility corporations, to which Mr. T. C. McReynolds referred in his presidential address, there will be few station managers who will remain indifferent to the need of supporting the State and National associations. And it is the men in the smaller cities and towns who need the help of the association the most and who should be—but often are not—most zealous in its support.

The program of papers presented at the first Indiana convention was an excellent one. The first paper, on "Central Power-Station Practice," by Mr. P. H. Palmer, of Kokomo, with its useful analysis of station operating costs, frankly divulged from practical experience, was alone worth attendance to the convention. The other papers were also worth while. The discussion of the meeting centered about the tung-

sten lamp and the relation of central stations and dealers in the sale of current-consuming devices. Mr. C. C. Perry, of Indianapolis, was elected president, and in his strong hands the Indiana association, now apparently firmly established, should surely advance to greater usefulness.

The Michigan Convention.

The convention of the Michigan Electric Association, held last week at Detroit, far exceeded in attendance all previous conventions of that association. The topics taken up were confined to three specific subjects, and one session was given to each. At the opening session, devoted to lamps and illumination, a gratifying increase was shown in the system of special lighting of downtown streets by means of arches of tungsten lamps suspended from span wires. As regards the use of the tungsten lamp in general for interior work, the novelty has very much worn off during the past year, and practically all progressive stations are a unit in the decision that the tungsten lamp has been most beneficial to the industry by enabling business to be secured which heretofore has been out of reach. The general effect has been an increase in gross revenue, although temporary decreases when tungsten-lamp installations have first been made are frequently noted. In one session given to electric-power subjects, special attention was paid to the application of curve-drawing wattmeters to power consumers' installations. President Hillman is an enthusiast as to the advantages of such curve-drawing instruments for the purpose of giving both the power company and the consumer information. The advantages of their use can best be brought out by specific examples of benefits derived. To the average central-station man perhaps the vigorous advocacy of the frequent use of such instruments among power consumers may look like an attempt to help out the manufacturing companies to extend the sale of expensive instruments. To judge from some of the experiences related at the Michigan convention, however, the central station has been the first to take the initiative.

One of the most important uses of the curve-drawing instrument, on both light and power loads, is to show the consumer just at what hours electricity has been used. Frequently the record indicates use by janitors or watchmen which the consumer little suspected, and which he had previously charged up to the inaccuracy of the company's meters. As a method of settling complaints of this kind, the curve-drawing wattmeter or ammeter is very useful. These instruments may be also very useful to give both the central station and the power consumer an accurate indication of the power required by various machines in actual operation. Such information is useful to the central station making up its statements of fixed charges caused by maximum demand, and also in figuring on new installations. In some cases the consumer has discovered from the charts that his employees are not working the machinery in a way to get the greatest output per day. In another case brought up at the convention, where a lighting consumer had bitterly complained of his bills, the curve-drawing instrument revealed the fact that 60 per cent of the total was being used by the janitor in sweeping out at night. The result thoroughly satisfied the consumer and showed him that he was not being over-charged; otherwise, he would have continued to consider the light needed by the janitor as of no consequence on the monthly consumption. The use of central-station power for electrolytic and electrometallurgical processes received a little attention, and it is evident that there is an increasing amount of this work in Michigan, where much water-power is available, and where power can be sold very cheaply during some hours of the day. One of these uses, already well established in one large factory, is the electrolytic production of bleaching solution. Another is electric welding in the manufacture of small metal articles. It was also mentioned during one of the discussions that one large water-power company is figuring on the electrolytic production of oxygen for a large consumer during the hours when the load on the water-power plant is the lightest.

International Conference of Telegraph and Telephone Engineers.

The *Transactions* of the Telegraph and Telephone Conference, held at Budapest last year, have now been published, and make a quarto volume of about 250 pages, finely illustrated. It is published in French and in German, the two languages running side by side in official texts, but appearing in indiscriminate succession among the papers. English and Italian papers have been subjected to translation. Fortunately, English units of length and mass have also been translated, in most cases, into international metric equivalents. One valuable outcome from the conference, as manifested in the *Transactions,* is the collection of a number of valuable telegraphic and telephonic statistics into a single volume for international reference. Another noteworthy result of the conference is the evidence of the advantage that pertains to placing the management and technical disposition of both telegraph and telephone circuits of a country in the hands of the same staff. In this country, although the telephone companies lease many circuits for telegraph service in private offices, yet, broadly speaking, the telegraph wires are exclusively in the hands of telegraphists, and the telephone wires in the hands of telephonists. There would be advantage in a union of these interests, if the financial situation were favorable to such a merger. The Budapest conference was strictly European, and it is to be hoped that the United States will be represented at the next conference, which is scheduled for 1910. Our telephone systems are second to none in the world, largely because engineering talent has been amply employed in their development; but our telegraph systems are much behind the times, and are yearly growing relatively worse, largely for the corresponding reason that so little engineering talent is nowadays here employed in telegraphy. Participation in such meetings would have a good effect in making better known to foreign leaders wherein we excel technically, and in impressing upon our representatives wherein we are deficient. At one time Americans took a leading part at international electrical meetings, but in recent years we have ranked with China in abstention. It is to be hoped that this is not an indication that in this country all interest has finally become absorbed in the commercial side of engineering, and that its scientific and technical aspects not immediately representing dollars, are no longer considered worth attention.

More Data Concerning Tantalum.

A recent lecture before the Royal Institution by Alexander Siemens gives a very interesting view of the present state of the tantalum industry. As is well known to our readers, the tantalum lamp, although badly beaten in efficiency by the tung-

sten, is still in wide use, especially in Germany and on 220-volt circuits. Moreover, in addition to its uses in incandescent lamps it bids fair to have other important commercial applications particularly when proper development of its ores, which are very widely distributed, shall tend to bring down its cost when used in quantity. At the present time it is obtained very largely from tantalite, a raw material having the advantage of being practically free of niobium, which, having a lower melting point than tantalum and being rather difficult to separate from it, is an undesirable constituent in the ore. The metallurgy of tantalum begins with obtaining it from tantalite in the form of a double fluoride of tantalum and potassium. This is then reduced by metallic postassium to the form of a black powder.

This method of production is an interesting one in view of the fact that it would have been commercially impossible until within a few years, because only recently has potassium been obtainable in commercial quantities at a price which would permit of such use. The powder thus obtained is melted *in vacuo* in an electric furnace, thereby obtaining small buttons of very nearly pure tantalum. The present commercial tantalum is decidedly purer than that obtained at first and more uniform in quality, so that it is now possible to draw it into wire of a tenuity not practicable in the beginning of its utilization. Commercial wire for lamps is now produced barely .03 of a mm in diameter, the standard diameter of the earlier tantalum filaments being .05. The improvement in purity shows in a decrease of the specific resistance and an increase in the temperature coefficient of the present commercial wire as compared with that at first obtained. The tensile strength of the commercial wire rises to 57 tons per square inch, which is comparable with the best of steel wire.

As regards other commercial applications other than to incandescent lamps, these have not been fully developed on account of the cost of material. For chemical purposes tantalum gives considerable promise, inasmuch as it is untouched by all ordinary agents below 300 deg. C., and its general characteristics, which are very like those of steel, enable it to be applied with advantage instead of steel, where it is of the utmost importance to avoid rust. One use of considerable interest is for pen-points. It is found that it is admirably suited for this use and wears away less rapidly than steel. Curiously enough, it is improved in this function by a slight oxidation prior to its final polishing, which apparently increases the hardness of the surface and consequently the wear of the pen very much. At high temperatures, dull red heat for instance, it tends to absorb, like many metals, gases, especially hydrogen and nitrogen, and becomes brittle, so that its efficient use is confined to more moderate temperatures. At still higher temperatures it oxidizes on the surface and burns, so that a very thin wire can be ignited by a match. When used in an electrolyte it has, as has been known for some little time past, convenient application as a rectifier. Altogether, the more recent experiments with tantalum tend to increase one's estimate of its general value in spite of the coming of the tungsten lamp as an active competitor in incandescent lamp industry. Of the rare metals used for lamps, tungsten seems to hold the field for incandescent filaments, tantalum and osmium being apparently doomed to a subordinate position, however useful the former may be for certain purposes. Dr. Siemens gives an interesting note on the production of osmium, which of itself is quite sufficient to show the improbability of its assuming a large importance in spite of its undeniable possession of unusual radiating properties. The total production of osmium per year amounts to only about 8 kilograms for the whole world, of which 5 kilograms or thereabouts are required for medical and chemical purposes. The production of tantalum he does not state, but it is so much greater than this as to admit of no comparison, and should its general uses increase, which is quite certain, owing to its wide distribution it can be obtained in reasonably large quantities.

The Luminous Equivalent of Radiation.

A recent number of the *Bulletin* of the Bureau of Standards contains a long paper by Mr. P. G. Nutting on the general problem of the luminous equivalent of radiation. The paper points out that the terminology of the subject is much confused. The word "light" is used by some writers to designate the subjective physiological sensation, and by others to designate the objective stimulus which gives rise to the sensation. There is much need for a revision of terms and definitions, so that physical and physiological researches may be expressed in common terms. If we confine ourselves to a small element of the visual spectrum—say that lying between the limits of 0.5μ and 0.51μ—so that we only consider what is practically one color of light at a time, the physiological stimulus produced depends upon the intensity of the radiation in that color, but not in a simple proportion. If we increase the intensity of radiation in that color, we increase the sensation, but in a manner which is different in different parts of the spectrum, and is not uniformly graded in any one part. Moreover, the sensation depends upon the duration of the stimulus, increasing for the first tenth of a second at a rapid rate, reaching a maximum value in less than one second, and thereafter slowly diminishing with time in a manner that depends upon the intensity. It is supposed that if for each element of the spectrum the intensity effect and the duration effect could be properly assigned, the total sensation would be the sum of the sensations due to each element. Even this proposition, however, is open to discussion, and it has been asserted that the total sensation stimulus is generally less, but occasionally more, than the sum of all the individual component stimuli, if each acted alone.

It may be judged from the foregoing how difficult a task lies before the investigator who endeavors to express completely and accurately the stimulus equivalent or light sensation of any assigned intensity of radiant power, within the limits of the visible spectrum. The eye may be likened to an alternating-current instrument which responds to alternating electric currents in a certain complex manner. Various frequencies of alternating current affect the instrument differently and perhaps in a different manner when the pointer is at different parts of the scale. All we can do for the present is to observe the increase of deflection as we gradually increase the strength of current of one frequency at a time, and then gradually accumulate data as to the cumulative effect of currents of different frequencies.

Western Union Receives Large Award in Telephone Case.

Mr. Everett W. Burdett, special master in the case of the Western Union Telegraph Company against the American Telephone & Telegraph Company under a contract made in 1879 under which the former retired from the telephone field, has reported an award to the Western Union Company of $2,579,914 and 20,087 shares of stock, the total aggregating about $5,000,000.

The contract out of which the litigation arose was entered into at a time when a serious conflict for supremacy in the telephone field was imminent between the Western Union and the National Telephone company, now the American Telephone & Telegraph Company. The National Telephone Company thought it best to compromise, and the terms of the compromise were embodied in the contract in litigation.

Under it the Western Union Telegraph Company agreed to go out of the telephone business and turn over all its telephone patents to the Bell company, the latter agreeing not to interfere with the telegraph business and to pay the Western Union 20 per cent of all rentals or royalties received from licenses or leases for telephones in the United States for a period of 17 years.

After this contract was made the Bell company gave exclusive licenses to companies in various parts of the United States for a certain percentage, generally 35 per cent of their stock, free of cost. For four years after the making of the contract the Western Union received an annual income from telephone royalties of between $400,000 and $500,000, but in 1883, when these stock transactions came to its attention, the Western Union entered a protest. The case was first given to Judge John Lowell as referee, who ruled that the Western Union was not entitled to recover. Judge Colt confirmed the referee's decision. The case was taken to the Court of Appeals, with the result that the Western Union was given a decision entitling it to 20 per cent interest in the shares of the Bell sub-companies, with accrued dividends, during the 17 years of the life of the contract.

The present case has been before Mr. Burdett since Feb. 1, 1904, when he was appointed by Judge Colt as a result of the decision of the United States Circuit Court of Appeals, handed down in December, 1903, in which the court ruled that the Western Union was entitled to an accounting, thus reversing the decision of the single justice.

The question before the master was not whether the plaintiff was entitled to recover, that having been decided affirmatively by the Circuit Court of Appeals, but as to how much stock and how much cash the Western Union should recover from the Bell company under the terms of the contract in dispute. Although the amount awarded is only about half the amount claimed by the Western Union, it is regarded in financial circles as a great victory for that company. The claim of the plaintiff was for 38,188 shares of stock, par value about $3,500,000, and $5,873,292 in cash. The master's report is a printed document of over 100 pages. If the parties are not satisfied they may then take exceptions, which will be argued later before the court. It is understood that the Western Union is willing to accept the findings, but that the defendant corporation will take exceptions.

Calcium Carbide Suits.

Judgment has been rendered before the United States Circuit Court of the Northern District of New York in two suits of the Union Carbide Company versus the American Carbide Company. Both decisions were written by Judge Ray, and both are in favor of the defendant. One suit was based on the product patent, 541,138 of Willson, of June 18, 1895. The validity of this patent is upheld, but no infringement is found, the judge holding that the "new product" patented by Willson as "crystalline calcium carbide existing as masses of aggregated crystals" is a new and special subdivision of crystalline calcium carbide and that when thus constructed infringement of this narrow claim is not made out. The other suit was based on the process patent, 563,527 of July 7, 1896. Infringement was not found because the patent refers to an arc furnace, while Judge Ray holds that the furnace used by the defendant is essentially a resistance furnace.

Government Telegraphs in America.

A recent bulletin of the U. S. Bureau of the Census gives some surprising data as to the extent of Government telegraphy and telephony in this country. In detailing the telegraphic and telephone operations of the Weather Bureau the bulletin states that during the year 1907 it operated 537 miles of telegraph and telephone lines, including about 96 miles of submarine cable. At the end of the fiscal year 1907 the telegraph was being used to supply 2280 places with daily forecasts, 734 places with special warnings, and 5998 places with emergency warnings, all at the expense of the Government. Through the service of governmental telegraphs, railroad telegraphs, telephones, railroad trains and mails, daily forecasts were being sent to 2,141,151 addresses, and through the cooperation of other telephone companies the dissemination of this information was materially increased. These lines rendered valuable service in obtaining aid for shipping in distress; in reporting inbound and outbound vessels to owners, maritime associations and others; and in affording residents in isolated places and others probably the only means of telegraphic communication.

During the year 1907 the Government had charge of the operation of telegraph and telephone systems in our outlying possessions. The length of such lines amounted to 65 miles in Panama, 484 miles in Porto Rico, 1403 miles in Alaska and 6438 miles in the Philippines, and in addition there were 2524 miles of submarine cable in Alaska and 1437 miles in the Philippines. More than one million (1,090,308) messages were transmitted over these lines during the year. Because of the excessive cost of maintaining land lines in the interior of Alaska, the use of wireless telegraphy is particularly desirable in that country. In 1907 a wireless system covering 107 miles was in operation, and other stations were contemplated which would furnish connections between Safety and St. Michael and the United States.

Another Large Mexican Hydro-Electric Project.

A large electric-power and transmission enterprise, backed by American capital, is the latest Mexican hydro-electric development. It will be operated under the name of the Nazas River Power Company, the organization of which has just been effected. Mr. G. L. Nies, of New York, financial representative of the company, who has been spending some time in Mexico on business connected with the project, is authority for the statement that not less than $10,000,000 will be spent in the construction of the hydro-electric plant and the building of transmission lines. Mr. J. A. Spofford, of New York, is president of the company; Mr. L. H. Hacker, vice-president and general manager, and Mr. C. A. Bobst, secretary. The hydro-electric plant will be located in the Fernandez canyon, situated 125 km above the city of Torreon. The Nazas River flows through this canyon and the initial water-power will be obtained by building a high dam across the narrow gorge. The initial capacity of the power plant will be 20,000 hp, which can be increased as the demands may require. Representatives of the company have been quietly at work securing contracts for electric-power for some time. It is stated that contracts have already been signed for all the 20,000 hp that the initial plant will generate. The transmission lines will run to the cities of Torreon, Gomez Palacio, Lerdo, San Pedro, Mapimi, Durango, Velardena and other places. The power will be used chiefly in mining operations and industrial plants. The concession for the enterprise was originally obtained from the Federal Gov-

ernment by Messrs. Juan F. Farias and Andres L. Farias, Monterey, Mexico, from whom it was purchased by the Nazas River Power Company. The contracts call for the completion of the big enterprise by Jan. 1, 1911. Mr. Walter F. Lineberger, of Torreon, Mexico, is the engineer in charge of the work. The company will maintain its Mexico offices at Torreon.

Electrical Show for Boston.

An electrical show, the first of its kind in Boston, will be held in the great exhibition hall of the Mechanics Building on Nov. 15 to 25, inclusive. The exhibits will include all the novelties in time, labor-saving and comfort-giving devices, as well as everything up to date in various other electrical lines. The decorations and lighting effects will, it is stated, be novel and elaborate. There will be special departments for the exhibits of amateur wireless operators, and the inventions and ideas of amateurs; prizes will be awarded for deserving suggestions or to inventors of practical ideas. The association promoting the exposition is known as the Electrical Exposition Association, of which Mr. Chester I. Campbell, a successful promoter of large expositions, is general manager. The president is Mr. C. W. Holtzer, and Mr. A. B. Tenney, of the Malden Electric Light Company, is vice-president. The executive committee includes Messrs. Stuart, of the Stuart-Howland Company; W. H. Atkins, of the Boston Edison Company; J. N. Keller, of the New England Telephone & Telegraph Company; Herbert S. Potter and Frank J. Stone, of the Electric Storage Battery Company. The advisory board consists of members of some of the large electrical manufacturing companies.

Expediting Telegraph Business.

The Postal Telegraph Company inaugurated recently a new method of handling its business between important cities and town which reduces very materially the time a message is in its care—i.e., from the moment it is accepted from the sender until its delivery to the addressee. This gain of time is effected, not by any improvement in apparatus or increased speed in transmission over the wires, but by the readjustment and concentration of office methods and the elimination of many handlings of messages, which consume time.

The means of accomplishing these results is simple. In the New York office the important wires are grouped on desks arranged in the form of a quadrangle, instead of being scattered all over the office, as formerly, the inner space of the quadrangle being occupied by clerks who take the messages the moment they are received and hand them over to the operators on the wires over which they are to be forwarded to their destination, in the case of relayed or through messages. Local messages are immediately put into a pneumatic tube and despatched to the delivery department. By the old method a relayed message was handled 10 times during its course from wire to wire in the office, with an inevitable waste of many minutes. The new system cuts down the handling from 10 to 1 with a corresponding saving of time. At the cities where the new system has been introduced the arrangement of the instruments and the method of handling the business are the same as those employed at New York.

The company reports that this improved internal method of expediting the traffic over the wires has reduced the time of transit so that its patrons may receive answers from Chicago, Boston, St. Louis, Denver, San Francisco, New Orleans and other points in less than 30 minutes after the messenger has been signaled to take the message. A maximum schedule time limit is fixed for the transit of every message in the operating, delivery clerks and messenger departments. The average elapsed time, for instance, from the time a messenger is called in New York to delivery to the addressee in Chicago is 15 minutes. In cases where the distance from office to addressee is short messages are frequently delivered in less than 15 minutes. The company makes no extra charge for this "Special Rush Service" as it is called.

Corporation Tax Plans.

The first step in the collection of the corporation tax was taken to-day when Acting Secretary of the Treasury Reynolds sent out to internal revenue collectors instructions for the compiling of lists of corporations within their districts. The corporations will be listed under five heads—financial and commercial organizations, public service, industrial, mercantile and miscellaneous. Their reports will have to be in early as the tax is to be collected for the present calendar year.

The question blanks which the corporation officers will have to fill out have not yet been prepared, and it is expected that nothing will be done in that direction until Royal Cabell takes his place as Commissioner General of Internal Revenue, succeeding John G. Capers, of South Carolina. It is recognized that the corporations could not answer the questions intelligently anyhow until near the end of the year for which the earnings are to be computed.

Telephone and Telegraph Legislative Investigation.

The legislative committee which has been appointed to look into the question of whether the public service laws of New York should be so amended as to place telephone and telegraph companies under the supervision of the commissions, held a preliminary meeting last week and is preparing to begin its work. Senator George A. Davis, who was chosen chairman of the committee, says that the committee will first investigate the telephone and telegraph companies in all parts of the State, to see whether they are now giving good service and determine whether the service could be bettered by putting them under the commissions.

Senator Davis also says that it is within the scope of his committee's powers to investigate the commissions themselves to ascertain whether they are performing the duties for which they were created. It is expected that public hearings will begin about Dec. 1 and that a report will be ready for the Legislature when it meets in January. In addition to the chairman the members of the committee are: Senators John Kissel and James J. Frawley, and Assemblymen Edwin A. Merritt, Jr., John Yale, Artemus Ward, J. A. Waters and Thomas B. Caughlan.

Patent Office Criticism.

At a meeting held in Washington last week, at which about 35 inventors were present, a permanent organization of inventors was formed, having for its object the correction of alleged patent abuses. The chairman of the meeting was Mr. W. P. Armstrong, and the secretary, Mr. J. J. O'Brien. During the meeting the Patent Office was sharply criticised, and manufacturing organizations were accused of systematically cheating inventors of their rights. Commissioner of Patents Moore, in replying to some of these charges, said that the inventors were too hasty and severe in their criticism of patent office methods and patent office examiners. If any faults exist in patent laws, he said, they are faults of the laws and not of the officials who administer them. A general meeting of the association formed is scheduled for some time in September.

New York Public Service Commission News.

The Public Service Commission of the First District of New York, without passing upon the reasonableness of the price of $300 a share which the receivers of the Metropolitan Street Railway Company offered to pay the receiver of the New York City Railway Company for 500 shares of the Bridge Operating Company, has granted its approval to the proposed transfer of the stock. The commission at the same time has ordered an investigation to be started to ascertain the condition of the Bridge Operating Company, which, under the plea that it is

organized as a business corporation and not as a railroad company, has failed to file reports with the commission. The commissioners have expressed the opinion that if the value of the shares has multiplied three times within a few years it is proper to investigate the question of rates and service.

The Public Service Commission of the First District has taken under advisement the application of the Long Island Electric Railway for permission to reduce its capital stock from $2,100,000 to $600,000. At a public hearing last week the company claimed that the increase of its capital stock to the present figure was made to cover paper assets, which were of no benefit to the company, and that it wanted the stock reduced to represent the real value of the company's property.

The Citizens' Tunnel Committee of Staten Island has presented to the Public Service Commission plans for a subway route that it is claimed will prove a solution for the transportation difficulties the Borough of Richmond now suffers. It is proposed that the Brooklyn Fourth Avenue line shall be continued and run from 101st Street in Brooklyn under the Narrows to Rosebank, S. I. The citizens of Staten Island also have some hope of securing an extension of the MeAdoo tunnel from Jersey City, through Bayonne and entering into their territory.

The Public Service Commission of the First District has accepted the invitation of the management of the State Fair, which opens at Syracuse on Sept. 14, to make an exhibit. Elaborate charts will be prepared which will show all of the transportation facilities of Greater New York.

The Public Service Commission of the First District, under the authority of the transportation corporation law, passed by the last Legislature, has taken the Fifth Avenue Stage Coach Company under its jurisdiction. This company operates a line of electric buses on Fifth Avenue, upper Broadway and Riverside Drive. The company holds a franchise giving it the right to operate over any streets in the city with the approval of the commission. The commission has called upon the company for a statement of rates, routes, transfer points, number and condition of cars operated, etc. The commission intends to investigate as to whether the service is adequate to the public demands.

The Public Service Commission of the First District has completed inspection of the Eastern Parkway, assessment subway route and the Coney Island and Fort Hamilton route in Brooklyn. Property owners along the former of these routes have signified their desire to have an elevated extension of the subway constructed by assessment, and a hearing has been called on the proposition for Sept. 8. The inspection of the Fort Hamilton line was for the purpose of ascertaining whether the assessment plan could be applied.

The Public Service Commission, Second District, has authorized the Deer River Power Company to exercise franchises in the village of Copenhagen, Lewis County, and to issue its capital stock to the amount of $25,000 to be used for the purposes of expense of organization and paying its indebtedness incurred in purchase of certain water-powers, riparian rights and land at High Falls on Deer River.

The commission has consented to the consolidation of the Plattsburgh Light, Heat & Power Company and the Lozier Light & Power Company, under the corporate name of Plattsburgh Gas & Electric Company, and given its permission that the companies may, pursuant to the terms of the agreement of consolidation, transfer all their property, franchises, etc., to the new corporation formed by such agreement of consolidation.

A petition has been received from the Babylon Electric Light Company asking for approval of an increased issue of capital stock from $45,000 to $75,000. The company furnishes street and house lighting by electricity in the village of Babylon and in its parts of the towns of Babylon and Islip, and contemplates an extension to the village of Farmingdale. The proceeds of the stock issue are to be used for the construction and improvement of its plant and distributing system, for the improvement and maintenance of its service, and for the discharge of lawful obligations.

Indiana Electric Light Convention.

Organized Nov. 24, 1908, the Indiana Electric Light Association held a special meeting in Indianapolis last January, but its first annual convention was held at the French Lick Springs Hotel, French Lick, Ind., on Aug. 18 and 19, 1909. The attendance was not large, about 80, of whom perhaps 30 were central-station men. But the program of papers was an excellent one, if short, and the association, under the direction of its first president, Mr. Thomas C. McReynolds, of Kokomo, demonstrated its vitality and gave promise of growth in numbers and usefulness. Mr. C. C. Perry, president of the Indianapolis Light & Heat Company—perhaps the most widely known central-station man in the State—was elected president and Mr. Fred Leslie, of Muncie, was re-elected secretary and treasurer. Two sessions were held and six papers or addresses were presented and briefly discussed.

OPENING BUSINESS.

The first session of the convention was held on the afternoon of Wednesday, Aug. 18. Mr. McReynolds was in the chair and Mr. Leslie, the secretary and treasurer, was at his side. In his opening address President McReynolds referred to the likelihood of a public-service commission in Indiana. While the bill had not passed at the last session of the Legislature, the subject will no doubt be taken up at the next session. The association should not wait until that time to reach its own conclusions in the matter. The organization can be a help to its members in this and many other ways.

The growth of the industry is in no way abating. Many companies will no doubt be able to show gross earnings of $10 per capita within the next 10 years. Rates have been reduced; many companies are now selling energy for certain purposes at less than 2 cents a kw-hour. Indications are that in the future managers of public-utility corporations must take greater responsibilities and assume heavier burdens; they must be alert to take advantage of all opportunities for advancement. The technical press and technical societies show the trend of development. Greater care must be exercised in the selection of employees. Improvement in the art requires increased intelligence and skill on the part of its followers.

Mr. Thomas Taggart, president of the French Lick Springs Hotel Company, delivered a pleasantly worded address of welcome. Mr. Taggart, who operates a commercial plant at French Lick, was afterward elected a member of the association and appointed on the advisory committee.

The secretary and treasurer expressed his regret that the number of central-station men attending the meeting was not greater. The association has 72 members and a satisfactory balance in the treasury.

Mr. P. H. Palmer, of the Kokomo (Ind.), Marion & Western Traction Company, read an excellent paper on "Central-Station Power Practice." The paper contained useful figures of operating costs from actual records. It will be presented in abstract in a following issue. Mr. Leslie and Mr. C. C. Perry, of Indianapolis, discussed the paper briefly.

MAYOR BOOKWALTER'S SPEECH.

Mayor C. A. Bookwalter, of Indianapolis, was present at the invitation of Mr. Perry, and he addressed the convention at the request of President McReynolds. He said it did a public officer good to attend a gathering of this kind, meeting men who try to please an indulgent public. The newspapers often attack public-utility corporations. They raise their rates for advertising at will, but want the service companies to reduce their rates. Publicity is akin to light, so there is an inconsistency in this. The newspapers should first pluck the beam from their own eye. Indiana will some day have a public-service commission; a reasonable law of this kind will be all right. But public-utility companies have a right to live and to do business at profitable rates. The men in the association should give their advice to those drafting the bill. The general public is more concerned in first-class service from first-class plants than in witnessing the ultimate forcing into receiverships of the men

who furnish that service. As a concrete instance of the proper way of doing things, the Mayor mentioned the new City Hall electric plant in Indianapolis. Mr. George M. Brill, of Chicago, is consulting engineer for the plant, and when he was asked whether the city should buy electricity or make it, he advised a contract with the central-station company, which, he said, could undoubtedly sell electrical energy to the city cheaper than the latter could make it. Mayor Bookwalter's speech pleased the central-station men, and they applauded vigorously.

TUNGSTEN-LAMP DISCUSSION.

"The Commercial Effects of the Tungsten Lamp and Its Later Developments" was the subject of a paper read by Mr. N. S. Merrill, of the National Electric Lamp Association, Cleveland. The relation between the lamp manufacturer and the central-station man is very close, the speaker said. The stations have found the tungsten lamps valuable in attracting much new business by low rates adapted to the new lamps. The new lamps stimulate a desire for more light. Stations with kw-hour rates based on current consumption of the old carbon lamps looked with some dismay on the lamps. But, as in the case of the introduction of the mantle in the gas business, these fears have not been justified. Public interest in lamps and lighting is aroused as never before. The tungsten lamp makes possible a degree of illumination which would have been prohibitive a few years ago on the score of expense. The residence customer who cuts down his current consumption for light by using the tungsten lamp is apt to install electric flatirons or other convenient electric devices, thus helping the day load and the load factor of the station. In stores the advertising value of the new lamp, with its white, color-true light, makes it of great value, but the lamp should be properly installed.

Never before has the central station been in such an excellent position to meet gas competition. There is no doubt, too, that the lamp will be improved; perfection has not been reached in three years. A 150-watt lamp has recently been added to the line to fill the rather wide gap between the 100-watt and 250-watt sizes. One interesting announcement made by the speaker was that the 220-volt tungsten lamp will soon be obtainable. Mr. Merrill dwelt on the advantages of series tungstens for street lighting. The lamp for this purpose is rugged, and there is no question of its merit.

Low-voltage tungstens are used for outdoor decorative and sign lighting. Lamps of 4 cp are large enough. These require low-voltage circuits, and 8-volt to 12-volt tungstens can be procured. They must be burned in series or series-multiple or with transformers if alternating current is available. The transformers should be controlled from the primary side. Voltage drop in secondaries must be small and the transformers should be operated at as near full load as possible. Sign and decorative lighting is most frequently done on a flat-rate basis, so that by the saving afforded by tungsten lamps a reduction in rate can be made to the customer, while the company secures a better return. Tungsten lamps are also being rapidly introduced for train and automobile lighting, often supplanting gas or oil. The pocket flashlamp is another form where the new filament is particularly advantageous. In closing, Mr. Merrill said that a broad policy on the part of the central-station man cannot fail to win in the end. Give the customer the best medium of converting electricity into light and he will appreciate it.

Mr. George C. Osburn, of the General Electric Lamp Works, Harrison, N. J., spoke of the opportunities afforded by the tungsten lamp of getting much lighting now done by gas companies. The series tungsten lamp is particularly useful for central stations furnishing street lighting. Compared with gas, the deterioration of incandescent mantles is much more rapid than that of tungsten filaments.

Mr. Charles H. Howe, of the Holophane Company, of Chicago, said the tungsten lamp should be used to place the central station in a better position in the eyes of the public.

Mr. R. W. Waite, of New Albany, brought up the question of using tungsten lamps in residence lighting. Did Mr. Merrill really think it feasible? Mr. Merrill did not see why not. If installed properly the lamp should prove adapted for houses or apartments.

Mr. Perry, of Indianapolis, said he uses tungsten lamps in his own house. In his judgment, the lamps are all right for this purpose.

Mr. J. H. Harding, of Laporte, explained that the trouble was in adapting the new lamp to existing fixtures designed for carbon lamps. Mr. Perry's house is a new house. Customers complain of the brilliancy of the light. As to the reduction of wattage, Mr. Harding attaches no importance to that objection. The company will get about a certain amount of money from the average man; it is better to have part of the demand for electrical energy go into irons and other domestic appliances using electricity in the daytime. The principal question is the proper installation of the new lamps in residences.

Mr. Howe agreed with the latter proposition, and said that a naked tungsten lamp should never go into a house.

Mr. G. E. Varney, of Danville, Ind., was not so sure about the tungsten in houses. A soft, mellow light is needed in the home; perhaps the new lamp is too brilliant, giving too much of a glare.

Mr. Howe pointed out that it is not necessary to have bright points of light with the tungsten; the indirect system of lighting can be used, for instance.

Mr. Harding inquired concerning the old fixtures. Customers have their houses equipped with fixtures designed for carbon lamps, and they do not feel that they can afford to throw them away.

Mr. Howe said the old must give way to the new; it is the law of industrial progress. But sometimes, as the older brother's clothes are cut down for the younger, the old fixtures can be made over for the new lamps.

CENTRAL-STATION HEATING.

The morning session of Thursday concluded the convention. The first business was the presentation of a paper written by Mr. W. H. Schott, of Chicago, on "Central-Station Heating." The paper was read by Mr. J. C. Hornung, of the Schott Engineering Company. The author said that central-station heating plants had been in operation for 25 years. Some have been successful, some have been failures. In the latter case the cause may have been that the plant was not properly situated for district heating or the plant itself may have been at fault. There are four systems: high-pressure and low-pressure steam and high-temperature and low-temperature forced-circulation water systems. To be a success a central-station heating plant should serve a territory of substantial size; its design should be efficient, but not too expensive; the type of construction should allow low depreciation; distribution equipment should be carefully installed; sufficient equipment should be placed on customers' premises, and all features of the plant should be given proper attention. If the situation is favorable and if installation and rates are correct, central-station heating plants may be made to pay either on a coal-burning basis or by using exhaust steam. Charts were used to show costs, income and financial results of a heating plant combined with an electric plant in an Indiana city of about 10,000 population. Mr. Schott said that the results in this case had been very satisfactory. In general he recommended central-station heating plants, suitably located, as good investments.

GREETING TO SISTER SOCIETY.

On the suggestion of Mr. C. A. Howe, supported by Messrs. C. C. Perry and J. H. Harding, the following telegram, signed by President McReynolds, was sent to Mr. H. W. Hillman, president of the Michigan Electric Association, then in session in Detroit:

"The Indiana Electric Light Association, in session at French Lick, extends its compliments and congratulations to the Michigan Electric Association."

NEW BUSINESS AND ADVERTISING.

Mr. A. P. Tills, of the Evansville Gas & Electric Light Company, read two short papers on "New Business" and "Advertising." He emphasized the importance of having sufficient

solicitors in the field. In hard times, especially, the company must keep in close touch with the people. Solicitors may be paid on a commission basis if necessary. Peak business will come without solicitation, but off-peak business will not. The speaker recommended a liberal policy of doing wiring at cost and selling motors and heating appliances at close margin. The way to secure new business is to go out and get it, said Mr. Tills, sententiously.

In relation to advertising, the speaker believes that but slight returns are received from advertising in the daily papers. Perhaps it may be advisable to place such advertising, but if so it should be treated as an expenditure for public policy and not for new business. Specialists in advertising by light may be sent out to interest storekeepers in lighting schemes—outline, sign and show window. This lighting is intended for advertising, not for illumination. Attention might be called to installations of this kind by advertising in the daily papers. Mr. Tills does not believe in the use of circulars unless followed up by solicitors.

Mr. Perry has used newspaper advertising in Indianapolis and believes it has been of benefit. At any rate, it has a favorable effect on the public; it gives the impression that the company is progressive and aggressive and "in the game."

Mr. G. E. Varney, who is engaged in the supply business in Indianapolis as well as the central-station industry in Danville, asked if central stations and electrical dealers and contractors might not co-operate in the getting of new business. In Buffalo there is a Tuesday Lunch Club, where the station men and the contractors get together. There has been some feeling on the part of the dealers and contractors because the station buys apparatus in large quantities and distributes it practically at cost. The dealer must have a margin, if only a small one. Perhaps if the consumer pays a fair price for high-class lamps or heating devices he will value them more highly.

Mr. Perry could understand Mr. Varney's position and appreciated his suggestion. But, on the other hand, the whole object of the central station is to sell electrical energy. The Indianapolis lighting company sells appliances practically at cost. If the "other fellow" does the work of marketing he is entitled to his profit; but he does not do the work of pushing the sale of current-consuming devices in a systematic manner. The company must take up the work of educational campaigns and spend its own money in considerable amount; it has the organization to do it. The station can reach its own customers; the supply man does not know who these customers are. It would save much money and effort if the station could dispense with its new-business campaigns, but Mr. Perry does not see how it can be done. The company itself is bound to push out to make its business grow.

Mr. Varney said that it was true that the dealer could not make the central-station's business campaign, but as this campaign is expensive, why not sell the appliances at a profit to cover this expense? Why could not an arrangement be made for co-operation with dealers on the basis of the station selling the appliance at a fair price, to be agreed upon, permitting a profit? Let the selling expense of the station be charged to profit-and-loss account, making prices for appliances at which the dealer also could sell at a profit.

Mr. Perry replied that the station must meet the conditions that confront it, particularly if there is competition in supplying electrical service, as is the case in Indianapolis. The company must make new uses for the sale of energy. It would probably be impracticable to rely on the dealer to push the central-station business.

Mr. Varney said that he was not asking the station to drop its new-business department, but simply suggesting that a proper price be charged for appliances. A reduction of a few cents in the price of a flatiron is not a great inducement to a customer in view of the cost of the energy for operating it.

Mr. Howe thought it well to secure the co-operation of the contractors.

Mr. L. E. Holderman, of Terre Haute, told of a plan of paying commissions to contractors by the central station for the sale of energy-consuming apparatus. For lamps this commission is 50 cents per customer plus 5 cents per 16-cp equivalent; for fans, 50 cents for 12 in. and 75 cents for 16 in.; flatirons, 40 cents and 50 cents. Lamps are sold to dealers at 2 cents less than the regular price, and motors are sold to them at 7½ per cent to 10 per cent reduction from retail price.

Mr. R. W. Waite, of New Albany, contended that the station might just as well have a reasonable profit on appliances put out. He heartily favors a policy of this kind, which can be brought about if the central stations will stand together.

USE OF FLUX-OF-LIGHT TABLE.

Mr. Charles A. Howe, of Chicago, with the aid of blackboard diagrams, explained the practical value of the Cravath-Lansingh flux-of-light method of determining the amount of illumination necessary for a given room. He illustrated the simplicity of the system by example. The table will enable anyone who uses it intelligently to lay out a lighting scheme, so far as the necessary wattage is concerned. Central-station solicitors will find it very useful. With it they will have confidence to go out and figure on nearly any lighting proposition.

LOAD FACTOR.

Mr. Henry E. Eells, of J. G. White & Company, New York, read a paper entitled, "How Can We Best Improve Our Load Factor?" He defined "load factor" as the ratio of average to maximum load. He showed that it is highly desirable to load the station to its full maximum capacity for safe operation, and said that a careful canvass of the community should be made to secure all available power business. Rates should be definite and strictly adhered to. Motor installations may be paid for in installments. One interesting suggestion related to the disposal of old machinery replaced by electric motors. The central-station company should exhibit a willingness to take this off the hands of the customer. Perhaps a sort of clearing-house association could be formed by the companies of, say, one State to dispose of second-hand machinery secured in this way. In going to a merchant for sign or advertising lighting, try to interest him also in power. If he is a grocer ask him to use a coffee-mill motor, and so on. Residences now afford an opportunity for day load with the numerous domestic electric appliances of the present day. The introduction of the tungsten lamp has had a direct influence on the load factor of the lighting-companies system. A satisfied lighting customer, made so by the tungsten lamp, is well disposed toward the day load.

Answering Mr. Leslie's question, Mr. Eells said that 40 per cent is at present considered a good load factor for a central-station system.

LIGHTNING ARRESTERS.

Mr. E. E. F. Creighton, of the General Electric Company, Schenectady, gave a lecture on lightning arresters, with practical demonstration. The apparatus consists essentially of a large induction coil and Leyden jars arranged for an impressed e.m.f. of about 70,000 volts. The equivalent needle-gap, choke coil and multi-gap arresters were explained and illustrated. The speaker said that the aluminum arrester is the only one to use on transmission lines of over 30,000 volts. Below that voltage down to 2300, there is a choice between the aluminum and multigap arresters, but, perhaps, the former should be given the preference. The multigap arrester has reached its limit of improvement. Its weak point is its limitation in time of discharge. The aluminum arrester is designed to charge for half an hour. Below 2300 volts the aluminum arrester is relatively expensive. On distributing circuits it is not commercially practical to use the aluminum arrester on account of its cost and the need of daily inspection. Arresters should be wisely distributed on distributing circuits to give the best results. A smaller number can be used in cities than in the open country.

ELECTION OF OFFICERS.

President McReynolds spoke of the high character of the papers and thanked the authors. He expressed regret that a larger proportion of the active members was not present, but

said he was satisfied that the association had gained a firm foothold and he had little doubt that there would be a larger attendance at the next meeting. He took occasion to thank the supply men for their attendance.

On the report of a nominating committee, the following-named officers were elected:

President, Mr. C. C. Perry, Indianapolis.

Vice-president, Mr. G. E. Varney, Danville.

Secretary-treasurer, Mr. Fred Leslie, Muncie.

Executive committee: Messrs. J. H. Harding, Laporte; L. E. Holderman, Terre Haute; W. B. McDonald, Evansville; J. P. Ohmer, Elkhart; R. W. Waite, New Albany.

Advisory committee: Messrs. T C. McReynolds, Kokomo; Thomas Taggart, French Lick; H. M. Case, Connersville.

Finance committee: Messrs. Fred B. Hofft, Indianapolis; J. N. Moncrieff, Bloomington; Clemens Blank, Martinsville.

In taking the chair, Mr. Perry thanked the members and said that he believed the association would prove of great benefit to the industry in the State. The members should act in concert for the common good. A vote of thanks was extended to the retiring president and to the secretary, and the convention stood adjourned.

Mr. C. C. Perry, the new president, is a prominent figure in the central-station industry. He has been engaged in electrical pursuits all his business life, and is now president of the Indianapolis Light & Heat Company, which he organized in 1888 and has developed to large proportions with 15,000 kw in station capacity and 16,000 meters on the circuits. Mr. Perry was born in Richmond, Ind., in 1857 and was a telegraph operator and superintendent for the Central Union Telephone Company at Fort Wayne before engaging in the light and power industry. He has the distinction of establishing the first commercial electrical plant in the State at Richmond in 1880. Since that time he has watched the development of the business and has been an active participant in it. He went to Indianapolis to engage in electrical manufacturing with the old Jenney Electric Company in 1885, and three years later he organized the central-station company which he still controls. He is vice-president of the Association of Edison Illuminating Companies. In Indianapolis he is, of course, very well known. He is a former president of the Board of Trade and of the Marion Club of that city. His strength and prestige should be important assets to the new State association.

CONVENTION NOTES.

No action was taken in reference to place of holding the next annual meeting. It has been suggested that French Lick be the regular meeting place for the Indiana conventions.

The entertainment consisted of taking the waters at French Lick, horseback riding, golf and dancing in the evening.

After the convention finally adjourned there was an informal after-meeting on Thursday afternoon at which Mr. E. E. F. Creighton, of the General Electric Company, went further into the subject of lightning protection for the benefit of all interested.

While the attendance of central-station men might have been larger, still it amounted to 60 per cent of the active membership—a good proportion.

Neat badges were provided for members and visitors. The button, of bronze, displayed Franklin's key and lightning flashes, surrounded by the words "Indiana Electric Light Association" in a circle. Above was a cross-bar with space for the wearer's name and beneath a small ribbon—purple for active members and light blue for associate members.

Public Service Commission Hearing on Meter Test Reports.

The Public Service Commission of the First District will hold a hearing at 2:30 p. m., on Aug. 30, at its office, 154 Nassau Street, New York, for the purpose of determining whether, in order to insure the reporting to the commission of all tests of electric meters according to a standard form of report, an order should be issued by the commission containing substantially the following provisions:

The contemplated regulations stipulate that all tests of electricity meters shall be made under actual operating conditions as regards voltage, frequency, temperature, stray fields and vibration. Where shunts, series transformers or shunt transformers are used in connection with meters, the latter shall be tested from the line side of such apparatus when the voltage does not exceed 600. If the tension exceeds 600 volts, the meter may be tested as a self-contained instrument and the ratio certificates of the transformers may be used in calculating the true line watts. When rotating standard meters are used the connections must be so arranged as to give the tester full control of the starting and stopping of the standard and at the same time allow him that he may count the revolutions of the meter under test.

Each meter must be tested independently and not while it is connected in series with one or more other meters unless the potential circuit of each meter is so arranged as not to be fed through the field of any meter under test or rotating standard.

Direct-reading indicating wattmeters shall be used as standard instruments in making tests of consumer's meters. The commission calls for tests at one-tenth normal and full load rating of meter, and the average of the three tests obtained by multiplying the result of the normal load test by 3, adding the results of the light and full-load tests and dividing the total by 5, shall be deemed the condition of the meter. This final average is required to be reported to the commission on a prescribed form.

If a meter is found to be connected to a load which takes a current varying not more than 5 per cent of the rating of the meter and consisting of one or more units which will furnish such a load regardless of its method of control, then such load shall be used as the normal and only load during the test of a complaint meter. Unless an actual examination of the consumer's installation and use shows an important variation from that given herewith, the following classification in percentage of installation shall be used in determining normal load: Residence and apartment lighting, 25 per cent; elevator service, 40 per cent; factories (individual drive), churches and offices, 45 per cent; factories (shaft drive), theaters, clubs, entrance, hallway, and general store lighting, 60 per cent; saloons, restaurants, pumps, air compressors, ice machines, etc., 70 per cent; sign and window lighting, blowers and moving-picture machines, 100 per cent.

If a meter is found to be connected to an installation consisting of two or more of the above classes of loads, the normal load must be obtained by taking the average. Three tests shall be run on each load at which the meter is tested and should any two fail to agree within 1 per cent, a fourth test shall be run and the average for that load shall be the average of the three tests agreeing with each other within the limits of 1 per cent.

The commission provides two forms, one for a meter tested as a result of a complaint, and the other for meters tested periodically.

Convention of the Michigan Electric Association.

The Michigan Electric Association held its sixth annual convention at Hotel Tuller, Detroit, Mich., Aug. 17, 18 and 19. The arrangement of the sessions was somewhat different from that ordinarily prevailing in State conventions of this kind. The first session was held Monday evening, the second session Tuesday morning, and the third session Thursday morning. This left Wednesday and Thursday afternoon open for the entertainments which the Detroit people had provided in unusual abundance. The first session was called to order at 8 o'clock Monday evening by President H. W. Hillman, of Grand Rapids. Mr. Hillman said that there has probably never been a time

when the association has given more attention to the subject of incandescent lamps. Therefore, this first session was to be devoted to tungsten lamps, which lamps, however, no longer seem to be new. The heating branch of the industry has likewise advanced since the last meeting. Considerable interest was shown at the last convention of the National Electric Light Association with regard to heating devices, and the heating committee of the Edison Association, which meets next month, will have some interesting features to report as to extension of electric-heating business. Electrochemical and electrometallurgical matters are now coming before central stations for discussion and handling. A few have had to supply energy for bleaching purposes. Information on this character of load for central stations cannot be found in the ordinary hand-books and literature. At the National convention several delegates brought up this subject, but so much attention was attached to the motor business that no time was available for bringing out the important features in connection with electrochemical work. For fear the Michigan association will make a similar mistake, Mr. Hillman recommended that the incoming president appoint a committee of three members to be known as the committee on electrochemical and electrometallurgical matters. At the last meeting in Grand Rapids many delegates expressed satisfaction with the tungsten arch lighting on Canal Street. During the 12 months past there have been upward of a dozen streets there illuminated in a similar manner by the merchants. Instead of the old arc lamps taking 7 kw per mile of street, the merchants have adopted a standard of 60 kw to 70 kw per mile. Individually and collectively merchants speak of the arch illumination on all the streets in the highest praise. New business of this kind is being continually closed. A year ago only one street was illuminated with the arch system, and it was more or less a trial for the observation and consideration of the merchants of that city.

To-day the system represents a practical, popular method of lighting pleasing to the public, capable of extension on all the streets of the business districts, and with an annual earning capacity of more than $10,000 for the power company. He feels that similar results can be secured in all the cities and towns in the State of Michigan. The situation as to electric motors is one which should be studied more than ever. At this meeting Mr. Hillman said unusual importance would be attached to the forcible presentation of the merits of curve-drawing wattmeters and their value in connection with electric motor drives. Experience would seem to indicate that the curve-drawing wattmeter is as important to the electric motor branch of the industry as illuminating engineering has proved to be in relation to the lighting field. Therefore, several papers would be read on the subject. He hoped that every member would give careful attention to this matter to the end that the stations of Michigan will have been first to benefit from the extensive use of curve-drawing wattmeters. To emphasize this subject still more fully, Mr. Hillman said that the watchword of this convention would be curve-drawing wattmeters.

The president appointed a nominating committee consisting of Messrs. F. T. Masterson, of Grand Rapids; O. S. Wood, of Ionia, and William Constable, of Grand Rapids.

ILLUMINATION SESSION.

The session of this evening was devoted to lamps and illumination. The first paper presented was by Mr. E. G. Berg, of the General Electric Company, on tungsten lamps. Another paper, on the same subject, was presented by Mr. B. F. Fisher, of the Westinghouse Electric & Manufacturing Company. Mr. F. T. Masterson, of the Grand Rapids-Muskegon Power Company read a short paper on the care of tungsten street lamps, reviewing the experience in Grand Rapids with the maintenance of the arch system so extensively used there. The tungsten lamp in the residence was the subject of a paper by Mr. John Vandervliet, of the Grand Rapids-Muskegon Power Company. Mr. J. R. Cravath gave a talk illustrated with blackboard sketches on the principles of efficient illumination. Mr. Fred T. Benson, of the General Electric Company, was then called upon and read extracts from letters of a number of central-station companies giving experiences as to the effect of the tungsten lamp on business. Mr. Benson read only a few letters, but stated that he had 50 along the same line. These all agreed as to the beneficial effect of the tungsten lamp on central-station business, and that it had enabled central stations to get business which heretofore was out of reach. Several noted reductions in revenue on some installations when tungsten lamps were first installed, but the consumer usually increased his consumption after a few months. Mr. W. J. Trott, of the Fostoria Incandescent Lamp Company, Grand Rapids, spoke briefly of the tungsten arches in use in Michigan cities, and also of a company organized in St. Louis for the purpose of cleaning and maintaining lamps and reflectors for electric light consumers. The discussion was participated in by Messrs. A. C. Marshall, of Port Huron; E. F. Phillips, of Detroit; Harry Fee, of Adrian, and others.

POWER SESSION.

The Tuesday morning session was devoted to the consideration of electric power, and especially to the advantages in the use of curve-drawing instruments placed on consumers' loads to indicate the hours during which electricity is used and the amount used at various times. Some papers were also devoted to descriptions of these instruments. A paper by Mr. M. S. Mead, chief engineer of the Brunswick-Balke-Collender Company, was read in his absence. This described the electric-motor installation in one of the largest wood-working plants in the country, which is that of Mr. Mead's company at Grand Rapids. Mr. Charles H. Scott, of the General Electric Company, Boston, gave a large number of facts and figures in a paper on power used in the re-manufacture of lumber, with special reference to electric power. He showed that wood-working plants use an important percentage of the total amount of power employed for manufacturing purposes in this country. In sawmills, where lumber is first turned out, there is usually not so much chance to get electric power as in wood-working establishments, which handle the lumber after it is manufactured and which have a smaller percentage of refuse to burn.

President H. W. Hillman then introduced the subject of curve-drawing wattmeters and said that there is a chance for the Michigan Electric Association to do some pioneer work in bringing about a recognition of the value of such instruments. Curve-drawing wattmeters give to the central station the much-sought opportunity to prove the superiority of electric-motor drive over steam. No such instrument as the curve-drawing wattmeter can be applied to steam-driven factories. Mr. W. B. Wreaks, of the Westinghouse Electric & Manufacturing Company, of Detroit, read a paper introducing the subject of curve-drawing wattmeters and their value in measuring consumers' demands. Mr. Paul MacGahan, of the Westinghouse Electric & Manufacturing Company, presented a paper illustrated with lantern slides, giving a full technical description of different available forms of curve-drawing wattmeters, including both the cheap types and the precision types. Another paper on curve-drawing instruments and some of their applications, which was written by Mr. J. M. Van Splunter, was read by Mr. Louis Friedmann. In discussion of this paper President Hillman gave some further experiences in which the record of a curve-drawing wattmeter on a lighting customer was very helpful in straightening out what would have otherwise been a complaint. Miss Sarah M. Sheridan, contract agent of the Detroit Electric Company, gave some Detroit experiences and practice with curve-drawing instruments, and her remarks were supplemented by Mr. B. J. Denman, also of Detroit. Mr. D. J. Fleming, of the Westinghouse Electric & Manufacturing Company, presented a paper illustrated with some lantern slides, in which records from several installations were presented.

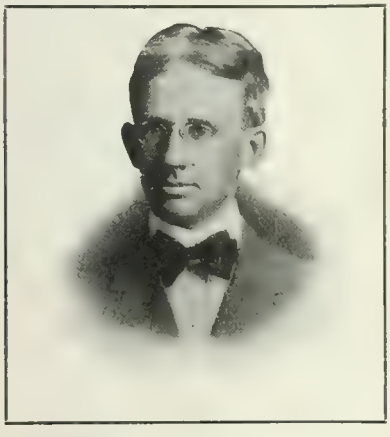
As a result of the papers and discussions on curve-drawing instruments it appeared that the Detroit and Grand Rapids companies were the only ones which have used these instruments to any extent. Representatives of both companies were agreed on the desirability of having such instruments connected on consumers' loads wherever consumers could be induced to purchase them, as their records frequently revealed to the

consumer unforeseen chances for improvement in the operation of the plant, or in the economical use of electricity, and they show also the actual power taken by different machines.

HEATING SESSION.

Thursday morning all of the papers were devoted to electric heating. Mr. J. D. A. Cross, of the General Electric Company, of Chicago, presented a paper on the extension of the heating-device business. Mr. William Constable, chairman of the electric-heating committee of the association, presented a report of that committee, which consisted of Messrs. Wm. Constable, H. A. Mott and R. W. Hemphill, Jr. An abstract of the paper read before the National Electric Light Association by Mr. Charles J. Russell on heating devices for industrial purposes was given by Mr. H. W. Hillman. In the discussion on electric heating, Mr. H. J. Mauger, of the General Electric Company, said a few words as to the lines of development and improvement carried out by his company. Recent improvements make it possible to run heating elements at a much higher density in watts per square inch than was formerly possible and may considerably change future practice. Mr. William Constable called special attention to electric welding in various kinds of manufacture. Following the subject of electric heating, a paper on central-station advertising was read by Mr. J. O. Little, of the Westinghouse Electric & Manufacturing Company.

A vote of thanks was passed to the Detroit Edison Company, and especially to Messrs. E. F. Phillips and A. P. Biggs for the handsome entertainment provided for the convention. Mr. R. N. Hemphill presented a report of the finance committee



PRESIDENT A. C. MARSHALL.

which showed a cash balance over and above liabilities. Mr. F. T. Masterson presented the report of the nominating committee, which resulted in the election of the following officers:

President, Mr. A. C. Marshall, of Port Huron; vice-president, Mr. George B. Westover, of Cadillac; secretary and treasurer, Mr. A. P. Biggs, of Detroit; executive committee: Messrs. A. C. Marshall, of Port Huron; R. W. Hemphill, Jr., of Ann Arbor; A. Parshall, of Jackson; O. S. Wood, of Ionia, and William Loudon, of Traverse City; finance committee: Messrs. William Chandler, of Sault Ste. Marie; Harry Fee, of Adrian, and W. P. Hetherington, of Belding.

The new president, Mr. A. C. Marshall, took the chair and a vote of thanks to retiring President Hillman for his services the past two years was unanimously passed.

The registration at the convention was between 200 and 300. Entertainment was lavishly provided by the Detroit central-station people and manufacturing interest. Wednesday morning an automobile trip was given to the ladies over the beautiful parks, boulevards and streets of Detroit. Wednesday afternoon the whole convention was taken by special cars to the American League ball park to witness the game between the Detroit and Chicago clubs. In the evening all attended a vaudeville entertainment at the Temple Theater. Thursday afternoon a special boat was chartered for a trip down the Detroit River, which was both interesting and enjoyable. Several engineering works of great interest are being carried out in the Detroit River at present. One of these is the sinking of the concrete sections of the Michigan Central tunnel, and another is the Livingstone cut which is to create a new channel through the shallowest part of the Detroit River. Much of this cut is through solid rock, and the work is being carried out "in the dry" by building coffer dams around the section to be excavated. After visiting the work at this cut the boat went on down the river to Lake Erie and returned to Bois Blanc Island for supper. The boat then returned to Detroit, reaching there about 10 p. m.

Mr. A. C. Marshall, president-elect of the association, was born in 1872 at Middletown, Ohio, but was brought up and has spent most of his life in the vicinity of Detroit. He is a graduate of the Detroit high schools, and took the electrical engineering course at the University of Michigan, at Ann Arbor, from which he was graduated in 1893. At the time of his graduation Mr. Alex Dow was building the municipal street lighting plant of Detroit, and Mr. Marshall occupied various positions under Mr. Dow during the construction of that plant. He remained with the plant in various operating positions, including that of assistant city electrician until 1899. That year he became electrical engineer during the construction of the Rapid Railway from Detroit to Port Huron, which was the first interurban road to employ high-tension transmission out of Detroit. When this road began operation he continued with the company as chief engineer, having charge of power plant, line and shops. After the consolidation of the Rapid Railway with the Detroit United Railway he entered the employ of the Detroit Edison Company in various engineering capacities for one year. In 1905, when the control of the Port Huron Light & Power Company passed under the control of the Detroit Edison interests, Mr. Marshall became general manager of the Port Huron company. He has been secretary of the Michigan Electric Association since its organization in 1905 and so has been closely identified with its progress.

Mr. A. P. Biggs, the secretary-elect, amply demonstrated his ability to get results by the way he carried out the details of the entertainment program, and an efficient administration seems assured.

Abstracts of the papers and discussions presented at this convention will be printed in later issues.

CURRENT NEWS AND NOTES.

WINNIPEG MUNICIPAL PLANT.—According to a statement made to the City Council by the power committee, the municipal power plant now being constructed by the city of Winnipeg at a cost of $3,500,000, will be in operation by 1912.

MANITOBA TELEPHONE ORGANIZATION.—The Manitoba Government Telephone Commission has decided to divide the Province into districts, each of which will be under the direct charge of a manager. Each district will be managed under three heads—commercial agent, superintendent of plant and superintendent of service. The new system goes into effect on Sept. 1.

CONVENTION SOUVENIRS.—The American Street and Interurban Railway Manufacturers' Association has notified its members that the practice of distributing souvenirs at conventions has become objectionable to a majority of members, that the practice should be discouraged, and that the matter should be taken up for disposition at the next annual meeting of the association.

ELECTRIC TRACTION IN PARIS.—Sixty-two electric railway lines are operated in Paris or radiate therefrom, which are owned by five companies. The annual average of passengers carried is 190,000,000. The fare inside the fortifications is generally 6 cents for inside and 3 cents for the upper deck. The total mileage of all lines is 12,348, the average annual receipts being $5,146,538.

CONVERSING 155 MILES BY WIRELESS TELEPHONE.—According to a cable despatch from Toulon, France, wireless telephone conversation was carried on between Toulon and Port Vendres, a distance of 155 miles, on Aug. 1. The instruments used are the invention of Lieutenants Jeance and Colin, of the French navy.

VERMONT ELECTRICAL ASSOCIATION.—The annual convention of the Vermont Electrical Association will be held at Burlington, Sept. 15 and 16. The first day will be devoted to a business session and the reading and discussion of papers, and the second day to a boat trip on Lake Champlain with luncheon at Hotel Champlain, Bluff Point.

MARINE MAGNETIC SURVEYS.—The new non-magnetic yacht *Carnegie,* recently finished, left the shipyard where it was built last week, and after final tests of its machinery will sail north in order to commence a series of magnetic surveys. It will skirt the Labrador coast, and then enter Hudson Bay, where the work of determining the various terrestrial magnetic constants will be continued.

INCREASE OF TELEGRAPH RATES.—The Western Union and Postal Telegraph companies have announced a new schedule for cipher messages, to go into effect Sept. 1. Cipher messages will be charged at the rate of five letters to the word instead of 10 letters, unless the telegram consists of words which appear in the dictionary. Domestic messages are only affected by the new rule.

SIGNAL CORPS ELECTRICAL ASSISTANT WANTED.—The United States Civil Service Commission will hold an examination Sept. 29 to fill two or more vacancies in the position of electrical assistant in the Signal Service at Large, at $1,080 per annum, and provide for similar future vacancies. A circular as to qualifications, etc., may be obtained from the Washington office of the commission.

OLD-TIME TELEGRAPHERS.—The annual joint convention of the Old-Time Telegraphers' Association and the Society of the United States Military Telegraph Corps was held in Pittsburgh last week, beginning Aug. 17. The old officers were re-elected as follows: President, Col. Wilson; vice-presidents, Messrs. W. L. Ives and C. A. Tinker, of New York; secretary and treasurer, David Homer Bates.

GLACE BAY WIRELESS PLANT BURNED.—The main Marconi wireless station at Glace Bay, Nova Scotia, was destroyed by fire on Aug. 21, but the power house was uninjured. The building destroyed contained the operating and condenser rooms and a quantity of valuable machinery and apparatus. While wireless communication to Europe is interrupted, the usual wireless service to and from steamers off the coast will be maintained.

SUMMER MEETING OF NEW ENGLAND N. E. L. A. SECTION.—The first summer meeting of the New England Section of the National Electric Light Association will be held at Wentworth Hotel, Newcastle (Portsmouth), N. H., on Thursday and Friday, Sept. 9 and 10. An interesting and instructive program is being arranged, including papers on the latest developments of electricity, and entertainment of members and guests. Mr. C. H. Hodskinson, Boston, is secretary of the section.

PARIS TO NEW YORK BY WIRELESS.—A newspaper report recently published that the Eiffel Tower wireless station was in daily communication with New York is pronounced ridiculous by the wireless telegraph companies operating stations in this country. The installation on the tower was put in by the French Government, and is largely of an experimental nature. If any American station has ever picked up a message from the Eiffel Tower the matter has not been reported to the wireless companies.

ELECTRIC DRIVE FOR WAR VESSELS.—It is reported that Prof. Reginald A. Fessenden has recently submitted a proposition to the Navy Department for the equipment, experimentally, of a war vessel with turbo-electric drive. Professor Fessenden's plan is to use steam turbine three-phase generators, with induction motors on the propeller shafts. He claims that higher power can be obtained with less weight under this system than any other. The Navy Department has as yet made no decision as to whether it will make the experiment.

EDISON CONVENTION.—The thirtieth convention of the Association of Edison Illuminating Companies will be held at Briarcliff Lodge, Scarborough-on-the-Hudson, during the coming week, as already announced. An excellent program has been provided, but, as usual, the meetings will not be open to the public. A very large attendance of members is already registered and special interest is given to the occasion by the dinner to Mr. and Mrs. Edison on Sept. 2, commemorative of the thirtieth anniversary of the incandescent lamp. To this function a number of pioneer associates of Mr. Edison have also been invited. The week will thus be an eventful one in the annals of this body, which is composed of Edison lighting licensee companies.

A. I. E. E.—Mr. Ralph W. Pope, secretary of the American Institute of Electrical Engineers, left New York on Aug. 18 to attend as its delegate the Conservation Congress at Seattle, his two colleagues being Messrs. John C. Hays and J. Harisberger. He will also participate in the convention of the Northwestern Electric Light and Power Association. He will then visit the various Institute branches and sections on the Coast and attend the Denver street-railway convention for the Institute in October on his way home. It is worthy of mention that Mr. Pope is one of the distinctive Alaskan pioneers, being an active member of the Western Union Telegraph expedition in the early sixties to build a land line to Europe across Alaska and Siberia, just before the Atlantic cable became a success.

NEWFOUNDLAND CABLE CONTROVERSY.—The Anglo-American Telegraph Company has announced its support of the contention of the Newfoundland Government in its revocation of an agreement with the Commercial Cable Company as to certain privileges which had been granted to it by the Newfoundland Government. In a statement, General Manager Geo. C. Ward, of the Commercial Cable Company, stated that his company sought to fight its battle directly with the Premier of Newfoundland, and resents the entry of the Anglo-American Telegraph Company in the controversy. He says that the issue is whether the Newfoundland Government has the right to repudiate a legal and reasonable agreement, on the faith of which over $1,000,000 has been expended by an American corporation.

MONTREAL ELECTRIC ICE PLANT.—The Light, Heat & Power Company, of Montreal, Que., has announced that it would engage in the ice business. This end will be accomplished by obtaining water from artesian wells and freezing it by electric power. In addition to being absolutely free from garbage, dirt, etc., it could be turned out in any shape desired, which would obviate the necessity of the icemen cutting it on delivery. Such a plant as the company proposes to install will cost between $125,000 and $150,000, and commercial ice could be sold at a much lower price than at present. It is understood that a similar scheme has been proposed to the directors of the Winnipeg Electric Company, at Winnipeg, Man., where the river from which the ice harvest is obtained is not of the purest. In the latter city power is as cheap as in any Canadian city and ice is as dear as anywhere despite the cold winters.

Hydro-Electric Generating Station of the Great Western Power Company on the Feather River.

EIGHTEEN miles above the city of Oroville, Cal., the North Fork of the Feather River makes a big bend in the Sierras, and after winding through mile after mile of ravine and canyon, the river comes back to a point within three miles of where the bend starts. This section is known as Big Bend, and here it was that some years ago a mining company headed by Dr. Pierce, of patent medicine fame, drove a tunnel two miles in length, intended to divert the water through the mountain and leave the bed of the river around the bend dry, whence

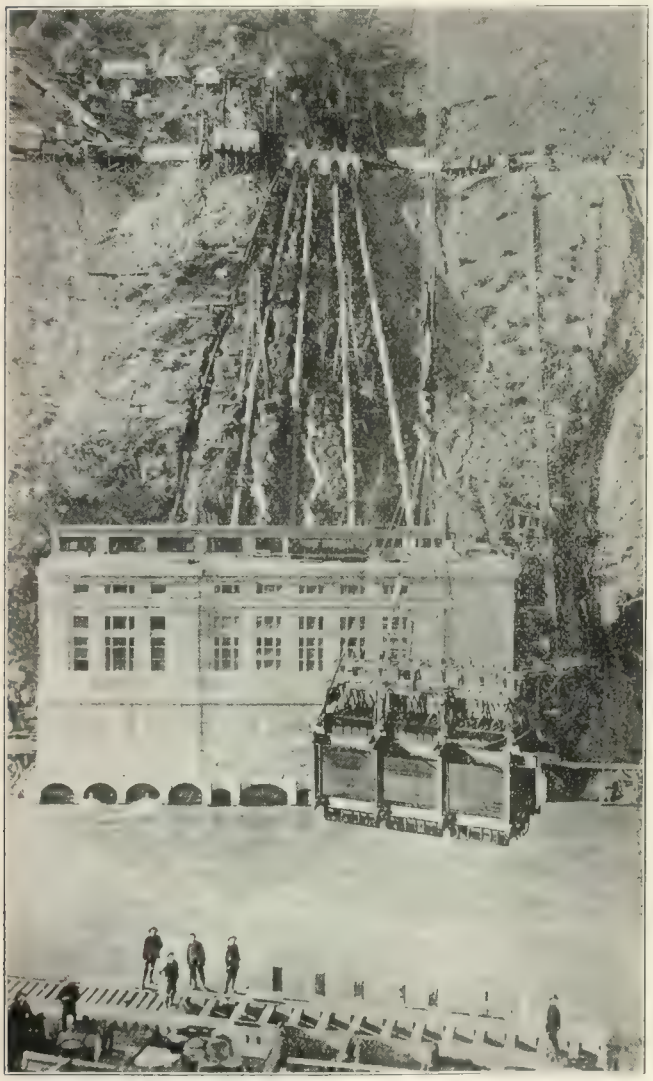


FIG. 1.—VIEW OF GREAT WESTERN POWER STATION FROM OPPOSITE BANK OF THE FEATHER RIVER.

the gold which it was said to contain could be easily secured. The Great Western Power Company acquired the tunnel from the Big Bend Tunnel & Mining Company, enlarging it and utilizing the drop for the manufacture of electricity on a large scale.

The initial development provides for diverting the water from the North Fork of the Feather River at the upper end of Big Bend through a tunnel 15,000 ft. long to a point in the hillside above the power house, from which point the water is carried through steel feeder pipes 450 ft. long to hydraulic turbo-generators, the present effective head being about 425 ft. A timber dam was constructed for diverting the flow of the stream through the tunnel, and the latter was enlarged so as to have a capacity of 2500 second-ft. flow, and lined with concrete.

The company excavated and lined with concrete a new tunnel 3450 ft. long from a point near the end of the old tunnel to the point of discharge above the power house. At the outlet of the tunnel, the necessary header pipes, surge pipes, valves, gates, etc., for regulating and controlling the flow of the



FIG. 2.—MAP OF POWER DEVELOPMENT.

water were constructed, with steel feeder pipes leading from the header to the turbines. The power house, which is constructed of concrete and steel, contains an initial installation of 40,000 kw. Leading from it are duplicate 100,000-volt lines on steel towers leading to Oroville, Marysville, Sacramento, Oakland and other points, the maximum transmitting distance being 165 miles. In connection with the transmission circuits substations are erected at Brighton (Sacramento), Antioch, Cowell and a terminal station at Oakland. In addition to the terminal station at Oakland there has also been erected a steam auxiliary station. From Oakland it is intended to transmit electrical energy to San Francisco, across the bay.

In designing the tunnels, intake tower, headers, pipes, etc., or, in other words, the complete hydraulic construction, it was with a view to utilizing the full flow of the river so that the dimensions are such as will permit of an ultimate generation of 120,000 hp in the power house. The additional units can be installed without in any way interfering with the operation of

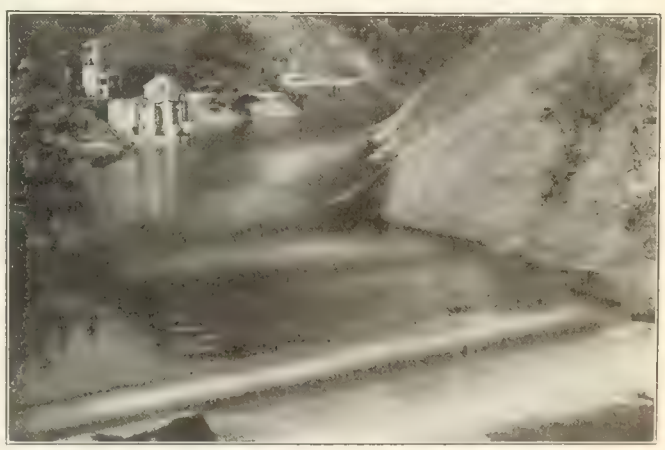


FIG. 3.—CONCRETE INTAKE TOWER AND TIMBER DAM ON FEATHER RIVER.

the plant. Feeder pipes are now provided for four 18,000-hp turbines and connections with the header for four more.

Prior to beginning work on the development, it was necessary to open 20 miles of new roads, build bridges, etc. This preliminary work was completed seven months after it was

begun, or in April, 1907. Two steam compressor plants were built for construction purposes, two sawmills, living accommodations for 1100 men, etc. The nearest railroad station when the work began was that of the Southern Pacific at Oroville, and, owing to the rough character of the country, considerable difficulty was experienced in teaming from Oroville to the site. The line of the Western Pacific Railroad was pushed through the canyon and opened in February, 1908, to a point opposite the power house. The railroad was finished in time to make delivery of heavy machinery to the power house over it, a Lidgerwood cable hoist being used to transport the material to the opposite shore. Two steel towers 1200 ft. apart were connected by two 2¼-in. steel cables, over which a load of 35 tons could be transported from the railroad to the power house, and a load of 10 tons up the hill to the header pipe.

The main branch of the Feather River rises in Nevada, and in summer the flow of water is small, while in winter it is quite large. The North Fork rises in the Big Meadows, at Prattville, Cal., where the company plans to erect a massive storage reservoir, flooding 40 sq. miles and impounding 47,000,000,000 cu. ft. of water. By means of this reservoir the ordinary low-water flow of the river at the station, which is 1000 cu. ft. per second, can be made 1800 cu. ft. per second as a minimum. The Big Meadows abound with springs and rocks of volcanic origin which are porous and hold the water. From July to November, however, there is no rain in California, and it is during these five months that the water will be drawn from the reservoir. The maximum flow of the Feather River is 125,000 cu. ft. per second, at which times the river carries much silt, but is otherwise free from debris.

The crest of the timber dam thrown across the river has an elevation of 896 ft. above tidewater, and the water in the tailrace at low stages in the river is at an elevation of 456 ft. above the sea. The available head at the waterwheels is 428 ft., there being a loss of 12 ft. due to friction in the tunnel, etc. The river below the tailrace is quite open and the descent to Oroville quite rapid, so that there is no danger of backwater at any time. There is very little level ground throughout the canyon, as will be observed from the illustrations. Indeed, the chief difficulty encountered in the work was to find level spots for the camps and for storing material. This rendered construction difficult. The company was able to purchase 300 hp from the electric light company in Oroville, and in addition had about 700 hp in locomotive-type boilers. Cord wood was used for fuel at first until all the cord wood in the district was burned up, when recourse was had to fuel oil brought over the lines of the Western Pacific Railroad. A camp was erected at about the middle point of the tunnel, where a compressor plant, machine shop, crusher, concrete mixer and lodgings for 600 men were provided. Another camp was pitched at the intake, where a compressor plant, crusher and concrete mixer, together with dwellings for 400 men, were installed.

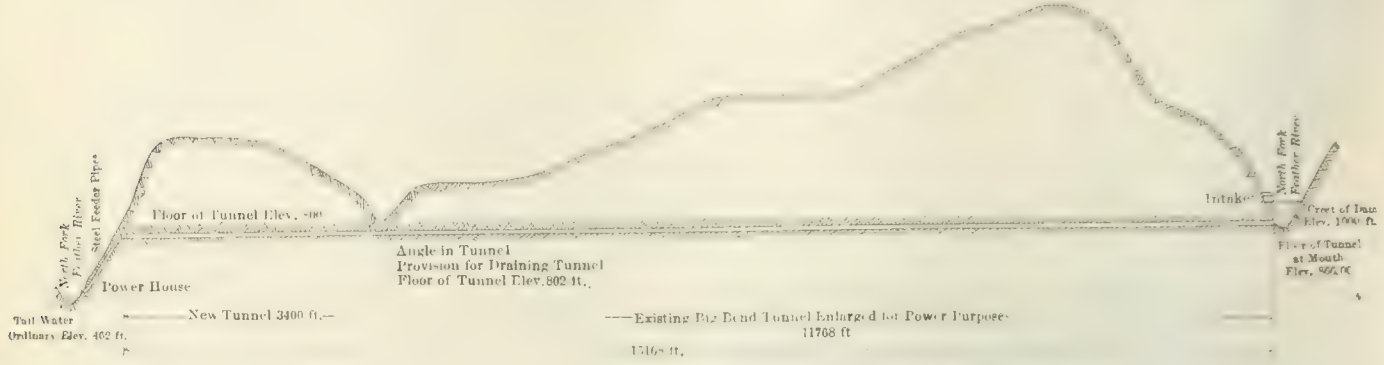


FIG. 4.—CROSS-SECTIONAL ELEVATION OF MOUNTAIN AT BIG BEND SHOWING TUNNEL.

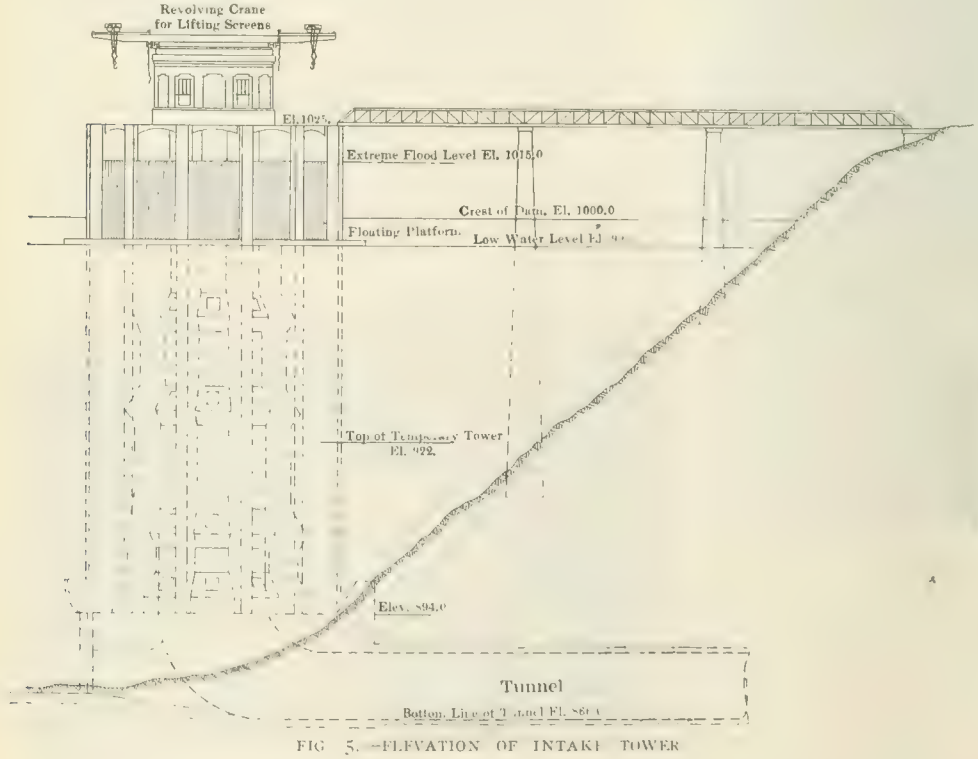


FIG. 5.—ELEVATION OF INTAKE TOWER.

A feature of the development is the intake tower. This is built entirely of concrete on rock bottom, about 600 ft. above the timber dam. It is cylindrical in shape and is designed with buttresses and guides for racks with openings at four levels. It is located some distance from the river bank, and is shown in the background of Fig. 3. Fig. 5 shows an elevation of the tower as it will appear when completed. At present there are 24 3-ft. 3-in. x 4-ft. openings and four 5-ft. x 12-ft. 3-in. openings provided with gates having a tendency to shut themselves so that head-gate troubles will be avoided. By means of the tower clean water and large gate openings are assured. It is also possible by this means to shut off water from the tunnel and make the tunnel accessible from the tower end. The water enters the tunnel at the bottom of the tower, as shown, and the craneway is used for lifting the screens and gates. The latter are lifted electrically, and, as just pointed out, close without the application of any power whatever. The top of the finished portion of the tower is at present 922 ft. above the sea. When the work is entirely

completed, the timber dam will be replaced by one of masonry, whose crest will be 1000 ft. above tidewater.

The old tunnel has a grade of one-half of 1 per cent, and the newer section has a grade of 1 ft. in 3000 ft. As will be seen from the profile of the tunnel, the drop is slight. The tunnel is bored through rock its entire length and is lined with concrete 21 in. thick. The net cross-sectional area of the tunnel is 220 sq. ft., and it was designed for a maximum pressure of 87 lb. per square inch. A view of the tunnel is given in Fig. 4, and Fig. 12 is a view of the end connecting with the feeder pipe. The latter pipe extends into the tunnel 125 ft. from the portal. It is built of steel plate varying in thickness from 1 in. to ½ in. and has an inside diameter of 16 ft. 9 in. tapering to 9 ft., as shown in Fig. 8, and connecting with a surge pipe 9 ft. in diameter. The surge pipe is 302 ft. long and continues up hill to an elevation of 940 ft. and empties into a concrete spillway chamber, whence the water escapes to the river.

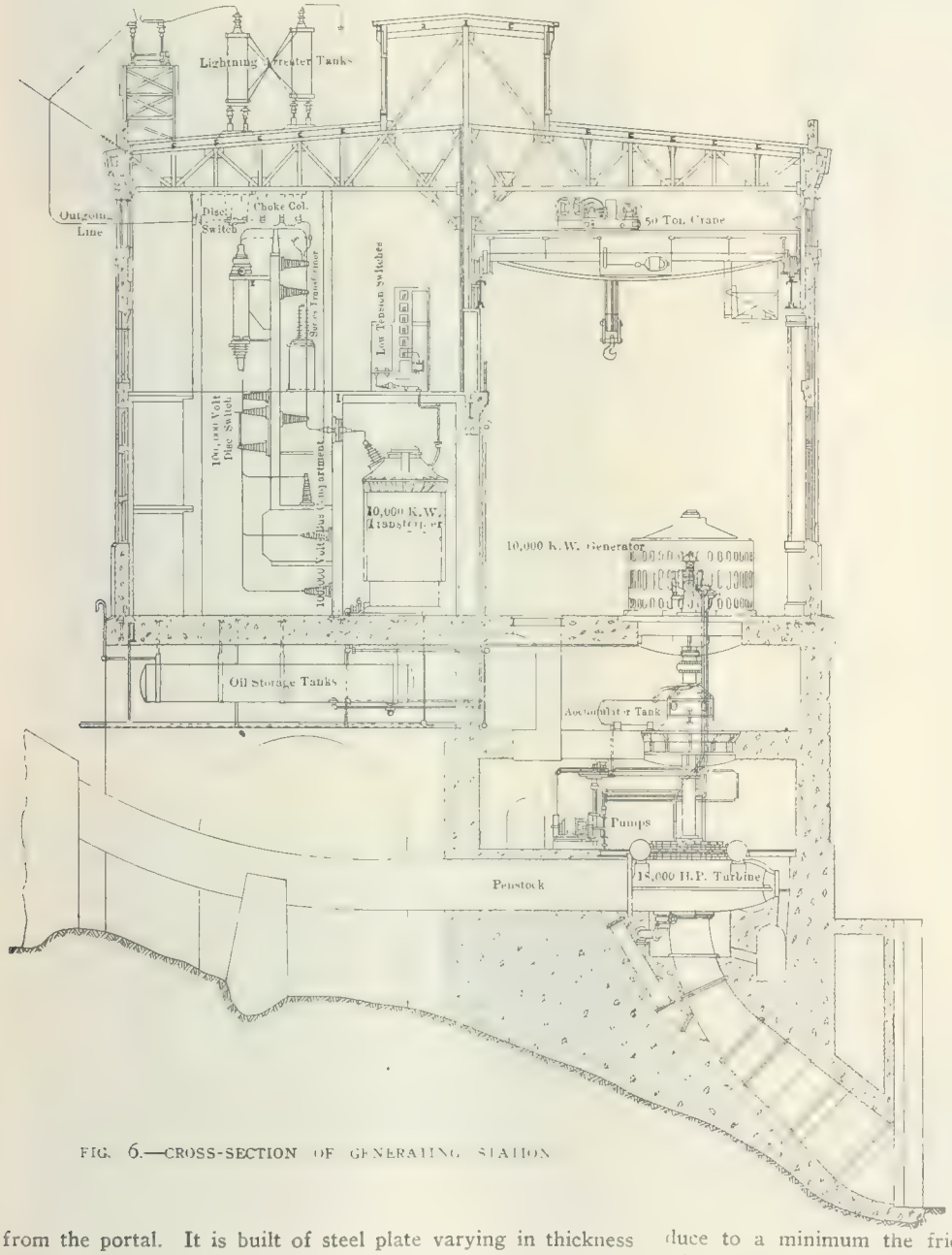


FIG. 6.—CROSS-SECTION OF GENERATING STATION.

The penstocks are 5 ft. in diameter except those for the exciter sets, which are 2 ft. in diameter, and are built of steel imported from Germany and varying in thickness from 17 mm to 10 mm. The penstocks are the largest yet built for the pressure used. Air and butterfly valves are provided at the top of the penstock, the latter operated by hand, and the gate valves are operated by direct-current motors controlled from the switchboard. The valves and gates are shown in Fig. 10. No gates are provided at the power house end of the large penstocks except the gates in the wheels. Gates are fitted to the penstocks feeding the exciter turbines.

The generating station is 71 ft. 4 in. wide and 183 ft. 6 in. long and houses the following equipment: Four 18,000-hp reaction turbines, direct-connected to as many 10,000-kw, 11,000-volt, 60-cycle, three-phase, vertical-type alternators; two 500-hp impulse wheels, direct-connected to 250-kw, 250-volt, horizontal, direct-current generators; four 10,000-kw, three-phase, water-cooled, oil-insulated, 11,000-volt to 100,000-volt, delta-connected transformers. Each of the latter, with oil, weighs over 200,000 lb., and the core alone weighs 35 tons. The arrangement of the equipment is well shown in Fig. 6, which is a cross-sectional elevation of the station.

Especial interest centers in the generating equipment because of its size. The turbine wheels were designed and built by the I. P. Morris Company, of Philadelphia, and are of the vertical-shaft, inward-flow Francis type, operating at a speed of 400 r.p.m. under an ultimate head of 525 ft. The runner operates in a cast-steel volute casing. Each unit consists of bronze runner and cast-steel guide vanes, steel shaft, cast-iron draft tube, cast-steel volute casing, guide bearings, oil-disk thrust bearings, double floating-lever governor, oil pumps and auxiliaries. The turbines are the highest powered wheels in the world and are applied to a higher head than has been the custom for reaction turbines. Only a few years ago a head of 300 ft. was considered the upper limit for a wheel of this type. The turbines are operated without relief valves and the casings are made strong enough to withstand the increase in pressure due to the closing of the gates at a higher speed than the operating cylinders are designed to give. The runner of each unit is cast in one piece, the cores being fitted so as to insure uniform thickness of metal, and the vane surfaces made smooth so as to reduce to a minimum the frictional losses. The water is distributed to the runner by cast-steel movable guide vanes. Each vane has cast with it a shank which extends through the stuffing boxes in the head cover and is connected at its outer end through a lever and link to the operating ring. The latter is controlled by two hydraulic cylinders mounted on the wheel casing. These cylinders are controlled by the double floating-lever governor.

The volute casing is 5 ft. in diameter at the intake and it is split by a vertical plane passing through the axis of the shaft. The halves are bolted together on a vertical flange. A babbitt-lined guide bearing is situated directly above the runner and incorporated in the head cover. The weight of the revolving parts of the turbine (25,500 lb.) and the weight of the rotor

of the generator (119,500 lb.), or a total weight of 145,000 lb., is carried by an oil-disk thrust bearing. This bearing con-

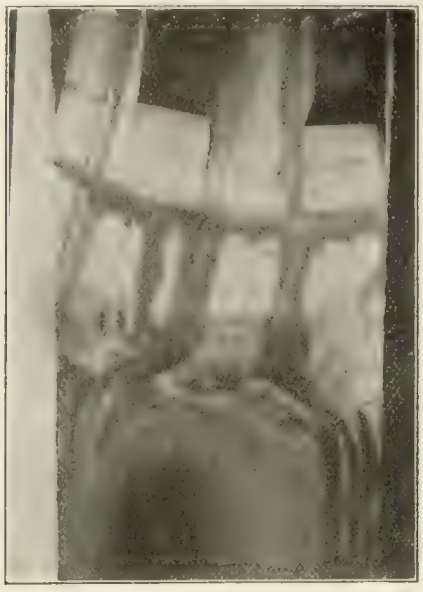


FIG. 7.—INTERIOR VIEW OF INTAKE TOWER.

sists of two disks, the lower one stationary and the upper one revolving with the shaft. Between the two disks is an annu-



FIG. 8.—DETAIL OF FEEDER AND PENSTOCKS.

lar chamber into which oil is forced at a pressure of about 250 lb. per square inch. The weights of the revolving parts are,



FIG. 9. INTERIOR VIEW OF FEEDER PIPE.

therefore, carried on a film of oil at high pressure. Oil is supplied to the thrust bearing by an I. P. Morris Company's horizontal triple pump, which is driven by belt and gearing from the turbine shaft. Oil is supplied to the governor by a duplicate of the thrust-bearing pump, driven by a direct-current motor. The oil on its way to the governor passes through an accumu-



FIG. 10.—MOTOR DRIVEN PENSTOCK VALVES.

lator tank, the function of which is to maintain a steady and uniform pressure for the oil supplied to the governor. The



FIG. 11.—OUTLET CHAMBER AT TOP OF SURGE PIPE.

contents of this tank are maintained at one-quarter oil and three-quarter air and at a pressure of about 250 lb. per square

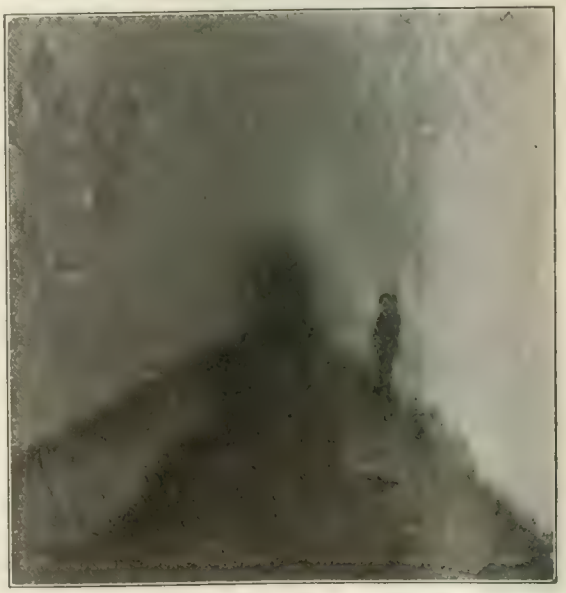


FIG. 12.—INTERIOR VIEW OF TUNNEL THROUGH MOUNTAIN.

inch, the same as in the thrust bearing. This is accomplished by means of a quantity regulator which is placed in the discharge pipe line to the governor pump. When the load on the turbine is fairly constant and no oil passes to the governor, the

pressure on both sides of the regulator is equalized and the oil from the governor pump is discharged through a relief valve into the thrust bearing. In this way the thrust bearing acts as an automatic relief for the whole system. Both the pumps take their suction from a large plate-steel storage tank holding 100 cu. ft. placed beneath the floor. The returned oil from the governor and thrust bearing is discharged into this tank. The oil is cooled by coils of wrought-iron pipe through which water from the turbine casing is circulated. All piping and valves used for oil in connection with the thrust bearing and governor are of brass.

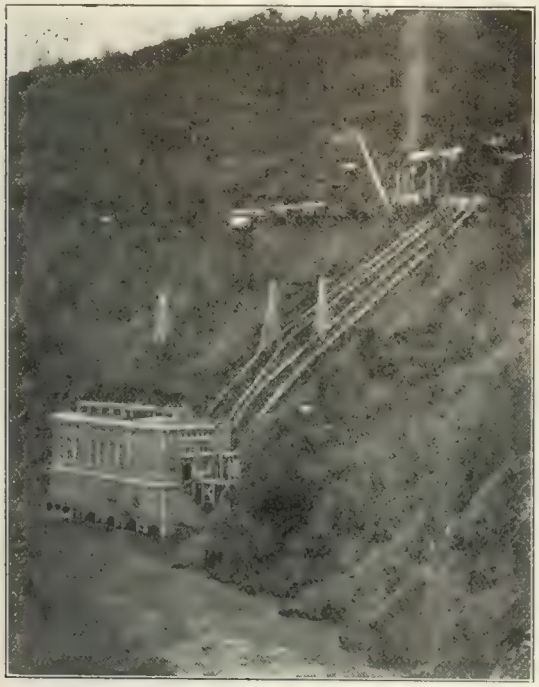


FIG. 13.—VIEW OF STATION SHOWING PENSTOCKS AND SURGE PIPE.

The governor and controlling valve are located on the generator-room floor some 24 ft. above the turbine floor and connected by piping to the two operating cylinders located on the turbine directly below. Should the governor be out of commission, the wheel may be operated by a small hand wheel controlling a valve placed on top of one of the operating cylinders. Again, should the oil supply fail, the wheel may be operated by this same valve, using water from the wheel casing in one cylinder only. One cylinder gives sufficient power to open and close the gates, but the power is insufficient to regulate the water turbines properly. The efficiency tests of these units have not as yet been made, but the guarantees are as follows: Full load, 80 per cent; three-quarter load, 82 per cent; one-half load, 76 per cent for heads ranging from 460 ft. to 525 ft. and with a constant speed at all heads. Fig. 14 shows one of the units assembled in the shop of the builder, but does not show the shaft. In the condition shown the wheel casing was put under a severe hydrostatic test to insure that the steel castings were perfectly sound and all points tight.

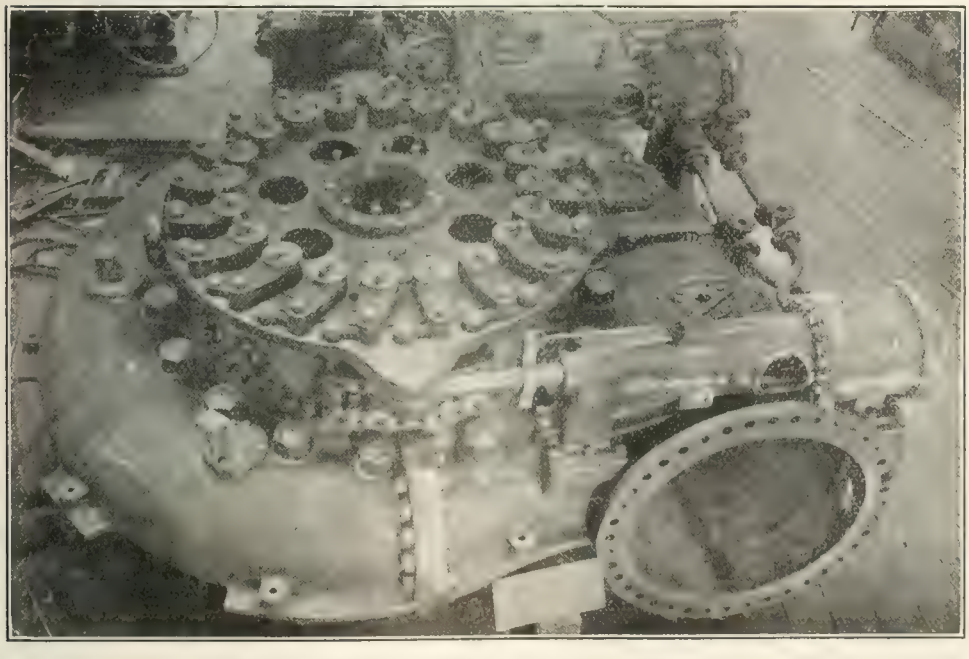


FIG. 14.—DETAIL OF 18,000-HP VERTICAL TURBINE.

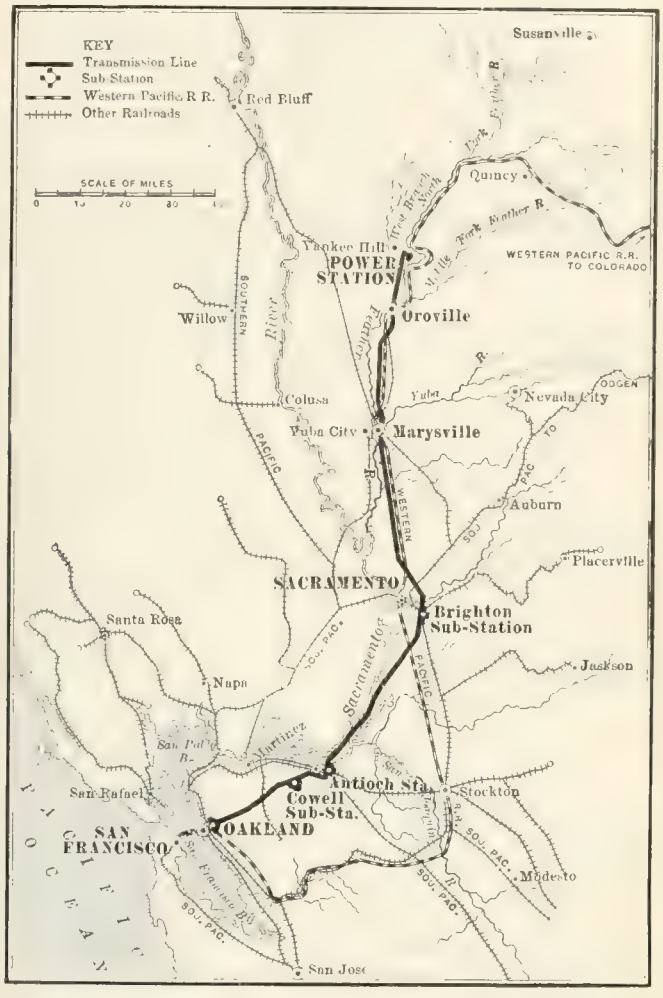


FIG. 15.—GENERAL PLAN OF TRANSMISSION LINE.

Like the water turbines, the electric generators, transformers, etc., are characterized because of their size, being among the largest ever built. A feature of unusual interest is the employment of 100,000-volt pneumatically operated oil switches on the outgoing high-tension lines. This is the first installation of switches of this type made.

The details of the electric equipment and other features of this development will be taken up in a subsequent issue.

Polyphase Magnetomotive Forces.

By J. D. Nies.

IN an ideal polyphase apparatus the winding is laid into an indefinitely large number of slots, an indefinitely small amount of current is carried in each slot, and these currents are distributed sinusoidally, both in space and in time. Under these conditions the m.m.f. and the magnetic flux are also distributed sinusoidally. In actual machines it is necessary to mass the conductors in a relatively small number of slots, and to use a small number of phases and consequently a non-sinusoidal distribution of the currents. The m.m.f. and flux developed under these conditions deviate more or less from sine space distribution, and assume an irregular distribution represented by the familiar "step curves"—examples of which are given in every text-book. The object of the present article is to derive rules by means of which any step curve can be resolved into sine components, a fundamental and higher harmonics.

These rules lead to simple formulas for calculating counter e.m.f. and magnetizing current in induction motors. There are already many methods in practical use for making these calculations, but anyone who has had occasion to compare them cannot have failed to note that serious differences exist between them. There appears to be a need for rules capable of general application, covering all kinds of windings, which can be used not only in induction-motor work, but also for calculating the armature reaction m.m.f. in alternators, rotary converters

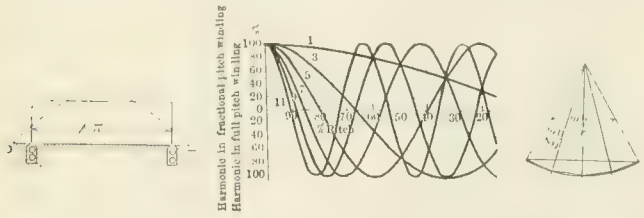


FIG. 1.—M.M.F. OF A COIL WITH ONE TURN. FIG. 2.—HARMONICS IN THE M.M.F. OF FRACTIONAL PITCH COILS. FIG. 3.—RESULTING M.M.F. OF A PHASE BELT.

and even direct-current machines where it is desired to separate the total m.m.f. into fundamental and harmonic components

ANALYSIS OF SINGLE-COIL M.M.F.

The m.m.f. of a single coil of fractional pitch λ is represented in Fig. 1, the limits of the pole arc being 0 and π. This m.m.f is the same at all points within the spread of the coil, but varies with the time in accordance with the law of variation of the current in the coil, and has for a current of sinusoidal wave form the maximum value

$$\sqrt{2}\, I\, n_c$$

where I = effective amperes per circuit in the winding.

n_c = turns per coil, or half the turns per coil in consequent pole windings.

The rectangle in Fig. 1 is composed of a fundamental sine curve and a series of odd harmonics. In order to combine conveniently the m.m.f. of this coil with that of the others in the same belt it is necessary to find the values of these components. This is easily done by multiplying by the mth harmonic unit sine analyzer, $\sin mx_s$—where x_s is the angle measured from 0 in Fig. 1—then integrating between the limits $\frac{\pi}{2}(1-\lambda)$ and $\frac{\pi}{2}(1+\lambda)$, and multiplying by 2. This operation gives as the maximum of the fundamental component of Fig. 1 the expression

$$\frac{4\sqrt{2}}{\pi} I\, n_c \sin\frac{\lambda\pi}{2} \qquad (1)$$

and the maximum value of the mth harmonic component

$$\frac{4\sqrt{2}}{m\pi} I\, n_c \sin\frac{m\pi}{2} \sin\frac{m\lambda\pi}{2} \qquad (2)$$

The fundamental component of the single coil m.m.f. is drawn in dotted line in Fig. 1.

In a fractional-pitch winding the harmonics are usually smaller than in a full-pitch winding. In a full-pitch winding the quantity $m\lambda$ is always equal to an odd number. If the pitch is shortened until $m\lambda$ = an even number, the harmonic vanishes; a further shortening of the pitch causes the harmonic to reappear with reversed sign, and when $m\lambda$ = next lower odd number the harmonic has the same value as in a full-pitch winding, but with opposite sign. For example, the third harmonic vanishes in a winding of 0.666 pitch, and reappears with full value (negative) in a winding of 0.333 pitch. The changes in the harmonics due to changes in the pitch are shown in Fig. 2 for the harmonics up to the eleventh expressed as fractions of the values which they have in a full-pitch winding. It is evident that by the choice of a suitable pitch it is possible to suppress any particular harmonic or bring about a considerable reduction of the more important ones.

RESULTANT M.M.F. OF A PHASE BELT.

Usually the conductors of each phase winding of a polyphase machine are distributed among several slots, each group of coils constituting a "phase belt." The coils of a phase belt are always connected in series, and therefore there is no time-phase difference between their m.m.fs.; there is, however, a space-phase difference between the m.m.fs. due to the overlapping of the coils, and, therefore, the total m.m.f. of a phase belt must be found by vector addition instead of arithmetical addition. The notation used here is adapted from a paper by Prof. C. A. Adams, read before the A. I. E. E. in June, 1908:

Let N_{sp} = slots per pole.

p' = phase belts per pole.

The single-coil m.m.fs. and their resultant are shown in Fig. 3, drawn for the mth harmonic. With unit radius the length of a single chord

$$2\sin\frac{m\pi}{2N_{sp}}$$

and the length of the resultant chord

$$2\sin\frac{m\pi}{2p'}$$

$$\frac{\text{Resultant}}{\text{Single}} = \frac{\sin\frac{m\pi}{2p'}}{\sin\frac{m\pi}{2N_{sp}}} \qquad (3)$$

For the fundamental, letting $m = 1$, this becomes

$$\frac{\text{Resultant}}{\text{Single}} = \frac{\sin\frac{\pi}{2p'}}{\sin\frac{\pi}{2N_{sp}}} \qquad (4)$$

Multiplying (1) by (4), and (2) by (3), it is found that the m.m.f. of a phase belt contains a fundamental component having the maximum value

$$\frac{4\sqrt{2}}{\pi} I\, n_c \sin\frac{\lambda\pi}{2} \frac{\sin\frac{\pi}{2p'}}{\sin\frac{\pi}{2N_{sp}}} \qquad (5)$$

and contains harmonic components having the maximum value

$$\frac{4\sqrt{2}}{m\pi} I\, n_c \sin\frac{m\lambda\pi}{2} \sin\frac{m\pi}{2} \frac{\sin\frac{m\pi}{2p'}}{\sin\frac{m\pi}{2N_{sp}}} \qquad (6)$$

ROTATING M.M.FS.

The m.m.fs., the values of which are given in (5) and (6), are stationary in space. In polyphase windings several such m.m.fs. are combined, developing a resultant m.m.f. which is in motion with respect to the coils that produce it. When the value of this resultant m.m.f. is obtained by means of a step curve, it is found that the shape of the m.m.f. wave, and its mean value, both change as the wave advances from point to point along the inner circumference of the primary, and that the wave as a whole travels at non-uniform speed. Many expedients have been devised for taking these irregularities into account, since the production of a sinusoidal field moving at a constant speed is a very important consideration in motor de-

sign. Failure to reach this desired end may have a very bad effect upon the rotor copper and iron loss, and starting torque.

These irregularities are due, of course, to the presence of harmonics. It is a very interesting and peculiar fact that in any machine the m.m.f. wave is made up of components which are constant in value and in speed. The value of the fundamental component of the m.m.f. curve in a machine of two, three, four or six phase-belts per pole may be found by multiplying (5) by the proper factor taken from the first row of Table I. The value of any harmonic component may similarly

TABLE I.—MULTIPLICATION FACTORS.

p' =	2	3	4	6
m = 1	1	1.5	2	3
m = 3	−1	0	0	0
m = 5	1	−1.5	0	0
m = 7	−1	1.5	−2	0
m = 9	1	0	2	0
m = 11	−1	−1.5	0	−3
m = 13	1	1.5	0	3
m = 15	−1	0	2	−0
m = 17	1	−1.5	2	0
m = 19	−1	1.5	0	0
m = 21	1	0	0	0
m = 23	−1	−1.5	−2	−3
m = 25	1	1.5	2	3

be found by multiplying (6) by the proper factor. The negative sign of some of these factors indicates that the harmonic in question rotates backward with respect to the main or fundamental m.m.f.

Thus in the irregular step curve of m.m.f. in any polyphase apparatus there is a constant fundamental component rotating at constant synchronous speed, and various harmonics, each of which is constant in value and rotates at a constant speed equal to $\frac{1}{m}$ th of the synchronous speed. In a two-phase machine with full-pitch winding there is a third harmonic of m.m.f. rotating backward at one-third synchronous speed, a fifth rotating forward at one-fifth synchronous speed, etc. In three-phase machines the third and all multiples vanish; the fifth rotates backward at one-fifth synchronous speed, the seventh rotates forward at one-seventh synchronous speed, etc. (In fractional-pitch windings, as noted above, certain harmonics may vanish, but the direction of rotation is always the same regardless of the pitch.)

The calculation of the magnetizing current is an important step in induction motor design. This is frequently done by finding the "equivalent sinusoidal m.m.f." whose average value is the same as that of the step curves, several of which are drawn corresponding to different instants; for example, Figs. 4, 5 and 6. This method is sufficiently exact, but is indirect. Other methods, based on empirical formulas, are lacking in generality. The writer believes that the most rational method is to base the calculation upon the fundamental component of the step curve—neglecting the harmonics, since only a small part of the total counter e.m.f. of the machine is due to them.

Let h = desired mean m.m.f. per pole.

Then from (5), making some substitutions, the following rules are obtained for calculating the magnetizing current:

In a two-phase machine the magnetizing current per circuit is

$$I = \frac{\pi^2 h \sin \frac{\pi}{2N_{sp}}}{8 n_c \sin \frac{\pi}{2}} = 1.234 \frac{h \sin \frac{\pi}{2N_{sp}}}{n_c \sin \frac{\pi}{2}} \qquad (7)$$

In a three-phase machine the magnetizing current per circuit is

$$I = \frac{\pi^2 h \sin \frac{\pi}{2N_{sp}}}{6\sqrt{2}\, n_c \sin \frac{\pi}{2}} = 1.163 \frac{h \sin \frac{\pi}{2N_{sp}}}{n_c \sin \frac{\pi}{2}} \qquad (8)$$

The following examples will serve to illustrate the application of these rules. What is the magnetizing current per terminal in a two-phase four-pole motor with 48 stator slots, 6 turns per coil, 1 circuit per phase, 83.3 per cent pitch winding, single air-gap 0.05 cm, net pole area 200 sq. cm, total flux 700,000 lines per pole?

The necessary mean m.m.f. per pole is

$$h = \frac{\text{air gap} \times \text{total flux}}{1.257 \times \text{pole area}} = 139 \text{ amp-turns.}$$

The magnetizing current per circuit is, from (7),

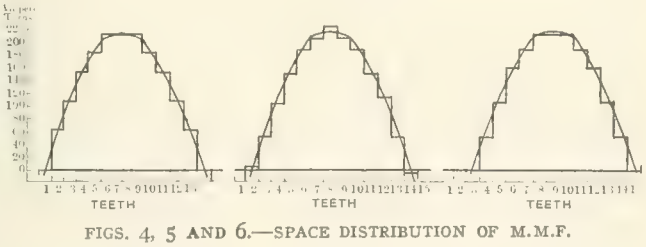
$$I = \frac{1.234 \times 139 \times \sin \frac{\pi}{24}}{6 \times \sin \frac{.833\ \pi}{2}}$$

$= 3.85$ effective amperes per circuit, which is the current per terminal since there is but one circuit per phase winding. If the same frame is wound for three-phase with delta-connection and the same flux per pole is desired, the magnetizing current will be, from (8),

$$I = \frac{1.163 \times 139 \times \sin \frac{\pi}{24}}{6 \times \sin \frac{.833\ \pi}{24}}$$

$= 3.64$ effective amperes per circuit, which is equivalent to 6.31 amp per terminal, since the winding is delta-connected.

Step curves for the three-phase machine are given in Figs. 4, 5 and 6 for 3.64 amp per circuit. Fig. 4 represents the m.m.f. produced by this current at the instant when the current in



FIGS. 4, 5 AND 6.—SPACE DISTRIBUTION OF M.M.F.

one of the phase windings is at maximum and that in the others is at half-maximum value. Fig. 5 represents the m.m.f. at a time 15 deg. later than Fig. 4. Fig. 6 represents the m.m.f. when the current in one phase winding is zero and that in the others is at 86.6 per cent of maximum value, 15 deg. later than Fig. 5. The fundamental component, a sine curve with a mean value of 139, is drawn for comparison in these diagrams. It should be noted that the step curve is practically equivalent to its fundamental, and does not deviate much from the desired sine form at any instant. This is due to the 83.3 per cent pitch which reduces the fifth and seventh harmonics to small fractions (about 25 per cent.) of their full-pitch values, as may be seen by a reference to Fig. 2. If the winding were full pitch, the step curve in Fig. 4 would have a pronounced peak, that of Fig. 5 would be bulged on one side, and that of Fig. 6 would have a flat top. The use of this pitch value results in a smoother field, and one which moves along the air-gap at a nearly uniform rate—that is, approximates closely to the motion of the fundamental component.

COUNTER E.M.FS.

If the reluctance be assumed constant over the entire air-gap area the fluxes set up by the various harmonic m.m.fs. will be proportional to the latter. Under this assumption the slot openings are considered as bringing about a reduction of the pole area merely, their effect in causing local variations of the flux being disregarded. This assumption is justified in the case of the fundamental and larger harmonics, but not in the case of a harmonic whose half-wave length nearly equals the distance between slots.

With uniform reluctance, the primary element of any polyphase apparatus is the seat of a rotating wave of flux composed of a fundamental and harmonics the values of which may be calculated by the aid of the equations given above. Of these harmonics a certain number travel in the same direction as the fundamental and others travel in the opposite direction. Since each harmonic rotates at $\frac{1}{m}$th synchronous speed and has m times as many poles as the fundamental, the counter e.m.fs. due to the harmonics are all of fundamental frequency.

The counter e.m.fs. due to the harmonics are all of the same sign and add directly to the counter e.m.f. due to the fundamental; this is true whether the harmonic rotates backward or forward, is positive or negative regardless of the pitch of the winding. Since, as will be shown later, the counter e.m.fs. due to the harmonics are vanishingly small in comparison with the counter e.m.f. due to the fundamental, it is better to base the counter e.m.f. calculation upon the fundamental only than upon the "equivalent sinusoidal field."

Let E_1 = effective counter e.m.f. due to the fundamental flux component.
ϕ = total fundamental flux.
b = coils in series per circuit.
f = cycles per second.

The following equations give the relation between flux and counter e.m.f. In a two-phase motor

$$E_1 = \frac{2\pi b n_c f \phi \sin \frac{\gamma\pi}{2}}{10^8 N_{sp} \sin \frac{\pi}{2N_{sp}}} \qquad (9)$$

In a three-phase motor

$$E_1 = \frac{1.5\sqrt{2}\pi b n_c f \phi \sin \frac{\gamma\pi}{2}}{10^8 N_{sp} \sin \frac{\pi}{2N_{sp}}} \qquad (10)$$

Equation (10) gives the delta or star e.m.f. according to the connection of the winding.

From these equations the flux necessary to produce any given counter e.m.f. can be calculated readily, and from this the necessary m.m.f. and the magnetizing current can be found, as in the above examples. The accuracy of the calculation depends only upon the assignment of the proper value to the fringing coefficient in estimating the net pole area, and upon making the right allowance for the m.m.f. consumed by the iron part of the magnetic circuit.

The effective e.m.f. E_m induced by the mth harmonic of the flux wave, retaining the assumption of uniform air-gap reluctance, is determined most conveniently as a fraction of the e.m.f. induced by the fundamental. In the case of a motor with open secondary this fraction is

$$\frac{E_m}{E_1} = \frac{1}{m^2}\left(\frac{\sin \frac{m\pi}{2p'} \sin \frac{\pi}{2N_{sp}} \sin \frac{m\lambda\pi}{2}}{\sin \frac{\pi}{2p'} \sin \frac{m\pi}{2N_{sp}} \sin \frac{\lambda\pi}{2}}\right)^2 \qquad (11)$$

The ratio $\frac{E_m}{E_1}$ is very small in most cases. In full-pitch single slot windings it has the value $\frac{1}{m^2}$, and in such windings the third harmonic induces 1/9th as much counter e.m.f. as the fundamental, the fifth induces 1/25 as much as the fundamental, etc., except where the harmonic vanishes entirely, as do the third and its multiples in three-phase machines. In support of the contention that the counter e.m.fs. due to the harmonics are negligible, Table II has been worked out, giving the ratio $\frac{E_m}{E_1}$ for three motors, one of which is the three-phase fractional pitch motor referred to above; the others are full-pitch motors with the same number of slots. In motors with closed secondaries these values would be considerably smaller.

TABLE II.—VALUES OF $\frac{E_m}{E_1}$ WITH 12 SLOTS PER POLE.

	Two phase full pitch.	Three-phase full pitch.	Three-phase 83.3 per cent pitch.
$m = 1$	1.000	1.000	1.000
$m = 3$	.0131	.000	.000
$m = 5$	.00182	.00182	.000124
$m = 7$	.000755	.00055	.000039
$m = 9$	.000443	.000	.000
$m = 11$	.000142	.000142	.000142
$m = 13$	.000101	.000101	.0001

SECONDARY CURRENTS.

The presence of harmonics in the flux wave means that "stray" currents exist in the secondary conductors of an induction motor the rotor of which is driven at synchronous speed, since the speed of each harmonic is different from that of the fundamental, and synchronism for the fundamental is out of synchronism for all the harmonics. At any slip s, the frequency of these stray currents is

$$f[m(1-s) \pm 1]$$

in which the positive sign is taken when the harmonic rotates backward, and the negative sign when the harmonic rotates forward. At standstill all of the stray currents are of fundamental frequency. At synchronism the frequency of the rotor currents in a two-phase motor is $4f$ for the third and fifth harmonics, and $8f$ for the seventh and ninth. In a three-phase motor the frequency is $6f$ for the fifth and seventh, and $12f$ for the eleventh and thirteenth. These frequencies are all high as compared with the fundamental, and therefore the torque due to the harmonics is probably very small when the speed is near synchronism.

During acceleration the harmonics may give rise to considerable torque under certain conditions, and may seriously impair the ability of a motor to start its load. For example, in a two-phase motor, at standstill, the fundamental pulls forward, the third backward, the fifth forward, etc. As the speed increases the rotor comes into synchronism with the forward moving harmonics one after another, the last one being the fifth, which is the fastest forward-moving harmonic. As soon as the rotor overtakes any harmonic the torque due to that harmonic reverses. When the rotor speed is slightly above 1/5th synchronism all of the harmonics pull backward, and the rotor speed will not rise above this value unless the torque due to the fundamental is greater than the pull-out torque of the fifth harmonic plus the backward torque of all other harmonics plus the torque required by the load. This speed is far below synchronism, and if the rotor resistance is low the torque due to the fundamental is low; thus the fundamental working at a disadvantageous speed point has to overcome the backward torque of all of the harmonics, one of which—the fifth—is at its most advantageous speed point. The available torque of a motor may be reduced materially in this way.

Mr. O. S. More, of the Western Electric Company, has observed that in certain two-phase motors running at normal speed the e.m.f. impressed on one phase winding can be reversed without causing the motor to reverse its direction of rotation, the speed merely dropping to about one-third synchronism and remaining there indefinitely. If the power is cut off, thereby allowing the speed to decrease somewhat, and is then restored, the speed returns to the one-third value. This action is undoubtedly due to the third harmonic, which becomes a forward moving harmonic upon reversal of the e.m.f. on one phase winding; the torque due to the third becomes maximum at a speed slightly less than one-third of synchronism, and the backward torque of the fundamental, under the very unfavorable condition of nearly 133 per cent slip, is unable to overcome the pull-out torque of the harmonic, and the motor cannot reverse its direction of rotation.

The effect of the harmonics is to cut notches in the speed-torque curve at certain critical speeds. To get rid of these it is desirable to use that value of fractional pitch which most nearly eliminates the objectionable harmonics.

The reaction of the stray secondary currents upon the primary is of fundamental frequency at any speed, and tends to neutralize the harmonics in the rotating field; if this neutralization is complete the harmonics will disappear and the fundamental will remain alone, but this is not possible unless the rotor impedance is zero. The neutralization is always sufficiently complete to justify the method adopted in the present article in which all calculations are based solely upon the fundamental.

The stray currents, of course, increase the copper loss of the machine as a whole, and the additional copper loss is a quantity that increases with the load. Since the harmonics are not completely neutralized, their presence leads to an increase in the iron loss; this iron loss also increases with the load, differing in this respect from the iron loss due to the fundamental.

The following conclusions appear to be justified:

1. The magnetizing current required to set up a given flux in a given frame is 6.1 per cent greater in a two-phase than in a three-phase machine.

2. The counter e.m.f. developed by a given flux in a given winding is 6.1 per cent greater in a three-phase than in a two-phase machine.

3. The exciting reactance is therefore about 13 per cent higher in a three-phase than in a two-phase machine.

4. Since the exciting volt-amperes required to develop a given flux in a given frame are independent of the number of phases, the number of slots, the pitch of the winding, and the number of turns per coil—that is, are independent of the winding, machines should not be compared on the basis of the exciting volt-amperes, but rather on the basis of the exciting reactance.

5. The use of a suitable fractional pitch for the windings results in the reduction of the secondary copper loss and the iron loss, and smoothes out the low points on the speed-torque curve.

6. To secure these advantages the best winding pitch for three-phase machines is about 83.3 per cent, and for two-phase machines about 75 per cent.

The Weiss Laboratory Electromagnet.

By M. P. Misslin.

NO modern electrical testing laboratory can be considered as having a complete equipment of apparatus without possessing an electromagnet of great strength. Especially during the last few years such magnets have formed the object of a series of studies tending not only toward a perfection as far as their construction is concerned, but chiefly also toward obtaining magnetic fields of as high intensity as possible.

Thanks to the researches of Stephan[1], the most advantageous form of pole-pieces has been known for some time, but the question as to the dimensions to give the magnetic circuit has generally not been solved in the same satisfactory way.

The usual procedure to obtain powerful magnetic fields consists in magnetizing two cylindrical coils, separated by a gap, parallel to their common axis. In order to obtain the maximum possible intensity of magnetic field, it is evident that it is necessary to produce in the pole-pieces a magnetizing intensity as near as possible to saturation. With most of the magnets previously designed it is impossible to approach sensibly such density, as will be shown in the following:

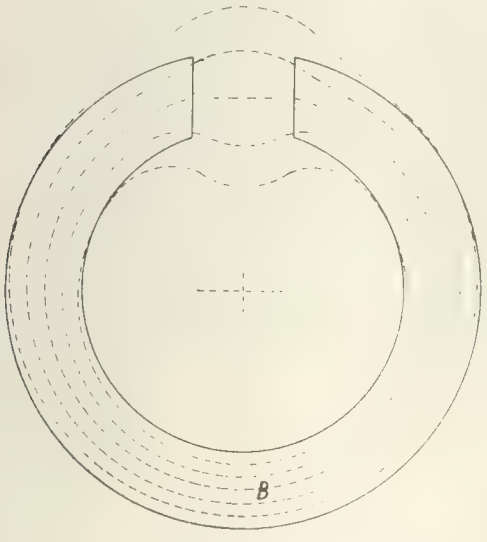


FIG. 1.—RING ELECTROMAGNET.

Fig. 1 shows a ring interrupted by a gap and the magnetic field produced by means of a winding uniformly distributed over the whole ring surface. It will be noted that the density is not the same in all parts of the ring and that the derivations of the flux increase toward the poles. The part *B*, most distant from the poles, will thus become saturated first and will play the part of a second gap, whereas the remaining portion of the ring will behave as if the magnetic circuit were opened at *B*.

In Fig. 2 the field produced in the air-gap has been recorded as a function of the magnetomotive force as the curve *O P Q*. The magnetic contraction produced by the saturation of the

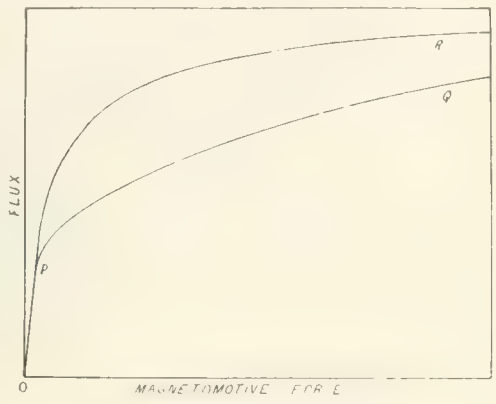


FIG. 2.—SATURATION CURVES.

section *B* (Fig. 1) takes place at the bend *P* (Fig. 2). From this point the increase of flux is so slow that experiments which may be carried out will have to be interrupted long before the flux has reached its maximum value, which corresponds to the saturation of the pole-pieces, owing to the excessive heating of the magnetizing coils. For the above reasons it is not possible to obtain saturation of the pole-pieces with a magnetic circuit of uniform cross-section.

The above facts, first described by P. Weiss[2], have for a long time been misunderstood and even at present they are often contested. As a matter of fact, most of the electromagnets for sale to-day have magnetic circuits of uniform cross-section. At first sight it would seem that the magnetic contraction at *P* (Fig. 2) can be displaced by giving the magnetic circuit a section varying over its whole length, and that the contraction could completely be avoided if the section at each point were so proportioned that saturation takes place simultaneously over the whole circuit. The curve *O P Q*, in Fig. 2, would then be replaced by curve *O P R*.

To arrive at simultaneous saturation over the whole range of the circuit the following rule must be observed: The section of the magnetic circuit measured at the greatest distance from the air-gap, to the section measured at the air-gap, must decrease gradually in such a way that saturation will be retained up to the poles in spite of any loss of flux by leakage. Evidently, saturation is of importance at the poles only, and therefore the portions of the magnetic circuit distant from the gap can be given a greater section than would be demanded by the above-mentioned rule. It is even of advantage to adopt the latter method, because instead of wasting flux over the greater portion of the circuit the circuit may be magnetized to less intensity without changing the flux passing to the poles. As a matter of fact, in order to obtain an intensity of magnetization 20 per cent smaller than the maximum intensity at the poles a field only 1 per cent as powerful will suffice. It follows that in increasing all of the sections of the magnetic circuit which are not close to the poles, in the proportion of 1:5, an enormous saving in the number of amp-turns required may be realized. By employing this principle, Prof. P. Weiss has designed the laboratory magnet which is clearly shown in the illustrations (Figs. 3, 4 and 5), which was made by the Maschinenfabrik Oerlikon, Switzerland.

The magnetic circuit is formed by a heavy U-shaped yoke of extra soft steel, carrying two cylindrical cores 15 cm in diameter of the same material. The yoke is cast in one piece and offers the rigidity absolutely necessary for a design in which the attraction of the two poles may attain 4400 lb. The cylin-

[1] *Wied. Ann.* p. 440: 1889.

[2] *Bulletin* des séances de la Société Française de Physique. (1er et 2e fascicules, 1907.)

drical cores threaded at one end can be moved forward and backward by means of suitable gearing, so that the distance between the poles can easily and accurately be regulated. The whole apparatus is carried by a vertical pivot so that the magnet can be set to any azimut by means of a worm gearing operated by a hand-wheel.

The bobbins are placed as closely as possible to the pole-pieces to avoid too great a derivation of the flux. The first electromagnet (Fig. 3), built for the laboratory of the Institute of Physics at Zurich, has bobbins formed of copper tape 1 mm in thickness and 15 mm in width, wound up helically, the windings being separated by an insulating tape 0.2 mm in thickness. Each bobbin is formed of 15 divisions, held together by tapes and spaced 3.5 mm apart from each other.

In using copper tape in place of copper wire a saving of about one-third of the bobbin volume has been effected, the result being a corresponding shortening of the magnetic circuit.

The two bobbins have been calculated very liberally, in view of the manifold requirements which the magnet should meet. has, therefore, been built with a less number of amp-turns. The bobbins of the latter magnet have 10 divisions, each with 75 turns, so that a total of 1500 turns is obtained. The resistance of these bobbins, cold, is 2.5 ohms. With this magnet a m.m.f. up to 150,000 amp-turns could be obtained.

For research work requiring a large air-gap it is preferable to retain the number of amp-turns of the first apparatus described. A third magnet, similar to the one above described, has been supplied to the Bureau of Standards at Washington.

Smaller magnets, with bobbins of copper wire, but designed on the same principle, and for m.m.fs. up to 30,000 amp-turns, are turned out by the Société Genevoise pour la Construction d'Instruments de Physique et Mécanique, Geneva (Fig. 5).

With magnets as described above it has been possible to establish fields of higher intensity than were obtainable previously. For instance, a field of 46,000 gausses was obtained with the magnet at Zurich, with pole-pieces having the form of truncated cones, whose smaller bases had a diameter of 3 mm and which were separated 2 mm from one another. This field exceeds by

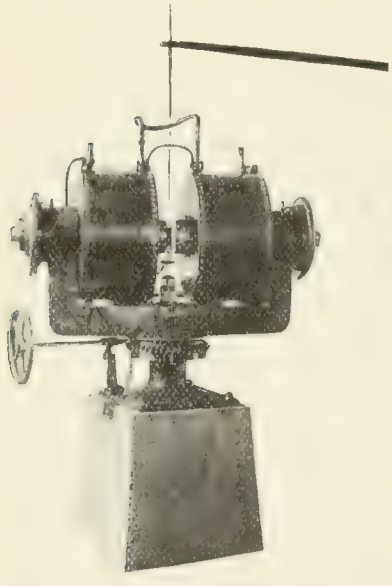


FIG. 3.—ZURICH ELECTROMAGNET.

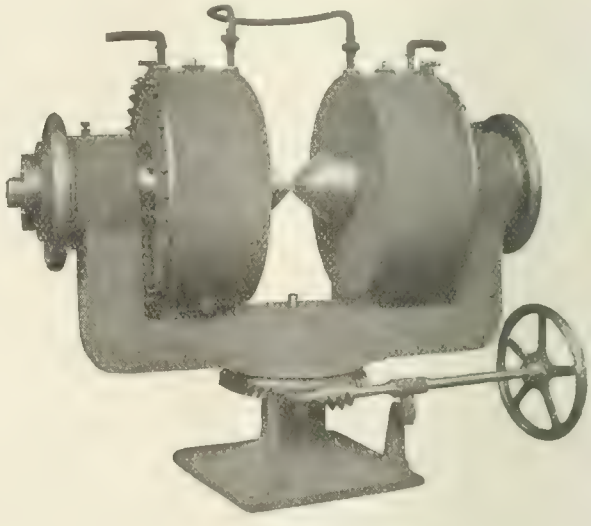


FIG. 4.—PARIS ELECTROMAGNET.



FIG. 5.—GENEVA ELECTROMAGNET.

Each bobbin has 1600 turns of a section which will carry to 60 amp, so that a maximum total m.m.f. of about 200,000 amp-turns is obtained. The total resistance of the bobbins, when cold, amounts to 4.9 ohm. As the total power consumed by the magnet amounts to 18 kw, special provisions had to be made to permit the carrying off of the heat produced. For this reason the bobbins are enclosed in suitable receptacles filled with paraffin oil, through which cooling coils are run.

After a rather long use of the apparatus, the increase in temperature of the cooling water did not exceed 20 deg. C. and the pole-pieces remained perfectly cool. The artificial cooling adopted in the first instance to accommodate the necessary number of amp-turns has in actual use proved still more valuable, owing to the constancy of the temperature in the space occupied by the magnetic field, thus doing away with the numerous troubles experienced with older designs resulting from the heating of the pole-pieces. The magnet has been provided with a number of different pole-pieces, the form of which must be decided according to the special services the magnet has to perform.

In Fig. 3 the magnet is illustrated with pole-pieces of parallel, vertical end surfaces. To permit the carrying out of magneto-optical experiments the magnet cores have an opening drilled through their whole length, which—in order to avoid any reduction of the section for other experiments—can be closed up by inserting accurately machined plugs.

Most of the experiments carried out with the first apparatus built did not require more than 25 amp. A second magnet (Fig. 4), supplied to the Ecole Normale Supérieure de Paris, about 8000 gausses those which have been obtained for distances of the same magnitude by magnets of other design.

In this connection, the accompanying table, giving results of tests on Creusot steel and Swedish iron, carried out with the

Distance between poles — 1.95 mm.

Creusot Steel. Amp.	Gausses.	Swedish Iron. Amp.	Gausses.
0.625	11,050	0.625	12,030
1.25	21,100	1.25	21,670
2.5	28,750	2.5	29,150
5	35,480	5	35,700
10	41,100	10	41,300
15	43,830	15	44,670
20	45,430	20	45,110
25	45,710	40	45,650
30	46,250		

Zurich magnet, with truncated pole-pieces 10 cm in diameter at the larger surface, and 3 mm diameter at the truncated end, and a separation of 1.95 mm between poles, as reported by Prof. P. Weiss[3], will certainly be of interest.

Bavarian Water Powers.

Ministerialrat Stengler has recently made a report on the proposed development of water powers in Bavaria. Five hundred thousand hp could at once be utilized without any difficulty, perhaps even 700,000 hp. The State proposes to reserve for its own use one-fifth of the 500,000 hp—that is, 100,000 hp; this would include the electrification of railroads; 400,000 hp would be available for industrial purposes.

[3] *Bulletin* des séances de la Société Française de Physique. (1er et 2e fascicules, 1907.)

Lane Technical High School, Chicago.

WITHIN the last few years there has come into being a widespread demand for practical industrial education for the benefit of those boys (and perhaps girls) who must leave school at a comparatively early age to earn their own living and who have no hope or desire of reaching the technical college, or are, perhaps, not intellectually equipped for the thorough scientific study which must underlie an engineering education. This subject attracted attention at the recent educational convention in Denver, and in his annual address on that occasion as president of the National Education Association Mr. Lorenzo D. Harvey said: "For the great mass of those needing industrial education the existing public schools, elementary and secondary, must furnish the facilities. They must recognize that the great majority of their pupils must earn their living by their hands, and they must undertake to give definite instruction and training for at least the beginning of industrial efficiency."

In Chicago a new public high school was dedicated on Washington's Birthday, 1909, which is of exceptional interest, as indicating the effort that is being made to grapple with this problem. It is the Albert G. Lane Technical High School at Sedgwick and Division streets, and although open less than a full school year it had, at the end of the school year in June, about 1500 pupils in charge of 55 teachers. The pupils are all boys, and they appear to be enthusiastic in their work. While some of the boys are preparing for technical colleges, the majority of them are taking the school work with the idea of securing practical training that will be of immediate help to them as wage earners or in business after they leave school. Practical electrical instruction forms a part of the course, although not a very conspicuous part as yet. All machinery and machine tools are electrically driven by individual motors or through shafting, and there is an isolated plant for generating electricity which is probably the largest in any technical high school in the country. This plant has a rated capacity of 600 kw, and as it is capable of 25 per cent overload its maximum capacity is 750 kw.



FIG. 1.—GENERAL VIEW OF LANE TECHNICAL HIGH SCHOOL.

FUNCTIONS OF THE SCHOOL.

At the recent dedication to which reference has been made the principal of the school, Mr. William J. Bogan, delivered an address on the functions of the school, in which he said the school was designed with practical education as its keynote and the making of an honest living as its goal. To this end the Board of Education has provided the best building, the best tools and the best machinery that could be secured. Mr. Bogan said that teachers make a great mistake who believe that all pupils are given an equal chance through the workings of the old-time course of study. He asked if the boy with a taste for mechanics has an equal chance in the ordinary high school with the girl who takes all the Latin and Greek that is offered her and then cries for more. Much of the high school education in the past has been, as one critic phrases it, "a merry-go-round for girls," the impracticability of which the speaker illustrated by telling a story of a Norwegian servant girl who seemed to do everything the wrong way. This girl made a failure of scrubbing; she wrecked the kitchen stove, and in ironing scorched the daintiest garments. Finally, in a moment of exasperation the mistress said: "Well, Hulda, is there anything you can do?" "Y-aas," answered the servant, "Ay can milk a reindeer."

Statistics of school attendance show that only a small percentage of pupils complete the work of the elementary schools and that a large number never go beyond the first half of the elementary grades. In Chicago there are thousands of boys and girls between the ages of 14 and 16 who are not in school and are not at work. In Chicago there are 17 high schools, two of which are technical high schools; and it is significant, as pointed out by Mr. Bogan, that nearly 50 per cent of all the boys in the city high schools are in these two schools. The average loss in Chicago high schools between the first and second years is 35 per cent, while at the Crane Manual Training School on the West Side the loss is only 17 per cent. In the judgment of Mr. Bogan these facts justify the erection of schools where practical education is emphasized.

One feature of the Lane school is the night sessions attended largely by men. Mr. Bogan told his hearers that it would stir their blood to spend an evening going through the school and questioning these adult pupils as to the reason for their attendance. One man of 55, for instance, said that he was a blacksmith's helper, but that he didn't intend to be a helper all his life. The principal of the school expressed himself as dissatisfied with the existing curriculum and said the course should be made much more practical than it is at present. The fact should be boldly faced that only a small percentage of the students who enter high schools will ever go on to college, and the energy of the secondary public schools should not be directed toward the development of the few at the expense of the many. Referring to industrial training in penal institutions for the young, Mr. Bogan made the striking statement that it long has been a reproach that only through the commission of a felony can a boy secure the education best suited to his needs. The education fitted to reclaim a youthful criminal is the kind of education best suited to the prevention of crime. Emphasis should be placed on shop work rather than on academic attainments that will lead only to college.

Mr. Bogan gave his ideas as to the manner in which the course could be modified advantageously to make it more practical, and in concluding he said: "I often wonder what it is in our make-up as teachers that impels us to stand afar off and gaze at our work through the telescope of tradition and precedent, which magnifies the importance of Greek and Latin and ancient literature, while we ignore the pitiful sight of mankind on its knees offering up the prayer in all its terrible literalness, 'Give us this day our daily bread.'"

STUDIES AND EQUIPMENT.

The present schedule of studies which Mr. Bogan thinks might be improved embraces three four-year courses—Latin, modern language and scientific. The subjects ordinarily taught in high schools are included with the addition of such subjects as mechanical and freehand drawing, woodworking, gymnasium exercises, blacksmithing, foundry and pattern work and machine-shop practice. In the scientific studies emphasis is placed on physics and chemistry of course.

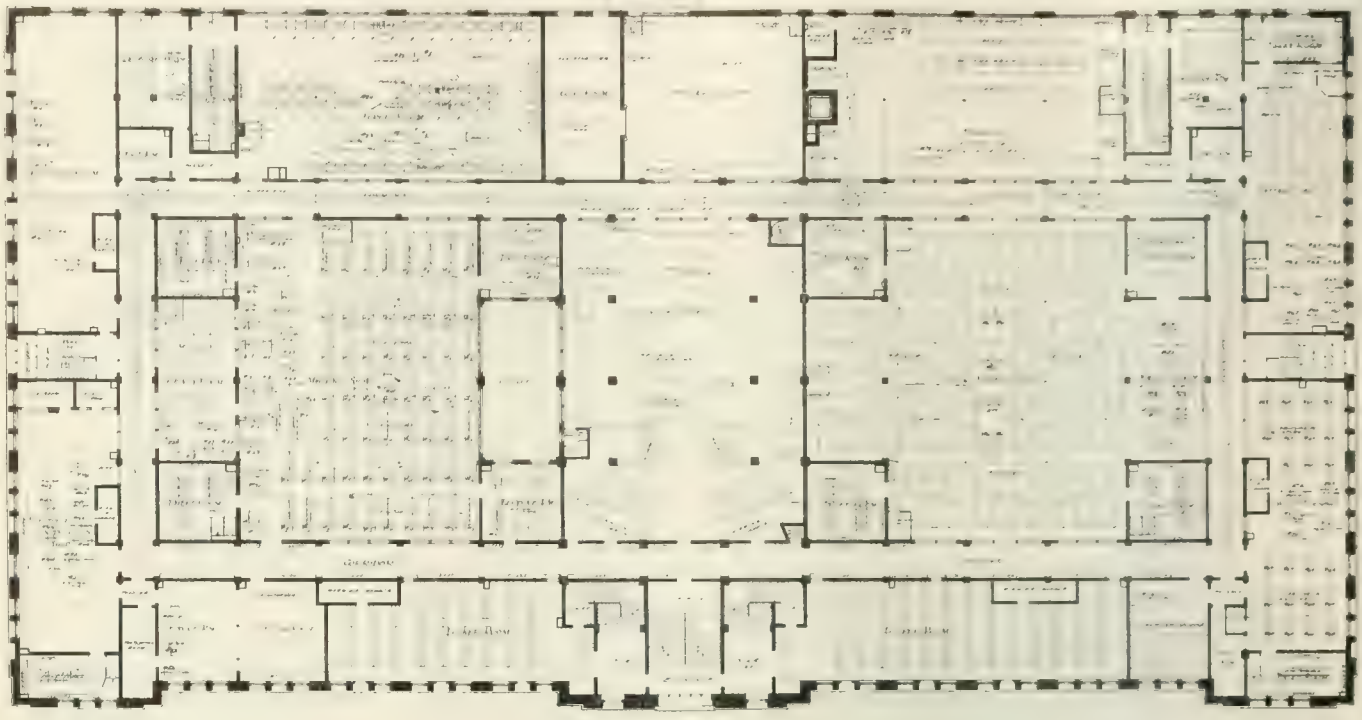


FIG. 2.—GROUND FLOOR PLAN.



FIG. 3.—VIEW IN ELECTRICAL CONSTRUCTION SHOP.

LANE TECHNICAL HIGH SCHOOL, CHICAGO, ILL.

The Lane school will accommodate 1600 students, divided into three periods in the daytime and one in the evening. The shops located on the ground floor have a working capacity of 400 pupils during one period, the working unit being 24 pupils or one-half of the unit of the other departments, which are arranged for 48 pupils. On the ground floor of the large building are the locker rooms, machine shop, chipping and receiving rooms, woodworking shop, foundry and forge department, pattern and woodturning shops and also the electrical construction shop with its lecture and testing rooms. The power plant is also placed on the first floor, with ample accommodations for coal storage, boiler room and engine room. Above the ground floor are two upper floors, while in the central portion of the building there are a fourth and fifth floor. The second and third floors contain the principal's office, laboratories, drawing departments, library, assembly hall and a large number of class rooms. There is a lunch room with kitchen on the third floor, and the fourth floor is given over to the gymnasium which is supplied with a running track, shower baths and the like.

A conspicuous feature of the ground floor is the machine shop, which is 60 ft. x 80 ft. in size lighted by skylights and side transoms from the courts. The shop is equipped with machinery for 72 pupils and this machinery consists of lathes, drills, grinders, milling machines, planers, crank shapers, boring and turning mill, an automatic screw machine, etc. In all there are 82 machines in this shop. At the foot of each engine lathe in the machine shop is a small vise bench provided with five individual student's drawers and one general tool drawer, as well as two compartments for storage of work under construction. A tool room also is connected with the machine shop.

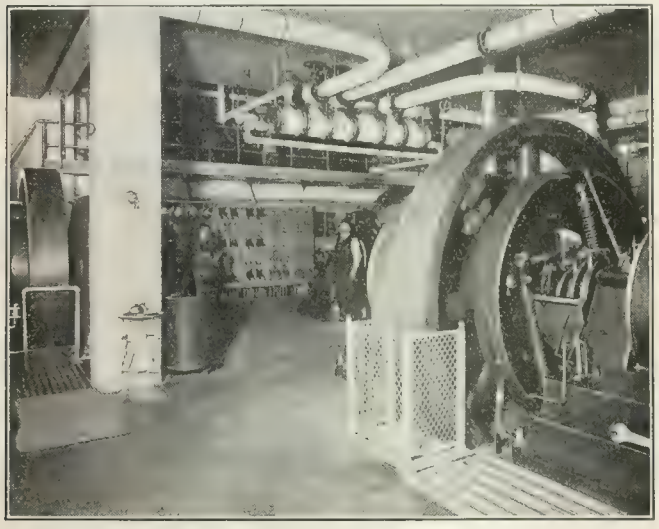


FIG. 4.—PARTIAL VIEW OF POWER PLANT.

The chipping room is provided with benches to accommodate 24 pupils. This shop is equipped with six machines, consisting of crank shapers, grinders, drill press and tool-tempering furnace.

The woodworking shop is equipped with 72 double work benches, giving a student capacity of 144. It is provided with band saws, planers, boring machines and other equipment. The pattern shop likewise is completely equipped. The same is true of the wood-turning shop.

The foundry is 40 ft. x 80 ft., having a floor composed of round cedar blocks, with crevices filled with sand. This shop has been equipped for the accommodation of 40 pupils and has a two-ton cupola and a one-ton traveling crane with other necessary machinery. The forge room is similar in size and has been equipped with 48 down-draft forges. Under each of the forges are located steel cabinets, each containing three individual student's drawers for the storing of tools.

All the shops are provided with lecture-rooms, and there is also a receiving room where is stored all materials and supplies needed in the shops and other departments. Various motor-driven tools are placed in the receiving room.

The building has ground dimensions of 331 ft. x 174 ft., and with its equipment cost about $750,000.

POWER PLANT.

The power plant of the Lane Technical School includes three 200-kw, 220-volt, direct-current Western Electric generators, directly coupled to Russell four-valve engines. There is also a compensator set rated at 14 kw and designed to care for an unbalanced load of 125 amp. Steam is furnished to the engines by three 350-hp Freeman water-tube boilers provided with Swift automatic stokers in which screenings are burned. Draft is provided by a 125-ft. brick stack. A large part of the load on this plant is due to the various motors for driving the machines in the school shops, and also the ventilating fans and other apparatus needed in the operation of the school building. There are 47 motors installed in the building and they have a combined rating of about 450 hp, ranging from 2 hp to 100 hp, the latter machine being used to run the machine shop. The lighting system includes 62 arc lamps and about 3000 incandescent lamps ranging from 16 cp to 50 cp. The arc lamps are placed principally in the shops and in the gymnasium. The switchboard in the power plant is a handsome structure of gray Vermont marble with eight panels—three for the generators, one for the compensator, two for motor circuits, and two for lighting circuits. The equipment of boiler-feed pumps, house pump, air compressor, feedwater heater, oil separator, etc., is placed in the engine room, and the whole plant is clean, airy and well kept, so that it may be easily inspected by the students. The building is heated by exhaust steam from the engines. The electric wiring, switchboard, generator and engine equipment, together with the installation of motors, was designed and superintended by Pierce, Richardson & Neiler, consulting engineers, Chicago. The heating, ventilating and boiler-room equipment throughout was designed by the engineering department of the Board of Education, Chicago.

ELECTRICAL INSTRUCTION.

The pupils' work in the electrical department at present consists mainly of the construction of motors and generators. The department contains a construction shop, a testing-room, lecture-room, battery-room, toolroom, stockroom and locker-room. The construction room is equipped with lathes, drills, punch presses and all other machines necessary for the lighter machine work. The heavier work, such as boring out frames, is done in the main machine shop of the school, which is equipped for such work with large lathes, vertical borer, planer, radial drill and other machines. All of the lighter machining is done in the electrical construction shop—such as turning shafts, commutators, and machining small pieces. The winding and testing of armature and field coils are also done in the construction shop, the room being equipped with a power winder and testing boards.

The testing room is used for experimental work and for testing the power, efficiency, permeability, heating, etc., of machines. It has a triple-current Roth Brothers motor-generator, which gives, in connection with a storage battery, all direct-current voltages up to 220, and all alternating voltages from 5 up to 200, supplying several switchboards throughout the school with these voltages, including two-phase and three-phase alternating currents. The lecture room has a large distributing and demonstrating switchboard; also a transmission and reflecting optical lantern, a large assortment of continuous and alternating current machines in various stages of completion, and such other apparatus as may be necessary in order to show the methods of designing, constructing and testing electrical machines.

The battery-room contains a storage battery of 24 American cells, so arranged that they may be connected to give any voltage from 2 to 48, in steps of two. There is also a supply of various kinds of primary cells. This room adjoins the lecture room and thus allows two wires from each cell to be run directly to the main switchboard, so that the battery voltage

may be regulated or the individual cells tested by the lecturer before a class. The toolroom contains all such tools and supplies as are likely to be used in the construction of electrical machines or apparatus; and the stockroom contains material, such as insulation, brass, copper, iron and steel of all desired dimensions and shapes, together with asbestos wood, electrical molding, conduits, and the like. The locker-room contains an iron locker for each pupil, a large number of washbowls, and the usual toilet-rooms.

From the beginning it has been the aim to put the electrical department in such shape that all work could be turned out according to approved methods, and so that all finished machines not rejected would be in no way inferior to those of the best shops. No reasonable expense has been spared for machines, tools or material.

There are both day and evening classes. The day classes continue for the full school year, averaging an hour a day, while the evening classes last one-half year with two hours a day. In the day classes fourth-year pupils only are allowed to take the electrical work; and as they have just had a full year in the machine shop and a half-year of the study of electricity (physics), they are qualified to take up the electrical construction work.

The evening pupils consist of those who have had no electrical instruction in any way, others who have had shop work or wiring, and others who have had both study and practice. Thus classes are formed in beginning electricity, others in shop work and others in advanced electrical work. As many as six teachers were employed in the evening school, including an expert machine man and an armature winder.

In both the day and evening schools, however, much of the

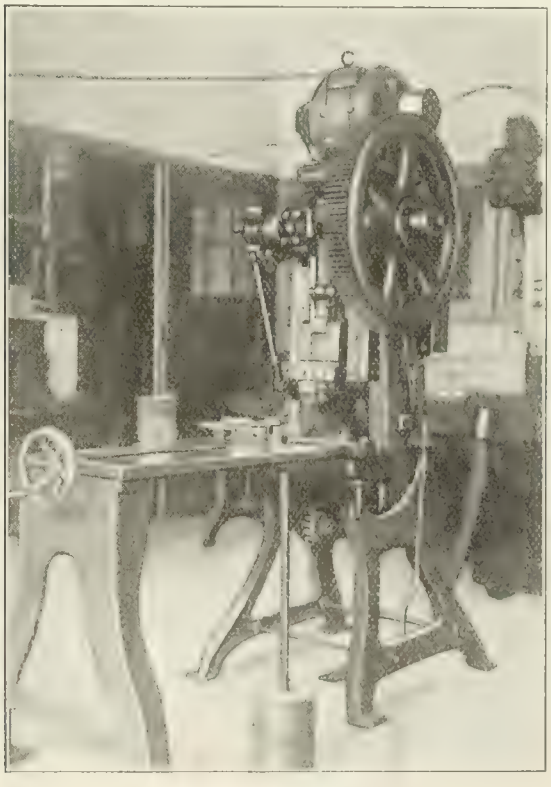


FIG. 5.—ARMATURE-DISK NOTCHER.

work is done by pupils in other departments of the school. In the day school the patterns are made by the first-year pupils; the more difficult ones by night pupils of some experience; the molding and blacksmithing are done by the second-year pupils, and some of the machining, drafting and blueprinting by the third-year pupils. All of the electrical work, however, is done by the fourth-year pupils—that is, the designing and all work involving insulation or requiring electrical knowledge such as the winding and connecting of coils, the building of commutators and assembling and testing machines. The general plan of instruction is somewhat similar to that which is in vogue in the evening school.

The construction work has to be carried on constantly with a view to the ability of the pupils. They are not experts such as are usually employed at similar work. The machines which are to be made have to be designed with reference not only to efficiency and economy, but also to the inexperience of the workmen. The insulation must be a little thicker or of better



FIG. 6.—ARMATURES IN PROCESS OF CONSTRUCTION BY PUPILS.

material, or "shorts" or grounds will develop. The machines, for given output, must be slightly larger than usual so that the armature slots may be large enough to force in the coils without injury, so that the shaft bearings may allow slightly more winding space, and so that the magnetic reluctance may be sufficiently low in spite of slight defects in the yokes, in the contacts between yokes and poles or in other portions of the magnetic circuits.

For punching the armature disks special guides are needed so that they can be quickly and accurately applied, and that the fingers will be protected. A boy punching a few hundred disks, perhaps setting guides but once, cannot do so as accurately and quickly as an expert. And if much time is lost on each portion of the work but little can be accomplished during the year, as much of the work has to be rejected and repeated. Therefore, the dies and guides for punching the disks and for notching them have been so designed that they can be instantly set, will remain accurate and are practically fool proof.

Also in varnishing the notched disks, rollers cannot well be used where the varnishing is done only for an hour or two once or twice a week, as too much time would be wasted in keeping the varnish from caking. Hence, a centrifugal method has been designed which, with the boys, is more rapid than the roller and fully as effective. Jigs for quickly fitting and rigidly holding parts to be machined also have been designed. The aim throughout is to enable the pupils to devote as much time as possible to the actual construction work.

Designing the machines to meet the needs of the inexperienced boys does not need materially to affect the efficiency or the size of the motors or generators, but it does materially affect the work of the instructors. The instructors need to be not only skilled mechanicians, but also electrical engineers with thorough technical training and much experience in designing and manufacturing. They should also be good teachers, because they come more intimately in contact with each pupil than at almost any other line of teaching, and as the pupils are usually much interested in the work and frequently expect to make it their life work, the influence of the instructor for good or evil is very great.

Mr. Ernest J. Andrews is director of the electrical department. Thanks are due both to Mr. Bogan and Mr. Andrews for assistance in the preparation of this article. Some of the photographs reproduced herewith were taken by pupils, members of the Lane Camera Club.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Coal Hole Sign at Middletown, Ohio.

The Middletown Lighting Company, of Middletown, Ohio, is utilizing the sidewalk coal hole in front of its office for advertising purposes. Use is made of a glass cover with a sign lettered on the glass. Underneath the glass is a lamp with a "skidoodle" socket, giving a flasher effect, which on the unsuspecting passerby is sometimes quite startling.

Tungsten Sign Lamps at Canton, Ohio.

The Canton Electric Company, of Canton, Ohio, is experimenting with tungsten lamps for electric signs. Its rate on 4-cp carbon-filament sign lamps has been $2 per year per lamp. It is now making a rate of $1 per year for a 4-cp, 5-watt tungsten sign lamp, including renewals. These lamps are placed 11 in series on a 115-volt circuit. It is hoped to extend greatly the use of electric signs by means of the low rate which is made possible by a tungsten lamp. Mr. W. C. Anderson, the manager of the company, however, regards the business as somewhat experimental until more is known about the performance of the tungsten sign lamp.

Peculiar Turbine Arrangement at Canton, Ohio.

The Canton Electric Company, of Canton, Orio, is operating a steam turbine under unusual conditions. The turbine is a 500-kw Curtis machine and is sometimes operated in the ordinary manner by supplying high pressure steam to the first stage, which then passes to the second stage. It is frequently operated, however, as a low-pressure turbine in connection with the exhaust of one of the steam engines in the station. When so operated, the exhaust of the engine is supplied to the second stage. The first stage is, therefore, out of action. The second stage works as a low-pressure turbine deriving most of its power from the vacuum maintained by the condenser. In order to provide against slowing down the turbine under over-load, the throttle is open so that high-pressure steam will be supplied by the governor to the first stage whenever the speed falls below a predetermined amount. The governor is so adjusted that under ordinary conditions no high-pressure steam is supplied, but the governor will open the valve to admit high-pressure steam the instant the speed falls.

Commercial Use of Ozone Generators.

That ozone can be commercially produced in quantity by means of electric discharges of high frequency through the atmosphere has been known for many years, and in Europe the process has received considerable application. At present there seems to be a tendency to make a more extended commercial use in this country of apparatus embodying this principle. Several companies are placing on the market ozone generators, and activity in this direction seems to be especially marked in Chicago. Machines are produced for office use and also to be placed in the home, particularly in sleeping apartments to keep the air fresh and invigorating during the night. It is asserted that persons troubled with insomnia have received benefit by the production of a moderate degree of ozone in their sleeping-rooms at night. Larger machines are made to be used in public buildings or assembly halls, and there is an installation of this character in the Chicago Public Library, where an ozone generator is placed in one of the air ducts provided for ventilation. The ozone generators are made both for alternating and direct current, although in the latter case a small motor generator is usually made a part of the machine. This commercial use of ozone indicates another possibility in the way of new business for the central station, and as such is perhaps worthy of attention. The Ozone Pure Airifier Company, of 160 Adams Street, and the National Air Filter Company, of 199 East Madison Street, both of Chicago, are concerns which are engaged in pushing the sale of ozone generators.

Record of New London (Wis.) Light and Waterworks.

The municipally owned electric light and waterworks of New London, Wis., of which Mr. H. C. Sterling is superintendent, is operated under the supervision of a commission, and has recently made a statement covering the period of 15 months ending June 30, 1909, complying with the order of the State Railroad Commission. The electric light plant is credited with gross earnings amounting to $11,887.94. Deducting operating expenses from this has left a net profit of $3,556.98. The waterworks, which is operated by the same force in the same building, is credited with gross earnings amounting to $3,815.60, with expenses of $3,554.31. The commission in its report explains that the loss on the waterworks operation is due to an expenditure of $203.25 in a last attempt to secure a pure water supply; otherwise, a profit of about that amount would have been made. The general balance sheet shows assets in the shape of electric and water plant, etc., of $67,761.03. Bonds outstanding amount to $48,500. It is impossible to entirely separate the electric and water investments. However, taking the report as to the value of the various parts of the plant, it is found that $19,693.93 consists of items which are evidently entirely electric investment, and that $36,059.88 consists of items entirely applying to the water investment. The balance of the investment consists of items so divided between electric and water service that no separation can be made. The striking thing about the report is the fact that the electric gross earnings are about three times the water gross earnings, while the water investment is apparently about double the electric investment. New London has a population between 3000 and 4000.

Campaign for Electric Refrigeration in New Jersey.

By William H. Stuart.

The Public Service Corporation of New Jersey recognizing the value of electric refrigeration in its territory, has instituted a campaign to secure it. While this year the work has not been carried along on any large scale, preparations are being made for an extensive campaign which will open early next year. Throughout the State there are quite a number of large meat and food product warehouses and storage plants. In Jersey City especially there are quite a few, this city being the termini of four or five large trunk line railroads. Newark, Hoboken, Camden, Paterson, Plainfield and Perth Amboy are other cities where there are a number of large refrigerating plants. Besides the business from this source a great many of the large residences scattered throughout suburban New Jersey have small refrigerating plants. Thus the business has been divided into two classes, known as commercial and residential.

About a month ago the Public Service Corporation called a meeting of the power solicitors from all over the State at the home office in Newark. This was for the purpose of giving a special and practical demonstration of an electrical refrigeration plant and ice-making machine in actual operation. Price talk combined with selling points and actual advantages were

brought before the solicitors. Examples of refrigeration plants operated by isolated generating systems which had been abandoned for central-station service and valuable suggestions on introducing central-station service in places where ice, brought from ice dealers, was the means of refrigeration were brought before the solicitors.

The company has made a special rate for this business on the larger plants. For all energy consumed during the summer months a net rate of 3 cents per kw-hour is made. For the balance of the year the rate is increased 1 cent, making the rate 4 cents per kw-hour net. A minimum charge of $1 per horse-power connected per month is made on all installations. This rate is given to all consumers whose equipment is larger than a 1-hp motor. On installations of 1 hp or smaller the consumer is placed on the regular power rate. This schedule has a base rate of 10 cents per kw-hour with liberal discounts that bring it down to 3 cents per kw-hour. The discounts are governed by the maximum demand. It is estimated that for refrigeration equipments of from 1 hp to 20 hp about $7 worth of ammonia is required per year. This does not apply to the ice-making equipment.

Since bringing the matter before the solicitors, quite a few large installations have been fed from central-station service in each of the larger cities. Of the commercial business quite a large-sized load has been acquired. As the season is well advanced at present no elaborate plan for securing all the business possible is used. The solicitors are, however, giving the matter considerable attention. Next year the idea will be to have special literature sent out to every prospect and to follow all inquiries up closely. The present soliciting force will take care of this end of the business. The manufacturers of refrigeration apparatus will all be invited to co-operate in this work. Two of the largest manufacturers have signified their intention of entering the territory with a well-equipped sales force. About January active work will be started on the plans for this work so as to have the situation well in hand.

That this business is profitable is already proved by the installations connected at present. The majority of the installations are in use 10 hours each day, although some of the larger plants operate on a 24-hour basis. This load comes on early in the day and is thrown off just before night. The storage boxes are kept closed all night without undue drop in temperature. An automatic device regulates the apparatus so as to keep an even degree of temperature at all times. While the first cost of an electrical refrigerator is considerable, the owners are satisfied with the saving accomplished over ice cooling. The Public Service Corporation is entirely satisfied with the gain in this business so far this year and looks forward to a greater increase next year.

Benefits Derived from Development of Electric Heating Devices.

By H. W. Hillman.

Without considering most carefully the development and extension of electric heating devices, many may fail to realize the important relation of this particular class of development to other branches of the industry. In the erection of a new home the owner does not now consider whether it will be lighted by electricity or gas, but the question is how many of the convenient outlets and extra receptacles does he require to have a modern house. The miscellaneous electric heating devices have been so extensively introduced that there has been a marked increase in the manufacture and sale of sockets, receptacles, wire, knobs, cleats and other interior wiring devices. The manufacturer has not only gained in this respect, but the wonderful extension of the electric flatiron has been no small factor in promoting the continual demand for steam turbines and increased generator capacity. More and more the equipment of central stations will be taxed by the speedy introduction of the electric flatiron, and the electric manufacturer benefits by the sale of the apparatus. He will still further be benefited, and to a large degree, when the electric light and transmission companies take advantage of the sale of energy for many industrial purposes other than motors and lamps.

After the manufacturer, the lighting and power companies will be benefited from the development and introduction of electric heating devices. A display window and exhibition-room never cease to attract the attention of the people. There is a novelty about electric devices aside from their convenience which people enjoy, and they do not fail to show their appreciation. Therefore, the lighting and power companies are forcibly and valuably advertised in this manner. The income to the central station is gradually increasing to a substantial sum, and as every central-station manager is searching for ways and means of increasing the earnings, the benefit in this respect from the heating branch of the industry is decidedly welcome.

A few years ago no engineer or central-station manager anticipated that a substantial income would be secured from the introduction of flatirons, yet to-day it is an established fact that the income is substantial, and the business is permanent and profitable. Recently, through the aggressiveness and activity of the manufacturers and engineers, the electric toaster has been produced, which is so simple as to attract unusual attention. Its initial cost is low, and it is considered exceedingly durable and practically indestructible. If station managers will now stop to consider what an excellent income-earner this device promises to be, the toaster will be installed in every home where the flatiron is now used. A central-station company recently claimed that 75 per cent of its residence customers are using electric flatirons and within six months every house wired will own and use an iron. The same situation can be brought about with the toaster, and the central station will benefit thereby.

Admitting that the manufacturers and central-station companies profit by the extension of electric heating devices, what about the public? Can it be shown that all three parties interested are benefited? Surely, the public has shared in the benefits to the fullest extent. It wants convenient devices for the home, and appreciates improvements which will save money. The wonderful development of the electric coffee percolator is interesting to relate. Only a few years ago it required 12 to 15 minutes for the device to percolate. One of the first improvements in the design decreased the time required to about 8 to 10 minutes. A new idea was again presented, and four to five minutes was the result of that improvement. Now coffee percolators are being produced which will percolate in 50 seconds. The public always benefits when a saving in time is effected, and experience has given it confidence in electric heating devices. As a consequence, such devices will be more quickly and broadly extended than in the past.

The flatirons, toasters and percolators are emblems of engineering activity and advancement, for which much credit is due, and this credit belongs to the electric heating engineers. The public believes in convenient electric devices. Watch persons while attending electrical shows at Chicago, New York and elsewhere. They gather about the booths which exhibit the electric household utensils. They eagerly ask questions about the vacuum cleaner, and upon return to their homes the central stations receive requests in connection with these popular electric devices. If the people were not benefited then one might expect that they would cease to exhibit an interest. Such is not the case. Every exposition attracts more and more interest.

In the development and extension of electric heating devices the benefits are not confined to a particular class of people. On the contrary, all classes are benefited. The servant girl who irons out on the piazza where it is cool and pleasant work appreciates the electric iron. She tells her friend, who is still using the old method, and time and experience show that servants are now demanding these benefits. The heating branch of the electrical industry is destined to grow to enormous proportions because so many of the miscellaneous devices have been made durable as well as convenient and are sold at popular prices. At no distant date electric cooking and baking outfits will be ready for greater extension and more aggressive attention by all interested.

The writer took a meal recently in a New England home where a 6-lb. roast beef was cooked in an up-to-date kitchen coal stove in one and a half hours, at a cost, approximately, of 6 cents. A day later the same kind of dinner was cooked with an electric outfit and an 8-lb. roast was cooked in one and one-quarter hours, with only 1200 watts of energy at a cost of 6 cents. There was 33 per cent more food product to be cooked and it was cooked more quickly, and at the same cost of coal, also without the bother and inconvenience of ashes, coal and constant attendance.

Why should not the future look bright for electric cooking and baking? Opponents have said that electric stoves are slow and inefficient. Let them now investigate the new heating units which are so vastly superior to the past development as to call forth the heartiest congratulations among the electric heating engineers associated with the art. Electric stove lids consuming only 400 watts or 500 watts, and reaching a satisfactory heat in 17 seconds, represent an advance in the art of heating that will cause the most conservative engineers to admire the progress which is really being made. Notwithstanding that the new unit is highly efficient and wonderfully rapid, it is said to be remarkably durable. The most exhaustive tests have failed to show that the unit is not durable.

A recent visit to the heating department of one of the largest manufacturers has made the writer more enthusiastic than ever on the subject of electric heating devices. Ample evidence is offered to show that the development and extension of this art has been of great benefit to the manufacturers, to the central stations and to the people in general.

INTERIOR WIRING AND ILLUMINATION

Superior (Wis.) Ornamental Street Lighting.

The ornamental street lighting of Superior, Wis., which was described in these columns May 27, is the subject of an appreciative article in the *News-Tribune* of Duluth, which is reprinted below. As there is a strong rivalry between these neighboring cities, the compliment paid to the lighting is an exceptional one.

"HATS OFF TO SUPERIOR.

"The Duluthian who visits Superior at night, or who, looking down from the boulevard after nightfall, sees the fairy land of light below him and notes the brilliant line marking our sister city's chief thoroughfare, must acknowledge that the people across the bay have shown Duluth how.

"Tower Avenue at night is a 'Great White Way.' Its lighting is artistic and fascinating. At each corner, and at regular intervals in each block, is a handsome iron post supporting a cluster of lights. The effect is not only brilliant, but most alluring.

"The avenue is made one long promenade; it is a place where men and women, young folks and old, will delight to take an evening stroll, meeting friends and exchanging greetings. It gives all the pleasure and enjoyment of a night park.

"It is a gorgeous evidence that the spirit of progress is abroad in Superior. That its men are willing to pay good money for the beautiful. That they have not surrendered to Mammon, but are willing to divide with the populace.

"More than this, it is evidence that they have a great pride in their city, and that enterprise will greet enterprise as comrades. It is the sign of a warm welcome to a wide-awake city such as people may be glad to make their homes, and where they may safely invest their capital.

"Duluth has been dallying with a similar project for First Street. If the property owners on that street would visit Tower Avenue, they would not linger longer in well doing. First Street is Duluth's coming business thoroughfare. It needs such an attraction to draw the people, and Duluth needs it to relieve the uncomfortable congestion on Superior Street."

The Mercury-Vapor Lamp in Signs.

A comparatively recent adaptation of the Cooper Hewitt mercury-vapor lamps is in electric sign work. Two examples of this sort are illustrated herewith. In Figs. 1 and 2 the glass sign, "Reuter's Fine Candies," suspended over the sidewalk in front



FIG. 1.—MERCURY-VAPOR LAMP IN SIGN LIGHTING.

of a candy store on Randolph Street, near Dearborn Street, in Chicago, is illuminated by a mercury-vapor lamp tube in a regular holder. The tube is operated on a 115-volt direct-current circuit and takes 3½ amp. It is rated at 700 cp, and it is interesting to note that seven ordinary carbon 16-cp lamps having

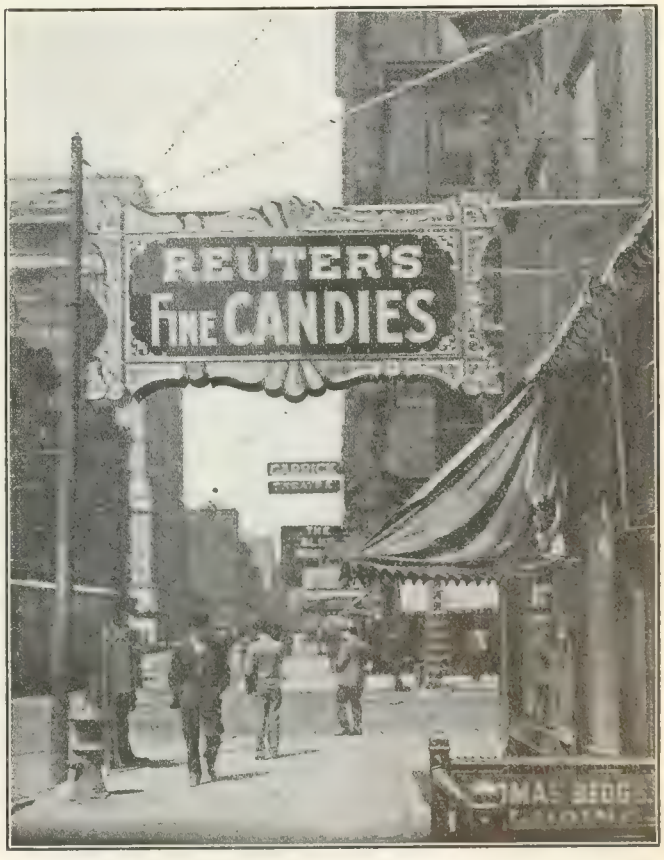


FIG. 2.—MERCURY-VAPOR LAMP IN SIGN LIGHTING.

112 cp would consume the same amount of energy. The tube is wired from the sign to the auxiliary, which is placed within the building. The sign is made of beveled glass decorated in chipped and burnished gold. It is about 5 ft. long and 2 ft.

deep, and consists of two sides about 8 in. apart. The mercury-vapor tube is placed within this space and the greenish-blue light shines through letters of frosted glass, giving an unusual and individual effect. The background of the lettering is of



FIG. 3.—GLASS-BARREL SIGN ILLUMINATED BY MERCURY-VAPOR TUBE PLACED INSIDE.

glass rendered opaque by black enamel so that the light is only seen through the letters in sharp contrast to the background. The mercury-vapor tube is placed in the center of the space, but the light is well distributed and the letters are evenly illuminated.

In Fig. 3 is shown a glass barrel which is illuminated from within by a Cooper Hewitt mercury-vapor lamp of the same size as that used in the Reuter sign. This barrel is suspended in front of a liquor store on Randolph Street, near Clark Street, Chicago, and is a handsome piece of leaded art-glass construction.

The staves of the barrel are reddish brown, while the hoops or bands are black. The lettering on the sides is in white opalescent glass. The head of the barrel, which shows white in the picture, is of "flashed" frosted glass. Formerly the barrel contained 16 16-cp carbon-filament lamps. Electric signs with mercury-vapor lamps have been in use only a few months in Chicago, and owing to the characteristic color of the light they attract considerable attention.

Flaming-Arc Lamps on a Detroit Power House.

Advertising illumination is very effectively employed by the Murphy Power Company, of Detroit, Mich., in the form of a number of flaming-arc lamps disposed about the roof line and smokestack of its power house on the corner of Wayne and Congress streets, in that city. There are 21 Excello flaming-arc lamps on the roof, and four are placed about the square portion of the stack extending above the roof. The roof lamps are placed about 150 ft. above the street, while the lamps on the smokestack are 60 ft. higher up. They are connected five in series on 250-volt, direct-current circuits, and are suspended on brackets extending out 16 ft. on the corners of the building and 12 ft. on the sides between the corners. The lamps are rated at 3000 cp each, and are of the 10-amp type burning 17 hours on one trimming.

It is reported that the Murphy Power Company spent about $5,000 in making this installation of flaming-arc lamps, and that it is very well satisfied with the result attained in making its building conspicuous at night. The installation has been satis-



FIG. 1.—DAY VIEW OF FLAMING-ARC LAMPS ON DETROIT POWER HOUSE.

factory, and has required very little attention. The company before making this arc-lamp illumination considered the advisability of outlining the building in incandescent lamps, but



FIG. 2.—NIGHT VIEW OF FLAMING-ARC LAMPS ON DETROIT POWER HOUSE.

it was calculated that in five years the saving in consumption of electrical energy of the arc lamps compared with the incandescent lamps would be sufficient to pay for the arc-lamp installation.

Advertising Illumination for a Theater.

Situated a little to one side of what has been considered the downtown theater district in Chicago, the American Music Hall, of 440 Wabash Avenue, formerly the Garden Theater,

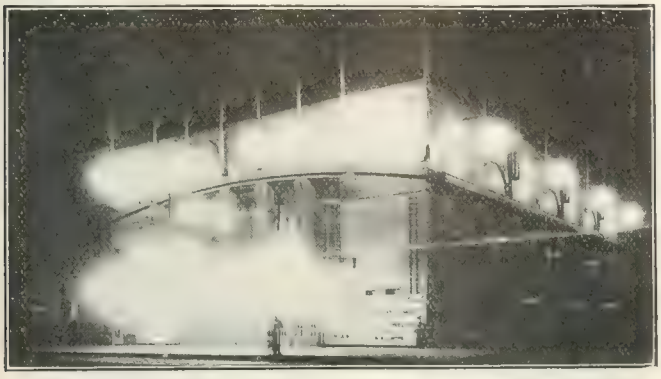


FIG. 1.—FLAMING-ARC LAMPS, AMERICAN MUSIC HALL, CHICAGO.

makes itself conspicuous by 12 Excello flaming-arc lamps of 3000 cp each. Ten of these lamps are suspended from brackets near the roof line of the building, six on the Wabash Avenue side and four on the Peck Place side. Two of the lamps are



FIG. 2.—FLAMING-ARC LAMPS, AMERICAN MUSIC HALL, CHICAGO.

placed under the sidewalk canopy at the Wabash Avenue entrance to the theater. The brightly lighted corner can be seen from a long distance at night.

New Telephone Patents.

HIGH-TENSION LINE GUARD.

Where high-tension lines cross telephone lines, the latter are exposed to the dangers of high voltage crosses unless some special protection be provided. Of course, the normal separation is more than sufficient for safety, but should the wires break the lines might become crossed. To obviate this danger

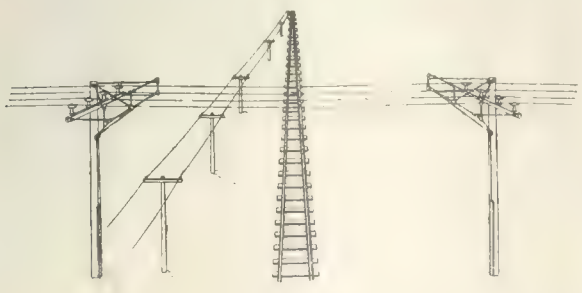


FIG. 1.—ELLIOTT GUARD FOR WIRES.

many sorts of cradles and guards have been tried, and Mr. C. J. Elliott, of Oxnard, Cal., has obtained a patent for one type of guard. This is shown in Fig. 1, and comprises a heavy conducting and grounded cage mounted on the high-tension pole. If the wires part in the exposed span, if they sag down, the contact with the grounded frame causes the wire end to burn off and fall to the ground.

GROUP-EXCHANGE SYSTEM.

To save the wire plant, it has been suggested to associate a group of neighboring subscribers upon automatic switches distant from the central office, trunk wires being extended to the latter. It is with such a system that the patent of Mr. D. W. May, of Kansas City, Mo., is concerned. He uses three-wire trunks to the switch point, the automatic switches being arranged to select automatically the first non-busy trunk for an originating call, and, under the control of the central-office operator, to select any local station for an incoming call. As soon as a selection of trunk or line is made, the signals are given as though the connected station were on a direct line from the exchange.

NEW APPARATUS.

Mr. F. R. McBerty, of New York City, has patented a type of single-contact relay wherein the plane of the armature is parallel to the core axis. An end view is shown in Fig. 2,

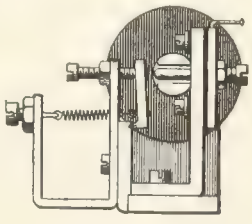


FIG. 2.—M'BERTY RELAY.

from which the arrangement will be understood. The Western Electric Company has obtained the patent by assignment.

A transmitter is the subject of a patent granted to Mr. F. Gottschalk, of New York City. The novelty lies in a cup-piece mounted upon the center of the diaphragm and so registering with the mouthpieces as to concentrate the mechanical effect of all received sound at that point.

A wall-set cabinet has been designed and patented by Mr. A. Larsson, of Buffalo, N. Y. This is of sheet steel following the generally approved shape of common-battery shelf sets, but having an extension below the shelf adapted to enclose two dry cells.

Letters to the Editors.

Depreciation.

To the Editors of Electrical World:

Sirs:—When we see the results of the operations of certain electric corporations, as well as municipal plants, and note their financial condition, it is very evident that proper attention has not been given to the matter of depreciation, and that too much money has been taken out of the plant for dividends or otherwise or else that sufficient income has not been received to warrant the proper charges to the depreciation account. During my connection with the Salem (Mass.) Electric Lighting Company many changes have taken place through replacement of out-of-date apparatus and I have had an opportunity of seeing the necessity of taking care of these charges out of earnings, where they properly belong. In a way, it makes no difference to the public whether these earnings are used for renewals of apparatus at the time the change is made or whether higher rates have to be paid for energy on account of interest charges on greater plant accounts, the result of failure to charge proper amounts for depreciation in the years past.

There are two ways of looking at this matter: One is whether a corporation shall always apparently be poor, with consequent impairment of service; the other is whether it shall have foreseen the future by keeping down to a proper level the plant valuation and thereby appearing to be wealthier in consequence and better able to supply high-grade service.

I am afraid that there are too few companies that realize the advantage of and that do make a true inventory of their property. Failure to do so means ignorance of the true value of the assets. If this should be a State or Government requirement—and the writer is very much in favor of State supervision where business-like and practical—it would be to the benefit of the corporation as well as to its stockholders to require plant conditions to be kept up and excessive capitalization to be kept down. Excessive capitalization must be determined to the interests of the public and to the corporation, both as a purveyor of public service and as a safe and sure investment for the public. It seems to me that no better example of this very idea can be found than by referring to the conditions of electric lighting companies in Massachusetts. Most of these companies show, where it is possible to make a living, excellent results, but there are, no doubt, instances where electric lighting companies show very meager returns on the capital invested and ought never to have been started. I cannot help feeling that the matter of depreciation enters most seriously into the operation of every electric lighting plant.

Salem, Mass. S. Fred Smith.

A Purchasing Agent's View of the Jobber.

To the Editors of Electrical World:

Sirs:—Your editorial in the issue of July 29, entitled "The Electrical Contractors' Convention," strikes a right chord. It has been said, by a man prominent in matters electrical, that any one who styles himself "a jobber" is so accepted by the Jobbers' Association even though he has but a miniature office with a "5-ft. shelf" of catalogs and a lady typewriter, whereupon he can obtain jobbers' prices and sell to the big contractor and to the still bigger consumer—the central station.

Another phase is the opening of a "supply store" (often not larger than the office of the above-mentioned jobber) by a small illuminating company, to which are then granted jobbers' prices. Some of the largest consumers have no supply stores, but buy very much larger quantities than those who possess such outlets for the sale of accumulations of short lengths of wire and broken package goods or of odds and ends which go out at a good profit; but the big central stations prefer to confine themselves to sticking to their legitimate line—that of generating and selling electrical energy.

In answer to the query, What does the jobber do for the manufacturer, it may be replied that he does for him as much as possible. He prints a catalog replete with lots of illustrations and takes the customers' orders for *everything,* but creates no demand. If, unfortunately, he is too small to have an individual catalog, he proceeds to get busy with a rubber and erases the name of the compiler from the top of each page and rubber-stamps his own instead; or perhaps makes up "a neat scrap book" with clippings from others' catalogs, and thus fortified sallies forth as a jobber to take orders.

Manufacturers know that to get their goods directly into the hands of the big buyer means missionary work on their own part, but missionary work becomes tiresome and unprofitable if done merely to enable the jobber to take orders. Selling to big consumers is less expensive, less uncertain of results and of payment and more satisfactory in that the manufacturer knows his goods are being used, and can follow up complaints, look after the consumer in general for future business and increased orders.

Jobbers have been known to jump from one manufacturer to another for the slightest discount. They naturally prefer to sell that class of material which pays the best profit. The consumer will listen to the manufacturer's representative regarding quality and method of manufacture as he knows him to be posted, the result being that he receives the big consumer's order at a price satisfactory to the latter and secures a steady customer. A visitor to the writer illustrated the situation by employing a Spanish proverb, translating it into the vernacular: "Show me your order and I will show you my price"; and the big buyer may rest assured that so long as he buys only from manufacturers, he will be kept in touch with the market and know the different grades of material. You say "Competition among manufacturers will regulate matters," and "it is right that it should;" also "That quantity governs price," therefore, why should not the buyer who purchases big quantities be granted big discounts without the bugaboo of the Jobbers' Association interfering?

Detroit, Mich. H. L. Jackson.

Safety Service Box for Induction Motors.

To the Editors of Electrical World:

Sirs:—The writer is very much interested in the article in your issue of Aug. 12 by Mr. Robert J. Young on "Electrical Accidents Around Machinery and Their Prevention," which has the merit of novelty. We have plenty of Underwriters' rules and regulations for the protection of property, but the human being seems to have been left to look out for himself.

For some years it has been the writer's duty to secure adequate and fool-proof electrical machinery for severe service in coke-oven and chemical plants, and the lack of safety appliances on the market has been found very marked, though the alternating current is now so prevalent, with its higher voltages and consequent greater danger to life.

It is no uncommon thing to find 20,000-volt line wires run down a side wall of some small substation, from the lightning arresters to the transformers, bare, or very inadequately covered with insulation, and a continual menace to the station attendant or some ignorant helper who may be employed to clean up around the apparatus, or some carpenter making repairs. As to danger from shocks due to grounds, usually, in the case of large industrial systems operating motors in wet and inaccessible places, the circuits are grounded, and, of course, it is only necessary for some careless person to touch accidentally an exposed live contact to receive a shock that may be fatal on even such a low voltage as 440. Skilled electricians are not in so much danger as are the ignorant helpers and laborers; the electrician knows what to expect from an apparently innocent-looking wire or terminal, but the non-technical man may accidentally or unconsciously make a contact, particularly if the motor is idle and the machinery driven by it is shut down.

It is right here that I wish to call attention to the universal practice of supplying induction motors of all voltages with the open type of fuse panel, with the terminals and metal ends of the enclosed fuses always alive—a relic of the early days when voltages were low, and now continued on not only 440-volt motors, but also, I am told, on motors of 6600 volts right in New York and Brooklyn power houses. These exposed fuse panels are a serious menace; the terminals are alive whether the motor is running or not, in the majority of cases, where the starting compensator is used without an extra line switch to cut off the current. Most persons on seeing that a motor is not running are not so careful around the wiring and fuses, thinking, if at all, that the current is off.

I wish to cite one instance of fatal shock resulting from the comparatively low voltage of 440 volts, 60 cycles, directly due to this condition. A machinist took opportunity to work at night when the motor was idle in order to erect a shield over the machine to keep off water, and being tired with his long day's work rested himself by leaning one hand on the slate fuse panel that belonged to the idle motor. He received a fatal shock from the 440-volt current, and his hand gripped the support so hard that his helper could not detach him; there was no way of shutting off current except from the power house, a quarter of a mile away, and by the time that help had arrived, and the man was pulled away from the terminal, he was beyond recovery. Now this motor was not running, the starter having cut off the current, but the line, fuse and compensator terminals were fully alive and there were no means at hand to render them quickly and safely dead.

The writer then took up with many of the concerns all over

the country the question of securing a safety type of induction-motor service box that would prevent such accidents. The ordinary cast-iron box with removable fuses would not answer because there was no way of by-passing the starting current of the motor around the fuses to allow the use of proper sizes of fuses to protect under running conditions. No company could furnish such apparatus from anything that it had previously built, and the writer then developed and patented a type of service box for induction motors of all voltages having the following desirable features not previously to be found in apparatus on the market:

1. A service box that would by-pass the starting current of the motor.

2. That would remain closed to the entrance of dirt, foreign matter or moisture, whether the contacts of the same were in the open or closed condition. (All present boxes are wide open when they interrupt the circuit.)

3. That could not be opened or tampered with by any but the authorized attendant, and yet that could be used to open the circuit in case of need by anyone.

4. That, once opened, could not be closed again until the proper attendant had investigated the trouble and taken his precautions.

Some such safety appliance should be required by wiring rules just as much as any fire-protective device, as the present fuse panels supplied with motors of all voltages are a constant menace to life of non-technical laborers, helpers and workmen.

Syracuse, N. Y. H. Walter Sykes.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Triple-Frequency Currents in Neutrals of Three-Phase Star-Connected Alternators.—E. W. Marchant and J. K. Catterson-Smith.—The authors show how triple-frequency currents arise in the neutrals of three-phase, star-connected alternators. The effects (increased heating, wrong indications of power-factor meters) produced by such currents are considered, and finally means are indicated for rendering these effects negligible. The authors think that alternators running in parallel should have their neutrals earthed and that choking coils between the neutral points of each machine and earth are the best means of preventing triple-frequency currents.—Lond. *Electrician,* Aug. 6.

Direct-Current Turbo-Dynamos.—E. Ziehl.—The conclusion of his long illustrated article on direct-current turbo-dynamos. He now gives details of the best construction of the brushes and brush holders to insure sparkless commutation. Means are also discussed for reducing the troublesome noise of turbo-generators. It is usual in Germany to enclose all turbo-dynamos, although this necessitates artificial ventilation and reduces the efficiency of the machine.—*Elek. Zeit.,* Aug. 5.

Lamps and Lighting.

Street Lighting.—L. Bloch.—The first part of an illustrated review of recent progress in street lighting. The first installment deals with progress in gas lighting, and discusses the Lukas lamp, upright compressed gas lamps and inverted gas lamps. Some data are given on gas lighting in several streets of Berlin; in one of them the horizontal illumination at the height of 1.5 m above the ground was measured at different points between inverted compressed gas lamps and was found to be between 0.99 and 1.9 lux. The ratio of both figures is 52, which indicates a considerable lack of uniformity of illumination. The mean horizontal illumination of the whole streets is 18 lux, which is rather high for German conditions, although the same mean value is reached in the illumination of various places in Berlin by means of flame-arc lamps.—*Elek. Zeit.,* July 29.

Street Lighting.—L. Bloch.—A continuation of his serial on progress in street lighting. In the present installment the author deals with electric street lighting, and discusses the introduction of Nernst lamps, tantalum lamps and tungsten lamps for these purposes. The disadvantages of metallic-filament lamps at present are their high price and their sensitiveness with respect to vibration. For the present a voltage of 110 is far preferable to 220. The tungsten lamp now also begins to compete with smaller types of arc lamps, tungsten lamps being made for 200 cp to 400 cp, consuming 1.1 watts per candle. For this high candle-power 110-volt lamps are just as good as 220-volt lamps, with respect to price and durability. With respect to the total cost of current, renewal of lamps and attendance, these lamps can successfully compete with arc lamps with pure carbons for smaller currents. Though they are less brilliant and, therefore, less effective than arc lamps, they have the great advantage that they need not be cleaned. Graphitized carbon lamps are also being used in Europe. The author makes some remarks on series connection and parallel connection of incandescent lamps; the parallel connection is almost universally used in Europe. With respect to arc lamps he mentions that enclosed arc lamps have not by any means found as much favor in Europe as in the United States. In Europe the chief importance appears to be laid on a light source of high efficiency and on good illumination of the streets and much less on the cost of attendance. The magnetite arc lamp has not been introduced in Europe. The mercury-vapor lamp in the form of the new quartz-type lamp is in its external form quite similar to an arc lamp, and is useful for lighting streets in which the objectionable green color of the light is of no importance—for instance, freight stations, docks, storehouses, etc. The manufacture of quartz lamps has recently been taken up by several large arc-lamp factories. Finally, the development of the "intensive-flame arc lamp" is described. In its early history the gases evolved from the impregnated carbons caused many troubles. They are liable to destroy the regulating mechanism of the lamp and to have a corrosive effect on the glass globes. It is, therefore, of great importance to remove these gases as quickly as possible. An arrangement for this purpose is shown in Fig. 1. Air is introduced from the outside at the bottom of

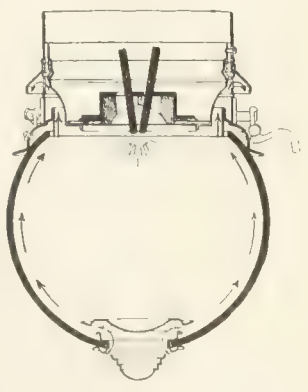


FIG. 1.—ARRANGEMENT FOR REMOVING GASES.

the globe and then passes in the globe, along the inner surface, in the direction of the arrows, preventing a contact of the gases from the arc with the globe. Immediately above the globe the air leaves the globe again and takes the obnoxious arc gases away by means of suction, so that these gases cannot have an unfavorable effect on the globe and the regulating mechanism. Formerly a glass globe was practically destroyed by such corrosion within six or eight weeks, while with a proper ventilation the globes are now still in good condition

after a year. To prevent corrosion still further, the globes when cleaned are suitably rubbed on the inside with a mixture of kerosene and paraffin oil. Formerly cleaning by means of diluted acids was employed, but this has not proved successful, and is, moreover, very inconvenient.—*Elek. Zeit.*, Aug. 5.

Physiological Effects in Illumination.—An editorial referring to the fact that metallic-filament lamps with clear globes are now often used and directly fitted in the old shades for the carbon lamps, which were made for very much smaller lamps. The result is that a metallic filament is left generally quite unobscured and its intrinsic brightness has a painful effect on the sensitive eye. Frosted lamps should be more generally adopted. Reference is made to the recent article by S. W. Ashe in *Electrical World*, and a former investigation by Broca and Laporte on visual acuity for different colors.—Lond. *Electrician*, July 30.

Stage Lighting.—V. Paetow.—An illustrated description of a new system of stage lighting. It is an indirect lighting system operated by arc lamps so as to produce diffused light similar to daylight.—*Elek. Zeit.*, July 29 and Aug. 5.

Generation, Transmission and Distribution.

Textile Mills.—H. W. Wilson.—A paper read before the (British) Inst. Mech. Eng., reviewing the arguments for and against the use of electrical transmission as the method of conveying power to the various departments of a textile factory. The main differences of opinions among engineers designing the lay-out of electrically equipped mills arises over the question of group or individual driving. The author is in favor of the individual driving of ring spinning frames and the group driving of all other machines, but keeping the groups fairly small. The mere substitution, as in some factories, of a large motor for the rope pulley on a line shaft can hardly be regarded as the final step in the adaptation of an electrical installation to suit textile manufacturing needs. A point needing attention is the heating effect of the motors. It is now the best practice to build motors for a ring spinning-room with hollow frames, and to bring cooling air from some external source round the frames, thus preventing the discharge of heat to the room. A few notes are given at the end on the horse-power required by different machines.—Lond. *Electrician*, July 30.

Railway Generating Station.—A fully illustrated description of the new power house and the outlying substations of the Coney Island & Brooklyn Railroad. This company, during the past two years, has completely reconstructed its power generation and distribution system, replacing 19 direct-current units in three power stations with two 3500-kw turbo-generators delivering 11,000-volt alternating current, which is transformed in three substations to 600-volt direct current for feeding to the trolley.—*Elec. Rail. Jour.*, Aug. 4.

Boilers.—J. Izart.—An article on the maintenance of boilers for central stations. The importance of purifying the water for the reduction of fuel consumption is pointed out, and notes are given on the purification of boiler waters and the regular cleaning of boilers at intervals, emphasizing the necessity of not only internal but also external cleaning.—*L'Industrie Elec.*, July 10.

Operation of Bessemer Converter Plant.—F. Hartig.—The conclusion of his illustrated description of the electrically operated blowing system for the converters in the Peine rolling mills, giving results of tests, ec.—*Elek. Zeit.*, July 29.

Traction.

Single-Phase Versus Direct-Current Traction.—F. Eichberg.—A reply to the criticism of H. F. Parshall, which formed part of a discussion of Murray's paper on the New Haven electrification. The present author endeavors to show that the reasons why Parshall prefers direct current are wrong. On the basis of several years' experience, he claims that the cost of maintenance and the certainty and safety of operation are at least equal with the alternating-current system to anything that has so far been obtained with an equivalent direct-current equipment. "It is quite impossible to compare the results of American railways, where combined alternating-current and continuous-current equipments are generally adopted, with the results obtained on European lines. The combined system must be incomplete and unsatisfactory, because the number of parts and the complications are more than double those of a simple single-phase system, and the consequent cost of maintenance and up-keep must be much greater. European engineers have never recommended the use of the combined system." Lines which are purely urban, such as the underground railways in London and New York, may work best with continuous current or with single-phase currents. Every such case must be considered by itself. Suburban railways (Stadt-und Vorortbahnen) and long-distance lines can only be equipped economically and with certainty of safe operation with alternating current. The overhead-conductor system is the only one permissible in connection with main-line railway electrification. Complicated switch yards and freight yards cannot be equipped with the third-rail. The third-rail increases the cost of maintenance of the permanent way and renders it much more difficult. The overhead-conductor system is far better from a mechanical point of view and much safer than the third-rail. The total cost, including the power station and distribution, as well as the motor equipment, is much cheaper for single-phase than for direct-current, and the general over-all efficiency is greater with alternating current than with direct current. As to the development of the modern single-phase system, it is pointed out that, "for example, the Hamburg car is better in its mechanical details than any existing direct-current car, and the catenary overhead construction is 10 times better from a purely mechanican standpoint than the third-rail."—*Elec. Rail. Jour.*, Aug. 7.

Electric Drive and Marine Propulsion.—A. J. Maginnis.—In a paper on the advance of marine engineering in the early twentieth century, the author discusses the direct electric drive for propellers as follows: The fact that the coming power for marine propulsion must be directly rotary coupled with the success of the steam turbine has brought forward another system, which, in the author's opinion, will soon be widely adopted—namely, the application of electric power direct to the propeller shaft. The advantages likely to accrue from the adoption of direct electrical shaft drive are: (1) Reversal of the propeller with full effective power is attained and readily effected. (2) The design of both the steam and electric plant can be so modified as to enable the naval architect to make better and more profitable arrangements for both passenger and cargo space. (3) The movements of the propellers can be controlled direct from the bridge. (4) Electricity, like steam, is capable of being readily applied to all the other requirements of shipboard, such as steering, windlass and winch work, with more economical distribution. It is not proposed to use electric drive on fast vessels (naval or mercantile), where the turbine has been so successful, but to apply it to the slower-going cargo tramps, as if the promises now put forward are carried out it will present the most simple means of obtaining rotary motion slow enough to apply to the ordinary screw propeller working at from 70 r.p.m. to 120 r.p.m. "Should this system of main electric drive come about, it may be safely said that a new era of electric navigation is about to dawn, and one promising great results. For instance, the continued decrease in the boiler pressures as commenced with the steam-turbine machinery will, no doubt, be further continued, and even lower pressures than now exist will be made use of, which will largely decrease the weight of boiler installations and so cheapen the first cost. Through the fact of the greater portion of the machinery being electrical, other than mechanical, the heavy weights of such moving parts as pistons, piston and connecting rods, valves, etc., will be done away with, and so render the outfit and overhauling of the electric boat more simple and more easily effected than on the steam-propelled craft at present in use."—Lond. *Electrician*, Aug. 6.

Installations, Systems and Appliances.

Electric Lighting and Central Stations.—K. Hahn.—If the electric lamp shall replace the kerosene lamp in comparatively small residences, this can be accomplished only by low-candle

power metallic-filament lamps. If for the lighting of a residence seven incandescent lamps, each of 18 watts, and four incandescent lamps, each of 6 watts, are to be used in a flat, the total consumption is 150 watts, and if 400 hours of burning are assumed the yearly consumption is 60 kw-hours. If a rate of 10 cents per kw-hour is assumed, the yearly cost for current is $6, the cost for the renewal of lamps $2.50 and the cost for the measurement of the current also $2.50. Hence the total is $11 per year. This is by no means higher than the cost of illumination by means of kerosene lamps. The author does not believe that lamp manufacturers will succeed in making economical and durable low-candle-power lamps for relatively high voltages. He, therefore, concludes that central stations will have to reduce the voltage of distribution. In alternating-current plants small transformers for reducing the voltage may be employed, but even in such stations a general reduction of the voltage is recommended for most cases, with separation of the large motors from the lighting network. For new plants it is recommended to employ a 2×55-volt network. The author then discusses the question whether it is preferable to measure the current or to employ a flat rate. With the types of meters now on the market it is difficult to measure the small quantities of energy which are here to be taken into consideration, and in many cases the measuring of the current will be more expensive than its generation. The writer, therefore, advocates the flat rate. In order to prevent the excessive use of current or unnecessary long connection of lamps to the networks, he advises the use of fittings which are provided with a counting device which always counts one more number, whenever the lamp is removed from the volts to be replaced by another one.—*Elek. Zeit.,* July 29.

Adelaide.—An illustrated description of the undertaking of the Adelaide Electric Supply Company in Port Adelaide, Australia. The system of distribution within the city is the three-wire, continuous-current system with a pressure of 400 volts between the outers, and the suburban portions supply by means of single-phase alternating current. The present direct-current installation consists of two 200-kw steam generators, one 850-kw turbo-generator and two 750-kw steam generators. Two 100-kw steam balancers and one 30-kw motor balancer are also installed. In the suburban single-phase distribution system concentric feeders at 2000 volts are run underground, on the solid system, to a number of transformer substations placed beneath the pavements. Secondary distribution on the three-wire system with 400 volts between the outers is carried out entirely above ground by means of bare, hard-drawn copper cables, supported on poles.—Lond. *Elec. Review,* Aug. 6.

German Central Station.—Roentsch.—A description of the municipal central station of the sity of Lehe, in the Province of Hanover, in Prussia. There are three steam engines, two of 150 hp to 200 hp each and the third of 330 hp to 440 hp. These are directly coupled with three shunt dynamos. Since they are used both for lighting and for traction, the voltage can be regulated in the limits of from 440 to 550 $\pm$ 6 per cent. For charging the storage battery a 60-kw booster is used, the voltage being adjustable from 50 to 300 with a number of 350 r.p.m. to 650 r.p.m. The booster is provided with interpoles and also with a compensating winding. The storage battery has a capacity of 648 amp-hours.—*Elek. Anz.,* July 22.

London.—The annual report of F. Sumner, the engineer to the City of London Corporation, deals, among other things, with street lighting and overhead wires. There are now 398 "open" arcs in the city of London, costing $130 per lamp per annum, and, in addition, 34 flame arcs and 18 enclosed arcs, all of which are used in connection with the experimental lighting. The number of private owners of overhead wires is now 137 and the number of companies 23, there being now a total of 733,828 spans.—Lond. *Elec. Eng'ing,* July 29.

Speed Regulation of Direct-Current Motors.—A note on a recent British patent of the British Thomson-Houston Company and E. Garton (14,700, 1908; July 29, 1909). The inventors describe means for keeping the speed constant with varying line pressure. A centrifugal governor driven from the motor shaft controls a contact, which, by means of a differentially wound relay, intermittently short-circuits a resistance in the shunt-field circuit of the motor. At normal speeds the resistance remains in the shunt-field circuit, but should the speed rise, a coil of the relay is energized and an armature moves, causing the resistance to be short-circuited. When the speed has fallen, the contact is broken and the resistance reinserted.—Lond. *Elec. Eng'ing,* Aug. 5.

Electrophysics and Magnetism.

Potential Drop at Surfaces of Glowing Carbon.—J. A. Pollock, A. B. B. Ranclaud and E. P. Norman.—Owing to the projection of ions by hot substances, a discontinuity of potential will occur at the surfaces of the electrodes in any circuit in which these latter are formed of heated materials. In a circuit with one heated electrode in air at ordinary pressure, the projection of ions from the hot surface necessitates the establishment of a potential difference between the electrodes if the current in the circuit is to be zero. The author has determined experimentally the potential differences for zero current as function of the temperature, the result being given in a diagram. In all cases the hot carbon was positive to the cooler electrode for zero current. On the basis of these results he deduces that the velocity with which electrons are projected from glowing carbon varies from 1.5×10^8 cm per second at 3375 deg. absolute to 2.5×10^8 cm per second at 3690 deg. absolute. In a similar way, a lower limit to the velocity with which electrons are projected from the Nernst filament is calculated at 3×10^7 cm per second.—*Phil. Mag.,* August.

Low-Temperature Experiments in Magnetism.—G. Gray and H. Higgins.—An abstract of a paper read before the Royal Society of Edinburgh. A description is given of experiments carried out on steel wire, special hard steel and manganese steel by alternate cooling with liquid air and warming. The experiments resemble those of Dewar and Fleming, except that the specimens were magnetized at the temperature of liquid air, and the results are very striking. Various experiments were made especially with manganese steel.—Lond. *Electrician,* July 30.

Electrochemistry and Batteries.

A Transition Point in Zinc Amalgam.—H. S. Carhart.—A paper read before the Physical Society of London. The paper gave the preliminary results of an investigation which has for its primary object the determination of the heat of dilution of zinc amalgams. This heat of dilution is negative—that is, the dilution of zinc amalgam by the addition of mercury absorbs heat. The method employed was electrical, by means of a concentration cell, the only difference between the two legs of the cell of H-form being in the concentration of the amalgam composing the electrodes. The ratio of the zinc to the mercury, expressed as a percentage, was in every case twice as great in one leg of the cell as in the other. This relation was secured by weighing out pure mercury in two portions, as one to two, and depositing in them the same quantity of zinc electrolytically by connecting the two in series with anodes of pure zinc, and both in series with a silver conductor. The operation was conducted in an atmosphere of hydrogen, and the concentration cell was exhausted of air and filled with hydrogen to avoid oxidation. Such a concentration cell is reversible and the Gibbs-Helmholtz equation applies to it. By measuring the e.m.f. at a known temperature and by determining the temperature coefficient of the e.m.f., the equation gives the heat of dilution in passing from no concentration to one-half. At a concentration of 2.3 per cent there is an abrupt change, which, according to the author, indicates a transition point in the zinc amalgam.—Lond. *Electrician,* July 23.

Resistors for Heating.—A note on a recent British patent (6106, 1909; July 29, 1909) of G. Cooper and F. C. Sharp, for resistance elements, particularly adapted for heating and cooking apparatus, and consisting of a thin metal strip wound spirally on a porcelain bobbin, the turns being insulated from each other by asbestos tape, also wound spirally. The width of the tape may also be less than the width of the metal strip.

so that the radiation at the edges may be increased.—Lond. *Elec. Eng'ing,* Aug. 5.

Units, Measurements and Instruments.

Temperature Errors in Shunted Ammeters.—Various communications by E. F. Moy, C. H. Wright, K. Edgcumbe and others with respect to the recent article by Fennell on temperature errors in shunted ammeters. Moy thinks that the material used for resistance strips in the shunt should be carefully selected so as to prevent the production of thermo-e.m.fs. He advises the use of manganin, which does not form a thermocouple with brass or gun metal, and which is besides quite suitable on account of its low temperature coefficient of resistance. Fennell thinks, however, that the high heating of the shunt at one end was not thermo-electric, but due to a bad contact. Edgcumbe describes a simple arrangement by which thermo troubles can be avoided in shunts. The arrangement is shown in Fig. 2, where *CC* are the end blocks, *D* the shunt strip, and

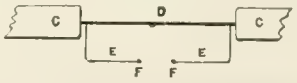


FIG. 2.—DIAGRAM OF ARRANGEMENT.

EE the two strips or wires of the same material as *D*. Into the ends *FF* of these the connections leading to the instrument are either soldered or clamped. Whatever the temperature difference between the two ends of *D* (on which alone the error depends) the points *FF* will both be practically the same temperature, and since the circuit *FEDEF* is composed throughout of the same material, the resulting e.m.f. will be dependent solely on the difference of temperature between the points *FF* and will consequently be zero, so that the ammeter remains unaffected. While, theoretically, the wires *EE* should be attached direct to *D*, the error introduced by fixing *E* into the block *C* instead of to *D* direct is extremely small, since, in the first place, *C* and *D* will not differ much in temperaure, and, in the second, the difference, whatever it may be, is very largely compensated by the similar difference which exists at the other end of the shunt. It is, moreover, immaterial whether the shunt consists of one strip, as shown in the figure, or of several. In a switchboard instrument no compensation is, as a rule, found necessary, owing to the extreme smallness of the e.m.fs. produced. For many purposes, however, such as portable instruments, where the contact surface is often deficient owing to the cables used, and still more for potentiometer work, where the e.m.fs. to be measured are frequently very small, such thermo-e.m.fs. are of considerable importance and have to be eliminated. Two courses are open, one being to use manganin for the shunts and the other to adopt the simple method of compensation described above.—Lond. *Electrical Review,* July 9, 16 and 23.

Photometry of Differently Colored Lights.—Various communications with reference to the paper by L. Wild, abstracted recently in the Digest. L. Lauriol refers to tests made by himself when comparing a Nernst lamp and an ordinary carbon lamp: (1) With the same photometer, when the distance of both lamps from the screen was varied, the relative value of one lamp to the other varied 20 per cent. (2) With the same distance, and with the flicker photometer, the relative value also varied 20 per cent according to the method of using the photometer: (a) with the disk moving at about 10 to 15 revolutions per second and the photometer really acting as a flicker photometer; (b) with the disk at rest, and the photometer acting without flicker, like any photometer of the equality of brightness type. J. Abady (inventor of a flicker photometer) does not find anything in Wild's figures in the nature of a proof that for testing tungsten lamps the flicker photometers will have to be discarded in favor of the Bunsen disk. "Those of us who have studied the question know perfectly well that photometer heads constructed on the contrast or equality-of-brightness principle will give different results from the flicker photometer, and this is on account of the color difficulty." L. W. Wild replies that the reason why he prefers to go by the results of a Bunsen or a Lummer photometer rather than the flicker photometer is that with the former the conditions are nearer to those of practical illumination. He also offers a physiological explanation why the flicker photometer gives incorrect results.—Lond. *Electrician,* July 30 and Aug. 6.

Unit of Candle-Power.—C. C. Paterson.—His paper read before the Physical Society, of London, on the proposed new international unit of candle-power. An abstract of this paper has already been noticed in the Digest.—*Phil. Mag.,* August.

Telegraphy, Telephony and Signals.

Egnér Holmström Telephone Apparatus.—Some notes on recent progress made in long-distance telephony by two Swedish telephone engineers, Egnér and Holmströmer. The essential principle of their system is the use of a special microphone capable of standing greater current strength than usual, as this increases the distance over which telephonic conversation can be carried on. The experiments carried on in Sweden have given the following results as to the respective capacity of the ordinary Swedish State telephone apparatus and that of the Egnér-Holmström type:

	Longest distance in kilometers with ordinary State telephone apparatus.	Conversations carried on through the new apparatus over the following distances in kilometers.
With 3-millimeter copper-wire line	1000 to 1200	2000
With 4.5-millimeter copper-wire line	1800 to 2000	4000
With 3-millimeter iron-wire line	180 to 200	400

In all these experiments the microphone current used for the new apparatus was from 1 amp to 1.25 amp.—Lond. *Engineering,* July 16.

Submarine Telegraphy.—S. G. Brown.—An illustrated paper read before the Royal Institution, in London, on the fundamental principles of modern submarine telegraphy. The author explains the time rate of signaling as determined by the K. R. law, gives data on the resistance and capacity, etc., of various cables, discusses the attenuation in a cable, and the method of duplex working, and then describes receiving and transmitting instruments, dealing especially with the progress made by the invention of the drum-cable relay and the magnetic shunt. He finally gives some notes on experiments made in 1908 with his high-speed system of working. With the new method, using a special relay, traffic has been carried continuously duplex at 230 to 240 letters per minute. "The principle of operation is as follows: When a submarine cable is forced beyond its normal speed of working the quick-changing signals, such as make up the letter C, are the first to fail, or, in other words, do not arrive with sufficient strength to work the receiver. It was found on trial that allowing more of the current from the cable to flow through the receiver—say, by increasing the size of the receiving condenser—the first and last signal of a series of reversals could be obtained with sufficient strength to work the relay efficiently. The relay, once started, is arranged to bring in fresh energy from its local battery, through a special retarding circuit, to add to the strength of the quick-changing currents on its own coil and thus the reversals are made strong enough to give a good record, which without this aid they would have been unable to do. By these means weak signals are built up at the receiving end of the cable, and the speed of working can be thus materially increased. It is fortunate that the class of signals that has the greatest difficulty in getting through the cable is the easiest to be added to when received. The "high-speed" relay works, therefore, not from the signals received from the cable only, but also from those that it transmits through its own local circuit, the record that it makes being the combined action of the two."—Lond. *Electrician,* July 30 and Aug. 6.

Transmitting Photographs and Drawings into the Distance.—L. Semat.—A paper presented before the French Academy of Sciences on the "Teleautocopist" of L. Semat, made by F. Ducretet and E. Roger, in Paris. The object is to transmit writings, photographs and drawings over a transmitting line without the use of selenium or photographic apparatus. There

are two revolving rolls, one at the transmitting end and the other at the receiving end. Both are of different diameter, but if the transmitted picture shall have the same size as the original picture, both rolls have the same length. On the smaller roll of the transmitting apparatus a metallic film is wound on which the picture to be transmitted is imprinted, or inserted in some other way, so that the picture covers the whole surface of the cylinder. The black lines of the drawing are electric insulators. A stylus touches on the cylinder and closes the circuit whenever it is in contact with the metallic film. The circuit is opened when the stylus gets in contact with the insulating black lines of the drawing. The roll on the receiving station has a larger diameter, and on it is wound a sheet of carbon paper and above it a sheet of ordinary paper. If the surface of the smaller cylinder is seven-eighths of the surface of the larger one, the reproduced picture on the larger cylinder will cover only seven-eighths of its surface. The speeds of the two rolls are in the reverse ratio of the surfaces—that is, the small

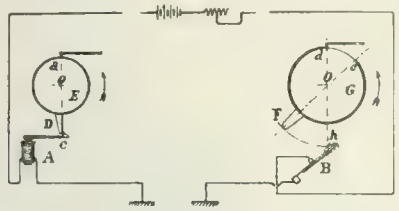


FIG. 3.—DIAGRAM OF CONNECTIONS.

roll completes a full revolution within seven-eighths of the time of the revolution of the larger roll. Moreover, the small roll, whenever it has completed a revolution, stops to revolve. It begins to revolve again only after the larger roll has completed its revolution. If a picture is to be reproduced in larger or smaller size the dimensions of the rolls must be correspondingly changed. The apparatus can be connected to ordinary telegraphic or telephonic lines, requiring no skilled labor The connections for producing synchronism are shown in Fig 3. The left side shows the transmitting station and the right side the receiving station. The electromagnet *A* attracts the armature, which arrests the pin *D* of the roll *E* as long as the electromagnet is excited. In the receiving station the interrupter *B* breaks the circuit whenever the pin *F* (inserted on the roll *G*) makes contact with *B*. The diameter of *E* is smaller than that of *G*. The angular speed of *E* is higher than that of *G*, so that the smaller roll *E*, whenever it has completed a revolution comes to rest because pin *D* is being held by the catch *c*. The roll *E* remains at rest until the larger roll *G* has completed its revolution, when the pin *F* acts on the interrupter *B* and breaks the circuit so that the electromagnet *A* is now without current and its armature releases the pin *D* of the roll *E*.—*L'Industrie Elec.*, July 10.

Wireless Telegraphy.—Count Arco.—A long and sharp reply to von Lepel on the question of priority of invention of the new Telefunken system.—Lond. *Electrician*, Aug. 6.

Miscellaneous.

Drawings.—A. Lang.—The writer endeavors to show that the present German laws are sufficient to protect the property rights of an engineer in his drawings against undesired reproduction, etc.—*Elek. Zeit.*, Aug. 5.

NEW APPARATUS AND APPLIANCES

Bryan-Marsh Salesmen's Association.

The annual business meeting and outing of the Bryan-Marsh Salesmen's Association was held at the Spring Lake Hotel, on Spring Lake, near Grand Haven, Mich., on Aug. 1 to 7, inclusive. There were 22 persons present, including visitors, factory managers and salesmen of the Bryan-Marsh Company. Morning and afternoon sessions were held, and a number of papers were read. Mr. J. L. Barnard, of the Minneapolis office, was elected president of the association; Mr. W. H. Reker, of Chicago, secretary, and Mr. J. S. Corby, of Chicago, treasurer and commissary. The delegates were quartered in a large cottage near the hotel, and there were baseball games, fishing, sailing, bathing and other outdoor sports after 3 p. m., when business was over for the day. Instruction and recreation were mingled pleasantly.

Indiana Electric Light Convention Commercial Notes.

While there were few exhibits at the meeting last week at French Lick Springs, there was a considerable attendance of commercial men. An interesting exhibit was made by the Shelby Electric Company, of Shelby, Ohio, represented by Henry W. Strock and W. H. Myers. It included both carbon and tungsten incandescent lamps. The Shelby lamps are used in the hotel, and Mr. Strock had a temporary dark cabinet arranged where he displayed the comparative light-giving qualities of a Shelby 16-cp carbon lamp and of another lamp of the same type and rating made by another manufacturer. In the same room was an exhibit of Holophane shades and reflectors, including the new reflectors for factory lighting, made by Charles A. Howe, manager of the Chicago office of the Holophane Company. Mr. Howe demonstrated the flux-of-light method of determining the required illumination for rooms. He also gave color tests to demonstrate the daylight quality of tungsten light and showed a new type of sign for show windows which conceals the lamps, reflects light on the goods displayed and at the same time serves as a sign with translucent letters in an opaque background.

The General Electric Company had eight representatives at the convention, the delegation comprising E. E. F. Creighton, Schenectady; Geo. C. Osburn, Harrison, N. J.; J. W. Dunbar and Oscar Camman, Cincinnati; J. R. Farrell and P. Worth, Indianapolis; H. C. Houck and C. P. Murchison, Chicago. Visitors at "G. E." headquarters were hospitably entertained.

The Westinghouse men present included J. C. Henderson, of Indianapolis, and F. O. Kirkpatrick, of Cincinnati, for the Westinghouse Electric & Manufacturing Company, and M. L. Spaulding, of Cincinnati, for the Westinghouse Lamp Company.

Other manufacturers and supply dealers were represented as follows:

Allis-Chalmers Company.—R. C. Sueve, Cincinnati.

F. Bissell Company.—M. E. Townsend, Toledo.

Brilliant Electric Company.—H. H. Cudmore and Arthur M. King, Cleveland.

Central Electric Company.—W. H. Pearl, Chicago.

Duncan Electric Manufacturing Company.—Adrian Tobias, Lafayette.

Electric Appliance Company.—Perry R. Boole, M. S. Walker and J. H. Bell, Chicago.

Fort Wayne Electric Works.—J. E. Hall, Fort Wayne.

General Incandescent Lamp Company.—Harry C. Rice, Cleveland.

Illinois Electric Company.—J. W. Kampman, Chicago.

Indianapolis Belting & Supply Company.—A. L. Wright, Indianapolis.

Monarch Electric Company.—Thos. H. Gage, Chicago.

Monarch Electric & Wire Company.—A. D. Gillespie, Chicago.

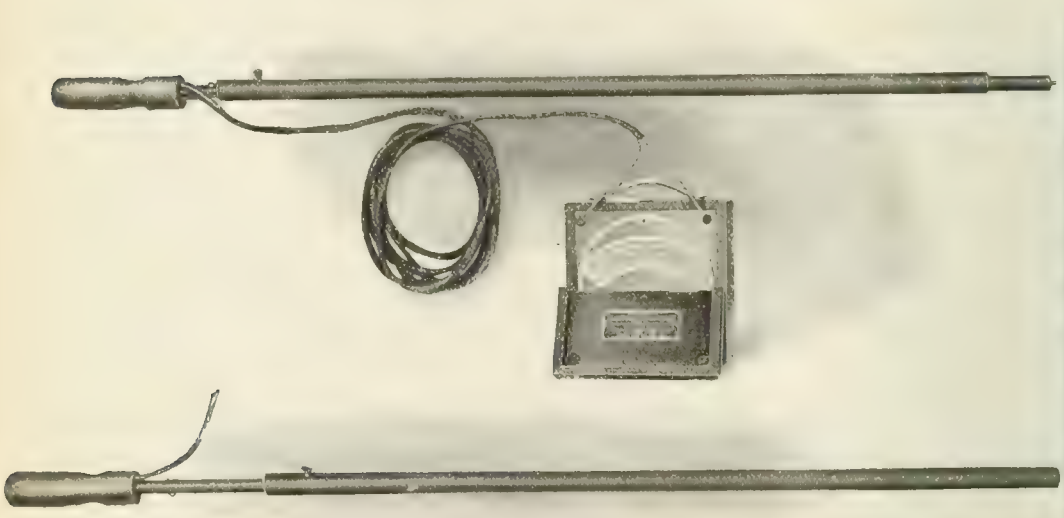
W. G. Nagel Electric Company.—L. F. Carney, Toledo.

National Carbon Company.—J. F. Kerlin, Cleveland.

Portable Electric Pyrometer for Quick Readings of High Temperatures.

A new quick-reading form of the Bristol pyrometer has been designed, consisting of a compound thermo-electric couple used in connection with a special portable instrument equipped with a pivot jewel-bearing Weston movement. The complete outfit is shown in Fig. 1. The thermo-electric couple is shown externally in Fig. 2. Fig. 1 shows the couple with the protecting sheath pulled back against a stop leaving the tip of the thermo-couple exposed. When a reading is to be taken with this special thermo-couple, it is inserted into the furnace or kiln, as shown in Fig. 2, with the tip protected from mechanical injury, and the iron pipe protecting sheath is then slipped back so that the tip is exposed to the hot gases whose temperature is to be measured. After a reading has been taken the couple is quickly withdrawn and partially cooled off before another reading is taken.

This form of couple is the invention of Prof. William H. Bristol, formerly of Stevens Institute, and now president of the Bristol Company. The compound construction of the element is shown in Fig. 3. The point *A* corresponds to the regular junction of an ordinary thermo-couple, and the two elements which join at the point *A* are platinum and platinum-rhodium, this being the particular couple selected as a standard by the German Government. The platinum and platinum-rhodium elements extend to the points *B* and *C*, where they are welded to two other wires made of inexpensive alloys so selected that the e.m.fs. generated at *B* and *C* are practically equal and opposed when these junctions are both exposed to temperatures not higher than 1200 deg. Fahr. These inexpensive alloy elements are extended to the point *D*, which is the cold end of the couple.



FIGS. 1 AND 2.—ELECTRIC PYROMETER.

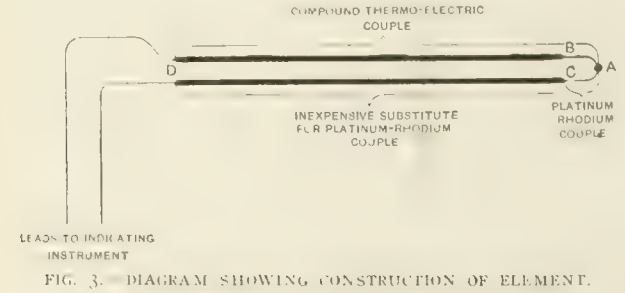


FIG. 3.—DIAGRAM SHOWING CONSTRUCTION OF ELEMENT.

This construction of the quick-reading couple is such that the platinum-rhodium tip of the couple *A* may be exposed to excessively high temperatures, up to 3000 deg. Fahr., without having the temperature of the junctions *B* and *C* exceed a safe limit. The temperature at *A* may be quickly measured with this special couple, as the platinum-rhodium tip is exposed directly to the hot gases in the furnace or kiln. In this way an inexpensive substitute is provided for the expensive platinum-rhodium couples previously employed for the measurement of such high temperatures.

The manufacturers of this instrument state it has been tested under very severe conditions and found extremely valuable for such applications as brick-kiln temperatures, boiler furnace fire-box temperatures, by-product coke-oven combustion flue temperatures, soaking-pit temperatures, etc. The complete outfit is portable, and readings of temperatures in the neighborhood of 2500 deg. may be obtained in a very few seconds after inserting the tip of the couple to the point where the temperature is to be measured. By using a special form of the platinum and platinum-rhodium tip this type of thermo-couple can be used to measure the temperature of red-hot surfaces of metal or other material.

Motor-Controlling Panels.

In the accompanying illustrations are shown motor-controlling panels with devices for varying both the armature and field-circuit currents. Fig. 1 illustrates a starting panel equipped with a no-voltage release device, an interlocking overload circuit-breaker and a field-circuit rheostat for a 2-to-1, 3-to-1 or a 4-to-1 speed variation. On the panel for larger motors the main circuit double-pole switch is replaced by two single-pole circuit-breakers. These panels are built by the Ward Leonard Electric Company, Bronxville, N. Y.

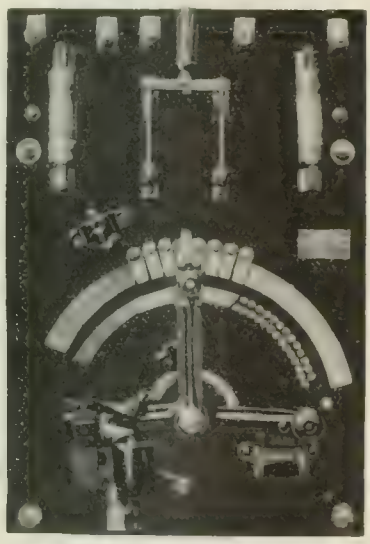


FIG. 1.—MOTOR-STARTING PANEL.

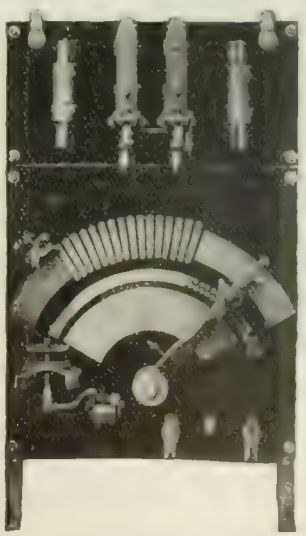


FIG. 2.—PANEL FOR LARGE MOTORS.

Blake-Knowles Multi-Current Feed-Water Heater.

In the matter of feed-water heating it has been convincingly demonstrated that to attain the highest efficiency the heating steam and the water to be heated must be kept in motion at a considerable and uniform speed and that the changes in direction of flow shall result in counter currents of steam and water in close contact and so directed as to compel the greatest transfer of heat possible. The accompanying illustration shows a heater in which these principles are embodied, made by the Blake-Knowles Steam Pump Works, New York.



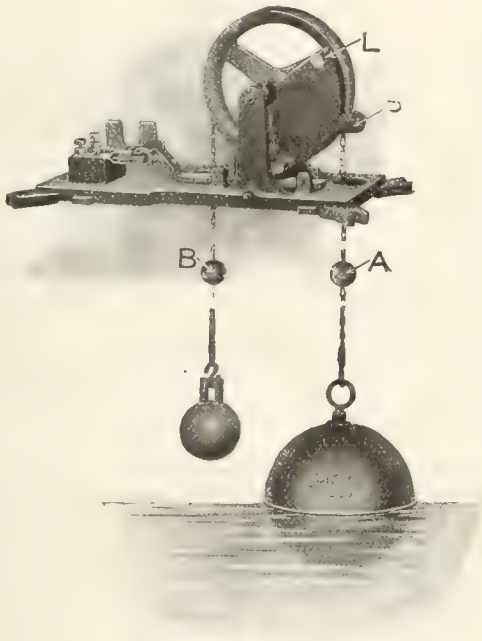
FEED-WATER HEATER.

The interior of the shell, through which the steam passes, is divided by longitudinal partitions in which the water-tubes are arranged so that the steam flows the entire length of the shell in close contact with these tubes three times before finally passing out. The water-tubes are expanded into the tube heads, one of which is a part of the main casting, while the other is bolted to a flexible diaphragm the periphery of which is fastened to the shell flange. This takes care of the tube expansion and makes unnecessary any troublesome stuffing boxes for the individual tubes. These water-tubes are of small diameter so that the heat passes quickly through the water, and six changes in direction of flow give the high water velocity essential for the best working results. Removal of the heater heads gives access to the interior, and the tubes are easily cleaned from the top end. These heaters are also made horizontal and are fitted with saddles in place of feet, as in the case of the vertical type.

Automatic Tank Switch.

The tank switch illustrated herewith is intended for service on top of the tank or sump cover, so as to permit any desired variation in water level to be automatically maintained without the necessity of relocating the electrical apparatus. Its operation in starting and stopping the motor is dependent upon the movement of a falling hammer, whose motion in turn is governed by a freely suspended copper float which is nearly counterbalanced by a cast-iron ball. Referring to the illustration of the interior mechanism, which is shown arranged for tank service, the two small wooden balls on the chain are adjustable and their position determines the variation of water level between operations of the pump. The switch is shown as when the pump is in operation. As the float rises, the ball *A* comes in contact with the projection *F* on the hammer and carries the latter past the center. The hammer then falls to the other side of the pulley shaft by gravity, and in so doing the lug *L* strikes a projection on the switch and disengages the knife, thus stopping the motor by interrupting the circuit. The switch movement is quick to avoid unnecessary arcing, and since the hammer remains in contact with the switch arm there can be no rebound.

The switch is held in the open position by the hammer until the water in falling to a lower level brings the other wooden ball *B* into contact with the hammer lug, which reverses the hammer, throws the knife into contact and starts the motor again by completing the circuit. The wheel acts merely as a carrier for the copper chain and plays no other part in the operation of the switch. As arranged for draining sumps, the copper float and iron ball are reversed in position so as to reverse the switch action and cause the pump to start when high water prevails. The knife arm is thoroughly insulated from every other part of the switch mechanism, and the two contact points are mounted on slate. A suitable opening is provided in the



AUTOMATIC TANK SWITCH.

body for inserting the tube and making the connection to the binding posts.

The shaft is constructed of bronze and the working parts are enclosed in an iron case to protect them from the elements and from injury. The switch is made in both single-pole and double-pole pattern by the Watson-Stillman Company, of New York City.

Sterling Salesmen in Session.

The annual convention of the salesmen and office managers of the Sterling Electrical Manufacturing Company was held on Aug. 4, 5 and 6 at Warren, Ohio, the headquarters of the company. There were about 30 company men in attendance, drawn from different parts of the country. Daily meetings were held in the open air under the trees on the nursery farm of Mr. William Coale, treasurer of the company, where luncheon was also served.

The meeting was notable for the number of papers read and the close attention manifested in the discussions during the three-day convention. All branches of the incandescent lamp business, including design, manufacure and marketing, were up for discussion. On the evening of Aug. 5 Mr. C. E. Davidson, of the Holophane Company, delivered a lecture on the applications of Holophane glassware. Mr. J. Robert Crouse, of the National Electric Lamp Association, addressed the gentlemen present on Aug. 6. On the afternoon of that day the party was driven to a farm about three miles out in the country, where an old-fashioned chicken dinner was served. In the evening there was a stereopticon lecture at the Grand Theater, Warren, given by Mr. P. F. Baudér, of Cleveland. This lecture was similar to one given at the recent Atlantic City convention of the National Electric Light Association, by Mr. Bauder, and gave the result of the speaker's researches into the color values of various illuminants. A number of citizens of Warren and Niles attended this lecture, and the hall was filled with an attentive audience. The convention was accounted a successful one in every respect.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The improvement in trade conditions continues as the vacation season draws to a close and completion of harvests gives to the producers definite results. The jobbing and wholesale cereal trade reports a healthy expansion of business, and buyers' excursions to various trade centers have done much to stimulate orders, especially for dry goods, clothing, shoes and hardware. While trade is thus showing improvement, there is no indiscriminate rush of buying. From almost every market comes the report that, while buyers are taking hold better than at any time during the past two years, there is still a sentiment of conservatism and caution. Purchases are carefully considered and are rigidly limited to safe amounts. The lesson of the recent period of depression seems to have been more deeply instilled than that of any similar period which has gone before. In the industrial world there continues to be a distinct improvement. Orders are still running heavy and more workmen are being employed. In iron and steel the mills are constantly advancing prices, and premiums are being required for prompt deliveries. Structural material continues to be in heavy demand, and the railroads are purchasing cars and locomotives quite freely. About 20,000 tons of steel rails were ordered last week for delivery before the end of the year, and inquiries are said to be numerous for delivery early in 1910. Although collections are reported to be somewhat better, they are still not up to what the improved conditions of trade would seem to warrant. It is believed that as soon as crops begin to move to market more freely there will be much prompter payments. Business failures for the week ended Aug. 19, as reported by *Bradstreet's*, were 183, compared with 219 the previous week, 236 in the same week of 1908, 153 in 1907, 155 in 1906, and 176 in 1905.

THE COPPER MARKET.

There has been so little doing in the copper market during the past week that it would be impossible to attribute to it any definite character. Trading has been extremely light, and buyers, both for speculative accounts and for consumption, have been very scarce. In spite of this stagnation selling prices have been fully maintained, and at the close of the week transactions on the Metal Exchange were at figures fractionally in advance of those a week previous. The statistical position of the market is but little more encouraging in spite of the heavy reduction of stocks in producers' hands, shown in the association's figures for July. Production continues on a record basis and the actual melting is still more or less curtailed. The remarkable deliveries of July are regarded as a freak of trade not likely to be soon repeated, and it is recognized that consumers must have accumulated stocks far beyond their immediate needs. What figure these accumulations will cut in the future demand remains a question. During the past week the London market has been extremely unsettled and prices have fluctuated. This has done much to cause buyers on this side to hesitate and consider it wise to await developments. Exports for August will probably be 10,000 tons less than for July. Up to and including Aug. 23, they were 15,091 tons. The daily call on the Metal Exchange at 12.30 o'clock, Aug. 23, quoted standard copper as follows:

	Bid. Per lb.	Asked. Per lb.	Settling price. Per lb.
Spot	12.75	13.00	.....
August	12.75	13.00	12.85
September	12.75	13.00	12.87½
October	12.75	13.00	12.87½
November	12.80	13.05	12.92½
December	13.00	13.10	13.05

Prices in the London market Aug. 23 were as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	59 15 0	59 13 6
Standard copper, futures	60 13 0	60 12 6
Market	Firm	Steady
Sales of spot		500 tons
Sales of futures		1,600 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	[illegible]	12.02½
Lake	[illegible]	12.55
Electrolytic	[illegible]	12.12½
Casting	[illegible]	12.00
London, spot	£59 [illegible] 6	£54 12 6
London, futures	61 15 6	55 10 0
London, best selected	67 [illegible] 0	59 0 0

LIGHTING PLANT FOR GROTON, MASS.—The town of Groton, Mass., has determined to construct a distribution system for lighting. Energy will be purchased from the Ayer Electric Light Company, which is owned by the Massachusetts Lighting Companies. The plant will cost $15,000, and the city will use 180 32-cp tungsten lamps for street lighting. The commercial rate to consumers will be from 15 to 18 cents per kw-hour.

SOUTH CAROLINA ELECTRIC POWER & MANUFACTURING COMPANY.—It is reported that the Electric Power & Manufacturing Company, which has an extensive hydro-electric plant at Gaston Shoals, S. C., is now negotiating for the purchase and development of another water-power site in the same section. This company, which owns the Spartansburg Railway, Gas & Electric Company, and which furnishes energy to the municipal light and power plant at Gaffney, S. C., is said to be interested in the development, by merger and construction, of an extensive interurban trolley system in the northern section of South Carolina. It will also furnish energy to a number of cotton mills in that neighborhood.

CIPHER TELEGRAPH RATES ADVANCED.—The Western Union and Postal Telegraph companies have announced a new schedule on cipher messages, to become effective Sept. 1, which will result in a material advance in rates. Under the new schedule all messages not composed of ordinary words found in the dictionary will be charged for at the rate of five letters to the word, instead of 10 as at present. This schedule refers to domestic messages only. As explained in the issue of Aug. 12, the cable companies have already determined to eliminate impossible words in cipher cablegrams. It is explained that the telegraph companies have been forced to this policy on account of the difficulty of handling the increasing number of code messages.

LIGHTING CARBONS STILL IMPORTED.—The importers of lighting carbons say that they have no intention of going out of business on account of the increase in tariff duties under the new tariff schedules. One importer, who took an active part in the fight before the Ways and Means Committee to secure lower rates, had this to say about the future of the business: "I not only am not discouraged, but I am doing more business at present than ever before. I have just sent out to central station managers throughout the country 3000 circular letters advising them to make no contracts for carbons without having first consulted us on terms. I may be in a more fortunate condition than some of the other importers on account of the differential in price made on single length carbons by the German factory I represent. It is possible for me to get in New York 1000 single-length carbons very much cheaper than I could formerly get 500 double-length carbons, and while I only paid a duty of 45 cents per hundred feet formerly and now pay 65 cents, the difference in first cost and the elimination of the rehandling cost practically offset the increase in duty. I will not have to increase my prices under the new tariff."

INSULATED WIRE TRADE IMPROVING.—The demand for insulated wire is said by the manufacturers to be very much better at present than it has been at any time within the past year. The vast amount of building that was begun early in the spring is beginning to bring in returns to the wire men, and the number of inquiries being received indicates a very heavy trade in the fall. A representative of one of the leading concerns had this to say: "We are just feeling the benefits of the boom in building. Orders are coming in rapidly and there is a prospect for large business in the fall. We are very well satisfied with present conditions and are enthusiastic about the future."

NEW CANADIAN RUBBER AND INSULATION PLANT.—The factory of the Walpole Rubber Company, Ltd., which has been incorporated with a capital of $250,000, at Granby, Quebec, is nearing completion; the general sales offices are in the Eastern Township Bank Building in Montreal. The officers and directors of this new company are for the most part officers and directors of the Massachusetts Chemical Company, operating the Walpole Rubber Works, the Walpole Varnish Works and the Walpole Shoe Supply Works, at Walpole, Mass., U. S. A. The Walpole Rubber Company, Ltd., of Canada, will operate upon similar lines to the parent company, producing all kinds of rubber splicing, insulating and friction tapes, and miscellaneous rubber sundries, together with the well-known varnishe and insulating compounds, such as armalac, insulac, the Walpole hot-water bottles under the Gleason fusible core process, the "cat's-paw" rubber heels, etc. The growth of the business of the Massachusetts Chemical Company, and the ever-increasing demand from all parts of Canada for the products named, necessitated the establishment of a manufacturing equipment in the Dominion to properly care for and encourage it. The city of Granby, aside from being the home of one of the directors, offers exceptional inducements for such an enterprise, furnishing an excellent water-power sufficient for all factory purposes and unexcelled shipping facilities.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—The entire force of the Westinghouse Electric & Manufacturing Company at East Pittsburgh was placed on full time last week, and is now working 10 hours a day. Heretofore a majority of the workmen were employed only eight hours. A representative of the company states that at the present time there are between 10,000 and 11,000 men on the payrolls, as compared with 6000 at the low point last year. The gross business is now running at about $2,500,000 per month, or $30,000,000 per year. During July the business was $3,000,000, but this is recognized as being above the average. The foreign companies are also making excellent returns. In connection with this increased business, there has been a renewal of the talk of the early resumption of dividends. It is reported that the payment of the back dividends accrued on the preferred stock may be made in October, and that a 5 per cent dividend on the assenting stock may be paid early in 1910. When the reorganization plan was under discussion those who took the assenting stock at par were assured that dividends would be paid at the earliest possible moment.

GENERAL ELECTRIC COMPANY'S SALES.—Officials of the General Electric Company report that business is slowly improving, but that as yet the majority of orders are for small machinery rather than for heavy apparatus. Manufacturing plants all over the country are considering the introduction of electrically driven machines, and many inquiries are being made and many specifications being considered in this direction. Among the recent sales of the company in this territory are one 1500-kw rotary converter to the New York Central Railroad Company for lighting service in that portion of the new Grand Central Station which has already been completed. The energy will be obtained from the Port Morris power house. Other sales include an electrically driven installation, with 450-kw engine-driven generator, for the Firth Carpet Company, of Firthcliff, N. Y.; 500-kw turbo-generator for the Brighton Mills, at Passaic, N. J., and complete installation for the Standard Oil Company's plant at Montrose, N. Y. The demand for domestic appliances is said to be constantly on the increase.

ELECTRICAL EQUIPMENT.—The new power plant of the Southwestern Portland Cement Company, El Paso, Texas, will contain two 600-kw Westinghouse steam turbo-alternators delivering 60-cycle, three-phase current at 440 volts. Excitation current is furnished by a 55-kw, 125-volt, engine-driven generator, and by a motor generator set comprising 55-kw and 20-kw direct-current generators driven by 115-hp induction motor. The turbines exhaust into Westinghouse-LeBlanc condensers, which maintain a vacuum of 28 in. The motor equipment of the mill comprises a number of three-phase 440-volt induction motors of both vertical and horizontal types and ranging from 5 to 100 hp. All motors were furnished complete with starting apparatus by the Westinghouse Company. The power plant of the Southwestern Portland Cement Company supplies lighting service in addition to operating the cement mill.

SUIT TO RECOVER WIRELESS PROPERTY.—Floyd N. Bradley, receiver of the International Wireless Telegraph Company, has instituted suit at Trenton, N. J., against the American De Forest Wireless Company to recover the assets of the International Company amounting, it is claimed, to $7,500,000, which the petitioner says, was transferred to the De Forest Company without compensation. As both of these companies are in practically a moribund condition, the suit is not regarded as very important by people who are interested in wireless telegraphy.

SUSQUEHANNA ELECTRIC POWER COMPANY.—The Susquehanna Electric Power Company, the $10,000,000 proposition which is now constructing a dam for a hydro-electric plant on the Susquehanna River, will, it is said, compete for the light and power business in the city of Baltimore. This company is the only one that has a right to enter the field against the Consolidated Gas, Electric Light & Power Company, which now holds a monopoly for distributing electric energy in that city.

TORONTO TO BUY ELECTRICAL APPARATUS.—The City of Toronto will receive bids until Oct. 14 for the following electric apparatus: Four 1500-hp synchronous motors, two 1500-hp induction motors, four 500-hp induction motors and two 225-hp synchronous motors, with exciters, switchboards and connections. Bids will also be received at the same time for a number of large-sized turbine pumps, piping, valves, etc.

CANADIAN PACIFIC ELECTRIFICATION.—It is reported that officials of the Canadian-Pacific Railway will shortly look into the possibilities of electrifying the Columbia & Western branch. It is stated that 35,000 hp is available at Bonnington Falls, while there are several other good water-powers along the line not yet developed. Lorne A. Campbell, Nelson, B. C., may be addressed on the subject.

EXTENSION OF FT. WAYNE WORKS.—Plans are under way for the construction and equipment of a four-story addition to the plant of the Ft. Wayne Electric Works, involving the expenditure of nearly a half million dollars. Part of the additional space is necessary for the manufacture of the Wood new style magnetite arc lamp, for which a large demand has developed.

THE HAWKS ELECTRIC COMPANY, Goshen, Ind., has added a department for the care of electric vehicles. For a monthly consideration the company will take care of all electric vehicles, including pleasure cars, light delivery machines and trucks, providing skilled attendance and service. The company has also taken an agency with the Woods Electric Company, of Chicago.

CALGARY HYDRO-ELECTRIC PLANT.—The Calgary Power & Transmission Company will shortly call for tenders for the construction of a power plant, 45 miles west of Calgary, and also for the erection of the necessary transmission lines. Smith, Kerry & Chace, consulting engineers, Toronto, Ont., have the plans.

LOCKE INSULATOR PLANT.—The insulator manufacturing plant of Fred. M. Locke, at Lima, N. Y., which was destroyed by fire several months ago, is being rebuilt and will be ready about the middle of September for the manufacture of insulators under Locke patents.

PORT HOPE, ONT., HYDRO-ELECTRIC SCHEME.—The Durham-Northumberland Power Company is completing arrangements for the development of extensive water-power rights in the vicinity of Port Hope, Ont. J. A. Culverwell is managing director.

NIPISSING HYDRO-ELECTRIC PLANT.—The Nipissing Electric Company, Ltd., is constructing a power plant 19 miles from North Bay, Ontario, to supply that town. Smith, Kerry & Chace, consulting engineers, Toronto, Ont., have the work in charge.

ARROW ELECTRIC COMPANY.—The Arrow Electric Company has purchased the entire capital stock of the Marshall Electric Company, of Boston, and that corporation will be operated under its management. No particulars relating to the purchase have yet been made public.

WINNIPEG MUNICIPAL PLANT.—Plans will be prepared at once for a line to distribute power from the civic plant now under construction. Address F. E. Cambridge, city electrician.

SALES OF "NEW AMERICAN" TURBINES.—The Dayton Globe Iron Works have recently received a contract from the United States Government for two 44-in. improved New American turbines, to be installed vertically in open concrete flumes, at the turbo-compressor plant, which the United States Government is erecting at Lock No. 5, Monongahela River. An order has also been received from the Beaver Valley Water Company, Beaver Falls, Pa., for its New Brighton station, for two vertical turbines, one a 51-in. wheel, and the other a 19-in. wheel, each complete with vertical and horizontal shafting, and bevel gears and arranged to direct connect to the pumping units. Other recent orders are for head gate work for the Twin Falls-Salmon River Land & Water Company, for installation at the Salmon River Dam, in Idaho. This consists of four cast-iron gates and frames, complete with specially constructed steel piers, each of the gates to be 2 ft. 6 in. wide by 10 ft. high, and will be operated at the controlling works for the outlet into the tunnel, and work under approximately 84 ft. head of water, the hoisting mechanisms being placed approximately 92 ft. above the bottom of the gates. Connell & Connell, engineers, of New York City, have ordered the complete head-gate hoisting mechanism for four 6 ft. by 17 ft. 6 in. gates, which will be installed in the hydroelectric plant now being built by the Uniform Fibrous Talc Company, at Gouverneur, St. Lawrence County, N. Y.

CAMPAIGN OF EDUCATION FOR TUNGSTENS.—Beginning with their September issues, all of the popular magazines will carry full-page advertisements from the General Electric Company setting forth the value and economy of tungsten lamps for household lighting. This is the opening gun in an extensive campaign that has been planned for the purpose of popularizing tungstens. In this campaign the General Electric Company intends to use only the popular press and will make its appeal direct to the consumer. The advantages and economy of illumination by tungstens will be fully explained, and readers will be advised to buy their lamps from the local lighting companies. It is proposed to continue the propaganda through the fall.

NEW ENGLAND COTTON MILLS ELECTRICALLY EQUIPPED.—The Allis-Chalmers Company has recently contracted to furnish the new Nashawena Mills, in New Bedford, Mass., with two 3000-kw and one 500-kw steam turbines. These mills were recently financed by William Whitman, and are now being equipped in the most modern fashion. The same company has also contracted with the Whitman Mills, of New Bedford, for power house equipment, including one 2000-kw steam turbine, and with the Byron-Weston Company, of Dalton, Mass., for 1750-kw steam turbine. The Allis-Chalmers Company has recently sold to New England cotton mills 27 steam turbines with an aggregate of 36,000 hp.

CONSUL DESIRES CATALOGS.—U. S. Consul Edwin S. Cunningham, Durban, Natal, Africa, asks us to say that he will be very glad to receive catalogs of American manufacturers, which will be carefully filed for permanent reference.

Financial Intelligence.

THE WEEK IN WALL STREET.

The past week in Wall Street was one of heavy liquidation, and in the case of the pronounced market leaders of serious declines. Out of a total sales of more than 6,000,000 shares, the four issues—Union Pacific, Southern Pacific, Reading and Steel common—footed up considerably more than half. In the case of Union Pacific and Steel the sales of each ran more than 1,000,000 shares. It is not necessary to go very far to discover the reason for the heavy breaks in these market leaders. As has been pointed out before, many of the leading stocks, in which speculation has been active for months, have been pushed to levels entirely beyond what is warranted by business conditions. Recent advances in these issues have been very rapid—unsafely rapid—a condition undoubtedly brought about by the enthusiastic speculative trailers who follow the great market leaders. The real strength of the market has been indicated by the fact that beyond the few speculative issues, no damage was done. One disquieting subject that was worked overtime during the early part of the week was the condition of Mr. Harriman's health. From a dying incurable to a restored Ajax, the rumor factories ran the gamut. As the great man neared the American shore, trading paused through sheer fear of commitments on the wrong side. In the meantime there continues to be a steady and legitimate business in bonds. Many limited issues, largely of public utilities, are daily appearing and are being eagerly absorbed by small investors. The money market has been stronger as the volume of trading increased, but at the end of the week under review was practically the same as at its beginning. Rates Aug. 23 were: Call 2¼@2½ per cent, 90 days 3¼@3½ per cent. The quotations in the table are those of Aug. 23.

NEW YORK.

	Aug. 16.	Aug. 23.	Shares sold.		Aug. 16.	Aug. 23.	Shares sold.
All. Ch.	15½	15¼*	1,240	Int.-Met., pfd.	46¾	46⅞	23,100
All.-Ch., pfd..	53⅞	53⅝	1,700	Mackay Cos...	83*	84	200
Amal. Cop. ..	85⅛	85⅜	137,400	Mackay Cos., p.	74½	74½*	252
Am. D. T.....	20½	20½*	67	Man. Elev. ..	143¾	142½	1,100
Am. Loc.....	65	63	22,220	Met. St. Ry...	24*	23	500
Am. Loc., pfd..	120*	116½	300	N.Y. & N.J.Tel.	141	140½	300
Am. Tel. & Cbl.	76*	76*	-	Steel, com....	76¼	77⅜	1,045,110
Am. T. & T...	141½	140⅜	18,100	Steel, pfd	125⅛	125	27,805
B. R. T.....	79	80½	42,565	W. U. T.....	74	73	3,250
Gen. Elec.....	169	169	5,100	West'h. com..	86	87¾	7,420
Int. Met., com.	14¼	15	11,300	West'h. pfd .	130*	125*	200

PHILADELPHIA.

	Aug. 16.	Aug. 23.	Shares sold.		Aug. 16.	Aug. 23.	Shares sold.
Am. Rys.....	45⅞*	46½*	-	Phila. Elec ...	12¼	12⅛	——
Elec. Co. of A.	12⅛	12⅛*	——	Phila. R. T....	30⅜	30¼	——
Elec. St. B'ty..	61¾	61	——	Phila. Trac...	91	90½*	——
U. S. B'ty, pfd.	49*	49*	——	Union Trac...	54½	54⅛	——

CHICAGO.

	Aug. 16.	Aug. 23.	Shares sold.		Aug. 16.	Aug. 23.	Shares sold.
Chi. City Ry.	180*	180*	——	Chi. Tel. Co.	135½*	135*	——
Chi. Rys., Ser. 1.	119½*	119½*	——	Met. El., com.	17¾	17¼*	——
Chi. Rys., Ser. 2.	37	37¼*	——	Met. El., pfd.	49*	49*	——
Com. Edison..	121*	120⅞*	——	Nat'l Carbon.	98	95	——
Chi. Sub'ws ..	20½*	19½*	——	Nat'l C., pfd...	119*	120*	——

BOSTON.

	Aug. 16.	Aug. 23.	Shares sold.		Aug. 16.	Aug. 23.	Shares sold.
Am. T. & T..	141⅝	140⅜	——	Mex. Tel.....	2⅛*	2⅝*	——
Cum. Tel.....	142½	143*	——	Mex. Tel., pfd.	5¾	6¼*	——
Edison E. Ill.	252	252*	——	N. E. Tel....	137	137	——
Gen. Elec.....	169	166½*	——	W. T. & T....	11⅝	10¾*	——
Mass. E. Ry..	14⅛	14¼	——	W. T. & T., p.	81	89*	——
Mass E. R., p.	75	74	——				

*Last price quoted. Shares sold are for week Aug. 16 to Aug. 21.

DIVIDENDS.

American Railways Company, quarterly 1½ per cent, payable Sept. 15.

Blackstone Valley Gas & Electric Company, preferred, quarterly 1½ per cent, payable Sept. 1.

General Electric Company, quarterly 2 per cent, payable Oct. 15.

Mobile Electric Company, preferred, quarterly 1½ per cent, payable Aug. 16.

Northern Texas Electric Company, non-cumulative preferred, semi-annual 3 per cent; common, initial, 2 per cent; both payable Sept. 1.

Philadelphia Electric Company, quarterly 1½ per cent, payable Sept. 15.

Seattle Electric Company, common, quarterly 1¾ per cent; preferred, semi-annual 3 per cent; both payable Oct. 1.

HOME TELEPHONE COMPANY OF MICHIGAN.—The organization of the Home Telephone Company of Michigan has been completed at Detroit, with $5,000,000 capital stock and an authorized bond issue of $10,000,000. The new company proposes to take over the properties and business of the Home Telephone Company of Detroit and the Interstate Long Distance Telephone Company. A number of St. Louis, Mo., capitalists appear in the list of directors. Fred T. Moran, of Detroit, was elected chairman of the board, and W. A. Jackson, formerly president of the Michigan State Telephone Company, was elected president. The St. Louis directors are Albert N. Edwards, E. A. Faust, A. W. Lambert, M. F. Bayard, Bliss Michael, Henry Koehler, Jr., E. F. Goltra and Samuel D. Jeffries. The company is planning to expend $1,000,000 immediately on extensions.

YAKIMA CENTRAL HEATING COMPANY.—The Yakima Central Heating Company, capitalized at $100,000, of North Yakima, Wash., has been incorporated to do a central-station heating business. The company will build a plant having 800-hp boiler capacity, with feed-water heaters, boiler feed pumps, etc. The distributing system will require about 10,000 ft. of street mains, of from 4 to 10 in. diameter. Live steam will be used for heating, and customers will be charged on a metered basis at rates ranging from 75 cents to $1 per thousands pounds of condensation. The Schott Engineering Company, of Chicago, has the contract to install the complete plant, which will cost about $100,000.

EMPIRE DISTRICT ELECTRIC COMPANY.—The new holding company, known as the Empire District Electric Company, which was recently incorporated under the laws of Kansas to take charge of the interests now owned by H. L. Doherty & Company in the Joplin mining district, has made its formal offer of securities. The new company will acquire at once the properties of the Consolidated Light, Power & Ice Company, the Joplin Light, Power & Water Company, of Joplin, Mo.; the Galena Light & Power Company, of Galena, Kan., and 57 per cent of the stock of the Spring River Power Company, of Lowell, Kas. It is planned to build a 16,000-hp modern steam-turbine station to further supply the demands of the district in which the new company will operate. It is intended to supply energy for lighting the cities of the entire district, and also for street and interurban railways and for mining operations. As stated in last week's issue, the authorized capital will be $6,000,000 in bonds; $3,000,000 in preferred stock, and $3,000,000 in common stock. The immediate issue will be $1,250,000 of bonds; $500,000 of preferred, and $1,600,000 of common. The subscribers to the bonds at par are offered 25 per cent in preferred and 40 per cent in common stock as bonus. It is stated that the securities that are to be offered at present have already been oversubscribed, but that a small amount will be offered to the public, which originally had been purchased by the broker's firm of Williams, McConnell & Coleman, 60 Wall Street, New York.

ELECTRIC TRACTION IN TEXAS.—An unusually large number of street railway and interurban electric railway enterprises are on foot in Texas. One of the latest of these projects is that of the Medicine Mound & Quanah Electric Railway Company, which is preparing to build an interurban electric line 18 miles long, to run between Quanah and Medicine Mound. It is stated that the building of this road is practically assured. The electric street railway system in San Angelo, which has been in the hands of a receiver, has been taken over by the San Angelo Street Railway Company, having a capital stock of $100,000. The property consists of four miles of track and other valuable holdings. The new company will immediately build four miles of additional track and make other important improvements. Sam Crowther is at the head of the company. The Port Arthur Traction Company, which was recently organized with a capital stock of $200,000, is arranging to build an extensive system of street railway in Port Arthur, and to construct and operate interurban electric lines to points near that town. The chief stockholders of the new company are H. J. Myers, A. H. Reeder and S. M. Krohn, all of Dayton,

CLIFF ELECTRICAL DISTRIBUTING COMPANY.—The .Cliff Electrical Distributing Company has petitioned the Public Service Commission, Second District, for permission to increase its capital stock to $500,000, and to issue $1,500,000 in mortgage bonds, and for approval of the transfer to it of that part of the franchise and works of the Niagara Falls Hydraulic Power & Manufacturing Company relating to the generating and distribution of electric power, in which part of the petition the latter company joins. The company was incorporated in order to separate the electrical development and distributing properties of the Niagara Falls Hydraulic Power & Manufacturing Company from its other properties, the latter company, besides its hydraulic canal in Niagara Falls for furnishing water for power purposes, owning two flour mills and various pieces of real estate not connected with the electrical generating and distributing business. A part of these properties is not subject to the Public Service Commission and its regulation, and hence the desire to put it under separate corporate administration.

WESTERN UNION GETS AWARD.—Everett W. Burnett, master appointed by the court to settle the dispute between the Western Union Telegraph Company and the American Telephone & Telegraph Company, has filed his report in the United States Court at Boston. He awards to the Western Union 20,087 shares of stock in 37 subsidiary Bell companies, and $2,579,914 in cash. This award is a reduction of 18,101 shares and of $3,293,377 in cash from the claim filed by the Western Union. The award excludes from the accounting 5000 shares of American Telephone & Telegraph, 3895 shares of New England Telephone & Telegraph, 200 shares of the Bell Telephone of Pennsylvania, 396 shares of Chicago Telephone Company and 8609 shares in various other companies. The officials of the American Telephone & Telegraph Company have recently expressed the opinion that this case was likely to be in the courts for another 10 years, so that it is not probable that the Western Union will collect this award in the near future. It is reported that a compromise and cash settlement are not unlikely.

AMERICAN TELEPHONE & TELEGRAPH STOCK EXCHANGE.—It is announced that the American Telephone & Telegraph Company is meeting with satisfactory success in the transfer of its stock for the shares of the Bell of Pennsylvania, the New York & New Jersey, the Bell of Buffalo, and the Central District Telephone Company of Pittsburgh. Up to this time more than 40 per cent of the outstanding minority stock in these companies has been turned in. The offer which the big company made to these four companies will expire Aug. 31, and it is announced that it will not be extended. The shareholders who hold off after that date will lose the opportunity to transfer their holdings. It is certain that the American will have practical control of all the companies by that time.

MICHIGAN PUBLIC SERVICE MERGER.—A. G. Hodenpyl, of Hodenpyl, Walbridge & Company, New York, says that the published report that a merger is being effected between the Saginaw Bay City Light Company, the Kalamazoo, Jackson and Pontiac gas properties, the Grand Rapids Railway Company, the Flint and Cadillac gas properties, and the water-power rights on the Sabule River, is premature. All of these properties are controlled by the Hodenpyl firm and E. W. Clark & Company, of Philadelphia. Mr. Hodenpyl says that some investigation as to the practicability of placing these properties under one management has been made, but that the matter is still in an embryonic shape, and probably will not be taken up for some months to come.

COMMONWEALTH EDISON COMPANY.—The stockholders of the Commonwealth Edison Company, of Chicago, have been called to meet on Nov. 9 to vote on a proposition to increase the capital stock of the company from $30,000,000 to $40,000,000. It is the present intention of the directors to offer $3,000,000 of the new issue to the present stockholders at par up to 10 per cent of their present holdings. The proceeds of the sale of this stock will be used to cover improvements and extensions. A new plant will be constructed on Fiske Street, and the present substations will be enlarged.

KANAWHA & OHIO VALLEY TRACTION COMPANY.—The Kanawha & Ohio Valley Traction Company has recently been incorporated under the laws of West Virginia, for the construction of a traction system from Kanawha Falls to Point pleasant, on the Ohio River, a distance of 150 miles. The preliminary capital of the incorporation is $100,000, but it is expected that the entire systetm will cost about $5,000,000. Former Governor F. P. Groscup is one of the incorporators. This new line will open up a large area of valuable mineral and timber land that is now without transportation facilities.

OTIS ELEVATOR COMPANY.—For the first half of the present fiscal year the sales of the Otis Elevator Company have been almost up to the high average made in 1907, which was the banner year in the company's history. During that year the company did a gross business of more than $15,000,000. It is altogether likely that this year's net earnings will run somewhat better than 10 per cent on the common stock. The present dividend rate is only 3 per cent, but this is likely to be increased in the Fall.

PACIFIC STATES ELECTRIC COMPANY.—The new consolidation on the Pacific Coast, which was started by the incorporation in July of the Pacific States Electric Company with a capital of $500,000, has practically consummated deals to take over the Pacific Electrical Works, Los Angeles; the Crescent Electric Company, Oakland, and the Sterling Electric Company, San Francisco. All of these concerns are dealers in electrical supplies and machinery.

LIGHT AND TRACTION MERGER PROJECT.—It is reported that the Union Gas, Electric Light & Railway Company, which controls the Evansville Gas & Electric Light Company, is making headway in project to effect a merger of its Evansville holdings with the Evansville & Southern Indiana Traction Company, and possibly with other traction interests entering Evansville.

PHILADELPHIA ELECTRIC COMPANY.—The directors of the Philadelphia Electric Company have authoritatively denied the report that they are considering making another call on the stockholders for $5 a share.

GENERAL NEWS

Construction News.

ANNISTON, ALA.—Application has been made to the City Council for a franchise by Col. William H. Zinn to construct a street railway system in Anniston.

BIRMINGHAM, ALA.—The City Council of North Birmingham has passed a resolution authorizing the sale of the North Birmingham water and light plants to James L. Cole and A. I. Thorpe for a consideration of $1 and the assumption of the bonded indebtedness, amounting to $190,000. The new owners agree to furnish the city of North Birmingham with street lamps at the rate of $50 per lamp per year and water hydrants at $35 each per year.

GLOBE, ARIZ.—A. H. Stern, representing Los Angeles capitalists, has petitioned the City Council for a franchise to construct a street railway in Globe, to be operated by electric or gasoline motors.

POLAND, ARIZ.—The Fairbanks-Morse Company has been awarded the contract for the complete equipment for the Poland Mining Company, at Poland.

PRESCOTT, ARIZ.—The Arizona Central Copper Company is reported to be in the market for new electrical equipment for the Shylock mine, which will include an electrical hoist, electrical pump and Temple drills. J. B. Cleveland is general manager.

PINE BLUFF, ARK.—The contract for electrical equipment and electrical wiring for the new seven-story bank and office building to be erected by the Citizens' Bank in this city was awarded to the Pine City Electric Company, of Pine Bluff, Ark.

MONETTE, ARK.—The Monette Lumber Company is reported to have applied for a franchise to install an electric light plant.

MURFREESBORO, ARK.—We are informed that bids will be called in about 90 days for the construction of the proposed hydro-electric power plant of the Pike County Water Power Company on the Little Missouri River, near Murfreesboro. The cost of the work is estimated at $600,000. The Fuller-Coult Company, of St. Louis, Mo., are consulting and supervising engineers.

ELSINORE, CAL.—The Consolidated Reservoir & Power Company, recently organized with a capital stock of $1,000,000, is preparing to construct large dykes across Elsinore Lake and proposes to utilize the water for irrigation purposes as well as for power purposes. The officers of the company are: Edwin Moore, of Los Angeles, president; R. B. Sheldon, of Riverside, vice-president, and W. B. Scarborough, secretary and treasurer.

MODESTO, CAL.—The transmission lines of the La Grange Light & Power Company, of La Grange, have been extended to this city.

MONROVIA, CAL.—The committee appointed to investigate the question of installing a new lighting system for Myrtle Avenue reports that the installation of a new system would cost about $1,300. Fred Goodsell is chairman of the committee.

STANWOOD, CAL.—The Pacific Gas & Electric Company is reported to have purchased the property of the Valley Power Company, and is said to be planning to install a large power plant on the property.

WILLOWS, CAL.—The Sacramento Valley Colony Company, which owns the Kraft ranch, is reported to have decided to erect a large power plant on its holdings, from which electricity will be transmitted to the different pumping plants which are to be established on the tract. It is said that this company is negotiating with the Sacramento Valley Land Company, which will permit the latter to connect its lines to those of the former at the intake of the canal, instead of building a line either to Hamilton or Orland.

CASTLE ROCK, COL.—The town of Castle Rock is contemplating the erection of a steam-driven electric light station, and may also install equipment for an ice manufacturing plant in connection with the electric plant.

CRIPPLE CREEK, COL.—Electrical power will be used in the work of extending the Blanchard tunnel on Copper Mountain. It is said that the transmission line recently extended to the Gold Issue Mine on Carbonate Hill will be further extended to Fluorine lode, where an electrically driven compressor will be installed.

HUGO, COL.—The Hugo Water, Light & Power Company has been granted a 20-year franchise to furnish the town with water and electricity for lamps. The cost of the combined plants is estimated at $70,000. The lighting and pumping plants will be combined.

JEWETT CITY, CONN.—Work will soon commence on the construction of the Hopeville dam for the Ashland Cotton Company. The dam will be located on the Pachaug River and will be 17 ft. high and 80 ft. long. An electric plant with an output of at least 400 hp. will be erected at the dam, and will furnish electricity for lighting the Hopeville mill and for operating the motors to be installed.

WILMINGTON, DEL.—The Wilmington City Electric Company has purchased a 1500-kw turbo-generator, one 500-kw motor-generator set, with exciter and new switchboard, of the Allis-Chalmers Company, of Milwaukee, Wis., for $75,000. The motor-generator set will be placed in the Fifth Street plant and the turbo-generator will be installed in the railway and light plant on the Brandywine River. The Fifth Street plant supplies the direct-current service.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Aug. 31, for furnishing at the navy yards and naval stations the following supplies: Mare Island, Cal., Schedule 1524, electrical supplies; 4000 cored and 4000 solid carbons. Mare Island, Cal., or Brooklyn, N. Y., Schedule 1527, 18,750 lb. rolled bronz, 7200 lb. brass tubing. Washington, D. C., Schedule 1535, insulating a room in basement of the naval medical school. Bids will also be received until Sept. 7 at the same place as follows: Mare Island, Cal., or Brooklyn, N. Y., Schedule 1548, 6000 lb. seamless drawn brass tubes. Applications for the proposals should designate the schedule desired by number.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Sept. 18 for installing two electric elevators at the Navy Yard, Mare Island, Cal. Plans and specifications can be obtained on application to the above bureau or to the commandant of the navy yard named. William M. Smith is acting chief of bureau.

SOUTH JACKSONVILLE, FLA.—The question of establishing an electric light plant, water and sewer systems is under consideration. Although the Legislature declined to authorize the Council to legalize a bond issue for municipal improvements, arrangements are being made for the granting of a franchise to private interests for the construction and operation of the system.

ATLANTA, GA.—The Railroad Commission has granted the Georgia Power Company permission to issue $1,550,000 in capital stock and $1,550,000 in bonds. The company has recently acquired the properties of the North Georgia Electric Company and the Etowah Power Company, and proposes to develop the water power on the Etowah River, near Canton, and the Chattahoochee River near Atlanta.

COLLEGE PARK, GA.—A committee has been appointed to make investigations pertaining to the installation of an electric light plant, water works and sewerage system. Charles A. Wickersham, J. C. W. Woodward, W. S. Cox, A. C. Brown and P. H. Brewster are members of the committee.

CHICAGO, ILL.—At the annual meeting of the Commonwealth Edison Company to be held Nov. 9 the stockholders will be asked to approve a recommendation made by the directors that the capital stock of the company be increased from $30,000,000 to $40,000,000. If the increase is authorized, $3,000,000 of the new capital stock will be issued to the stockholders at par, the proceeds to be used to cover the cost of improvements and extensions to the property.

OREGON, ILL.—The Oregon Power Company is carrying out extensive improvements. The town is situated on the Rock River. The flow at Oregon is sufficient for the ultimate development of 4000 to 5000 hp with a head of 10 ft. The company is now putting in the wheelpits for three 66-in. wheels and plans considerable changes in its generating equipment. The auxiliary steam plant will also be enlarged. G. W. Sturtevant, of Chicago, Ill., is consulting engineer in charge of the work, and in his absence on the coast Frank F. Fowle, of Chicago, has been in charge. The company is building transmission lines to supply various small towns in the vicinity of Oregon. Electricity will be transmitted at 13,000 volts, three-phase, 60 cycles.

BRAZIL, IND.—Both the Brazil Electric Company and the Terre Haute, Indianapolis & Eastern Traction Company submitted bids for furnishing electricity for lighting the city buildings, fire department and the viaduct in Brazil. Both bids were the same—6 cents per kw-hour. The Council rejected both bids.

INDIANAPOLIS, IND.—A permit has been granted to the Merchants' Heat & Light Company for the erection of a substation on Susquehanna Street.

KOKOMO, IND.—The County Commissioners have granted C. C. McFann, president and general manager of the Kokomo Western Traction Company, a franchise to construct a railway from Kokomo to Young America, which later will be extended to Burlington and Flora, a total distance of 15½ miles.

MARION, IND.—It is reported that the City Council is preparing to ask for bids for new equipment for the municipal electric light plant.

NEW ALBANY, IND.—Bids will be received by the Board of Public Works until Oct. 20 for lighting the streets, alleys and public places of the city by electricity for a term of 10 years from Sept. 1, 1910, according to specifications, which can be secured at the office of the board. John C. Short is city clerk.

SCOTTSBURG, IND.—The citizens have voted in favor of the proposition of giving a subsidy of $43,000 to the Cincinnati, Madison & Western Traction Company for the construction of its railway from Scottsburg to Madison. The line will ultimately extend to French Lick and Salem.

BOONE, IA.—At an election held Aug. 16 the citizens voted to grant

E. E. Hughes and associates a franchise to install an electric light and heating plant in Boone.

EOLIA, KY.—Arrangements are being made to build a local independent telephone line from Eolia, Ky., via Flat Gap, Va., Dewet, Guest's River and Lipps to Norton, Va., a distance of 30 miles. James P. Hartt and J. L. Hartt are interested in the project.

GUTHRIE, KY.—The Guthrie Light & Power Company is planning to install an electric plant in Guthrie, for the purpose of supplying electricity in Guthrie, Trenton, Pembroke, Elkton and Allensville. The company is in the market for second-hand 180 to 200-kw., three-phase, 60-cycle, 2200-volt, alternating-current generator, General Electric or Westinghouse make preferred. S. G. Ragsdale is interested in the company.

ALEXANDRIA, LA.—The citizens on Aug. 17 voted in favor of the proposition to issue $40,000 in bonds for improvements to the municipal electric light plant and water works system. Ira W. Sylvester is city engineer.

CLINTON, LA.—The question of issuing bonds for purchasing an electric light plant is under consideration.

BALTIMORE, MD.—The Architectural Commission has authorized Parker & Thomas, architects for the new power house to be erected at Bayview, to prepare plans for the building.

CONOWINGO, MD.—It is reported that the Susquehanna Electric Power Company is planning to begin work on the construction of its proposed hydro-electric plant on the Susquehanna River, for which surveys have already been made. The plans call for the construction of a dam and power plant and pole lines for the transmission of electricity to Baltimore and other cities. As yet no engineer has been engaged. The company is capitalized at $10,000,000. Joseph W. Marsh, president of the Underground Cable Company, of Pittsburgh, Pa., is president, and William H. Surratt, of Baltimore, Md., vice-president.

AMESBURY, MASS.—Extensive improvements are contemplated by the Hamilton Woolen Company, which will involve an expenditure of about $30,000. The work will include the construction of a new dam and the installation of new waterwheels, which will give the company 500 additional horsepower, making a total of 1500 hp. A power house will be erected at the large dam at Lake Gardner, where the water power will be utilized to generate electricity. It is estimated that 500 hp will be developed, giving the company 2000 hp in all. By using electricity the company will be able to abolish the engine and water wheels at No. 7 mill and close down the boilers and engines in mill No. 4, on Water Street, from eight to ten months in the year.

BELCHERTOWN, MASS.—At a special town meeting, held Aug. 17, the citizens voted to appropriate a sum not exceeding $600 to install an electric plant in the town.

BELLINGHAM, MASS.—At a special town meeting held recently a committeee was chosen to enter into a 10-year contract with the Edison Electric Illuminating Company for street lighting at the north end of the town, and with the Union Electric Light Company, of Franklin, to install 45 lamps in the South and Centre, for a term of three years. The lamps at the north end have been used for several years. The Selectmen, Hadley Perkins and Judson Camp are members of the committee.

GROTON, MASS.—The town has accepted the report of the special committee appointed to investigate the question of lighting the streets of the town by electricity. The committee recommended that the town install its own distributing system, at a cost of $15,000, and purchase electricity from the Ayer Electric Light Company. The street lighting system will include 155 tungsten lamps of 32 cp. in the town proper and 25 lamps in West Groton. The town will also furnish electricity to private consumers for lamps. The contract calls for 2300-volt, three-phase system, under which the town agrees to take 20,000 kw. a year at the rate of six cents per kw.-hour; the next 10,000 kw. at five cents per kw.-hour, and the second additional 10,000 kw. at four cents per kw.-hour. The commercial rate will be from 15 to 18 cents per kw.-hour. Henry K. Richards, Myron P. Swallow and Frank F. Waters are members of the committee.

SOUTHBRIDGE, MASS.—The Webster & Southbridge Gas & Electric Company will secure electricity from the Webster plant to operate the local system in the near future. The local power plant will be closed, but will be held in reserve for emergencies.

TURNERS FALLS, MASS.—The Franklin Electric Light Company is planning to establish an independent plant to supply electricity, and using the exhaust steam in public heating service. The company now secures electrical energy for operating its system from the Turners Falls company.

TOLUCA, MEX.—The Sultepec Electric Light & Power Company contemplates extending its 25,000-volt transmission line to Zacualpan, about 16 miles. R. J. M. Danley is vice-president and general manager.

MARQUETTE, MICH.—The City Council has granted the Cleveland-Cliffs Iron Company a franchise to construct and operate an electric transmission line within the city limits. The company is planning to extend its transmission lines from the Maas mine and from its power station on the Swanzey range. Two 1500-kw steam turbines will be installed. A new boiler will also be installed at the Maas mine power house.

DETROIT, MINN.—The citizens have voted to issue bonds for improvements to the municipal electric light and water works systems.

TYLER, MINN.—Bids will be received by P. D. Christensen, village recorder, until Aug. 27 for the construction of an electric light and water-works system, including the erection of a concrete building, gas-producer plant, pumping plant, dynamo, switchboard, pole line and wiring; also a 50,000-gal. concrete reservoir and 15,000-gal. air compressor tank. Oscar Claussen, of St. Paul, Minn., is engineer.

MACON, MISS.—Bids for remodeling the municipal electric light plant and water works will be opened Sept. 8. George U. Borde, of New Orleans, La., is consulting engineer.

PATTONSBURG, MO.—Plans have been completed for the construction of an electric light plant in Pattonsburg. It is proposed to erect transmission lines from Trenton to Pattonsburg, via Gallatin and Jamesport and establish a 24-hour service in Pattonsburg and intervening towns. Edgar B. Everly, manager of the Pattonsburg telephone exchange, is interested in the project.

ST. LOUIS, MO.—The plant of the Consumers' Light, Heat & Power Company has been put in operation and is now furnishing electricity in the Arcade Building. William H. Hauss is president of the company.

GLASGOW, MONT.—It is reported that plans are being considered for enlarging the electric light plant, which will include an addition to the power house for boiler room and pump pit; installation of boiler, two 500,000-gal. steam pumps, with necessary steam and water connections.

GREAT FALLS, MONT.—G. H. Gay, of Great Falls, has been granted a franchise by the Village Trustees to erect an electric plant in this village. It is said that Mr. Gay is planning to install a water-power plant, at a cost of $35,000.

LODGE POLE, NEB.—The question of establishing an electric light plant in Lodge Pole is under consideration.

MALMO, NEB.—At a special election held recently the citizens voted to issue bonds for the establishment of a lighting system.

VALLEY, NEB.—At a recent election the citizens voted in favor of the proposition to issue $17,000 in bonds to establish an electric light plant and water-works system in Valley.

HOBOKEN, N. J.—The Citizen's Light, Heat & Power Company has made a second application to the City Council for a franchise to erect an electric light plant in Hoboken. The company was granted a franchise by the Council last spring, which it did not accept.

IRVINGTON, N. J.—Proposals accompanied by plans and specifications for the installation of a municipal electric light plant will be received at the office of the town clerk until Sept. 7. For further information address George M. Williams, chairman.

ORANGE, N. J.—Plans prepared by Runyon & Carey, of Newark, N. J., consulting engineers, for the proposed municipal electric light plant have been approved by the Common Council. The cost of the plant, with wires placed underground on Main Street, is estimated at $76,000 and with wires overhead $65,000. The plans call for two 160-kw. generating units, switchboard, condenser, steam piping, etc. The street lighting system calls for nine arc lamp circuits, providing for 365 magnetite arc lamps and 65 tungsten street lamps. The equipment will be installed at the water works pumping station. Bids will be received until Sept. 20 for the above equipment.

PATERSON, N. J.—The residents of Totowa Borough and of West Park are considering the question of establishing an electric light plant to furnish electricity in this borough.

ALAMOGORDO, N. M.—The application of the White Mountain Power Company for water rights of the Ruidoso River and tributaries in Lincoln County sufficient to develop 5000 hp has been granted by the territorial engineer. The company proposes to utilize the power to generate electricity to be used for pumping purposes, electric lighting and other purposes at Fort Stanton, Carrizoza and other places. One of the conditions of the grant is that power is to be supplied to the settlers in the Ruidoso Valley at the same price that it is sold to other customers. The cost of the plant is estimated at $200,000, and the main canal is to be 10 miles long. Oliver M. Lee, C. E. Mitchell and J. L. Lawson, of Alamogordo, are interested in the enterprise.

PORTALES, N. M.—The United States Sugar & Land Company, of Garden City, Kan., is reported to have contracted with the farmers around Portales to furnish electricity for pumping water for irrigation. The company proposes to install a large power plant in Portales.

BROOKLYN, N. Y.—Harry P. Brearley, 12 Gates Avenue, Brooklyn, N. Y., is in the market for one 150-kw, 250-volt, direct-current belted generator; one 60-kw, 250-volt, direct-current belted generator; one 50-hp, 250-volt, direct-current motor; two 25-hp, 250-volt, direct-current motors; two 50-hp, two-phase, 220-volt motors; two 25-hp, two-phase, 220-volt motors; one 14-inch Corliss engine; two 100-hp, tubular boilers, and one 75-kw, direct connected, 220-volt unit.

LOWVILLE, N. Y.—Surveys are being made by the Wetmore Electric Company for an extension of its transmission line to Beaver Falls, Naumburg and Castorland. The main line will be tapped about one mile south of Croghan. The company will furnish electricity for house and street lighting and also for motors in all three villages. At Beaver Falls the company will supply electricity for the large plant of the James P. Lewis Company, which will utilize 500 hp. Electrical energy will be supplied to operate the two large grist mills, owned by Sidney Virkler, and several other small manufacturing plants in Castorland.

NEW YORK, N. Y.—The New York, Westchester, Manhattan & Boston Railway Company has applied to the Public Service Commission, Second District, for permission to an increase of $20,000,000 in its cap-

ital stock, which at present is capitalized at $4,000,000. The corporation, which is controlled by the New York, New Haven & Hartford Railroad Company interests, recently acquired the property and holdings of the New York & Port Chester Railroad, and asked for permission to consolidate the two properties, the same to be operated under the name of the New York, Westchester & Boston Company, which is constructing a four-track electric railway from the Lenox Avenue terminal of the subway to Port Chester, with a double track running from Mount Vernon to White Plains. It was stated at the hearing that the company will not build power plants of its own, but would secure electricity from the New York, New Haven & Hartford Railway Company.

NEW YORK, N. Y.—The Long Island Railroad Company has applied to the Public Service Commission, Second District, for permission to issue debentures to the amount of $16,500,000, the proceeds to be used to pay the Pennsylvania Railroad Company $6,032,951 loaned by that company and expended for various improvements during the years 1905 to 1908. The company states that it will require within the next three years additional capital for the construction work and for equipment necessary to continue the improvements which have been commenced, and on which large sums of money have been expended, which will include the main line improvement between Woodside and Jamaica, $2,000,000; Jamaica Terminal, $1,000,000; North Side improvements, double track electrification, $1,000,000; Bay Ridge improvement, elimination of grade crossings, $1,000,000.

HICKORY, N. C.—Surveys have been completed for the hydro-electric development near Hickory, being promoted by Col. T. J. Thornton, of Hickory, work on which will begin in September. Colonel Thornton also contemplates the organization of a company to erect a large cotton mill, to be operated by electricity, using 6000 hp.

CADIZ, OHIO.—Application has been made to the City Council by the Wheeling, Cadiz & Tuscarawas Traction Company for a franchise to construct an electric railway over certain streets in this city. A. E. Townsend, of Cadiz, is president and general manager.

GARRETTSVILLE, OHIO.—Plans are being considered for increasing the output of the local electric light plant, which will include the installation of a new engine and dynamo. Bruce, Fisher & Tuttle are owners of the plant.

COLUMBUS, OHIO.—Preparations are being made by the managers of the municipal electric light plant to establish a day service by Nov. 1. H. Gamper is superintendent.

LEBANON, OHIO.—Plans are being made by the Lebanon & Franklin Traction Company to extend its railway to Springboro, a distance of four miles. Robert E. Kline, Bank Building, Dayton, Ohio, is general manager.

McARTHUR, OHIO.—The City Council is reported to be considering the installation of a 60-hp gas engine direct connected to a 220-volt generator in the municipal electric light plant. A. E. Noble is superintendent.

MILLERSBURG, OHIO.—The question of establishing a day service is under consideration by the Millersburg Electric Light Company. Howard Richards is superintendent.

XENIA, OHIO.—It is understood that the plant and holdings of the People's Gas & Electric Light Company will be sold by the receivers in the near future. The Union Savings Bank & Trust Company, of Cincinnati, Ohio, is receiver.

RALSTON, OKLA.—T. E. Bryant, city clerk, writes that bids will be received about Sept. 1 for the construction of a municipal electric light plant and water works, for which an issue of $25,000 in bonds was recently voted. M. A. Earl & Company are engineers.

SUPPLY, OKLA.—Bids will be received by the State Board of Public Affairs until Sept. 14 for the complete installation of a heating and power plant at the Hospital for the Insane, at Supply, Okla., in accordance with plans and specifications prepared by Layton, Smith & Hawks, architects, of Oklahoma City, Okla., and to be erected under the supervision of the State Board of Public Works. Plans and specifications may be seen at the office of E. G. Newell, superintendent of hospital, Supply; at the office of the architect of State Board of Public Affairs, Guthrie, Okla., and at the office of Layton, Smith & Hawks, architects, Oklahoma City. Bidders to include in their proposals a two-ton ice-making plant to be installed in said building, plans and specifications for which to accompany the proposal, to be subject to the approval of the board and architects. Proposals to be addressed to Victor E. Harlow, secretary, Guthrie, Okla.

FOREST GROVE, ORE.—The United Railways Company has petitioned the City Council for a franchise to construct an extension of its system into Forest Grove.

PENDLETON, ORE.—The Umatilla Railway & Electric Power Company is planning to construct an electric railway from Pendleton to Dale, a distance of about 100 miles, and also proposes to erect a hydro-electric plant on the John Day River. The company is capitalized at $100,000, and the officers are: Douglas Belts, of Pilot Rock, president; George A. Brown, vice-president and general manager, and A. R. Turner, secretary and treasurer.

PORTLAND, ORE.—Plans are being considered by the Rose City Park Improvement Association for lighting and paving the Sandy Road, known as the Rose City Avenue. It is proposed to install lamps from Twenty-eighth Street to the city limits at once.

UNION, ORE.—A special election will soon be called to vote on the proposition to issue bonds for the construction of a municipal electric plant.

ERIE, PA.—The Erie Electric Company, it is reported, is planning to construct a large electric power plant on the bluff of the harbor, just west of the Pittsburgh docks. The cost of the plant is estimated at about $200,000. The three-phase system will be installed. When the new station is completed the present power house will be used as a distributing station.

PHILADELPHIA, PA.—The Philadelphia Electric Company has awarded the contract for the construction of its new power house on Kensington Avenue, north of J Street, to John R. Wiggins & Company, for $18,000.

SPARTANSBURG, S. C.—The Electric Power & Manufacturing Company, which has a large hydro-electric plant at Gaston Shoals, S. C., is reported to be negotiating for the purchase and development of another water power site in the same section. This company owns and operates the Spartansburg Railway, Gas & Electric Company, and is said to be interested in the development of an extensive interurban railway system in the northern section of this State.

INKSTER, S. D.—The citizens are considering the question of installing an electric light plant.

IPSWICH, S. D.—It is reported that work will soon commence on the construction of an electric light plant in Ipswich, for which $10,000 has already been subscribed by the citizens.

RAPID CITY, S. D.—The Dakota Power Company, it is said, has consolidated the Richards, Duncan and Mansfield water rights, thus securing a fall of 1009 ft., capable of developing 8000 hp. The company proposes to build a power plant at a cost of about $1,500,000.

BROWNSVILLE, TENN.—The Brownsville Cotton Oil & Ice Company has purchased the plant and holdings of the Brownsville Light & Power Company. It is said that the new owners will remodel the plant and install new machinery. Robert N. Bond will be general manager.

LEBANON, TENN.—H. B. Bond, of Lebanon, has been granted a 99-year franchise to construct and operate a street railway in Lebanon.

PADUCAH, TEX.—The citizens are considering the question of installing an electric light plant. W. H. Winton, secretary of the Commercial Club, would like to correspond with parties interested.

BRIGHAM CITY, UTAH.—Arrangements have been completed by Messrs. Bell, Ray and Baker, of the Ogden Portland Cement Company for the transmission of electricity from the power plant of the Utah Smelter, at Hot Springs, to their cement factory at Brigham City.

LOGAN, UTAH.—Application has been made to the City Council by David Eccles, president of the Ogden Rapid Transit Company, of Ogden, Utah, for a franchise to construct a street railway system in Logan. The proposed extension which is to extend from Ogden to Logan, via the Cache Valley, a distance of sixty miles, has already been built as far as the Ogden Valley, a distance of fifteen miles.

BARTON, VT.—Arrangements are being made by the Village Trustees to begin work on the installation of a new penstock at the Barton electric plant at Charleston. Electricity for operating the local system will be furnished by the Island Pond Electric Company, while the municipal electric plant is shut down for repairs, which it is expected will take about two weeks.

MARTINSVILLE, VA.—Plans are being considered for enlarging the dam and increasing the output of the municipal electric light plant.

SEATTLE, WASH.—The City Council has passed the ordinance providing for the installation of cluster lamps on Eleventh, Twelfth, Thirteenth, Fourteenth, Fifteenth, Sixteenth and Eighteenth avenues.

WHEELING, W. VA.—The City & Elm Grove Railroad Company has made application to the County Commissioners for a franchise to extend its electric railway around Wheeling Park and at Park View.

DE PERE, WIS.—The De Pere Electric Company is preparing to change its system from direct to alternating current, at a cost estimated at $10,000.

NEW RICHMOND, WIS.—Preparations are being made by the Wisconsin Telephone Company for rebuilding its entire plant in this city. Aerial wire will be replaced by cables throughout.

SOMERSET, WIS.—Negotiations have been completed by the Apple River Power Company, a subsidiary of the Washington County Light & Power Company, of Stillwater, Minn., for the purchase of the Ames-Mason mill property, just below Somerset. The new owners propose to erect a dam with a 41-ft. head and install another electric power plant. It is estimated that about 2000 hp will be developed, which will be transmitted to Stillwater and the Twin Cities. When completed it will make the fifth plant operated by the company.

LADYSMITH, B. C., CAN.—The city has awarded the contract to the Canadian Westinghouse Company for a complete power plant. G. M. Turney is city electrical engineer.

NELSON, B. C., CAN.—The officials of the Canadian Pacific Railroad Company, it is reported, are contemplating equipping the Columbia & Western branch to be operated by electricity. It is said that 35,000 hp is available at Bonnington Falls; there are also several other good water powers along the line, not yet developed. For further information address Lorne A. Campbell, Nelson, B. C.

NEW WESTMINSTER, B. C., CAN.—The international Electric Railway Company will soon commence the construction of its proposed electric railway from a point in the Municipality of Surrey to a point at or near

Port Kells. Bowser, Reid & Wallbridge, of Vancouver, B. C., are attorneys for the company.

WINNIPEG, MAN., CAN.—Preparations are being made to erect the transmission lines for the distribution of electricity from the municipal electric plant now under construction.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Railway Company is planning to construct a nine-track car barn to be erected in the north end of the city at a cost of $100,000, which includes the cost of the construction of a repair shop and substation.

COBALT, ONT.. CAN.—Orders have been placed by the Mines Power Company for four 5000-cu. ft. air compressors, giving it a total capacity of 20,000 cu. ft. Each of the compressors will be operated by a 1000-hp, alternating-current motor, electricity for which will be obtained from the company's electric power plant located at the Matabitchuan in South Lorain. The new machinery will be installed in the two substations at Kerr Lake and Cobalt, which will supply the upper and lower ends of the Cobalt camp with electricity and air. The two stations will be connected, so that they can be thrown into one system.

FORT FRANCIS, ONT., CAN.—The Rainy River Radial Railroad Company is seeking a charter to build several electric car lines between Fort Francis, Ont., and the American boundary near International Falls.

HARTLAND, ONT., CAN.—John E. Stewart and A. E. Downworth are reported to be interested in a project to construct an electric railway to connect Hartland, Foreston, Rockland, Windsor and Knowlesville.

PORT HOPE, ONT., CAN.—Arrangements are being made by the Durham-Northumberland Power Company for the development of extensive water power rights in the vicinity of Port Hope. Ont. J. A. Culverwell is managing director.

TORONTO, ONT., CAN.—John Hagmen & Company, of London, Ont., have been awarded the contract for the construction of the interswitching station, and also for the step-up transformer station in connection with the hydro-electric development. The prices are, respectively, $35,000 and $47,700.

TORONTO, ONT., CAN.—Bids will be received by the city of Toronto until Oct. 14 for electric motors as follows: Four 1500-hp. synchronous motors; two 1500-hp. induction motors; four 500-hp. synchronous motors; four 500 hp. induction motors and two 225-hp. synchronous motors, with exciters, switchboards, connecting material, etc. For specifications and form of tender apply to the city enginer. Bids will also be received by the city on the same date for the following turbine pumps: Four 13,500,000-gal. pumps, 100 lb. pressure; two 5,000,000-gal. pumps, 300 lb. pressure; two 10,000,000-gal. pumps, 65 lb. pressure; two 10,000,000-gal. pumps, 110 lb. pressure; two 6,500,000-gal. pumps, 90 lb. pressure; two 6,500,000-gal. pumps, 160 lb. pressure; two 1,500,000-gal. pumps, 65 lb. pressure; two 1,500,000-gal. pumps, 110 lb. pressure, with valves, piping, bed plates, couplings, etc. For specifications and form of tender apply to the city engineer.

MONTREAL, QUE., CAN.—The Montreal Light, Heat & Power Company is contemplating the installation of an ice plant, to cost from $125,000 to $150,000.

REGINA, SASK., CAN.—Plans have been completed for the construction of an electric street railway system in Regina, which are now under consideration by the City Council. For further information address Alderman Peverett.

New Industrial Companies.

THE ACKER-NIGHTINGALE CONSTRUCTION COMPANY, of New York, N. Y., has been incorporated by Craig E. Nightingale, of Rye, N. Y.; B. S. Acker, of Cresskill, N. J., and George A. Acker, of Haworth, N. J. The company is capitalized at $2,500 and proposes to do designing, construction, engineering, architecture, etc.

THE AUTOMATIC FALSE ALARM DETECTIVE COMPANY, of Wilmington, Del., has been incorporated with a capital stock of $100,000, by J. B. Nicholson, D. B. Miller, Jr., F. C. Geiger, of Washington, D. C.

THE DEXTER-CHAPMAN ENGINEERING COMPANY, of Arlington, N. J., has been incorporated with a capital stock of $25,000, by E. Norton, A. H. Jackson and J. L. McCord, of Arlington, N. J. The company proposes to do a general engineering and contracting business.

THE HULIT TRANSMITTER COMPANY, of Topeka, Kan., has been chartered, with a capital stock of $50,000, for the purpose of manufacturing and dealing in telegraph transmitters, keys, equipment and apparatus. The directors are: E. C. Arnold, O. C. Neiswander, C. E. Curry, E. A. Clarke and J. A. Rosser.

THE INTERNATIONAL COMPANY, of Wilmington, Del., has been incorporated with a capital stock of $50,000, by E. G. Reed, R. L. Reed, of Wilkinsburg, Pa., and C. R. Buckhelt, of Pittsburgh, Pa.

THE INVINCIBLE CLEANING COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $50,000, to manufacture renovators and cleaning machines, by M. E. Poffingbarger, W. H. Duval and A. E. Lake.

THE WIEBE ENGINEERING COMPANY, of New York, N. Y., has been chartered, with a capital stock of $100,000, by W. C. Gilmore, C. F. Hathaway and F. K. Jones, of New York, N. Y. The company proposes to do a general engineering construction business, etc.

THE WUNDERBUTTON LIGHT COMPANY, of New York, N. Y., has been chartered by W. V. Ebert, W. G. Smith and P. J. Smith, of New York, N. Y. The company is capitalized at $100,000 and proposes to manufacture lamps, machinery and appliances for the production of light and heat.

New Incorporations.

BIRMINGHAM, ALA.—The Birmingham Water, Light & Power Company has been incorporated, with a capital stock of $20,000, by Charles E. Glover, of North Birmingham and others.

BIRMINGHAM, ALA.—The National Mining & Power Company has been organized, with a capital stock of $2,500,000, and proposes furnishing power throughout the mining section in the State of Alabama. The officers of the company are: C. F. Wheelock, of Birmingham, president; W. K. Wheelock, vice-president, and M. H. Bone, secretary and treasurer.

SAN FRANCISCO, CAL.—The Railroads & Power Development Company has been incorporated under the laws of Maine. The company is to be a holding company for the Stanislaus Power Development Company and the San Francisco Electric Railways Company, and will also hold $10,000,000 of the $18,000,000 of the common stock of the United Railroads of San Francisco.

CARTERVILLE, ILL.—The Interurban Electric Company has been incorporated by F. W. Richart, E. E. Denison and H. B. Cassel. The company is capitalized at $150,000, and proposes to operate an electric light, heat and power plant.

ELDORA, IA.—The Iowa Light & Traction Company has been incorporated under the laws of South Dakota with a capital stock of $500,000, for the purpose of constructing an electric railway from Boone to Ogden, Ia., with branches to Ames, Story City, Eldora, Des Moines, Webster City and Perry, Ia. The officers of the company are: Henry S. Osborne, chairman of board; Andrew Stevenson, of Chicago, Ill., president and general manager; E. Hughes, of Boone, Ia., vice-president and treasurer, and J. F. Hardin, of Eldora, secretary. The headquarters of the company are at 153 LaSalle Street, Chicago, Ill.

AURORA, MO.—Articles of incorporation have been filed for the Lawrence County Light, Heat & Storage Company, with a capital stock of $250,000, by J. E. Woodhill, E. Emmett Brown and C. M. Kirby.

ST. LOUIS, MO.—The St. Louis & Kansas City Electric Railway Company has been organized to construct a double-track, high-speed, polyphase, electric railway from St. Louis to Kansas City, a distance of 250 miles. The company will be capitalized at $15,000,000. W. D. Nevi, of Denver, Col.; W. H. Chase, B. F. Gray, Edgar R. Talton, of St. Louis, Mo., and Daniel F. Miller are interested in the enterprise.

NINNEKAH, OKLA.—The Ninnekah Electric Light & Power Company has been incorporated, with a capital stock of $21,000, by R. M. Evans, of Chickasha, Okla.; R. J. Gordon and C. M. Lentz, of Ninnekah.

OKLAHOMA CITY, OKLA.—The Oklahoma City & Suburban Railway Company has been chartered with a capital stock of $250,000 for the purpose of constructing four interurban railways, the main route to extend from Britton to Edmond and Oklahoma City to Moore, 32 miles in length. The incorporators are: Charles W. Ford, superintendent of the Oklahoma Railway; J. J. Johnson, Fred S. Combs, W. A. Haller and Richard Durret, all of Oklahoma City.

PORTLAND, ORE.—Articles of incorporation have been filed for the McKenzie Power Company, with a capital stock of $25,000, by A. Welch, I. Andeson and E. W. Hall.

PORT ARTHUR, TEX.—The Port Arthur Traction Company has been chartered, with a capital stock of $200,000, to construct an electric railway in Port Arthur six miles in length. The incorporators are: H. J. Myers, A. H. Reeder, of Dayton, Ohio, and A. L. Davis, of Harris County. The headquarters of the company are at 503 Reibold Building, Dayton, Ohio.

NORTH YAKIMA, WASH.—The Yakima Central Heating Company has been incorporated, with a capital stock of $100,000, to do a central-station heating business. It is proposed to erect a plant having 800-hp boiler capacity, with feed-water heaters, boiler feed pumps, etc. The Schoot Engineering Company, of Chicago, Ill., has the contract for the installation of the plant, the cost of which is estimated at $100,000.

GREAT CACAPON, W. VA.—Articles of incorporation have been filed for the Hydro-Electric Development Company by William B. Osler, Morris A. Ornduff, of Great Cacapon; William F. Disher, of Berkeley Springs, W. Va.; Samuel R. Boyer, of Hanover, Pa.; and Albert Holland, of Baltimore, Md. The company is capitalized at $100,000, and proposes to develop the water power of the rapids in the Great Cacapon River to be utilized to generate electricity, which will be transmitted to towns in Hampshire and Morgan counties.

OTTAWA, ONT., CAN.—The Dominion Electric Company has been incorporated here, with a capital stock of $40,000, by T. A. Low, R. Hadley and W. T. Guest.

Legal.

COURT HOLDS UP LIGHTING CONTRACT.—Judge Stevens of the County Court on Aug. 9 granted a temporary injunction against the execution of the contract recently awarded to the Metropolitan Electric Company by the City Council of Reading, Pa., for a period of 10 years. At the final hearing, which will take place in two weeks, the city will be enjoined from awarding a contract for a longer period than five years.

Personal.

MR. R. S. WALLACE has been appointed general manager of the Peoria Gas & Electric Company, of Peoria, Ill. For several years Mr. Wallace has been superintendent of the company.

MR. HARRY B. KIRCHER has resigned as local manager of the Belleville Gas & Electric Company, a position he has held for five years. Mr. Kircher is undecided as to what work he will take up in the future.

MR. W. L. WATERS, engineer in charge of turbo-generator work of the Westinghouse Electric Mfg. Co., sailed for Europe August 25 on a short business trip. Mr. Waters expects to be away about a month.

MR. HAROLD S. SCHUTT, manager of the Michigan City Gas & Electric Company, of Michigan City, Ind., has been appointed general manager of the Wilmington Gas & Electric Light Company, of Wilmington, Del.

MR. H. E. M. KENSIT, of Messrs. Smith, Kerry & Chace, consulting engineers, Toronto, has left Toronto and will in future reside in Calgary, Alta., where that firm has opened an office at 68 McDougall Block.

MR. HUGO REISINGER was received by the Emperor and Empress of Germany on Aug. 21 during a visit of their majesties to the Saalburg Museum, to which Mr. Reisinger had presented a valuable collection of Roman antiquities.

MR. WILLIAM N. PATTEN, engineering manager of the Stone & Webster Engineering Corporation, has become associated with the construction department of the company, and Mr. Frederic N. Bushnell has succeeded him as engineering manager.

PROF. L. P. DICKINSON, for the past six years assistant professor of electrical engineering in Lafayette College, has resigned from that institution to accept the chair of physics and electrical engineering in Rhode Island State College, Kingston, R. I.

MR. E. D. RASMUSSEN has resigned from the Choctaw Railway & Lighting Company, McAlester, Okla., to join the Allis-Chalmers Company. Mr. Rasmussen was formerly electrical engineer and superintendent of the power plant of the El Paso Southwestern System.

MR. F. C. ARMSTEAD, supervising engineer of the stoker department of the Westinghouse Machine Company, who, for a number of years, has been located at East Pittsburgh, Pa., has moved his headquarters to the Westinghouse works, Attica, N. Y., where the stokers are manufactured.

MR. PAUL H. SMITH, formerly district engineer for the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., in charge of the erecting department in St. Louis, Mo., has been appointed superintendent of the Pittsburgh & Butler Street Railway Company, of Pittsburgh, Pa., succeeding Mr. W. M. Kessler, resigned.

PROF. ALBERT A. MICHELSON, professor of physics at the University of Chicago, received the honorary degrees of doctor of philosophy and master of liberal arts from the University of Leipsic on the occasion of the five-hundredth anniversary of that institution. Professor Michelson's work in optics gained him the Nobel prize of $40,000 in 1907.

MR. HOWARD P. LINGO, formerly with the Foster & Glidden Engineering Company, of Buffalo, N. Y., has accepted a position with the Northern Idaho & Montana Power Company, and will be located at Kalispell, Mont. Mr. Lingo was for a number of years connected with the construction department of the Westinghouse Electric & Manufacturing Company.

MR. ARTHUR ROSCOE DENNINGTON, who was formerly in charge of the electrical engineering laboratories at the Pennsylvania State College, and who for the past two years has been assistant principal of the electrical department of the International Correspondence Schools, will spend a year in England assisting in the development of technical correspondence courses for the London branch of the International Educational Publishing Company.

PROFESSOR MILLARD C. ERNSBERGER has been appointed Dean of the new department of Applied Science at the University of Rochester. Professor Ernsberger graduated from the University of Rochester in 1888, and took up the practice of law. Finding this uncongenial, he entered the industrial field, and after rising to be general superintendent of a large works, resigned to enter Cornell University to take its course in mechanical and electrical engineering, and upon graduation remained as instructor in Sibley College.

MR. FREDERIC N. BUSHNELL, who has just been appointed engineering manager of the Stone & Webster Engineering Corporation, joined the staff of Stone & Webster in February, 1907, taking charge of the construction of the Lincoln, Harvard and Charlestown power stations of the Boston Elevated Railway. This work consisted in substantially enlarging the structures of the three original stations and installing 20,000 hp of new generating capacity with boilers and all other auxiliaries. It was carried out in the exceptionally short period of 10 months. Previously, Mr. Bushnell was chief engineer of the Rhode Island Company, in charge of design and construction of power stations, substations, car barns, bridges, tracks, and also of operation of power stations. In connection with a large station designed and built under his supervision at Providence, there was conducted a service test which lasted an entire year and established a record for economical operation that has rarely been equaled. Mr. Bushnell is regarded as an authority on the design and operation of power stations.

Obituary.

GEORGE T. HEDRICH, for the past 18 years in the electrical engineering department of the Westinghouse Electric & Manufacturing Company, died on Aug. 9 at Pittsburgh after a short illness, at the age of 49 years. He is survived by a widow.

MR. CHARLES S. KNIGHT, for many years prominently identified with the electrical business throughout the country, died at his home at Fort Wayne, Ind., Aug. 14, from Bright's disease and other complications. In the early eighties Mr. Knight was manager of the Fort Wayne Gas Company. In 1885 he became associated with the late R. T. McDonald in the old Fort Wayne Electric Company, and was vice-president and sales manager of that company until 1898, when he removed to Chicago to become general manager of the Siemens & Halske Electric Company. After this company was sold to the General Electric Company, Mr. Knight returned to Fort Wayne and for the past several years devoted his time to his mining interests.

Trade Publications.

ASBESTOS.—A mailing folder being distributed by the H. W. Johns-Manville Company, 100 William Street, New York, briefly describes, illustrates and lists the various materials in which use is made of asbestos.

CONTROLLERS.—The Electric Controller & Manufacturing Company, Cleveland, Ohio, has issued in booklet form a series of five articles dealing with electric-motor control, written by its president, Mr. A. C. Eastman. The articles are of a more or less technical nature, but are written in a style to be readily understood by any one familiar with machinery.

TRANSMISSION LINE SPECIALTIES.—A loose-leaf catalog issued by the Monroe Electrical Manufacturing Company, Monroe, Mich., contains descriptions and price lists of cable-hangers, duct-rods, cable-arms, plug-boxes, pole-seats, time-switches, turnbuckles, pay-out reels, distribution racks, guy anchors and other devices used in the erection of transmission and distribution circuits.

WAKEFIELD FIXTURES.—The F. W. Wakefield Brass Company, Vermilion, Ohio, has issued a folder explaining and illustrationg the "Wakefield idea" in electrical fixtures. With a relatively few Wakefield parts in stock a practically unlimited number of styles of fixtures can be quickly assembled. Moreover, the detail parts are of such a design that the fixtures in which they enter can be given an artistic appearance far superior to that of the staple low-priced fixture.

Business Notes.

THE CROCKER-WHEELER COMPANY will open an office in the Ford Building, Detroit, Mich., on Sept. 10. Mr. Charles W. Cross will be the manager of the new branch.

THE SCHOTT ENGINEERING COMPANY, of Chicago, Ill., has moved its office from 125 Monroe Street to 315 Dearborn Street. At the new location, on the ninth floor of the Manhattan Building, the company is fitting up a handsome suite of offices.

THE GARWOOD ELECTRIC COMPANY announces that it has appointed the Charlotte Contract Company, Charlotte, N. C., as sales agent for North Carolina and South Carolina. The Charlotte Contract Company is a well-known concern, making a specialty of cotton machinery and steam-heating apparatus.

THE HOYT ELECTRICAL INSTRUMENT WORKS announce that Mr. E. W. Carter, who has for some time past been in charge of the Boston office, will hereafter be connected with the factory, and Mr. A. K. Brown will succeed him in charge of the Boston office. Mr. Brown has been identified with Hoyt instruments for a considerable time, and is therefore well equipped for his new position.

THE CRESCENT COMPANY, 106 South Clinton Street, Chicago, Ill., announces that it has recently taken the agency for the American Conduit Manufacturing Company, of Pittsburgh, Pa., maker of American rigid iron conduit and "Wireduct" non-metallic flexible conduit. It has also taken the agency for the Lowell Insulated Wire Company, of Lowell, Mass., maker of lamp cords, telephone wire and all kinds of rubber insulated wire. The Crescent Company carries a complete Chicago stock of all that is standard in each of these lines so as to insure prompt shipment of rush orders.

DALLAS WESTERN ELECTRIC BUILDING.—The Dallas business of the Western Electric Company was recently moved into its new quarters in its own building, at Pacific and Evay streets, a three-story and full-basement model structure. The Western Electric Company has been in Dallas two years, but during this time business has increased to such an extent that the old quarters were found inadequate, and as a result this new structure, costing approximately $100,000, has been built. The building, which serves as a storehouse, and contains the offices of the company, also includes a large repair shop, to take care of the ordinary repairs of the apparatus handled by the company. Employment will be given to about 125 men, which is an increase of 50 per cent over those formerly employed by the company.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED AUG. 17, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

931,033. LIGHTNING ARRESTER; W. E. Butler, David City, Neb. App. filed July 16, 1908. Lightning arrester of the mercury type in which the terminals enter a bath of mercury contained in the vessel.

931,034. X-RAY APPARATUS; E. W. Caldwell, New York, N. Y. App. filed March 5, 1906. Combined closed cabinet and impervious shield with the indicating and control devices arranged near a window through which the protected operator looks.

931,055. AUTOMATIC TELEGRAPH AND SELECTIVE SYSTEM THEREFOR; A. C. Gilmore, Chicago, Ill. App. filed Oct. 6, 1904. Selectively controls a printing machine by means of a relay controlled by the line impulses which mechanically operate a set of selectors controlling the type wheel.

931,068. GALVANIC SOLE; F. Kennedy and J. V. Davis, Bournemouth, Eng. App: filed Aug. 8, 1908. Details.

931,072. AUTOMATIC TELEPHONE EXCHANGE SELECTOR; F. H. Loveridge, Chicago, Ill. App. filed Aug. 2, 1906. The selector has a number of rows of line terminals arranged in a field with a contact arm, which rotates to select one of the rows and moves longitudinally to the desired terminal in the selected row.

931,081. PROCESS OF PREPARING STORAGE BATTERY ELEMENTS; D. P. Perry, Chicago, Ill. App. filed Dec. 26, 1903. Dissolves and cadmium precipitates the hydrates converts to their oxides and secures the oxides to a support.

931,082. PROCESS OF PREPARING ALKALINE ELECTROLYTES FOR STORAGE BATTERIES; D. P. Perry, Chicago, Ill. App. filed Dec. 26, 1903. Prepares an alkaline zincate by placing it within a battery, charging the battery, pouring off the solution and washing out the battery and replacing with a purified alkaline solution.

931,092. ELECTROLYTIC PRODUCTION OF MAGNESIUM; G. O. Seward and Franz von Kugelgen, Holcombs Rock, Va. App. filed March 28, 1906. Fuses magnesium chlorid, to which is added a denser alkaline earth chlorid.

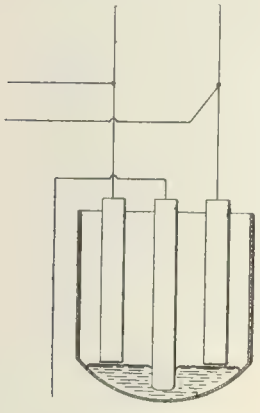
931,105. COMMUTATOR FOR DYNAMO ELECTRIC MACHINES; J. E. Webster, Pittsburgh, Pa. App. filed Sept. 8, 1908. For direct-current turbine-driven generators, in which the commutator includes a series of disks with wedge-shaped blocks electrically connected.

931,114. SYSTEM FOR VAPOR ELECTRIC APPARATUS; F. Conrad, Swissvale, Pa. App. filed Jan. 10, 1908. For mercury vapor lamps upon alternating circuits, in which a current rectifier is used and a transformer interposed between the circuit and the rectifier, having means for introducing inductance into the circuit supplied therefrom.

931,115. SYSTEM OF DISTRIBUTION FOR MERCURY VAPOR RECTIFIERS; F. Conrad, Swissvale, Pa. App. filed Dec. 6, 1907. Includes a transformer with two series connected secondaries and two series connected primaries movable with respect to the secondaries, together with a core having a leakage path and a rectifying device.

931,116. DYNAMO-ELECTRIC MACHINE; J. D. Forrer, Pittsburgh, Pa. App. filed Oct. 7, 1908. Improvement in commutators which are protected from excess lubricating fluids by flanges which carry off the fluid by centrifugal force.

931,123. DEVICE FOR HOLDING FIRE ALARM KEYS; A. Iske, Lancaster, Pa. App. filed June 23, 1908. Prevents the key from being taken surreptitiously by providing a wheel with a key holding compartment registering with an opening so that the key cannot be withdrawn until the wheel is turned to register with the opening.



931,033.—Lightning Arrester.



931,133.—Arc Lamp Electrode.

931,124. CURRENT RECTIFYING APPARATUS; R. P. Jackson, Wilkinsburg, Pa. App. filed March 9, 1908. A transformer having a magnetizable core with two legs, a plurality of coils surrounding each leg, the intermediate ones being subdivided and leakage paths of low reluctance between the coils.

931,126. CONTROL SWITCH AND SYSTEM; H. D. James, Pittsburgh, Pa. App. filed Dec. 14, 1908. The switch contacts have an operating coil, a blow-out coil, a spring restrained armature for the blow-out coil and means for holding it in position when the main switch is closed.

931,127. TELEPHONE TRANSMITTER; A. G. Kaufman, New York, N. Y. App. filed Aug. 28, 1907. Regulates the instrument to varying heights by cord and pulley attached to the transmitter.

931,130. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES; B. G. Lamme, Pittsburgh, Pa. App. filed Oct. 7, 1908. For cooling commutators by providing ventilating ducts, the commutator segments being of unequal depth to form the ducts.

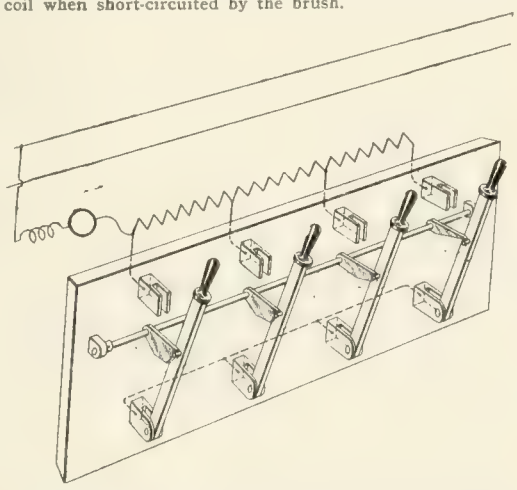
931,133. ARC-LAMP ELECTRODE; G. M. Little, Pittsburgh, Pa. App. filed Sept. 3, 1907. A flaming arc lamp, in which the electrode contains an alloy of iron and chronium in a granulated condition.

931,136. VARIABLE SPEED ALTERNATING-CURRENT MOTOR; R. D. Mershon, New York, N. Y. App. filed May 28, 1906. A rheostat controls the secondary by means of a motor.

931,138. PRIVATE BRANCH INTERCOMMUNICATING TELEPHONE SYSTEM; J. L. McQuarrie, Oak Park, Ill. App. filed Nov. 23, 1907. For answering a call on a trunk line at any one of several stations, the answering telephone being also utilized for communicating with another local station without disconnecting the signal at central.

931,148. MULTIPLE-SWITCH RHEOSTAT; O. S. Schairer, Pittsburgh, Pa. App. filed Nov. 8, 1908. Provides a series of independently actuated switches with a plurality of inter-connected dogs mounted for rotative movement to prevent each switch, except the first of the series, from closing unless the next preceding switch is closed.

931,150. WINDING OF ARMATURES FOR ALTERNATING-CURRENT MOTORS; B. C. Shipman, Baltimore, Md. App. filed Jan. 29, 1906. Single-phase commutator motor generates in the leads between the coil and the bars an e.m.f. equal and opposite to that in the coil when short-circuited by the brush.



931,148.—Multiple Switchboard Rheostat.

931,156. WINDING FOR DYNAMO ELECTRIC MACHINES; H. C. Specht, Wilkinsburg, Pa. App. filed July 26, 1906. For a synchronous motor windings in which a plurality of groups of coils are used, each group producing a pair of adjacent unlike poles and successive groups in the circuit being arranged in a different order as to position in the winding.

931,157. ELECTRIC SELF-WINDING CLOCK; J. Steiger and J. Besancon, La Chaux-de-Fonds, Switzerland. App. filed Feb. 11, 1907. The driving weight is suspended by a cord wrapped around a drum released by a pawl and ratchet and driven by the motor.

931,165. FLEXIBLE CONNECTION FOR CO-OPERATING MEMBERS; J. E. Webster, Pittsburgh, Pa. App. filed Dec. 3, 1906. For connection between a motor and the part driven thereby, the connection including a chamber with a co-operating member and resilient means surrounding the member within the chamber.

931,168. ARC LAMP; S. P. Wilbur, Wilkinsburg, Pa. App. filed April 28, 1906. Cut-out and feed regulator for arc lamps, including an E-shaped core with an auxiliary projecting portion and suitable windings mounted on the projections.

931,169. ELECTRODE FOR ARC LAMPS; S. P. Wilbur, Wilkinsburg, Pa. App. filed April 28, 1906. Flaming-arc lamp having a tubular electrode with lateral apertures surrounded by a hood.

931,179. TELEPHONE DESK STAND; J. A. Birsfield, Chicago, Ill. App. filed Oct. 24, 1906. Hinged joint for the transmitter of neat construction having a positive hinge and ample clearance for the wires. Also details in the hook switch mechanism.

931,205. CONTROL SYSTEM AND SWITCH; H. D. James, Pittsburgh, Pa. App. filed Dec. 14, 1908. For controlling electric motor by means of a plurality of solenoid operated switches with blow-out magnets.

931,231. MOUNTING FOR TELEPHONE INSTRUMENTS; H. E. Shreeve, Wyoming, N. J. App. filed Aug. 21, 1908. Watch-case type of receiver mounted on a handle. Details.

931,242. AUTOMATIC POLE CHANGER; F. H. Williams and C. W. Welch, Greene, N. Y. App. filed March 8, 1907. Switchboard of telephone exchange in which the signaling apparatus is controlled by the operator's key for ringing the magneto bells. The improvement relates to the pole changer for the signaling circuit.

931,264. CIRCUIT BREAKER; R. L. Browne and A. R. Howell, New York, N. Y. App. filed May 11, 1906. The circuit breaker includes a liquid column conducting the current, a trough therefor, an insulator thereon, with means for volatilizing the liquid and for collecting the volatilized liquid and returning it.

931,292. TROLLEY AND SUPPORT THEREFOR; S. S. Goldman, St. Louis, Mo. App. filed Sept. 14, 1908. For preventing the trolley from leaving the wire by providing the wheel on opposite sides with a pair of carrier arms carrying guard wheels.

931,301. TROLLEY WIRE HANGER; R. B. Heimbecker, Wilkinsburg, Pa., and S. R. M. Orum, Philadelphia, Pa. App. filed Feb. 24, 1908. A clamp for use with grooved trolley conductors, consisting of a sheet-metal gripping member of triangular shape with hook-shaped projections at the lower end, a wedge, a hanger rod and nut.

931,302. INDUCTION MOTOR, R. E. Hellmund, Pittsburgh, Pa. App. filed Dec. 4, 1907. An induction motor of the squirrel-cage type in which certain conductors are connected in multiple, and others separated by a distance different from the pole pitch are connected with means for establishing and interrupting the connections.

931,307. PRIVATE BRANCH INTERCOMMUNICATING TELEPHONE SYSTEM; N. H. Holland, Chicago, Ill. App. filed Nov. 23, 1907. For answering a call over a trunk line at any of several stations whereby the telephone used for answering may also communicate with a local station without disconnecting the signal at central.

931,330. TELEPHONE EXCHANGE SWITCHBOARD APPARATUS; J. L. McQuarrie, Oak Park, Ill. App. filed March 8, 1906. A one-wire circuit for central switchboards. Details.

931,331. TELEPHONE KEY; J. L. McQuarrie, Oak Park, Ill. App. filed Nov. 23, 1907. A plurality of plunger keys each when depressed being locked to close individual contacts, and when further depressed closing a pair of contacts common to all the keys.

931,336. PROCESS AND APPARATUS FOR PRODUCING DIRECT CURRENTS HAVING LIMITED STRENGTH; M. M. Osnos, Frankfort-on-the-Main, Germany. App. filed Oct. 29, 1907. Sets up a subsidiary magnetic field to the armature dependent upon the strength of the working current, which weakens the main field on increase of the working current.

931,345. TROLLEY CLAMP; E. E. Rose, Pittsburgh, Pa. App. filed May 6, 1907. Includes a pair of detachably hinged jars having screw-threaded shanks with a hanger rod into the sleeve which separates the shanks.

931,353. TROLLEY HANGER; T. Varney, Pittsburgh, Pa. App. filed May 1, 1905. For use with a catenary suspension in which the cable has a clamp carrying a pivoted portion adjustable vertically to which the conducting clamping members are secured.

931,354. OVERHEAD LINE CONSTRUCTION FOR ELECTRIC RAILWAYS; T. Varney, Pittsburgh, Pa. App. filed April 5, 1907. For suspending lines of the catenary type in tunnels by means of longitudinally disposed insulating bars having brackets for attaching the bars to the cable.

931,355. TROLLEY CLAMP; T. Varney, Pittsburgh, Pa. App. filed May 6, 1907. The clamp has a cup projecting downwardly containing a pair of jaws with expanded shanks, the outer ends of the jaws gripping the conductor.

931,356. TROLLEY HANGER; T. Varney, Pittsburgh, Pa. App. filed March 9, 1908. The cable carries the trolley conductor by means of two rigid hinged connected links whose combined length may be varied.

931,357. TROLLEY CLAMP; T. Varney, Pittsburgh, Pa. App. filed Nov. 6, 1908. A pair of separable hinged connected jaw members have shanks containing recesses with plugs in the recesses and movable to turn the jar members on their hinges.

931,358. TROLLEY HANGER; T. Varney, Pittsburgh, Pa. App. filed Dec. 31, 1908. The hanger rod carries a conductor clamp with a link between the parts having a movable connection with the rod to limit its movement.

931,366. TROLLEY HANGER AND CLAMP; C. Aalborg, Wilkinsburg, Pa. App. filed Sept. 9, 1907. Two interchangeable jaw members have hollow body portions and projecting sleeves extending into the hollow portions with set nuts on a rod passing through the sleeves.

931,367. HANGER AND CLAMP FOR WIRES AND CABLES; C. Aalborg, Wilkinsburg, Pa. App. filed Sept. 9, 1907. Details in the clamp somewhat like patent 931,366.

931,368. CLAMP FOR TROLLEY CONDUCTORS; C. Aalborg, Wilkinsburg, Pa. App. filed Sept. 9, 1907. The clamp has jaw members and a clamping member engaging inclined surfaces on the jaw member.

931,375. DYNAMO-ELECTRIC MACHINE; B. A. Behrend, Norwood, Ohio. App. filed Sept. 19, 1904. A rotatable field magnet having wedge-shaped poles and previously formed wedge-shaped coils made of strips of conducting material wound edgewise.

931,376. BRUSH STUD SUPPORT; B. A. Behrend, Norwood, Ohio. App. filed Sept. 16, 1905. For supporting and bracing the brush forks to eliminate the vibration.

931,377. AUTOMATIC FIRE ALARM; P. Bonini, New York, N. Y. App. filed Aug. 13, 1908. The circuit closer or thermostat operates levers and is contained within a box, the distance between the points of contact being adjustable from the outside of the box.

931,380. PUSH-BUTTON APPARATUS; R. D. Burk, New York, N. Y. App. filed Oct. 4, 1907. Uses a magneto, instead of a battery, in connection with a push-button to ring a bell.

931,384. MOTOR CONTROLLER; H. W. Cheney, Norwood, Ohio. App. filed Feb. 29, 1908. Fool-proof potential starter for induction motors. Details.

931,385. SECTION INSULATOR; H. B. Clarke, Highland Park, Ill. App. filed May 21, 1906. A section insulator in which the wearing parts are readily detachable and renewable.

931,390. TROLLEY CLAMP; H. P. Davis, Pittsburgh, Pa. App. filed Oct. 5, 1907. A trolley conductor clamp in which the jaws are provided with the hooks engaging a grooved conductor and secured by means of a ring nut and screw.

931,391. TROLLEY CLAMP; H. P. Davis, Pittsburgh, Pa. App. filed Oct. 5, 1907. A trolley conductor hanger in which the jaws are clamped by means of a block, and the height regulated by means of a screw and nut.

931,392. TROLLEY HANGER; H. P. Davis, Pittsburgh, Pa. App. filed April 10, 1908. Includes a triangular frame with cable clamps at two corners, a sleeve member at the third corner, and a trolley clamp having jaws, a gripping sleeve with means for suspending the sleeve so as to permit vertical and longitudinal adjustment.

931,393. TROLLEY CONDUCTOR HANGER; H. P. Davis, Pittsburgh, Pa. App. filed Dec. 14, 1908. The cable carries a clamp with a hanger rod suspended therefrom having a loop engaged by the trolley conductor clamp.

931,397. TROLLEY HANGER; G. B. Dusinberre, Cleveland, Ohio. App. filed Sept. 9, 1907. A pair of identical plates of stamped metal having interlacing jaw teeth and are fulcrumed upon each other to clamp the wire.

931,398. TROLLEY HANGER; G. B. Dusinberre, Cleveland, Ohio. App. filed Dec. 9, 1907. A pair of gripping devices have interlaced teeth for attachment to a supporting wire and to a trolley wire, and also have a single fastening means for both of the gripping devices.

931,399. CABLE HANGER CLAMP; S. B. Dusinberre, Pittsburgh, Pa., and G. B. Dusinberre, Cleveland, Ohio. App. filed Dec. 9, 1907. The clamp includes a bar with a longitudinal slot and a lever with a neck in the slot, and its other parts engaging the faces of the bar.

931,400. TROLLEY HANGER; G. B. Dusinberre, Cleveland, Ohio. App. filed Feb. 25, 1908. The hanger rod is provided with wedges and a nut for operating clamping jaws which hold the wire.

931,404. SYSTEM OF ELECTRICAL DISTRIBUTION; B. Frankerfield, Norwood, Ohio. App. filed March 30, 1907. Electrical connections for shunt-wound motors mechanically connected to a common load, having a shunt-field winding for each of the motors connected in series with a shunt-field winding of another of said motors.

931,408. LIGHTNING ARRESTER; W. Gifford, Traverse City, Mich. App. filed July 24, 1908. Lightning arrester has an impedance coil with a magnetic core included in the circuit between the line and the instrument, and an air gap in a ground branch connected to the line.

931,412. GAS LAMP LIGHTING AND EXTINGUISHING SYSTEM; A. Grossmann, Rheydt, Germany. App. filed Dec. 16, 1908. Details in electrical means utilizing induction coils for lighting gas jets.

931,415. BRUSH HOLDER FOR MOTORS; H. C. Grant, Bayonne, N. J. App. filed Jan. 22, 1908. Has a yoke-shaped member of spring metal with a brush holder of sheet metal engaging the yoke member.

931,416. ELECTRIC MOTOR; H. C. Grant, Bayonne, N. J. App. filed Jan. 22, 1908. A small motor in which screws or bolts are dispensed with and the parts joined by overlapping projections.

931,417. ELECTRIC TOY MOTOR; H. C. Grant, Bayonne, N. J. App. filed June 6, 1908. Details in the construction of a motor and its driven mechanism.

931,445. ELECTROMAGNET COIL CONSTRUCTION; A. A. Low, Horseshoe, N. Y. App. filed Dec. 12, 1908. Employs bare wire, instead of insulating wire, and interposes insulating material in grooves between the wires.

931,448. DYNAMO-ELECTRIC MACHINE; E. Mattman, Milwaukee, Wis. App. filed Jan. 30, 1909. The commutator and armature having skewed commutator leads for causing the cooling.

931,452. TELEPHONE TRANSMITTER MOUTHPIECE; R. E. Miller, Dayton, N. M. App. filed Sept. 24, 1902. For disinfecting mouthpieces, the mouthpiece being made in sections with disinfecting material between the sections.

931,464. METERING PANEL BOARD; A. C. McWilliams, Chicago, Ill. App. filed June 29, 1907. Improvements in a board which may be increased to accommodate an increased number of meters without change.

931,476. INCLOSED FUSE; F. P. Poole, Bridgeport, Conn. App. filed July 8, 1908. The fused link is folded in folds lengthwise of the link.

931,477. INCLOSED FUSE; F. P. Poole, Bridgeport, Conn. App. filed Dec. 17, 1908. The fused link consists of a twisted tube of metal with portions cut away.

931,478. INCLOSED FUSE; F. P. Poole, Bridgeport, Conn. App. filed Dec. 17, 1908. The fused link is 8-shaped in cross-section.

931,507. INSULATOR FOR ELECTRIC WIRES; A. V. Siler, Newark, Ohio. App. filed June 9, 1909. The body portion has a slot receiving the wire, the bottom of the slot being convex. Pins pass over the slot to hold the wire in place.

931,513. ELECTRODE; H. Specketer, Griesheim, Germany. App. filed March 21, 1907. Manufactures electrodes for electrolysis from molten magnetic oxide of iron.

931,518. ELECTRICAL APPLIANCE; J. S. Stewart, New York, N. Y. App. filed Jan. 29, 1908. A socket for incandescent lamps. Details.

931,521. OUTLET BOX CONSTRUCTION; E. W. Stull, Milwaukee, Wis. App. filed April 15, 1909. Details in the construction of an outlet box carrying a lightning arrester and chocking coil.

931,540. ELECTROMAGNET COIL CONSTRUCTION; M. J. Wohl, New York, N. Y., and H. Hertzberg, Brooklyn, N. Y. App. filed April 21, 1908. A solenoid wound with aluminum wire without artificial insulation between the convulsions and having a composite insulating strip between the layers of mica with outer layers of combustible material.

931,541. ELECTROMAGNET COIL CONSTRUCTION; M. J. Wohl, New York, N. Y., and H. Hertzberg, Brooklyn, N. Y. App. filed Nov. 18, 1908. An electromagnet coil wound with alternate turns of copper and aluminum wire.

931,542. ELECTROMAGNET COIL CONSTRUCTION; M. J. Wohl, New York, N. Y., and H. Hertzberg, Brooklyn, N. Y. App. filed Nov. 18, 1908. Electromagnet coil with turns of copper wire and aluminum wire coiled about the copper wire.

931,548. ANNUNCIATOR BOARD; J. Zickel, Berlin, Germany. App. filed Jan. 14, 1909. The annunciator board carries a series of electromagnets in a circle each with an armature and each controlling an annunciator disk.

931,556. DYNAMO-ELECTRIC MACHINE; H. A. Balcome and A. Freier, Boston, Mass. App. filed Feb. 10, 1908. Has a two-part, sheet-steel frame, each part forming a support for the armature shaft and a cylindrical casing carrying the field.

931,566. PICTURE MOLDING; L. Cholet, New York, N. Y. App. filed April 10, 1908. The picture molding is made to project from the wall so as to provide a passage for electric wires.

931,573. CONNECTION BOARD FOR ELECTRIC MACHINES; J. G. Crawford, La Grange, Ill. App. filed Sept. 8, 1906. The front and rear portion of the board have recesses between them with thermal lugs lying therein.

931,586. RECEIVER FOR WIRELESS TELEGRAPHY AND TELEPHONY; S. Eisenstein, Kiew, Russia. App. filed March 27, 1908. A resonant circuit with a primary receiving transformer coil in the circuit together with a secondary transformer coil arranged to be continuously moved with respect to the primary coil and connected to a detector.

931,592. TROLLEY HARP; T. A. Gannoe, Warren, Pa. App. filed April 1, 1908. The trolley harp is provided with a guard for preventing the wheel from jumping the wire.

931,604. SIGNAL DEVICE; H. J. Heeney, Boston, Mass. App. filed Oct. 10, 1907. The signal has a case with an opening in front of glass, which when broken allows access to the signal. Details in the construction of the interior mechanism.

931,605. ELECTRICALLY HEATED GRATE; M. Hermansen and Tygerson, Ephraim, Utah. App. filed May 11, 1908. For heating the water passing to the boiler. Uses two pipes with smaller pipes whose ends are secured to the larger pipe and means for heating them electrically.

931,606. DYNAMO-ELECTRIC MACHINE; F. E. Hirt, Milwaukee, Wis. App. filed May 1, 1909. Improvement in rotors for turbo-generators.

931,613. TRAIN LIGHTING SYSTEM; D. C. Jackson, Madison, Wis. App. filed May 5, 1906. The dynamo is driven by the axle from the train, and the storage battery provided with a switch controlled by the motor.

931,620. DYNAMO-ELECTRIC MACHINE; W. S. Kelley, Brookline, Mass. App. filed Feb. 10, 1908. The field is made up of laminæ with annular clamping members between which the laminæ are clamped.

931,632. ELECTRIC SIGNALING; J. Mladek, Prague, Austria-Hungary. App. filed April 19, 1907. For transmitting impulses of opposite polarity by means of a sensitive spring contact which is maintained in position by the residual magnetism.

931,706. ELECTRIC GROUND CLAMP; F. Stevens, Philadelphia, Pa. App. filed June 4, 1908. The clamp for attachment to pipes includes corrugated sections which interlock with each other.

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Developments in Street Lighting.

While developments have been quite rapid in the lighting field, due to the recent advent of high-efficiency arc and incandescent lamps, it has required time to introduce the new illuminants—not that there was any doubt as to their increased efficiency, but civilization refuses to quicken its steps to accommodate an energetic industry. Lighting companies, their vision warped by fears of decreased earnings, were also backward for a time in meeting the issue squarely, until observation proved their suspicions groundless and they found themselves hindering the march of progress. The signs are now favorable for a general awakening. Merchants' associations everywhere, even though impelled thereto by the selfish motives of increased trade, have given an impetus to the demand for greater outdoor illumination. At present most of this work is paid for from private sources, but it is not reasonable to suppose that such a condition of affairs will long endure. The general public, seeing first-class lighting, appreciates its importance and realizes its practical value; and in many cases it is only a matter of time when these special installations will become part of the public lighting system. The rivalry of cities will cause such installations to be widely adopted, and the standard of public illumination will thus be materially increased. That the movement is from below and not from above, if the relation of taxpayer to politician can be thus expressed, is certainly indicative of ultimate success.

Happily, the development has been toward larger units, and there are illuminating engineers to act as a sort of fog-bells to warn one of the rocks and shoals to be encountered. Street lighting with small units has often been advocated on ample theoretical and economical premises; but unfortunately the anticipated results have not always been realized in practice. As pointed out elsewhere, there may be conditions which justify the substitution of the tungsten lamp for the enclosed arc lamp in rural communities, but many considerations enter into the proposition. The tendency in large cities is to displace the old carbon-arc lamps with luminous and flaming arcs. This transition from insufficient to sufficient is natural; and any movement in the opposite direction is to be deplored. Because of the reduced maintenance from the substitution of the tungsten lamp for the arc lamp, movements in a retrograde direction are to be anticipated. Unless, however, the resulting illumination is as good or better, the step is wrong. That the present enclosed arc lamp has seen its day is doubtless true; but if it must go, the unit which replaces it should be a more efficient arc and not an incandescent lamp of smaller candle-power. The standard of public street lighting can be materially advanced with advantage to any community. The method of replacing carbon-arc lamps with luminous-arc lamps, which is practised in New England, for instance, is to be commended. Boston, however, has gone a step further and thereby placed itself at the head of the list of cities where lighting conditions are measurably near

what they should be. The most powerful lamps ever used in this country for public street lighting are installed without any increase in the space distribution, and better uniformity of illumination is obtained by increasing the height of the lamp from the street. The Hub now obtains more light per lamp than in the case of any other city and the expenditure per unit of light is less.

The International Unit of Candle-Power.

The London *Electrician* has recently printed an interesting article, by Mr. C. C. Paterson, on the subject of the international unit of candle-power, in which a number of comparisons between the British, French, German and American standard candle-power, as obtained by different observers at various times, are tabulated. The article draws attention to the fact that the photometric comparison of flame standards is always difficult and troublesome, if only on account of variations in the temperature, humidity and CO_2 contents, of the photometer-room atmosphere. The precision of such flame comparisons is, therefore, relatively limited. On the other hand, the precision of comparisons between incandescent secondary-standard lamps of the same color is considerably greater, and it is intimated that in the hands of good observers, provided, with good apparatus, the precision may reach three significant digits—that is, say, one part in a thousand—while even the fourth digit is alluded to vaguely. If, however, we can establish and maintain an agreement between our various national candle-powers, we shall be well content. This, we believe, is only possible with monochrome photometry, by the use of seasoned incandescent lamps circulated at regular intervals among the laboratories. By this means we eliminate all atmospheric questions, and confine our attention to voltmeters and incandescent lamps.

Gas Competition.

There appears never to have been a time in the history of electric lighting when the central station has had gas as much at a disadvantage as now. This, too, in spite of the fact that several improvements have been made in methods of utilizing gas light recently, so that with proper equipment there is no need of the gross waste of light which formerly was a necessity with gas burners. The tungsten lamp is, of course, largely responsible for the present satisfactory competitive condition of electric lighting, as it has removed the last argument which the gas man had against electric light, namely, that of its great comparative cost. It has become apparent from reports from all parts of the country that with good central-station service the number of consumers who will put up with the inconveniences of gas lighting is becoming relatively less and less. The three inherent defects of gas lighting which the public does not like are: first, the inconvenience of lighting and extinguishing; second, the heat, smell and evil effect on decorations, and, third, the uncertainties as to mantles, with the resultant uncertainty of candle-power and gas pressures.

Now, the gas man naturally has very plausible arguments with which to meet all three of these points, but somehow in practice they do not seem to work out. As to ease of control (lighting and extinguishing), he will talk glibly about the various modern contrivances for lighting and extinguishing gas from a distance, but somehow one seldom sees these devices in actual use, for the simple reason that a consumer who has money and enterprise enough to install such distant-control apparatus almost invariably prefers to install electric light. As to the heat question, the gas man will tell you that the heat generated by a gas-mantle burner is really so small as to be noticeable only to a person with imagination, and that, after all, it is a good thing to have some heat to create natural ventilation in the room, which ventilation, he claims, is better in a room having the heat of gas burners than one where this heat is absent. It is true he will cite some scientific tests, which were no doubt accurate, in which the ventilation of rooms was improved by the presence of burners, but he fails to state that those tests were not made under the conditions usually prevailing in actual practice. Many thousands of users of electric light who have tried both know full well that gas creates a bad odor in a room in the winter and adds perceptibly and uncomfortably to its heat in summer. The heat of the gas burner is further largely responsible for the well-known blackening of ceilings where gas burners are used. This blackening is so pronounced that if ceiling decorations are to be kept presentable the cost of decorating where gas is used will make it dear at any price. If this is not true, why do the prominent real-estate firms of Detroit insert in their leases the provision that nothing but electric light shall be used? These big real-estate firms have many decorating bills to pay every year and they know very well the cost of redecorating gas-lighted apartments as compared with those using electric lights. In passing, we may refer to the destructive effect on books of the vapor from gas light, which in time will utterly ruin the exposed part of a leather binding.

When we come to the question of candle-power, there is no doubt that the gas man can make a very fine showing on paper when he uses as a basis tests of gas-mantle burners made under laboratory conditions. The discrepancy between these laboratory conditions and those obtained in actual practice are to the undoing of the gas-mantle burner as a competitor of the tungsten lamp. While it is not to be claimed that electric lamps in practice are as efficient as they are when clean and new and operated at the proper voltage under laboratory conditions, they come much nearer in practice to laboratory conditions than do the gas-mantle burners. Depreciation in candle-power of a tungsten lamp in practice is caused by dirt and sometimes by low voltage. In the case of the gas-mantle burner there are many more things to interfere with results. A considerable number of mantles are burned long after they are partially broken. This causes a great decrease in candle-power, and can only be obviated in practice by regular maintenance of these burners by the gas company. This item is, therefore, under the control of the gas company as regards stores and large installations, but not as regards residences and the numerous small individual burners. The gas-mantle burner will give its maximum candle-power only when adjusted for the pressure which happens to exist at the burner at any particular moment. It, therefore, follows that even if a burner is properly adjusted at the time it is put on, it will be out of adjustment a large proportion of the time because of the fact that the gas pressure in practice varies considerably from hour to hour. Any adjustment that is made, whether by the gas company or the consumer, must, therefore, be a compromise, no matter how intelligently it is made. The average user pays little attention to adjustment and gets correspondingly poor results. For example, in a certain dining-room, about 15-ft. square, where there are four standard

Welsbachs in a central chandelier, it is found necessary to use a lamp on the dining table within a month after new mantles are placed on the burners. Difficulties of adjustment, together with difficulties of keeping mantles in good condition, are inherent in gas lighting and are not likely to be overcome. The inherent advantage which the tungsten lamp has over the gas-mantle burner has been well brought out in some recent competitive trials of series tungsten street lamps versus gas-mantle burners. The gas-mantle street lamps used had a beautiful rating as to candle-power, but the difficulties of maintaining this candle-power under actual conditions on the street, as contrasted with the ease with which the series tungstens were kept in good condition, brought ridicule on the competitive claims of the gas companies. The inherent difficulties with which the gas man has to contend are serious.

The Protection of the Eyes Against Ultraviolet Rays from Artificial Light Sources.

As mentioned in the Digest, the *Elektrotechnische Zeitschrift* has recently published an article, by Dr. W. Voege, on the subject of eye-protection from the ultraviolet rays emitted by modern electric and gas lamps. The same author contributed to this subject another article last year, to which reference was made at the time in our news and editorial columns. That article met with considerable criticism. It indicated that our modern lamps were more dangerous to eyesight than natural sunlight, owing to the influence of ultraviolet rays. The criticisms on the article pointed out that sunlight also contains ultraviolet light, and that, consequently, there was no extraordinary comparative danger in the light from modern artificial illuminants. The new article returns to the charge, and endeavors to maintain the original proposition, with the aid of additional experimental evidence. It appears to be generally accepted, by all parties to the discussion, that ultraviolet rays are capable of injuring the human retina. The only question is as to the intensity of such rays, and the duration of their application, which are necessary in order to produce injury. It is clear that since ultraviolet rays are present to some extent in sunlight, even granting the absorption of the crystalline lens for this type of radiation, it is highly probable that so long as the intensity of the ultraviolet light reaching the retina does not exceed a certain moderate value, there is no danger of injury to the retina.

It is also admitted on all sides that the carbon arc-light, the mercury arc-light and even the incandescent and Welsbach-mantle lamps emit ultraviolet rays especially the naked arcs. It seems quite likely that if a person were to look steadily for long intervals of time at either the midday sun, or a naked arc lamp close by, he would be likely to injure his eyes. Very likely the ultraviolet and violet rays would be the most injurious rays in these beams. In a lesser degree, it is quite reasonable that a person might injure his eyes by steadily gazing at a powerful incandescent lamp, or a strong Welbach-mantle gas lamp, for long intervals of time. It is, however, unlikely that injury to the normal eyes would be produced either by sunlight, arc light or any other type of illumination, which was not unduly powerful, if the eye were not allowed to rest on the vivid source. Bright sunlight illumination on a book or drawing, watched closely for an hour at a time, may be very harmful, and bright arc-light illumination likewise; but we all know that moderate daylight illumination, and moderate artificial illumination of any kind, is harmless, if we do not gaze directly at the source of light. No sensible person gazes directly at the midday sun. Unfortunately, many persons, ordinarily sensible, do gaze directly at an arc lamp, or other strong artificial illuminant, if they have the opportunity to do so.

The inference is, therefore, that all strong lights should be hidden from direct gaze, whether they are rich in violet rays or not. If they are rich in violet rays, there is all the more reason in hanging them out of direct vision. If the lamps must be suspended in full view, then shades or diffusing globes should be used. Finally, if shades or diffusing globes cannot be availed of, then plain glass globes help, for they absorb ultraviolet light to a considerable extent, while special brands of tinted glass may absorb ultraviolet rays altogether. Even then, the practice of gazing steadily at the shaded lamps should be avoided by all who respect their eyesight. When arc lamps or other violet-rayed lights are hidden from direct gaze there should be no danger from violet rays if the working illumination is moderate. Daylight is the argument for this proposition.

Indeterminate Franchises.

Ever since Wisconsin established its public utility commission there has been considerable interest in that State regarding the indeterminate franchises or permits which are provided for by the Wisconsin public-utility law. This general idea has been well tried out in Massachusetts, but the legal status of the indeterminate permit in Wisconsin is yet to be fully determined. It is notable that the last session of the Wisconsin Legislature extended to 1911 the time within which the public service companies of the State may, if they desire, relinquish their present franchises and place themselves in the hands of the commission under an indeterminate permit. The present Wisconsin commission is much in favor of the indeterminate permit idea, which it considers is based on grounds of sound economics. The commissioners believe that for a company to be able to give the lowest possible rates and best service, it must have the exclusive and perpetual right to operate within its territory as long as it is willing and able to conform to reasonable regulation. If there is an uncertainty as to the renewal of a franchise at the end of a definite franchise period, provision must be made for large sinking funds to retire the securities of the corporation by the time the franchise expires. Such a condition of affairs is neither conducive to the lowest rates nor to the best service. From the standpoint of public policy it is held to be extremely undesirable, because a public-service corporation should be in a position to improve continuously and extend its plant without the complications caused by the expiration of a franchise with no provision as to what shall become of the physical property at the end of that franchise. The only reason that the definite-term franchise has ever been at all satisfactory or feasible in practice has been the general understanding that at the expiration of any franchise a company already in the field stands an excellent chance of renewing the franchise with possibly some changes in terms. There have, however, been a number of cases the past few years where the expiration of franchises has meant trouble both for the public and for the companies. Questions have been raised as to whether the companies had any rights whatever on the streets and whether if the franchise were not renewed any provision should be made for the purchase of the physical property. The

public has suffered from inadequate service during the time such franchise controversies have been going on. The Cleveland and Chicago street railway franchise controversies are the most notable cases. It is, of course, perfectly true that in the smaller towns the general attitude of the public toward public-service corporations is more favorable than in the large cities, and the question of renewing franchises is not so serious.

In Wisconsin one of the chief questions raised in connection with the indeterminate permit is whether the bond-holders of a company who are secured by a mortgage on a certain definite franchise may not raise objections to the surrender of this supposedly definite piece of property in exchange for something indefinite. What the decision of a court might be in this matter cannot be predicted, but from the standpoint of business commonsense it would certainly seem that the bond-holders of a company with an indeterminate permit would certainly be better off than if the company had a definite term franchise. While the exact meaning of the term "indeterminate permit" is not defined in the Wisconsin law, the evident intent is to give public-service companies operating under it permission to operate perpetually, dependent only on good behavior. Now, if a public-service company operating under a definite franchise does not conduct itself in a way to meet public approval, it is practically little better off than if it were operating under an indeterminate permit, because ways and means will be found by the public to harass through their official representatives the company in a way which will seriously interefere with profits and make the financial standing of the enterprise uncertain; so that while technically it may have a definite franchise, practically its investment is insecure under adverse public sentiment, no matter whether its franchise is determinate or indeterminate

The Tendency Toward Flat Rates.

It is curious to note a certain spontaneous movement from the extreme refinements of metering toward the old line of flat rates similar to those used in the very early days of electric lighting. We are not considering here such flat rates as are the result of legislative meddling; merely those which have come about from natural causes, the principal one being the introduction of high-efficiency lamps. No theory of charging has ever been able to take account with even-handed justice of all classes of customers, while every theory deals successfully with some classes. The fact that nearly every scheme of charging gives the short end of the stick to the small consumer is the basis of most of the protests, which sooner or later have to be heeded. The mere fact that gas companies live and prosper on a flat, or nearly flat, rate makes it very difficult to persuade the public that really the fairest and best thing is to fix up a plan of intricate discounts all in favor of the big and steady consumer. Hence of late there has been a backward swing of the pendulum, resulting in a tendency toward flat rate, at least in the case of residence lighting. All pure quantity discounts, maximum-demand schemes and stand-by charges tend to bear heavily on domestic uses of electricity, with the result that residences are almost everywhere the gas companies' best customers and their owners the gas companies' best friends.

Hence, in one way or another, many electric light companies have devised means of smoothing out the inequality in rates by concessions of more or less special character, of which the flat rate is only one example, and, in our opinion, not a very desirable one. On broad general principles it is fairer to pay by meter for the energy used. To be sure, from the standpoint of many ratemakers, the consumer gets a great deal besides energy; but, on the contrary, the gas company sets up no charges for a real or hypothetical use of its mains. There is no doubt that the costs of carrying the small residence customers are abnormally high, and perhaps the losses through excessive use of flat-rate lamps are offset by the general expense items avoided. This seems at least to be the theory of modern flat-rate charging, when not simply an expedient to meet the high-efficiency lamp income problem. The high general expense is due to meter costs and charges, to accounting costs and to collections. The first can be greatly reduced when a cheap meter appears, as it is now likely to do very soon. In the past, the high cost of meters, reaching $30 per kilowatt, has severely taxed central stations. The second item will remain in spite of cheap meters, as will also the third. On a flat rate there is no meter charge, and the bookkeeping and collection work are comparatively simple. It seems to us that there is room for some simplification in both these departments, so that with a cheap meter available the cost of carrying the small consumer may be greatly reduced. Meanwhile data on wasted current from flat rates will accumulate to an extent that will enable an intelligent comparison to be made. The flat rate is now being tried in a number of foreign cities, in one at least with meters read at infrequent intervals as a check on undue consumption.

The residence consumer, in spite of his relatively large occasional demands and the general expense he entails, has one compensating virtue in that his peak load does not, upon the whole, add itself to the general peak, but follows it. The load curves of the few cities having heavy residence business show this fact very plainly. One English investigator has recently figured that a central station can actually afford to supply residences at a cheaper rate than offices or shops burning lights for short hours. Be this as it may, a load that is off the peak is in itself a good load to cultivate. In addition to the lighting there is now no small amount of incidental use of electricity for heating and cooking that deserves to be encouraged. At a rate low, but still remunerative, a large amount of such business can be secured. In at least one considerable city this, too, is being taken on a flat rate, which strikes us as a little hazardous. Better cultivate the cheap meter, perhaps using even an amp-hour meter, than take chances with the considerable amounts of energy involved in heating and cooking. Detroit, in which the domestic load is considerable, uses schedules so adjusted as to throw most of such load upon the secondary rate, which seems far preferable to flat charges. The long and the short of the matter is that the flat rate in residence work is merely a convenient way of putting such work on a special schedule that will get the business. Its aggregate amount is large, as the profits of the gas companies show, and, while it is made up of small items, their total is not to be despised. It does not seem necessary, however, to take so radical a method as flat rates to build up a suitable schedule for the purpose. Simplified metering and accounting will accomplish the same result without abandoning the very valuable safeguard of measured energy.

THE LOGIC OF CONSOLIDATIONS.

The present strong tendency to unite, by purchase or merger, groups of electric properties, whether contiguous or not, into consolidated companies is one that calls for very careful consideration on the part of publicists. The component properties are, almost without exception, public-service corporations of one sort or another, in close and intimate relations with the daily lives of many people. Further, from this condition they are in an increasing measure under public control. Whatever may be the ethics of such control, it must be in fact recognized as a growing force which must be reckoned with in discussing the present issue. In view of the enormous extent to which industries and interests have been consolidated in late years, and the sinister view which the public is apt to take of them, too often from the standpoint of bitter experience, every merger or union of public-service organizations must show due and just cause for its existence, else it will render itself liable to action that may be severe and unfriendly. In other words, mergers of this kind are, rightly or wrongly, objects of public suspicion and are intrinsically charged with the burden of proving their innocence. Indeed, at the present time every merger is assumed by the public to be guilty until the contrary is proved, and in the case of electric mergers the public is rapidly acquiring full power to act through courts or commissions, so that its judgments are enforceable. In point of fact, many unions of electric properties are actually to the public benefit, instead of having a hostile import, and ought to be encouraged. Others are perhaps to the public detriment and ought to be severely dealt with. It is our purpose here to consider the relations of various sorts of electric consolidations to the public interest, in the hope of establishing some fair basis of judgment by which the guilty and the innocent may, in a measure, be separated. Each class should receive its proper deserts.

At the start one may separate consolidations into two radically distinct classes—physical consolidations and fiscal consolidations. The former class is what the term implies, an actual union of service in contiguous plants, and generally involves a certain amount of physical reorganization, bringing the system into unified action and securing the full advantage of a single equipment and management. As a rule, the public gains by every consolidation of this character, since it is a matter of experience that a big plant with a large yearly output can both generate more cheaply and distribute more economically than a group of small plants, to say nothing of the lessened general expense and the stronger backing obtained. Since electric plants are rarely in actually competitive condition, owing to charter limitation, their physical consolidation has no tendency to raise prices. Indeed, as a matter of experience again, the result is in practically every case a reduction in price, either throughout the whole territory or in part of it, and no increase in price anywhere. This is the ordinary experience in the numerous cases in which a large city station has gradually taken on contiguous systems in outlying territory and thus expanded into a consolidation covering a great area. Still another type of physical consolidation may be found in the numerous transmission networks that have grown up from hydro-electric plants. Here there is an especial chance for material gains both in the generation and distribution of the energy, even extending to the better hydraulic utilization of the available water perhaps even on different watersheds. On the whole, one can properly say that unless the financing of a physical consolidation involves serious watering, the public is the gainer. Fanciful prices for property, however, involve undue fixed charges which put a burden on the plant that the public ultimately has to bear. Sooner or later, regulation of prices is likely to avenge this stock watering. A public-service corporation if caught in such a deal is liable to have the water squeezed out with much unpleasant violence.

Fiscal consolidations are quite another sort of thing. The bringing of a group of properties under intelligent management with strong financial backing, of course, enables some economies to be made, and the service to be in some respects bettered. If the properties are merely in the same hands, the gain to the public lies in somewhat bettered service, without any special countervailing disadvantage, except perhaps the loss of a certain local interest that is always to be regretted. But, unhappily, fiscal consolidations often go farther than this, and involve a financial union with the issuing of a large block of securities on which the interest has virtually to be paid from the profits of the more prosperous members of the group. In other words, the group is bonded heavily and the few good properties have to take care of the "cats and dogs" used to float the bonds. Consolidations of this sort are clearly to the detriment of that public which has to foot the bills, and hence the commissions are likely to take a vigorous hand in such cases, and offenders need expect little sympathy if they suffer for their sins. The general tendency is to allow to public-service corporations a good return on capital actually invested, but not upon watered securities if known as such. Fiscal combinations are too often mere stock-watering devices, and it would be a good thing for the electrical industry and the public if they could be brought to book whenever they offend in this way.

However, whatever form a combination may take is of small consequence to the public compared with the purpose of the combination. If it is to sell the maximum possible amount of bonds and stock on the property involved the scheme is bad, and from every standpoint a fraud upon the public. As an illustration of this class we need only point to the New York City traction fiscal orgie and its evil effect directly on the local public and on stockholders, and indirectly on the traction interest at large, through bringing all companies under suspicion, and on the electrical manufacturing interest through the partial closing for a considerable period of the largest single market for street railway apparatus and material. If the purpose is to take advantage of the gains from concerted action, while holding to the lines of conservative investment, the public is quite invariably the gainer, and the consolidation is a good one for all concerned. In looking over the field as a whole one finds many good unions of properties, a few scandalously bad ones and many that must be classified as indifferent and that deserve rigorous investigation before they are given a clean bill of health. These are groups where securities have been stretched a little too far and the load has been hard to carry, where service has not improved from undue economy chargeable to over-large capital. For such there should be stern remedial measures in the public interest, or copious bloodletting via a reorganization that may put the group in sounder health.

Winnipeg Convention of the British Association for the Advancement of Science.

For the third time since its organization the British Association for the Advancement of Science has been holding its annual convention on Canadian soil. The first of the Canadian conventions was held at Montreal in 1884, the second at Toronto in 1897, and the third at Winnipeg during the past week. In spite of the fact that only a few of its members live in Canada, 600 delegates were in attendance at the opening meeting on Aug. 25.

Sir Joseph J. Thomson, professor of experimental physics in Cambridge University, as president of the association delivered the annual address, which gave an outline of recent developments in physics. President Thomson said that among the discoveries in physics made since the previous Canadian convention, the first in importance is that of the Roentgen rays. "It is not, however, to the power of probing dark places, important though this is," he remarked, "that the influence of the Roentgen rays on the progress of science has mainly been due; it is rather because these rays make gases, and, indeed, solids and liquids, through which they pass conductors of electricity.

"We have already made considerable progress in the task of discovering what the structure of electricity is. We have known for some time that of one kind of electricity—the negative—and a very interesting one it is. We know that negative electricity is made up of units all of which are of the same kind, and that these units can be obtained from all substances." He stated his belief that this latter fact was true also of positive electricity.

The speaker said he had not the slightest doubt that engineers would ultimately succeed in utilizing the heat of the sun directly for power, "and when coal is exhausted and our water-power inadequate," he declared, "it may be that this is the source from which we shall derive the energy necessary for the world's work."

He pointed out that the discovery of radium has entirely altered the aspect of one of the most interesting geological problems—that of the age of the earth. Scientists, he said, had been forced to abandon Lord Kelvin's estimate, based on the theory that the earth's crust is cooling at a uniform rate due to the exhaustion of interior heat—that the age of the planet is less then one hundred million years. It has furnished another method, however, by which it is possible to determine the age of a rock by measuring the amount of helium gas it gives off during a certain period

"The new discoveries made in physics in the last few years," the president concluded, "and the ideas and potentialities suggested by them have had an effect upon the workers in that subject akin to that produced in literature by the Renaissance. It has quite dispelled the pessimistic feeling, not uncommon at that time (20 years ago), that all the interesting things had been discovered, and all that was left was to alter a decimal or two in the physical constant."

On the second day of the convention meetings were held by the various sections for the discussion of geographical research, chemistry, engineering, economic science and agriculture. The president of the engineering section, Sir W. H. White, discussed Canadian conditions relating to transportation, and stated that the most important problem to-day is that of providing cheap transportation for agricultural, mineral and forest products from the interior to the seas. He expressed the hope that British capital will be freely employed in the development and utilization of all of the resources of the Dominion.

A resolution expressive of the loss to science in the death of Simon Newcomb, the astronomer, was presented by President Thomson.

The Friday session was devoted to the meetings of the various sections. The engineering section discussed the plans connected with the world's waterways, including the Panama Canal and the Hudson Bay route, the former being described by Colonel Goethals and the latter by Dr. Robert Pell.

No session was held on Saturday. Opportunities were afforded to the delegates for visiting the various points of interest in the neighborhood of Winnipeg.

During the meeting on Monday, President Thomson described a series of experiments to prove the existence of a definite positive unit of electricity and to estimate its size.

As a result of an election held on Aug. 30, Dr. T. G. Bonney, F.R.S., the British geologist, was chosen president for the year 1910-11. The president-elect, who is now emeritus professor of geology in University College, London, was born in 1835 at Rugeley, England. He was educated at Uppingham and St. John's College, Cambridge, and was tutor at his alma mater from 1868 to 1876. In 1884 he was made Hulsean lecturer at Cambridge; from 1890 to 1892 he was Boyle lecturer, and in the latter year became Bede lecturer.

The meetings next year will be held at Sheffield, England, from Aug. 31 to Sept. 7.

Convention of the Association of Edison Illuminating Companies.

The Association of Edison Illuminating Companies opened its thirtieth convention at Briarcliff Manor, N. Y., on Tuesday of this week and was still in session as we went to press. At the first session the following papers were presented, in addition to the usual presidential address and reports of committees: "Report of Committee on Meters," Mr. J. W. Cowles, Boston; "Prepayment Meters," Mr. F. G. Vaughen, Schenectady; Report of Committee on Storage Batteries, Mr. Ernest Lunn, Chicago; "The Tungsten Lamp Situation in Various Cities," Mr. E. A. Baily, Brooklyn. At the evening session Mr. Samuel Insull, of Chicago, gave an address entitled, "Combination Lighting and Railroad Loads." The report of the committee on incandescent lamps was presented by Mr. J. W. Lieb, Jr., of New York.

The following papers and reports were scheduled for Wednesday: Report of Committee on National Code, Mr. W. C. L. Eglin, Philadelphia; Report of Committee on High Potential Disturbances, Mr. W. F. Wells, Brooklyn; Report of Committee on Steam Turbines, Mr. Alex. Dow, Detroit; "New Low-Pressure Turbine Installations," Mr. W. L. R. Emmet, Schenectady; "Gas Power," Mr. I. E. Moultrop, Boston; "Standard Colors for Station Piping," Mr. J. P. Sparrow, New York; Report of Committee on Electric Heating and Kindred Uses of Electricity, Mr. J. F. Gilchrist, Chicago; "Special Illumination Features of the Hudson-Fulton Celebration," Mr. Arthur Williams, New York; "The Central Stations and the Electric Vehicle," Mr. F. M. Tait, Dayton; "Commercial Problems," Mr. J. F. Gilchrist, Chicago; "Electrochemical Processes as Applied to Central-Station Service," Mr. C. J. Russell, Philadelphia.

The final session was held on Thursday, the program being: Report on Fire Insurance; "Notes on a Neglected Phase of the Insurance Question," Mr. C. D. Haskins, Schenectady; "Rules for Employees from a Legal Viewpoint," Mr. J. V. Oxtoby, Detroit; "The Present Conditions on the Edison Tube System," Introduction to Discussion by Mr. W. F. Wells, Brooklyn; "Rotaries versus Motor-Generator Sets for Central-Station Service," Mr. C. W. Stone, Schenectady. Attendance on meetings of the association is confined to members, and papers presented are only in exceptional cases given out for publication.

The election of officers also took place at Thursday's session. As a fitting conclusion and also in commemoration of the thirtieth anniversary of the introduction of the incandescent lamp a dinner was given to Mr. and Mrs. Edison on Thursday night. Invited to this function were a number of pioneer associates of Mr. Edison.

New Canadian St. Lawrence Hydro-Electric Development.

The construction of a large hydro-electric plant will soon be commenced on the St. Lawrence River near St. Timothee, Quebec, Canada. The old Beauharnois Canal passes around the rapids in the St. Lawrence River at Grand Isle, and the Canadian Light & Power Company has acquired from the Government the right to enlarge, modify and use the Beauharnois Canal for power purposes. Near St. Timothee the canal passes within 2000 ft. of the river bluff, and here the power station will be located. The available head is about 50 ft. and the water supply is constant the year round.

The present initial development provides for 21,600 shaft horse-power, with such further developments as may be required in the future.

The main features of the present initial construction will be as follows:

The construction of a canal intake and headgates at Valley field about 3200 ft. below the present intake.

The enlargement of the Beauharnois Canal from the intake to the station site—32,000 ft.—to the capacity of the present initial installation. This will be done by dredging from a 10-ft. depth to an 18-ft. depth and building some embankments, and will involve changes in certain railroad and highway bridges and highways.

The construction of a forebay at the power-station site. The concrete head wall will be of gravity section and about 40 ft. high. The embankments will have a clay puddle core and will average about 30 ft. in height. Also, a tailrace excavation for the complete 10 units.

A power station for four main units and two exciter units, the equipment of which will be as follows: Three 7200-hp turbine units; two 440-hp exciter turbine units; governors, etc.; three 4000-kw generators; two 250-kw generators; three 4000-kw transformers; switchboard, etc.

A 27-mile transmission line to Montreal, a substation and distribution system in that city.

Some of the more important quantities involved in the work are as follows: Excavation, 1,243,000 cu. yd.; embankment, 387,000 cu. yd.; concrete, 45,000 cu. yd.; cribwork, 6000 cu. yd.

It is estimated that the present initial development will cost about $4,000,000. The Canadian Light & Power Company proposes to do this work by contract on the basis of unit prices. J. G. White & Company, who will design and construct the plant, are now preparing plans and specifications for the forebay excavation and embankment and power house and headwall concrete work to be submitted to prospective bidders, and similar plans and specifications for other divisions of the work will follow rapidly.

Ungrounded Secondary in an Italian Village.

During a furious thunder storm on Aug. 18, a transformer broke down and subjected the low-tension distribution system supplying the village of Olginate, near Lecco, north of Italy, to a voltage of 3000. Electrical discharges followed in houses electrically equipped, and instinctively an attempt was made to switch off the lights for the purpose of preventing the danger of fire. The result was that 12 people were killed outright, and 29 received severe shocks and burns.

Important Consolidation of Companies Approved in Massachusetts.

The Massachusetts Gas and Electric Light Commission has issued an order approving the consolidation of the electric properties of the Boston Consolidated Gas Company, the Chelsea Gas Light Company, the Newton & Watertown Gas Light Company, and the Waltham Gas Light Company with the Edison Electric Illuminating Company of Boston, through the purchase of the above suburban organizations by the last-named corporation. This most important development will greatly extend the sphere of influence and service of the Edison Company in the Boston metropolitan district. It will add 24 per cent to the population now served by the Edison Company, making the population supplied by the entire Edison system nearly 871,671, according to the report of the commission for 1908. The additions are: Boston Consolidated Gas (Brookline, Brighton, outer Back Bay), 56,418; Chelsea, 37,287; Newton and Watertown, 48,085; and Waltham, 26,282.

The Boston Edison Company is now supplying electricity from its lines in the cities of Boston, Somerville and Woburn, and in the towns of Arlington, Ashland, Bellingham, Canton, Dedham, Dover, Framingham, Holliston, Hopkinton, Medfield, Medway, Millis, Milton, Natick, Needham, Norfolk, Sharon, Stoneham, Walpole, Wayland, Westwood and Winchester. All the municipalities supplied by the several companies are contiguous to one or more of these supplied by the Edison company except Waltham, which is nearer Newton and Watertown. By the terms of the several contracts executed by these companies with each other the Edison company is to pay for the electric locations and property of the Boston Consolidated Gas Company, $1,300,000; for those of the Chelsea company, $350,000; those of the Newton company, $500,000; those of the Waltham company, $600,000, and the Newton company is to pay $500,000 for the gas franchise and property of the Waltham company. The several companies selling their electric properties also agree that they will not, unless compelled by law, attempt to carry on the business of furnishing electricity or gas, as the case may be, for light, heat or power.

The $1,300,000 proposed to be paid for the Boston electric property is to be applied to the cancellation of an equal amount of its floating debt. Upon the sale of both its gas and electric properties, the Waltham company is to be liquidated. The purchase by the Newton company of the gas property of the Waltham company is essentially an exchange of the latter property for the gas property of the Waltham company. After its consummation the capital and debt of the Newton company will be the same as at present. The $175,000 outstanding bonds of the Chelsea company are to be cancelled, and that company will realize for its electric property a substantial sum above its other debts, which will be available for other corporate needs. The aggregate amount of the capital stock and the aggregate amount of the debt of the several companies will not be increased by the purchases. At the present time the Boston and Waltham gas companies generate the electricity which they sell, but the Newton and Chelsea companies have for several years past purchased all their electricity from the Edison company. The direct result of the purchases will be to separate the gas business from the electric business in the communities affected. The electric plants purchased will hereafter be legally and physically a part of the Boston Edison system. The Newton and Chelsea Gas companies will be physically and integrally parts of the system of the Boston Consolidated Gas Company. No facilities in either the electric or gas fields are to be diminished by the consolidation.

The board states the following broad economic reasons why the consolidation is desirable: "In the light of the progress which has already been made, both in the gas and electric light business, it is clear that gas and electricity can be profitably supplied over far wider areas than was formerly thought feasible. It is equally clear that greater efficiency in operation and greater economies in investment and operating costs are possible to a large gas or electric plant serving a given territory than to several independent small plants serving different sections of the same territory. Experience also indicates that there is a public advantage in communities of the size of those now under consideration in having the gas and electric business separately conducted and under independent management and control. The two kinds of business are so far competitive that the natural rivalry between the two is stimulating to both managements and should result in substantial benefits to the public.

"Compared with that of the Edison company, the electric business of all the others is small in volume, less varied in character and transacted at substantially higher prices. When the volume and character of the business of these companies are considered, it may safely be assumed that the Edison company can readily supply electricity in the several territories of the other companies at lower costs and charges than any of these companies could reasonably be expected to do. The advantages to the public to come from a consolidation of the Newton and Waltham gas properties and business, after disposing of their electric business, may not at first seem so obvious, but the savings from a union of these corporations through the maintenance of a single organization and its closer affiliations with the much larger Boston company, both for managerial and engineering purposes, may reasonably be expected in due time to lead to substantial reductions in price and improvements in service throughout the territory now occupied by these companies.

"The maximum net prices per kw-hour for electricity in the districts served by the several companies are as follows: Edison, 12 cents; Boston, 14 cents; Newton, 12 cents; Chelsea, 15 cents; Waltham, 16 cents. Prior to the present year the price in Newton was 18 cents, but the price was reduced in anticipation of the actual transfer of its electric property to the Edison company pursuant to the proposed purchase, provision for which had already been made. The immediate result of a consummation of the purchases for which approval is sought will be the establishment of the Edison prices throughout the territory now served by the other companies. The Edison company has also assured the board that after it has had time to avail itself of such economies as may follow the bringing the electric business of the several selling companies under its own management—that is to say, not later than Jan. 1, 1910—it will reduce its maximum price to 11 cents throughout the territory which it will then be supplying." In the Newton and Waltham districts the price of gas is to be reduced to 95 cents from the present price of $1 by Jan. 1 next."

The total amount of money required for the purchase of the electric properties is nearly $3,000,000.

Valuation of Public Utility Plants.

One of the most important cases pending before the Railroad Commission of Wisconsin affects the Madison Gas & Electric Company. This case was brought before the commission by a complaint regarding the rates charged by the company for gas. Its consideration involved a valuation of the physical property of the company by the engineering staff of the commission. Full testimony was given by Prof. W. D. Pence, engineer of the commission, at one of the hearings on the case, concerning the methods employed by the staff in making the valuation.

The reproduction cost new of each item was taken, based upon accumulated figures secured by the staff from a variety of sources, from the cost of like work similarly done and the experience of men in previous work, always guarding against extreme fluctuations in market prices and by adopting a five-year average basis for prices wherever practicable. The staff sought to obtain a reasonable middle ground figure, neither high nor low. The inventory, therefore, would not show the minimum figure at which the plant might be reproduced, but a liberal treatment of the property, the witness said.

Afterward, the staff had a series of conferences with the engineers of the company, the tendency of which was to raise the unit prices and make an important advance in the inventory. The advance in valuation was due probably two-thirds to additions to the inventory and one-third to increases in prices. In only a very few instances did the staff lower its prices; so that the final valuation represented what was a liberal price to start with.

Professor Pence testified that in his judgment the final valuation would cover the reproduction of the property by piecemeal construction. Each item had been taken separately, as though purchased in the open market, and no consideration was taken of the fact that the company or contractor would secure special figures in purchasing much of the material and equipment. An added cost of piecemeal construction over continuous construction was recognized. There would be some embarrassment owing to the necessity of maintaining continuous operation of the plant, but none with respect to a large part of this plant. In cases where the fair average figures taken for cost and installation were insufficient to cover contingent costs arising through the necessity of maintaining uninterrupted operation of the plant, the witness said that such contingent costs would be covered by the allowance for contingencies.

The appraisal doubtless contained some figures that were less than the actual cost to the company, but other figures were assuredly greater than the actual cost to the company. While the first valuation assumed largely continuous construction and no percentage had been added for the designated purpose of covering additional cost for piecemeal construction, the increases made in the successive conferences and revisions would cover any such additional cost.

The staff had had in mind the elements of obsolescence and inadequacy in establishing a basis for depreciation of the plant, and Professor Pence believed the inventory valuation fairly covered depreciation from physical decay and from inadequacy and obsolescence. These latter elements of depreciation were considered in fixing the lives of the items of the inventory. It was suggested by the witness that the law provides for annual valuations, so that if substantial losses were to develop through obsolescence and inadequacy they would appear in subsequent valuations. There was some equipment in use in the Madison plant that might profitably be replaced, but the property was in a fairly normal condition.

The percentage allowed for supervision, engineering, etc., was first set down as 10 per cent, then raised to 12 per cent for the final valuation, partly as a result of the conferences. As a tentative subdivision 5 per cent was allowed for engineering, 3 per cent for interest during construction and 2 per cent for contingencies and other items. In the increase to 12 per cent there was added for the interest item 1 per cent, making it 4 per cent, and 1 per cent to the contingency allowance, making it 3 per cent. While the witness doubted the practicability of construction in one year, he believed 4 per cent interest ample, assuming a correct handling of finances. The 3 per cent for contingencies would cover omissions, legal expenses, etc. The omissions would be slight, owing to the extreme care in taking the inventory and the amplification and correction of it in the conferences.

Construction in Madison was assumed in the process of valuation to be somewhat more costly than would be the case with a plant of the same size located in another place.

Work done by contract at the prices allowed by the valuation schedule of the staff would not, in the opinion of the witness, result in a loss through any inadequacy of allowance for insurance.

The rule of taking a five-year average of prices was departed from in the case of poles and other material the prices of which tend steadily upward and would probably never come down.

Professor Pence defended the staff's method of valuation involving the use of a life curve, as an expert and not an arbitrary valuation. Each particular thing received an expert examination, and the application of the life curve or average condition method contributed additional accuracy to the result.

In valuing the real estate, the staff had used the method of averages, taking the average assessed value per acre or other unit of several selected similarly situated tracts, and applying the percentage of assessed value to the average bona fide sale value during the last year in the assessment district, as determined in the office of the State Board of Assessment, to find the value per unit. If the land in question involved the acquisition of a number of separately owned parcels, 10 per cent was added on that account. This 10 per cent was added in the case of the site of the gas works, but not as to the site of the electrical works. It was testified by the witness that rather than condemn land exorbitant prices would be paid willingly by

possessors of the power of condemnation rather than to invoke such power. Investigations of the staff of the Wisconsin commission showed that the actual prices paid by railways for right of way averaged 2½ to 2¾ times the normal local price of land for farming purposes, but this ratio would not apply to city land values. Thus railways were willing to be "held up" for 2½ to 2¾ times the going price of land before they would use their power of condemnation in rural districts. This price, however, must not be considered as entirely a "hold up" price, for it included not only the land bought, but all incidental damage to land affected by the fact that the railway was to go through.

While the witness maintained that the staff's method of valuing real estate in cities had been tested thoroughly and found reliable and productive of accurate results, he admitted that in particular isolated instances its application might leave uncertainty in the result. This would be true in case some land used in comparison was not on the market at any price, which would perhaps be true of the most valuable land, in respect to which the smallest number of sales would be reported. Professor Pence maintained, however, that actual sales considered in almost any community were bound to be representative of the values for that particular year. It was admitted that a more refined or discriminating application of the method would be desirable in some cases than in others, using sales or transfers in the given neighborhood or group of blocks in preference to the sales for a large district for determining the sales ratio. Property in a city like Madison, however, rose not by a single step, but by a general tendency, such as was bound to affect an average of this sort.

The method adopted by the staff had been tested, the witness said, on a large scale and found to be reliable and he would not feel free to vary this method by what someone had said he had heard that someone had offered for a piece of property, or because some real-estate man had said he thought he could sell a certain piece of property for a certain price to someone whom he had never consulted with respect to it; such method witness would consider less reliable than that adopted by the staff, even though he did not understand the staff's method had yet prevailed in any court of justice in determining the value of land.

Electric Light for Destroying Insects.

European forests have recently been ravaged by a moth which appears in immense numbers and has caused serious damage, especially to conifers. In Saxony means to abate the plague have been given particularly careful study, and the electric light was found to be the best weapon of defence.

It was noted that the moths were most active between the hours of 10 p. m. and 1 a. m., and it was during these hours that the electric light was employed. In Zittau the street lights were turned off at the earlier hour, and the load of the town electric lighting plant thus rendered available was used to operate 40-amp searchlights in pairs. Between each pair a powerful suction ventilator was stationed, having a piece of wire netting a few inches beyond the outlet. The insects attracted by the light were drawn into the ventilator, and when discharged against the netting were either disabled or killed. The beams from the searchlights were directed toward the neighboring forest, and insects in enormous numbers were attracted to the brilliant source of light and finally sucked in by the ventilator and destroyed.

In the perfected device, as finally adopted, two searchlights are employed, adapted for currents from 30 amp to 50 amp, and shielded in front by highly polished glass disks. In front of them and somewhat lower are two arc lamps regulated for currents of 10 amp and protected by glass globes. Immediately below and between these two lamps is the opening of the ventilator. An electric motor attached to this produces 1200 r.p.m., and sucks through about 2800 cu. ft. of air in the same time. The outgoing blast of air enters an open box alongside, three sides of which are composed of wire netting. In this the moths meet their fate, and it is emptied as fast as their bodies accumulate in such quantities as to obstruct the free passage of the air blast.

Four of these devices were installed in the town of Zittau upon the roofs of the electrical works, the town hall, a schoolhouse and a factory. Some few minutes after the searchlight is turned on, scattered moths appear. Then the number rapidly increases until thousands arrive simultaneously and flutter in and out of the great beam of light. Steadily they near its source until suddenly they are within the grasp of the equally unseen suction of the ventilator, pass through it and fall crushed and helpless to the bottom of the wire cage.

The effectiveness of this new destructive agency seems to have been somewhat variable and dependent upon meteorological conditions. The maximum result attained in a single night by such an installation as above described was a total weight of 141 lb., representing about 400,000 dead moths. Frequently, however, the weight would be less than 70 lb. under unfavorable conditions as to wind and weather.

Cambridge (Mass.) Central Station Report.

The annual return of the Cambridge Electric Light Company has been filed with the Massachusetts Gas and Electric Light Commission, covering the year ending June 30, 1909. The company's business increased about 4.3 per cent over the previous year, the gross earnings for 1909 being $310,209.42 as against $297,238.51 for 1908. The principal gain in revenue was in electric-power sales, which were about 17 per cent larger in 1909 than in the preceding year. The power revenue is now $72,573.46, while that of 1908 was $62,136.20. Returning prosperity is reflected in the company's statement to the board. The street-lighting revenue this year is almost the same as last.

The operating expenses for 1909, including the cost of manufacture, distribution, office expenses, management taxes, insurance, legal expenses and miscellaneous were $161,375.49, compared with $166,232.13 in 1908, showing a saving of 3 per cent for the present year. The ratio of operating expenses to gross earnings is 52 per cent for 1909, compared with about 56 per cent in 1908. The balance to profit and loss for 1909 is $148,833.93. For 1908 the balance was $131,006.38. The total cost of the plant as of June 30, 1909, was $1,074,601.65. The company declared 10 per cent in dividends on its capital stock, or $78,500 for 1909.

The total energy sales of the company for 1909 were 5,706,241 kw-hours, compared with 5,334,462 kw-hours last year, or an increase of about 7 per cent. The total energy generated in 1909 was 6,484,140 kw-hours compared with 6,043,204 kw-hours in 1908. The company accounted for 88 per cent of its generated energy this year against the same percentage last year. In the following table a few operating data of general interest are given for 1909:

CAMBRIDGE ELECTRIC LIGHT COMPANY

Income from:	
Commercial incandescent lights	$158,115.65
Commercial arc and incandescent lights by meter	3,347,66
Public street arc lights	56,130.78
Public street incandescent lights	11,149.51
Electric power	72,573.46
Energy sold other companies	8,892.36
Total	$310,209.42
Cost of	
Manufacture	$66,050.03
Distribution	37,309.91
Office expenses and management	16,051.31
Other expenses, taxes, legal, insurance, etc	41,364.24
Total	$161,375.49

There was a saving of $12,400 in manufacturing cost in 1909 and $2,100 in distribution.

Large Transvaal Hydro-Electric Plant.

Consul Edwin N. Gunsaulus, of Johannesburg, reports that in addition to the great scheme for supplying power to the Rand, a new company, to be known as the Pretoria Power Company, is being formed to supply power and to manufacture, at a hydro-electric station on Crocodile River, nitrate of lime

and nitric acid. Three large banks in Europe are said to be supplying the capital. For the initial works, which are to furnish 20,000 hp to 25,000 hp, $3,469,875 will be required, and for the nitrate of lime and nitric acid works $1,250,000 additional will be necessary. The present cost of nitrate of soda delivered to South African ports is about $54 per ton, while nitrate of lime, which serves the same purpose as a fertilizer, can be produced and sold, it is said, at half of that price in the Transvaal. There is considerable demand for nitric acid in South Africa for use in the manufacture of dynamite for mining purposes.

American Fire Alarm Systems.

The U. S. Bureau of the Census has just issued a bulletin, No. 102, giving some details of interest as to the fire alarm systems of the country at the close of 1907. It appears that for sending fire alarms and police patrol signals, there were 1157 systems, using 70,812 miles of single wire, with 62,504 signaling stations, or boxes, giving 120,719 fire alarms. Of these 1157 systems, 48 were used interchangeably for fire alarms and police patrol purposes, 931 for fire alarms solely, and 178 for police signaling only.

Electric fire alarm systems were in use in 1907 in all but two (Kansas City and St. Joseph, Mo.) of the 38 cities with a population of over 100,000 in 1900; in all but one (Kansas City, Kan.) of the 40 cities with a population of from 50,000 to 100,000; in all but three (Quincy, Ill., and Chester and Williamsport, Pa.) of the 82 cities with between 25,000 and 50,000 inhabitants; in all but 36 of the 281 cities with from 10,000 to 25,000 inhabitants. Five cities—Belleville and Galesburg, Ill.; Ashtabula, Ohio; Guthrie, Okla., and Austin, Tex.—depended upon the telephone as a means of reporting fires. One system covers Bay City and West Bay City, Mich. Kokomo, Ind., was reported as then installing an up-to-date fire alarm system. Thus 90.5 per cent of the cities with a population of at least 10,000 in 1900 were equipped with electric fire alarm systems.

The systems devoted entirely to electric fire alarm signaling had 35,337 miles of single wire, 40,897 boxes or signaling stations, and 2143 special telephones. During 1907 such systems reported 96,516 fire alarms. The lines used interchangeably for the two purposes had 21,897 miles of single wire and received 24,203 fire alarms.

The mileage reported for police patrol signaling systems alone was 13,578, and the number of signaling stations was 8694. The reports for 1907 show 41,961,650 police calls, of which 29,946,757 were telephone calls. Of the 38 cities with a population of 100,000 or over in 1900, 35 reported electric police patrol systems in 1907, while 33 of the 40 cities with from 50,000 to 100,000 inhabitants had such systems.

A large proportion of the underground wire employed for fire alarm and police patrol signaling in the different cities was reported for a few cities, the distribution of such mileage for the eight leading cities being as follows: Philadelphia, 4281; Washington, D. C., 3091; New York, 2830; Chicago, 1904; Boston, 1844; Cleveland, 1250; Detroit, 1105, and Milwaukee, 1097.

Truckee River (Cal.) Power Deal.

Considerable newspaper comment has resulted in California from the contract drawn up between the United States Reclamation Service and the Truckee River General Electric Company concerning the control of the outlet of Lake Tahoe in the Sierras of California. Under this contract the power company relinquishes control of the Truckee River outlet to Lake Tahoe to the Government. The Federal Government in exchange grants the Truckee River General Electric Company perpetual rights in the Lake Tahoe and Truckee River watersheds. The Government agrees to pay one-half the cost of building the new Truckee dam, which is to cost $25,200, and the full cost of operating the same for irrigation purposes. Mr. A. W. Maltby, of the Government Forestry Bureau, has been on the ground to see whether the contract interferes in any way with forest rights in the Lake Tahoe region, and states that the Government rights are fully protected.

The following explanation of the contract is made by Mr. A. E. Boynton, secretary for Mr. W. P. Hammon and his associates of California, New York, Boston and London, who own the Truckee River General Electric Company and its allied corporations: "Lake Tahoe has but one outlet, the Truckee River. The Truckee River General Electric Company controls this outlet because it owns 55 acres of land right at the point where the lake runs into the river. The company has had for a number of years a dam at this point, and is now erecting a new concrete dam. The company's right to this property and to this dam has been legally adjudicated and it has been in possession for a number of years. The Government has in Nevada what is known as the Truckee-Carson irrigation project, which is the first irrigation project to be completed under the reclamation act. The Government has spent $4,000,000 on the project for the purpose of irrigating about 130,000 acres of land, which it is said, will finally be settled upon by some 3000 or 4000 families. Water for this irrigation project is obtained from the Truckee River. The difficulty which presents itself to the reclamation people is the fact that they are not in a position to regulate the flow of water in the Truckee River, because they do not control the dam site. It is their desire to perfect the irrigation project by getting in some manner possession of our company's dam site, so that they can legally control the outflow of water from the lake into the river and thus control the flow of the water from the river into the main irrigation canal. It was for this reason that the reclamation people opened negotiations with the Truckee River General Electric Company. The latter met the reclamation people half way, and on July 1 last the contract was signed. By this agreement the Reclamation Service will hereafter be able to control the flow of water in the Truckee River. This will be a final perfection of the Truckee-Carson irrigation scheme. In return the Government gives Mr. Hammon and his associates certain privileges in the surrounding watershed of the lake."

Mr. Thomas H. Means, engineer in charge of the Truckee-Carson irrigation project, states that the contract means much to Nevada, as it assures the use of the waters of Lake Tahoe for all time, because the Government will oppose any attempt on the part of California capitalists or others to tap the lake on the California side and use the water for San Francisco and other California cities, as has been proposed.

Soon after the contract was made public Mr. William Kent, the California naturalist and guardian of its big trees, sent a formal protest to President Taft, advising him that in his opinion this contract was against public interest. This protest is now being investigated in the Interior Department at the instance of the President. Mr. Boynton, while he admits that the ultimate plans of the syndicate are greater than have yet been announced, asserts that Mr. Kent has nothing to fear in the way of an invasion of the natural beauties of the lake, and that there is no intention of molesting "the timber, the water, the fish in the water, or any other of the natural beauties of Lake Tahoe." He says: "We have no intention of diverting the water of Lake Tahoe to the California side of the Sierra." Boynton states that no power plant will be constructed at the lake, but that the plans which are in the hands of the engineers contemplate extensive developments on the Truckee for the fuller utilization of the fall of the water.

Further interest in the Hammon power development plans in Nevada and California is given in the report that some of the banking clients of J. Pierpont Morgan are associated with Hammon, and have approved the agreement with the Reclamation Service. It is stated that these Morgan clients, together with London parties and Hammon as the only Pacific Coast capitalist, constitute the so-called Hammon electric transmission syndicate, which recently purchased for $3,000,000 a lot of electric plants and water rights in Nevada and certain water rights on the Rubicon River in El Dorado County, this

State, and for which F. P. Baum, of San Francisco, is the engineer. One of the Nevada plants the syndicate purchased is the Truckee River General Electric Company, which controlled the outflow of Lake Tahoe into the Truckee. The Hammon syndicate has at present three power plants on the Truckee River and plans to build more on that river and also on the Carson and Walker Rivers in Nevada. These, together with long transmission lines to many Nevada points, will constitute a complete system, which, when finished, will represent a cost of between $6,000,000 and $7,000,000. By being first in the field with a comprehensive transmission plant, the Hammon people hope to have a monopoly of the Nevada market for electric light and power, or at least a control of all the market in middle and western Nevada. It is their intention, it is said, to perfect their Nevada project as soon as practicable, and before they pay much attention to the development of their water rights in California. With the latter eventually they propose to have a plant which will compete in the central and northern California districts with the Great Western Power Company, of Butte County, and the two transmission plants to Oakland and San Francisco now controlled by the Pacific Gas & Electric Company, of San Francisco.

Plans for Extending Chicago Street Lighting.

By the recent action of the Illinois Legislature the city of Chicago is given authority to make an additional bond issue of $16,000,000, provided certain preliminaries are complied with. As the city is in need of extensions of its electric street-lighting service in many directions, it is proposed to make an effort to secure a considerable portion of the money realized from this bond issue, if made, for this purpose. Mr. William Carroll, the city electrician, will probably ask that $2,500,000 of the $16,000,000 be applied to electric street-lighting extensions. The proposition must be submitted to the people by referendum, and it is likely that this will be done at the spring election of 1910. It is required also that the purposes to which the money is to be applied must also be submitted to the voters, and so it is probable that at next spring's election there will be a proposal on the "little ballot" authorizing the city to issue its bonds to the extent of $2,500,000 for extending the lighting of the streets and alleys of the city by electricity. Electricity will be obtained from the Drainage Canal hydro-electric plant at Lockport, Ill., if the proposed extensions are made, and will be transformed and controlled for street arc-lighting circuits in the manner described in the article on "Street Lighting in Chicago by Energy from the Drainage Canal" in the *Electrical World* of May 20, 1909.

If funds are secured for this purpose, as is hoped, it is probable that series tungsten 100-watt lamps will be placed at alley intersections in cases where the location of an arc lamp at these intersections would bring two arc lamps too near together. If the tungsten lamps are used in this manner they will be connected directly on the arc-lighting circuits. The city of Chicago now operates about 12,000 arc lamps for street lighting.

Massachusetts Commission News.

A petition has been presented to the Massachusetts Railroad Commission by about 250 citizens of New Bedford asking that a five-cent fare be inposed on all street railway lines within the city limits. The question at issue arose from the fact that two different companies operate cars terminating their routes at Lund's corner, a point about three miles from the city line, but within the city. It is alleged by the petitioners that the Old Colony Street Railway Company operates a line of cars between Lund's Corner and the city line, collecting a five-cent fare from all passengers boarding the cars between these points. From Lund's Corner to other parts of the city the service is performed by the Union Street Railway Company, another five-cent fare being charged. The petitioners contend that with a five-cent fare to the city limit 200 houses would be built north of Lund's Corner within five years. The board will give a hearing on the case at its offices in Boston on Wednesday, Sept. 8.

The Boston Elevated Railway Company has petitioned the Railroad Commission to approve plans which have been prepared, modifying the design of its stations at Sullivan Square, Dudley Street, Dover Street and the South Station, in connection with the anticipated operation of eight-car trains, and the extension of the elevated lines to Forest Hills and Malden. The principal changes at Sullivan Square include the building of new platforms for unloading surface cars and loading elevated trains, with suitable bridge connections, the construction of a surface car loop in place of the stub terminal tracks now operated in the west half of the station, and the extension of the central elevated train unloading platform to a maximum length of about 350 ft. By the proposed plan traffic moving in opposite directions will be largely subdivided, relieving congestion. The principal change at the Dudley Street terminal consists of the construction of two surface car loading platforms inside the present loops, enabling the inward and outward bound traffic to be separated. At Dover Street the principal changes are platform extensions and stairway relocations, while at the South Station a middle siding is planned, with cross-over tracks to enable the company to discontinue the running of inter-terminal trains to Beach Street. A hearing will be given on Sept. 8.

The Springfield Street Railway Company and the Western Massachusetts Street Railway Company have requested permission of the Railroad Commission to consolidate. A hearing will be given on Sept. 8.

The Athol Gas Electric Company has petitioned the Gas and Electric Light Commission for authority to issue 1748 shares of new capital stock at the par value of $100 each, for paying indebtedness incurred in the purchase of property at Wendell Station and Orange, Mass., including the purchase of a transmission line between these points.

The Fitchburg Gas & Electric Light Company has been authorized to issue new stock to the amount of $385,000 by the Gas and Electric Light Commission.

The Board of Gas and Electric Light Commissioners has approved the issue by the Malden & Melrose Gas Light Company of 2000 shares of new capital stock of the par value of $100 each to pay its floating debt and the cost of future additions to its plant. The company has expended about $250,000 in additions and improvements in the past two years, without a stock issue, and the proceeds of the new shares will be assigned to the liquidation of this indebtedness. The board approves a selling price of $140 per share in respect to the new issue.

Wisconsin Rate Commission News.

Resumption of hearings by the Wisconsin rate and public utilities commission took place this week. The members have been taking vacations to a large extent, but expect to have a busy month in September with hearings of all kinds. Railroad hearings started the first of this week, but a large number of electric cases are on the docket.

The principal work of the commission during the summer, aside from handing down the important decisions reported in these columns, has been the continuing of investigations on the part of the satistical experts.

The commission has rendered an opinion at the request of a Milwaukee alderman in regard to an attempt to have the Milwaukee Electric Railway & Light Company equip its cars with air brakes. The commission ordered the new cars of the road equipped with air brakes in accordance with statute and there is a fight on in Milwaukee to have all of the 40,000-lb. cars thus equipped. The commission, however, says in its letter that unless the situation were materially different from what it was, according to the testimony on a former hearing, no further

requirements would be ordered. The commission rather discourages the idea of granting franchises with certain conditions attached, saying that the matters of service and rates are subject to regulation at all times and franchise conditions cannot stand in the way of the commission requirement.

It says that as a general proposition it is not wise to deal with the operations for definite periods by contract, as in the progress of the art new inventions bring about radical changes in the cost and methods of operation and safety. The general law is held to be broad enough to safeguard the public in the matter of air-brakes and the commission says no electric road should be given a franchise with conditions providing for things that may be secured under the general laws.

New York Public Service Commission News.

Mr. W. R. Willcox, chairman of the Public Service Commission of the First District, returned from his vacation in Europe last week. Shortly after his return, Mr. Willcox announced that the commission was ready to proceed with the building of additional rapid transit lines in New York, and that he thought there would be no difficulty about securing plenty of money for their construction. He intimated, however, that the Board of Estimate and Apportionment had blocked all progress in this direction, and that until this board was willing to agree to going on with the work the commission was powerless to act. Mr. Willcox also sent to Theodore P. Shonts, president of the Interborough Rapid Transit Company, a long letter discussing the Interborough subway proposals. In this letter Mr. Willcox intimated that the Interborough propositions were not in accord with the commission's plans, and were calculated to block the eventual carrying out of the lines that had already been agreed upon.

Mr. Willcox said that the commission was determined that the Lexington Avenue and Broadway line be constructed as originally outlined by the old Rapid Transit Board. He intimated that the commission might be willing to come to some working arrangement with the Interborough in regard to the proposed extensions of its elevated facilities by the third tracking of its two East Side lines. He asked if the Interborough would consider building a Madison Avenue branch of the subway from Forty-second Street to the Harlem River, and a Seventh Avenue branch from Times Square, by way of what is known as the Varick Street route, to the Battery.

The Public Service Commission of the First District has finally made public its appraisal of the properties of the Coney Island & Brooklyn Railroad Company. This appraisal, which has been under way since January, has been made in order that the commission may intelligently pass judgment upon the question of a 5-cent fare to Coney Island. The figures show that the grand total of the property of the company was worth on Feb. 1, 1909, $5,676,895. The appraisal of the Brooklyn Rapid Transit system is nearing completion, and the appraisal of the Third Avenue Railway property is under way.

The Public Service Commission of the First District has issued an order approving an agreement entered into by the Central Crosstown Railroad Company, owning the Eighth and Fourteenth street crosstown lines, and the Metropolitan Street Railway Company, whereby the receivers of the latter company will continue to operate the two lines in question at a reduced rental, pending the permanent reorganization of the Metropolitan system. This is the third time that the leases of these two lines have been modified. Under the new arrangement the Metropolitan will pay about $210,000 less per year than under the original agreement.

The Public Service Commission of the First District has approved the application of the Long Island Electric Railway Company for a reduction of its stock from $2,100,000 to $600,000. This company operates a surface line from Brooklyn to Jamaica and Far Rockaway, with a branch to Belmont Park. Its original capital was $600,000, and its directors claim that when it was consolidated with the New York & North Shore Railway, in 1899, its capital stock was increased to $2,100,000 without any adequate addition to the actual property of the road, and it was to eliminate this stock that the reduction was asked.

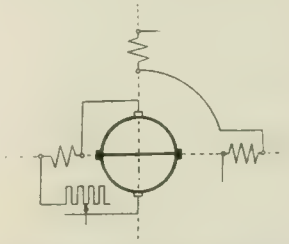
The hearing called for Aug. 30 by the Public Service Commission, upon the regulations governing electric meters, was postponed until Sept. 13.

The Public Service Commission, Second District, has authorized the Lockport Light, Heat & Power Company to issue $70,000 5 per cent 50-year gold bonds, to be sold at not less than 85. The proceeds are to be used for the discharge of obligations of the company, amounting to $45,784.18, and for the construction of additions and betterments to the plant and distributing system.

Self-Starting, Single-Phase Induction Motor.

A single-phase motor arranged to start from rest as a so-called repulsion and operate normally as an induction motor, in which the power-factor and torque have better values than obtained in the usual design of this machine, forms the subject of a patent issued on July 20 to Mr. Val. A. Fynn. The inventor places on the commutator two additional brushes in electrical space-quadrature with the brushes that are short-circuited upon themselves, and impresses between the added brushes an e.m.f. of proper value and time-phase position to supply magnetizing current to the motor under running conditions.

The e.m.f. for secondary excitation is obtained from an auxiliary winding placed on the stator 90 electrical space



SECONDARY EXCITING CIRCUITS

degrees from the brushes to which current is supplied. The e.m.f. is of the full circuit frequency and has a time-phase position varying directly with the electrical space position of the coil in which it is produced by the revolving field magnetism. The current is of the full circuit frequency in the stator coil, but the motion of the rotor has the effect of varying the frequency in the armature in such a way that it reduces to zero at synchronous speed. Thus, the excitation introduced into the revolving secondaries requires a negligible amount of wattless volt-amperes as compared with the normal full-frequency primary excitation. The arrangement of the primary and auxiliary exciting circuits are indicated in the accompanying illustration, which, however, does not show the well-known scheme used for short-circuiting the secondary when the motor is running at full speed.

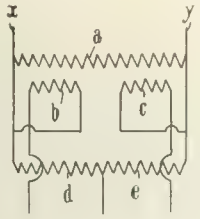
Voltage Regulation of Auto-Transformers.

Messrs. H. M. Hobart and E. Coad, of England and Germany, respectively, have been granted a United States patent for an arrangement of the windings of an auto-transformer by which the voltage of each secondary distributing circuit of the transformer is unaffected by the loads on the other secondary circuits.

Messrs. Hobart and Coad refer to the arrangement as one employing both a transformer and an auto-transformer in conjunction, but all of the circuits surround a common cone and

are electrically interconnected so that the apparatus is in reality merely an auto-transformer. However, a portion of the secondary winding is external to the primary circuit. That is to say, considering the transformer as possessing one continuous winding, a certain portion near the middle forms the primary, while the individual secondary circuits are made up of parts of this portion and parts of portions external to the primary winding and in series therewith.

The advantage claimed for this arrangement, which is illustrated herewith, resides in the fact that when any portion of the transformer is loaded the e.m.f. of any remaining portion within the primary circuit increases, while that of any portion

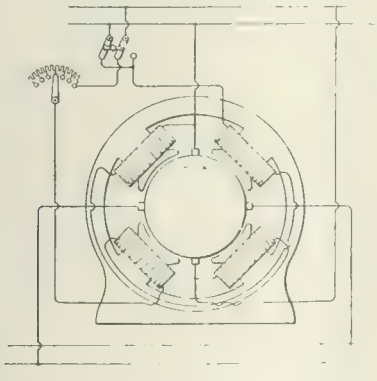


AUTO-TRANSFORMER ARRANGEMENT.

external to the primary decreases, and the combination of an external with a primary portion allows the resultant e.m.f. to be independent of the load on any other secondary circuit. For example, when the secondary winding made up of the portions *e* and *c* are loaded, the e.m.f. across portion *d* increases and that across *b* decreases so that the e.m.f. across *b* and *d* in series remains constant.

Rotary Converter for Direct Current.

In a patent issued on July 6 to Mr. L. A. Hawkins there is described a method for converting direct current from one voltage to another in a machine passing only one armature winding and a single commutator. The field structure is provided with double the number of pole cores ordinarily required, there being four pole cores for a two-pole machine, as shown in the accompanying illustration. There are two sets of brushes, one of which is connected to the supply circuit and



ROTARY CONVERTER FOR DIRECT CURRENT.

the other to the delivery circuit. The voltage between one set of brushes bears to the voltage of the other set the increase ratio of the sums of the magnetic fluxes interposed between the brush sets. Since the resultant flux between one set of brushes can be altered without changing the flux between the other set, merely by increasing the magnetism in two of the pole cores and decreasing the magnetism in the other two cores by an equal amount, it follows that the ratio between the supplied and the delivered e.m.f. is variable throughout a wide range.

This variation is obtained by means of the rheostat and reversing switch in the magnetizing circuit of two of the field cores.

CURRENT NEWS AND NOTES.

ELECTRIFICATION OF CHILEAN RAILROADS.—A cable dispatch reports that the Chilean Government has decided to electrify 1160 km of railway beginning, as an experiment, with 184 km.

BRITISH ELECTRIC RAILWAYS IN 1908.—The annual British Board of Trade statistics relating to railways show that at the end of 1908 the length of single-track line operated exclusively by electricity was 204 miles, and that 200 miles were being operated partly by electricity. The corresponding length of line at the end of 1907 were 196 and 182 miles respectively. The total quantity of electrical energy used in 1908 was 249,287,308 kw-hours as compared with 213,675,447 in 1907.

NEW ORLEANS WIRELESS ASSOCIATION.—An association has been formed in New Orleans to further the interests of wireless telegraphy and telephony, under the name of the Wireless Association of New Orleans. One of its objects will be to prevent experimenters from interfering with commercial and naval wireless stations. The following officers were elected: President, Mr. L. J. Nadau du Treil; vice-presidents, Messrs. George Siebert and H. S. Chluter; treasurer, Mr. L. Reiss; secretary, Mr. P. Gernsbacher, 1608 St. Charles Avenue.

REVOLVING FIELD CORE CONSTRUCTION.—A constructive arrangement of the revolving field core and coils by means of which the centrifugal force acting upon the windings will tend to hold each coil in position, rather than to distort it and throw it out of position, was patented by Mr. B. A. Behrend on Aug. 17. The field coils are former wound of flat copper straps placed edgewise, the ends being parallel and the sides converging. The pole cores are wedge-shaped so that the sides of the surrounding coils are radial with respect to the revolving structure. Wedges of proper shape serve for retaining the coils in place against the direct action of centrifugal force.

ELECTRIC RAILWAYS FOR FRANCE.—The Western Railway of France has obtained authority from the Government to electrify its lines. A beginning is to be made with the lines which run from the St. Lazare Station in Paris to Argenteuil and Saint-Germain-en-Laye. Special tracks will be laid, so that the service can be effected without any interference with the steam-driven trains. Substations will be erected which will supply continuous current at 600 volts. It is anticipated that from 12 to 20 trains of six double coaches, 65 ft. long, can be run per hour. The permanent way, equipment of line, etc., will cost $5,800,000; the rolling stock and converter stations, $4,000,000; interest on capital and other expenditure bringing the total amount to $11,400,000 for the 20 miles of line which are to be constructed.

MARCONI ON WIRELESS.—Commenting on the fact that an international conference will be held in Baden Baden, Sept. 12, to consider the advisability of lowering underwriters' premiums on vessels equipped with wireless telegraph. Mr. Marconi in a newspaper interview pronounced this move of the underwriters an excellent thing for ships and their owners, and also a good thing for the wireless telegraph. He considers that compulsory wireless equipment of all steamers is bound to come in time. The delinquency of various governments in erecting shore stations has, however, to a certain extent discouraged ship owners in taking action. He considers it absolutely necessary that steps should be taken at once to erect land stations for all regular steamship routes, and added that if the various governments would not do this, his company was prepared to take up the matter if ship owners would bear some of the expense.

FRENCH WIRELESS STATIONS.—The French Government maintains four wireless telegraph coast stations, including one in Algiers, two of which were established in 1904 and two in 1908. The normal wave length of three stations is 600 m and of the fourth, 300 m.

A. I. E. E. MEETING.—The next regular meeting of the American Institute of Electrical Engineers will be held in the Engineering Societies Building, New York, on Oct. 8. The title of the paper to be presented and the name of the author have as yet not been announced.

CONSERVATION CONGRESS FAVORS PINCHOT.—The National Conservation Congress, held last week at Seattle, Wash., adopted a resolution favoring permanent Government control of power sites and water rights, and asserting that the Government has no moral right to make a special grant of natural resources, which resources should belong to the people.

CHICAGO ELECTRIC CLUB.—The Chicago Electric Club at its noonday meeting Aug. 25 had some light entertainment provided for after luncheon. At the next meeting, Sept. 1, the regular plan of this club's meetings will be resumed. The speaker for this occasion will be Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company, who will speak on the "Conservation of Natural Resources."

WIRELESS AROUND THE WORLD.—In a recent interview Mr. Marconi said that his ambition was to link up the British Empire by wireless telegraphy, which he said could be accomplished by establishing stations at Malta, Cario, Aden, Bombay, Singapore, Perth, Adelaide, Sydney, Wellington, Hong Kong, Mombasa, Durban, Cape Town, Bathurst, Sierra Leone, Helena, Mauritius, Nelson Island, Montreal, Jamaica and British Guiana.

ELECTRICALLY SMELTED STEEL.—A Redding (Cal.) newspaper reports the receipt here recently of a carload of 20 tons of pig iron, from the electric process iron smelter at Heroult, on the Pitt River. The iron was delivered to a local foundry at $25 a ton, or less than it could be bought at tidewater, and is pronounced to be of the finest quality for casting purposes. The electric process iron smelter at Heroult is stated to be producing 25 tons of pig iron a day.

CHICAGO TELEPHONE COMPANY VOLUNTARILY INCREASES ITS CAPITAL ASSESSMENT.—President B. E. Sunny, of the Chicago Telephone Company, after having received the assessor's figures for the valuation of the property of his company, voluntarily added $2,000,000 to the total. In so doing he stated that his company has put in improvements which the additional amount fairly represents, and that it had no desire to conceal the increased value from the tax assessors. This addition brought the tax assessment of the company up to $12,132,700.

CALIFORNIA POLE-LINE DECISION.—Under the State constitution of California, according to a recent decision of the United States Circuit Court of Appeals, in California, written by Judge Ross, a telephone or telegraph company has the right, providing that it does an interstate business, to erect its poles and string its wires through any city or town in the State without a franchise, a municipality having only police power concerning where such poles or wires may be placed. The case in point was the appeal of the Sunset Telephone & Telegraph Company against the city of Pomona.

A MUNICIPAL PLANT CRITICISED.—The municipal electric light and water-works plant of Columbia City, Ind., has been condemned in a report by Mr. E. R. Vincent, of Indianapolis, who was employed to make an investigation of the plant. Mr. Vincent, who is an electrical engineer, declared the plant nearly ready for the scrap heap and emphasized the necessity for the expenditure of $25,000 for its rehabilitation. Mr. Vincent's report was acted upon to the extent of preparing advertisements for bids for three new vertical boilers of 200-hp capacity. The Council decided, however, that Mr. Vincent's estimates for improvements were too high, and that the plant could perhaps be replaced as a whole for about $15,000.

WESTERN SOCIETY OF ENGINEERS.—The Western Society of Engineers, Chicago, has just issued its yearbook, containing lists of officers and members. This shows that the society now has a total of 1001 members, of which 798 are active, 66 associate, 134 juniors and 3 honorary. The electrical section of this society was formerly the Chicago Electrical Association. Announcement is made of the following papers of interest to electrical men to be given during the coming fall and winter: "The Kilbourne Plant of the Southern Wisconsin Power Company," by Prof. D. W. Mead, Madison, Wis.; "Economies in Central-Station Management," by Mr. W. L. Abbott, Chicago; "Depreciation and Reserve Fund for Electric Properties," by Mr. Willilam B. Jackson, Chicago; "New Illuminants," by Mr. Carl Wiler, Chicago

MONTEREY DISASTER.—It is estimated that 2000 lives have been lost as a result of an 18-in. rainfall over the valley of the Santa Catarina River in the neighborhood of Monterey, Mexico. The electric service in Monterey City was completely suspended, both on account of the many falling wires and by reason of the damage done to the generating station of the Monterey Light & Power Company. The inundated region covered a stretch of territory about 300 miles in length from Matamoras to Torreon. The greatest loss of life is said to have been caused by the giving away of a reservoir dam. Monterey is situated in a cup-like valley, and is surrounded on three sides by steep mountains. The waters rushed into this valley down the bed of the Santa Catarina River. This stream is ordinarily 150 yd. wide, but with the advent of the flood its banks were fully three-quarters of a mile apart.

SHUNT MOTORS IN MECHANICAL AND ELECTRICAL PARALLEL.—A patent issued on Aug. 17 to Mr. Budd Frankenfield describes an arrangement by means of which the load on several short-wound direct-current motors connected in both mechanical and electrical parallel can be divided equally among the machines. Each motor is provided with as many separate field-coil sections as there are individual motors, the sections on one machine being joined in series with those on the other machines. The arrangement is such that any change in the field circuit resistance of one machine varies the strength of the fields of all the machines equally. This action prevents either motor from taking more than its share of the load, as would be the case if the motors were independently connected to the supply system and the field winding of one became hotter and therefore admitted less current than the field winding of the other motor.

EDISON GOLD MEDAL TO BE AWARDED.—The first award by the American Institute of Electrical Engineers of an Edison gold medal will probably be made this fall. Some years ago a fund of $5,000 was established by associates and friends of Mr. Edison, the annual proceeds of which were to be given as prizes for meritorious graduation theses. This plan was not found practicable, owing to lack of intrinsic merit of the small number of theses that were submitted, and it was finally decided to establish instead a gold medal, to be awarded whenever in the judgment of a committee of the Institute a resident of the United States, its dependencies or Canada merits it by discovery, invention or research in electricity. The design for the medal has been furnished by Mr. James Earle Frazer, a New York sculptor. It bears on its obverse a portrait of Thomas A. Edison, and on its reverse the legend. "The Genius of Electricity Crowned by Fame."

Combination System of the Hydro-Electric & Gas Company, of Warren, Ohio.

THE hydro-electric system built for the Peerless Electric Company, of Warren, Ohio, is of interest, not because of the size of the plants, but owing to the fact that the scheme embodied the uniting a number of water-powers of various heads, and at widely scattered points, into a single system, and delivering the energy at Warren, where a steam-engine and a gas-engine auxiliary are used on the same system, all operating in parallel. The system is controlled by the Hydro-Electric & Gas Company, of Warren, Ohio.



FIG. 1.—HYDRO-ELECTRIC PLANT AT LEAVITTSBURG, ON THE MAHONING RIVER.

The steam-engine plant is at the factory of the Peerless Electric Company and the gas engine at the gas works. Leavittsburg, on the Mahoning River, is the nearest water-power plant to Warren and at a distance of three miles from the Warren substation. Formerly a small grist mill was operated at this point, the power being derived from a 7-ft. dam of the crib and brush type usual for such mill powers. The new dam was built about 200 ft. below the old dam and gives a maximum head of 9 ft. It is of the reinforced concrete gravity type, is 200 ft. long and stands on a soft shale bottom. To prevent undermining, an extension mat 12 ft. long (up and down stream), 12 in. thick and reinforced with ⅞-in. lug bars, was built on the shale and under the overpour. The crest of the dam contains 4-in. gas pipes, 4 ft. on centers, to receive wood posts for the flash boards. The abutment at the west end is of the buttressed, reinforced concrete type. Directly in line with the dam at the east end stands the power house, a view of which is given in Fig. 1. The wheel pits are of reinforced concrete and three in number, each containing a 54-in. American turbine, all being geared to a single horizontal line shaft running at 118 r.p.m. (Fig. 2). As the back water frequently rises above the level of the dam's crest, each turbine has a different gear ratio so that each wheel has an efficient speed for its own particular stage of the back water. Calling the gears nearest the generator No. 1, No. 3 is coupled to the line shaft through a jaw coupling, as this turbine will only be placed in service, or started, when the plant is shut down. Turbine No. 2 has a Hill friction clutch, as it must be thrown in without shutting down, a condition due to the fact that on the peak loads it will be called on to help turbine No. 1, and while its gear ratio is not the most efficient at normal head, nevertheless the duration of the peak is such that the slightly reduced efficiency is not of great consequence. Turbine No. 1 is geared directly to the line shaft. Turbines No. 1 and No. 2 may be disconnected from the line shaft by sliding their pinions thereon, having any one of two turbines working. The gates are so geared to the horizontal governor shaft that any turbine may be thrown out of gear at any time and operated by hand. Fig. 3 shows the

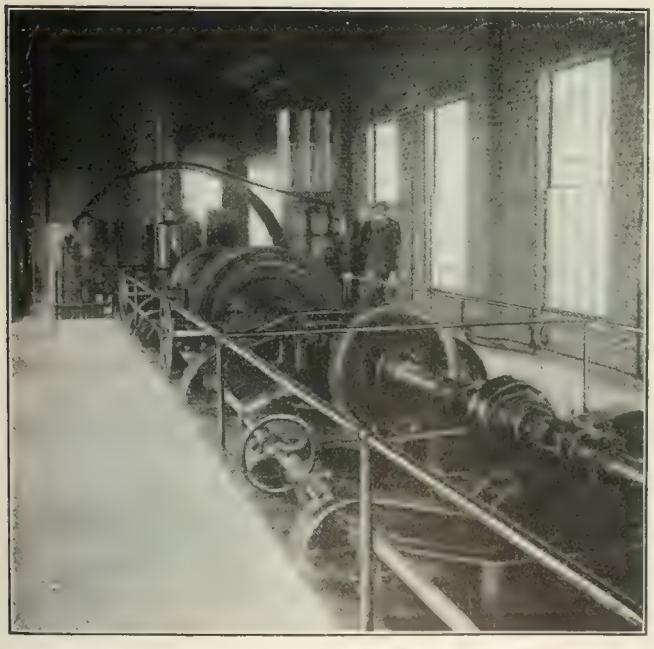


FIG. 2.—INTERIOR VIEW OF GENERATING STATION.

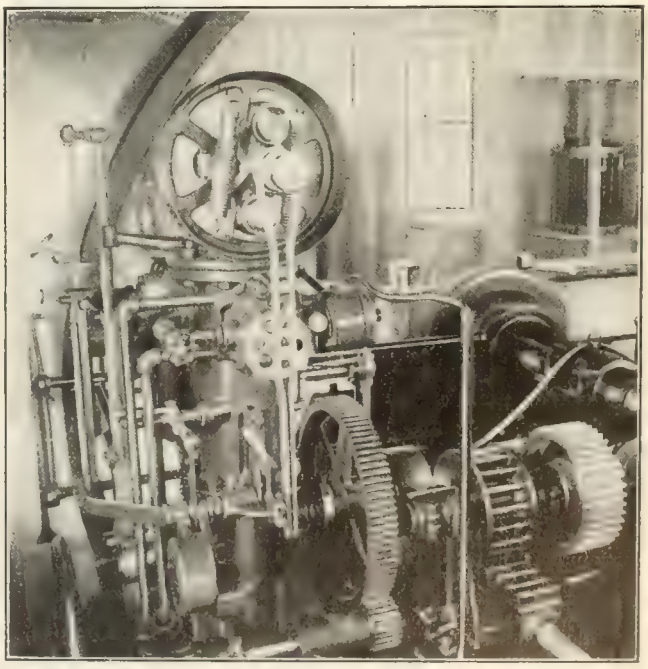


FIG. 3.—GOVERNOR MECHANISM.

governor mechanism. It will be noted that there is but one coupling pin, thus eliminating the usual danger of the operator leaving in one pin and inserting the second, thereby breaking off the levers or stripping the gears. The turbine gates are of the balanced wicket type connected to the vertical shaft by means of a ring mounted on ball bearings, and a link and lever motion. It was guaranteed that a governor exerting 12,000 lb.

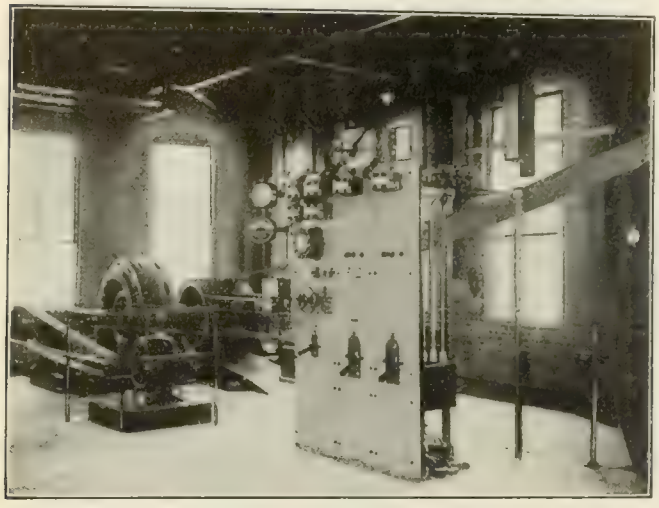


FIG. 4.—BELT-DRIVEN GENERATOR AND SWITCHBOARD.

through a distance of 1 ft. in one second would easily handle the gates and a Sturgess governor was installed and is reported as working successfully. Owing to the low speed of the line shaft, 118 r.p.m., a pulley 165 in. in diameter is required to drive the 300-kw generator at 514 r.p.m. (Fig. 4).

Each turbine is placed in a separate pit, and by shutting the head gates any one of the three may be inspected or repaired without shutting down the plant. These head gates are made of white oak and the stems are provided with a rack plate and a cast-iron rack. A crab driven by a 2-hp induction motor runs on channel-iron rails along the side of the power house and serves all the gates (Fig. 5). The usual practice is to have a hoist for each gate, but this largely increases the cost where there are six or more gates to lift. Steel racks protect the turbines from floating trash.

The superstructure is of brick and exceptionally well lighted. The window and door sills are of reinforced concrete. The roof is built of slabs laid on reinforced concrete T-beams and covered with tarred felt. The slabs have a span of 6 ft. and are 1.5 in. thick. The under side of each slab is corrugated, and after the roof is completed the ceiling is plastered between the T-beams. All floors are of concrete. The building is fireproof in every respect, and no insurance is carried. A 3-ton traveling crane runs the full length of the power house.

The East Branch plant, shown before completion by Fig. 6, is situated on the East Branch of the Mahoning, at Newton Falls, and about 10 miles up the river from Leavittsburg. At this point there had been a grist and roller mill for over 30 years.

The East Branch has about two-thirds the flow of the Mahoning River at Leavittsburg, but the head secured at the East Branch power house is 16 ft. The dam is similar to that at Leavittsburg except that it is provided with a movable crest and has a passageway underneath. The movable crest has an up-and-down movement of 2 ft. and was built more especially for legal reasons. The sections are about 20 ft. long and held up by notched struts spaced 4 ft. on centers along the dam. Underneath the dam an iron dog engages the notches and may be disengaged by a pull on a steel cable passing through the dam along the footway and up into the power house. A pull of 4 in. on the cable lets down three sections at the far end of the dam. Another 4-in. pull lowers three more sections, and so on until all are down. The lowering of the crest in this way is done in case of emergency, as, when water conditions permit, the sections are operated by two men going under the dam and lowering the sections 6 in. at a time by means of a jack.

The power house is built entirely of reinforced concrete. It at present contains three waterwheel units, geared to a horizontal shaft driving a 300-kw generator at 300 r.p.m. (Fig. 7), and there is provision made for the future installation of a second line of turbines. Each of the three wheel pits is provided with head gates and steel racks so that any wheel may be inspected at will. The wheel pits open up stream into a forebay which is protected from coarse trash by a rack 50 ft. long and 12 ft. deep. This trash rack is parallel with the river's flow and flush with the river side of the power house and, therefore, a large proportion of the drift does not lodge upon it, but passes over the dam.

In order to diminish the maximum depth of flood water on the dam three waste gates were built, each as shown in Fig. 8. Each of these has a capacity of about 30,000 cu. ft. per minute. It is also expected that built in this way there would be a material increase of power at such times, on account of the ejector effect. The water passing through these waste ways will have nearly twice the velocity of the discharge from the turbines and mixing with, or picking up, the latter, will increase the velocity, and, therefore, the effective head on the turbine. However, no actual test has yet been made. Fig. 9 shows the waste way forms during construction.

The building is of "Beardsley Slab" construction, consisting of slabs of reinforced concrete corrugated on one side to receive plaster and set up on edge with reinforced concrete pilasters, spacing them apart 8 in. or more. Each slab is reinforced with No. 28 gage expanded metal and the corrugations are formed by placing 5/8-in. rods in the fresh concrete and pulling them therefrom two or three hours after initial set. After curing, the slabs are set edge to edge as shown in Fig. 10. The form boards *A* act both as spacers and as pilaster forms. The boards *b* are then wired into position, the pilaster reinforcing placed and the concrete poured. This construction gives a large air chamber between the inner and outer walls, making a warm and dry building. After the pilaster concrete has thoroughly set, the corrugated surfaces are plastered. Built in this

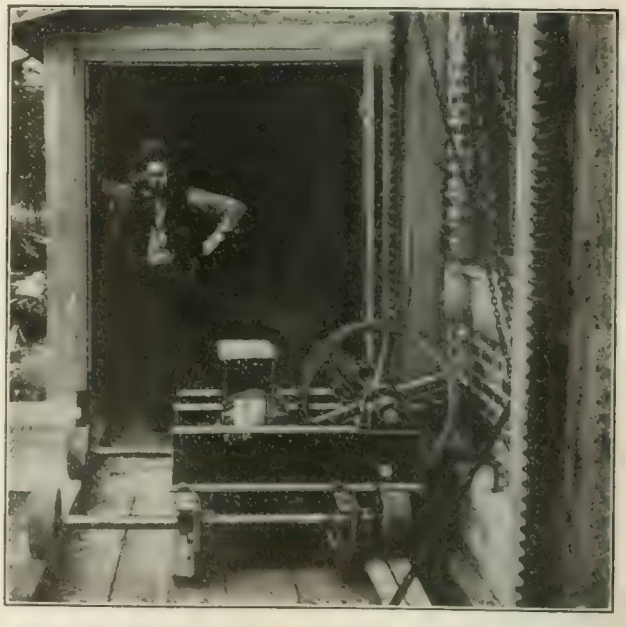


FIG. 5.—MOTOR DRIVEN CRAB FOR GATES.

way there is no tendency for unsightly cracks, as all setting has taken place before plastering. An excellent chance was afforded to learn the comparative cost of a power house built in this manner with one built of brick, as at Leavittsburg. At Leavittsburg all conditions were favorable to cheap brick work, while at East Branch the slab work was done by inexperienced labor, and yet the walls, corniced as shown and plastered on both

sides, cost several cents less per square foot than the plain unplastered walls at Leavittsburg. The roof is of the slab type and similar to that at Leavittsburg. A 3-ton crane serves all the machinery.

The hydraulic equipment consists of three vertical 49-in. improved New American turbines, geared to a line shaft in a manner similar to that at Leavittsburg. The conditions here are such that the back water frequently obliterates the head, and it was desired to keep the plant going as long as possible. The aggregate horse-power at normal head is 975, which, under the usual conditions of backwater, suffices to keep up the speed and power. Mr. R. C. Beardsley made a test on these turbines using a Francis weir and a water-cooled dynamometer and found the efficiency at about ¾ gate to be about 82½ per cent. At ⅞ gate opening and at full gate the efficiency was slightly above 80 per cent.

A third plant is located in the same village, but on the West Branch of the Mahoning (Fig. 11, taken before completion). The normal working head is 20 ft. and the minimum about 12 ft. This, therefore, is the only one of the three plants that can carry its full load under all flood conditions. Were it not for the fact that in any case a steam or gas-engine plant was needed for extreme low water this would have been made the peak load plant and two 300-kw generators installed, but under the conditions it was decided to install only one 300-kw generator.

The dam is similar to the Leavittsburg dam and is built on a sandstone ledge. At the east end of the dam a 50-ft. spillway was excavated in the solid rock. The power house stands at the west end of the dam, and is built of concrete throughout. There are three wheel-pits, each containing a turbine. The increaser design was carried out at this plant even more completely than at East Branch, as will be seen on inspection of Fig. 12. In this case the high-velocity water completely surrounds the draft tubes and is brought to the orifice surrounding the same with practically no loss of head. Above each wheel pit are two head gates and a steel trash rack. The head gates are operated from a horizontal shaft driven by a 2-hp motor and worm gears. By throwing the rack gears in or out of mesh with the rack on the gate stem any gate may be lifted or lowered.

The turbine near the generator No. 1 is a 34-in. improved New American and of such size as just to take the normal flow of the stream at ¾ to ⅞ gate. Turbines No. 2 and No. 3 are 49-in. New Americans having higher gear raters. All three turbines are geared to a horizontal shaft which is directly connected to a 300-r.p.m., 300-kw generator. The gates are hung from a ball-bearing ring and connected to the vertical shaft by a link motion. The horizontal governor shaft is connected in the same way as at Leavittsburg and East Branch, permitting hand control of any turbine. The harness work and gearing



FIG. 6.—GENERAL VIEW OF EAST FORK GENERATING STATION AT NEWTON FALLS.

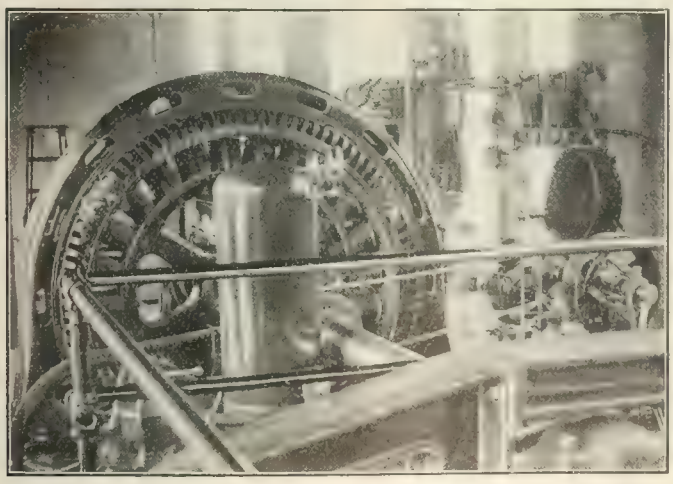


FIG. 7.—INTERIOR VIEW OF EAST FORK STATION.

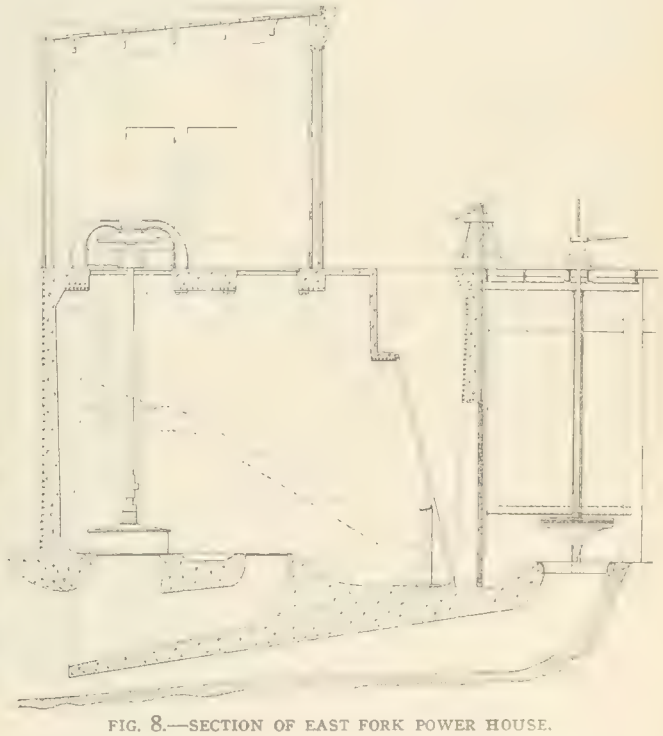


FIG. 8.—SECTION OF EAST FORK POWER HOUSE.

are also similar, there being a jaw clutch for turbine No. 3 and a friction clutch for turbine No. 2. Fig. 3 is an interior view of this plant and shows the unusual solidity of the hydraulic equipment. As in the other plants, a Sturgess oil pressure governor controls the gates.

The superstructure is like that of the East Branch power plant, except the roof, which consists of slabs resting on steel

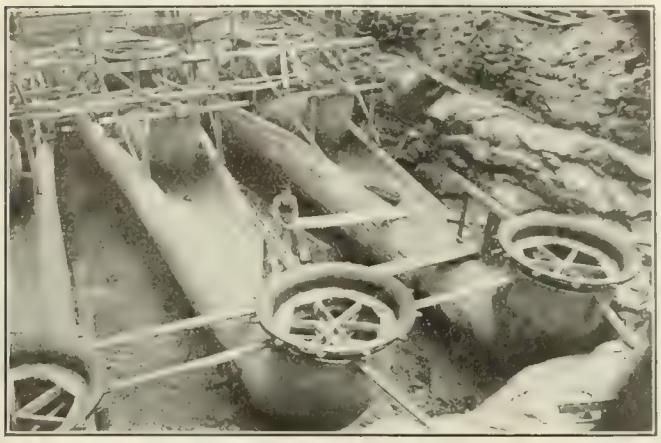


FIG. 9.—WASTE-WAYS IN COURSE OF ERECTION.

I-beams. This type of roof is more quickly built, costs less, and has a neater appearance than the concrete T-beam construction, and, while not so completely fireproof, it is practically so in the case of a building containing little inflammable material.

All the hydraulic machinery was furnished by the Dayton Globe Iron Works and the governors by the Sturgess Engineering Department of the Ludlow Valve Manufacturing Company. In the operation of the three plants one attendant is employed per shift, which indicates first-class alignment and bearings.

The Roberts & Abbott Company, of Cleveland, were the engineers for the water-power development, their representative being Mr. R. C. Beardsley. The electrical engineer was Mr.

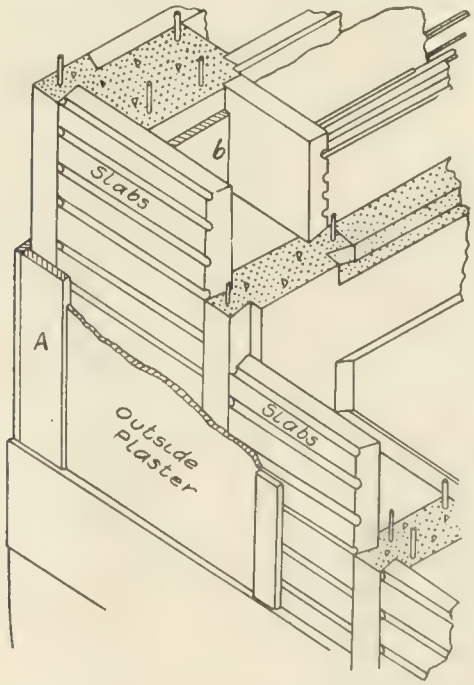


FIG. 10.—DETAIL OF WALL AND PILASTER CONSTRUCTION.

Byron T. Mottinger, of the Hydro-Electric & Gas Company.

The West Forks station contains one 300-kw Electric Machine Company generator rated at 300 r.p.m., 2300 volts, three-phase, 60-cycle, with a guaranteed regulation from full load to no load of 7 per cent. The efficiencies at one-half, three-quarter and full loads are 93.5, 94 and 94.5, respectively. The fields of the machine are excited by a 7.5-kw, 125-volt Colonial belt-driven exciter.

The switchboard is of blue Vermont marble and is equipped with a voltmeter for reading the potential of the phases, an ammeter for reading the current of the three phases and a synchronoscope. The exciter circuit is provided with an ammeter and a watt-hour meter registers the total output.



FIG. 11.—GENERAL VIEW OF WEST FORK POWER STATION.

The West Forks power house is electrically connected with the East Forks plant, which is located at a distance of about a mile, by a 2300-volt line. The line between the two plants is virtually an extension of busbars. In the West Forks station there is a 300-kw Electric Machine Company 2300-volt, three-phase, 60-cycle generator. The guarantees on this machine are identical with those of the West Fork generator. The exciter used in this case, however, is of somewhat larger size, being a

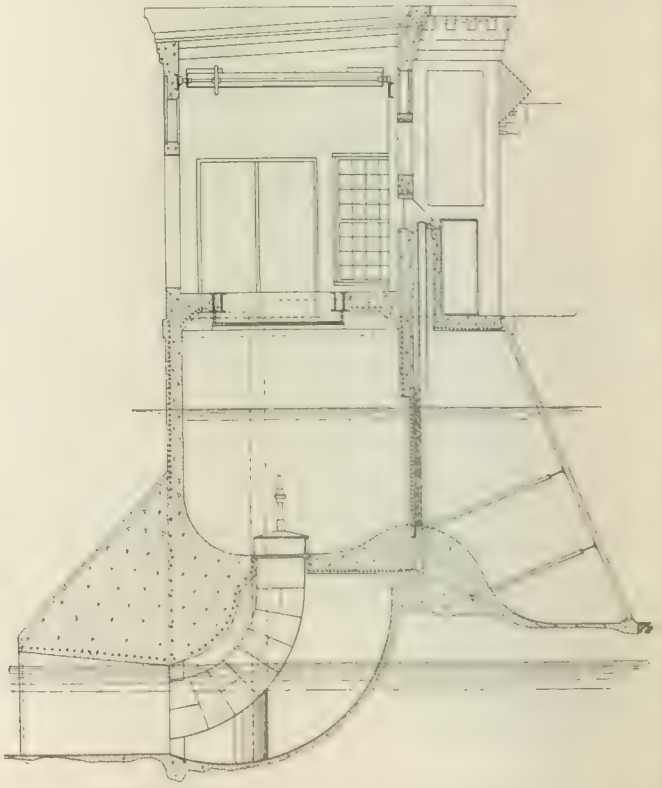


FIG. 12.—SECTION OF WEST FORK POWER STATION.

25-kw Peerless machine, belt driven. This exciter will also be used for a second generator to be installed in the future. The switchboard consists of five panels: an exciter panel, a generator panel, a blank panel and two transformer panels. It is provided with two voltmeters and the necessary voltmeter plugs for reading the potential of any bank of transformers, or of any one of

the three phases of the generator. The other instruments are: a synchronoscope, an ammeter for reading current in the three phases, a direct-current voltmeter and ammeter for the exciter

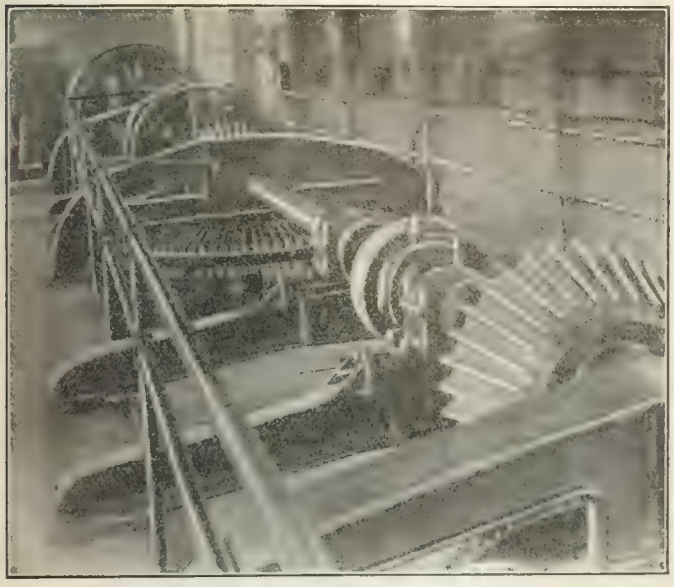


FIG. 13.—INTERIOR OF WEST FORK STATION.

bus, and also a direct-current ammeter in the field circuit. The generator is connected to the bus by a Westinghouse oil switch, and the transformer through a Westinghouse automatic oil

formers connected in delta between the 2300-volt bus and the 23,000-volt bus. Each transformer is provided with a 23,000-volt disconnecting switch. The 23,000-volt bus is connected to the transmission line through three-fused type Westinghouse circuit-breakers. In this plant are also located three high-tension choke coils and three low-equivalent lightning arresters. Between the high-tension busbar and the fused breakers are located three Wagner 60,000-volt, oil-type series transformers connected to three Wagner ammeters.

The Newton Falls plant is connected to the Leavittsburg plant by means of a 23,000-volt, three-phase line on Thomas insulators. The line between Newton Falls and Leavittsburg is of No. 3 medium hard-drawn copper. The wires are placed at the corners of an equilateral triangle, 48 in. on a side. The poles have an average spacing of 130 ft. The cross-arms are of long-leaf Southern yellow pine and the pins are of impregnated white oak. All poles are of chestnut, with not less than 7-in. tops.

The equipment in the Leavittsburg plant comprises one 300-kw, belted-type Electric Machine Company generator rated at 2300 volts, three-phase, 60-cycle, 514 r.p.m. This machine is driven by a two-ply Shultz belt 32 in. wide. The exciter is a 7.5-kw, 1200-r.p.m. belted Colonial machine. The switchboard consists of one combination exciter and generator panel supplied with a voltmeter and the necessary plugs for reading the potential of all phases, the potential of the transformers, etc.; an ammeter for reading the current of the three phases; a synchronoscope and watt-hour meter. The exciter circuit is provided with an ammeter and voltmeter. This plant is equipped with a Tirrill regulator. There are at present installed in this plant a bank of three 100-kw, single-phase, 2300-volt to 23,000-

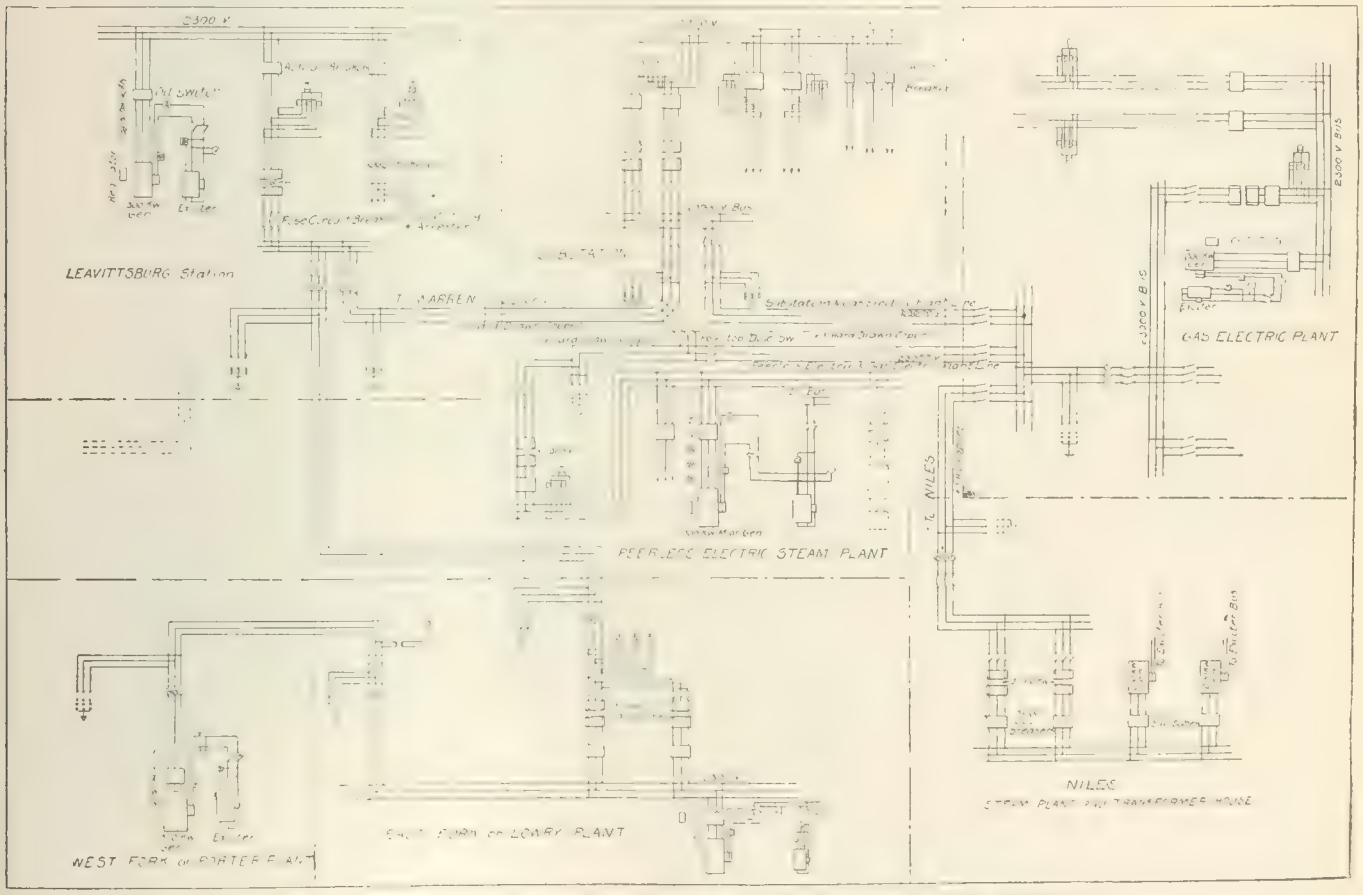


FIG. 14.—INTERLINKED GENERATING STATIONS, HYDRO ELECTRIC & GAS COMPANY.

breaker. The generator panel is supplied with a watt-hour meter.

This plant is equipped with a Tirrill regulator. The switchboard is located on a gallery and beneath it are located the high-tension transformers. There are at present installed six 100-kw Enterprise Electric 2300-volt to 23,000-volt, single-phase trans-

volt Enterprise Electric Company transformers connected on the high-tension side through fused circuit-breakers to 23,000-volt buses. To these buses the Newton Falls and the Warren high-tension transmission lines are connected through fused circuit-breakers. The Newton Falls and Warren lines have choke coils and lightning arresters at the Leavittsburg plant.

The Warren transmission line is identical with the Newton Falls line in general construction. The transmission copper, however, is No. 1. This large size of wire was used with special reference to, at some future time, adding at Leavittsburg a line from Parkman, the exact requirements of which are not known. The spacing of the poles on this line is 140 ft. maximum. The line runs to the substation located on North Park Avenue, in Warren. This substation is equipped with six 100-kw Enterprise transformers similar to the above. These transformers are connected on the high-tension side, through disconnecting switches, to a 23,000-volt bus, to which are also connected the Warren transmission line and the gas-electric power-plant line, the latter lines being provided with Westinghouse fused-type circuit-breakers, choke coils and lightning arresters.

The switchboard consists of six panels: two transformer panels, one three-phase panel carrying two circuits, and three single-phase panels with compensating voltmeter attachment, to be used later in connection with automatic potential regulators for commercial lighting. Both the transformer panels and the distributing panels are provided with ammeters. The station is large enough to house 1800 kw in transforming apparatus.

The Peerless electric steam plant contains one 250-kw, belt-driven Electric Machine Company generator, bearing characteristics as before, and a 7.5-kw, belted Peerless exciter. The switchboard consists of a combination exciter and generator panel and a combination transformer and distributing panel. This board is supplied with a voltmeter and a Tirrill regulator.

The transformers are located in a transformer house and are connected on the high-tension side to the Warren transmission line by means of fused-type circuit-breakers. The lines are protected by the necessary choke coils and lightning arresters. The equipment in the gas-electric power plant consists of one Olds 350-hp, two-cylinder, four-stroke-cycle, horizontal gas engine. The flywheel on this engine is 12 ft. in diameter, has a 34-in. face and weighs 88,000 lb. Cyclic variation of this flywheel under normal load is guaranteed not to exceed 1/300. The gas engine is belted to a 250-kw Burke generator. The same guarantees are given on this generator as on the generators built by the Electric Machine Company. This plant is built to accommodate four engines and generators of the same rating as the unit already installed, and to accommodate 1200 kw in transformers.

At present the switchboard consists of three panels and has the same general arrangement as those previously described. The high-tension side of the transformers is connected by disconnecting switches to a 23,000-volt transformer bus. This second bus is located in a cupola on the top of the station, and to it are connected the lines leading from the substation to the gas plant, a line from the Peerless Electric steam plant to the gas plant, and a transmission line leading to Niles.

Under a 20-year contract to furnish the city of Niles with electrical energy for lamps and motors, the company has built a transformer house on the grounds of the municipal lighting plant. This house is located in the rear of the present municipal buildings, and has installed in it, at the present time, six 100-kw transformers. The transformer house is made sufficiently large to house the necessary choke coils, lightning arresters, fused circuit-breakers and disconnecting switches in order to control the circuits properly. The transformers lower the e.m.f. from 23,000 volts to 2300 volts. The electricity is conducted from the transformers through lead-covered cable placed in vitrified conduit to the present generator-room of the municipal lighting station. The generators in the station are rated at 200 kw and 240 kw respectively. Both were formerly two-phase, 1150-volt machines and have been rewound for three-phase, 2300 volts. These generators, with the lines leading from the transformer house, are connected to a common bus by means of the necessary oil switches and automatic oil circuit-breakers. The generating equipment was placed in satisfactory operating condition by the power company to operate in connection with the new system, as an insurance policy for the city of Niles against any shortage which might occur due to accident to the transmission line or to any of the apparatus. The power company has equipped the generators with Tirrill regulators, fitted the engines with new pistons, erected new stacks on the boiler house and has made numerous repairs and changes, all of which will make it possible to give better service than heretofore. For these changes, some of which have been quite costly, the company has received the right to operate the plant as an auxiliary either to assist the city of Niles or its own lines in case of accident or shortage. For this privilege the power company pays a suitable rental for the right to use the machinery and bears such operating expenses as are required for the operation of such mechanism as is necessary for auxiliaries. The transmission line connecting the city of Niles with the city of Warren is of the same general construction as the transmission line between Newton Falls and Leavittsburg. The line is of No. 3 medium hard-drawn copper. The wires are placed at the corners of an equilateral triangle 48 in. on a side. This line connects with the system in Warren on a common bus, located in a high-tension cupola placed on the roof of the gas-engine plant.

The transmission line from Warren to Niles is a duplicate of that between Newton Falls and Leavittsburg. There will be located in Niles a transformer station with the usual necessary switching and distributing apparatus. The transformers thus far used are all of the self-cooled type manufactured by the Enterprise Electric Company, with guarantees on efficiency and regulation as follows: ½ load, 97.8 per cent; ¾ load, 98.15 per cent; 4/4 load, 98.24 per cent; 5/4 load, 98.3 per cent; regulation at unity power factor at full load is 1.1 per cent, and the regulation at unity power factor with 1½ load is 2 per cent. After a run of normal full load for 24 hours the rise in temperature is guaranteed not to exceed 40 deg. C. With 125 per cent full load and after a run of five hours the temperature rise does not exceed 45 deg. C. The switchboards for all of these developments were furnished by the F. Bissel Company, of Toledo, Ohio. All of the switchboard-indicating instruments are of Wagner make. The watt-hour meters, oil switches and automatic oil breakers are of Westinghouse design.

An Electric Hotel.

THE new Stanley Hotel, recently completed, at Estes Park, Col., is unique among the hotels of the world in that electricity is the sole source of light, heat and power. The hotel is 25 miles distant from the nearest railroad point, and a water-power 4½ miles away has been utilized to generate electricity, which is exclusively used for all cooking and water-heating purposes, for running the refrigerating and laundry machinery, and, of course, to supply all lighting. As the hotel is open only during the summer season, electricity is not utilized for heating rooms, but the manager's house, occupied all the year round, is fitted throughout with electric heaters.

The hotel itself has over 100 guest-rooms, mostly with bath, and represents the highest type of summer hotel. From it for nearly a mile winds a road, bounded by a retaining wall on the low side, with equally spaced columns bearing tungsten clusters in globes, as shown in Fig. 2.

The power plant is located on Fall River, and consists of a 350-hp, double-nozzle impulse water-wheel operating under an effective head of 320 ft., direct-connected to a 200-kw, 6600-volt, 60-cycle, single-phase generator, with a 7½-kw, 120-volt exciter mounted on the extended shaft. The switchboard consists of but two panels, a combination exciter and generator-field panel, and a feeder panel upon which is mounted a static ground detector In addition to the usual indicating wattmeter, a frequency meter on a swinging bracket takes the place of a tachometer. In view of the severe electric storms in the locality it was decided to install 6600-volt aluminum-cell lightning arresters near the hotel and at the station, while multi-gap arresters are placed at two other points on the branch lines feeding the neighboring town and summer cottages, thus giving unusually good protection.

Owing to the scattered location of the summer load among the cottages and the fact that the town, or all-year, load will be small in comparison, it was decided to run a single-phase distribution as being preferable to a proposed three-phase system. A

6600-volt primary is fed through No. 6 copper direct from the generator to transformers, where the voltage is reduced to 220-110 for distribution.

The transformers for the hotel are located in a transformer house 100 ft. away from the hotel buildings, and the low-tension feeders are taken from the secondary buses as follows: One two-wire, 110-volt circuit to the laundry; one three-wire to manager's house; one three-wire to the hotel and one two-wire to casino and garage. The secondary is effectually grounded at its middle point to the 6-in. water mains supplying the hotel. In the laundry a 7½-hp, 110-volt, single-phase motor is installed,



FIG. 1.—HOTEL LOBBY.

belted to a countershaft running a washing machine, a centrifugal dryer and mangles. In the manager's house a brilliant illumination has been allowed for, and provision has been made for electric heaters using units of 2000 watts capacity; from two to three of these heaters being installed in each room. In the west basement of the hotel, beneath the kitchen, is located a brine-cooling system driven by a 3-hp, 110-volt, single-phase motor. This cooling system is also of sufficient capacity to furnish 500 lb. of ice per day. In addition to the above there are 3200-amp capacity water heaters and one three-compartment bake oven, using approximately 100 amp at 110 volts. The bal-



FIG. 2.—FIXTURES FOR LIGHTING GROUNDS.

ance of the cooking apparatus is located in the kitchen proper, and the following list of the equipment may prove interesting:

Three roasting ovens, maximum demand	98	amp.
One broiler, maximum demand	98	amp.
Two gridirons, maximum demand	36	amp.
Nine frying pans, maximum demand	7	amp.
Two large stew pans, maximum demand	22	amp.
Six sauce pans	5½	amp.
One twelve-slice and two two-slice toasters, total demand	82	amp.
One warmer	6	amp.
One plate warmer	40	amp.
One carving table	50	amp.
Two vegetable kettles and two stock kettles, using, each	45	amp.
Three irons with a total demand of	64	amp.

All the current for cooking and water heating is taken from a special panel board located in the basement and is balanced as nearly as possible, according to the use of the apparatus, on the 220-110-volt mains. In addition to the above, approximately 80 kw in lighting load is demanded by the various buildings, tungstens of from 40 watts to 250 watts capacity being used for the hotel main floor and the casino building.

By this installaton, which is primarily for the hotel and is used only incidentally for the village and cottage lights, Mr. F. O. Stanley has secured to his guests the entire absence of all danger from fire, to say nothing of the added convenience and cleanliness of the equipment. The insurance rates, which are usually high on isolated summer hotels, are also greatly reduced by this increased safety. The water-power, being owned by the hotel company, the comparative cost with respect to coal hauled 25 miles over the mountains, is found to be little to the advantage of the electrical equipment. Messrs. Vail, Walbrau & Reid were the consulting and construction engineers for most of the installation.

Electricity in Construction Work.

Within the past few years progressive contractors in all parts of the country have been adopting electricity quite extensively for driving all kinds of apparatus used in construction work and for illuminating the site so that 24-hour operation is possible, where the contract warrants it. In many instances the adoption of electricity by erecting engineers is the result of much missionary work by central-station managers far sighted enough to appreciate the value of the day load which such work affords. Oftentimes the whole electrical outfit has been designed by the central-station company, which also secured the electricians to operate it after its installation, the contractor being thus relieved of the work of selecting and installing apparatus with which he was not familiar.

The average contractor is not overburdened with any system of cost keeping. Electrically driven apparatus was at first

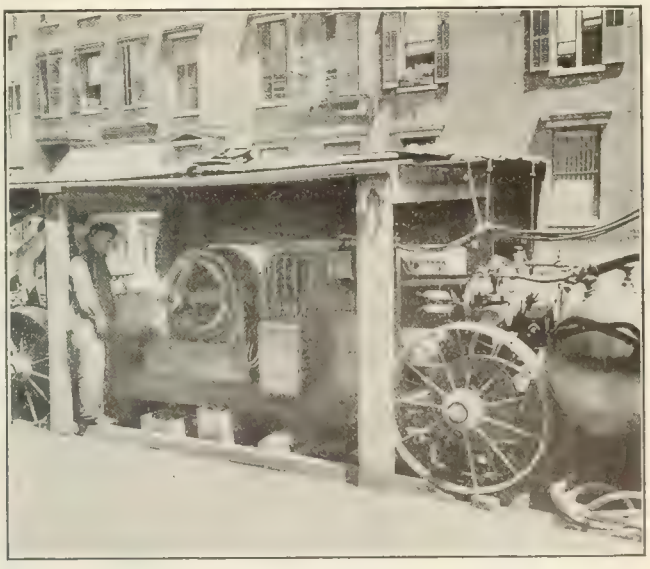


FIG. 1.—PORTABLE MOTOR-DRIVEN COMPRESSOR USED IN CONDUIT WORK.

accepted on faith with an appreciation of the fact that by its use the trouble of obtaining coal and water in localities where these would have to be brought to the work, was eliminated. With the ordinary donkey engine the contractor has had an experience of years; and it does not require so extended an experience with electricity to convince one that it is better and cheaper than the older methods in every respect. This is evidenced by the fact that large contracting firms which have used electricity for operating compressors, concrete mixers, hoists, etc., do not return to the old steam-driven methods unless electricity is not available, and not a few contractors in such

cases build a small isolated electric plant where water and coal are convenient and transmit the energy to the work.

The introduction of electricity and its economical use must be brought home to the contractor in terms with which he is familiar. It will be necessary for a central-station manager



FIG. 2.—COMPACT ELECTRIC DERRICK USED IN FOUNDATION WORK.

to pay close attention to the requirements of contractors, if the good, steady business which is available is to be obtained. A perfunctory letter asking for the business does not appeal to this class of men who are not given to letter writing and who only reason in dollars and cents. The business is worth a number of personal interviews and a study of the situation from the contractor's viewpoint. A contractor may be, and often is, illiterate; but it is not wise to presume on that fact, for a knowledge of men is one of a successful contractor's prime requisites. It needs no argument to convince him of the value of electric light for night work, every contractor will admit its superiority and use it if he has occasion to do so. All the energies of a central-station manager should be directed to securing the motor load. The fact that an engineer is not required to run an electric motor will appeal to a contractor, for by that means he can save from $1 to $3 per day on labor on every engine which is replaced by a motor. The adaptability of the electric motor and the ability with which it can stand the abuse of ignorant help must be shown, however; for if ever machinery of any kind needs to be tested for ruggedness, a contractor can be relied on to give it that test.

The rate for energy should be low enough to warrant the installation of electrical apparatus in place of steam-driven apparatus, for the question of first cost is the greatest stumbling block to the acquisition of the load. It is not an easy matter to induce a contractor to discard steam-driven equipment which he possesses, and for which he has already paid, for more expensive machinery concerning which he may have many doubts. Account must also be taken of the fact that the load is only temporary, but the rate cannot be unduly increased because of this. The load factor of the installation is high while it lasts, and in most cases the load goes off at sundown, work being carried on only during daylight.

In many cities where building operations are going on regularly, it might be profitable for a central-station company to own hoisting equipment which it can rent to building contractors. The design of the equipment could be such that the motor could be removed from the hoist and be attached to other machinery if necessary, so that the investment would not be excessive. Second-hand machinery would be suitable for this purpose, and it should prove an easy matter for a central-station company to induce contractors to use the apparatus. It is certain that the contracting and erecting field offers abundant opportunities for motor-driven equipment and the load is a very desirable one for any central station.

In New York City the steam-driven hoist has been almost entirely superseded by the electric hoist in building construction work. Both alternating-current and direct-current motors are employed for this service. Electric motors are also used to drive air compressors for operating drills in tunnel and excavation work throughout the city, concrete mixers, locomotives, etc. Detailed descriptions of extensive work carried on by means of electrically operated machinery have already appeared in these columns. That the work is by no means confined to cities and that companies having transmission lines can acquire very profitable loads near the transmission lines will be shown in articles which will appear shortly. The illustrations show examples of motor-driven equipment used by erecting engineers in New York City.



FIGS. 3 AND 4.—ELECTRIC WINCH IN STREET USED FOR PULLING LOADED WAGONS IN EXCAVATION WORK.

Recent Developments in Street Lighting

THE introduction of luminous and flaming-arc lamps and of tungsten incandescent lamps of high candle-power has had its effect on street-lighting practice, both in small towns and in large cities as well. The former, by reason of very limited funds and scattered population, had been seriously handicapped for the want of an efficient lighting unit not as large as the arc lamp nor as small as the ordinary incandescent lamp, and on which maintenance is not a large item, which need has been supplied by the tungsten lamp in various candle-powers. Large cities in quest of more illumination and with an eye to economy have chosen the more efficient composite electrode arc lamps, with the result in some instances of revolutionizing the entire lighting system. The articles published herewith show what has been accomplished in this direction.

Street Lighting for Small Towns.

By J. R. Cravath.

THIS article is intended to deal principally with the street lighting of towns of 15,000 population and less. In larger cities the great density of population per block usually makes available a larger amount of money for street lighting purposes. The problems of the city and of the small towns are, therefore, very different. In the small town it is necessary to apply a meager street lighting appropriation to illuminate a large area because the density of population and the assessed valuation of property per block are low. While much that may be said in this article may seem to suggest lower standards of street illumination than should rightly prevail, it must be remembered that it is not the task of a moment to get adequate street lighting appropriations where inadequate appropriations have been the rule for many years.

The amount of money expended for street lighting annually per capita in towns of the size under consideration varies greatly and is usually lower in new, rapidly growing communities than in the older communities. In rapidly growing towns the assessment valuations for taxation purposes always lag behind the actual valuations, and the amount raised by taxation lags likewise.

No actual averages have been compiled by the writer on the amount expended annually on street lighting, but most of the figures will fall between 50 cents and $1.50 per capita per annum. Many fall below $1 per capita, and of such it can only be said that appropriations should be increased to a point where it will be possible to provide street lighting which comes nearer to being adequate. Even if $1 per capita be considered as an average figure for the amount expended on lighting in small towns, it is evident that the street lighting must be rather poor. The most that can be done by those who are seeking to improve street lighting conditions in these towns is to work for a gradual increase of appropriation, as it is usually out of the question to make any very sudden changes in street lighting appropriations unless a change to a new and very much improved system is involved.

Among the new street lamps available for small towns at the present time are the luminous magnetite arc, operated by direct current; the luminous, titanium carbide arc operated by alternating current; and the series tungsten incandescent lamp. The titanium carbide arc has been so recently placed on the market that it can hardly be considered fairly out of the experimental stage, and will doubtless be subject to considerable improvement. The luminous magnetite arc, and the series tungsten lamp, however, are now well established. The older lamps, such as the open and enclosed carbon arcs, and common carbon-filament incandescent lamps, are being displaced by the newer lamps, and it becomes an interesting and important study to determine just what advantage can be obtained by replacing the old lamps with the new.

In towns which are at present lighted with enclosed carbon arc lamp, and in which the annual street-lighting appropriation amounts to $1 per capita or less, it is usual to hang an arc lamp at every other street intersection. In the majority of towns where the town is free to spread in all directions without restriction, the town covers a sufficient area so that an annual street-lighting appropriation of $1 per capita of population is generally only sufficient for an arc on every other street intersection. Towns where this condition exists will be considered first, and then towns where the street lighting appropriation is sufficient to provide for more frequent spacing of lamps.

This system of placing an arc lamp on every other corner is about as unsatisfactory a method of lighting a town with electricity as can be devised. This is especially true when the blocks are long and there are many large trees. Large lamps at such long intervals are blinding, as all who have faced them at night know. The blinding effect of any lamp depends very much on its surroundings. A lamp of high candle-power in a dark setting, as for example, a searchlight on a dark night, is much more dazzling than the same lamp placed in light surroundings. As an extreme case one has only to see the insignificant dazzling effect of any lamp of high candle-power by daylight. Hence it is that on a street with arc lamps on every other corner (a distance apart of 600 to 900 ft.) each lamp is much more blinding to a person walking toward it than if the general illumination of the street and surroundings is raised by the placing of lamps on every corner.

It may be argued by some that the system of lighting a town by means of arc lamps on every other block, and sometimes by even greater spacing than this, is too crude to be worth considering, and that a great increase should be made in the amount of light provided. The crudity of the system cannot be questioned, but whatever improvements are made in towns where this condition exists must not involve too radical a change in the annual expense.

Before attempting to improve such existing conditions it is well to determine, as nearly as possible, what is the probable illumination at present obtained. The committee on street lighting of the National Electric Light Association reported, at the 1907 convention, in favor of a rating of street lamps by the normal illumination delivered at the height of an ordinary observer on the street at points 200 to 300 ft. from the lamp; this illumination to be tested under actual working conditions on the street. At the 1908 convention this committee concluded its report by presenting figures from a large number of tests on different types of street arc lamps made under commercial conditions on the street. The committee, as a result of these tests, recommended certain values of illumination to be considered as standards for the various types of lamps. This method of rating, by means of actual measurements taken on the street, has been criticised severely by some because of the uncertainties of correct photometric measurements under such adverse conditions, and with such low values of illumination. While these difficulties of measurement doubtless exist, it must be admitted that for determining the actual commercial performance of street lamps, measurements taken under ordinary working conditions are likely to be more correct as to the actual illumination obtained than laboratory measurements. In the case of arc lamps, laboratory measurements are especially liable to lead one astray because of the absence of dirt and other accumulations on the globes, which exist in practice on the street, and which have a very important influence on the illumination obtained. The tests made by the National Electric Light Association's 1907 committee, which were carried on under the supervision of Mr. W. D'A. Ryan, assigned a value of 196 cp to the 6.6-amp, series enclosed carbon arc. If, therefore, the street is provided with one of these arcs on every other corner, and the blocks are 400 ft. long, the normal illumination in candle-feet at the darkest corners midway between lamps

will be 196 cp divided by the square of 400, or .00122 candle-foot from any one lamp. With 7.5-amp lamps of the same type, to which the committee rating assigns 256 cp, the illumination would be .0016 candle-foot. In a case of this kind a decided improvement, both in measured and effective illumination, can be made by the use of an 80-cp tungsten lamp at each corner. Such a lamp, which gives 80 mean horizontal cp, has its candle-power at the angles most useful for street lighting increased 25 per cent by the use of a flat fluted reflector customarily used with these lamps. It is the writer's custom in systems of this kind to assume that dirt and depreciation of the candle-power of the lamp, due to blackening inside the bulb, will on the average counterbalance this 25 per cent gain caused by the use of the reflector. Therefore the rated horizontal candle-power of the lamp may be taken for comparison. With 400-ft. blocks, the illumination midway between corners, with an 80-cp lamp on each corner, will be .002 candle-foot. This is compared with a minimum illumination of .00122 candle-foot for the 6.6-amp arc and .0016 candle-foot for the 7.5-amp arc. In other words, the 6.6-amp arc placed on every other corner gives only about 60 per cent of the minimum illumination between lamps given by a tungsten lamp of 80 cp on each corner.

The practical effectiveness of the tungsten system is even much greater than these figures indicate. In other words, the difference of 40 per cent does not by any means represent the greater comfort and ease with which one can see his way along a street illuminated with the tungsten lamp on every corner as compared with the arc lamp on every other corner. The tungsten lamps being in smaller units more distributed along the street have much less blinding or dazzling effect. The same ratios, of course, hold with blocks other than 400 ft. in length.

The difference between the arc and tungsten systems just outlined is so marked as to be immediately apparent to the non-technical observer. A demonstration with a trial installation on the street is all that is necessary to convince a City Council at once, provided, of course, it is thoroughly explained and agreed upon in advance of the trial that ease of seeing one's way along the street at all points is to be the test rather than the apparent brilliancy or candle-power of the lamps. Two cases of this kind have recently come under the writer's personal observation, and doubtless the same thing has happened in many other places. One of these cases occurred at Grinnell, Iowa, where the arc-on-every-corner system prevailed. A practical demonstration with a few 80-cp tungsten lamps was more convincing than any amount of argument, and brought about an acceptance of the central station company's offer to change the entire street lighting system to tungsten. The other case was at Lawrenceville, Ill., where the Council was strongly predisposed to the arc lighting system, presumably because of the idea that it gave the town a more metropolitan appearance. The Council was taken out one evening to inspect a stretch of street lighted with an 80-cp tungsten lamp on every corner, as compared with 6.6-amp arcs on every second or third corner. The demonstration was so convincing that there was no room left for argument, and the tungsten system was adopted. It may be argued that the illumination produced by an 80-cp tungsten lamp on every corner with 300 or 400-ft. blocks, is far from being up to the standard which should prevail for street lighting. It is true that this illumination leaves much to be desired, but it is so far in advance of the illumination which is prevalent in towns where the annual appropriation is only $1 per capita that it is certainly a great step in advance, and will pave the way for still further improvements in the future. In both cases just referred to, immediate increases in street lighting appropriations to a point where better street illumination than this could have been provided, would have been out of the question.

The flexibility of the tungsten system just outlined for small towns of this class is another very strong feature, which appeals to Mayors and City Councils who are constantly being besieged for additional lamps in the outlying district. The addition of an arc lamp at a cost of $60 to $90 per annum means a much larger addition to the street lighting appropriation than the addition of a tungsten lamp at $15 to $35 per annum. In a town which is growing in population to a point where a higher standard of illumination is desirable than can be obtained with an 80-cp lamp on every corner, the system offers the possibility of adding lamps midway between corners without changing the existing system. In the downtown district lamps can be placed still closer.

The tungsten system is also applicable for additions to existing series arc systems. As the lamps are run on standard series arc circuits, it is easy to add tungsten lamps on the series arc circuits, as may be necessary.

As to the relative cost of a system using an 80-cp tungsten lamp on every corner, as compared to an arc lamp on every other corner, it is hardly safe to generalize because of the difference in local conditions. From what has been said, however, it is apparent that by using twice as many 80-cp tungsten lamps as there are 6.6-amp arc lamps in a town where the arcs are now placed on every other corner, an improvement in illumination of 66 per cent is secured, with a reduction in wattage to about 42 per cent of that used by the arc system. Therefore, if two tungsten lamps are supplied for the present price of one arc lamp, the city would enjoy a very marked increase in illumination. There is no question but that it would pay both the city and the company to make a change under ordinary conditions, but just how this cost of the change should be divided between the city and the company is a matter depending on local conditions, and calling for the decision of some very nice questions. For example, consider the case of a town which is now paying $65 per annum per arc lamp. From what has been said above it is evident that if the company were willing to supply 80-cp tungsten lamps at half this price, or $32.50 per annum, the city should be more than willing to make the change. However, the price of $32.50 per annum on a moonlight, all-night schedule, calling for 3000 hours burning, would amount to nearly 11 cents per kw-hour, and more than this on a midnight or 3 a. m. schedule. Now, while this rate might be fair enough under certain conditions, where the displacement of a lot of comparatively new street-lighting apparatus is involved, it looks high on its face to any city official who may take the pains to figure out the rate on a kw-hour basis. This is the city's side of the case. The company's side is that a change of the street-lighting system so as to provide two 80-cp tungsten lamps for one arc, under the foregoing conditions, will not bring to the company 1 cent increase in gross revenue per year from street lighting. A change which involves considerable investment without any immediate increase in gross revenue is certainly not attractive to the central-station investor. If along with the change a considerable addition to the street-lighting area can be made with a consequent increase in gross revenue, the proposition looks more favorable to the company. It may be argued that the reduction in kw-hours brought about by the tungsten system will reduce the company's operating expenses and bring about an increase of net revenue which will pay the company for making the change. In actual practice, however, this reduction in operating expenses is not likely to be realized. Under the conditions prevailing in the majority of small central stations the reduction in kw-hour output caused by such a change of the street-lighting system would be disappointingly small. The reason for this is that the average small station is operated most of the time at such a poor load factor, and with machinery so much underloaded and with such high fixed losses, that reductions in output do not cause proportionate reductions in fuel expense. The other operating expenses besides fuel, being practically fixed and independent of small changes in the output, would not be altered. The only change in station operating expense brought about by reduction in the kw-hour output, therefore, would be a very small reduction in the total coal required.

As to the cost of maintaining arc lamps versus the cost of maintenance and renewals of tungsten lamps, sufficient experience has not been gained at the present time to make reliable comparisons. From present indications, however, the tungsten lamp accidental breakage is not excessive, while the normal life

of a series tungsten lamp is such as to call for only one or two renewals a year.

The chief advantage to the company in making such a change is one which it will take it some time to be beneficial. This advantage is the release of a certain amount of station equipment the output of which can, in every growing central station, be sold to other consumers or to the city for additional street lighting. As the fixed charges on the investment necessary to provide a certain station equipment are such an important percentage of the total cost of supplying energy from central stations, this release of station equipment will, in the course of a year or two, mean more to the central station in a case of this kind than any reductions in operating expenses.

When considering the station equipment required for the two systems, one must consider the low power factor of the arc-lighting system if operated by alternating current. The power factor of a fully loaded constant-current transformer operating a series of tungsten lamps which give a non-inductive load is stated by one manufacturer to be about 85 per cent and by another 95 per cent. The power factor of small constant-current transformers operating a series of alternating and enclosed arcs is not over 65 per cent to 75 per cent. Taking 95 per cent power factor for the tungsten system and 75 per cent for the arc system, both of which figures are far higher than the average attainable in practice, because of the underloaded condition of transformers, there would be about 105 volt-amp plus the line loss for each 100-watt, 80-cp tungsten lamp. For the 6.6-amp arc, taking 403 actual watts with a 75 per cent power factor for the entire circuit, the volt-amp per lamp would be 536. As two tungstens would replace one arc, there will be under the tungsten system 210 volt-amp per unit of street excluding line loss, and under the arc system 533 volt-amp per unit of street, excluding line loss, or a difference of 323 volt-amp of station output, which is the amount released by the change per unit of street lighted, the line loss not being figured.

The amount of gross revenue earned by central stations per kilowatt of station equipment varies from $40 to $139 per annum. If $75 be an average rate of gross earning per kilowatt of equipment, this 323 volt-amp per unit of street can be set to earning revenue from other sources amounting to 0.323×75, or $24.20 per annum. However, it is not possible for the company to begin immediately to realize on this released investment, and where a change is made it is only fair that the city be willing to pay a high price for its tungsten lamps the first few years in recognition of the fact that the company is getting but small immediate direct returns from the change. In many central stations where the load has nearly reached the rating of the plant, the company is confronted with the necessity of either enlarging its generating plant or reducing its load by some such expedient as this. It will sometimes be found that the investment required to make a change of this kind is no more than would be required to install a corresponding amount of additional generating apparatus. As a general proposition, it is wise for the central station to make the rate on street lighting as low as is consistent with the protection of its investment. If a town is reasonably prosperous, the company can usually figure on a better chance of increased street-lighting revenue by the addition of lamps in the outlying district with small tungsten lamps than with large arc lamps, for reasons before stated.

Moonlight-lighting schedules, from dusk to midnight or dusk to 3 a. m., are common. These schedules call for lighting 2000 hours to 3000 hours per annum, as against 4000 hours for an all-night, every-night schedule. In order to reduce the rate as figured on a kw-hour basis, when making a change of this kind, it will frequently be desirable to offer the city an all-night, every-night schedule. This will justify a higher gross yearly rate than could otherwise be reasonably asked.

The consideration of street lighting of towns where the annual appropriation is sufficient to provide an arc lamp on every corner, or an equivalent amount of incandescent lighting, may now be considered. Unless the population of the town is very thickly clustered together an expenditure of over $1.25 per capita will be required annually. In towns of this class the conditions are altogether changed from those in the class before considered. Under such conditions, large units, such as arc lamps, are more desirable than in the former case. With the street illumination produced by arc lamps on every corner, the blinding effect of distant lamps is much reduced. The new luminous arcs using titanium salts in their electrodes, such as magnetite and titanium-carbide lamps, must receive attention. With lamps 400 ft. apart, the 6.6-amp, alternating-current series, carbon arc giving 196 cp will yield an illumination of 0.0049 candle-foot 200 ft. from the lamp. The direct-current magnetite 4-amp lamp, according to the National Electric Light Association committee figures cited above, gives 484 cp, resulting in 0.0121 candle-foot 200 ft. from the lamp. By using one 80-cp, 100-watt tungsten lamp on each corner and one similar lamp midway between corners, an illumination of 0.008 candle-foot is obtained at 100 ft., or midway between lamps, as against 0.0121 which would be obtained with a magnetite luminous arc on each corner. To light a town with this system, using one lamp on each corner and one midway between corners, will require three times as many tungsten lamps as there are corners, or three times as many tungsten lamps as arc lamps. It has been already shown that one 4-amp luminous arc will give 50 per cent greater minimum illumination than the tungstens spaced in this way. To reduce the systems to an equality, therefore, a city could afford to pay three times as much for one luminous arc as for one 100-watt tungsten, and then add to this price 50 per cent. This would make each magnetite arc worth 4.75 times as much as each 100-watt tungsten lamp for this particular purpose. Few central-station companies would be willing to supply 100-watt tungsten lamps at a rate which would enable them to compete with the luminous arc under such conditions. Hence, it is that a luminous arc on new work of this character has the field very much to itself.

It is interesting to see where the 6.6-amp enclosed alternating-current arc falls in this comparison. Such a lamp gives only 0.0049 candle-foot 200 ft. from the lamp. Therefore, as compared with an enclosed arc on each corner the 80-cp tungsten, as used before, giving 0.008 candle-foot, has much the advantage, both in energy consumed and in illumination. In fact, it is coming to be a question whether a cluster of tungsten lamps of equivalent candle-power to the carbon arc could not be supplied cheaper. A cluster of three 80-cp tungstens, requiring a total of 300 watts, giving 240 cp, would certainly give steadier and more satisfactory illumination than the enclosed arc. The uncertain feature of the tungsten cluster is its cost of maintenance.

The situation will become still more interesting if the talked-of 250-volt, 200-cp series tungsten lamp is placed on the market and proves successful. After the success so far attained with the 250-watt multiple tungsten lamp, it would seem that a 250-watt series lamp ought to be easily produced and to be low in maintenance cost, barring the one important question of breakage by the small boy with a stone. Such lamps, if produced, will be practically the equivalent in commercial performance, and in some ways superior to the 6.6-amp carbon arc. They can, therefore, be substituted for such arcs.

In this article no figures have been given on the titanium-carbide series arc which is meant for use on 60-cycle alternating-current circuits, as its performance under commercial conditions is not yet sufficiently known. Enough has been said, however, to indicate the general lines which it is safe to pursue in ordinary street lighting with these new illuminants. It is evident that the engineers who are responsible for changes in street-lighting systems at the present time have plenty to think about.

So far this article has dealt altogether with ordinary street lighting as carried on in the majority of towns where the attempt is made only to light the street sufficiently so that pedestrians with ordinarily good eyesight can find their way. There is another class of street lighting which is receiving increased consideration, both in large and small towns; that is, the special lighting of down-town streets. Conditions are rapidly

shaping themselves to a point where a town which is not provided with some special lighting for its down-town streets will be considered asleep and unprogressive. It may be thought that such luxuries are only for the larger cities, but this is not so, as has been demonstrated by the adoption of special lighting schemes by towns with a population as low as 5000. The three principal plans for down-town street lighting in small towns may be enumerated as the arch, the festoon, and the ornamental-post plans. The arch may either be made of iron-work or may have the lamps suspended from a span wire stretched across the street in such a way as to form an arch without the support being apparent. This is accomplished simply by hanging the lamps from different lengths of wire supported by the span wire. This plan is the one used on all the principal streets of Grand Rapids, and also in a number of other Michigan towns. It is unobtrusive in the day time, but makes a very beautiful effect at night. The usual plan is to use series lamps and supply a certain number in series from a 220-volt or 110-volt multiple circuit. This plan undoubtedly produces a greater effect for a small amount of money spent in construction than any of the various plans proposed. In some towns lamps are placed in festoons from post to post along each side of the street. Where there is no overhead line work on a street, the plan of placing ornamental posts at regular intervals usually finds the most favor. Both arc and tungsten lamps can be effectively used for ornamental-post lighting. The luminous arc gives the greatest amount of light for a given expenditure, but has not the artistic effect of a cluster of tungstens in diffusing globes.

Street-Lighting in New England.

THE present street-lighting situation in New England is characterized by a steady increase in the use of the series-tungsten lamp for the illumination of thoroughfares of minor importance, and by a gradually growing appreciation of the limitations of the old types of open and enclosed arcs for effective and economical service. In the annual lighting number of this paper, Sept. 5, 1908, the rapid advance of the tungsten lamp was a salient feature. At that time the installations of luminous arc lamps, which were being tried out in New England, were to some degree experimental. To-day the end of the old open-arc lamp appears plainly in sight, but there is still more or less uncertainty as to the illuminants which will become generally accepted as the standard for municipal service. It is estimated that at the present time there are over 20,000 series-tungsten lamps in street-lighting service in New England. So far these lamps have not entered the field of larger lighting to any notable extent, although an installation in the park system of Hartford is clearly demonstrating that the tungsten filament will be heard from still more in the future. The advent of the 450-watt lamp into the market provides the central-station manager with a powerful illuminant of demonstrated flexibility, and there are not lacking managers in New England who will put this size of lamp in important street service within the next few years. It is clearly established that the old series-carbon street lamp must go.

Several notable installations of magnetite lamps are now at work in New England streets, and in subsequent pages some of the particulars of these layouts are given. All but one of the magnetite installations are of General Electric manufacture, but the Westinghouse Electric & Manufacturing Company has lately entered this field with a 400-lamp, 4-amp installation in Chicopee, Mass. It is estimated that there are now about 7000 magnetite lamps in service or under contract in the New England field, Boston having the largest installation in point of lamp size and number of units to be placed in service. The principal installations of these lamps are located outside of Boston, in Worcester, Fall River, Hartford, Bridgeport, New Haven, Rockland and Calais, Me. In Calais and Rockland the service is supplied from Brush arc generators, and this type of dynamo is used in Boston, but in the latter city a previous installation of some 40 synchronous motor-generator sets is used in order to transform the alternating-current energy into direct current. Rectifiers of the mercury arc type are extensively used elsewhere, and experience seems to indicate that the life of these tubes is, on the whole, entirely satisfactory. Good records are being obtained by individual companies of the life of the electrodes, although on account of the short time in which some of these installations have been in service, there is a disposition to withhold the data from publication. Both the direct-current and the alternating current arc lamp have been displaced by the new types.

The titanium lamp appears to have made but little headway thus far in New England, although a trial installation of two years' service at Haverhill, Mass., afforded an interesting example of progressive lighting and, so far as experience indicates, is giving good service as to reliability. It is understood that the cost of operating this system indicates that an encouraging future may be expected from the smaller sizes of flaming arcs in the lighting of cities of moderate size. The titanium lamp is not, of course, as well tried out as the magnetite, but the objections urged against it in some quarters on account of color would seem to have comparatively little weight in the illumination of the street, for this is a class of service where refinements in coloring are of minor importance. At Pawtucket and Woonsocket, R. I., two recent installations of the 2.5-amp titanium lamps appear to be giving excellent results, and views of the Woonsocket installation by day and night are shown herewith.





FIGS. 1 AND 2.—DAY AND NIGHT VIEWS OF TITANIUM ARCS AT WOONSOCKET, R. I.

The flame lamp of the General Electric Company is conspicuously in evidence in the lighting of Copley Square, Boston,

and full particulars of this installation are given in following pages. Another installation of effectiveness in the flame-arc equipment is at Pittsfield, Mass., where the business center is thus illuminated.

The victory of the magnetite arc lamp over all other competitors for the major street lighting of Boston was a notable event in New England lighting circles during the past year, and some of the tests which showed the inferiority of gas on business streets and on avenues in Boston's most exclusive residential section are included in this number.

Even the municipal plants have turned away from the old open arc in New England to a significant extent. At Mansfield, Mass., the open-arc lamps of the 6.6-amp size have been superseded by 6.6-amp, 250-watt tungstens with Wheeler reflectors. The change has met with universal approval, and the absence of shadows, compared with the dark belts and relative unsteadiness of the old series alternating-current lamps, is noteworthy. In this town 31 arc lamps have been replaced so far, the new lamps being installed from 20 ft. to 25 ft. above the streets, except in a few cases where they were installed on the same mast-arms as the old arcs, with good results. In six months' service not one of these lamps has burned out.

At Braintree, Mass., in the outlying districts a number of 250-watt lamps have replaced the old arcs, and the same movement is under way at Taunton, Mass. At Waverley, Mass., one of the western suburbs of Boston, the town has installed two 250-watt tungstens in place of one arc. One tungsten lamp is put in the location of the old arc, 22 ft. above the ground, and the other situated about 175 ft. away, 18 ft. above the ground. Wheeler concave reflectors are used in each case. The energy consumption is about the same as that of one arc, but the distribution and quality of light for the same street arangement are much improved. It is intended to replace the arcs in the town by tungstens, using a 14-ft. mast-arm with pulley. The experience gained here indicates that the best type of local illumination will consist of an installation of one 250-watt unit every 300 ft., the lamp being 22 ft. above the ground. A decided saving in maintenance compared with the old open-arc lamp is anticipated. Things are stirring in the New England lighting field, although the more modern types of arc lamps of domestic and foreign design are yet to be tried out on a thoroughly comprehensive scale in general street service, excepting those already cited in the larger cities named above.

WORCESTER, MASS.

The first city in New England to be equipped with luminous arc lamps on a large scale, and in fact the one having the first representative installation of magnetites, was Worcester, Mass. The present system of lighting was installed about three years ago by the Worcester Electric Light Company, and there are now 852 4-amp arcs in service on the system, operated through mercury-arc rectifiers and constant-current transformers. The previous installation consisted of 9.6-amp series-arc lamps of the open type, operated from Brush machines. Since May 1, 1906, the price of the service at Worcester has been 25 cents per lamp per night on a 4000-hour per year schedule. The magnetite lamps have been found to give more and better light than the preceding installation, while the cost to the city is considerably reduced for the service rendered.

In his report for the year ending Nov. 30, 1908, Superintendent Henry A. Knight, of the Worcester Street Lighting Department, refers briefly to the excellent general condition of the new lighting service and the small number of complaints received. The city has continued its policy of lighting thoroughly whatever streets it attempts to light at all. The outages for the year in Worcester were very small, amounting to 166 lamp nights, and representing a money deduction of $41.50 from a total bill of $75,215.75.

The magnetite lamps in Worcester are at present operated on 18 circuits, the maximum number of lamps on any circuit being 50. Twenty tub transformers and 20 rectifiers are installed at the Faraday Street station. The company has installed a primary meter just beyond the alternating-current busbars of the plant so that the total energy input to the system can be read and recorded daily. Hourly ammeter and voltage readings are made in the station on each circuit. A special wire, No. 6 B. & S. gage, composed of 45 per cent pure rubber insulation, is used in the station between transformers to guard against open circuit. The lamps are carried from 22 ft. to 24 ft. above the ground on wooden poles, 65 per cent of the latter being hard pine. The top suspension, the hang-out suspension and the mast-arm suspension are all used, according to conditions. A cut-out is installed on every pole, there being no switch in the lamp itself. The conductors are carried up the side of the pole in a 2-in. wrought-iron pipe running about 12 ft. above the ground. The poles are generally from 27 to 30 ft. long, with 8-in. tips and 12-in. butts, the latter being set 5 ft. in the ground.

The company has found that it is a good day's work for a man to trim 50 lamps. With open or enclosed arc lamps a man could trim 85 lamps per day. The magnetite lamp proves to be simple in operating details and a man can be quickly taught to trim and care for it. With the magnetite lamp it is, of course, unnecessary to trim it anywhere nearly as often as the older forms of arcs. The company has been gratified to find that the life of the rectifier tubes has exceeded the manufacturer's guarantee. The outages of the magnetites have been far less than those of the old open arcs. In general, the distribution circuits were not altered as the change was made in the lamps. The Worcester company has more underground wire installed than any other central station in Massachusetts outside of Boston, practically all its service in the more poulated parts of the city being distributed from conduits. The underground arc circuits are all of rubber-covered, lead-sheathed wire. These circuits are tested daily for grounds. Outages are reported by the company's inspectors, by the police, or by citizens over the telephone.

HARTFORD, CONN.

The street-lighting system of Hartford, Conn., is at present being changed over from an installation of 1100 6¾-amp, 450-watt, alternating-current, enclosed arc lamps run from tub transformers to an equipment of 500 4-amp series-magnetite lamps and 100 multiple-magnetite lamps of General Electric manufacture. The latter are operated on the three-wire, 250-volt, direct-current service of the local central-station organization. The Hartford Electric Light Company supplies all the electric street illumination in the city, and in addition to the above arc lamps operates about 1500 series-tungsten lamps of the 125-watt size in street service. A few 50-watt tungstens are installed in the outlying districts, to acquaint the residents with the attractiveness of this kind of lighting and create a demand for a larger service.

The series-magnetite lamps are located about 25 ft. above the street, and the multiple magnetites are at the same height. The series tungstens are usually carried 15 ft. above the streets. The city pays $60 per year for magnetite lamps operated from the overhead system of the company and $64 per year for each lamp operated from underground cables. The rate on tungsten lamps of 100 cp is $17 per year each. A five-year contract was signed last spring. Dr. Louis Bell, of Boston, was the consulting engineer for the city. At present the city tests one electrode in each lot of a hundred, the quality of electrode being selected by the city's engineer.

In the parks at Hartford there are a large number of multiple-tungsten lamps operated by the company for the park commission independently of the street-lighting contract. These are of the 125-watt size, operated on the company's Edison three-wire, 220-volt mains. Each lamp is mounted on the top of a pole about 10 ft. above the street, without any reflector, the bulb being carried in a slightly frosted globe. The advantages of this method are the absence of all high-tension construction and a first-class diffusion of light. The company had a test circuit of 18 multiple-tungsten lamps in operation on Pearl Street for a year, and the results were very pleasing. President Dunham is a strong believer in the future of the tungsten lamp for street lighting, and states that the advent of

the 450-watt lamp will sooner or later tend to displace the arc lamp for such service. The flexibility of the tungsten incandescent lamp with regard to location appeals to him particularly.

HAVERHILL, MASS.

Street lighting at Haverhill, Mass., is noteworthy through the installation of the titanium lamp for this service by the Haverhill Electric Company about two years ago. This company is one of a group managed by the Tenney-Royce syndicate, of Boston, and is at present the only plant using any of the later forms of arc lamps of the flaming or luminous type. The Haverhill installation consists of 200 2.5-amp titanium units operated at about 80 volts each at the lamp terminals. They replaced about the same number of old open-arc lamps, and were installed in the same locations on the streets. There is an average of approximately 190 watts to 200 watts input to the system per lamp, the power factor measured at the station busbar being 54 per cent. The titanium system was fully described in the issue of Aug. 5, 1909, page 307.

The lamps in Haverhill are installed about 22 ft. above the street, with clear-glass globes, and compare very favorably with the 4-amp magnetite lamp in illumination. The bottoms of the globes are sand-blasted for a distance of about 4 in. above the underside. The copper electrodes are 16 in. long and ⅞ in. in diameter, and the titanium electrodes 12 in. long and 7/16 in. in diameter. These lamps are operated in series from 75 light current transformers taking up the following space each in the station: Length, 3 ft. 3 in.; width, 2 ft. 6 in.; height, 3 ft., over-all dimensions. The service at Haverhill is 4000 hours per year, and the feed of the lamps has been found to be very steady. The average hours of burning of the titanium electrodes is 84. The outages for the two years have averaged less than 1 per cent per month. The penetration of the light has been found especially good in hazy weather. The price of these lamps per year to the city is $100 each. A number of 40-cp tungsten incandescents are operated in series with the titanium lamps.

NEWPORT, R. I.

The street lighting of Newport, R. I., is supplied by the Old Colony Street Railway Company from a turbine station located on the harbor side of the city. There are now in service 165 General Electric magnetite lamps of the 4-amp size, operated in six circuits from oil-immersed mercury-arc rectifiers, these lamps replacing the old open arcs run from Thomson-Houston machines. The circuits are of No. 6 copper. The minor streets in Newport are gas lighted. The old arc machines were driven by belts and shafting from alternating-current motors located in the station on the level of the switchboard gallery. The new installation eliminates this and the wiring has been centralized, with the switchboard panels all on one level instead of at different heights, as in the old layout.

Although the Newport station of the Old Colony system is practically the first plant in which Curtis turbines were installed in New England for regular service, it is a modern installation at this day, with motor-driven auxiliaries and apparatus arrangements according to first-class practice. The plant now contains three 500-kw Curtis-General Electric turbo-alternators wound for 2300 volts. The boiler-room and the auxiliary machinery are lighted by tungsten lamps, five of the 250-watt size being used for the firing aisle, which is approximately 60 ft. long by 15 ft. wide. Coal is handled on push cars run upon narrow-gage tracks, with excellent weighing facilities in front of the boilers. The railway service in the territory is supplied through motor-generator sets. An interesting feature of the station is a rotary converter installation consisting of two 100-kw General Electric machines wound to supply 250 volts for three-wire, direct-current service. These are connected with the neutral of the three-wire system in the transformer wiring. Energy from this service is used in about half a dozen garages in Newport which charge electric automobiles. A few dentists also use the three-wire service. After midnight the two rotaries are usually connected in series and operated on the 500-volt street-railway load, which is too light for the efficient operation of the motor-generator sets. There are three of the latter, each being rated at 250 kw. The plant has one steam-driven exciter, and is equipped with a Tirrill regulator. The latter has proved to be very useful, since the railway generator sets are driven by induction motors. The company is extending its business steadily and has recently taken over the lighting and power service of two of the large Newport estates which formerly had plants of their own.

Special Street Illumination in Chicago.

CHICAGO, with its wide area and lean city treasury, is not an especially well-lighted city. The city operates its own street-lighting plants, using electrical energy from the hydro-electric plant of the Sanitary District Drainage Canal. This lighting is intended almost entirely for police protection of the streets at night, and a considerable part of it is done by gas lamps. However, the city electrical department will make an effort within a few months, to secure funds for electric street-lighting extensions by a bond issue of $2,500,000. If this money should become available, it is believed electric street lighting by arc lamps operated by Drainage Canal electricity will be extended to cover practically the entire city.

The fact that the general street lighting is not particularly



FIG. 1.—DAY VIEW OF MILWAUKEE AVENUE, CHICAGO.

good gives rather more than the usual opportunity for various business men's associations in different parts of the city to establish neighborhood illumination to attract business to their particular localities by the brilliance of the streets at night. There are several of these business men's lighting associations, and some of their efforts are illustrated herewith. The formation of these associations is encouraged by the Commonwealth Edison Company, which enters into a special arrangement with the members of the organization in each case, providing the lamps and posts, wiring and electrical energy for a certain flat rate to be paid weekly.

There is a distinct tendency toward the improvement of the street lighting of Chicago in all directions, and various plans have been proposed for downtown associations to provide more ornamental fixtures and profuse lighting than is now the case, although in the downtown streets the brightly lighted show windows of the stores help out the ordinary street lighting very materially.

Another development that tends to improve street-lighting conditions is the real estate activity in outlying areas. Subdivisions are divided into lots, which are sold sometimes very successfully after an active advertising campaign. To make these properties attractive special systems of street lighting are sometimes employed.

The business men's street-lighting installations, to which attention is directed in this brief article, are all in localities some distance from the heart of the city. In making the rates the

central-station company considers, first, the amount of electricity that will be used. The energy consumption is then ascertained and the company determines how much it should receive for it. Then the investment charges on the installation must be



FIG. 2.—MILWAUKEE AVENUE, CHICAGO, BY NIGHT.

added, and, of course, this varies with the style of post and character of lamps supplied. If more elaborate fixtures are wanted, the fixed cost will, of course, be higher and the final rate depends on these two considerations—amount of electricity consumed and character of the special work provided. It is expected that an association of this character will use at least 50 lamp-post units, whether the fixture supports one or more lamps.

On Milwaukee Avenue, near Chicago Avenue, there has been in existence for some time an installation of special street illumination by business men. Here the posts support five 60-watt tungsten lamps. One of them surmounts the post in a globe somewhat larger than the others and is mounted upward. The other four lamps are encased in globes a little smaller in size, and placed on brackets near the top of the post, with the lamps burning downward. There are about 50 of these fixtures, and they are spaced about 50 ft. apart. The store fronts are usually 25 ft. wide, so that two adjoining shopkeepers pay together for a lamp post placed as nearly as possible on the dividing line. In the case of large stores, the proprietor pays for one or more lamp posts by himself. The rate is $2.10 a week for each lamp-post under a two-year contract with the central-station company. The installation has given complete satisfaction, and there has been no trouble at all with it since its erection. It has attracted attention to the locality, and has helped in the location of other special street-lighting schemes on other outlying business streets. The lamps are burned seven days in a week from dusk to 10 p. m., except that on Saturday they are burned until 12 p. m. The company controls the lighting entirely, and the price paid by the members of the association covers all charges.

A special arc-lighting street-illumination installation has been placed on Halsted Street and Twelfth Street by the members of the South Halsted Street Business Men's Association. Here



FIG. 4.—ARC LAMPS ON TWELFTH STREET, CHICAGO.

350-watt, direct-current enclosed arcs are used, and they are installed on regulation street-lighting posts with no particular claim to originality, as shown in an accompanying illustration. There are about 50 of these lamps, and the company deals directly with the members of the association in collecting for the service, charging $1.35 a week for each lamp. The lighting is controlled by the company, and the hours of burning are the same as in the case of the Milwaukee Avenue installation. This installation has been in service about two years, and the association is now figuring on renewing its contract with the central-station company at the rate of $1.15 net per week for each lamp. The company feels that it can make a lower rate because for the second two-year period the installation charge may be omitted.

A third installation of this character is much more recent. It is found on West Twenty-second Street, near Kedzie Avenue. In this case four 60-watt tungsten lamps will be placed on an attractive fluted post having small brackets near the top. In this installation the lamps are all arranged to burn downward, and the company believes that this is really the best arrangement in installations of this description, as the lamps do not cast shadows. The posts are of cast iron, and the center line of the globes is about 10 ft. from the ground. There are about 50 lighting units in this installation. Each member of the association pays $1.50 a week for two years for each lamp-post unit. He may take as many as he desires, but in ordinary practice each customer becomes responsible for one lamp-post placed in front of his store. The width of the store fronts is

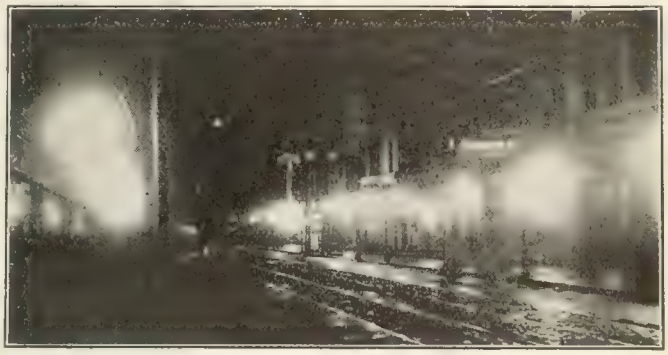


FIG. 3.—NIGHT VIEW OF TWELFTH STREET, CHICAGO.

about 25 ft. The price of $1.50 a week represents all charges except the city inspection fees, which the customer is required to pay. This provision is, indeed, true in the cases of all the business men's street-lighting associations. This West Twenty-second Street equipment is the latest effort of the Commonwealth Edison Company in this line, and is thought to provide attractive special street lighting for advertising purposes at a moderate cost. The installation is being watched with great interest, as the West Twenty-sixth Street merchants, near Kedzie Avenue, are considering entering into a contract for a similar installation using about 80 lamp-post units.

In other localities merchants are considering the formation of special street-lighting associations for neighborhood advertising, and the central-station company has several projects of this character under advisement.

Street-Lighting Conditions in Boston.

ELECTRICITY won a conspicuous triumph over gas in Boston in the spring of this year, when the Edison Electric Illuminating Company entered into a five-year contract with the city for street lighting, after many weeks of strenuous effort on the part of the local gas company to capture the illumination of the most important thoroughfares and squares of the New England metropolis. In our issue of May 6, 1909, an account was printed of the negotiations and investigations which led to the awarding of the contract to the Edison Company, and an extended abstract of the report of Mr. Guy C. Emerson, Superintendent of Streets, to Mayor George A. Hibbard, giving the reasons which convinced the city authorities that electricity is far superior to all other agencies for street lighting.

Under this contract with the Edison Company the city of Boston secures more light from each lamp than is obtained by any other city in the United States, and also gets more light for the same money than any other city in the entire country. About 3500 lamps were involved. The most interesting feature of the situation was the establishment of the 6.6 amp magnetite arc lamp as the standard for the general illumination of the

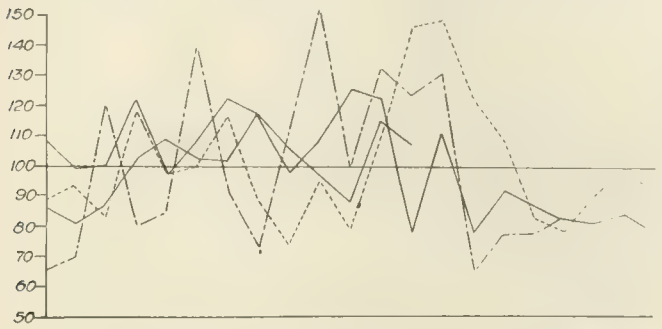


FIG. 1.—PER CENT CANDLE-POWER VARIATION ON THE STREET OF GRAETZIN TWO-MANTLE INVERTED GAS LAMPS, BOSTON.

important streets. The cost of each of these lamps per year is fixed at $103.54 for 3828 hours service, or 1.75 cents per lamp-hour. These lamps show about three times more candle-power in a given direction than could be secured from the old enclosed 6.7-amp series Gilbert arcs which were for a long time the standard of illumination for the Boston service. The cost of the remaining Gilbert lamps to the city under the new contract is $92.39 per year, or 1.6 cents per lamp-hour, but the lighting is much less satisfactory than that produced by the new 6.6-amp lamps, and it is probable that within a comparatively few months the last Gilbert lamp will have disappeared. Besides providing for a general illumination by magnetite lamps throughout the city, the contract stipulated the installation of



FIG. 2.—MAGNETITE LAMP-POLE, COMMONWEALTH AVENUE, BOSTON.

a considerable number of General Electric flaming-arc lamps for use in the special lighting of various important public squares and malls, and a price was included for series-tungsten incandescent lamps for the lighting of secondary streets on the regular schedules of the company. The total amount of the contract is about $350,000 per year.

Exhaustive studies of different methods of lighting were made prior and subsequent to the awarding of the Boston contract, and some exceedingly convincing comparisons were made between gas and electricity. In the tests that were made the Edison Company was represented by its consulting engineer, Dr. Louis Bell, of Boston. A number of tests were also made by the Edison Company's department of standardizing and testing, and by the Electrical Testing Laboratories of New York, and numerous photographs were taken of representative installations on Boston streets. Prof. W. L. Puffer, of Boston, consulting engineer, was also called into the investigations by Mayor Hibbard. Superintendent Emerson's notable report to Mayor Hibbard was built up from a large number of scattered tests, combined with conferences with lighting experts in Boston and in other cities of the Atlantic seaboard. All the tests made have never been assembled in a single report, but several which are available were made with such care that they are of interest individually as well as in relation to the general street-lighting situation in Boston.

There were two types of gas lamps offered in competition with the old 500-watt, 6.7-amp, direct-current enclosed arcs of the form designed by the late Mr. Gilbert of the old Boston Electric Light Company and also with the 6.6-amp, 500-watt magnetite arcs covered in the new agreement. These were a high-pressure gas lamp of foreign make and a number of so-called 250-cp, double-inverted mantle Graetzin street lamps working at the ordinary gas pressure. Incidentally, several tests were made of ordinary Welsbach lamps and series tungstens for use on minor thoroughfares. The particulars of a number of the tests are given below.

Test of Welsbach Street Lamps, "60-cp" Size, Made Under the Personal Direction of Dr. Louis Bell.

Lamp number.	Candle-power.	Lamp number.	Candle-power.	Lamp number.	Candle-power.	Lamp number.	Candle-power.
1	42.6	6	31.5	10	24.5	14	30.6
2	30.7	7	24.5	11	25	15	34
3	16.6	8	26.5	12	24.2	16	32.5
4	40 8	9	29	13	34.3	17	24.8
5	66.3						

These lamps were taken just as they came, without any selection. The first five were taken in Dorchester in the fall of 1908, and the last 12 in Roxbury in the summer of 1908. The report of the test states that from frequent measurements that have been taken on isolated lamps elsewhere these appear to be fair samples of the performance of single-mantle Welsbach street lamps as found in service on the streets. When new, as was probably the case with lamp No. 5, the candle-power is high, and the lamp looks exceedingly well. Under the combined effect of prolonged burning and the dust which is

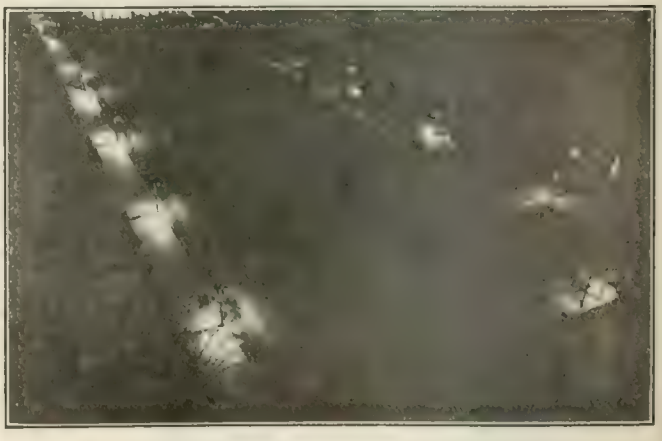


FIG. 3.—GRAETZIN INVERTED DOUBLE-MANTLE GAS LAMPS ON COMMONWEALTH AVENUE, BOSTON.

unavoidable on the streets, the performance of the lamps is seriously impaired. Sometimes even after a few days there is enough falling off to reduce the light to an unsatifactory enough falling off to reduce the light to an unsatisfactory of the 60-cp (75-watt) size will give considerably more light throughout its effective life on the average than a single-mantle

Welsbach. The 50-cp, 40-watt tungsten will compare very well with Welsbach lamps in its effective life under ordinary conditions, and will prove superior to them most of the time. These tungsten lamps, like all other incandescent units, fall off slightly in candle-power after burning several hundred hours, but in much less degree than Welsbach lamps, owing not only to the greater stability of the tungsten filament, but also because the sealing of the lamp keeps out the dirt which is apparently so serious with Welsbachs used on the streets.

Test of Street Gas Lamps, March 17, 1909, made by Electrical Testing Laboratories.

Description of Lamps.

Test 1.—Inverted mantle gas lamps, single burner, with metal reflector. Installed on Marlborough Street, between Berkeley and Clarendon Streets.

Test 2.—Graetzin lamps, inverted double-mantle burner with metal reflector. Installed on Commonwealth Avenue, between Berkeley Street and the Public Garden.



FIG. 4.—COMMONWEALTH AVENUE, BOSTON, ILLUMINATED BY MAGNETITE ARCS.

Method of Test.

The tests were made with the aid of a Sharp-Miller photometer, in which a tungsten lamp served as a standard of comparison. This instrument was set up at distances of about 33 ft. from the lamps to be tested. From the intensity of illumination produced at such distances the candle-power has been computed. Observations were continued over a sufficient period to afford an approximate determination of this value, considered to be sufficiently accurate for all practical purposes.

Results of Test.

TEST 1.

Berkeley to Clarendon St. Curb.	Lamp.	Angle below horizontal, degs.	Candle-power.
North	First	15	42
South	First	15	24
North	Second	15	28
South	Second	15	31
Average candle-power			31

TEST 2.

Berkeley St. to Public Garden. Curb.	Lamp No.	Angle below horizontal, degs.	Candle-power.
South	1	15	120
South	2	15	120
South	3	15	118
South	4	15	123
South	5	15	95
South	6	15	97
Average candle-power			112

Test of Street Arc Lamps, March 17, 1909, Made by Electrical Testing Laboratories.

Description of Lamps.

Test 1.—Gilbert series enclosed-arc lamps, 6.7 amp, clear inner and clear outer globes, metal reflector. Lamps installed on Commonwealth Avenue, between Dartmouth and Exeter Streets.

Test 2.—Lamps similar to those in Test 1, but equipped with opal globes. Installation, Commonwealth Avenue, Exeter to Fairfield Streets.

Test 3.—Magnetite lamps with ½-in. lower electrodes, 6.7 amp, opal globes, installed on Commonwealth Avenue between Clarendon and Dartmouth Streets.

Method of Test.

The method of test was similar to the preceding test of gas lamps, except that the instrument was set up about 66 ft. from the lamps instead of 33 ft.

TEST 1.

Location of lamp.	Angle below horizontal, deg.	Candle-power.
North side, east of Exeter Street	14	354
On Exeter Street, center of Parkway	14	319
Average candle-power		336

TEST 2.

Location of lamp.	Angle below horizontal, deg.	Candle-power.
South drive, west of Exeter Street	14	242
South drive, second west of Exeter Street	14	271
Average candle-power		257

TEST 3.

Location of lamp.	Angle below horizontal, deg.	Candle-power.
South drive, east of Dartmouth Street	16	1,210
South drive, second east of Dartmouth Street	16	1,130
South drive, east of Clarendon Street	16	1,180
South drive, second east of Clarendon Street	16	1,120
North drive, west of Berkeley Street	16	1,425
Average candle-power		1,213

Test of Candle-Power of Street Arc Lamps, March 18, 1909, Made by Electrical Testing Laboratories.

Description of Lamps.

Series magnetite, 6.7-amp lamps with opal globes. Diameter of lower electrode not stated. Installed 25 ft. above street surface on Boylston Street between Massachusetts Avenue and Exeter Street.

Method of Test.

The tests were made with the aid of a single Sharp-Miller photometer and one other photometer of somewhat different design. In each photometer a tungsten lamp served as a standard of comparison. These instruments were set up on opposite sides of each lamp in such fashion that the candle-power at a given angle below the horizontal could be measured simultaneously.

RESULTS OF TEST.

Location of lamp on Boylston Street.	Candle-power 15 deg. below horizontal.	Candle-power 25 deg. below horizontal.
Corner Massachusetts Avenue	1,313	1,361
West of B. & A. bridge	1,007	1,024
On B. & A. bridge	918	1,082
South side Hereford Street	1,038	1,052
Corner Gloucester Street	1,028	1,043
Between Gloucester and Fairfield Streets	1,059	1,186
Corner Fairfield Street	1,220	1,486
Between Fairfield and Exeter Streets	1,051	1,103
Corner Exeter Street	1,321	1,297
Southeast corner Exeter Street	1,110	1,122
Average candle-power	1,106	1,176

Test of Street Gas Lamps, Double-Burner Graetzins, April 9-10, 1909, Made by Electrical Testing Laboratories.

Description of Lamps.

The lamps were of the double inverted-mantle, Graetzin burner type, equipped with clear glassware and white enamel reflectors. They were installed on Commonwealth Avenue between Arlington and Berkeley Streets.

Method of Test.

The tests were made with two Sharp-Miller photometers of similar construction, but with different optical systems. In each photometer a tungsten lamp served as a standard of comparison. Two observers employed these instruments simultaneously in test of the lamps at different vertical angles.

RESULTS OF TEST.

Candle-power of lamps at angles indicated.

Lamp number	Below horizontal. 30 deg.	15 deg.
1	131	101
2	135	107
3	148	126
4	112	127
5	134	128
6	93	81
7	149	134
8	109	98
9	60	60
10	156	132
11	118	98
12	166	121
13	146	112
14	200	145
15	113	103
16	138	108
Average candle-power	225	192

TABLE 2.—FLUCTUATIONS IN CANDLE-POWER IN 10-MIN. READINGS TAKEN AT ABOUT 30-SEC. INTERVALS.

Lamp No. 4 at 15 deg.			Lamp No. 6 at 30 deg.		
139	148	98	77	86	76
135	123	116	81	125	90
137	137	109	139	176	90
155	158	104	94	115	97
126	155	102	101	153	137
137	98	105	158	142	...
155	141	98	108	152	...

The accompanying curves show the per cent variation in the candle-power of four Graetzin lamps tested under service conditions on the street by the Electrical Testing Laboratories, the readings being about 30 sec. apart. These diagrams show that serious fluctuations in the quantity of illumination attended the use of these lamps under normal gas supply, the changes being exceedingly objectionable from the point of view of the citizen desiring a steady light, to say nothing of the tendency of shortening the life of the mantle.

In discussing these results Dr. Bell pointed out that only one of the Graetzin lamps tested even remotely approached the claims that had been made for them by the manufacturers. He considers it possible that a carefully adjusted double Graetzin lamp, tested under the most favorable conditions in the laboratory, might reach the figure claimed—say, 250 cp—at some favorable angle considerably below the horizontal, if used with the German gas and under the pressure common in that country. There is always to be expected a considerably decreased effectiveness in lamps in regular service on the streets, as compared with the same lamps freshly cleaned and equipped with new mantles tested in the laboratory. The reason for this difference is twofold. On the street, glassware soon gets dirty and cuts off a considerable amount of light; and the mantles rapidly deteriorate under the influence of use and of the access of dust. Also, lamps tested in the laboratory can be constantly worked at the point of maximum efficiency, by keeping the air and gas supply just right and the gas pressure constant and at the proper point. None of these conditions can be fulfilled when the lamps are out on the street in service and affected by drafts and dust. Again, the single-mantle lamp is somewhat hypersensitive to small variations of conditions when adjusted for maximum efficiency. A very small change in the gas pressure, quality of gas or air supply lowers the candle-power to a surprising extent. Very small fluctuations in pressure or general conditions vary the result greatly. Dr. Bell was unable to get stable burning from a single Graetzin lamp at the Boston gas pressure and a consumption as low as 3.5 cu. ft. per hour, which is the usual stated consumption. The lowest consumption he obtained was 3.9 cu. ft. per hour with steady burning.

An interesting comparison of the appearance of Commonwealth Avenue when lighted by gas lamps and then by magnetites is shown in the accompanying photographs. Fig. 3 shows an installation of Graetzin double-burner, inverted mantle lamps on the Commonwealth Avenue block between Arlington and Berkeley Streets, the view being taken at night from the top of Haddon Hall Building. Fig. 4 shows a view of the next block on the avenue, between Berkeley and Clarendon Streets, illuminated by the magnetite lamp. Both plates and prints were treated precisely alike as to exposure, development, printing and fixing. The exposure was 5 min., with a No. 8 stop. The superiority of the electric lighting is indisputable, and the absence of heavy shadows on the sidewalks, the clearness of detail in the middle of this famous thoroughfare, which is 200 ft. wide with 640 ft. blocks, and the sharp definition of the building façades with the magnetite lamps are significant. Fig. 5 shows a night view of the Arlington-Berkeley Street block at the ground level, with the gas illumination, and Fig. 6, the next block, illuminated by the magnetites. Again the pictures were treated exactly alike, having 5-min. exposures with the No. 8 stop, with the same development and printing details.

The great volume of light indicated by the magnetites in comparison with the Graetzin lamps is apparent on the most superficial examination of the photographs. An interesting point in connection with these comparative tests was the relative cost for a given illumination. The gas-lighted block represented a charge to the city of $560 per year, and the magnetite charge for service in the next block was only $518, despite the superiority of the electric illumination. Between Arlington and Berkeley Streets, 16 Graetzin lamps at $560 per year thus gave a total illumination by test of 1600 cp at 20 deg. from the horizontal, or 2.85 cp per year for $1. Five magnetite lamps between Berkeley and Clarendon Streets gave a total of about 7500 cp for the same length of block at a cost of $518, as stated above, or 14.6 cp per year for $1.

The Press-gas lamp installed in Boston in competition with electricity did not prove a serious rival of the latter form of illumination. Tests by a number of independent observers showed that the candle-power of the lamp erected on West Street, in front of the offices of the local gas company, was between 2000 cp and 2400 cp, instead of 4600 cp, as claimed. Such a lamp could not compete with the electric arc without practically giving away the gas, under the Boston conditions. It has been fully shown in London that the Press-gas lamp is unable to compete anywhere on nearly equal terms with flame arcs as an illuminant.

THE WORK AT COPLEY SQUARE.

One of the most notable changes in connection with the Boston street-lighting contract was at Copley Square, one of the famous plazas in the Western hemisphere. This square is the literary and religious center of the city, with the Public Library Building on its west side, Trinity Church on the east, 400 ft. distant; the old Museum of Fine Arts on the south, and other noted churches on the north. This place was formerly illuminated by seven of the Gilbert enclosed-arc lamps located about 19 ft. above the ground and consuming about 500 watts each. The cost of the service provided by these lamps was $828 per year, and the illumination, while on a par with the lighting of urban squares elsewhere which are but little aided by store-window and electric-sign installations, gave the distinct impression that it was somewhat scanty. In place of the old enclosed arcs were installed three General Electric flaming arcs with the centers of the globes about 50 ft. above the ground. Each of these flaming lamps requires 6.7 amp, direct current, and from 75 volts to 80 volts. The lamps are located at the apexes of a triangle with a 250-ft. base and 200-ft. sides, and give an excellent distribution of light. A daylight view of one of these lamps is shown in Fig. 8.

An interesting public demonstration attended by a large number of people was made shortly after the flaming arcs were installed. At an hour which had been previously advertised the new lamps were cut off and the square was illuminated for a short period by the old method. Then the old lamps were switched out of circuit, and the new installation cut in. The results were regarded with much popular favor. Since this demonstration was made the old enclosed arc lamps have been succeeded by the new magnetite units, but retaining the flaming arcs for the main lighting of the square itself. The cost of the three flaming arcs per year under the new contract is $468. The square is thus illuminated at a greatly reduced cost, and yet has over twice the amount of light that obtained when the Gilbert lamps were used. Fig. 7 shows the excellent volume

and distribution of light under the new plan. It was printed from a negative exposed 10 min., using a No. 8 stop.

TEST OF STREET ARC LAMPS IN COPLEY SQUARE AND VICINITY.

This test was made on the street with a portable photometer upon three flaming lamps, two magnetite and five Gilbert lamps. In each case the measurements were taken at an angle of 25 deg. below the horizontal, and the test stations were selected with particular reference to the non-interference of the side rods of the carbon holders. The flame-arc lamps averaged 2515 cp, the magnetites, 965 cp, and the Gilberts, 495 cp.

Ten magnetite lamps located on Commonwealth Avenue were tested for candle-power on April 29 at an angle of approximately 25 deg. below the horizontal. Precautions were taken to see that the lower electrode supporting rod was not in the path of the light which was being measured. The average of the readings was 1150 cp.

On May 26 tests were made upon 12 gas lamps and 9 series tungstens in the Jamaica Plain district. The tungsten lamps were placed 13.5 ft. above the roadway and were fitted with Wheeler radial reflectors. Two types of gas lamps were tested, the Graetzin single-mantle inverted lamp and the Welsbach upright mantle lamp. The Graetzins were located with the mantle 15 ft. above the roadway, and the Welsbach mantles were 11 ft. above. The Graetzins were very unsteady, and a variation of 50 per cent on each side of the normal candle-power was noted while the wind was blowing. The Welsbachs were much more steady. All tests were made at an angle of 25 deg. below the horizontal. The tungsten lamps averaged 59.8 cp, the Graetzins, 79.3 each, and the Welsbachs, 61.3. The age of the mantles was not stated in the test record, but from the results it is probable that they were practically new.

On June 21 another set of tests was made upon the Copley Square flame arcs and upon magnetite lamps located in the Summer and Devonshire Streets section. Six sets of readings were taken upon each magnetite lamp, the tests being made from three different positions. The test on each lamp extended over a 20-min. period. All tests were made at an angle of about 25 deg. below the horizontal. The flame arcs averaged about 2520 cp and the magnetites 1134 cp.

The Edison Company is now installing about 600 magnetite lamps per month, well distributed about the city, and about 25 locations for flaming arcs have been selected. Fig. 2 shows the standard pole for the magnetite lamps, while Fig. 8 shows the flaming-arc pole. The flaming-arc poles are provided with wooden grooving up the sides in which the lead-covered arc cables are run, this groove then being enclosed. The magnetites are carried from a graceful casting on top of wooden board poles with the cables run in the hollow interior.

All the new lamps are tested and adjusted by the Edison Company before being placed upon the streets. Series-tungsten lamps are being installed at an increasing rate, about 800 being in service on Aug. 1. The standard height for these lamps runs from 15 ft. to 18 ft. above the street, according to conditions.

In connection with the improved street lighting recently effected, the company placed an exhibit in its Boylston Street window consisting of the direct-current, series magnetite arc lamp, the Gilbert lamp, a flaming arc like those in Copley Square, and, incidentally, a direct-current, series-multiple arc lamp for interior service. These lamps were all arranged to light for comparison and were suitably labeled with the particulars of their candle-power and service, so that the public could obtain a closer view of the units which have practically revolutionized the standards of illumination in Boston.





FIGS. 5 AND 6.—INVERTED DOUBLE-MANTLE GAS LAMPS AND MAGNETITE ARCS ON COMMONWEALTH AVENUE, BOSTON.



FIG. 7.—FLAMING ARCS, COPLEY SQUARE.



FIG. 8.—FLAMING ARC LAMP-POST IN COPLEY SQUARE.

Importance of Testing Meters.

By H. W. Richardson.

THREE fundamentally essential elements are represented in a successful electric light and power company: first, sagacious business management; second, efficient equipment; third, attention to repairs and up-keep of the system. The second depends upon the third element, and they both in turn reflect the first quality. An electric light company that keeps its equipment in good repairs is sure to give reliable service. Reliable service is the foundation for retaining old and for securing new business. It seems, however, to be the policy of some companies to delay repairs as long as possible. Such a policy seldom gets business and usually results in loss to the company that pursues it. This policy of delay is probably as well crystallized in the meter system as in any department of the plant.

The writer is familiar in a general way with meter conditions at a number of electric light plants. After making a list of some of the towns and cities (which come to mind), there are a total of 90 companies, of which 42 periodically test their meters and either have a well-organized meter department or endeavor in some way to test systematically and periodically all the meters in service. The meter systems of companies in the first and second-rate cities come under this classification, also the majority of companies in towns and cities having a population as low as possibly 10,000. This figure, 10,000, is purely arbitrary, for the writer visited a city of 10,000 population where there were approximately 350 meters in service. No attempt had ever been made to test or keep them correct. The only testing device owned by the electric light company was a portable voltmeter. The case cited, however, is a rather extreme one.

One finds upon leaving the larger cities and getting into the smaller towns that the importance of a meter system and meter testing are not given so much attention. Aside from the 42 places previously mentioned, there were nine towns supplied with electricity on a flat-rate basis, 14 places where there had been more or less of a spasmodic attempt at meter testing, and the remaining 25 places where practically no attention has been given to this subject. The 14 towns in which spasmodic attempt was made are those in which the meters are tested only when the customer complains or the monthly bill plainly indicates some discrepancy or trouble with the meter, but tests have never been made on the entire system. There were thus 39 out of the 90 companies which can be said to view with more or less indifference the value of meter testing.

The companies using the flat rate usually offer the excuse that they have no money to make the change or else they do not know how the customers will take to a meter basis. They all admit, however, the necessity of meters and state that they will have to use them sooner or later. The companies that neglect meter testing offer as an excuse the lack of time, money or men, while others do not consider it worth while. To pronounce such conditions as deplorable may be unjust, for in a sense the electrical industry is young compared to many industries. The attitude of the 39 companies referred to, however, emphasizes two features which are doubtless representative of conditions in other localities: first, the value of a meter system to a central station, particularly its relative importance to the revenue, is not properly appreciated; second, the importance of meter testing and general up-keep of the meter system is not fully realized.

With reference to the first point, it is universally recognized in all trades that some device is required to measure the units of product bought or sold. This applies not only to the buying or selling of grain, lumber, minerals or manufactured products, but also to the distribution of electric energy. It is the poorest kind of policy to conduct any business without a device for measuring the units bought or sold. It is anything but good management then for a station to be without some form of a meter. Flat rates have nothing in their favor except simplicity. They are not based on the units of energy sold. Flat rates discriminate between different customers, an injustice in itself sufficient to condemn this system of charging. They cause needless burning of lamps, thus unnecessarily loading the station. They place a premium on waste of energy and poor service resulting in augmented expenditures and small revenue returns on the investment. Flat-rate plants sometimes find it necessary to purchase and install an additional generator just to carry the peak load. It is generally true that a plant run on a systematic, well-icared-for meter basis is in better financial condition than a plant run on flat rates. With a meter basis the connected load on the station can be fully 30 per cent or 40 per cent greater than with flat rates without any increase in the generating capacity. This represents almost clear profit.

The writer calls to mind a company that formerly on a flat-rate schedule was unable to meet the expense of a day circuit. Meters were installed and within a year a day circuit was being maintained and motor business secured. Another company changed from flat rates to a meter basis and in two years the revenue had increased 45 per cent. Without meters it is impossible to tell the amount of energy generated or sold, nor is there any way of determining the load factor or the cost of producing a unit of electric energy. The management has no check on the energy produced and does not know what has become of it; it is impossible to tell if the same income might not have been secured with less expense.

With reference to the second point, the importance of meter testing, it should be remembered that the revenue received depends upon the accuracy of the meters measuring the energy. It is then a matter of dollars to the central-station company to have its meters accurate. Accurate meters lessen complaints. To permit meters to run slow for several months and then correct them, as some companies do, naturally causes the customer to complain at his recently increased bill. The customer's "kick" is not without justice, for it discloses the lax business policy pursued by the company. Customers judge the service given by the quality they, as individuals, receive. Failure to give good service breeds prejudice which is hard to overcome. It is the sum total of all the services rendered to the community that determines the company's success. Success means more business, increased dividends and pleasanter business relations with the customers. It is a false idea of economy to neglect the accuracy of meters, when better and greater results can be secured by systematic testing. Improper care and maintenance of a meter system are analagous to the false economy of a man who neglects to repair his house when it needs it.

Paradoxical as it may at first appear, indifference to meter accuracy may not only cause loss of business, but even cause the introduction of competitive apparatus, such as acetylene or gasoline lighting in hotels, large houses and factories, or gas engines, steam plants, etc., in the place of electric motors; for how can a superintendent secure correct data from inaccurate meters as to the probable cost of energy for a proposed installation? It is more than probable that the station superintendent who gives no attention to meter testing will not take the time to tabulate with any approximation of accuracy, if at all, the energy required for various applications of motors or electrical devices. Indifference to meter testing is synonymous with carelessness.

The curves shown herewith illustrate approximately the characteristics for varying degrees of accuracy of meters which have not been tested for a considerable time.

THEORETICAL ACTION OF METERS WHICH ARE ALLOWED TO GO UNTESTED.

In a certain residence with a connected load of 13 16-cp lamps, the average daily energy consumption throughout the year is found to be distributed as follows:

6	lamps	burn	½	hr.	at	50	watts	150	watt hours
3	"	"	1	hr.	"	"		150	" "
2	"	"	1	hr.	"	"		100	" "
1	"	"	2	hr.	"	"		100	" "
Total daily consumption								500	" "

For 30 days or 15 kw-hours per month at 10 cents per kw-hour 500 watt-hours bring the average monthly bill to $1.50.

With this residence load and the curves, Tables I and II have been developed to illustrate the bearing of inaccurate meters on the financial side of the station management. Table I shows the amount registered by a 5-amp meter for the curves A, B and C. Table II shows the actual average monthly bill, the annual loss to the station from a slow meter, the annual loss on a proportionate basis for a system of 300 meters, and the capitalization represented by such loss when it is equivalent to interest at a 6 per cent rate.

TABLE I.

Load on Meter.	Watt-Hours Recorded for Various Curves A	B	C
6 lamps, 60% load	149.37	148.12	146.25
3 " 30% "	148.74	146.25	142.50
2 " 20% "	98.75	96.25	92.50
1 " 10% "	97.50	92.50	85.00
Actual watt-hours registered	494.36	483.12	464.25
Per cent of total registered	98.87	96.62	92.85

TABLE II.

	A	B	C
Actual monthly bill	$1.48	$1.45	$1.39
Annual loss (meter)	.20	.61	1.29
Annual loss 300 meters	60.00	183.00	386.00
Capitalization represented	1,000.00	3,050.00	6,435.00

Tables III and IV show a record similar to Tables I and II for another residence having a connected load of 22 16-cp lamps and metered with a 10-amp meter, but in this case the meter operates a larger percentage of the time on light loads, thus illustrating the value of sustained light load accuracy.

The average daily energy consumption throughout the year is:

12	lamps	burn	1/6	hour	at	50	watts	per lamp	100 watt hours
8	"	"	½	"	"	"	"		200 " "
6	"	"	1	"	"	"	"		300 " "
4	"	"	2	"	"	"	"		400 " "
2	"	"	2	"	"	"	"		200 " "
Total daily consumption									1200 " "

1.2 × 30 = 36 kw-hours per month at 10 cents per kw-hour, the average monthly bill should be $3.60.

TABLE III.

Load on Meter.	Watt-Hours Recorded for Various Curves A	B	C
12 lamps, 60% load	99.58	98.75	97.50
8 " 40% "	198.74	196.24	192.50
6 " 30% "	297.48	292.50	285.00
4 " 20% "	395.00	385.00	370.00
2 " 10% "	195.00	185.00	170.00
Actual watt-hours registered	1185.80	1157.49	1115.00
Per cent of total registered	98.81	96.46	92.91

TABLE IV.

	A	B	C
Actual monthly bill	$3.56	$3.47	$3.35
Annual loss (1 meter)	.51	1.53	3.06
Annual loss 300 meters	153.00	459.00	918.00
Capitalization represented	2,550.00	7,650.00	15,300.00

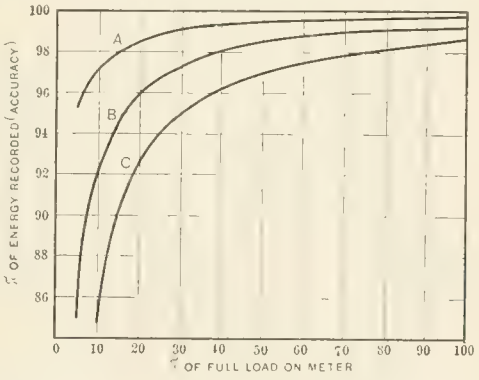
While the data developed in the tables are theoretical, they are surely representative of actual conditions. Curve *A* when analyzed represents the conditions to be expected from modern meters in service two to four years without any testing or inspection. Curves *B* and *C* will represent the action of meters after three to five years' service, the latter curve illustrating the action of the older type meters.

It should be remembered that in domestic lighting probably 60 per cent to 75 per cent of the time the meter load is usually less than one-quarter the meter's rating and approximately 50 per cent of the time less than one-eighth load. This shows at once the extreme importance of meter testing and inspection, for this class of lighting can only be made profitable by maintained meter accuracy.

Meters should be tested at the point of installation. It is recognized as the best practice, and it saves the delay, inconvenience and expense of transportation of meters to and from the station. The use of the rotating standard test meter makes this possible, since the service meter can be tested under its actual operating conditions. The troubles encountered in service meters can in probably 90 per cent, if not 95 per cent, of the cases be eliminated at the point of installation.

Aside from the commercial phase of metering there are certain engineering features fully as important. It is important that every part of a meter installation be of high-grade construction and material. The best meter poorly installed may give trouble, or a poor meter used with the best wiring devices and installation gives equally poor service. Not only must the installation be of the best workmanship, but there must be an intelligent comprehension of the requirements to be met and a knowledge of the operating characteristics of various types of meters. It is excellent practice to secure several of each of the best known meters on the market, connect them up at some convenient place, in the office or station, so that they all measure the same load for several months or a year. Aside from this test, tests for accuracy at different loads under commercial variations or voltage, power factor and frequency may be made. Too much importance must not be placed on the merits of a meter by the initial tests. The meter which is of most value to a central station is the one which, after being calibrated correctly, will maintain its calibration over the longest period of time. Initial tests are essential, but they are by no means the whole criterion for making final selection. They assist in eliminating the poor grade of meters, but to select the best grade meter requires a careful following of the action and tests on meters in actual service for a considerable time.

It is the best practice to use commutating meters only on direct-current circuits. While they will operate on alternating current they are not as satisfactory as the induction meter. They are seldom lagged for alternating-current service, hence they are inaccurate on inductive loads, the error increasing with decreased power factor. They require more care and the cost of maintenance is two or three times more than the induction meter. After a considerable time they tend to run slower



CHARACTERISTIC CURVES FOR VARIOUS DEGREES OF ACCURACY.

than the induction meter, due to the friction incident with the use of the commutator and brushes.

In order to secure satisfactory maintained accuracy, commutating meters should be tested at least once a year, preferably every six to nine months for the smaller and oftener for the larger sizes. It is seldom necessary to test small induction meters oftener than once a year. The reason for more frequently testing larger size meters, rated at 50 amp and higher, is because an error of 2 per cent or 3 per cent means more in dollars and cents than on a 5-amp or 10-amp meter.

The periodicity of testing is not only determined by the rating of the meter, but also by the comparative expense of testing and the relative loss of revenue from inaccurate meters. Periodicity of testing is also influenced by the commercial value of the moral effect produced on customers by systematic and periodic inspection.

The introduction and development of high-efficiency lamps cause the sustained light load accuracy of meters to become a more important feature than in the past. In the future, the minimum light load which a meter will be called upon to register will require more attention. Of course the average and maximum loads will still have their bearing on the selection of a meter of proper rating.

Finally, it is evident that the financial success of an electric-light company depends upon adoption and selection of proper meters, periodicity of inspection and on maintenance of accuracy. Success rests in the attention to seemingly little things, and systematic testing and inspection of meters will produce a marked and healthy change in the central-station revenue.

The Fellow-Servant Rule or the Doctrine of Common Employment.

By John Edson Brady.

THE fellow-servant rule, which relieves an employer from liability to an employee injured through the negligence of a fellow employee, where the master has exercised proper diligence in the selection of competent workmen and furnishes them with suitable means to perform their labors, is subject to a limitation, referred to and known as the "vice-principal limitation." This limitation holds the employer liable to one servant for the negligent performance by another servant of the personal duties which every employer owes to those in his employ. Although there are decisions which have repudiated or failed to recognize this limitation, yet in nearly all the States, including those which refuse to adopt the superior servant rule, it is held that an employee intrusted with the entire management and supervision of the business of the employer or with the entire management and supervision of a distinct department of the business is a vice-principal, so that the employer is liable for his official acts. For example, the president, directors, general superintendent or other managing agents of a corporation are vice-principals. 26 Cyc., 1313.

The law imposes upon the master certain duties which concern the safety of his servants, and, while he may, of course, delegate the duties to another, his doing so in nowise affects his responsibility for their proper performance. If one employee is injured by reason of the negligent performance of one of these duties by another employee to whom it has been delegated by the master, the master cannot escape liability on the ground that the negligence was that of a fellow servant. In other words, where an employee is intrusted with the performance of one of the master's personal duties, he is, with respect to that duty, a vice-principal or representative of the master, who will be liable to another employee for the negligent performance by the vice-principal of the delegated personal duty to the same extent as for his own negligence. 12 A. & E. Encyc. of L., 946. The establishment of this doctrine has undoubtedly been brought about by a recognition of the fact that unless the employer is held responsible for the negligence of a vice-principal the rule that an employee does not assume the risk of being injured through the negligence of the employer, at the time of entering into the latter's service, would be rendered nugatory.

A New York case illustrates this principle: The defendants were engaged in the manufacture of articles from wood. The lumber used in the business was planed on the first floor of the factory, and then passed up through an opening to the floor above. The opening was in a passageway where those employed on the second floor were obliged to pass back and forth in the course of their work, and when not in use it was enclosed by a heavy trap-door. The plaintiff, an employee of the defendants, was going along the passageway in the performance of his work when the trap-door was suddenly raised from below by a workman in the planing-room, with the result that the plaintiff fell through and was severely injured. The plaintiff had been in the defendant's employ about 22 months at the time of the accident and was acquainted with the location of the trap-door and the manner of its construction. One of the defendant employers had given orders that the trap-door should not be opened from below, and the employee who opened it had been so instructed by the foreman. It was held that the defendants were not liable, as the injury was caused by the negligence of a fellow servant and not a vice-principal. Anthony v. Leeret, 105 N. Y., 591.

A railroad company had a number of gangs of men at work on the line of its route, under the control and direction of foremen or local bosses having power to employ and discharge laborers, but subject themselves to the control of a general superintendent and assistant, who passed along the route and inspected the camps at certain periods. Some of these gangs used giant powder for blasting the rocks and frozen earth, and in such case the foreman was charged specially with the duty of handling the powder and thawing it when frozen. The general superintendent was aware of the danger of thawing the powder before a fire. He had given general instructions not to thaw it in this manner and had provided safe appliances, called "heaters," for the purpose, furnished to the gangs upon the requisition of the local bosses. The plaintiff was employed as a common laborer in one of the gangs where powder was always thawed without a "heater" before the fire. While assisting in thawing some powder in this manner under the direction of his foreman he was injured by its explosion. It was held that the local boss stood in the place of the defendant and that his neglect to obtain and use a "heater" and his directing the plaintiff to thaw powder before a fire without the security of such an appliance were acts for which the defendant was responsible. Gilmore v. Northern Pacific Ry. Co., 18 Fed. Rep., 868.

An important case involving the vice-principal limitation is that of Tedford v. Los Angeles Electric Company, decided by the California Supreme Court in August, 1901, 54 L. R. A., 85. The defendant was a corporation engaged in distributing electricity throughout the city of Los Angeles for lighting and other purposes. Tedford, the plaintiff, was employed by the defendant company, and, at the time of receiving the injuries for which the suit was brought, was at work about 18 ft. above the ground on one of the defendant's poles, under the direction of a foreman named Burge, who was working on the same pole several feet above Tedford. Tedford was standing on a small platform attached to the pole, scraping one of the wires supported by the pole, and was injured by the sudden turning on of a current of electricity. The defendant claimed that the plaintiff was injured through the negligence of Burge, the foreman, and that, inasmuch as they were fellow servants, the defendant was not liable. A verdict for $15,000 in favor of the plaintiff was nevertheless affirmed. "There are certain duties," said the Court, "which an employer owes personally to his employees, and he cannot avoid responsibility for injury to one servant caused by the failure to perform such duties by delegating their performance to another servant. In such case the fellow-servant to whom the performance of such duties is assigned becomes, with respect to that particular duty, the special representative of the employer—sometimes called a vice-principal. In such case the negligence of the servant is the negligence of the principal, for which the latter must answer. Some of such duties, well established in the law, are to furnish proper machinery and appliances and to keep them in repair; to exercise care in selecting competent servants; to take reasonable care for the safety of the employees, etc. It is also one of these duties to give careful instructions to a youthful or inexperienced servant of unusual and hidden dangers of which the employer is aware, and of which the servant, to the employer's knowledge, is ignorant."

Some of the States have held that an employee to whom the employer has intrusted the entire management and supervision of a distinct and separate department of the business is a vice-principal or representative of the employer. This rule has been adopted in Indiana, Michigan, North Carolina, Pennsylvania and Washington.

On the other hand, it is held that, to justify imputing the negligence of an employee to the master, "he must be more than a mere foreman to oversee a batch of hands, direct their work under the supervision of the master, see that they perform their duty, and, in case of dereliction, report them." Dobbin v. Richmond & D. R. Co., 81 N. C., 446. The most numerous instances of the doctrine that vice-principalship is not deducible merely from the possession of a power of control over the injured servant are furnished by the decisions absolving the employer of labor from liability for injuries caused by the negligence of employees appointed to direct the labors of those small bodies of servants who, in every industrial concern of any considerable magnitude or complexity must necessarily be intrusted with certain distinct duties which are of such a nature as to segregate them into more or less independent

groups, but which are commonly of a somewhat mechanical character not requiring for their performance the exercise of any of the higher qualities of a superintending officer.

In O'Brien v. American Dredging Company (N. Y.) 21, Atl. Rep., 324, the Court said: "Whether the master retains the superintendence and management of his business or withdraws himself from it and devolves it upon a vice-principal or representative, it is quite apparent that, although the master or his representative may devise the plans, engage the workmen, provide the machinery and tools, and direct the performance of the work, neither can, as a general rule, be continually present at the execution of all such work. It is the necessary consequence that the mere execution of the planned work must be intrusted to workmen, and, where necessary, to groups or gangs of workmen, and in such case that one should be selected as the leader, boss or foreman to see to the execution of such work. This sort of superiority of service is so essential and so universal that every workman, in entering upon a contract of service, must contemplate its being made use of in a proper case. He, therefore, makes his contract of service in contemplation of the risk of injury from the negligence of a boss or foreman, as well as from the negligence of another fellow workman. The foreman, as superior servant, stands to him, in that respect, in the precise position of his other fellow-servants."

In a few of the States constitutional and statutory provisions materially modify, and in some cases abrogate, the common-law rule exempting a master from liability for injuries to a servant caused by the negligence of a fellow-servant. Some of these statutes apply only to railroad companies, and most of them apply only where the employer is a corporation and draws no application to an individual employer or to a partnership. In several States the statutes make the employer liable where an employee is injured through the negligence of another employee superior to him in point of rank without regard to whether the superior servant at the time of the negligent act was performing the duties of a superior or those of a common laborer. In other jurisdictions the statute imposes a liability upon the employer where the injury to a servant is caused by the negligence of a co-servant intrusted with and exercising powers of superintendence.

Firing Cheap Grades of Coal Economically.

By William Kavanagh.

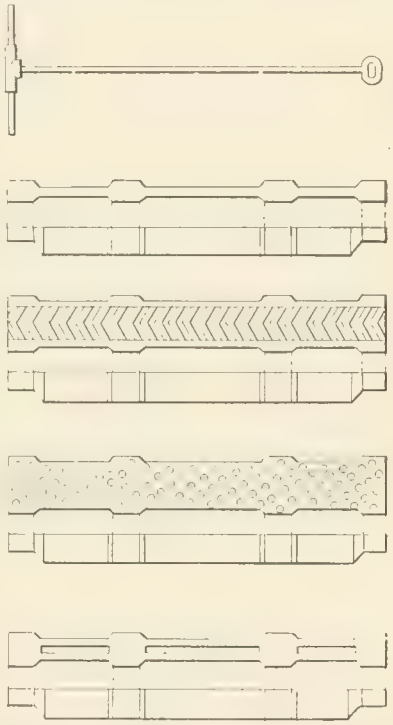
THERE are three methods usually employed in banking fires. The first, and the one probably most generally used, is to bank at the bridge wall; the second is to bank at the furnace door, and the third method is to bank to one side of the furnace. Banking at the bridge wall has its advantages, and it is doubtless the best plan to adopt for the following reason. After the good fire is pushed back and covered with a sufficient quantity of coal, the ashes can remain spread on the grate bars and exclude the cold air from circulating around the heating surface of the boiler should the damper and ash-pit doors happen to leak. When the time arrives for spreading fires it will be only necessary to kindle up the bank and haul out the ashes, making the grate bars clean, then pull down the banked fire and spread it evenly on the surface of the grate bars. Coal may be spread and the fire allowed to burn brightly. Before spreading a banked fire the damper should be opened and the banked fire allowed to burn fairly bright. If the bank is not sufficiently heavy to spread, extra coal may be shoveled on, and in this way the bank can be thickened and a sufficient quantity of live fuel obtained to start the new fire.

Banking at the furnace door is unhandy, and if ashes are kept in the furnace at the back of the fire to help in excluding cold air, it will be difficult to rake the ashes down through the grate bars, or else jump them over the good fire. If the ashes happen to be fine they will deaden the fire, unless considerable labor is used in raking down the good fire in order to sift the ashes out of it. This raking down of the good fire entails a loss of fuel which might otherwise be saved.

Banking fires at the side of furnace is not a bad plan; but more fuel is liable to be used in the banking than with the bridge-wall plan. The plan of side banking soft-coal fires is employed to a considerable extent and excellent results are obtained from it.

When a soft-coal fire banked at the side of the furnace is to be spread, the majority of experienced firemen employ the slice bar to perform the operation. After the bank is burned up, the lazy bar is placed across the furnace door, the slice bar is pushed behind the bank and fulcrumed on the door jam and the live coals are spread in a remarkably short time, the ashes, of course, being previously removed. The fire is then leveled and fresh coal thrown on, after which the furnace doors are shut, the damper opened and the fire allowed to burn brightly. The system of firing to be adopted is then followed during the remainder of the run.

When the soft-coal fire banked at the bridge wall is to be spread, the damper is opened and the bank allowed to burn up or become bright. The lazy bar is then placed across the furnace door and the ashes hauled out on the boiler-room floor or



FIGS. 1 TO 5.—LEVELER AND GRATE BARS.

into a barrow or ash can. The bank is then pulled down from the bridge wall by means of a rake or hoe and spread evenly over the grate surface. Green coal is then fired, as in the previous case. In spreading a bank, sufficient live coal should be at the front. The new fire will always burn back toward the bridge wall rapidly, but from the bridge wall toward the furnace door very slowly, hence this point is worth remembering. Sometimes after spreading a fire black spots may appear here and there in the fire and considerable difficulty is encountered in removing them. The best plan is to rake them down thoroughly, and after the raking process is over push the unburned coal to one side, making sure to uncover the bars wherever the black spots appear. Hoe good fire over the spots and coal, and it will be found that the fire will soon develop a uniform brightness. The spots appearing in the fire are due to dust or ashes beneath the good fire which exclude the air from finding a passageway at those particular points and effectually prevent combustion; sometimes a lumpy fire will appear even though the fire is handled by an experienced fireman. The reason for this is that the coal fired may consist of different grades, or is not of the uniform quality. A portion of the coal may be "hard-burning," while the remainder of the coal may be "free-

burning." Again, a lumpy fire occurs when the admission of air through the grate bars is not uniform; and in this way the experienced fireman is sometimes handicapped. In order to overcome such a difficulty a tool called a leveler, and shown in Fig. 1, is used, and drawn across the surface of the coal or fire. The device is principally used with the small grades of anthracite coal, and is also used with soft coal where the pancake system of firing is followed. It is a very handy tool and it can be made from a piece of ⅜-in. or ½-in. steam pipe having a tee on one end to which are screwed two pieces of pipe of sufficient length to enter the furnace door.

The stationary grate bars, on which the small grades of hard coal are burned, are generally three kinds, any one of which will give good results. The plain straight bar is shown in Fig. 2; the herringbone bar is shown in Fig. 3, and the pinhole grate is shown in Fig. 4. The plain straight bar has its advantage, especially when cast singly. If, however, the bar is cast in pairs, as shown in Fig. 5, its advantage is not so great.

The ease with which air can enter the unobstructed openings between the bars is one of its advantages, and should a single bar drop while the furnace is full of fire, the hole thus made is easily stopped and a great deal of fire cannot drop into the ash pit. Should a herringbone or pinhole bar drop, the hole made is large, difficult to stop and usually a large quantity of fire finds its way into the ash pit. Soft coal can be easily burned on the straight and also on the herringbone bars, but there is some difficulty met with in burning soft coal on the pinhole bar. The kind of grate bar to employ to suit the various grades and sizes of hard and soft coal and to give the best results should receive serious consideration because of the loss than can occur with unsuitable bars. When the bars are not suited for the kind of coal used, large quantities of coal fall into the ash pit and result in a loss, because every boiler plant is not equipped with a screening apparatus with which to screen the ashes. It pays to screen and wash the ashes and the coal thus recovered could be used under auxiliary boilers with forced draft if necessary. Inspection of the ash heaps at the average power house and isolated plant shows that a large per cent of good coal finds its way to the dump. Hence, the selection of a proper bar is very important. There are numerous bars manufactured now that are very reliable, and by using a trial set the right bar can be selected.

The Prevention and Removal of Boiler Scale—IV.

By W. H. Wakeman.

SEVERAL years ago a boiler compound was put on the market consisting of a thick, black oil which appeared like a very cheap grade of cylinder oil. It would remove some kinds of scale, but it had exactly the same effect as cylinder oil when the absence of a good separator allows it to pass from engines and pumps into a heating system. The hot-water pump sends it into the boiler, and if it would come out with the steam and go into the engine cylinder again it would result in a great saving of oil, but it does not. On the contrary, it circulates through the boiler gathering particles of foreign matter into small lumps which float around on or near the surface until a portion of them go into the water column and gage-cock connection, filling them with a pasty mass. The remainder settles to the bottom of the shell, where it prevents the free passage of heat.

Lumps of tallow have been put into boilers for the purpose of removing scale, as it was expected to melt as soon as heated and then work under the hard scale. It has accomplished this desirable end in some cases, but at the same time there is always a decided element of danger in such practice, because much of the tallow of commerce contains too much acid to be safe in a boiler. When heat is applied to tallow it does not all melt. In some cases the lumps remaining have rolled around in the bottom until they have gathered solid matter of various kinds, and can easily be removed through the manhole; but while this seems to be an advantage, there is too much danger of bagged plates and collapsed flues connected with this practice to make it desirable.

Some engineers seem to use almost anything that can easily be procured for a boiler compound, without knowing what the results will be. Investigation of such matters should always be encouraged under reasonable conditions, but caution should be exercised in making such experiments, as the result of a mistake is too serious to be ignored. If anything is to be suspended in a boiler it is much better to select a scientifically prepared device, as illustrated in Fig. 1. It consists of an iron cage in which metal balls are confined, and the whole boiler cleaner is attached to a brace or fixed in the water in some other suitable way. These balls contain something that affects the scale-making solids in the water and prevents them from forming into solid masses and adhering to the internal surfaces. The process of making the balls is a trade secret, therefore, when one set is worn out, another must be purchased, which constitutes an objection to their use because it may not always be possible to secure them at reasonable prices when wanted. However, the fact that it is practicable to discard the system at any time should form a natural check on any desire of the makers to charge an exorbitant price for the balls. If the claims made for it are realized in practice, thus removing old scale and preventing the formation of new, it is a valuable invention that is sure to be appreciated by steam users.

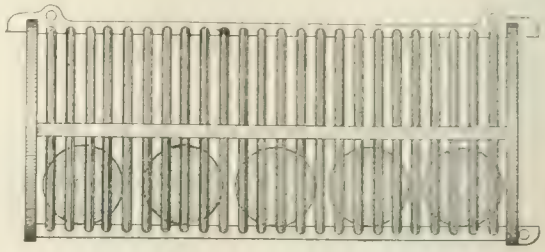


FIG. 1.—SUSPENDED IRON CAGE WITH COMPOSITION BALLS.

Zinc is sometimes used in boilers to prevent scale from forming on the tubes and plates, but it is absolutely worthless for preventing scale. When pitting was discovered in boilers consisting of iron shells and brass tubes the trouble was ascribed to galvanic action between the two metals, but when the advocates of this theory found that the same pitting rendered boilers unsafe where brass tubes were not used, it became necessary for them to invent another theory, and the idea that pitting is due to the action of electricity, which is generated by any parts of the boiler, is not so very generally held now.

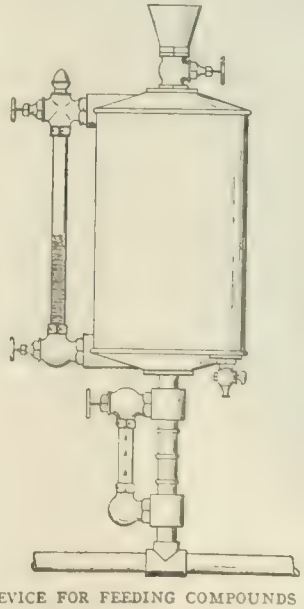


FIG. 2.—DEVICE FOR FEEDING COMPOUNDS TO BOILER.

Ignorant boiler attendants sometimes adopt the following

crude plan for removing scale, although it is sure to injure every boiler to which it is applied. The water is blown out under pressure and the boiler cooled as rapidly as possible by filling it with cold water. This cools the iron or steel of which the boiler is made quicker than the scale, hence the difference in contraction causes the scale to crack and fall from the shell and tubes, whence it is removed through the manhole. Another plan is to empty the boiler of water and allow it to cool thoroughly, then draw shavings into the tubes and light them. As they are quickly consumed the tubes are not burned by the process, but they are heated rapidly and expand while the shell remains stationary. Neither method causes all parts of the boiler to be affected alike and this is what causes trouble.

Fig. 2 illustrates a device for feeding compounds. It is fitted with a glass gage at one side of the body by means of which the engineer can tell how much is in it, and also with a sight-feed attachment so that it is possible to regulate the feed. The iron or brass support that is parallel to the sight-feed glass is solid, therefore the compound must pass through the glass or not be fed at all. The device is fastened to the suction pipe of the boiler feeder, consequently the compound is drawn downward and the feed is regulated by the angle valve shown above the glass.

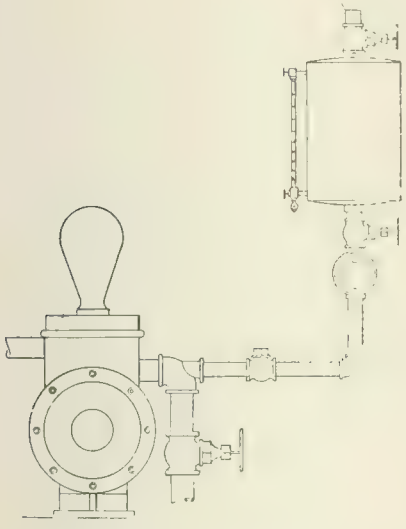


FIG. 3.—SIGHT-FEEDING DEVICE.

Fig. 3 illustrates the application of a somewhat similar device in which the sight feed consists of two circular pieces of glass set in a suitable brass frame, between which the compound passes in visible drops. The gage glass is fitted with several rubber bands which can be set at pleasure to show the amount used per day. If it is desired to feed 2 qt. per day, or 116 cu. in., and the feeder is 10 in. in diameter, its area is 78 sq. in., therefore, 2 qt. will occupy a space $116 \div 78 = 1.48$ in. deep. If the bands are set 1½ in. from center and the compound is lowered from one to the other in a day, the boiler will receive 2 qt. One advantage of using a comparatively small feeder is that when the feed is not adjusted correctly and the contents is used in a few hours the waste is not excessive and the danger of injuring the boiler is not great. A check valve is used in the horizontal pipe to prevent water from backing up from the suction pipe and filling the sight-feed glass, especially if the suction pipe receives water under pressure. In this case the lower valve must be nearly closed, thus causing the pump to draw on the feeder. This is a disadvantage because it renders water pressure from the street mains useless, therefore more steam must be used to feed the boilers, and this applies to the use of injectors as well as pumps.

Fig. 4 illustrates a device that permits the use of pressure in the suction pipe, the operation of which is as follows: The small tank 2 is made strong enough to withstand boiler pressure, which is communicated to it by the feed pipe 3 through the small equalizing pipe 4. The rate at which the compound is fed to the boilers is regulated by the valve 5 which allows it to drop into a circular mixing chamber. Water from pipe 3 is allowed to enter this mixing chamber slowly by the regulating valve 6 after a full supply is admitted by valve 7. When pressure accumulates in this chamber until it exceeds the pressure

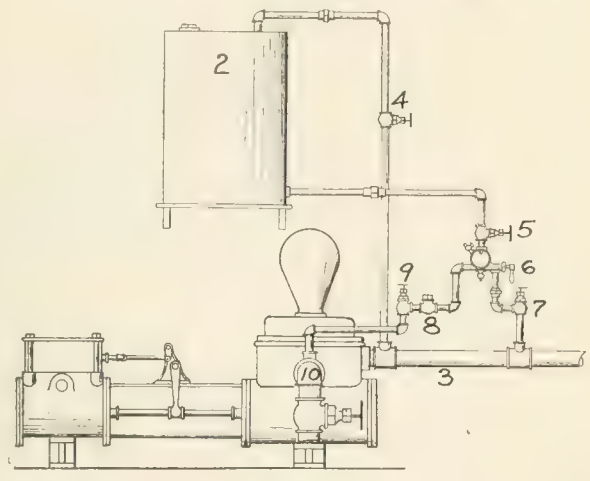


FIG. 4.—COMPOUND FEEDER WITH PRESSURE IN SUCTION PIPE.

in the suction or supply pipe, the diluted compound flows through the check valve 8 and the angle stop valve 9 into the suction or supply pipe 10.

Fig. 5 illustrates a compond feeder attached to a receiver 2 into which hot water from a heating system flows through pipes 3 and 4 under atmospheric pressure only. The return pipes of this system are all fitted with traps which remove the water as fast as it comes to them, protecting the receiver 2 from unbalanced pressure. The steam end of this duplex pump appears in the foreground, with a sight-feed lubricator attached to the steam pipe. Oil from this lubricator passes into the steam before it reaches the balanced throttle valve attached to the receiver head, thus keeping it lubricated thoroughly. Water flows from the receiver 2 through the suction pipe 5 into the water cylinders of the pump, which are directly behind the steam cylinders.

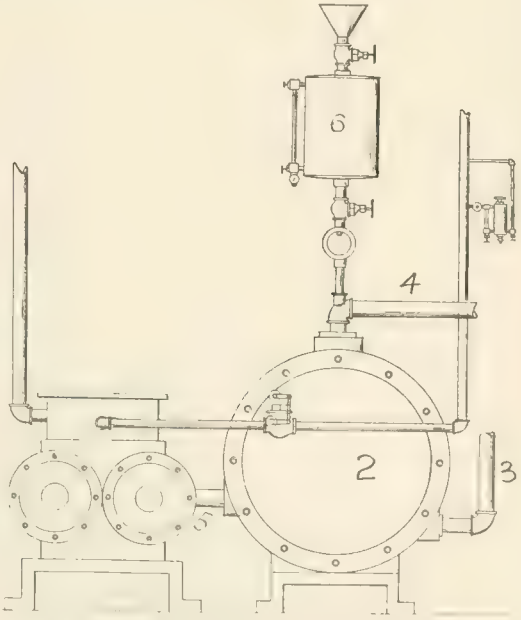


FIG. 5.—COMPOUND FEEDER ATTACHED TO RECEIVER.

This system of feeding compound is only suitable for a receiver under no pressure, as the scale resolvent is put into the small tank 6 from which it passes drop by drop through the sight feed and into the receiver, whence the pump delivers it to the boiler.

LETTERS ON PRACTICAL SUBJECTS

TROUBLE IN EXCITER CIRCUIT DUE TO DEFECTIVE PILOT LAMP.

A rather peculiar case of excitation trouble in a small hydraulic plant recently came to the writer's attention. The plant in question contains, beside steam auxiliaries, two belted Stanley inductor-type generators, rated at 100 kw, 60 cycles, 1200 volts. To each generator is belted a 2-kw, 125-volt, shunt-wound exciter. The designer of the plant evidently tried to save a few dollars at the expense of good operation and instead of voltmeters used an ordinary pilot lamp across the exciter terminals, with no fuses in circuit. When the trouble developed, generator No. 2 was running alone, carrying a mixed load, while generator No. 1 was temporarily out of commission, owing to turbine repairs. The voltage suddenly dropped to zero; no short-circuit or other cause being apparent, and the operator at once picked up the load with his auxiliary engine and proceeded to investigate. He removed and laid aside the exciter pilot lamp and connected in its socket a portable voltmeter through an ordinary attachment plug, then tested the exciter field, generator field and all field wiring for open circuits, but found nothing out of order. The unit was brought slowly up to speed and everything seemed normal again, full voltage being easily obtained. The load was then placed on the generator and carried with no sign of distress. Thinking that all trouble, whatever it had been, was over, the operator removed the voltmeter plug from the exciter and again screwed in the lamp. Immediately the voltage dropped to zero. The lamp was, of course, removed at once and the voltage came back to normal. Examination showed the lamp to be short-circuited in the base, thus short-circuiting the shunt field of the exciter. It is needless to say that in that particular plant pilot lamps have been replaced by voltmeters.

Boonton, N. J. R. N. Dickinson.

MOTOT COUPLING.

When erecting an electric motor fitted with a pulley, it is only necessary to see that the shaft lies fairly level and in line with the shaft or machine to which it is to be connected; then when the holding-down bolts have been tightened, and switches and starters connected, the machine is ready for work. In the case of a dynamo direct-connected to a high-speed engine, or an electric motor to a machine, some little attention and care are necessary in the setting up and locating of the dynamo or motor if a quiet and cool-running job is desired. For connecting a dynamo to a high-speed engine a flanged coupling is generally used. (See Fig. 1). To insure that the coupling face will be true to the shaft, the completed armature with the coupling keyed in position is placed on the lathe centers and a light cut taken over the face, recess and outside edge of the coupling, as the coupling is thrown out of true by the wedging action of the key, the extent depending somewhat on the tightness with which the coupling has been fitted to the shaft.

It is the practice in some shops when turning motor couplings to finish only the bore and inside face and boss; the outside face, recess and edge being roughed up to within 1/32 in. of size and the finish cut taken when the coupling is keyed in place. When the flywheel boss is made to serve as a coupling, as in Fig. 1, owing to the weight and diameter of the flywheel, the joint face for the coupling is often left unturned after the flywheel has been keyed on. Very often the flywheel is keyed on after the crankshaft has been bedded in place and connected up with the valve gear and connecting rods. As the flywheel is usually made a nice fit for the shaft, and the keying carefully done, it should not be much out. Care should be taken when fitting the key to see that it bears evenly all along and is not bearing harder at one end than the other.

The smaller sizes of machines are usually mounted on the same base as the engine, the patches on which the motor feet rest being planed or milled to the correct height. After removing all dirt and any rags from the base and feet of the motor, also the coupling face, the motor should be placed on the base and the couplings brought together. The first point to notice is whether the spigot on the coupling will enter the recess on the flywheel. If the shafts are exactly the same height, it will enter freely, and the faces be brought against each other. The recess is usually about 1/16 in. clear of the face of the spigot It is advisable to turn the keyways to the top with both shafts and make a mark that can be noticed on the edges of each coupling. Having the couplings brought together in this position the joint faces should be tried with a very thin feeler to ascertain if they are metal-to-metal. If this is found correct, the holes in the two couplings may be set as truly to each other as possible, and after two or three temporary bolts have been inserted and tightened up, one of the holes may be reamed out to fit the turned bolts; the finished bolt being fitted into place and tightened, then one of the temporary bolts removed and the process repeated till all the turned bolts are fitted. When the coupling holes are drilled through jigs, the turned bolts may be inserted without reaming the holes.

Before fitting in the bolts it may be advisable to test the coupling face on the flywheel to see if it is true to the shaft. Keeping the marks on the couplings opposite each other, both shafts should be given one-quarter turn and the couplings tested with the feelers. It is assumed that the coupling face has been trued up after keying. Should the faces show slightly open at the marks, the dynamo should not be moved, but the degree of error should be noted, then both shafts rotated back one-half turn, the marked edge now being at the opposite side, and the feelers again tried. Should it be open the same amount it shows that the flywheel face is slightly out of true through the keying. The marked place should now be turned to the bottom and the surfaces tried in this position. If they have been close all round when the mark was at the top, and slightly open at each side, the amount they will be open at the bottom will be double what it was at the sides. This shows that the outer end of the dynamo is high and should be lowered till the coupling shows open at top and bottom the same amount as the sides. The easiest method is usually to reduce the strip on which the outer feet rest. If the base has been planed at one setting, this error shows that the dynamo shaft is not in line with the feet There may not be very much error in the machining of any one piece, but enough when assembled to throw the shaft out of line with the feet.

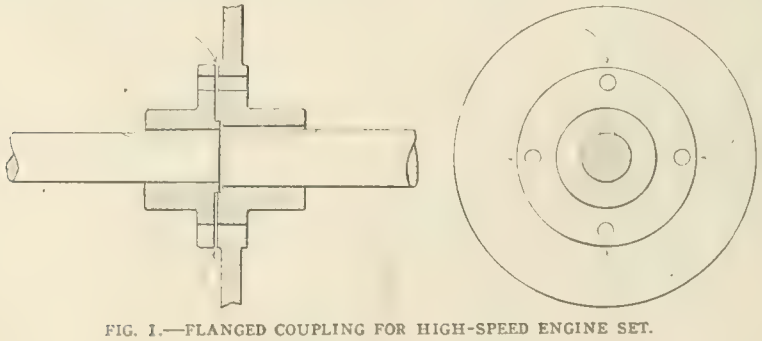


FIG. 1.—FLANGED COUPLING FOR HIGH-SPEED ENGINE SET.



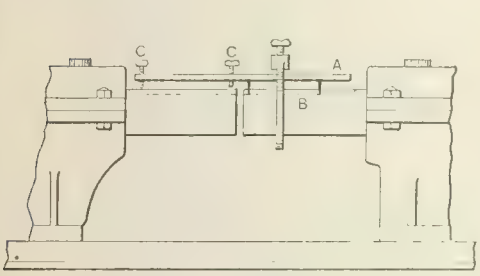
FIG. 2.—SLEEVE-TYPE OF COUPLING.

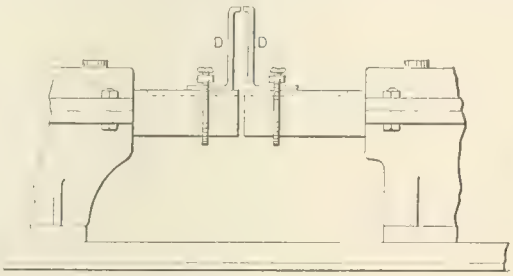
The amount of error at the couplings may not be very great, and, to try if the machine will run without any fitting being done, temporary bolts may be placed in the coupling holes and tightened up. Previous to this the crankshaft should be tried to ascertain if it turns freely, and if it does not involve too much work, the connecting and eccentric rods may be disconnected. This will give a better chance to find if the coupled shafts will turn easily. Should they not be tight or bind at any part, the holes for the holding-down bolts and steady pins can be marked and bored. If the dynamo requires to be shifted, light chisel marks should be made on the feet and base in order that it may be placed exactly in its former position. Should the shaft bind at any place, the bolts should be loosened and the error located as described. The dynamo being set as accurately as possible for height, and being in line, it may be necessary to file the high place on the flywheel face to allow the couplings to come metal-to-metal without springing. When this is done the shafts will usually turn freely, though it is not very often that the flywheel is enough out to require filing; also, before filing the key should be withdrawn and examined, and if found to be bearing hard at any point and so throw the flywheel out of true, a new key should be fitted.

When the sleeve type of coupling (Fig. 2) is used to connect a motor to a machine it is essential that the shafts be set very accurately in line with each other, as owing to the couplings being halved, it is easy to place the two parts in position and screw up the bolts only to find that the shafts bind and do not turn freely. As there is not usually much space on the shafts beyond what is required for the coupling, feathers are used in place of keys. If the motor is not very large the coupling may be placed on the shaft, the bolts tightened up and the motor moved about till a position is found in which the shafts turn freely, then the motor may be fixed in place. This method, however, is somewhat impracticable for the larger sizes. Fig. 3 shows one method of setting up. A piece of wood or iron *A* is clamped to one of the shafts, as shown, a piece of packing *B* being placed underneath to keep the rod *A* a slight distance away from the other shaft. Two small pointed screws *C* are fitted as shown, the distance apart being kept as great as possible to minimize any inaccuracy in the setting. A feeler or a small slip of metal or hardwood may be used to try the distance between the shaft and the screws. Care should be taken to have the screw points in line with the shaft on which the carrier *A* is fixed. By measuring the distance between the shaft and the points of the screws, then rotating the shaft carrying the pointer one-quarter turn, then again measuring, it is easily seen in which direction the motor requires to be moved; this operation being repeated till the measurements at each part, top, bottom and sides are equal. If any doubt is entertained as to the straightness of the shaft to which the motor is being set, after the motor has been set exactly as described, the machine shaft should be rotated one-half turn and the measuring process repeated. Should a slight error be detected, the motor should be moved until the error is halved between the two settings. This method of setting is usually accurate enough for most machines, but should greater accuracy be desired the method shown in Fig. 4 may be used.

As will be seen from the sketch, two angle pointers *D* are formed as shown, a piece of light iron, square or flat of suitable size being very handy, and clamped at the end of each shaft as shown, the keyway in each shaft forming a very suitable place for holding it. The angle pointer should be made fairly heavy so that it will not deflect in different positions, the method being to move the motor or machine till an equal measurement is obtained at top, bottom and sides. Care should be taken during the operation to see that both shafts are bearing fairly against a journal, as any end movement of the shafts will disturb the accuracy of the setting. The setting does not determine whether the shafts are concentric or not; this, however, may be easily done by placing a small rule or parallel slip on one of the shafts and moving the other shaft till the two ends are fair with each other, trying the rule at top, bottom and sides.

A point that should be noted when setting up a motor, especially a fast-running machine, is to make sure that the shaft is exactly level, as some cases of heating of journals which at first may seem mysterious may be caused by the motor being placed on a floor surface supposed to be level enough and yet when the machine shaft is tested by a level it may be found to be quite a distance out. In this connection an instance may be cited of a machine running over 2000 r.p.m. and which was always heating at one of the journals. After bedding down the brushes until they could not be made any better and the heating being as bad as ever, it was discovered that the machine was out of level, and when this was corrected there was no further trouble. The flexible coupling shown in Fig. 5 is very effective and gives a smooth drive, though the machines are not exactly in line, it also allows some end play. Should the leather at any time give way it can be easily and cheaply replaced. Two or more thicknesses of leather may be used for any desired size and load.





FIGS. 3 AND 4.—METHODS OF SETTING UP SHAFTS.

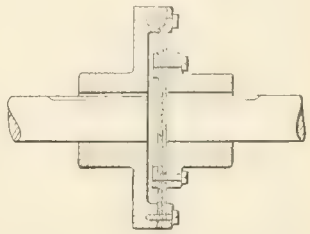


FIG. 5.—FLEXIBLE COUPLING.

PITTSBURGH, PA. W. BURNS.

AN UNUSUAL CASE OF SWITCHBOARD TROUBLE.

The introduction of increasingly high transmission pressures on polyphase systems has involved a very great increase in the care which is necessary in the construction of the switching apparatus. As one of the chief points at which a breakdown would be most detrimental to the supply is at the main switchboard of the power house, an entire revolution in design has been accomplished within recent years resulting in the development of the cellular type of board. This compartmental arrangement in one of its various forms has now become standard practice in alternating-current systems dealing with pressures in excess of 3000 volts. In the details of design, extreme care has to be exercised to avoid insulation troubles, and the practice of mounting the connecting leads upon porcelain insulators, these being fixed into the concrete or brick construction of the cells, is now almost universal. In some instances the insulators alone can be relied upon, the conductors being of bare copper, while in other cases increased safety is sought by encasing the conductors themselves in insulation. A breakdown which occurred on the main switchboard of a three-phase supply operating at 6000 volts between phases illustrates, however, that considerable care should be exercised as to the type of covering adopted for such cables, even when mounted on insulating supports. In this case each piece of high-tension apparatus was enclosed in a brick or concrete cell, and the high-tension cables were run over insulators. In addition, they were India rubber covered and had an outer covering of asbestos braid,

which was added in order to improve the fireproof qualities of the board. Unfortunately, however, the switchboard was located in a somewhat damp position, the atmosphere of the switchroom being at times rather humid. Owing to the hygroscopic properties of the asbestos braid, moisture was absorbed, and a static discharge was set up in the form of a succession of sparks between the cable and the concrete cell. This had the effect of breaking down the insulation of the cable, the sparks puncturing the rubber sheath, and an almost immediate "dead earth" on one of the phases was the result. In order to preserve continuity of the main supply it was necessary to switch that cable out of action until a convenient time for repair was found, and in the interval the section of the supply served by that feeder had to lie dead, no possible means of restoring supply being immediately available. In order to prevent a recurrence of the trouble, however, lengths of lead strip were taped by hand over the asbestos of the repaired cable and the insulated connecting wires of the other phases and feeders, these strips being grounded. It will be seen that by this means the porcelain insulators were practically put out of action, full reliance being placed upon the rubber insulation of the cables. So far as trouble arising from the above cause was concerned, however, no further difficulty was occasioned and under normal circumstances this arrangement worked quite well. Further events, however, proved that this device was not entirely satisfactory, inasmuch as, when another fault on the switchboard developed and set up heating, the lead melted and ran, setting up further earths and splashing the apparatus. The final repair, which ultimately removed all further trouble, was effected by removing the rubber insulated, asbestos braided and lead-sheathed conductors from all parts of the board, and putting in their place either round copper bars or else copper strips according to location, the conductors being protected with high-tension tape and thoroughly varnished.

Newcastle-on-Tyne, England. Samuel J. Adams.

SETTING DIRECT-CONNECTED ENGINE SETS.

The setting of a direct-connected set upon its foundation requires some care if the unit is to work properly. It is an easy matter for the erecting man to go wrong in setting one of these

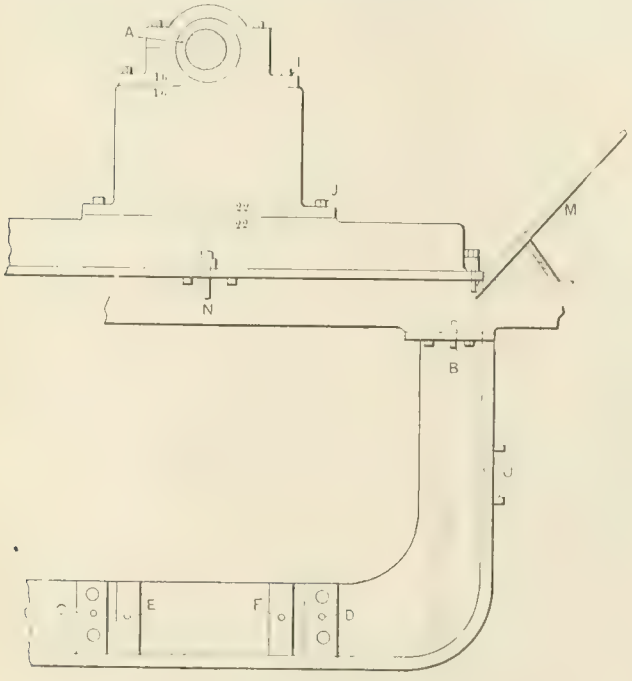


FIG. 1.—ELEVATION AND PLAN OF BEARING FOUNDATION.

units. The subbase of the engine is fitted at the factory, as well as the U-shaped arm which carries the outer bearing for the engine and armature shaft. The arms are usually planed, bolted and doweled. These joints are supposed to bring the arm back in line when placed upon the foundation, and some of the engine builders instruct erecters to bolt down the engine subbase level and then to bolt the arm. However, such instructions do not always result in the proper setting of the engine. In erecting one of these sets in a power plant recently the arm was out of true and had the appearance as shown at *A* in Fig. 1. The shaft was some distance out of center, although the main joints, which are planed and doweled, were in place.

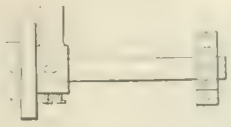


FIG. 2.—MAIN BEARING CLAMPED ON SHAFT.

By means of a pinch bar, as shown at *M* in Fig. 1, the arm was sprung in place. A strip was placed under the bar until the arm was clamped, and finally some iron wedges placed under the subbase, as shown at *U* and *N*. These were keyed up and the bolts fastened. The bearing was then calipered to see if it was right. The wedges should be placed as shown, on each side of the bolt, as placing them on one side only would spring the base. Another defect found in such engines is the absence of dowel pins in the bearings, such as shown at *C, D, E* and *F*, Fig. 1. Usually bolts are employed, as shown at *I, J*, Fig. 1, and these give only a loose fit, so that the bearing may be swung in almost any position. No marks are placed upon the bearing

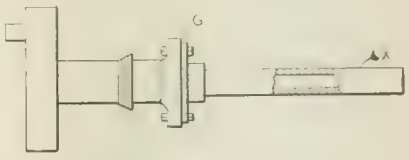


FIG. 3.—TEMPLATE SHAFT.

pedestal or the bearing. If these were stamped, as indicated in the engraving, much trouble would be spared. When the engine under discussion was being lined up the writer had some dowel pins set in place so that the pedestal and bearing would remain in proper place. Afterward cement grouting was used and allowed to stand a few hours before the generator was mounted. Builders send out a template for shaft, shown in Fig. 3. The short end is, of course, on the engine and the end *X* is made hollow and fastened by means of a flange which is bolted to a flange on the short shaft. The face *G* should be carefully cleaned and all bolts should be drawn up equally, as the shaft may be thrown out of true by tightening one bolt more than another. When calipering, a mark should be placed

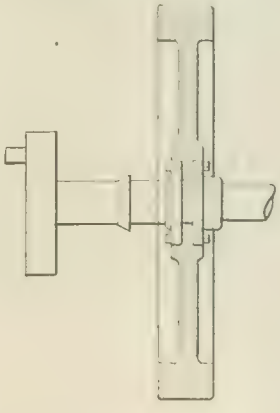


FIG. 4.—TWO-PIECE SHAFT BOLTED TO WHEEL.

as at *A*, Fig. 1, and four marks placed on the bearing. The shaft should be moved and calipered at these marks. In this way errors are avoided. Two-piece shafts oftentimes are out of true when bolted into the wheel, and sometimes have to be papered in the flange, as shown at *O* in Fig. 4. When there is any variation it requires a great deal of work to eliminate it.

Fig. 2 shows a method used by the writer on small engines. The main bearing is clamped on the shaft and the outer bearing is set in place. Some erecting men attempt to place the rotor on the shaft or fasten the extended shaft to the short engine shaft, and then set up the base. It is necessary to remove the piston and crosshead and run a line through the cylinder to make a good job this way. Where the manufacturers have provided a template shaft for lining the engine, the method noted is not to be followed.

Lynchburg, Va. C. R. McGahey.

PROVING A METER CORRECT.

The amount of care and attention given to a new customer often makes him a permanent one or prejudices him so strongly against electric lighting that he orders the service discontinued and uses gas. Two almost parallel cases which recently came to the attention of the writer illustrates very forcibly the value of taking care of a new customer, particularly one who has never used electricity before. In two Ohio towns two hotels, one in each place, were wired in a very similar manner. The hotel lobby and dining-room were fitted with eight tungsten lamps and the other rooms were fitted with ordinary 16-cp lamps. The lamps on the clerk's desk in the corridors and in the closets were connected to all night circuits. The guest-rooms, kitchen, parlors, etc., were wired in appropriate groups and the several circuits were brought together at a convenient point in the hall on the second floor where the meter was located with the controlling switches.

One of the hotels was given electrical energy with the promise by the local central-station manager, who was a friend of the hotel proprietor, that he would make the cost all right and with this assurance the hotel manager ceased using natural gas and began using electricity. Matters ran along in this manner for about two months, the hotel man taking great pride in the fine illumination and burning the tungsten lamps as long as there was a guest in the lobby. One day a collector dropped in with a bill for 380 kw-hours at 10 cents per kw-hour, and the hotel proprietor, whose expenditure was thus $19 per month for lighting his 19-room hostelry, was simply astounded. He immediately, with pencil and paper, estimated the number of hours each lamp was kept burning, reduced the result to lamp-hours and then multiplied by 0.33 watt for each lamp-hour and at once discovered that the meter reading was about twice what the energy consumption could possibly have been. The hotel man was instructed in the reading of the meter, which he read every morning and entered the result upon a slip of paper posted on the wall adjacent to the instrument. Then the hotel man began to discover things he did not understand. One morning in June, when electricity bills should be the smallest of the year, the meter showed that three kw-hours had been accounted for by that instrument. The next morning five kw-hours were shown to have been used, and so on, the amount fluctuating day by day. The hotel man was unable to see why the daily consumption was not uniform, neither could he make the amount of energy come anywhere near checking with his summation of the estimated lamp-hours. Natural gas cost him 30 cents per 1000 cu. ft., so he put in a gas engine, a 75-light generator and the necessary switchboard, and he professes to be very well satisfied with the change and says that energy costs him less than one-half what he paid the local company.

The other hotel man was very much afraid that the bill for electricity would be more than he could afford, and he did not rely upon any promise by the local manager, or anyone else. Instead, the new customer was fully informed that the cost of electricity would be 10 cents per kw-hour with 10 per cent discount for prompt payment. As soon as the electricity had been turned on, the proprietor was on hand with his pencil and pad, took the meter reading and began to figure the lamp-hours he was paying for. Like the first hotel man, he could not make his figures agree with those taken from the meter. A complaint was promptly made to the local manager, and the course taken by the manager was one which should be followed by other managers in similar cases, and in cases where it is possible that similar conditions might develop. The latter sat down with the hotel man and went over the estimates of the lamp-hours. After a careful consideration of the estimates, and the daily reading of the watt-hour meter, he told the hotel man that there could not be any doubt but what the amount of electricity registered had actually been supplied to the hotel lamps, therefore there could be only one cause for the heavy consumption of energy and that was that the number of lamp-hours was greater than estimated. Of course the hotel man protested that his estimate was just, and the manager saw that there were good grounds for the position taken by the proprietor, as every lamp in the hotel was noted in the estimate, and a certain number of hours' service had been assigned to each lamp. It was explained that the excessive energy consumption was due to the lamps being burned longer than was estimated. To prove it a recording wattmeter was temporarily set up in the hotel, at the meter, and a permanent record of power furnished during each hour of the night was secured. The next night, the lamps were permitted to run in the regular way, and no attention was given to the amount of electricity used, as the house happened to be full, with every room occupied. But upon the following morning, the regular meter showed that five kw-hours were used during the night and the proprietor and the manager proceeded to analyze the record of the recording wattmeter. The manager quickly marked upon the record the time during which the lobby and dining-room lamps were lighted and he drew upon the disk an approximate record in pencil of what the record would have been had there been no tungstens in circuit. Then he marked upon each hour-space on the record the number of incandescent lamps which were burning at that time, and this was easily accomplished by dividing the watts recorded by the number of watts which the preliminary test had shown was required by each lamp. The record now bore a curve consisting of various steps both up and down, and the uniform portions of the curve between the points of variation were marked by the manager with the number of lamps which must have been burning during the several periods. The summation of energy consumed, as indicated by the recording instrument, agreed very closely with the five kw-hours called for by the watt-hour meter. This proved to the hotel proprietor that the meter was correct, and the proprietor and the manager went over the watt-record together and the manager marked under his figures, in each uniform portion of the curve, other figures showing what lamps the proprietor knew should have been legally burning during those hours. Then there was found to be a considerable discrepancy between the estimated and the actual figures at certain hours. From 9 p. m. to 12 p. m. the two sets of figures agreed very closely, but there was a wide discrepancy between the time when energy was turned on at dusk in the evening and again between 12 o'clock, midnight, and the hour when electricity was turned off in the morning. The figures varied from 6 to 10 lamps during the periods mentioned. It was evident that some guests were burning lamps all night, and inspection proved this to be the case. Not only were a number of lamps burned all night in the guest-rooms, but the lamps were left turned on when the circuit went off at daylight, and not being burning at the time the chambermaid cleaned the rooms, the lamps were lighted again when circuit was turned on at early dusk. A little more attention is given these matters now. There is a notice posted in each room that lamps burning after midnight will be charged extra, and the chambermaids see that the switch of each lamp in guest chambers is in the "out" position when they visit the rooms in the morning. And the number of all-night lamps has been cut down to the limit, also the hours during which it is necessary to burn lamps in the kitchen and other workrooms. The result is less energy consumption for the electric-light company, but it has secured a satisfied customer.

Willoughby, Ohio. James F. Hobart.

QUESTIONS AND ANSWERS

Should bare wire be used for inside wiring on high-tension transmission work? J. B.

Yes. Almost every high-tension plant is thus wired.

Are there power-factor meters for frequencies of 125 cycles? E. A.

This frequency is obsolete for motor circuits, so that it is doubtful if it is possible to obtain a power-factor meter for such circuits.

How strong should the solution be in the ordinary wet battery? L. M.

The directions vary with different cells, but 5 oz. of sal-ammoniac to 1 qt. of water is an average solution. If the solution is too strong crystals will be deposited on the zinc. These have a tendency to increase the internal resistance of the cell and also to lower the e.m.f.

How can I ascertain the power factor of a circuit with ordinary instruments? C. H.

Connect a voltmeter, ammeter and wattmeter to the circuit in the usual manner and take reading of all three simultaneously. Divide the wattmeter reading by the product of the voltmeter and ammeter readings; the result will be the power factor of the circuit.

How is the size of wire for the outside feeders of a three-wire system calculated? S. C. E.

The outer wires are calculated exactly as though the circuit were a two-wire one of the voltage used between the outer wires. Thus, if the voltage from the neutral to each outer wire is 110, the total voltage is 220 and the outer wires should be determined as if they were intended for a 220-volt, two-wire circuit.

Why does the steam pressure in water-tube boilers fluctuate more than in horizontal tubular boilers? M. T.

The water-tube boiler is more sensitive to the influence of the fire because a much larger portion of the total body of the water is in direct contact with the heating surface. Therefore any fluctuation in the firing shows on the steam gage very soon. Widely fluctuating demands for steam also affect the steam pressure because the steam space is comparatively small.

Is it possible, in emergencies, to quicken the steaming power of boilers fitted with stokers so as to keep up the steam pressure under heavy load? L. M. P.

Almost all stokers can be forced. In certain types of stokers using bituminous coal it is possible to throw green coal on the front of the firing plate and drive off the gases, which burn as they pass over the hotter portions of the fire. This expedient is used in a number of stations requiring steam hurriedly to keep up the boiler pressure under peak-load conditions.

Is it possible to increase the output of an enclosed motor by means of ventilation? B. T. L.

The output of a motor of proper design is limited solely by the temperature elevation of its parts, and the extent to which the temperature can be kept down depends entirely upon the facility with which the heat can be dissipated as it is evolved. All the losses appear in the form of heat. If, therefore, means are provided for getting rid of the heat, the output can be very greatly increased. Indeed, with a forced blast of cold air the output of entirely enclosed motors can be made much greater than the output of open motors.

Is there a frequency meter on the market whose operation is independent of the wave-form of the current? H. W. F.

Yes. There is an instrument having a scale for frequencies, say, from 80 to 115, and tuned to the intervals of these numbers would be 36 steel springs. A broad arm, on the axis of which is an alternating-current magnet system, is turned around the scale by means of a button. When it comes opposite to the steel spring tuned to the frequency of the current under investigation, the spring vibrates, emitting a tone which is readily detected. The frequency is read directly from the scale. Modifications of such an instrument are also made.

Are incandescent lamps preferable to voltmeters in phasing generators? M. K.

Incandescent lamps lack sensitiveness. As a rule, a lamp will not glow until a voltage more than 50 per cent of normal is applied, so that a large phase difference is required to give any indication of difference in light of the lamp. If one of the primaries of the synchronizing transformer is reversed so that in a condition of synchronism the lamp is burning brilliantly, a small voltage change produces a large change in the light. The disadvantage of both arrangements is that when the two machines are nearly in phase a comparatively large phase displacement is necessary to cause an appreciable change in the cross-e.m.f. A synchroscope is preferable to either lamp or voltmeter.

Is there much danger from explosion with oil-cooled transformers? G. D.

There is no danger to be expected from the oil used in the transformer. The danger, if any exists, has been attributed to the explosive mixture formed by the vapor of the solvent of the insulating varnish and air. Many insulating varnishes consist of linseed oil or other substances dissolved in naphtha. If, after impregnation, the transformers are not subjected to a prolonged dying process to drive off all the solvent, this will accumulate in the transformer tank, and can be exploded by means of a lighted taper if the transformer is not ventilated after taking the cover off the opening. If baking varnishes are used, the danger of benzine or naphtha forming an explosive mixture is very remote; because with such varnishes the volatile matter is driven off during the drying process and the only change in the varnish is that resulting from oxidation. With air-drying varnishes the danger might be present.

What system of distribution is best for an alternating-current suburban service having a mixed load? A. B.

Distribution for commercial and industrial loads is usually at a potential of 2200 volts. The four-wire, three-phase system seems to have many advantages for suburban work. In this system the generator or transformers are Y-connected, the neutral being brought out and connected to a grounded fourth wire or busbar. Single-phase mains are used for lamp circuits and three-wire or four-wire, three-phase mains for motor circuits. Large motors are supplied from three standard transformers with primaries connected in star and secondaries in delta. Small three-phase motor installations may be supplied from two-phase wires and neutral by two standard transformers in open delta. The four-wire system makes it possible to distribute over a much larger area than can be reached economically by either the two-phase system or the three-wire, three-phase system, and this advantage is secured without departing from the use of standard apparatus.

What is the function of the oil used in large transformers and what are its properties? S. G. S.

The oil used in transformers performs two functions: It serves to insulate the various coils from each other and from the core, and it conducts the heat from the coils and core to some cooler surfaces where it is either dissipated in the surrounding air or transferred to some cooling medium. It is evident that the oil should be free from any conducting material; it should be sufficiently thin to circulate rapidly when subjected to differences of temperature at different places, and it should not be ignitable until its temperature is raised to a very high value. Numerous kinds of oil have been tried in transformers, but at the present time mineral oil is used almost exclusively. This oil is obtained by fractional distillation of petroleum unmixed with any other substances and without subsequent chemical treatment. A good grade of oil should show very little evaporation at 100 deg. C., and it should not give off gases at such a rate as to produce an explosive mixture with the surrounding air at a temperature below 180 deg. C. It should be neutral, and not have an acid or alkali reaction, nor should it contain water or sulphur compounds. Moisture reduces the dielectric strength of the oil very much.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Tungsten Street Lamps for Maywood.

The village of Maywood, Ill., a suburb of Chicago, has renewed its street-lighting contract with the North Shore Electric Company for a period of five years. Replacing the 20-cp carbon lamps which have been used, the central-station company is now installing 32-cp series tungsten lamps. Tungsten street lamps will also be used by the North Shore company in lighting the streets of Franklin Park and River Grove.

Cost of Power Production in a Representative Central Station.

Figures have just come to hand covering the cost of power production in a central station of 4950-kw rating for the past year and showing a reduction of 17 per cent per kw-hour compared with the preceding 12 months. The plant is a representative steam generating station, with compound condensing engines installed in four units. The service consists of alternating supply at 2300 volts and direct-current power facilities at 500 volts. About 44 per cent of the company's output is devoted to motor operation, a gain of nearly 4 per cent in this class of business compared with the previous year. The boiler equipment of the station consists of eight Babcock & Wilcox water-tube outfits rated at 400 hp each, hand-fired, with natural draft. The engine units are McIntosh & Seymour General Electric machines, two being of 600-kw, one of 1500-kw, and the fourth of 2000-kw rating, generator ends.

During the year the company generated 6,484,140 kw-hours and sold 5,706,241 units. The power sales came to 2,514,122 kw-hours. The fuel consumption was 9377 tons of bituminous coal, with an average cost of $3.72 per ton, making the fuel expense per unit generated 0.54 cent. Singularly enough, the total coal consumption was exactly the same last year to a ton, but the cost per ton was then $4.40 at the plant, which brought the total fuel bill for 1908 to $41,546 contrasted with $34,909 in 1909. The unit fuel cost in 1908 was 0.69 cent. The labor cost per kw-hour this year was 0.34 cent against 0.35 cent last year, but in spite of an increase in the energy generated at the station, the total cost with all manufacturing charges included, was $66,050 this year compared with $74,426 in the preceding 12 months. The oil and waste, water, station building, steam plant and electrical equipment repairs came to 0.14 cent per kw-hour generated in 1909. Last year these charges amounted to 0.2 cent. The total labor cost for 1909 was $22,095, compared with $20,920 last year. The chief item of economy was therefore in the fuel cost. The coal consumption per kw-hour delivered at the station switchboard was 3.48 lb. in 1908, while this year it was 3.24 lb. The total energy delivered at the bus was 7.3 per cent greater this year than last. The tabulated data follows:

COST OF MANUFACTURE YEAR ENDING JUNE 30, 1909.

Kw-hours delivered at the switchboard	6,484,140
Kw-hours sold	5,706,241
Power sales, kw-hours	2,514,122
Coal burned, tons	9,377
Average coal cost per ton	$3.72
Fuel cost, per kw-hour at 0.54 cent	$34,909.53
Oil and waste	1,300.71
Water	3,730.26
Station wages, per kw-hour at 0.34 cent	22,094.64
Station building repairs	2,402.15
Steam equipment repairs	2,412.85
Electrical equipment repairs	1,199.89
Total	$66,050.03

The distribution cost for the fiscal year 1908-9 was $37,309.91, or 0.66 cent per kw-hour sold. The station labor consisted of four engineers, three oilers, one engine-wiper, four switchboard men, six firemen and two coal-passers.

Central Station Advertising.

In an interview printed in the New York *Commercial*, Mr. Harold Almert, manager of the department of examinations and reports of H. M. Byllesby & Company, consulting engineers, Chicago, while at the Hotel Belmont recently, speaking of the advertising of a public utility, said that in no industry has there been such a radical change of policy and awakening to the possibilities to be derived from comprehensive and intelligent campaigns of advertising as in the marketing of the product of public utilities.

"Ignorance on the part of the consumer is the principal retarding element which prevents a much more extended use of public-utility service. If the public understood all the varied uses, economies, comforts and conveniences obtainable from the intelligent use of gas, electric light and electric power service, the output of central stations and gas companies of the country would be three times what it is to-day.

"The connecting link between the prospective consumer, who does not understand the varied uses, and public utility or producer who does, is advertising. Such advertising, to be eagerly read, must be in the form of a campaign of education, setting forth step by step the whole truth and nothing but the truth, in simple language, devoid of technical terms so that the reader can readily comprehend it.

"Until recently the owners of public utilities believed that if the public needed and wanted their service they would hunt up the office and ask for it, and that to advertise, display and solicit was a waste of good money. They now realize that the successful marketing of their products is different only in degree from any other commodity. As an illustration, take a city of 50,000 population located in the Middle West. By changing from the old policy to the new, in two years the net profits have been trebled and by the increased output it has been possible to reduce the rates to the consumer 33 1/ per cent.

"Equitable rates, good service and intelligent publicity have done wonders for and added materially to the value of securities of public utilities in the last five years, which now represent an investment of something over a billion dollars of American capital."

Suggestions Toward Promoting Electric Vehicle Service Through Central Stations.

By J. H. Vail.

THE writer having central-station experience, and a knowledge of what electric vehicles can bring to central stations as new revenue, ventures to set forth a few points for consideration. The electric vehicle occupies a position nearly parallel with that of the electric motor in 1887 and 1888. It was then for a time very difficult to get a central-station company interested in the prospective revenue, or to advocate electric motive power as a source of income. As quickly as the value of the power proposition was grasped, the business obtained a firm footing. No company would consider abandoning the motive-power field to-day, and motive-power experts are now employed everywhere to negotiate the business for the station.

The fact must be recognized that the electric vehicle for pleasure, business and commercial purposes is here to stay. Its field of usefulness is too large and its economy of service too great to be ignored any longer; and the conclusion seems obvious that within reasonable time nearly as much current will be sold to serve electric vehicles as for other motive power. Mr. Edison says: "It will in time be the largest power load of the New York Edison system.

In this work it appears central station companies may be divided into three classes. First, those companies which, understanding the value of this new business, are proving their faith by using vehicles in their own service; co-operating with vehicle manufacturers in developing new business, and already beginning to reap their reward, which recent statistics show aggregates upward of $500,000 per annum of new revenue. Second, those companies which are apparently surrounded by a Missourian atmosphere, and the expansion of their income is thereby throttled by doubt. There exists a justifiable hope that this condition is working for an early change. Third, those companies unfortunately located where very steep grades, absence of bridges and bottomless streets in certain seasons, operate against the success of the electric vehicle. Fortunately, this class is limited.

There need be no hesitation on the part of the central-station company endorsing the use of properly selected vehicles. The electric increases the earning capacity of the individual who uses it, and it is therefore becoming recognized as an economic necessity. One commercial electric vehicle is capable of doing two to three times the service of a corresponding horse team, and in all places where physical conditions will admit its successful operation it should receive strong endorsement, with the certainty that it will make good in efficiency and economy, and please the customer by saving 20 per cent to 40 per cent. over horse service. This is accomplished by reducing cost of drivers, and by the fact of one vehicle covering a larger radius of work.

The progressive manager of a company in a city of about 200,000 population stated recently that he "expected within five years his company would supply current to at least 1000 electric vehicles." This will mean an additional income to his company exceeding $100,000. The case is already proved by actual practice that thousands of vehicles are successfully used with large economy over horse transportation by non-expert owners, and the heretofore uncertain question of maintenance is completely covered by the protection to be secured under a maintenance guarantee contract which will be presented to each purchaser.

The knowledge of the work that electric vehicles will accomplish, and of the cost to operate and maintain, has been learned by continual observation and inspection of a very large number of motor wagons and trucks in actual operation during more than seven years' service. The records of certain companies are kept with great precision, and are more than ordinarily complete in analytical details. This kind of account-keeping permits the owner to spot any weak or abnormally expensive points and thereby reduce his cost of operation. It cannot be too emphatically stated that the surest method of getting the public more deeply interested in electric vehicles is for each central-station company to adopt a vehicle equipment for its own service. This is the master-key to the secret of success in developing the sale of energy in this comparatively new field. The central-station company should always be on "the firing line." Progress is not made by restraint of trade.

No business agent of a central-station company can consistently advocate electric-vehicle service if he drives to the customer's premises in a gasoline car. Each company should have two or more electrics in daily service. In fact, seriously considered, they cannot afford to do without them. Eliminating the few localities where the topography and roads are abnormally bad, there remain hundreds of cities where a comparatively small investment in a superintendent's runabout, a delivery wagon, etc., by the electric light and power company will not only facilitate largely the company's own service, but by inducing business concerns to adopt electric vehicles the company's investment will indirectly return a large interest.

The use of an electric pleasure vehicle is an accepted mark of social distinction, and the use of commercial electrics is likewise viewed as a distinct economic advance in business enterprise. The central-station company and the manufacturer have each their product to sell, and cordial co-operation should serve to promote the business to their mutual advantage.

Success will attend the intelligent application of commercial electric vehicles. It is important not to underestimate the delivery capacity of such vehicles. The speed and radius of service exceed more than twice the ability of horses. Actual practice proves that the ability of a two or three-ton electric truck in express service to make from 125 to 200 delivery stops in 10 to 12 hours, over a route of 35 to 45 miles, crowds the working capacity of operators. In other words, the capacity of the truck exceeds the ability of the man to handle the merchandise.

The delivery wagons having a capacity of 1000 lb. and 2000 lb. prove capable of exceeding 40 miles daily service and 200 delivery stops. This work is frequently done between 8:30 a. m and 4:30 p. m. Any operator can estimate the horse service required to duplicate this daily work. The getting-away time and the quick acceleration after a stop are important factors. Better economy is obtained by having a three-ton vehicle worked daily to its full capacity, than a five-ton truck rarely doing its full quota of service. The rated speeds are within the limits of safety and legal requirements. It is a menace to public safety and a strain on wearing parts to drive a heavily-loaded car at too high speed.

Instances may be encountered where business will be held up on account of the merchant who does not require more than one wagon, and he may hesitate to undertake the care of it. Under such conditions the business may be promoted by the organization of a merchants' express or motor delivery company to serve several firms. A business of this kind is sure to grow into a profitable enterprise. The individual ownership of vehicles is desirable, and it would appear that the best care would be given them if several owners would keep their vehicles at one garage.

The question as to whether the central-station company shall institute garage service for the accommodation of its vehicle patrons is one to be determined largely by local conditions. It would seem to be an ideal plan working for the benefit of the customer and the company. The knowledge that if he purchases an electric truck it will be cared for in a garage specially devoted to this service will often enable a customer to reach an affirmative decision with the agent. It is safe to state that electric-garage service can be operated with some direct profit to the company, and more satisfaction to the vehicle owner, and thus it will indirectly stimulate the wider use of electric vehicles. Garage service by the electric company, as in St. Louis, shows a very commendable spirit of business enterprise.

There are numerous excellent public garages that give proper care for electric vehicles. The public garages that care for gasoline cars rarely give the electrics the right attention. The gasoline cars require more care and repairs than the electric, and are a better paying proposition for the garage operators. Under any conditions the garage charges should not be so high as to retard business development. A good horse properly fed and groomed is a satisfaction to the owner and user. So will an electric vehicle properly cared for attract attention by its constant good service, and thus benefit both the owner and the company. One-half the time bestowed on grooming and feeding a team of horses, attending harness and truck, will serve to keep an electric truck in splendid working condition. Any sober, intelligent man who will drive a good team with care can with less real work drive an electric truck. Thousands are doing it daily.

It is most important to keep to the front the fact that the central-station company is not required to invest new money for additional equipment to supply current to serve this new load. The present equipment will earn the money, whereas additional peak load would mean new investment for enlargement of plant. For the purpose of considering the income value of an electric vehicle load, an estimate has been prepared of the approximate current required for an average daily mileage and assumed rates per kw-hour. The estimated approximate annual income to the central station per vehicle is shown in the following table:

Type of vehicle.	Estimated daily mileage.	Assumed average kw-hrs. daily demand.	Rate per kw-hr.	Miles in 300 ds.	Estimated annual income to station.
Five-ton truck	25	34	3c.	7,500	$306.00
Two-ton truck	30	20	4c.	9,000	240.00
One-ton express wagon	35	15	4c.	10,500	180.00
Domestic vehicle	20	10	5c.	6,000	150.00

It will be understood that the above figures are an approximately conservative estimate only; the rates are a fair basis of charge per kw-hour for an off-peak load, and can be modified to suit local conditions.

The rated miles from one charge of battery and miles per hour are based upon travel on level asphalt road, and variations in conditions of pavement of grades modify the traveling ability; nevertheless, the commercial electric wagons travel over bad roads and negotiate strong grades with great success. The rates charged per kw-hour for current to electric vehicles will have an important bearing on advancing or retarding business. Local conditions and cost of current production must receive due consideration; also the cost of horse maintenance. Metropolitan conditions as to all items of horse-keep are altogether different from the cost in cities surrounded by rich agricultural territory.

The commercial electric is not intended for any but delivery and trucking purposes; therefore the rate that may be charged for energy should be governed by certain specific conditions. Let it be stipulated that the charging of batteries shall not be done between the hours of 7 a. m. and 6 p. m. This places the service in a special class, and during daily periods where the electric company's investment is not earning up to its ability the plan permits attractively low rates to be offered, thus working to the mutual advantage of the company and the customer, and tending to increase the volume of business.

It rests with each company to fix its minimum monthly guarantee, and its kw-hour charge based on current per vehicle will be governed by the daily mileage. It does, however, appear that a fixed daily charge of $1, or a kw-hour rate of 20 cents, will not induce growth of business in this line. These rates worked out make the electric wagon more costly to operate than the horse vehicle. To induce business and for fair returns to the company the writer knows that rates of 2 cents to 6 cents during non-peak load hours will be attractive to the customer, and the company will make a handsome profit.

The Price of Electricity.

By Wm. D. Marks.

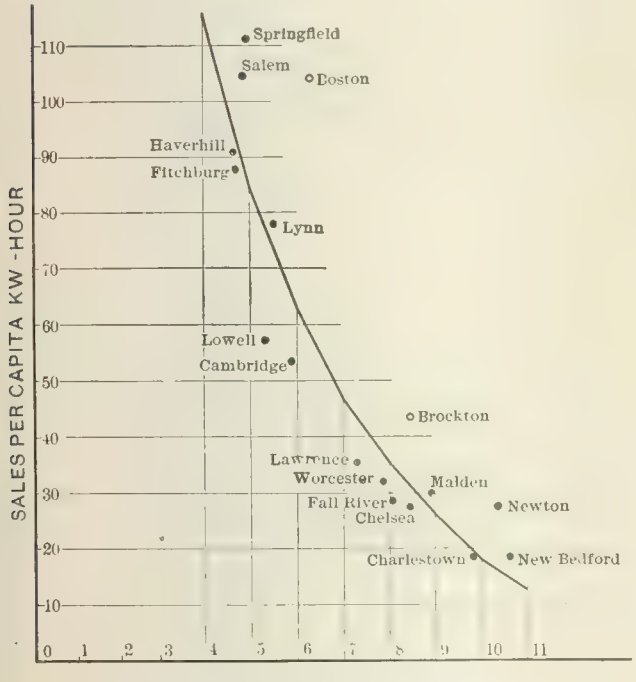
FROM the public's point of view the method of fixing the proper price of electricity is usually a mystery. The various forms of sliding scales of price and the discounts used by the electric lighting companies arise from the practical impossibility of cheaply storing electric energy. Since the consumer usually has the right to call upon the electric light company at any time for the maximum amount of electric energy required by his installation of lamps or machinery the electric light company must prepare to meet his demand by installing an equal amount of generating machinery, although it is quite possible that the consumer may have use for his maximum demand only once in a year, or never at all.

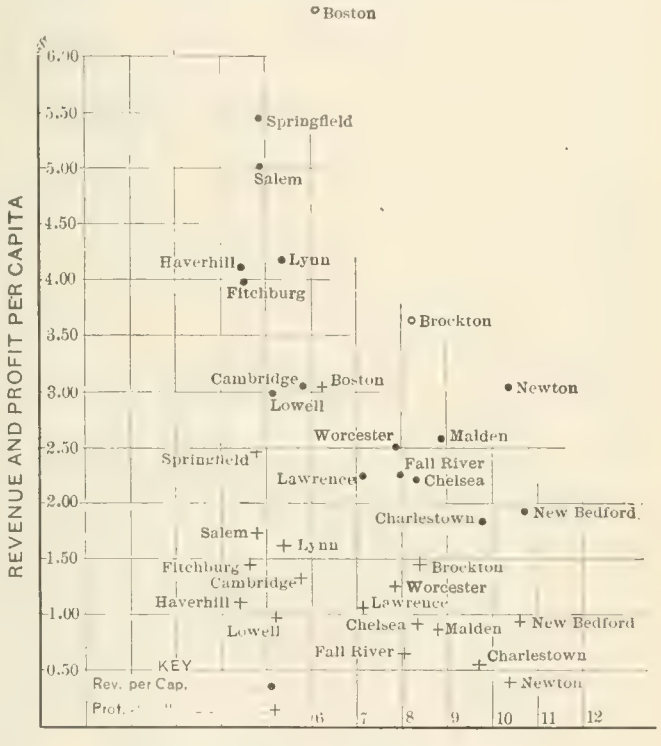
A maximum-demand meter has been installed by some electric light companies for the purpose of fixing a consumer's maximum demand each month, but this, it is obvious, is of little value, for the maximum demand at any period of the year is the measure of his requirements of the company's generating machinery. For these reasons the prices fixed for electricity have been based upon two factors: (1) The actual cost in productive labor and raw material of generating and delivering the electric energy measured to the consumer. (2) The profit and depreciation upon the installation required to generate and deliver the maximum electric energy required by the consumer.

So far as he knows, the writer published the first sliding scale of prices on this basis in the *Transactions* of the Edison Illuminating Companies in 1891 after having used it in Philadelphia for a year. Since then, the discussions of the basis of prices for electricity have been innumerable and will not here again be renewed.

In its report, June 30, 1908, the Massachusetts Gas and Electric Light Commissioners went into the factors of cost of electricity in Boston at great length and fixed the maximum price of electricity at 12 cents per kw-hour, but from the point of view of the station manager desiring to reap as large a profit as possible this subject is no longer fresh in its interest, and others may be referred to it as a most excellent analysis of a single case.

The effect of the average prices for electricity upon the





FIGS. 1 AND 2.—CURVES SHOWING SALES OF ELECTRICITY PER CAPITA AND PROFIT IN VARIOUS CITIES.

growth of communities is now becoming a matter of grave concern to State and city officials and to commissions charged with the regulation of public utilities. Since it is a universally acknowledged fact that any institution not doing a profitable business is ultimately an injury to the community it serves, it is the duty of these officials to guard carefully against any action resulting in a loss to the electric generating companies, and as it is an equally well-recognized fact that lowered prices for electricity result in great benefits to the community served, it is also in a broader field their duty to fix prices for electricity as low as is consistent with a fair profit upon the true cost of the electric plant. Superficial theories and incorrect reasoning are common alike to the operators and the consumers of electric light companies. In many instances local causes and obscure forces and influences greatly vary the results attained by companies. In fact, only experiment on an extended scale and in a broad field can furnish reliable data for forming an opinion solidly based upon the actual, practical facts and figures of the cost of electric plants and electric energy.

The effect of price upon the sales of electricity also is a matter in which no theory as to results has been formulated, and yet it must be obvious that the controlling influence of price upon sales is the all-important factor in fixing prices for electricity. . There is one important point to be recollected, for it is one not generally grasped in the discussion of prices, and that is: it is not always necessary to reduce the cost per unit of generating electricity to increase the sales and profit of the company.

The reason is this: If increased sales at a lower profit per unit result from lowered prices, this increased sale also reduces the investment or capital per unit sold, and so the same or greater profits or dividends may result from lowered prices, if the plant does not have to be appreciably enlarged for the greater sales.

Dividends are based upon the cost or capital of the plant, and furnished by the gross profits of the current sales. For the purpose of discovering the practical relation between the average price and the sales per capita of electricity, the report of the Board of Gas and Electric Light Commissioners of Massachusetts, June 30, 1908, may be employed:

ABSTRACT FROM REPORTS OF 1908 TO THE COMMISSIONERS OF GAS AND ELECTRIC LIGHTING OF MASSACHUSETTS.

	Name.	Kw-hours generated.	Per cent sold.	Kw-hours sold.	Population.	Kw-hour sold, per capita.	Income.	Average price per Kw-hour Cents.	Revenue per capita. Total Figures.	Check.	Profit per capita.
1	Boston { Edison Ill.	88,535,490	79.1	70,031,572	.....	.....	$4,229,239.02	....	.....	.....	.....
	Boston { Block Plant.	621,660	....	433,879	703,597	103.3	24,007.89	6.20	$6.39	$6.40	$3.08
	Boston { Consoli. Gas	3,071,478	71.5	2,196,007	.....	.....	255,257.24	....	.....	.....	.....
2	Worcester	5,400,192	79.	4,262,151	131,549	32.	332,375.16	7.86	2.51	2.51	1.23
3	Lowell	9,426,511	67.	5,315,762	110,786	57.	328,032.59	5.19	2.96	2.94	.97
4	Fall River	4,061,284	73.	2,964,737	105,762	28.	237,054.54	8.00	2.24	2.24	.64
5	Malden	4,647,545	64.	2,974,370	101,129	29.	260,236.62	8.89	2.57	2.57	.83
6	Cambridge	6,043,204	85.	5,136,723	97,434	52.7	297,238.51	5.79	3.05	3.05	1.34
7	Lawrence	4,363,416	70.9	3,093,662	89,972	34.4	221,554.08	7.16	2.46	2.46	1.07
8	Lynn	8,776,166	78.	6,845,409	89,358	77.	370,577.32	5.41	4.13	4.16	1.65
9	Springfield	16,230,797	59.	9,576,170	86,486	111.	465,082.35	4.86	5.38	5.39	2.45
10	New Bedford	1,747,178	81.6	1,425,697	79,777	18.	151,238.07	10.60	1.89	1.90	.95
11	Brockton	3,803,885	65.	2,472,425	57,484	43.	206,664.67	8.36	3.59	3.59	1.43
12	Newton & Watertown (Edison)	2,062,724	68.	1,402,652	48,085	29.	146,316.29	10.40	3.04	3.01	.32
13	Charlestown (Edison).	1,138,599	65.	740,089	39,983	19.	72,557.82	9.80	1.81	1.86	.55
14	Haverhill	4,408,965	78.	3,438,993	37,830	91.	155,206.94	4.51	4.10	4.10	1.18
15	Salem	4,462,550	88.	3,927,004	37,627	104.	188,316.43	4.80	5.00	4.99	1.75
16	Chelsea (Edison)	1,453,200	70.	1,004,640	37,289	27.	84,129.72	8.37	2.22	2.25	.88
17	Fitchburg	3,288,623	87.	2,861,102	33,021	87.	130,607.83	4.57	3.95	3.97	1.42

The published scale of prices (subject to discounts) of only 17 electric companies serving the largest cities in Massachusetts will only mislead. The average sales and prices are obtained as follows, and while not closely accurate in a technical sense, they are near enough for our commercial purposes: (Report Table 7, page CCXXXV.) From the total kw-hours generated are subtracted kw-hours generated for street lighting. The remainder, divided into kw-hours sold to consumers, gives the per cent efficiency of distribution for consumers, and is approximately the efficiency of the whole system with sufficient accuracy for commercial comparisons. The total kw-hours generated, multiplied by per cent efficiency of distribution, gives total kw-hours sold. This is rudely approximated in the abstract subjoined.

As each city differs from the others in population (census 1905) the kw-hours sold per capita is found by dividing the total kw-hours sold by the population. The average price per kw-hour sold is found by dividing the total income by the total kw-hours sold. The revenue per capita is found by dividing the total income by the population, and this is checked by multiplying the kw-hours sold per capita by the average price per kw-hour. The small variations found are of no consequence in the present research. The profit per capita is found similarly, and is given to assure against the use of unprofitable precedents. The sales per capita in kw-hours are the index of the working of the law of supply and demand at a given average price. It answers the question: What will the people buy at a given average price? The profits per capita tell what the electric company can realize at a given price. It tells how good an electric company's management is, just as the profit per acre tells how good a farmer is, or, at least, how his farm is cared for when compared with others of equal fertility. For this reason the results in Boston cannot be compared with those of the other cities in Massachusetts.

In so large a metropolis, the teeming multitudes and the irresistible tide of business activity would make it difficult to escape a sale of 100 kw-hours per capita, and Boston must be used only in comparison with other large metropolitan cities. By sheer good management it has been surpassed in kw-hours sales per capita both by Springfield and Salem. By reason of the relatively high price per kw-hour maintained, Boston's profits per capita ($3.08) are larger than the revenue per capita of any of the 17 cities, except Lynn, $4.16; Springfield, $5.39; Brockton, $3.59; Haverhill, $4.10; Salem, $4.99, and Fitchburg, $3.97. Boston's revenue per capita is $6.40, and its average price 6.2 cents per kw-hour.

Brockton, like Boston, because of its relative seniority and retention of high prices for electricity, must be excluded from comparison with the remaining 15 Massachusetts cities selected.

This leaves 15 cities, ranging from 33,000 to 132,000 population, for use in tracing the relation between price per kw-hour and sales per capita in kw-hours as graphically shown in Fig. 1. Fig. 2 shows the relation between collections per capita and price to be of a similar nature.

The profit per capita, shown in Fig. 2, is of interest, but, as the cost of the various managements per kw-hour enters in, is of no value save to prove the vagaries of managers, as against the relatively regular response of the mass of consumers to reductions in prices. It is interesting to note that both the revenue and profit per capita appear generally to increase with lowered prices.

	Name.	Price.	Per capita. Revenue.	Profits	Sales.
1	Springfield	4.86c.	$5.39	$2.45	111 kw-hr.
2	Salem	4.80c.	5.00	1.75	104 kw-hr.
3	Haverhill	4.51c.	4.10	1.18	91 kw-hr.
4	Fitchburg	4.57c.	3.97	1.42	87 kw-hr.
5	Lynn	5.41c.	4.16	1.65	77 kw-hr.
6	Lowell	5.19c.	2.94	0.97	57 kw-hr.
7	Cambridge	5.79c.	3.05	1.34	33 kw-hr.
	Totals	35.13c.	$28.61	$10.76	580 kw-hr.
	Averages	5.02c.	4.13	1.54	83 kw-hr.

The remaining eight cities in the abstract give the results shown on the next page.

The average practical results of the electric light companies' operations of 15 cities in Massachusetts are: At an average price of 5 cents per kw-hour the sales per capita (83 kw-hours) are three times the sales (27 kw-hours) at 8.9 cents per kw-hour. The profits per capita ($1.54) are nearly twice the profits ($0.81) at 8.9 cents per kw-hour. It does not necessarily follow because the sales are increased threefold that the investment in machinery and plant required be even doubled.

Name.	Price.	Per capita. Revenue.	Profit.	Sales.
1 Lawrence	7.10c.	$2.40	$1.07	34 kw-hr.
2 Worcester	7.80c.	2.51	1.23	32 kw-hr.
3 Newton	10.30c.	3.01	0.32	29 kw hr.
4 Malden	8.89c.	2.57	0.83	29 kw-hr.
5 Fall River	8.00c.	2.24	0.64	28 kw-hr.
6 Chelsea	8.37c.	2.25	0.88	27 kw-hr.
7 Charlestown	9.80c.	1.86	0.55	19 kw-hr.
8 New Bedford	10.60c.	1.90	0.95	18 kw-hr.
Totals	71.08c.	18.80	6.47	216 kw-hr.
Averages	8.89c.	2.35	0.81	27 kw-hr.

Marks' Empirical Law of Demand.

The law of increase of the sales per capita can be rudely approximated by the curve of an equilateral hyperbola giving conservative results.

Let s = the sales per capita in kw-hours.
" p = the average price per kw-hour in cents.

The equation is

$$s = (640 \div p) - 45.$$

If $p =$ 4 cents	$s =$ 115 kw-hours.	Difference for 1 cent.	
" $p =$ 5 "	$s =$ 83	"	— 32 kw-hours.
" $p =$ 6 "	$s =$ 62	"	— 21 "
" $p =$ 7 "	$s =$ 46	"	— 16 "
" $p =$ 8 "	$s =$ 35	"	— 11 "
" $p =$ 9 "	$s =$ 26	"	— 9 "
" $p =$ 10 "	$s =$ 19	"	— 7 "

Laying down this equilateral hyperbola on Fig. 1 it appears to average the practical results of 1908 very closely, giving a general empirical law of supply and demand for electricity in cities.

The interesting facts appear that while a reduction of from 10 to 9 cents produces an increase of 7 kw-hours per capita, a similar reduction of the average price from 5 to 4 cents produces an increase of 32 kw-hours per capita, or about 4½ times as much. At 10 cents per kw-hour the sales per capita are 19 kw-hours, and at 5 cents 83 kw-hours, or over four times as great. Present experience does not appear to have fixed any point of satiation for consumers or minimum profitable price for electricity.

Fig. 2 is not susceptible of geometric analysis, for into the collections and profits shown enter the aberrations due to the personal equations of the various managements of these electric companies. Fig. 2 is given to show this, as Fig. 1 shows sure response of consumers to the lowering of average prices.

In commercial affairs it is impossible in each case to predict results with scientific accuracy, but it does appear from the above to be quite possible in dealing with the demands of large populations to learn and predetermine the general trend of business results, as shown in Fig. 1. It is particularly of value to learn that the lowered average price of the first group of seven cities results in revenue and profits per capita increasing in a geometric ratio far more rapidly than the reduction of price per kw-hour made from the average of the second group of eight cities, and that this appears to be irrespective of the population of these cities between the limits of population selected.

This is a new law of supply and demand which should be the controlling factor in the careful deliberations of commissions, courts or officials charged with the extremely serious responsibilities of fixing prices for electricity (or gas) furnished by public utilities. The question of cost and profit upon electricity is one that should be treated separately and subsequently to the question of price and sales per capita. Geographic and climatic differences, relative wealth per capita and characteristic industries will largely influence the resulting sales of electricity outside of Massachusetts cities used in this case, but the underlying law of increase remains the same in all places and allowance can be made for differing conditions.

The matter of the time of beginning operations has given to the older companies a very decided advantage in sales per capita. A certain length of time is obviously required for the consumers of electricity to adapt their dwellings and commercial buildings to the use of electricity, but the rapid growth of cities and buildings is daily rendering this factor of less importance. The important thing proved by the Massachusetts records as classified, giving Marks' empirical law of demand, is that the public's unceasing struggle for lower price for electricity is not unreasonable or inconsiderate, but, on the contrary, of advantage and profitable to electric generating companies when wisely met, as well as to consumers, who demand it. One of the principal reasons why public-utility companies have in some instances objected to lower rates is their overcapitalization and the resulting attempt to make watered securities dividend paying, although this has been rarely the case in Massachusetts because of the supervision of the Board of Gas and Electric Light Commissioners over the public utilities.

MARKS' SLIDING SCALE FOR 16-CP, 50-WATT LAMPS.

Hours of daily use.	Price per kw-hour.	Gross daily earnings.	Remarks.
1	25.0c.	$0.0125	A minimum rate of 1¾ cents per 16-cp lamp per day required from each installation.
2	13.8c.	.0138	
3	10.2c.	.0153	
4	8.4c.	.0168	
5	7.2c.	.0180	For power 15 cents per horse-power per day for minimum rate.
6	6.4c.	.0192	
7	5.8c.	.0203	Average daily hours are computed from four weeks' (28 days) run.
8	5.4c.	.0216	
9	5.2c.	.0234	
10	5.0c.	.0250	
11	4.8c.	.0264	
12	4.6c.	.0276	Over 12 hours rate 4.5 cents.
78		.2399	Small motors 7½ per hp-hour.
3.9 kw-hr.	6.15c.	.2398	Over 1000 hp-hours per month 5 cents.
Average 6.5 hours for 12 lamps.			Very large power special rates.

The above table was computed for carbon-filament incandescent lamps using 3.1 watts per candle-power. It will require recomputation for the recently introduced incandescent lamps requiring less power, such as, roughly: metallized filament, 2.5 watts per candle-power; tantalum filament, 2.2 watts per candle-power; tungsten filament, 1.5 watts per candle-power. For different energy cost it requires recomputation also.

With newer lamps, while the structural cost of station per kw-rating will not vary, it will be reduced per lamp, as will the fixed expenses also. Could it be convincingly shown that increased demand is sure to follow reduced prices, the eight companies in the second Massachusetts group of cities should of their own volition inaugurate a systematic reduction of rates for the purpose of obtaining the larger revenues and profits per capita of the first group of seven cities.

The sliding scale already given is an attempt to divide equitably the operating expense and profit of an electric company among its consumers.

Marks' Sliding Scale for Electricity.

During his nine years' service as engineer and president of the Edison Electric Light Company, of Philadelphia, and subsequently in other cases, the writer used a scale for fixing prices based on the following data:

Structural cost per kw-rating	$300.00
Profit and depreciation 14 per cent per kw	42.00
Fixed expenses per 16-cp lamp per year	1.40
Fixed expenses per kw-rating per year	28.00
Lamps installed per kw (80 per cent of 20)	16.00
Cost of energy in raw material and productive labor per kw-hour.	0.028

The cost of energy is derived from a non-condensing, steam-driven station and is too small for minor stations.

Probable Gross Earnings.

It is the function of this sliding scale to fix the price per kw-hour yielding 14 per cent profit and depreciation, and this sliding scale should be carefully computed for each case using its particular data as to costs of structure and operation so as to know the daily and yearly hours' use required for each price per kw-hour. Particular heed must be given to the peak station load as compared with the total attached load when computing the constant expense per kw-hour. From the empirical law of demand, it will then be possible to predetermine the probable sales per capita for each price, and, therefore, the gross earnings from the entire population served.

Comparing the law of demand and the sliding scale, the following data may be derived from the smaller stations of the past:

Average price per kw-hour.	Sales per capita.	Daily approximate hours' use.
5 cents	83 kw-hour	10
6 cents	62 kw-hour	6½
7 cents	46 kw-hour	5½
8 cents	35 kw-hour	4¼
9 cents	26 kw-hour	3¼
10 cents	19 kw-hour	3
11 cents	13 kw-hour	2¾

Showing that, other things being equal, the station obtaining the longest hours' use for electricity from its consumers can sell energy cheapest and obtain the largest revenue and profit per capita while retaining a constant profit on its plant.

Similarly computed sliding scales can be evolved for differing lamps, but the above will suffice for the present.

RECENT RESULTS—1908.

Let C = cash valuation of plant or capital, as preferred.
N = kilowatt rating, year 1908.
$(a+d)$ = per cent required to cover profit and depreciation.
n = annual hours' use of electricity.
f = fixed expenses per kw-hour sold.
v = variable cost of energy per kw-hour sold.
p = price of energy per kw-hour.

then,
$$p\,n - f\,n - v\,n = \frac{(a+d)}{100}\,\frac{N}{C}$$

$$n = \frac{(a+d)}{100\,(p-([f+v])}\,\frac{C}{N}$$

For an average steam, non-condensing station having a rating less than 1000 hp,

Let $(a+d) = 14$ per cent.
$\frac{C}{N} = 375.$
$f = 3.8$ cents.
$v = 2.8$ "
$p = 13.8$ "
$n = 730$ hours per annum (2 hours per diem).

These figures are the basis of the sliding scale given. Comparing them with Springfield's figures,

$$\frac{C}{N} = \frac{\$1{,}224{,}400 \text{ (capital)}}{11{,}515 \text{ (kw)}} = \$108.06 \text{ per rated kilowatt.}$$

$(f+v) = 2.64$ cents.
$p = 4.86$ "

$$(a+d) = \frac{\$212{,}210.78}{\$1{,}224{,}400} = 17.6 \text{ per cent.}$$

Average $n = 857$ hours per annum (2.4 hours per diem).

Considering Worcester:

$$\frac{C}{N} = \frac{\$800{,}000}{4960 \text{ kw}} = \$161.29 \text{ capital per rated kilowatt.}$$

$(f+v) = 4.03$ cents.
$p = 7.86$ "

$$(a+d) = \frac{\$162{,}478.87}{\$800{,}000} = 20.31 \text{ per cent.}$$

Average $n = \frac{3274}{3.83}$
$= 855$ hours per annum (2.4 hours per diem).

The full generating ability of these works perhaps is not reached at any time and so the average daily use of electricity at the peak of the station load (the maximum of the attached load on the distribution system) averages more than 2.4 hours daily.

The reduction of price with profit in the case of Springfield apparently arises from the reduction of capital investment per kilowatt rating reached by applying profits to increase of equipment without increase of capital stock, or from premiums on new stock sales as well as from the reduced manufacturing and distributing cost per kw-hour.

The vagaries of bookkeeping render the use of the book assets dangerous and so the capital (checked by tax value) is perhaps the safer basis of computation, unless an inventory can be obtained giving the original structural cost less depreciation (excluding appreciation of land), or, if preferred, the actual or reduplication structural value of plant.

From what has been shown it is apparent that a low profitable price per kw-hour for electricity requires: (1) A low manufacturing and distributing cost per kw-hour; (2) a low capitalization per kilowatt rating; (3) long hours of daily use of electricity.

Marks' Dividing Scale for Non-Competitive Rates.

This dividing scale is a completion of the incomplete theory of the London sliding scale for gas, which fails to divide surplus profits equally between producer and consumer when the reduced price departs a little from the standard price fixed. In its perfected form this dividing scale is applicable to any non-competitive specialty business, selling gas by the 1000 cu. ft., water by the gallon or 1000 cu. ft., electricity by the kw-hour, freight by the ton-mile, travel by the passenger-mile, etc. Its theory has been explained at great length and need not here be repeated.

The object of the use of the London sliding scale for gas in England is to induce lower prices from monopolies by permitting increased divisible profits for the producer with reduced prices to the consumer, and thus to offer an inducement to energy and economy of management ordinarily supplied by competition in general business matters. Its practical success has been marvelously satisfactory to both producer and consumer of gas, but the empirical London sliding scale is insufficient in range, and so progress has been limited by it.

The completed rational and practical theory of the dividing scale for non-competitive rates does not present this difficulty, its range and applicability being unlimited. The operation of the dividing scale must be based upon the average price reached per kw-hour for electricity and the producer should be left free to apply the sliding scale of prices within reasonable limits to individual consumers.

Let C = the total valuation of company or plant in cents.
S = the total annual sales in kw-hours.
p = the standard average price of electricity per kw-hour in cents.
c = the average annuual cost of electricity per kw-hour in cents.
a = the standard dividend upon dividing scale stock.

The first or starting equation of condition agreed upon is

$$\frac{a}{100} \times \frac{C}{S} \quad p - c$$

Let r = the reduction in average price per kw-hour in cents.
x = the increment of standard dividends required to divide equally, the saving in cost of gas, or in the reduction of investment per kw-hour sold.

Let B = cost in cents demanded by extension required.
Z = increase of total sales in kw-hours.

$$\frac{C+B}{S+Z} \quad \frac{a+rx}{100} \quad p - c - r$$

If now the increase of dividend is made equal to the reduction of average price to the consumer,

$$r = \frac{C+B}{S+Z}\,\frac{rx}{100}$$

Hence

$$x = \frac{100\ (S+Z)}{C+B}$$

Since $\frac{C+B}{S+Z}$ is the investment or capital or whatever valuation is agreed per kw-hour sold for each regimen reached, m may be substituted for it and $x = \frac{100}{m}$ the increment of dividend for each 1-cent reduction in price.

Substituting in the general equation

$$r = \frac{p - c - \frac{m \cdot a}{100}}{2}$$

In new plants of the highest perfection the average total cast per kw-rating appears to be $375, and the hours of lighting to average:

For incandescent lamps only	1,000 hours per year
For arc lamps, streets	4,000 hours per year
For mixed city lamps and motors	850 hours per year
For motors regularly used	3,000 hours per year

The actual investment per kw-hour delivered can in most cases be taken as follows:

For incandescent lamps	53½ cents per kw-hour
For arc lamps	9.4 cents per kw-hour
For mixed city service	44.1 cents per kw-hour
For all-day motor service	12.5 cents per kw-hour

As only rude approximations are dealt with, 45 cents per kw-hour may be assumed for an example.

$m = 45$ cents per kw-hour sold.

$p = 7\frac{1}{2}$ cents per kw-hour standard average price.

$c = 3$ cents per kw-hour.

$a = 7$ per cent dividend standard.

$$x = \frac{100}{m} = \frac{100}{45} = 2.2 \text{ per cent.}$$

$$r = \frac{7.5 - 3 - \frac{7}{\frac{100}{45}}}{2} = \frac{1.35}{2} = 0.67 \text{ cent}$$

Reduced price $= 7.50 - 0.67 = 6.83$ cents average.

Increased dividend $7 + \frac{2}{3}$ of $2.2 = 7 + 1.48 = 8.48$ per cent.

This would indicate that with a general service city station it would be fair, on an adequate capitalization, to allow an increase of something over 2 per cent dividend for each 1-cent average reduction in price per kw-hour.

It was shown that Springfield averages a price of 4.86 cents per kw-hour with a profit on capital per kw-hour (13 cents) of 17 per cent and a cost of 2.64 cents per kw-hour sold. The difference between 13 cents and 45 cents capital cost per kw-hour sold may be due to lack of symmetrical proportions of plant, or to specially low prices for parts of plant, or to an intentional reduction of capital below the fair value of plant, which is not unusual in Massachusetts. It does not appear probable that this plant's original structural cost was $108 per kilowatt rating or that it could be reduplicated for such a low figure if it did cost that.

The investment per kw-hour sold yearly can be varied enormously from below 9 cents to 53 cents or more, as shown above, and so any application of the dividing scale to electric works is vastly more intricate than it is in the case of gas works, which are usually operated with comparatively little variation of regimen throughout the year.

Influential electrical associations have indiscreetly made vague favorable reports upon the application of the London sliding scale in a modified form, to prices and dividends for electric companies, it therefore has been necessary to examine quantitatively into the practical working of electric generating companies at so great length as to forestall imprudent action on the part of managers.

Any attempt to adapt the London sliding scale for gas to electricity, or to apply any similarly constructed dividing scale to it, will require an exhaustive investigation of the special character of the electric works concerned, and the utmost care in the adjustment of the standard price and the standard dividend and its increment to the total annual hours of use of the electric load.

There are also special cases of the transmission of electrical energy throughout the 24 hours of and for every day in the year which are of interest only to the few contracting parties. Each of these cases should have a special study as a matter of large importance.

INTERIOR WIRING AND ILLUMINATION

Show-Window Lighting for the Small Merchant.

Particular attention is paid to the lighting of the show windows of small retail dealers in Chicago by the Commonwealth Edison Company, of that city. A special proposition is made to merchants of this class. The wiring for show windows is installed complete with lamps and individual reflectors at the rate of $1 a lamp, to which 10 cents must be added for the city inspection fee for each lamp, with minimum fee of $1. The customer guarantees a minimum consumption of electricity amounting to 25 cents a lamp per month, and enters into contract for one year. In addition the central-station company paints a strip across the window, concealing the line of lamps, which may be suspended on an iron bar perhaps 3 ft. or 4 ft. below the level of the top of the window and close to the glass. This strip must not exceed 10 in. in width, under this arrangement, and on it the Commonwealth Edison Company letters the name of the merchant and of his business, as "John Smith, Groceries." Thus the strip not only serves to conceal the lamps, but it is also a sign advertising the customer's business. The customer can use any kind of incandescent lamp he wishes, so long as the guarantee as to energy consumption is fulfilled. The lamps are usually spaced 1 ft. apart on the bar holding them in the case of ordinary 16-cp lamps. If tungsten lamps are used the spacing is naturally wider. Should the customer desire to use trough lighting, the installation charge is figured at the rate of $1.50 a lamp.

Shoe-Store Window Lighting.

Shoe merchants require a comparatively large amount of light in their display windows, owing to the nature of the goods exhibited. The accompanying illustration shows a particularly attractive shoe-store front on State Street, Chicago, where the fronts and sides of the two show windows are simply large panes of plate glass fastened at the corners. The goods are lighted from above by three rows of tungsten lamps with prismatic glass reflectors. Each window is provided with 24 of



SHOE-STORE WINDOW LIGHTING.

these lamps, which are of the 40-watt size, and suspended on bars attached to the ceiling of the window by chains. Hangings are provided at the tops and sides of the windows to conceal the lamps. A prominent electric sign above the windows further serves to call attention to the store at night. The whole display is one well calculated to arrest the attention of any one in the vicinity.

Roller Coaster Illumination by Flaming Arcs.

At the southern end of the White City Amusement Park in Chicago there is a large roller coaster known as the "racing coaster," which is lighted by an installation of flaming-arc lamps that possesses some features of interest. The area covered by this amusement device is reported to be 900 ft. long and 100 ft. wide, or 90,000 sq. ft. The roller coaster is illuminated in all its parts very brilliantly by 20 flaming-arc lamps. These lamps are suspended from posts at a height of 70 ft. from the ground in the manner shown in the accompanying illustration.

The lamps are lowered to a platform beneath for trimming. It was originally intended to outline the coaster in 16-cp incandescent lamps, and if this had been done 3000 lamps would have been needed, or a total of 48,000 cp. The candle-power of the present equipment is calculated to be 44,000, showing a saving for the arc lamps of 4000 cp. The consumption of energy for the 20 arc lamps is reported to be but 11 kw per hour compared with 165 kw per hour for carbon incandescent lamps. The saving in copper is said to have been 30 per cent, while it is asserted that the general illumination is about 50 per cent better with the arc lamps on posts than would have been the case had the structure been outlined in incandescent lamps. The whole area is illuminated with almost daylight intensity, and



ROLLER COASTER ILLUMINATION BY FLAMING ARCS AT WHITE CITY AMUSEMENT PARK, CHICAGO.

this illumination serves a double purpose, for it not only makes the roller coaster conspicuous and thus have an advertising value, but it also makes the attraction brighter and more attractive to the public. There are five of the 70-ft. poles, and there are four lamps to a pole.

Large Animated Signs in New York City.

Every central-station manager has envied New York its huge electric signs, and, what with increasing numbers, it has become necessary for the advertising concerns who make a specialty of this business to introduce novelties from time to time; otherwise the advertising merit of the signs is not what it should be. At the present time there are being operated in New York two large signs of more than passing interest. One is located at Times Square and the other at the head of Long Acre Square, and both are in the heart of the hotel and theater district, where it is estimated 300,000 to 400,000 persons pass every 24 hours. The signs are thus viewed by the most cosmopolitan audience that is brought together in any city of the world.

The sign at the southwest corner of Seventh Avenue and Forty-second Street is shown in Fig. 1. It is 50 ft. high and 56 ft. wide, and is designed with six colors and 3000 lamps. The lady herself is 40 ft. high and her parasol is 15 ft. in diameter. The sign is particularly appropriate for the situation—Times Square being one of the windiest spots in the city—and has attracted more attention perhaps than any electrical display ever put up in New York. The falling of the rain and the switching about of the lady's skirt, all of which are produced by



FIG. 1.—ELECTRIC SIGN AT TIMES SQUARE, NEW YORK.

electrical devices, are very realistic indeed. Incidentally, the view also shows billboards lighted by means of high-powered



FIG. 2.—ELECTRIC SIGN ON LONG ACRE SQUARE, NEW YORK.

tungsten lamps instead of arc lamps which have been used for this purpose heretofore. The lamps are suspended from above and are enclosed in reflectors, which are visible in the engraving.

Fig. 2 is a view of the sign located at the apex formed by the intersection of Broadway and Seventh Avenue at Forty-seventh Street. The sign is 60 ft. high by 50 ft. wide. The letters "C and C" are each 12 ft. high by 15 ft. wide. The bottle is 35 ft. long and the rays denoting its effervescence shoot 43 ft. into the air. The mechanism of the sign causes it to make three distinct flashes. The first shows simply the bottle and the lettering; the second shows the effect of the cork being "popped" and the contents of the bottle shooting into the air; the third shows the liberated liquid foaming down the neck of the bottle. The lower portion of the sign is a painted bulletin 15 ft. high by 45 ft. long, so that it makes an effective advertisement by day as well as by night. There are over 3000 lamps in the sign.

Dry-Goods Store Window Lighting.

Effective lighting of the large show windows of the State Street dry-goods store of Charles A. Stevens & Brothers, of Chicago, is accomplished very efficiently by 100-watt tungsten lamps placed within individual helmet reflectors. There are two windows, each 28 ft. long, 8 ft. deep and 17 ft. 4 in. high. Each window is provided with 14 lamps placed as close to the ceiling as practicable and close to the glass of the window. The reflectors are not seen from the outside, as the upper part of the window is concealed by curtains. In the illustration given herewith the lamps which are apparently seen are reflections from the actual lamps from the glass partitions in the back of the window. Electricity is purchased from the Commonwealth

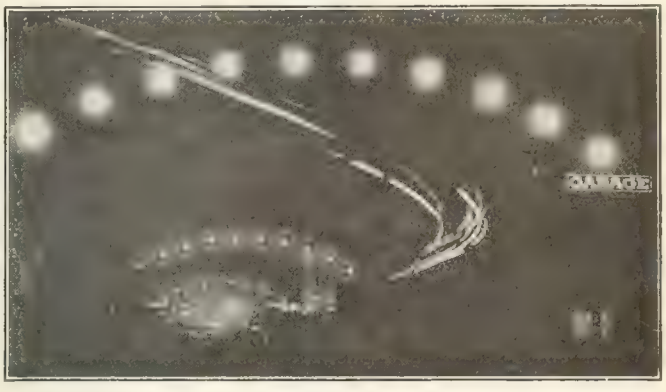


DRY GOODS STORE WINDOW LIGHTING.

Edison Company. Although the lamps are placed very high, the light is thrown where wanted and confined to the window by the reflectors, and the illumination is of very satisfactory character, pleasing to the owner and attractive to passersby, for the goods displayed are clearly and well lighted without the source of light being obtrusive. For effective bringing out of the goods on display the illumination is not surpassed by that of any show window on the street, while the watts per lineal foot of window is only 50, which is considerably less than is used in some neighboring windows where tungsten lamps are used without precautions for confining the light to the window and concealing the sources of light from the eye.

Special Illumination at Fort Wayne, Ind.

Following the example of Grand Rapids, Mich., and some other cities a number of merchants in Fort Wayne, Ind., have caused the erection of a special system of street lighting by arches spanning the street, as shown in the illustration, which represents a portion of Columbia Street in Fort Wayne at night. There are two blocks of this arch street lighting on Columbia Street, one on Calhoun Street and one on West Main Street. The installation consists of four arches to the block with 10 100-watt tungsten lamps on each arch. These lamps are operated in multiple on 110-volt lighting circuits. The arch is made of conduit with outlets spaced at regular intervals for the 10 lamps on each arch. This conduit is supported by galvanized-iron strands attached to buildings on each side of

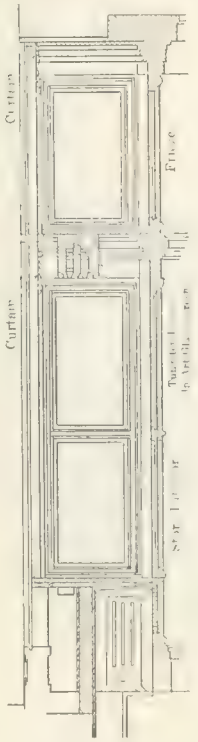


SPECIAL STREET ILLUMINATION, COLUMBIA STREET, FORT WAYNE, IND.

the street. The feeders for the arches are also placed in conduits and are run along the face of the buildings from an alley in the center of the block; if there is no alley, the feeders are run from one end of the block, connected, of course, to a transformer placed in one of these locations. The installation was made by the municipal electric light plant of Fort Wayne, and electricity is furnished by the same plant. It is understood that the merchants pay $500 per street block for the first year for the installation and maintenance of this lighting. After the first year the price is to be $300 per year for the same service, but the entire equipment is to remain the property of the city.

Show Window Lighting at Chicago.

Seven large show windows are a conspicuous feature of the Electric Shop of the Commonwealth Edison Company, corner of Michigan Avenue and Jackson Boulevard, Chicago. In these windows are displayed many beautiful electric table lamps and shades, as well as numerous electric cooking and heating devices and other objects of utility. The plan of lighting adopted for night illumination is rather out of the ordinary, but can be understood by an examination of the accompanying drawing, representing a window in cross-section. Depending from the roof of the window is a handsome screen or trough of art-glass about 12 in. deep and 12 in. wide. Within this enclosure, which is open, of course, at the bottom, are placed 10 60-watt tungsten lamps for each window in a line running the length of the window. These lamps have prismatic glass shades and are hidden from view by the screens on each side of them and at the ends. The screens are not visible from the outside, as a rich silken hanging is provided for the upper part of the window. In the floor of the window four flush receptacles are provided so that lamps or other electrical devices on display may be connected to a source of electricity and shown in operation. Above the window proper is a space with silk hangings on the street side and a beautiful frieze of art-glass on the inside. In this space tungsten lamps are placed



CROSS-SECTION OF SHOW WINDOW.

horizontally in reflectors, the light being diffused through the frieze, which is of handsome coloring, producing a fine effect on the inside of the store.

Window Lighting in New York.

Electric store-window lighting is fast becoming an unassailable stronghold in New York, as evidenced by the hundreds of brightly lighted display windows in the business districts of the city.

This illumination may be divided into two main classes, according to the purpose that they are chiefly intended to serve: first, that in which the object is to display the goods, and, secondly, that in which the object is to draw the attention of those passing at a distance from the window. It will be noticed that in well-lighted stores, even where a great display of light is made outside by the aid of luminous or flaming-arc lamps, that in addition the store window itself is taken care of by independent concealed lamps, generally placed at the borders or tops of the windows, full advantage being taken of reflecting mirror and other patent systems, such as "Linolite."

Tungsten lamps are being rapidly adopted for window lighting, and have met with universal satisfaction. As an example of this, the show windows of A. Powell & Company's store, 827 and 829 Broadway, are notable. The width of the store is 45 ft.; in one window there are three 250-watt tungsten units on the ceiling, and the other window has two 250-watt tungsten units. The upper trimmings of the windows are white, to furnish a contrasting color to the goods. The installation, including the store lighting, has proved highly satisfactory to the owners.

Another notable window lighting installation is that of the New York Edison Company's office at 124 West Forty-second Street. The front windows have been equipped with tungsten lamps, and the illumination is greater in amount than any ever before obtained in show-window lighting. The ceiling above the two windows and the entrance has been studded with a total of 80 100-watt tungsten lamps. Each lamp is equipped with a prismatic reflector which concentrates the light directly beneath it, thereby securing 650 downward candle-power from each 80-cp lamp. The total downward candle-power in each window is in excess of 25,000, and the illumination at the bottom of each window is 100 candle-feet, as shown by a recent illuminometer test. When it is remembered that one to two candle-feet is a very satisfactory illumination for ordinary reading, and that 10 candle-feet is probably the maximum illumination ever required, even where the most exacting work is carried on, such as etching and draughting, the figures given above will convey some idea of the intensity of the illumination in these windows.



FIG. 3.—CLOTHING STORE FRONT



FIG. 1.—TUNGSTEN WINDOW LIGHTING IN CLOTHING STORE AND HABERDASHERY.



FIG. 2.—WINDOW OF EDISON COMPANY'S OFFICE.



FIG. 4.—DRUG STORE WINDOW LIGHTING.

Outside of the quantity and quality of the light from this tungsten installation, the lighting is particularly effective on account of the fact that the sources of light are completely concealed from the eyes of the passerby. This is a very necessary condition, so far as the effective displaying of goods in a show window is concerned; for if bare lamps of high intrinsic brilliancy are placed in the field of vision the ability of the eye to discern any neighboring objects is materially lessened. That this fact is not generally recognized is very evident from an examination of the methods employed in lighting the average show window.



FIG. 5.—SIGN AND WINDOW LIGHTING IN TAILOR SHOP.

The accompanying illustrations show several examples of excellent window lighting. It may be of interest to remark upon the cost which is incurred in order to secure the results in the Edison office. At the highest rate for energy charged by the New York Edison Company, the cost of burning this installation for one hour, including the cost of renewing the tungsten lamps, is approximately $1; at the wholesale rate, this hourly cost would be reduced by nearly one-half. It must be remembered that this window is probably the most brilliantly lighted one in the world, and that an installation costing a small fraction of the above amount would, in the majority of cases, be sufficient to accomplish results.

This form of advertising reaching such a large number of people is carried on at comparatively low cost. No other method of advertising can be made as effective as where goods are displayed under such an illumination as that described, before the eyes of the thousands who traverse the prominent streets of a large city by night.

LETTER TO THE EDITORS.

Low vs. High Candle-Power Tungsten Lamps.

To the Editors of Electrical World:

SIRS:—The tungsten lamp has provoked much discussion, especially in relation to its effect on central-station revenue. One of the most important factors in this connection appears, however, to have been overlooked, namely, the relative list of lamps of different candle-powers.

The cost of manufacturing the 25-watt lamps is about as great as that of the 40-watt and 60-watt sizes, the cost of the two latter being about the same. If the prices of the lamps had been made nearly equal, the cost price of the 25-watt size being put at, say, $1, the 40-watt at $1.05 and the 60-watt at $1.10, no doubt many consumers who now use the 25-watt size would have used the larger sizes, to the great advantage of the central station as well as to the manufacturer.

In Europe the 40-watt and 60-watt sizes are sold at the same price, and some German manufacturers up to within a short time charged more for the 25-watt size in large lots than for the lamps of higher candle-power. This has encouraged the sale of the larger sizes to everybody's advantage, including the consumer, for he is getting more light than formerly with no increased cost.

If the three sizes were sold at a uniform price, the large-size lamps would, no doubt, sell in largest numbers, and the public would get accustomed to larger units, thus naturally increasing central-station revenue. If, instead of raising the price of the 25-watt size to that of the 40-watt, the price were reduced on the 40-watt and 60-watt sizes to that of the 25-watt, the effect on the lighting industry would unquestionably be very material and advantageous.

NEW YORK. LOUIS J. AUERBACHER.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Turbo-Dynamos.—An account of the joint discussion which followed the three papers of Groddeck, Rosenberg and Ziehl, all of which have been noticed in the Digest. Czeija referred to the use of radial ventilating slits by the British Westinghouse Company. He thinks that the use of ventilating channels which are perpendicular to the plane of lamination is more effective for carrying the heat off; in this way the troublesome noise is also reduced. As to the regulation of the voltage of alternators, he referred to a method using a principle of Blondel. A transformed current proportional to the current of the generator is supplied to the armature of the exciter, which runs in synchronism with the generator. This current reacts on the field of the exciter in such a way that an exciting current can be taken from the commutator suitable for the theoretically exact maintenance of constant voltage at the terminals, independent of the strength and the phase of the generator current. The Siemens-Schuckert Company has used this compounding method with good success in such cases in which there is a rapid variation of load and phase difference, as, for instance, for traction purposes. Charlet, Epstein and Schueler did not think that the entirely compensated machine is so much superior to the interpole machine, as claimed by Ziehl's paper, but Ziehl maintained that the entirely compensated machine is the intrinsically superior type and summed up the reasons for his opinion.—*Elek. Zeit.*, Aug. 12.

Commutation.—RÜDENBERG.—An illustrated translation in abstract of his recent German paper on commutation for dynamo-electric machinery. As noted before, the article is an advance on the usual theories of commutation in so far as it considers the important part played by the paths in parallel with the armature coils as they leave short-circuits. A criterion is deduced which shows the conditions under which these shunt circuits may prevent a serious rise of pressure or dangerous current density at the leaving brush tip, and at the same time the excellent influence exerted by the equalizing connections during short-circuit is emphasized.—Lond. *Electrician*, Aug. 13.

Heating of Magnet Coils.—G. T. WILLIAMS.—An account of an experimental investigation in which the author separates the heat losses experimentally. He finds that about one-half is dissipated by convection, the remainder being removed by radiation and conduction. One-half of that removed by convection is accounted for by the fanning action of the armature. —Lond. *Electrician*, Aug. 13.

Lamps and Lighting.

Incandescent Lamps.—A. C. JOLLEY.—An account of an investigation of various types of incandescent lamps. The fol-

lowing four types were tested: 16-cp, 100-volt carbon lamp; 55-watt, 100-volt osram lamp; 100-volt tantalum lamp and 16-cp graphitized carbon lamp. The horizontal candle-power, power consumption and resistance of each lamp were determined and plotted against the voltage in Figs. 1 to 4. By plotting

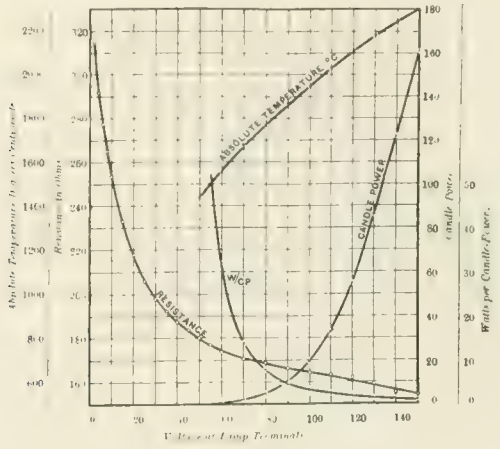


FIG. 1.—CARBON LAMP.

logarithmic curves the law for the variation of candle-power with voltage V has been found in each case. For the carbon lamps it is:

$$cp = 3.2V^{5.4} \times 10^{-10} \text{ for values above 85 volts,}$$

and

$$cp = 1.26V^{7.2} \times 10^{-12} \text{ for values below 85 volts.}$$

In the case of the graphitized carbon filament it is:

$$cp = 1.91V^{4.45} \times 10^{-8} \text{ for values above 95 volts,}$$

and

$$cp = 1.66V^{5.5} \times 10^{-10} \text{ for values below 95 volts.}$$

For the purely metallic filaments there is no break in the law, which for tantalum lamps is $cp = 1.59V^{4.00} \times 10^{-7}$, and for the osram (tungsten filament $cp = 4.79V^{3.60} \times 10^{-7}$. The author then refers to filament temperatures and discusses the application of the radiation laws. Reference is made to Nernst's value, 2092 deg. C. absolute, for the temperature at which a black body emits 1 hefner per square millimeter, and which he proposes as a definition of the unit of light. The temperature of the crater of the open arc is estimated as 3630 deg. C. The article is to be continued.—Lond. *Electrician*, Aug. 13.

Metallic-Filament Lamp.—A note on a recent British patent of S. Marietti (14,483, 1908; July 29, 1909) for fusing of metallic filaments to supports. The end of the support or leading-in wire is flattened out and bent into tubular shape, and the filament is passed through this portion, which is bent at right

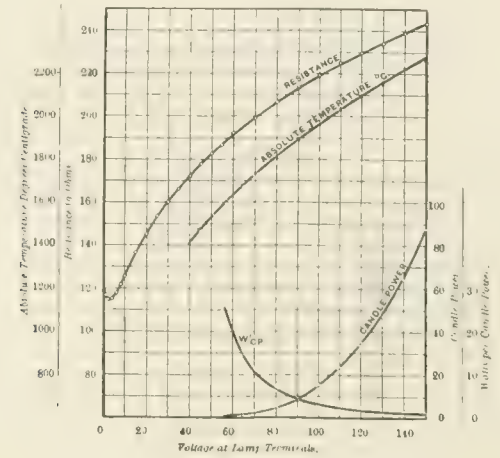


FIG. 2.—METALLIC-FILAMENT LAMP.

angles to the wire. An arc is struck from the tubular end of the support to an electrode and the whole fused together, while a current of air is directed onto the joint and away from the filament to prevent the hot gases from oxidizing the latter. The tubular formation protects the filament from oxidation, insuring a highly conductive joint and the use of air current renders it unnecessary to carry out the fusing operation in a chamber filled with an inert gas.—Lond. *Elec. Eng'ing*, Aug. 5.

Metallic Filament.—A note on two recent British patents of C. Trenzen and F. R. Pope (14,852 and 14,853, 1908; Aug. 5,

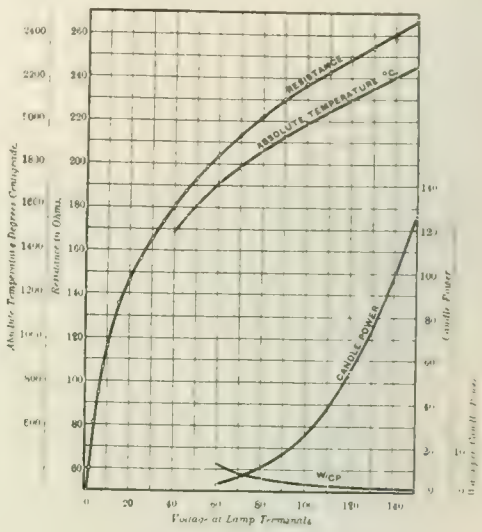


FIG. 3.—TANTALUM LAMP.

1909). The first specification relates to a process of manufacturing filaments of titanium by mixing the mixture of titanium and titanium nitride obtained by treating titanic acid with ammonia with a binding agent containing carbon. On heating filaments squirted from this mixture, the carbon combines with the nitride to form titanium cyanide, which evaporates, leaving a pure titanium filament. In the second specification, a process in which a non-carbonaceous aqueous solution of a tungsten-ammonium salt is squirted into a water-absorbing liquid, as alcohol, is described. Stopping up the dies is said to be obviated as the filament is coagulated after the mass has been passed through.—Lond. *Elec. Eng'ing*, Aug. 12.

Arc Lighting.—L. Bloch.—The conclusion of his paper read before the Berlin Electrical Society on recent progress in street lighting. In the concluding instalment, the author refers to the great favor which the flame-arc lamps with "Alba carbons" (recently also called "T. B. carbons") have found in Germany. They belong to the class of "effective arc" carbons impregnated with salts. The special feature is a thick impregnated core, consisting mainly of the illuminating salts, within a thin surrounding cylinder of pure carbon. The carbons are placed vertically one above the other. The arc is comparatively long be-

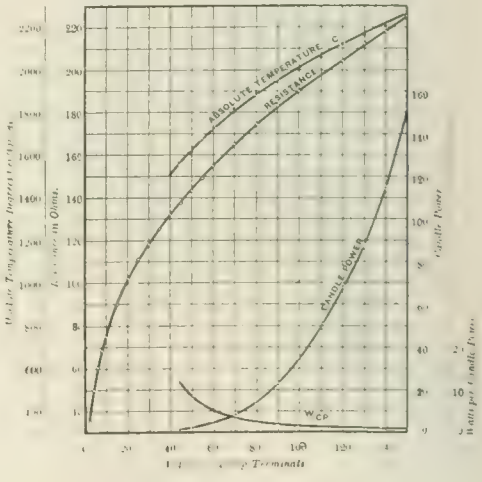


FIG. 4.—OSRAM LAMP.

cause almost the complete light comes from the arc itself and not from the incandescent ends of the carbons. The construction of the Allgemeine Elektricitäts-Gesellschaft flame-arc lamp, with Alba carbons, with and without globe, is shown in Fig. 5. The lamp gives an almost pure white light in comparison

with which the light of ordinary arc lamps looks pale and blue. The light is at least as quiet as that of "intensive flame-arc lamps." Fig 6 gives comparative curves of direct-current arc lamps for 15 amp and 825 watts, all with an opal glass globe. Curve *A* refers to the flame arc lamp with Alba car-

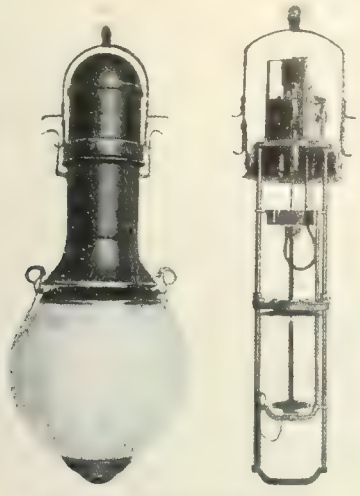


FIG. 5.—FLAMING-ARC LAMP.

bons, Curve *B* to intensive flame-arc lamps with "effective arc" carbons, and Curve *C* to the ordinary arc lamp with pure carbons. The curves give the distribution of light in hefner candles. Finally, the efficiency of Alba carbons is still somewhat higher than that of effective arc carbons in intensive flame-arc lamps. The former consume 0.14 watt to 0.15 watt, the latter 0.16 watt to 0.18 watt per hefner candle of lower hemispherical candle-power, neglecting the loss in the series re-

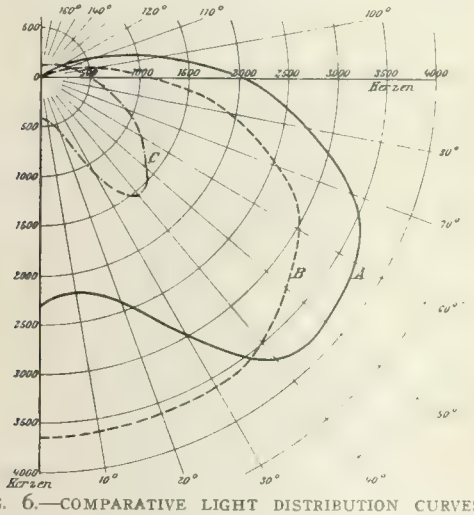


FIG. 6.—COMPARATIVE LIGHT DISTRIBUTION CURVES.

sistance and in the globes. Flame-arc lamps with Alba carbons are about three times as effective as ordinary arc lamps with pure carbons. The efficiency of Alba carbon lamps is also high for currents as low as 6 amp. These lamps are also applicable for low arc voltages, so that three lamps may be connected in series at 110 volts and six lamps at 220 volts. The Alba arc lamp is, therefore, useful for street lamps of strong, medium or low intensity and is quite economical in any case. It needs attendance, but the attendance is less than with intensive flame-arc lamps. "It seems that the flame-arc lamp with Alba carbons will soon become of considerable importance, especially for alternating-current networks. In this case it offers a solution of the difficulties found heretofore in the use of effective arc carbons, with full utilization of the higher efficiency." The author then gives some data on street lighting in Berlin with flame-arc lamps with Alba carbons, and concludes that under ordinary conditions electric lighting with flame-arc lamps with Alba carbons or with intensive flame-arc lamps is more economical than lighting with inverted gas lamps. Finally, it is pointed out that the possible control of electric lamps from a distance is a distinct advantage over gas lighting, especially in large networks.—*Elek. Zeit.*, Aug. 12.

Street Lighting.—An account of the discussion which followed the paper of Bloch on recent progress in street lighting. Mollenkopf refers to recent attempts to obtain, with carbons arranged side by side, a similar distribution of the light as with carbons one above the other. This is accomplished by using certain glass globes ("Dioptrische Innenglass"). These globes have prismatic rings at their lower part, so that the light rays are deflected more into a horizontal direction. The speaker thought, however, that this was a very artificial remedy and breakage of the globe might result. Passavant emphasized that the effective arc lamp, with its excellent efficiency, has, in fact, been the decisive factor in obtaining the superiority for electric lighting over gas lighting. But it has the great disadvantage of high cost and of relatively short hours of burning. With titanium and similar arc lamps, attempts have been made to increase further the economy and to prolong the life of the electrodes. He thinks further progress must be looked for from the invention of electrodes with a longer life. Kuhlmann referred in a complimentary manner to the use of tungsten lamps for street lighting in the United States (Grand Rapids). *Elek. Zeit.*, Aug. 12.

Relighting of the Carbon Arc.—J. A. POLLOCK, E. M. WELLISCH AND A. B. B. RANCLAUD.—An illustrated abstract of their paper read before the Royal Society of New South Wales, in which the relation between the potential difference across the carbons and the maximum time of interruption of the circuit within which the arc will re-form is investigated. The effect of the relative positions of the carbons is also dealt with.—Lond. *Electrician*, Aug. 13.

Generation, Transmission and Distribution.

Paris.—Some further notes on the rearrangement of the electricity supply in Paris, which has already been noticed in the Digest. It is the intention eventually to erect two large stations, one in the north and one in the south of Paris. The undertakings of the original "sectors," which are now absorbed by a new company, are being linked up. Some of the smaller generating stations are being shut down and new substations established. Direct current at 110 volts on the three-wire and five-wire system is distributed in the more central districts, and single-phase and two-phase alternating currents in the more outlying parts. A great part of the supply will be from the St. Denis station for the present.—Lond. *Elec. Eng'ing*, Aug. 12.

Manchester.—An abstract of last year's financial report of the municipal central station of Manchester. Private consumers required 37,150,022 kw-hours, public lighting 99,593 kw-hours and the tramways 29,675,249, while no less than 6,791,020 kw-hours were used on the works. The energy lost in distribution or unaccounted for only amounted to 16.96 per cent of the kw-hours generated, a much smaller figure than that for several years past. The maximum supply demanded was 20,956 kw on the lighting and power mains, equivalent to a load factor of 20.5 per cent, and 10,162 kw on the traction system, the latter load factor being 33.3 per cent, while the load factor for the whole undertaking works out at 24.6 per cent, compared with 25.39 per cent in the previous year. The plant capacity amounted to 39,300 kw on March 31. The cost per kw-hour sold, not including capital charges, was 1.32 cents, and including capital charges 2.40 cents; the total receipts 2.64 cents per kw-hour.—Lond. *Electrician*, Aug. 13.

Traction.

Bearing Friction and Power Consumption.—M. B. AYRES.—An article in which the author analyzes the power consumption of a 41-ton interurban car on a typical run of one-half mile in 80 seconds, separating the consumption required for each of the several factors, such as loss in rheostats, acceleration, loss in motors, wind friction and bearing and track friction. Track and bearing friction accounts for 9.55 per cent of the total en-

ergy supplied. The percentage of saving in power required if this friction is eliminated entirely is even larger, running up as high as 42 per cent in some cases, where frequent stops are made.—*Elec. Rail. Jour.*, Aug. 21.

Rapid Transit for Berlin.—R. Petersen.—An article in which the author speaks against the present policy of the suburbs of Berlin, which intend to permit rapid traction only in the form of tunnel roads. He urges that the construction of tunnels should be restricted to the city itself, where rapid traction in other forms is impossible. He calls attention to the very poor financial results obtained by some tunnel roads, especially in London.—*Elek. Zeit.*, Aug. 12.

Railless Traction.—A note stating that railless traction is advocated for the extension of the trolley system in Madras. The first cost is less than with the trolley system and the construction is quicker. The trolley arm is constructed to give a lateral deviation of 10 ft. on either side of the overhead wires. —Lond. *Elec. Eng'ing*, Aug. 12.

Cableway.—L. Dubois.—An illustrated description of the electrically operated aerial cableway for lifting passengers on the slope of the Wetterhorn Mountain, in Switzerland. Great care has been taken in providing safety and braking devices.—Lond. *Electrician*, Aug. 6.

Rail Welding.—An illustrated article on the electric welding of rail bonds.—Lond. *Electrician*, Aug. 13.

Installations, Systems and Appliances.

Electric Lifting and Central Stations.—C. von Miller.—Wherever possible the author recommends a flat rate. The lamps used in different rooms he divides into four classes according to the probable number of hours for which they are used; he provides a flat rate for each class. This has proved quite successful in various water-power stations. In steam-power stations he seems to prefer measurement of the energy by meters, but he strongly urges to allow a discount on monthly consumption and not yearly consumption.—*Elek. Zeit.*, Aug. 5.

Electric Conditioning Oven.—An illustrated description of an electric conditioning oven for use in the textile industry. It is much more quickly ready for use than a gas furnace, and its temperature regulation is perfect. The apparatus is likely to interest central-station engineers, particularly those in the woolen and worsted districts.—Lond. *Electrician*, July 30.

Wires, Wiring and Conduits.

Bonding and Earthing.—G. W. Partridge.—A communication with respect to the recent article of W. J. U. Sowter on bonding and grounding. The present writer upholds the principle of bonding, but points out that there is great difficulty in providing a good ground so as to cause the fuse or circuit-breaker to act when a failure of insulation occurs. A plate buried in the earth is not, in his opinion, a good enough ground connection for large installations. He suggests the use of a safety device consisting of two metal plates separated by a mica disk between the outer concentric system and the ground wire connected to the transformer at the end of the feeder. If the pressure across the plates rises above a certain amount, owing to the failure of the transformer, the gap is bridged and the outer of the system is used as a return path, causing a complete short-circuit. He concludes with a warning with regard to the use of series transformers.—Lond. *Elec. Eng'ing*, Aug. 12.

Electrophysics and Magnetism.

Magnetic Properties of Copper Alloys.—A. D. Ross and R. C. Gray.—An abstract of a paper read before the Royal Society of Edinburgh. Manganese-aluminum bronzes exhibit less hysteresis, but are also less magnetic, after quenching. If rich in copper they are more magnetic at —190 deg. C. than at 15 deg. C. Continued baking reduces the susceptibility and increases the hysteresis toward definite limits. In Heusler alloys containing 76 per cent, 62 per cent and 55 per cent copper, respectively, and the remainder manganese and aluminum in atomic proportions, the critical temperatures are 280 deg. C., 500 deg. C. and 345 deg. C. The quenching and liquid air effects in the Heusler alloys are very similar to those in Cu_2Al. —Lond. *Electrician*, Aug. 6.

Gamma Rays.—A. S. Eve.—An account of an experimental investigation of primary and secondary gamma rays. Some of the chief results are as follows: Change of hardness of the gamma rays makes little difference in the relative intensities of the incident corpuscular secondary radiation from various elements, and the intensities follow the order of atomic weights of the radiators. Change in hardness of the gamma rays makes a marked difference in the relative intensities of the emergent corpuscular secondary radiation from various elements. Such radiation do not follow the order to atomic weight. Hardening of the gamma rays is readily produced by lead screens, but not by iron screens of great thickness. On hardening the gamma rays the emergent radiation from carbon and aluminum is increased relatively to heavier substances; on softening it is decreased.—*Phil. Mag.*, August.

Electrochemistry and Batteries.

Storage-Battery Plates.—In order to prevent the troublesome contraction of the active mass of the negative plates, with resulting loss of output, it has become a practice during the last years to add certain inert material to the active mass of the negative plate. These additions prevent contraction of the lead salts and their sintering together into solid masses. On the other hand, if they are used in sufficient quantity to become effective they produce a considerable increase of volume in time, and it is necessary to prevent the active mass from dropping out of the grid. For this purpose a German storage-battery company uses perforated hard-rubber plates, which are pressed against the lead plates by means of the glass tubes, which maintain a constant distance between the plates. The perforations in the hard-rubber plate are so small (diameter 0.6 mm to 0.8 mm) that the lead salts are successfully prevented from getting through the holes, while the very large number of the holes permits sufficient circulation of the acid. It is stated that the capacity of the negative plates is maintained constant in this way.—*Elek. Zeit.*, Aug. 12.

Electrolytic Deposition of Brass.—S. Field.—A Faraday Society paper on the conditions which determine the composition of electro-deposited alloys, with special reference to copper-zinc alloys. The conditions under which brass is deposited from a mixed solution of copper and zinc cyanides are investigated. The alloy is deposited quantitatively, but the deposits are not good physically. Any condition tending to raise the e.m.f. increases the percentage of zinc in the deposit. Anodes dissolve freely if the solution is warm.—Lond. *Electrician*, July 30.

Ferro-Molybdenum.—J. Escard.—An article on the electro-thermic and elumino-thermic methods for the manufacture of ferro-molybdenum.—*La Lumière Elec.*, Aug. 14.

Units, Measurements and Instruments.

Electric Units.—De Baillehache.—A highly theoretical paper on absolute systems of electric units, with special reference to so-called suppressed dimensions. He gives an outline of what he calls System B and emphasizes its advantage.—*La Lumière Elec.*, July 31, Aug. 7 and 14.

Motor Meter.—An official communication of the Reichsanstalt describing a motor meter for direct current of the Siemens-Schuckert Company for two-wire and three-wire installations, and announcing its admission for the official calibration by the Reichsanstalt.—*Elek. Zeit.*, Aug. 12.

Apparatus for Radiography.—A note on an improved apparatus which has been devised for taking instantaneous radiographs. An equipment for veterinary work, capable of taking radiographs with an exposure of only one-tenth of a second, comprises a 14-in. spark coil, taking 90 amp at 220 volts on the primary and delivering 100 milli-amp to the Roentgen tube, the target of which has to be especially designed to withstand the high intensity of the cathode rays.—Lond. *Elec. Eng'ing*, Aug. 5.

Thermo-Couple.—H. Pecheux.—In a continuation of his article on the measurement of high temperatures by means of

thermo-couples, he discusses the nickel-copper couple.—*La Lumière Elec.*, July 31.

Telegraphy, Telephony and Signals.

Telephony.—Devaux-Charbonnell.—The conclusion of his long mathematical paper on a study of telephone lines. He now discusses lines consisting of sections of different diameters, or lines composed partly of overhead lines and underground cables. In the latter case the cable sections have a bad effect on good sound transmission. Cables of medium diameter, such as 2.5 mm, are the most advantageous, although they are far from satisfactory. Cables of low capacity are best and can compete with cables loaded with Pupin coils and have numerous advantages.—*La Lumière Elec.*, July 31

BOOK REVIEW.

Hydro-Electric Developments and Engineering. By Frank Koester. New York: D. Van Nostrand Company. 454 pages, 500 ills. Price, $5.

This book is an excellent review of the state of the art in the modern great field of hydro-electric development; and what constitutes its value, in no small degree, is the international nature of its data. Europe and America are both rich in examples of good hydro-electric engineering; while in like manner, failure of certain principles is not limited to the practice of either continent. Mr. Koester has made an exhaustive study of the evolution of the past 15 or 20 years, and has brought his material into compact, sequential form; with the result that we are indebted to him for an exceedingly interesting and instructive volume.

The book is divided into parts and chapters that present the subject in natural steps from a consideration of the laws of hydraulics to the discussion of the latest methods of line construction and insulation. Dams, headraces, and penstocks are followed by power plant in its mechanical and electrical equipment; and then transmission is taken up, in the various branches of line conductor, towers, arresters and substations. While all this is profusely illustrated from actual examples, Mr. Koester has reserved for a final section, which is overmodestly styled an appendix, a comprehensive account of eight typical modern plants, two in North America, one in Mexico, and five in different parts of Europe. When it comes to long transmission lines at high voltage, the United States, with its vast areas, seems to have been boldest in design and execution; yet it is to Austro-Hungary that credit must be given for actual 30,000-volt generation "in the machine," without any step-up transformers, the current going straight to line from four turbo-electric units, for final consumption at 48 volts 21 miles away. This plant in Dalmatia is a striking instance of the advance of practice in recent years. The reader will find, however, in this handsome, well-written, well-indexed volume, many other—in fact all—the latest ideas, "fads and fancies," and real scientific triumphs of the hydro-electric art. By way of possible improvement we would suggest that in the further editions which will surely be needed, the cuts be numbered seriatim throughout, instead of being numbered separately for each chapter.

NEW APPARATUS AND APPLIANCES

Universal Test Set.

The Universal test set, illustrated herewith, is designed for telephone exchanges. It is virtually a small portable wire-chief's desk that indicates trouble and also locates it. It consists of a 10,000-ohm, 0-15-volt voltmeter mounted in a box 12 in. x 9 in. x 7 in., with shunts, switches, keys and an ingenious circuit that performs all the test-desk tests and at the same time



UNIVERSAL TEST SET.

gives the location of troubles by an accurate "loop-test" method. The advantage claimed is that it makes all tests with great speed, thus allowing every wire and coil in the exchange to be connected, and revealing thereby troubles that might otherwise never be cleared. Ten small dry cells are mounted in the box, making the instrument self-contained.

To make resistance readings, the readings of the needle are referred to a scale in the lid of the box, where the figures are correct for any of the shunts, the combined resistance of the voltmeter and shunt always being some multiple of 10. These shunts afford sufficient accuracy, as all readings are taken with the needle near the center of the scale where the accuracy is high. For instance, in reading a resistance of 100 ohms, the 100-ohm shunt would be used and the needle would be at the center of the scale.

The set is greatly improved, at an additional expense, by a magnetic shunt across the moving system, which varies the flux through the moving coil 20 per cent. With this addition, variation in the operating battery may be neutralized and the scale in the lid of the box dispensed with, the resistances being marked directly on the scale of the instrument as on an ohmmeter.

The electrical shunts allow small currents to be read. The instrument may be used as an 0-15 ammeter or an 0-15 voltmeter. The range of resistance readings, sufficiently accurate for trouble locations, is from 1 ohm to 30,000 ohms. Insulation resistances can be read up to 15 megohms, reading to tenths of divisions.

The method of making the voltmeter "loop test" is interesting and electrically accurate. The pushing of a button throws the battery across the terminals of a loop, and the operating of the "tip" and "sleeve" ground key gives two readings, one being the drop along the loop to the trouble on one wire, and the other reading is the drop along the other wire. The error of the shunting effect of the voltmeter cancels in the formula which is simple. Middleton Brothers, 1361 Monadnock Building, Chicago, manufacture this instrument.

Flaming-Arc Lamps for Street Lighting.

A consideration which is stated to have militated against the adoption of the flaming-arc lamp with inclined electrodes for street-lighting purposes is the character of the distribution curve, which, unless means are taken to rectify it, makes it imperative to space the lamps close together to secure a reasonable uniformity of illumination. This, in turn, calls for an expenditure of energy per mile far in excess of what is allowed by present practice. By the use of a prismatic inner globe designed after the fashion of the Fresnel lighthouse lens and giving photometric curves, as shown in Fig. 1, the Excello Arc Lamp

Company, of New York, claims to have produced a lamp which may be spaced 150 ft. and still give a minimum illumination midway between the lamps which is greater than that obtained

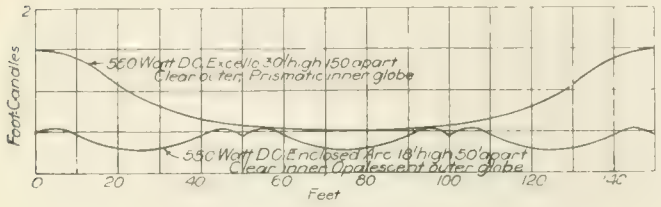


FIG. 1.—PHOTOMETRIC CURVES.

by the use of enclosed lamps spaced 50 ft. apart. The curves shown herewith indicate the relative performances of ordinary and flaming-arc lamps. The distribution curves shown in Fig. 2 would indicate that the illumination of business streets, public squares, boulevards, etc., may be increased considerably by the

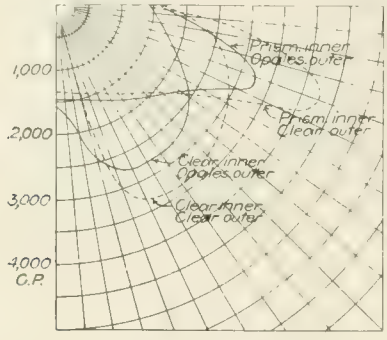
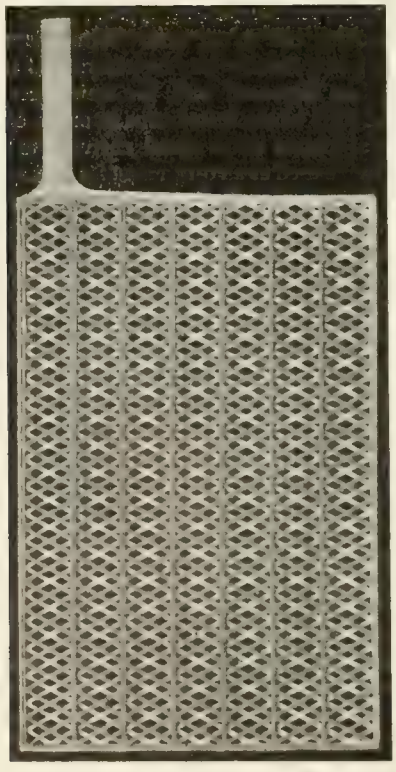


FIG. 2.—DISTRIBUTION CURVES.

adoption of lamps of this type. The active interest now being manifested in improved street lighting by business men's associations is leading to notable improvement in standards of street lighting. In many cases the flaming-arc lamp has been adopted as the most suitable means of achieving the desired improvement, and the company claims that the distribution indicated by the curves here given may be obtained at a cost very favorable to the use of the flaming-arc lamp.

Storage Batteries for Electric Vehicles.

The Philadelphia Storage Battery Company, of Philadelphia, Pa., manufactures a line of storage batteries with grids of three thicknesses for commercial and pleasure vehicles, specializing in this line. The type of grid used in these cells is shown below. It is claimed that the mechanical strength to resist twisting or buckling is very great in this diamond-grid design, the members of the grid being crossed diagonally as in truss bridge construction. Soon after this type of grid was placed on the market the company realized that the stiffness and holding qualities of the grid were such that a thinner type of plate was possible. After experimentation, the thickness of the plate was reduced to an extent that allowed the addition of a positive and a negative plate to each cell without increasing the size of the containing jar. Batteries of this type were tried out in practice and the medium plates, although intended originally for pleasure vehicles, proved so reliable, and the increased mileage was of such great importance, that the type came into general use for commercial trucks of the lighter types. For pleasure vehicles the company has brought out a thin plate which permits an increase of two positives and two negatives in each cell. The plates are designed for certain specific uses. The standard plate is intended for the heavy class of work in large commercial wagons; the medium plate for the smaller wagons and pleasure vehicles, and the thin plate for light runabouts and in cases where greater mileage is desired.



STORAGE-BATTERY GRID.

Conduit Rod Coupling.

A new coupling for conduit rods, made by the Chicago Conduit Rod Coupling Company, 2050 Cuyler Avenue, Chicago, is shown in the accompanying Figs. 1 and 2. This coupling is more than a simple hook; it is a joint so constructed as to prevent end play and lost motion in twisting. There is, however, enough side play to permit the rods to be used in conduit which has the usual slight irregularity and changes the direction. The coupling is made of malleable cast iron. The fixed part of the casting is at the point where the greatest wear occurs. Four-ft. rods may be connected and disconnected with ease in small manholes. Double rivet holes are provided, and the tongue is pierced so that a pulling cable can be attached. The castings are made from a highly finished metal pattern so as to secure accurate fit between couplings and interchangeability.



FIGS. 1 AND 2.—CONDUIT ROD COUPLING.

Pull Socket.

Harvey Hubbell, Inc., of Bridgeport, Conn., has brought out a pull socket possessing several interesting features. The design, mechanically and electrically, is patterned after the well-known but older form of pull socket made by the same manufacturer, but differs from the latter in being smaller in size and having a removable chain eyelet. The new socket is 2¼ in. long, or the same in size as the standard key socket. The eyelet simply slips in place, where it remains without the use of springs, clamps or screws. Where it is desirable to finish the eyelet differently from the rest of the socket, this arrangement is particularly advantageous. The socket also has a snap shell. In high-class fixture work, especially where husks are employed, the use of snap-shell sockets results in a saving of time and labor. In the socket shown the shell snaps into a positively secure lock, in



PULL SOCKET.

which position it cannot be directly pulled apart nor can it become loosened through the operation of the socket or owing to vibration of the lamp. The device is known by its number, 35,038. The lamp base is equipped with a heavy spring contact.

High-Voltage, Multiple Direct-Current Arc Lamp.

The accompanying illustrations show the arc lamp made by the Sun Ray Electric Lamp Manufacturing Company, of New York City, for outdoor and indoor illumination. The lamp is diminutive in size only, as it possesses a strong, sturdy mechanism despite its small dimensions. The length over all is 22 in. A number of novel features are incorporated in the lamp structure. There are no sliding contacts, all moving connections being bonded. The arc is claimed to be true and steady and to be centered at all times in the center of the globe. The mechanism is quite simple and is claimed to be indestructible and fool-proof. The electrode life of the low-voltage lamp, designed for circuits having a potential of 115 volts, varies from 75 hours to 85 hours on one trim. The positive carbon and the negative carbon are 12 in. and 4 in. long, respectively, and both are 7 mm in diameter. A high grade of carbon is employed, and the arc is thoroughly enclosed so that the deposit is only slight at the end of the electrode life. The lamp is designed for 3 amp, 4 amp or 5 amp, and is said to consume 1 watt per hemispherical cp. The lamp is also made for 230-volt circuits, the voltage across the carbons at the arc being 150. The high-voltage lamps are made for 2 amp, 2.5 amp or 3 amp. Each lamp is fitted with a non-slipping clutch having a very sensitive but positive feed. Reference to the cross-sectional elevation of the lamp shows the details of construction very clearly. Ample space is left for the carbon to pass, so that sticking of the electrode below the clutch does not take place. The globe plate and shell are insulated from the lamp mechanism. The flexible copper connection between the carbon holder and the positive lead is well shown in Fig. 2. The lower carbon holder, it is claimed, cannot be burned except by a reversal of polarity. The lamp gives a brilliant white light and is exceptionally well adapted for decorative lighting. For indoor illumination a reflector may be employed, as shown in Fig. 1.

Electroliers for Public and Private Lighting.

The efficient and high candle-power tungsten incandescent lamp has given an impetus to the use of ornate standards for street lighting. That such metal posts lend themselves to very

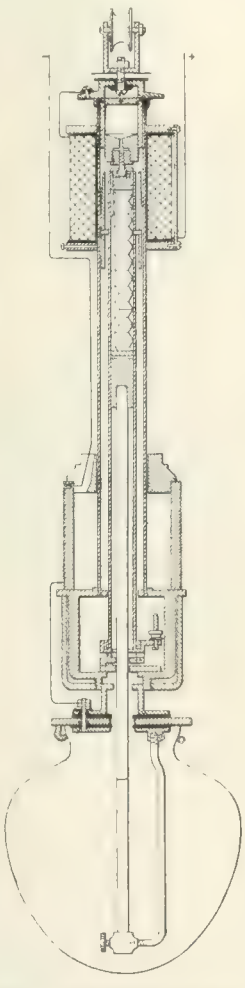


FIG. 1.—SECTION OF ARC LAMP.



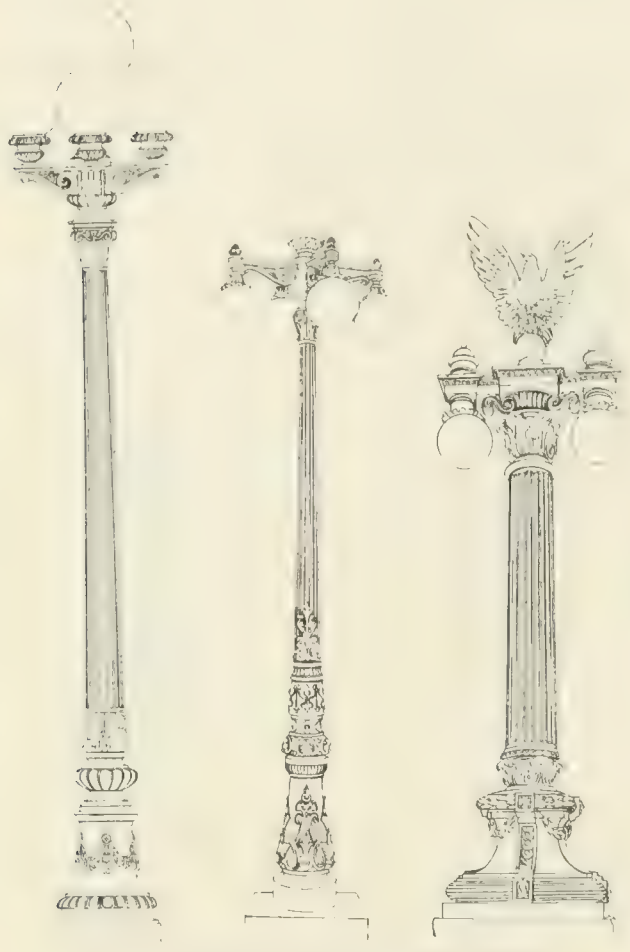
FIG. 2.—LAMP FOR INTERIOR ILLUMINATION.



FIG. 3.—BRACKET ELECTROLIER.

artistic treatment is appreciated and is also evident from the sketches shown herewith. There are, of course, abundant opportunities for diversity in post designs. In many instances it is desirable to have the standard in keeping with the architectural or landscape surroundings, and in private lighting or in the lighting of public buildings, the standard should bear an intimate relation to the architecture of the building before which it is placed. For general illuminating purposes, however, no particular architectural design is necessary provided the standard is serviceable and pleasing in appearance. The sketches shown represent a few of the latest electroliers made by the J. L. Mott Iron Works, of New York, which are especially serviceable for incandescent lamps. The posts are made either in bronze, iron or spelter, or a combination of these, and the glass-

ware can be chosen to suit requirements. Of the two forms of special street-lighting—arches and posts—the latter is the more dignified and lasting of the two. For park and boulevard



FIGS. 2, 3 AND 4.—FLECTROLIERS OF NEW DESIGN.

lighting, standards are used almost exclusively. Brackets are not used to any great extent in public lighting, being ill adapted to present lighting conditions unless fastened to the sides of lamp or other posts or columns. For entrances, hallways, etc., of buildings they are particularly appropriate and are used extensively. By means of a small goose-neck fixture placed within the globe, the incandescent lamp is held in a downward position.

Rotary High-Vacuum Air Pump.

The steadily increasing demand for higher economy of steam prime movers which has been accompanying the development and application of steam turbines during the past few years made a simultaneous advance in the design of condensing apparatus necessary. Guided by such considerations, the C. H. Wheeler Manufacturing Company, of Philadelphia, has developed a type of rotary air pump embodying all the essential features of a high-grade and high-vacuum air pump, occupying a minimum of space, with the additional advantage of being adapted for direct-connection to another auxiliary. Fig. 1 illustrates one of the standard arrangements, consisting of vertical steam engine direct-connected to a "Rotrex" air pump on one side and a centrifugal circulating pump on the other. The construction of the "Rotrex" pump is simple, consisting of a light-weight cylindrical casing, one rotor eccentrically mounted on a shaft carried in outboard, ring-oiled bearings independent of the stuffing-boxes (Fig. 2). Division between the suction and discharge in the pump cylinder is made by means of a radius cam which is carried in independent bearings and is operated by means of a lever and crank from the rotor shaft on the outside of the pump. By this arrangement internal contact is eliminated, the rotor operating with a close clearance from the bore of the pump cylinder and the cam maintaining a close clearance from the rotor. The clearances, by an ingenious arrangement of

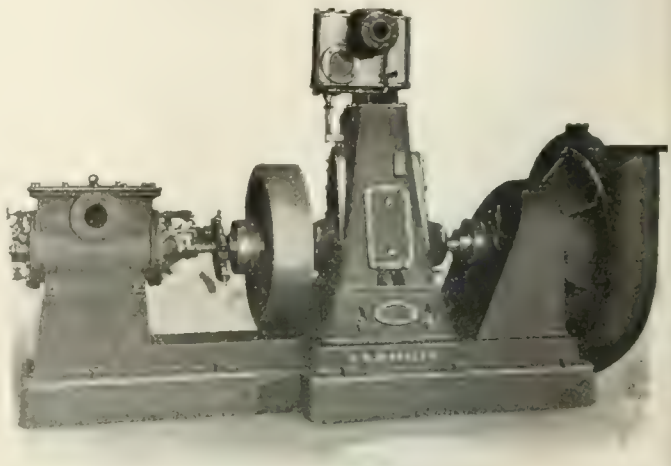


FIG. 1.—ROTARY AIR PUMP.

ports, are thoroughly water-sealed at all times, that is, the pump relies on water-sealed clearances to produce the high vacuum obtained and not surface contact or sliding fits. The other feature of the pump is a special arrangement of metallic discharge valves, no suction valves being used. Due to the high speed, the over-all dimensions are very small, which fact will be appreciated from the illustration showing the proportionate size of the air pump as compared to the circulating pump. The

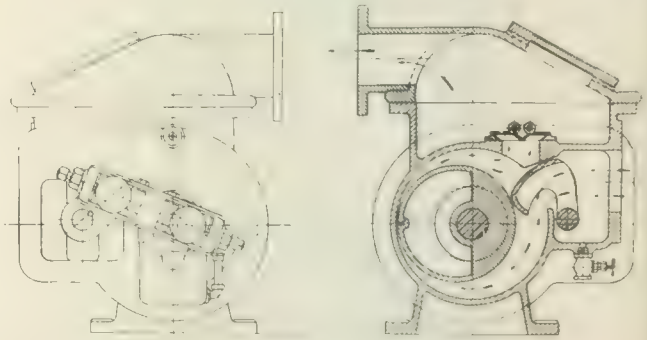


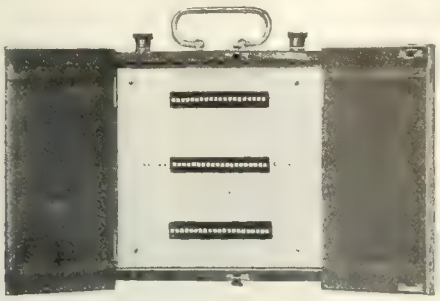
FIG. 2.—DIAGRAM OF CONSTRUCTION OF PUMP.

pumps are manufactured in sizes of from 50 hp to 5000 hp in one unit; beyond that size multiple units are used, an independent air-pump engine having one pump direct connected to each end of its crankshaft.

Reed Frequency Meters.

The operation of the frequency meter shown in the accompanying illustration depends upon the fact that a steel spring held at one end will be set into strong vibration when acted upon by rhythmic impulses (such as arise from an alternating current, or intermittent direct current), when the number of impulses per unit of time corresponds with the vibration rate of the spring in question. In the "Lux" vibrating reed instrument shown, the springs are made of watchspring steel, 3 mm wide, supported at one end and the free end turned up at right angles for a short distance, the turned-up part being enameled white, so that it can be more readily seen when in vibration. Usually anywhere from 11 to 61 of these springs or reeds are mounted side by side, forming a sort of comb, and so tuned as to cover any desired range of periodicity. Around the comb

of reeds is a solenoid, which is traversed by an alternating current or interrupted direct current, thus subjecting the reeds to the necessary rhythmic impulses. The reed, with the same periodicity as the exciting current, responds by a very clearly visible vibration. In this way, when the reeds are properly



FREQUENCY METER.

calibrated, it is very easy to read off the frequency of the current; or, if desired, the calibration may be in r.p.m.

As there is no iron whatever in the electrical circuit and hence no eddy currents, the instruments work with greater accuracy than when an electromagnet is used in place of the solenoid. It has also been proved from experience that the accuracy is neither affected by continued operation nor by variations in the pressure of the exciting current. When properly adjusted a reed is scarcely affected by the excitation unless its periodicity corresponds within very narrow limits.

The "Lux" instruments are made in portable and switchboard types, and will be found valuable in central-station work, commercial testing, and for general experimental work in college laboratories. The chief advantages claimed are: 1. Unvarying accuracy in the readings, whatever be the variations in the pressure and the resistance of the line. 2. Extremely precise readings, owing to the great sensitiveness of the reeds to rhythmic impulses.

The "Lux" instruments are being placed on the market by James G. Biddle, 1114 Chestnut Street, Philadelphia.

Core-Loss Voltmeter.

Since guarantees of transformer core losses are generally based on a sine wave of e.m.f., it is necessary that some method be employed to secure a sine wave shape or its equivalent when testing transformers for the performance guaranteed. The equivalent loss due to a sine voltage wave at a normal frequency of, say, 60 cycles, can be secured under normal conditions of wave-form and frequency by either lowering or raising the voltage. What is needed then is an indicator which will enable a voltage adjustment to be made to give a core loss equivalent to that produced by a sine wave at normal frequency and voltage. To render such an adjustment possible the core-loss voltmeter, shown in the accompanying illustration, has been designed by the Westinghouse Electric & Manufacturing Company.

This meter consists essentially of a ring or core of laminated steel excited by a winding and a wattmeter of suitable design on which to read the power input to the ring and all copper circuits in the instrument. The core and meter are mounted in suitable cases, as shown in the illustration, and the whole instrument is entirely self-contained and portable. All connections are made inside the instrument and there are but two terminal posts to which line connections are made.

On the laminated core is placed a winding, the core and winding being mounted in the lower case with the two leads of the winding brought through the top and into the instrument case which contains the meter movement. A stationary current coil is connected in series with the winding. The shunt circuit consists of a moving coil, a non-inductive resistance and a compensating coil, all in series across the instrument terminals. The compensating coil is wound parallel to the stationary current coil and has the same number of turns. The deflection of the wattmeter movement is caused by the total input of the instrument, which consists of the hysteresis and eddy loss in the ring, or magnetic rheostat, and the I^2R losses in the copper circuits of the instrument.

The instrument is calibrated in parallel with an alternating-current voltmeter on a pure sine-voltage wave of the required frequency from a small smooth-core alternator and the scale is drawn to agree with the alternating-current instrument. Two scales are provided—one reading watts input of the instrument itself and the other volts.

In application, the core-loss voltmeter is connected across the terminals of the transformer under test, in the same manner as an ordinary voltmeter. The wattmeter is also connected in the circuit in such a way as to measure total input of both transformer and core-loss voltmeter. The voltage of the circuit is then adjusted by any convenient means until the voltmeter reading is the same as the normal voltage of the transformer. The total power input is then read on the wattmeter and the watt input of the instrument read on the watt-scale of the core-loss voltmeter, the difference being the core loss of the transformer.

The core-loss voltmeter may be used as a portable voltmeter in testing transformer core losses on any reasonably distorted



CORE-LOSS VOLTMETER.

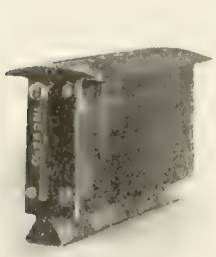
wave of voltage and without any knowledge of the wave-form. The voltage regulation may be secured by the aid of resistance or reactance, thus dispensing with the usual multi-voltage transformer and avoiding the inconvenience of varying the field current of the generator. The frequency need only approximate the normal value. The final result of core loss as measured on the wattmeter will be the same value as that which would be obtained on a sine voltage-wave at the normal voltage and frequency of the transformer.

There are many advantages which will result from the use of the core-loss voltmeter. Chief among these is the comparative simplicity in testing equipment, since very little apparatus is required and no oscillograph is needed to determine the form factor. Another advantage is that transformers need not be tested at the source of power. This is a great convenience when it is desired to measure the core loss in lowering transformers in substations where close voltage regulation, except by auxiliary apparatus, is difficult to obtain. Competitive tests are also very much simplified when the core-loss voltmeter is used because there is no need of having similar conditions of wave-form, frequency, etc., for each transformer tested.

The illustration shows the core-loss voltmeter as at present constructed. A new style of instrument is being made up which is more compact than the one shown. This new design will have the meter element mounted in the center of the core instead of above it. A line of double-scale voltmeters is also being manufactured which combines in one instrument the advantages of a high- and low-reading voltmeter.

Generators and Motors of the Synchronous Type.

In the design of the synchronous generators and motors, the details of which are illustrated herewith, especial attention has been paid to the essential mechanical and electrical proportions. The revolving field core is built up on a solid hub containing



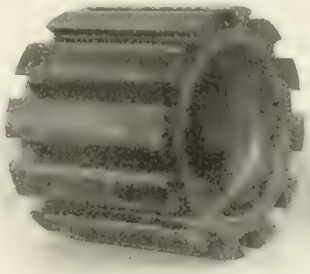


FIG. 1.—A POLE-PIECE. FIG. 2.—REVOLVING-FIELD CORE.

dove-tailed slots in which are inserted the assembled pole-pieces. The pole-pieces are formed of steel laminations bolted to make a compact mass in which the eddy currents are suitably minimized. Before being wedged into place on the hub,

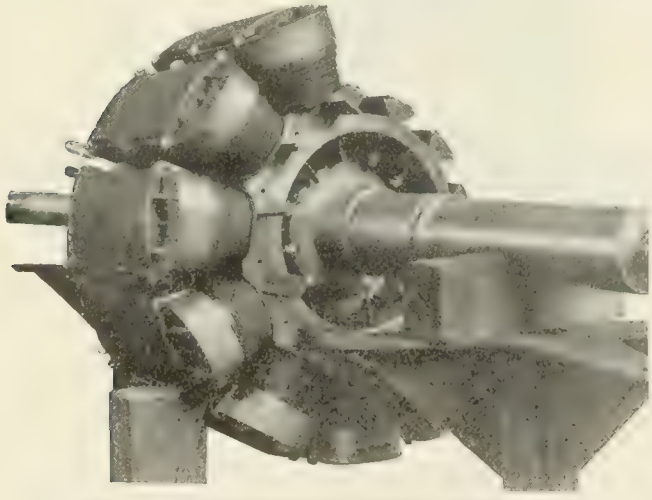


FIG. 3.—REVOLVING-FIELD CORE PARTLY ASSEMBLED.

each pole-piece is provided with a previously assembled field coil, which is wound with square wire for small machines or with flap strips on edge for large machines. The revolving-

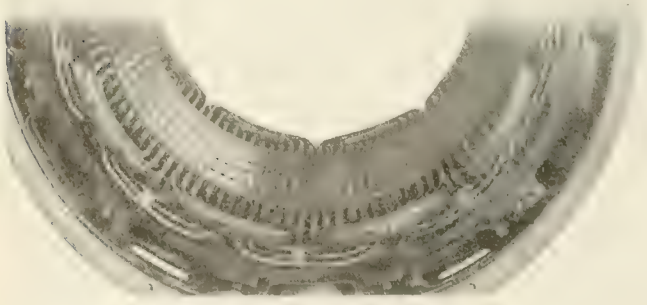


FIG. 4.—SECTION OF ARMATURE.

field core of a 300-kw machine, partly assembled, is shown in Fig. 3, the individual parts being illustrated in Figs. 1 and 2.

It is stated that the shape of the pole-faces has been chosen with special reference to the form of the e.m.f. wave of the machine. The e.m.f. wave shape is also affected largely by the number of slots per pole per phase. In order to obtain a satisfactory wave-form use is made of at least two coils per pole per phase in three-phase machines and not less than three coils per pole per phase in two-phase machines. As seen in Fig. 4, the armature slots are of the open type, so that the coils can be completely formed and insulated before being placed in the core.

In each slot is placed an insulating cell which surrounds the coil and separates it from the core. Fiber wedges serve for

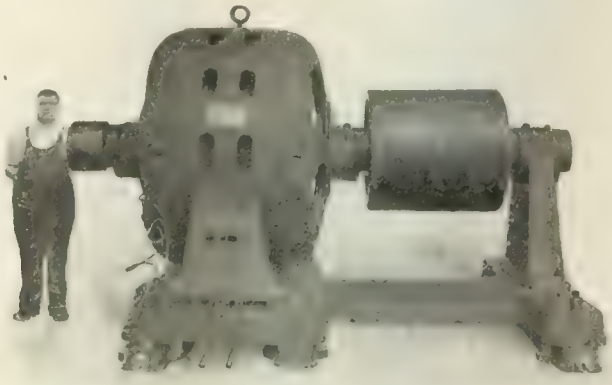


FIG. 5.—COMPLETE MACHINE.

holding the coils in place and preventing their becoming chafed by vibration.

A completely assembled machine is illustrated in Fig. 5. The machines are arranged for use as generators and as motors. The field cores of the generators are operated at a relatively high magnetic density in order to insure good voltage regulation, while the motors are run at low field density so as to allow a considerable range for adjustment and permit the machine to retain its synchronizing power. These machines are being placed on the market in sizes ranging from 60 kw to 400 kw by the Wagner Electric Manufacturing Company, St. Louis, Mo.

Buckeye Electric Company's Annual Conference.

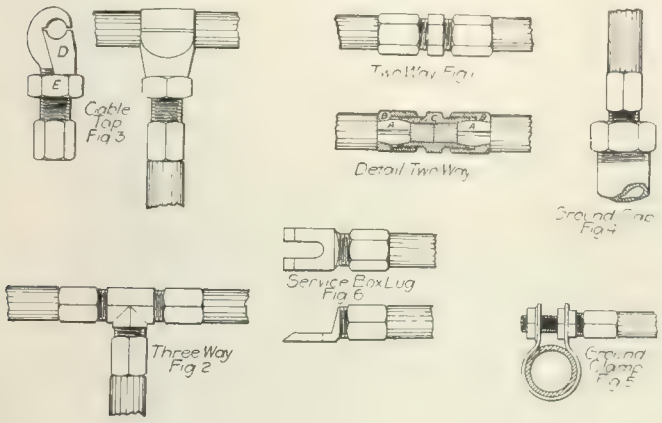
Following his annual custom, Mr. L. P. Sawyer, general manager of the Buckeye Electric Company, called his salesmen to Cleveland on Aug. 16 for their regular yearly conference. A distinct innovation in the conference was that this one was held at "Camp Buckeye," a fully equipped camp which was established about 15 miles east of Cleveland on a high bluff on the shore of Lake Erie. Twenty-three men were present at the confer ence, which lasted the entire week. The camping equipment was complete in every way, including 10 large sleeping tents, a commissary and a large tent in which the various conference meetings were held.

Culinary quarters, under the charge of a competent chef, were established in a nearby house which was pressed into service, and a conveniently located cottage was used for additional accommodations, the lower floor being devoted to offices. The first evening of the encampment a regular election for mayor, vice-mayor and chief of police was held. Two tickets were in the field and the campaign, which lasted most of the evening, with its stump speeches, lobbying, torch-light parades, etc., was very lively. After the election the victorious party had an enthusiastic celebration.

By way of varying the monotony of business sessions, many interesting and novel amusements were brought out. One of these was a band in which all of the campers participated and which was much in evidence early and often. Upon breaking up all agreed that the conference and the camp were an unqualified success.

Mechanical Connectors.

The increasing use of mechanical wire connectors in many classes of wiring has led to a steady development and improvement in these devices. As an example of the latest practice in this line, a description is given below of the method followed by the Edison Illuminating Company of Brooklyn in wiring



FIGS. 1 TO 6.—TYPES OF CONNECTORS USED.

up transformers. Mechanical connectors are used exclusively from the tap-off at the pole line feeder cable to the service cut-out boxes in the building served, soldering processes being entirely eliminated.

One of the accompanying illustrations shows the different types of connectors used. The mechanical detail of the joint is shown in Figs. 1 to 6. The part that grips the wire is the bushing or sleeve *A*, a piece of tubing slotted longitudinally and tapered at both ends. One end of this sleeve fits into the tapered part of the nipple *C*, while the other end fits into the tapered part of the nut *B*. When the nut is screwed up on the nipple, the action of the taper causes the sleeve to decrease in diameter and grip the wire. A joint made in this manner will hold up under an exceedingly large tensile strain and will not heat.

The Brooklyn Edison Company supplies transformers through single-phase lines and uses three-wire secondaries. The con-

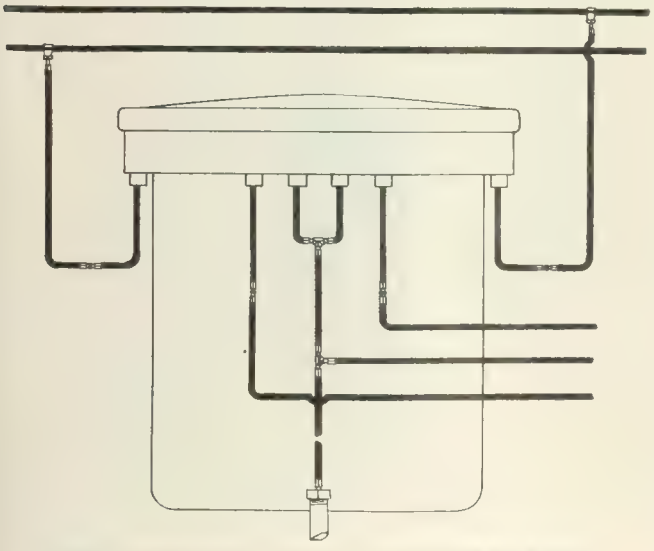


FIG. 7.—CONNECTORS APPLIED TO TRANSFORMER WIRING.

nectors used in installing a transformer are the two-way (Fig. 1), three-way (Fig. 2), cable tap (Fig. 3) and grounding cap (Fig. 4).

The primary leads are connected to the mains by use of the cable tap. This connection is so made that it is not necessary to cut the mains in order to take off a lead. By screwing the jam nut *E* down on the shank of the connector, the cover *D* can be removed. To make this connection the hook, with the cover taken off, is placed over the bare wire. The cover is then put in place and tight contact obtained by screwing up the jam nut. The shank of this tap is supplied with a compression nut and sleeve as previously described, by means of which the lead is fastened to the connector. The primary transformer leads are connected to the leads from the fuse boxes by means of a two-way connector.

In connecting to the secondary two of the service wires are connected to the two outside secondary leads by means of two-way connectors. The two middle secondary leads are then connected together by means of a three-way joint. From the remaining branch in this three-way, a lead is taken which runs into another three-way joint, from the two remaining branches of which the middle secondary and ground wire are taken. The ground wire is connected to the earth as follows: A galvanized iron pipe 14 ft. long is driven into the ground for a distance of 7 ft., the part remaining above ground being stapled to the pole and covered with a wooden guard. To the top of this pipe a grounding cap is screwed to which the ground wire is connected by means of a mechanical sleeve. When the ground wire is to be connected to a pipe already installed, the ground clamp (Fig. 5) is used. The service wires are connected to the building circuits through a porcelain service cut-out box. The wires are connected to the two sides of this cut-out by means of the mechanical lug shown in Fig. 6.

This completes the connections so far as the company is concerned, and the only tools necessary are a wrench and an instrument for stripping the insulation from the ends of the wire. The conductors can be disconnected at any time in a few minutes with the aid of a wrench, leaving the ends of the wires in perfect condition. Such connections can be made in all kinds of weather without the least difficulty. All the connectors used by the company are universal; i.e, they will take any size of wire from one predetermined to the smallest size used. This is accomplished by having the nipples and nuts of the connectors made all the same size and using sleeves or bushings with the same outside diameter that they may fit into the connectors, but with the inside diameter or wire hole made to fit the different sized wires in question. Many advantages are claimed for the system, the principal ones being that it makes better joints and costs less. The connectors used are known as Dossert joints.

Twenty-Four-Hour Central-Station Service at Appleton, Minn.

In the latter part of 1905 it was decided advisable to maintain a 24-hour service at Appleton, Minn., but it was found that the cost of operating their generating unit during the day would be prohibitive. Consequently a battery of "chloride accumulators," manufactured by the Electric Storage Battery Company, of Philadelphia, was installed in January, 1906, consisting of 128 cells, with a capacity of 25 amp for eight hours.

A careful comparison of the records of this plant for the year preceding and the year following the installation of the battery was kept. This comparison showed that the installation of the battery effected an increase of 14 per cent in the gross receipts of the company. Notwithstanding this increase in the output of the plant, the fuel actually consumed in 1906 was less than that used in 1905. The comparison further showed that, after allowing the proper interest and maintenance charges on the battery equipment, a net return on the investment was shown of approximately 14 per cent. It should be borne in mind that this was the return effected by the battery in the first year of its service. At that time sufficient business had not been acquired to call for the complete output of the battery; as this business, however, has grown since then the net return during 1907 and 1908 has naturally been greater. By being in a position to offer its customers light and power at any time, the Appleton plant has been able to increase the number of customers as well as the actual plant output.

Alternating-Current Flaming Arc Lamps Equipped with Rapid Striker.

The alternating-current arc is more sensitive to voltage fluctuations, strong drafts or small inhomogeneity of the carbon than the direct-current arc. While the induction-motor feeding mechanism is very satisfactory in regard to gradual and exact

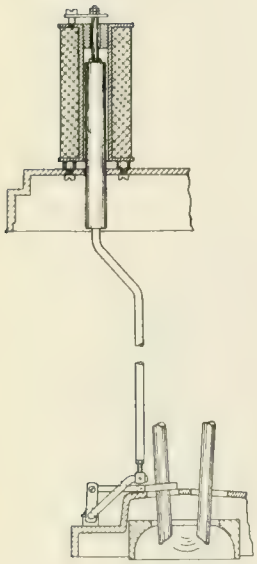


FIG. 1.—"RAPID STRIKER."

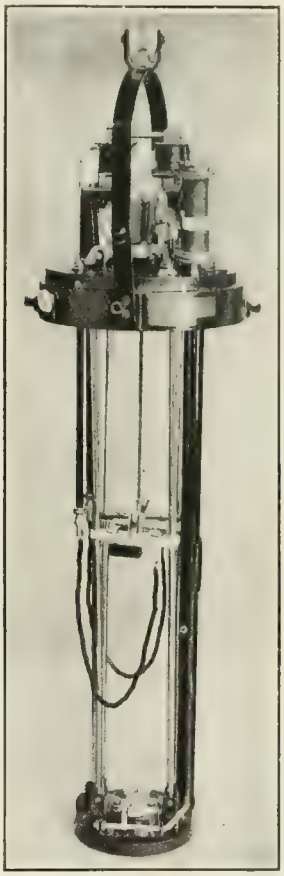


FIG. 2.—LAMP WITH "RAPID STRIKER" ATTACHMENT.

regulations, should the arc be extinguished, it takes nearly a half minute to strike it anew and put the arc into its normal condition.

To obviate this objection, the device shown in Fig. 1, called the "Rapid Striker," has been added to the "Aurola" alternating-current arc lamp, of which the Charles L. Kiewert Company, Milwaukee, Wis., have the American rights.

The iron core moving inside of a coil sinks down by its own weight in case the lamp is not switched on or the arc is not yet established. By this downward sliding of the core, a plate which guides one of the carbons is moved in such a direction that it brings the two carbons nearly together. As soon as the lamp is put in circuit a few revolutions of the aluminum disk are sufficient to bring the carbons to touch, and thus so striking the arc.

As soon as this happens the coil operating the "Rapid Striker" gets power, attracts the core upward and causes the guide plate to separate the carbons. A few revolutions of the motor will then establish the proper arc length.

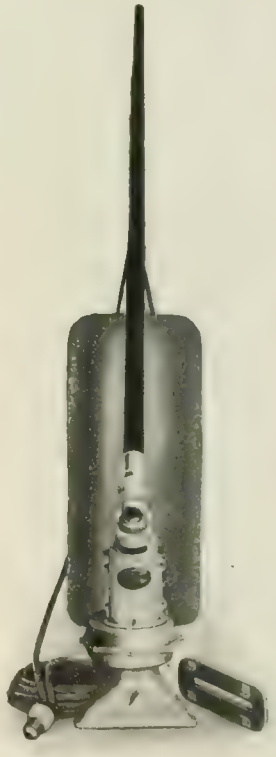
It is clear that the operations described follow one another very rapidly and are instrumental in starting the lamp with a minimum of current. Should the arc be interrupted for one reason or another, the "Rapid Striker" will immediately establish it again.

Fig. 2 shows a photograph of an "Aurola" lamp with the "Rapid Striker" attachment. It is stated that lamps with this attachment are operating absolutely successfully on 25-cycle circuits, thus rendering "Aurola" lamps available for this low frequency.

Small Electric Vacuum Cleaner.

The Standard Electric Works, of Racine, Wis., are making an electrically operated vacuum-cleaning machine known as the Arnold electric cleaner that is distinctive owing to its small size, compact arrangement, light weight and low price. As shown by the accompanying illustration, the machine consists simply of a handle which is attached at the lower end to an aluminum casing containing a ⅛-hp electric motor connected to a rotary suction fan arranged to exhaust the air through cleaning tools attached to the nozzle at the end of the cleaner. There is also provided a dust bag of a special textile fabric woven to filter the air drawn in through the cleaning tool, retaining all dust and dirt in the bag. Provision is made for a lamp-cord attachment to an ordinary incandescent socket, and 30 ft. of cord is provided. A switch is placed on the cleaner so that the electricity can be turned on or off by the operator at the machine. All operating mechanism, including the motor, fan and the brush of the cleaning tool, is enclosed in a polished aluminum casting. The machine illustrated weighs but 10 lb., not much more than the ordinary carpet sweeper, and it can be carried easily to any part of the house.

The motor not only rotates the fan, but it also operates the sweeper brush back and forth very rapidly with a peculiar pounding motion. This agitates the fibers of the rug or other fabric being cleaned, and loosens the dirt, which is drawn by the suction fan into the dust bag. The brush is easily removed, and, if desired, a felt polishing shoe, especially designed for cleaning and polishing tile and hardwood floors, may be attached, or the cleaner can be used with the suction only without either the brush or the felt shoe. It requires but little effort to move the cleaner back and forth. When through cleaning, the operator removes the clip from the top of the dust bag and empties the contents of the bag. The handle is adjustable to



ELECTRIC VACUUM CLEANER.

any angle desired, and there are only two places where oil should be applied. These cleaners are equipped with both direct-current and alternating-current motors. The manufacturers of this machine declare that they have produced a suction cleaner which is within the reach of everyone, and that every user of electric light is a possible customer.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The steady improvement in trade conditions has continued during the past week, although there has not been the rush of business that many of the wholesalers anticipated on account of the roseate views given out earlier concerning the new crops. In truth, there is at present a disposition to trim down the exuberant estimates of the wheat and corn yields. While it is still apparent that crops will be large, and the condition is as yet considered satisfactory, unfavorable weather has to some extent cut down the estimates regarding corn, and the actual harvests of wheat have shown smaller yields than were at first anticipated. In the South the cotton crop will not exceed 12,000,000 bales. This, however, has been practically expected for two months. During the past week quite a number of heavy orders for equipment were placed, and the steel car business is in a flourishing condition. Reports are being received that the mills, especially those manufacturing structural material and plates, are behind in their orders, and are demanding premiums for prompt deliveries. But few steel rail orders are being placed for immediate delivery, although it is stated that about 200,000 tons were ordered last week for Southern and Western roads to be delivered in 1910. In the electrical trades both the General Electric and Westinghouse companies report that July business was unusually heavy. The Western Electric is particularly busy in the manufacture of telephone apparatus, and its plants are running full time. Collections show considerable improvement, especially in the West and Northwest, and in the South are no slower than heretofore. Business failures for the week which ended Aug. 26 were: 201 as against 183 the previous week; 136 in the same week of 1908; 167 in 1907; 138 in 1906, and 161 in 1905.

THE COPPER MARKET.

The copper market during the past week has been practically at a standstill; price changes have been insignificant, and trading on the Metal Exchange and by private sale has been very limited. The demand from domestic consumers is notably quiet, although there are a good many inquiries for metal, showing that the melters are thinking of adding to their stocks whenever there is a favorable price condition. Speculative demand abroad is also smaller than it has been, and reports from Europe indicate that stocks are increasing in the warehouses there. The statistical position of copper for the month of August is interesting to the trade. It is generally conceded that exports during the month will not exceed 50,000,000 lb., the lowest figure for the last five months. In the meantime the production is known to have continued at highwater mark, and domestic takings, as indicated above, appear to have been rather light. It is by no means certain, however, that the figures of the Copper Producers' Association will reflect this situation. It is remembered in the market that the July figures furnished a surprising reduction in producers stocks. There may be another surprise in store for those who follow conditions and think that they have formed correct conclusions. The exports for the month up to and including Aug. 30 were 21,869 tons. The daily call on the Metal Exchange at 12:30 o'clock Aug. 30 quoted standard copper as follows:

	Bid.	Asked.	Settling price.
Spot	12.60	12.75	.....
August	12.60	[illegible]	12.67½
September	12.75	12.85	12.77½
October	12.75	12.90	12.82½
November	12.80	12.95	12.87½
December	12.85	13.00	12.92½

The London prices Aug. 30 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	59 12 6	59 15 0
Standard copper futures	60 1 0	60 12 6
Market	Firm	Firm
Sales of spot	100 tons	
Sales of futures	600 tons	

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.00	12.62½
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Cast	14.12½	12.00
London, spot	£64 2 6	£54 12 6
London, futures	64 2 6	55 10 0
London, best selected	67 15 0	59 0 0

PENNSYLVANIA AND LONG ISLAND TERMINALS.—The Pennsylvania tunnels, with all their equipment and depot facilities, will be ready for operation by July, 1910. It may be that the advanced condition of the work will permit an earlier opening. It is said that the majority of the contractors are ahead of their schedules. The total expenditure, so far, has been about $90,000,000, and this will reach something more than $100,000,000 before the work is complete. The progress of the work on the Long Island section of the road is fully as far advanced as on the main terminal. Ralph Peters, president of the Long Island Railroad, is quoted as saying that operation from many points on the western division of his system to Manhattan would be under electricity through the tunnels before the end of this year. Already the ties for the tracks in the East River tunnels have been stored in Long Island City. The first division of the road from Long Island City to Jamaica will probably be ready within a few months, and the double tracking of the North Shore line to Port Washington will be completed before the end of the year. The tracks through the yards at Long Island City are being rapidly prepared for electrification.

LIGHTING COMPETITION IN MINNEAPOLIS.—There is quite a contest taking place in Minneapolis over the question of granting a franchise to the Northern Heating & Electric Company, a newly organized concern, which is seeking to enter into competition with the General Electric Company. Those opposing the granting of another franchise state it should not be granted unless it can be demonstrated that the present company cannot, or will not, furnish energy at reasonable rates. It is argued that one company with one plant ought to be able to furnish service cheaper than two companies with two plants. It is also argued that competition between public service corporations usually results in a rate agreement, or in the sale of one concern to the other. A strict regulation of the existing company is favored rather than the encouragement of competition.

BELL TELEPHONE OF ST. LOUIS.—A new schedule of rates will be put into effect Sept. 1 by the Bell Telephone Company of St. Louis. The rates will be substantially the same as those of the Kinloch Telephone Company. The Bell Company makes a reduction of $46.80 a year on the unlimited direct; $18 on the unlimited two-party line, and $6 on residence phones. This change is made in order to make full use of the company's exchange and wire facilities, which were enlarged in 1907. The company expects to easily accommodate 20,000 more patrons, and the low rate is made as an inducement.

NEW FACTORY OF WARNER ARC LAMP COMPANY.—The Warner Arc Lamp Company recently found it necessary to increase its manufacturing facilities, but instead of enlarging its Muncie factory, as has been done several times previously, it was found advisable to locate a factory west of the Mississippi River. A fireproof building, equipped with the most modern machinery for the manufacture of arc lamps, was therefore erected at Wilton, Iowa, to which point the general office of the company has been moved from Muncie.

NEW SAVANNAH TRACTION COMPANY.—Plans are under way at Savannah, Ga., which embrace the laying of more than 30 miles of new electric railway track. While this scheme has not been entirely worked out, it is expected that several sections of the country hitherto not reached by electric lines will be opened up. The new project is said to be backed by interests which are identified with the Savannah Lighting Company. The latter company is now making extensive improvements in its plant.

SAN JOAQUIN LIGHT & POWER COMPANY.—The San Joaquin Light & Power Company, Fresno, Cal., has plans on foot for improvements and development of the system entailing an expenditure of $500,000. A. G. Wishon, manager of the company, has just received authorization from the Huntington interests in Los Angeles, who control the company, to proceed with certain features of the works. The large earth dam in Crane Valley is now being worked on, and the No. 1 ditch and a good deal of other work, especially that of getting equipment into the hills, is being pushed forward as rapidly as possible. The big dam will contain 20,000 cubic yards of rock, 310,000 cubic yards of earth, 12,000 cubic yards of concrete and 120 tons of metal. The enlargement of the No. 1 ditch will be almost exclusively by the construction of tunnels. Out of the present 7½ miles of ditch, all but one mile will become tunnel, and the one mile of open ditch will be concreted. Four hundred men are now at work. An electric substation is being established at Crane Valley, which will be used for operating all the machinery in the construction work there.

GOOD DEMAND FOR LIGHTING SPECIALTIES.—I. P. Frink, 551 Pearl Street, New York, dealer in reflectors and lighting specialties, reports that there has been an excellent demand during the summer for this class of goods. Since this firm equipped the National City Bank of New York, some months ago, with a system of concealed desk lighting it has received quite a number of orders from other financial institutions, which have been pleased with this installation. Besides a number of banks in New York, the Mechanics American National, the National Bank of Commerce and the Title Guarantee Trust Company, of St. Louis, have all recently been equipped with this system of desk lighting, and the Old Colony Trust Company, of Boston, has also adopted it. One novel installation which the Frink firm has recently put in is that of the University Club in Chicago. In connection with this there are concealed lighting systems for the squash and tennis courts, and it is reported that the players can now use these courts at night just as easily as in the day time.

MONTGOMERY LIGHT & WATER POWER COMPANY.—George Williams, of the firm of H. L. Doherty & Company, who has been in Montgomery, Ala., for six months conducting a campaign of education in behalf of the Montgomery Light & Water Power Company, says that his concern is now doing a large portion of the business in this territory, and that it is adding to its customers every day. It has been making a special feature of signs and street illumination, and these have become very popular with the business people of Montgomery. A second transmission line has just been completed from the hydro-electric plant 27 miles from the city, and the power station at that point is installing new machinery. Four new water turbines have been ordered to take the place of the machinery now in service, and when these are all installed the total capacity of the plant will be about 8000 hp.

CHANGE IN TELEGRAPH CODE RATES POSTPONED.—Owing to the vigorous protest made by the National Association of Manufacturers against the change in the use of code telegrams, limiting them, except in the case of dictionary words, to five letters per word, the Western Union and Postal Telegraph companies have decided to postpone action until Dec. 1. John Kirby, Jr., president of the association, which it is claimed has 3000 members, pointed out that it was impossible for the manufacturers now using code systems to revise them in accordance with the new regulations by Sept. 1, and the telegraph companies agreed to the postponement rather than interfere with the business of their customers.

PORT HURON (MICH.) LIGHT & POWER COMPANY.—In the report of the convention of the Michigan Electrical Association in our issue of Aug. 26, it was stated in mentioning the election to the presidency of A. C. Marshall, manager of the Port Huron Light & Power Company, that this company in 1905 passed under the control of the Detroit Edison Company. This statement is, we learn, an error, as the Port Huron company is in no wise connected with Detroit Edison interests. The company is the successor of the Excelsior Electric Company, incorporated in 1884, and in 1901 re-incorporated as the Port Huron Light & Power Company, the stock remaining in the hands of the original incorporators.

NEW POWER PROJECT IN UTAH.—Jesse Knight, of Provo, is planning an electrical transmission system for Utah that may, in time, rival the famous Telluride Power Company's system, which now furnishes light and power for a greater part of the State. Mr. Knight's plan is to establish power plants in the several available canyons throughout the State, and to furnish power and light to many of the towns now supplied by the Telluride company, as well as towns that are without electrical energy. The district through which the plants will operate is from Logan on the north to Nephi on the south, a belt 200 miles long and 100 miles wide through the most thickly populated portion of the State.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in the present issue are announcements of proposed new plants or considerable extensions of present plants at Sioux City, Ia.; Erie, Kan.; Radersburg, Mont.; Astoria, Ore.; Tenino, Wash.; Berlin, N. H.; Columbia City, Ind.; Salt Lake City, Utah; Eugene, Ore.; Athens, Ga.; Aurora, Ind.; Ralston, Neb.; White Plains, N. Y.; Midland, Ont., Can.; New Haven, Conn.; Dorris, Cal.; Tacoma, Wash.; Yreka, Cal.; Grand Rapids, Wis.; Claremont, N. H.; Waterville, Me.; Poughkeepsie, N. Y.; Detroit, Minn.; Hydro, Okla.; Binghamton, N. Y.; Rochester, N. Y.; Portland, Ore.; Crosbytown, Tex.; Brandon, Miss., and Deming, N. M.

HOME POWER & IRRIGATION COMPANY.—A number of Denver and Eastern capitalists are promoting a project for the purpose of developing a large water-power and irrigation proposition on Bear Creek, near Morrison, Col. The name of the new company is to be the Home Power & Irrigation Company. It is planned to take over all the water rights on Bear Creek, consolidate them and then construct a large reservoir at Evergreen, where the power plant will probably be located. It is said that the minimum development will be 5000 hp, and probably will eventually reach 10,000 hp.

MUNICIPAL OWNERSHIP IN FT. WAYNE, IND.—J. Levering Jones, of Philadelphia, president of the Ft. Wayne & Wabash Valley Traction Company, has issued an open letter in which he endeavors to show that in going into municipal and commercial lighting the city of Ft. Wayne has acted against the interest of its taxpayers. He declares that no further investments will be made in Ft. Wayne by his company until it is certain that the disposition of the community is favorable to the corporation.

ELECTRIC MACHINERY COMPANY SALES.—The Electric Machinery Company, Minneapolis, has sold through the Rumsey Electric Company, of Philadelphia, a 500-kw, three-phase, 2300-volt alternator to the city of Martinsburg, W. Va., where it will be installed in the water-power plant on the Potomac River. The same company has also sold to the Independent Electric Light & Power Company, of Independence, Kans., a 480-kw alternator for direct connection to a gas engine.

HAVANA HOLIDAY ELECTRICAL ILLUMINATION.—Mr. R. Jiminez, A. I. E. E., Havana, Cuba, writes that the City Council of Havana has authorized an elaborate celebration of the winter holidays, involving considerable electrical display, which latter consideration may interest American electrical manufacturers and supply dealers. Mr. Jimenez will be glad to give further information on the subject upon application. His address is Malecon 240 altos, Havana.

IRWIN (PA.) & HERMINIE TRACTION COMPANY.—A company named the Irwin & Herminie Traction Company has been organized in Pittsburgh to take over the property of the Pittsburgh & Westmoreland Railway Company, which now operates a line between Irwin and McKeesport. The new company will issue $40,000 in bonds, the proceeds of which will be used for improvements.

DONGAN ELECTRIC MANUFACTURING COMPANY.—The Dongan Electric Manufacturing Company, 52 Green Street, Albany, N. Y., has purchased the business of the Dongan Electrical Instrument Company. It will continue the manufacture of Dongan instruments, to which line other types will be added in the future.

FT. WAYNE ELECTRIC WORKS INCREASES FORCE.—The force of employees at the Ft. Wayne Electric Works has been largely increased in order to care for the new business

BERLIN 1910 AMERICAN EXPOSITION.—Prince Henry of Prussia has accepted the honorary presidency of the American Exposition to be held in Berlin in 1910 and heads a German committee, consisting of men of the highest standing in the empire, who will co-operate with the regular German Advisory Committee in making the exposition a success. Messrs. J. Pierpont Morgan and Thomas A. Edison have joined the honorary American committee. The Hamburg-American Line and the North-German Lloyd have increased their original freight reduction from 20 to 30 per cent. Arrangements have been made whereby exhibitors who do not intend to send a man of their own to Berlin can have their exhibits unpacked, installed and demonstrated, for a moderate charge, by a special sales office and bureau of information established in the Exposition Palace, so that it will only be necessary for them to ship the goods to New York to be taken entire care of from there on by the exposition management. The exposition aims, by bringing together in a magnificent exposition palace much larger than Madison Square Garden, New York, in the commercial heart of Europe, a representative collection of the best American ingenuity, skill and experience can produce; to foster and strengthen trade relations with Germany and to increase American exports generally. It will be an exposition without extras, all incidentals being included in the space-rental. Max Vieweger, 50 Church Street, is American manager of the exposition.

TELEPHONES FOR TRAIN DESPATCHING.—A new telephone equipment furnished by the Western Electric Company for train despatching upon the Fitchburg division of the Boston & Maine Railroad has been in operation since Aug. 7, and it is now announced that it has given perfect satisfaction. It is expected that other divisions of the road will be equipped speedily in the same manner. Nineteen stations have been using the telephones on this experimental division. The officials of the railroad believe that the new system will save from 20 per cent to 50 per cent of the time in handling traffic, and will eliminate a number of delays. One of the novelties of the apparatus installed by the Western Electric Company was a special instrument in one station for a one-armed telegraph operator. That he might not lose his position, a special foot switch was arranged in order that his single hand would be left free to record messages.

READY TO BID ON CHICAGO SUBWAY.—George W. Jackson, of the firm of George W. Jackson, Inc., has announced that he is prepared to build the Chicago subway system at a cost of upward of $80,000,000 for cars and other equipment. Mr. Jackson has sent a letter to Mayor Busse, asking him to investigate the financial standing of his company, in order that the city may give serious consideration to his proposition. The Jackson project contemplates a traction system entirely independent of the present lines, but proposes to provide sufficient space to make it possible for the elevated lines to run underground in the business district. Provision is also made for gas and electric conduits.

WORKING ON McCALL FERRY DAM.—More than 100 men were put to work last week on the big dam of the McCall Ferry Power Company on the Susquehanna River. It has been nearly two years since operations on this plant were discontinued. The men now at work are employed on the concrete construction work. It is understood that the number of workmen is to be steadily increased until as large a force as can be accommodated will be employed. The plant is about 80 per cent finished, and it is estimated that it can be completed and power turned on within a year.

SEATTLE ELECTRIC COMPANY SUBSTATION.—The Stone & Webster Engineering Corporation, of Boston, has taken a contract for the construction of a new substation at Ballard, Wash., for the Seattle Electric Company. The new station will supply the energy for the northern section of Seattle and also for the Puget Sound International Railway & Power Company which is constructing a line between Seattle and Everett. The new station will have a capacity of 25,000 kw in railway motor-generator sets and 4000 kw in light and power equipment.

WIRELESS EQUIPMENT FOR PACIFIC STEAMSHIP.—The United Wireless Company has just completed the manufacture of a 3-kw wireless equipment for the new Matson Transportation Company steamship *Wilhelmina*. This is one of the largest and handsomest steamships on the Pacific Coast, and will ply between San Francisco and Honolulu. It is said that this wireless equipment is expected to work over a radius of 2,000 miles. It was manufactured for the United company at the plant of the International Telegraph Construction Company in Jersey City.

PITTSBURGH MOTOR VEHICLE COMPANY.—The Pittsburgh Motor Vehicle Company asks us to contradict reports being circulated to the effect that it has moved its business from Pittsburgh to Washington, D. C. Such reports, it states, are not only untrue but calculated to mislead both present and prospective customers. The company is doing business as usual in Pittsburgh, Pa., and intends to continue so doing.

ELECTROMAGNETIC TOOL COMPANY.—James S. Knowlson, until recently with the General Electric Company, has gone into the manufacture of electric percussion drills, under the firm name of the Electromagnetic Tool Company, with offices at 128 South Clinton Street, Chicago, Ill.

MYSORE, INDIA, ELECTRICAL ENGINEER APPOINTMENT.—The official secretary of the Government of Mysore, India, asks us to announce that the post of Chief Electrical Engineer to the Government of Mysore, for which applications were invited in January, has been filled.

Financial Intelligence.

THE WEEK IN WALL STREET.

It is not out of line to say that Wall Street during the past week experienced a "Harriman market." It was not as in the old days a market of Harriman manipulation, but the absorbing topic of conversation and the controlling influence on prices were the reports from the financier's bedside. Few deny that the reaction was logically due, for most observers have recognized for months that the advance had been too radical and was too far ahead of commercial conditions to be healthy. The Harriman rumors merely unsettled the nerves of the promotors and gave the bears the courage they had heretofore lacked. Liquidation of speculative holdings in the market leaders became very general and the shorts took an inning. There was little in a news way, beyond the Harriman reports, to affect the market. Crop reports were not so rosy as heretofore, but were still good and the industrial and railroad

NEW YORK.

	Aug. 23.	Aug. 30.	Shares sold.		Aug. 23.	Aug. 30.	Shares sold.
All.-Ch.	15½*	15½	800	Int.-Met., pfd.	46⅞	46¾	6,800
All.-Ch., pfd.	53⅝	53½	1,200	Mackay Cos.	84	84⅜	1,900
Amal. Cop.	85⅝	84¼	90,875	Mackay Cos., p.	74½*	75	100
Am. D. T.	20½*	20½*	——	Man. Elev.	142½	143*	550
Am. Loc.	63	60	25,132	Met. St. Ry.	23	23*	——
Am. Loc., pfd.	116½	116	1,250	N.Y. & N.J.Tel	140½	139¼*	100
Am. Tel. & Cbl.	76*	76*	——	Steel, com.	77⅜	77¾	1,008,600
Am. T. & T.	140⅜	140⅛	11,000	Steel, pfd.	125	125½	20,037
B. R. T.	80½	79½	38,620	W. U. T.	73	74½	4,020
Gen. Elec.	169	168⅛	4,370	West'h, com.	87¼	86	6,700
Int. Met., com	13	14⅜	3,750	West'h, pfd.	125*	125*	—— ——

PHILADELPHIA

	Aug. 23.	Aug. 30.	Shares sold.		Aug. 23.	Aug. 30.	Shares sold.
Am. Rys.	46½*	46¾*	——	Phila. Elec.	12⅛	12⅜	——
Elec. Co. of A.	12⅛*	12⅛*	——	Phila. R. T.	30⅛	30⅜	——
Elec. St. B'ty.	61	61	——	Phila. Trac.	90½*	90½*	——
E. S. B'ty.pfd.	49*	49*	——	Union Trac.	54⅛	54¼	—— ——

CHICAGO.

	Aug. 23.	Aug. 30.	Shares sold.		Aug. 23.	Aug. 30.	Shares sold.
Chi. City Ry.	180*	180*	——	Chi. Tel. Co.	135*	135⅛	—
Chi. Rs.,Ser.1.	119½*	119*		Met. El., com.	17¾*	17¾*	—
Chi. Rs.,Ser.2.	37½*	37¼*	——	Met. El., pfd.	49*	49*	— —
Com. Edison.	120⅞	121	—	Nat'l Carbon.	95	95*	— —
Chi. Sub'ws.	19½*	20½	—	Nat'l C., pfd	120*	120*	—— —

BOSTON.

	Aug. 23.	Aug. 30.	Shares sold.		Aug. 23.	Aug. 30.	Shares sold.
Am. T. & T.	140⅛	139	——	Mex. Tel.	2⅜*	2¼	—
Cum. Tel.	113*	111	——	Mex. Tel., pfd	6½*	6*	—— —
Edison E. Ill.	252*	251	—	N. E. Tel.	137	136*	— —
Gen. Elec.	166½*	167¼	— —	W. T. & T.	10¾*	11	— —
Mass. E. Ry.	14	14	——	W. T. & T., p.	80*	81*	——
Mass. E. R., p.	74	74*	——				

*Last price quoted.
Shares sold so far this week, Aug. [illegible]

situation indicated continued improvement. The truth of the whole matter is that prices had been pushed beyond their legitimate level and had been held there by persistent and powerful bulls. The break came when these men and their followers began to fear disaster. Ranks were broken and it was a scramble to save paper profits. But it was far from a rout and on Aug. 30, when assurances were given out that the financier's condition was not alarming, there was an immediate

and sharp reaction. Not all the losses were recovered, but enough to show that the bear side is dangerous. Regardless of stock fluctuations the bond market remains strong with ready sales for every good issue. The wonder of the market is that there are not more issues from comparatively obscure industrial concerns. It looks as if the opportunity existed. The money market is practically unchanged. On Aug. 30 rates were: call, 2¼ @ 2½ per cent; 90 days, 3¼ @ 3½ per cent. The quotations in the table are of the close Aug. 30.

DIVIDENDS.

American Locomotive Company, preferred, quarterly, 1¾ per cent, payable Oct. 21.

Brooklyn Rapid Transit Company, quarterly, 1 per cent, payable Oct. 1.

Galveston-Houston Electric Company, preferred, semi-annual, 3 per cent; common, 1½ per cent, both payable Sept. 4.

Mackay Companies, preferred and common, quarterly, 1 per cent each, payable Oct. 1.

Rochester Railway & Light Company, preferred, quarterly, 1¼ per cent, payable Sept. 1.

NEW POWER COMPANIES IN MICHIGAN.—Articles of incorporation were filed with the Secretary of State of Michigan last week for 18 new power companies, with a total paid in capitalization of $3,200,000. Practically all of these companies are being promoted by Eastern capital. Fourteen of the new concerns are water-power companies, which propose to develop sites upon the Au Sable River in Northeastern Michigan. The incorporators of these companies are E. F. Loud and H. K. Loud, of Au Sable, each of whom holds one share of stock in each company, and L. A. Wood, of 7 Wall Street, New York, who holds the balance of the shares in each company. Mr. Wood is identified with the interests of Hodenpyl, Walbridge & Company. The other four companies which were incorporated are the Saginaw Power Company, capital $1,000,000; the Bay City Power Company, $500,000; the Pontiac Power Company, $200,000, and the Charlotte Power Company, $50,000. The incorporators of the first three of these are: George E. Hardy, W. M. Eaton and J. C. Weadock, all of New York, and all identified with the Hodenpyl, Walbridge & Company interests. It is the understanding that these three new companies are eventually to take over the extensive power and traction interests owned in Saginaw, Bay City and Pontiac by the New York bankers mentioned above. The Charlotte Power Company, which seems to be a Michigan concern, is incorporated by George H. Clark, E. Clark and George A. Crawford, of Detroit.

WASCO COUNTY ELECTRIC WATER POWER COMPANY.—The Wasco County (Ore.) Electric & Water Power Company has filed a mortgage in the office of the county clerk of Wheeler County in favor of the Carnegie Trust Company, of New York, N. Y., as security for an issue of $15,000,000 in bonds, which covers all the rights of way, equipment and water filings of the electric company in the counties of Wasco, Crook, Grant, Wheeler, Gilliam and Sherman. The document also shows the purchase of the water rights of the Oregon Gold Prospecting & Promoting Company for $2,625,000 of capital stock of the electric company and $3,775,000 in bonds. The latter company has two water rights, one on the Deschutes River, between the Warm Springs and Melotius Rivers, and one on the John Bay River. The mortgage also provides that prior to the completion of 300 miles of projected railways through Central Oregon that the Inland Oregon Electric Railroad Company shall be formed and $15,000,000 in bonds sold to the Portland, Baker City & Butte Electric Railroad Company. The offices of the Wasco Electric & Water Company are at 318 Marquam Building, Portland, Ore.

HUDSON RIVER POWER CORPORATIONS.—The appraisers of the properties of the various Hudson River power companies, which are now in bankruptcy, have filed their reports in the United States District Court at Utica. The total appraisals value the property at $7,117,093, divided as follows: Hudson River Electric Power Company, $852,803; Madison County Gas & Electric Company, $150,634; Ballston Springs Light & Power Company, $56,024; Saratoga Gas, Electric Light & Power Company, $443,101; Empire State Power Company, $357,654; Hudson River Power Transmission Company, $681,199; Hudson River Water Power Company, $3,049,642, and the Hudson River Electric Power Company, $1,526,037. The power house at Mechanicsville, owned by the Hudson River Power Transmission Company, is appraised at $390,642, and the Spier Falls plant, owned by the Hudson River Water Power Company, is valued at $1,831,700.

PACIFIC STATES ELECTRIC COMPANY.—The officers of the New Pacific States Electric Company, the formation of which was announced in the last issue, are H. V. Carter, president and general manager; J. C. Gilson, first vice-president; W. L. Goodwin, second vice-president and sales manager; F. J. Quinn, secretary and purchasing agent, and W. E. Elliott, treasurer. The officers of the old companies—the Sterling Electric Company, of San Francisco; Pacific Electrical Works, of Los Angeles, and the Crescent Electric Company, of Oakland—will remain in their present locations under the name of the new company. C. H. Carter has been appointed local manager at Los Angeles, and C. L. Gilson, at Oakand, and F. J. Quinn will have charge of the San Francisco store. Branches will be located at Seattle, Wash., and Portland, Ore., in the near future.

SOUTH DAKOTA WATER-POWER COMBINATION.—It is announced that a deal has just been consummated through the promotion of Eastern capital by which the Consolidated Power & Light Company, of Deadwood, S. D., will secure control of the plants and business of the Black Hills Traction Company, which is the one competitive company in the manufacture of electricity. The deal, it is said, involves about $500,000, and the two companies will continue to be operated as separate organizations. The traction company owns a hydro-electric plant on Redwater Creek, which is equipped at present to develop 1700 hp, and can be made to develop an additional 2000 hp. There is a steam auxiliary plant which furnishes about 500 hp. The plant is now supplying many mines and mills in the vicinity, and is lighting the city of Belle Fourche.

CONSOLIDATION AT PLATTSBURGH, N. Y.—The Plattsburgh (N. Y.) Light, Heat & Power Company and the Lozier Light & Power Company have been consolidated under the name of the Plattsburgh Gas & Electric Company. The capital stock of the new company will be $225,000. Extensions of both the gas and electric service will be made. The company has a hydro-electric plant capable of developing 2000 hp and a steam auxiliary plant. H. G. Runkle, of the Plattsburgh Light Company, will be president of the new concern and George M. Cole, of the Lozier Company, will be vice-president and general manager. The company will continue to furnish energy for the Plattsburgh Traction Company.

BROOKLYN RAPID TRANSIT EARNINGS.—The annual report of the Brooklyn Rapid Transit Company for the year ended June 30, 1905, shows gross earnings of $19,694,462, which is a decrease of $176,104 from the previous year. A reduction in the operating expenses, however, of $544,923 leaves a gain in the net earnings for the year of $368,119. The report shows that the tax charges against the company have about doubled within the last eight years, and now amount to $1,337,620. President Edwin W. Winter in his report protests against increasing the burden of taxation, and also complains that the "transfer evil" absorbs more than its proper share of the earnings of traction companies.

INTERBOROUGH RAPID TRANSIT REPORT.—The report of the Interborough Rapid Transit Company for the year ended June 30, 1909, shows considerable improvement over the preceding 12 months. The gross earnings for the year were $25,775,392, as compared with $24,699,505 in 1908. The operating expenses were $10,747,443, compared with $10,722,694. This gives an increase in net earnings of $1,051,138. One of the best features of the report is the evidence of economy in the operation of the road. The surplus for the year is $1,439,823. The listing committee of the New York Stock Exchange has admitted to the list the Interborough Rapid Transit Company's $11,590,000, 45-year 5 per cent bonds.

MARYLAND ELECTRIC RAILWAY COMBINE.—A report is current in Baltimore that plans are being matured for the combination of a number of electric railway properties into the hands of a holding company, which, it is stated, will be capitalized at $100,000,000. It may be that the Maryland Electric Railways Company will become the holding company, and that the Annapolis Short Line and the Maryland & Pennsylvania Railroad, a steam line between Baltimore and the Pennsylvania State line, will be included in the deal. The Maryland Electric Railways was organized to finance the United Railways & Electric Company, and is owned by interests identified with that corporation.

GRAND RAPIDS-MUSKEGON POWER COMPANY.—A plan is being developed to separate the business of the Grand Rapids-Muskegon Power Company into two organizations. It is understood that the Muskegon Production Company, with a capital of $350,000, will suppy light and power to Newaygo and Mescota counties. Of this company, J. G. Emery, Jr., will be the principal owner and manager. The other company is to be called the Western Power Company, and will furnish light and power in Mescota, Newaygo, Oceania, Muskegon, Kent and Otsego counties. The officers of the old company will control this concern. Its capital stock will be $300,000.

MASSACHUSETTS ELECTRIC DEAL APPROVED.—The Gas Commission of Massachusetts has approved the joint petition of the Edison Electric Illuminating Company and the Massachusetts Gas Companies for the sale of the electric plants of the Boston Consolidated Gas Company; the Chelsea Gas Light Company; the Waltham Gas Company, and the Newton & Watertown Gas Light Company to the Edison Company. The price to be paid for the electric end of the Boston Consolidated Company is $1,300,000; for the Chelsea plant, $350,000, the Newton & Watertown, $500,000, and for the Waltham, $600,000.

ROCKLAND (N. Y.) RAILROAD COMPANY BONDS.—The Public Service Commission, Second District, of New York has received an application from the Rockland Railroad Company, which proposes to build electric railroad lines throughout Rockland County, for permission to issue bonds in the amount of $2,767,000, and for increase of its capital stock from $100,000 to $630,000, and permission to issue stock up to the total of its capital as so increased. The proposed road is to have a total mileage of 49.62 miles, of which 41.12 are within the State of New York. The balance is in New Jersey.

AMERICAN LOCOMOTIVE COMPANY.—The directors of the American Locomotive Company have authorized an issue of $5,000,000 of 5 per cent gold debenture notes to reimburse the treasury for money expended in improvements, and also to provide additional working capital. The improvements outlined entail an expenditure of about $3,500,000, and consist of extensions of the plants at Schenectady, Dunkirk, Pittsburgh and Richmond.

NEW HAVEN TAKES OVER TROLLEY LINE.—It is given out in Hartford that the New York, New Haven & Hartford Railroad Company, through the Connecticut Company, the trolley operating concern of the railroad, has taken over the Farmington Street Railway Company. The capital stock of this company is $189,000, of which five-sixths has been paid in. The line connects Unionville, Farmington, West Hartford and Hartford.

PACIFIC LIGHT & POWER COMPANY.—The Pacific Light & Power Company is back of a proposed $250,000 hydroelectric plant at Triangle Lake, Ore. It is proposed to furnish light and power to Eugene Junction, Springfield, Corvallis, and all other cities in the upper Willamette Valley. C. P. Houston, of Junction, is interested, and Leland Spencer, of San Francisco, is to superintend the construction of the dam and canal.

MALDEN & MELROSE GAS LIGHT COMPANY.—The Massachusetts Board of Gas and Electric Light Commissioners has approved the Malden & Melrose Gas Light Company's issue of 2000 shares of new capital stock to liquidate its $250,000 indebtedness for improvements and additions incurred in the past two years. A selling price of $140 per share for the new issue also approved by the commission.

ELECTRIC TRACTION ASSESSMENTS REDUCED.—The Board of Review of the City of Chicago has reduced the traction tax assessment by $1,000,000 for each company, which makes the Chicago Railways assessment $14,000,000, as against $8,322,285 last year; and the Chicago City Railway assessment $15,889,000, as against $11,400,000.

LOCKPORT (N. Y.) LIGHT, HEAT & POWER COMPANY.—The Public Service Commission of the Second District of New York has authorized the Lockport Light, Heat & Power Company to issue $70,000 5 per cent bonds to be sold at not less than 85. The proceeds will be used for extensions and betterments.

REPORTS OF EARNINGS.

	Gross earnings.	Expense.	Net earnings.	Charges.	Surplus.
American Cities Railway & Light Company:					
July, 1909	$483,072	$279,548	$203,524	$106,250	$97,274
July, 1908	446,835	272,109	174,726	105,742	68,984
American Pneumatic Service Company:					
Quarter ended June 30, 1909	442,487	341,862	100,615	27,569	73,046
Quarter ended June 30, 1908	357,218	304,884	52,334	22,241	30,093
American Telephone & Telegraph Company:					
July, 1909	4,101,802	205,887	3,895,915	526,015	3,369,900
July, 1908	3,787,900	173,991	3,613,909	614,493	2,999,416
Bell Telephone Company of Canada:					
Year 1908	4,580,606	3,156,332	1,424,274	409,842	1,014,432
Year 1907	4,829,657	3,785,859	1,043,798	167,592	876,206
Birmingham (Ala.) Railway, Light & Power Company:					
July, 1909	183,186	101,974	81,212	.....	.....
July, 1908	170,261	99,775	70,486	.....	.....
Brooklyn Rapid Transit Company:					
Year ended June 30, 1909	19,694,462	11,394,655	8,299,807	6,969,015	1,936,609
Year ended June 30, 1908	19,870,566	11,939,578	7,930,988	6,534,938	2,073,873
Cumberland Telephone & Telegraph Company:					
July, 1909	520,923	302,123	218,800	41,177	177,623
July, 1908	500,094	283,473	216,621	37,347	179,274
Denver Gas & Electric Company:					
July, 1909	.....	.....	75,422	33,800	41,622
July, 1908	.....	.....	60,702	32,273	28,429
Detroit United Railways Company:					
July, 1909	771,453	466,319	305,134	162,050	155,734
July, 1908	679,447	417,869	261,577	135,978	132,061
Geneva (N. Y.) Waterloo, Seneca Falls & Cayuga:					
Quarter ended June 30, 1909	23,405	13,600	9,804	.....	.....
Quarter ended June 30, 1908	23,107	13,495	9,612	.....	.....
Interborough Rapid Transit Company:					
Year ended June 30, 1909	25,775,392	10,747,443	15,027,949	11,822,770	4,589,823
Year ended June 30, 1908	24,059,299	10,722,694	13,336,605	10,856,116	3,700,659
Keystone Telephone Company:					
July, 1909	91,020	45,533	45,487	34,135	11,352
July, 1908	88,336	45,098	43,238	34,531	8,707
Montreal Street Railway Company:					
July, 1909	345,572	180,412	165,161	49,883	115,278
July, 1908	329,524	165,413	164,111	49,345	114,766
Norfolk & Portsmouth Traction Company:					
July, 1909	180,227	101,163	79,064	.....	.....
July, 1908	181,803	98,326	83,477	.....	.....
Oneonta & Mohawk Valley Railroad Company:					
Quarter ended June 30, 1909	46,172	46,548	*376	1,146	*1,522
Quarter ended June 30, 1908	46,291	44,935	1,356	1,112	244
Portland (Ore.) Railway, Light & Power Company:					
July, 1909	424,815	195,141	229,674	123,391	106,283
July, 1908	384,170	191,814	192,356	113,841	78,515
Toledo Railways & Light Company:					
July, 1909	206,564	134,221	72,343	55,539	17,804
July, 1908	199,237	111,065	87,572	71,781	15,912
United Electric Securities Company:					
Six months ended June 30, 1909	163,848	21,838	142,010	109,469	32,541
Six months ended June 30, 1908	171,604	16,225	155,379	99,065	56,314
United Railways of St. Louis:					
July, 1909	948,241	597,590	350,731	232,449	118,282
July, 1908	898,311	578,528	319,682	232,852	86,830
Warren (Pa.) & Jamestown Street Railway Company:					
Quarter ended June 30, 1909	21,030	8,740	12,280	5,265	7,024
Quarter ended June 30, 1908	20,965	10,074	10,891	7,056	3,834

* Deficit.

GENERAL NEWS

Construction News.

ANNISTON, ALA.—It is proposed to install an electric light plant in the Cositorium Theater, the equipment to include a dynamo and 10-hp gasoline engine.

DOTHAN, ALA.—The citizens have voted to issue $6,000 in bonds, the proceeds to be used for extensions to the municipal electric-light plant.

HUNTSVILLE, ALA.—It is reported that the Nashville & Huntsville Railroad Company, which proposed to construct an electric railway from Huntsville to Nashville, Tenn., has abandoned the proposition and is returning the $200,000 subscribed by the people of Davidson, Marshall and Giles counties, Tenn., and Madison County, Ala., with 4 per cent added.

FLAGSTAFF, ARIZ.—The Arizona Overland Telephone Company is making extensive improvements to the local system, including the construction of a new exchange building, installation of a new switchboard and replacing wires with cables. The Overland company recently took over the plant of the Flagstaff Mutual Telephone Company.

GLOBE, ARIZ.—The Old Dominion Company, it is said, contemplates the installation of a new pumping plant at its mines.

TOMBSTONE, ARIZ.—Preparations are being made for the installation of a large air compressor at the Tombstone Consolidated mines.

WICKENBURG, ARIZ.—It is reported that the Central Arizona Power Company is planning to install new engines in its power plant at Wickenburg.

YUMA, ARIZ.—An election will soon be held to vote on the proposition to issue $200,000 in bonds for the construction of an electric-light plant and water-works system.

LITTLE ROCK, ARK.—Plans have been approved for placing the wires of the Southwestern Telegraph & Telephone Company underground in Louisiana Street.

BISHOP, CAL.—The citizens have voted to issue bonds to establish an electric light plant in Bishop.

CEDARVILLE, CAL.—At an election held recently the citizens voted to establish a lighting district in this town.

DORRIS, CAL.—Butte Valley is to have electrical power in the near future, both for electric pumps to irrigate the land and for electric lighting. Moore Brothers, of Klamath Falls, are interested in the project. It is proposed to install a $75,000 plant on the Klamath River and erect transmission lines throughout Butte Valley to furnish electricity for lamps and motors to the towns of Dorris, Macdoel and Mount Hebron, though the main object will be the furnishing of electrical power to operate the various pumping plants throughout the valley. Many of the progressive farmers of the valley have already installed pumping plants consisting of centrifugal pumps with gasoline engines for power.

EUREKA, CAL.—At a meeting of the business men of Humboldt County held recently a committee, consisting of William S. Clark, president of the Humboldt Gas & Electric Company, and E. E. Skinner, as secretary, and others, was appointed to arrange preliminary matters for the organization of a company to construct an electric railway to connect Eureka and Redding, 100 miles in length.

EUREKA, CAL.—Arrangements are being made by J. B. Mortsolf, superintendent of the Hoopa Indian Agency, for installing an electric light plant to furnish electricity for lighting the agency buildings and grounds.

FRESNO, CAL.—The Fresno Power Company has purchased water rights and property covering power plant projects on the Kings River.

HIGHLAND, CAL.—The lighting district established by the Town of Highland has been approved by the Board of Supervisors, and bids will be called for at once for the erection of transmission lines and lamps.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has completed surveys for the proposed extension in Pomona on the Huntington Boulevard route to a point beyond Ganesha Park.

LOS ANGELES, CAL.—The Board of Supervisors has granted the petition of the residents of East Hollywood for permission to establish a highway lighting district.

NAPA, CAL.—The San Francisco, Vallejo & Napa Valley Railroad Company contemplates extending its railway from St. Helena to Calistoga, a distance of seven miles. The company is also planning another extension into Lake County with terminals at Lakeport and Clear Lake.

REDDING, CAL.—Water was turned on Aug. 18 for the first time in the south power house of the Northern California Power Company, near Manton, and 5000 hp was added to the company's electrical output in Shasta County. The water that operates this plant is used before at Volta, five miles above, where 7500 hp is developed. This plant is the fourth of the Northern California Power Company, which now generates 15,500 hp.

SAN BERNARDINO, CAL.—Application has been made to the City Council by Fred Durham, of Redlands, Cal., for a franchise to construct an electric railway on certain streets of the city.

SAN DIEGO, CAL.—The Chamber of Commerce is considering the question of extending the street lighting system in the residence district; both ornamental iron posts and porch lights are under consideration. It is said that a petition will be presented to the City Council for the proposed extension.

SAN JOSE, CAL.—The Board of Supervisors has awarded to the Los Gatos Ice, Gas & Electric Company a franchise to construct and operate transmission lines for an electric light and power system in Santa Clara County for a period of 50 years. J. D. Farwell, manager, states that the company proposes to furnish electrical service to practically all of the foothill country between Los Gatos and Palo Alto. Mayfield, Mountain View, Sunnyvale, Los Altos and vicinity will be connected with the local plant.

YREKA, CAL.—The Siskiyou Electric Power & Light Company is enlarging its Fall Creek power house to make room for the installation of an additional 1250-kw generator. The nine miles of pole line down the Klamath River to McConnell Bar is completed, and electrical energy is now being used at that point by the large dredger built by the Northern California Mining Company.

GREELEY, COL.—The Colorado Telephone Company has purchased a site, on which it proposes to erect an exchange building, to cost $25,000.

MORRISON, COL.—Preparations are being made by Denver and Eastern capitalists for incorporating a company under the name of the Home Power & Irrigation Company for the purpose of developing a large water power and irrigation project on Bear Creek, above Morrison. It is planned to take over all the water rights on Bear Creek and consolidate them and to construct a large reservoir at Evergreen, where the power will be utilized to generate electricity. The water will be carried from Evergreen through pipes down to Morrison to irrigate the lands between that section and Morrison. The minimum development will be 5000 hp, with an ultimate extension to 10,000 hp. A. B. Sanford, Dr. Waddell and Mr. Herrington, of Kansas City, are interested in the enterprise.

SOUTH BOULDER, COL.—A map and statement have been filed for the South Boulder Pipe & Ditch Line, J. C. Cooper, of Denver, president, contemplating some water rights on the Frazier River, which are to be diverted to the east side of the range by a tunnel through the Continental Divide and conducted down the bed of South Boulder Creek. According to the filings, water is to be taken from Boulder Creek and conducted about 10 miles through a ditch 6 ft. deep and 20 ft. wide, to an intake, where it will be conducted through 56 pressure pipes back to Boulder Creek with a fall of approximately 2000 ft. After using this head for power purposes, the filings claim the right to use this water again for irrigation, and supplement the supply by water taken from underflow by pumping, and thus to irrigate large bodies of land at present above ditch levels in Boulder, Adams, Arapahoe, Weld, Morgan, Logan, Sedgwick, Phillips, Yuma and Washington counties, or practically the northeastern part of Colorado.

MIDDLETOWN, CONN.—The contract for street lighting between the City and the Middletown Electric Light Company has been signed and goes into effect at once. The company will furnish electricity for arc lamps for $89.50 each per year, and is to replace the old series incandescent lamps with tungsten lamps without extra charge to the city. Under the old contract the city paid $92 per lamp per year for arc lamps.

NEW HAVEN, CONN.—Plans have been prepared by the prudential committee of the New Haven Hospital for the installation of a new electric-light plant and an ice-manufacturing plant, the cost of which is estimated at $25,000.

PUTNAM, CONN.—The Putnam Light & Power Company has purchased the old Doane electric light plant in Thompson and is operating it in connection with the Putnam plant. The company is now furnishing electricity to the French River Textile Company at Mechanicsville and is giving Thompson a 24-hour service.

ROCKVILLE, CONN.—Belding Brothers & Company, who recently purchased the Regan mills adjoining their property, are planning to make some changes to the water power privileges owned by them. It is proposed to turn the water, which has operated the three mills separately, into what is known as the old stone mill to be utilized to generate electricity to operate all the mills. An electric power plant will be installed.

HAVANA, CUBA.—The City Council has authorized an elaborate celebration of the winter holidays, which will involve considerable electrical illumination. For further information address R. J. Jimenez, Malecon, 240 altos, Havana, Cuba.

WASHINGTON, D. C.—The Edgemore Iron Company has been awarded the contract for installing new boilers with oil burners at the Puget Sound and Mare Island Navy Yards for $90,000.

ATHENS, GA.—The Athens Electric Railway Company is contemplating the installation of a 300-kw, 60-cycle railway rotary converter, contracts for which will be placed in the near future. The company is also planning to rebuild its track, contracts for which have already been placed.

ATLANTA, GA.—As a result of the passage of the Boyd bill by the Senate, it is reported that a consolidation will be effected by the interests

of the Macon Railway & Light Company, of Macon, Ga.; the Central Georgia Power Company, of Atlanta, Ga.; Griffin & Atlanta & Macon Electric Railway Company, the Macon Electric Railway and the Macon, Americus-Albany Electric Railway companies, the two last-named holding charters for interurban railways to connect the cities mentioned in their titles. The Central Georgia Power Company, it is said, will furnish electricity to operate the proposed railways. The power company is constructing a power plant on the Ocmulgee River, which when completed will have an output of 21,000 hp.

ROME, GA.—Col. Wright Willingham, of Rome, is reported to be interested in a project to construct an electric railway from Chattanooga to Atlanta, via Rome, a distance of about 160 miles.

SAVANNAH, GA.—Plans are under way which contemplate the laying of more than 30 miles of new electric railway tracks. The new project is said to be backed by interests which are identified with the Savannah Lighting Company. The latter company is making extensive improvements in its plant.

COEUR D'ALENE, IDAHO.—Investigations are being made by the water committee, consisting of J. W. Arnold, J. H. Shepard and T. A. Daughters, chairman, together with Prof. O. L. Waller, of the Washington State College, for the installation of a municipal electric light plant and water works system.

ST. MARIES, IDAHO.—The City Council has awarded a franchise to G. H. Jay to erect an electric-light plant.

CHICAGO, ILL.—Plans for the construction of a subway system that will eliminate the present loop in the downtown district and substitute eight loops, that will operate entirely underground, have been prepared by George Jackson, and are to be submitted to Mayor Busse. The cost of the system is estimated at $80,000,000. The proposed subway will be operated distinct from any existing street car or elevated railroad company, but the plans provide for sufficient space for all elevated roads to go underground within the downtown district. Space is also provided in the tunnels for telephone conduits, gas and water mains, electric light and power conduits, cold air mains, steam for power and heating, and high pressure water system, a complete and modern sewerage system and a freight service.

CHRISTOPHER, ILL.—The City Council has granted H. M. Rea, of Christopher, of the Christopher Light, Heat & Power Company, a 25-year franchise to contruct and operate an electric light plant.

EAST ST. LOUIS, ILL.—The East St. Louis and Suburban Railway Company has recently contracted for a horizontal Curtis turbine and a 200-kw, three-phase, 25-cycle, 1500 r.p.m., 13,200-volt generator.

FITHIAN, ILL.—A committee has been appointed to make investigations in regard to the installation of an electric light plant and water works system.

AURORA, IND.—We are informed that the Engineering Equipment Company will soon be in the market for generators, oil engines, rails, crossties and other railway equipment to be used in the construction of the proposed electric railway to be built by the company, which is to connect Aurora and Rising Sun. Most of the surveys have been completed and rights-of-way are being secured. The company has been granted a franchise to build its railway in Aurora.

COLUMBIA CITY, IND.—The City Council has authorized the purchase of three boilers for the municipal electric light and water works plant. Bids will be opened Sept. 11.

EVANSVILLE, IND.—The Evansville, Suburban & Newburg Railway Company is contemplating the extension of its railway from Evansville to Henderson and Uniontown, Ky.

NOBLESVILLE, IND.—The large dam, for electric power purposes, which is being built by the White River Heat, Light & Power Company, one mile north of this city on White River, and which has been under construction for nearly four years, the work having been delayed by injunction proceedings and lack of financial backing, will be completed by Sept. 15. The company is negotiating with Elwood, Tipton, Lebanon and other surrounding towns and cities to furnish electrical service.

PORTLAND, IND.—It has been decided to hold an election to vote on the proposition to install a new electric light plant or whether to enter into another contract with the Bimel Manufacturing Company, which has furnished the city with electricity for operating the municipal lighting system for the past two years. The people are anxious to secure a reduction in the price of electricity for lamps and motors and many think this can be done by the city owning a plant.

ROCKVILLE, IND.—The Sanborn Marsh Electric Company, of Indianapolis, Ind., has been awarded the contract for electrical work for the proposed tuberculosis hospital to be erected at Rockville, for $3,236. Henry Moore is president of commission.

COUNCIL BLUFFS, IA.—The contract for the construction of the terminal elevator with a capacity of 100,000 bushels at West Council Bluffs, for the Middle West Elevator Company, of Omaha, Neb., has been awarded to Moulton & Evans, of Minneapolis, Minn. The elevator will be equipped with electrically operated machinery capable of handling 25 cars of grain per day.

DES MOINES, IA.—The contract for the electrical work on the new coliseum has been awarded to the Des Moines Electric Company for $2,100.

DES MOINES, IA.—The Des Moines City Railway Company is planning to construct 10 miles of new track, work on which will soon begin.

EARLHAM, IA.—The contract for the construction of the municipal electric light plant and water works has been awarded by the Town Council to Joseph A. Bortenlanger, of Omaha, Neb., for $16,696. An alternating-current lighting system will be installed.

SIOUX CITY, IA.—The Sioux City Service Company is planning to erect a new boiler room, 131 x 77 ft., in which four new boilers will be installed. The cost of the work is estimated at $75,000.

ERIE, KAN.—The City is considering the installation of an electric light plant, sewers and water works system, to cost about $50,000. J. C. Denison is city clerk.

MANHATTAN, KAN.—Work has commenced on the construction of the transmission line of the Rocky Ford Dam & Power Company from its power plant at Rocky Ford to Manhattan. The posts are of concrete, 25 ft. long. The company expects to have its plant ready to put in operation by January, 1910, and will furnish electricity in Manhattan and probably Junction City and Fort Riley.

WINCHESTER, KY.—B. R. Jonett, M. T. McEldowney and John E. Garner have submitted a proposition to the citizens of Bath and Bourbon counties offering to construct an electric railway from Winchester to Sharpsburg if the towns will give the right of way and a bonus of $100,000.

HOUMA, LA.—The new municipal electric light plant has been completed and will be put in operation about Sept. 1. The street-lighting system includes about 200 lamps. Main Street is to be lighted by arc lamps and the other streets by 50-cp tungsten lamps.

WATERVILLE, MAINE.—Bids will soon be asked for by the Messalonskee Electric Company for the construction of a new power house at Rice's Raps on the Messalonskee stream. The dam will be 20 ft. high, built of reinforced concrete.

ATHOL, MASS.—Work will soon commence on the construction of the high-tension transmission line of the Athol & Orange Electric Company from Wendell Depot to Athol. The poles will be 60 ft. high and the line will be operated at a pressure of 14,000 volts.

BOSTON, MASS.—The State Board of Gas and Electric Commissioners has issued its approval of the sale of the electric properties of the Boston Consolidated Gas Company, of Boston, Mass.; The Chelsea Gas Light Company, of Chelsea, Mass.; Newton & Watertown Gas Light Company, of Newton, Mass., and the Waltham Gas Light Company, of Waltham, Mass., to the Edison Illuminating Company, of Boston, Mass. The Edison company also asked for the approval of the sale of the gas franchises and property of the Waltham Gas Light Company and the Newton & Watertown Gas Light Company, which was granted by the commission.

BOSTON, MASS.—The Fitchburg division of the Boston & Maine Railroad Company is to be equipped with telephones to take the place of the telegraph in the despatching of trains. It is likely that other divisions of the company will also be equipped with telephones.

CHESTER, MASS.—The Chester Electric Light Company has petitioned the Massachusetts Gas & Electric Light Commissioners for authority to issue $5,000 in capital stock. A new company has been formed to take over the plant and holdings of the plant operated by E. Leroy Gardner. The plans of the promoters is to pay $8,000 for the property, for which $5,000 in capital stock will be taken in part payment and an issue of bonds will be secured by a mortgage on the property to cover the remainder. Clara M. Gardner is president of the new company; D. Clayton Fay, vice-president, and E. Leroy Gardner, treasurer and general manager.

DALTON, MASS.—Contracts have been awarded by the Byron Weston Company for machinery for its new mill, now under construction, as follows: To the Robb-Munford Boiler Company, of Boston, Mass., for an 84-in. boiler; a 1000-hp turbo-generator set, to the Allis-Chalmers Company, of Milwaukee, Wis., to be installed in the Defiance mill. The new generator will be capable of furnishing electricity to drive the entire plant. Ten new electric motors will be installed in the new mill and the Centennial mill. A new smokestack, 150 ft. high, will be erected at the Defiance mill. The company is installing an electric railway to connect the different mills.

GARDNER, MASS.—The branch transmission line from the main cables of the Connecticut River Transmission Company to the substation of the Gardner Electric Company at the south shore of Crystal Lake is nearly completed. Electricity for operating the local system will soon be supplied from the hydro-electric plant at Vernon, Vt. The small motors supplied to individual firms and other apparatus in Gardner have been changed to meet the requirements of the new system. The Ashburham municipal lighting system, electricity for which is supplied by the Gardner Electric Company, is to be changed from 133 cycles to the new system. The municipal plant in Templeton will also be changed, which also secures electricity from the Gardner Electric Company. The local power plant of the Gardner Electric Company will be kept in reserve to use in case of emergencies.

HYDE PARK, MASS.—It is reported that the control of the Dedham & Hyde Park Gas & Electric Company has passed from the control of New York capitalists to New England men, with John Joyce, of Andover, Mass., as president, and Vincent Goldthwaite, secretary and treasurer.

LONGMEADOW, MASS.—The United Electric Company, of Springfield, Mass., has applied to the Council for a franchise to extend its transmission lines to Longmeadow to furnish electricity for lamps and motors.

NORTON, MASS.—The Sturdy Electric Lighting Company, it is reported, is contemplating extending its transmission lines through Barrowsville and the Center.

RUSSELL, MASS.—John Donahue, of Springfield, Mass., has been awarded the contract to complete the repairs on the dam and construction of a power house for the Russell Falls Paper Company.

WORCESTER, MASS.—The Connecticut River Power Company has applied to the City Council for authority to furnish electricity for lamps and motors in Worcester. The company has already secured franchises in some of the towns west of this city.

DETROIT, MICH.—It is reported that bids will soon be called for extensions to the municipal electric light plant and water-works system, plans for which have been prepared by Loweth & Wolf, engineers, St. Paul, Minn.

DETROIT, MICH.—The Home Telephone Company of Michigan has been organized to take over the properties of the Home Telephone Company of Detroit and the Interstate Long Distance Telephone Company. The new company is capitalized at $5,000,000 and contemplates an issue of $10,000,000 in bonds, and also making immediate extensions, which will involve an expenditure of about $1,000,000.

GRAND RAPIDS, MICH.—It is reported that the Grand Rapids Muskegon Power Company will be dissolved and two separate companies formed under the names of the Muskegon Production Company and the Western Power Company. The Muskegon Production Company is capitalized at $350,000, and will furnish electricity in Newaygo and Mecosta Counties. J. G. Emory, Jr., of Muskegon, is the principal owner. The Western Power Company has a capital stock of $300,000 and will furnish electrical service in Mecosta, Newaygo, Oceania, Muskegon, Kent and Otsego Counties. The officers of the old company will control the new corporations.

KALAMAZOO, MICH.—Application has been made to the City Council by J. P. Clark, vice-president of the Michigan United Railways Company for a franchise to construct an electric railway on several streets in this city.

MASON, MICH.—The installation of a new dynamo in the municipal electric light plant is under consideration.

PINE RIVER, MINN.—C. H. Smith, of Duluth, Minn., B. E. Wideman and E. L. Forbes, of Pine River, have applied for a franchise to install an electric light plant in Pine River.

ROCHESTER, MINN.—It is reported that an election will be held to vote on the proposition to issue bonds for improvements to the municipal electric light plant.

TYLER, MINN.—Contracts have been awarded for the construction of an electric light plant and water works system to the Minneapolis Steel Machinery Company, of Minneapolis, Minn., and Andreas Swenson, of Tyler, for $13,133.

BRANDON, MISS.—The Brandon Machinery & Lumber Company will install an electric light plant if sufficient patronage is guaranteed to pay for installation of same.

JACKSON, MISS.—W. G. Clark, superintendent of the Capital Light & Power Company, writes that the company will soon install a 500-kw unit in its plant.

LATHROP, MO.—An election will be called to vote on the proposition to issue $7,500 electric-light bonds.

ST. LOUIS, MO.—The Union Electric Light & Power Company has made modifications in its "guarantee requirements," which will result in a reduction in lighting rates to its consumers. The company has heretofore demanded a guarantee of $2 a month on lighting contracts and $3 per month on power contracts. The minimum charge on lighting contracts is now $1 per month and on power service contracts $1.50 a month. Consumers can if they choose combine their light and power service in one contract. Heretofore two contracts have been made. But one contract cannot be made on the rates of the power-service schedule.

BUTTE, MONT.—The property of the Boston & Corbin Company in the Corbin camp will be equipped to be operated by electricity in the near future. Electrical energy for operating the mines will be secured from the electric plants near Helena, Mont. The transmission line is already completed. The question of erecting a smelter in the Corbin district is under consideration. Homer E. Emerson is superintendent.

RADERSBURG, MONT.—Plans are being prepared by Julius Berg Townsend for the construction of a hydro-electric power plant at Crow Creek Falls, on Crow Creek, about 12 miles northwest of Radersburg, in the Elkhorn division of the Helena national forest. The initial unit will be 1000 hp, which can be greatly increased by raising the dam. It is said that construction work will begin as soon as permission is secured from the forest service.

ARAPAHOE, NEB.—The contract for the construction of the water-works system and electric light plant has been awarded to N. Brooks & Sons, of Jackson, Mich. The lighting system will be installed by the Drummond Electrical Company, of Lincoln, Neb.

RALSTON (P. O. SOUTH OMAHA), NEB.—The Nebraska Traction & Power Company is planning to erect a substation, contracts for the construction of which will be placed in the near future.

RENO, NEV.—It is reported that C. D. Galvin and F. H. Hall, of San Francisco, Cal., have purchased the water rights on the South Fork of the Humboldt River, in this State, owned by Hayden Henderson and J. J. Hylton. The new owners, it is said, will develop the water power for use of the mining companies in and about Ely.

BERLIN, N. H.—Arrangements are being made by the Cascade Light & Power Company for the rebuilding of its electric plant, which was recently destroyed by fire.

MORRISTOWN, N. J.—Preparations are being made by the Morris County Traction Company to extend its railway from Denville to Boonton, a distance of three miles, work on construction of which will begin at once. David Grimg is president of the company.

WILDWOOD, N. J.—The construction of an electric railway from Cape May court house to Wildwood Junction, Grassy Sound, Anglesea and Wildwood Crest is under consideration. Augustus Hilton is said to be interested in the preject.

DEMING, N. M.—It is reported that arrangements have been completed for the installation of a central power plant of 800 hp in Deming. The equipment will include a soft coal gas-producer and Buckeye double-tandem engines direct connected to the generators. The plant will furnish electricity for pumping water to irrigate 6000 acres. The cost of the plant is estimated at $250,000.

SILVER CITY, N. M.—The Grant County Telephone Company contemplates replacing its wires in this city with cables.

BABYLON, N. Y.—The Babylon Electric Light Company has applied to the Public Service Commission for authority to increase its capital stock from $45,000 to $75,000, the proceeds to be used for construction and improvements to its plant and distributing system. The company furnishes electrical service in the Village of Babylon and in parts of the towns of Babylon and Islip, and is contemplating extending its system to Farmingdale.

BINGHAMTON, N. Y.—Plans are being made by the Binghamton Railway Company for the installation of a turbine, additional boilers and other apparatus for its power house, contracts for which have practically been closed.

BUFFALO, N. Y.—The Lackawanna Bridge Company, it is reported, will install a direct connected 300-hp Corliss engine to drive an electric generator.

EAST AURORA, N. Y.—The Buffalo Southern Railway Company, of Gardenville, N. Y., has applied to the Village Board for a franchise to construct and operate an electric railway on Main Street.

EDWARDS, N. Y.—Arrangements are being made by U. O. Webb to install an electric light plant to furnish electricity for street lamps and for commercial lighting. Electrical equipment is being installed in the grist mill owned by Mr. Webb, which will be operated by water power. A 100-hp water wheel has just been installed.

LOCKPORT, N. Y.—The Lockport Light, Heat & Power Company has received authority from the Public Service Commission, Second District, to issue $70,000 in bonds, to be sold at not less than 85.

OSWEGO, N. Y.—The Syracuse, Lake Shore & Northern Railroad Company has been granted a franchise to extend its electric railway through Oswego, a distance of about 20 miles.

PLATTSBURG, N. Y.—The Plattsburgh Light, Heat & Power Company and the Lozier Light & Power Company have been consolidated under the name of the Plattsburgh Gas & Electric Company. The new company is capitalized at $225,000 and proposes to make extensive improvements. It is proposed to extend both the gas and electric service to a large portion of the city not now supplied. The company has a water power capable of developing 2000 hp with a steam auxiliary, and a gas plant with a daily capacity of 100,000 cu. ft. The officers of the new company are: H. G. Runkle, president; George M. Cole, vice-president and general manager; Oscar J. Nichols, secretary and H. E. Bernard, treasurer.

POUGHKEEPSIE, N. Y.—Preparations are being made for the construction of the new automobile plant of the Fiat Automobile Company in Poughkeepsie, N. Y. The buildings will be equipped to be operated by electrical power throughout, electricity for which will be supplied by the local power company. Hedman & Schroen, of New York, N. Y., are the architects, and W. P. Seaver, of New York, N. Y., consulting engineer.

ROCHESTER, N. Y.—Plans for improvements to its No. 4 power station at Genesee Falls are being made by the Rochester Railways & Light Company, which include the installation of a 2000-hp general electric converter and switchboard.

WHITE PLAINS, N. Y.—Contracts will be placed during the next two weeks by the New York Central & Hudson River Railroad Company for the construction of a substation at White Plains, N. Y. George W. Kittredge is chief engineer.

KINSTON, N. C.—At an election held Aug. 24 the citizens defeated the proposition to issue $50,000 in bonds for extensions to the municipal electric-light plant.

ROCKINGHAM, N. C.—Judge Pritchard, of the United States Circuit Court on Aug. 25 signed a decree confirming the sale of the Rockingham Power Company's plant to the reorganization committee for $1,000,000. The committee is composed of Eastern capitalists who will complete at once the construction of the large hydro-electric plant located at Blewett's Falls, on the Yadkin River, owned by the company.

HENDERSON, N. C.—The capital stock of the Henderson Light & Power Company has been increased to $125,000. R. M. Oates is president of the company.

SAXAPAHAW, N. C.—J. W. Menefee and associates are interested in a project to erect a hydro-electric power plant and cotton mill.

DOUGLAS, N. D.—A company has been organized to construct a telephone system in Douglas. C. H. Crockett is secretary.

GRAND FORKS, N. D.—The contract for the construction of a municipal electric light plant was awarded to the Electric Construction Company, of St. Paul, Minn., for $29,651. Earle D. Jackson, of St. Paul, Minn., is engineer.

CLEVELAND, OHIO.—The contract for the new boiler for the municipal electric light plant was awarded by the Board of Control and Board of Public Service to the Babcock & Wilcox Company. When the new boiler is installed, it is said, that the city will be able to extend the street lighting system over nearly all the West Side.

COLUMBUS, OHIO.—The State Emergency Board, it is stated, has decided to allow an appropriation of $82,000 for the purchase of equipment for the penitentiary power plant, as no provision was made for it by the State Legislature.

DAYTON, OHIO.—The County Commissioners have granted a 25-year franchise to Thomas A. Ferneding, of the Dayton & Xenia Transit Company to construct electric railways over the Shakertown, Dayton and Wilmington pikes. It is understood that the franchise will be transferred to the Dayton, Springfield & Xenia Southern Traction Company, which was organized some time ago to extend these railways to Washington C. H.

FINDLAY, OHIO.—The Toledo, Bowling Green & Southern Railway Company is contemplating extending its electric railway to Kenton within a year.

BLACKWELL, OKLA.—Bids for extensions to electric light plant and water works system will be opened about Sept. 15. Burns & McDonnell, Scarritt Building, Kansas City, Mo., are engineers.

CRESCENT, OKLA.—At an election held Aug. 24 the citizens voted to issue $30,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system.

HYDRO, OKLA.—We are informed that contracts for the construction of water-works and electric light plant will be awarded about Sept. 20. Roy M. Felton is city clerk.

MAGNUM, OKLA.—The citizens have voted to extend the franchise of the Mangum Light & Power Company from seven to 25 years. It is said that the company will enlarge its plant.

WOODWARD, OKLA.—The Woodward Interurban Railway Company, it is reported, is making surveys for its proposed electric railway to connect Mutual, Richmond and Canton, Okla., with Buffalo and Englewood, Kan., a distance of 140 miles. Homer Wilcox and Frank Tucker, of Woodward, are interested in the project.

ASTORIA, ORE.—Preparations are being made by the Hammond Lumber Company for the construction of an electric plant on its property at the Tonguo, to furnish electricity for lamps, heating and motors for its groat plant. Electrical energy for operating the plant will be secured from the Astoria Electric Company. The cost of the work is estimated at from $75,000 to $80,000.

CONDON, ORE.—A company headed by H. V. Gates, in which local capitalists are interested, has filed water rights on the John Day River, about 12 miles above Monument. The company proposes to construct a hydro-electric plant to supply Heppner with electricity for lamps and motors.

EUGENE, ORE.—It is reported that a large hydro-electric plant will be erected on Triangle Lake, Oregon, at a cost of $250,000. The proposed plant will furnish electricity for lamps and motors in Eugene, Junction City, Springfield, Corvallis and other cities in the upper Willamette Valley. It is said that the Pacific Light & Power Company is back of the project. C. P. Houston, of Junction City, is interested in the enterprise, and Leland Spencer, of San Francisco, will have charge of the construction of the dam and canal.

PORTLAND, ORE.—Preparations are being made by the Portland Railway Light & Power Company to commence preliminary work on a new hydro-electric power plant on the east side of the Willamette River at Oregon City. The plant when completed will have an output of 45,000 hp.

REDMOND, ORE.—The Crook County Light & Power Company has commenced work on the construction of a dam located about one mile above Cline Falls, on the Deschutes River, where it is proposed to raise the water of the entire stream 20 ft.; the water will be diverted into a flume 6 ft. in depth, 20 ft. wide on the bottom and one mile long. The power plant will be erected opposite Cline Falls. It will have an output of 15,000 hp and will supply electricity for lamps in several of the towns in the Deschutes Valley and later may furnish electrical energy for electric railways.

UNION, ORE.—The citizens have voted in favor of the proposition to issue bonds for the construction of an electric light plant. F. M. Housh, of Boise, Idaho, is consulting engineer.

BENTLEYVILLE, PA.—The Council has granted the Pittsburgs, Monongahela & Washington Railways Company a franchise to construct a railway in Bentleyville. The proposed railway will connect Monongahela and Washington, a distance of 32 miles. J. W. Bridge is general manager.

BLOOMSBURG, PA.—The Columbia Power, Light & Railways Company has recently purchased a 250-kw railway rotary converter from the General Electric Company; 1600-kw of transformers from the Westinghouse Electric & Manufacturing Company and a 250-kw belted generator for railway service.

EMAUS, PA.—A 30-year franchise has been granted to the Emaus Telephone Company to construct and operate a telephone system in Emaus.

IRWIN, PA.—The Irwin & Herminie Traction Company has been organized to take over the property of the Pittsburg & Westmoreland Railway Company, which operates a railway between Irwin and McKeesport. It is said that the company will issue $40,000 in bonds for improvements.

PHILADELPHIA, PA.—Plans have been completed for lighting the Walnut Lane Bridge across the Wissahickon River in Fairmont Park. Ornamental poles are to be erected at the four terminals of the balustrades of the bridge on which will be supported five arc lamps. For lighting the center of the bridge four ornamental iron sidewalk-poles will be placed, each bearing two arc lamps. The cost of the entire lighting scheme, including both the bronze and iron posts, will be about $7,500.

PHILADELPHIA, PA.—It has been decided not to light Market Street with ornamental lamps set between the street car tracks, nor by steel arches across the street, owing to the expense, which is estimated at $200,000. It is said that the only way to provide for further illumination of the street is to erect additional lamps along the sidewalks, which will require 180 lamps, the cost of erection of which will be about $8,000, and cost of maintenance about $18,000 per year.

PHILADELPHIA, PA.—The Lehigh Valley Railroad Company has decided to adopt the telephone system for operating its trains. Work has commenced on a line between Mount Carmel and Easton. The cost of this work is estimated at about $40,000.

PITTSBURGH, PA.—The Rochester & Mars Street Railway Company is reported to have prepared plans and secured the right of way for its proposed electric railway to extend from the Baltimore & Ohio Railroad depot in Mars to Rochester, a distance of 23 miles. The cost of the railway is estimated at $400,000.

PITTSBURGH, PA.—The Pittsburgh Railways Company is contemplating the construction of a substation at the south end of the Mount Washington Tunnel. bids for which have been asked.

SUNBURY, PA.—The Edison Electric Illuminating Company is reported to have entered into a contract with Eyre-Shoemaker, contractors, to furnish 60 arc lamps and 500 incandescent lamps in connection with the contract for the construction of the classification yards at Northumberland, Pa.

NEWPORT, R. I.—Bids will be received at the office of the constructing quartermaster, Fort Adams, Newport, R. I., until Sept. 23, for construction and remodeling the electric-lighting system at Fort Adams; also for furnishing transformers, tungsten lamps, watt meters and other apparatus required in the above work. Plans and specifications can be seen at the above office and at the offices of the chief quartermasters at Governor's Island, New York, and Chicago, Ill., and depot quartermasters at Philadelphia, Pa., and Boston, Mass. For information and blank proposal forms apply to office of the constructing quartermaster, Fort Adams, Newport, R. I. Capt. C. Metcalf is constructing quartermaster.

PAWTUCKET, R. I.—The Pawtucket Electric Company is reported to have submitted a proposition to the Pawtucket Merchants' Association for improving the lighting system in the shopping district on Main Street. It is proposed to replace the present outside arc lamps with 80-cp tungsten lamps to be installed in the store windows, which will be furnished at a flat rate. The contract will call for service seven nights a week, from dusk until 11 o'clock. The company will furnish the first lamps, but repairs will be looked after by the merchants. D. C. Barnes is superintendent of the company.

ARLINGTON, S. D.—The City Council is considering the question of installing an electric-light plant in connection with the water-works system.

DEADWOOD, S. D.—A deal has been consummated whereby the Consolidated Power & Light Company, of Deadwood, S. D., has secured the controlling interest in the property and holdings of the Black Hills Traction Company. The two companies will continue to be operated as separate organizations. The traction company has a large water plant on Redwater Creek with an output of about 1200 hp and owns water rights on the creek which will develop fully as much more, and is now furnishing electricity to many of the mines and mills in and around Deadwood, and to the City of Belle Fourche.

COAL CREEK, TENN.—The Coal Creek Railway & Light Company, recently incorporated, proposes to construct an electric railway from Coal Creek to Briceville. The company will generate its own power. James Day is chief engineer.

HALLS, TENN.—The Halls Light, Water & Ice Company is extending its transmission lines to Gates and will furnish electricity for lamps and motors in that town. The company is also erecting transmission lines in parts of Halls which heretofore have not had electrical service.

CLEBURNE, TEX.—The Cleburne Water, Ice & Light Company is making arrangements for extensive improvements to its plant, which will involve an expenditure of about $30,000. The contracts have been awarded. John B. Hawley is consulting engineer.

CROSBYTOWN, TEX.—Plans are being considered for the development of the Silver Falls water power and the construction of an electric power plant for the transmission of electricity. P. L. Coonley, 1901 Indiana Avenue, Chicago, Ill., J. S. Coonley, and E. P. Bailey, both of Chicago, Ill., are interested in the project.

DALLAS, TEX.—Plans are being made by the Dallas Interurban Electric Railway Company for the construction of its proposed electric railway to connect Dallas, Fornly, Masquite, Terrell, Canton and Tyler,

for which rights of way and franchises have been secured in Dallas. The company is capitalized at $2,400,000. Henry Dorsey is president.

LUBBOCK, TEX.—Contracts have been awarded by the Lubbock Light, Ice & Power Company to the Hobson Electric Company, of Dallas, Tex., for the construction of its proposed electric plant. R. B. Ellis is manager.

TEMPLE, TEX.—The City Council has granted a 25-year franchise to the Southwestern Telephone & Telegraph Company to erect and operate its system in Temple.

QUANNAH, TEX.—The Quannah & Medicine Mound Traction Company has been formed for the purpose of constructing an electric railway to connect Quannah and Medicine Mound, a distance of seventeen miles. The power station and repair shops will be located in Quannah. The company probably will furnish electricity for lamps. We are informed that the company has not yet been incorporated and that nothing further will be done until a sufficient bonus is raised. For further information address W. L. Johnson, Medicine Mound, Texas.

MODENA, UTAH.—Contracts have been awarded by the Gold Mining & Power Company for the construction of a complete gas producer electric power plant at Modena, to the Westinghouse Machine Company, of Pittsburg, Pa. The F. C. Richmond Machinery Company will have charge of the installation of the plant, which is to be completed by Dec. 1, 1909. The plant will cost approximately $50,000 and the equipment will include two 190-hp Westinghouse bituminous gas producer engines, two 16 x 18 three cylinder gas engines with a rating of 162 hp at the altitude of 5500 ft., and two 110-kw generators with complete electrical equipment. Automatic electric pumps will be installed to keep the tanks supplied with water, and one mile of pipe line will connect the tanks with the plant. The power plant will supply electricity for the Golds Springs company and for the neighboring camps, and also for commercial lighting in Modena.

SALT LAKE CITY, UTAH.—Plans are being prepared by Jesse Knight, of Provo, for an extensive electrical transmission system in Utah. Mr. Knight proposes to establish power plants in several available canyons throughout the State, and to furnish electricity for lamps and motors to many of the towns now supplied by the Telluride Power Company, as well as towns that are without electrical service. The district through which it is proposed to operate is from Logan on the north to Nephi on the south, a belt 200 miles long and 100 miles wide through the most thickly populated portion of the State.

CLAREMONT, N. H.—Plans are being prepared for the installation of an electric power plant at the Monadnock Mills.

MONTPELIER, VT.—A new Corliss engine, recently installed in the Middlesex power plant of the Vermont Power & Lighting Company, has been put in operation, owing to the lack of water power. The engine is belted to a 350-kw generator.

PERKINSVILLE, VT.—The Soapstone Company is planning to install an electric plant with sufficient output to supply 1500 lamps.

RUTLAND, VT.—The Home Telephone Company has been given permission by the Board of Aldermen to erect and operate telephone lines in Rutland. The offices of the company are located in Randolph, Vt.

RUTLAND, VT.—The Rutland Railway, Light & Power Company is raising its dam at East Pittsford about 6 ft., which will nearly double the capacity of the reservoir.

BREMERTON, WASH.—The contract for furnishing and installing power plant equipment, including piping, pumps, condensers, heaters, etc., at the navy yard, Puget Sound, Wash., was awarded to the D'Olier Engineering Company, of Philadelphia, Pa., for $57,950.

CENTRALIA, WASH.—The North Coast Railroad Company has filed on an appropriation of water from the headwaters of the Cowlitz River. The water is to be carried a distance of six and a quarter miles to the site of a power plant which the company proposes to build on Lake Frederick. The company will furnish electricity in Lewis, Pierce, Kittitas, Yakima and King counties for manufacturing, domestic and other purposes.

EDMONDS, WASH.—The capital stock of the Independent Telephone Company, of Edmonds, has been increased from $5,000 to $10,000.

METHOW, WASH.—The Methow Irrigation, Power & Traction Company has commenced work on the construction of its power plant on the Methow River, six miles above Winthrop. The entire volume of the north branch of the river will be utilized, with a 140-ft. fall, to generate electricity. The company will install at once a 1000-hp unit, which it expects to put in operation in four months. The plant when completed will have an output of 4000 hp, which will be distributed in Methow and Okanogan valleys. Contracts have been made to furnish 800 hp for pumping water for irrigation purposes to the high bench lands in upper end of the Methow Valley, and about 200 hp will be used by the Town of Twisp for water works and lighting systems.

SEATTLE, WASH.—The Seattle Electric Company has awarded a contract to the Stone & Webster Engineering Corporation, Boston, Mass., for the construction of a new substation at Ballard, from which electricity will be supplied to operate the new railways in the northern part of Seattle. This station will also supply electrical energy to the Puget Sound International Railway & Power Company, which is constructing an interurban railway between Seattle and Everett. It will have an ultimate rating of 25,000 kw in railway motor-generator sets and 4000 kw in light and power equipment. Energy will be received from the generating station over a 13,800-volt, three-phase transmission line. It is proposed to install one 500-kw motor-generator set immediately, adding a 1000 kw set and two 1000-kw, 13,800-2200-volt transformers in the fall, which will give the station 1500 kw in railway machines and 2000 kw for lamps and motors.

SNOHOMISH, WASH.—J. E. Wickstrom, of Seattle, Wash., is reported to have purchased the property and holdings of the Snohomish Electric Light & Water Power Company, and is planning to partly reconstruct the distributing system.

TACOMA, WASH.—Frank C. Kelsey, special engineer for the city, has completed surveys for the city power plant and is now at work on the surveys for the transmission line to the city. Plans and details are to be ready so that contract can be let before the first of the year. A reservoir will be created by a dam 45 ft. high and 300 ft. long. Plans call for the development of 30,000 hp. A tunnel 10,000 ft. long will be constructed. Water will be carried across the river by a riveted steel pipe, supported by concrete arches. About a year will be required to build the plant.

TENINO, WASH.—Plans are being prepared by the Tenino Light, Power & Water Company to construct a dam at the headquarters of the Skookumchuc River for power purposes. The dam will be located about 20 miles from Centralia and about 15 miles from Bucoda. Samuel W. Fenton is president of the company and W. Doan Hayes, secretary.

PARKERSBURG, W. VA.—The Parkersburg, Marietta & Interurban Railway Company is planning to extend its railway across the Little Kanawha River in Parkersburg and from Marietta, through Lowell and Coal Run to Beverly, Ohio.

WHEELING, W. VA.—The County Commissioners have granted the City & Elm Grove Railroad Company a franchise to extend its electric railway around Wheeling Park and Park View.

APPLETON, WIS.—A. L. Gettys and C. L. Robins, of Chicago, Ill., are reported to be promoting the construction of an electric railway from Appleton, Wis., to Menominee, Mich., via Seymour, Oconto, Green Bay and Marinette, Wis.

GRAND RAPIDS, WIS.—We are informed that the Electric & Water Company is contemplating rebuilding its entire distributing system. M. N. Weeks is manager.

BRUCE, WIS.—The Wisconsin Telephone Company has purchased a controlling interest in the Chippewa Valley Telephone Company, which has been reorganized with the following officers: W. A. Blackburn, of Bruce, president; Glenn H. Williams, of Bruce, secretary; O. H. Seymour, of Milwaukee, treasurer and manager, and P. J. Skolsky, of Eau Claire, superintendent. The company proposes to erect copper wire along the lines at once and make direct connection with the Twin Cities.

CHEYENNE, WYO.—The Rocky Mountain Bell Telephone Company is planning to construct a new telephone line between Laramie and Rawlins, and also the reconstruction of the main telephone line between Rawlins and Salt Lake City.

LACOMBE, ALB., CAN.—The town of Lacombe is now without electrical service owing to the washing out of the dam of the Blindman's River & Power Company. It is said that there is little prospect of the service being resumed this year.

CHILLIWAC, B. C., CAN.—The Puget Sound Ditch & Dredging Company has secured the contract for the construction of Section 3, 12 miles in length, of the British Columbia Railway Company's electric line between Chilliwac and New Westminster. Another section will be let shortly.

KAMLOOPS, B. C., CAN.—The Board of Trade is considering the advisability of building a long-distance telephone line to Grande Prairie, as neither the British Columbia Telephone Company nor the Provincial Government can be induced to do so.

CHIPPEWA, ONT., CAN.—Announcement has been made by Reeve W. E. B. McKenzie that the Electrical Products Company, of which F. A. FitzGerald and P. McM. Bennie, electro-metallurgical chemists, of Niagara Falls, N. Y., are principal owners, is planning to locate a factory in Chippewa. Five acres of the old racecourse have been purchased for a site, and it is said that work will commence at once on construction of the buildings. A contract has been made with the Ontario Power Company to furnish 1000 hp as soon as the plant is completed.

MIDLAND, ONT., CAN.—The Simcoe Railway & Power Company is reported to have commenced work on the construction of its proposed power plant at Big Chutes on the Swern River, 30 miles from Midland. The company proposes to build an electric railway to connect Penetanguishene, Midland, Victoria Harbor, Waubaushene and Coldwater. C. H. and P. H. Mitchell, electrical engineers, of Toronto, Ont., have charge of construction of the plant. Douglas L. White and James Playfield, of Midland, are interested in the company.

NORTH BAY, ONT., CAN.—The Nipissing Electric Company is building a power plant, located 19 miles from North Bay, and will furnish electricity in this town. Smith, Kerry & Chace, of Toronto, Ont., are consulting engineers.

TORONTO, ONT., CAN.—The city, it is said, will soon ask for bids for supplies, including copper and aluminum conductors, poles, cross arms, pins, braces, etc. For further information apply to the Electrical Department, City Hall, Toronto.

MONTREAL, QUE., CAN.—Announcement has been made by the Montreal Light & Power Company that a reduction will be made in the price of electricity for lamps, to take effect Oct. 1, 1909. On and after that date the charge will be 15 cents per kw-hour, less 33 1-3 per cent., making the price 10 cents per kw-hour, which is the same rate charged before the consolidation of the present companies. W. McLea Walbank is vice-president of the company.

New Industrial Companies.

THE APPLEGATE SANITARY VACUUM SWEEPING COMPANY, of Hoboken, N. J., has been incorporated with a capital stock of $100,000 to manufacture sanitary sweepers. The incorporators are: E. J. Forhan, H. M. Browne and J. J. Harper, all of New York, N. Y.

THE CALIFORNIA ELECTRIC AUTO COMPANY has been chartered, with a capital stock of $50,000, by M. A. Gallivan, I. U. Pepler, T. M. Kelly, H. T. Stuart and G. Gallagher.

THE DEXTER-CHAPMAN ENGINEERING COMPANY, of Arlington, N. J., has filed articles of incorporation, with a capital stock of $25,000, for the purpose of doing a general contracting and engineering business. The incorporators are: Eliot Norton, Alex. H. Jackson and J. L. McCord, all of New York, N. Y.

THE ECLIPSE ELECTRIC ARC LIGHT COMPANY, of New York, N. Y., has been incorporated by George H. Shuman, Nathan C. Solomon and Robert E. Love, all of New York, N. Y. The company is capitalized at $15,000 and proposes to do electrical work.

THE ELEVATED MONO-RAILWAY COMPANY, of Wilmington, Del., has been chartered with a capital stock of $1,000,000 by George G. Schroeder, of Washington, D. C.; Charles G. Guyer and S. E. Becker, of Wilmington, Del.

THE ENGINEERING BUREAU, of New York, N. Y., has been incorporated by Nathan J. Mitchell, Louis B. Abel, Michael G. Connolly, of 7 Pine Street, New York, N. Y., for the purpose of doing a general engineering business manufacturing storage batteries, etc. The company is capitalized at $2,000.

THE FLINT SANITARY MOUTH PIECE COMPANY, of Saranac Lake, N. Y., has been chartered with a capital stock of $25,000 to manufacture telephone, telegraph, musical and surgical instruments by B. B. Flint, G. A. Rutherford and A. K. Botsford, all of Saranac Lake, N. Y.

THE HAZARD ENGINEERING COMPANY, of Bates, N. Y., has been chartered with a capital stock of $100,000 for the purpose of manufacturing automobiles, and marine gasoline engines, by Ernest C. Hazard, George E. Hazard, William J. Robinson, all of Rochester, N. Y., and John Bennett, of Buffalo, N. Y.

THE HERZOG ELEVATOR SIGNALS COMPANY, of Newark, N. J., has been chartered, with a capital stock of $500,000, by F. B. Herzog, of New York, N. Y., and E. C. Lum and C. W. Farie, of Newark, N. J. The company proposes to manufacture elevator signals and appliances.

THE INLAND CONSTRUCTION COMPANY, of New York, N. Y., has been incorporated by H. C. Mitchell, Harry T. Ramsey and W. N. Wolfe, all of New York, N. Y. The company is capitalized at $100,000 as general contractors to build roads, bridges, subways, etc.

THE KEYSTONE ENGINE & MANUFACTURING COMPANY, of Wilmington, Del., has been chartered with a capital stock of $100,000 by John J. Taylor, Martin Simon, both of Dallastown, Pa., and J. M. Frere, of Wilmington, Del.

THE MUMFORD MANUFACTURING & SUPPLY COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $25,000, for the purpose of manufacturing belt lacing devices, tools, electrical machinery and implements, etc. The incorporators are: F. A. Schultz, A. R. Costigane, F. C. Wilde, of New York, N. Y.

THE NATIONAL MOTORS COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $2,000 by B. S. Mantz, John R. Turner and L. H. Gunther. The company proposes to manufacture motors, engines, machines, automobiles, etc.

THE NEW YORK SELF-WINDING ELECTRIC CLOCK COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $50,000 for the purpose of manufacturing electric self-winding clocks, batteries, etc. The incorporators are: Stephen W. Livingston, Herbert A. St. George and C. Royall Frazier, all of New York, N. Y.

THE PACIFIC ELECTRIC AUTO COMPANY has been incorporated, with a capital stock of $50,000, by W. E. Williams, F. S. Van Trees, G. E. McCrea, F. J. Gobel, A. A. Brewer, P. W. Smyly and C. A. Lee.

THE PHOENIX METER COMPANY, of Camden, N. J., has been incorporated with a capital stock of $60,000 to manufacture gas, water, and electrical meters. The incorporators are: George H. Hobdell, Leon A. Stecklair, George H. Lucas and Frederick Smith, all of Camden, N. J.

PRENTICE-STURGES ENGINEERING & CONSTRUCTION COMPANY, of Scranton, Pa., has been incorporated with a capital stock of $300,000 by Clarence P. Sturgis, Dwight S. Prentice and Jesse Dimmick, of Scranton, Pa.

THE SHEFFIELD GAS POWER COMPANY, of Kansas City, Mo., has been organized, with a capital stock of $150,000, to take over the property, patents, good-will and charter rights of the Weber Gas Engine Company, which was declared bankrupt in June. George M. Hawes is president; Freeman Field, vice-president and general manager, and Henry C. Page, secretary.

THE STEWART CONSTRUCTION & ENGINEERING COMPANY, of Tulsa, Okla., has been chartered with a capital stock of $10,000 by Charles E. Stewart, George A. Stewart and Philip Kates.

THE TINGLEY ELECTRIC COMPANY, of Green Bay, Wis., has been chartered with a capital stock of $6,000, to do general electrical construction work and to deal in electrical and gas supplies. Joseph L. Mueller is president and John B. Tingley, secretary, treasurer and general manager.

THE TYGARD ENGINE COMPANY, of Plainfield, N. J., has been chartered with a capital stock of $250,000 by Guy M. Neagley, Fred C. Tygard and William R. Buhl, all of Pittsburgh, Pa.; Elizabeth E. Tygard and Asa F. Randolph, all of Plainfield, N. J. The company proposes to manufacture the "Tygard engine," motor cars and carriages, etc.

THE UNITED WATER POWERS COMPANY, of Wilmington, Del., has been chartered with a capital stock of $1,000,000 by F. R. Hansell, George H. B. Martin and S. C. Seymour, all of Philadelphia, Pa.

THE VERMILYE & POWER COMPANY, of New York, N. Y., has been chartered by F. M. Vermilye, F. Paul and T. Jaeckel, all of New York, N. Y. The company is capitalized at $25,000 and proposes to deal in machinery, hardware, rails and railroad appliances, and to construct, and equip railroads, mines, etc.

THE WELCHEL ELECTRIC COMPANY, of Anderson, Ind., has filed articles of incorporation with the Secretary of State. The company is capitalized at $25,000, and proposes to establish and operate a plant to manufacture magnetos and general electrical appliances and machinery, and will also carry on a general repairing business. B. Welchel, J. W. Jones, and A. S. McCall are directors.

THE WESTERN TELEPHONE MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated, with a capital stock of $25,000, to manufacture telephone apparatus. The incorporators are: Horace E. Anderson, N. E. Simonton and Harry P. Simonton.

THE WIND ELECTRIC POWER COMPANY, of Eau Claire, Wis., has been chartered by H. T. and F. A. Lange, of Eau Claire, and others to manufacture an invention to generate electricity through wind power.

THE WINDES & RUSSELL NORTH SHORE ENGINEERING COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $2,500 by Z. F. Windes, Frank A. Windes and Marx A. Stockley. The company proposes to do a general civil engineering business.

New Incorporations.

CLYDE, GA.—Articles of incorporation have been filed for the Savannah Hydro-Electric Company with a capital stock of $300,000 with the privilege of increasing it to $1,000,000 by George H. Miller and Samuel K. Platshek. The company, it is said, will construct hydro-electric plants in Georgia, Alabama, South Carolina and Florida, which are controlled by D. G. Zeigler & Company, of Jacksonville, Fla. The company will have its main office at Savannah, Ga. For further information address D. G. Zeigler & Company, of Jacksonville, Fla.

SAINT MARIES, IDAHO.—Articles of incorporation have been filed for the St. Maries Light & Power Company with a capital stock of $50,000 and the following named directors: P. T. Sweney, of St. Maries; C. C. Prost, of Great Falls, Mont., and G. H. Jay, of St. Maries. The company proposes to generate and sell electricity.

GALESBURG, ILL.—Articles of incorporation have been filed for the Abington Light & Power Company with a capital stock of $30,000 to construct and operate an electric-light plant. The incorporators are: J. Welsh, A. K. Hardy, Judd Haryzell, of Galesburg, Ill.

KANKAKEE, ILL.—Articles of incorporation have been filed for the Kankakee & Urbana Traction Company by R. F. Cummings, George M. Bennett, Ira N. Palmer, W. J. West, Upton Asahub, C. E. Thrasher, F. J. Hennessy, W. J. Brock and W. D. Moore, Jr. The company is capitalized at $200,000 and proposes to construct an electric railway from Kankakee to Piper City.

QUINCY, ILL.—The Quincy, Mount Sterling & Northeastern Traction Company has been incorporated to construct an electric railway from Quincy to Liberty, Mount Sterling and Rushville. The capital stock is placed at $5,000 and the incorporators are: Henry A. Gardner, Henry L. Stern, Henry A. Gardner, Jr., Abel Davies, William F. Anderson, Julius H. Masser, Herbert J. Friedman, M. M. Hart, G. H. Bent, F. P. Losier and Charles T. Farson.

RENSSELAER, IND.—The Home Telephone Company has been incorporated to build a system of telephones covering the greater portions of Jasper, White, Newton and Porter Counties, with principal exchange in Rensselaer. Frank Welsh is president.

DENNISON, IA.—The East Boyer Telephone Company has been incorporated, with a capital stock of $5,000, by H. Chapman, T. Chapman, James North, David Bell, Geo. W. Slater and others.

EAST HEBRON, MAINE.—Articles of incorporation have been filed for the East Hebron Telephone Company with a capital stock of $10,000 by A. M. Fogg, F. J. Dunbar, of East Hebron; Everett E. Johnson, W. H. Packard, George E. Needham, W. W. Harrington and Ora P. Brown, of Hebron, Maine.

BALTIMORE, MD.—The Baltimore & Eastern Shore Railway Company has been incorporated by William H. Fehrenfeld, Charles H. Knapp, E. A. Davis, E. T. Jones and others, of Baltimore, Md. The company is capitalized at $50,000 and proposes to construct an electric railway from Baltimore to Cambridge with a ferry connecting Bay Shore and Kent County.

TYNGSBORO, MASS.—The Tyngsboro Electric Light Company has been organized and the following named officers elected: Perry A. Flint,

president, Albert A. Flint, vice-president and treasurer, and Charles P. Littlehale, clerk.

LANSING, MICH.—Articles of incorporation have been filed with the Secretary of State by 18 power companies with a total paid in capital stock of $3,200,000. L. A. Wood, of New York, N. Y.; George E. Hardy, of Englewood, N. J., and E. Clark, of Detroit, Mich., are the principal stockholders of the various companies. The companies, it is said, will generate gas and electricity for lighting, heating and fuel. Of the new concerns 14 are water companies, the incorporators of which are: E. F. Loud and H. K. Loud, of Ausable, Mich., each of whom holds one share of stock, and L. A. Wood, of New York, to whom is credited the other 998 shares. In the second group are the Saginaw Power Company, capitalized at $1,000,000; Bay City Power Company with a capital stock of $500,000 and the Pontiac Power Company, the capital stock of which is placed at $200,000. The stockholders of the above companies are: George E. Hardy, of Englewood, N. J.; W. M. Eaton and J. C. Weadock, of New York, N. Y. The Charlotte Power Company with a capital stock of $50,000 is chartered by George H. Clark, E. Clark and George A. Crawford, of Detroit, Mich. Mr. Hardy is a member of the firm of Hodenpyl, Walbridge & Company, of New York, N. Y. He is also secretary, treasurer and director in many Michigan lighting companies. The companies will operate principally in Alcona, Oscoda, Iosco, Arenao and Bay counties. The companies propose to develop the power of the Ausable River, which runs through a wild section of the northern part of the lower penisula of Michigan.

WYANDOTTE, MICH.—The Detroit River Telephone Company has been organized and the following officers elected: H. Lord, of Trenton, Mich., President; Henry Roehrig, of Wyandotte, Mich., Vice-President; M. A. Losee, of Trenton, Mich., secretary, and C. F. Babcock, of Wyandotte, treasurer. The company has taken over the property and holdings of the Interstate Telephone Company.

LOUISVILLE, MISS.—Articles of incorporation have been filed for the Winston Telephone Company with a capital stock of $10,000 by G. W. Jones, J. D. Fulton and others.

JOPLIN, MO.—The Empire District Electric Company has been incorporated with a capital stock of $6,000,000 for the purpose of taking over by consolidation the properties and holdings of the Consolidated Light, Power & Ice Company, of Joplin; Joplin Light, Power & Water Company and Galena Light & Power Company and to purchase 57 per cent of the stock in the Spring River Power Company, which was recently acquired by Henry L. Doherty & Company, of New York, N. Y. The new company proposes to issue bonds to the amount of $6,000,000, of which $1,250,000 will be issued immediately. Plans have been prepared for the construction of a large power plant on Spring River, near Joplin, Mo., where the Spring River Power Company now owns and operates a plant with an output of 10,500 hp. It is hoped to have the new plant in operation by Jan. 1, 1910.

MANCHESTER, N. H.—The Hampstead & Haverhill Electric Railroad Company has been incorporated for the purpose of constructing an electric railway from Manchester to Derry, via Hampstead. The incorporators are: Arthur M. Emerson, of Hampstead, N. H., president; Albert A. McReel, of Exeter, N. H., secretary and treasurer; Roswell Annis, of Manchester, N. H.; directors, Henry T. Rosewell, of Derry, N. H., and George A. Sawyer, of Atkinson, N. H.

ALDER CREEK, N. Y.—The Alder Creek Telephone Company has been incorporated, with a capital stock of $2,000, by Thomas Jones, of Boonville, N. Y.; Willis Wheeler and John I. Morris, of Alder Creek.

ATLANTA, N. Y.—The Atlanta Home Telephone Company, of this city, has been chartered with a capital stock of $3,000. Among the incorporators are: B. C. Booth, R. W. Landers and Charles Hanan, all of Atlanta.

KULM, N. D.—The Farmers' Union Telephone Company has filed articles of incorporation with a capital stock of $15,000. The incorporators are John Meidinger, of Hellwig, N. D.; Gottleib Sandau, of Kulm, N. D.; Philip Woehl, of Kulm, and others.

LA MOURNE, N. D.—The Oakes Junction Independent Mutual Telephone Company has been incorporated by C. A. Malm, A. Faruenburg and G. J. Schmidt, all of La Mourne, N. D.

MERRICOURT, N. D.—Articles of incorporation have been filed by the Dickey County Telephone Company. It has an authorized capital stock of $25,000, and the incorporators are: C. W. Sullivan, J. N. Crabtree and Heinbold Hasz, all of Merricourt.

TAYLOR, N. D.—The People's Telephone Company has been chartered with a capital stock of $10,000 by S. L. Price, of Taylor, N. D.; E. Paulson, of Knife River; A. J. Hennings, of Emerson, N. D., and others.

NEWCOMERSTOWN, OHIO.—The Newcomerstown & Postboy Telephone Company, capitalized at $500, has been incorporated by I. W. George and others, and expects to construct a telephone line from Newcomerstown to Postboy.

DACOMA, OKLA.—The Citizens' Telephone Company has been chartered with a capital stock of $1,000 by Frank Born, A. W. Lewis and C. W. Kendricks, of Dacoma.

RIPLEY, OKLA.—The Olive Grove Telephone Company, of Ripley, has been incorporated by J. H. Bennett, Harry Greer and W. F. Tietz, all of that city.

STILLWATER, OKLA.—Articles of incorporation have been filed by the Payne County Rural Telephone Company, of this city. It has an authorized capital stock of $1,500. Among those interested are: H. A. Jones, O. W. Triggs and S. M. Stanley, all of Stillwater.

WESTVILLE, OKLA.—The Westville Electric Light & Power Company has been incorporated, with a capital stock of $10,000, by P. J. Dore, W. T. Tipton, H. G. Noeland and T. E. Sheffield.

EUGENE, ORE.—The Eugene-Pacific Western Railroad Company has been chartered to take over the property and holdings of the Eugene-Pacific Electric Railway Company, which proposed to construct an electric railway from Eugene to Florence, a distance of about 40 miles. The incorporators are: F. J. Bergot, Joseph Fellman and F. A. Anderson, all of Eugene.

WOODBURN, ORE.—Articles of incorporation have been filed for the United Telephone Company, with a capital stock of $20,000, by W. H. Waterbury, Blaine McCord and William Mishler.

DENVER, PA.—The Intercourse Telephone & Telegraph Company has been granted a charter with a capital stock of $10,000. The incorporators are: Willis R. Knox, John M. Beam, W. J. Caldwell, P. B. Buckwalter, Augustus M. Rodgers, Chester A. Diller, Martin D. Murtz and R. K. Lindsay. Willis R. Knox is treasurer.

HARRISBURG, PA.—Charters have been granted to the Hemlock, West Hemlock and Valley Electric Companies to operate in Columbia County. Each of the three companies has a nominal capital of $3,000, and E. R. Stonsler is president.

TOPTON, PA.—The East Rural Telephone Company has been organized with R. Frank Harpel as president. The company will connect with the Bell Telephone Company's lines at Kutztown.

RICHBURG, S. C.—The Richburg Telephone Company has been incorporated, with a capital stock of $500, by R. H. Ferguson, J. O. Barber and others.

TRAVELERS REST, S. C.—The Travelers Rest Telephone Company has been incorporated with a capital stock of $500 by J. H. Roe, R. Lanford and J. R. Anderson.

STANTON, TENN.—The Stanton Telephone Company has been chartered with a capital stock of $2,000 by W. B. Douglas, W. S. McMahon, F. G. Rawlins, P. O. Wilkerson and W. J. Poppedge.

SAN ANGELO, TEX.—The San Angelo Street Railway Company has been incorporated with a capital stock of $100,000 to take over the property and holdings of the Angelo Power & Traction Company, which was sold at a receiver's sale to Samuel Crowther, of San Angelo, for $38,000. The railway includes about four miles of track. It is proposed to resume operation and add four miles of track to the system the first year. The incorporators are: Samuel Crowther, Charles W. Hobbs, C. A. Broome, L. L. Farrar, A. M. Hicks, F. W. Walker and John W. Harris.

WICHITA FALLS, TEX.—The Wichita Falls Traction Company has been chartered to construct an electric railway from Wichita Falls to Lake Wichita, five miles distant. The company has recently purchased the property of the Falls Water & Light Company. The company is capitalized at $50,000 and the incorporators are: J. A. Kemp, Frank Krell, Charles C. Huff and F. P. St. Clair.

CHARLES CITY, C. H., VA.—The Charles City Telephone & Telegraph Company has been chartered, with a capital stock of $5,000. The officers of the company are: H. S. Saunders, of Shirley, Va., president; H. T. Harrison, of Bradley's Store, vice-president; L. M. Nance, of Roxbury, secretary and treasurer.

WALLA WALLA, WASH.—Articles of incorporation for the John Day Power Company have been filed by H. G. Blalock, Y. C. Blalock, W. J. Mariner and A. D. Lyman, with a capital stock of $500,000. The object of the company is to generate electrical power from the John Day and Deschutes rivers and their tributaries and to supply water for irrigation and domestic purposes in the States of Washington and Oregon.

PENNSBORO, W. VA.—Articles of incorporation have been filed by the North Bend & Southern Telephone Company, of this city, its intention being to construct and operate telephone lines in Ritchie and Tyler counties. The capital stock is placed at $1,500, and among those interested are Zadok Ash and others, of Joseph's Mills.

BONDUEL, WIS.—The Bonduel Telephone Company has been incorporated with a capital stock of $5,000 by C. Bonin, W. F. Felkenhener and Robert Pitt.

BRUSSELS, WIS.—Articles of incorporation have been filed for the Sturgeon Bay & Gardiner Telephone Company, with a capital stock of $1,500, by Hubert Dandois, S. A. Geise and Jule Gerondale.

WILD ROSE, WIS.—The Wild Rose Telephone Company has been incorporated with a capital stock of $3,500. Arrangements have been made with the Waushara Telephone Company whereby the new company will take over the village exchange with all appurtenances.

Legal.

JACKSONVILLE WITHOUT AUTHORITY TO REGULATE TELEPHONE RATES.—The charter of the city of Jacksonville, Fla., contains the following provisions, viz.: "The Mayor and City Council of the city of Jacksonville are hereby authorized by ordinance to regulate, require and provide for the opening, grading, paving, improving and repairing of any and all streets, and to require the owner of lots fronting or abutting thereon or contiguous thereto and specially benefited thereby to do such work, or to pay the cost thereof; . . . to pass all ordinances neces-

sary for the convenience and safety of the citizens, and to carry out and accomplish the objects of this incorporation." A telephone company was operating in said city under an ordinance which contained no condition or provision fixing maximum telephone rates or reserving the power in the city to fix such rates. It was held that under these circumstances the city had no power or authority to pass or enforce an ordinance, subsequent to the one under which the telephone company was operating and using the streets of the city, fixing maximum rates to be charged by the company. City of Jacksonville vs. Southern Bell Telephone & Telegraph Company, Supreme Court of Florida, 49 So. Rep. 509.

STUMBLING OVER GUY WIRE.—A pedestrian at Fort Worth, Tex., recovered a judgment of $7,500 from a telephone company for injuries received from stumbling over a guy wire, belonging to the company, anchored in the sidewalk about 6 in. from the curb. The testimony showed that this method of anchoring guy wires was the one commonly adopted in the city of Fort Worth. One of the witnesses, who appeared as an expert, testified that an anchor post, or short pole sunk in the ground, and the guy wire attached to it, was sometimes used instead of the wire itself being anchored in the sidewalk. He further stated that an anchor post could be more easily seen at night than a guy wire, and there would be less danger of a pedestrian running into it; that guy wires are sometimes boxed up with boards so as to keep people from walking into them. There was no box around the wire over which the plaintiff tripped. City of Fort Worth vs. Williams, Court of Civil Appeals of Texas, 119 S. W. Rep. 137.

Personal.

MR. GEORGE R. WICKER has been appointed census special agent to investigate electric railway reports.

MR. R. P. BACHE, formerly manager of the Colorado Springs Electric Light Company, has taken offices in Denver for the practice of consulting engineering in the Rocky Mountain territory.

MR. FRANK H. HILL, who has long been identified with the sales and engineering department of the New York office of the Sprague Electric Company, assumed the duties of manager of the branch office in Atlanta, Ga., on Sept. 1, in place of Mr. F. V. L. Smith, who has resigned.

MR. GLENN MARSTON, who has been interested in the relations of public utilities and their patrons for several years, sails for Europe this week to gather material on public relations abroad. Mr. Marston will also devote some attention to foreign commercial methods in central station practice.

MR. JAMES S. KNOWLSON has severed his connection with the General Electric Company and has started in business for himself, under the name of the Electro-Magnetic Tool Company, with offices at 128 South Clinton Street, Chicago, Ill. The company will manufacture electric percussion drills.

MR. W. D. RAY on Sept. 1 became general manager of the Northern Indiana Gas & Electric Company, which operates the gas and electric light plants at Hammond and Michigan City, Ind., controlled by C. H. Geist & Co., Philadelphia. Mr. Ray has for some time been contract agent of the Sanitary District of Chicago, in charge of the marketing of power which the Sanitary District had to sell in Chicago.

MR. JOSEPH F. BECKER, general agent of the Edison Electric Illuminating Company, of Brooklyn, N. Y., will assume, on Sept. 15, the duties of superintendent of the sales department of the United Electric Light & Power Company, of New York. Mr. Becker has made an enviable record with the Brooklyn company and will find even larger opportunity in his new environment.

MR. J. E. WOODBRIDGE, formerly editor of the *Electrical World*, has resigned from the railway engineering department of the General Electric Company to become connected with the firm of Ford, Bacon & Davis. Mr. Woodbridge will take local charge of the work in and near San Francisco in connection with the Stanislaus power development and the supply of power to the United Railways of San Francisco.

MR. SAKUTARO SATAKKE, president of the Tokyo Electric Lighting Company and member of the House of Representatives, and Mr. Michio Doi, president of the Osaka Electric Lighting Company and president of the Osaka Chamber of Commerce, are members of a large delegation of Japanese financiers and industrial leaders which will arrive at Seattle Sept. 2, and make a tour of financial, commercial and industrial centers of this country.

MR. C. G. YOUNG, who was formerly chief engineer with J. G. White & Co., has just returned from a trip around the world, during which he paid special attention to lighting and traction properties and "prospects" in the Far East. He took opportunity to establish engineering and financial connections in Japan, China, Russia, London and Paris, etc., and has now opened an office for general practice and consultation at 60 Wall Street, New York City.

MR. THEODORE INSLEE JONES, manager of the sales department of The United Electric Light & Power Company, New York City, has resigned his position in order to accept the position of general agent of the Edison Electrical Illuminating Company, of Brooklyn. The change will take place Sept. 15, 1909. As noted in these columns at the time he took his position with the United Company, Mr. Jones is an electrical engineer, graduating from the Massachusetts Institute of Technology. After graduation he was identified with the American Telephone & Telegraph Company, and also as illuminating engineer with the Nerst Lamp Company. For the past five years, in addition to his regular duties, Mr. Jones has been delivering, for the New York Board of Education, a number of lectures on electrical engineering and electric light and power problems. His position as manager of the sales department of the United Company has been held over two years, during which time a number of large installations have been placed on the United Company's mains, of which note has been made from time to time. A number of articles have been contributed by Mr. Jones to the electrical press, among the more recent being a contribution on "The Growth of Alternating Current in New York City," appearing in the *Electrical World* a few months ago. At the last convention of the National Electric Light Association held at Atlantic City, Mr. Jones read a valuable paper on the "Development of Revenue from Existing Customers."

Obituary.

MR. NICHOLAS WAY, superintendent of the New Lisbon Gas Company, New Lisbon, Ohio, died at his home in New Lisbon, Aug. 16. Mr. Way was in his sixty-fifth year, and is survived by three daughters and three sisters.

MR. G. A. SKINNER, chief draftsman of the Sterling Electric Company, Lafayette, Ind., was instantly killed last week by electric shock, due apparently to a transformer defect which subjected a 110-volt circuit to the primary voltage of 2200. Mr. Skinner, who was 44 years of age, had been connected with the Sterling company for seven years, and was a leading member of the local electric club.

Trade Publications.

ELECTRIC LIGHT MATERIAL.—The Wesco Supply Company, St. Louis, Mo., has issued a lighting number of its price current and discount sheet, which contains interesting suggestions on electric lighting material.

BLUE-PRINT PAPERS.—Keuffel & Esser Company, 127 Fulton Street, has issued a circular on the subject of blue-print papers, giving information concerning different varieties of papers, selective for various uses, etc.

POLYPHASE INDUCTION MOTORS.—The General Electric Company has issued Bulletin No. 4674, illustrating and describing polyphase induction motors and the controlling apparatus for use with them. An interesting illustration in this bulletin is that of a 6000-hp, 6600-volt induction motor installed at Gary, Ind.

AUTOMOBILE SUPPLIES.—The Central Electric Company, Chicago, Ill., is distributing a new flyer descriptive of automobile electric lighting specialties, consisting of connectors, flush receptacles and plugs, limousine switches and two-point round switches. This flyer should be of interest to owners or users of automobiles.

TUNGSTEN MINIATURE LAMP.—The Western Electric Company is distributing a bulletin illustrating and describing the Sunbeam tungsten miniature lamp for use on voltages between 1½ and 20. These lamps vary in efficiency from 0.9 watt per candle-power to 1.33 watts per candle-power and are particularly applicable for use in automobiles, flashlights, signs, dental, optical and surgical instruments, and, in fact, any place where battery or low-voltage circuit lamps are used.

COMMUTATING-POLE MOTOR.—Bulletin 4679 issued by the General Electric Company describes a line of commutating-pole constant-speed motors using a self-contained draft arrangement which the company is placing on the market. These motors are made in both slow-speed and moderate-speed types, in ratings of from 20 to 250 hp in the former and 30 to 350 in the latter. They can be operated entirely open, semi-enclosed or totally enclosed, and may be installed on the floor, wall or ceiling. The bulletin gives a detailed description of the motors.

WAGNER BULLETINS.—The bulletins of the Wagner Electric Manufacturing Company, as recently published, indicate a radical departure from the usual character of such publications. A bulletin on the subject of alternating-current generators, just issued, is typical. The story in the bulletin, which contains much information of value to any prospective purchaser of alternating-current generators, is written without reference to the particular design of the Wagner Company, reliance being placed in that regard almost entirely upon carefully selected illustrations and the descriptions which accompany them as captions. Recent Wagner trade literature comprises bulletins on generators, central-station transformers, polyphase motors and single-phase motors. All will assist the buyer in eliminating from his discussions with the salesman points in reality of little importance, but often dwelt upon to the exclusion of the really essential points.

LAMPPOSTS AND BRACKETS.—Under the title of "Electroliers, Lanterns and Brackets," the J. L. Mott Iron Works, Fifth Avenue and Seventeenth Street, New York, have just issued a superb catalog in oblong form, 13¾ in. x 6½ in., in illuminated decorative cover. It contains 64 pages devoted to the firm's work on posts and lanterns for gas and electric lighting, all the styles being thrown in tint block. These posts are made in bronze, iron or spelter, though not often in bronze on account of the cost. Many of them adorn and beautify some of the most notable buildings, bridges and thoroughfares, adapted felicitously to their situation and environment. An extremely interesting section is that devoted to tungsten lampposts. Separate sheets are issued by the firm of the larger electroliers and arc light poles for public lighting. With such admirable examples no central-station company is justified hereafter in pleading guilty to the accusation of lack of public spirit in putting up ugly poles and fixtures. Beauty is never expensive, and in these instances it is brought down to the basis of a fraction of a cent per pound of metal.

Business Notes.

THE AMERICAN SEWER PIPE COMPANY announces that on and after Aug. 28 the general office of that company will be located at Akron, Ohio, and all communications to the company should be addressed to that city.

GARWOOD AGENCIES.—Among recent agencies established by the Garwood Electric Company are the following: The Atlanta Brokerage Company, Atlanta, Ga., sales agents for the State of Georgia; Montilius Price Company, 526 New York Block, Seattle, for the States of Oregon and Washington.

UNIVERSAL FLAT-IRONS.—The Central Electric Company, of Chicago, Ill., is distributing a new booklet descriptive of its new universal electric flat-irons. These irons employ a new type of heating element for which very high efficiency is claimed. Special attention has been given in this new design to securing a uniform heat distribution on the ironing surface and yet maintain a very low temperature at the top of the iron.

NEW HOYT WORKS.—The Hoyt Electrical Instrument Works have bought a piece of land, fronting 100 ft. on Main Street, Penacook, N. H., which forms part of the Central Trunk Boulevard being built through the White Mountains, and will erect a modern, fireproof garage and salesroom. The demand for Hoyt meters has made it necessary to devote the entire Washington Street plant to their manufacture, and hence the necessity for a new works.

THE SHEFFIELD GAS POWER COMPANY has been organized to take over the property, patents, good will and charter rights of the Weber Gas Engine Company, of Kansas City, Mo., which went into a receivership last December and was declared bankrupt June 21. The company is capitalized at $150,000 and will continue to manufacture gas engines at the plant located in Kansas City, Mo. The officers of the reorganized company are: George M. Hawes, president; Freeman Field, vice-president and general manager, and Henry C. Page, secretary. Mr. Field, the vice-president and general manager, has been Western manager for the Olds Gas Power Company in Kansas City for 12 years and has a wide experience in the gas power industry.

MOORE TUBES.—The Moore Electrical Company, of Newark, N. J., has closed a contract for installing the Moore light in the new building of the Emigrant Industrial Savings Bank, at 43-51 Chambers Street, New York, of which Raymond F. Almirall is the architect. This installation is to consist of 42 tubes of the Moore Light, and approximately 4500 ft. of glass tubing. The lighting is designed to produce useful illumination at a low current consumption and to make extremely pleasing lighting effects. The building is to be 16 stories and will be built in two sections, the first half to be completed within six months. The Moore Electrical Company states that several other banking houses will probably adopt the Moore light in the near future.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

ALABAMA LIGHT & TRACTION ASSOCIATION. Secretary, Lloyd Lyon, Mobile, Ala.

AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, St. Louis, Mo., Nov. 15-18, 1909.

AMERICAN ELECTRO-CHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next meeting, New York City, Oct. 28, 29 and 30, 1909.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Pine Bluff, Ark., 1910.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, G. H. Winslow, 557 Frick Building Annex, Pittsburgh, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Room 511 Harvester Building, Chicago. Next meeting, Los Angeles, Cal., May, 1910.

AMERICAN STREET & INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia. Next meeting, Denver, Col., Oct., 1909.

AMERICAN STREET & INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, John W. Corning, Boston Elevated Railway Company, Boston. Next meeting, Denver, Col., Oct. 4-8, 1909.

AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York. Next meeting, Denver, Col., Oct. 4-8, 1909.

ASSOCIATION OF CAR LIGHTING ENGINEERS. Secretary, G. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next meeting, Chicago, Oct. 5, 6, 7 and 8, 1909.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, D. L. Huntington, Spokane, Wash.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

BOSTON ELECTRICAL SHOW. Secretary, Chester I. Campbell, 5 Park Square, Boston. Mechanics' Building, Nov. 15-25, 1909.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, A. L. Neereamer, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, J. C. Lawler, Colorado Springs, Colo. Next meeting, Denver, Oct. 7-9, 1909.

EASTERN STATES INDEPENDENT TELEPHONE ASSOCIATION OF PENNSYLVANIA, NEW JERSEY, MARYLAND AND DELAWARE. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

ELECTRIC VEHICLE AND CENTRAL STATION ASSOCIATION. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

ELECTRIC CLUB, CHICAGO. Secretary, W. S. Taussig, 204 Dearborn St., Chicago. Meets every Wednesday noon at Chicago Automobile Club.

ELECTRIC CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, Nov. 4, 1909.

ELECTRIC TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York, Board of Directors meets second Thursday of each month.

EMPIRE STATE GAS & ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York. Next meeting, New York City, Oct. 6 and 7, 1909.

FLORIDA ELECTRIC LIGHT AND POWER ASSOCIATION. Secretary, G. F. Doig, Gainesville, Fla. Next meeting, Tampa, Fla., April 21, 1910.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chubbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, P. S. Miller, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago. Next annual convention, New York City, Sept. 27, 28 and 29, 1909.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Fred. Leslie, Muncie, Ind.

INTERNAL COMBINATION ENGINE ASSOCIATION. Secretary, Walter I. Sittig, 61 Ward St., Chicago.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Atlantic City, N. J., Sept. 14, 15 and 16, 1909.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. C. Dean.

IOWA ELECTRIC ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting second Wednesday in March each year.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Sioux City, April, 1910.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Wichita, Kan., Sept. 22 and 23, 1909.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

MAINE ELECTRICAL ASSOCIATION. Secretary, Fred D. Gordon, Auburn, Maine.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. P. Biggs, Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, B. W. Cowperthwait, Faribault, Minn. Next meeting St. Paul, third week in March, 1910.

MISSISSIPPI ELECTRIC ASSOCIATION. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, Jefferson City, Mo., April 14, 15 and 16, 1910.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, John F. Gilchrist, 139 Adams St., Chicago. Headquarters, 33 West 39th St., New York.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRICAL TRADES' ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings second and fourth Tuesdays of each month.

NEW YORK ELECTRICAL SHOW. Madison Square Garden, Oct. 11-21, 1909.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash. Next meeting, Seattle, Sept. 7, 8 and 9, 1909.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, John S. Allen, Lake Geneva, Wis. Next meeting, Milwaukee, January, 1910.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, David Gaehr, Schofield Building, Cleveland, Ohio. Next meeting, Lima, Ohio, Nov. 19 and 20, 1909.

OKLAHOMA PUBLIC UTILITIES ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla. Next meeting, Sapulpa, Okla., 1910.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, F. J. Scherrer, 195 Broadway, New York.

PACIFIC COAST ELECTRIC AUTOMOBILE ASSOCIATION. Secretary, J. T. Halloran, 604 Mission St., San Francisco, Cal. Next meeting, Oakland, Cal., February, 1910.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. L. Smith, Towanda, Pa. Next meeting, Eagles Mere, Pa., Sept. 8, 9 and 10, 1909.

PENNSYLVANIA STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PHILADELPHIA ELECTRICAL SHOW. First Regiment Armory, Broad and Callowhill Sts., Feb. 15-27, 1910.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, C. E. Russell, Boston, Mass. Monthly meeting, fourth Monday of each month.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D. Next meeting, Jan. 11 and 12, 1910.

SOUTHWESTERN ELECTRIC & GAS ASSOCIATION. Secretary, E. T. Moore, Dallas, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, care of J. G. White & Co., New York.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester, Vt. Next meeting, Burlington, Vt., Sept. 15 and 16, 1909.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Detroit, Mich., Oct. 26, 27 and 28, 1909.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WIRELESS INSTITUTE. Secretary, Sidney L. Williams, 42 Broadway, New York.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED AUG. 24, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

931,202. SWITCH KEY; N. H. Holland, Chicago, Ill. App. filed Nov. 23, 1907. A plunger with a plurality of contacts and a locking plate, the last operated contacts being adapted to be operated by the depression of the plunger beyond the normal locked position of the key. (Issued Aug. 17.)

931,721. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Oct. 17, 1904. Plural lamp socket with a small base like a hemisphere with a plurality of openings, a sleeve in each, a lamp receiving shell disposed therein and a lining ring within each sleeve for insulating the shell for the sleeve.

931,722. CLUSTER LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed July 18, 1907. Disconnectable body portion carrying the lamps, disconnecting the electrical connections.

931,743. ELECTRIC ENGINE; W. Farrell, Philadelphia, Pa. App. filed Aug. 3, 1908. A revoluble frame, a stationary circular track, an electric motor with the revoluble body, a wheel carried by the armature of the motor and engaged with the track and electric connections to the motor.

931,771. HANGER FOR TROLLEY WIRES; C. A. Kraynik, Racine, Wis. App. filed July 10, 1908. When the trolley wire breaks, the broken portion is automatically disconnected from circuit. Levers carrying the wire. When it breaks the lever opens the circuit.

931,775. SMELTING FURNACE; S. B. Ladd, Washington, D. C. App. filed June 7, 1907. Furnace for sulfid ovens having an elongated hearth, twyers above it and means for passing an electric current through it.

931,806. RECTIFIER; C. W. Sirch, Los Angeles, Cal. App. filed Nov. 2, 1907. Converts alternating into direct current by a mercury rectifier, the interior of the bulb being kept cool by circulating cooling air through its center by a special construction of bulb.

931,807. INCANDESCENT LAMP; E. H. Smith, Aberdeen, Wash. App. filed Aug. 21, 1908. Controllable glow lamp. When the bulb is turned it completes the circuit through a longer or shorter filament [illegible]

931,835. ELEVATOR SIGNAL SYSTEM; J. F. Baker and A. C. Moore, Kansas City, Mo. App. filed Oct. 22, 1907. A common switchboard, a separate contact for each signal and operated by the elevator mechanism to close a circuit through the signal independently of the contact.

931,854. RELAY MECHANISM; S. B. Fowler, La Fayette, Ind. App. filed June 5, 1907. For telephone exchanges for controlling the line and supervisory signals. Special arrangement of electromagnets and their armatures.

931,904. TELEPHONE SYSTEM; H. G. Webster, Chicago, Ill. App. filed July 27, 1906. A rotary switch for each subscriber's line operated by step by step mechanism from current supplied by a pulsating generator. Uses two relays—one a cut-off to connect the line limbs to the wipers of the switch when the line circuit is selected, the other is a "line relay" which starts and stops the rotary switch during the selection and disconnection of the link circuit. Also has improvements in the calling signal.

931,905. TELEPHONE SYSTEM; H. G. Webster, Chicago, Ill. App. filed July 27, 1906. A rotary switch for each subscriber's line, actuated intermittently by current from a pulsating generator normally resting on dead contacts, but when a plug is inserted into its jack, the switch moves one step, removing the normal battery and preventing further operation of the switch while the plug is in. When the plug is removed at the end of the talking, the switch steps ahead to normal.

931,906. TELEPHONE SYSTEM; H. G. Webster, Chicago, Ill. App. filed Aug. 13, 1906. Link conductors are interchangeably associated with subscriber's lines. A traveling switch establishes a connection between the calling line and an idle link circuit with driving means therefor, a controlling magnet, a local circuit for the magnet whose windings are so arranged as to prevent electrical variations in the circuit from producing disturbing currents in the line.

931,911. CONTACT DEVICE FOR SWITCHES; J. A. York, Hartford, Conn. App. filed May 18, 1908. Rotary snap switch. Improvement in pole, plate.

931,929. SECONDARY BATTERY; H. F. Joel, Forest Gate, England. App. filed April 13, 1908. Increasing circulation of electrolyte by

using cylindrical grids, one within the other, the space between permitting the circulation of fluid.

931,930. CABLE CLAMP; W. H. Kempton, Hartford, Conn. App. filed Aug. 27, 1908. For cables for overhead electric roads in which an ear with a groove holds the cable, a strap passes around the ear to the messenger cable above.

931,944. PROCESS FOR ELECTROLYTIC DEPOSITION OF METALS; F. C. Mathers, Bloomington, Ind. App. filed Aug. 24, 1909. Uses the metal as anode in a solution containing salts of perchloric acid and deposits the metal on the cathode.

931,945. PROCESS FOR MELTING AND WORKING QUARTZ GLASS; H. Mehner, Friedenau, near Berlin, Germany. App. filed Aug. 14, 1906. Melts the quartz, compresses it, cools and works it.

931,947. RECHARGEABLE AND NON-INTERCHANGEABLE INCLOSED THERMAL CUT-OUT. T. A. Miller, South Hingham, Mass. App. filed June 13, 1908. Fuse plug preventing under and over fusing having separable members forming a casing with means for keeping the casing assembled only when a fuse of predetermined capacity is enclosed therein.

931,994. TIME LIMIT DEVICE FOR CONTROLLERS; H. W. Cheney, Norwood, Ohio. App. filed Sept. 29, 1906. Overload protection for motors whose sensitiveness is varied a predetermined time after the circuit is closed. Actuated by electromagnets, one whose coils is operative only after the circuit has been closed a predetermined time.

932,003. MEANS FOR PROTECTING OPERATORS' RINGING LEADS FROM SHORT CIRCUIT; W. W. Dean, Elyria, Ohio. App. filed Aug. 9, 1905. For telephone exchanges having an operator's cord circuit and a ringing generator, and a protecting device including a buzzer relay connected between the buzzer and ringing key.

932,013. ELECTRIC TRANSFORMER FURNACE; O. Frick, Stockholm, Sweden. App. filed Dec. 26, 1906. Has low self induction and a high power factor, an annular hearth for the material forming the secondary circuit, the primary being divided into coils, facing more than one side of the hearth, and also having a magnetic core, one limb surrounded by the hearth and by the primary.

932,018. STEP-OPERATED CIRCUIT BREAKER FOR ELECTRIC CARS; B. B. Herron, Toledo, Ohio. App. filed May 3, 1909. Prevents premature starting of an electric car by using a step-controlled circuit breaker.

932,019. TELEGRAPH KEY; J. A. Hulit, Topeka, Kan. App. filed March 26, 1908. A break circuit key arranged near the typewriter keyboard so that the receiving operator can break the circuit when necessary.

932,042. SUPPORT FOR COMMUTATOR LEADS; E. Mattman, Norwood, Ohio. App. filed Jan. 31, 1907. Armature core made by laminæ with end heads, one having an annular bracket, a winding on the core, commutator necks bearing against the bracket and clamped thereto.

932,056. ELECTRIC SNAP-SWITCH MECHANISM; C. G. Perkins, Hartford, Conn. App. filed Oct. 25, 1907. Parts may be assembled to form a single pole or a double pole switch with indicating dial.

932,069. ELECTRIC FURNACE; F. J. Tone, Niagara Falls, N. Y. App. filed Dec. 12, 1907. Has a supporting hearth which is pervious to the products with a collecting space beneath.

932,072. SYSTEM OF DISTRIBUTION; H. L. Van Valkenburg; Norwood, Ohio. App. filed Aug. 31, 1906. High voltage protecting switch having a relay operated for different values of current.

932,079. LEAK DETECTORS; J. B. Williams, Coraopolis, Pa. App. filed July, 27, 1908. For detecting leaks in vessels comprising a shell enclosing a diaphragm, an alarm controlled thereby, and an airtight space between the shell and side of the vessel.

932,083. TURBO-ROTOR; A. H. Wouters, Norwood, Ohio. App. filed Feb. 28, 1907. Avoids displacement of windings by centrifugal force by using bands encircling the projecting portions of the windings and radial adjustable bolts.

932,084. DYNAMO-ELECTRIC MACHINE FOR DISTRIBUTED BALANCING WINDING; E. C. Wright, Newport, Ky. App. filed Jan. 22, 1906. A double commutator machine which balances the current taken from the commutators by means of a plurality of auxiliary field coils in parallel with each other and in series with the brushes on each commutator.

932,087. GAS-CONTROLLING APPARATUS FOR BATTERY CELLS; O. D. Apple, Miamisburg, Ohio. App. filed Feb. 13, 1908. When overcharging the gas is discharged by a vent pipe from each cell to a common discharge point through a transparent reservoir filled with liquid, thus showing the condition of the cells.

932,097. ROTOR CONSTRUCTION; B. A. Behrend, Norwood, Ohio. App. filed Dec. 1, 1905. The core circuits of disks having radial slots and wedge-shaped poles with a coil of edgewise-wound copper surrounding each pole.

932,105. MORSE TELEGRAPHIC APPARATUS; G. Bogni, Sesto Calende, Italy. App. filed Aug. 28, 1905. Uses a second key so as to make two elementary signs instead of the dot and dash now in use.

932,111. PRODUCING HIGH-FREQUENCY OSCILLATIONS; R. A. Fessenden, Washington, D. C. App. filed Dec. 14, 1905. Avoids using a spark gap by charging the capacity of a condenser rapidly by varying the distance between the plates.

932,112. LIGHTNING ARRESTER; R. A. Fessenden, Brant Rock, Mass. App. filed Aug. 24, 1909. The discharge gap is in a compressed air reservoir and a highly damped oscillatory circuit is shunted around the gap.

932,114. CAR-LIGHTING SYSTEM; E. C. Folsom, Saginaw, Mich. App. filed April 16, 1908. A headlight is on each side of the car and a reversing cylinder automatically thrown in the proper headlight when the car is reversed.

932,139. LAMP SOCKET; W. H. Kempton, Hartford, Conn. App. filed Feb. 13, 1909. For incandescent lamps, the socket having a recessed body of insulating material with an insulating washer which is thrust against the bottom of the cup when the lamp is screwed in.

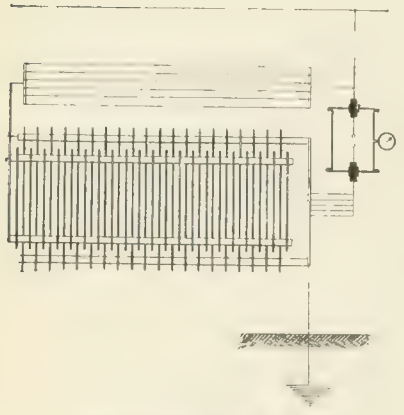
932,161. APPARATUS FOR GENERATING CASES BY ELECTRIC DISCHARGES IN AIR; J. E. Mitchell, St. Louis, Mo. App. filed May 14, 1909. Two rotatable electrodes, one mutilated, are brought into contact at intervals and an air blast blows out the arc.

932,196. ELECTRIC INSULATING OUTLET BOX; W. H. Vibber, New London, Conn. App. filed Jan. 22, 1909. An anchor can be bodily inserted edgewise into an opening in the plaster; the box is then inserted and screws passed into the box and anchor to hold it in place.

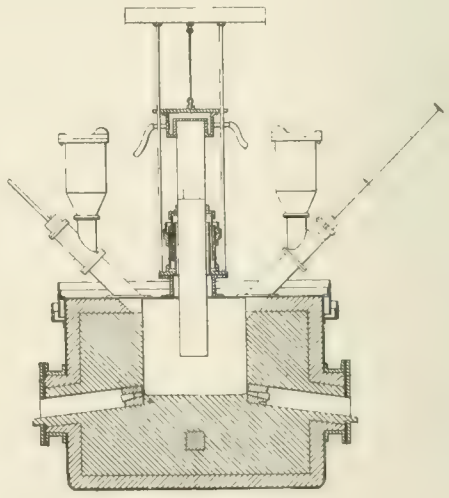
932,242. ELECTRIC PRODUCTION FOR HEAT FOR COOKING AND OTHER PURPOSES; A. F. Berry, Ealing, Eng. App. filed Aug. 9, 1906. A transformer has a bare sectional secondary located in the water of the heater.

932,246. INCANDESCENT LAMP SOCKET AND SWITCH; I. L. Cash, Portland, Ore. App. filed Feb. 15, 1908. A steel with a slot, block conductor plate and switch lever, latter moving the contact plates to close the circuit.

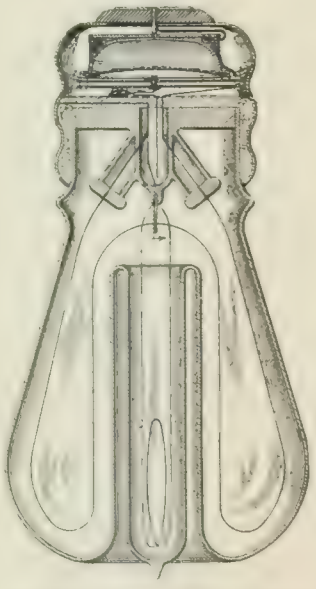
932,273. ELECTRICALLY LIGHTING UP GAS LAMPS; A. E. Hacking, West Bridgford, Eng. App. filed May 20, 1907. Two carbon electrodes, one fixed and the other axially movable, and an electric ignition circuit including the electrodes.



932,111.—Lightning Arrester.



932,296. Electric Furnace.



932,406. Automatic Flash Lamp.

932,296. ELECTRIC FURNACE; G. E. Landis, York, Pa. App. filed April 8, 1907. Special construction of lining having a carbon terminal extending into the working chamber and embedded in the lining.

932,309. BRUSH HOLDER; A. L. McHugh, Norwood, Ohio. App. filed June 5, 1905. The brush slides in the holder, metal strip embraces it and has a guide groove for it, and a flexible conductor is secured thereto.

932,312. MOTOR VEHICLE; L. G. Nilson, Philadelphia, Pa. App. filed Feb. 23, 1906. A generator unit including a storage battery assists the engine in case of overload and is provided with a speed controller.

932,323. TELEPHONE MOUTHPIECE; G. H. Reed, New York, N. Y. App. filed Jan. 16, 1909. Removable wire gauze diaphragm with annular disinspecting pad located in a groove in a conical shield.

932,358. BURGLAR ALARM; A. Verhoeven, Marinna, Ark. App. filed May 6, 1909. For the locks of doors, so that if the knob is turned while the door is locked the alarm is given.

932,363. TROLLEY WHEEL; F. S. Yoder, Werbersville, Pa. App. filed Sept. 30, 1908. A trolley wheel with a groove and flanges to prevent the wire from leaving the wheel.

932,368. ELECTRIC FURNACE; F. M. Becket, Niagara Falls, N. Y. App. filed June 6, 1908. A metallic electrode dips in the furnace. Cooling means therefor which are adjustable to regulate the cooling effect at the working end of the electrode.

932,399. FIRE-ALARM SYSTEM; W. B. Klahre, Johnstown, Pa. App. filed Aug. 1, 1906. Make and break wheel driven by a motor, the wheel carrying removable contact pins.

932,401. ENCLOSED PANEL; H. Krantz, Brooklyn, N. Y. App. filed April 4, 1906. For switchboards to make the enclosed parts accessible.

932,405. DOUBLE-FILAMENT INCANDESCENT LAMP; H. E. Meyers, Denver, Col. App. filed March 31, 1906. The globe has a central chamber and a communicating surrounding chamber with a filament in each chamber.

932,406. AUTOMATIC FLASH LAMP; H. E. Meyers, Denver, Col. App. filed April 30, 1906. The flashes are intermittent, being produced by a thermal switch operated by the heating of the lamp.

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NEW YORK, THURSDAY, SEPTEMBER 9, 1909.

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Trade Cultivation.

It is well that our Government should spend $50,000 or even $100,000 in ascertaining the lines of least resistance for the development of export trade. There is a great deal to learn on the subject, and little that is systematic has been done since Mr. Frank A. Vanderlip made his intelligent explorations abroad on behalf of the United States Treasury, when he was connected with it. American ministers and consuls do excellent work in filing reports and answering questions, but such efforts are necessarily spasmodic and in need of correlation. The new plan promises good results. We hope that the opportunities for the larger export of electrical goods will receive full attention, believing as we do that in such articles there lie very great possibilities of increasing the export trade. The bulk and scale on which electrical apparatus is made in this country put it into most open foreign markets on equal terms, and even in "closed" markets it finds as ready entrance on the grounds of quality and price as do the like goods from any other country. The electrical industries of America double every five years, a rate at which consumption soon becomes enormous, with consequent lowering of price. Electrical service is one of the few things in this country that has steadily cost less during the last 10 years, in spite of the universal tendency toward higher costs in living and manufacturing.

Some of the difficulties in the way of larger export trade as pointed out recently by a bank president in discussing Latin-American powers of absorption are lack of steamship facilities, want of banking facilities, uncouthness of traveling representatives, refusal of credit facilities, improper packing, and general non-accommodation of customers. To these might well be added lack of information abroad as to American products. But all these are susceptible of improvement; some of them can be removed entirely. Perhaps it will be some time before Americans can give banking facilities and credits abroad as freely as do English, German or French financiers and merchants; but our recent attitude in regard to the Chinese loan, our participation in the Japanese loans, our operations in Mexico, all point to coming changes in that respect. The demand for new capital to develop our own vast resources will continuously be intense, but American capital has already shown that it has international fluency; and that in turn means a great stimulus to export trade. Meantime, electrical producers of all kinds have their duty set before them clearly in trying to ameliorate the evils enumerated above. To show what such things mean, we note as this is being written that $200,000,000 of French capital is now going into Brazil, our authority being the President of the Republic himself. It follows that the engineering enterprises thus fostered will draw heavily on French materials and supplies; but some of this work was ready for American backing and was offered to this country. What applies to French capital is not less true of English and German.

The Price of Electric Service.

Professor Marks' able discussion of this topic in our issue of last week will arouse, we think, a touch of new interest in a hackneyed subject. The pros and cons of various methods of charging for electric service have been theshed over so often that anything new is seldom disclosed, yet an orderly exposition of the fundamental facts is always in order. Of making systems of charging there is no end; and, while the general principles of most of them are similar, their ramifications are in almost endless variety. As Professor Marks very justly indicates, the basic fact in most modern systems of charging is the difficulty in cheaply storing electrical energy, which causes the consumer's demand to be an important instead of an insignificant factor in the cost of serving him. Hence the very general introduction of some form of standing charge based on estimated or measured demand plus a service charge based, in the last report, upon the operating costs. There has been upon the whole a public recognition of the fairness of the general proposition which is very gratifying. It is to the details of this rate-making plan, however, that one must look for a final judgment upon the particular plan adopted. Broadly, there are objections, and sound ones, to any scheme yet projected. No application of a general law is sound unless it takes account of the adaptability of that law to the concrete problem in hand. On the other hand, it is no arraignment of the main principle to bring up cases that are without its scope. In such cases one merely finds usually that the law is not in its general form, as when one tries to deal with high-frequency currents by the sole aid of Ohm's law in its simplest form.

Now, in the rate-making process there is one fact too commonly overlooked to which we have over and over called attention. That fact relates to the consumers' demand in its bearing on the standing charge. It is emphatically and evidently untrue that the capacity of a central station doing ordinary urban business must be equal to the sum of the consumers' maximum demands, still less to the sum of their connected loads. Central-station men, of course, have time and again recognized this and have acted upon it. In other words, the capital required for the actual standing service of a consumer is not generally in fact determined by his maximum demand. The condition under which it would be exists only in the mind of the doctrinaire. The determining factors actually include the time and the place of the load as well, and until these things are recognized it will be idle to make anything like a logical standby scheme equally fair to all kinds of consumers; and a system that systematically punishes by the effect of its incomplete assumptions certain groups of consumers, has not yet the essential elements of logical completeness. This statement denies neither the usefulness nor the business-like adaptability of many schemes of charging now used. They deal with the time and place factors by general average, and ill or well according to the skill with which this average is handled. So, indeed, one can deal with the amount of demand itself by average, as is implicitly done in the two-rate system. Every study of rates is valuable as disclosing new bearings of the essential facts; and while it is safe to say that the whole problem is somewhat too complex for general statement, one can yet arrive at proximate solutions of value, as Professor Marks has done. The whole subject is not a science, but a fine art, like most of skilled human attempts to deal with diversified human affairs. Practically each city presents its own rate-making problems, and these must be worked out by patient application to the physical and human data before one.

The Design of Stationary Transformers.

In determining the relations between the electric and magnetic circuits of a stationary transformer, one cannot fail to be impressed with the fact that the calculations connected with the electrical requirements are of minor difficulty compared with those relating to the thermal and mechanical requirements. For example, if the core is to be subjected to a certain loss per pound, then there exists a definite, easily determined relation between the cross-sectional area of the core and the number of turns in each coil, the product of the area and the turns being a constant. However, the design problem is far from being solved when the value of this constant has been ascertained; an indefinite range remains for the choice of the exact value of the area or turns, while no account has yet been taken of the temperature limits, mechanical requirements, life of the insulation and the output characteristics. The latter features are of predominating importance, and cannot be treated so simply as can the purely electrical features. There are several practical features of construction and operation of a transformer which serve as a guide to the designer. For example, the amount of separation between coils is determined by the voltage and the character of the insulation to be employed, while the maximum efficiency is obtained when the copper loss equals the iron loss.

Even when these features are fully considered, the problem still contains many variables for which values must be selected by the designer. Suggestions concerning methods that may be employed in selecting the final dimensions are given in an article elsewhere by Mr. Roger P. Heller, while the effect of changing the design proportions are treated at length in an article by Mr. E. G. Reed. Attention should be called to a statement in the latter article that the total losses in a transformer will be a minimum when the iron loss is approximately 15 per cent greater than the copper loss, which statement may seem to be in conflict with the well-known fact that the maximum efficiency occurs at that load, causing the two losses to be equal. The author's demonstration is based on an assumed change in the e.m.f. at constant output, while a transformer is usually operated at constant e.m.f. with changing output. Each conclusion is in accordance with the initial assumptions.

The Distribution of Electric Stress in Three-Phase Cables.

An interesting paper by Messrs. W. M. Thornton and O. J. Williams on the above subject was presented at the Winnipeg B. A. meeting. In order to indicate visually the electric flux-paths in the three-conductor cable, the authors prepared a hydrodynamic model of such a cable. The model consisted of a glass cell formed of a pair of flat circular glass plates clamped closely together with a thin water-tight rim washer. The sections of insulator were represented in the model by thin clearance films, the space between the glass disk being filled in with wax. The sections of conductor were represented in the model by

circular cavities without any wax filling. A circular trough round the edge of the model just inside the rim washer represented the conducting lead sheath of the cable. Through three perforations in one of the glass disks, glycerine could be admitted and withdrawn from the cell. The admission nozzle introduced alternate jets of clear and red glycerine, so that the liquid stream lines showed themselves in colored lines within the model. By using pinch cocks on the two outlets, and pinching them differentially, various conditions of phase-difference in an alternating-current cycle could be manifested and photographed. The liquid stream-lines in the model corresponded to electric stream-lines in the cable, and the liquid stream velocities to electric stress. The pictures obtained from the model are in substantial agreement with those heretofore obtained by calculation. The model must be very fascinating to watch when the two outlets are pinched cyclically, so as to imitate alternating voltage application.

The paper points out that when the three conductors of a three-phase cable are changed in cross-section from the circular to the "clover-leaf" form, as is a practice, especially in Europe, the intensity of the electric stress in the layers of insulator close to the conductors is markedly reduced. This has been known from computation and it is manifestly by the hydrodynamic model. In fact, the paper may be considered as a tacit plea for clover-leaf section, three-phase cables. Much ingenuity and mechanical skill are required in the preparation and manipulation of these hydrodynamic models. The specific inductive capacity of the insulation material has to be imitated in a model by the precise degree of thickness of the thin film between one glass wall and the wax layer built on the opposing wall. A very small error in the thickness of this film will distort the liquid stream lines considerably and give a picture which corresponds to some modified quality of cable. The same principle has already been applied to the illustration of magnetic problems, but this seems to be the first use of the principle for visualizing the flow lines in electric distributions. It should be capable of affording an instructive lecture experiment.

Atmospheric Loss Off High-Tension, Direct-Current Circuits.

Among the papers presented to the British Association for the Advancement of Science at the Winnipeg convention is one by Mr. E. A. Watson, on the electrical corona. This paper contains much interesting matter, both from the theoretical and practical points of view. It adduces the results of an experimental research on coronal formation around cylindrical wires, as the electric potential was increased. The source of this potential was an influence machine, so that the experiments were all of the unidirectional, or direct-current, type, as distinguished from the usual alternating-current type. There are certain manifest advantages pertaining to direct-current corona tests, as the voltage and current are relatively easy to measure, and the question of their difference of phase is mercifully eliminated. Almost all of the results are stated in terms of electric intensity at the surface of the tested wire, in kilovolts per centimeter, as deduced from the critical coronation voltage, and the geometry of the wire system. There are certain advantages and certain disadvantages in expressing the results this way. Air, at ordinary barometric pressures, crushes electrically at an intensity of about 40 kv per centimeter, or 100 kv per inch, when the intensity is applied between opposed parallel plane-surface conductors. It is very doubtful as to what the crushing intensity is when we use small wires. A corona forms when air is crushed in the immediate vicinity of a wire, without actual discharge to a distance.

The corona is the visible evidence of the crush, and the ammeter in the wire circuit also gives evidence of the same; but the presence of the corona virtually extends the boundary of the wire, because the corona is itself a fairly good conductor. The maximum stress on the air molecules is therefore conveyed to the surface of the corona as though the wire had been enlarged. All conclusions as to the magnitude of the maximum stress at the wire surface based on the metallic diameter are thus vitiated and rendered unreliable. This state of things is suggested by the results given in the paper. The apparent critical intensity at the wire surface was 80 kv per centimeter with small wire of less than 1 mm in diameter, but approached 40 kv per centimeter with wires of about 1 cm in diameter. The paper points out in fact that at normal barometric pressure the critical coronation intensity tends to reach about 40 kv per centimeter as the wire diameter increases. The results reported are shown to be in remarkably close agreement with those reported by Professor Ryan in his classical A. I. E. E. paper of February, 1904. Ryan's results were all obtained with alternating-current excitation. Consequently, it is the maximum voltage applied to a wire that determines its coronation, and whether that maximum is steadily maintained in direct-current fashion, or whether it is only reached momentarily once each half cycle in alternating-current fashion, apparently does not matter.

Watson's paper lays emphasis on the surface condition of the wire tested. If the wire is clean, it takes a higher coronation voltage than if it is dirty. Of course, this is explainable on the basis of geometry. A clean wire is a pure cylinder down to the molecular dimensions, whereas a dirty wire is a cylinder with sharp points and projections. Ionization of the air will be sooner likely to occur at the greater electric intensities near the points, when the potential is raised. Curiously enough, Watson's paper reports no appreciable influence of moisture vapor in the coronation voltage of air under laboratory conditions when the wire is clean. With dirty wires in the open air, the loss into the air was much greater and was affected by water vapor. It is suggested, however, that the water vapor produced a leakage loss before the coronation voltage was reached. A factor of safety of 2 is recommended, therefore, for application, in practice, to the critical voltages obtained in the laboratory with clean wires. Working with reduced barometric pressures down to about half an atmosphere, the coronation voltages were reduced, in straight line law, roughly proportional to the pressure; so that, on high mountains, the coronation voltage should be lower than on the plains. A remarkable difference in the quality of the corona was found according as the potential of the wire was positive or negative, and there was also a small noticeable difference in the coronation voltage between the two conditions. The paper is a valuable contribution to this important subject. Much remains, however, to be cleared up.

Winnipeg Convention of the British Association for the Advancement of Science.

Our issue for last week contained an account of the convention of the British Association for the Advancement of Science, then being held at Winnipeg, Canada, while abstracts of several of the papers presented are given in the present issue.

The convention was attended by scientists from virtually every civilized country. Many new theories were advanced and the year's work of the men at the head of their respective lines were set forth in the papers. The scientists were divided into 12 sections, each of which was devoted to a particular branch of study, and in this way those interested were able to attend the lectures pertaining to their calling. The bulk of the electrical papers came under the heading of "Engineering."

The address of President Thomson on "Positive Electricity," which was outlined in our issue for last week, was said to be the most complete ever delivered on this subject. Mr. Ormond Higman, chief electrical engineer of the Electrical Standards Laboratory, Ottawa, Canada, explained "International Electrical Standardization" in a lengthy paper giving the rules in various countries for testing electrical apparatus. He said that the United States was the first country to study the subject, taking up the work in 1899 when the first report on the subject was issued by the American Institute of Electrical Engineers. France, Germany and Great Britain followed with their respective ruling which, though dealing with practically the same subjects, contained many differences. He apologized for following in the steps of Sir John Wolfe Barry, K.C.B., who read a somewhat similar paper before the association meeting at York, England, in 1906. "The Distribution of Dielectric Stress in Three-Phase Cables" was the subject of a paper given by Professor W. M. Thornton and G. J. Williams. The voltage gradient at any point in the cross-section of a three-core cable as used for three-phase currents at any time during the cycle of electricity was dwelt on at much length. It was stated that it appears impracticable to attempt to solve it analytically by finding and superposing the fields between the various conductors in turn. In addition to the papers mentioned above there were several in the physics section which dealt with the subject more in a theoretical than a practical way.

These lectures were given mostly during the mornings, afternoons and evenings being devoted to trips to points of interest to the various sections. The agriculturalists visited the farm lands around Winnipeg; the educationalists made a round of the various schools and colleges in Winnipeg and the immediate vicinity; the engineers saw the bridges, the railroad shops, high-pressure water system, St. Andrews locks and other engineering features. Those interested in the electrical branch made two trips—one to the civic power plant under construction at Point du Bois and the other to the electrical station and other works of the Winnipeg Electric Company.

A large number took in the trip to the power plant being built by Winnipeg at Point Du Bois, a distance of 65 miles from the city. Mr. Cecil B. Smith, who has charge of the construction, accompanied the tourists and explained in detail the working of the plant which, when completed, will have cost approximately $3,500,000. The visitors were generally surprised when informed that the city expects to be able to supply energy at $18 per hp-year after allowing for all operating expenses, sinking fund and other incidentals.

On a later afternoon a party was shown over the plant of the Winnipeg Electric Company and many of them were impressed with the equipment of the substation for the distribution of energy throughout Winnipeg. A feature which seemed to interest many was the chart showing a peak load for the day previous of only 7,500 hp whereas the plant has a 27,000-hp equipment. They were shown the iron towers and high-tension rooms where the 60,000-volt wires enter from Point du Bois, 65 miles away. The circuit is then carried to banks of transformers with a secondary e.m.f. of 2,300 volts. From the secondary side of the transformers through busbars taps are taken off to supply the energy for Winnipeg. The lighting apparatus is capable of supplying energy to 150,000 incandescent lamps through seven smaller substations. In addition, energy is furnished for operating street cars in Winnipeg as well as some 40 miles of line outside the city.

Gift to Institute Library.

The Western Electric Company has presented to the library of the American Institute of Electrical Engineers a most valuable addition in the shape of a patent specification library. This gift constitutes the largest accession since the original creation of the library by Dr. S. S. Wheeler with the Latimer-Clark collection.

The patent library which the Institute thus acquires contains no fewer than 461 substantial leather-bound volumes containing approximately 100,000 specifications. These specifications begin with May 30, 1871, and run to December, 1908, thus covering the entire period of activity which includes the telephone, the electric light, electric railways and the electric motor. From May 30, 1871, up to the last day of 1887 the volumes are complete, containing all the specifications issued by the Patent Department, certified. From July, 1887, up to Dec. 1, 1908, the volumes contain all the electrical specifications not certified.

The original set cost over $4,000, and duplicates of these specifications, if now purchased from the Government and bound, would cost between $4,000 and $4,500. This library has been accumulated by the Western Electric Company in Chicago, from which city it is now being brought to New York to be added to the rich collection of technical literature housed in the Engineering Societies Building. Mr. Edward Caldwell, chairman of the library committee of the Institute, has already taken the matter in hand as to proper care and installation of the library, so that the members may derive the greatest possible benefit from having such a collection at their disposal, and has also taken measures to complete the set to date. It is generally believed that this splendid contribution from the Western Electric Company will prove one of the most valuable accessions that the library could possibly have from the standpoint of practical utility, and that it will be likely to stimulate further generosity of the same kind. It is a most fortunate coincidence that the Institute had already been presented with a set of specifications antedating the period prior to those included in this gift.

Condition of the German Electrical Industry in 1908.

Whatever may be the present condition of the German electrical industry, it is evident from compilations made by Dr. J. Einhart and published in the *Deutschen Wirtschaftszeitung* that the industry as a whole was very much at a standstill in 1908. Numerous causes are attributed to this condition, chief among which were the financial depression and harassing legislation. Sales in heavy electrical machinery were less than in the same period in 1907, and the motor output of four of the largest manufacturers for a number of years is shown in the accompanying table. The output of tungstens during 1908 being twice that of the previous year. The condition of the carbon industry was said to be satisfactory, while on the other hand electric vehicles fared very badly.

	1895.	1900.	1904-05.	1906-07	1907-08
Allg. Elec.-Ges.	68,000 hp	208,208 hp	647,573 hp	1,161,060 hp	1,350,327 hp
Schuckert	39,460 hp	207,350 hp	964,118 hp	1,060,150 hp	1,014,225 kw
Lahmeyer			265,000 hp	382,000 hp	358,000 hp
Siemens & Halske			773,181 hp	1,060,150 hp	1,014,225 hp

The difficulty of obtaining ready money except at high rates has led the larger companies to form banks or trust companies, two of which have already started, one by the Allgemeine Elektricitäts-Gesellschaft and Siemens-Schuckert Works with a capital of 30,000,000 marks ($7,500,000) and the other by Felten & Guilleaume-Lahmeyer Works with a capital of 25,000,-

000 marks ($6,250,000). The value of the bonds issued by both companies is three times the stock value. The trust companies are not regarded favorably by the Government.

	1895-6.	1900-1.	1905-6.	1906-7.	1907-8
Allg. Elektr.-Ges.	13	1.	11	12	12
Schuckert	14	9	5	5	5
Siemens & Halske	10	8	10	11	11
Lahmeyer	5	11	7	7	7

Although the output during 1908 was somewhat restricted, the dividend did not fall off, as is indicated by the table herewith showing the dividend passed by four companies during five different years. Of 45 electrical manufacturing companies, having an aggregate capital of 573,000,000 marks, the dividend for 1906-1907 averaged 8.1 per cent, while in 1907-1908 it averaged 8.3 per cent. Stock quotations were as follows:

	Jan. 2.	March 5.	Aug. 30.	Oct. 6.	Dec. 31.
Allg. Elektr.-Ges.	196,—	198,20	217,—	223,—	214,75
Schuckert	100,—	103,20	107,—	120,—	115,70
Siemens & Halske	171,—	170,40	178,50	201,—	205,50
Lahmeyer	121,—	115,—	119,50	122,20	117,—

This shows that the companies are in a healthy condition. In 1908, 190,625 tons of copper were used as against 164,217 tons the previous year. The price of copper was also reduced. There were 180,000 tons of lead used by the electrical industries in 1908 as against 189,000 tons in 1907 and 185,000 tons of zinc and 15,000 tons of tin. The various manufacturers of insulating material combined in 1908 to keep up prices and as a result the cost of insulating material has increased from 50 to 200 per cent and over. The import and export of electrical material are given in the following table. The value of the exports of large electrical machinery increased over 50 per cent:

	Imports.		Exports.	
	1908. Marks.	1907. Marks.	1908. Marks.	1907. Marks.
Total electric products	111,641,000	144,254,000	704,809,000	673,562,000
(1) Machines	70,182,000	83,194,000	420,692,000	387,272,000
(2) Traction	9,178,000	8,956,000	185,219,000	167,333,000
(3) Other electric products.	32,281,000	52,104,000	98,898,000	118,957,000

The Edison Electric Light Convention.

The Association of Edison Illuminating Companies closed, on Sept. 2, a most successful convention, the general details of which were published in these columns last week. On the last day, the officers for the incoming year were elected as follows: Messrs. T. E. Murray, president; C. R. Huntley, vice-president; L. A. Ferguson, treasurer; executive committee: S. Insull, C. L. Edgar, J. W. Lieb, Jr., J. B. McCall, W. W. Freeman.

On Thursday evening a banquet was given in honor of Mr. and Mrs. Edison by the association in the large dining hall at Briarcliff Lodge. The room was superbly decorated and illuminated by the New York Edison Company, which took a rather cold and colorless room and turned it into an exquisite bower. In the ceiling all the holophote lighting was removed, and at each outlet baskets were put, the lamps and foliage being secured in the basket and flowers being clustered over all. From basket to basket streamers of flowers and foliage were suspended, all interspaced with lamps. All the columns were masked by wirework panels which in turn supported lamps and foliage and flowers in profuse abundance. All the corners were massed with light and color in the same way, and the entrance to the room was masked by a trellis, giving the effect of a flower garden. The center of the room was occupied by a huge table, oblong, and broad proportionately, built for the occasion, at which some 72 people sat. It was heavily banked with roses, ferns, etc., in beds of moss, and all through frosted lamps were concealed. Several thousand miniature and decorative lamps were employed in this scheme of illumination, which in itself was a felicitous and most beautiful compliment to the inventor of the Edison incandescent lamp. Special mention must be made of the intelligent and untiring work for the New York Edison Company of Messrs. Rhodes and Weissenberger, aided by Warendorf, the florist.

The dinner party included about 300, among whom were a number of Mr. Edison's early associates in the development of the great electric lighting art and industry. With these, whose names will readily suggest themselves, were several other special guests, such as President Cortelyou, of the Consolidated Gas Company; President Vanderlip, of the National City Bank, and Mr. A. N. Brady. The dinner itself was excellent, and the "exercises" were extremely interesting. The retiring president, Mr. W. W. Freeman, proposed the health of Mr. Edison as "a benefactor to mankind," and it went gloriously; but as a matter of fact the health had been drunk with musical honors all through the dinner; and later again each speaker in rhythmic succession gave the same toast. There seemed to be no other proper finale to a speech, and everybody was glad to have another chance at thus signalizing the sentiment of the hour. Mr. Freeman having done his modest share very adequately, turned the conduct of affairs over to Mr. Insull, as toastmaster, and he made good immediately. He spoke of Edison as the foremost inventor of his time, of the Anglo-Saxon race, a man whose name would live through all posterity. As to the lighting art itself, aside from the lamp and the dynamo, Edison's own financial support and help to the first station were part of his claim to honor, while the Edison system of distribution still remained dominant in the art. Mr. Insull followed his eloquent speech by presenting messages from Messrs. C. A. Coffin, T. N. Vail, C. Batchelor, R. R. Bowker, S. Bergmann, Elihu Thomson, John I. Beggs, N. F. Brady, Capt. W. Brophy and many others.

Mr. E. H. Johnson, former president of the Edison Electric Light Company, gave some intensely interesting reminiscences of the early days, and of his own acquaintance with Mr. Edison dating from 1870. He pointed out that the recognitions of Edison's work were, if anything, warmer abroad than in America, and that such men as the Lord Chief Justice of England and Lord Avebury hastened to do him honor. But great as was the intellectual capacity, immortal as was the product, Edison was "a man with a heart as big as his brain." Mr. Johnson was himself received with a burst of enthusiasm that must have warmed the very cockles of his own big heart.

Next came Mr. F. P. Fish, whose reminiscences were those of the representative of a once rival camp, and who took occasion to discuss the breadth and tolerance of Edison from that angle, citing also the intense admiration at all times expressed to him by Prof. Elihu Thomson of Edison's creative work. Mr. Fish referred to the lamp as not only a great invention, but "one of the greatest intellectual operations in the world," because Edison reasoned it out. And in like manner he had reasoned out other inventions applying different methods of attack to different problems.

Dr. C. P. Steinmetz made one of the happiest speeches of his life in trying to define Edison's position as an inventor, neither theoretical nor practical, but both in a great summation of intellectual and material achievement that placed his name in next and fitting sequence to those of Faraday and Helmholtz. Dr. Steinmetz pointed out how under changes of vast range the Edison fundamentals still persisted, and even as to the carbon lamp he saw qualities of permanence that did not inhere in even its latest rivals.

President-elect Murray was then inducted and made a quietly forceful speech in which he avowed that always registering at hotels, from Brooklyn, he more gladly did so since a fellow townsman had located the North Pole. He gave a pledge of loyalty to the high ideals of the association and then declared the close of the memorable convention of 1909—thirtieth anniversary of the lamp and thirtieth meeting of the body.

MR. THOMAS E. MURRAY.

The new president of the Association of Edison Illuminating Companies, Mr. Thomas E. Murray, has long been one of the leaders in the electric light and power industry. He was born at Albany, N. Y., on Oct. 21, 1860, growing up in that city and taking very early to mechanical pursuits, his aptitude for which was supplemented by hard night study. While still a very young man he became engineer of the Albany Water Works, and about 23 years ago he was made chief engineer of the Electric Illuminating Company of Albany. His promotion as general manager soon followed, and while holding that position he acted as consulting engineer for the electrified street railway and lighting properties of Albany and Troy. When the lighting interests

in Brooklyn were consolidated in the Kings County Lighting Company's system, Mr. Murray was brought to Long Island to effect the physical merger of the systems; and about 11 years ago he removed permanently to New York City in order to carry out the even more responsible program of physical consolidation on Manhattan, a gigantic task performed so easily and smoothly the general public never knew it was in process of execution. Such work included not only the designing of the new Kings County Station, but that in New York—the Waterside—and this was followed by kindred work in designing the Third Avenue plant of the Brooklyn Rapid Transit and its large Williamsburg turbo-generator plant and all the substations. Incidentally, Mr. Murray designed also the plants at Albany, Troy, Rochester and Utica, being in all such work the man to whom the Brady interests owe so largely their extraordinary record for clever and successful mechanical engineering over a wide range of properties; and serving as another instance of that shrewd judgment of men always shown by Mr. A. N. Brady. From first to last, Mr. Murray has to his credit over 600,000 hp installed in some of the best plants America can exhibit. In all this work the preëminent qualities manifested have been clearness of vision and sanity of decision.

Mr. Murray has been interested in the Edison Association for about a dozen years, but has hitherto declined flatly to take office. He is also a member of the American Institute of



PRESIDENT THOMAS E. MURRAY.

Electrical Engineers, of the American Society of Mechanical Engineers, and of the National Electric Light Association. His vice-presidency of the New York Edison Company is but one of many similar positions held by him in the industry. Aside from his notable gifts as an engineer, Mr. Murray is also a versatile inventor, having at least threescore patents in various lines, such as cut-outs, fuses, seals, electric signs, electro-hydraulic elevators, etc., many of the articles being now manufactured in large quantities.

In 1887 Mr. Murray married Miss Katherine Bradley, daughter of the late Senator Bradley, of Brooklyn, and he now has a family of four sons and four daughters, two of the boys being at Yale and one at Georgetown. His happy family life is the only possible endorsement he acknowledges of Rooseveltian policy. Passionately fond of music, he has always cultivated it, and his associates and many a delighted convention audience know what the operatic stage lost when he devoted himself to the mechanic arts.

Dielectric Stress in Three-Phase Cables.

A paper by Prof. W. M. Thornton and Mr. O. J. Williams, read at the Winnipeg convention of the British Association for the Advancement of Science, contained a description of apparatus employed in representing the dielectric stresses in three-phase cables by means of a mechanical analogue. Use was made of two circular glass plates 6 in. in diameter in one of which were bored three holes 3 in. apart placed equidistant about the center by means of nozzles and length of hose glycerine was allowed to flow from one or two holes and leave by way of the other two holes or one hole. The flow of glycerine was adjusted by screw clips on the discharge nozzles, so as to represent electrical conditions at 6 deg. time-intervals. Diagrams of the stream lines were obtained by photographing the model in use, projecting the photographs upon large sheets of drawing paper and sketching in the lines by hand. The dielectric stress was determined from the gradients of the stream lines.

Three-Phase Charging Currents.

Prof. E. W. Marchant presented at the Winnipeg convention a paper, "The Calculation of Charging Currents in Three-Phase Cables," in which formulas were developed for expressing the current in terms of the electrical quantities and mechanical dimensions. The charging current per kilometer of wire in an aerial three-phase system with wires arranged at the three corners of an equilateral triangle, when expressed in amperes, is $E\omega \div (31.18 \times 10^6 \log \epsilon D \div r)$ where E is the effective voltage between wires, D the distance between wires and r the radius of each wire ω being $2\pi f$. In a three-phase cable the maximum charging current per wire is $E\omega\,(2C_1 + C_2) \div \sqrt{3}$, where C_1 is the delta capacity between adjacent wires, and C_2 is the star capacity between each wire and the sheath. The value of $(2C_1 + C_2)$ is given directly by a ballistic test between one core and the other two connected to the sheath.

Standardizing Electrical Equipment in Mining.

At the Pittsburgh, Pa., session of the American Mining Congress, held early in December last year, a resolution was adopted authorizing the appointment of a committee of seven persons to report back for the consideration of that organization means for bringing about the standarization of electrical equipment in mining and recommendations looking to uniformity in electrical practice in general. The resolution, which was introduced by Mr. David B. Rushmore of the General Electric Company, Schenectady, N. Y., was as follows:

"Recommended, that a standing committee be appointed by the president of the American Mining Congress, to standardize as far as possible and make recommendations concerning electrical practice in mining work, said committee to consist of seven members, an electrical engineer, two representatives of the manufacturers of electrical equipment, two representatives of the labor organizations and two mine operators."

In accordance with this resolution the following members have been appointed to serve on the committee: Dr. Edward B. Rosa, the Bureau of Standards, Washington, D. C., chairman; Mr. David B. Rushmore, General Electric Company, Schenectady, N. Y., representing the manufacturers; Messrs. J. R. Bent, Oglesby Coal Company, Oglesby, Ill., and George R. Wood, Pittsburgh Coal Company, Pittsburgh, Pa., representing the mine operators; Messrs. T. L. Lewis, president U. M. of A., Indianapolis, Ind., and James O'Connell, vice-president A. F. of L., Washington, D. C., representing labor.

While the committee has been so recently organized that not much work has thus far been accomplished, it will render a preliminary report to the next session of the Mining Congress, which will be held at Goldfield, Nev., Sept. 27 to Oct. 2. It will then continue its work and within the next few months will doubtless be prepared to complete its recommendations. As the absence of uniformity in the installations of electrical equipment in coal and precious metal mines has given rise to problems very annoying to operators and manufacturers, the work of this committee will doubtless be watched with interest. Those having any views to offer on this subject are invited to send them to Dr. E. B. Rosa, Bureau of Standards, Washington.

Convention of New England N. E. L. A. Section.

The convention of the New England Section of the National Electric Light Association, to be held at Hotel Wentworth, Newcastle (Portsmouth), N. H., on Thursday and Friday of the present week, promises to be a successful affair. Very complete arrangements have been made for the entertainment of attendants, including a sail on the bay, a visit to the navy yard at Kittery, Me., and a banquet on Thursday evening. The ladies will, on Thursday afternoon, be shown about Portsmouth by guides provided by the Portsmouth Board of Trade, and on Friday will enjoy an automobile ride along the shores and beaches of New Hampshire.

At the general sessions on Thursday and Friday mornings the following papers will be read and discussed: "Advantages of Steam Heating for Electric Lighting Companies," by Mr. Charles R. Bishop; "Liability Insurance and How It Affects the Employer," by Mr. Walter L. Mulligan; "Low-Voltage Tungsten Lamps," by Mr. Frederick Welles Prince; "Hydro-Electric Development of the Connecticut River Power Company," by Mr. H. I. Harriman.

Lake Tahoe Water Rights.

It is reported that the negotiations of the Hammon syndicate with the Truckee River General Electric Company and the Reclamation Service, previously noted in these columns, are at a standstill pending action by President Taft. Briefly summarized, the Hammon contract contains the following provisions: 1. Control of the land, but not the title thereto, at the outlet of Lake Tahoe. 2. Right to regulate the flow of water, provided it shall always be kept up to the requirements of the Truckee General Electric Company. 3. Privilege of paying half the expense of a new dam to replace the old one at the outlet of the lake. The Truckee General Electric Company is to receive: 1. The right to select without cost and to hold in perpetuity sites for reservoirs, right-of-way for flumes, ditches and transmission lines over the public lands within the entire watershed of Lake Tahoe and the Truckee River. 2. Privilege of making these selections over a period of five years. 3. Right to make new power developments from the waters of Tahoe. 4. Authority to cut a tunnel from the northeast corner of the lake over into Lake Washoe.

Direct-Current Line Corona Losses.

At the Winnipeg convention of the British Association for the Advancement of Science a paper entitled "Atmospheric Loss of Wires Under Direct-Current Pressures" was presented by Mr. E. A. Watson. The author reported the results of tests similar to those conducted by Messrs. Mershon and Ryan in this country, but using direct current instead of alternating. The tests made to determine the effect of changes in barometric pressure upon the critical voltage at which loss commences and the relation between the critical stress and the wire diameter agreed substantially with Prof. H. J. Ryan's results, and showed that the voltage of formation of the corona is very nearly the same whether the stress is alternating or steady, provided in each case the maximum value and not the effective value be taken.

As a result of his tests, the author concluded that there is a definite critical stress for which loss occurs from a direct-current line just as from an alternating-current one; the direct-current stress required to produce this loss is the same as the maximum alternating-current one, and it is substantially the same whether the wire is positive or negative, provided that it is clean, as for dirty wires the electric stress is lowered much more for negative than positive charges; the critical stress is greater the smaller the wire diameter; the critical stress is reduced by a reduction of the air pressure, but not proportionally; the presence of water vapor in the air does not affect the loss or critical stress for a clean wire—an actual transmission line does not behave exactly like a perfectly clean wire, and the loss is affected by the presence of water vapor in the atmosphere.

Conservation of Resources.

At the noonday meeting of the Electric Club, in Chicago, Sept. 1, Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company, gave a talk on "The Conservation of Resources," thus putting the club in line with other professional bodies in the discussion of this political and economic topic. Unlike most speakers on the subject, however, he did not deal in glittering generalities, but announced that he had a plan which far transcended anything heretofore proposed in the way of forest preservation. This consisted in increasing the amount of carbon dioxide in the air, thus encouraging vegetation, which would cause our depleted forests to rise rapidly again and force barren places to become productive. Taking up details, he solemnly elaborated a scheme for the production of carbon dioxide by burning the useless fuel which is now going to waste under the surface of the earth. He would require all coal-mining operators before abandoning a mine to set fire to the coal which could not be mined and keep this burning by means of forced draft. He would also open up some of the thin veins of coal which are not of good enough quality to mine for fuel. In this way, he thought, that the present consumption of coal, amounting to about 1,000,000,000 tons of coal a year, could be increased to 500,000,000,000 tons, which might sufficiently enrich the air with CO_2 to accomplish the desired results. Mr. W. S. Taussig inquired how long it would take to accomplish these results with our present rate of coal burning. Mr. Abbott replied about 2000 years. Mr. E. N. Lake asked whether Mr. Abbott had elaborated any scheme for producing electrical energy along with this scheme for utilizing coal. Mr. Abbott said that it had been suggested that these thin veins of coal be operated as gas producers supplying carbon monoxide to gas engines, these engines to produce electrical energy. Fortunately, no one was unkind enough to ask Mr. Abbott whether he was conscientiously trying to do his share in increasing the carbon dioxide in the air by burning as much coal as possible per kw-hour in the great electric generating plants which are under his charge.

High-Frequency Oscillations.

At a meeting of the Wireless Institute, held on Sept. 1 at the Engineering Societies Building, New York, Mr. Harry Shoemaker presented a paper entitled, "The Production of High-Frequency Oscillations." The author outlined the characteristics of damped and sustained oscillations and stated that, while the latter are used for wireless telephony, the former are employed almost exclusively for wireless telegraphy. Damped oscillations are produced in practice by the discharge of a condenser across a spark-gap through an inductive circuit. The period of the oscillation depends upon the product of the capacity of the condenser and the inductance of the circuit. The antenna may be directly connected to the exciting circuit or it may be inductively associated therewith. In practice use is frequently made of a combination of the two connections. The ratio of the mutual inductance to the square root of the two self-inductances is known as the coupling coefficient; it may be as low as 0.1, but is usually about 0.2. Best results are obtained when the natural period of the antenna circuit is the same as that of the exciting circuit. Energy stored in a condenser during each cycle has a value proportional to the product of the capacity and the square of the voltage; the power utilized varies directly with the number of cycles per second. It is found that a 0.0075-mf condenser requires 1 kw when operated at a frequency of 60 cycles and an e.m.f. of 20,000 volts. Five kilowatts are used when the frequency is 120, the capacity 0.03 mf and the e.m.f. 28,000 volts.

In a conversational discussion following the reading of his paper, the author remarked that the best form of antenna is a straight wire mounted in the vertical plane. Energy for the condenser in the exciting circuit is obtained from the secondary of a transformer constructed with a large amount of magnetic leakage so that the current remains practically constant from full load to direct short circuits. On account of the leading condenser current the actual, secondary e.m.f. is much greater than the value found by multiplying the primary e.m.f by the ratio of turns. Moreover, the e.m.f. per turn is not uniform throughout the secondary coil, being greater at the end-turns.

Government Power Plant at Washington Nearing Completion.

The electrical power station on Capitol Hill, Washington, is almost complete and when fully equipped for the purpose of its construction will cost almost $2,000,000. The station, which was described in our issue of June 1, 1907, will supply light, heat and power for the office buildings of the House of Representatives and Senate, the Congressional Library and the Capitol. It is located near the Capitol in Garfield Park near the intersection of Virginia and New Jersey avenues, southwest. The station is connected with the legislative group of buildings mentioned by tunnels through which steam pipes and cables run. The tunnels are large enough to permit a man to walk through them so that breaks and other troubles can be quickly located and repaired. The tunnels are over 7000 ft. long in the aggregate. The cornerstone of the power station was formerly the base stone of the Greenough statue of Washington which stood for many years on the plaza of the east front of the Capitol and was recently removed to the Smithsonian Institution.

Electric Rates Reduced by Boston Suburban Consolidation.

The Edison Electric Illuminating Company of Boston assumed charge of the electrical business of the suburban companies in Waltham, Newton, Watertown, Brookline, Brighton and Chelsea on Sept. 1, in accordance with the recent decision of the Massachusetts Gas and Electric Light Commission authorizing the purchase of these companies by the larger organization centering in Boston. Except in Newton and Watertown the change introduced reductions in rates from 16 cents to 12 cents per kw-hour, or 25 per cent. In Newton and Watertown the rates were reduced from 18 cents to 12 cents per kw-hour early in the present year, when the assumption of the business by the Edison Company was anticipated. The Massachusetts Gas Companies have controlled the gas business of the above-named companies for some time, and the taking over of the electrical service by the Edison Company enables each service to be pushed to its most effective limit.

A feature of the new arrangement is a 10-year contract which the Edison Company has made to supply power to the electric railway lines controlled by the interests which have operated the Waltham Gas Light Company. These roads include the Lexington & Boston, the Natick & Cochituate, the Newton, the Newton & Boston, the Middlesex & Boston, the Westboro and Hopkinton, and the Newtonville & Watertown. For several weeks these lines have been using power supplied by the Edison Company, and the steadiness and efficiency of the supply have created a favorable impression. There will be no interruption in the lighting and power service of the customers of the suburban companies which have been taken over by the Edison system, the transfer being largely a matter of business details. In Waltham a turbine station of about 1200-kw capacity has been taken over by the Edison Company, and in Chelsea the service has for some time been supplied from the Edison system, as has been the case in Newton and Watertown. It is expected that the Allston plant of the Boston Consolidated Gas Company, which formerly supplied Brookline and a part of Brighton, will be taken out of service as soon as possible, as it is not of modern design and cannot be operated at first-class economy of production with its present equipment. All the service of the suburban communities now a part of the Edison system will be centralized at the L Street station of the company in South Boston.

Idaho Water-Powers.

Under date of Aug. 30, Mr. William E. Curtis contributes from Idaho an interesting letter to the Chicago *Record-Herald* giving an account of the great water-power resources of that State. The Snake River, which, he says, has been called "The Jugular Vein of Idaho," runs 800 miles through the State and drops between 5000 ft. and 6000 ft. during its circuitous course between the boundaries of Wyoming, where it rises, and Washington, where it flows into the Columbia. It irrigates, with its tributaries, more than 3,000,000 acres of land, and its tremendous current has energy enough to turn all the wheels that are revolving in the United States to-day.

This valuable property has been gradually absorbed by corporations from California, Colorado, Illinois, Pennsylvania, New York, Massachusetts and other States, as well as by local individuals and syndicates, chiefly for speculative purposes. But there is, he says, no evidence to be found to sustain the contention that there is any collusion or understanding, much less a partnership between the interests represented. Nor is there any evidence, or even a ground for suspicion, that the General Electric Company, or the Westinghouse Company, or any of the great corporations of the East are behind the movement, as has been so frequently alleged. On the contrary, the people who are getting hold of the power sites are either local electric light and power companies, who wish to utilize the energy that is going to waste, or speculators who desire to obtain control of available sites in order to make a profit by selling out to companies which may be organized in the future to utilize them.

Nobody in Idaho believes, he says, in the alleged water-power trust. There is more evidence of rivalry and even hostility among the interests that hold the claims. "Instead of collusion there is a grand scramble to secure a share of the wonderful possibilities represented by the Snake River and its tributaries purely as a gamble on the future. There is nothing whatever to justify the assertion that these claimants are filing in the interest of other persons. Those who are familiar with the affairs of the General Electric and Westinghouse companies and similar corporations know that water-power sites, more or less valuable, in different parts of the country are offered to them every day, usually for fabulous prices, based upon the President's message, the report of the conservation commission and the popular impression that a water-power trust is grabbing everything it can reach.

"Water-power sites can be acquired under the laws of Idaho by filing an application and paying a fee, provided they have not already been located. These applications are granted by the officials at Boise City upon the stipulation that the power is to be utilized in good faith, and the locator must do a certain amount of work within a certain limit of time. If he has a market, he usually organizes a stock company, floats bonds enough to pay for a plant and sells light and power to the public. If the applicant is merely a speculator he "puts up a bluff," and when his legal rights expire he arranges for a partner or a friend to make a filing on the same location before he relinquishes. By repeating that process a syndicate of speculators can control the water-power site for a number of years, but if the power is needed for any practical purpose it fights for control or sells out to those who would make practical use of it.

"Within a radius of 90 miles of Boise there is not less than 100,000 hp awaiting development, but all of the available sites have been taken up by individuals and corporations which are well known and do not represent any monopoly East or West.

There is no collusion between them. They have no relations whatever and have conflicting interests. This water-power represents several million dollars worth of coal annually to Boise City, and the optimists of this section are confident that the time will soon come when it will be needed and used for practical and profitable purposes. There is no manufacturing here now. There is no possible use for this power, but there are plans for electric mills to grind the wheat into flour, for factories to spin and weave the wool from the sheep that graze upon the mountain sides. There are plans for mills to manufacture breakfast foods and other patent 'cereals'; and engineers who are thoughtful enough to grasp the situation recognize that a considerable part of the energy of the Snake River will be needed in a few years to pump its own water into irrigating canals at higher levels than can be reached by the ordinary flow."

A number of power plants are already being operated by corporations in Idaho, most of them controlled by outside capital. A notable exception is the plant at American Falls, on the Snake River, 25 miles west of Pocatello, which is owned entirely by Governor J. H. Brady. It present capacity is 4000 hp, which can be increased to 60,000 hp. Near Mountain Home, 50 or 60 miles east of Boise, a Canadian syndicate has undertaken the development of 30,000 hp, and has contracted to furnish 7500 hp for lighting and manufacturing purposes by April 1, 1910. At the town of Rupert the United States Government is preparing to develop 12,000 hp to pump water for irrigation purposes. Mr. H. L. Hollister, of Chicago, has a 10,000-hp hydro-electric plant at Shoshone Falls, which distributes electrical energy over a large area at prices so low that farmers can use it for every kind of purpose. These falls, which are stated to have a power capacity equal to Niagara, are owned by ex-Senator W. A. Clark, who is said to be waiting a proposal for their purchase. Forty miles further down the canyon, at Lower Salmon Falls, near the town of Hagerman, the Kuhn Brothers, of Pittsburgh, are building a dam for irrigation and power purposes which will create a lake 13 miles long, and will impound water enough to irrigate 120,000 acres of land, and will furnish power for electric light and traction. Five miles from Hagerman are the Upper Salmon Falls, held by an Eastern company, which are capable of furnishing an equal amount of power.

New York Public Service Commission News.

A committee of the Twenty-third Street Improvement Association, which is composed of property owners and merchants in the vicinity of Twenty-third Street, Fourth, Fifth and Sixth Avenues, has presented to the Public Service Commission of the First District of New York plans for amending the proposed Broadway-Lexington Avenue route for a new subway by including a loop which will leave the line at Broadway and Tenth Street, continue up Broadway to Thirty-first Street, thence west to the new Pennsylvania Railroad Station at Seventh Avenue, and under that thoroughfare to Times Square. This plan, it is claimed, will give a Broadway line from end to end and will connect the new station with both the present and the proposed subways. Immediately after these proposals were made known the Bradley-Gaffney-Steers Company, which has announced its intention of bidding on the Lexington Avenue route, expressed its willingness to conclude the loop in its bids.

Members of the Public Service Commission had the first of a series of conferences last week with President Shonts and General Manager Hedley of the Interborough Rapid Transit Company. These conferences are for the purpose of arriving at some sort of an agreement between the commission and the Interborough as to new subway routes.

An investigation was begun last week into the reasonableness of a three-cent fare across the Williamsburg Bridge, as charged at present by the Bridge Operating Company. It was shown at the hearing that the total tangible property of the company is only $100,764. The hearings will be continued Sept. 9.

The Public Service Commission, Second District, has authorized the Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Company to deliver and execute to the West End Trust Company, of Philadelphia, a mortage to the amount of $2,500,000, to be executed under and by the corporate name of Geneva & Auburn Railway. The corporation is authorized to issue at present $500,000 5 per cent, 30-year bonds to be sold at not less than 90. Four hundred thousand dollars of the proceeds are to be used for the discharge of the outstanding bonds of the corporation and $100,000 for the acquisition of property and extension and improvement of facilities of the corporation. Among the improvements are an extension to Cayuga Lake, costing $50,000; four new cars, costing $36,000; temporary power house, $7,728; new turnouts, $4,509, and a "Y" at Seneca and Exchange streets, Geneva, $4,002.

The Elmira Water, Light & Railroad Company has been authorized to issue its first consolidated 5 per cent 50-year gold bonds to the amount of $196,000, to be sold at not less than 85. Of the proceeds of the sale $59,874.17 is to be used for the payment and discharge of indebtedness incurred in constructing additions and betterments to its property, and the balance for future additions and betterments.

The commission has authorized the Patchogue Electric light Company to exercise franchises to furnish light for public and private use, granted it by the town of Brookhaven, L. I.

The Public Service Commission, Second District, has completed its investigations and examinations of the applications made by the Associated Gas & Electric Company for the readjustment of its financial affairs by the issuance of new mortgages and bonds. Action was taken some weeks ago and orders issued in relation to the Newark, Penn Yan, Hornell and Norwich companies. After hearings and conferences with the applicants and their attorneys, King, Waters & Page, of Syracuse, final orders have just been issued in the cases of the Ithaca, Homer and Cortland, Palmyra, and Lyons companies.

The Ithaca Gas Light Company applied for authority to make a mortgage for $750,000, but afterward amended its petition and asked that this amount be placed at $400,000. The company is authorized to issue the mortgage to the amount of $400,000 and at this time bonds thereunder to the amount of $260,000 in 5 per cent, 40-year bonds to be sold at not less than 90. The proceeds of these bonds are to be used as follows: $200,000 to refund outstanding bonds, $27,400 for the discharge of certain obligations and the remainder for betterments to the plant and distributing system of the corporation. Authorization is made upon the condition that the mortgage shall contain a provision for creating a sinking fund for the amortization of the bonds to be issued under this mortgage. Each year until the bonds mature an amount equal to one-half per cent of the aggregate amount of the bonds shall be paid to the trustee, who will apply this money for the redemption of the bonds at a price not to exceed 105. The mortgage shall also contain a provision that the company will pay over to the trustee each year not less than 40 per cent of the net corporate income of the company until this shall amount to $90,000. The trustee may from time to time pay to the company a whole or any part of this fund to be used for additions and betterments to the plant and distributing system of the corporation. When the investment fund shall have amounted to the sum of $90,000 it shall all be turned over to the company to be held by it without further condition or limitation. Further provision is made that a further sum of $20,000 shall be raised after the $90,000 has been secured to be used in the same manner.

The Lyons Gas Light Company applied for permission to issue a mortgage in the sum of $150,000 and thereafter amended its petition to make the mortgage $100,000. Permission was given to execute a mortgage in the latter sum and the issuance at this time of $50,000 in 40-year 5 per cent bonds to be sold at not less than 85. Of this amount $34,000 is to be used for the discharge of obligations and $9,600 for the construction of a new high-pressure gas main.

The Homer & Cortland Gas Light Company originally applied for a mortgage in the sum of $500,000, but afterward amended its petition and asked that this amount be placed at

$250,000. The commission authorized the latter amount and at this time granted permission to the issuance of $160,000 in 40-year 5 per cent bonds to be sold at not less than 90. Of this amount $100,000 is to be used to refund outstanding bonds, $39,750 for the payment of certain obligations and the remainder for additions and betterments to the plant and distributing system.

The Palmyra Gas & Electric Company is authorized to make a mortgage in the aggregate sum of $100,000 and to issue at present $60,000 in 40-year 5 per cent bonds to be sold at not less than 90.

In the Lyons, Homer and Cortland, and Palmyra applications provision is also made for sinking funds to provide for final wiping out of items which the commission did not deem the proper subject of capitalization, and sufficient time in each instance is given to allow the companies to put their affairs in shape desired by the commission and also to allow them to proceed with the proper service to the public and making of necessary improvements.

The commission will hold a meeting on Tuesday at Port Jervis to hear a proposition to be submitted by C. F. Wright, E. P. Emerson, I. N. Beardslee, C. Richard Taylor and Frank R. Moody, who have been granted franchises by the Common Council of the city of Port Jervis, for furnishing gas and electricity and operating an electric railway in that city. For a long time back there has been complaint of the lighting and street surface properties in that city. The old company is now undergoing reorganization and the reorganization committee has an application pending before the commission for the refinancing of the existing properties in that city. On Wednesday, at Albany, the commission will hear the application of the Economic Power & Construction Company for approval of its franchises which it is now exercising in the city of Geneva. The granting of the application will be opposed by the Geneva-Seneca Electric Company, one of the companies of the General Electric Company. On Friday will be heard, at Buffalo, the complaint of the Buffalo General Electric Company against the Prudential Building Company relative to the alleged unlawful rendering of electric service without the authority of the commission, the complaint of residents of the town of Amherst against the Buffalo & Williamsville Electric Railway Company relative to the fares on that road, and the complaint of various other patrons of the Buffalo & Williamsville Electric Railway Company as to service rendered and lack of accommodation.

The commission has authorized the Babylon Electric Light Company to issue its capital stock to the amount of $30,000 for the payment of various indebtedness outstanding against the company.

Methods of Wisconsin Commission for the Valuation of Public Utilities.

The Wisconsin laws affecting public utilities provide that the Railroad Commission of the State "shall value all the property of every public utility actually used and useful for the convenience of the public." It is also provided by law that the commission, in making the valuation, may avail itself of any information in possession of the State Board of Assessment. The reason for this latter provision arose in part from the fact that the Railroad Commission and the Board of Assessment for several years have been served by a joint engineering staff, at the head of which is Prof. W. D. Pence, engineer for the two commissions. The importance of the attitude of the Wisconsin laws toward the subject of valuation is further indicated by the provision that the Railroad Commission can make a revaluation, at any time, on its own initiative.

Valuations made by the engineering staff for the Railroad Commission are considered in the decisions of the commission concerning rates charged for public-utility services and are, therefore, matters of vital concern to the utility corporations of the State. It is understood that the position of the commission is that the valuations at which the engineering staff arrives constitute evidence for consideration in all proceedings bearing on the adequacy of rates. As submitted by the staff, the valuations are regarded as somewhat tentative and subject to revision always if the justice of change is made plain.

Ordinarily, in making a valuation, a complete inspection of all the physical property of the corporation is undertaken and every effort is made to ascertain original costs and to determine particularly in what manner and to what extent values are affected by conditions that are peculiarly local. The staff is so organized that the principal branches of the work are referred to different heads of departments, who, with their assistants, make complete reports, which, when combined, form the basis of the final conclusions embodied in the tentative valuation submitted to the commission.

Professor Pence, in discussing the advisability of regarding the valuations reported by the staff as tentative, stated that while it is believed that the methods followed yield the fairest estimates obtainable, precedents have to be created in many instances and, therefore, neither the staff nor the commission is willing to regard these valuations as necessarily conclusive until a final decision in each case is rendered by the commission.

Heads of the various departments of the engineering staff principally concerned in the work of valuations explain the methods followed, as indicated below.

OVERHEAD EQUIPMENT.

Mr. W. F. Sloan, who has charge of the field inspection and estimates of overhead and telephone equipment, said that in most cases actual field inventories of the physical property are made. In the valuation of the railway property of the Milwaukee Electric Railway & Light Company, however, it was found that the records of the company were nearly complete. The valuation staff, therefore, secured the company maps and copied the official records and checked the equipment in the field by inspection. In this case, the staff did not inspect by personal visit all of the apparatus and equipment. Over 90 per cent of the overhead work and over 10 per cent of the manholes were inspected personally by members of the staff. The intent was that the staff should be assured by actual inspection that the records of the company were substantially correct, and enough field work was undertaken to substantiate this fact. With the other properties in the State, which are all smaller, the practice is to plot the location of the poles on large insurance maps. In valuing the wiring, 80 per cent is allowed for copper and 20 per cent for insulation. During the inventory of properties through the State interesting facts were learned bearing on the average life of different units. By digging down 6 in. or 8 in. below the surface, the staff inspected various poles carefully. As a result of this inspection, extending to practically all parts of the State, an extreme variation of 10 to 20 years in the life of wooden poles is assumed, but the average is about 12 to 18 years. Due to conditions peculiar to certain localities, it was found that poles in one community had a very short life, and in another a life far in excess of any which the staff had been justified in assuming as normal. The dates of purchase and installation of the poles are secured in each place.

In valuing telephone properties, an inventory of the overhead equipment is made in about the same manner as that followed for electric lighting and power overhead equipment. Dates of purchase of telephone apparatus and all other available information bearing on the cost or life is secured.

The staff making these valuations has endeavored to ascertain, as far as possible, the scrap value of the material and the approximate minimum percentage of value at which service could be maintained profitably. The staff determines the service value of the equipment, estimating the age, if not known.

BUILDINGS AND OFFICE EQUIPMENT.

Mr. R. M. Fuestel has direct charge of the field inspection of buildings and office equipment. In making valuations of these classes of property, the practice is to sketch a plan of the power station, showing the inside dimensions, and to prepare absolute contractors' estimates covering all parts. The contractors' profit is figured on each item. Local costs and profits on mate-

rials are taken into account on each unit in the different communities. The practice is to take the cost of reproduction of buildings new and then tentatively depreciate the same according to a 4 per cent sinking-fund curve; but in the final calculation the staff relies more on the facts than on the figures developed by any other means. The general practice of the engineering staff of calculating a five-year average price for each unit is not followed altogether in the valuation of buildings and office equipment. In this case, a two-year average price is applied to almost all building materials, except steel work, for which a five-year average price is calculated. The first change from the general rule of the five-year average price was made in computing the cost of lumber, and there has been no contest on the action of the staff in adopting two-year average prices for materials of this character. A complete inventory is made of office furniture.

The custom, in starting the work of valuation, is to interview reliable contractors in the community, getting such information concerning the local costs of labor and materials and conditions affecting building as they are willing to give. No serious difficulties have been met in securing this information. The following lives have been assumed usually, although there are variations from these figures:

	Years.
Average brick structure	50
First-class stone and concrete structure	75
Frame passenger station	35
Coal sheds and outbuildings	20 to 25

No scrap value is figured in the majority of the buildings. It is considered that when they are torn down the cost of wrecking would absorb any value that might be left in the material. In the inspection and the final determination of the life of the structure the practice which the management has followed as to maintenance of the property is given proper consideration.

POWER STATION AND ROLLING STOCK EQUIPMENT.

Mr. R. W. Harris, who has direct charge of valuations of rolling stock and electric power station equipment, stated that in valuations of rolling stock the first step was to learn how many cars were owned by the company and then to inspect them thoroughly. If possible, a ride is taken on every car. After this is done, a study of the methods of maintaining the cars is made. Shop methods are observed carefully, and especially the method of washing the cars. A photograph is taken of each type of car and a statement made of the estimated life and minimum service value of the different types. The various parts of the car and equipment have been found to depreciate at different rates. The life of a truck is assumed to be 20 years, and of a car body 15 years. Railway motors of modern types are allowed a life of 20 years, and of obsolete types, 15 years. The minimum service value of a modern type of car is assumed to be 35 per cent of the cost value new, and of an obsolete type, 20 per cent.

When valuations of power-station equipment are made, a detailed inventory is drawn up, covering the complete plant. Every machine is inspected. The name-plate data are taken. The statistical record compiled for every machine gives the age and goes particularly into the conditions of maintenance. Every unit is assumed to be in good, fair or poor condition. "Good" condition represents standard maintenance. "Fair" is 10 per cent less than "good." If a machine is badly run down and very much overloaded, the report calls the maintenance "poor," which means 20 per cent less than "good." After all the machines are inspected and the desired information obtained, a similar course is followed with the switchboard. After the data relating to the switchboard have been secured, a sketch is made of the buildings. When the complete inventory of the power-station equipment has been completed, the staff returns to the office of the company undergoing valuation and places a value on each individual piece of apparatus. In fixing these prices it is believed that average conditions are secured by following the general practice of the staff in calculating five-year averages. After fixing the five-year average value, the final price, which may involve some deviation up or down from the average value, is reached. Various conditions of actual purchase may have an effect on cost value that may cause marked deviation in the final price adopted. After the contract or original value is secured, and the various elements affecting price are considered, the present value is fixed. The cost value as calculated includes the cost new and the freight plus the expense of installation. In figuring the present value use is made of the unit cost minus the scrap value, leaving the wearing value to be depreciated according to age and conditions of operation.

MECHANICAL.

Prof. J. G. D. Mack, chief mechanical inspector of the commission, has under his direction the valuation of mechanical equipment and material. Forms are provided so that a complete inventory may be made of the mechanical apparatus if used by any one who is not familiar with the property. It is necessary that the inventory shall be so made that the equipment may be traced by the description on the form. It is considered that inspectors will not be able to compute the present value to within 10 per cent of the true condition. Books are provided in order that the inventory of the piping may be made complete. Thirty per cent is usually added to the cost of piping, new, as calculated, to cover the expense of freight and erection.

BUILDING SITES AND RAILWAY RIGHT OF WAY.

Mr. W. E. Miller, assistant engineer and office engineer, said that in valuing the right-of-way of electric railways the practice is to make a map of the property by towns and to send to the county seat and ascertain the assessment of similarly situated lands by the latest tax rolls available. Usually this assessment was made one year prior to the one in which the valuation is prepared. From this data the assessment for a certain strip along the line of the road is learned. From the total acreage and the total assessed value in certain adjacent strips of lands the total assessment value per acre is derived. The records of the State Board of Assessment give the assessment ratio based upon exhaustive field investigations of actual transfers for the year, and then the average assessed value per acre is divided by this ratio and the result is assumed to be the true market value per acre based on sales for the year in the assessment district. The cost of acquiring land used for railway right-of-way is assumed to be 2½ times the local value for farming purposes; and by multiplying the true market value per acre, as ascertained in the manner outlined, by 2½ the result for valuation for railroad purposes is given.

The following illustrations indicate the practice followed in making valuations of right of way for railways. By 11 transactions land aggregating 9.93 acres was purchased for a consideration of $1,750, making the average price per acre to the railway $176.13. The assessed value of land aggregating 1676.59 acres, used for farming purposes and located on both sides of the railway, was $110.565, or an average of $65.93 per acre. From the records of the statistician of the State Board of Assessment the assessment ratio was ascertained by which the staff was able to find the assumed real value per acre. By dividing the assessed value by the ratio, the true value for ordinary purposes is ascertained. Thus, $65.93 is divided by 0.793, giving $83.14. The latter figure, it was held, represented the true value of land in that district for farming purposes as determined by farm sales. To this value was applied the ratio of 2½ already mentioned. Since the railway company in this case paid $176.13, its land cost about 2⅛ times the nominal market value obtained in the manner above outlined. In another similar instance there were seven separate transactions for land aggregating 10.88 acres used for right-of-way purposes. The total cost was $1,785, and the average price per acre $164.36. At approximately the same time it was found that the assessed value on the tax rolls for 2526.75 acres was $160,770, or an average per acre of $63.62. The records of the State Board of Assessment showed an assessment ratio for the district of 86.78 per cent. By dividing $63.62 by 0.8678 the real market value per acre was ascertained to be $73.32. In this case it is known from the company's records that it actually paid $164.36, so that this land cost about 2¼ times the market value. The two instances here-

cited chance to show ratios less than 2½, which latter ratio was derived from extended investigations over the entire State.

In making valuations of land used for location of power stations and like purposes a diagram is usually drawn showing the total value of real estate in the city in question from 1901 to 1907, inclusive, for instance. If the tax rolls are not made out for 1908, the value of all land in the city is determined from the summary of values of real estate found in the tax rolls and from the corresponding assessment ratios. The value of all the land in the city is learned and these values are reduced to diagrams. There has been almost a uniform upward tendency in the value of real estate in the communities of Wisconsin, and, therefore, it is assumed by the engineering staff that real estate continued to rise in value in 1908 at the same general rate as during the several preceding years. Unless evidence to the contrary is found, it is assumed that the value of all the real estate throughout a city, and, therefore, of the tract under investigation, increased in the same proportion; for example, in one specific instance, where the calculation was made by this method, it was determined that the 1908 value would be 9.1 per cent more than in 1907. The figures in the method outlined apply only to land for improved real estate and to unimproved land, a separate valuation being made for the buildings. After the value is fixed in this way from prices of surrounding lots it has been the usual practice, in valuing large tracts, to add 10 per cent for the extra cost of acquiring the property in small pieces to bring it under single ownership. There is variation from this practice in the valuation of private right of way for railroads in large cities. For property of this kind 10 per cent is usually added for the larger tracts of land and 33 1/3 per cent for strips of 100 ft. in width or less.

The members of the staff whose names are given in the foregoing article have all had experience in railway or other public-utility properties, and some of those mentioned had experience in important appraisals of large properties prior to their connection with the staff. A complete set of printed forms have been provided for use by the staff in collecting and tabulating the data for the valuations.

CURRENT NEWS AND NOTES.

METER TEST REPORTS.—In the article, Public Service Commission hearing in New York on meter test reports, published in the Aug. 26 issue, it was stated that "direct-reading indicating wattmeters shall be used as standard instruments in making tests of consumer's meters." The regulations are to the contrary, the word "not" having been omitted after the word "shall."

STORAGE BATTERIES IN AUSTRIAN CENTRAL STATIONS.—Of 367 direct-current central stations in Austria, no less than 229 employ storage batteries, the total battery capacity being 10,225 kw. There are only 173 alternating-current stations in the Empire, including 21 stations generating both alternating and direct current, which latter have 9553 kw in storage batteries installed.

MUNICIPAL ENDORSEMENT OF NATIONAL ELECTRICAL CODE.—The city of Rifle, Col., has passed an ordinance requiring National Electrical Code construction within the city, with the additional requirements that there shall be 6 ft. spacing between high-tension and low-tension wires, that in buildings, cabinets shall in all cases be installed, and that secondaries shall be grounded effectually.

ELECTRICITY FOR BLEACHING.—The Amazon Knitting Mills, of Muskegon, Mich., is using an electrolytic process for the production of the bleaching solution required in its factory. The cells are of a type employed in laundries heretofore and were made by the National Laundry Machinery Company, of Dayton, Ohio. The cost of bleaching is stated to be less, and the uniformity of results much better since this process was put in operation at the Amazon mills.

ELECTRIC BELLS ON LOCOMOTIVES.—The Indiana Railroad Commission has issued a circular calling the attention of steam railroads to the recently enacted law which provides that after Jan. 1, 1910, all locomotives used on their lines shall be equipped with efficient automatic or electric devices for ringing the bell on such locomotives, and that it is made the duty of the commission to enforce the provision of the law.

EUROPEAN TRACKLESS TROLLEYS.—Our issue for Aug. 19 contained an article entitled "European Trackless Trolley Cars," in which certain estimates were given for the working expenses. The values stated should have been expressed in cents instead of dollars. Thus, the cost in the case of the Mercedes-Stoll system was 9.04 cents per car-mile and not $9.04, and that of the Filovia system 11.29 cents and not $11.29.

NINE MILLION-HP CANADIAN DEVELOPMENT.—The minimum-flow development of all the water-powers of Canada, according to Mr. J. B. Challies, of the Canadian Department of the Interior, is estimated at over 25,680,000 hp, of which about 516,900 hp has as yet been utilized. Hamilton River, in the Labrador Peninsula, is the largest available power, with a possible development of 9,000,000 hp, Niagara Falls being second to it.

THEORY OF EARTH'S MAGNETIC POLE.—The discovery of the north pole is followed by a letter in a Rochester daily newspaper disclosing the discovery of the cause of the effect of the earth's magnetic pole on a magnetic needle. "The cause of the magnet needle," the writer says, "can be readily explained by the theory that the heat from the molten mass of the earth's center and the intensely cold water cause steam. Then the motion of the globe causes a whirlpool of the vapor that rushes forth from the hot center. Why, then, heat, cold, moisture and friction—it's what? Why, magnetic. And the vapor spreads out and forms into an ice belt that encircles the globe around the North Pole or Arctic Ocean, where the vapor whirlpool is located." The writer's manner of begging the question is unique.

TELEPHONES IN THE TRANSVAAL.—Numerous extensions and improvements are planned for the Transvaal telephone system. It is reported that every town not yet linked up with the telephone system is to be brought into it, and the main trunk lines are to be carried to every point where the railway lines cross the border, with a view of preparing the way for the ultimate extension to the coastal ports and Buluwayo. It is regarded as certain that the Union Government will find telephonic communication between Cape Town and Pretoria absolutely essential under the proposed arrangement by which Parliament will meet at a place so far removed from the administrative center. The scheme contemplates connections with farmhouses and the establishment of call offices at convenient centers in rural districts. It is estimated that the coast extensions definitely undertaken will cost $1,250,000.

PERPETUAL MOTION BEFORE THE B. A.—At the Winnipeg meeting of the British Association for the Advancement of Science, an inventor, S. H. Schneider, exhibited a model for producing electricity which, he claims, will revolutionize the electrical world. It is a waterproof and airtight box so constructed that it opens and shuts like an ordinary folding dinner box. When folded it naturally sinks to the bottom of water, but reaching bottom the contrivance opens by means of a magnet and, being lighter than the water it displaces, rises to the surface, where it again folds up and sinks. The inventor states that by the action of this box electrical power can be generated, and claims that a "generator" weighing 600,000 lb. displaces 10,000 cu. ft. of water and will generate 831,998,000 foot-pounds per half minute. As no fuel of any kind is required, Mr. Schneider claims power can be generated at a very low price.

A South American Gas-Engine-Driven Central Station.

By J. P. STONE.

A VERY successful example of a central station driven by gas engines is in the city of Dolores, Argentine Republic, situated about 125 miles to the south of Buenos Aires, in the Province of the same name. A company was formed in 1907 by the most influential citizens and business men of the city to build an electric generating station to supply the city and surrounding country. They secured the authorization of the Provincial Government by a decree of July 13, 1907, and, having looked into the question of the most suitable power, and studied the operating costs of both gas and steam plants, decided to adopt gas power. The contract was signed on Aug. 19, 1907, with Messrs. Agar, Cross & Company, Limited, of Buenos Aires, for the complete installation of station machinery and the distribution system throughout the city.

Dolores is one of the oldest cities in the Province, and is in the middle of a rich stock-raising district. Here are situated the courts of justice, banks, a fine club-house, and one of the provincial jails.

The street illumination in the city is provided by open-arc lamps, which burn nine in series across 440-volt mains. The lamps require 8 amp, are recarboned daily, are suspended over the center of the streets, and are raised and lowered by windlasses which are placed on the poles. One lamp is placed at each street corner, but in the central streets an extra lamp is placed midway between. In the principal plaza, however, there is in addition to the other arc lamps a special series of eight flame-arc lamps, which are only lighted on special occasions. The arc-lamp circuits are separate from the private lighting feeders, and each circuit of lamps is controlled from the arc-lamp board in the power house, which has a single-pole knife switch and ammeter for each circuit.

The power station shown in Fig. 2 is situated at the corner of two of the principal streets near the distribution center of the cable network. The building is of brick with cement finish in imitation stone and is provided with large windows giving ample light and ventilation. It is divided into sections, having producer room, engine and dynamo room, general manager's office, show and salesroom, storeroom, etc. The engine-room has tiled floor, and the walls are faced with glazed tiles to a height of 6 ft. The producer room has a tiled floor, as well as large windows to give ample ventilation. A large water tank is placed on the roof, and in the yard is a large cement reservoir having a cooling tower built over its entire length.

The generating machinery consists of two units, the smaller of which is a two-crank, tandem, vertical gas engine, with four cylinders, two of 10½ in. and two of 11½ in. diameter by 14-in. stroke. This engine develops 100 bhp, and is direct-connected to a 65-kw, three-wire, 440-220 volt, direct-current generator having a current output of 147 amp. The larger engine is a three-crank, tandem, vertical gas engine and has six cylinders, three 10½ in. and three 11½-in. by 14-in. stroke. This engine develops 150 bhp and is direct-connected to a 95-kw, three-wire, 440-220-volt, direct-current dynamo, having an output of 216 amp. Both these engines run at a speed of 325 revolutions per minute.

The dynamos are of the multipolar engine type, with an outboard bearing, the shaft having a half coupling which is bolted to the engine flywheel. Each machine supplies the three-wire circuits direct, without any rotary-balancer sets, and is of the

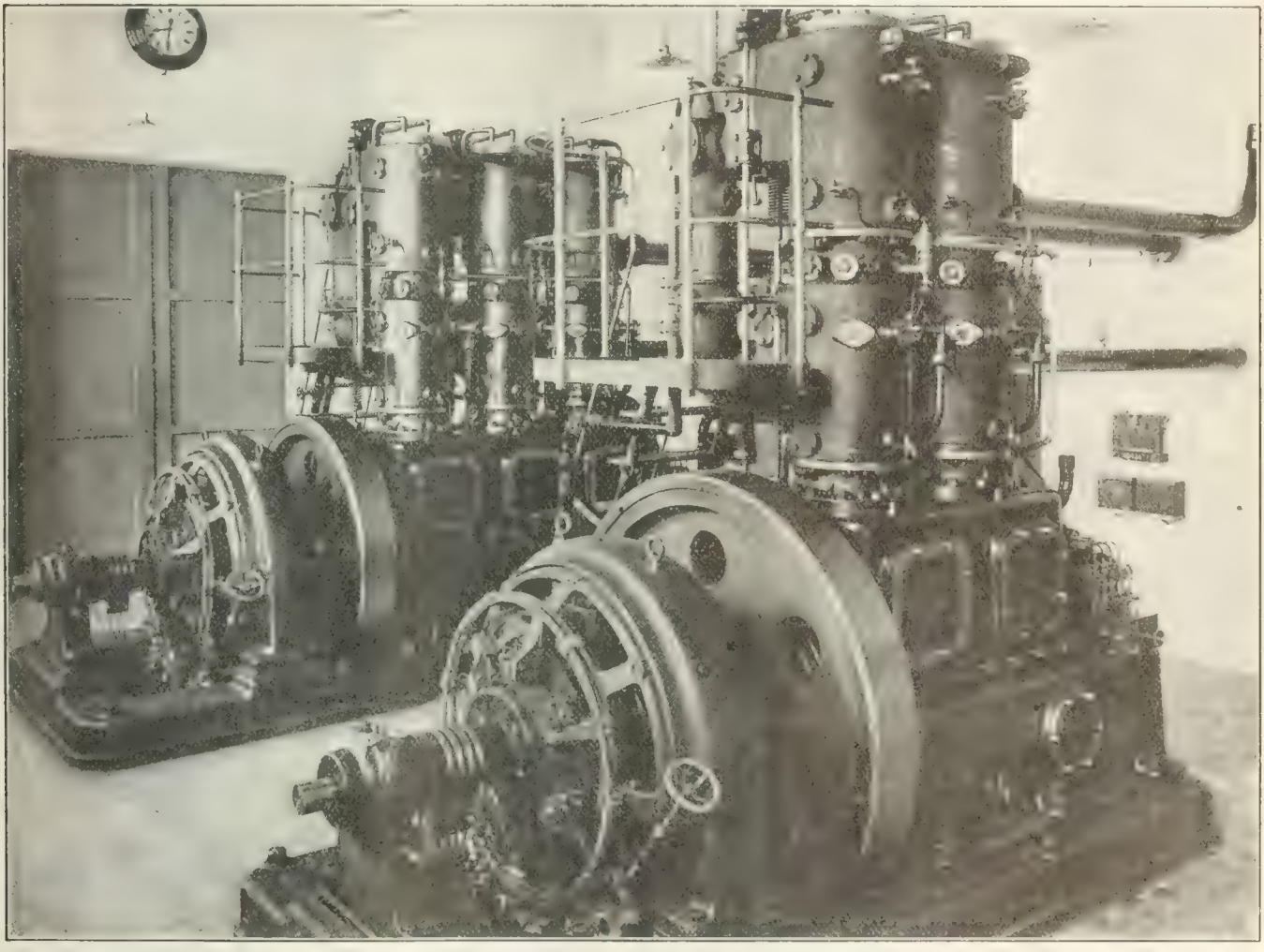


FIG. 1.—INTERIOR OF GENERATING STATION AT DOLORES.

usual six-pole construction with cast-iron yokes and laminated pole-pieces, the yoke being parted horizontally. Each pole carries two distinct sets of series windings, one of which is connected in each of the main leads, to enable the machine to take care of unbalanced loads, which they are capable of supplying up to 25 per cent without disturbing the regulation. The third or neutral wire is formed from four taps which are taken from the armature at equidistant points, and brought out to four collector rings, the leads from which are connected to two balancing coils or transformers, the center points of whose windings are connected, and which form the neutral point of the generator, from which the connection is taken to the neutral busbar on the switchboard.



FIG. 2.—POWER HOUSE, DOLORES.

The gas engines shown in Fig. 1 are the British Westinghouse Company's vertical tandem type, and were built at its Manchester works. The cylinders are arranged in pairs one above the other, and the water jackets and valve chambers are in one casting, a cast-iron intermediate cover separating the upper and lower cylinders, this being held in place by eccentric bolts, the joint being made by a copper ring. Both heads are water jacketed. The two pistons act on one crank, and as the pressure is always downward on the connecting rod, there is much less wear on the bearings and they are therefore made non-adjustable. The moving parts are enclosed in the crank-case, which acts as an oil chamber in its lower part. All the bearings are oiled by forced lubrication at a pressure of 30 lb. per square inch by means of oil pumps actuated by anchored eccentrics on the main shaft, the oil being filtered before reaching the pumps. The filters are in duplicate and either can be removed for cleaning without interfering with the operation of the pumps. The upper cylinders and piston rod glands are lubricated by a special pump having sight feeds and a flushing arrangement, but the lower cylinders are oiled by restricted splash.

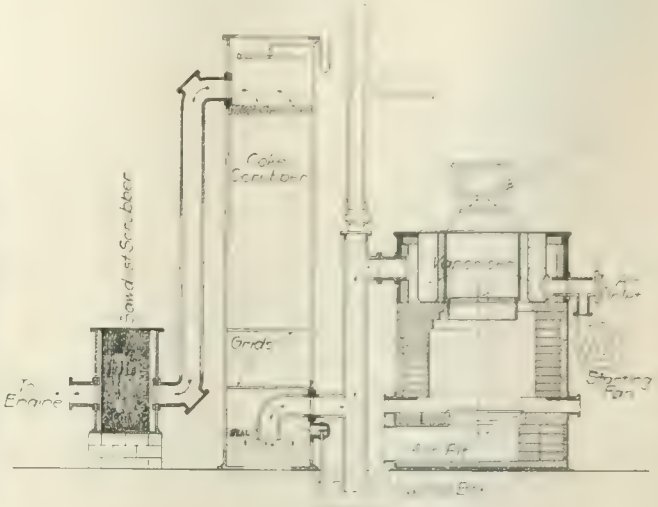


FIG. 4.—SUCTION GAS-PRODUCER PLANT.

The ignition system used is high tension with trembler coils, a commutator on half-speed shaft controlling the low-tension circuits. A movable yoke carrying the brush holder permits of retarding or advancing the spark, the energy being supplied by a small dynamo, and storage batteries at 6 volts. The governor of these engines is mounted directly on the end of main shaft, and is connected to the throttle valve by a bell crank lever, without the intervention of any gearing, as was formerly employed, and so controls the volume of air and gas admitted to the cylinder. The air and gas are kept separate until they reach the inlet valves, which minimizes the danger of explosions in the manifolds. The inlet and exhaust valves are of the mushroom type, the inlet valves being of steel with chamfered seats, and the exhaust valves of cast-iron with flat seats, neither being water-cooled.



FIG. 3.—VIEW OF GAS-PRODUCER ROOM.



FIG. 5.—SWITCHBOARD AND MOTOR-DRIVEN CIRCULATING PUMPS.

The starting of the engines is accomplished by admitting compressed air under 300-lb. pressure to the lower cylinders, this air entering through non-return valves and so starting the

engine under full compression. The admission of air to the starting cylinders is controlled by tappets operated by cams on a secondary shaft, which are normally held out of action by springs, but when the compressed air starting valve is opened these are thrown into action by the air pressure and admit air to the cylinders at the right moment to produce the starting impulse. As soon as the gas explodes in these cylinders, the air supply is automatically cut off. The attendant only has to open the compressed air valve to start the engine, and after one or two revolutions shut the valve, there being no cams or other gear to manipulate. The exhaust manifolds are water jacketed, but no water is used in the exhaust pipe. The exhaust pipes pass through the dividing wall into the gas-room where the silencers are situated, and from there the escape pipes pass up through the roof.

The gas plant, shown in Figs. 3 and 4, consists of two Dowson suction producers, one of 100 bhp and one of 150 bhp, together with their coke and sawdust scrubbers and purifiers. The coke towers have a water spray at the top to wash impurities out of the hot gases as they are delivered from the producers, after which they are filtered through damp sawdust. Each producer is piped direct to its engine, and a cross connection provided between the two pipes for emergencies. Anthracite coal, which costs $12 per ton, is used in the producers.

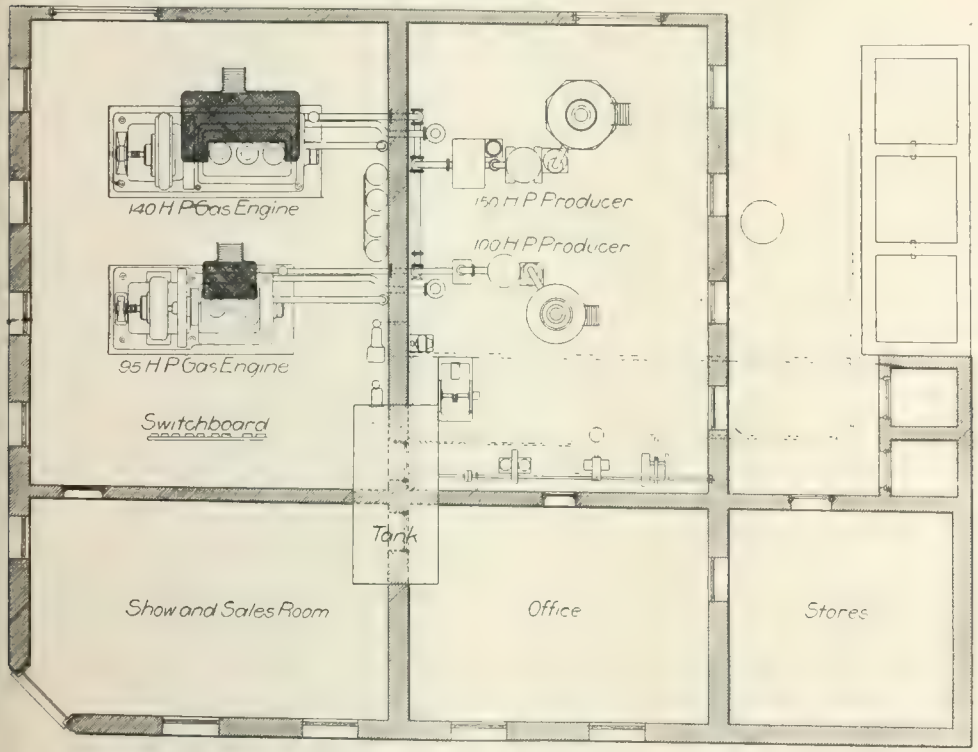


FIG. 6.—PLAN VIEW OF POWER HOUSE.

The switchboard, shown in Fig. 5, is of white marble and built of four panels, two being for the dynamo, one for the lamp and motor feeders, and the other for the arc-lamp circuits. All circuits have switches, enclosed fuses and ammeters, the instruments having black marine finish. The dynamo panels have automatic circuit-breakers which are provided with both main and equalizer contacts. The busbars are carried on cast-iron brackets bolted to the angle iron supports, these same brackets being provided with porcelain insulation and clamping blocks. There are four three-wire feeders leaving the switchboard for the private lighting, and eight arc-lamp circuits. Overhead construction is used throughout, the wires and cables being carried on deep groove-glass insulators with steel pins. The poles are of hard pine with hardwood feet bolted on, and hardwood cross-arms. All wires and cables have double-braided, weatherproof insulation, and the whole cable network is amply protected by Westinghouse-type lightning arresters, the neutral conductor being earthed.

Cooling water for the engines is taken from the tank on the roof of the building, from which it flows by gravity through the jackets and empties into a large cistern in the yard. The latter reservoir is divided into three compartments, and has a cooling tower construction over the whole of its length. The hot water from the engines empties into one of the end compartments, and from here a triplex pump elevates it to the top of the cooling tower, which is filled with brushwood, through which it slowly trickles into the middle compartment, which has an outlet communicating with the other end section into which the cold water flows. The centrifugal circulating pumps (shown in Fig. 5) take it from here and deliver it into the tank on the roof of the building. Thus the water is used continuously; only that lost by evaporation or used for gas washing has to be made up. An artesian well and pump are provided for this purpose, the piping being so arranged that the cold well water can be forced either into the yard reservoir or the overhead tank.

The pump and air compressor are placed in the gas-room, and are belted to a line shaft, which can be driven either by an electric motor or a naphtha engine. The general arrangement of machinery is shown in Fig. 6. The roof tank provides a sufficient supply of water to start up the gas plant, and insures a supply of water for the engines for some time, in case of failure of one of the centrifugal circulating pumps, and would enable the plant to keep running until the pump could be put right.

This station went into service in August, 1908, operating from dusk to 6 a. m., as the only load was that of the 72 street arc lamps, necessitating the operation of only the small engine. The company, as soon as it began operations, was overwhelmed with calls to give private connections, and it had to put on a staff of men for this purpose, which resulted in such a rapidly increasing load that within a month the large engine had to be run regularly to carry the peak load. A diagram of the station load, taken only two weeks after the plant started, is shown in Fig. 7. The load has steadily risen until now both engines are run to carry the maximum demand, and after that the large engine is run alone.

All energy for lamps and motors to private customers is supplied by meters (Westinghouse watt-hour meters being used throughout). Up to 5 amp, the installations are two-wire, 220 volts, and above that three-wire, 220-440-volt mains are used.

The energy rate for lamps is 17 cents up to 50 kw-hours and for energy in excess of 50 kw-hours 15 cents per kw-hour. The rate for motors up to a consumption of 200 kw-hours is 13 cents. Energy in excess of 200 and up to 500 kw-hours is charged at the rate of 11 cents, and above 500 kw-hours the rate is 8.5 cents. Electricity is supplied to the provincial jail at a flat rate of $252 per month, the installation consisting of 200 incandescent lamps, and six 5-amp, enclosed arc lamps. For each street arc lamp the charge is $11.85 per lamp per month for 72 lamps and $10.50 per lamp per month after the additional 36 lamps are added. For the series of eight flame-arc lamps, which are lighted on special occasions, averaging five times per month, the rate is $3.50 a night. The company does not do installation work, but keeps a showroom in the

station where the latest appliances and fixtures can be seen, among which is the tungsten lamp. Since Dec. 1, 1908, a day service has been maintained to enable electric fans to be used, and the company has been rapidly building up a day load. Since day service has been inaugurated electric motors have been installed in a number of places, and several factories having steam plants are arranging to put in motors and discontinue the use of their steam power. There is also a company being formed to build a flour mill, which will take electricity for lamps and motors from the central station.

A comparison of the load curves for Sept. 1 and 29, illustrated in Fig. 7, shows the increase of load in one month clearly and the load curve. A curve taken a few months later, shows an increased output of this station during the short time it has been in operation; the peak at 8:30 p. m. reaching 246

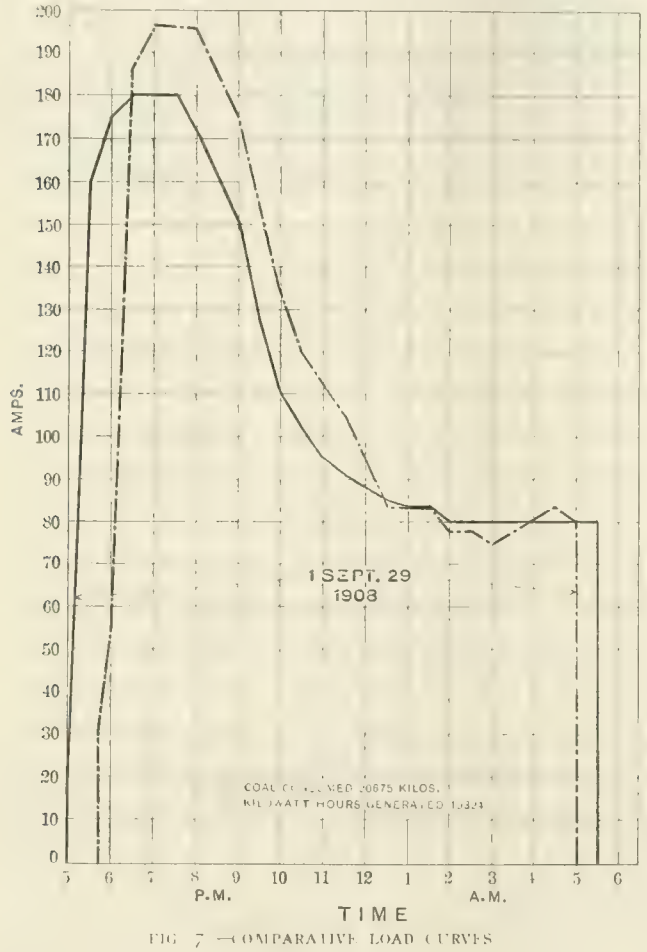


FIG. 7.—COMPARATIVE LOAD CURVES.

amp. Public street lighting is being extended, and 36 more arc lamps added, which brings the peak load up to 350 amp.

As the station equipment is now loaded up to its full rating, very few new installations can be taken on. However, to enable the company to provide an adequate service to cope with all the increasing requests for electricity, it was decided to enlarge the station and install a 240-hp gas engine, direct-connected to a 150-kw, three-wire, 440-volt dynamo, with a suction gas producer of corresponding rating. To keep a homogeneous power-house equipment, this new set, together with its switchboard, will be of the British Westinghouse Company's make, and the gas-producer plant will be supplied by the Dowson Company. When this new unit is put in, the output of the station will be doubled, and the company will be in a position to extend its lines and cope with the rapidly increasing demands. The plant is operated by three men to a shift, and they are the ordinary type of mechanic and laborer found in the country. The station is one of the most successful and economical in the Argentine Republic, and is giving the greatest satisfaction. The coal consumption is one-third of what it would have been if a steam plant had been adopted.

Hydro-Electric Development of the Connecticut River Power Company.

WHILE there are several hydro-electric transmission plants in New England, these have been developed by public-utility companies for their own purposes and the transmissions are restricted to their respective territories and are more or less limited in scope. The first hydro-electric plant in New England with a transmission line that serves a market represented by a number of prosperous towns and cities to which electrical energy is sold in bulk is that of the Connecticut River Power Company. The site selected for the generating station is desirable because the natural conditions are most favorable to the hydraulic development, and the wisdom of this selection is further borne out by the fact that before the

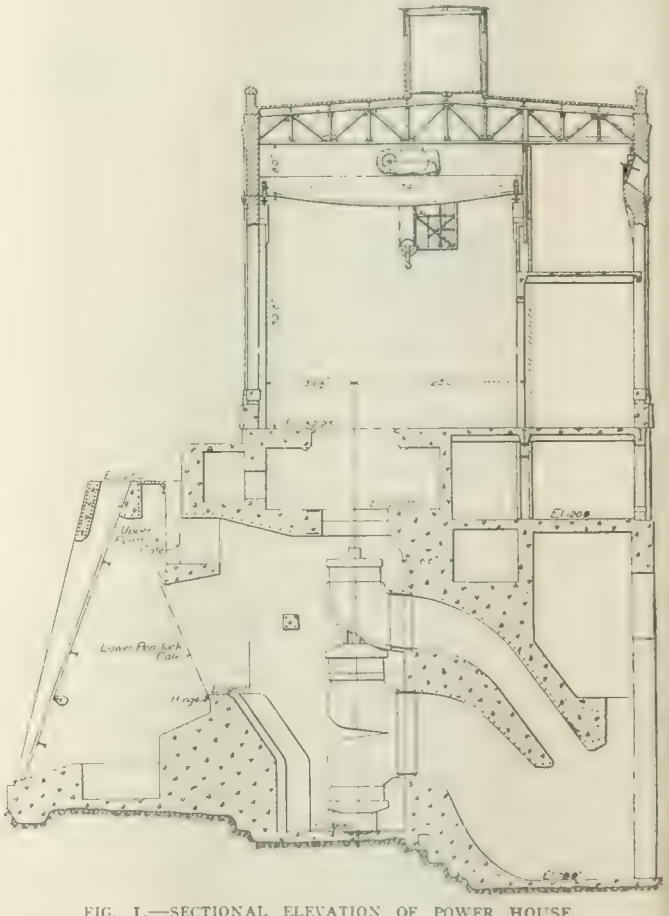


FIG. 1.—SECTIONAL ELEVATION OF POWER HOUSE.

station was placed in operation, and practically without much solicitation, enough energy had been contracted for to cover fixed charges and operating expenses.

The generating station and dam are located on the Connecticut River between Vernon, Vt., and Hinsdale, N. H., and five miles from the Massachusetts State line. The river at this point is supplied by a drainage area of 6300 square miles, having an average rainfall of approximately 36½ in. The length of the dam at the crest is 600 ft., and the maximum head available is 34 ft. The average head is 32 ft., and the pond area back of the dam, 1900 acres. The power house is designed for an ultimate output of 20,000 kw, but the present installation is only 12,500 kw. The water available and the reciprocal provisions in contracts made permit the use of customers' steam plants as auxiliaries, so that the company will be enabled to deliver for an average year 67,000,000 hp-hours in primary power and 33,000,000 hp-hours in secondary power, or a total of 100,000,000 hp-hours. The transmission lines are 66 miles long.

The market which the company serves lies within a radius of 60 miles of the generating station and comprises one of the richest manufacturing districts in New England. The lines at

present reach the following centers: Brattleboro, Vt., Keene, Winchester, Hinsdale, N. H.; Winchendon, Gardner, Fitchburg, Shirley, Leominster, Clinton, Marlboro and Worcester, Mass. The aggregate population of the towns and cities



FIG. 2.—EXTERIOR VIEW OF GENERATING STATION AND DAM ACROSS CONNECTICUT RIVER.

enumerated is 271,000. The industries in them are widely diversified, there being not less than 3000 different classes of product, and in many instances the factories located in the district are the largest of their kind in the United States. In addition to the industrial demand for electrical energy, there are within the area served 10 lighting and five street-railway companies, with some of which contracts have already been made. With such a large market for energy, it is but natural that the cost of steam power, which is brought in competiton with the water-power, should be an important factor. The prevailing price of coal in the region is $4.50 per ton and at this price it is an easy matter for the company to compete with steam-driven stations already in existence.

The masonry structures composing the development at Vernon have a length of 846 ft., extending from the Vermont to the New Hampshire shore. Of this 600 ft. are taken up by a plain concrete spillway; 13 ft. by a log sluice, and the remainder by the power house, which is 51 ft. x 219 ft. inside dimensions. The power-house substructure is built of reinforced concrete and the superstructure of steel and brick. The earth embankments on either side rise 20 ft. above the spillway crest and are retained by abutments. The latter are parallel with and at a

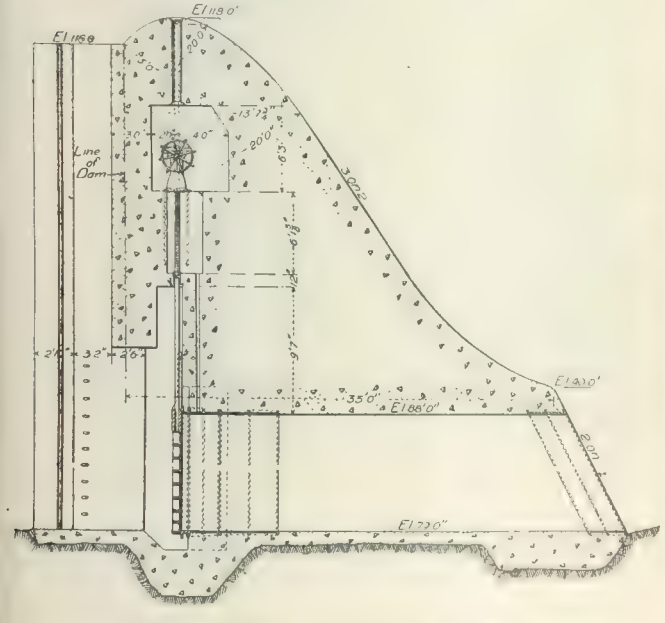


FIG. 3.—SECTIONAL ELEVATION OF DAM.

small angle to the flow of the river, and the dam at one end and the power house at the opposite end are built against them. Not only do the abutments and wing walls retain the bank and protect them from erosion, but they also serve as cut-off walls, extending and being bonded to rock foundation. The width at the top of the abutments and wing walls is 3 ft. The east abutment is 445 ft., and heavy rip-rap protects both sides.

The portion of the dam across the river channel is 50 ft. above the rock on which it rests, and a portion 250 ft. in length is not more than one-quarter of this height. About 150 ft. east of the center of the length of the dam the height from foundation to crest is 70 ft. The crest of the dam is at elevation 118 about 30 ft. above normal low water, and flash boards are used to raise the level of the pond to secure a working head of 33 ft. to 34 ft. The down-stream face of the dam is ogee shaped. The normal section, except through the portion containing the sluice gates, differs from the section shown herewith only in having a straight vertical face in the plane indicated as "line of dam" in the drawing. In order to pass moderate floods, 10 permanent sluice gates, each 7 ft. x 9 ft., are built in the section of the dam across the main channel, and are separated from the power house by a log sluice and a portion of the normal dam section 54 ft. long. The gates are opened by hand-wheel stands in a chamber built within the dam. Manganese bronze rising stems pass above the roof of the chamber into a 6-in. circular-steel lining built into the dam, and terminating a few inches beneath its crest. Access to the operating chamber is had through a 4 ft. x 6¼-ft. passageway 54 ft. long built into a section of the dam between the sluice gates and the log sluice, where the entrance is located.

The sluiceways are placed on 18-ft. centers and have 8-ft. walls of concrete between them. Extending up-stream from the normal face of the dam between adjacent sluice-gate open-

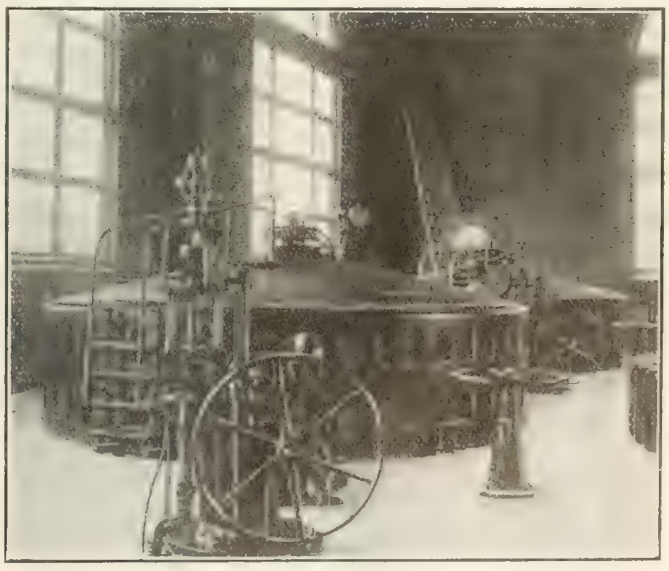


FIG. 4.—CORNER OF GENERATOR ROOM.

ings are monolithic concrete piers rising to within 2 ft. of the crest, which afford space for stop-log grooves and gratings for catching trash. The piers decrease in thickness from 9 ft. to 4 ft., and have a flaring approach to the sluiceways, with a maximum width of 14 ft. The trash racks are made up of 2-in. round-iron rods, spaced 15 in. on centers vertically, and

anchored to similar rods imbedded in the concrete. The stop-logs are dropped from the pond level into the grooves provided for them when it is desired to make repairs to the sluice gates. The discharge ends of the sluice-ways have cast-iron linings for a length of 3 ft. The log sluice is separated from the main body of the dam by a 4-ft. wall. It is fitted with a timber bear-trap dam, the crest of which can be raised 9 ft. In ordinary operation, logs, trash and floating ice will be diverted to it by means of floating booms running diagonally in front of the power house on the shore. The booms consist of heavy built-up floating logs, held in grooves on the faces of reinforced concrete piers spaced about 70 ft. The total length of the booms is about 350 ft. The four piers used to hold the booms are 8 ft. wide and 10 ft. long on top, and about 40 ft. high from the rock foundation.

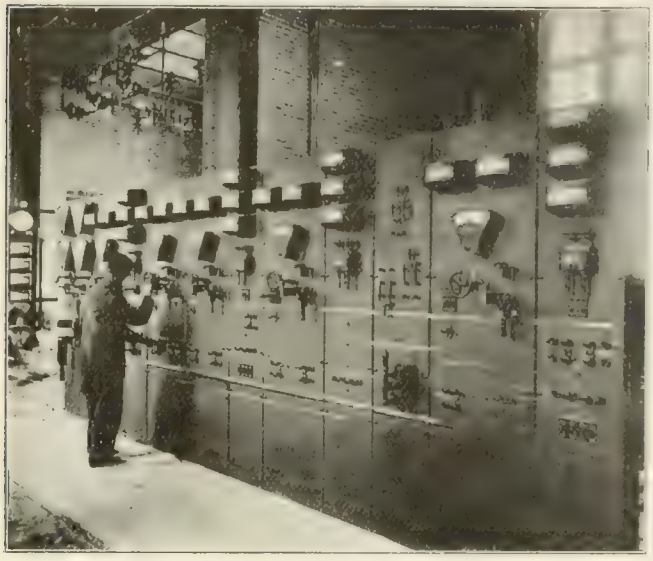


FIG. 5.—VIEW OF MAIN SWITCHBOARD.

The generating station is on the Vermont side of the dam, and houses in the reinforced-concrete substructure the turbines, penstocks and draft tubes, and in the superstructure the main electrical units, exciters, transformers and switches. The superstructure is provided with two longitudinal bays; one 35 ft. wide being occupied by the generators, exciters and switchboard, and the other, 15 ft. wide, containing two stories, housing the transformers and auxiliary electrical equipment. The generator-room is designed for 10 units; eight main units, five of which are installed, rated at 2500 kw, three-phase, 60-cycle, 2300 volts and 133 r.p.m., and two exciters rated at 300 kw at a speed of 100 r.p.m.



FIG. 7.—[illegible] LINES ON ROOF.

All the units are placed parallel to the length of the power house on 24-ft. centers, and are of the vertical-shaft type. The waterwheels were built by the S. Morgan Smith Company, of York, Pa., and are regulated by Lombard governors. The entire electrical equipment was built by the General Electric Com-

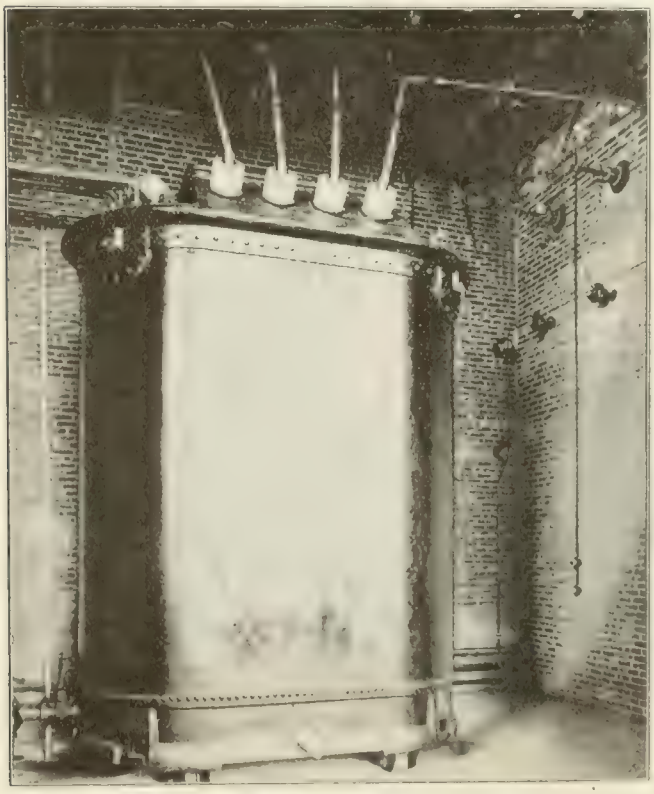


FIG. 6.—5000-KW STEP UP TRANSFORMER.

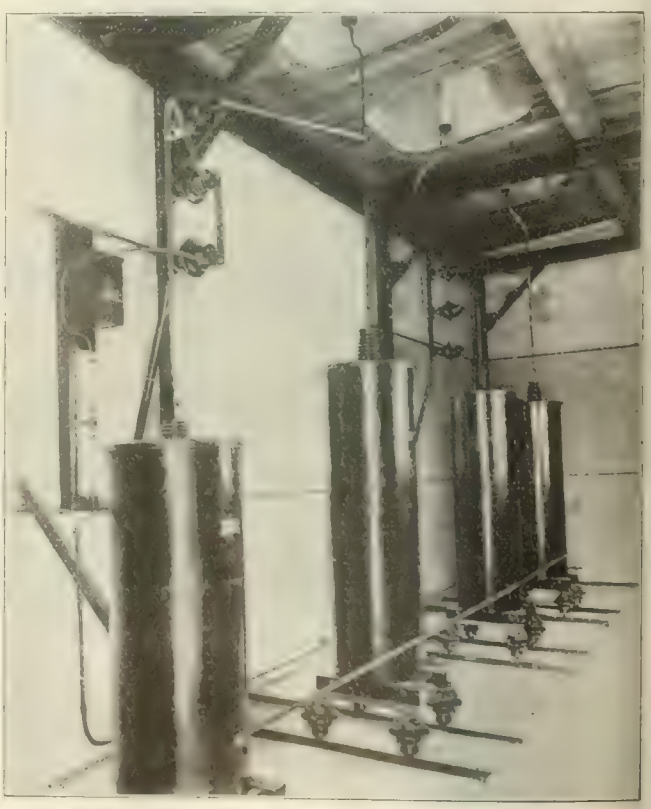


FIG. 8.—ALUMINUM CELL LIGHTNING ARRESTERS.

The generating station is on the Vermont side of the dam, and houses in the reinforced-concrete substructure the turbines, penstocks and draft tubes, and in the superstructure the main electrical units, exciters, transformers and switches. The superstructure is provided with two longitudinal bays; one 35 ft. wide being occupied by the generators, exciters and switchboard, and the other, 15 ft. wide, containing two stories, housing the transformers and auxiliary electrical equipment. The generator-room is designed for 10 units; eight main units, five of which are installed, rated at 2500 kw, three-phase, 60-cycle, 2300 volts and 133 r.p.m., and two exciters rated at 300 kw at a speed of 100 r.p.m.

All the units are placed parallel to the length of the power house on 24-ft. centers, and are of the vertical-shaft type. The waterwheels were built by the S. Morgan Smith Company, of York, Pa., and are regulated by Lombard governors. The entire electrical equipment was built by the General Electric Com-

The penstock for each main turbine unit is 20 ft. 9 in. wide, and is separated from the adjacent penstock by a 3 ft. 3 in. vertical reinforced-concrete wall, which extends up-stream from the power-house structure to form a support for the racks. Each penstock enlarges in height to 40½ ft. to form the wheel

chamber, in which are three wheels on the same vertical shaft. Each large generator is direct-connected to two 60-in. and one 57-in. wheel. The draft tubes are in two parts, the top wheel discharging into the upper one, and the other two wheels into the lower one. The upper draft tube is 7 ft. 8 in. in diameter at its beginning in the down-stream wall of the wheel chamber

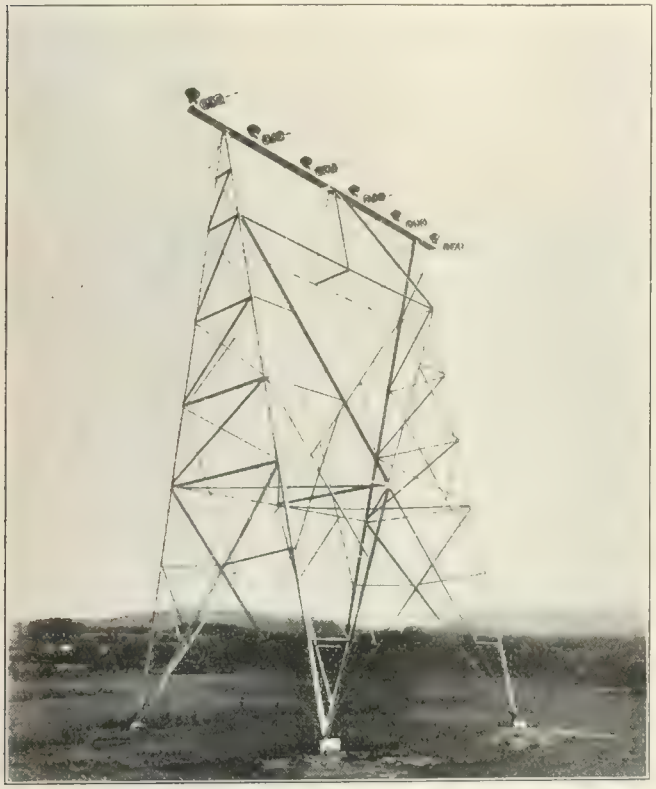


FIG. 9.—ANCHOR TOWER ON NEW HAMPSHIRE SHORE AT END OF 1375-FT. SPAN ACROSS RIVER.

and changes gradually to a rectangular section 4 ft. 9 in. high and 19 ft. long, this change being made in a length of 14½ ft. The final section then continues for over 13 ft. to a point where the upper and lower draft tubes join into one, and discharge into the tail-race about 8 ft. above the down-stream wall of the power house. The lower draft tube is 11 ft. high and 11½ ft. wide at the down-stream wall of the wheel chamber, and increases in size to about 15½ ft. in height and 19 ft. in width. The draft tubes discharge to the tail-race through arches carrying the down-stream wall of the power house. The exciter penstocks have a width of 8 ft. 10½ in., and each exciter discharges separately into a single flaring riveted-steel draft tube.

In order to be able to drain each wheel chamber to inspect and repair the turbines, penstock gates are provided back of the racks on the up-stream side of the power house, and stop-log grooves are provided just within the arches supporting the down-stream wall. Each turbine being in a separate wheel chamber, any one of them can be shut down without interfering with the operation of the others. Each large penstock is divided into two unequal parts by a heavy horizontal reinforced-concrete girder that enables the penstock to be shut by two separate gates, one above and the other below the girder. The lower opening has a height of 15 ft. and is closed by a steel gate 20 ft. 5½ in. wide over all and 17 ft. 5 in. high. The upper opening is 6¾ ft. high and is divided longitudinally by a 3-ft. vertical pier into two 8 ft. 10½ in. widths, each of which is closed by a timber gate 9 ft. 7¼ in. wide and 6½ ft. high. The dividing pier rests upon the heavy reinforced-concrete girder and extends to the level of the penstock. The lower gates are made with 12-in., 40-lb. I-beams in vertical planes 11½ in. apart, and are riveted at the top by means of two angles each to an I-beam of the same size, and at the bottom to a 12-in., 40-lb. channel. The front is covered by a ⅜-in. plate riveted to the I-beams and the back is left open. The upper gates are made of dressed pine.

The lower gate is hinged on its lower end, and when raised to close the penstock slopes up-stream, the upper end taking bearings on the heavy girder already referred to. When lowered to allow flow through the penstock the gate falls outward and rests upon the floor of the forebay. Water-tightness is secured at the walls by means of oak strips against which the gates bear. The gates are raised and lowered by means of a chain passing through a 6-in. pipe placed on the center line of the penstock and running up into the main generator-room, where it is attached to the traveling crane with which the station is equipped. The upper gates are raised and lowered in a vertical plane, the hoists for this purpose being located on a runway along the upstream wall of the power house and immediately back of a similar walkway from which the racks may be cleaned and hauled out for repairs.

The cross-sectional elevation of the power house, Fig. 1, shows the arrangement of floors. The main floor carries the generator, transformers and governors, and the lower floor carries the thrust bearings and governor pumps, the piping and oil tanks for both, and on the down-stream side of the dividing wall the low-tension busbars and switches. The thrust bearing is located in the lower chamber between the wheel and the generator. The initial transforming equipment consists of three 5000-kw oil and water-cooled, three-phase transformers which step-up the potential to 66,000 volts, and a 900-kw transformer for feeding a few customers in Vermont. The lines emerge from the roof of the station and cross the Connecticut River to the New Hampshire shore, the span being 1375 ft. The transmission line is made up of No. 2 seven strand, hard-drawn copper with soft copper core and is protected at the station end and at the substations by aluminum cell lightning arresters. The line is equipped with telephone service and a ground wire is carried along the tops of the towers. The 66 miles of line to Worcester consist of two separate circuits, either one of which in an emergency can carry the entire load. The transmission system has been erected with a view to giving continuous service during the extreme conditions of winter weather in New

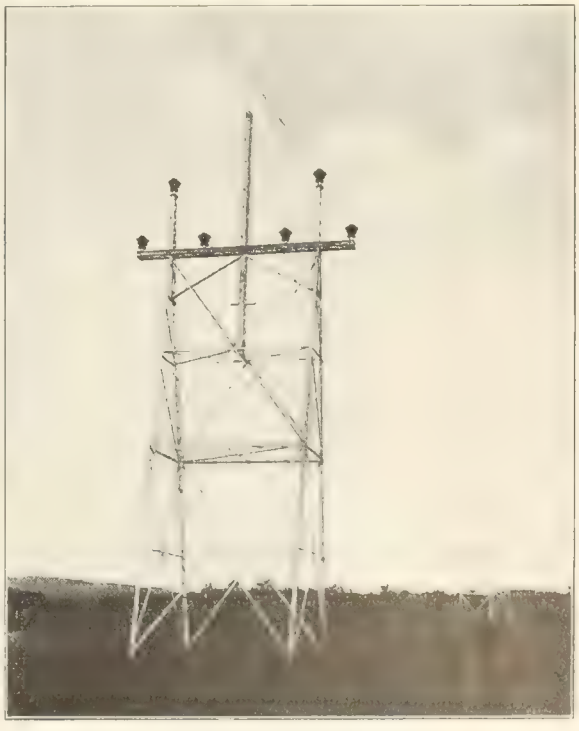


FIG. 10.—VIEW ALONG TRANSMISSION LINE.

England. There will be five substations erected, four of which are already in operation. Other details of the equipment and a description of the transmission system will be given in a later issue.

The Design of Shell-Type Transformers.

By Roger P. Heller.

With the commercial introduction of the new alloy steels there has come about a radical modification in the construction of transformers. The following procedure for the rapid determination of the dimensions of transformers may, therefore, be of some immediate use.

The designer is presented with a series of specifications which he is called upon to realize as closely as possible in the finished apparatus. As is well known, different designers will produce apparatus which may differ to an extreme in general proportions, and yet be remarkably similar in performance. This result is, of course, due to the large number of variables, which offer a great number of like solutions, from which it is the duty of the designer to pick the most economical. While the method here outlined leaves much latitude for such choice, it will greatly hasten the work of comparing the results of the separate arbitrary assignments.

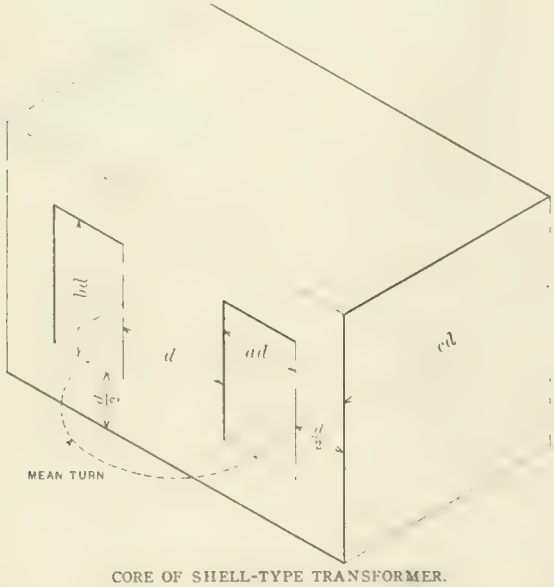
We assume that the specifications imposed are: Primary voltage, E_1; secondary voltage, E_2; frequency, f; secondary watts output, W_2, and full-load efficiency, e. From these can be computed the primary and secondary currents and the total losses. The latter may be divided between the copper and iron at the discretion of the designer, according to the average load of the transformer, in order to procure a satisfactory all-day efficiency, although it is now being recognized that this is not as important a matter as was formerly considered.

The fundamental equation of the transformer is here shown. It gives the relation between the counter-e.m.f. induced, by the alternating flux, in the primary winding (substantially equal to the applied primary e.m.f.) and that flux.

$$E_1 = 4.44 \times B \times A \times f \times N_1 \times 10^{-8},$$

where

B = maximum flux-density in the iron.
A = area of cross-section of iron, normal to flux.
N_1 = Number of turns in series, primary winding.



CORE OF SHELL-TYPE TRANSFORMER.

The core of a shell-type transformer is built up as shown below where the several dimensions are indicated. Neglecting any subsequent trimming of corners, it may be shown that the gross volume of the core is

$$2 \times c\,d^3\,(a + b + 1),$$

and if 10 per cent be allowed for japanning, etc., between laminations, the net volume of iron is

$$V = 1.8 \times c\,d^3\,(a + b + 1).$$

The cross-section of iron offered to the flux in the middle tongue of the core is

$$0.9 \times c\,d^2 = A,$$

and the rest of the magnetic circuit is so proportioned as to offer the same area to the flux.

The area of the "window" through which the primary and secondary coils are to link is $a\,b\,d^2$, and of this area a certain fraction is occupied by copper. This gross "space-factor" s is rather low, as there must be plenty of room for the necessary insulation and passages between the coils for oil or air. It may vary from 0.3 to 0.4, and the designer must choose a value consistent with the degree of insulation and cooling desired.

Knowing the primary and secondary currents—the magnetizing current in the primary being ignored for these preliminary determinations—one can readily find the cross-sectional areas of the wires for primary and secondary windings which will give a proper current density k, say, from 850 amp to 1000 amp per square inch, in the copper at full load. The designer chooses a suitable value for k and then selects that standard size of wire which will most nearly fulfill the desired condition, unless special wire is to be drawn. The amp-turns of the two coils being substantially the same, the areas occupied by the primary and secondary copper are equal for a given current density, or

$$N_1 \frac{I_1}{k} = N_2 \frac{I_2}{k}$$

One may then write,

$$2 N_2 \frac{I_2}{k} = s\,a\,b\,d^2$$

Or,

$$I_2 = \frac{k\,s\,a\,b\,d^2}{2\,N_2}$$

And also,

$$E_2 = 4.44 \times B \times A \times f \times N_2 \times 10^{-8}$$

$$4.44 \times B \times (0.9 \times c\,d^2) \times f \times N_2 \times 10^{-8}.$$

The rating of the transformer is then, in volt-amperes,

$$E_2 I_2 = 2.22 \times 0.9 \times B \times f \times 10^{-8} \times k\,s \times a\,b\,c\,d^4.$$

In such preliminary work, in which the main object is to fix the main dimensions, it is entirely admissible to ignore such details as the effect of the magnetizing current upon the total primary current, or the differences between the counter-generated and the terminal voltages, for at the most these amount to only a few per cent. The procedure of design will be as follows: Suitable values are set down for s and k, not much latitude being offered in this direction. From curves showing the watts lost in the particular grade of iron per pound or per cubic inch at the specified frequency, plotted in terms of flux-density, there is chosen such a density as will give a reasonably low value of core loss. It must be borne in mind that with the new alloy steels the density can be run up nearly to the knee of the saturation curve, with a low core loss, but such practice tends to make the transformer take an abnormal rush of current under abnormal voltage-conditions. It will now be possible to express numerically the value of $a\,b\,c\,d^4$ by substituting in the last equation. This numerical value is then represented thus,

$$P = a\,b\,c\,d^4.$$

It is desired to build up a set of equations which will render the determination of the dimensions possible. To do this it is necessary to assume a definite number of turns for the windings. This is done with due regard to the separation of each winding into a number of coils, which may be put in series or parallel according to the voltages of primary and secondary mains. It is desirable to take several values for N_2 in order that the several separate calculations may be compared. This does not involve much extra labor, as the specifications are fixed, the space factor and current density are fairly definite, and there are definite limits to the flux density, so that the number of turns is the only variable which may be altered between widely differing values.

From the total core loss previously decided upon, the volume of the iron core is determined and one can set down a numeric

$$\frac{V}{1.8} = c\,d^3\,(a + b + 1).$$

From the assumed number of turns the area of the window is set down as,

$$a\,b\,d^2 = \frac{2\,N_2\,I_2}{s\,k} = w$$

From the total copper loss previously decided upon, the currents in the primary and secondary and the sections of wire chosen, the mean length of a turn is determined. This is set down as m, expressed in the same units as the other dimensions. The relation between m and these dimensions is

$$m = 2cd + \pi(d + ad) - d(2c + 3 + 3a).$$

This assumes the end bends to be semicircular and the factor π is set down approximately as 3.

There are now four equations from which can be determined the four unknown quantities. They are very inconvenient to solve, but by a tedious process of reduction the writer has arrived at the following cubic equation, in which d alone is involved, the coefficients of d being expressed in terms of the quantities previously assumed so that they reduce to numerics. The equation is:

$$3w^2(Pm - 3Qw)d^3 + w(3Qw^2m - 9w^2l' - m^2wP - 6P^2)d^2 + 2w(2P^2m - 3Qwl')d - 4l'^2 = 0$$

Having solved for d, the remaining dimensions follow:

$$cd = \frac{P}{wd}$$

$$ad = \frac{m - 2cd - 3d}{d}$$

$$bd = \frac{w}{ad}$$

A rough drawing may now be made, and it may then be seen whether a practical set of conditions has been assumed. It may be that the assumed number of turns would require an unduly long core, with a great number of stampings, or that the window would be out of proportion, so that great magnetic leakage will result, or that the stampings are of unduly large dimensions. By working out the problem for several values of N_2 the best construction is soon ascertained, for there cannot be very much choice in the other variables at the control of the designer. The several sets of results should be carefully compared for leakage reactance, radiating surface, no-load current and cost before any are cast aside and the final drawing is commenced. At high power factors the regulation is mostly dependent upon the resistances of the windings, so that this will have been taken into account in deciding upon the permissible copper losses. At lower power factors the effect of leakage reactance becomes more marked, so that it may become a determining feature.

It is hoped that this method of attack may be of some assistance to those who are called upon to take advantage of the properties of the newer magnetic materials. It is to be kept in mind that, while the above equations are applicable to any system of units, whatever system is chosen must be followed implicitly.

Relations Between Output, Losses, Dimensions, Weight and Cost of Transformers.

By E. G. Reed.

A TRANSFORMER consists essentially of a winding composed of a number of turns of copper wire, interlinked with a core made up of sheet iron. The copper wire forms circuits for the alternating current and the iron core a path for an alternating magnetic flux. The current-carrying element is divided into two parts; one receiving energy from the supply circuit called the primary winding and the other delivering current to the load, called the secondary winding. The iron core is magnetized by a current taken from the supply circuit through the primary winding. When the secondary is loaded, the magnetizing effect on the core of the secondary load current is balanced by an additional primary current drawn from the supply circuit.

Iron and Copper Losses.

The resistance to the electric current offered by the copper wire in the windings of a transformer is the cause of an energy loss called the copper loss. The repeated magnetization and demagnetization of the iron core is the cause of a loss called the iron or core loss.

For the purpose of computation, the copper loss may be thought of as being the product of the loss per pound of copper and the total weight of copper in the transformer. The power loss per pound of copper, p_c, is dependent on the current density in the wires and may be expressed as follows:

$$p_c \propto \lambda^2 \qquad (1)$$

where λ is the current density in the wires, or the current per unit of their sectional area. The symbol $\propto$ indicates that p_c varies as λ^2 or is proportional to λ^2.

By definition,

$$p_c \left(\frac{\text{watts}}{\text{pound}}\right) \propto \frac{i^2 r}{lq}$$

In this expression i is the current in the conductor, r its resistance, l its length, and q its sectional area. Since r is directly proportional to l and inversely proportional to q, this relation may be written:

$$p_c \propto \frac{i^2 l}{lq^2} \propto \frac{i^2}{q^2} \propto \lambda^2,$$

since λ is by definition the current carried by the conductor per unit of its sectional area.

The iron loss may be considered as being the product of the power loss per pound of core and the total weight of the core. The iron loss per pound of core p_i is dependent on the magnetic flux density, or the induction B in the core and the frequency of f of the alternating flux. Its value may be expressed as follows:

$$p_i \propto fB^n \qquad (2)$$

where n is a constant.

The value of B may be expressed in terms of the area of the iron core, A_i, at right angles to the magnetic lines, of the frequency f and voltage E of the supply circuit and of the number of turns N in the primary winding, as follows:

$$B \propto \frac{E}{fNA_i} \qquad (3)$$

This relation is fundamental in the study of the transformer and is based upon the law that the induced electromotive force in each turn is equal to the rate of change of the magnetic flux through its opening when expressed in c.g.s. units.

Relation Between the Copper and Iron Losses, the Impressed Voltage Being Variable.

The losses in a transformer may be varied by changing the voltage impressed on its primary winding, the load current changing so that the permissible output remains constant.

The output of a transformer is rated in volt-amperes, or the product of the secondary voltage and the current delivered to the load. Thus, if the voltage delivered by the transformer is decreased, the current must increase if the output is to remain constant.

The induction in the iron core varying with the impressed voltage, increases or decreases the iron loss. When the voltage is low, the current is large and consequently the copper loss is increased and when the voltage is high, the current and the copper loss are low.

For a transformer having a given kva output at a primary voltage of E the current i for this voltage may be expressed thus:

$$i = \frac{kva}{E}$$

or

$$i^2 = \left(\frac{kva}{E}\right)^2$$

Since the copper loss P_c of a transformer is proportional to the square of the current in its windings, its value may be written:

$$P_c \propto \frac{1}{E^2} \qquad (4)$$

The copper loss curve (Fig. 1) shows in a graphical form the relation expressed in equation (4), the impressed voltage and copper loss being given in terms of their normal values, or the values for which the transformer was designed.

Equation (2) shows that at a given frequency the iron loss

per pound of iron and consequently the total iron loss in the transformer is proportional to B^n. Therefore, the core loss of the transformer may be expressed thus:

$$P_i \propto B^n$$

Since the induction in the core B is proportional to the voltage E impressed on the transformer, the above relation may be written:

$$P_i \propto E^n \qquad (5)$$

The iron loss curve in Fig. 1 shows the relation expressed by equation (5), between the impressed voltage and the iron loss, for a value of $n = 1.7$.

From the iron and copper loss curves shown in Fig. 1, it is apparent that as the iron loss becomes small, the copper loss increases very rapidly. On the other hand, when the copper loss in turn reaches low values, the iron loss does not increase as rapidly as did the copper loss.

The sum of the iron and copper loss may be plotted as in Fig. 2. From the three curves shown in Fig. 1 it is interesting

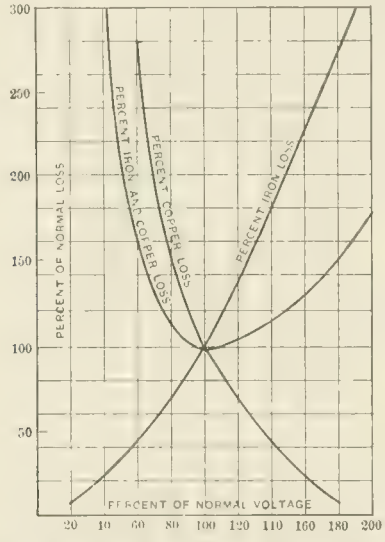


FIG. 1.—VARIATION OF IRON AND COPPER LOSSES AND THEIR SUM WITH IMPRESSED VOLTAGE, THE KVA OUTPUT REMAINING CONSTANT.

to note that as the iron loss increases and the copper loss decreases, the sum of the losses decreases until a minimum is reached, after which it again increases. From an inspection of the curves, it is apparent that the sum of the losses is a minimum somewhere in the region of equality of the iron and copper losses.

Combining equations (4) and (5) there is obtained $P_c P_i^{2/n} =$ constant.

The constant in this equation bears a certain relation to the losses, but is not expressible in watts. Representing this constant by Q_l the relation may be written:

$$Q_l = P_c P_i^{2/n} \qquad (6)$$

This is an important relation which may be interpreted as follows: A transformer having a core and windings of fixed dimensions, with a constant rating at a definite frequency, has losses such that the product of the copper loss and the iron loss to the $2/n$ power is equal to a constant quantity, the change in the relative values of the iron and copper losses being produced by varying the voltage impressed on the transformer. This results, when the output remains constant, in a varying current in the windings; the core is operated at different flux densities and the copper at various current densities.

The iron and copper losses may be plotted as in Fig. 2, their values satisfying equation (6). This curve is based on a value of Q_l of 1000 and a value of 1.7 for n.

Since equation (6) results from the combination of equations (4) and (5), the curve in Fig. 2 expresses the same relation as do the two loss curves in Fig. 1. The curves in Fig. 1, however, represent the general case of any transformer, the iron and copper losses varying with the impressed voltage; the impressed voltage in this case is expressed as a percentage of the normal voltage of the transformer. The curve in Fig. 2 represents the particular case of a transformer having a value of $Q_l = 1000$, the losses being expressed in watts rather than as a percentage of their normal value.

When a curve similar to that shown in Fig. 2 is available for a certain transformer, it is a simple matter to determine the copper loss associated with any iron loss, or vice versa. It is not an easy task to plot this curve, and when drawn it is applicable to only a particular transformer. A general method of arriving at the same result may be developed as follows:

If P_i and P_c are the normal iron and copper losses respectively of a transformer and P'_i the iron loss associated with a new value P'_c of the copper loss, the relation between these four quantities may be determined from equation (6) as follows:

$$P_c P_i^{2/n} = P'_c P'^{2/n}_i$$

$$P'_i = P_i \left(\frac{P_c}{P'_c}\right)^{n/2}$$

Assuming that n is equal to 1.7, the last equation may be written:

$$P'_i = P_i \left(\frac{P_c}{P'_c}\right)^{.85} \qquad (7)$$

Thus when the normal value P_i and P_c of the normal iron and copper losses in a transformer are known and some new values of either the copper loss P'_c or iron loss P'_i are assumed, it is an easy matter from equation (7) to calculate the value

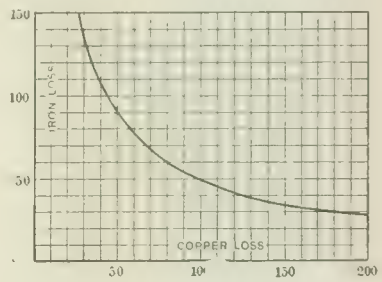


FIG. 2.—RELATIVE VALUES OF THE IRON AND COPPER LOSSES, THE IMPRESSED VOLTAGE CHANGING AND THE KVA OUTPUT REMAINING CONSTANT.

of the unknown iron or copper loss.

Assuming the normal values of the iron and copper losses to be 100 per cent and the new values of the losses to be expressed in per cent of their normal values, equation (7) may be rewritten as follows:

Percentage of normal iron loss = 100

$$\left(\frac{100}{\text{Percentage of normal copper loss}}\right)^{.85}$$

This relation is perfectly general, and to make it more convenient for use, the percentage of normal iron loss resulting from various values of the percentage of normal copper loss may be plotted as in Fig. 3.

Relation of the Losses for Their Sum to be a Minimum.

It has been shown that the sum of the losses is a minimum when they are approximately equal to each other. Their exact relation for the sum to be a minimum may be determined as follows:

The total loss P is equal to the sum of the iron and copper losses, or

$$P = P_i + P_c \qquad (8)$$

Substituting in this equation the value of Pc from equation (6),

$$P = P_i + \frac{Q_l}{P_i^{2/n}}$$

Placing the differential of the above equation equal to zero and substituting the value of Q_l from equation (6),

$$\frac{P_i}{P_c} = \frac{2}{n} \qquad (9)$$

If n has, for example, a value of 1.7, the sum of the losses

will be a minimum when the iron loss is approximately 15 per cent greater than the copper loss. This is a perfectly general relation and for a transformer of any rating, voltage or frequency, of any type of design, if the losses bear this relation, their sum will be a minimum.

Relation Between the Copper and Iron Losses, the Primary Turns Being Variable.

Instead of changing the losses of a transformer by impressing a variable voltage on its primary winding and keeping its output constant, the same result may be accomplished by varying the number of turns in the primary winding, keeping output, voltage and the volume of the copper constant. It is assumed that the frequency at which the transformer is operating is constant in both cases.

From an inspection of equation (3) it is apparent that an increase in the number of turns N will decrease B the induction in the core and consequently the core loss. Decreasing N, on the other hand, will increase the core loss. The total volume of the copper remaining constant, an increase in the total number of turns of wire necessitates a reduction of its sectional area and an increase of its length. If the turns are decreased, a shorter length of wire having a greater section results. As the resistance of a conductor increases as its length becomes greater and its cross-section less, the copper loss increases with the number of turns in the winding. On the other hand, a reduction in the number of turns decreases the copper loss. This shows that the copper loss varies in-

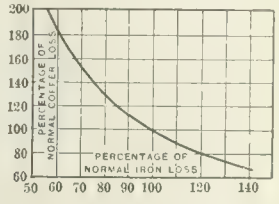


FIG. 3.—RELATIVE VALUES OF THE IRON AND COPPER LOSSES EXPRESSED AS A PERCENTAGE OF THEIR NORMAL VALUES.

versely with the iron loss. The exact relation between the losses may be determined as follows:

If P_c be the copper loss, its value by definition is

$$P_c = i^2 r$$

where i is the current in the windings and r its resistance. Since the output of the transformer remains constant during the change in the relative values of the iron and copper losses, we may write:

$$P_c \propto r \propto \frac{l}{q}$$

where l is the length of copper wire in the winding and q its sectional area. As the number of turns of wire in the winding varies, it is assumed that the space-factor of the coil is constant. The space-factor may be defined as the percentage of the total space available for the winding actually occupied by the wires; in other words, as the sectional area of the wires multiplied by the total number of turns and divided by the opening in the core at right angles to the wires. As the number of turns in the winding increases, the insulation on the wires becomes a greater percentage of the total available winding section and thus the space-factor is not strictly constant as the turns vary. The space-factor does not change greatly for a limited variation in the number of turns, and it may be considered constant without introducing any considerable error.

Since the space-factor remains approximately constant, the total volume of the copper does not change and the sectional area of the wire necessarily varies inversely as its length. Therefore, the above equation may be written:

$$P_c \propto \frac{l}{\frac{1}{l}} \propto l^2 \qquad (10)$$

Since the mean turn of the winding does not change, the number of turns N is proportional to the length of the wire l. Therefore,

$$P_c \propto N^2. \qquad (10)$$

Since N is inversely proportional to B, from equation (3), this may be written:

$$P_c \propto \frac{1}{B^2}$$

This is the same relation as expressed by equation (4), since E in that equation is proportional to B, when B is caused to change by varying E the impressed voltage. Evidently in both cases the iron loss is the same function of the induction and as a result the losses bear to each other the same relation as in the former case.

It may be stated as a general proposition that the relation of the losses is the same when they are varied by changing the impressed voltage as when they are varied by changing the number of turns while keeping the impressed voltage and the volume of copper constant. Assuming, of course, that the output remains constant in both cases.

Variation of the Losses with Changing Frequency.

In the preceding cases, the losses were assumed to be varied by changing the impressed voltage or the number of primary turns in the winding while keeping the output and frequency constant. It will be of interest to show the variation of the iron loss while keeping the voltage and output constant and varying the frequency of the supply circuit. The question is

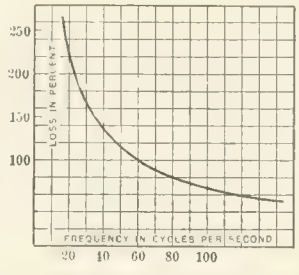


FIG. 4.—VARIATION OF THE IRON LOSS OF A TRANSFORMER WITH FREQUENCY AT CONSTANT VOLTAGE.

one of variable iron loss only, as evidently the copper loss is not effected by changing the frequency of the current.

Combining equations (2) and (3), and since P_i is proportional to p_i,

$$P_i \propto f\left(\frac{E}{fNA_i}\right)^n$$

Since E, N and A_i are constant, this may be written:

$$P_i \propto \frac{1}{f^{n-1}} \qquad (11)$$

Fig. 4 shows the variation of the iron loss of a given transformer with the change in the frequency.

Expression for the Volt-Ampere Rating of a Transformer.

An expression for the output of a transformer, in terms of the various quantities involved, may be developed as follows:

Combining equations (2) and (3) we have:

$$E \propto fNA_i\left(\frac{p_i}{f}\right)^{\frac{1}{n}}$$

By definition:

$$\lambda = \frac{i}{q} = p_c^{\frac{1}{2}}$$

where i is the current in the windings and q is the sectional area of the wire in the windings. Combining the last two equations,

$$Ei = kva \propto p_c^{\frac{1}{2}} p_i^{1/n} qNA_i \frac{1}{f^{1/n}}.$$

The product of the sectional area of one wire and the number of turns in the winding is equal to the total sectional area of the copper. By definition the space-factor of the winding may be expressed thus:

$$fc = \frac{qN}{A_c} \qquad (12)$$

where A_c is the area of the total winding space in the core. Substituting the value of qN from this relation in the above equation we have,

$$kva \propto p_c^{1-n} p_i^{1-n} f c_i c_c A_i A_c \frac{1}{f^{1-n}} \qquad (13)$$

A consideration of this relation shows that the output of a transformer is a function of the magnetic and current densities at which the iron and copper are working, the space-factor, the area of the iron and copper sections, and the frequency at which the transformer is working.

It is evident that with other things constant, the greater the densities at which the iron and copper are working, the greater will be the output of the transformer. It is also apparent that the greater the working densities in the iron and copper, the greater the iron and copper losses. The limit to which the densities may be increased is set for the core by the point of saturation of the iron and in the copper by considerations of heating.

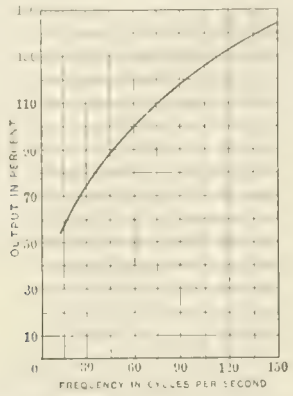


FIG. 5.—VARIATION OF THE OUTPUT OF A TRANSFORMER WITH CHANGING FREQUENCY, THE LOSSES REMAINING CONSTANT.

Equation 13 also shows that, other things being constant, the output of a transformer is related to the frequency of the supply circuit, such that,

$$kva \propto f^{1-1/n}.$$

Assuming that n is equal to 1.7 this becomes

$$kva \propto f^{.41} \qquad (14)$$

The output of a transformer at, for example, 25 cycles, is 69 per cent of its output at 60 cycles. Fig. 5 shows the output of a transformer at various frequencies in terms of its output at 60 cycles.

Relation Between the Output of a Transformer and Its Dimensions, Weight and Cost.

If in equation (13) the values of the working densities in the iron and copper, the space-factor in the winding and the frequency at which the transformer is working are constant, it is evident that the output in kilovolt-amperes is proportional to $A_c A_i$ or

$$kva \propto A_c A_i.$$

Since each of these areas is proportional to the product of their dimensions, they are proportional to the square of one of the dimensions of the transformer. If one of the dimensions of the transformer be represented by b, then the product of $A_c A_i$ is proportional to b^4, then, on

$$kva \propto b^4 \qquad (15)$$

or the output of a transformer is proportional to the fourth power of its dimensions. For example, when the dimensions of a transformer are doubled its rating is four times its former value. This relation assumes that as the dimensions and rating of the transformer increase, its output is not limited by the heating of its core and coils.

Since the weight and cost of the active material in a transformer increase as the cube of its dimensions, from equation 15 one is able to determine the relation between its output, cost and weight. These relations are as follows:

$$kva \propto (\text{weight})^{4/3} \qquad (16)$$

$$kva \propto (\text{cost})^{4/3} \qquad (17)$$

Relation Between the Output of a Transformer and Its Loss.

The sum of the iron and copper losses of a transformer may be expressed in terms of its kilovolt-ampere rating. The sum of the losses P may be expressed in terms of the iron and copper loss as follows:

$$P = P_i + P_c.$$

The weight of iron and copper in the transformer is proportional to the volumes of those elements. Since the volume of an object is proportional to the cube of its dimensions, assuming that the flux density in the iron and the current in the copper are constant, the sum of the losses varies as the cube of the linear dimensions of the transformer. It has been shown in equation (15) that

$$kva \propto b^4$$

and since

$$P \propto b^3$$

$$P \propto (kva)^{3/4} \qquad (18)$$

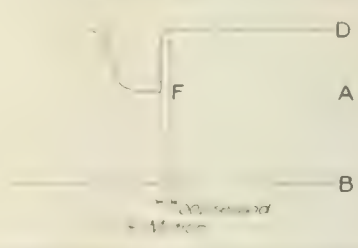
Equations (16) and (18) show that the weight and total loss of a line of transformers increase as the ¾ power of the output rating.

Time-Constant of a Storage Battery.

By Sydney W. Ashe.

An investigation of the storage battery has been carried on by the writer at Columbia University during the past few months under the direction of Prof. F. B. Crocker. The purpose of this study was to determine if possible just how much time is required for the current in a storage battery to rise from zero to the normal operating value after closing the circuit. This question has been under discussion many times in cases where a storage battery is operating in parallel with a rotary converter and a short-circuit occurs. The question which arises is, will the time-constant of the rotary circuit be greater than the time necessary for chemical action in the battery to take place, and, if so, will the battery select the load more quickly than the rotary, allowing the circuit-breaker of the rotary to open before it flashes over the commutator?

With a view to arriving at a conclusion in reference to the time for chemical formation, rate of migration of ions, rate of diffusion of acid, time-constant of the battery or whatever may be the explanation of this apparent time-interval, a simple test was made with an oscillograph, obtaining a curve, a copy of which is shown herewith. A contact-maker was operated upon one end of the film carrier of the oscillograph, making four contacts per revolution, opening and closing the current circuit each time. The zero current and potential lines are shown at the bottom of the figure, *A* and *B*, the potential on closed circuit being shown at *C*, and likewise the closed circuit current at *D*. The



TIME-CONSTANT OF A STORAGE BATTERY.

direction of motion of the film is from left to right; as the circuit is opened by the contact-maker the potential rises to *E*, the current falling to *F*.

The battery had a normal six-hour rate of discharge of 15 amp. and the current on closed circuit was maintained at this value. Slight irregularities in the brush contact are shown by the variation of the current curve. A small spark formed on opening the circuit accounts for the gradual fall of the current curve. The rise of current on making contact was very rapid, the time interval represented between the two parallel lines being 0.002 second. The time necessary for the potential to fall was about one-fourth as great as this value, which would seem to indicate that the time value for the current was even of a smaller magnitude than 0.002. This experiment seems to indicate that the time-interval of the battery is much smaller than that of the generator or the converter.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

A Large Plow Factory Motor-Driven.

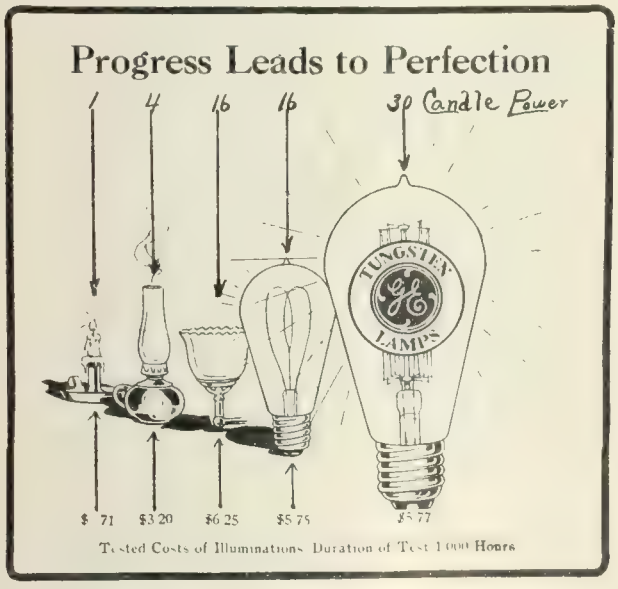
The Moline Plow Company, of Moline, Ill., is changing its entire factory from drive by engines and long line-shaft to group drive with electric motors. There will be over 3200 hp in induction motors. All of the wiring will be placed in conduit, which is unusual for mill work of this kind. The contract is being carried out by the Electric Construction & Machinery Company, of Rock Island.

Electric Arch for Denver.

The business men of Denver, Col., have secured the co-operation of the City Government in the construction of an electric arch at First Avenue and Broadway. The contracts for the construction and lighting of the arch were drawn up at a recent conference between the business men and the City Attorney. The arch, which will be built by the Denver Gas & Electric Company, will be about 35 ft. high, spanning 65 ft., and constructed of iron and steel. There will be 800 lights, and the city will pay half of the cost for operating them. This represents the beginning of the extension of general lighting schemes in the southern part of Denver.

Central-Station Advertising.

The Danville (Ky.) Electric Light, Power & Traction Company has for some time been conducting a "new business" campaign, in which circulars, newspaper advertising and night lantern projections have been effectively employed. The accompanying illustration is reproduced from a lantern slide which was used for a week, the projection being received on a house-top screen and also on the stage curtain of the local theater.



LANTERN SLIDE FOR CENTRAL-STATION ADVERTISING.

Electric Power for Water Pumping.

The Northern Colorado Power Company, which has for its particular field the irrigated agricultural territory from Boulder to Fort Collins and Greeley, has been gradually undertaking a considerable business in water pumping for irrigation purposes. This has proved so satisfactory both in the obtaining of a full load curve and to the farmers in making otherwise arid land, which could not be placed under ditch, fertile, that the power company is now entering an extensive campaign for this kind of business. The average lift is from 10 ft. to 20 ft., though in some cases by lowering the level of the pump, water is lifted profitably over 30 ft. Instances are given where dry land valued at $15 per acre has been increased to $150 per acre, with a cost for irrigation not much more than the maintenance charges on the average ditch.

Electric Heating at the Michigan Convention.

One session of the Michigan Electric Association convention, held at Detroit in August, was given to a consideration of electric heating, which was the subject of a report from the electric heating committee of the association, consisting of Messrs. William Constable, H. A. Mott and R. W. Hemphill, Jr. The report noted a steady increase in the introduction and sale of the popular devices. Flatirons still lead, as they did last year, and will probably continue to do so. A large number of good irons are now on the market—that is, irons with resistor units easily renewed and of longer life than heretofore. The toaster seems to be second in the list of popular devices. Its simplicity and cost make it more popular every year, and it is believed that the central station may derive a healthy revenue from this little device, owing to its frequent use in the household and low cost of operation. Percolators, chafing dishes, water heaters and other small devices occupy about the same position as last year. The first cost and infrequent use of these devices by the general public prohibit the universal sale afforded the flatirons.

No rapid advances have been made in the fireless cooker, probably on account of the Fire Underwriters' rules. Manufacturers have been busy improving the present devices. It is believed that industrial electric heating is in its infancy, and being comparable with the situation as regards the electric motor for industrial purposes 10 years ago. The commercial development of new alloys and improved electrical insulators will greatly enlarge the possibilities of industrial heat applications.

In Michigan there are a number of electric welders in use. The development of spot and point welding and of the automatic punch press welders, where unskilled labor may be used, is a marked advance in the art of electric welding. This device appeals especially to those whose products are manufactured from sheet metals. Foundries offer a large field for the use of the electric arc in repairing cracked or defective castings. The fuse-bath type of electric furnace for heating steel before tempering has proved its great merits, as has also the oil-tempering bath for the manufacture of dies. One large electric manufacturing company has developed a very satisfactory machine at a reasonable cost. Printing, publishing and bookbinding trades offer a large field for the use of electrically heated machines. The matrix table offers the greatest field, owing to the elimination of the high-pressure steam boilers necessary for their present operation. Glue-pots and glue-cookers offer a great inducement to woodworking concerns, which otherwise would have to install an intricate steam piping system throughout their factories. The leather trade offers a large field for electrically heated tools on account of maintaining a constant temperature in comparison with flame-heated tools. In the clothing and textile trades electric irons have displaced all others in many of the larger clothing factories.

Mr. J. D. A. Cross, of the General Electric Company, presented a paper on "The Extension of the Heating-Device Business." He called attention to the installation in a prominent

hotel in the West of a complete kitchen and laundry equipment. It is estimated that the consumption of power during the preparation of meals will vary between 30 kw and 75 kw. There is an 85-kw electric steam boiler, which supplies energy to the laundry mangle and other laundry devices. Nearly every central station now appreciates the possibilities of increasing the day load by selling electric irons. While most irons have been sold during the hot months, their use may be extended through the year. The campaign for irons should be supplemented by one for toasters for household use.

Mr. Cross thinks that the vertical radiant-type toaster will develop into a more standard and profitable device than the flat-iron after consumers have been educated to its simplicity and practicability. The consumption of these on an average use for 20 minutes per day would amount to 6 kw-hours per month. After the toaster has been installed for a while the customer will be convinced that cooking by electricity is practical and simple, and other devices will be employed.

Mr. Cross called special attention to the oil-tempering bath for tools. The close regulation which is necessary with oil tempering can only be successfully obtained by the use of electrically heated baths. The electrically heated oil-tempering bath can be obtained in three sizes, having a capacity of from 9 gal. to 37 gal. of oil and having a consumption of from 6 kw to 20 kw. This power is sufficient to heat the oil to a temperature of 450 deg. Fahr. in less than one hour, starting cold. The bath is equipped with means of heat regulation, making it possible to raise the temperature to 250 deg. Fahr., after which the "work" is introduced and the temperature is then raised to the desired point. This device will be welcomed by all who temper steel, whether they be manufacturers of steel tools and implements or whether they temper tools and dies for use in their own manufactures.

There will be placed on the market this fall an attractive and varied line of ornamental chafing dishes, percolators and disks for holiday trade, and an unusual effort will be made for holiday business. He favored the raising of prices on the sale of electric heating devices to protect local dealers, and if possible to make a working arrangement with them. He also urged central stations to look well after the maintenance of heating devices, in order that these devices may be kept in constant use and not put aside for lack of repair. The cost of this maintenance can be compensated for by an increase in the selling price.

DISCUSSION.

Mr. H. J. Mauger, of the General Electric Company, predicted that the successful electric range of the future would be along the lines of the gas range in connection with the fireless cooker. Recent improvements make it possible to get higher temperatures than formerly. With electric heating units which can withstand 40 watts per square inch, the rate of heating will be equal to that obtained with gas, and the electric unit can compete with the gas flame. The new resistor metal developed by the General Electric Company known as "Calorite" has twice the resistivity of German silver, and can be operated at a temperature of 1200 deg. C. A small stove made with this material has only 0.003 in. of mica between it and the surrounding metal to which the heat must be conducted. Such a disk can be run at 900 deg. C. with a consumption of 40 watts per square inch. The old type of 9-in. or 10-in. disk stove could not safely be made to take more than 15 watts per square inch. It is expected that there will be available for next season an electric range in which the heating elements will be permanently mounted on the range.

Curve-Drawing Meters.

One of the features of the convention of the Michigan Electric Association, held at Detroit in August, was the consideration given to the subject of curve-drawing instruments as applied to motor and lighting circuits of consumers. Several papers were read on this subject.

Mr. J. M. Van Splunter, in a paper on "Curve-Drawing Instruments and Some of Their Applications," said that in the power equipment of factories and in the records kept, electrical instruments make it possible to show the distribution of the load over the factory, the power used per machine, the character of the load, the condition of the cutting tools and the time to complete different operations. To obtain these results data obtained from the records of curve-drawing instruments are so complete that the situation can be sized up in every detail and the necessary changes and corrections made at the proper point. Up to within the last few years it was the practice to install a single prime mover which furnished power for the entire plant by means of numerous shafts and belts. This practice is gradually being changed to that of installing a separate motor for each machine. By using curve-drawing instruments it is possible to show just how much power each machine takes, how long it is in use each day and the cost of energy for its operation. Such records also show with what promptness the employees start to work in the morning and their time of shutting down. Furthermore, they tell when it is necessary to install new machines, and when by some changes fewer machines can be made to do the required work. In other words, the instruments can be used to check the efficiency of the employees, as well as that of the machines. If each central station would procure a curve-drawing wattmeter for demonstration purposes, it would soon result in numerous motor sales, as the record would show the actual conditions throughout the day. The writer recently visited one of the largest power companies in Michigan, which is continually using four curve-drawing wattmeters for this purpose, and its success in the motor field amply justifies the position it has taken in their use.

An example of its use is very interesting as showing conditions that were wholly unexpected: A curve-drawing wattmeter was installed at a place where the customer insisted that the energy used and the energy paid for were at a variance. The record for the day was normal, but a rise in the curve at 9:30 at night could not be accounted for. It was found that the night watchman was in the habit of using all the elevators when making his nightly inspection, and thus the extra energy used was checked.

Another instance, in a department store, was also very striking: The customer complained of excessive bills, and after a curve-drawing instrument was installed, the record showed that there was more energy consumed at night than during ordinary business hours. This was also found to be due to the watchman using the lamps during his rounds. In this manner the instrument not only showed how much energy was used, but also when the energy was being consumed.

It is a well-known fact that in a factory driven by steam engines through a system of line shafts and belts that it is a very difficult thing to ascertain the efficiency of a department, and even that of a single machine. This is not so, however, with the plant electrically driven. The efficiency of the entire plant, any department, or combination of departments, or even groups of machines, or single machine, can be very easily ascertained by electrical measuring instruments, and most readily so by curve-drawing instruments.

DESCRIPTIONS OF CURVE-DRAWING INSTRUMENTS.

Mr. Paul MacGahan presented a paper giving descriptions of the principal types of recording meters. He classified such meters as, first, those in which simplicity and low first cost have been determining factors; and second, those in which accuracy has been made the prime requisite. Unfortunately, the qualities of simplicity and accuracy are still more antagonistic in recording meters than in indicating meters. The purchaser of meters of either type should consider whether an easily manipulated rough-and-ready instrument of a low order of accuracy is sufficient, or whether instruments of precision are needed. Until recently recording meters were limited to the simple cheap class which lacked accuracy. These usually have a stationary coil attracting a movable iron armature actuating directly an arm fitted with a pen. The pen travels in the arc of a circle across a circular dial plate. Taking up the second class, of high cost and accuracy, he said that it is absolutely necessary

to separate the functions of the measuring element and of the marking device, because the friction introduced by the pen on the paper interferes seriously with the accuracy. Some of the schemes which have been utilized for overcoming this difficulty are as follows: (1) Making a continuous photographic record of the position of the pointer, as in the oscillographs; (2) allowing the bent arm of the pen to swing slightly above the paper and to make a dot at fixed intervals by means of an electromagnet; (3) causing a high-tension discharge or spark to pass from the pointer through the paper; (4) the relay type. The second and third schemes are of little importance at present. The relay type, both in this country and abroad, appears to be a good solution of the problem. The meter is separated into two interdependent elements, the meter element or measuring coils and the motor element or pen-oprating device. These elements are connected by the control spring of the meter.

The function of the meter element is limited to making and breaking contacts, which energize the pen-actuating element. Thus the meter element need not have any greater torque than that of an indicating meter; it can, moreover, be made as accurate electrically as any indicating meter. On the other hand, the pen-actuating or motor-element derives its power from a separate source and can have as much torque as is necessary to control the pen. The chart may be made as broad as desirable, and in this way an instrument of high accuracy is obtainable.

DISCUSSION.

Mr. H. W. Hillman, of Grand Rapids, produced the record of the curve-drawing wattemeter from the department store spoken of in Mr. Van Splunter's paper, from which it appeared that the janitor used 19 kw-hours in lighting while sweeping, as against 7 kw-hours used during business hours.

Miss Sarah M. Sheridan, contract agent of the Edison Illuminating Company, of Detroit, said that the Detroit Company had user curve-drawing instruments both to determine the character of the demand made by motor users and also to show lighting customers just when and how much energy was used. She wished that all customers would purchase such instruments for their own information, but thought that very few would do so. The Detroit company has about 2200 customers having motors rated at from 8 hp to 15 hp. Of this class she thought few would purchase such instruments. Some of the larger customers might be persuaded to do so. In some cases the company had found it possible to satisfy complaining electric lighting customers by reading the watt-hour meter twice a day—morning and evening—to show when the energy was used.

Mr. B. J. Denman, of Detroit, expressed himself as not being as enthusiastic about the extensive use of the higher-priced recording instruments as were the former speakers. He thought that the cheaper instruments of the Bristol type, giving approximate indications, would answer most purposes. A few customers in Detroit buy primary energy and use their own transformers. Such have fairly complete switchboards and might purchase recording instruments. The use of energy by janitors can be detected by cheap instruments or by reading the regular consumer's watt-hour meter night and morning. He reported one case in which an amount equal to 60 per cent of the consumption used during business hours was used outside of business hours. Miss Sheridan said that the Detroit companies had three or four curve-drawing instruments for temporary use on consumers' premises. Mr. Denman explained that the rate made in Detroit, known as the "demand rate," was based on the maximum hourly demand as taken by hourly readings of the watt-hour meter. On one or two consumers the Chicago printing attachment will be used to take this hourly reading.

Mr. Hillman emphasized the point that curve-drawing wattmeters used in connection with the electric drive in factories give information which cannot be obtained in the steam-driven factory, and that the more this advantage is appreciated by manufacturers the more favorable will be their general sentiment toward electric service.

INTERIOR WIRING AND ILLUMINATION

Mammoth Moving Sign at Detroit.

The Campus Martius, in the heart of Detroit's business district, was recently packed with people on the occasion of the starting of an enormous sign of an unusual character built by the R. R. Sign Company, of Dayton, Ohio. This sign is reported to contain 11,000 lamps, and is located just south of the Detroit City Hall, facing the Campus Martius. The striking feature of this sign is the moving-picture effect obtained by means of flashers. The moving picture is that of a chariot race with one chariot with its team of horses in full view and another close behind. After this race is continued for a few seconds an advertisement of one of "Detroit's leaders" is flashed out at the top of the sign. These advertisements are changed after every chariot race in regular order. The sign is equipped with colored lamps, and the effect is beautiful as well as striking. A similar sign was previously erected at Dayton, Ohio. It is impossible by means of photographs to give any adequate idea of this striking piece of work.

Spectacular Lighting During Firemen's Convention at Poughkeepsie, N. Y.

The Volunteer Firemen's Association of the State of New York held its annual convention in the city of Poughkeepsie during the week ending Aug. 21, and in order to make the event commemorative in the annals of the organization, as well as



FIG. 1. MUNICIPAL BUILDING AND HOOK AND LADDER HOUSE.

those of the city, the historic town on the east bank of the Hudson underwent quite a transformation. The buildings were bedecked with flags and bunting in profusion; but the feature of the entire decorative scheme was the electric illumination at night, the like of which was never before witnessed on the famous river. Portions of Main and Market streets were transformed into a great "White Way," the culminating feature of which was the Court of Honor on Market Street. Barring some minor changes, the latter was the same as that used in the pageant attending the inauguration of President Taft in Washington this spring. In addition many merchants had arranged individual electrical displays of decided merit.

It is estimated that some 20,000 lamps were used in the decorations. Main Street, from Washington to Hamilton streets, was brilliantly lighted by duplicate rows of lamps festooned from poles spaced 100 ft. apart on both sides of the roadway. The Elblight system was employed throughout. A view of

Main Street, as well as some of the individual decorated buildings on the thoroughfare, are shown herewith. Fig. 4 shows a rather poor view of the Court of Honor on Market Street. On the top of each of the huge columns were large flower baskets made of wicker work, with electric lamps placed in each of the apertures. The lamps were vari-colored, and with the foliage gave a very pretty effect. Swinging from column to column were festoons of lamps running parallel and transversely with the street, as shown in the engraving. The lamps were supplied with electricity from air-cooled transformers erected on poles especially for the occasion, and were controlled from switches on these poles. The transformers used were rated at 35 kw each.

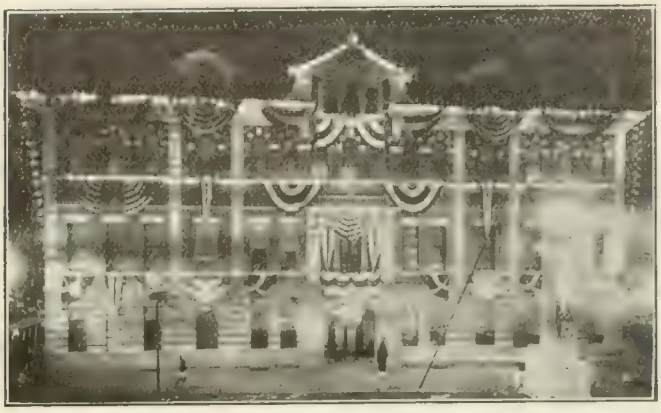


FIG. 2.—COURT HOUSE AT MARKET AND MAIN STREETS.



FIG. 3.—GENERAL VIEW OF LOWER MAIN STREET.

The Poughkeepsie Light, Heat & Power Company, whose office is on Market Street, also made an elaborate display, as did also the Poughkeepsie City & Wappinger Falls Electric Railway Company. The car barn of the latter company was brilliantly illuminated by a large electric star and ropes of incandescent lamps. Fig. 5 is a view of the office of the lighting company as it appeared during the celebration. Much of the credit for the entire electric illumination in the city during the convention is due to Mr. G. A. Voorhees, superintendent of the lighting company, who also had personal charge of the installation of the Court of Honor. An effort is being made by some of the merchants to have portions of the business district permanently lighted in a manner somewhat similar to that employed during the firemen's convention.



FIG. 4.—COURT OF HONOR, ON MARKET STREET.

Lamps and Illumination at the Michigan Convention.

A number of short papers were presented at the convention of the Michigan Association, in August, at Detroit, on tungsten lamps and illumination. One of these, "The Tungsten Lamp in the Residence," was written by Mr. John Vandervliet, of Grand Rapids, who called attention to the unsuitability of ordinary fixtures for tungsten lamps and the idea of the fixture manufacturers in the past to make fixtures with graceful curves that would appeal to the public regardless of the results the customer would get in lighting. In most of the cases he had personally investigated in residences Mr. Vandervliet found that the lamps were hung at an angle of about 45 deg. with a close-fitting frosted or colored shade, and often in addition to this a frosted lamp. In one case the consumer had combination fixtures in which the gas burners were equipped with large white polished reflectors to catch and redirect the light coming from the mantle, while the electric lamps were surrounded by small frosted shades. He showed the consumer how the electric lamps were very unfavorably equipped to deliver useful light, while the gas lamps were well equipped. To show the customer that it was possible to get excellent distribution from the same fixture with electricity he used three 40-watt tungsten lamps with prismatic reflectors, using tungsten adapters to place the lamps in a downward position. With any one of these lamps the customer could read better than with one gas burner. The customer was pleased, and made no further complaints. The company does not wait for complaints, but has two men who make a systematic canvass of residence customers with the above-mentioned combination which they install in a reading-room to be left on 30 days' trial. In nearly every case the customer sees enough improvement to warrant the purchase of the outfit. Mr. Vandervliet believes that the tungsten lamp is the salvation of electricity as against the gas mantle in the home. Nothing smaller than a 40-watt lamp is used at Grand Rapids in this work.

Mr. E. G. Bieg, of the General Electric Company, read a paper on "The Supremacy of the Tungsten Lamp." He said that this fortunate heritage to central-station interests has come none too soon to enable them to hold their own in the field of lighting in competition with the improved methods of using gas, gasoline and acetylene. One difficulty in electric lighting has been, not the cost to the consumer, but that the returns obtained for the expenditure were so meager as compared to gas and other illuminants as to be a serious handicap to electric lighting. The tendency in illumination is to increase the volume and amount of light used, and the tungsten lamp

gives the increase and improvement which are desired. The filaments employed in the various sizes of tungsten multiple lamps run from 0.001 in. to about 0.0055 in. in diameter, and larger. A human hair has a diameter three times as large as that of the filament used on the 25-watt lamp. The comparative intrinsic brilliancy in candle-power per square inch of filament area is about 100 for tungsten as compared to 440 for carbon. It requires 30 to 40 times as long to exhaust a tungsten lamp as it does a carbon lamp. All metallic-filament lamps rise rapidly in candle-power the first few hours of burning. Tungsten lamps are therefore seasoned by being placed on racks and burned for a limited period at excess voltage, so that the lamp will not operate at a higher rating than normal when started in service. The first cost of tungsten lamps is less than that of the early carbon lamp. The life of the tungsten lamp is so good at normal rating, running well up to 1000 hours or more, with well-maintained candle-power, that it is unnecessary to order lamps of excess voltage to insure satisfactory service, as many customers felt was necessary with the first lamps.

In no form of tungten lamp has its success been so marked as in the case of the street series type. This lamp competes successfully with gas street lamps in the matter of cost, with all the superior advantages of the electric incandescent lamp for such service. The life of the tungsten street series lamp is from 1500 to 2000 hours in service. The lamp can be depended upon to give a brilliant light until it fails, with small depreciation in candle-power. The introduction of the tungsten series lamp has already doubled the sales of street series lamps, and over 85 per cent of the incandescent lamps used at present for street series work are tungsten lamps.

The 4-cp, 5-watt sign lamp has been developed. Data obtained show an average life of over 1500 hours, which is at least equal to if not better than the carbon sign lamp. The maintenance of candle-power is very much better than with the carbon lamp. The lamps are made for 10, 11 and 12 volts, so as to burn 10 in series on commercial direct-current circuits. On alternating-current circuits they are usually burned in multiple with a transformer having a 10 to 1 ratio. Consumers who have wanted to advertise by means of an electric sign and have been unable to do so owing to the cost can now do so at the ordinary rates for electricity. Customers now using carbon lamps can, by substituting tungsten lamps, be induced to light their signs longer every night, as it will cost no more, and this results in a better character of load for the central station.

Mr. B. F. Fisher, Jr., of the Westinghouse Lamp Company, also presented a paper on tungsten lamps. He said that the tungsten lamp appeared fully developed and a commercial success in less than two years. It is being made in sizes of 25, 40, 60, 100, 150 and 250 watts for voltages from 100 to 125 and in sizes of 45 to 50, 70 to 80, 110 to 120, and 180 to 200 watts for voltages from 200 to 250. Spectacular and sign lighting are taken care of by the 10, 11 and 12-volt, 5-watt sign lamp.

Street series lamps are made in 25, 32, 40, 60, 80 and 200 cp. Train-lighting lamps for voltages from 28 to 34 are made in 12, 20 and 32 cp, and for voltages from 58 to 65 in 12, 16, 32 and 40 cp. Nearly 100 different tungsten lamps have been successfully developed in these two years of commercial tungsten history.

Mr. J. R. Cravath, of the *Electrical World*, gave a talk on illumination, with reference to the use of tungsten lamps. He gave special attention to recent advances in illuminating engineering knowledge, and pointed out that it is no longer necessary to advocate before a body of central-station men the use of proper reflectors or directing devices upon incandescent lamps used for general illumination. The use of reflectors has become general with the introduction of the tungsten lamp. However, the proper type of reflector is not always selected, and for that reason he called special attention to the necessity of selecting a reflector giving the kind of distribution needed for the room under consideration.

For the general lighting of rooms he condemned the use of flat reflectors which exposed a large portion of the lamp filaments. Such reflectors were used in considerable quantities in the days when the graphitized lamp was first brought out. They were known as the distributing type. There are also a number of clusters on the market at present employing flat reflectors. For general lighting of rooms such reflectors are deficient in two respects. A considerable portion of the flux of light from an incandescent lamp in a pendant position is given off at angles near the horizontal. Flat reflectors fail to intercept and redirect this flux of light. It consequently strikes the upper part of the walls of a room and must be reflected back and forth between the walls many times before reaching the working plane where the illumination is most desired. This multiple reflection between the walls causes excessive loss, especially if the walls are dark. The other defect of these reflectors is that they do not shade the lamp filaments from the eye. The bare filaments produce a partial blinding effect which makes the effective illumination appear less to the persons in a room.

It has been found that with bowl-shaped reflectors which completely cover the incandescent lamp it is possible to obtain any kind of light distribution desirable in ordinary general lighting of rooms. There reflectors are made in forms which are

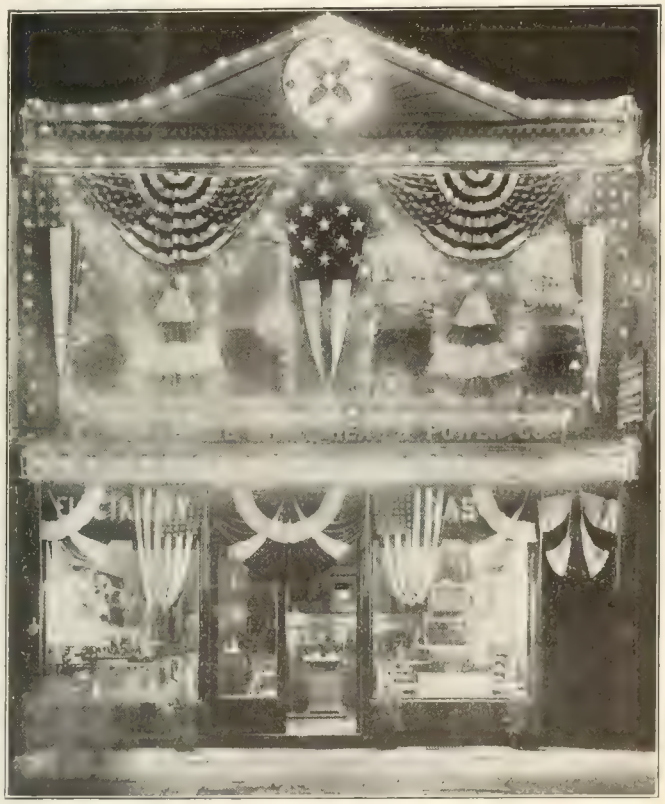


FIG. 5.—OFFICE OF POUGHKEEPSIE LIGHT, HEAT & POWER COMPANY.

very concentrating and also in forms which give a wide distribution. He cautioned his hearers against using reflectors giving the wide or extensive type of distribution in high, narrow rooms with dark walls. In such rooms a concentrating reflector should be used. The general principle should be followed that as much light as possible should be prevented from striking dark walls where it will be lost by absorption. Any type of reflector which causes a considerable portion of the flux of light to be directed against dark walls is likely to be inefficient. For this reason concentrating reflectors must usually be used where the lamps are at great height, especially if the room is narrow.

A considerable advance has been made in three years in reflector manufacture. Three years ago the only scientifically designed line of reflectors on the market was of the clear prismatic type. There is now an increasing number of designs in opal, prismatic with enameled and satin finish, and opal with various satin finishes. The number will doubtless be increased as various manufacturers of glassware come to appreciate the importance of scientific design of reflectors. Among the

opaque reflectors available are the one-piece corrugated mirror reflectors, the mirror reflectors made up of many pieces or sections, the aluminum reflectors, steel reflectors with aluminum finish, and white enameled reflectors.

As a result of numerous tests on the illumination of various rooms in the past three years, engineers now have a much more definite idea than formerly as to the results which can be obtained with a given expenditure of electrical energy. Mr. Cravath showed a compilation of over 150 tests made on the illumination of various rooms in various ways, which indicated that illuminating engineering is coming to be an exact science, as far as measured illumination is concerned. He called attention to some of these figures which show the very important influence of the color of ceiling and walls on illumination. The results obtained by Messrs. Lansingh and Rolph in a given room with the same lamps gave a difference in illumination under extreme conditions in the ratio of 4½ to 1. In a room with dark ceiling, walls and floor, with one bare lamp at the ceiling, 0.77 watt per lumen (watt per square foot per average foot-candle) were obtained, while in a room with light ceilings, walls and floor and with a reflector over the lamp, 0.16 watt per lumen was obtained.

After all, the author said, illumination is not altogether a matter of measured foot-candles, but of measured foot-candles combined with avoidance of blinding effect and annoying shadows. He took up the points to be observed to secure efficiency with indirect lighting, and showed that the same principles must apply as in direct lighting—namely, the avoidance of excessive loss by allowing too much light to escape to the walls of a room. Cove lighting is inefficient because of excessive loss on the walls. Lighting from central fixtures which are made to direct most of the light against central areas of a ceiling can be made much more efficient. The efficiency of the latter kind of installation will depend much upon the reflectors and on the distance of the lamps from the ceiling. If the lamps are hung too low, too large a percentage of the light directed to the ceiling leaves the ceiling at angles which cause the rays to strike the walls and cause loss. The aim should be to have as much as possible of the light directed from the ceiling straight to the working plane without having it undergo several reflections from the walls.

In the discussion which followed, Mr. A. C. Marshall, of Port Huron, said that his company had almost completely tungstenized the store lighting of Port Huron. In some cases there was a reduction in bills the first month after the change was made. On the whole, there had been no reduction in revenue. In regard to the advantages urged for the 4-cp tungsten sign lamps he called attention to the fact that in many cases a 2-cp lamp will make a more legible sign that the 4-cp lamp; large numbers of such 2-cp lamps are being used in signs both in Port Huron and Detroit. The saving claimed for the 4-cp tungsten sign lamp would therefore be divided by 2 in competition with 2-cp carbon lamps.

Mr. E. F. Phillips, of Detroit, speaking of the effect of the tungsten lamp on the business in small towns, said that it had brought a wonderful increase in business because of the consumers who used other illuminants than electricity. There was also a small decrease in some consumers' bills at first.

Mr. Harry Fee, of Adrian, told of the campaign his company had carried on under the motto, "Watch It Grow—Tungsten." While Adrian had been formerly very much given over to the use of gas, the situation as regarded relative use of gas and electricity had been reversed. As to street lighting, his company now has a contract to supply 110 series-tungsten lamps, of 40 cp each, at $19.80 a year. These had been placed up in competition with inverted gas-mantle burners which the gas people had claimed would give 125 cp. His company had claimed only 40 cp for the series-tungsten lamp, but the depreciation in gas mantles and pressure variations brought the candle-power of the gas lamp so low as to make the claims of the gas people seem absurd. Another gas-mantle burner for which extravagant claims were made was also tried. Since both fell so far short of the claims made, and appeared to give less actual illumination than the 40-cp series-tungsten lamp, his company received the contract.

A Notable Example of Indirect Lighting.

The lighting of the new ballroom of the South Shore Country Club, at Chicago, has attracted much favorable comment in the short time since it was completed, and is one of the most notable examples of indirect lighting for a very large area to be found in this country. The total floor dimensions of this ballroom, a general view of which is shown in Fig. 1, are about 86 ft. x 136 ft. The dancing floor proper is about 62 ft. x 112 ft. Around this dancing floor is a promenade 12 ft. wide. The ceiling above the dancing floor is 28 ft. high, and the ceiling of the promenade 20 ft.

The large central area, or dancing floor, is lighted from three fixtures. Each of these three fixtures contains 23 tungsten 100-watt lamps, each equipped with a bell-shaped corrugated one-piece mirror reflector pointed up. The fixtures are of composition, finished in old gold and lined with red silk, which shows through the open work of the fixture baskets.



FIG. 1.—VIEW OF BALL-ROOM.

Over the promenade around the dancing floor there are 28 fixtures, each containing one 100-watt tungsten lamp equipped with similar reflectors. These one-lamp fixtures harmonize in general design with the large fixtures over the dancing floor. In the lobby, or hallway leading to the ballroom from the main club building, there are nine one-lamp fixtures.

The large fixtures are 63 in. in diameter and are hung with the top of the basket 6 ft. from the ceiling, this ceiling distance being that calculated to give the best results. The fixtures over the promenade are 36 in. from the ceiling. In this case the fixtures were hung a little lower than the proper distance to give the best illuminating results in order to better fit in with the architectural design.

The central area or dancing floor uses about 1 watt per square foot. The total area—that is, the dancing floor and promenade—uses 0.83 watt per square foot. The average illumination with the installation now is estimated to be an average of 2.3 foot-candles, although no measurements have been taken.

The results exceeded the expectation of the board of gover-



FIG. 2.—LOBBY.

nors of the club, and are free from the objectionable flatness which accompanies indirect lighting by the cove method. One notable feature of the illumination is the ease with which persons can be seen at a distance across the floor, presumably because of the absence of exposed lamps in the field of vision.

The baskets of the fixtures which hold the reflectors are somewhat larger than needed for the reflectors in the case of



FIG. 3.—PROMENADE.

the one-light fixtures, and this permits some reflected light from the ceiling to shine back through the silk lining and softly illuminate this silk so that the design does not appear black and dead. The same thing is accomplished in the large fixtures by the light which shines through from the ceiling between the reflectors. The ceilings are very light in tint. The walls are "American Beauty" red. The illuminating engineering was done by Mr. J. R. Cravath, of Chicago. The reflectors used were made by the National X-Ray Reflector Company, of Chicago. The architects for this ballroom are Messrs. Marshall & Fox, of Chicago, and the fixture designs were made by them.

New Telephone Patents.

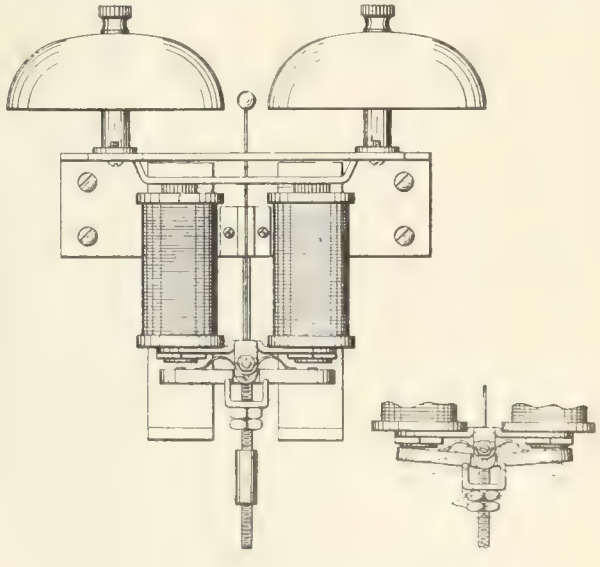
SERVICE METER CIRCUIT.

Where the service meter system of charging is in use it becomes necessary to provide a counting device for each line which may be actuated by the operator to count one call for each completed connection. For three-wire systems the meter may be included in the sleeve or cut-off relay circuit, but it must fail to operate upon the normal currents of this circuit, while its special operating current must not injure the other apparatus. Some consider it an advantage to have the service meter lock upon the normal cut-off current, after being once operated. It is with this type of meter that a patent granted to Mr. W. Reid, of Chicago, Ill., is concerned. Mr. Reid puts two differentially connected windings upon his meter and thus there is less tendency for the meter to respond to normal currents. On the other hand, the lock circuit shunts out one of these windings, making it easy to lock up the meter. This patent is assigned to the Kellogg Switchboard & Supply Company.

NEW APPARATUS.

A patent has been granted to Mr. J. Erickson, of Chicago, Ill., on a tubular-type relay, one side of the shell being flattened to afford a seat for the mountings for contact springs and also to afford a knife edge or corner for the hinge point of the L-shaped armature. This latter has a part of its spring actuating leg cut away so as to permit a small clip, screwed to the relay shell, to extend over its vertical leg in a manner to secure the armature in position.

Mr. B. W. Sweet, of Cleveland, Ohio, patented and assigned to the Century Telephone Construction Company a removable coil drop for use as part of a combined drop and jack. The steel drop shell is open at the rear, and the coil slip within, having bent lugs which register with screw binders on the proper jack springs, so that no soldering need be done. The drop armature carries a stationary spindle, which drops into



SWEET SELECTIVE RINGING MAGNETO BELL.

open slot bearings, being then secured by small movable hooks. Above is shown a ringer for selective work, also the invention of Mr. Sweet. It is designed for harmonic selection. The armature is two-part and is carried upon a frame which in turn is attached rigidly to a spindle. This latter is clamped at the end of a flat spring extending down from the framework. The armature is adjustable, thus controlling the air-gap; two polar-

izing magnets are used. The cut shows clearly the arrangement.

Messrs. C. O. Sisler and L. D. Smiley, of Uniontown, Pa., have jointly patented an apparatus for the step-by-step control of a party line upon the lock-out basis. The patent covers largely details of arrangement and construction.

Letters to the Editors.

Movement of Magnetic Material in a Rotating Field.

To the Editors of Electrical World:

Sirs:—In your issue of July 22, on page 204, there appears a letter regarding an experiment with a rotating field and two sets of uniformly shaped iron filings and iron disks on edge, free to revolve or turn, on non-magnetic plates placed one above and one below the horizontal plane of the rotating field. Reference is made to the action of the iron pieces on the upper plate tending to revolve in a direction opposite to, and those on the under plate in a direction with, the rotating field. An explanation is given on page 180 based on the hysteretic action in the iron pieces, which, however, in the writer's opinion, is not of sufficient magnitude to cause the effect described.

A logical explanation would be that the tangential pull of the rotating field acting at the lower periphery of the top set of iron pieces and at the upper periphery of the under set of iron pieces, shown in illustration, causes a natural tendency in the two sets of iron pieces to revolve or rotate in relatively opposite directions.

Madison, Wis. C. W. Lange.

Printing and Illumination.

To the Editors of Electrical World:

Sirs:—Referring to an article entitled "Printing and Illumination," which appeared in your issue of July 29 on pages 259 and 260, I would like to remark that the author has apparently lost sight of the essentials of the theory of light-tinted symbols on a dark background.

First of all, I have no knowledge of any considerable discussion in the technical press during the past year on the subject of white letters on black backgrounds; the theory of light-tinted symbols on dark backgrounds, however, has received some attention. The writer may recall that in some articles he has written on this theory, he opposed the use of great contrasts in printing, such as white letters against dark or black backgrounds for reading purposes, claiming that such contrasts are not only unnecessary, but exceeding injurious to the eye, just as the present style of black on white is undesirable.

In the latter part of the second paragraph of the article referred to, the statement appears that "It is not the area that produces trouble, but the over-stimulation of any part of the area." I quite agree that it is not the area that produces trouble because the area might be anything; but that it is the character of the area that is to blame, and certainly printing as done on even white mat surfaces over-stimulates the eye.

I have advocated that until by proper process of evolution the light-tinted symbol theory can be successfully established, printing, especially in school books and periodicals requiring lengthy concentration of the eye and mind, be on an india-tinted matt surface or other tinted paper acceptable to the eye.

Aside from the theoretical side of this theory, one might also consider the purely practical aspect. Does it not seem to be the sensible thing to endeavor to "see" something that one looks at—which is the case of the light-tinted symbols on a dark background—rather than to see purely by contrast or indirectly, as is the case of our present method? Evidences of the appreciation of the light against dark theory may be readily noticed by referring to the use of such theory in a vast amount of sign work and display advertising. It is only a matter of time when it will be used for printing.

Finally, I would like to remark that just as data based on actual use are conspicuous by their absence in the discussion of the theory, such data are not in evidence in the article referred to, nor apparently used in arriving at the conclusions set forth. I would suggest that some experimentation be made before "findings" are offered.

New York A. J. Marshall.

Locating Vessels by Wireless Telegraphy.

To the Editors of Electrical World:

Sirs:—We have read the very interesting letters published in your issues of April 23, May 13 and 27, July 22 and Aug. 12 on the subject of the locating of vessels by wireless telegraphy. The letters indicate, however, that the use of our radiogoniometer for determining the position of a transmitting station is evidently not sufficiently well known, and there appears also to be some misconception as to the case of application of the method on board ship. For this reason we think that some information on the subject may prove of interest to the readers of the *Electrical World.*

For ship installations we employ only two equal and mutually perpendicular directive aerials, each one composed of two antennæ convergent at the upper ends and joined at the lower ends by a conductor, in circuit with which latter is the corresponding winding of the radiogoniometer. Each directive aerial makes an angle of 45 deg. with the longitudinal axis of the ship, and owing to this arrangement the antennæ do not form any incumbrance on the vessel, since they follow the line of the shrouds. In addition to the directive aerials, an ordinary vertical antenna is connected to the radiogoniometer.

The detector connected to the radiogoniometer can be of any known type—that is to say, a telephonic apparatus, a coherer, a reflecting galvanometer or even the Gáti barretter.

The direction of a transmitting station is obtained by determining the two limiting positions of the movable coil of the radiogoniometer where the reception vanishes and by bisecting the angle formed by these two positions. By taking several pairs of readings, an approximation of 1 deg. is readily obtained. The whole operation takes but a very brief time, as an ordinary wireless operator can make 10 pairs of observations in one minute, which number is more than sufficient to obtain the bearing of the transmitting station to the above approximation.

The chief advantage over all other methods, which depend mainly on quantitative measurements, consists in the fact that the direction is determined from the ordinary signals constituting messages, no special signals of long duration or at a low speed being necessary. By simultaneously employing the directive aerials and the vertical antenna one can determine both the direction and the sense in which the radiation arrives with respect to the position of the ship. The receiving arrangement usually employed makes use of telephonic reception; but if aural reception is disturbed by extraneous noises, the same results are obtainable if any other of the types of receiving apparatus mentioned above is employed.

One very important property of the radiogoniometric method of determining the direction of a transmitting station is that this determination is made instantly and independently of the course being followed by the vessel, while with all other methods the ship is obliged to make several attempts before it is possible to know if it is approaching or receding from the transmitting station. This property represents a saving of precious time and it is consequently evident that by the radiogoniometric method it is possible to bring, with the greatest rapidity and the least delay, the assistance demanded by a ship in distress. It is illusory to suppose that if a vessel in distress succeeds in signaling its position it is certain that the rescuing vessels will be able to find her easily. As a matter of fact, the ship, being generally at the mercy of the waves, the wind and the current, will have drifted from her original position while awaiting succor, and therefore the rescuing vessels, after

having reached the spot signaled them, will have to search, for hours perhaps, for the ship in distress. It is hence indispensable that the rescuing vessels should have at their command a system for locating the position of any ship which is sending signals; and the radiogoniometric method is the one which lends itself best to the attainment of this object.

Besides the use of the radiogoniometer for determining the direction of a ship in distress, we might call attention to the value of the same method for enabling one to avoid collisions in time of fog. For this purpose vessels fitted with wireless equipments have only to send signals from time to time during such atmospheric conditions, and then if such vessels are fitted with a radiogoniometer, each vessel can determine whether or not any of the others is on her course.

Another use of the radiogoniometer is in connection with making port, which in foggy weather is always dangerous. But if there is a wireless station in action in the neighborhood, a ship fitted with the radiogoniometer can, by taking the bearing of this station and regulating her movements thereby, make a landing with the greatest certainty, in the same manner as in clear weather, by taking the bearing of a light or other visible signal. The radiogoniometer in this way becomes a Hertzian "standard compass."

TURIN, ITALY. E. BELLINI AND A. TOSI.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Temperature Within Magnet Coils.—K. HUMBURG.—The maximum temperature which occurs in the interior of a magnet coil cannot be directly measured. However, since this maximum temperature is of importance for determining the permissible current, it is advisable to calculate the maximum temperature within the coil from the mean temperature, which can be determined by resistance measurements and from the temperature on the surface. The author gives the mathematical theory of the distribution of the temperature in the interior of magnet coils of rectangular cross-section.—*Elek. und Masch.* (Vienna), July 18 and 25.

Single-Phase Commutator Motor.—C. NOOME AND K. H. HAGA.—An account of an experimental investigation of the iron losses in the rotor of a single-phase commutator motor. The authors describe a test in which they find that the rotor iron losses are a function of the speed, and that, beginning with a certain low speed, the iron losses are about proportional to the speed.—*Elek. Zeit.*, Aug. 19.

Single-Phase Motors.—F. EICHBERG.—An illustrated translation of his German paper, recently noticed in the Digest, on different types of alternating-current commutator motors. The author investigates the influence of the frequency on the generators, transformers, transmission line, and more especially on single-phase commutator motors.—Lond. *Electrician*, Aug. 20.

Leakage Reactance.—J. REZELMAN.—The first part of an illustrated mathematical article in which the author deals with the leakage reactance of the stator windings of alternating-current machines, the rotors being removed. The leakage flux is separated into its component parts, for several machines, by means of experiments; the effect of the type of winding upon the overhang leakage, and the relationship between the reactance of the windings in three-phase and in single-phase working are observed. Formulas are given by means of which the stator reactance can be calculated.—Lond. *Electrician*, Aug. 20.

Losses in Three-Phase Motors.—A. LANG.—In three-phase motors the measured iron losses are sometimes found much greater than the calculated losses, although in other cases the calculated and measured losses agree closely. The disagreement has been investigated by Bragstadt and Franckel as the "additional losses" in three-phase motors. The present author has applied a theory of his own to various motors and finds that it agrees very well with the experiments.—*Elek. und Masch.* (Vienna), July 25.

Lamps and Lighting.

Metallic-Filament Lamps.—A. LIBESNY.—The first part of a paper read before the German Association of Electrical Engineers concerning the question of the best conditions (especially watts per candle) under which metallic-filament lamps may be operated. He states that even incandescent-lamp experts make mistakes in this respect. He describes a graphical method showing the relation between the different factors which determine the best conditions of operation. In this graphical method he gives the price of the lamp in units of energy. For instance, if a lamp costs 75 cents and 1000 watt-hours cost 7½ cents, then the cost of the lamp is stated to be 10,000 watt-hours. His graphical method is first based on the consideration of "ideal" lamps, which maintain their efficiency constant throughout their life. He finally gives life tests of osram lamps operated at different specific consumptions, namely, 1.1 watt, 1.0 watt, 0.9 watt, 0.8 watt, 0.7 watt, 0.6 watt, 0.5 watt per hefner candle. (Fig. 1.) The abscissas are hours,

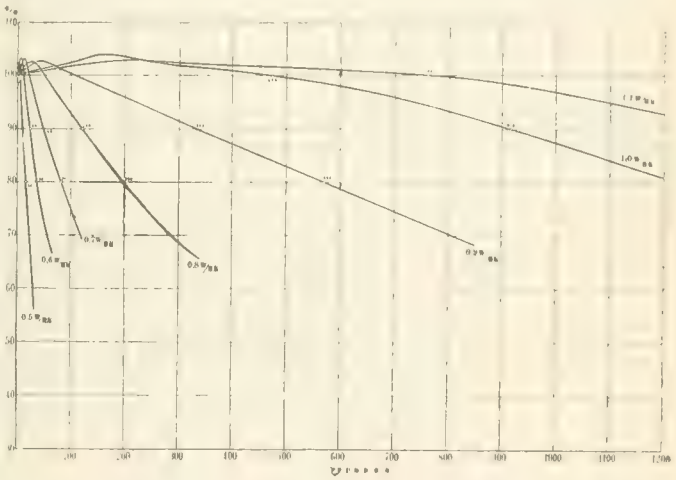


FIG. 1.—LIFE CURVES OF OSRAM LAMPS.

the ordinates are per cents of the original candle-power. The paper is to be concluded.—*Elek. Zeit.*, Aug. 19.

Incandescent Lamps.—A. C. JOLLEY.—The conclusion of his illustrated paper on modern incandescent electric lamps. In the present instalment the author deals with the temperature of the filament and calculates the temperature on the basis of the formulas of Stefan, Petavel, Rasch and Nernst. The results are given in diagrams and summed up in the following table:

Type of filament	Watts per cp.	Temperatures deg. C. Stefan.	Petavel.	Rasch.	Nernst
Carbon	3.5	1,557	1,607	1,647	1,657
Gem (graphitized carbon)	3.13	1,632	1,667	1,687	1,717
Tantalum	1.645	1,427	1,527	1,717	1,737
Osram (tungsten)	1.25	1,517	1,827	1,777	1,807

He points out that the figures given in columns 5 and 6 are in practical agreement with the empirical law of Lummer and Kurlbaum, namely, that the light emitted by a glowing body increases as the twelfth power of the absolute temperature in the neighborhood of 1900 deg. C. absolute. He finally thinks that a careful study of the form of the energy curves of incandescent bodies is the direction in which one must look for further advances in economical light production; for, apart from the difficulty in finding suitable refractory materials which are permanent at very high temperatures, one is always confronted by the facts that, firstly, at the highest temperatures, by pure temperature radiation, more than 50 per cent efficiency can never be attained, and as temperatures are pushed up the increase in economy must be always offset by the serious sur-

face disintegration, and consequent short life which always accompanies it.—Lond. *Electrician*, Aug. 20.

Photometry of Differently Colored Lights.—H. Morris-Airey.—A letter on the reason why the flicker photometer gives varying results when the sources of light to be compared are of different tint. Since the eye includes two types of sensitive elements—the rods and cones—Wild has suggested that as the speed of the flicker head is increased the cones are unable to follow the changes, so that there is rod vision only, and since for color sensation one depends on the cones, the comparison of the differently colored lights will lead to inaccuracies. However, it has been shown that the cones respond much more quickly to stimulation than the rods. The present author thinks that the real explanation is to be found in the excitation curves of the retina for differently colored lights. If two lights are compared by means of the flicker photometer, then at one speed practically the red components are being compared, while at another speed it may be the violet components which are preponderating in the stimulus of the retina. Clearly this can only lead to correct results for the comparative intensities, when the two lights have their component colors mixed in exactly the same proportions—that is, when the two lights are identical in tint.—Lond. *Electrician*, Aug. 20.

Generation, Transmission and Distribution.

Influence of Wave-Forms on the Efficiency of Energy Transmission.—C. F. Holmboe.—The author describes a case in which differences in the wave-form of two electrically connected synchronous machines resulted in considerable losses. From a large central station energy was transmitted by three-phase currents at 5000 volts to substations. The central station was a direct-current station, which was to be changed over to three-phase, and during the time of a change a motor-generator transforming from direct current to three-phase currents was installed—indicated by *I* in Fig. 2. The three-phase generator

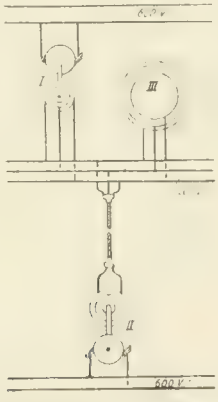


FIG. 2.—DIAGRAM OF CONNECTIONS.

of this set produced three-phase currents at 5000 volts which were transmitted to a three-phase, direct-current motor generator *II* in the substation. Both sets *I* and *II* were exactly identical in construction and electrical design, since after the change of the central station was completed it was intended to install set *I* also in the substation. The rating of both *I* and *II* was 100 kw. The efficiency of the transformation of direct current to three-phase currents in set *I* and of the transformation from three-phase currents to direct current in set *II* was found to be 84 per cent. At normal load—200 kw—and with correct magnetizing current, the power factor was unity. After this plant had been in use for one and a half years the new three-phase station could be started and the set *I* became superfluous in the central station. The substation was now connected to the steam-driven three-phase generator *III* in the central station. It was then found that the efficiency of transformation from three-phase to direct current of set *II* had been reduced to 79 per cent. Moreover, it was no longer possible to get a unity power factor. It was found that this was due to the difference in wave-forms of the three-phase machines *II* and *III*. The former had three and the latter two slots per phase and pole. The yearly losses of the company corresponded to the interest on a capital of some $10,000.—*Elek. und Masch.* (Vienna), July 11.

Gas Producers.—O. Nagel.—An article on the evolution of the gas producer, with brief illustrated descriptions of a great many different types of producers.—*Electrochem. and Met. Industry*, September.

Water-Power in Winter.—W. von Winkler.—An article giving practical notes on the operation of a water-power station in winter.—*Elek. und Masch.* (Vienna), Aug. 15.

Traction.

Hungaria.—Statistical data on the electric railways in Hungaria at the end of 1908. There were four electric interurban roads, with a total length of 44 km, of which 8 km are double-track, and 14 electric street railways, with a total length of 217 km, of which 142 km are double-track.—*Elek. und Masch.* (Vienna), July 18.

Single-Phase Railway.—Henry.—An illustrated description of the single-phase railway from Rotterdam to La Haye and Schveningen. Each of the cars has two 180-hp motors. These are Siemens series motors with commutator poles and compensated winding.—*L'Industrie Elec.*, Aug. 10.

Rail Corrugation.—Peterson.—An abstract of a report on an exhaustive study of the causes for rail corrugation. The author attributes corrugation largely to the formation of incipient waves in the rails during the process of rolling, and discusses the whole process of rolling girder rails. He makes some recommendations as to changes in methods by which he believes corrugations can be prevented.—*Elec. Rail. Jour.*, Aug. 28.

Cable Roads.—E. E. Seefehlner.—A long mathematical article on various points in the theory and practice of cable roads, with illustrated descriptions of two new mountain cable roads in Tyrol and Hungaria.—*Elek. und Masch.* (Vienna), Aug. 1 and 8.

Installations, Systems and Appliances.

Central-Station Statistics of Austria.—The first complete statistics of the central stations of Austria. Only those stations are mentioned which supply energy for public purposes. Traction stations are excluded and also all isolated stations which do not supply energy to other customers. There are now in Austria 571 central stations. For 561 of the same, with a total rating of 285,353 kw, the system used is known. Direct current with storage batteries is used in 229 stations, direct current without storage batteries in 138 stations, single-phase current in 14 stations, two-phase currents in 5 stations, three-phase currents in 154 stations, and combined alternating-current and direct-current systems in 21 stations. In the alternating-current stations the frequency is 50 cycles in 112 stations, 42 cycles in 36 stations, while other frequencies are used in 10 stations. Cable networks are used in 14 stations, overhead wires in 232 stations, both cables and overhead wires in 115 stations, while no information is available about 209 stations. In direct-current stations the three-wire system is used in 190 stations, the five-wire system in 2 stations, and the two-wire system in 165 stations. One hundred and eleven stations are operated by steam, 275 by water, 85 by steam and water, 21 by gas, 17 by oil engines, 2 by gasoline engines, 10 by steam and gas engines, 30 by water and gas engines, and 6 by steam, water and electric motors. Ten stations have a rating above 5000 kw, 32 stations a rating between 1000 kw and 5000 kw. The tariff system used is classified in the following table:

	Number of stations	
	For lighting.	For other services.
[illegible]	118	198
[illegible]	80	
[illegible]	98	
[illegible]	78	
[illegible]	191	
[illegible]	6	
[illegible]	571	

Some of the newer works are using metallic-filament lamps.—*Elek. und Masch.* (Vienna), Aug. 8.

Circuit-Breaker.—A note on a recent British patent (20,268,

1908; Aug. 12, 1909) of the Siemens Brothers Dynamo Works for a switch for automatically breaking the connection between two separately fed sections of a traction conductor as soon as a fault develops in either, and for automatically reconnecting the two sections when the fault is removed. When the circuit-breaker operates, it simultaneously closes a resetting switch, which causes the breaker to be closed again when both sections are at the normal pressure.—Lond. *Elec. Eng'ing,* Aug. 19.

Wires, Wiring and Conduits.

Cable Laying.—C. A. SMITH.—An illustrated description of two appliances for cable laying, useful in out-of-the-way places. They are a "cable-drum carriage" and a special "duct reel" for threading underground cable tubes with draw wires.—Lond. *Elec. Review,* Aug. 20.

Electrophysics and Magnetism.

Mechanical Equivalent of Heat.—H. T. BURNS.—A paper read before the (British) Royal Society on the absolute value of the mechanical equivalent of heat in terms of the international electrical units. In 1902 the author and H. L. Callendar determined the capacity for heat of water at different temperatures between 0 deg. C. and 100 deg. C. by means of the continuous method of calorimetry. A steady electric current was used to heat a steady flow of water through a fine-bore tube, bringing about steady temperature conditions in the calorimeter. The energy given in joules was expressed in terms of the international electric units, and was consequently dependent on the values of the standards used in the measurements. They adopted the legal value of the Clark cell. Since that value of the cell has been shown in the meanwhile to be slightly erroneous, the author has calculated the former results on the basis of the new value for the Clark cell. The mean value of the thermal capacity of water at different temperatures between 5 deg. C. and 95 deg. C. in joules per calorie is now 4.1835, compared with 4.1888 originally stated. The author compares his result with those of other experimenters. He finds an excellent agreement, which shows that at the present time the knowledge of the electrical units must be not far from the truth, both as regards the voltage of the Clark cell and the ohm.—Lond. *Electrician,* Aug. 20.

Spectroscopic Measurements.—An account of an investigation carried out in the German Reichsanstalt in which spectrum

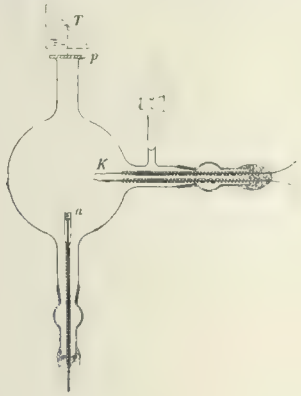


FIG. 3.—SPECTROSCOPIC MEASUREMENTS.

lines of considerable intensity and sharpness were produced by means of an arc in vacuo. In the vacuum tube with incandescent Wehnelt cathode electric currents of considerable strength can be used so that the anode becomes so hot that it melts and evaporates. The arrangement is shown in Fig. 3. The anode *a* ends in a porcelain tube which contains the material to be evaporated. The material is in electric connection with the metallic wire of the anode. *K* is the Wehnelt cathode brought to incandescence by means of current from an auxiliary battery. The light emitted from the anode *a* vertically upward passes through a horizontal plate *p* and is deflected by means of the prism *T* so as to direct it in horizontal direction into the spectroscope.—*Elek. Zeit.,* Aug. 19.

Conductivity and Tension of Wires.—J. SAHULKA.—An account of some experiments which were made to determine whether the tension in stretched iron or aluminum wires has any effect on their conductivity. He found that the conductivity does not change as long as the tension does not go beyond the elastic limit.—*Elek. und Masch.* (Vienna), Aug. 15.

Electrochemistry and Batteries.

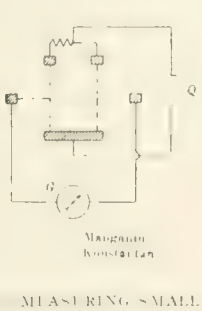
Electrode Losses.—C. A. HANSEN.—An account of an experimental investigation of the consumption of electrodes by oxidation, with special reference to graphite and carbon electrodes. The importance of having mechanically strong electrodes is pointed out in view of the great troubles due to breakage. The author thinks that there is nothing in the nature of amorphous carbon which would prevent making large and perfectly strong electrodes from it.—*Electrochem. and Met. Industry,* September.

Electrode Losses.—C. HERING.—An article on the heat losses through electrodes. For any material it is possible to predetermine theoretically the best dimensions of an electrode in which the heat losses through the electrodes become a minimum. These best dimensions depend on the current, the temperature and the specific properties of the material. It is wrong to select the dimension of electrodes on the basis of current density.—*Electrochem. and Met. Industry,* September.

Units, Measurements and Instruments.

Measuring Small Alternating Currents.—A description of a new arrangement used by the Reichsanstalt for the measuring of small alternating currents with thermo-couples. It permits the measurement of small voltages with small energy consumption. The arrangement is shown in Fig. 4, in which the lines consisting of dashes represent manganin wires and the lines consisting of dots represent constantan wires. The current coming from the source *Q* of direct or alternating current passes through the manganin and the constantan wires in parallel, both being 20 microns in thickness. A constantan wire is connected to the center of the manganin wire and one terminal of the galvanometer *G*. A manganin wire is connected to the center of the constantan wire and to the other terminal of the galvanometer. The connections are made by soldering with silver. The thermo e.m.fs. of the two joints are added together and there are no Peltier effects. A suitable resistance permits distribution of the current between the two wires in such a way that the current in the galvanometer circuit is zero.—*Elek. Zeit.,* Aug. 19.

Speed Regulator.—In investigations by the German Reichsanstalt of an automatic speed regulator for motors is em-



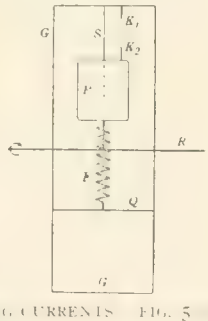


FIG. 4.—MEASURING SMALL ALTERNATING CURRENTS. FIG. 5.—SPEED REGULATOR.

ployed the arrangement of which is shown in Fig. 5. *R* is the axle of rotation of the shunt-wound motor. The weight *P* is movable along a steel wire *S*. This wire is stretched between the axle *R* and the frame *G*. *Q* is a cross-connection which can be placed at different points of the frame *G*. The spiral spring *F* is stretched between the weight *P* and the cross-connection *Q*. At a certain speed the weight begins to move away from the axle until the points K_1 and K_2 come in contact, whereby a resistor in series with the magnet winding of the motor is short-circuited. The speed of the motor is thereby reduced until the contacts K_1 and K_2 are separated again. By adjusting the position of the cross-connection *Q* of the frame *G* it is possible to adjust the speed for which the arrangement becomes operative.—*Elek. Zeit.,* Aug. 19.

String Electrometer.—T. H. LABY.—A paper read before the

Cambridge Philosophical Society. The author gives an account of experiments in which he substituted a stretched silvered-quartz fiber for the gold leaf of an electroscope. The string electrometer used in these experiments consisted of two vertical insulated plates 15 cm long by 0.8 cm thick, with their edges parallel and at an adjustable distance apart. These plates were connected to the terminals of a battery, the middle of which was earthed. The silvered-quartz fiber was stretched parallel to and equidistant from the two plates by the lateral movement of its points of support, while its tension, which must be kept very constant, was controlled by a screw. The terminals of the middle cell of the battery were connected to a potentiometer, the middle of which was earthed, so that the potential of the fiber could be varied from —1 volt to +1 volt by steps of 0.02 volt. As the fiber was not highly insulated, tests could not be made with it isolated, so that the results given later were got with the potential of the fiber maintained. The motion of the middle of the fiber was observed by means of a microscope. This string electrometer is not only quite sensitive, but it also appears to be useful for automatically recording rapid changes of voltages. In its use for the study of continuous phenomena the movement of the fiber is recorded photographically.—Lond. *Electrician,* Aug. 20.

Ohmmeter.—E. Siedek.—A description of a new ohmmeter which is based on the fact that if the current through a resistor is 1 amp, or 10 amp or 100 amp, a voltmeter applied to the terminals of the resistor gives directly the ohms or the ohm multiplied by 10 or 100, etc. The principle is shown in Fig. 6, where x is the resistor whose resistance is to be measured and w_s is a series resistor whose resistance is large enough to permit short-circuiting *I* and *II* without hurting the instruments. *A* is an ammeter and *V* a voltmeter. The sliding contact *s* is moved along the resistor *W* until the ammeter *A* shows exactly 1 amp. Then the volts read on the voltmeter give directly the resistance of x in ohms. The resistance of the ammeter *A* (which has been determined previously) must, of course, be subtracted. There is no necessity to calibrate the resistance of w_s and w. To improve the accuracy of determination, two sliding contacts may be used. A further modification is also described as is also an arrangement which can be employed as the universal apparatus which permits one to read directly the voltage, current and resistance.—*Elek. und Masch.* (Vienna), July 18.

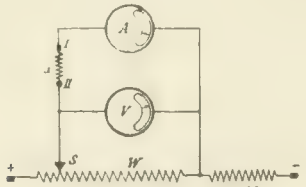


FIG. 6.—DIAGRAM OF OHMMETER CONNECTIONS.

Thermo-Couples.—E. Alkenkirch.—A mathematical paper in which the author calculates, on a theoretical basis, the maximum possible efficiency of a thermo-couple.—*Phys. Zeit.,* Aug. 15.

Reichsanstalt.—A review of the work of the Reichsanstalt in the year 1908. The results of some special investigations are noticed elsewhere in the Digest.—*Elek. Zeit.,* Aug. 19.

Telegraphy, Telephony and Signals.

Telegraph Statistics.—H. von Hellrigl.—Statistical tables on telegraphy in the different countries of the world in 1907. The tables refer to traffic, extension of networks, telegraph stations, apparatus, financial results, etc.—*Elek. und Masch.* (Vienna), Aug. 1.

Miscellaneous.

Electricity in the Bible.—E. Stadelmann.—An article pointing out that it is highly probable that the ancients had a knowledge of electricity, which was restricted, however, to the priests. The priests had a knowledge of many physical phenomena by means of which they could exhibit their superiority over the common people. It has been established that the priests in temples and some distance from each other communicated by a kind of light telegraphy, using almost exactly the system now employed in war of sending light rays by means of mirrors to certain points. The author further claims that the old Israelites knew the lightning rods, as the temple was protected by lightning rods. References are made to various descriptions in the Bible. It is also claimed that the Ark of the Covenant was a large Leyden jar. This was charged by means of rods on the temple with atmospheric electricity. Under the climatic conditions of the country, the author thinks that quite strong effects could be obtained. If anybody came near the Ark of the Covenant and touched its outside he would get an electric shock and would perhaps be killed. The priests protected themselves with clothes of metallic foil (gold foil), which is quite similar to the metallic protecting suit now used by Professor Artemieff in his experiments with high-voltage electricity. It is probable that the altar was also a large Leyden jar. Numerous references are made to the Bible. The author thinks that Moses got his knowledge of electricity from the Egyptians. —*Elek. Anz.,* July 25.

Heat Conductivity of Refractory Materials.—S. Wologdine and A. L. Queneau.—The first part of a long account of an experimental investigation of the heat conductivity, porosity and gas permeability of refractory materials. The chief figures of the heat conductivities of various refractory materials in the temperature range up to about 1000 deg. C. are given in the following table:

Material.	Conductivity. Gr. cal. per sec. per sq. cm. per cm. per 1° C diff.	Kg. cal. per hr. per sq. cm. per cm. per 1° C diff.	Relative conductivity
Graphite brick	.025	9.0	100.0
Carborundum brick	[illegible]	8.32	92.4
Magnesia brick	[illegible]	2.54	28.4
Chromite brick	[illegible]	2.05	22.8
Fire brick	[illegible]	1.50	16.7
Checker brick	.0039	1.42	15.8
Gas retort brick	[illegible]	1.36	15.2
Building brick	[illegible]	1.26	14.0
Bauxite brick	[illegible]	1.19	13.2
Glass pot	[illegible]	.96	12.4
Terra cotta	.0023	.84	9.3
Silica brick	[illegible]	.71	7.8
Kieselguhr brick	[illegible]	.64	7.1

The figures selected are representative of the grade of refractory materials that are available for every-day furnace work —*Electrochem. and Met. Industry,* September.

Exposition at Nancy.—J. Izart.—An illustrated description of various exhibits of French companies at the exposition at Nancy.—*L'Industrie Elec.,* Aug. 10.

Atmospheric Electricity and Air Ships.—L. Zehnder.—The author shows that discharges of atmospheric electricity may become dangerous for balloons if considerable portions of the balloon itself or near it are good conductors of electricity. The following remedies are recommended for the Zeppelin airship: first, the aluminum frame may be replaced by a wooden frame; second, the aluminum frame may be provided with special lightning arresters, and, third, the whole cover of the balloon could be made of very thin metal. The last recommendation appears to be favored.—*Elek. Zeit.,* Aug. 12.

College.—An illustrated description of the electric equipment of the new building of the Merchant Venturers' Technical College, in Bristol, describing the lighting and power systems, the equipment of telephones and time distribution by electric clocks; also the equipment of the electrical engineer's laboratory, the engine and testing-room and the electric supply for experimental purposes.—Lond. *Electrician,* July 30 and Aug. 6.

Australian Manufacturing Plant.—J. H. Davies.—An illustrated description of the works of the S. Weymouth Proprietary Company, Limited, of Melbourne. Their production includes electric generators, transformers and switchgear.—Lond. *Electrical Review,* July 20.

Pump.—An illustrated description of the Gaede high-vacuum mercury pump.—Lond. *Electrician,* Aug. 13.

Ferro-Tungsten.—J. Escard.—The first part of a serial on the preparation of ferro-tungsten.—*La Lumière Elec.,* July 10.

Electric Heaters.—A description of electric heaters in which the radiating tubes are made of fused quartz and contain pure nickel wire spiral resistors. The use of the quartz tube renders a high temperature possible.—Lond. *Elec. Eng'ing,* July 8.

BOOK REVIEWS.

La Machine á Influence. By V. Schaffers. Paris: Gauthier-Villars. 506 pages, 197 ills. Price, 10 francs.

This is a treatise on the influence machine in which the evolution of this form of electrostatic generator is given very fully. It differs from the smaller work of J. Gray, to which frequent reference is made, in being practical as well as descriptive. Beginning with Bennet's doubler, he describes in turn all the machines of importance, their defects as well as their good points; their theory as well as their history. Considerable space is devoted to the best known forms, such as the Holtz, the Voss, the Wimshurst and the Bonetti. The conditions for efficiency and auto-excitation are carefully studied, as well as the causes which bring about reversal of polarity. He takes care to say that a Wimshurst machine constructed as usual with 16 or more sectors and with brushes making good contact is practically independent of hygrometric conditions and is irreversible in polarity. The author has given considerable attention to the function of the characteristic parts of the leading types of machines and the play of electric forces in them, as is evident from the great number of experimental investigations made by him for the purpose of clearing up certain doubtful matters regarding output and theory.

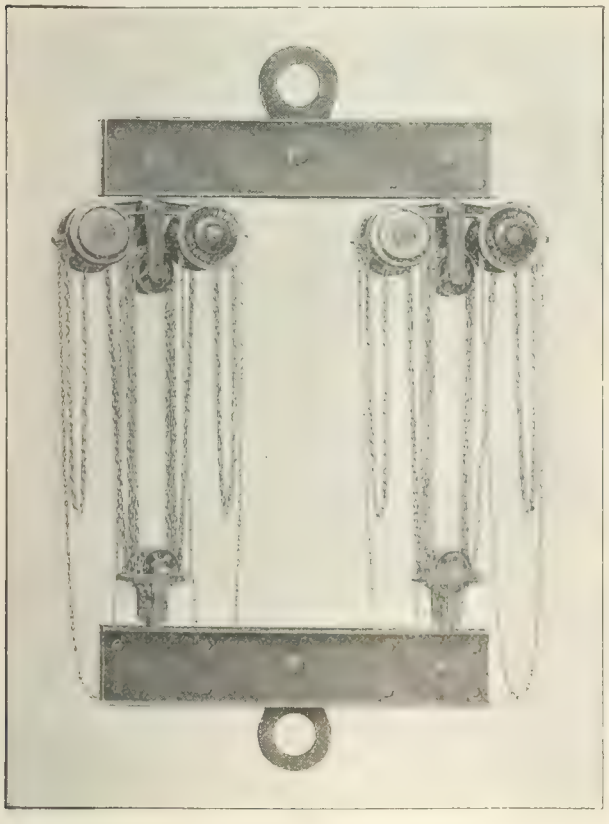
La Definition et la Mesure Industrielles de l'Acceleration des Trains. By C. O. Mailloux. Paris: Gauthier-Villars. 12 pages.

This reprint from *La Revue Electrique* of Nov. 30, 1908, gives the complete text of the original paper presented, in French, by the author, before Section V of the International Electrical Congress, at Marseilles, in September, 1908. The reprint also contains the discussion of the paper by M. Legouëz, managing director of the Paris "Metropolitan" (subway system), who was one of the vice-presidents of Section V. It also includes an editorial by M. Blondin, the well-known electrical writer and authority, for many years the editor of *L'Eclairage Electrique* and now editor of *La Revue Electrique*. A condensed and paraphrased English translation of the paper was published in the *Electric Railway Journal* of Feb. 13, 1909 (Vol. XXXIII, pp. 277-279), with an editorial comment (p. 270).

NEW APPARATUS AND APPLIANCES

Forty-Ton Triplex Chain Block.

When the ordinary mechanical man thinks of a chain block it is usually one of the smaller capacities, ranging from the one-eighth differential to the one-ton, two-ton, or maybe five-ton blocks of higher efficiency. Even engineers, who should be



FORTY-TON TRIPLEX CHAIN BLOCK.

hoisting experts, but who are not directly in touch with the latest practice in the use of hand hoists, are apt to think of chain blocks above 10 tons as something unusual, to be tried only when no other means of handling heavy loads can possibly be made available. In point of fact, the larger sizes of chain blocks are just as available under certain circumstances as the differential is for light loads. The Yale & Towne Manufacturing Company has regularly for years made its triplex chain blocks up to 20 tons capacity, and the 40-ton triplex illustrated herewith has recently been developed to meet the demands of engineers for a dependable hand hoist to handle very heavy loads where the installation of an electric crane or powerful steam hoist, because of time or cost, would be out of the question.

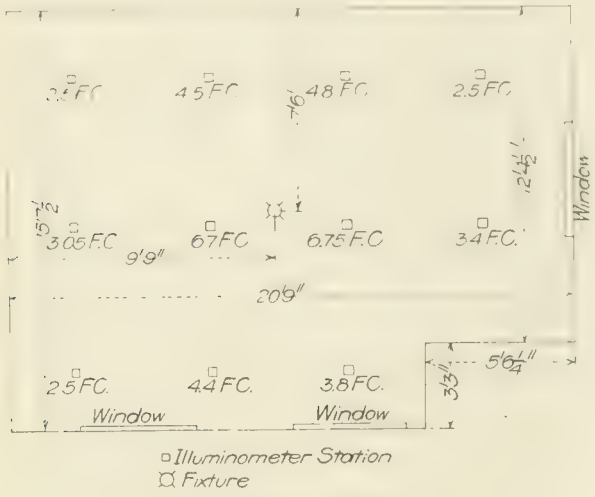
The 40-ton triplex is composed of two 20-ton units with equalizing bars at the top and bottom. This provides for single-point suspension and for a single point for attachment of load. The equalizing bars are made of two channels placed back to back with separators. Provision is made for the swiveling of each unit at top and bottom. The clevises or points of attachment enable the user easily to put the hoist in place wherever used, and also afford a convenient point for the attachment of the load.

It will find its fields of usefulness in manufacturing plants, and generally for loading and unloading. It may be installed over railroad tracks on a properly guyed temporary or permanent trestle. Lateral motion may be secured by one or more trolleys running on a large I-beam. It is available for handling heavy weights, etc., where headroom, cost, infrequency of lift or other conditions do not permit the use of power cranes of sufficient capacity. The hand chains are arranged to permit two, four or eight men to work effectively. Where the load is larger than 40 tons, it is generally of sufficient size to permit two of these hoists to be worked together, giving a capacity of 80 tons.

Test of Indirect Lighting of a Small Office.

A measurement was recently made of the illumination obtained in a small office-room in Philadelphia employing indirect lighting using the system in which all the light is first directed to the ceiling by a reflector placed under the lamp. The illumination of the room is accomplished by reflection from a light-colored ceiling. The test was made with a Sharp-Miller photometer under the direction of Mr. R. B. Ely. A plan of the office-room in which these tests were made is shown on page 628. This office was 9 ft. 9½ in. high with light buff ceiling and walls. The floor had a dark green carpet and the window shades were dark brown. The woodwork was golden oak. Four 100-watt frosted-bowl tungsten lamps were used, under each of which was placed a No. E-100 "I-Comfort" reflector,

made by the National X-Ray Reflector Company, of Chicago. The fixture was located in the center of the room, as indicated below. The lamps were 27½ in. from the ceiling. Lamps and reflectors were clean. Readings to obtain the illumination in foot-candles were taken at 11 stations located as



PLAN OF ROOM TESTED.

indicated by the squares above. The plane of illumination in which the test was made was 34 in. above the floor. The illumination in foot-candles obtained at each test station is marked at each station. The room was 308 sq. ft. in area and 400 watts were used, the watts per square foot thus being 1.3. The average illumination was 3.99 foot-candles, the maximum being 6.75 and the minimum 2.4. The watts per lumen (watts per square foot per foot-candle) were 0.325 and the lumens per watt 3.07. In connection with this test Mr. Ely notes that the installation was made by the use of adaptable units on existing fixtures, and that the efficiency of the installation could be increased by shortening the fixture so as to bring the lamp to within 18 in. of the ceiling.

A Folding Chandelier.

Mr. L. V. Hornbeck, New York Life Building, Minneapolis, Minn., is the designer and inventor of a folding chandelier which is shown in the accompanying engravings. One of these chandeliers complete and ready for use is shown in Fig. 1;



FIG. 1.—COMPLETE CHANDELIER.

is folded up in shape for packing and shipment in Fig. 3; and unassembled in Fig. 2. Fig. 4 shows the details of construction. Upon removing the ornamental knob at the bottom, the lower canopy is removed and the arms can be inserted or taken out. The arms are held in place by the set screws and by the upper part of the canopy and also by the head or center casting. The removal of the lower half of the canopy does not allow the chandelier to fall to pieces, but simply makes it accessible for the insertion or removal of the arms and wiring. This fixture is wired, connected and assembled in the factory, and when



FIGS. 2 AND 3.—FOLDING CHANDELIER.

ready to pack the set screw is loosened and the arms are folded alongside the stem, as in Fig. 3. The fixture can be

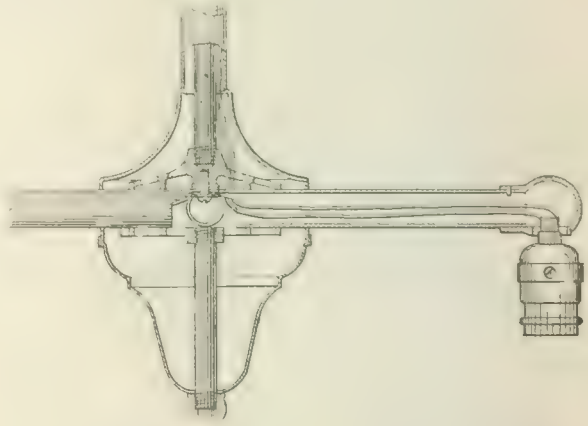


FIG. 4.—WIRING DIAGRAM OF FOLDING CHANDELIER.

packed in a box 6 in. x 6 in. x 18 in., or whatever length the fixture happens to be. It is claimed that it can be unpacked and the arms inserted ready to hang in five minutes' time.

Electric Automobile for Royalty.

The Baker Motor Vehicle Company, of Cleveland, has just completed a luxurious electric automobile for the King of Siam.

The chassis and body of the automobile are standard. The body and running gear are finished in ivory. The top is made of a special leather enameled in white. The dash and fender are of white patent leather.

The upholstering is in a delicate green broadcloth, the royal color of Siam, with silver-gray Persian broad lace tapestry, puff rolls and silver-gray silk cord. All metal parts are silver plated and equipped with special silver electric lamps and meter case. The lever handles are of pearl. The hood has beveled-glass windows at each side and in the rear. The side panels and front of the hood are emblazoned with the royal crest of the King of Siam. In order that Clevelanders might see and appreciate the richness and elegance of the car, it was put on exhibition at the corner of Euclid and Huron Road from Aug. 9 to Aug. 14.

Magnetic Fault-Finder for Lead-Covered Cables.

An apparatus has recently been put on the market by Middleton Brothers, Monadnock Block, Chicago, of considerable interest to electric-light and power companies using underground or aerial, lead-covered cables. It is a device for locating faults in cables magnetically, from the induction of a sharply irregular alternating current sent over the faulty wire and returning over the lead sheath or an adjacent wire.

The magnetic fault-finder for power cables consists of an electrolytic or mechanical interrupter, with a four-winding

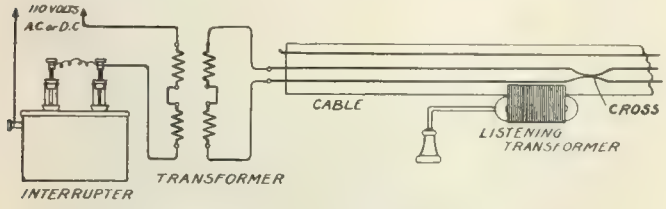
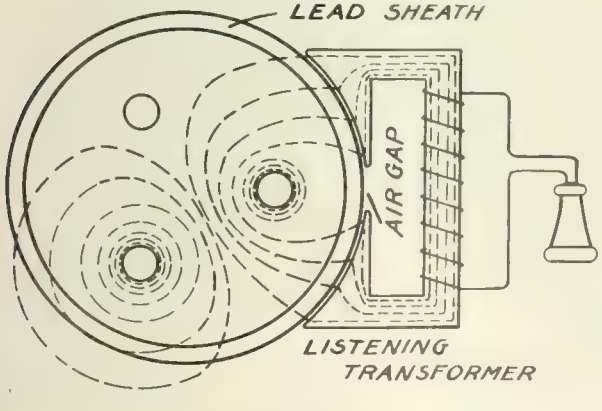


FIG. 1.—DIAGRAM OF CONNECTIONS.

transformer. These are stationed at the cable terminal and connected to 110-volt alternating or direct-current mains. With a listening transformer in series, a man with a receiver at each ear investigates the sound of the current in the faulty wire at various points along the cable (see Fig. 1), and the fault will be found where the sound ceases. The fault can often be located within 2 in. or 3 in. As the method does not depend upon the resistance of the conductor, the cases that do not lend themselves to a bridge measurement can thus be located inductively.

The success of the method depends on a sharp alternating wave, a sine wave not being sufficiently noisy in a receiver. Again, the testing current must be radically different from any regular wave such as 25 cycle or 60 cycle. An electroytic interrupter lends itself well to the production of a current that is easily distinguished. If two interrupters of the Caldwell type are connected in multiple with a large aperture in one, and a small one in the other, the action of the large hole predominates until the electrolyte rises to a certain height, when the smaller tube assumes control while the electrolyte runs out. The result is an intermittently interchanged high- and low-frequency current which is very distinctive.

The important thing in the design of the transformer is that it will receive all possible influence from the faulty wire without gathering in the neutralizing lines of force from the return circuit. In case of a ground, this is simple enough, but in



CONSTRUCTION.

FIG. 2.—DIAGRAM SHOWING PRINCIPLE OF TRANSFORMER

case of the current wholly returning over an adjacent conductor the distinction becomes important. Fig. 2 shows the principle on which the laminated transformer core is made. The broken lines indicate the influence on the receiver. The reluctance of the air-gap is much greater than the path through the coil, even if the tips of the core are much closer together than shown.

Should the lay of the cable become 6 ft., and it is impossible to get at the cable except on one side, there will be quiet nodes every 3 ft. and first one phase will predominate, then the other phase.

It is not necessary to remove the tiling from high-tension cables in the manholes, as the ear picks up the sound distinctly 8 in. or more away. When all the current returns on the sheath, the centers of the circles of force are at different distances from the air-gap of the listening transformer, and therefore one predominates over the other.

Breakdowns are often so severe that the conductors are

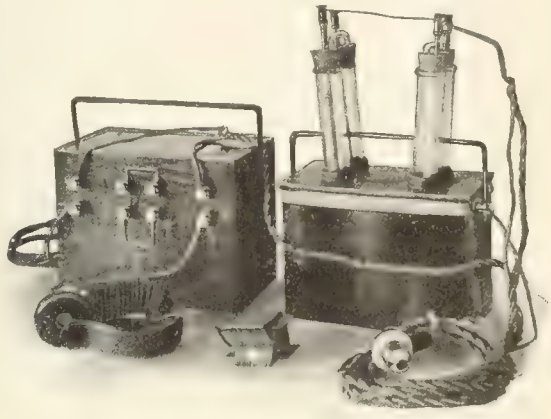


FIG. 3.—CABLE FAULT FINDER COMPLETE.

burned completely in two, or are badly damaged. A loop test then becomes impossible, or very uncertain. If one of the conductors can be broken down to ground, or crossed with one of the other phases sufficiently to get a few amperes through the fault with a safe voltage, the fault can be quickly located with the listening transformer. This transformer may be called a magnetic trap that is focused, in a way, on the faulty wire. The transformer is in series with the double receiver and is wound accordingly.

A 10-ft. flexible copper cord allows the listener to remain outside the manhole while the transformer is applied to the cable. The loudness of noise in the receiver depends upon the strength of current in the faulty wire; therefore, the interrupter transformer at the cable terminal is made with two windings on each primary and secondary. Thus a large current may be sent out on large and small conductors, on long and short cables.

The electrolytic interrupter is in duplicate and the cable can be instantly switched, so that the testing current will be continuous. A mechanical interrupter may be substituted for the electrolytic one and telegraph signals sent out over the cable. This fault-finder, which has been successfully employed in electric-light cable testing in Chicago for several months, may also be employed for locating faults on telephone, telegraph and signal cables.

New Factory of Moore Electrical Company.

The Moore Electrical Company has recently purchased a factory at 167-171 Malvern Street, Newark, N. J., consisting of a brick building 42 ft. x 100 ft., of mill construction and three stories in height, with 16,000 sq. ft. of floor space, and cement basement. The building is well lighted on all sides and has skylights over the third floor. The plant, which is equipped with boiler-room, engine, and freight elevator, is modern throughout. This space will provide proper manufacturing facilities for the constantly growing business of the Moore lamp. The first floor is used for the glass department and shipping. The machine shop and offices are located on the second floor, and the engineering department is on the third floor.

Reid Lightning Arrester.

A company has been formed in Colorado Springs., Col., with C. T. Fertig as president; O. E. Collins, vice-president; A. Elliott Hart, treasurer; C. B. Garnett, secretary, and Andrew Reid, general manager, which will undertake the manufacture of a new form of lightning arrester recently invented by Mr. Reid. The device is intended for pole line or station use and its field is restricted to the lower voltages.

The arrangement in this arrester differs from that of the types at present in use on the market, in two principal respects. The principal departure from existing forms is that practically no resistance is offered to the passage of the discharge during the ordinary periods of such discharges. It con-

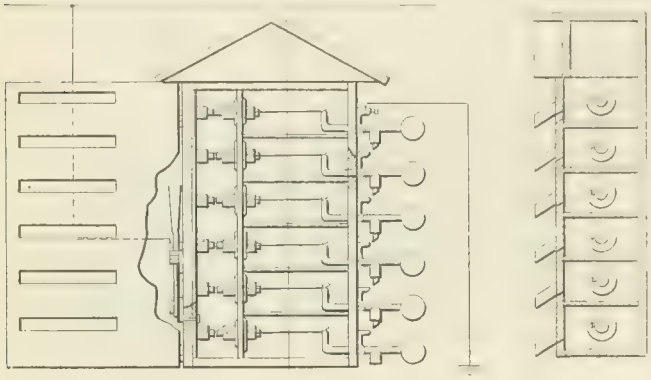


FIG. 1.—DIAGRAM OF LIGHTNING ARRESTER CONNECTIONS.

sists, as shown by the accompanying illustrations, of a wood box with asbestos wood compartments, usually seven in number, all covered with one door. The large compartment at the left facing the box is arranged with a number of carbon gaps, which are spaced by 20 mills, each one of these gaps being in series with a fuse, with each fuse wired in a separate compartment and joined to separate lever arms, the upper lever arm being in direct connection with the ground wire. The

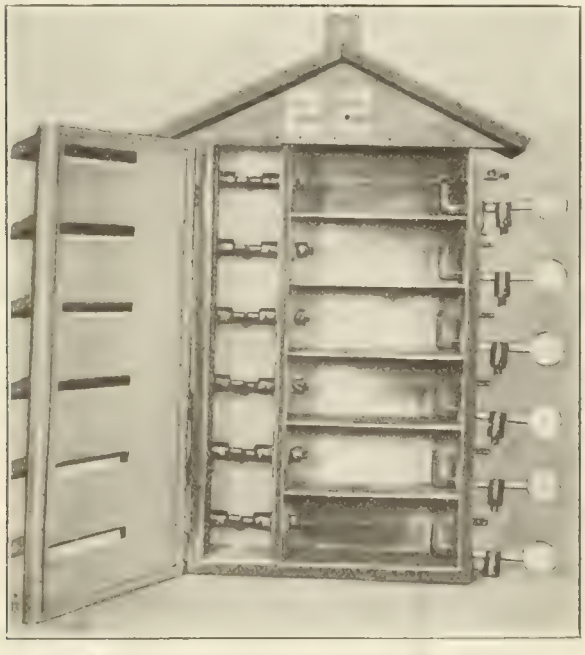


FIG. 2.—VIEW OF INTERIOR OF LIGHTNING ARRESTER.

line to be protected is connected through a disconnecting switch at the side of the box to one side of all the carbon gaps, and as discharges take place they successively blow the fuses from the top downward. As each fuse blows its lever arm drops and makes contact through a carbon point (to prevent "freezing") with a lug connected with the lever arm below, thus making the ground for the next protecting gap and fuse.

The size of compartments and length and size of fuse wire have been developed by very thorough experiments, and it is claimed that the device will give protection where other types of arresters had failed.

Some hundreds of these arresters have been installed during this season on the trolley and trolley feeders of the Colorado Springs & Interurban Railway Company, and in spite of the fact that the season has been the most severe electrically for many years, no car armatures have been lost or station machinery injured by lightning entering over wires protected by these arresters. This is an exceptionally good record, as during last year, a comparatively mild year for this district, the Colorado Springs & Interurban Railway had some 20 armatures burned out by lightning, although the lines were very heavily equipped with the standard types of arresters.

The lever arms form a sort of semaphore, and by dropping serve to indicate the number of discharges which have been taken care of and indicate the readiness of the arresters to care for other discharges. The arrester offers an absolutely

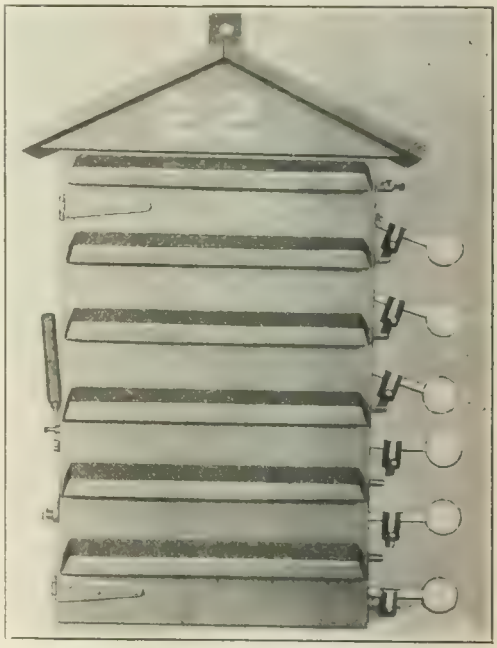


FIG. 3.—LIGHTNING ARRESTER CLOSED, SHOWING POSITION OF SEMAPHORES.

straight path without resistance for discharges, and it is claimed that many discharges which would before cause severe bucking, are now taken care of so easily as to be unnoticeable on the cars, although possibly dropping two or three of the semaphore arms in an arrester immediately above the car. The maximum number so far noted as dropping with any one discharge is two arms, and the present arrangement includes only six fuses, although this number could be increased.

The Rocky Mountain region is usually considered to be exceptionally severe in electrical storms, and it is difficult to secure adequate arrester protection. In other cities of this region it is an ordinary practice to stop cars, either individually, when near the center of an electrical storm, or frequently the entire power system, from half to three-quarters of an hour during the most severe electrical storms, in order to protect apparatus, and even then the losses are frequently severe.

Colorado Springs, with the protection afforded by this arrester, has no difficulty in maintaining its service at all times during storms, and it is expected that this will mean the extension of the use of this arrester throughout this district. In practice the operation of the arrester is easy, and the destruction of the carbon gaps very slow. The re-fusing is quickly and readily done with safety to the linemen by the pulling of the line switch, even if some other portion of the line is experiencing a storm. The size of the arrester, which may be somewhat modified later, is not objectionable, the largest dimensions being about 30 in. The regular manufacture of this device is expected to begin at once.

Industrial and Commercial News

Financial Intelligence.

THE WEEK IN TRADE.

As the fall season advances there is more and more evidence that trade is rapidly nearing normal conditions. During the past week the business of the wholesalers and jobbers has expanded in a marked degree and buyers have been in all the central markets in great numbers. This activity is especially noted in dry goods and textile lines and in millinery. It must be remarked, however, that while buyers have taken hold quite freely, there is much greater conservatism than was in evidence in the flush days of 1906. There is practically no disposition to overload or to be reckless in the purchase of expensive wares. This is especially noticeable in the case of purchasers from the South, where the shortness of the cotton crop is admitted, and from the West where the corn crop will fall considerably below the earlier expectations. In the industrial world only the most encouraging reports are made. Employment is more general, payrolls are larger, and a number of employers have made wage advances. Building operations continue to be active, sustaining the demand for structural iron, and there was during the past week quite a considerable tonnage of steel rails ordered. In this latter particular several large orders are known to be pending. Railway equipment purchases have been fairly liberal and the demand for steel cars has forced advances in sheets. Collections are much improved. Failures for the week ended Sept. 2, as reported by *Bradstreet's*, were 166, against 201 for the same week last year, 210 in 1908, 130 in 1907, 121 in 1906 and 137 in 1905.

THE COPPER MARKET.

There was only fair activity in the copper market last week, although there was considerable evidence that domestic consumption was improving. The producers assert that domestic takings during August will amount to 60,000,000 lb. and that imports will be about 51,000,000 lb. Taking the production for the month to be about 118,000,000 lb. the same as during July—the months being of equal length—and there remains an apparent increase in stocks in this country of 7,000,000 lb. In the meantime the foreign statistics show that the visible supply of copper abroad increased during the month of August about 26,000,000 lb. and now amounts to approximately 200,000,000 lb. These figures are not encouraging. They mean that at home and abroad there is now in sight for sale more than 325,000,000 lb. The stocks that are not in sight are believed to be very heavy, for it is admitted that during July and August consumers bought far in excess of their actual requirements. From all of which it appears that without producing another pound there is enough copper on hand to last the world for five months. One of the features of the past week was the heavy reselling by speculators. These, it is said, were in many cases made at concessions, and were generally attributed to increased difficulty in financing long holdings. Final exports for the month of August were 22,839 tons, the smallest amount since March. The daily call in the Metal Exchange, at 12:30 o'clock, Sept. 3, quoted standard copper as follows:

	Bid.	Asked.	Settling price.
Spot	12.40	12.70	.....
September	12.40	12.70	12.55
October	12.40	12.70	12.55
November	12.50	12.75	12.62½
December	12.60	12.85	12.72½

The London prices Sept. 3 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	59 2 6	59 2 6
Standard copper, futures	60 0 0	60 1 3
Market	Easy.	Quiet.
Sales of spot		400 tons
Sales of futures		600 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.00	12.62½
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6

BATTLES & COMPANY.—Announcement is made that a joint partnership has been formed under the name of Battles & Company to transact a banking, investment and brokerage business at 60 Broadway, New York, and 131 South Fifth Street, Philadelphia. The new firm will take over the business heretofore conducted by Battles, Heye & Harrison, and will be comprised of all of the members of that firm, with the addition of Pahud F. Thompson.

CHICAGO SUBWAY RUMORS.—The report that there is about to be a reorganization of the Chicago Subway Company is positively denied by interests heavily loaded up with the stock. Armour interests, which control the company, declare that the recent break in the price of the stock makes no difference in the value of the property and, that as they own their shares outright and do not want to sell, they are not interested in the market fluctuations.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY.—The report of the Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., for the year ended June 30, 1909, shows net earnings, after deducting $40,658 for repairs and maintenance, of $144,688. During the year the liabilities of the company were reduced $566,467, which was mainly accomplished through the collection of accounts and the conversion of investments. The surplus at the end of the year, after paying fixed charges and allowing $61,860 for depreciation, amounted to $28,028. The company's total surplus now is $136,898.

JASONVILLE (IND.) ELECTRIC COMPANY.—Plans have been approved for the installation by the Jasonville Electric Company, Jasonville, Ind., at that city of a combined electric and water-works plant. The cost of the electric system will be about $30,000, and of the water works about $50,000. It is proposed to extend the lighting system as far as Hymera, Ind. The Reliance Engineering Company, of Cincinnati, has drawn the plans for the new work.

TO OPEN THE GUNNISON CANAL.—The great Gunnison Canal, the first project undertaken by the United States Government Reclamation Service, will be opened by President Taft, Sept. 13, and the flow of the Gunnison River will be turned into the main canal and associate canals. This will irrigate about 150,000 of semi-arid lands in southwestern Colorado. This work has been under way for about 4½ years, and has just been completed. The cost of the tunnel and distributing canal will be more than $5,000,000. The water, after leaving the tunnel, will have a fall of 372 ft., which will probably be used to develop electricity which will be distributed for commercial purposes.

WASHINGTON POWER COMPANY.—A reduction of about 27 per cent has been made by the Washington Power Company at Spokane, Wash., in its rates for electricity for lamps. The new schedule, which went into effect Sept. 1, is on a sliding scale. The charges are for the first 30 kw, 10 cents per kw-hour; 9 cents per kw-hour for the second 20 kw; 8 cents for the third 20 kw, and 5 cents per kw-hour for all energy consumed above 60 kw.

TO INVESTIGATE CENTRAL STATION RATES IN BUFFALO.—The Civic Conference and Chamber of Commerce Committee on Municipal Affairs, of Buffalo, have started a movement for lower rates in that city for central station service, and propose to bring the matter formally before the Public Service Commission. It is stated that many experts will be called to support at the hearing the contention for lower rates.

BUFFALO GENERAL ELECTRIC COMPANY.—The Buffalo General Electric Company has commenced building a large fireproof office building at Washington, Huron and Genesee Streets. Special provisions will be made for show rooms in which all the latest methods of display will be used. The offices of the Cataract Power & Conduit Company, at present in the Fidelity Building, will also be located in this building.

HUDSON & MANHATTAN RAILROAD TUNNEL EXTENSION.—William G. McAdoo, president of the Hudson & Manhattan Railroad Company, is authority for the statement that the extension of the Sixth Avenue line to Thirty-third Street will be completed and open ready for operation on May 1, 1910, at which time it is expected that the new department store on that corner will begin business. Work at the present time has been completed up to Twenty-seventh Street, and the station at Twenty-eighth Street will be finished before the end of the year, but the line will not be opened above Twenty-third Street until the date indicated. With regard to the extension to the Grand Central station, it is announced that the company has already secured 35 per cent of the consents of property owners out of the 50 per cent that is required, and it is expected that the others will be secured within a few months, and that work will begin upon the tube before the end of the year. The Public Service Commission will have to approve the plans before work can be begun. The company is considerably hampered at this time by the failure of the Pressed Steel Car Company, on account of the strike, to deliver the cars ordered. Of the 90 that were contracted for only 30 have been received, and the road is short of operating equipment. Within a very short time through trains will be run from Twenty-third Street through to Cortlandt Street without change of cars at Hoboken. A two-minute service is now maintained during rush hours, and a better service will be installed as soon as sufficient equipment is received. The extension of the Jersey City tunnel to Summit Avenue will be completed before very long, and connection will there be made with the Pennsylvania Railroad tracks so that there can be a service through to Newark.

STANDARD GAS & ELECTRIC POWER COMPANY.—A $600,000 corporation has been formed under the laws of Pennsylvania by Samuel S. Eveland, president of the Standard Roller-Bearing Company, for the manufacture of commercial and pleasure automobiles. The name of the new company is to be the Standard Gas & Electric Power Company. Operations have already been begun at the plant of the new company in Philadelphia. Mr. Eveland has been developing the plans for the concern for a year and a half, and says that the books of the company already contain orders for $1,375,000 worth of output. The company will manufacture 35-hp touring cars to sell at $1,800 and three-ton commercial trucks to sell at $3,500. A feature of the car will be that it will combine gas and electric motive power. It will also have an automatic gear shift operated by the pressure of a button, to do away with the present lever system. It is said that the company will also manufacture an interurban railroad car to be operated by gas. The engine in this car will be only 75 hp.

IMPROVED ALUMINUM SALES.—There has been some improvement in the aluminum business within the past few months. According to a statement made by an official of the Aluminum Company of America, the sales of the company have shown a gradual increase, and there are more inquiries for future work than at any time within recent years. There have not as yet been any very important sales of aluminum wire for transmission, but there have been many small sales, and the manufacturers are confident that this material is growing in popularity. The prices for aluminum in ingots remain about the same, 21 to 23 cents per pound, according to quantities. Although the patents under which the Aluminum Company of America manufactured expired last spring, no other concern has as yet entered the field as a competitor. The demand for aluminum domestic utensils has increased very considerably, and showrooms have been opened at 99 John Street, New York, for the exhibition of these wares.

GREAT WESTERN POWER COMPANY.—H. H. Sinclair, vice-president and general manager of the Great Western Power Company, of San Francisco, who recently took up the general management of that company, is gradually placing in effect some important changes in both its organization and business policy. William S. Cone has been appointed assistant general manager and will also act as superintendent of construction. Mr. Cone was associated with the Edison Electric Company, at Los Angeles, for the past five years and also spent about a year as general manager of the Mount Whitney Power Company. Chester Pennoyer, who has been in charge of the construction works, has tendered his resignation to resume his former position as manager for the National Conduit & Cable Company on the Coast. C. W. Hutton, of the engineering department, has been promoted to the position of superintendent of operation. The general offices of the company will be moved from San Francisco to Oakland.

DEMAND FOR PLATINUM INCREASING.—According to the statements made by one of the largest platinum importing firms in this country, the demand for this metal has very considerably increased within the past few months. "Since the general improvement in business the demand from the jewelry trade for platinum has very largely increased," said this importer, "and the demand from the electrical companies is also much heavier." Quotations have not advanced materially, and platinum is now selling at from $25 to $27 per ounce.

TUNGSTOLIER COMPANY OF CANADA.—The Tungstolier Company of Canada has been incorporated with a capital of $48,000, and has been organized with the following officers: President, E. J. Kulas; vice-president and general manager, R. B. Basham; secretary, W. H. Wissing; treasurer, C. F Koepge. Mr. Basham has been general Western manager at Chicago of the Tungstolier Company, of Cleveland, of which Mr. Kulas is president. The same financial interest controls the American and Canadian companies.

PROPOSAL FOR U. S. MARINE CORPS ELECTRICAL PLANT.—The Quartermaster, United States Marine Corps, Washington, will open bids in his office at 11 a. m. Sept. 20, for furnishing and installing complete, at the Depot of Supplies, Marine Corps, 1100 South Broad Street, Philadelphia, Pa., a horizontal side-crank engine, 15 in. x 20 in., a 100-kw, 220-volt, two-phase generator with switchboard complete. Proposals for the engine are to be submitted independently of the generator.

WESTINGHOUSE CONTRACTS FOR JAPAN.—Three 55-hp Westinghouse Machine Company gas engines have been installed by the Furawaka Coke Works, of Tokio, Japan, to operate their coal-washing plant. These engines will use as fuel the sulphur gas derived from the coke ovens. This new equipment is additional to a pair of 11 in. x 12 in., two-cylinder Westinghouse gas engines driving a 125-volt direct-current generator.

WESTERN GAS ENGINE COMPANY.—Orders have been placed with the Western Gas Engine Company of Los Angeles, Cal., for an initial engine and generator equipment of 450 hp, by the West Side Electric Company which proposed to construct a lighting plant near Maricopa, Cal. The new installation will be in operation by Oct. 15. Plans are being drawn to develop 900 hp additional in the near future.

4500-KW PLANT FOR LOUISVILLE.—C. W. Humphrey, consulting engineer, Chicago, is drawing up the plans for a 4500-kw generating plant for the Kentucky Electric Company, of Louisville, Ky. This plant will employ steam turbines, and is designed for an ultimate capacity of 10,000 kw. Bids will be invited soon. The water for condensing purposes will be taken from the Ohio River.

Financial Intelligence.

THE WEEK IN WALL STREET.

During the short week that preceded the three-day holiday there was very little business done in Wall Street. The market was fairly strong and prices advanced to a quite thorough recovery of their previous losses, but there was a lack of enthusiasm in the trading. It is not an unusual thing that traders are disinclined to carry heavy commitments over a holiday. In fact it is the regular thing. There was little to stimulate activity in the ordinary happenings of the week. The excitement over the condition of Mr. Harriman's health having subsided, the crop situation being practically settled and there being no financial disturbances, the market simply loafed along on the upward course, which the increasing commercial prosperity of the country seems to warrant. One effect of this was the sharp advance in United States Steel common. This was easily the feature of the week. On Sept. 3, the last day of trading, this issue reached 80¼, the highest point in its history. The volume of trading was fairly large and predictions were freely made that par would be reached before the end of the year. The most encouraging point about this advance is that it can hardly be catalogued as speculative. It is the natural sequence of the reports that are being made daily of the business of the "Trust." It is given out that the production of pig

iron is running now at a rate in excess of the banner year 1907. The mills are busy to their limit and prices have been advanced to a profitable basis. There is plenty of talk to be heard about an increase in the dividend on Steel common and there is no doubt that the economies of operation inaugurated by the company will be reflected in larger net earnings. Among the stocks, not heretofore particularly active, which were prominent in the trading last week, were American Telephone & Telegraph and American Smelting & Refining. Transactions in each of these issues were large and prices advanced. Good earning reports were responsible in each case for this interest. There was a genuine desire on the part of outsiders to buy. This is one of the healthiest indications in the market. Whenever there is information that an industrial or a railroad is doing particularly well there always seems to be plenty of honest investment money ready to grab at the bargains. It has been shown for many months in the bond market and, this having been swept quite clean, investment is now turning to the better class of stocks. The money market continues to be easy and there is no trouble for investors and the better class of speculators to carry any purchases they make. Quotations Sept. 3 were: call 2¼ @ 2½ per cent, 90 days 3¼ @ 3½ per cent. The quotations in the table are those of the close Sept. 3.

NEW YORK.

	Aug. 30.	Sept. 3.	Shares sold.		Aug. 30.	Sept. 3.	Shares sold.
All.-Ch.	15½	15¼	2,300	Int.-Met., pfd..	40¼	46½	5,925
All.-Ch., pfd..	53½	53	1,400	Mackay Cos....	84⅜	84	700
Amal. Cop....	84¼	84	84,100	Mackay Cos.,p.	75	75⅛	840
Am. D. T....	20½*	20½*	——	Man. Elev....	143*	143*	——
Am. Loc.....	60	59⅜	14,600	Met. St. Ry...	23*	23*	——
Am. Loc., pfd.	116	115	1,010	N.Y. & N.J.Tel	139¼*	139¼*	——
Am. Tel. & Cbl.	76*	76*	——	Steel, com....	77¾	80⅛	672,365
Am. T. & T...	140⅛	141⅞	27,720	Steel, pfd.....	125½	127¼	19,000
B. R. T.....	79½	79	13,070	W. U. T.....	74½	75¼	4,500
Gen. Elec.....	168⅜	166½	3,500	West'h, com...	86	86	3,420
Int.-Met., com.	14⅜	14⅛	2,900	West'h, pfd. .	125*	130	100

PHILADELPHIA.

	Aug. 30.	Sept. 3.	Shares sold.		Aug. 30.	Sept. 3.	Shares sold.
Am. Rys.....	46¾*	46*	——	Phila. Elec....	12⅛	12⅛	——
Elec. Co. of A.	12⅛	12¼	——	Phila. R. T....	30⅛	30¼	——
Elec. St. B'ty..	61	63¼	——	Phila. Trac....	90½*	91*	——
E. S. B'ty.pfd.	49*	30*	——	Union Trac...	54¼	53¼	——

CHICAGO.

	Aug. 30.	Sept. 3.	Shares sold.		Aug. 30.	Sept. 3.	Shares sold.
Chi. City Ry..	180*	180*	——	Chi. Tel. Co..	135⅛	136	——
Chi. Rs.,Ser.1.	110*	110*	——	Met. El., com.	17¼*	17¼*	——
Chi. Rs.,Ser.2.	37¾*	37½*	——	Met. El., pfd..	49*	49*	——
Com. Edison...	121	120½*	——	Nat'l Carbon...	95*	95*	——
Chi. Sub'ws...	20½	18⅝	——	Nat'l C., pfd..	120*	120*	——

BOSTON.

	Aug. 30.	Sept. 3.	Shares sold.		Aug. 30.	Sept. 3.	Shares sold.
Am. T. & T...	139⅞	141⅞	——	Mex. Tel.....	2¼	2¼*	——
Cum. Tel.....	144	144*	——	Mex. Tel., pfd.	6*	6*	——
Edison E. Ill..	254	256	——	N. E. Tel....	130*	136	——
Gen. Elec.....	167½	167½	——	W. T. & T....	11	12½*	——
Mass. E. Ry..	15*	17	——	W. T. & T., p.	89*	89*	——
Mass. E. R., p.	74½*	77	——				

*Last price quoted.
Shares sold are for week Aug. 30 to Sept. 3.

DIVIDENDS.

American Smelting & Refining Company, preferred, quarterly, 1¾ per cent, payable Oct. 5; common, quarterly, 1 per cent, payable Act. 15.

Chicago Telephone Company, quarterly, 2 per cent, payable Sept. 30.

Interborough Rapid Transit Company, quarterly, 2¼ per cent, payable Oct. 1.

North American Company, quarterly, 1¾ per cent, payable Oct. 1.

Oklahoma Gas & Electric Company, quarterly, common, 1¼ per cent, payable Sept. 15.

Philadelphia Traction Company, semi-annual, 2 per cent, payable Sept. 8.

Railways Company General, initial, 10 per cent, payable Sept. 15.

San Diego Consolidated Gas & Electric Company, common, quarterly, 1¼ per cent, payable Sept. 15.

CUMBERLAND TELEPHONE & TELEGRAPH COMPANY.—The earnings of the Cumberland Telephone & Telegraph Company for the month of July continue to show an increase. The gross earnings for that period were $536,985, an increase of $32,621 over the corresponding month last year. The net earnings were $193,166, an increase of $16,385 over the same month last year. The growth of this company has been something enormous since its beginning in 1894. At that time the capital stock was $1,695,700, and the net earnings for the year were $137,212; in 1908 the capital stock was $19,680,150, and the net earnings were $1,993,607. The rate of dividend has increased in that time from 4 per cent to 8 per cent. On July 1, 1909, the company had 201,422 subscribers. Extensive improvements are being contemplated in the Memphis territory, which include part of Western Tennessee, Northern Mississippi and Southwestern Kentucky. Part of the line between Memphis and Jackson, Miss., is to be built; a new line is to be erected in Mississippi btween Winona and Starkville, a distance of about 75 miles, and a new line will be built from Union City, Tenn., to Jordan, Ky. The cost of the entire improvements is estimated to be about $100,000.

BURBANK POWER & WATER COMPANY.—The property and holdings of the Pasco Power & Water Company, of Pasco, Wash., have been transferred to a group of Seattle capitalists, who have organized a new company under the name of the Burbank Power & Water Company. The properties transferred include valuable water rights on the Snake River at Five Mile Rapids, four miles above Pasco, and several thousand acres of land on the Columbia River in the fruit belt. They also include a water-power plant, irrigation system and townsite at Burbank in Walla Walla County. James D. Hoge is president of the new company. An issue of $500,000 in bonds will be made.

ALBANY & HUDSON RAILROAD REORGANIZATION.—The plans for reorganizing the Albany & Hudson Railroad Company, proposed by the committee representing a large number of the stockholders and bondholders, have been approved by the Public Service Commission of the Second District of New York. These plans were detailed in our issue of Aug. 12, and contemplate the formation of a new company, the stock of which will be given for the outstanding stock and bonds, and for a new bond issue of $1,500,000. The commission announces that it will subsequently take testimony as to the amount of new securities that should be issued.

GENEVA & AUBURN (N. Y.) RAILWAY BONDS.—The Public Service Commission of the Second District of New York has authorized the Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Company to execute a mortgage to the West End Trust Company of Philadelphia, under the corporate name of the Geneva & Auburn Railway. The corporation is authorized to issue at once $500,000 30-year, 5 per cent bonds to be sold at not less than 90. Of this amount $400,000 is to be used to discharge outstanding bonds and the balance for extensions and new equipment.

MINNESOTA LIGHTING COMBINATION.—The Washington County Light & Power Company, of Stillwater, Minn., has taken over the gas and electric light properties of the Apple River Power Company and the Western Gas & Improvement Company at Riverdale and Somerset, Wis. It is said that improvements are contemplated which will involve the expenditure of $210,000.

DEER RIVER POWER COMPANY.—The Public Service Commission of the Second District of New York has authorized the Deer River Power Company, of Copenhagen, N. Y., to exercise its franchises in that city, and to issue capital stock amounting to $25,000, the proceeds of which are to be used to pay the cost of organization, and in the purchase of water rights at High Falls, on Deer River.

ELMIRA WATER, LIGHT & RAILROAD COMPANY.—The proposed issue of $196,000 5 per cent bonds by the Elmira Water, Light & Railroad Company has been approved by the Public Service Commission of the Second District. The bonds cannot be sold for less than 85 and all but about $60,000 of the proceeds are to be used for extensions and betterments.

BUFFALO RAPIDS POWER COMPANY.—Articles of incorporation have been filed in Montana for the incorporation of the Buffalo Rapids Power Company with a capital of $300,000 to use the water of the Yellowstone River for a hydro-electric plant and for irrigation purposes. A dam will be built in the Yellowstone which will cost $250,000.

CALERA (ALA.) WATER & LIGHTING COMPANY.—A new company will soon be organized in Alabama called the Calera Water & Lighting Company, which will build an ice-making plant and water-works system. It is capitalized at $25,000.

MICHIGAN POWER INCORPORATIONS.—In connection with the many new power companies recently incorporated in the State of Michigan, reference to which was made in our last issue, the following list of companies, with their capitalization, has been received: The incorporators of the majority of these companies are E. F. and H. K. Loud, of Au Sable, Mich., who have long been known to control the power situation on the Au Sable River. In connection with them are the Hodenpyl, Walbridge & Company interests, of New York, and the E. W. Clark & Company interests, of Philadelphia. In addition to the four companies mentioned last week, these have been incorporated: Cooke Hydro-Electric Generating Company, Detroit, $100,000; Five Channels Hydro-Electric Generating Company, Detroit, $50,000; Loud Hydro-Electric Generating Company, Detroit, $100,000; Lewis Hydro-Electric Generating Company, Detroit, $100,000; Rock Hydro-Electric Generating Company, Detroit, $50,000; Au Sable Electric Generating Company, Detroit, $500,000; Wells Hydro-Electric Generating Company, Detroit, $100,000; Bamfield Electric Generating Company, Detroit, $50,000; Mansfield Hydro-Electric Generating Company, Detroit, $100,000; Rogers Hydro-Electric Generating Company, Detroit, $100,000; Baker Hydro-Electric Generating Company, Detroit, $50,000; Mio Hydro-Electric Generating Company, Detroit, $100,000; State Road Hydro-Electric Generating Company, Detroit, $100,000. The new companies will have plants in Oakland, Gennessee, Arenal, Iosco, Bay, Osceola, Alcona and Eaton counties. By Michigan capitalists not associated with the interests incorporating the above companies, the following articles were filed Aug. 31: Little Muskegon Water Power Company, capital $125,000; Montcalm Electrical Company, $75,000; Western Hydro-Electrical Company, $500,000, all of Grand Rapids, with Bruce Goodfellow, of Detroit, as trustee, holding the larger share of the stock. Associated with him are Orrin T. Bolt, of Muskegon, and Jay Reach and Robert T. Hughes, of Grand Rapids. A number of land and lumber companies were also incorporated before the end of August. The explanation of this rush of incorporations in Michigan is the fact that a new law went into effect Sept. 1 making it necessary for all corporations doing any sort of public-utility business to obtain the permission of the Railroad Commission before making any increase or change in capitalization. It is said that a combined attack by the power companies of the State will be made on the new law.

BOND ISSUE ENJOINED.—A temporary injunction has been issued by the United States Court of Montgomery, Ala., restraining the Citizens' Light & Power Company of that city from selling $500,000 worth of new bonds, for which a mortgage was recently recorded. The action which resulted in this injunction was brought by Daniel A. Cullinan, a stockholder. The main allegation in the suit is that the company, as originally incoporated, had only $50,000 of capital stock, and that under a law existing at that time corporations were prohibited from issuing bonds in excess of their capital. Another suit is pending against the same company in the Montgomery courts which involves an action brought by C. E. White, another stockholder, who asks to have the charter of the company declared void. In this suit it is alleged that a fictitious increase in the capital stock of the Citizens' Light, Heat & Power Company, the predecessor of the present company, had been made.

METROPOLITAN SECURITIES COMPANY.—The United States Court, New York City, has appointed Sidney Smith, a lawyer, as receiver for the Metropolitan Securities Company. This action was taken as a supplementary proceeding to the execution of a judgment for $5,271,582 obtained last February in the United States Court by William W. Ladd, receiver for the New York City Railway Company. This judgment was confirmed by the United States Supreme Court, and last week the United States Marshal of the New York District filed a report in court that he had been unable to discover any property belonging to the Metropolitan Securities Company on which to levy in order to satisfy the judgment. It was subsequent to this report that the receiver was appointed.

MARTIN MALONEY PURCHASES ROCK HILL (S. C.) PLANT.—Martin Maloney, of Philadelphia, purchased at receivers' sale Aug. 31, the entire property and franchise of the Rock Hill Water, Light & Power Company. The price paid was $80,000, which is $20,000 less than the liabilities of the company. The property will be brought up to date by the new owner.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Aurora, Elgin & Chicago Railroad Company:					
July, 1909	$167,614	$77,895	$89,719	$28,899	$60,820
July, 1908	148,748	72,208	76,540	27,778	48,762
Cape Breton Electric Company:					
June, 1909	18,569	12,208	6,361	4,071	2,289
June, 1908	19,959	11,504	8,394	4,046	4,348
East St. Louis & Suburban Railway Company:					
July, 1909	170,250	92,371	77,878	.....	.....
July, 1908	165,450	87,622	77,828	.....	.....
Edison Electric Illuminating Company of Brockton:					
June, 1909	18,201	10,243	7,958	2,897	5,060
June, 1908	14,833	8,145	6,688	2,390	4,297
Electric Light & Power Company of Abington and Rockland.					
June, 1909	4,458	3,023	1,434	375	1,059
June, 1908	4,315	2,525	1,790	354	1,435
Fonda, Johnstown & Gloversville Railroad Company:					
Quarter ended June 30, 1909	211,396	92,187	119,208	93,444	25,263
Quarter ended June 30, 1908	191,947	89,775	102,172	93,970	10,125
Galveston-Houston Electric Company:					
June, 1909	105,802	57,805	47,996	18,669	29,327
June, 1908	92,442	53,235	39,206	18,400	20,806
Houghton County (Mich.) Electric Light Company:					
June, 1909	17,055	9,094	7,634	3,504	4,130
June, 1908	15,994	9,457	6,202	3,202	2,965
Lowell (Mass.) Electric Light Corporation:					
June, 1909	25,694	16,014	9,679	3,555	6,123
June, 1908	25,494	16,125	9,369	4,006	5,362
Milwaukee Electric Railway & Light Company:					
July, 1909	361,014	169,017	192,897	106,012	86,884
July, 1908	336,888	160,883	176,005	99,989	76,016
Minneapolis General Electric Company:					
June, 1909	82,416	37,855	44,561	29,546	15,014
June, 1908	70,760	31,837	38,928	31,507	7,420
Northern Texas Electric Company:					
June, 1909	103,307	57,027	46,280	17,189	29,090
June, 1908	90,549	66,051	24,498	19,190	5,308
Ogdensburg Street Railway Company:					
Quarter ended June 30, 1909	9,787	5,564	4,222	3,795	426
Quarter ended June 30, 1908	8,821	6,982	1,839	3,468	*1,628
Plattsburg Traction Company:					
Quarter ended June 30, 1909	6,030	4,009	2,020	1,802	218
Quarter ended June 30, 1908	5,575	3,722	1,852	2,086	*233
Rochester Railway Company:					
Quarter ended June 30, 1909	536,200	338,486	197,714	123,573	84,956
Quarter ended June 30, 1908	597,216	404,589	192,627	126,209	67,452
Twin City Rapid Transit Company:					
July, 1909	733,794	277,571	362,523	140,251	222,272
July, 1908	606,373	278,138	328,235	128,361	199,874
Westchester Electric Railroad Company:					
Quarter ended June 30, 1909	107,843	99,535	8,308	11,371	*2,864
Quarter ended June 30, 1908	97,747	104,102	*6,355	9,819	*16,037
Whatcom County (Wash.) Railway & Light Company:					
June, 1909	21,005	18,030	12,565	8,085	4,480
June, 1908	[illegible]28	16,861	9,266	7,969	1,297

*Deficit.

GENERAL NEWS

Construction News.

CALERA, ALA.—Plans are being made to organize a company under the name of the Calera Water & Lighting Company to build lighting and ice plants and waterworks system. The company will be capitalized at $25,000. The Rossland Development Company, 211 Woodward Building, Birmingham, Ala., is interested in the project.

PHOENIX, ARIZ.—Preparations are being made by the Arizona Verde Copper & Gold Mining Company to commence extensive developments in the Black Hills district on the Emma Gray group. A complete electrical equipment will be installed.

PHOENIX, ARIZ.—H. P. DeMund, W. D. Fulwiler and Elliot Evans are reported to be interested in the project to construct a belt electric railway to connect with the new extension of the Indian school car line of the Phoenix Railway, and also a loop of 12 miles to end at Six Points and connect with the Grand Avenue line.

GURDON, ARK.—The Ohio Stave & Lumber Company, it is reported, is contemplating the installation of an electric light plant.

CHICO, CAL.—Investigations are being made by the Pacific Gas & Electric Company, with a view of locating sites for new plants on Mill Creek, in Tehama County, in this vicinity.

COLMA, CAL.—An election will soon be held to vote on the proposition to form a lighting district and for installing and maintaining a street lighting system in Colma.

MARICOPA, CAL.—Plans are being made by the West Side Electric Company for the construction of an electric light plant to supply electricity for the field. It is said that the main plant will be located on the lease of the Sunset Rex Company, near Maricopa, and the initial equipment will have a rating of 450 hp. Orders have already been placed with the Western Gas Engine Company for machinery. It is expected to have the plant in operation by Oct. 15, and to supply electricity in Maricopa at that time. The transmission lines will be extended to Midway and McKittrick as soon as possible. Contracts have also been placed for machinery to develop 900 hp in addition to the first installation. J. F. Stratton is vice-president and general manager of the company.

OAKLAND, CAL.—The directors of the Oakland & Antioch Railway Company have authorized a bonded indebtedness to raise funds with which to construct an electric railway from Oakland to Antioch by the way of Walnut Creek, Concord and Bay Point. A. W. Maltby is interested in the project.

SANTA BARBARA, CAL.—City Attorney Butcher proposes the construction of a municipal plant to generate electricity for lighting the city and operating the tunnel now being driven through Santa Ynez Mountains for a water supply, the cost being estimated at $10,000. The city attorney suggests that water now going to waste could be confined in a high-pressure pipe to feed a turbine water-wheel. There is a sentiment in town that the time is not yet ripe for the project.

SAN FRANCISCO, CAL.—Announcement has been made that the property of the Stanislaus Water Power Company has been transferred to the Sierra & San Francisco Power Company. This company will furnish electrical energy to the United Railroads of San Francisco. It is estimated that this service will make a saving of between $500,000 and $600,000 in the cost of operating the United Railroads of San Francisco.

SAN JOSE, CAL.—The Peninsular Railway Company, it is reported, will begin at once the construction of an electric railway from San Jose to Stanford University, a distance of 17 miles.

SENORA, CAL.—The La Grange Power Company is at work on considerable development work on the Tuolunine River in Stanislaus County. The new transmission line has been extended nearly to Modesto and a new substation is to be built at once. The storage capacity of the reservation is also to be increased.

DENVER, COL.—The great Gunnison Canal, the first project undertaken by the United States Government Reclamation Service, which has been under construction for four and one-half years, is completed and will be opened by President Taft, Sept. 23, turning the flow of the Gunnison River into the bore, main and distributing canals, which will irrigate 150,000 acres of semi-arid land. The cost of the tunnel and distributing canals, when completed, will be more than $5,000,000. The water after leaving the tunnel will have a fall of 372 ft., which can be utilized to generate electricity and distributed for commercial and industrial purposes.

GREELEY, COL.—The Colorado Telephone Company is planning extensive improvements to its system in Greeley and throughout Weld County, which will involve an expenditure of about $125,000. It is proposed to erect a new exchange building in Greeley and place its wires in aerial and underground cables.

RIFLE, COLO.—The transmission system of the Rifle Light, Heat & Power Company, recently organized, will have a potential of 11,000 volts from the hydro-electric plant above the city to city limits, where it will be stepped down at a substation to 2300 volts for distribution in the town.

TRINIDAD, COL.—It is understood that Frank P. Read, receiver of the Southern Colorado Power Company, with permission of the court, will soon place orders for new machinery for the new power station, which will replace the one destroyed by fire in June. The company is to be reorganized with a capital stock of $5,000,000.

WILMINGTON, DEL.—Preparations are being made by the New Castle Leather Company to build an addition to its power house, which will be equipped with a 250-kw, direct-current generator, belt-driven, to drive six 30-hp motors.

WILMINGTON, DEL.—The Street and Sewer Directors have adopted new specifications for street lighting. Bids will be received until Oct. 5, and the contract will go into effect April 1, 1910. The present contract with the Wilmington City Electric Company will expire Sept. 7, but it is expected that it will be extended until next April, when the new contract will go into effect. The incandescent lamps now in use are of 16 cp, but, under the specifications, they will be changed to 40 and 60 cp, and improved arc lamps will be used. The specifications call for at least 425 incandescent lamps and 300 arc lamps. Bids will be received for two-year and five-year terms, beginning April 1, 1910. Specifications may be obtained at the office of the department. Leslie V. Christy is secretary.

WASHINGTON, D. C.—Bids will be received by the Quartermaster, U. S. Marine Corps, Washington, D. C., until Sept. 20, 1909, for furnishing and installing complete, at the Depot of Supplies, Marine Corps, 1100 South Broad Street, Philadelphia, Pa., one horizontal side crank engine; one 100-kw, alternating-current, 220-volt, two-phase generator, with switchboard complete. Proposals to be submitted independently on generator.

WASHINGTON, D. C.—Bids will be received until Sept. 14 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Ostrich Bay, Wash., Schedule 1554—Compressed air locomotive, two electrically driven air compressors. Washington, D. C., Schedule 1605—A generating set and a set of spare parts. Charleston, S. C., Schedule 1607—A hand feed motor-driven panel raiser, a blind stile borer and mortiser. Norfolk, Va., Schedule 1609—A heavy duty gasoline engine. Bids will also be received until Sept. 21 as follows: Mare Island, Cal., Schedule 1586—A three-motor overhead traveling electric crane; Schedule 1587—A motor-driven two-plunger single-acting hydraulic pump. Puget Sound, Wash., or Brooklyn, N. Y., Schedule 1611—Electric motors and spare parts. Applications for proposals should designate the schedules desired by numbers.

MACON, GA.—A number of land owners along the line of the Central Georgia Power Company transmission route have been served with legal notices, and condemnation proceedings will be ordered where necessary, thus insuring the speedy entrance of a hydro-electric transmission line into Macon. The energy will be transmitted from Capps Shoals and Lloyd Shoals. W. Jordan Massee is president of the company.

SENOIA, GA.—At an election to be held Sept. 11, the proposition to issue $10,000 in bonds to establish an electric light plant will be submitted to the people.

PECK, IDAHO.—It is reported that D. E. Peck, owner of the Peck flour mill, is planning to install an electric plant in connection with the mill and will furnish electricity to the mines in this vicinity.

SANDPOINT, IDAHO.—The Idaho & Montana Power Company has commenced work on the construction of the transmission line from this city to Newport, which will supply electricity in Newport and all adjacent towns from Sandpoint. H. H. Bylsbey & Company, of Chicago, Ill., are owners of the plant here. Improvements to the extent of $2,000,000 are planned. R. Tappan Tannatt, of Spokane, Wash., has been retained as chief engineer of work of construction of the power plant on Priest River.

CHAMPAIGN, ILL.—The capital stock of the Illinois Traction Company has been increased from $13,000,000 to $16,000,000.

CHICAGO, ILL.—Bids will be received until Sept. 15 by the South Park Commissioners for furnishing approximately 70,000 ft. of single electric conduit, to be delivered at specified points over the South Park system. E. G. Shumway is secretary.

GALENA, ILL.—The Des Moines Bridge & Iron Company has secured the contract for the construction of a large power house for the Interstate Construction Company. Improvements are contemplated by the company which will involve an expenditure of about $150,000.

HUNTINGTON, IND.—B. F. Burke, of Marion, Ind., is reported to have petitioned the City Council for a franchise for an electric light, heat and power plant.

INDIANAPOLIS, IND.—The proposed lighting of the Central business streets of this city by the Peacock-Wooley Light Company, of Chicago, in exchange for the advertising privileges on the lamps, is about to be held up on account of the alleged disfiguring of the "city beautiful." The Board of Public Works is opposing the plan on the ground that ten lamps to the square would "make the street look like a torch-light procession." It has been decided to test a few of the tungsten lamps and note the appearance before closing the contract.

JASONVILLE, IND.—The Jasonville Electric Company is preparing to install a combined electric and waterworks plant. The cost of the electric system is estimated at about $30,000 and the waterworks at $50,000. It is proposed to extend the electric lighting system to Hymera, Ind. The Reliance Engineering Company, of Cincinnati, Ohio, has charge of the engineering work.

MOROCCO, IND.—A mutual telephone company has been organized by the citizens of Rensselaer and Jasper counties for the purpose of establishing and operating telephone lines in Jasper, Newton, Pulaski and White counties. The capital stock of the company is placed at $50,000.

SOUTH BEND, IND.—It is reported that the Vandalia steam line from South Bend to Logansport will be equipped to be operated by electricity.

SOUTH BEND, IND.—At a recent meeting of the directors of the Home Telephone Company, the sum of $50,000 was appropriated for the improvement and modernizing the company's plant. Work on the improvement will begin soon.

VALPARAISO, IND.—The Northwestern Indiana Telephone Company has notified the Secretary of State that the capital stock of the company had been increased from $50,000 to $100,000, the proceeds to be used in extending the lines and new equipment.

NEVADA, IA.—The electric plant owned by the Nevada Electric Company, which supplied the city with light and water, was destroyed by fire Aug. 26, leaving the city without either light or water service. Efforts will be made to have a temporary plant in service at once. F. E. Harris is owner of the plant.

RED OAK, IA.—The power plant of the Red Oak Electric Company is reported to have been badly damaged by the breaking of a fly wheel.

CALDWELL, KAN.—The citizens are considering the question of making extensions and improvements to the municipal electric light plant and water-works system. An election will soon be called to vote on the proposition to issue $30,000 in bonds to pay for the same.

LUCAS, KAN.—At an election held Aug. 19 the citizens voted to issue $30,000 in bonds for the construction of an electric light plant and water-works system, of which $10,000 will be used for electric plant and $20,000 for water works.

FORT LEAVENWORTH, KAN.—Sealed proposals will be received at the office of the Constructing Quartermaster, Fort Leavenworth, Kan., until Sept. 16, for extending and making certain changes in the electric lighting and fire-alarm systems at Fort Leavenworth. Full information and blank proposal forms will be furnished on application to the above office. Plans and specifications may be seen at this office, also at the offices of Chief Quartermaster, Omaha, Neb.; Depot Quartermaster, St. Louis, Mo., and Master Builders' Exchange, Kansas City, Mo. Capt. William D. Davis is quartermaster.

HUTCHINSON, KAN.—The Southwest Kansas Independent Long Distance Telephone & Telegraph Company is contemplating the erection of a telephone line from Hutchinson to Liberal, a distance of 200 miles.

WAKEENEY, KAN.—We are informed that bids will be opened Sept. 15 for the construction of an electric light plant, the cost of which is estimated at $10,000. George P. Taylor, of Stockton, Kan., is engineer.

CADIZ, KY.—Plans are being considered by A. P. White & Company for the installation of an electric-light plant in Cadiz. The company, it is said, has agreed to install the plant this fall if the City Council will contract for 12 or more street lamps. Power will be secured from the dam at the mill of the company in Cadiz. Gasoline engines will also be installed to furnish power during the low-water periods.

CARLISLE, KY.—The Carlisle Telephone Company, which is controlled by the East Tennessee Telephone Company, has applied to the City Council for a franchise to operate in this city. The company has been operating an exchange in this city for several years by permission, but has no franchise. It is said that the company will make improvements to its plant if granted a franchise.

JEFFERSONVILLE, KY.—All of the private telephone lines operating in the eastern part of the county have been absorbed by the New Washington Telephone Company.

NEW IBERIA, LA.—H. A. Mentz, representing New Orleans capitalists who are trying to secure a franchise to construct and operate an electric railway through this city, and a suburban line to Jeanerette, has submitted a proposition to the Municipal Electric Light and Water Works Board, offering to lease the municipal electric light and water plant for a term of 25 years. He agrees to furnish the city, free of cost, the quantity of water and electricity it is now using, and to charge only $6 per year for each additional 16-cp incandescent lamp required, and $75 per year for each additional arc lamp and $50 each for additional water hydrants. He also agrees to have the plant entirely renovated and running within nine months, and the electric railway system between this city and Jeanerette, and within the city limits within two years. The present rates for electricity and water furnished to private citizens are not to be increased.

LAKE CHARLES, LA.—The Cumberland Telephone & Telegraph Company is planning to make extensive improvements to its local system, which will involve an expenditure of approximately $65,000. The company is also considering the question of erecting a telephone line from Lake Charles to Cameron Parish in the near future.

BELFAST, MAINE.—The Penobscot Bay Electric Company expects to have its transmission line completed and to be ready to furnish electrical service in Belfast by Nov. 1. Several local industries have made arrangements to secure electricity from the company to operate their plants. The power company has opened an office in this city under the management of A. C. Hopkins, formerly superintendent at Bucksport.

BALTIMORE, MD.—Separate bids, marked "Proposals for Mantle Street Lighting," "Proposals for Incandescent Electric Street Lighting," "Proposals for Iron Lampposts" and "Proposals for Testing Electric Meters," addressed to the Board of Awards, care of J. Sewall Thomas, Register, City Hall, Baltimore, Md., will be received until Sept. 15, in accordance with specifications, which can be secured at the office of the superintendent of lamps and lighting, City Hall, Baltimore, Md. Robert J. McCuen is superintendent of lamps and lighting.

BOSTON, MASS.—Bids will be received at the United States Engineer Office, Boston, Mass., until Sept. 30 for boilers, engines and generators for Philippine Islands. For further information apply to Lieut. Col. Edward Burr.

BOSTON, MASS.—The Edison Electric Illuminating Company of Boston on Sept. 1 formally took over the operation of the electric plants of the Waltham Gas & Electric Company, Newton & Watertown Gas & Electric Company, the Boston Consolidated Gas Company and the Chelsea Gas Company. Owing to the consolidation, the cost of electricity in several suburban places will be reduced 25 per cent. The charge in Allston, Brighton, Brookline, Waltham and Chelsea will hereafter be 12 cents, instead of 16 cents. In Newton and Watertown it has been 12 cents since Jan. 1, when a reduction was made from 18 cents, which was made on the condition of the Gas Commission's approval of taking over the properties of the Newton & Watertown Gas Company. It is understood that the Waltham power house will be used by the Edison Company, but that the Allston power station, from which Brookline, Allston and Brighton are supplied, will eventually be abandoned, and these sections supplied from the South Boston power house.

MILFORD, MASS.—The Selectmen have signed a new contract with the Milford Electric Light & Power Company for street lighting for one year. The company is to furnish 42 arc lamps of 1200 cp and 72 tungsten lamps. The tungsten lamps will replace 16 of the arc lamps now in use. The cost of the service will be $5,000 per year, and the town will have more lamps without additional cost.

NORTON, MASS.—The Selectmen have granted the Norton Electric Light & Power Company, of Chartley, permission to extend its transmission lines from Chartley to the center of this town.

PLAINVILLE, MASS.—The installation of an electric system to furnish electricity for lamps and motors in Plainville is under consideration. Tungsten lamps will be used for street lighting and electrical power will be utilized by the jewelry factories. Electrical energy for operating the system may be purchased from the North Attleboro municipal electric light plant. William Plattner is superintendent of the North Attleboro plant.

BATTLE CREEK, MICH.—H. C. Hawk, representing the Post Land Company, has applied to the Board of Supervisors for a franchise to construct and operate an electric railway through its property, just west of the city in Battle Creek Township. The railway will be about six miles in length.

DETROIT, MICH.—Bids will be received at the office of Departments of Parks and Boulevards, City Hall, Detroit, Mich., until Sept. 13 for 20 pedestal one-lamp posts, including lamp and fixtures complete for 110-volt, alternating-current. Posts to be similar to Claw & Son's' No. A-973 lamp post. M. P. Hurlburt is commissioner.

GRAND RAPIDS, MICH.—Those interested in the Muskegon Production Company and the Western Power Company, reported as incorporated by parties interested in the Grand Rapids-Muskegon Power Company, in the issue of Sept. 2, it is said disclaim any connection with the Grand Rapids-Muskegon Power Company. John G. Emery, Jr., one of the incorporators of the Muskegon Production Company, states that the company was organized to hold flowage rights, with no immediate plans for power development. The incorporators of the company are John G. Emery, Jr., R. H. Minty and G. H. Emery. The Western Power Company was incorporated by George L. Erwin, Oscar Waer and H. B. Erwin.

DETROIT, MINN.—Bids will be received by W. L. Taylor, president of the City Lighting Committee, until Sept. 14, for the installation of a light, power, water and heating plant in Detroit. Steam and electric equipment, water mains, intake pipes and pumps are included. The cost is estimated at $75,000. L. P. Wolff, of St. Paul, Minn., is engineer.

FAIRFAX, MINN.—The question of establishing an electric light plant in Fairfax is reported to be under consideration.

GLENWOOD, MINN.—The installation of an electric light plant in Glenwood is under consideration. Mr. Templeman is reported to be interested in the project.

HAWLEY, MINN.—The contract for the construction of electric light plant and waterworks system has been awarded to Fairbanks, Morse & Company, of St. Paul, Minn. Oscar Claussen, of St. Paul, Minn., is engineer.

WILLMAR, MINN.—The special committee appointed by the Council recommends that plans and estimates be prepared for the installation of a municipal telephone system.

MACON, MISS.—The City of Macon is contemplating the purchase of entire new equipment for the municipal electric light plant. The present plans call for the installation of two 50-kw, single-phase, revolving field generators; one steam exciter set; one motor-driven exciter set; one 4-in. vertical-shaft Volute pump direct connected to a single-phase, 2300-volt motor, having a rating of 250 gal. per minute against a head of 160 ft., which will require a 25-hp motor; one 3-in., two-stage turbine pump having a rating of 250 gal. per minute against a head of 180 ft., which will require a 25-hp motor; one 2-in., single-stage turbine pump having a rating of 75 gal. per minute against a head of 25 ft., which will require a 2-hp motor. G. B. Baskerville is superintendent.

CHILLICOTHE, MO.—An election will soon be held to vote on the proposition to issue bonds, the proceeds to be used for purchasing and improving the present electric plant and water works system, or the construction of a new combined plant. About $150,000 in bonds will be issued. The Fuller-Coult Company, Chemical Building, St. Louis, Mo., successors to the W. A. Fuller Company, has been retained as engineers.

LIBERAL, MO.—The Liberal Rolled Feed Mill & Elevator Company is planning to install an electric plant, the equipment of which will include a 30-kw direct-current generator.

ST. LOUIS, MO.—James D. Houseman has been granted a franchise by the county court to construct an electric railway from Jefferson Barracks to Spanish Lake. The franchise provides for branch lines to Fenton and other towns which have no transportation facilities.

CLAY CENTER, NEB.—It is reported that M. M. Johnson, of this town, is contemplating the installation of an electric light plant to furnish electricity for lamps and motors in Clay City.

GOLDFIELD, NEV.—The Walker River Power Company has placed surveyors in the Lucky Boy Mining District to locate reservoir sites between Bridgeport, Cal., and Sweetwater, Nev. Two sites are said to have been selected which will send water back four miles. The purpose is to furnish electricity for lamps and motors for all districts around Lucky Boy.

MANCHESTER, N. H.—Plans have been completed by the Amoskeag Manufacturing Company for the installation of a large electric power plant to furnish electricity to operate the new Coolidge mill, now under construction. The plant will be equipped with two 3500-kw generators and horizontal Curtis turbines. The Coolidge mill will be equipped with 100 25-hp motors, fourteen 50-hp motors, seven 200-hp motors, two 185-hp motors, one 850-hp motor and several elevator motors. The plant will eventually furnish electricity for lamps and motors for the Amory, Jefferson and Langdon mills. The construction of the power house will probably not be completed before next February or March.

ORANGE, N. J.—Sealed proposals will be received by the Common Council until Sept. 20 for the installation of a municipal electric light plant, in accordance with plans and specifications, copies of which may be seen at the office of Runyon & Carey, 122 Market Street, Newark, N. J. All proposals to be directed to Willett B. Gano, city clerk, Canfield Street Engine House, Orange, N. J.

COPENHAGEN, N. Y.—The Deer River Power Company has received authority from the Public Service Commission, Second District, to exercise its franchises in Copenhagen, and to issue capital stock to the amount of $25,000, the proceeds to be used to pay the cost of organization and its indebtedness in the purchase of certain water powers, riparian rights and land at High Falls, on Deer River.

HUDSON, N. Y.—The contract for the new power house and coal pocket for the women's refuge in Hudson was awarded Aug. 31 to John Dyer, Jr., of Albany, N. Y., for $50,200.

LITTLE FALLS, N. Y.—Plans are being made to develop the water power of East Canada Creek, to furnish power for another large electric plant for the Inghams Mills. Guy R. Beardsley, president of the East Creek Electric Light & Power Company is promoter of the project.

NEW YORK, N. Y.—Bids will be received by the Commissioner of Docks, Department of Docks and Ferries, Pier "A," foot of Battery Place, North River, New York, until Sept. 13 for furnishing and delivering iron, steel, pipe valves, electrical supplies, etc., as per contract No. 1162. Blank forms and further information may be obtained at the office of the Department. Denis A. Judge is deputy and acting commissioner.

NEW YORK, N. Y.—Bids will be received by the Commissioner of Docks, Department of Docks and Ferries, Pier "A," foot of Battery Place, North River, New York, until Sept. 14 for furnishing all material and labor and appliances, etc., to complete the electric installation at the department yards at West Fifty-seventh Street, North River, and East Twenty-fourth Street, East River. Blank forms and further information may be obtained and plans and drawings may be seen at the office of said Department. Denis A. Judge, deputy and acting commissioner.

OLEAN, N. Y.—Arranagements have been completed by the Olean Electric Light & Power Company for doubling the output of its plant. The interior of the power house is being entirely remodeled, including the installation of two 200-hp gas engines with new generators.

SENECA, N. Y.—The Board of Public Service Commission, Second District, has authorized the Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Company to execute a mortgage to the Western Trust Company, of Philadelphia, Pa., to secure bonds to the amount of $2,500,000. The company is granted permission to issue at present $500,000 in bonds, to be sold at not less than 90; of the proceeds $400,000 are to be used for the discharge of outstanding bonds of the corporation and $100,000 for the acquisition of property and for extensions and improvements.

SYLVAN BEACH, N. Y.—At an election held recently, the citizens voted in favor of the proposition to install an electric light and power plant. Edmund Brown is clerk of the Board of Trustees.

ASHEVILLE, N. C.—The progress of the Asheville & East Tennessee Railroad Company, which recently began in a modest way as the Asheville-Weaverville electric line, about ten miles in length, is now said to be assured of backing ample to push the line on to connect with the new Clinchfield Railway from West Virginia to the Atlantic Coast, tapping the railroad probably in Yancey County. The electric railway has just received additional rolling stock enabling it to operate passenger, express and freight service to and from Weaverville, with the aforesaid promise to finally reaching the Clinchfield railroad.

HICKORY, N. C.—The A. A. Shuford Mill Company, recently incorporated with a capital stock of $80,000 for the purpose of manufacturing cotton yarns, will use electricity for motive power and has already contracted for 200 hp.

HICKORY, N. C.—The transmission lines of the Southern Power Company will be completed to Hickory, a distance of about 125 miles from the generating plants, by November 1, according to present plans. The Thornton Light & Power Company will handle 400 hp from the Southern Power Company, using 150 in its own plant, the remainder to be distributed among numerous industries in the town and vicinity. The Thornton Company will control the power only within the city limits; outside, where a number of larger industries are located, the Southern Power Company will have full sway. Col. Thornton, of the local company, declares that he now has in sight the money for developing a water power on the Catawba River, near Hickory, from which he proposes to supply several smaller towns to the north of Hickory with electricity.

FAYETTE, OHIO.—The contract for installing an electric lighting system, bids for which were opened Aug. 28, was awarded to George F. Avis and J. Mills Lamb, of Hudson, Mich. The contract also includes street lighting service at the rate of $60 per lamp per year. Electricity for operating the system will be secured from their plant located in Morenci, Mich.

GIRARD, OHIO.—The Youngstown Consolidated Gas & Electric Company, it is said, contemplates making extensions and improvements to its local system, if certain concessions are granted.

ENID, OKLA.—We are informed that the Enid & Central Oklahoma Traction Company proposes to commence work on the construction of its proposed electric railway from Enid to El Reno, 65 miles in length, about Oct. 1. The company expects to furnish electricity for lamps to towns along the route. W. S. Whittinghill, of Enid, is president of the company.

NINNEKAH, OKLA.—The Ninnekah Electric Light & Power Company is reported to have made arrangements to secure electrical energy for lamps and motors from the hydro-electric plant on the Washita River. E. W. Dent is general manager.

SAPULPA, OKLA.—The plant and holdings of the Sapulpa Light & Power Company have been purchased by H. Miller Hammett, of Tulsa, Okla.; and A. Measley, of Philadelphia, Pa. (the latter represented by T. F. Fulkerson, of Trenton, Mo.) for $150,000. It is understood that improvements to cost $50,000 are to be made to the plant at once.

TALOGA, OKLA.—Plans are being considered for the installation of an electric light plant and waterworks system, bonds for which were recently voted.

BAKER CITY, ORE.—Surveys are being made by the Baker Interurban Railway Company for its proposed railway from Haines to North Power and Rock Creek. It is said that work on construction of the road will commence within a few weeks. Electricity or gasoline will be used for motive power. T. B. Neuhausen, of Portland, Ore., is president of the company.

MEADOW BROOK (P. O. MULINO), ORE.—Preparations are being made by the Canby Canal Company for the construction of a power plant in Meadow Brook, where it is now constructing a dam. The company proposes to furnish electricity for lamps and industrial plants.

UNION, ORE.—The citizens have voted in favor of the proposition to issue $25,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant.

WATERLOO, ORE.—The Lebanon Paper Mill Company is making extensive improvements to its plant, including the installation of two 500-hp water wheels and an electric generator.

DALLASTON, PA.—Owing to the York & Windsor Electric Company having served notice upon the Borough Council that, after the expiration of the present contract, the price for street lamps would be increased from $20 to $30 per lamp per year, the Council voted to install a municipal plant. The proposition will be submitted to a vote of the people. The contract expires July, 1910.

DRYVILLE, PA.—It is proposed to erect a telephone line from Topton to Dryville and New Jerusalem. R. H. Angstadt and Alan S. Angstadt are interested in the project.

JOHNSTOWN, PA.—The Johnstown Electric Light Company has filed an amendment to its charter, increasing its capital stock from $1,200,000 to $1,600,000.

LANCASTER, PA.—The Edison Electric Light, Heat & Power Company is installing a 3000-kw, three-phase, 25-cycle, alternating-current generator connected to a 6000-hp Parsons turbine.

LANCASTER, PA.—The Conestoga Traction Company is building a car barn, a rotary converter station and waiting room, about one-half mile east of Parkersburg on the Lancaster and Cartersville line.

LEBANON, PA.—The Ephrata & Lebanon Street Railway Company will soon apply for a charter. The railway will be 22 miles long, for which the right of way has been secured. It is now proposed to operate with gasoline motors. F. H. Shaw, of Lancaster, Pa., is consulting engineer.

MERCER, PA.—Proposals will be received by the Mercer County Commissioners until Sept. 18 for the construction of a power-house. J. E. Callahan, John Hassel and Frank P. Craag are commissioners.

MURRAYSVILLE, PA.—The Murraysville Telephone Company has increased its capital stock from $5,000 to $10,000.

PALO ALTO, PA.—The capital stock of the Palo Alto Heat, Light & Power Company has been increased from $5,000 to $1,000,000. The company is controlled by the Eastern Pennsylvania Railway Company.

PHILADELPHIA, PA.—Arrangements are being made by the Philadelphia Rapid Transit Company for enlarging its power plant on Market Street. Permits have been granted for the construction of a brick addition to the plant, 78 ft. x 85 ft. at the corner of Market and Thirty-third Streets, to cost $61,000.

PHILADELPHIA, PA.—A new company has been organized, under the name of the Philadelphia & Suburban Elevated Railroad Company, to construct an elevated railway on Twelfth Street from Johnson Street south to Glenwood Avenue on the north, and a parallel line on Thirteenth Street, which will be connected at each terminal by loops. Several branch lines will be built. Stewart S. Neff is president of the company.

BATESBURG, S. C.—The capital stock of the Delmar Telephone Company has been increased from $800 to $3,000.

GEORGETOWN, S. C.—It is reported that the proposed electric railway system here has materialized, that rolling stock and equipment has been purchased, the output of the local electric lighting plant has been increased to meet the larger power demand, and that the tracks will be laid soon.

GREENVILLE, S. C.—The Southern Power Company, of Charlotte, N. C., is just completing new transmission lines to this city, the first terminus to be run to the Monoghan cotton mills, where electricity will be used as motive power. It is predicted that every cotton mill in and about Greenville will have the electric drive installed within twelve months.

NEWBERRY, S. C.—The Southern Power Company has completed the survey for its transmission lines to this city and Whitmire, the lines to be about 40 miles in length, tapping the main transmission lines from the power plant at Great Falls to Greenville, S. C.

ROCK HILL, S. C.—The entire holdings, franchise and other properties of the Rock Hill Water, Light & Power Company were sold at auction on August 31 by P. A. Wilcox, receiver, of Florence, S. C., to Martin Maloney, a capitalist of Philadelphia, Pa., for $80,000. The liabilities of the company are said to have been about $102,000, including bonded debt, etc. It is said that the plant will be renovated by the new owner.

MEMPHIS, TENN.—The Cumberland Telephone & Telegraph Company is planning to make extensive improvements in the Memphis territory, which includes part of West Tennessee, Northern Mississippi and part of Southwest Kentucky. Part of the line between Memphis and Jackson, Miss., is to be rebuilt; a new line is to be erected in Mississippi, between Winano and Starkville, a distance of about 75 miles. A new line will also be built from Union City to Jordan, Ky., and another from Selmer and Adamsville; a new exchange will be installed in Selma to take care of the increasing business. Other improvements will be made in a number of West Tennessee towns, and also in several places in Kentucky. Extensions will be made to the lines in Memphis this fall, which will involve an expenditure of between $25,000 and $30,000. The cost of the entire work is estimated at about $100,000.

ALEXANDRIA, VA.—The Alexandria Electric Light & Power Company is contemplating extending its transmission lines to St. Elmo and Del Ray, for the purpose of furnishing electricity for commercial and street lighting purposes. It is said that the Town Council is considering a contract for lighting the streets with electric incandescent lamps, of which 28 will be placed in Del Ray and 12 in St. Elmo.

MARTINSVILLE, VA.—The Martinsville Cotton Mills Company, recently organized, has its building nearly completed and ready for machinery, and will install 18,000 spindles, 446 looms, etc., for manufacturing fine sheeting. The company has contracted with the city for 500 hp to be supplied from the municipal electric plant. It is said that the city officials are preparing to raise the city dam, so as to provide more power for the plant.

MONTEREY, VA.—W. F. Kyle, of the Monterey Water, Light & Plumbing Company, has purchased a site for an electric light plant, and preliminary work has commenced on construction of the power house. Mr. Kyle was granted a 30-year franchise last year. P. H. Trout, of Staunton, Va., electrical engineer, is making estimates, etc., for the proposed plant.

RICHLANDS, VA.—A franchise has been granted to Messrs. Clark & Davy to construct and operate an electric light plant and water works in the Town of Richlands. They have also secured a contract to light the streets of the town with 40-watt tungsten lamps.

CHEWELAH, WASH.—The City Council is considering plans for increasing the output of the municipal electric light plant from 55 hp to 190 hp. It is said that a fall of 300 ft. can be secured from Chewelah Creek by going above the present site of the wheel. The cost of the work is estimated at about $5,000.

FRIDAY HARBOR, WASH.—The Western Mills & Lumber Company has been granted an electric light franchise in Friday Harbor.

HAYES, WASH.—A company has been organized to construct a telephone line from Hayes to Etna, connecting with the main line at La Center or Woodland. Eighteen miles of pole line will be erected. The officers of the company are: Walter Horton, president; H. F. Hewett, vice-president; August Scottburg, secretary, and E. Roslund, treasurer.

PASCO, WASH.—The property and holdings of the Pasco Power & Water Company have been transferred to a group of Seattle capitalists under the name of the Burbank Power & Water Company. The properties include valuable water rights on the Snake River at Five-Mile Rapids, four miles above Pasco; several thousand acres of rich sage brush land in the Columbia River fruit belt, and power plant, irrigation system and townsite of Burbank, in Walla Walla County. The officers of the new company are: James D. Hoge, president; Jacob Furth, vice-president; C. E. Farnsworth, secretary and treasurer; William H. Parry and J. E. Chilberg are trustees, all of Seattle, Wash. It is said that bonds to the amount of $500,000 have been floated.

SEATTLE, WASH.—It is reported that the Seattle Electric Company will soon issue $1,150,000 in common stock, the proceeds to be used to carry on construction work already started and contemplated in and around Seattle, as well as to take care of bonds that fall due during the next few months.

SPOKANE, WASH.—A reduction of practically 27 per cent in the rates for electricity for lamps has been made by the Washington Power Company. The new schedule went into effect Sept. 1 and is on a sliding scale as follows: For the first 30 kw, 10 cents per kw-hour; 9 cents per kw-hour for the second 20 kw; 8 cents for the third 20 kw, and 5 cents per kw-hour for all energy consumed above 60 kws. Under the old rates the prices were 13 cents per kw-hour for the first 25 kw; 12 cents for the next 15 kw; 11 cents for the next 20 kw, and 10 cents for all energy consumed by lamps for residential lighting in excess of 60 kw and less than 150 kw. Under the new schedule the definition of residential lighting will be strictly enforced.

TEKOA, WASH.—Arrangements have been made between the City Council and the Idaho & Washington Light & Power Company, whereby the latter will furnish electricity for lighting the streets of the town for $75 per month. The company is to furnish 30 lamps of 80 cp at the rate of $2.50 each per month.

ALGOMA, WIS.—The capital stock of the Algoma Farmers' Telephone Company has been increased from $5,000 to $25,000.

EAU CLAIRE, WIS.—We are informed that the Chippewa Valley Railway, Light & Power Company has closed a contract with the Red Wing Gas Light & Power Company, of Red Wing, Minn., to supply it with electrical energy to operate its entire plant. Work has commenced on the construction of the transmission from Menominee to Red Wing, a distance of 40 miles. The company expects to have its transmission line completed and to furnish electricity in Red Wing about Jan. 1, 1910. Electrical energy will be developed from one of the dams owned by the company on Red Cedar or Menominee River. George B. Wheeler is secretary and general manager of the Chippewa Valley Railway, Light & Power Company.

MANITOWOC, WIS.—Plans are being made by the Wisconsin Telephone Company for the extension of its telephone toll lines between Milwaukee and Green Bay along the lake shore. Work will soon be under way from Manitowoc to the Bay.

NEW RICHMOND, WIS.—The Washington County Light & Power Company, of Stillwater, Minn., has taken over the entire gas, electric light properties and franchises of the Apple River Power Company and the Western Gas & Improvement Company. It is said that extensions and improvements are contemplated which will involve an expenditure of about $210,000.

STURGEON BAY, WIS.—The capital stock of the Door County Telephone Company has been increased from $1,500 to $10,000.

CASPER, WYO.—The entire system of the local electric light plant has been changed from direct to alternating current, which has required considerable change in pole lines, as well as replacement of the direct-current generators and switchboard by alternating-current equipment.

LACOMBE, ALTA., CAN.—The town is considering the installation of a municipal light and power plant. Service, until recently, was given by the Blindman River Electric Light & Power Company, which has been obliged to shut down owing to the washing out of its dam, and it is estimated repairs cannot be completed within a year.

VANCOUVER, B. C., CAN.—An engineer will be appointed to make report with a view to the city purchasing an extensive water power at Lilooet to be used in connection with the erection of a municipal power plant. For further information address Alderman Goodman.

WINNIPEG, MAN., CAN.—The Manitoba Telephone Commission ha divided its work between three superintendents, each having charge of a department which will be known as traffic, commercial and plant. The province will be divided into six divisions with a superintendent for each department in each division who will report to the head superintendent, and the head superintendent will be responsible to the commission.

SHEDIAC, N. B., CAN.—Plans are under way for the construction of an electric light plant in Shediac. It is proposed to utilize the water power at Smith's Mills. A company has been organized under the name of the Shediac Electric Light & Power Company, of which A. E. Smith is president. It is stated that the capital required will not exceed $15,000, a greater portion of which has been subscribed.

BROCKVILLE, ONT., CAN.—It is reported that plans are being considered for rebuilding the municipal electric light plant.

GUELPH, ONT., CAN.—The Civic Light and Power Commissioners have awarded a contract to Vandeleur & Nichols for two large frequency changer sets and switchboards and for motors manufactured by the Lancashire Dynamo & Motor Company, aggregating about 1600 hp.

TORONTO, ONT., CAN.—The entire system of telephones along the line of the Temiskaming & Northern Railroad is to be reconstructed, and several important extensions will be built this year.

TORONTO, ONT., CAN.—Bids will be received by the city of Toronto until Oct. 28 (an extension of date from Oct. 14) for turbine pumps, valves, piping, bed plates, couplings, etc. The date for receiving bids for electric motors, with exciters, switchboards, connecting material, etc., has also been extended from Oct. 14 to Oct. 28.

COATICOOK, QUE., CAN.—The citizens are considering the question of establishing an electric light plant in Coaticook. The proposition to appropriate money for the plant will soon be submitted to a vote.

MONTREAL, QUE., CAN.—An announcement is made that on and after Oct. 1 the Montreal Light, Heat & Power Company will give a discount of 33⅓ per cent on 5-year contracts against the present discount of 15 per cent.

MONTREAL, QUE., CAN.—The Canadian Light, Heat & Power Company is reported to have made arrangements with J. G. White & Company, of New York, N. Y., for the engineering work and supervision of the construction of its proposed hydro-electric plant on the St. Lawrence River, near St. Timothee, Que. The company has secured permission from the Government to enlarge and use the Beauharnois Canal for power purposes. The present plans provide for an initial development of 21,600 hp, with provision for further developments, as may be required. The work includes the construction of a canal; enlargement of the Beauharnois Canal from the intake to the station site; construction of forebay at the power site; a power station for four main units and two exciter units; tailrace excavation for the complete ten units; transmission line to Montreal, and erection of substation and distributing system in Montreal. Plans and specifications are now being prepared by the engineers. The cost of the initial development is estimated at $4,000,000.

MONTEREY, MEX.—The damage to the electric light plant, street railway system, by the recent flood, all of which are owned by the Monterey Railway, Light & Power Company, is estimated at $2,000,000. William McKenzie, of Toronto, Ont., Can., is president.

TORREON, MEX.—Another large electric power plant and transmission system, backed by American capital, is being promoted in Mexico. It will be operated under the name of the Nazas River Power Company, the organization of which has just been completed. The hydro-electric plant will be located in the Ferndale Canyon, about 80 miles above the city of Torreon. The Nazas River, which flows through this canyon, will be utilized by the construction of a high dam across the narrow gorge. The initial output of the plant will be 20,000 hp, which can be increased as the demands may require. It is stated that contracts have already been signed for all of the 20,000 hp. The transmission lines will extend to the cities of Torreon, Gomez, Palacio, Lerdo, San Pedro, Mapimi, Durango, Velardena and other places. Electricity will be supplied chiefly to mining districts and industrial plants. The contracts call for the completion of the plant by Jan. 1, 1911. The cost of the plant and transmission lines is estimated at about $10,000,000. The officers of the company are: J. A. Spofford, of New York, N. Y., president; L. H. Hacker, vice-president and general manager, and C. A. Bobst, secretary. The office of the company will be at Torreon, Mex.

New Industrial Companies.

THE INTERNATIONAL GAS & ELECTRIC FIXTURE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $4,000, to manufacture gas and electric fixtures by Joseph Moshkowitz, Isaac Wolsky, Samuel Berlin and William Rubin, all of Brooklyn, N. Y.

THE MANHATTAN RAILWAY SUPPLY COMPANY, of New York, N. Y., has been incorporated with a capital stock of $110,000 by A. J. Hammerslough, A. L. Strasser and L. M. Wallstein, all of New York, N. Y. The company proposes to manufacture and deal in railway supplies.

THE OLDHAM ENGINEERING COMPANY, of New York, N. Y., has been incorporated by David J. T. Oldham, William S. Miller, Buel C. Haff, all of New York, N. Y. The company is capitalized at $20,000 and proposes to manufacture generators, engines, pumps, bridges, structures, etc.

THE PUBLIC SAFETY APPLIANCE COMPANY, of Albany, N. Y., has been chartered with a capital stock of $3,000 to manufacture fire, police and watchman alarm systems and appliances. The incorporators are: Perry J. Fitzgerald, George Haswell, of Albany, N. Y., and Theodore M. Brush, of Elyria, Ohio.

THE REPUBLIC ELEVATOR & MACHINE COMPANY, of Rochester, N. Y., has been incorporated by F. A. Stoffel, G. H. Fagan and H. L. Morgan, all of Rochester, N. Y. The company is capitalized at $30,000 and proposes to manufacture machinery, elevators, tools, etc.

THE SANDY STREAM DAM & IMPROVEMENT COMPANY, of Augusta, Maine, has been incorporated with a capital stock of $25,000, for the purpose of erecting and maintaining dams, etc. F. E. Smith is president, and J. H. Sturgis, treasurer, both of Augusta, Maine.

THE SCIPLE-GOCHENAUR MANUFACTURING COMPANY, of Trenton, N. J., has been incorporated by C. R. Ruhlman, of Trenton, N. J.; J. H. Boyer and W. B. Warnes, of Philadelphia, Pa. The company proposes to manufacture boilers, marine and other engines. Also to take over the business of W. N. Gochenaur, 631 Arch Street, Philadelphia.

THE STANDARD GAS & ELECTRIC POWER COMPANY, of West Philadelphia, Pa., has been incorporated with a capital stock of $600,000 for the purpose of manufacturing automobiles, which will be operated by both gas and electric motive power. Samuel S. Eveland, president of the Standard Bearing Company, is interested in the company.

New Incorporations.

GADSDEN, ALA.—The Noccalula Light & Power Company has filed articles of incorporation with a capital stock of $100,000 for the purpose of constructing a hydro-electric power plant at Black Creek Falls. The officers of the company are: Joseph M. Baker, president; Joseph B. Evans, vice-president, and Joseph P. Parish, secretary and treasurer.

SANTA BARBARA, CAL.—The Merchants' Mutual Light & Power Company has been incorporated to effect the consolidation of the Merchants' Mutual and Edison companies. The new company has a capital stock of $1,000,000 and its directors are C. H. Frink, John F. Diehl and H. R. Weldon, of Santa Barbara; S. M. Kennedy, of Alhambra; R. H. Ballard, William Dieterle and Herbert F. Keenan, of Los Angeles; L. J. Lee and H. J. Bauer, of Pasadena. The first three are understood to represent the stockholders of the Mutual company, which was financed by local men, while the Los Angeles and Pasadena directors are associated with the Edison company of Los Angeles, which will hold a controlling interest in the local company. The principal place of business is Santa Barbara.

SAN FRANCISCO, CAL.—The Solano-Yolo Land & Water Company has been chartered, with a capital stock of $500,000, by C. M. Wooster, of San Jose, Cal.; Harvey S. Loveland, H. H. Sanborn, F. H. Gould and S. R. Chapel, all of San Francisco. The company proposes to erect a dam at Hell's Gate, west of Winters, to develop electrical power and to divert water at the same point for irrigation purposes in Yolo and Solano counties.

LEWISTON, IDAHO.—The Northwestern Corporation of Walla Walla has been incorporated with a capital stock of $5,000,000. It is said that the company was formed by the same interests that own the local gas company and operate in several towns, including Pendleton, Eugene and Albany, Ore.

GOLDEN, ILL.—The Golden Farmers' Telephone Company has been organized to install a telephone system in Golden. The directors are: L. G. Clark, E. C. Sherrow, Andrew Bartell, Scott Taylor and John P. Beckman.

MONTICELLO, IND.—The Indiana Northwestern Traction Company, with headquarters in this city, has incorporated with a capital stock of $50,000. The company proposes to construct, finance, equip and operate an electric railroad from Hammond to Lafayette. The company also proposes to furnish electricity for lamps and motors to towns and cities along its route. Charles D. Meeker, William Breckner, Jacob Timmons, of Monticello; George W. Goff, Rensselaer, and George A. Haskell, of Chicago, Ill., are directors.

CLARION, PA.—Articles of incorporation have been filed for the Clarion & East Brady Electric Railway Company by G. E. Arnold, R. M. Werner, T. S. Arnold, I. N. Langham and E. W. Witherell. The company proposes to construct an electric railway from Clarion to East Brady, via Sligo and Rimersburg, a distance of 25 miles.

HARRISBURG, PA.—Charters have been granted to the Aston Electric Light, Heat & Power Company, the Marple Electric Company, the Middletown Electric Light & Power Company and the Nether Providence Electric Company. Each company is capitalized at $5,000. The following named parties are directors of all of the companies: H. E. Marlor, of Philadelphia, Pa., treasurer; H. W. Rhodes and W. Roger Frontfield, of Media, Pa.

HOLLIDAYSBURG, PA.—The Juniata Electric Light, Heat & Power Company has been incorporated with a capital stock of $5,000. The directors are: Harry D. Hewitt, treasurer; John T. Leet and Peter S. Duncan, all of Hollidaysburg, Pa.

LIMERICK, PA.—The Limerick Telephone Company has been granted a charter by the State Department. The company is capitalized at $5,000.

SAN ANGELO, TEX.—The San Angelo Street Railway Company has been organized, with a capital stock of $100,000, to construct an electric railway from San Angelo to Carlsbad and Sterling City. The directors are W. H. Shaffer and A. H. Shaffer, and J. J. Lanin, of New Hampton, Ia., manager.

LAGRANGE, TEX.—The Southern Texas Telephone Company has been incorporated, with a capital stock of $20,000, by C. C. Robson, H. C. Schumaker and M. V. Povlitz.

ALEXANDRIA, VA.—The Braddock Light & Power Company has been chartered, with a capital stock of $5,000, to construct and operate an electric light plant. The officers of the company are: Clarence F. Norment, president; F. J. Whitehead, secretary, and H. W. Fuller, treasurer, all of Washington. D. C.

NORTON, VA.—The Norton Light & Power Company has been chartered, with a capital stock of $25,000. The officers of the company are: W. N. Surface, president; J. B. Sterrett, vice-president and general manager, and G. H. Esser, secretary and treasurer.

WAVERLY, VA.—The Surry & Sussex Telephone Company has been incorporated, with a capital stock of $3,000 and the following-named officers: J. E. Wilcox, president; J. W. Rogers, of Waverly, secretary and treasurer, and W. O. Rogers, of Savedge, Va., manager.

TACOMA, WASH.—Articles of incorporation of the Northwestern Electric Company have been filed by City Electrician F. H. Lauzon, E. L. Hollingstead, H. D. Nowlin, F. McFarland and J. P. Covert. The capital stock is placed at $300,000.

WALLA WALLA, WASH.—Articles of incorporation have been filed for the Spokane, Walla Walla & Western Railway Company by E. M. Symonds, M. S. Parker, G. S. Haynes, A. H. Hoffman and E. C. Maxon, of Spokane, Wash.; H. M. Hanger, of Dayton, and W. L. Russell, of Walla Walla. The company is capitalized at $1,000,000, and has taken over the holdings of the Columbia & Walla Walla Traction Company, which proposed to construct an electric railway from Dayton to Wallula, a distance of about 60 miles.

ARGYLE, WIS.—The Argyle Telephone Company has been chartered with a capital stock of $5,000 by A. G. Hawley, H. F. Hawley and D. S. Hawley.

CENTER, WIS.—The Twelve Corners & Mackville Telephone Company has been incorporated, with a capital stock of $8,000, by Martin Striegal, C. F. Giedt and John L. Parker.

RIDGEVILLE, ONT., CAN.—The Ridgeville Electric Light & Power Company has been organized by George Arnold, of Ridgeville; Hugh A. Rose and Frank W. Houston, of Welland; J. C. Stoat, of Fenwick, and H. S. Arnold, of Toronto. The company is capitalized at $40,000 and proposes to supply electricity for lamps and motors in the townships of Thorold, Pelham and Gainsboro. Franchises have already been secured in Thorold and Pelham.

Legal.

RECEIVER FOR THE JUNIATA WATER & POWER COMPANY.—A bill of equity has been filed in the Common Pleas Court No. 1 for a receiver for the Juniata Water & Power Company, of Huntingdon, Pa. The company defaulted on its first mortgage 5 per cent bonds last May, and the present suit is the result of that and differences as to the management and reorganization of the company. The capital stock outstanding is $7,500,000, and also an indebtedness of the same amount, consisting of first mortgage 5 per cent bonds. A second mortgage of $500,000 is authorized but not issued.

RECEIVER APPOINTED FOR THE SOUTHERN COLORADO POWER COMPANY.—District Judge Henry Hunter has appointed Frank P. Read, of Denver, Col., receiver of the Southern Colorado Power Company, of Trinidad, Col. The company is said to be solvent in every way and the receivership method is used in preference to foreclosing, in order that time may be saved in rebuilding and enlarging the plant, and was agreed upon by the stockholders when Brown Brothers, of New York, N. Y., consented to take over the controlling interest in the company and organize a new and larger corporation. The new company will have a capitalization of $5,000,000, and ample capital will be available to make all improvements and extensions as they are needed. The receiver, it is understood, with the permission of the court, will immediately order new machinery for the plant. It is said that the plant which was destroyed by fire in June will be replaced in a few months by a new and larger station. Mr. Read was formerly owner of the Trinidad Electric Light Company and the Trinidad Street Railway Company.

Personal.

MR. A. GRONWALL, of Ludvika, Sweden, is in Ottawa in connection with the establishment of several electrical furnaces in Canada for smelting ores. He will consult with Dr. Haanell, of the Department of Mines, who has given special attention to the subject of electric smelting.

MR. S. L. PRENTER, who for 24 years has been connected with the Canadian Pacific Railroad, has been appointed assistant manager of the British Columbia Electric Street Railway system with charge of the branch line now being built between New Westminster and Chilliwac, B. C.

MR. WILLIAM RAY, of Chicago, has been appointed general manager of the Northern Indiana Gas & Electric Company's interests in Michigan City, Hammond, East Chicago, Indiana Harbor, Whiting, West Hammond, Burnham and Chesterton. These properties form part of the Geist Gas & Electric Syndicate, of Philadelphia.

MR. L. J. B. WALL, of Perth, Western Australia, has acted as an expert in arbitration proceedings attending the proposed purchase by the city of Perth of the electric light and gas properties of that place, the value of which is about $2,000,000. According to *The West Australian*, Mr. Wall, who is a member of the American Institute of Electrical Engineers, was on the stand for more than a week continuously.

MR. HAROLD K. WELD resigned his position in the engineering department of the Chicago Telephone Company Sept. 1 to enter the sales department of the McRoy Clay Works, manufacturers of underground conduits. His office will be at The Rookery, Chicago, Ill. Mr. Weld's work with the Chicago Telephone Company has been for the past four years in connection with the engineering of underground conduit construction, and this new work is therefore of a kind for which he is well fitted by his previous experience.

MR. ERNEST GONZENBACH has been elected president and general manager of the Sheboygan Light, Power & Railway Company, Sheboygan, Wis., to succeed the late Dr. F. A. C. Perrine. Mr. Gonzenbach was formerly vice-president and treasurer of the company, and Mr. August Westermeyer, heretofore auditor of the company, has been elected to succeed him as treasurer. During the five years Mr. Gonzenbach has been connected with the company the gross earnings have almost doubled and the net earnings have more than trebled. Mr. Gonzenbach's election to the presidency will not mean any change in the policy or personnel of the company, beyond that mentioned in the case of Mr. Westermeyer.

MR. ALFRED J. THOMPSON, 71 Broadway, New York City, who, since his departure from four years' service in the laboratory of Thomas A. Edison, in 1893, has devoted his entire time to the sale, installation and operation of American machinery in Latin American countries, is about to form a selling organization for business in this rapidly developing part of the world. In his 16 years' experience traveling through every republic in Central and South America, he has gained the good will and personal regard of their largest consumers. The organization will have its headquarters in New York and Mr. Thompson will make occasional trips to these countries to call on resident representatives. His traveling associates all speak Spanish and have had extensive shop and selling training in the United States.

Trade Publications.

LUBRICATION.—Lubricants of various kinds are well described in a neat booklet recently published by the Dearborn Drug & Chemical Works, Chicago, Ill.

ARC LAMP REGULATORS.—A regulator designed for governing the arc lamp used with moving picture shows is described in a folder issued by the Vindex Electric Company, Aurora, Ill.

TUNGSTEN LAMPS.—The economical features of the tungsten lamp, in comparison with the carbon lamps, are discussed in a convincing manner in folder No. 3850 of the General Electric Company.

FLAMING ARC LAMPS.—The constructive features and operating characteristics of the Alba flaming arc lamp are fully discussed in a booklet issued by the Charles L. Kiewert Company, of New York.

WATER SOFTENERS.—The advantages attending the softening of water for boiler feeding are outlined in a bulletin published by the Harrison Safety Boiler Works, Seventeenth Street and Allegheny Avenue, Philadelphia.

WIRING SPECIALTIES.—Bulletin No. 18 of the Harvard Electric Company, 60 West Van Buren Street, Chicago, Ill., is devoted to wiring hardware, including brackets, self-welding joints, switch boxes, outlet boxes and fuse blocks.

ELECTRICAL REPAIRS.—The Gregory Electric Company, Chicago, Illl., has issued a neat folder, which represents an effort on its part to double its repair business during the coming year, for which it has recently increased its facilities.

ASBESTOS ROOFING.—A roofing particularly designed for use on factories, power houses and similar structures is listed and fully described in catalog No. 303 of the H. W. Johns-Manville Company, 100 William Street, New York.

INDUCTION MOTORS.—The Triumph Electric Company, Cincinnati, Ohio, has issued Bulletin No. 351, giving a complete description of the constructive features of its polyphase induction motors. These motors are built in ratings from 1 hp to 75 hp.

AIR HEATERS.—Bulletin No. 123 of the Green Fuel Economizer Company, Matteawan, N. Y., deals with a waste-heat air heater, designed for utilizing the heat in chimney flue gases to raise the temperature of air for buildings and industrial drying processes.

RECIPROCATING ENGINES.—The American Engine Company, Bound Brook, N. J., is distributing a bulletin discussing in an instructive manner the considerations affecting the floor space, steam economy, valve design and balancing of automatic high-speed engines.

INCANDESCENT LAMPS.—Bulletin No. 8A of the Western Electric Company, of Chicago, Ill., is devoted to the Sunbeam incandescent lamps. The lamps are of the tungsten miniature and low-voltage types. The bulletin contains complete illustrated descriptions of each of the types listed.

ELECTRIC CARRIAGES.—The 1909 catalog of the Rauch & Lang Carriage Company, Cleveland, O., is a well-executed pamphlet giving information in detail relating to electric pleasure vehicles. The carriages are built as runabouts, stanhopes, victorias, surreys and all of the various styles required in high-class service.

LAMP FITTINGS.—The British Thomson-Houston Company, Rugby, England, has issued, as price list No. 220, a bulletin devoted to tungsten lamp fittings, which have been developed for the purpose of running the lamps in groups so as to perform the work formerly accomplished by means of arc lamps.

ARC LAMPS.—A self-regulating arc lamp, designed without clockwork and intended for use with all standard values of current, voltage and connections, and with which either flamming electrodes or pure carbon electrodes may be used, is described in a catalog issued by the Regina Arc Lamp Works, Ltd., Cologne-Sulz, Germany.

INSULATION.—Of unusual interest is the catalog of the Massachusetts Chemical Company, of Walpole, Mass., which gives a résumé of the liquid, plastic and solid insulations, tapes, fabrics and molded rubber goods which it manufactures. The specific use for which each insulating material is best adapted is fully discussed.

PUMPS.—Price lists and brief descriptions of pumps intended for operation by means of small motors are contained in Bulletins Nos. 102, 103 and 104 of the Jarvis Engine & Machine Works, Lansing, Mich. Bulletin No. 101 gives general information concerning these pumps, while Bulletin No. 105 is devoted to automatic controllers for motor-driven pumps.

TELEPHONES.—The De Veau Telephone Manufacturing Company, 472 Eighteenth Street, Brooklyn, N. Y., has issued as its fourteenth catalog a 56-page publication, giving complete information concerning its various lines of telephones and telephone supplies. A price list is given relating to each of the devices dealt with, and circuit diagrams are shown for all of the usual telephonic arrangements.

AUTOMOBILE ROUTE BOOK.—The Studebaker Automobile Company, South Bend, Ind., has issued a 149-page automobile route book, which gives many popular routes between the principal cities of the Central States. It gives maps of each route, and also the total mileage and intermediate mileage of every route. Copies of this book can be obtained by addressing the route department of the company, at South Bend.

ELECTRIC SPECIALTIES.—The G. & W. Electric Specialty Company, 128 West Jackson Boulevard, Chicago, Ill., has issued a number of folders descriptive of its various electrical devices. Bulletins Nos. 30, 31, 32, 34, 35, 36 and 37 deal with pot heads, while combination pot heads are described in Bulletins Nos. 39, 41 and 42. Safety line disconnectors are treated in Bulletin No. 33, and ground pipe caps in Bulletin No. 38. An illustrated pamphlet, designated as Folder A, shows some typical installations where these devices are employed.

Business Notes.

CHARLES F. BEAMES has resigned from the staff of J. G. White & Company to accept the position of general manager of the Cobalt Power Company, Cobalt, Ont.

NEW FACTORY OF TRIUMPH ELECTRIC COMPANY.—The Triumph Electric Company will very shortly move into its new factory, situated in Oakley, a suburb of Cincinnati, Ohio.

THE ELECTRIC CONSTRUCTION COMPANY, Little Rock, Ark., will move to larger quarters on Oct. 1, owing to increase in business and the addition of a department for manufacturing and finishing chandeliers.

SUNBEAM HIGH-VOLTAGE TUNGSTENS.—The Western Electric Company announces that it is now in a position to furnish Sunbeam tungsten lamps in voltages between 200 and 250. The lamps are made in four sizes at present, namely, 45, 70, 112 and 180 watts, and have given up to date equally as good satisfaction as tungsten lamps of 110 volts range.

BLUMENTHAL-KAHN ELECTRIC COMPANY.—S. C. Blumenthal and A. Kahn have formed a partnership as electrical contractors and dealers in electrical supplies, with offices at 8 South Howard Street, Baltimore, Md. Both of the members of the firm were formerly with the Jos. M. Zamoiski Company, and have had a long experience in the installation of interior wiring and electrical construction generally.

WILLIAMS & WILSON have opened an office at 39 Cortlandt Street, New York, N. Y., as dealers in electrical specialties, and will represent several large firms with standard lines, and the experience of these two men in the electrical field insures success. Mr. J. E. Wilson for the past nine years has represented the Stuart-Howland Company, of Boston, Mass., in the New York State territory, and previous to that was for nine years with the Pettingell-Andrews Company. Mr. G. G. Williams, of this firm, has also had a large experience both in selling and manufacturing.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED AUGUST 31, 1909.

[Conducted by W. F. Bissing,, Pat. Law, 2 Rector St., N. Y. City.]

932,426. TROLLEY REPLACER; W. M. Austin, Swissvale, Pa., and S. C. Cooper, Johnstown, N. Y. App. filed May 3, 1907. A spring pressed piston returns the trolley pole and arms above the wheel surround the wire and prevent the wheel from leaving it.

932,433. COVERLET; C. R. Bold, Charleston, S. C. App. filed April 10, 1909. Outlet box having detachable end sections with flanges to cover the ends.

932,441. ELECTRIC WELDING MACHINE; A. E. Buchenberg, Toledo, Ohio. App. filed Aug. 19, 1908. Separate work carrying means, a single transformer with its secondary connected with said means, and a mechanism to carry the current, the articles held by the work holder.

932,459. METHOD OF REDUCING AND MELTING OXIDS AND THE LIKE; O. Frick, Sheffield, England. App. filed April 19, 1907. Reduces the solid material by placing it between electrodes above an annular crucible and then melt the reduced material by induction.

932,469. ELECTRIC FURNACE; J. A. Hay, London, Eng. App. filed June 19, 1909. Has a passage for the limbs of the core and a winding and a metallic shield with a large radiation surface.

932,481. CURRENT INTERRUPTER FOR ELECTRIC CIRCUITS; F. W. Lord and F. W. Erickson, New York, N. Y. App. filed April 27, 1907. Includes two electrodes and a disk having a series of separate metallic segments with means for changing the relative positions between electrodes and segments.

932,505. ELECTRICAL SIGNALING SYSTEM; F. M. Slough, Elyria, Ohio. App. filed July 10, 1906. A plurality of current producing means individually driven at constant but different speeds with a synchronizer.

932,511. TROLLEY; N. W. Storer and T. Varney, Pittsburgh, Pa. App. filed Oct. 18, 1905. A pivotal arm having a piston rod connected thereto and movable switch contact member, both arm and switch being simultaneously movable.

932,519. TROLLEY FOR ELECTRIC VEHICLES; T. Varney and N. W. Storer, Pittsburgh, Pa. App. filed May 23, 1908. A trolley having a plurality of contact members and a wind vane for adjusting some of them as the speed increases.

932,523. INSULATOR FOR THIRD RAILS; E. M. Weaver, Ozone Park, N. Y. App. filed Sept. 10, 1908. A metallic standard with a flat ring-shaped seat at the top and inverted cup-shaped having ring face and a downwardly projecting portion.

932,537. DYNAMO-ELECTRIC MACHINE; A. L. Cushman, Concord, N. H. App. filed Feb. 15, 1908. A frame for the field and the commutating magnets, having a commutating magnet core besides the main core for overcoming armature reaction.

932,538. TROLLEY; H. P. Davis and T. Varney, Pittsburgh, Pa. App. filed Nov. 8, 1907. A supporting frame with a cross rod at its upper extremity and a pair of elongated contact shoes separated from each other and having lateral projecting arms with a spring to force the shoes together.

932,539. CURLING IRON HEATER; H. W. Denhard, San Francisco, Cal. App. filed Aug. 10, 1908. A heating chamber with a resistance coil in it and a central cone with electrical connections with a space between the cone and chamber.

932,541. ABNORMAL POTENTIAL DISCHARGING AND ARC DISRUPTING DEVICE; F. W. Erickson and F. W. Lord, New York, N. Y. App. filed April 27, 1907. For overhead transmission lines to prevent lightning flashes by an arc dissipator having a plurality of disks immersed in oil and driven by a motor.

932,545. TELEPHONE ANTISEPTIC MOUTHPIECE; J. M. Haff, Los Angeles, Cal. App. filed April 24, 1907. A telephone mouth-

piece having a lining, an absorbent antiseptic disk and a gauze retainer to secure the disk in the lining.

932,584. TROLLEY; R. P. Jackson and C. Aalberg, Wilkinsburg, Pa. App. filed April 28, 1906. The base is supported by pointed links pressed by a spring and piston.

932,557. SWITCH HOOK CONTROLLING DEVICE; M. M. Kahn, Louisville, Ky. App. filed Oct. 29, 1908. For holding the receiver by means of an arm attached to the transmitter support and weighted to cut out the line.

932,570. SUPPORTING PIN FOR INSULATORS; F. A. C. Perrine, (Deceased) Plainfield, N. J. Application filed Oct. 1, 1903. Vertical metal tube with its lower end flanged through which a securing bolt passes.

932,613. ARC LAMP CUT-OUT; L. E. Jones, Anaconda, Mont. App. filed Jan. 28, 1909. A hanger having a cylinder of conducting sections and insulating material. Details.

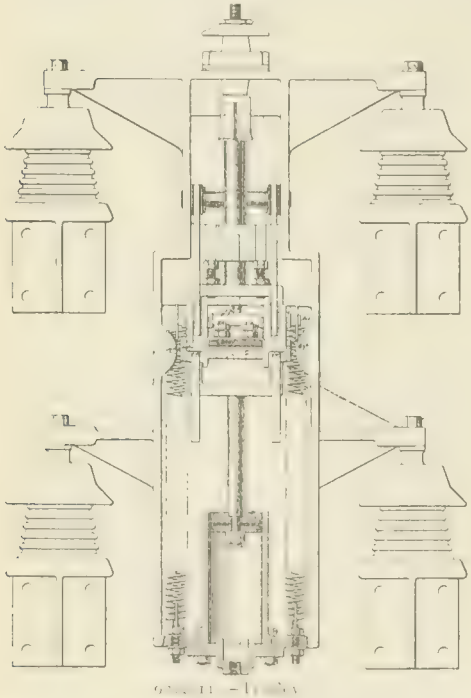
932,616. BRUSH FOR DYNAMO-ELECTRIC MACHINES; E. R. Knight, Norwood, Ohio. App. filed Feb. 7, 1906. A carbon block has a channel engaging a guide plate with a conductor clip on the opposite side of the brush.

932,622. COMPOSITION OF MATTER; T. D. Lynch, Wilkinsburg, and J. Crane, Swissvale, Pa. App. filed Jan. 10, 1908. An insulating cement containing asphalt, brick dust, china clay, etc.

932,625. INDUCTION MOTOR; E. Mattman, Norwood, Ohio. App. filed Sept. 5, 1905. A shaft having a plurality of collector rings with winding terminals connected thereto with an axially sliding member for short-circuiting the rings.

932,627. WINDOW COVERING; J. E. Medland and L. E. Capps, Seattle, Wash. App. filed Sept. 10, 1908. Guard consisting of hollow rods, holding a fluid which when the fluid runs out rings an alarm.

932,637. CONTAINER FOR SECONDARY BATTERIES; E. L. OPPERMANN, London, Eng. App. filed Aug. 22, 1908. For holding batteries, consisting of a thin metal frame lined with vulcanite.



932,641. DYNAMO-ELECTRIC MACHINE; W. D. Pomeroy, Norwood, Ohio. App. filed June 16, 1906. A stator for integral bearing housings, a rotor with adjusting wedges for the rotor shaft and bolts for holding them in position.

932,642. TROLLEY; T. Varney, Pittsburgh, Pa. App. filed Jan. 15, 1906. A contact member and a pantograph therefor with a spring for expanding the frame, and pneumatic means for collapsing the frame.

932,652. TROLLEY FOR ELECTRICAL VEHICLES; T. Varney, Pittsburgh, Pa. App. filed April 5, 1907. Sliding trolley with auxiliary contacts having springs adapted to follow the variations in the supply line.

932,653. TROLLEY; T. Varney, Pittsburg, Pa. App. filed April 5, 1907. A supporting frame and galvanized steel contact plate having an upward curvature at each end.

932,654. TROLLEY; T. Varney, Pittsburgh, Pa. App. filed Nov. 8, 1907. A supporting frame and a pair of bow contact shoes with their bow faces outward and rotatively adjustable relative to the frame.

932,655. TROLLEY FOR ELECTRIC VEHICLES; T. Varney, Pittsburgh, Pa. App. filed April 22, 1908. As the speed increases, wind actuated vanes press the contacts mounted on a pantograph with increased force against the wire.

932,656. TROLLEY FOR ELECTRIC VEHICLES; T. Varney, Pittsburgh, Pa. App. filed Oct. 7, 1908. A main shoe and auxiliary strips, parallel to the main member.

932,661. DIRECT-CURRENT TURBO-GENERATOR; A. H. Wouters, Norwood, Ohio. App. filed Nov. 3, 1906. A laminated core, coils and an end clamp with an annular shoulder.

932,662. ROTOR CONSTRUCTION; A. H. Wouters, Norwood, Ohio. App. filed Jan. 31, 1907. A shaft, a core, windings, a collector ring and overlapping straight rods for connectors.

932,700. AUTOMATIC MAIL CARRIER; P. M. Hacking and A. H. Bastian, Milwaukee, Ore. App. filed July 11, 1908. An electric motor driven telpher on a trolley wire.

932,707. ELECTRIC LOCOMOTIVE; W. F. Hunt, New York, N. Y. App. filed Nov. 21, 1907. Circuits including storage battery, a three-arm trolley and two contacts connected to one side of the motor, the other side being connected to the trolley contact.

932,753. CALL BOX; H. S. Bullock, Jr., New York, N. Y. App. filed Jan. 17, 1907. A break wheel and brush with a driving member moving a shorter distance for one class of signals than the other.

932,773. ELECTRIC ARC LAMP; J. B. Fournier, Paris, France. App. filed Nov. 21, 1903. Regulator includes an automotor elastic tube with a spiral tube therein, a resistance between the spirals, the tube filled with liquid. For each vapor pressure, the end of the tube assumes a definite position.

932,775. ELECTRO-THERAPEUTIC INSTRUMENT; C. W. Gaston, Fresno, Cal. App. filed June 5, 1909. A tube open at both ends and exteriorly grooved with wires of opposite metals in the grooves.

932,792. SWITCH FOR ELECTRIC LAMPS; E. A. Lefebre, Jr., and W. I. Miller, Brooklyn, N. Y. App. filed Jan. 13, 1909. An insulating block with a two part shaft thereon and a rotatable contact maker secured to one pair of the shaft and insulated therefrom.

932,799. COHERER; W. W. Massie, Providence, R. I. App. filed Aug. 16, 1905. Like patent No. 809,119 with special construction of bridge so that it can be separated from the supports without throwing tapper out of adjustment.

932,819. OSCILLIAMETER; H. Shoemaker, Jersey City, N. J. App. filed Dec. 11, 1906. For producing and measuring wave lengths of definite frequency by means of a condenser and inductance and scale.

932,820. TRANSMITTING APPARATUS; H. Shoemaker, Jersey City, N. J. App. filed Aug. 19, 1907. On oscillation circuit containing pairs of inductance and a capacity, the pairs in parallel with means for discharging the capacities through the inductances and an oscillation circuit in getting its energy therefrom.

932,821. TELEPHONE AND TELEGRAPH TRANSMITTING APPARATUS; H. Shoemaker, Jersey City, N. J. App. filed July 25, 1908. Wireless telegraph having a continuous oscillating circuit of a low, natural period above the limit of audition, a high frequency, disruptive oscillation circuit, deriving energy from the first circuit; a radiator and means for controlling the radiator to represent a signal.

932,835. ELECTRIC FURNACE; J. B. Trillon, St. Jeoire, France. App. filed July 6, 1907. Two electrodes and a conducting bath forming two hearths with a third conductor for the return current.

932,841. BATTERY COVERING; G. E. Andrews, Providence, R. I. App. filed May 21, 1909. Two part rubber covering for making the battery water tight.

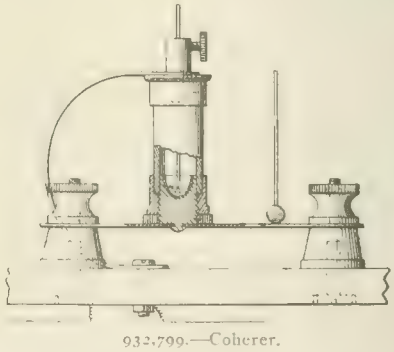
932,863. CIRCUIT BREAKER; J. B. and H. E. Howe, Windber, Pa. App. filed March 19, 1909. For trolley wires. Details.

932,877. AUTOMATIC SYNCHRONIZER; H. Marshall, Vance, Colo. App. filed Oct. 6, 1906. For connecting an alternator to busbars by means of transformers, synchronizing switches, and a trip switch.

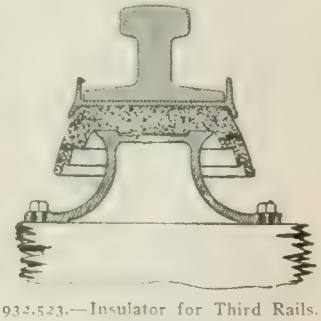
932,883. PUSH BUTTON ELECTRIC SWITCH; L. H. Moulthrop, Bridgeport, Conn. App. filed Nov. 12, 1908. A contact member and a detent comprising a spring acting as a retaining member.

932,896. ELECTRIC MOTOR; O. H. and A. F. Pieper, Rochester, N. Y. App. filed June 21, 1909. Suspended within a bracket; the field formed of disks.

932,897. DYNAMO-ELECTRIC MACHINE; A. A. Pifer, Cleveland, Ohio. App. filed April 1, 1909. A plurality of poles each with two pole pieces adjustable circumferentially and tapered.



932,799.—Coherer.



932,523.—Insulator for Third Rails.

932,898. ART OR PROCESS OF PRODUCING OZONE; J. F. Place, Glen Ridge, N. J. App. filed Feb. 26, 1909. Evaporates oxygen gotten from the atmosphere and mixing the vapors with air and conducting through an ozonizer.

932,913. RECEIVING APPARATUS; H. Shoemaker, Jersey City, N. J. App. filed April 28, 1905. A looped aerial with a wave responder in one loop and an adjustable inductance bridging the legs of the loop.

932,935. GAS LIGHTER; W. D. C. Wright, Philadelphia, Pa. App. filed Sept. 19, 1908. The handle contains batteries and a spark coil. Details.

932,966. ELECTROTHERMOSTATIC HEAT REGULATOR; L. G. Copeman, Berkeley, Cal. App. filed Oct. 1, 1908. A movable electric heater with inferior resistances and a main heat circuit, a hood, a thermostat within it and a shunt circuit controlling the main heat circuit.

932,970. ELECTRIC LIGHT CORD ADJUSTER; O. Dodge, Colorado Springs, Col. App. filed Oct. 12, 1908. For drop lights having a spring actuated drum for the cord.

932,984. TROLLEY POLE BASE; C. C. Hale, Wapakoneta, Ohio. App. filed Feb. 17, 1909. The base is mounted in a housing and is carried on ball bearings.

932,986. TRANSFORMING SMELTING FURNACE; H. Helberger, Munich, Germany. App. filed Sept. 11, 1908. Terminal electrodes with secondary windings clamping a crucible between them, the electrodes having ducts for a cooling medium.

932,998. TROLLEY GUARD; F. V. Polakoskey, Peekskill, N. Y. App. filed March 17, 1909. A wheel with a bracket and vertical levers hinged thereto and above the same to surround the wire.

933,011. CIRCUIT MAKING AND BREAKING DEVICE; H. S. Baker, Wilkinsburg, Pa. App. filed March 23, 1906. For alternating current in which an elastic movable arm with a contact piece at one end is provided and has a retarding device at one end of the arm.

933,027. ABNORMAL POTENTIAL DISCHARGING AND ARC DISRUPTING DEVICE; F. W. Erickson and F. W. Lord, New York, N. Y. App. filed July 11, 1908. For lightning discharges. A plate driven by a motor lies between two electrodes for the spark gap.

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It is with deep regret that we announce the resignation of Mr. T. C. Martin as co-editor of the *Electrical World*, in order to assume the position of General Secretary of the National Electric Light Association. While this step will not entail a complete severance of editorial relations, the departure of Mr. Martin will be keenly felt by his associates and, we believe, also by the electrical public which he has so ably and so loyally served in a journalistic capacity for more than a quarter of a century. One of the founders of the National Electric Light Association, Mr. Martin has continuously been closely associated with the activities of that body, which some years ago in recognition of valuable service transferred him to the dignity of honorary membership; and as electrical special agent of the United States Census Bureau for the past nine years, he came into still closer contact with the central-station industry represented by the association. Consequently, when the recent great growth of the body brought sharply forward the necessity of a permanent executive officer, the selection was obvious, and acceptance was urged as a duty. While the answer to the call has entailed a loss to this journal, it feels in compensation that Mr. Martin in his new field of effort will continue a powerful factor in the advancement of the electrical industry, and particularly of the active branch on which he will now concentrate his great ability and rare executive talent. The field of work is vast, and with proper cultivation the results possible are beyond present measure; and we can divulge that a strong hesitation on the part of Mr. Martin to leave the journalistic field was only overcome through conviction as to the great future before the National Electric Light Association, and a desire, bred by his long connection with it, to contribute toward advancing our national central-station organization to a leadership among the great industrial organizations of the world.

The Plant of the Great Western Power Company.

It is altogether an off year when the coast does not furnish something instructive in the way of advances in hydro-electric work. The coast got into the game at the very start and has stayed right with it. An article elsewhere gives some interesting details of the electrical part of the equipment in addition to the account of the hydraulic works published some weeks since. The latter in themselves involved some innovations which would cause comment anywhere. Not only were the penstocks the largest ever built for similar head, but the turbines themselves were of record size, 18,000 hp, and are being used on what is certainly a record head for turbines of any size—525 ft. Reaction turbines such as these have commonly been used for moderate head only, but the requisition of great capacity at an economical speed for the generators made

turbines in this case far more desirable than the ordinary impulse wheels commonly used for these high heads. When it came to the generation of 10,000-kw output at 400 r.p.m., records were again attacked, this time in efficiency of high-voltage machines. Of course, winding machines so large as these for 11,000 volts is much less likely to cause loss of efficiency than in smaller units, all the windings being on a large scale; yet to pass 97 per cent at full load is a very notable feat. An interesting subsidiary feature is a hydraulic brake bearing on a ring at the base of the rotor by which the machine can be held in case of a leak through the wheel, or be checked quickly in an emergency.

The transformers are likewise of record size, being three-phase units of 10,000-kw output with an adroit combination of natural and water cooling. The normal voltage is 100,000 on the high-tension side, although taps are provided for 60,000 volts, at which the plant starts off. The full-load efficiency is 98.5 per cent, which leaves little to be desired. When one realizes that the combined generator and transformer efficiency in this plant rises to the full-load value of at least 95.5 per cent, it is sufficiently obvious that there is small improvement possible within the generating system. It is worth noting, too, that the generator efficiency is rising even at full load, so that the overload efficiency should be still very good. The line construction is interesting from the long spans used. The towers are about 71 ft. high, an unusually large figure, and are spaced at about 750 ft., while the line includes two spans of 3000 ft. on special towers. The obvious advantage of fewer points of support is an encouragement in the use of long spans, and we are glad to see the principle thus carried forward, although it would be interesting to know whether the present case is not quite near the limit of economical construction. With higher towers carrying relatively large wires, the general construction has to be very considerably strengthened, so that a point must be reached where one would find that cost could be lowered by using more and slenderer towers. This much is clear, that in work at very high tensions the tower line, or at least a line with long spans carried by the suspension type of insulator, is of the utmost value. The line here considered is an admirable specimen of the application of modern methods, and it is pleasant to recognize in the general manager of the system the pioneer in three-phase transmission on this side of the Atlantic.

The High Line in Voltage.

We give elsewhere in these columns some further details of the Grand Rapids-Muskegon plant, the first in the world to pass the 100,000-volt limit. It has been, upon the whole, singularly successful in securing effective and continuous service, and it is not too much to say that, upon the whole, it has done better than most plants at half the voltage. There is perhaps no especial secret in its success save very good construction and constant care, yet there are two elements which are worth comment in this connection. In the first place, it is equipped with suspension insulators, which are unquestionably better adapted for extreme voltage than any pin type of insulator yet devised, since by adding disks in tandem one can get any reasonable factor of safety without serious mechanical complication. So long as one adheres to pin construction, he deals with an arrangement that is essentially mechanical, the parts being badly arranged for the strains which must be borne. Second, the plant as a whole is free from unnecessary switching complications. The whole of each line is in permanent connection clear back to the generator leads. Even the switches in these are plugged shut. The load-limiting devices are in the distributing system, and short-circuits can do little harm by reason of the waterwheels giving up under any dangerous overload. Possibly this simplicity may be excessive, but it is a relief to see it after looking over systems in which one set of safeguards is set to watch over another until their aggregate is something terrible to pay for, and no joke to keep in order. Why should not a generator and its transformer be taken as a unit when the dimensions of the system permit? Surely this plant, enormous as is the voltage, has made good in a fashion that needs no apology, and at a cost far less than that of some much be-switched contemporaries.

New England and Pennsylvania Electric Light Conventions.

Elsewhere are given reports of the meetings last week of two of the youngest electric light associations, both of which, in attendance and discussion of papers, commence their convention careers in a manner that augurs well for the future. Indeed, some of the older bodies would find it difficult to select a record from their past which would equal that made at Portsmouth or Eagles Mere. At both of the conventions the leading topics were exhaust steam heating and, naturally, the tungsten lamp. It seems remarkable that there are only three exhaust steam heating plants in New England, while Pennsylvania counts 69. The advantages of the tungsten lamp to the central station in meeting gas competition and in popularizing the use of electricity, are evidently being appreciated increasingly by the central stations of the country. The difficulties of manufacturing a robust 110-volt tungsten lamp has evidently caused one company at least to take the bull by the horns and go back to the low-voltage lighting system which was in vogue many years ago. On alternating-current distribution circuits this is an easy matter, since it requires only the installation of a transformer giving a secondary e.m.f. of 50 or more volts instead of 110 volts as at present. Coupled with the longer life of low-voltage tungsten lamps the advantage is claimed that the ordinary 16-cp carbon-filament lamp can be displaced by a 50-volt or 60-volt tungsten lamp without necessitating any change in the present standard fittings or number of outlets. By a mere substitution of lamps in the same sockets and a reduction in voltage, the same distribution and illumination are retained while the cost of the illumination is reduced and the life of the lamps increased.

Enthusiasm over the work of the national association and its Pennsylvania branch was the keynote of the convention at Eagles Mere, where the attendance reached the 200 mark. Each of the papers presented partook of the nature of a report submitted by a committee, there having been assigned for its preparation an editor, with usually two or more assistant editors. Thus, the thoughts expressed represented a consensus of opinion of several rather than that of one man. Although this plan tends to eliminate personal opinion, yet it seems to invite rather than discourage discussion of the paper after presentation. This result is attributable to the fact that the participants doubtless held that they were discussing in an

impersonal manner the statements made in the paper and would not be considered as criticizing the author. While none of the papers could be characterized as dealing exclusively with local topics, yet there was in evidence a desire to limit the discussion to points of local interest and leave to the national association the discussion of topics of the more general features of the electric lighting business.

A New Type of Constant-Current Machine.

The constant-current dynamo was well known and much used in the earlier days of series arc lighting, although in recent years it has fallen into disuse, owing to the development of the constant-current or "tub" transformer. There were various types of constant-current dynamo, but a common expedient for maintaining constancy of current under varying load was to rotate the brushes around the commutator, by an automatic apparatus controlled by a current-measuring device. A new type of constant-current machine has been recently described in a paper by Herr Von Ch. Kraemer, before the Cologne convention of the Verband Deutscher Elektrotechniker, which is abstracted in the Digest. It consists essentially of a double compound machine in which there are three m.m.fs. acting, viz., a shunt m.m.f., a series m.m.f. and a separate m.m.f. The two latter are mutually opposed and cancel at normal operation, leaving the machine entirely shunt-working under such conditions. If the external resistance in the circuit of the machine is diminished, the series winding tends to overpower the separate winding, and opposes the shunt winding, thus lowering the generated voltage; whereas, if the external resistance increases, the series winding tends to weaken and the separate excitation tends to aid the shunt winding—the result being that the generated voltage rises until normal current strength is restored, provided that the working range of the machine is not exceeded.

A number of applications are given for this triple m.m.f. type of machine, of which the supply of current to a searchlight may be taken as an example. The usual method of operating a searchlight on board ship is to take current from the lighting mains through a ballast resistance. This is an objectionable method when powerful searchlights have to be used, because the large current required calls for a cumbersome and wasteful resistance. By inserting a local motor-dynamo, the dynamo being of the new constant-current type, the installation is made more compact and less wasteful of power. The dynamo may be short-circuited without giving rise to excessive current, and the current will be automatically maintained constant for all working conditions of arc length, from actual contact of the carbons to widest normal separation. The applications described as already existing for this machine relate at least as much to motor as to generator service.

Vibration Galvanometers.

During the last few years a new species of galvanometer has come into existence called the vibration galvanometer. This instrument is restricted to alternating-current measurements. It hardly gives any deflection with a direct current. Moreover, it will not respond effectually to any and every alternating current. The movable system has a certain free mechanical vibration-frequency. Within certain limits, this mechanical vibration-frequency is capable of adjustment. When the instrument is connected to an alternating-current circuit, so as to receive a feeble alternating current, there is very little response, unless the mechanical vibration-frequency of the movable system agrees with the alternating-current frequency, and then the deflection becomes very large. The alternating electromagnetic forces acting on the movable system set up mechanical resonance and build up a large swing. A form of vibration galvanometer that has become fairly well known consists essentially of a thin steel wire, placed so as to be free to vibrate in an alternating magnetic field produced by the current to be measured. The amplitude of the vibration is observed optically. Care has to be taken to tune the wire to the frequency of the circuit, and when this adjustment is correct, the deflection is very much greater than when the wire's mechanical frequency disagrees with the current frequency.

The advantage of a vibration galvanometer is that, when the alternating-current frequency is constant, a large deflection is obtainable, or the sensitiveness of the instrument is high. A peculiar fact about the behavior of the instrument is that it does not respond to harmonics in the current; but only to the fundamental sinusoid in the current. This property is sometimes an advantage, and sometimes a disadvantage. Even when it is a disadvantage, the advantage of sensitiveness in the instrument usually preponderates, because it is very difficult to make a galvanometer for alternating currents that shall have anything like the sensibility of the ordinary direct-current galvanometer. Another peculiarity of a vibration galvanometer is that it is a veritable alternating-current motor, and develops a very appreciable counter e.m.f. In fact, its sensibility depends upon the magnitude of this e.m.f., because the power absorbed in the movable system is the cophase product of the current and this e.m.f., and the smaller the damping force, the larger must be the vibration amplitude in order to dissipate this power.

In a paper recently read before the Physical Society of London, Mr. W. Duddell describes a new form of vibration galvanometer which possesses particular advantages. It consists essentially of a Duddell bifilar oscillograph, except that the suspension, instead of being damped by oil to an aperiodic condition, is left free to vibrate, in air, with as little damping as possible. The range of frequency adjustment is unusually large—from 90 to 1900 cycles per second—which is obtained both by altering the length of the wires and by varying their tension. The sensibility claimed for this new form of vibration galvanometer, within the range of its frequency, is very high. It is said that a few thousandths of a micro-ampere can be detected. The instrument promises to be of great service to the telephonist. At the same time, the resonance is so sharp that a very small change in frequency may affect the deflection of the spot of light materially. Thus, at a frequency of 595 cycles, a certain strength of current gave a deflection of 290 mm at 1 m scale-distance. At this frequency the tuning was correct. At 580 cycles, and again at 600 cycles, the deflection with the same current fell off to 50 mm. That is, a change of about 2 per cent in the frequency reduced the deflection to one-sixth of its former value. This means that great care will be needed to keep the frequency constant, and the instrument sharply tuned, when accurate measurements are made. Nevertheless, there can be little doubt that Mr. Duddell has introduced a distinct improvement into galvanometers of the vibration type.

New York Edison Entertains Philadelphia Electric.

On Saturday, Sept. 11, the Association of Employees of the New York Edison Company entertained the athletic association and guests of the Philadelphia Electric Company, the ocasion being the annual baseball game between the teams of both companies. The official guests, officers and committees of the New York Edison Company embarked from Pier 1, North River, on the steamboat *Majestic*, proceeding thence to the Adams Express dock adjacent to the Pennsylvania Railroad terminal in Jersey City, to meet the special 12-car train bearing the Philadelphia contingent. The latter numbered about 600 and included the company's officers and the entire Board of Fire Underwriters from the Quaker City.

When all were on board, the *Majestic* steamed down the river to the bay, passing the Statue of Liberty, around Governor's Island, proceeding up the East River along the Brooklyn shore as far as Man-of-War Rock, south of Blackwell's Island. Luncheon was served on the trip up the river, and after an exchange of salutes at the Waterside station, the boat headed down stream again along the New York shore, rounding the Battery and continuing up the North (Hudson) River, passing the Soldiers' and Sailors' Monument, Grant's Tomb and the Shadyside property of the New York Edison Company, landing at 158th Street. Here 40 automobiles met the party and conveyed it to the American League Baseball Park, 165th Street and Broadway, where, amid the usual din, waving of flags, etc., the Philadelphia and New York teams met on the gridiron before an audience of approximately 10,000 people.

The exciting game which followed was started by Miss A. Murray, daughter of the general manager of the New York Edison Company. The score remained 1 to 0 in favor of the New York team until the sixth inning, when four more runs were made and from that on to the end of the ninth inning no changes were made in the score, which at the end of the game was 5 to 0 in favor of the Edison team. After the game, the automobiles were again pressed into service, the party being driven to Pabst's Harlem Casino, on 125th Street, where covers were spread for 1200. At the conclusion of the dinner, short speeches of a felicitous nature were made by Mr. T. E. Murray, general manager and vice-president of the New York Edison Company, and Mr. J. B. McCall, president of the Philadelphia Electric Company. The Philadelphia guests were then escorted in automobiles down Seventh Avenue and the "Great White Way" to the Twenty-third Street Ferry and put aboard their special train for Philadelphia again. The general opinion expressed was that few ever crowded such a variety of amusement into nine hours and a half.

Consolidation of Central-Station Companies in Michigan.

At the meeting of the Electric Club, of Chicago, on Sept. 8, Mr. H. F. Holland, chairman of the membership committee, presented a report in which he said that the club has a membership of 250 and that a determined effort is to be made to secure a membership of 1000. The club was organized early last year, and is incorporated under the laws of Illinois. Its membership embraces many electrical men of prominence. Meetings are held every Wednesday after a mid-day luncheon, and at these some speaker is provided who addresses the club on a topic of current interest, the principal address being followed by a discussion. The annual dues are $5 a year, and the initiation fee is $5. At some future time the club hopes to secure permanent quarters, although this project will probably be held in abeyance until the membership is largely increased. In the meantime the weekly luncheons are held in the grill-room of the Chicago Automobile Club, which serves a table d'hote luncheon.

On the invitation of President Howlett, Mr. W. H. Zimmerman, late manager of the Michigan Power Company, of Lansing, Mich., addressed the club briefly on the subject of the marked tendency toward the consolidation of small electric power companies in the State of Michigan. He said that 18 power companies were recently incorporated in one day in that State. This movement has been characterized by great activity, and is watched closely by the people of Michigan. Many people of prominence are interested in it. There has been some suspicion on the part of the public that these combinations would result in an increase in the price of electricity, but there is really nothing to fear in the matter of excessive rates; indeed, the tendency is distinctly in the other direction, it being the undoubted policy of the new companies to make lower rates as the result of the economies effected by consolidation. Apparently the public is now satisfied that these combinations are not detrimental, and everything indicates that the outcome of the movement will be of great benefit to the communities affected. In Lansing a large number of small manufacturers have been attracted by the low rates for electrical energy. It would seem that this tendency toward the consolidation of electric power companies is one form of combination which is of general benefit.

Chicago Street-Railway Labor Situation.

While it appeared several weeks ago that the dispute between the street-railway companies of Chicago and their employees in relation to wages was settled to the satisfaction of both sides, the proposed settlement was not accepted by the men when they voted on it, although their representatives had expressed themselves as satisfied with it. Negotiations have been continued since that time, but so far with no definite result. The situation is complicated by the fact that there are two large companies in the city, and their policies in dealing with the men are not identical. The men say that the companies may be consolidated later and that it will be wise for them to make a uniform settlement throughout the city. Mr. Walter L. Fisher, a lawyer acting for the city in the effort to effect a compromise, makes this statement: "I am afraid that we have exhausted the possibilities of negotiation. When one of the companies refuses to join in a proposition because the wages are too high, and the men employed on the other line reject the same proposition because the wages are too low, there seems to be nothing to do but leave the entire matter to a board of arbitration whose decision shall be binding on both parties." If the dispute cannot be settled by arbitration, there is still a prospect that there may be an extensive street-railway strike in Chicago.

New Colorado Hydro-Electric Project.

Col. C. E. Apponi, of El Paso, a well-known consulting engineer, is promoting the project of establishing a great hydro-electric plant on the Colorado River at what is known as The Needles, situated about 25 miles south of Powell, Ariz. Colonel Apponi secured the water rights to a strip of the river territory five miles in length at the first rapids, and it is at that place the plant will be located. A complete survey of the location has been made, and a syndicate of Milwaukee has been interested. The initial plant will have a capacity of 30,000 hp, which can be increased from time to time as the demand for power may require. It is planned to build a number of transmission lines and to supply towns and industrial plants within a radius of 170 miles of the generating plant. There are many mines within the proposed radius that will also be given the opportunity of using the cheap power. In order to utilize the flow of the river, a large dam will be constructed. In connection with the hydro-electric project the water from the storage reservoir will be conducted by means of a system of canals over a large scope of land, which will be made productive by means of irrigation. The plans call for the expenditure of more than $2,000,000.

Mexican Hydro-Electric Projects.

The great benefit accomplished through the introduction of electric power in mining operations in the districts of Guanajuato, El Oro and Pachuca have given a great impetus to the installation of electric power plants in different mining sections of Mexico. The largest of these proposed hydro-electric plants is that which a Canadian syndicate, headed by Dr. F. S. Pearson, is preparing to erect on the Conchos River, near Santa Rosalia, State of Chihuahua, and which will generate power for transmission to the mining districts of Santa Eulalia and Parral. Many smaller hydro-electric projects are on foot. Most of them have in view the furnishing of electric power for mines and reduction mills. The Mines of Mexico Company, of Denver, Col., which obtained a concession from the Mexican Government several months ago for the installation of a large hydro-electric plant on the Mayo River, in the State of Sonora, has had the surveys made for the proposed plant and necessary dams and the active work of construction will soon be started. The sites for three dams were located. The hydro-electric plant will be located near Alamos. This place is in the center of a rich mining territory. It is planned to build several transmission lines for the purpose of furnishing power for mining districts situated within a radius of 175 miles. The company has extensive mining interests of its own in that section which will be greatly benefited by the securing of this cheap power.

Mr. L. E. Curtis, of Colorado Springs, Col., vice-president, treasurer and general manager of the Guanajuato Power & Electric Company, the Michoacan Power Company and allied interests, is of the opinion that the field for the use of electric power in Mexico is very broad outside of the mining industry. This American concern is the pioneer electric power enterprise in Mexico. It has its main hydro-electric plant at El Duro, State of Michoacan, and has transmission lines running into the Guanajuato, Irapuato and other mining and industrial districts. In discussing the affairs of his companies, Mr. Curtis said:

"We are increasing the capacity of our plants by inaugurating the work of constructing a new plant which, when completed, will bring the company's total capacity up to 21,000 hp. I find conditions auguring well for the future. The mining companies are now using electric power to the exclusion of all other methods for driving their machinery. They find it cheaper and far more convenient than any other power. But our operations have been increased very greatly by the more universal use of electricity in driving the wheels of industrial concerns in localities where mining is not carried on. The farming region in the States of Guanajuato and Michoacan are taking to electric power rapidly, and the factories in the territory reached by our transmission lines are adopting the power with hardly an exception. Thousands of wells for irrigation situated in the vicinity of Celaya, Irapuato, Ocotlan, La Barca, Silao, Leon and other places are being pumped by electricity instead of the ancient, primitive methods which were formerly in use. Factories in these districts are making heavy demands upon our plants, and it is for the purpose of meeting these demands that we have just begun the construction of our third hydro-electric plant, which is to have a capacity of 10,000 hp."

Jose Enriquez Guzman will soon begin the erection of a hydro-electric plant on the Altar River, near Altar, State of Sonora. He will build a dam across the river to form a water reservoir for generating electrical energy, as well as to afford an abundant supply for irrigating a large tract of valley land. The electric power will be transmitted to towns and industrial plants in that region.

Public announcement is made by the Chapala Hydro-Electric & Irrigation Company that it has obtained a loan of $2,200,000 from the Caja de Prestamos of Mexico City. This money will be used to erect a new hydro-electric plant at Puente Grande, on the Santiago River, near Guadalajara, and in the construction of transmission lines to the mining districts of Etzatlan and Hostotipaquillo. The company has also obtained a loan of $3,000,000 from the Federal Government, through the Department of Fomento. The latter sum will be used to build a dike across a portion of Lake Chapala and in the construction of an extensive system of irrigation canals and ditches. The company has headquarters at Guadalajara. E. Pinson is general manager.

Adolfo Fartinez has obtained a concession from the Federal Government for the installation of a hydro-electric plant on the Quetzalpa River, State of Hidalgo. He has had surveys made for the proposed plant, and it is claimed that 10,000 hp can be generated. Transmission lines will be built to industrial centers in that section. Mr. Fartinez is said to be representing large financial interests in the proposed enterprise. He lives at Pachuca, State of Hidalgo.

Jose Riaz Rubin, who recently obtained a concession from the Federal Government for the utilization of the water in the Matamoros River for generating electric power, is preparing to build a dam across the stream and install a hydro-electric plant. He will furnish power to neighboring towns and industrial plants in that section. He lives at Puebla.

The Guanajuato Reduction & Mines Company has begun the construction of an electric railway which will run from its Las Playas mines to the yards at Tepetaya. The road will do a freight business exclusively, and will be one of a number of electric mining roads in the Guanajuato district.

Winnipeg (Manitoba) Electric Lighting Controversy.

There is a legal battle pending in Winnipeg, Manitoba, between the city and the Winnipeg Electric Company, the result of which will have an important bearing on electrical interests all over Canada. It has been made public that there are some 600 householders who have made application for electric service who are not able to obtain it, as the city does not wish to prejudice its case by issuing permits for the erection of electric light poles.

In 1904 a Winnipeg livery stable sued the city for $16.50 damages resulting to a carriage which fell into a street excavation which the company claimed was not properly protected. This excavation was made by the street railway company under the authority of a permit issued to the Manitoba Gas & Electric Light Company, whose interests and charter rights were acquired by the Winnipeg Electric Street Railway Company, now absorbed by the Winnipeg Electric Company. The city endeavored to make the company a third party to the suit, but the application was opposed on the ground that there was no such corporation as the "Manitoba Gas & Electric Light Company." This is the only company that ever made a contract with the city for the supply of electric light and gas. The city was, therefore, in the position of not knowing whom it was dealing with. Later, the city solicitor notified the company that it could not bring in power from outside the city's limits without first obtaining the authority of the city. The company, however, brought in the power and sold it, and in the fall of 1906, Nov. 12, the city filed a claim asking the courts to declare that they had no right to do so, and no right to erect poles on the streets, etc. Since then there have been various stages of legal proceedings, and, in the meantime, the city had stopped the issuing of permits. In response, however, to the importunity of citizens to get electric light a clause was drafted and added to the permits. This "without prejudice" clause inserted by the city on the permits was objectionable to the company and they returned the permits.

During the past week both parties to the litigation have isssued ultimatums. The Winnipeg Electric Company has notified the city that it will erect poles where it wants without any permit from the city. On the other hand, the city has notified the company that it will be given until Sept. 20, 1909, to furnish these 600 householders with light and take out pole permits as provided by the city bearing the "without prejudice" clause. In the meantime the company is erecting poles on any of the city streets where a new pole line is required and so far the city has taken no action.

Fremont (Ohio) Hydro-Electric Plant.

Work on the new power plant of the Fremont Power & Light Company, of Fremont, Ohio, will soon begin, the contract having been awarded. The plant will be located at Ballville, one mile south of Fremont, and water-power will be obtained from a fall of the Fremont River at that point. The plant will have a capacity of 2500 hp, with a reserve steam plant of 1000 hp, and the total cost will be about $600,000. The first work will be the erection of a reinforced concrete dam across the Sandusky River. It will be 260 ft. long, 27 ft. high and 36 ft. thick at the base. The power house will be erected down the river in the bottom land and the water will be conducted to it through a steel pipe 14 ft. in diameter and 3000 ft. long, with a fall of 42 ft. in that distance. The plant will take care of all the lighting and power business in and about Fremont and in addition it is said that power will be supplied to two or three electric railways.

The company was incorporated about four years ago, and has been financed by Cameron & Company, of Chicago. Robert B. Lyle, of Chicago, has been awarded the contract for construction, and Mr. Walter Putnam will be the superintendent in carrying out the work.

Hearing on Appeal Against Connecticut River Transmission Company's Franchise.

The Massachusetts Gas and Electric Light Commission gave a public hearing at the Worcester City Hall on Sept. 7 in connection with the franchise granted the Connecticut River Transmission Company by the Board of Aldermen in July last, an appeal having been taken to the commission by the Worcester Electric Light Company. By the terms of the franchise the transmission company is authorized to enter the city with its lines and to maintain a power supply in certain specified districts, the service of individual customers having a connected motor load of 15 hp and above being a prominent feature of the grant.

The case offers many similarities to the recently decided appeal of the Fitchburg Gas & Electric Light Company in connection with the transmission company. In the latter case the board ruled that the transmission company might enter the Fitchburg power market through the sale of energy to consumers having connected loads of 300 hp and over, suggesting an agreement by which the local central station should purchase power of the Connecticut River organization, leaving the latter free to engage in the logical business of delivering power in large blocks over wide areas without becoming enmeshed in the problems of local distribution. The Worcester company conducted its case on much the same grounds as the Fitchburg organization, and early in the hearing the transmission company expressed itself as willing to leave the small power business to the local system, along the lines suggested by the Fitchburg decision. The city authorities of Worcester, however, urged that the lowest feasible rates be given to all classes of consumers, and the hearing went forward on the basis of making clear the ability of the Worcester company to meet the demands of power consumers at reasonable rates and the special fitness of the transmission company to supply service in the larger power field which is, for the present at least, beyond the scope of the local central-station organization. The Worcester company's case was conducted by its counsel, Mr. Everett W. Burdett, of Boston; the transmission company's side was presented by Mr. Charles T. Tatman, of Worcester, and the city of Worcester was represented by Mayor James Logan and City Solicitor Ernest H. Vaughan.

Counsel Tatman opened the hearing by outlining the development of the transmission company, stating that it is now supplying power in Gardner and Fitchburg, and will shortly serve Leominster and Clinton from its new plant on the Connecticut at Vernon, Vt. A capacity of 12,500 kw is now installed, and in a short time, probably within four weeks, power can be delivered in Worcester. The ultimate capacity of the plant is 20,000 kw. The company plans to operate a 70,000-volt line to a substation in the northwest corner of Worcester over private right-of-way; then to step down to 13,000 volts for transmission through the city to the South Works of the American Steel & Wire Company. It is hoped to carry the line very largely on private property, and to enter into an agreement with the Worcester company for a rental use of its underground conduits in the business portions of the city. The Worcester company will not permit the use of its conduits unless a large minimum power unit is fixed in connection with local sales. The transmission company is willing to serve customers along its lines requiring any amount of power, large or small, as required by the city authorities, but will not consider it a hardship if the commission should place the limit as high as 300 hp, although it would prefer a lower limit.

Chairman Barker made public a letter from Chief Engineer F. H. Daniels, of the American Steel & Wire Company, which stated that the installation in Worcester of a 15-ton electric furnace was dependent upon the introduction of Connecticut River power. This furnace is to be used for high-grade steel. The furnace will cost about $60,000, and will be operated by electricity on a fuel-cost basis with Pittsburgh. Unless this cheap power can be secured the furnace will have to be located in Pittsburgh or Chicago, where energy can be generated cheaply from coal at $1 per ton or by gas generated from blast-furnace wastes. The company has contracted for 5000 hp from the transmission company and will produce a grade of steel never before attained in Worcester, and also give employment to about 300 additional men.

Counsel Burdett then introduced a new schedule of power rates effective Sept. 1 on the system of the Worcester Electric Light Company. He stated that these rates represent a considerable reduction from those previously in force, running from 6 cents to 2 cents per kw-hour instead of from 8 cents to 2 cents, and invited comparison with power rates in other similar territory. He said three companies in Massachusetts are furnishing power at less than 2 cents per kw-hour. The new Worcester schedule starts with a power rate of 6 cents per unit from 0 kw-hour to 150 kw-hours per month, falling off gradually to 2 cents for a consumption of 25,000 units per month and over. The rates are tabulated so that the maximum bill which each consumer in a class can pay is stated in the schedule, together with the connected load which he can operate on the maximum bill. Thus, a consumer using between 800 kw-hours and 1000 kw-hours per month secures his energy at 4.7 cents per unit, with a maximum possible bill for the upper limit of consumption of $45 and a 5.35-hp load. Mr. Burdett said that the Worcester company welcomes the entrance of hydro-electric power so long as it is confined to its proper field of serving large consumers. If the transmission company should be obliged to sell power to small consumers of 15 hp, as fixed in the franchise, the result would either be bankruptcy or higher rates to the large industries, assuming that all the business offered were taken up. An investment of certainly $1,000,000 would be necessary to establish a distribution system delivering hydro-electric power to small consumers independently of the Worcester company. The Worcester Electric Light Company had only recently equipped itself to meet the full anticipated development of its power system, but it is now in first-class condition to meet a greatly increased demand for power service.

Mayor James Logan, of Worcester, who is also general manager of the United States Envelope Company, submitted an exhaustive discussion of the cost of electric power in Massachusetts cities of about 100,000 population, and purporting to show that this class of business had been more extensively cultivated in other cities than in Worcester. The report was based on figures prepared for the city by Mr. William D. Marks, of New York, consulting engineer, and in a large measure reviewed Mr. Marks' data printed in the *Electrical World* of Sept. 2, 1909, page 555. Mr. Marks was present at the hearing, but was not called upon as a witness.

Mr. Henry I. Harriman, president of the Connecticut River Transmission Company, called for examination by counsel for the Worcester company, briefly reviewed the physical data of the system as presented in the Fitchburg case, and abstracted in these columns. Mr. Harriman stated that, in the main, small consumers require the supply of primary power, although in certain cases where the consumer has an economical steam plant of moderate size secondary power would be as acceptable as in the case of a large industry. The transmission company now has three customers in Fitchburg using over the 300-hp limit set by the commission in the decision upon that appeal, with possibly 10 consumers of this size. In Clinton it is planned to supply the Bigelow Carpet Company, the largest concern in the city, with 4000 hp. The principal customer in Worcester will be the American Steel & Wire Company, although there are about 160 possible customers in Worcester who take over 50 hp each. Mr. Harriman said that his company has acquired other rights than those at the Vernon dam, and plans to develop them as soon as the power market warrants. Mr. Burdett said that the transmission company can sell all the power generated at the Vernon plant within a comparatively short time to large customers, which means a comparatively small distribution expense in any particular center of consumption. No prices have been quoted in Worcester to customers of less than 50 hp.

Mr. Fred H. Smith, electrical engineer of the Worcester company, testified that the total available capacity for power service alone is about 3500 kw. The maximum power load is now about 500 kw, but within four weeks the demand is expected to be 1000 kw. The new rates will doubtless stimulate business. The total capacity of the plant for all purposes is about 5000 kw. There are now between 500 and 600 motors connected to the system.

Mr. Burdett, in presenting the closing argument of the hearing, reviewed the principles established in the Fitchburg case and emphasized the action of the Legislature in setting a 300-hp limit in the charter of the French King Rapids Power Company and the similar action of the commission in the Fitchburg appeal. He argued that the transmission company's field is large power business; that it could not maintain its expected rates and meet the ordinary charges of local distribution; that a water-power company cannot sell to a small user much cheaper than a well-equipped and operated steam plant, and that a much larger limit than the Aldermen fixed is necessary. He stated that the Mayor's figures were of data prepared in 1908, whereas the new power schedule submitted earlier in the hearing compared favorably with any other city of the same size in the country. Regarding the charges that Worcester had been remiss in the development of power business, he reserved the right to answer the Mayor's brief in full at a later date, if necessary. It was important to realize, however, that gross income is not the measure of profits, and that in some cities the net income is reduced by the taking on of unprofitable business.

Chairman Barker, in concluding the hearing, announced that the commission would give the situation the closest study and render a decision at the earliest date consistent with the importance of the subject.

Hearing on Economic Company's Franchise Case.

A hearing on the application of the Economic Power & Construction Company for approval of its franchises and construction at Geneva, N. Y., was held by the New York Public Service Commission, Second District, at Albany, on Sept. 8. Chairman Frank W. Stevens presided.

Mr. Herbert P. Bissell, for the Economic company, then stated the grounds upon which its petition was based. It was incorporated under a special act of the Legislature, which granted the right, Mr. Bissell said, "to enter upon and use the ground or soil in any street, avenue, public place or premises, etc., without other or further authority of law or ordinance: and that the question of the validity of this feature of the grant was tested in the courts of the State and a decision rendered by the equity term of the Supreme Court, sitting at Buffalo, validating the grant, and that that decision was afterward affirmed by the Appellate Division of the Supreme Court, sitting at Rochester, and that thereafter on appeal the decision of the equity term, affirmed by the Appellate Division, was reversed."

The Economic company acquired the bonds and stock and property of the Geneva Steam Heating Company. Following the absorption of this property a 20-year contract was made with the city of Geneva for the use for the distribution of electricity of the ducts which the city owned in the streets. Recognizing the obligation under the present construction of the law governing the Economic company, Mr. Bissell had come to ask the approval of the construction already done in so far as it related to the manufacture and distribution of electricity and the laying of any work in the streets, and also to ask for the right to proceed further with the plant at Geneva. He also wished to enter an objection against the right of the Geneva-Seneca Electric Company to object, declaring that that company had no franchise in the city of Geneva.

Mr. J. A. Bendure, constructing engineer of the Economic plant in Geneva and general manager temporarily of that company, testified that the Geneva plant had distributed electric light and power since June 1, 1908. It started with 42 consumers for electric light and power and now had 76. It was distributing during 10 hours a day an average of 70 kw for power and light, and from 6 until 10 p. m. an average of about 50 kw per hour. The business had been extended somewhat during the summer and could be extended more. Mr. Bendure stated that with one exception the rates were unchanged from those scheduled by the Geneva-Seneca company. About $40,000 had been expended in changing and re-equipping the plant of the Geneva Steam Heating Company. The receipts from the sale of electricity from June 1 to Dec. 1, 1908, were $3,030.03; the expenses for the entire plant, including the steam heating, were $5,154.28.

Commissioner John B. Olmsted asked the witness, if the rates were practically the same, what benefit inured to the public from the entrance of the Economic company. The witness said that his company gave better service.

Mr. W. S. O'Brien, corporation counsel of the city of Geneva, stated that the Economic company was to pay an annual rental of 5 cents per lineal duct-foot for the conduits leased, together with 100 kw electricity for lighting purposes each month. That provided a net annual revenue of between $400 and $500, or about 10 per cent on the investment of the city. The performance of the contract was secured by a bond for $25,000 filed with the board of public works. The franchise granted to the Economic company reserved to the city the control of the streets, and that was one of the principles for which the city authorities were striving.

Answering a question as to the franchise of the Geneva-Seneca company, Mr. O'Brien said that all that he could say was that he had been unable to find it. He had never been able to find one except as embodied in the public lighting contract.

Mr. Lansing G. Hoskins, attorney for the Geneva-Seneca company, said: "You have found resolutions outside of the public lighting contracts authorizing this company's predecessor to string wires and erect poles in the streets."

Mr. Bissell stated that the testimony of which the foregoing is an abstract represented the case of the petitioner, reserving the right to show that there was no franchise and the right to rebut.

Mr. Lewis E. Carr, of counsel for the Geneva-Seneca company, said he could not conceive that what had been offered made out any case justifying the application. He thought he would enter on the minutes a motion on the part of the Geneva-Seneca company to dismiss the application on the ground that the facts did not justify the grant of the permission asked.

Chairman Stevens said that before passing on this motion it

was due to the applicant to say that when the application was received the commission held an informal conference and he was instructed to rule that in view of the decision of the Court of Appeals the commission would have to treat the applicant as a new company making an appearance, so far as the purposes of proof were concerned, and it would have to adhere to precisely the same rules which it had in other cases. The commission reached that conclusion as a mere matter of practice without in any way prejudging any question which might arise. The case that had been made at the present time was that the applicant went into the city of Geneva and commenced to furnish electric light without a franchise from the city and without the consent of the commission; it did so under a claim of right and a charter which apparently gave, according to its terms, that right from the State. It had the decision of the Supreme Court upholding its rights. The Court of Appeals had held, on the other hand, that it had no such rights. It raised the question of who took the chances that the company was wrong when it went into Geneva under those circumstances. Did it take the chances or did the existing company take the chances? If Mr. Bissell desired to argue in any way that this view of the commission was wrong, the commission would be glad to hear him. If he acquiesced in that view, he would have opportunity to furnish further evidence.

Mr. Bissell stated that the company now had a franchise from the city of Geneva. There was some evidence that the company was needed at Geneva. Chairman Stevens said that where there was an existing company in the town the commission held that an inquiry must be made into the facilities afforded by the company and as to whether it was rendering proper and adequate service to the public. In the Niagara Falls case, although the Common Council of the city had granted a franchise to the applicant, the application was denied by the commission for the reason that the existing company was furnishing adequate service at adequate rates, except in some matters of service which were within the power of the commission to correct, and which it did correct, and also except as to some rates which the commission required the existing company to change in order to make them fair and reasonable. It exercised its powers over the existing company to correct whatever evils existed, and with those corrections made there was no reason for another company in the city.

In other cases the commission had granted franchises.

Mr. Bissell, in response, said he could not believe that a commission would undertake to overrule a grant from a city where a condition existed such as had been shown by Mr. Bendure.

Chairman Stevens answered that the commission had never apprehended that it was to receive the decision of the Common Council as final and conclusive, and it could conceive of no reason why it should.

Mr. Bissell said he should have said that it was very important evidence of the necessity of this company.

Chairman Stevens stated that the action of the local authorities always should be given some weight and some importance in these matters, but it was not to be conceived of that they were controlling in view of the fact that the Legislature had created another body to pass upon the franchise and had endowed it with power to say whether a franchise that had been given could be exercised.

Mr. Bissell asked for a hearing at Geneva at which citizens could testify concerning the situation.

Chairman Stevens said that the commission also felt that it ought to inquire into the financial organization of the Economic company. In previous proceedings it had been disclosed that the capital stock was $50,000, of which $48,000 had been issued as consideration for certain patents, which, he assumed, had expired by this time and which certainly related to something other than electric lighting. The property at Geneva was under a mortgage for its full value. In a case of this kind the commission went into its financial organization to see that it was organized in such a manner that it would be capable of carrying out its duties to the public as it should; if it should incur some liability by reason of accident, whether it would be able to respond in damages. In other words, the commission thought there should be a full understanding of the relation of this company to the holding company.

Mr. Carr said that the contention of the Geneva-Seneca company was that under the decision of the Court of Appeals the Economic company had no right to do what it was seeking to do in Geneva, not even with the permission of the commission.

The hearing was adjourned until Sept. 23 at Geneva.

Convention of the Pennsylvania Electric Association.

The annual convention of the Pennsylvania Electric Association was held at The Forest Inn, Eagles Mere, Pa., on Sept. 8, 9 and 10. This association was organized at Eagles Mere last September, as the first State chapter of the N. E. L. A., with 41 Class A members, no Class B members and 6 Associate members.

President L. H. Conklin, of Scranton, in his opening address reported that there are now enrolled 72 Class A members, 235 Class B members and 15 Associate members. There were about 200 present at this convention as against 85 last year. Following the president's address were the reports of the secretary and treasurer and reports of the committees on by-laws and overhead line construction. The report of the latter committee was in printed form, presented as a special guide to the Pennsylvania companies in the application of the recommendations of the recent report to the N. E. L. A. on this subject. It was felt that these data could be made particularly useful to Pennsylvania companies if the certain portions applying to the special conditions in Pennsylvania were revised and emphasized.

The report dealt with detailed specifications covering the methods for pole-setting, pole-guying, attachment of cross-arms, and for stringing of wires thereon, together with specifications for material in connection with the work covered, which specifications apply to series street lighting circuits and constant-potential circuits for e.m.fs. not exceeding 2300 volts.

In discussing this report Mr. Orr, of Pittsburgh, said that the importance of standardizing material could hardly be exaggerated, as it unquestionably leads to better material and better prices. He recommended the continuation of the present committee.

Mr. Greene, of Altoona, in speaking of his experience with poles, stated that he considered second-growth chestnut poles most satisfactory. On account of the difficulty he had had in securing poles, he has made it a practice to buy a year in advance and allow the poles to weather, piled up on skids, so as to be raised off the ground. He finds that these poles have twice the life of the green pole.

Mr. McCabe, of Lewiston, said that he had found that poles cut in February are far superior to those cut at other seasons of the year, as at that time they are entirely free from sap. He uses white pine cross-arms, air dried, and, before putting them into service, fills up all cracks and holes with putty and gives them a coat of white lead.

Mr. Camp, of Philadelphia, stated that the kind of pole which gives the best service depends largely on the nature of the ground. He has found chestnut poles superior in some localities, while in others Michigan pine, Maine cedar or Georgia pine was more lasting. Great interest was shown in the subject of poles and there was strong sentiment in favor of a further investigation on the part of the association.

In addition to the regular program, a list of "Pertinent Questions" had been prepared and distributed among the members. In answer to the question, "Have any of the member companies experimented with, or do they know anyone who has used, concrete poles for electric lighting pole lines?" Mr. Orr, of Pittsburgh, stated that the Allegheny County Lighting Company has done considerable experimenting with concrete poles, with very good results. This has been largely the reinforcing of partly decayed poles. Mr. Orr stated that a 35-ft. or 40-ft. pole can be reinforced for about $3.

Mr. Scroll, of Philadelphia, said that the cost of transportation and the hauling and handling of concrete poles are prohibitive.

Mr. Orr asked for the experience of the members with iron cross-arms, and a general discussion ensued; it seemed to be the sense of the convention that the use of iron cross-arms under ordinary conditions introduced an element of danger and weakness.

At this point, and before taking up the regular program, President Conklin introduced President Frank W. Frueauff, of the N. E. L. A., who addressed the convention and was very warmly received. Mr. Frueauff made a strong appeal for co-operation with the national association and outlined the mutual advantages which would be obtained. Mr. Frueauff announced that on Oct. 1, Mr. T. C. Martin, well known to the industry as editor of the *Electrical World,* will become permanent secretary of the N. E. L. A., to devote his time to the service of the member companies.

The paper on "Steam Heat in Connection with Central Stations," by Mr. Paul Muller, of Erie, was read by Mr. Fogerty, also of Erie, as Mr. Muller had been unable to reach the convention.

In this paper Mr. Muller expressed the opinion that as a matter of economy one can afford to drive generators by simple engines and dissipate the electrical output in rheostats merely for the return obtained from exhaust steam heating.

The paper called forth a very warm discussion. Mr. Byle, of Westchester, in answer to criticisms by Mr. Penrose, stated that in the operation of a heating plant, he had found that in the evening, after a hard day's service, as the peak of the electric load comes on and he is able to turn more exhaust steam into the mains, the load on the boiler seems to decrease, and often the furnace doors are opened to check the pressure.

A motion was passed that a committee be appointed to investigate and report on the subject of steam heat at the next meeting of the convention.

The session was concluded with the reading of paper by Mr. A. R. Cheyney, of Philadelphia, on the subject of "Plant Economies with Special Reference to the Boiler-Room."

This paper gave an analysis of the various losses encountered in the boiler-room of a central station. The purchase of coal on a heat-unit basis was highly recommended. The essential requirement in furnace operation is the conversion of the coal into the maximum of carbon dioxide with the minimum loss of the heat units thus liberated. In conducting the firing of boilers it is well to note that the use of any boilers in excess of those absolutely needed is productive of waste and of low station economy; moreover, the greater the overload range of the boiler the less the cost of producing each kw-hour.

In discussing this paper, Mr. Graves, of Pittsburgh, stated that in the analysis of coal attention was paid to the heat units, sulphur and ash, but the careful regulation of the sulphur has been productive of the best results.

Mr. Orr told of a contract which provided for a system of penalties and premiums, depending on the analysis of the coal supplied, and which has worked out very successfully. It has led to a very healthy competition among the coal companies on a basis of strict quality. Mr. Orr recommends the use of the recording CO_2 meter as a check on the firemen.

President Conklin stated that he had been carrying on some experiments in Scranton in the utilizing of the culm piles. His company owns three very large culm banks, and is testing various mixtures of culm with different grades of anthracite, bituminous, washed coal, etc. Mr. Conklin expects to be able to report on this experiment in the near future, and offers the data to the members of the association.

Thursday's session was devoted to commercial subjects and the meeting was presided over by Mr. Duncan T. Campbell, of Scranton, chairman of the Commercial Day Program Committee.

The first paper was presented by Earl E. Whitehorne, editor of *Selling Electricity,* New York, entitled, "Dollar Ideas." This was followed by a paper by Mr. Van Dusen Rickert, of Pottsville, on the subject of "Methods of Securing New Business," a paper by Mr. R. A. Granger, of Chester, on "Commercial Effects of Tungsten Lamps," and a paper by Mr. D. T. Campbell, of Scranton, entitled "Advertising Direct and Indirect."

The paper entitled "Dollar Ideas" discussed the advantages of various schemes for popularizing the use of electricity. The schemes included window displays, porch lighting, public fans for cooling purposes, and advertising in the local papers.

The methods treated by Mr. Rickert related to business lighting, signs, windows, outlining and decorative features, and electric service in small residences. In discussing window lighting the statement was made that such use of electricity should be considered as advertising and not as illumination, and flat rates can well be given for this service.

In the paper by Mr. Granger it was stated that a growing demand for tungsten lamps has been noted by the central stations. Generally the policy adopted is to secure business heretofore unobtainable by the use of the lamps. Their use is encouraged to displace gas lamps and for satisfying disgruntled customers. The tendency is to increase the illumination, using about the same value of watts as formerly when replacing carbon incandescent lamps.

The paper of Mr. Campbell dealt with the successful methods of reaching the public through advertising. Particular emphasis was placed upon overcoming the false impressions of the central station and making the public understand that electricity is at its service at all times. The advertisements should be so arranged as to educate the reader concerning the advantageous features of electric service.

These four papers were discussed jointly, the discussion embracing the various phases of the central-station selling problem.

Mr. McCabe, of Lewiston, asked for information as to the policy of member companies toward making long extensions for churches, citing an instance where he was asked to connect a small Lutheran Church, 800 ft. from his lines. The general opinion seemed to be favorable to the connecting of churches, if possible, in consideration of the impression which it makes on the church members.

Mr. Granger told of an arrangement whereby the customer pays half the cost of the line extension which is rebated as new customers are secured along the line.

Mr. Greene, of Altoona, gave an interesting account of a farm installation situated six miles from his station, which brings in a revenue of about $200 a month, there being a full equipment of motor-driven churns, saws, etc.

In speaking of the tungsten lamp, Mr. Barton, of Philadelphia, warned the members against letting enthusiasm run away with better judgment, as the market for carbon lamps for use in closets and out-of-the-way places will continue for many years.

Mr. MacGregor, of Easton, cited an experience in a Western city where gas had been supreme. When the tungsten lamp was placed on the market, he succeeded in installing 75 four-lamp tungsten clusters inside of three weeks, with a very marked effect on public opinion.

Mr. W. C. Anderson, of Plymouth, then read a very interesting paper on the subject of "Co-operation with Contractors." He cited the experiences of the Luzerne County Company and the Allentown Electric Light & Power Company to show that it is best for the central station not to conduct wiring business unless by reason of keen competition between two companies it becomes necessary to take special action to meet special conditions.

The discussion of this paper was opened by Mr. Fogerty, of Erie, who stated that his company had been forced to do contracting and carry supplies. It sells annually about $20,000 worth of supplies, $30,000 worth of fixtures and secures revenue from wiring ranging from $3,000 to $5,000. Customers are required to pay for a part of the cost of extensions on a yearly percentage basis. Mr. Fogerty said that he had made some interesting experiments to determine the practical life

of the tungsten lamp and in one case a 60-watt lamp had burned over 3500 hours.

Mr. Hoffman described a very effective system in vogue in Philadelphia. The Philadelphia Electric Company has a standing offer of 25 cents per socket which is paid to any builder who secures the installation of electric wiring in any building he may erect. This arrangement has been in effect since 1896, and in one section where 196 houses have been built the cost for extensions, etc., has been about $3,500. The first year's revenue from 149 of these houses was somewhere in the neighborhood of $4,250, the other 47 houses being unoccupied. Some 4900 16-cp equivalents were installed, the bonus to the contractors amounting to over $800. These figures are approximate.

The session closed with the reading of a paper on "Power," by Mr. E. T. Penrose, of Tyrone. This paper represented an attempt to prove that the small central station in a manufacturing town should maintain a 24-hour service, and that the success of a central station depends upon its day load. The value of off-peak business, its influence on the cost of the kw-hour, the monetary value of a high-load factor and methods for obtaining a day load were discussed by Messrs. J. W. Reeves, T. E. Spence, J. B. Kilmore and R. A. MacGregor as assistant editors.

In connection with this paper Mr. Penrose submitted a number of selected data sheets, from figures which he had secured from various parts of the country, covering specific installations. These figures are worked out through successive stages to show the consumption per unit of product. Mr. Penrose made a strong appeal for co-operation in the circulation of such data.

Mr. McCabe, of Lewistown, decried the tendency of central-station men who conceal exact motor rates. He urged all members to join hands in the movement and show liberality in the interchange of real facts and figures.

Thursday evening was devoted to a lecture by Prof. E. E. F. Creighton on the subject of "Lightning and Lightning Phenomena." There was a large attendance of members, guests and ladies, and the experiments were exceedingly interesting.

The Friday session was scheduled to open with an address by Mr. T. C. Martin, of the *Electrical World*. Mr. Martin was unfortunately unable to be present and his address was read by the secretary.

Mr. E. B. Greene, of Altoona, read a paper on the "Commercial Value of Constant and Efficient Service," in which it was claimed that when the service is entirely satisfactory a normal growth or increase of business of 10 per cent per year may be expected. Moreover, an honest effort to correct any real or imaginary lack of constant service will tend to increase the receipts. To be able to realize the value from efficient service requires an organization composed of trained men who work in thorough harmony.

Mr. Rickert, of Pottsville, took exception to a statement by Mr. Greene that the cost of a lapse of service could be computed at 2 cents per minute per inhabitant. Mr. Greene explained that this was based on the number of customers effected. There was a general discussion in which Mr. Granger, of Chester; Mr. McCabe, of Lewistown, and Mr. Hoffman, of Philadelphia, cited instances where a lapse of service meant actual damage and expense to consumers.

This was followed by a paper on "New Methods and Specifications for Street Lighting," by Mr. J. H. Perkins, of Wilkes-Barre, which called attention to the confusion that has been caused by the initial rating of the old open arc at "2000 candle-power," and reviewed the conditions leading up to the work of the National Electric Light Association in forming specifications for street lighting based upon the distance at which an arc lamp must be placed from an object in order to light it with the same density of illumination as a standard 16-cp lamp. These specifications insure the obtaining of a certain foot-candle of illumination along the street.

In discussing this paper, Mr. Davis, of Williamsport, urged the adoption of the foot-candle as the unit of illumination in street lighting, as it enables the company to take advantage of new apparatus which may give better results in the illumination at a lower initial candle-power.

Mr. Scroll, of Philadelphia, heartily endorsed this recommendation. He stated that it is dangerous to make official tests of lamps in place, inasmuch as the figures will be materially effected by pavement, color of adjacent buildings, atmospheric conditions, season, etc. Marked interest was shown in the subject of street-lighting contracts, and a recommendation was made that the association secure further data on the subject.

At this point the meeting went into executive session to receive the report of the nominating committee. The nominating committee moved the re-election of present officers. President Conklin, however, after expressing his appreciation, urged the association against the establishing of such a precedent and asked that the matter be reconsidered, as he felt that it would serve the best interest of the association if the term of the chief executive were limited to one year by custom, if not by law. The committee took the matter under further consideration and the following officers were nominated and elected:

President, E. L. Smith, Towanda; vice-president, A. R. Granger, Chester; secretary, Van Dusen Rickert, Pottsville. Members of the executive committee: R. S. Orr, Pittsburgh; E. F. McCabe, Lewistown; J. H. Perkins, Wilkes-Barre, and M. J. Fogerty, Erie.

The balance of the session was given up to further consideration of commercial subjects and a motion was passed instructing the executive committee to consider ways and means to secure adequate legislation for protecting central stations against theft of electricity.

First Convention of New England Section, N. E. L. A.

The first convention of the New England Section of the National Electric Light Association was held at the Hotel Wentworth, Newcastle, N. H., on Sept. 8, 9 and 10, with an enthusiastic and representative attendance of central-station officials, manufacturers' engineers, ladies and other guests. There was a total registration of about 150 at the headquarters established in this renowned hostelry. The historic scenes in the vicinity lent an added charm to the meeting, and by the evening of the eighth many members and guests were on hand to attend the reception which was given by the officers in the hotel parlors. In the receiving line were President and Mrs. S. Fred Smith, of Salem, Mass.; Vice-President and Mrs. James E. Davidson, of Montpelier, Vt.; Secretary C. H. Hodskinson, of Boston; and Mr. Alexander J. Campbell, of the executive committee, and Mrs. Campbell, of New London, Conn.

The first business meeting occurred on the morning of the ninth, with President Smith in the chair. Mayor Adams, of Portsmouth, made a witty speech of welcome, and President Smith delivered a forcible address reviewing the circumstances which led up to the formation of the New England geographical section, the advantages of coalescing the previously scattered local associations with the national body, and the development now in prospect. To-day there are 413 members in the New England section, and it is the most powerfully organized section of the association. The thoroughness with which the geographical section can work, as compared with an unwieldly larger body requiring parallel sessions, was emphasized, although the importance and value of the prestige and strength of the national organization were not overlooked. In conclusion President Smith commended the plan of inaugurating geographical sections by combining several States in a group, rather than keeping close to State lines and thus multiplying organizations.

LIABILITY INSURANCE.

The first paper read was by Mr. Walter L. Mulligan, general manager of the United Electric Light Company, Springfield,

Mass., on "Liability Insurance and How It Affects the Employee," and is abstracted below:

The United Electric Light Company has for a number of years carried both public and employees' liability insurance, but has never believed in the policy of letting the insurance companies handle the cases alone. About 150 men are insured, excluding the office force. When a man enters the company's service it is understood that he is to obey orders, and if he is hurt in any way the company takes care of him and puts him as nearly as possible in his normal condition, without loss of pay, provided he does not bring suit. This obviates the grumbling in front of unpleasant tasks and induces loyalty to the company. Care is taken in the selection of men, and if a man shows any signs of carelessness the company tries to drop him before he can injure himself or its property. When a man is injured the company gives orders for him to have the best of everything if hospital treatment is needed, letting him select the hospital if he is able to do so. The accident is then investigated and a complete report given to the insurance company, no matter how small the injury may be.

The company does not feel that it pays to let the insurance people deal with employees directly, although that method is pursued in connection with public liability policies. There are, of course, quite a number of small cases during the year where a man may be laid up for a few days on account of some minor accident, and in all such instances the insurance company is not asked to pay anything unless the employee tries to make trouble, which rarely happens. The company assumes the doctor's bill and pays for the man's time, and has the insurance company behind it in case of need. This method saves the insurance company money and inclines it to be more liberal in settling cases into which it is called. The total amount of money paid out last year for liability, team, fire, automobile, and property insurance was $2,500, the liability portion representing about $1,700.

Discussion.

The discussion was largely made up of questions addressed to the author, who stated that the company endeavors to treat each man in the fairest possible way, paying his wages regardless of the responsibility for the accident, and before the liability is determined; looking after a man who is partially disabled, and providing in reason for a man's family according to circumstances; and in general making the men feel that they will be taken care of when an accident occurs. There is no agreement covering sickness, but recently an employees's benefit association has been organized for that purpose. The company has leased two rooms for the association, and intends to have practical talks there, and to equip the place with newspapers, etc.

Mr. H. T. Sands, of the Malden Electric Company, cited a case where an employee was injured by an accident to a coal-handling equipment, but who sued the central station with much less satisfaction than as though he had relied upon the company's fairness in settling the claim.

President James E. Davidson, of the Consolidated Lighting Company, Montpelier, advocated a liberal liability insurance policy, but felt that there is room for lower premiums. He has paid about $2,000 per year for a force of 35 men.

Mr. R. W. Rollins, general manager of the Hartford Electric Light Company, said that up to four years ago a 2 per cent premium had been paid by him to insurance companies for liability protection. The companies proposed to raise this to 4 per cent, and so the Hartford organization decided to insure itself, in both employees' and public liability. A better handling of the cases with employees is a notable result.

Mr. A. J. Campbell, of New London, made a strong plea for a revised attitude on the part of central stations toward employees' liability. The insurance companies are forcing the wrong attitude. The moment a man is hurt is the time to get closer to him. The New London company is putting money in the bank now by insuring itself, and in a few years it is hoped that the sum will be sufficient to enable the size of the present payments to be reduced. It is better to pay directly to the man than to contribute to hospitals and relief agencies in general.

Mr. L. D. Gibbs, assistant advertising manager of the Boston Edison Company, emphasized the importance of a liberal policy in relation to accident compensation in connection with the loyalty of employees and showed that the selection of high-grade men was a natural result of such methods as those practised in Springfield. If the employee feels that he will be protected by the company, loyalty is bound to be increased. The publicity which a satisfied, loyal employee can effect in favor of the company is very valuable.

Mr. C. D. W. Jarvis, of the New England Telephone & Telegraph Company, stated that his organization carries its own insurance for both the public and employees, and does much in the way of providing for sick employees. A most important point is to establish a standard of construction so high that accidents will be prevented in the first place.

Mr. Wilson, of the Berlin Electric Light Company, New Hampshire, described an employees' liability association in his organization. There are about 2000 men in its service, including large industrial enterprises under control of the company. Once a month a certain amount is taken from the pay of each member and put into a fund from which half wages are paid in case of disability. At the end of the year a dividend is declared and paid to each member on any balance remaining. The insurance is handled at cost, and the expense last year was less than $2 per employee. President Smith concluded the discussion by stating that in Salem it begins to look favorable for the company's insuring itself instead of paying the underwriters.

STEAM HEATING.

The next paper was by Mr. Charles R. Bishop, general manager of the American District Steam Company, of Lockport, N. Y., on "The Advantages of Steam Heating for Electric Lighting Companies."

Mr. Bishop emphasized the development of the past 30 years in central-station heating and urged the more general consideration of this subject in the New England field. Companies have doubtless been waiting for the full development of steam heating, but now methods of construction and operation have become thoroughly standardized; and equitable methods of charging have been introduced through the development of accurate meters. He reviewed the early experiments in the heating field. In New England there are 172 cities having populations of over 5000 each; but in only three are there steam-heating systems of any magnitude; while Pennsylvania, with 82 cities of over 5000 inhabitants, has central-station heating plants in 69 cities. Illinois has 30 systems in 51 cities of 5000 or over. Steam heating is a success as far south as Birmingham, Ala., where snow is almost unheard of and the mean winter temperature is higher than the mean temperature of October alone in New England.

There is as good a market for steam heat as for electric light and power. Mr. Bishop emphasized the point that many companies are manufacturing heat in the form of eletcricity at an efficiency of utilization of from 8 to 14 per cent, and throwing the balance away, either into the atmosphere or into condensers. It is perfectly practicable to sell this amount of energy otherwise lost for a price that will pay the original fuel cost, including water, oil, waste, and labor in boiler and engine-rooms. Companies are doing this and also earning interest and depreciation on the cost of the steam-distributing system. One company generated 1,903,000 kw-hours during the heating season at a total cost in the station, including coal, water, oil and waste and power-house labor, of $26,863. Its receipts from steam heating were $37,190. The steam investment outside the station, including street mains, services, trenching, repaving, street traps and meters was $122,000, and the total space heated was about 10,000,000 cu. ft. The season extended from Oct. 1, 1908, to May 25, 1909. The plant is a combination heating and lighting station operated for three years in a city of 17,500 population.

Mr. Bishop stated that as a general rule a fair heating price per 1000 lb. of steam is one-tenth of the price per ton which the customer has to pay for coal. This will enable the customer to save money by buying central-station heat and give the company a proper return as well. Another interesting manner of studying the foregoing actual results from practice is to add to the actual generating costs interest and depreciation on the investment for the steam main equipment, which is not properly an item of generating cost, but which is included for the sake of getting any cost whatever per kw-hour. In the first plant such an addition of 10 per cent to the generating cost, with deduction of the receipts from the sale of steam, gave an energy generating cost net of a little under 0.1 cent per kw-hour at the switchboard. In the second plant the unit cost drops to 0.5 cent by adding this charge and deducting the steam-heating revenue. Here the heat customers are using steam for only about two-thirds of the previous cost to them when generating with their own equipment, and hence the company's rate should be 50 per cent higher with a corresponding increase of revenue. In the third plant cited the net switchboard cost came to 0.32 cent per kw-hour. Here the steam charge was about 50 per cent too low.

In order to insure success in district steam heating, Mr. Bishop stated, the climatic conditions should insure a good market for the sale of steam; the generating station should be reasonably adjacent to the district in order to reduce the investment necessary; the rate should be well within the economic limits of the consumer, and still pay a satisfactory profit on the investment over and above the cost of manufacturing steam, including depreciation and amortization; the management should be efficient and the steam metered; the total amount of business should be large in relation to the possible market; and standard methods based on experience should be used. Where the heat is supplied by exhaust steam the heating demand during the minimum period should equal the full amount of exhaust steam from any single engine unit. Station piping should be arranged so that any engine can be operated condensing, non-condensing, or under back pressure while supplying heating steam, without reference to the other units in the station. This can be effected without much additional cost for piping, but when neglected is apt to result in back pressure being carried on a portion of the engine plant without compensating advantages. To secure the best results the demand for heating should be slightly in excess of the total amount of exhaust steam available at all times. In the modern steam main for district heating the drop should not be over ¼ lb. per 1000 lineal feet of main. Cumulative sliding scale rates are usually adopted. A very important factor is the additional electrical business which can be secured in connection with the ability of the central station to supply heat and shut down the isolated plant. With an extensive heating plant operated in connection with a lighting and power business, one is practically insured against a competing plant being installed, even though the threatened competition be a hydro-electric proposition.

Discussion

The discussion centered on the importance of preventing some of the present waste of fuel and on the technical details of service. None of the members had had experience with this service on any considerable scale, but much interest was shown in Mr. Bishop's paper. Questions brought out the point that a two-mile transmission is feasible commercially, the distance being measured in a direct line from the station. It is advisable to operate the condensing portion of the power plant on the summer load. It is not necessary usually to guarantee more than from 1 lb. to 2 lb. service pressure at the entrance of the heated building. In Detroit, St. Paul, Adrian, Mich.; Springfield, Ohio, and Birmingham, Ala., steam turbine plants are operated in connection with steam exhaust heating service.

Entertainment Features.

On Thursday afternoon the members and guests embarked on the steamer *Alice Howard* for a sail around the bay, stopping at the Kittery Navy Yard, visiting the Conference Chamber, where the Peace Treaty was signed by Japan and Russia, and then inspecting the power plant of the Rockingham County Light & Power Company, in Portsmouth, where refreshments were served. The ladies of the party were taken around Portsmouth during the afternoon by courtesy of the Portsmouth Board of Trade and shown many historic points of interest, with a tea at the Hotel Rockingham. In the evening a banquet was held in the dining-room of the Wentworth, and the entire registration, including ladies, were present. The floral decorations and favors were unusually attractive. Mr. L. D. Gibbs, of the Boston Edison Company, was toastmaster, and the speakers were Messrs. J. S. Whitaker, Portsmouth; T. N. Brady, New Britain, Conn.; H. T. Sands, Malden, Mass.; A. J. Campbell, New London, Conn., and C. B. Burleigh, Boston.

On Friday morning the ladies of the party were taken on an automobile ride southward along the seacoast to Rye Beach.

Friday Business Session.

President Smith called the session to order about 10:30 a. m., and introduced President Frueauff, of the National Electric Light Association, who with Secretary-elect T. Commerford Martin had just come from an enthusiastic meeting in Schenectady, where plans were effected for the forming of a company and local section attended by about 400 persons. President Frueauff brought the most cordial greetings to the New England section. He referred to the enthusiastic meeting at Schenectady, and then outlined the work which the several important committees of the association are taking up.

President Frueauff called attention to the library nucleus at the association headquarters in New York provided through the gift of Mr. W. D. Weaver, editor of the *Electrical World*, and extended a welcome to all members from the headquarter's office. He cited a case where a small company is obtaining the advice of the association's insurance expert through its membership at a nominal cost in a case where it has been sued for $90,000 on account of a fire, as a direct benefit of membership. Concluding, he wished the section the most complete prosperity and congratulated it upon the success of the first convention.

President Smith then announced that Mr. T. Commerford Martin, editor of the *Electrical World*, had recently accepted the post of secretary of the National Electric Light Association, and congratulated the membership that, after many years of distinguished service in the journalistic field, Mr. Martin has been induced to take up the work of the association in a more intimate official capacity, with a keen appreciation of the future opportunities and possibilities of the organization.

Mr. Martin was then called upon, and made a felicitous and inspiring address on the regret with which he lays aside his work in technical journalism, the ability and enthusiasm of the staff which he leaves behind him, the high heritage into which the National Association membership has entered, the important work which lies ahead, the opportunities of the secretary in maintaining a clearing house of information for all sections of the country, and the possibilities of co-operation in supporting and promoting the welfare of the association.

Chairman Campbell, of the committee on the president's address, then presented his report, recommending that it be placed in the hands of each section member, and particularly recommending that efforts be made to cultivate friendly relations with central-station men in municipal plants. The committee's report was unanimously accepted. Resolutions of thanks were then passed for courtesies extended during the convention by the Portsmouth Board of Trade and the Rockingham County Light & Power Company.

Low-Voltage Tungsten Lamps in Residence Lighting.

The first paper was on "The Low-Voltage Tungsten Lamp in Residential Lighting," by Mr. Frederick W. Prince, of the Hartford Electric Light Company.

Mr. Prince reviewed the commercial difficulties introduced by the advent of the tungsten lamp into residential service and said that with meters costing $4.50 per year to maintain and doing only 40 per cent of the work formerly done with the carbon lamp, the only satisfactory solution seems to be the introduction of the low-voltage tungsten lamp. The tungsten

low-voltage lamp has a slow, gradual increase in candle-power, does not blacken to any extent, and by a slight sacrifice in efficiency can be made to have a life of about 2000 hours. It overcomes the principal faults of the carbon lamp and in low voltages can be made in a candle-power of 10 and even lower. This is a great advantage in residential lighting. The 30-volt or 60-volt tungsten allows of ordinary handling with almost no breakage, compared with a 19 per cent loss in breakage with the 120-volt tungsten lamp. The price of the low-voltage lamp is only about 65 per cent of the high-voltage unit, and it can be made from the short cuttings of the high-voltage filaments. Since the filament can be mounted in an ordinary 10-cp or 16-cp lamp bulb, it is especially convenient in displacing existing lamps in residential fixtures. The short filament enables it to be burned at any angle.

The low-voltage system is adapted to present supply installations by the use of a transformer or balance coil with 112-volt primaries and four 28-volt secondary circuits. Extra taps are brought out on the primary side to admit of exact voltage adjustment on the secondary circuits. The first difficulty was found in large houses, owing to the drop in long distribution circuits at 30 volts. Under the low-voltage system a lamp of the same candle-power as the old carbon took half as much current again at one-quarter the voltage, so that the drop per candle-power was about six times that formerly obtained. This could be partially overcome by using the primary taps before mentioned, but when the transformer coil was installed on a residence circuit it rendered useless all the common flatirons, curling irons, fans, sewing-machine motors, etc., and circuits controlling this equipment had to be re-wired so as to remain on 112 volts. Both the drop problem and the latter difficulty were partially solved by adopting a 60-volt lamp. This cut the drop to only one-third more than the original loss. Most of the commercial heating apparatus can be made for 60 volts. The 60-volt lamp appears no more fragile than the 30-volt lamp, and it uses a standard 16-cp bulb. The consumption varies from 1.1 watts to 1.35 watts per candle-power. In the installation of a large number of transformer coils of the original pattern with only a two-wire, 112-volt primary difficulty was experienced in maintaining a balance on transformers and the three-wire aerial street system. There is now made a balance coil with a three-wire, 120-240-volt primary and a three-wire, 60-120-volt secondary. This coil simply reduces the whole house voltage suitably for the 60-volt lamp and retains the original balance on both the street and interior house wiring.

The Hartford Electric Light Company had 120,000 residential lamps on meters, showing a net income of $1.10 per lamp per year. This gave a good basis for handling the low-voltage tungsten on a flat rate, and the following proposition was made to the public:

Energy for 10-cp, low-voltage tungsten lamp....$0.10 per month per lamp
Energy for 20-cp, low-voltage tungsten lamp.... 0.15 per month per lamp
Energy for 30-cp, low-voltage tungsten lamp.... 0.25 per month per lamp

The first installation cost the customer 20 cents per lamp for all sizes. Renewals of all sizes are 10 cents each. The installation of the economy coil is free. Soon after the advent of the high-voltage lamp, customers purchased the 40-watt lamps and the company was obliged to install a maximum-demand controller, which causes the lamps to flicker when a lamp in excess of the number contracted for is turned on. Sensitive adjustments make the instrument act on only 12 watts excess load.

The Hartford company is carrying on an active campaign in the wiring of houses now using gas. A contract-job price of $35 is made, for which the house is wired on the three-wire system and six outlets provided. For these are furnished one three-light fixture, two two-light fixtures, one single-light fixture, one bracket and drop cord, or a total of 10 sockets. Thus, for an initial cost of $35 and $1 per month a man may have his house wired and burn 10 10-cp lamps. If the prospective customer demands a meter, his house is wired for the same price and carbon-filament lamps and a meter installed. Extra lamps can be installed at the original contract at $3.50 each, and extra lamp fixtures at the actual selling price. Two years ago the Hartford company wired 300 houses during the summer. Since June, 80 contracts for house wiring have been made. Most of them run in excess of the 10-lamp proposition, the average price paid the company being $51.99 for an average of 12 10-cp and three 20-cp lights at an average income per house of $1.65 per month.

Discussion.

In the discussion, Mr. Prince said that all the outlets in a residence are covered with the contract. Higher candle-power lamps are used in rooms where reading is to be done, and the lower sizes in hallways, etc. There are almost no complaints from customers. The cost of the economy coil and the flat-rate controller may be nearly the same as that of a meter, but there is practically no maintenance. By check meters the company found that the revenue from this new plan is about 6 cents to 12 cents per kw-hour.

Mr. Holbrook, of the General Electric Company, Lynn, said that at Fulton, N. Y., 28 contracts were secured by the introduction of the low-voltage lamp inside of two weeks, displacing gas in houses and small stores. The maximum demand was 9.6 kw for a connected load giving an annual income of $1,868.

Mr. Prince said that the large heating propositions are sometimes rewired and left on the meter. The loss in the economy coil is about 150 per cent of that in a meter, but there is no maintenance, reading or billing expense. There is not very much to be gained by customers' burning lamps extravagantly, as the renewals cost 10 cents each, and come in oftener.

In answer to the question whether the scheme might not appear to be a discriminating rate from the point of view of a State commission, Mr. R. W. Rollins, general manager of the Hartford company, said that he felt that the contract as made between the parties would stand. Any long-hour user is entitled to a lower rate than a short-hour user. The real test is that the company makes money on the proposition.

Mr. G. C. Osborn, of the General Electric Company, spoke of the recent improvements in the metallized-filament lamp's life, the 50-watt size running over 100 hours better than the old carbon lamps, to 80 per cent candle-power. The tendency is for the prices of high-voltage lamps to go down, with increased consumption of them. He advocated sustaining the 110-volt service and deprecated the reduction of voltage.

Mr. Rollins said that the central stations should all get together and buy enough of the low-voltage lamps to lower their prices. In his opinion, the 10-cp lamp is all right for residential service.

Mr. L. D. Gibbs, of the Boston Edison Company, then spoke strongly against the use of low-voltage lamps in residential service. He considers that even the 20-cp tungsten lamp is none too brilliant for satisfactory illumination. The central-station man should encourage the use of more light rather than less.

Mr. C. H. Hodskinson delivered a telling litttle speech on the future possibilities of the New England section and urged every member to get down to solid work in pushing the interests of the organization.

CONNECTICUT RIVER COMPANY'S HYDRO-ELECTRIC DEVELOPMENT.

The last paper was by Mr. H. I. Harriman, general manager of the Connecticut River Power Company, on the hydro-electric development of that organization. The plant was fully described in the *Electrical World* of Sept. 9, 1909, page 606. In addition to his description of the station and the line installation, Mr. Harriman emphasized the special hydraulic conditions encountered, necessitating the use of a third water-wheel designed to be operated under the lower head that occurs during times of high water. By this means the company can operate its generators at full capacity even in extreme floods. The gradual fall of the river at Vernon, where the plant is located, is a valuable feature. The company desires to be a wholesaler of energy rather than a seller of small power. Particulars of the distributing system and the general manner of handling the service were also given.

Discussion.

The discussion brought out the point that none of the lines of the company is run parallel to telephone circuits closer

than 100 ft. The lines are operated at about 60,000 volts. At crossings the towers are amply strong enough to avoid any danger of breaking. Brass caps of large size were placed on the insulators at crossings at the request of the telephone company, and no wire smaller than No. 0 is used in crossings. The private right-of-way for the line formed the most difficult part of the work. Over 400 rights had to be secured within 66 miles. In most cases a perpetual easement was taken at so much per tower. The most distant market is Worcester, 66 miles away. The minimum flow of the river is ordinarily about 1800 second-feet, but in extreme cases this may run as low as 1000 second-feet. In case the water supply gets low, the transmission company operates these steam plants as auxiliaries. In the average year it will not be necessary to use steam power over three months. Anchor ice is prevented by using a concrete arch construction in the forebay.

In the afternoon a brief business meeting was held in which the constitution and by-laws of the New England Section were ratified, and the meeting then adjourned, all those in attendance feeling that the first convention had been highly successful, with bright prospects for the future of the association, both locally and nationally.

Wisconsin Rate Commission News.

Whether the Wisconsin Rate Commission has jurisdiction over rates for electric lighting and power furnished a city when there is a specific contract existing between city and company is the most important question yet put before that body and is one that will be given much consideration.

The question has been raised in the application of the Darlington Electric Light & Power Company for authority to increase its rates. An increase would affect the city and it has stepped in to resist the application. It raises the point that the commission has no jurisdiction, since it has a specific contract with the company. Its attorneys maintain that the commission cannot go around the contract and has no jurisdiction either one way or the other. The commission heard arguments and citations of cases and decisions at great length. It has now allowed the parties several weeks' time in which to file briefs and these are expected to be voluminous. There is no question about the controversy going farther than the commission. The law gives a right to go into the Circuit Court and from there to the Supreme Court, so it may be several months before a final settlement is reached.

A point, similar to a slight degree, was decided in a Superior telephone case some time ago. The People's Telephone Company franchise provided for a certain number of free telephones for the city hall, the schools, etc. The commission immediately ordered this free service discontinued. In this case, however, the contract was held to be discriminatory and it was thrown out without hestitation. The Douglas County Telephone Company was also furnishing Superior with free telephones and was ordered to make a regular charge.

The Wisconsin Commission has received an application from the De Pere Electric Light & Power Company for authority to issue $10,000 in stock for improvements. The company is capitalized at $100,000 and has issued $50,000 worth of stock.

Boston Edison Return Filed.

The Edison Electric Illuminating Company, of Boston, has filed its return with the Massachusetts Gas and Electric Light Commission for the year ending June 30, 1909. The return shows gross earnings of $4,111,342 compared with $4,229,239 in 1908, the reduction being due to the recent cuts in the company's rates. The net earnings were $1,390,673 as against $1,577,262, and the balance for dividends was $1,194,971 as against $1,396,905. The dividend payments were slightly increased and a deficit of $229,418 was shown as compared with a surplus of $6,109 in 1908. This deficit is not considered a serious factor, and no change in the dividend rate is expected.

The management has expended money liberally for improvements that will increase the earning capacity and the business is expanding steadily. The income from the suburban companies recently absorbed will be considerable as soon as the economies of consolidation can be effected. The field for new business is very large in these suburban districts and with the better service and lower rates of the Edison company the use of electricity will increase largely. An analysis of the company's operations will be printed in a later issue.

New York Public Service Commission News.

At the first hearing before the Public Service Commission of the First District in regard to building a rapid transit line by assessment on the property holders, as provided for by the Travis-Robinson law, on the Eastern Parkway, Brooklyn, it developed that there was no unanimity of opinion as to the character of road that should be built. The majority of the property owners seemed to favor a subway, while many others argued that this would be too expensive. The matter was adjourned until Sept. 15.

Theodore P. Shonts, president, and Frank Hedley, general manager, of the Interborough Rapid Transit Company, have had another conference with Chairman Willcox, of the Public Service Commission, over the proposed subway routes, and it is intimated that some sort of an agreement will probably be reached. The commission is determined that the Broadway-Lexington Avenue route shall be built in its entirety and it is not unlikely that the Interborough officials will accept this ultimatum. So far nothing has been done toward asking for bids on rapid transit routes, but now that the members of the Board of Estimate and Apportionment are back from their vacations it is believed that the matter will soon be taken up.

The officials of the Third Avenue Railroad have furnished the Public Service Commission with estimates of the amount of business it is expected will be done on the new Queensboro Bridge line for which a subsidiary company has been organized. It is estimated that by operating three cars on a five-minute headway that 2700 passengers can be carried daily and that a net profit of about $13 per day can be earned above all expenses and fixed charges. The commission has taken the franchise application under advisement.

As the Public Service Commission has refused to approve the franchise of the South Shore Company over the Queensboro Bridge, and as that structure is still without transit facilities, Bridge Commissioner Stevenson has submitted to the Board of Estimate and Apportionment a plan for the immediate establishment of a temporary municipal trolley line. It is proposed to rent the cars from the South Shore Company and buy energy from the New York Edison Company. The rate of fare will be the same as on the other bridges, namely, 2½ and 3 cents.

The Rockland Railroad Company, which is to operate a trolley line 41 miles long in New York and New Jersey, has applied to the Public Service Commission, Second District, for permission to issue $2,767,000 of bonds and to increase its capital stock from $100,000 to $630,000.

The New York Public-Service Commission, Second District, has given permission to the Rensselaer Falls Electric Light & Power Company to construct, maintain and operate a distribution system in the town of DeKalb in the village of DeKalb Junction, St. Lawrence County, for the purpose of furnishing electricity for light, heat and power. An order has been served on the Hallett Light & Power Company and the Riverhead Electric Light Company requiring them to immediately improve their poles, guard-arms and wires in the streets of Riverhead, Suffolk County. At Albany, on Monday, a hearing was held on the application of the Pawling Electric Light, Heat & Power Company for approval of franchises in Pawling, Dutchess County, and for authority to issue stock, will be heard; also the complaint of a committee of citizens of West Albany against the United Traction Company asking that the lines be extended across the bidge spanning the New York Central & Hudson River Railroad tracks in the village of West

Albany, and the complaint of the village of Waterford against the Troy Gas Company relative to failure to furnish gas to the village of Waterford, which supply was cut off on June 10 upon the burning of the Union Bridge

Worcester Electric Light Company Report.

The annual return of the Worcester Electric Light Company to the Massachusetts Gas and Electric Light Commission has been filed for the year ending June 30, 1909. The company's statement shows that the total earnings for the year were $349,734.48 compared with $334,528.92 for the preceding year, a gain of slightly over 4.5 per cent. The total expenses of operation for the year just closed were $171,968.48, against $172,050.05 in 1908, which is practically the same total cost of operation in each case. The balance to profit and loss this year is $177,766. Last year it was $162,478.87. The balance is therefore about 9.4 per cent more this year than last. These figures indicate both improved business conditions and careful administration of the property, since a notably increased service was rendered by the company at about the same expense of operation in each case. The company paid 10 per cent in dividends upon its capital of $800,000 in the year just closed.

In the year ending June 30, 1909, the company generated 5,754,268 kw-hours and sold 4,879,973 kw-hours, or 85 per cent of the energy generated. There was a gain of about 354,000 kw-hours generated compared with 1908, and 349,000 more units were sold this year. The energy sales were 7.7 per cent larger in 1909 than in 1908. As the company's gross earnings were less than 5 per cent greater this year the public obtained a considerable portion of its supply at a lower relative cost turing Company's type, of a total rating of 3900 hp, and a principal source of income of the company in the year just closed was from commercial arc and incandescent lighting by meter, a gain of about $10,000 being shown here. The revenue and energy sold for the fiscal year were as follows:

WORCESTER ELECTRIC LIGHT COMPANY.

	Income, 1909	kw-hours sold, 1909
Commercial lighting contract, arc and incandescent	$14,796.89	$298,657
Lights by meter	198,197.18	2,363,574
Public street arc lights (delivered at switchboard)	77,002.00	1,301,100
Public street incandescent lights	3,631.50	
Electric power	53,915.96	916,642
Total net	$347,543.53	$4,879,973

These figures show that the average income per kw-hour sold was about 7.1 cents. The average income from commercial arc and incandescent lighting by meter was 8.4 cents, and the average revenue from electric power per unit sold was 5.85 cents. The company's power sales were about 11.6 per cent greater for 1909 than in the preceding fiscal year.

The principal expenses of the company for the year were as follows:

Cost of manufacture	$72,203.05
Purchased power (32,511 kw-hours)	1,625.55
Distribution	39,275.38
Office expenses and management	17,973.31
Miscellaneous, including taxes, insurance, legal, etc	40,891.19
Total	$171,968.48

The company had 3,122,494 ft. of cable installed in underground conduits on June 30 last, continuing to hold its position as the second central station in Massachusetts in length of underground wire in service. There are now 1550 manholes and 1983 service connections on the system. The company has installed 329,262 ft. of cement-lined and vitrified clay pipe, 293,331 ft. being of the four-duct type. There are 405 motors aggregating 1950 hp now connected to the company's power circuits, compared with 298 motors, totaling 1601 hp a year ago. The average size of each motor this year is 4.8 hp, compared with 5.4 hp last year, indicating a tendency toward the more extensive use of electric power among smaller consumers. The company installed 3¼ miles of conduit and 300,000 ft. of cable during the year. There are now about 2552 customers.

The equipment has remained unchanged, on the whole, during the year, except in the new underground construction noted and in the addition of a 500-kw Westinghouse motor-generator set which is used to supply part of the 500-volt power service. The steam generating plant now consists of 12 Stewart boilers of the horizontal, return-tubular type, rated at 250 hp each, and operating at 140 lb. steam pressure, hand-fired, with natural draft supplied by two brick stacks. The prime movers consist of four horizontal, cross-compound condensing engines of the Corliss and the American & British Manufacturing Company's type, of a total rating of 3900 hp, and a 1500-kw General Electric-Curtis turbo-alternator. There are three alternators of the direct-connected type with an aggregate rating of 2250 kw, besides the turbo-set. These units are all built for 2300-volt, 60-cycle operation. The magnetite arc system is in operation in the Worcester street-lighting service, the current being supplied through mercury-arc rectifiers and tub transformers. The company burned 8565 tons of bituminous coal during the year at an average cost of $4.59. The cost of manufacture was as follows for the fiscal year 1909:

Item.	Amount.	
Fuel	$39,426.36	or 0.69 cent per kw-hr. mfd.
Rental real estate	225.00	
Oil and waste	1,594.83	
Water	1,630.86	
Wages at station	19,570.91	or 0.34 cent per kw-hr. mfd.
Building repairs, station	2,890.98	
Steam repairs, station	4,159.43	
Electrical repairs, station	2,705.68	
	$72,203.05	or 1.25 cent per kw-hr. mfd.

The station operating force included four engineers, one electrician, five firemen and 12 station men. The increase in the company's small power business is a most gratifying sign in the enlargement of the future market for electric motor service in Worcester.

Organization of Engineering Staff of Wisconsin Commission.

An account of various general features of the work of the joint engineering staff of the Wisconsin Tax and Railroad Commissions, taken from a paper prepared by Prof. William D. Pence, engineer of the commission, was published in the issue of Jan. 14, 1909. The following additional information relates to the organization of the staff:

Directly under Professor Pence is the assistant engineer and office engineer, which position is now occupied by Mr. W. E. Miller. The organization plan provides ordinarily for a civil engineer inspector, but this office is temporarily vacant. There is a chief mechanical inspector, Prof. J. G. D. Mack. The office of chief electrical inspector is vacant temporarily and the duties are divided between two engineers, each having the title of field electrical inspector, as follows: Mr. R. W. Harris, who is responsible chiefly for electrical machinery and electric railway rolling stock, and Mr. W. F. Sloan, who has charge of valuations of electrical distribution systems, including electric lighting and power and street-railway and telephone properties. Prof. C. F. Burgess is expert on light and heat, and is also chief of two departments—gas engineering and gas and electric service inspections.

Omaha Electrical Club.

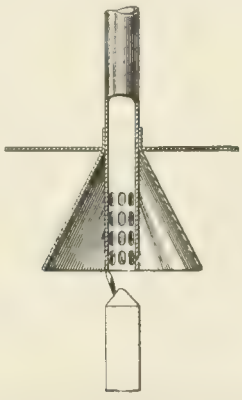
The Omaha Electrical Club dates back to 1903, when a number of electrical business men in Omaha and vicinity formed the organization for mutual assistance, as the wiremen were on strike at that time. Later the differences with the workmen were amicably adjusted and normal business conditions were resumed. The club was kept up, however, and it has been developed and broadened so that its purpose is now characterized by a wide outlook having to do with the improvement of its members. There are about 45 active members at the present time, and a great deal of good has been accomplished in creating harmony and pleasant relations among all the mem-

bers. During the winter season lectures and addresses are given by members and others.

Anyone directly connected with the electrical business is eligible to membership. The regular monthly meeting of the club is held on the second Wednesday of each month. An additional feature of exceptional interest is the weekly luncheon held at the Omaha Commercial Club every Wednesday noon. All electrical traveling men who may be in Omaha on that day are invited to attend this luncheon, and are called upon to speak, giving their views about the conditions in the electrical industry as they find them. During the summer of 1909 two outings were given by the club and were greatly enjoyed. The meetings are interesting and well attended. The present officers of the club are: President, Mr. Israel Lovett; vice-president, Mr. Benjamin McInerney; treasurer, Mr. Wilbur M. Burgess; secretary, Mr. H. P. Kerr.

Electrode for Flaming-Arc Lamps.

For the purpose of providing a chimney for the fumes from a flaming-arc lamp and affording a means for removing the slag formed upon the end of the composition electrode, Mr. S. P. Wilbur proposes to employ the arrangement illustrated herewith, for which a patent was granted to him on Aug. 17. The upper electrode is of copper constructed in the form of a tube, the inner diameter of which is less than the diameter of the other electrode. When the electrodes are brought together, in the usual manner, to start the arc the tubular electrode will

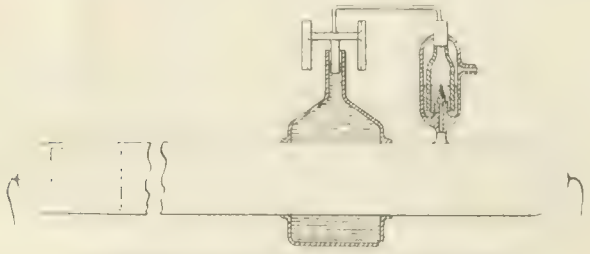


ELECTRODE FOR FLAMING ARC LAMPS.

cut or break any insulating slag that may have been formed on the other electrode. The tube also serves as a chimney through which fumes that are given off by the arc are conveyed to the exterior of the lamp by means of the draft set up by the lamp. In order to insure removal of all the fumes in this manner, the lower end of the tube is provided with apertures, and is surrounded by a conical shaped hood that collects the fumes and directs them into the openings. An annular flange, secured to the tube at the upper end of the hood, facilitates the radiation of heat from the electrode.

Gas-Feeding Valve for Vacuum-Tube Lamps.

A method for regulating automatically the flow of gas into a vapor-electric lamp according to the temperature at which



GAS FEEDING VALVE FOR VACUUM TUBE LAMPS.

the lamp operates forms the subject of a patent issued to Mr. D. McF. Moore on Aug. 10. The lamp is provided with a valve consisting of a pointed rod of carbon surrounded by liquid mercury; when the tip of the rod is covered by the mercury the valve is closed, while when it is exposed the gas enters the lamp through the porous carbon rod. A thermostat serves for regulating the height of the mercury by its action upon a plunger working in the chamber containing the mercury surrounding the carbon rod. The arrangement employed is shown in the accompanying illustration in which the thermostat is represented as a holder for mercury surrounding the tube lamp at such a point as to feel directly the changes in temperature due to the variation of the current traversing the gas in the tube. The adjustments are so made that when the vapor in the tube decreases in pressure the temperature rises and the thermostat admits more gas to increase the pressure within the tube.

CURRENT NEWS AND NOTES.

ELECTRIC HEADLIGHTS ON ENGINES.—The recent "electric headlight act" of the State Legislature of North Carolina, after being vigorously fought before the corporation commission, has been declared legal and will become effective. Twenty-five per cent of all engines are to be equipped annually, beginning April, 1910.

DESTRUCTION OF DAMS.—Heavy rainfalls have been so numerous in Colorado in the past several weeks, and river beds are so full that a number of irrigation dams, together with some power dams, have been washed away. Among the power plants of greater importance which have thus suffered are that of the Telluride Power Company and the Blue Water Plant near Albuquerque, N. M.

ELECTRIC STEEL WORKS IN RUSSIA.—The Slatons Works, in the Ural district, which belong to the Russian Crown, have secured the right to use the process of a German company for electric steel, the furnace in question being on the induction principle. The electric plant will be supplied by the Siemens-Halske Company. The Slatons Works intend to market directly the produce of their electric steel works.

LARGE NORWEGIAN WATER-POWER STATION.—A company has been formed, under the name of the Lysefjord Company, for the purpose of exploiting the Aardals and Lyse Rivers and disposing of the power to a foreign company. It is proposed to lead the water from the Nilsebu through a tunnel some 9300 ft. long to Kloggeli, where it passes into the Stalsaa River which opens into the Strandvand Lake. The Lyngvand is to be connected with the Strandvand through a tunnel some 6700 ft. long. This junction having been effected and the aggregate of the water now forming one stream, the latter will be taken, through several smaller tunnels and lakes, from the southwestern end of the Strandvand Lake to the mountain edge above Lysefjord at Maagelien, where there will be a fall of some 2000 ft., with a calculated effective capacity of 100,000 hp.

MANUFACTURE OF CALCIUM CARBIDE IN EUROPE.—Existing European carbide manufactories have an aggregate of 367,000 hp, while the present annual requirements are estimated at 192,000 tons. Of the total power used in this industry 70,000 hp are employed in Sweden and Norway, where the production only amounts to some 35,000 tons annually. The factories in question work under the most favorable conditions, and the cost of manufacture only amounts to $11.10 per ton. In France this industry takes 48,000 hp, with an output during 1908 of 26,000 tons, while the capacity of the existing plant amounts to 50,000 tons per annum, principally produced in the Alps of Savoy; the industry is protected by a duty of $12 per ton. Switzerland, with an aggregate of 60,000 hp, produces 30,000 tons annually, which go to Germany. Italy's production for 1907 amounted to 30,526 tons, the power at the service of the industry being 46,000 hp. Austria produces some 20,000 tons of carbide per annum, with an aggregate power amounting to 35,000 hp. Germany consumes about 40,000 tons annually.

ELECTRIC SIGNS IN LOUISVILLE.—Within a year the electric signs in Louisville have increased from 64 to 367, the sign lamps now having an aggregate candle-power of 80,000.

HOLYOKE MUNICIPAL STATION.—The output of the Holyoke municipal electric lighting plant was 66 per cent greater in August than in the same month of last year. The total output for last month was 628,460 kw-hours.

FRANCO-SPANISH TELEPHONE.—It is reported that negotiations for through telephonic communication between Madrid and Paris are well advanced, while it has been definitely decided to provide telephone lines between Madrid and Bordeaux.

WIRELESS TO SOUTH POLE.—The plans of the proposed British Antarctic Expedition provide for wireless equipments which will enable wireless messages to be sent to New Zealand from aboard ship and from stations at bases of supplies.

GREAT BRITAIN SECURES MARCONI HOME STATIONS.—The Postmaster-General of Great Britain has concluded an agreement with the Marconi Company for the transference to the Government of its wireless telegraph stations in the United Kingdom. The arrangement is purely insular, and does not embrace transatlantic communication.

DALLAS ELECTRICAL ORDINANCE.—The city of Dallas, Tex., has recently passed an electrical ordinance which it claims to be the best in the country. The ordinance requires bonds of every person who handles electrical appliances in any manner, including contractors and the men employed by them, window decorators, stage employees, etc. Before a permit for an installation will be given plans must be submitted showing every connection, and when finished the work will be inspected to see that it corresponds as to number of lights to the plans submitted. All secondaries are required to be grounded.

MEETING OF KANSAS ELECTRIC ASSOCIATION.—The annual meeting of the Kansas Gas, Water, Electric Light & Steel Railway will be held at Wichita, Kan., on Sept. 23 and 24. Of the eight papers to be presented only one deals with an exclusively railway subject. The others are entitled: "Scientific Illumination," by Mr. F. B. Galloway; "Sizes of Single-Phase Motors," by Mr. H. W. Briscoe; "Notes on Transformers," by Mr. B. F. Eyer; "Duties and Liabilities of Electric Companies," by Mr. J. C. Nicholson; "Series Tungsten Lamps for Street Lighting," by Mr. W. E. Sweezey; "Transformers," by Mr. J. L. Buchanan, and "Tungsten Lamps," by Mr. Benson.

SELF-EXCITING ALTERNATOR.—A patent for a self-exciting alternator, issued to Mr. William Stanley on Sept. 7, covers the machine described at length in an article by Mr. G. Faccioli which appeared in our issue for Sept. 15, 1906. The alternator is constructed so as to resemble an induction motor with a coil-wound secondary, the rotor being equipped with a commutator. During operation the rotor cuts across a revolving field which cuts the stator conductors. The frequency bears to the speed of rotation such a relation that the e.m.f. generated by speed action in the rotor is equal to the e.m.f. produced by transformer action in the stator. The frequency, therefore, depends upon the ratio of stator and rotor turns as well as upon the rotative speed.

N. E. L. A. SECTIONS.—On Sept. 9, at Schenectady, under the chairmanship of Mr. C. D. Haskins, a meeting of some 300 or 400 employees of the General Electric Company and of representatives from 22 central-station companies in the vicinity was held to consider the advisability of forming a company section of the National Electric Light Association, and possibly a geographical section. Great interest was shown in the matter. The gathering was addressed on behalf of the association by President Frueauff, Past-President Doherty, Mr. H. H. Scott, the chairman of the association membership committee, and Mr. T. C. Martin. At the close of the meeting a committee named by Mr. Haskins took up at once the question, and will report at an early date. There is every promise that Schenectady will support a large and active Class D company section. Similar movements are on foot at other electrical manufacturing centers.

NAVAL ACADEMY POST-GRADUATE ELECTRICAL COURSE.—A post-graduate electrical course will be opened Oct. 1 at the U. S. Naval Academy, Annapolis, Md., 10 officers having been ordered to report then for instruction. The course will be under the direction of Lieut.-Com. Milton E. Reed, of the navy, the head of the Marine Engineering School of the Navy. He will also have charge of the special course in naval engineering and marine engine design, which will also begin at the academy in October. The consolidation of the courses of steam engineering and electricity has been authorized because it is realized that officers who are detailed to take the course in naval engineering will also need the course in electricity. The officers designated to take the course in electricity will also be afforded periods of observations at plants and may attend technical schools where there are special courses in electricity. The four officers now on duty at the works of the General Electric Company, at Schenectady, N. Y., will form the first class in this post-graduate course.

DELINQUENCIES OF AMERICAN EXPORTERS.—U. S. Special Agent A. B. Butman, in a report on trade with Latin-American countries, says that the annual aggregate loss to the importer through careless packing is considerable, and reacts as a detriment to further development of American trade. Over against delinquencies in packing and short-time credits allowed by shippers from the United States, the Latin-American buyer weighs the satisfactory method of packing and the long period extended for credit by European competitors. Business communications should, he said, be courteously, not curtly, written. When dealing with foreign people, their customs must be observed. A case in point is mentioned: An importer in the city of Panama remitted a check of several hundred dollars, covering the amount of his bill, to a New York house. Accompanying the check was a most courteously written letter. This letter, when received in New York, was stamped "paid" and returned as a receipt to the sender, without further acknowledgment. The New York house in question is quite unlikely to receive further orders from that South American firm.

PUBLIC SERVICE AT THE STATE FAIR.—The Public Service Commission of the First District has placed in the State Fair, which is now being held at Syracuse, a very complete and instructive exhibit. By a set of charts and statistics the magnitude of the transportation, electric and gas business of Greater New York is set forth. There is, among other things, a chart showing the hourly ticket sales on the steam and elevated lines, ferries and bridges over the East River, and a large map of New York City showing all of the street railways within the city limits. Appliances used in the fender tests which took place last year in Schenectady and Pittsburgh are also shown, with figures and statistics. Among the startling figures that are furnished in this exhibit is the fact that in New York last year there was 1,323,326,655 fare passengers carried upon the transportation lines. This is 17.8 per cent of all the fare passengers carried in the United States. These figures are particularly significant when it is considered that the population of New York City is only about 5 per cent of the entire population of the United States, and with little more than half the population, New York carried almost twice as many passengers as London. Photographs and full descriptions of the commission's electric laboratory also form part of the exhibit.

ALABAMA LIGHT AND TRACTION ASSOCIATION.—The Alabama Light and Traction Association will hold its annual convention at Birmingham, Nov. 15 and 16. Mr. Lloyd Lyon, of Mobile, is secretary.

JAPANESE WIRELESS TELEPHONE.—The principal ships of the Japanese navy are being equipped with Professor Missuno's wireless telephone apparatus. These vessels are already provided with wireless telegraph equipments.

JAPANESE ELECTRICAL ENTERPRISES.—Out of 817 manufacturing industries in Japan 198 use electric power. The rating of electricity works now in service is 170,000 kw, while permits have been issued for an additional 210,000 kw.

FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—The next meeting of the French Association for the Advancement of Science will be held at Toulouse in 1910. The president is Dr. C. M. Gariel, professor of medical physics at Paris.

NEW YORK ELECTRICAL WORKERS BUSY.—The Electrical Workers' Union of New York has announced that the electrical illuminations for the Hudson-Fulton celebration require so many men that there is not a competent electrical worker in the city who is idle.

RADIUM IN CALIFORNIA AND COLORADO.—Reports from California state that valuable deposits of radium-bearing pitchblend have been discovered on the McCloud River. It is also reported that pitchblend has been discovered in the Cripple Creek district of Colorado.

ELECTRIC LOCOMOTIVES FOR JAPAN.—The *Japan Chronicle* has announced that the Middle District Railway Office has decided to dispense with steam engines on the Hachioji-Kafu line, and to use electric locomotives. Fifteen motor-cars have been ordered from the Osaka Railway Carriage Manufacturing Company.

BRITISH DAYLIGHT-SAVING SCHEME FAILS.—The select committee of the British Parliament appointed to consider the daylight-saving bill has issued a report which recommends that the bill be dropped because of grave doubts whether its objects could be attained without subjecting some important interests to serious inconvenience.

THE EMPIRE STATE GAS AND ELECTRIC ASSOCIATION.—On account of the Hudson-Fulton celebration, it has been found necessary to change the date of the annual meeting of the Empire State Gas and Electric Association from Oct. 6 and 7 to Nov. 17 and 18. Mr. Charles H. B. Chapin, 29 West Thirty-ninth Street, New York, is secretary.

TESTING MATERIALS CONGRESS.—The International Congress on Testing Materials, which has been in session at Copenhagen, Denmark, will hold its next meeting in New York in 1912. Mr. Charles B. Dudley, of Altoona, Pa., has been elected president of the International Association. Mr. Dudley is chemist for the Pennsylvania Railroad Company, and is a member of the American Institute of Electrical Engineers.

ENGLAND-SOUTH AFRICA WIRELESS.—Experiments are being conducted at Durban, Natal, with a view to installing a direct aerographic service between South Africa and England. It is proposed to try kites flying at a height of 1000 ft. to collect the Hertzian waves. It is anticipated that the Government of South Africa will eventually grant a subsidy sufficient to enable a charge of 2 cents a word. Initially the rate will be 24 cents.

LARGE SOUTH AFRICAN HYDRO-ELECTRIC DEVELOPMENT.—The United States consul reports that three large European banks will supply funds to the Pretoria Power Company for a great hydro-electric plant on the Crocodile River, South Africa. For the initial works, which will generate 20,000 hp to 25,000 hp, $3,469,875 will be required, with a further expenditure of $1,250,000 for a nitrogen fixation plant to which the energy is to be supplied. Nitrate of lime and nitric acid will, it is stated, be the final product.

INCANDESCENT LAMPS.—In the Digest in our issue for Sept. 2, on page 564, there appeared an abstract of an article by Mr. A. C. Jolley in which use was made of a radical sign in expressing the law of the variation of the candle-power with the voltage of incandescent lamps. In each of the equations there shown the symbol V should have been employed in place of the radical sign. Thus the first equation should read $cp = 3.2V^{5.4} \times 10^{-10}$, which shows the candle-power of a 16-cp, 100-volt carbon lamp when operated at electromotive forces not exceeding 85 volts.

ELECTRIC TRACTION DEVELOPMENT IN BRITISH COLUMBIA.—It is claimed there are few electric railway systems on this continent that have spent so much on development as the British Columbia Electric Company, which operates in western British Columbia. Since 1900 this company has expended approximately $6,000,000, including $2,000,000 for power development at Lake Buntzen. The agreement between the company and the city of Vancouver was entered into during 1900, and the plans of the company already accepted provide for the expenditure of a greater sum during the immediate future.

PROPOSED CHICAGO SUBWAY.—Mr. George W. Jackson, president of George W. Jackson, Inc., has sent a formal communication to the city clerk of Chicago offering to submit to the City Council plans for an $80,000,000 subway system for Chicago. The letter embodying this proposition was submitted to the City Council on Sept. 8 and was referred to the local transportation committee. Mr. Jackson says that he is ready at any time to discuss with the aldermen the details of the project. He assets that his company is prepared to start work at once on the construction of 12 miles of tunnels in the district bounded by Chicago Avenue on the north, Michigan Avenue on the east, Twenty-second Street on the south and Halsted Street on the west. In addition the company declares that it is prepared to submit figures for the construction of a much more extensive system serving a large portion of the city's area and including 80 miles of subway.

WIRELESS DISEASE.—According to M. P. Bellile, a French naval surgeon on board the *Descartes*, which has been engaged in the campaign in Morocco, the members of the ship's company who were employed in wireless telegraph duty developed various affections in consequence of the action of the Hertzian waves. Most commonly the telegraphists complained of their eyes, a slight conjunctivitis similar to that occurring among those who work with arc lamps being found. Although this of itself was not generally serious, in one case where the attacks recurred again and again, keratitis was produced which resulted in a leukoma of the right cornea and consequent impairment of vision. In order to protect the eyes from the ultra-violet rays of electric emanation, it was recommended that yellow or orange glasses should be worn. Not only were the eyes of the operators affected, but two cases of eczema—one of the wrist and one of the eyelid, both very difficult to cure—were seen. One of the officials who had been employed for several years in wireless telegraphy suffered from painful palpitation of the heart, which came on after working for any length of time at the instruments for sending messages. This man was quite free from any organic lesion of the heart. M. Bellile is disposed to think that a good many of the cases of nervousness and neurasthenia, which seem now to be getting rather common among naval men, may be due to the work which is being done in wireless telegraphy.

Electrical Equipment of the Great Western Power Company.

THE hydro-electric development of the Great Western Power Company, at Big Bend, on the Feather River, was described in the Aug. 26 issue. The project is on a grander scale than any of the numerous transmission plants having lines terminating on the Pacific coast, and the equipment throughout represents the limit thus far reached as to size. Preliminary surveys of the watersheds were made with as much care and in as minute detail as would be made by a city of 1,000,000 inhabitants seeking to safeguard its water supply for years to come. When completed, the station will

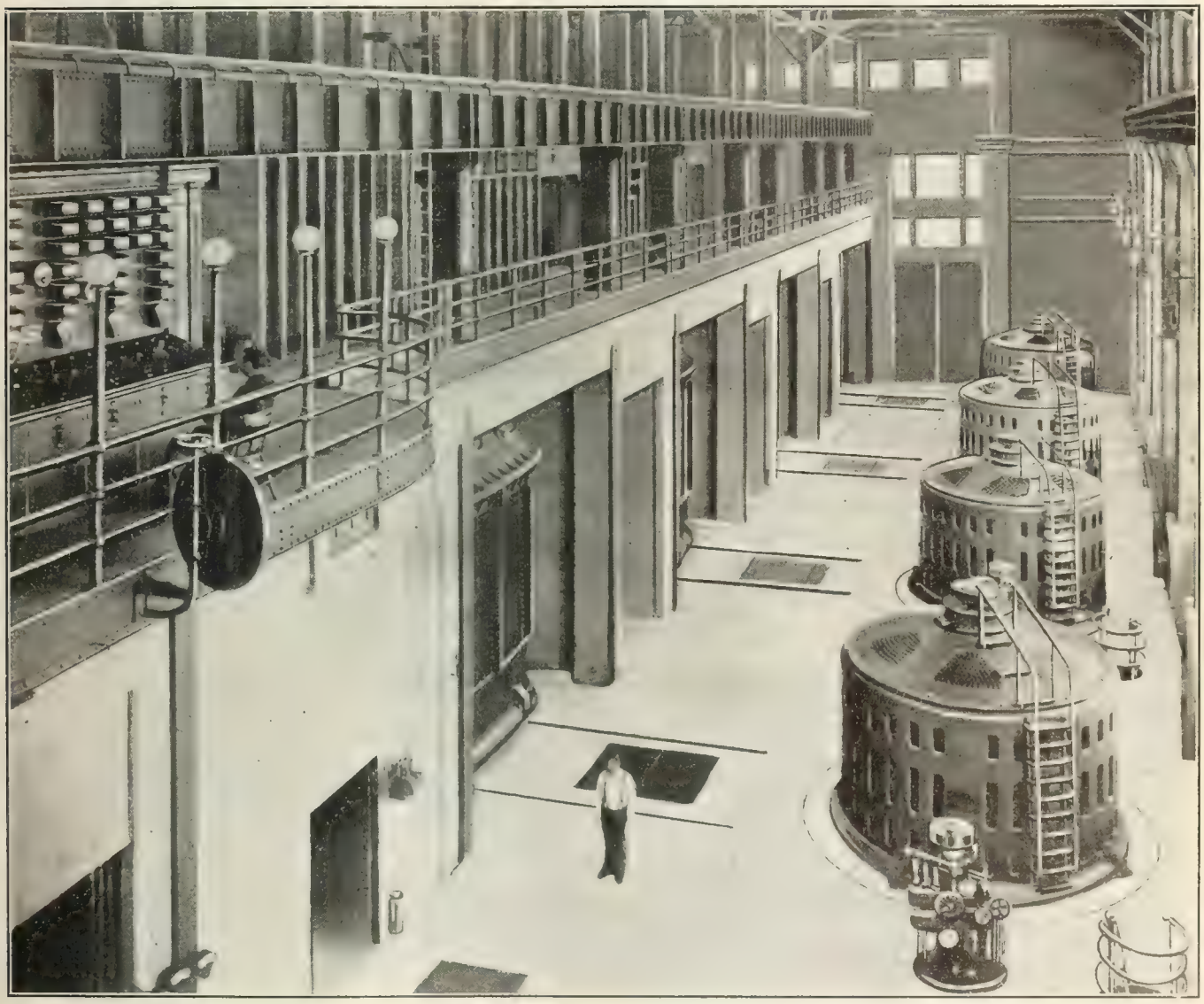


FIG. 1.—GENERAL INTERIOR VIEW OF THE GREAT WESTERN POWER COMPANY'S HYDRO-ELECTRIC STATION.

be the largest in the West and one of the largest in the world. A detailed description of the water turbines, which are the highest powered wheels in existence, was published in the previous article and details of the electrical equipment are given below:

The main generators, of which there are four at present in operation, are three-phase, revolving-field machines wound for 11,000 volts, 60 cycles, and have a rating of 10,000 kw each. The normal speed is 400 r.p.m. These alternators are of the vertical-shaft type, each supplied with two guide bearings, one immediately above and the other immediately below the generator. The shaft has a forged-on flange for coupling to the water-wheels. The details of the rotor were worked out with unusual care; the method of dovetailing the pole piece to the rotor rim was invented for this particular machine. The copper of the field coils is supported at the two ends against centrifugal forces by means of heavy steel disks, so arranged as to allow of circulation of large quantities of air over all the heated parts of the rotor and stator without excessive windage losses. The field copper along the sides of the poles is supported by means of two gun-metal brackets. A hydraulic brake is applied to a ring on the base of the field structure to hold the generator in case of leakage in the water-wheel and also to bring it to a standstill quickly when necessary.

A double speed test of the generators was made at the factory. The peripheral velocity at normal speed, 400 r.p.m., is 11,500 ft. per minute, hence at double speed it is 23,000, or somewhat over four miles per minute. Probably no high-speed water-wheel generator has ever been subjected to so severe a mechanical test. Complete tests of the machine showed efficiencies somewhat in excess of the guarantee, as follows:

	Guaranteed.	Actual.
Full load	[illegible] per cent	97.[illegible] per cent
Three-quarters load	96.0 per cent	96.4 per cent
One-half load	94.5 per cent	95.0 per cent

The temperature rise was within the [illegible] C. limit.

The transformers are of the three-phase, water-cooled type, and are the largest ever built. They have a normal rating of 10,000 kw at 100,000 volts delta on the high-tension side and 11,000 volts delta on the low-tension side at a frequency of 60 cycles per second. The transformer consists of a set of flat

primary and secondary coils, placed vertically and surrounded by a built-up steel core. The coils are so placed as to admit of a free circulation of oil between them, which acts not only as

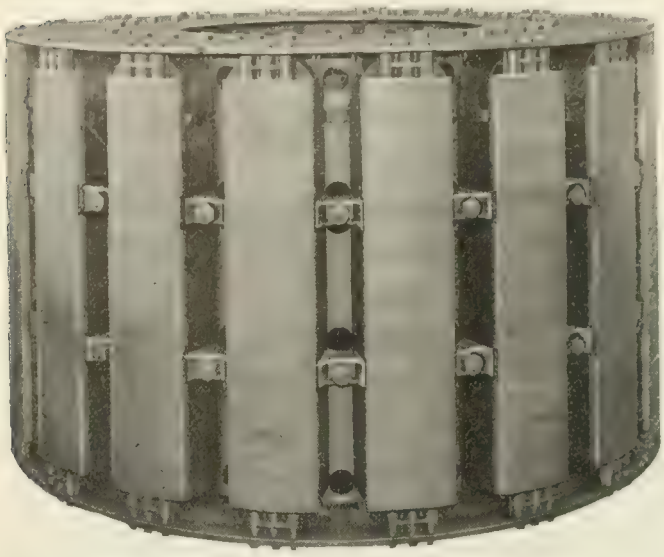


FIG. 2.—REVOLVING FIELD STRUCTURE OF 10,000 KW ALTERNATOR

an insulator, but as a cooling medium, by conveying the heat from the interior portions of the transformer to the tank and cooling coil by natural circulation. The primary and secondary windings are subdivided into several coils, each built up of flat conductors wound with one turn per layer so as to form thin, high coils which present a large radiating surface to the oil.

Placed between adjacent primary and secondary coils is a continuous insulating diaphragm which is rigidly held in position by spacing channels covering the edges of the coils. The assembled coils, except at the ends, are completely enclosed by continuous sheets of insulation which interpose a substantial barrier at all points between the winding and the core. The insulation between the primary coils and the core and between the primary and secondary coils will stand a test of 200,000 volts, alternating current, and between the secondary coils and core a test of 24,000 volts, alternating current. The core, windings and cooling coil are completely immersed in a specially refined oil, approximately 9000 gal. of which is required for each transformer. A valve for drawing off the oil is located in the base of the tank.

A coil of pipe for water circulation is placed in the oil in the upper part of the tank and surrounds the end of the winding. The combined surface of the coil and tank is sufficient to dissipate the heat generated and thus maintain the oil and all parts of the transformer at a low temperature. The water-cooling coil of copper pipe absorbs that portion of the heat that cannot be dissipated by natural radiation from the tank, and is made to fit closely the transformer, thus minimizing the oil and floor space required. The transformer is enclosed in a boiler-iron tank, which is secured to the cast-iron base by a joint made oil tight by heavy riveting and calking. The tank has been constructed with an arched cast-iron cover, from which the transformer is suspended.

The primary and secondary leads, consisting of insulated cables, are brought through porcelain bushings in the cover. For the primary terminals sectional oil-filled bushings are used. They are made up of a number of small annular sections assembled with press-board rings between them, which extend outward several inches from the bushings proper, thus greatly increasing the leakage surface. A heavy metal rod, which serves as a terminal lead, passes through the center of the bushing, binding together tightly the several sections and extending rings.

The oil space is divided into a number of sections by press-board cylinders which are made concentric with the lead. Bushings can be kept filled up to the proper level by the aid of a sight gage placed near the top. An eyebolt and hook are furnished with each bushing and are arranged to be screwed into the top of the terminal for convenience when handling the bushings. The completed bushings are so designed that they may be readily removed from the transformers.

The transformer has a tap in the high-tension winding for 60,000 volts with rating reduced in proportion. There are taps in the secondary winding of approximately 5 per cent and 10 per cent above and below 11,000 volts, with corresponding proportional changes in the transformer rating. The efficiency of the transformer when at full load is approximately 98.5 per cent.

For the purpose of exhausting the 1,300,000 cu. in. of air from the transformers prior to filling them with oil, a vacuum pump, rated at 50,000 cu. in. of air per minute, is installed. This is driven by a 250-volt motor through countershafting. Each transformer is mounted on flanged wheels, the bearings for which are lined with a bronze alloy to prevent rusting. By this means the transformers can be wheeled from their compartments and handled by the 50-ton crane with which the generator-room is equipped. In wheeling the transformers to and from their cells, block and tackle are employed, the ropes being fastened at one end to the transformer and at the other

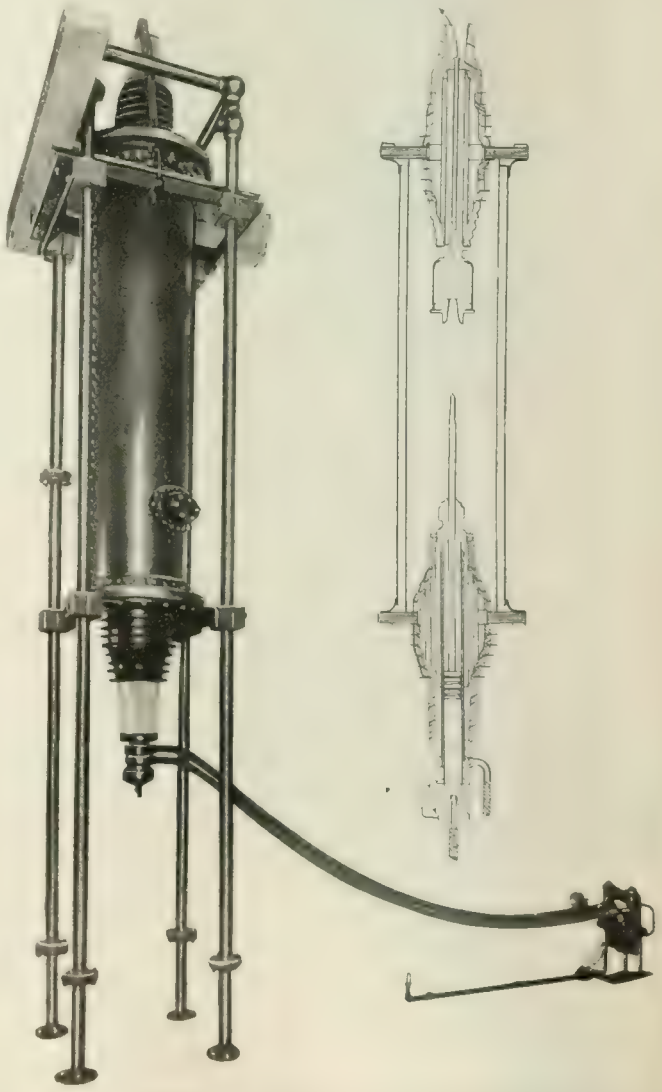


FIG. 3.—DETAILS OF PNEUMATICALLY OPERATED SWITCH.

end to the overhead crane. When pulled into position by this means, the parts of the transformer are handled directly by the crane.

The main switchboard is of the benchboard type and follows standard practice in its design. Below it on the generator floor

is an auxiliary switchboard from which are controlled all of the lamps in the station and all of the auxiliary motor-driven apparatus and penstock valves. The motors are 250-volt direct-

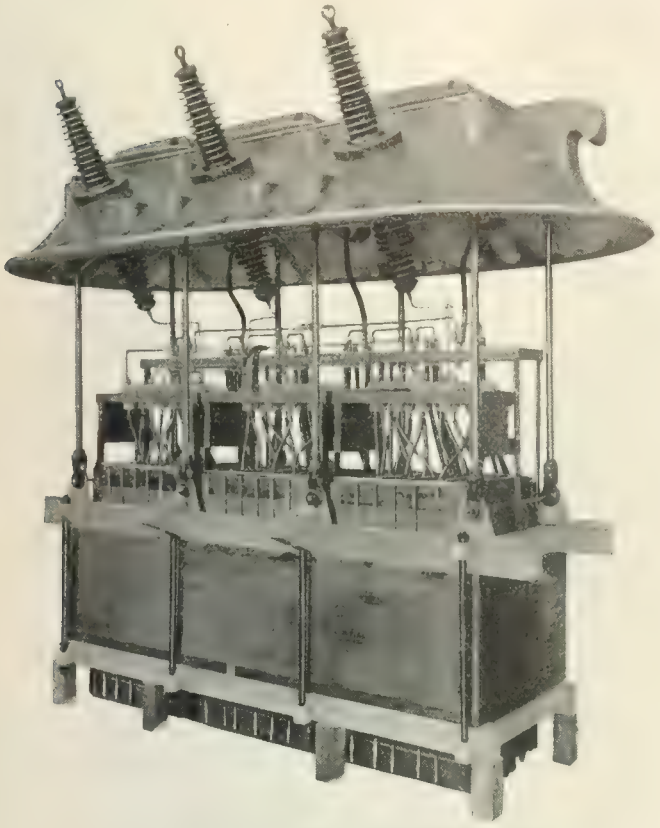


FIG. 4.—THREE-PHASE, 10,000-KW TRANSFORMER WITH COOLING COILS REMOVED.

current machines, and the lighting circuits are supplied from three single-phase transformers having a secondary potential of 110-220 volts. The main board overlooks the operating-room floor, and from it are controlled the motor-operated rheostats for the fields of the alternators, the motors on the

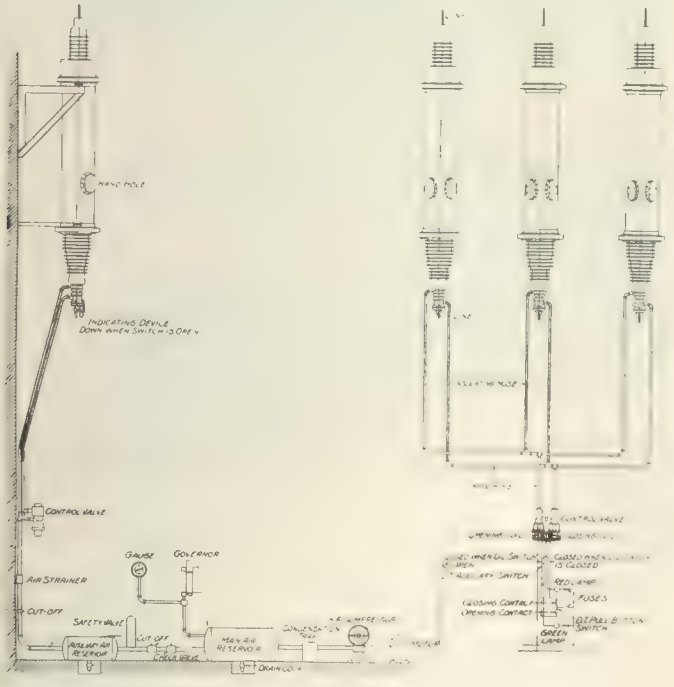


FIG. 5.—ARRANGEMENT OF 100,000-VOLT SWITCHES.

water-wheel governors, the 11,000-volt motor-operated oil switches, the 100,000-volt pneumatically operated switches, disconnecting switches on the main and auxiliary 11,000-volt buses, disconnecting switches on the 100,000-volt buses, etc. Series transformers are connected on the outgoing high-tension leads so that both the high-tension and low-tension currents

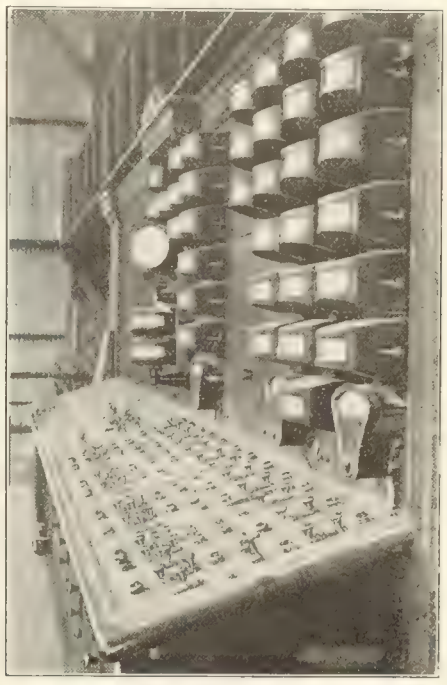


FIG. 6. VIEW OF MAIN SWITCHBOARD.

may be measured, and also in order that the current in each line as it leaves the station may be ascertained. The exciter buses are electrically operated. The high-tension pneumatically operated switches are of special interest, being the first of their type installed in power-plant operation and a brief description of their make-up is given below.

The 100,000-volt oil switches consist of three single-pole elements, pneumatically operated and electrically controlled. The



FIG. 7.—ALUMINUM CELL LIGHTNING-ARRESTERS ON ROOF OF STATION.

switches are opened and closed by means of single-pole, double-throw, hand-operated controlling switches, located on the controlling benchboards. The red and green indicating lamps,

which are a part of the controlling switches, are so arranged that when the oil switch is closed the red light shows up and indicates that the line is alive and dangerous. When the switch is open the green light indicates that the line is dead and not in use.

Aside from this indicating device, there is a mechanical indicator located at the bottom of the lower insulator, which shows whether the switch is open or closed, this insulator being operated by the piston. Each pole of the oil switch consists of a steel tube with an insulator at each end. The upper insulator contains the contacts, and the lower contains a piston which operates the contact rod, the piston being actuated by compressed air, as shown by Fig. 5. The contact consists of four sections of extruded metal held in position by a retaining nut and containing special tension springs to insure good contact. On opening, the arc is ruptured in a steel explosion chamber.

The switches are operated at 80 lb. pressure, controlled through valves electrically operated on the 250-volt direct-current circuit. The valve is located directly below the switch and is connected to the switch by means of a treated tube, giving sufficient insulation between the high-tension and low-tension parts. The valves are so designed that they may be tripped through switchboard relays. Each switch is supplied with a 3-cu. ft. capacity air tank, which allows of opening or closing the switch independently of the storage tanks. Check valves and air strainers are used between the storage and small tanks. The switches are arranged in a vertical position and supported under the upper flange of the tube and braced just above the lower flange, the outer casing being grounded. Special built-up insulators are used. The outside shell is made of heavy composition rings and washers and is filled with a compound of high insulating value.

The outgoing lines are protected by aluminum cell arresters on the roof of the station. Suspension-type insulators on steel towers support duplicate No. 3-0 copper lines running for the most part over a private right-of-way to Oakland. Running along the top of the towers is a ⅜-in. steel ground wire. The towers, which are about 71 ft. high above ground, are spaced 750 ft. apart, and transpositions are made every three and one-half miles.

There are approximately 1200 ordinary Milliken towers, with 13 special towers, varying in height from 150 ft. to 300 ft., in use on the 165 miles of line. In many sections very soft ground prevails, while in others marshes and water are crossed. The towers in these localities are erected on piles and concrete work. This is especially true of the section between Antioch and Sacramento, where the line runs across a number of small islands. Here concrete foundations are used and special towers. At Antioch there are two 3000-ft. spans from towers 292 ft. high.

From Oakland to Antioch the country is hilly, while from Antioch to Oroville the line follows the Sacramento Valley in perfectly flat country subject to floods. From Oroville to the power station the line runs along the foothills of the mountain. The foundations of the towers in many places have been strengthened by means of concrete since their erection. The line at present is being operated at 60,000 volts pending the completion of the substations.

The terminal station at Oakland will contain three 10,000-kw transformers, two of which are at present installed. There are two incoming and six outgoing lines at the station, with tie lines between it and the steam-auxiliary station at Oakland, which will be described in a subsequent issue. Messrs. Viele, Blackwell & Buck, of New York, are the engineers for the entire project. The electrical equipment was built by the General Electric Company. The officers are as follows: President, Mr. Edwin Hawley, New York; vice-president and general manager, Mr. H. H. Sinclair, San Francisco; secretary, Mr. H. P. Wilson, New York; treasurer, Mr. F. M. Tompkins, New York; auditor, Mr. C. E. Mynard, San Francisco, and purchasing agent, Mr. H. P. Pitts, San Francisco. The offices of the Great Western Power Company are in New York and San Francisco.

High-Voltage Generators.

By Frank Koester.

WHILE American engineers have been discussing the advantages and disadvantages of high-voltage generators feeding directly into a system, it remained for Continental engineers to design, construct and operate such machines. Of the several high-voltage generator installations which have been in operation for many years, probably the most prominent one is that recently erected at Manojlovac, Dalmatia. That high-voltage generators are practicable is proved by this 30,000-volt plant, feeding a 21-mile aerial transmission line, built for the same company, which has had a 15,000-volt generator plant in operation since 1903, feeding directly a six-mile aerial transmission system. Both transmission systems run over a section of mountainous country, subject to violent thunder storms and other atmospheric electrical discharges, the energy being utilized in the manufacture of calcium carbide.

The 15,000-volt plant is located at Jaruga, on the Kerka River, some six miles above Sebenico, Dalmatia, where the carbide works are situated. The equipment consists of two 3500-hp Francis turbines, running at 350 r.p.m., each being directly connected to a 42-cycle, 15,000-volt, two-phase generator, having a 3000-kva output, with a power factor of 80. The new plant is installed at Kerka Falls, and is equipped with four 6000-hp Francis turbines, each of which is directly connected to a 42-cycle, 30,000-volt, three-phase generator, making

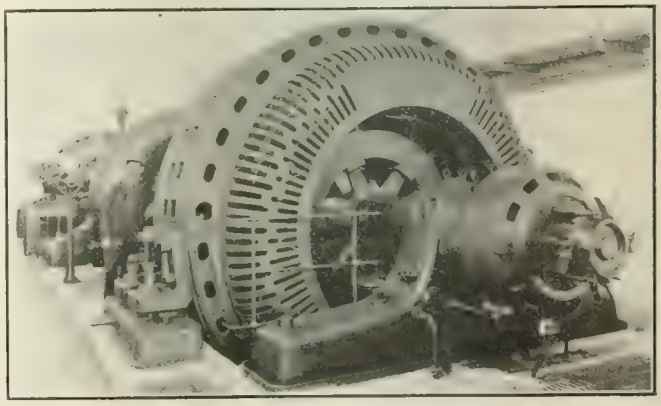


FIG. 1.—30,000-VOLT GENERATOR, MANOJLOVAC PLANT, DALMATIA.

420 r.p.m.; the output of each generator, at a power factor of 80, being 5200 kva. At this rating the efficiency is 94 per cent, and at half load, 91 per cent. When the load is suddenly thrown off from full to no load, with constant speed and excitation, the voltage rises 18 per cent. The machine is wound to withstand a short circuit for two minutes, with maximum excitation. The generators for both plants, designed and installed by Ganz & Company, Budapest, who also furnished the turbines, have many novel features; some details of the Manojlovac generator are given below.

The armature frame is split perpendicularly, forming two V-shaped rings, which again are split in halves, and when bolted together form a complete ring. As will be seen in Fig. 1, the frame has detachable feet: in the pit the armature rests on two pairs of rollers, so that after the feet are unbolted the whole frame rests upon these rollers, thus enabling the whole to be revolved. This is done for the purpose of inspecting and repairing the windings in the lower half without removing the revolving field.

Fig. 2 shows the armature coils. They are machine form-wound and of five different shapes. The copper conductor is rectangular in section and wound on edge. The convolutions of each coil give a winding of 26 conductors per slot per phase. The insulation of the coils is chiefly micanite put on in layers and held in place by insulating tape. The ends of the winding of each coil terminate in brass lugs and the coils of each phase are connected together by insulated copper cable.

The revolving field structure has 12 poles, the cores and pole cap being cast in one piece, dovetailed into a cast-steel ring, which is shrunk upon a cast-iron spider wheel. To insure additional security, each core is held by a conical bolt. The field winding consists of copper strip wound on edge; the layers are separated by paper sheets, and the whole is surrounded by a paper casing formed to suit the coils. The spider wheel is held in place by two keepers forced in by hydraulic pressure of 250 tons. The whole revolving field structure, with its shaft, not including that of the turbine, weighs 26 tons.

Another novel feature in connection with this type of generator is the exciter unit, which is mounted on the overhang of the shaft. Contrary to the usual practice, the collector rings are placed on the end of the shaft, adjoining the commutator of the exciter, so that, by extending the brush-holder arms of the latter, the copper brushes for the slip rings can be carried on them. Only one of the collector rings is insulated. The shaft is drilled up to the spider of the revolving field structure; through the hole of the shaft a flexible cable passes to the field coils. The return circuit for the exciter current is through the shaft itself. The generator shaft is rigidly coupled to that of the turbine, on each side of which is a bearing cast to a common bed plate. The bearings are 10⅝ in. in diameter and 37½ in. long. They are ball shaped, white metal lined and water cooled.

All the generators operate in parallel; to provide for regulation, the switchboard is equipped with an automatic device which opens the field circuit of all exciters in case of excess or diminution of generator voltage, or in case of current overload. This is done with the assistance of the automatic turbine regulators, which cut off the supply of the turbines. This regulator operates when the speed varies 10 per cent of normal, and requires three seconds to cut off the water supply from full to closed gate. As the load is a very steady one, this answers all practical purposes; the regulator comes into service practically only when the unit runs away.

Having no transformers, which are excellent protecting devices for the generator against atmospheric discharges to which the transmission system is exposed, the station is nevertheless well equipped with combinations of lightning arresters. There are two groups, one for busbars and the other for lines. Each phase of the bus is provided with an oil-submerged condenser, a horn gap provided with auxiliary gap and a multiple gas arrester, shunted by an oil-submerged resistance. Each phase of the outgoing lines is protected by a choke coil with capacity cylinder, a horn gap with auxiliary gap shunted by graphite resistance rods, a multiple-gap arrester with shunt resistance and a water-flow grounder. At the substation, with the exception of the busbar protection and water-flow grounders, the 21-mile transmission system has the same protection as when it leaves the power house.

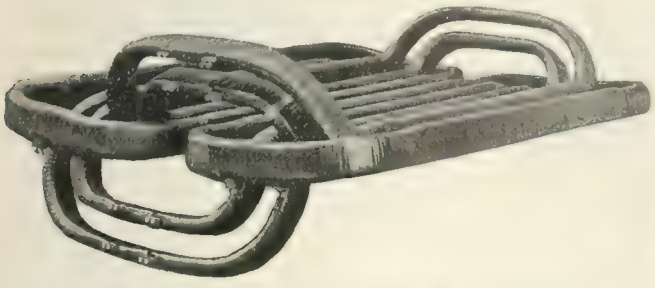


FIG. 2.—ARMATURE COILS OF 30,000-VOLT GENERATOR.

The Manojlovac plant has been in continuous operation for nearly two years, and there have been no interruptions due to atmospheric discharges. The claim of some engineers that high-voltage generators are impracticable seems to have no basis.

Another high-voltage generator plant is that of the Valtellina Railroad, located at Ponte de Desco. Here are installed three 2000-hp Ganz-Francis turbines, directly connected to 15-cycle, 20,000-volt, three-phase Schuckert generators. With a power factor of 70 the output of each, at 250 r.p.m., is 1050 kw and with normal load the temperature rise does not exceed 45 deg. C. With constant speed, and with a sudden change from no load to full load, the voltage drops 15 per cent; a sudden dropping of the load causes the voltage to rise 10 per cent. The generators can withstand a short circuit for two minutes, and for two hours a voltage of 30,000. In case the turbine regulator should fail to work, an automatic switch is provided which cuts in resistance in the generator field circuit, reducing the exciting current and thus the generator pressure.

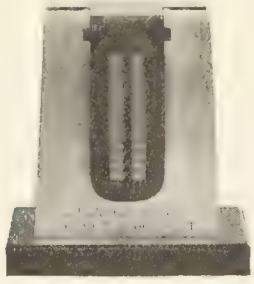


FIG. 3.—CROSS-SECTION OF ARMATURE COILS OF 30,000-VOLT GENERATOR.

The advantages of high-voltage generator plants are: Lower first cost; low operating expense; simplicity in wiring. With the employment of high-voltage generators, transformers and their attendant troubles are eliminated. A 30,000-volt generator is, of course, more expensive than a 6000-volt or other low-voltage generator. However, taking into consideration the step-up transformers necessary with low-voltage generators, the cost of the high-voltage generator is lower. The power house is also smaller and therefore less expensive. The simplicity in the station wiring is at once evident; there is no low-tension bus system with switches, transformers and measuring instruments, therefore no special low-tension compartments are necessary. However, better and more expensive instrument transformers are required. There being no step-up transformers to look after when generators are put into service, the operating performance of the station is simplified. When generators are to be run in parallel and thrown on the line, it is only necessary to bring the incoming machines to synchronism and connect it to the bus. The absence of transformers relieves the system of surges when connecting unloaded transformers on the buses.

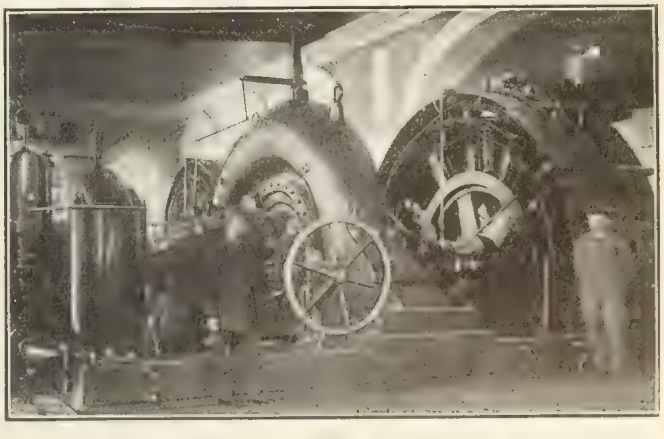


FIG. 4.—20,000-VOLT GENERATORS AT PONTE DE DESCO, ITALY.

The fear expressed by some engineers concerning the unreliability of operating high-voltage generators is practically without foundation; to entertain such fears would seem to indicate a belief that expensive high-tension transformers are the only reliable protecting devices for generators against lightning. Fortunately, other means of protection against lightning have been devised, such as those outlined.

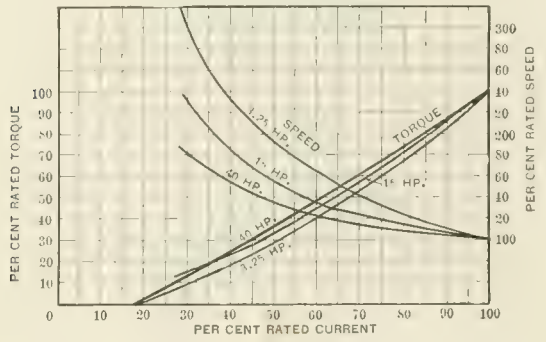
Speed-Torque Characteristics of Series Motors.

By Frank F. Seaman.

The general characteristics of the series crane motor are well known through the performance curves issued by the various manufacturing companies, but relative speed increase and torque decrease, with decreasing current, are not always stated in convenient form. The accompanying curves show, in a general way, the characteristics of a good line of series crane motor in this respect.

The magnetic circuit of a crane motor, as is well known, should approach saturation only at its rated load so as to permit of the maximum speed increase at less than full load on the crane.

By referring to the curves it will be seen that with 40 per cent of the rated current a speed increase of from 50 to 130



AMPERE-SPEED AND AMPERE-TORQUE CURVES.

per cent will result; the former for motors of from 40 hp to 50 hp, say, and the latter for motors of from 2 hp to 3 hp. The middle curve shows what may be expected of motors between these two ratings.

The curves here presented are closely true only for the motors from whose performance curves they were derived, but they are characteristic of any well-designed line of crane motor.

Characteristics of the "Spinner" Motor.

By Selby Haar.

In the Digest of a recent number of the *Electrical World* a description was given of a multi-speed induction motor which was called a "spinner" motor. The design illustrated was of a three-speed motor, the different speeds being obtained by a combination of electrical and mechanical devices.

It will be remembered that the motor consists of three parts —stator, spinner and rotor—the spinner carrying the secondary corresponding to the stator and the primary corresponding to the rotor.

It is easy to perceive how the high speed results from the connections described, because the internal magnetic field on the spinner has an absolute angular velocity in space, which is the sum of that due to the polar winding on the spinner and the actual velocity of the spinner. Thus the synchronous speed of the rotor is the sum of the synchronous speeds of the two elements.

It is not so simple, however, to devise an arrangement which will give the low speed, and, as a matter of fact, there is only one which is entirely operative. The following course of reasoning will develop the basis for this statement.

Assume, as a concrete case, a motor with shaft extended at one end only, the connection to the load being by a coupling mounted on the extended shaft. The two ends of the motor may then be called "front end" and "coupling end." Suppose, further, that when the observer faces the front end of the motor, the rotor is to turn clockwise.

The two motor-elements must be wound for different numbers of poles. If both have the same number, the spinner will rotate at practically synchronous speed, so that there will be little or no relative slip between the internal magnetic field and the rotor; this follows from the fact that the spinner and the internal magnetic field are traveling at practically the same speed in opposite directions, so that their sum is almost zero. Such a motor would be very inefficient.

Assume the stator wound for the smaller number of poles and the spinner for the larger. This is undesirable electrically because the lower-speed motor should have the larger diameter at the gap. Since the rotor is to turn clockwise, the internal polar winding on the spinner will be connected for clockwise rotation of the magnetic field. This requires that the magnetic field of the stator rotate counterclockwise. With the stator unexcited, assume voltage to be impressed upon the spinner. If the countertorque of the load at start exceeds the friction countertorque of the spinner, which is probable, the spinner will start and accelerate rapidly up to nearly synchronous speed counterclockwise, while the rotor remains stationary. A little reflection will confirm this description of the rotation of the spinner, because only in this way can the slip of the magnetic field past the rotor be reduced to a running-light value.

With the spinner running at the no-load speed corresponding to the larger number of poles, let the stator be excited. As soon as this is done the stator exerts a large torque on the spinner because it is running considerably below the stator synchronous speed and accelerates it to the higher speed. The spinner is now rotating counterclockwise faster than the magnetic field is traveling clockwise, so that this magnetic field has an angular velocity in space counterclockwise equal to (practically) the difference between the synchronous speeds of the two elements. The rotor will tend to follow this magnetic field and will try to run counterclockwise. If it does not revolve as fast as the magnetic field, the electrical relations are the same as those of an induction motor run at a negative slip and instead of the rotor exerting a torque it consumes torque, so that this arrangement is absolutely inoperative.

If the rotor runs counterclockwise a little faster than the magnetic field a torque is developed tending to accelerate the rotor in a clockwise direction so as to decrease the slip between it and the internal magnetic field. There is also a drag on the spinner in a clockwise direction which operates to reduce its slip with respect to the stator, which in turn reduces the torque exerted by the stator. The final result will be that the spinner is driven above the higher synchronous speed and becomes an induction generator, producing a drag on the spinner which balances the pull of the internal magnetic field. This arrangement is operative, the spinner consuming power from the line, transmitting some through the rotor to the load, and returning the rest (minus losses) to the line through the stator. The direction of rotation is counterclockwise instead of clockwise, but this can be reversed by reversing both sets of leads. This connection is then operative provided some external means for starting the rotor are provided, because, as shown above, the motor is not self-starting. If the motor is accelerated to the middle speed with the brake set, the speed can be decreased to the lower value by releasing the brake and making the necessary adjustments of connections to the line.

Assume, now, the stator wound for the larger number of poles, and the spinner wound for the higher speed. As noted above, this is the more advisable arrangement. Assume again the internal magnetic field connected for clockwise rotation. Let it be excited, and the spinner again comes up to speed counterclockwise, while the rotor remains stationary. This time, however, the spinner runs light at almost the higher synchronous speed. If now the stator is connected to the line so that its magnetic field rotates counterclockwise, the spinner and the stator become an induction generator consuming power from the spinner, which decreases its speed to a little above the lower synchronous value. The internal magnetic field thus acquires a clockwise rotation in space equal almost to the difference between the two synchronous speeds. As it acquires velocity it accelerates the rotor with it, so that this motor can be brought gradually up to operating speed. Here

again the power is supplied to the spinner, transmitted in part to the rotor, and in part returned to the line through the stator. If the load on the motor increases, the rotor exerts a greater pull on the spinner, increasing its speed in a counterclockwise direction; this means a greater negative slip of the spinner with reference to the stator, producing a countertorque to oppose the load torque. This arrangement is thus entirely stable.

It has been mentioned that the operation is partly by circulation of power through stator, spinner and the line. It may be interesting to consider how much power is circulated for a given motor output. Assume 10 poles and 14 poles and a frequency of 60 cycles. The synchronous speeds are 720 r.p.m. and 514 r.p.m., giving 206 r.p.m. as synchronism for the low speed. The full-load speed is considerably less, as the slip of both elements must be subtracted. If each is 2 per cent, the full-load speed is about 181 r.p.m. If the motor is rated at 100 hp, then the stator exerts $\frac{584}{181}$ 100 hp, or 278 synchronous horse-power in torque, and the spinner exerts $\frac{706}{181}$ 100 hp, or 381 synchronous horse-power in torque. Thus over 2¾ times as much power is circulated as is delivered to the load. This fact shows that the motor must be designed with very low copper loss in order to maintain the efficiency.

Spacing of Light Units.

By Alfred A. Wohlauer.

A correct physical conception of the flux of light leads immediately to the conclusion that in order to obtain a certain illumination a knowledge of the candle-power rating of the illuminants to be employed is sufficient for an exact determination of their distance apart; for it is a well-known fact that a certain total quantity of light flux can illuminate only a certain limited area with a certain illumination or flux density, and this area again affords a means for determining the distance between the lamps. There is, furthermore, a distinct numerical relation between the number of light sources, the area of the plane to be illuminated and the distance between the illuminants, these three quantities being interlinked in such a way that one of them can readily be ascertained when the other two are known.

In view of these facts, it seemed to the writer hardly necessary to enter into a special discussion on the topic of the spacing of light sources, at least up to the present time, it being considered sufficient to explain the physical as well as the numerical relations and to point to the various possibilities arising from a proper engineering treatment of this subject. It happened, however, of late that certain solutions of this problem offered in technical and trade publications are apt to disprove this very important task of engineering activity of its significant character. On this account it may be useful to dwell somewhat extensively on this question and bring before the reader considerations and relations which are of importance in connection with the engineering of the spacing of light sources.

The fundamental equation which may form the starting point from which all further determinations can be derived is the following:

$$D = \sqrt{aU \div Y} \qquad (1)$$

where

D = distance between the lamps, for rectangular spacing, in feet.
U = output of light unit, in mean spherical candle-power.
Y = expected illumination, in foot-candles, or the light flux density in lumens per square foot.
a = a factor.

The factor a, which forms the link connecting theoretical and practical illuminating engineering, is numerically equal to the number of effective lumens per mean spherical candle-power, and, therefore, gives an idea of the illuminating engineering efficiency of the installation. At an efficiency of 100 per cent it has the value of $4\pi = 12.57$. The factor a is an empirical value and must be ascertained by experiment or derived from actual installations. At the present state of illuminating engineering, lamp manufacture and reflector design, it has a general value of from 5 to 6 with an approximation sufficient for all conservative preliminary calculations as well as for general determinations of the contractor or architect. This value corresponds to an illuminating engineering efficiency of from 40 per cent to 50 per cent, and holds true for all commercial lamps on the market at the present time—for carbon and metal filament lamps in connection with prismatic or opal reflectors, for Nernst lamps in connection with alabaster globes, etc.—in short, for all general or commercial illuminating engineering. For more exact work in connection with the use of specially designed reflectors, etc., the factor a will be larger; it may run up to eight and even assume higher values, while under specially unfavorable conditions or in case of faulty designs its value may be found around three. Still, for all off-hand determinations the value five is a safe one to use.

Independent of the factor a the distance between the illuminants depends with theoretical as well as practical correctness only on the mean spherical candle-power (flux) of the lamps and on the illumination to be obtained, as expressed by the above formula. In order to demonstrate this relation and its significance for practical designs, the above table has been calculated by means of this formula. On account of practical considerations, it was found desirable to introduce into the table a number of the most popular lamps with their corresponding mean spherical candle-power instead of choosing a series of assumed candle-powers or light fluxes. For similar reasons of a purely practical nature, the value of the factor a was assumed as the same in all cases, namely 5. This is all the more justified as it constitutes the further advantage of revealing a true picture of actual and practical relations considered on an equal basis.

Thus, it is interesting and valuable to know, for instance, that 8-cp carbon lamps spaced 4 ft. apart give an illumination of 2 foot-candles while 25-watt tantalum lamps should be spaced 5 ft. apart in order to produce the same illumination.

Spacing of Lamps in Feet.

Commercial rating of lamps.	Mean spherical candle-power.	Flux in lumens.	Effective illumination in foot-candles or lumens per square foot: 1	2	3	4	5	6	7	8	9	10
8-cp carbon	6.4	80	5.67	4.00	3.25	2.83	2.50	2.33	2.16	2.00	1.92	1.83
25-watt tantalum	10	125	7.08	5.00	4.08	3.50	3.17	2.92	2.67	2.50	2.33	2.25
16-cp carbon	12.5	157	7.83	5.67	4.58	3.91	3.50	3.25	3.00	2.83	2.67	2.50
25-watt tungsten 50-watt Gem 40-watt tantalum	16	200	8.91	6.33	5.17	4.50	4.00	3.67	3.42	3.17	3.00	2.83
32-cp carbon 80-watt Gem 66-watt Nernst 40-watt tungsten	25.6	320	11.67	8.00	6.50	5.58	5.83	4.67	4.33	4.00	3.75	3.58
80-watt tantalum	32	400	12.58	8.91	7.42	6.33	5.67	5.17	4.75	4.50	4.25	4.00
88-watt Nernst 60-watt tungsten	38.5	480	13.75	9.75	8.00	6.92	6.17	5.67	5.25	4.83	4.58	4.33
110-watt Nernst	48	600	15.50	10.91	8.91	7.75	6.83	6.33	5.83	5.50	5.17	4.92
132-watt Nernst	60	750	17.33	12.25	10.00	8.67	7.75	7.08	6.58	6.17	5.75	5.42
100-watt tungsten	64	800	17.75	12.58	10.33	8.92	8.00	7.33	6.75	6.33	5.92	5.75
250-watt tungsten	160	2,000	24.33	20.00	16.25	14.17	12.58	11.50	10.67	10.00	9.42	8.92
5-amp enclosed arc 4-glower Nernst	250	3,140	35.33	25.00	20.42	17.67	15.75	14.42	13.33	12.50	11.33	10.67
10-amp flaming arc	1,100	13,800	74.00	52.33	44.75	37.00	33.00	30.17	28.00	26.17	24.67	23.42

Eight feet is the distance for an illumination of 2 foot-candles in the case of the 32-cp carbon lamp, 80-watt Gem lamp, 66-watt Nernst lamp and 40-watt tungsten lamp, the rated mean spherical candle-power for all of which has practically the value of 38.5. The 88-watt Nernst lamps give 3 foot-candles if suspended 8 ft. apart, while the 100-watt tungsten lamp gives 5 foot-candles at the same distance. One can thus easily determine the distance between the lamps, the value of which will prove correct whatever the wattage of the lamp, the light distribution or height of suspension may be.

If the number of lamps to be used is large, hardly anything is left to be added in regard to the remaining steps in the design of illumination, since there is ample, if not unlimited, scope for the selection of the light distribution curve or the height of suspension, as has been pointed out in an article of the writer in the *Electrical World* for March 21, 1909.

The rule for the location of outlets in the case of a comparatively large number of lamps can be stated as follows: Divide the area to be illuminated into squares, the size of which have a length equal to the distance determined by means of the above formula, and suspend the lamps above the centers of these squares at any height which is convenient with respect to local conditions. One restriction should be made, which, however, is rarely of importance in practice, namely, that the minimum height of suspension should not be smaller than one-half of the distance between lamps. When the room to be illuminated is so low that the possible height of suspension of the lamps is smaller than one-half of the distance, calculated by means of formula No. 1, smaller illuminants must be chosen in order to be able to bring the lamps closer together, thereby obtaining a practicable light distribution. However, for rooms of usual and more than usual height, the height of suspension of the lamps, as well as their light distribution, is irrelevant with respect to the illumination or its uniformity, as has been sufficiently explained by the writer in former articles in this journal.

For a comparatively small number of lamps the light distribution and height of suspension must be taken into account though they do not influence the distance between the lamps. In order to obtain the desired illumination, the height of suspension and the light distribution of the individual lamps must be selected and mutually adapted in such a way that the expected illumination is obtained at every point of the plane. The foremost and most plausible rule therefor may be expressed by the well-known formula:

$$u = Yh^2 \qquad (2)$$

wherein

u = candle-power of lamp vertically downward.
Y = illumination to be obtained, in foot-candles, or lumens per square foot.
h = height of suspension, in feet.

In the case of a single lamp, the light distribution curve should be such that the candle-power increases with increasing angle between light ray and the vertical in order to obtain nearly uniform illumination for a certain area, while for two or more lamps the candle-power u has usually the maximum value and decreases with increasing angle between the light vector and the vertical. The reflectors should then be designed accordingly, unless the original light distribution curve of a lamp or of a lamp unit with reflector answers the purpose.

For practical and commercial illuminating engineering it is hardly feasible every time to design special reflectors or light units according to the special or most favorable conditions; one must rather rely upon commercial products of lamps and reflectors which are offered on the market, but he may eventually modify the height of suspension according to the light distribution curve of the unit chosen.

The following rules should, therefore, be added to the above for the design of illumination in a case of a small number of lamps: After the distance between the lamps has been determined according to formula No. 1, the proper height of suspension should be selected with respect to the local requirements. The light distribution curve of the lamps should be decided upon with respect to formula No. 2. The height of suspension must eventually be modified according to commercial light distribution curves; only in extreme cases should the size of the lamp and the corresponding distance between the lamps be altered.

It is always preferable to suspend the lamps as high as possible, in order to remove them from plain view and to shield the eyes against glare; moreover, as in the case of a large number of lamps, the height of suspension of the lamps should never be smaller than one-half of the distance between them.

It may be added that these rules are applicable only to calculations of the so-called general illumination for which uniformity is most desirable. For localized illumination—for instance, in the case of workroom tables and desk illumination—different conditions prevail, which, as a rule, are subject to individual treatment and special design.

It, furthermore, may be remarked in regard to the intermediate territory which lies between comparatively large and comparatively small numbers of lamps, that it must be left to the judgment of the designing engineer to decide whether it is necessary to take the light distribution and the height of suspension into account. Of course, the results will be more accurate and the illumination obtained more uniform and satisfactory if attention is paid to the light distribution and the height of suspension; still, if this is overlooked even in the case of a small number of lamps, the mean or average illumination obtained will correspond to the one introduced into calculation with formula No. 1, though the illumination will be rather uneven and perhaps too small just where more light is required.

To give a résumé of this article, it is well to state that for a certain definite candle-power rating of lamp the distance between the lamps depends only on the illumination to be obtained; it is not influenced by the height of suspension, nor by the light distribution curve of the individual lamps. There is only one distance that can be allowed between illuminants of a certain flux in order to obtain a certain average illumination, and while in the case of a large number of lamps the light distribution of the individual lamp is of minor importance as to the unevenness of illumination, for a comparatively small number of lamps the height of suspension and the distribution of light from each lamp have to be taken into account to obtain a fairly uniform illumination of sufficient density at all points.

Operation of the 110,000-Volt System of the Grand Rapids-Muskegon Power Company.

Articles relating to the electrical generating and transmitting equipments of the Grand Rapids-Muskegon Power Company have appeared from time to time in our columns. Our issue for Nov. 3, 1906, contained a description of the 66,000-volt installation deriving its energy from Rogers Dam. An article in our issue for Sept. 14, 1907, dealt with the successful operation of the transmission circuits at 72,000 volts, while the 110,000-volt installation of the company was described in our issues for Nov. 2, 1907, and Feb. 4, 1909. However, many of the interesting features of this pioneer equipment have not been discussed previously.

In addition to employing a higher e.m.f. than previously attempted, the plant is unique in its simplicity. The only automatic device in the whole system is the speed regulator for the water turbines. In the high-tension lines there are no fuses, switches or cut-outs and no lightning arresters. Even in the low-tension side of the transformers at the generating station no use is made of regulating devices or automatic switches of any kind. As a matter of fact, the leads from the 6600-volt generators are connected directly to the primary coils of the transformers, and the secondary coils are joined directly to the 110,000-volt transmission lines without the insertion of any device whatsoever. In the generator leads there are oil switches operated by solenoids controlled by inverse-time element, bellows-type overload relays, but the switches have been plugged

shut so that they are no longer in circuit. However, the system is protected from overload by circuit-breakers in the distributing circuits, while the fact that the turbines are incapable of operating the generators at a dangerous overload furnishes additional protection.

Experiments have shown that when the e.m.f. on the transmission line is increased by, say, 10 per cent, the line loss due to "corona" discharges increases by almost 100 per cent. This condition shows that the line is operated at a voltage only slightly below the maximum permissible value for the present physical arrangement of the circuits. Due to this fact, any increase in the e.m.f. induced by lightning produces an excess of corona loss, and tends to minimize the disturbance from lightning, while the high factor of safety used in the line insulators provides protection to the line. This conclusion seems justified by the operation of the 110,000-volt line continuously under lightning conditions which caused damage to an adjacent 70,000-volt line constructed along the same right-of-way according to standard practice, and provided with the usual lightning protective devices. However, for the protection of the apparatus at the terminals of the 110,000-volt lines, use will be made the coming season of lightning arresters of the electrolytic type.

The energy for the 110,000-volt system is obtained from a hydro-electric installation at Croton, on the Muskegon River, from which place it is transmitted 40 miles to Grand Rapids. A dam across the river at Croton affords an effective head of 40 ft. by joining a lake 12 miles in length along the bed of the Muskegon. The dam, which is of concrete, provides one of the walls for the wheel house and generator-room. It is equipped with motor-operated discharge gates and log spillways, but no extra precautions have been taken for the removal of floating ice, because the still water of the lake allows the ice to form and then to melt without floating down stream.

The generating equipment consists of two 3000-kw Westinghouse, three-phase, 6600-volt, 30-cycle alternators, each of which is driven by eight horizontal-shaft Leffel turbines to which it is direct-connected. The reason for using so large a number of turbines for each generator resides in the fact that for the head available the arrangement selected afforded the most economical equipment for the power developed. The speed of each generator is controlled by two Lombard governors, each of which regulates the water admitted to two pairs of turbines. The speed at which the governors tend to cause the generator to operate is set by means of a miniature direct-current motor receiving power from the exciter circuits and remotely controlled by push buttons on the switchboard. A synchronoscope is used in paralleling the two generators for connection through 6600-volt busbars.

Each alternator is provided with a 40-kw exciter mounted on an end of its shaft extended beyond the main ring-oiler bearing. The usual array of exciter instruments and controlling devices is conspicuous by its absence. The exciter terminals are joined directly to the terminals of the field coils of the alternator, the only method of varying the e.m.f. of the alternator being by means of the rheostat in the field circuit of the exciter generator. The exciter is a compound-wound machine, but the series coils are not used. The alternator is provided with a field-circuit rheostat, but this has been abandoned. Moreover, the 6600-volt oil switches in the main alternator leads are no longer used, as noted above. The switchboard for each alternator contains a single ammeter and wattmeter, two push-button devices for setting the speed of the machine and an exciter field-circuit rheostat; the handle for the 6600-volt switches, which are located immediately behind the board, an overload relay and an alternator field-circuit rheostat are also represented on the board, but are not utilized.

The only devices in the main alternator leads are air-break disconnecting switches and series transformers. In case it becomes necessary for the attendant to open the circuit under load the oil switches, which normally are fastened in the closed position, can be released and operated by hand or by the relay.

The 6600-volt leads are joined directly in delta to the primary circuits of three Westinghouse oil-insulated, water-cooled transformers, the secondary circuits of which are connected in delta to the 110,000-volt transmission lines. The only prominent features of the transformers are the secondary bushings, which have been made extra long for the high voltage. The lines leave the building by way of porcelain disk bushings mounted in wooden windows; each line is anchored against the opposite side of the building by five disk-type General Electric strain insulators, each of which is rated for 25,000 volts and the five for 125,000 volts.

The transmission line, which was described in our issue for Feb. 4, 1909, contains three cables suspended by disk insulators from steel towers, spaced 10 per mile. Each cable consists of six strands of No. 10 copper wire with hemp core. Joints in the cable are made by means of figure 8 copper tubing, which is given a total of three complete turns per joint. There are five 25,000-volt insulating disks at each point of suspension. The efficiency of the arrangement of the line is shown by the fact that the only mechanical defect was developed during an unusually severe sleet storm, when one of the cables gave way under the excess load, while the only electrical break-down occurred to two of the five disks at one tower, which caused no interruption, because the remaining three supported the line and provided adequate insulation.

At the main substation in Grand Rapids there are three 3750-kw, oil-insulated, water-cooled transformers, duplicates of those at the generating station. No switches are used in the primary leads, which are joined directly to the 110,000-volt transmission cables according to an arrangement similar to that used at the generating station. The substation is provided with the usual equipment of recording devices, oil switches, etc., for a 6600-volt distributing system. Air-insulated busbars allow the 110,000-volt transmission system to be paralleled on the 6600-volt secondary side with a 70,000-volt system which transmits energy 60 miles from Rogers Dam, 20 miles upstream on the Muskegon above Croton. For the latter system the substation contains three 1250-kw, 70,000-volt to 6600-volt, oil-insulated, water-cooled transformers. The 70,000-volt transmission wires are carried on pin insulators arranged on wooden poles. For 40 miles, or to Croton, it runs adjacent to the 110,000-volt transmission system. A compartment in the station at Croton is employed for disconnecting switches for the 70,000-volt circuits, but these circuits are in nowise interconnected with the 110,000-volt system except at the Grand Rapids substation, as noted above.

For the purpose of assisting the transmission system in time of low water the Grand Rapids-Muskegon Power Company is erecting at its substation a steam-turbine generating station. This station will contain a 4500-kw turbo-alternator as its initial equipment. It will be provided with a concrete stack having the noteworthy height of 250 ft. The electrical engineer of the company is Mr. J. B. Foote, who planned the unusual arrangements outlined above.

Water-Power Legislation in Norway.

The Norwegian Parliament has passed a measure relative to the future exploitation of the country's water-power, according to which all waterfalls with a capacity of more than 1000 hp which hereafter are sold to a limited company, whether entirely Norwegian or not, shall pass into the possession of the State after the expiration of the concession. Concessions are given for a period of not less than 60 nor more than 80 years, and at the lapse of the grant the waterfall with all regulating works connected with it becomes Government property with full ownership and without compensation. It can also be decreed that the power stations, with plant and other equipment, shall also pass into the possession of the State without remuneration. Whatever else is not covered by the measure can be acquired by condemnation proceedings, or the State can demand the removal of a plant before a certain date. Attempts to modify the measure and to exempt waterfalls under 3000 hp, and a proposal to give the concessionaire an option to rent the water-power and plant for a certain period after the expiration of the grant, failed of adoption.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Day Circuit at Abingdon, Ill.

The Abingdon Electric Company, of Abingdon, Ill., which gives central-station service in a town of about 3000 inhabitants, has operated a day circuit for about one year. It has about 75 hp in motors connected, and the day service is just beginning to pay its way. The rating of the plant is 200 kw, of which 50 kw is in a three-phase alternator belted to an Ide engine and 150 kw in a three-phase alternator belted to a Bates-Corliss engine. The 50-kw unit carries the day load. During a recent visit to the plant the load at 11 a. m. was about 26 kva.

The company has pumped water for the city by piping steam across the street to the city water works for the operation of a deep-well pump from a direct-acting fire pump. This service it has performed at $55 per month, and it is believed by those connected with the company that this has been done at a loss, as the steam-pumping apparatus is very inefficient. Nevertheless, the City Council seems not to be satisfied even with this low figure. It is preparing to put boilers in the city plant and operate the plant. How this can be done when the city must hire a man to run the plant in addition to paying coal bills has not been made clear. With motor-operated pumps this work could probably be done with profit to both parties concerned.

Handling of Central-Station Construction Work.

The Macomb Electric Light & Gas Company, of Macomb, Ill., has an interesting practice in the handling of construction work and extensions. Instead of keeping men who divide their time between maintenance of lines, setting of meters and the running of new services and other extensions, as is usually done in towns of about 6000 inhabitants, this company keeps no men for this irregular work, but employs the local electrical contractor, which is the Macomb Electric Construction Company, under the management of Mr. W. I. Savidge. The advantage of this plan from a central-station standpoint is that it is not necessary to employ men constantly and keep them on the payroll for irregular work. The company pays the contractor about 25 per cent over and above the regular wages paid to the men. From the contractor's standpoint the scheme works well, because it gives steady employment to a larger number of men than could otherwise be employed, and makes it possible to handle large contracts properly without employing extra men. In other words, both the central station and the contractor are taking advantage of the diversity factor in the contractor's business and utilizing the same principle that makes central-station business profitable.

The electric end of the central-station company's business is handled by two engineers, who do their own firing, and one extra fireman. The manager and the bookkeeper divide their time between the gas and electric business. The plant contains one 75-kw and one 150-kw, three-phase alternator, each unit being belted to a Bates-Corliss engine. The boiler-room is just being remodeled, and two new horizontal return-flue boilers 6 ft. x 18 ft. are being installed. Owing to the fact that the gas business was started in Macomb before the electric business, the gas distribution system covers the city more thoroughly than the electrical. The company has an unusual number of gas ranges installed, and gas lighting in many of the residences has tended to keep down the number of electric consumers.

Twenty-four-hour service has been given about four years. It took the company one year to get the day service on a paying basis. The connected motor load is now nearly 100 hp, not including 165 fans. The company has a contract for pumping part of the city water. This is done at a rate of 2.25 cents per kw-hour, as metered at the central station. A 25-hp, three-phase motor is used, which belongs to the company, all of the other pumping equipment belonging to the city. The city water supply has been somewhat short, so that the electric pumps only pump about 60,000 gal. per day. The company's revenue from water pumping is from $180 to $250 per month.

A Chicago Flatiron Campaign.

As related in the *Electrical World* of April 8 last, the Commonwealth Edison Company, of Chicago, placed 10,000 6-lb. household flatirons in the homes of Chicago between Dec. 15, 1908, and March 17, 1909. These irons were loaned to customers of the company for six months without charge. They were placed by direct personal appeal following circulars with return postcards addressed to all the customers of the company who might be interested. Responses from the circularizing were followed up by young men who secured orders for the irons, delivered them and demonstrated them. The utensils were sent out in wagon-loads with four men to a wagon in charge of a captain. The men were paid a salary and commission. The plan provided that the customer could obtain the iron for six months, rental free, provided the irons were used regularly.

At the expiration of the six-month period letters were sent out, signed by Mr. E. W. Lloyd, general contract agent of the Commonwealth Edison Company, saying that, although the regular selling price of the iron was $4.50, a special price of $2 had been established for the irons on loan. Users were invited to take advantage of this reduced price and keep the irons as their permanent property. Return postcards were enclosed in these letters also, and up to Sept. 7 about 3000 of the irons had been sold to customers who had obtained them under the loan plan. The company has no doubt that in time all of the 10,000 irons will be sold outright. It was anticipated that probably quite a number of the loaned irons would be returned, and it was arranged that these returned irons would be sent out on another 30-day loan to other customers or sold outright as used irons at the $2 rate. Only used irons were sold at this reduced rate, however. The customers availing themselves of the 30-day loan arrangement had the privilege of retaining the irons for $2 each. This plan proved popular, and there was soon a waiting list of over 200 for the loan and sale of used irons. It was found that there was such a demand for the purchase of used irons at the $2 rate that the 30-day loan plan was gradually abandoned.

This flatiron campaign, undertaken on an unusually large scale, has been remarkably successful, and indicates the real demand for these convenient utensils.

One of the complaints against "ironing day" caused by the old method of heating irons on a stove is due to the fact that it compels women to remain on their feet all day long. The electric iron does away with this great objection, with the further advantage that there is no heat from the ironing stove to make the room uncomfortably warm. The point was brought out forcibly in a letter received by the Commonwealth Edison Company from a customer who received an electric flatiron under a six-month loan plan, and was notified that he could purchase the iron outright at the end of that period for a reduced price. In responding to this invitation the customer wrote the following interesting and self-explanatory letter:

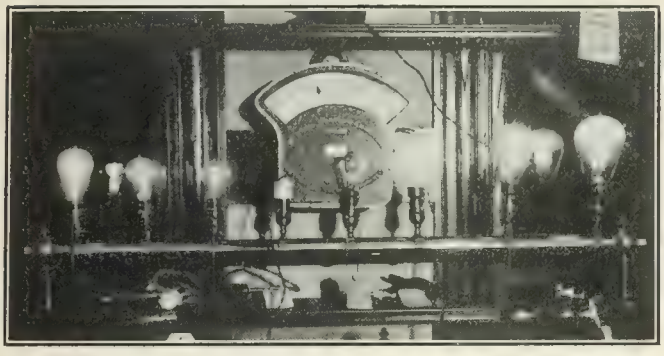
"I am only too glad to mail check for the $2 for the iron, for since it came into the house my wife has never used any other. She was not able to do her ironing before on account of standing. Now she sits down and goes ahead. She thinks it is the greatest blessing we have."

Office Exhibit of Narragansett Electric Lighting Company.

An interesting exhibit of electrical appliances is at present being maintained by the Narragansett Electric Lighting Company, of Providence, R. I., at the main offices of the organization in the business center of the city. The company's headquarters are up one flight in the Union Trust Building, and the windows are utilized for sign purposes, on each side of the premises. The designations on the windows, which are easily read from the street level or from passing cars, are as follows:

Narragansett Electric Lighting Company. Electric Power Ideal Drive. Electric Heat Without Fire or Flame. Electric Light Safe and Clean. Electric Light the Best Light. Electric Signs Increase Business.

Passing into the building and upstairs or via the elevators one is immediately attracted into the offices on reaching the second floor by the electrical display, which can be seen from the elevator car. A large variety of motors, heaters, lamps, shades,



OFFICE EXHIBIT OF NARRAGANSETT ELECTRIC LIGHTING COMPANY.

fittings and other equipment for office and domestic uses are shown close by the bill clerk's window and throughout the rest of the room. A feature of interest is illustrated herewith. It consists of an ammeter calibrated to read in the operating cost in cents per hour at the company's prevailing rates, and arranged so that any lamp or other moderate device of capacity on the wall or the table below can be connected to the instrument and the cost of operating it immediately shown to the prospective purchaser. In the photograph the ammeter is shown mounted behind a number of tungsten and carbon-incandescent lamps of different sizes, which are provided with plugs for insertion into the circuits running through the office. The exhibit has attracted wide attention locally on account of the simple way in which it shows operating cost.

Campaign for Electric Heating Devices.

Following its successful electric flatiron campaign, the Commonwealth Edison Company, of Chicago, has begun a new campaign to introduce industrial electric heating appliances, particularly the electric soldering iron. A circular letter has been sent out signed by Mr. George B. Johnson, in charge of the electric heating and specialty division of the contract department, calling the attention of men in charge of manufacturing establishments, repair shops, garages and places of like character to the advantages of the electric soldering iron, the tool recommended being made in seven sizes. In the circular letter the advantages to be derived from the use of these tools are pointed out. Among these advantages are convenience in use under automobiles and in other places where it is difficult to keep the ordinary soldering iron hot while the work is being done. In addition, the electric soldering iron can be used in places where it is dangerous to have an open flame; furthermore, the heat is generated at the tip, ready for instant conversion into work. The cost of operation is moderate, a medium-sized iron using only 120 watts, or but a trifle more than two ordinary 16-cp lamps.

Encouraging results have followed the effort to introduce electric heating tools on a wide scale, and these appliances have already been introduced into a number of manufacturing and repair establishments as the result of this campaign. One method of securing this class of business is worthy of special mention. Each of the company's solicitors for light and power is provided with a pad of blank forms 5½ in. wide and 3¼ in. high, reproduced in fac-simile herewith. When the solicitor, in making his rounds, receives any request for information in relation to electric heating or specialties he fills out this blank and sends it to Mr. Johnson, who has charge of this particular work in the contract department. A specialist from Mr. Johnson's division then follows up the "prospect" and secures the business if possible. If he is successful, the agent who sent in the "tip" is notified, and he gets credit for the amount of electricity consumed by the device sold in 50-watt equivalents. The man from Mr. Johnson's division, who actually concludes the deal, gets the credit for the sale of the apparatus.

The Commonwealth Edison Company maintains a division of its contract department for the sole purpose of looking out for

REQUEST FOR INFORMATION
REGARDING ELECTRIC HEATING AND SPECIALTIES

MEMO.
DATE REC'D ___
REMARKS
ORDERED .. 190
SECURED BY
ORDER NO ____
DELIVERED .. 190
NOTIFIED AGENT .. 190

MR GEO B. JOHNSON ____ 190
DEAR SIR
THE FOLLOWING PARTY DESIRES INFORMATION
REGARDING ____
NAME ____
ADDRESS ____
AGENT ____
SIGNED

AGENT WILL BE NOTIFIED WHEN ORDER IS SECURED

BLANK FORM FOR SOLICITORS FOR LIGHT AND POWER.

business of this class, which also includes electric flatirons, electric fans, ozone generators and various specialties and novelties. There is probably enough of this business to be had in every community to warrant the employment of at least one person to give his time exclusively to this line of development, and station managers may find it to their advantage to give more attention to the various electric specialties than they have done in the past. These devices add but little load singly, but in the aggregate they bring in a respectable volume of business. Furthermore, they are of a character that usually appeals to the public.

INTERIOR WIRING AND ILLUMINATION

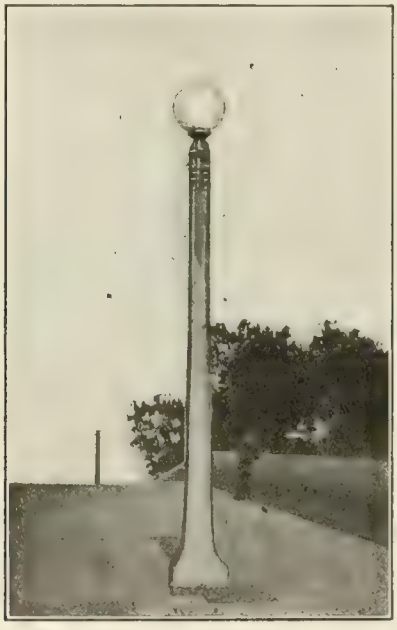
The Engineer and the Contractor.

Mr. Onward Bates, the noted Chicago engineer, in a recent commencement address at the Rensselaer Polytechnic Institute, pays tribute to the importance of the work of the contractor in terms which will be of interest to many electrical readers. "The engineer's education," says Mr. Bates, "'supplemented by business knowledge and the ability to handle men, makes the ideal contractor. For this reason the contractor's occupation offers an attractive field for engineers, and it is becoming common to find them engaged in it. With the great works carried on in these days, it is frequently the case that as much engineering talent is required in construction as in the making of plans. In such cases the engineer shares in the financial risk, and if successful his reward is greater than when employed under a salary. The old idea that engineers are saints and contractors sinners is going out of fashion. The men are the same under either title, and engineers become contractors without loss of self-respect, and without losing their rank as engineers."

New Concrete Arc Lamp Posts in Lincoln Park, Chicago.

A new type of lamp post especially designed for Lincoln Park, Chicago, and made of concrete, is being placed in that well-known pleasure ground. Although it is strong and substantial in appearance, as it is in reality, it is also notably attractive. The post is square, with chamfered corners, and the shaft tapers slightly above a spreading base having extreme dimensions of 2 ft. 4 in. square, until it is 7½ in. in diameter at the top. The post supports a 20-in. opalescent glass globe in which is placed a series 7½-amp Jandus arc lamp and operated by alternating current supplied from the Sanitary District's hydro-electric plant on the Drainage Canal. The center of the globe is 15 ft. above the base of the post.

The concrete of which the post is made consists of one part of Blanc cement, three parts of white sand and five parts of red granite screenings. The post is given a bush-hammer finish and is washed down with acid. The red granite gives it a pinkish tinge which contrasts well with the artistic metallic top piece, which is of cast bronze with verde-antique finish. Iron molds are used in making the post. About 170 of these handsome fixtures will be installed in the park at present; ultimately



CONCRETE LAMP POSTS IN LINCOLN PARK, CHICAGO.

all of the outdoor lamps for Lincoln Park will be supported on posts of this type. On streets and park roads the lamp will be spaced about 100 ft. apart on each side of the street.

This lamp post, which has also been adopted for the parks in Cincinnati, was designed by Messrs. Perkins & Hamilton, architects, of Chicago. It is not reinforced, except by the 1½-in. iron pipe encased within it, which serves to conduct the wires to the lamp. Architecturally, it is noteworthy in that it is not treated as a column, with a capital, as in the case of many other boulevard lamp posts surmounted by round globes.

Tungsten Street Arches in Michigan.

At the Michigan Electric Association convention at Detroit in August, there was naturally much discussion, both formally and informally, on the system of lighting downtown streets by means of arches of tungsten lamps hung from span wires suspended between buildings. Mr. W. J. Trott, representative of the Fostoria Incandescent Lamp Company, at Grand Rapids, furnishes the following list of such arches in use in various towns at the present time which have come under his knowledge:

Greenville, Mich.—Eight arches, 10 lamps per arch, 3.5-amp lamps, 60 cp; on 220-volt circuit.

Petoskey, Mich.—Twenty-two arches, 12 lamps per arch, 5.5-amp, 60 cp; operated from 220-volt circuit.

Belding, Mich.—Nine arches, 12 lamps per arch, 4 amp, 32 cp; operated from 155-volt circuit.

Big Rapids.—Six arches, 10 lamps per arch, 5.5 amp, 60 cp; operated from 110-volt circuit.

Columbus, S. C.—Twelve arches, 17 lamps per arch, 6.6 amp, 60 cp.

Grand Rapids has the following arches, all operated from 220-volt circuits: Canal Street, 15 arches, 18 lamps, 5.5 amp, 60 cp; Monroe Street, 25 arches, 14 lamps, 4 amp, 60 cp; Division Street, 18 arches, 14 lamps, 4 amp, 60 cp; Ionia Street, 16

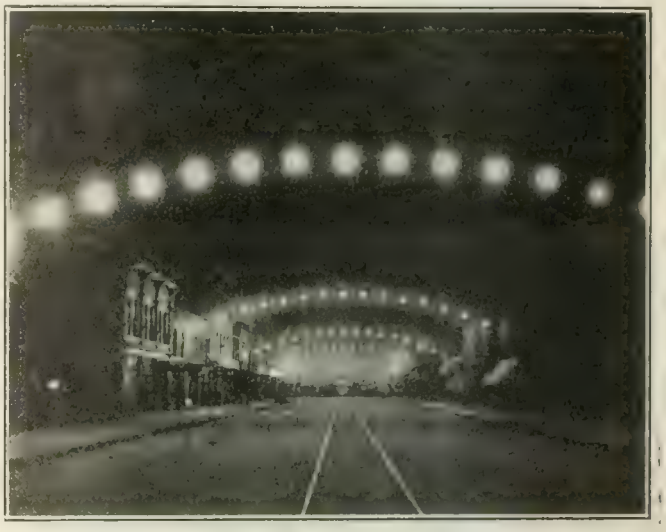


FIG. 1.—NIGHT VIEW OF ARCHES AT ADRIAN, MICH.

arches, 14 lamps, 4 amp, 60 cp; Market Street, 5 arches, 14 lamps, 4 amp, 60 cp.

With the various currents for which series-tungsten street lamps are made, it is easy to select a combination of lamps in series which will correspond in voltage to 110-volt or 220-volt circuits.

Mr. Harry Fee, manager of the Citizens' Light & Power Company, of Adrian, Mich., showed photographs of Adrian arches from which Figs. 1 and 2 are reproduced. The scheme of suspension differs from that originally used at Grand Rapids by having a steadying wire to which the lamp sockets are attached The original arches had lamps suspended from the span wire without this steadying wire. These arches were first put up for



FIG. 2.—DETAILS OF ARCH CONSTRUCTION.

a celebration in Adrian, and the company has now offered to maintain these for the merchants at the rate of $6.25 per night. There are 15 lamps per arch. The total installation consists of 330 40-watt lamps. There are 22 arches, placed from 115 ft. to 79 ft. apart. The highest lamp is about 28 ft. above the pavement.

Lighting of New Atlanta Auditorium.

By James O. Spear, Jr.

Within the past few years manufacturers, realizing the value of accurate data on their product, have inaugurated publicity campaigns with benefits along at least two lines. First, professional men have become more familiar with the product so advertised, have the more easily found places for its use and have secured better results. Second, the fact that publicity was



FIG. 1.—EXTERIOR VIEW OF ATLANTA AUDITORIUM.

to be given to the result of tests has proved an incentive to the manufacturer to keep abreast of the most advanced stage of the art. This has been especially true of lamps, reflectors and fixtures for lighting.

The advent of the tungsten lamp was the signal for an awakening and we soon had abundant examples of improved

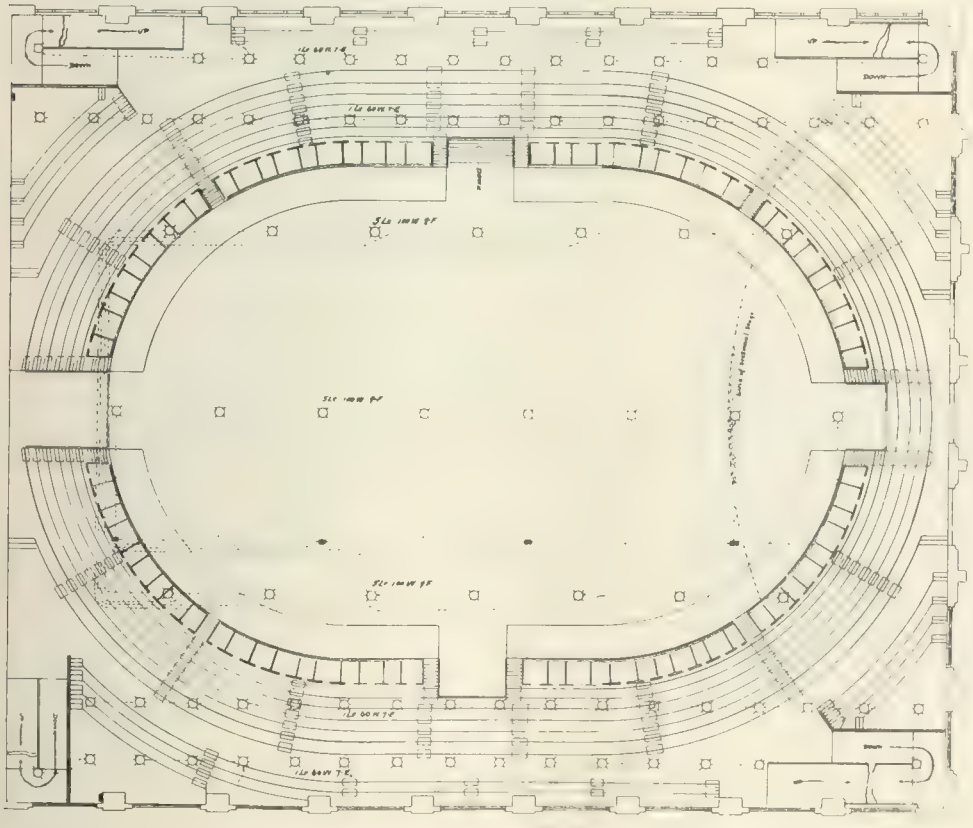


FIG. 2.—LIGHTING PLAN, ATLANTA AUDITORIUM.

lighting. So long familiar with the carbon-filament lamp, the temptation to use an equal number of the more brilliant units was often too strong, and one's eyes paid the penalty. In the past it has often happened that the factor of capacity for light-giving has been subordinated in an effort to have the lighting fixtures emphasize the architectural scheme. Nowhere has this done more damage than in churches and auditoriums. Too much or too little light—too great contrast in lighting—light in the line of vision, all cause fatigue to the eye and threaten

	Plan No. 1.	Plan No. 2.	Plan No. 3.
Station A, midway of seats.....	.998	8.149	2.226
Station B, 35 feet from center.....	.648	5.146	2.074
Station C, center of arena.....	.776	3.539	2.099
Average candle-feet illumination...	.807	5.611	2.199

permanent injury. The last two are by long odds a worse fault than the first.

When a large auditorium was planned for the city of Atlanta, after other items had been taken care of in the budget, the lighting apparently got what was left, and plans were issued calling for arc lamps. Fortunately, before the completion of the building, the committee having it in charge was

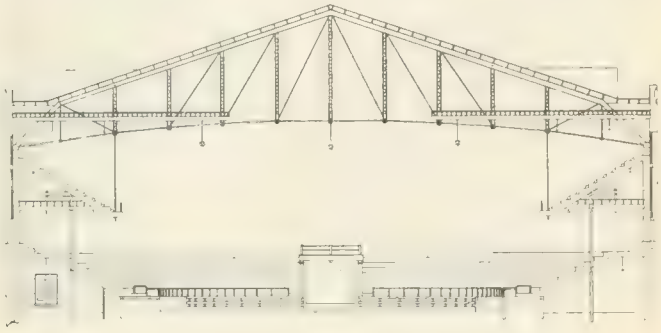


FIG. 3.—CROSS-SECTION VIEW OF AUDITORIUM.

brought to a realization of the importance of the matter of illumination and called for a report on lighting, first, by enclosed-arc lamps, second, by flaming-arc lamps, and, third, by tungsten-holophane units.

In the case of the flaming arcs it was proposed to use special prismatic inner globes where the ceilings were low. As a first essential it was recommended that all lights be above the line of vision from the upper balcony and the comparisons were made under these conditions. Three stations were selected for the purpose of comparison, and the writer's report showed the following results:

Plan No. 1 contemplated 38 550-watt enclosed-arc lamps, a total of 20,900 watts, equal to 0.427 watt per square foot.

Plan No. 2 contemplated 24 550-watt flaming-arc lamps, a total of 13,200 watts, equal to 0.269 watt per square foot.

Plan No. 3 contemplated 167 tungsten units, having a total wattage of 19,700, equal to 0.402 watt per square foot.

The figured illumination was as shown in the above table.

Plan No. 1 was ruled out on account of inadequacy of illumination. Plan No. 2 was also clearly out of the question because of the wide variation in intensity. The tungsten-holophane equipment was adopted and has excited only the most favorable comment. When it is considered that this auditorium will provide capacity for seating 8000 persons, the total, including foyer lights, etc., of 23.1 kw will at once appear small as a lighting load.

To return to the study of the basis for this layout. No plastering is used in the auditorium proper, the brick walls being left unpainted. For the sake of acoustics approximately 65 per

cent of the space under the roof is floored over, the joists and under side of floor being painted with cold-water white. The framing under the balcony and under the amphitheater is also finished in white. Floors, faces of boxes, etc., are stained in light brown. Under these conditions the walls contribute but little through reflection, and because of the height at which the main fixtures had to be hung—45 ft. above the plane of illumination—extreme concentration of light was essential.

The amphitheater or dress circle had the advantage of re-

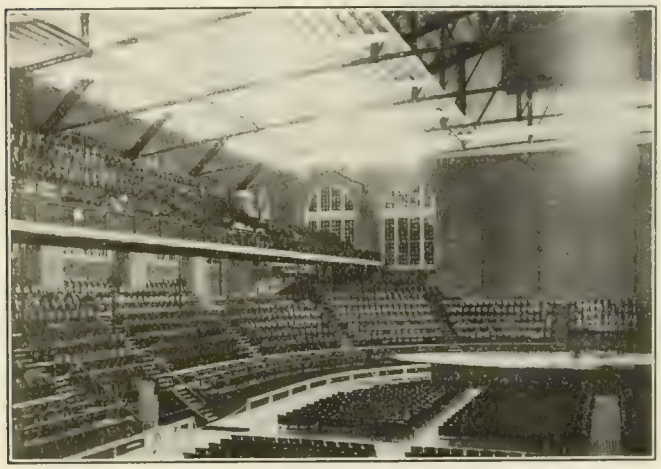


FIG. 4.—VIEW OF INTERIOR OF ATLANTA AUDITORIUM.

flection from the underside of the balcony, and having an average ceiling height of little over 15 ft., 61 60-watt clear-bulb tungsten lamps were allotted, 20 of these being used in intensive and 41 in extensive reflectors. The illumination of 2.226 candle-ft. was secured with an expenditure of 0.226 watt per square foot.

The average ceiling height over the gallery is 22½ ft., and although the white ceiling could be counted on for some help, an allotment of 58 60-watt clear-bulb tungsten lamps, or 0.35 watt per square foot, was necessary. Intensive reflectors were used throughout over the gallery.

The arena, with its ceiling height of 54½ ft., and with but the narrow edges of the white ceiling to help, presented the

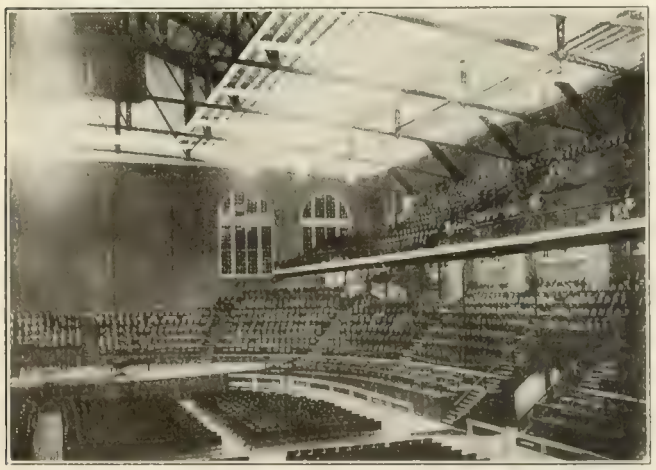


FIG. 5.—ANOTHER VIEW OF INTERIOR OF ATLANTA AUDITORIUM.

greatest difficulty. The equipment used consisted of 22 five-light Federal clusters with nickel-plated undercones, fitted with 100-watt clear-bulb tungsten lamps and focusing reflectors. An average illumination of 2.08 ft.-candles was secured with an expenditure of 0.67 watt per square foot.

For vestibules, stairways, etc., 60 bowl frosted tungsten lamps were used in extensive reflectors, the average wattage being 0.261 per square foot.

The total energy required for the whole building is 23,100 watts, equal to 0.368 watt per square foot. The sufficiency of the lighting and its evenness are best shown by the accompanying illustration engraved from a photograph made in 10 minutes with the lens stopped down to 16f.

New Telephone Patents.

EXCHANGE CIRCUIT SYSTEMS.

That the circuits of common-battery exchanges are subject to almost limitless variation has been evidenced by the numerout patents issued covering such circuits. Nearly all are designed to perform the same general functions, as the system of operation is now practically standardized. There have recently been issued to Mr. H. G. Webster, of Chicago, Ill., no less than 10 patents covering modifications of circuit system for common-battery exchanges employing two-strand cord circuits, ranging in date of application from 1904 to 1907. All of these patents have been assigned to Mr. M. G. Kellogg, and all are concerned with the signal system save one, which relates to the busy test.

Taking the patents at random, the first is found to employ a line relay and a double-wound cut-off relay, the battery being supplied with energy through both strands of the cord-circuit in parallel, a single supervisory relay serving for complete control of the supervisory lamp for each cord. When the cut-off relay operates it shunts out one of its windings, leaving the circuit resistance so distributed that the subscriber's line becomes a shunt of the supervisory relay, causing this latter to fall back and extinguish the lamp whenever this shunt is closed, this corresponding to the talking position of the switch hook. The shunt is opened with the depression of the switch hook.

In a second of these patents, a line relay is provided and a cut-off relay is placed in series with one limb of the line. The cut-off relay is equipped with a copper shell, or a non-inductive shunt, to reduce its impedance from the line circuit. The supervisory relay is double wound and is of the two-stage type. The first stage corresponds to the insertion of the plug in a jack. This action serves to light the supervisory lamp. The complete operation to the second stage occurs with the removal of the subscriber's receiver, through the energization of the second winding of the supervisory relay. In this position the supervisory lamp is extinguished.

In another of the systems a double-wound line relay is used with a battery tap through suitable retardation at a common point of the two windings. One of the windings is connected with the jack circuit and one with the windings to the line circuit. With a plug inserted the windings act differentially, causing the line lamp to become extinguished.

Another of the patents deals with a triple-wound cut-off relay inserted in the line circuit, the two talking limbs being led through differentially associated windings, one of which acts independently, with a third winding to cause a differential action of the cut-off relay.

In still another scheme the supervisory relay is omitted from the cord circuit, and its equivalent, in the form of a double-wound line relay, is included in the line circuit, the control of the line lamp being a double-wound, differentially connected cut-off relay.

One of the patents includes a double-wound, two-stage supervisory relay, with two-strand cord and plug, but with a three-wire jack circuit, the sleeve of the jack being connected to ground through the cut-off relay winding. In this system the first stage of the relay corresponds to the normal current through one winding of the supervisory relay and the cut-off relay in series. The second stage, with lamp out, corresponds to the talking condition.

A polarized supervisory relay, with tilting armature, is used in another system, in which the normal leakage current through the cut-off relay serves to tilt the armature from the normal position to that closing the lamp contact, while the removal of the subscriber's receiver causes a preponderance of magnetization in the other direction, causing the extinguishment of the lamp.

In two of the systems use is made of double-wound supervisory relays in which the windings act differentially, so that the energization of one illuminates the supervisory lamp, while the energization of both causes it to go out.

The busy-test circuit is designed with the idea of rendering an accidental crossing of one of the cord pairs of no effect on the busy-test relay. This latter relay is of high resistance and is normally connected to all non-busy cords, being removed with the actuation of the calling supervisory relay. The problem, therefore, is so to arrange the cord circuit that when any accidental crossing occurs the corresponding supervisory relay will immediately operate to disconnect the test relay. An added feature is the simultaneous display of a lamp to indicate the faulty cord pair.

CALL-REGISTER SYSTEM.

A call-register system has been patented by Mr. D. S. Hulfish, of Chicago, and assigned by him to the American Telephone & Telegraph Company. This register is arranged for operation in connection with automatic or semi-automatic telephone systems, the register being set for operation with the completion of a connection, but failing to operate until the actual response of the called party. Having once operated, the register locks itself against further action until the complete severing of this connection.

TELEPHONE REPEATER.

A telephone repeating generator forms the subject of a patent granted to Mr. M. R. Gilson, of Philadelphia. The generator comprises a small machine with both internal and external field magnets, a ring armature being driven between them by a pulley and belt. Mr. Gilson finds that such a generator will put a disturbing hum on a line due to the action of the commutator unless the residual magnetism of the fields be counteracted, leaving them neutral except for the magnetizing effect of the received telephone current, which is received upon the field magnet winding. To overcome the residual magnetism a depolarizing permanent magnet is associated with the repeating generator in a manner such that it may be adjusted to reduce the residual magnetism of the generator fields to zero, keeping them in perfect balance, and, therefore, susceptible to the minute received telephone currents. The action of this generator is as follows: The received telephone currents, being impressed on the field magnet of the generator, vary the flux through the armature correspondingly, and the armature, being driven at a constant speed, sends out additional energy to the telephone line corresponding in value at each instant to the instantaneous value of the received current.

MISCELLANEOUS.

An extension bell device has been patented by Mr. A. R. Marcotte, of Concordia, Kan., which consists of a contact push-button with a latch device upon its end. This will engage the magneto-bell rod when depressed, but will be released whenever the rod vibrates. Of course, it will be understood that pushing down this button opens the extension-bell circuit, while releasing it closes it.

Two receiver-holders for desk-stand use have recently been patented. One is of bent wire, the invention of Mr. B. E. Detrick, of New Albany, Ind. This controls the switch hook according to its position of use or rest. The other has a latch for locking the switch hook, and is the invention of Mr. C. R. Schafer.

LETTER TO THE EDITORS.

American Telegraph Engineering.

To the Editors of Electrical World:

SIRS:—I note that an editorial in your issue of Aug. 26 on the subject of the Budapest telegraph and telephone conferences contains the following statement:

"Our telephone systems are second to none in the world, largely because engineering talent has been amply employed in their development; but our telegraph systems are much behind the times, and are yearly growing relatively worse, largely for the corresponding reason that so little engineering talent is nowadays here employed in telegraphy."

This statement is extremely uncomplimentary to American telegraph engineers, and should not go unchallenged.

It is true that the telephone companies in this country have made wonderful advances; but direct comparison of telegraph and telephone equipment does not show the telegraph to be lacking in progressive efficiency.

Perhaps the writer of this editorial had in mind the failure of American telegraph companies to adopt extensively methods of transmission that more fully utilize the carrying capacity of the wires. But I have heard no one contend that the so-called "high-speed" telegraphs have any other merit than cheapness. We do not consider them even cheap, nor do they expedite the handling of traffic so far as the customer is concerned.

In the minds of intelligent men who are informed upon the subject there can be no question that the methods we have selected have greatly advanced and are steadily improving the service. Although there have been no striking changes in the methods of transmitting telegrams (except the printer experiments), there has been great improvement during the past few years in apparatus and equipment.

Speaking solely for my own company, I know that our pole lines will bear comparison with telephone lines, and that our interior equipment is as well suited to telegraph work as the highest grade of telephone equipment is suited to telephone work, and that it will compare favorably with any telephone or telegraph equipment on the face of the earth.

In short, the telegraph system that I represent is not "behind the times" and is not "growing relatively worse," and its telegraph engineers are entirely competent and progressive, and, to say the least, are quite as talented in their own line of work as the engineers of any other wire-using company.

NEW YORK. CHAS. P. BRUCH.

Vice-President Postal Telegraph-Cable Company.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Multi-Speed Motor.—An illustrated description of a new five-speed and six-speed, three-phase motor of the Oerlikon Company, based on different arrangements of the poles. The stator is wound with three different windings, the supply current having a frequency of 42 cycles per second. Allowing a certain percentage for slip, speeds of 210 r.p.m., 420 r.p.m., 630 r.p.m., 840 r.p.m. and 1260 r.p.m. are obtained with a number of poles equal to 24, 12, 8, 6 and 4, respectively. Two of the stator windings are available for two different numbers of poles having a ratio of 1:2. They are for this reason composed of elementary windings which are distributed regularly over the periphery and are divided into $6.\frac{p}{2}$ groups, where p is the minimum number of poles. These are connected in parallel when the number of poles is p, and in series when the number of poles is $2p$. The third winding is used only for a single number of poles. All three sets of windings are embedded in the same stator slots, the windings corresponding to 12 or 24 poles being placed nearest the gap, then the windings for four and eight poles, and, lastly, the windings for six poles are placed at the bottom of the slot. The output of the motor is 1260 r.p.m.—that is to say, with four poles is 23 hp when the terminal pressure is 280 volts. Naturally, the output decreases

with the speed and is only 6 hp when the motor is running under the 24-pole condition. The rotor winding is of the squirrel-cage type, and is composed of bars embedded in slots and connected at their ends by a short-circuited ring of brass. The pole-changing arrangement employed requires 15 terminals, six of which are intended for each of the two windings that provide two sets of poles, and three for the six-pole winding. By means of this motor several tests on a new method of

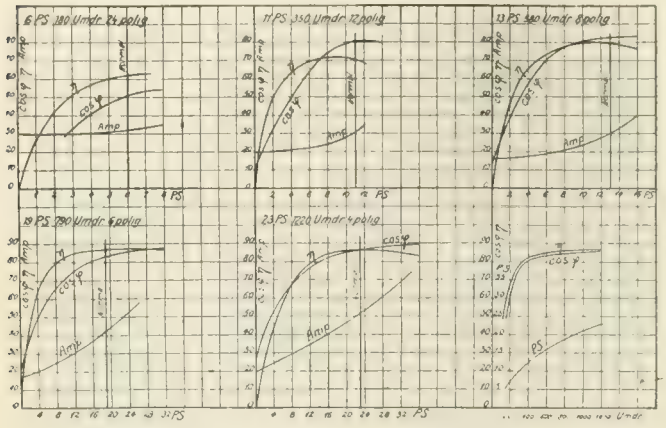
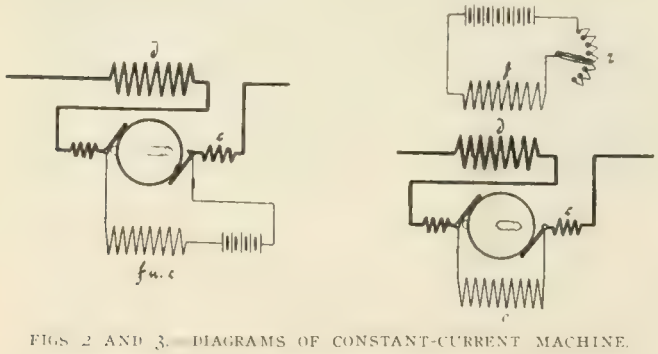


FIG. 1.—CHARACTERISTIC CURVES OF THREE-PHASE MOTOR.

pole-changing have been made possible. This arrangement allows a single winding to be arranged so that three different numbers of poles are obtainable from it in the ratio of 4:6:8 or 6:8:12. For this purpose the winding, which is designed to give 4:6:8 poles, is divided into 6. $\frac{p}{2}$ groups of elementary windings, the beginning and end of each group being connected to a terminal. Twenty-four terminals are thus necessary for winding giving four, six and eight poles. The distribution of the winding over the periphery is symmetrical both for poles and phases. On the contrary, for six poles the elementary windings are distributed irregularly. Under the first pole face, phase one has two windings in series and phases two and three one single winding only. Under the next pole, phase two has two windings and the other two have only one, and so on, but eventually each phase contains the same number of windings. The subdivision of the windings for 12, 16 and 24 poles is similar to that with 4, 6 and 8 poles, there being 36 poles with 72 terminals. Fig. 1 shows the operation at 260 volts, with a frequency of 42 cycles and using five speeds with three windings. In the illustration *P S* means horse-power, *Umdr* means revolution per minute, and *24-polig* means 24 poles. Results of tests of the motors as a six-speed motor at 280 volts with a frequency of 50 cycles are also given.. The six speeds are obtained in this case with 24, 16, 12, 8, 6 and 4 poles.—Lond. *Electrician,* Aug. 27.

Constant-Current Machine.—C. Kraemer.—An illustrated de-



FIGS. 2 AND 3.—DIAGRAMS OF CONSTANT-CURRENT MACHINE.

scription of a new constant-current machine of the Felten & Guilleaume-Lahmeyer Company. If a machine is excited by a series winding *J* (Figs. 2 and 3) and if this field is exactly compensated by a separate exciting coil *f*, every change of current is accompanied by a change of voltage. "This change of voltage can be used to introduce a self-excitation in another winding *e*, whereby with constant external resistance the current is brought back to the value corresponding to the separate excitation, since the self-excitation *e* replaces the field originally produced by the current change." There is, therefore, a sum of three fluxes. The self-excitation coil *e* and the separate-excitation coil *f* are either connected in series (Fig. 2) or in different circuits (Fig. 3). *c* represents compensation poles.

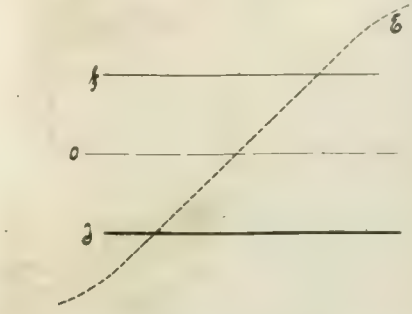


FIG. 4.—RELATION OF FLUX AND EXCITATION.

In Fig. 4 the line *f* represents the flux produced by the separate-excitation coil *f*, line *J* the flux produced by the main current, and the dotted line *E* represents the self-excitation, which depends on the voltage at the terminals of the machine. The sum of *J* and *f* must always be exactly zero. All three windings are placed together on the poles of the machine, which is otherwise of ordinary normal design. Since the sum of *J* and *f* must be exactly zero, it follows that the main current depends on the value of the separate excitation *f*, which may be adjusted by means of the rheostat *r* in Fig. 3. To prevent sparking the machine may be provided with compensation poles *c*. The machine is so adjusted that with constant current the voltage is automatically regulated according to the external resistance. The author describes applications of this machine in connection with the Ilgner hauling system, for rolling mills, as a booster for charging storage batteries, for arc-lamp circuits, etc. Since its design is exactly that of any standard machine, it is as reliable and sparkless in service as any standard direct-current machine.—*Elek. Zeit.,* Aug. 26.

Leakage Reactance.—J. Rezelman.—The conclusion of his illustrated mathematical article in which the author deals with the leakage reactance of the stator windings of alternating-current machines, the rotors being removed. The leakage flux is separated into its component parts, for several machines, by means of experiments; the effect of the type of winding upon the end-turn leakage and the relationship between the reactance of the windings in three-phase and in single-phase working are observed. Forumlas are given by means of which the stator reactance can be calculated.—Lond. *Electrician,* Aug. 27.

Speed Control of Induction Motors.—H. C. Specht.—The author discusses nine specific examples of the application of induction motors in cascade connection in comparison with single multi-speed induction motors.—*Elec. Journal,* August.

Direct-Current Motors.—F. B. Crocker and M. Arendt.—A continuation of their article, discussing motor losses, the rating of motors, and methods of controlling the direct-current series motors.—*Gen. Elec. Review,* September.

Transformers.—M. O. Troy.—The conclusion of his article on constant-potential transformers. The author discusses special steels for transformers and transformer constructions, and makes some remarks on judging a transformer with regard to its safety (durability, heating and insulation) and annual costs of operation.—*Gen. Elec. Review,* September.

Lamps and Lighting.

Metallic-Filament Lamps.—A. Libesny.—The conclusion of his paper before the German Association of Electrical Engineers on the development of the metallic-filament lamp during the last year. Fig. 5 gives curves showing the life of Osram lamps as a function of the specific consumption in watts per hefner candle. The ordinates are hours, the abscissas watts per hefner candle. The curve *ABS* gives absolute life, the curve

marked 20 per cent gives the useful life at the end of which the candle-power is decreased by 20 per cent of the original value. The curve marked 10 per cent gives the useful life at the end of which the candle-power is decreased by 10 per cent of the original value. For instance, when operated at 0.7 watt per hefner candle, the absolute life is 115 hours, while at the end of 48 hours the candle-power is 90 per cent of the original value, and at the end of 81 hours it is 80 per cent of the original

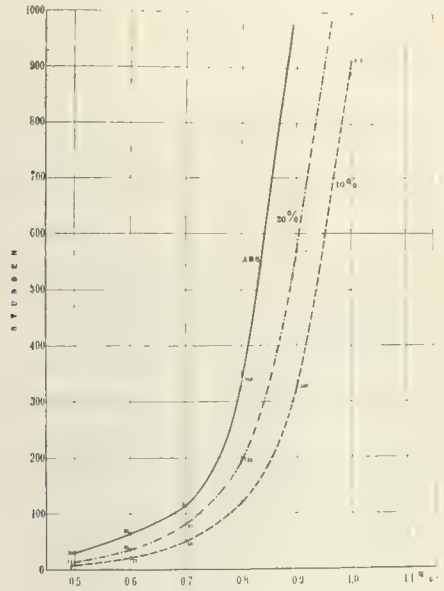


FIG. 5.—LIFE CURVES OF OSRAM LAMPS.

value. The author then applies his results to the graphical determination of the best conditions under which Osram lamps of present construction and price can be run. The results are given in the following table:

Cost of kw-hour.	Most economical specific consumption.
11.25 cents	1.10 watts per hefner candle
12.5 "	1.05 " " " "
15 "	1 " " " "
25 "	0.95 " " " "
50 "	0.90 " " " "
75 "	0.87 " " " "
100 "	0.85 " " " "
125 "	0.84 " " " "
150 "	0.82 " " " "

It will be seen that even at the enormous and practically impossible price of the energy at $1.50 per kw-hour a 0.7-watt per candle lamp is uneconomical. The net result is that with the present price of energy the most economical operation of Osram lamps relates to a consumption of 1 watt per hefner candle or more. During the last year the manufacturers of metallic-filament lamps have succeeded in extending the usefulness of these lamps to lower and to higher candle-powers. For instance, a 16-cp, 18-watt lamp for from 110 volts to 130 volts is now available. The author believes that the 25-cp lamp will be the lamp of the future, since there is now a demand for more light. For 220 volts a 32-cp, 40-watt lamp has been made. Finally, a high-candle-power lamp has become available in the form of the "intensive" Osram lamp of 600 or 1000 hefner candles measured horizontally. They are not intended to replace arc lamps of the same candle-power for direct current or arc lamps with impregnated carbons, but they can compete economically with alternating-current arc lamps with carbon electrodes. These intensive Osram lamps are also intended for indirect illumination in schoolrooms, drawing-rooms, etc.—*Elek. Zeit.*, Aug. 26.

Tungsten Lamps.—A. Beringer and R. Schuster.—An account of life tests of 23 tungsten lamps. The mean ratio of the mean spherical candle-power to the mean horizontal candle-power is 0.734, this being the ratio of the means of the two candle-powers for 1000 hours. The mean useful life at the end of which the candle-power is decreased by 20 per cent of the original value was 1044 hours. The following figures show the comparison of carbon, osmium and tungsten lamps.

Osmium lamps are no longer made; they represent merely a stage in the development of the metallic-filament lamp. The total cost of lighting with osmium lamps and with tungsten

	Carbon	Osmium	Tungsten
Mean watts per spherical hefner	4.171	2.145	1.353
Useful life in hours	707	1242	1044
Mean watts per horizontal hefner	3.411	1.662	1.026
Useful life in hours	681	1242	1044

lamps is cheaper than with carbon lamps by 45 per cent to 70 per cent, respectively.—*Zeit. f. Beleucht.*, Aug. 20.

Tungsten Lamp.—A note on a recent British patent (5821, 1909; Aug. 19, 1909) of the British Thomson-Houston Company (General Electric Company of this country). The higher oxides of the refractory metals are reduced to the lower oxides by heating them to a temperature of 800 deg. C. in graphite crucibles enclosed in carbon packing. Thus, if the yellow tungsten oxide WO_3 is treated in this way the air produces CO by action on the carbon packing, and this reduces the WO_3 to WO_2, forming CO_2. The CO_2 and the carbon packing react to form CO, which continues the reduction of the WO_3. The brown oxide WO_2 produced is made up into a squirting mixture.—Lond. *Elec. Eng'ing*, Aug. 26.

Generation, Transmission and Distribution.

Building Slip Equipments.—H. H. Broughton.—An illustrated article in which the author sets out the essentials which have to be embodied in the crane equipment of a building slip. The most widely used equipments are those in which either cantilever cranes, overhead traveling cranes, overhead wire cableways, gantry cranes or fixed or portable tower cranes are used. It is believed that the overhead-crane system most nearly satisfies the requirements of yards turning out the largest ships, and particulars of three equipments, which have been installed at Messrs. Beardmore's, Harland & Wolff's, and Krupp's, are here given.—Lond. *Electrician*, Aug. 27.

Saw Mills.—G. U. Borde.—An article claiming that almost any saw mill in this country is operated wastefully. The advantage of the electric drive is pointed out, with individual electric motors driving each piece of machinery separately. Reference is made to the manufacture of ethyl alcohol from sawdust.—*Gen. Elec. Review*, September.

Crane.—F. Niethammer.—A detailed illustrated description of a three-motor traveling crane for 30 tons.—*Elek. und Masch.* (Vienna), Aug. 22.

Machine Tools.—A. Comet.—Illustrated descriptions of electrically driven machine tools.—*La Lumière Elec.*, May 8, June 19 and 26, Aug. 7 and 21.

Condensers.—F. Hodgkinson.—A continuation of his illustrated article on "the choice of a condenser." The author begins to discuss different types of condensers, and deals in the present instalment with surface condensers.—*Elec. Journal*, August.

Traction.

Lyons.—An illustrated description of the overhead construction and rolling stock of two single-phase, 6000-volt suburban extensions of the direct-current tramway system of Lyons, in France. All poles are of steel, and single catenary construction is used throughout.—*Elec. Rail. Jour.*, Sept. 4.

Installations, Systems and Appliances.

High-Tension Interrupters.—Henry.—In a continuation of his long illustrated article on high-tension interrupters he describes numerous types. After some general notes on interrupters for e.m.fs. up to 1000 volts, and on oil interrupters, descriptions are given of various high-tension interrupters of the Westinghouse Company, Siemens-Schuckert Company, Allgem. Elek. Ges., Thomson-Houston Company, Oerlikon Company, General Electric Company, Hartman, and Kelman. The article is to be continued.—*L'Industrie Elec.*, Aug. 25.

Rheostat Control.—A. E. Button.—A second article on fundamental principles of rheostat control. The author discusses speed regulating rheostats with direct-current motors.—*Gen. Elec. Review, September.*

Wires, Wiring and Conduits.

Calculation of Lines.—A. Blondel.—The first part of an

article in which the author gives, for the case of lines with no capacity, simple graphical solutions of different problems. He gives, especially, a set of logarithmic curves which permit one to read off directly the diameter of conductors required for a given voltage drop.—*La Lumière Elec.*, Aug. 28.

Insulation of Wire.—A note on a recent British patent of P. MacGahan (23,007, 1908; Aug. 19, 1909). The copper bar to be drawn into wire is given a coating of aluminum before rolling. The wire drawn from this has thus a very thin coating of aluminum, and if it is passed through an electrolytic bath containing ammonium borate or other suitable solution, a thin film of aluminum oxide (which is a good insulator) will be formed. The metals need not necessarily be copper and aluminum.—Lond. *Elec. Eng'ing*, Aug. 26.

Electrophysics and Magnetism.

Atomic Theory.—E. Rutherford.—His address to Section A of the British Association for the Advancement of Science While formerly it has been thought that the atomic theory would always remain an hypothesis unverifiable by direct methods, some new direct methods have been found in recent years. They have to do partly with the Brownian movements. "The character of the Brownian movement irresistibly impresses the observer with the idea that particles are hurled hither and thither by the action of forces resident in the solution, and that these can only arise from the continuous and ceaseless movement of the invisible molecules of which the fluid is composed." Recent experiments of Terrin strongly confirm this view. Further, the behavior of the alpha particles of radium gives a direct method of determining the mass of each particle, its charge, and its velocity, while the general evidence indicates that the alpha particle is a charged atom of helium. From a great many different experimental and theoretical investigations, it may be concluded that the number of molecules in a cubic centimeter of any gas at standard pressure and temperature is about 2.77×10^{-10}, and that the value of the fundamental unit of quantity of electricity is about 4.65×10^{-10} electrostatic units. There has been a tendency in some quarters to suppose that the development of physics in recent years has cast doubt on the validity of the atomic theory of matter. This view is quite erroneous, for it will be clear from the evidence already discussed that the recent discoveries have not only greatly strengthened the evidence in support of the theory, but have given an almost direct and convincing proof of its correctness. The chemical atom as a definite unit in the subdivision of matter is now fixed in an impregnable position in science. Leaving out of account considerations of etymology, the atom in chemistry has long been considered to refer only to the smallest unit of matter that enters into ordinary chemical combination. The advent of the electron has shown that the atom is not the unit of smallest mass of which we have cognizance, while the study of radio-active bodies has shown that the atoms of a few elements of high atomic weight are not permanently stable, but break up spontaneously with the appearance of new types of matter. These advances in knowledge do not in any way invalidate the position of the chemical atom, but rather indicate its great importance as a subdivision of matter whose properties should be exhaustively studied.—Lond. *Electrician*, Aug. 27.

Law of Induction.—F. Emde.—A theoretical article giving some supplementary notes on the current formulation of the law of induction.—*Elek. und Masch.* (Vienna), Aug. 22.

Electrochemistry and Batteries.

Tests of Iron M. E. Rice and B. McCollum.—A description of a new method of testing iron using an electrodynamometer specially designed for ballistic work and having a rather long period of swing. The ballistic dynamometer may be used for determining both the hysteresis loss per cycle and the permeability of a sample of iron, thereby requiring only one set of apparatus for both purposes. Or, the regular ballistic galvanometer method may be used for determining the permeability curve. The sample of iron to be tested should be laminated; laminations of ordinary commercial thickness being entirely satisfactory. The laminæ should be separated by sheets of paper to insure that any slight eddy current loss will not be unduly increased by conduction from one sheet of iron to the next. The laminæ may be cut into the form of closed rings, and a number of them assembled and wound by hand, the magnetic circuit in this case being a closed one; or they may be cut into the form of half rings and a number of them inserted into ready wound magnetizing and test coils, the magnetizing circuit in this case having short air-gaps in it. The latter arrangement, while not satisfactory for determining the true permeability curve, is, however, commercially as good for determining the hysteresis loss per cycle and the corresponding value of the maximum magnetic flux density. It has, in addition, the advantage of enabling many different samples of iron to be tested in a short time when the apparatus has once been set up. To measure the hysteresis loss per cycle, the circuits

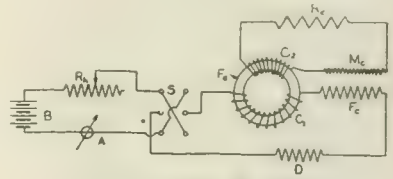


FIG. 6.—TESTS OF IRON.

are arranged as shown in Fig. 6. The iron ring *Fe* is magnetized by any desired current, which can be adjusted by the battery *B* or by the rheostat *Rh*, or by both. This current flows in series through the ammeter *A*, the rheostat *Rh*, the reversing switch *S*, the magnetizing coil *C*, the choke coil D and the fixed or field coils *Ee* of the electrodynamometer. The secondary or test coil C_2 is connected in series with a resistor *Re* and the movable coil *Mc* of the electrodynamometer. Reversing the switch *S* will cause a ballistic deflection in the dynamometer, which deflection may be read by a telescope and scale in the usual way. The energy loss per cycle in the iron, corresponding to a certain magnetizing current, is proportional to the deflection of the dynamometer. For determining the maximum magnetic flux density by the dynamometer method, the circuits are arranged as shown in Fig. 2. In the field coils *Fe* of the

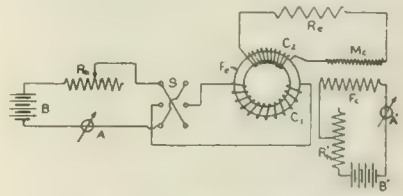


FIG. 7.—TESTS OF IRON.

dynamometer a separate steady current *I''* is maintained, adjusted to a suitable value by the rheostat *Rh'*. Reversing the magnetizing current by means of the switch *S* gives a deflection in the dynamometer as in the case of an ordinary ballistic galvanometer. The value of *B* of the maximum magnetic flux density, corresponding to any magnetizing current, is proportional to this deflection. The theory of the method is given, together with a numerical illustration, followed by comparative results showing the degree of accuracy attainable in practice.—*Phys. Review*, August.

Measurement of Short Electric Waves.—H. W. Webb and L. E. Woodman.—An account of a systematic study of vibrators and receivers for short electric waves. Wave-length determinations for short electric waves should be made with a non-selective receiver. Measurements depending upon tuned receivers are liable to errors arising from the process of tuning, which in general is very unreliable. A non-selective receiver may be obtained by using a Klemencic receiver of 10 or more times the resonance length. If the relative dimensions of a vibrator or of a receiver are maintained constant, the corresponding wave-length is directly proportional to the dimensions. Hence standard forms of vibrators and receivers may be selected, for which the dimensions may be easily computed for any desired wave-length, if one knows from experiment the

wave-length corresponding to any one size. The authors investigated such a vibrator and receiver and determined their properties. The wave-length emitted by a cylindrical vibrator of given length depends upon the extent and properties of the dielectric at the center, and the ratio of the diameter to the length, but not upon the nature of the metal, nor upon the length of the air-gaps. The length of the oil-gap, if small, was found to have little influence on the emitted wave-length. The wave-length corresponding to a Klemencic receiver of given length depends upon the extent and nature of the dielectric at the center, the width and thickness of the antennæ, or wings, and the length of the constriction at the center. A linear relation was obtained between the wave-length and the dimensions of a modified Righi vibrator.—*Phys. Rev.*, August.

Temperature Errors in Meters.—A note on a recent British patent of G. Hookham (15,802, 1908; Aug. 19, 1909) for a method of eliminating temperature errors in meters. The temperature error in mercury and other meters is compensated for by arranging a shunt-resistance wire in a chamber in such a way that when the temperature increases, mercury rises in the chamber and alters the effective length of the wire. The wire is provided with amalgamated kinks at intervals to make good contact with the mercury; movement of the mercury column is effected by the expansion of oil.—Lond. *Elec. Eng'ing*, Aug. 26.

Telegraphy, Telephony and Signals.

Telephone Circuit.—Pirro.—The first parts of a mathematical paper in which the author calculates the distribution of potential and current in a non-uniform telegraph or telephone circuit. With the term "non-uniform" the author means a circuit which comprises, for instance, overhead sections and underground cable sections, apparatus inserted at different points, connections to transformers, etc. The article is highly mathematical.—*La Lumière Elec.*, Aug. 21 and 28.

Miscellaneous.

United States and England.—J. S. Conover.—An article explaining some of the differences between English and American practice in electrical engineering. In England a regulation requires practically all electric lighting wires in cities and towns, large and small, to be placed underground. In England most of the towns were provided with a gas plant and distributing systems before the event of electricity into the lighting field. A large majority of electric lighting plants in England are owned by municipalities, which also own the street-railway systems. In smaller towns combined lighting and railways stations are favored; there is, therefore, a demand for direct-current generators which will give from 460 volts to 480 volts as shunt machines, and which are provided with series-field coils so that they will give from 500 volts to 550 volts when operated as compound-wound machines. The system of street lighting generally used in England is the series-multiple—that is, two, lamps in series on 220 volts, or four in series on 440 volts, or the straight multiple. In America practically all the house-service meters are watt-hour meters; in England nearly all direct-current house-service meters are amp-hour meters. The English demand for incandescent lamps has been primarily for voltages between 220 and 240, with the bayonet type of base. With the new metallic-filament lamps this high voltage presents great difficulties. The total yearly sale of incandescent lamps in America at the present time is estimated to be about 60,000,000, whereas in England, with a population approximately one-half as great, the total yearly sale probably does not exceed 15,000,000. On street railways the maximum speed permitted in England is about 12 miles per hour, and in America about 25 miles. Moreover, in England there is a regulation that the drop in voltage in the return circuit shall not exceed 7 volts. This regulation has made the use of track boosters quite common, and even with these boosters the cost of return cables becomes a serious item on lines extending into the suburbs. The usual type of street car in England is double-decked with seats on top. In England competition in most lines of manufacture is very keen, and profits are generally smaller than in America. The difference in conditions between the two countries extends even into the field of renewal parts. A characteristic of the English is their ability to make things last a long time and to continue to give good service. The English market can be classed as a very restricted one as compared with the American market.—*Gen. Elec. Review*, September.

BOOK REVIEW.

Congrès International des Applications de l'Electricité. Marseilles, 1908. Publié par les soins de H. Armagnat, rapporteur general. Paris: Gauthier-Villars. Three volumes, 709, 737, 553 pages, illustrated. Price, 68 francs.

These three portly volumes of 2100 pages, which in typographical execution are worthy of the great publisher whose imprint they bear, give the proceedings of an international electrical congress that unlike previous similar bodies, dealt almost entirely with practical electrical engineering. It would be impracticable to give here a complete list of the subjects dealt with, which included, among others, insulation, overhead construction, high-efficiency illuminants, the electric drive, electric heating, control and regulation, protection against accidents, electric tractors and canal haulage, fixative of nitrogen, central-station rates, electrochemistry and electrometallurgy, telegraphy, telephony, electrical measurements, electrical laboratories, cement poles, photometry, wireless telegraphy, engineering education, etc. Some of the topics formed the subject of two or more papers, and many of the contributions were followed by interesting discussions.

A paper by Prof. Blondel, on "What Should an Electrical Engineer Be?" formed one of the most important contributions to the congress, and led to a long and animated discussion. In the course of the paper Prof. Blondel classified electrical engineers as designing and constructing engineers, operating engineers, consulting engineers, electrochemical engineers and commercial engineers. He entered at length into the subject of technical education, and declared himself opposed to specialization at schools, though favoring professional specialization based upon a solid general technical course of instruction. The paper, with the lengthy discussion which followed, presenting various national views on the subject, forms one of the most important contributions thus far made to the subject of the training of the electrical engineer. Another interesting and lengthy educational paper was presented by Prof. Paul Janet and M. Chaumat, giving an account of the organization and courses of instruction of a large number of the leading electrotechnical schools of the world.

At the formal closing session of the congress a number of recommendations presented by the chairman of sections were adopted. Among these were that non-treated wooden poles should not be used where electrical circuits cross a public way or railroad line; that the Electrotechnical Commission be requested to take under consideration the formulation of a code of international standardization rules; that electric motors, in addition to the standard test, should be submitted to another of a duration having a relation to the service in which it will be used; that government regulations shall require the application in case of electrical accident of the method of the resuscitation by artificial respiration and rhythmic manipulation of the tongue, which shall be continued over a long period, or until the arrival of a physician. Mr. C. O. Mailloux offered a resolution proposing a permanent international electrical congress organization, and the present appointment of national committees to report on the subject to a provisional committee. The resolution was unanimously adopted and the provisional committee appointed.

The U. S. Government was represented at the congress by an army and a navy officer, and the American Institute of Electrical Engineers by Messrs. C. O. Mailloux, of New York, and R. O. Heinrich, of Berlin. Mr. Mailloux was a member of several of the important committees and sections, and took a leading part in the work of the congress.

NEW APPARATUS AND APPLIANCES

Sewing-Machine Motor.

The Bissell Motor Company, of Toledo, Ohio, has brought out a sewing-machine motor which possesses many features of interest. The motor can be applied to any machine on the market, occupying the space taken by the hand-wheel, which it replaces. Eight operations suffice to place the motor in position ready for operation. First, the hand-wheel is removed from the machine; then the bobbin winder, after which the end motion of the sewing-machine shaft is taken up by means of a collar. The motor is then slipped into position on the shaft and locked by means of a wrench, which accompanies the outfit. A leather cord from the rheostat beneath the motor is next attached to the treadle of the machine and one end of the conducting cord, which is furnished, is attached to any nearby incandescent-lamp socket, the other end being connected to the motor. The machine starts by a slight pressure of the toe on the treadle, and when the latter is pressed harder the speed is increased. The instant the foot is released the motor stops, owing to the operation of a brake. Two types of motors are built: one for direct-current circuits of 100 volts to 125 volts, and the other for alternating-current circuits having frequencies of 25 cycles to 60 cycles and voltages ranging from 100 to 125. The motor is not much larger than the hand-wheel which it replaces.

The operation of removing the hand-wheel varies slightly with different machines, but definite instructions are sent for standard makes; the same is also true of the other operations. Not all sewing-machines run in the same direction, so the motor is made easily reversible. The reversal of rotation is made by changing the connections under the name-plate and this operation is performed by loosening the screws holding the connecting strips and then changing the strips to a position at right angles to their former position. The motor has five speeds, and there are only three places on the motor requiring oil; one is on the front of the armature and the other two on the bobbin winder. The brushes and commutator are on the side of the motor next the machine, where they are free from accidental mishap. The motor is rugged in construction, and complete instructions are furnished by the maker so that it is not necessary for one to know anything about electricity in order to attach and operate the machine.



GENERAL VIEW OF MOTOR, SHOWING METHOD OF RAISING NEEDLE.

Flaming-Arc Window Lighting.

The Charles L. Kiewert Company, of Milwaukee, Wis., which markets a number of flaming and other arc lamps, has made an installation of street and window lighting of interest. The store illustrated in Fig. 1 was opened for business in February of this year. The white tile front is illuminated by two "Aurola" flaming-arc lamps using electrodes giving a white light, and the resulting effect is distinctly noticeable some distance away. The show window itself is illuminated in a very novel manner. A "Trucolor" arc lamp with electrodes giving a white light is suspended above the window as indicated in Fig. 2. A prismatic hemisphere diffuses the light over a large surface so as to decrease the intrinsic brilliancy. The onlookers can thus readily distinguish colors and are not disturbed by glaring light. The color value of the light is said to be such that the shades and the fabric do not suffer distortion.



FIG. 1.—FLAMING ARCS IN FRONT OF STORE.

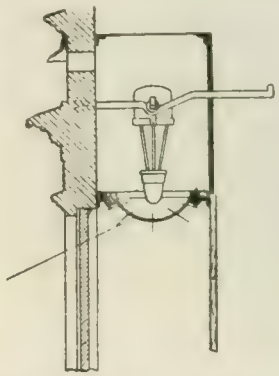


FIG. 2.—ARRANGEMENT OF LAMP FOR WINDOW LIGHTING.

Series-Multiple Direct-Current Arc Lamp.

The Westinghouse Electric & Manufacturing Company, which has been active in perfecting the series-multiple direct-current arc lamp, has recently brought out a new form of this type. The lamp is self-contained, having no external resistance that ordinarily must be mounted separately from the lamp. The



FIG. 1.—SERIES-MULTIPLE ARC LAMP.

mechanical development has been in the direction of simplification and the reduction of the number of parts, yet producing a lamp that is automatic and reliable in its operation.

The moving parts of this lamp are made of solid brass, and



FIG. 2.—MECHANISM OF SERIES-MULTIPLE LAMP.

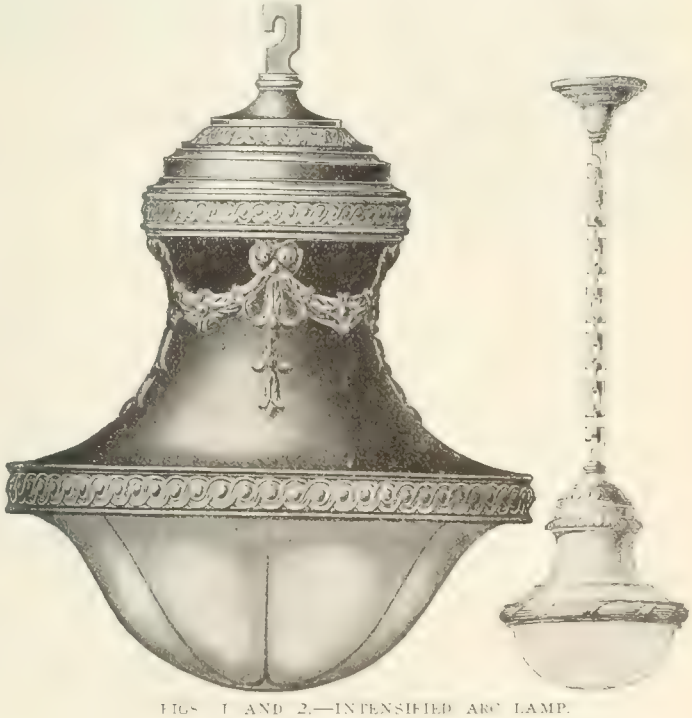
will not rust and stick as iron parts do. Other details of construction are correspondingly strong and durable, the insulation being fireproof, and the circuits so arranged that the points of potential stress are few and well spaced. The lamp is made in sections of sheet copper pressed into a fluted form with lines pleasing to the eye. One-third of the case can be swung open, making the mechanism readily accessible. This feature, together with the small number and durable nature of the working parts, tends to lower maintenance costs.

The characteristics of primary importance—prompt and silent starting and steady burning—have been successfully attained in this type of lamp. Since best results are obtained with an 80-volt, 5-amp arc, the lamp resistance is made adjustable so that the lamps may be connected two in series on 220-250-volt circuits, or five in series on 500-550-volt circuits.

These lamps are designed for operation in series groups, and if for any reason one lamp has its arc broken, an automatic cut-out switch short-circuits the mechanism protecting the shunt coils and inserting an equivalent resistance, which enables the other lamps in the group to operate normally. It is claimed that the small energy consumption, together with the superior quality and great quantity of light, makes this lamp a close competitor of the flame arc in places where either may be used, and the comparison grows more favorable when the small up-keep is considered, the carbon life being 125 hours to 175 hours per trim.

Intensified Arc Lamp.

For years the enclosed arc lamp has been greatly in favor for general mercantile lighting by virtue of the color of the light, low maintenance cost and efficiency. By a radical change of design, the General Electric Company has brought out an intensified arc lamp which maintains the special points of superiority possessed by the enclosed arc lamp and has other advantages. Two upper or positive carbons, 6 mm in diameter and 305 mm in length, are placed in converging tubes, so that the ends of the carbons are in contact. A self-acting weight, bearing down on the top, prevents one carbon from being consumed faster than the other. One lower or negative carbon is used, 9.5 mm in diameter and 100 mm in length. The lower carbon holder is movable in a vertical direction, being attached to a counterweight mechanism through which the action of gravity tends to hold it in contact with the upper car-



FIGS. 1 AND 2.—INTENSIFIED ARC LAMP.

bons. The magnets, acting through a clutch on a rod of the counterweight mechanism, draws the lower carbon downward away from the upper ones. In this way the magnets cause the carbons to strike and maintain the arc, keeping the lower carbon floating at the point of electrical equilibrium.

When an arc is formed, the current density is much greater at the carbon tips than in the case of the standard enclosed lamp; and as the resultant heat cannot be readily dissipated, the carbon tips pass beyond the usual red-hot poker stage to

the incandescent or white-hot stage. In order to obtain the highest efficiency possible, a small diffuser is used, located directly above the arc. In this way a greater percentage of light is distributed in the lower hemisphere. The resultant

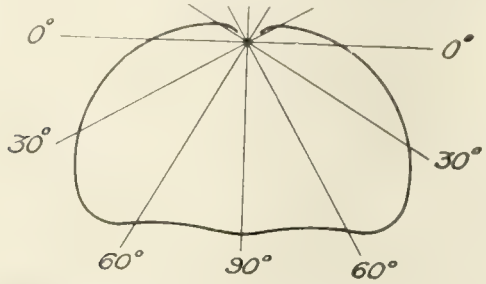


FIG. 3.—DISTRIBUTION CURVE OF INTENSIFIED ARC LAMP.

specific consumption, therefore, is equal to about 1¼ watts per mean hemispherical candle-power at 5 amp and 110 volts direct current.

The distribution of light, as shown in Fig. 3, is excellent for interior illumination, since maximum intensity is obtained in the working plane where most needed. One of the most noticeable features of the lamp is said to be the daylight effect created when in use. The light is of a soft, almost perfect white tone, and is steadily and evenly distributed.

At 5 amp and 110 volts direct current, a carbon life of 75 to 100 hours is claimed. This long life, together with the high efficiency, reduces the maintenance cost to a minimum, so that with the "intensified" arc lamp it is now claimed to be possible to obtain the very best grade of illumination in large interiors at a minimum cost. The lamp is made for either direct-current or alternating-current multiple circuits.

Fig. 1 represents the lamp equipped with ornamental casing. It will be noticed that this lamp differs materially from conventional designs. The outer globe is made of leaded glass to correspond in effect with the casing. The lamp is therefore appropriate for dry goods, clothing and department stores, as it is attractive by day as well as by night, and at the same time meets the requirements of high-grade illumination and minimum cost.

Motor-Starting Panels.

The accompanying cuts show the latest type of Ward Leonard motor-starting panels. The first shows a panel consisting of double-pole switch and fuses and no-voltage release motor-starter with interlocking overload circuit-breaker mounted upon slate. The panel thus comprises all of the necessary apparatus for the proper installation of the motor. Fig. 2 shows a panel having a double-pole circuit-breaker replacing switch and fuses, and a series of steps which are individually operated, the final switch short-circuiting the previously closed switches and opening the main-line circuit upon no-voltage.

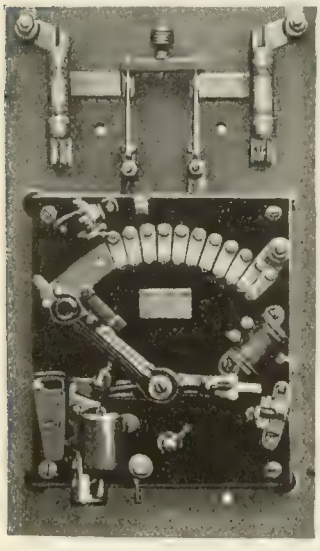


FIG. 1.—MOTOR-STARTING PANEL.

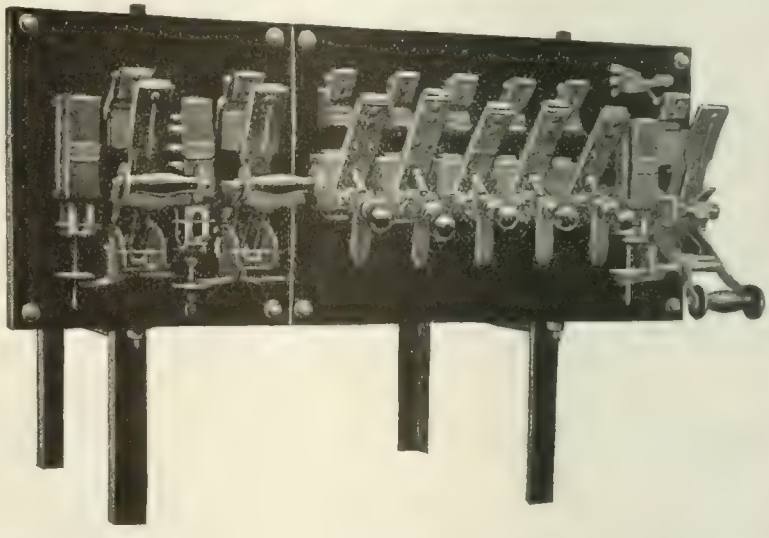
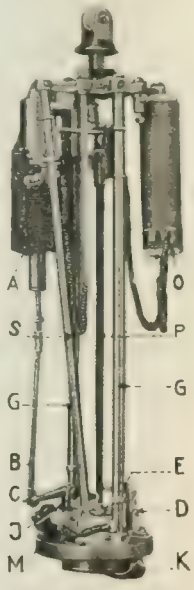


FIG. 2.—STARTING PANEL EQUIPPED WITH CIRCUIT-BREAKERS.

Self-Regulating Flaming-Arc Lamp.

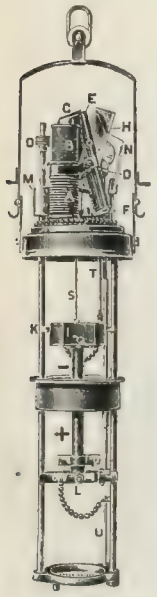
The Regina Arc Lamp Works, Limited, Cologne-Sülz, Germany, manufacture an arc lamp devoid of clockwork or regulating coils. The mechanism of the lamp, which is known as the "Conta," is illustrated herewith. The rods *G* form a guide for the electrode gear, which slides perpendicularly on them. The circuit is formed through the series coil *A*, thence through the blow magnet *M*, the self-contained line resistance, *O*, the movable electrode *S*, across the arc to the clutched electrode and then out through the second terminal. When the coil *A* is energized its iron core causes the rod *B* to lift the lever *C* and actuate the starting slide *J*, thus separating the converging electrode from the clutched electrode and striking the arc. This arrangement of the electrodes does not change during the time the lamp is lighted, and the feed of the electrodes thereafter is said to be regulated automatically. When the clutched electrode, which controls the feed, touches the non-combustible lower arm *K* of the clutch lever, which is pivoted at *D*, the small upper arm *E* of this lever grips the electrode immediately above the lamp plate. So long as a slight weight bears on the arm *K* the lever *E* grips the electrode *P*, but by the progressive consumption of the electrode this brake action on the lever *K* is released until the arm *E* permits the electrode to fall freely so as to rest again on the arm *K* when the lever *E* comes into action. The lamp does not require electrodes of a special shape, ordinary cylindrical flame or pure carbons being employed. The mechanism is separated from the arc chamber and as the electrode guide plates fit the electrodes exactly, and the latter are not subject to any movement, the guide rods are kept free from deposit due to the consumption of the electrodes. The power consumption of the lamp is said to be 0.13 watt per candle-power, and with flame carbons the mean hemispherical candle-power of the smallest type of lamps, which requires 330 watts, is said to be 1600 cp, the manufacturers claiming 5000 cp from their 660-watt lamp. The lamp is applicable for direct-current and alternating-current circuits and for operation singly or in series. When pure carbons are employed a separate resistance is necessary, and the length of burning between trims varies from 14 hours to 16 hours. With ordinary plain carbons it is necessary to trim the lamps every 8 or 10 hours.



SELF-REGULATING FLAMING-ARC LAMP.

Flaming-Arc Lamp for Street Lighting.

The "Santoni-Kosmos" flaming-arc lamp, manufactured by the Globe Electric Company, 11 Farringdon Avenue, London, E. C., England, and illustrated herewith, is a differentially wound lamp of standard design, adapted for the use of highly mineralized carbon electrodes, and provided with ample ventilation to permit the fumes arising from the arc to escape without attacking any of the working parts of the lamp. By reference to the illustration, it will be seen that the regulating mechanism consists of a double horseshoe, series magnet *A* and a double-shunt magnet *B*. The armature frame *E* moves on a shaft *D*, and the series and shunt armatures *F* and *G* depend upon the magnetizing action of the double differential magnets, the feed mechanism being attached to the armature.



SANTONI-KOSMOS FLAMING-ARC LAMP.

The negative or upper electrode is inserted in the holder *I*, which is attached to the guide fork *K*, the positive or bottom electrode being fixed to the ball joint *L* by means of which an accurate adjustment is obtained. The holders are suspended by a flexible cord *S*, led over the pulley of the feed mechanism. The dash-pot *M* is attached to the armature frame and feed mechanism. When the lamp is brought into use the circuit is completed through the negative terminal, a bead-insulated wire *T*, the upper electrode and so to the bottom electrode, thence by another bead-insulated wire through the guide rods to the series coil *A* and out at the positive terminal of the lamp. The lamp frame and guide rods are insulated. The shunt windings of the magnets *B* are connected in parallel across the terminals, and when the lamp is switched into circuit the differential magnet *A* attracts the armature *F*, and the feed mechanism, being coupled to the armature frame, draws the electrodes apart and thus the arc is struck. As the voltage increases the shunt magnet *B* attracts the armature *G* into its lowest position, permitting the ratchet gear of the feed mechanism to act in accordance with the requirements of the arc. Adjustment is secured by loading the dash-pot with lead washers *O* according to requirements. The construction of the lamp is said to make its burning independent of the weight of the electrodes, and the gravity feed is claimed to insure a regular and steady arc. The potential across the arc ranges from 30 volts to 33 volts, so that three lamps may be connected in series on 110-volt circuits. The electrodes employed have a large, highly mineralized carbon core, with a thin outer casing of carbon, and being placed in a vertical position the horizontal projection of the light makes the lamp suitable for illuminating streets, squares and large open spaces.

Bituminous Producer in Double Role in Sheet-Metal Factory.

A Westinghouse bituminous gas producer for supplying fuel to gas engines, as well as furnishing gas for solder baths and enameling kilns, has been installed by the S. F. Bowser Manufacturing Company, maker of oil storage and distributing tanks and automatic weighing pumps, in its modern factory at Fort Wayne, Ind. This Type T producer plant, of 350-hp capacity, supplies three 120-hp tandem-horizontal engines, direct-connected to direct-current generators. These furnish power to the shops, which are motor-driven throughout. The equipment replaced by the present installation comprised three 150-hp Scotch marine boilers, equipped with underfeed stokers, supplying steam to 50-hp and 125-hp simple engines. In the shops a large quantity of gasoline was formerly used for melting solder, while coke was required for the enameling kilns. Recognizing the superior economy to be obtained from producer equipment, as well as the advantage of doing away with gasoline and coke in its own special case, the Bowser company decided to install a complete new equipment for gas engines and gas producers. The matter of selecting a bituminous producer was carefully weighed, and members of the firm visited a number of installations throughout the country to study the performance of the types in operation at the present time. The West Virginia coal, 13,000 b.t.u. per pound, used in the producer at present is delivered at a cost of $2.55 per ton. A Green County, Indiana, coal, of approximately the same heat value, has been successfully experimented with, and will cost, delivered, $2.25 per ton. The installation has been under the supervision of Mr. A. A. Bowser, brother of the president of the company.

Combined Shaving Mirror and Lamp.

Men who shave themselves realize the great advantage of having a strong light thrown just where it is needed on any part of the face. The Federal Electric Company, of Chicago, has brought out a combined shaving mirror and lamp and reflector which, as shown in the illustration, can be placed in any position to throw the light where it is wanted. The reflector throws all the light on the face below the eyes. No light is reflected into the eyes or into the mirror. The mirror is 6¾ in.

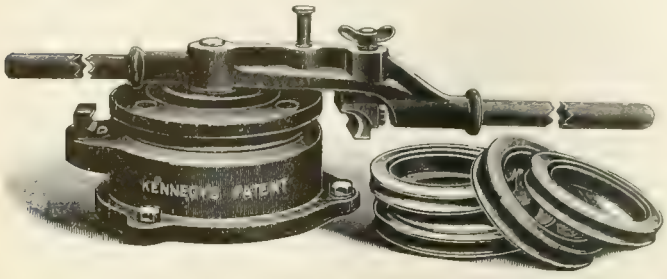

COMBINED SHAVING MIRROR AND LAMP.

wide and 9 in. high, and is mounted in an easel frame with a cylindrical reflector at the base. This reflector is equipped with a tubular incandescent electric lamp, the light from which is reflected through a horizontal opening. Six feet of lamp cord and a plug are furnished, so that this convenient device can be attached to any lamp socket. The fixture is made in nickel, brush brass, or oxidized copper finish, and the lamp is rated at 16 cp.

Conduit-Bending Machine.

A machine which is applicable for bending welded, butt-jointed and seamless tubing; also round, flat, angle, tee and channel bars in copper, brass, iron or other metal is shown herewith. The apparatus is built by the Kennedy Bending Machine Company and marketed by The Business Development Company, 36 Upper Thames Street, London, E. C., England. By its use any number of bends can be made at any angle and in any position on long lengths of work, thereby rendering the employment of stock elbows, bends, and sockets unnecessary and avoiding much cutting and screwing. Tubing within the capacity of the machine is bent cold, without annealing or loading. In the machine illustrated, for example, a ring, grooved to correspond to the size of the material and the radius to which it is to be bent, is placed in position on a screwed mandrel of the machine, between the top flange and base of the machine. The flange is tightened by hand until it just grips the work, and after bending the tube by means of the handle, the

top flange is unscrewed by depressing the plunger provided in the lever into one of the holes on the flange. A few drops of oil or grease are used on the working surfaces of the flanges to ease the bending operation. The machines are built in various sizes for manual or power operation. The smallest size takes brass and copper tubes from ¼ in. to ¾ in. outside diameter



CONDUIT BENDING MACHINE.

and standard iron tubing from ⅛ in. to ½ in. bore, the minimum radius of the bend ranging from 1⅛ in. to 2½ in. Six pipe rings form part of the equipment.

Telephones for Railroad Service.

The Cleveland, Akron & Columbus Railroad Company has recently installed a composite telephone circuit on its lines between Akron and Columbus, Ohio, a distance of 130 miles. The line is constructed of No. 9 copper, and has three intermediate telegraph offices between the terminal telephones. There are

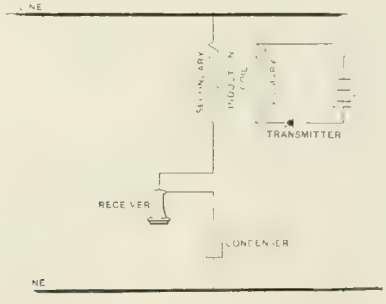


FIG. 1. ARRANGEMENT OF CIRCUIT

also three intermediate telphone stations connected to the line.

In connection with this service the company has equipped its wrecking train with a portable composite telephone, which may be connected to the line at any point along the road, thus enabling direct connection to be made with headquarters at all times. In addition to this, an extra portable composite tele-

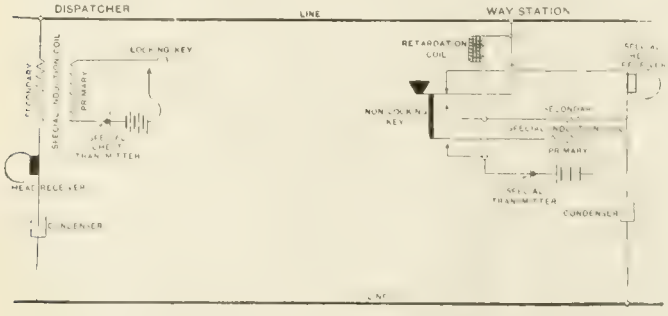


FIG. 2.—DIAGRAM OF COMPOSITE TELEPHONE CIRCUIT.

phone is kept at the division headquarters to be used on inspection trips or in cases of emergency.

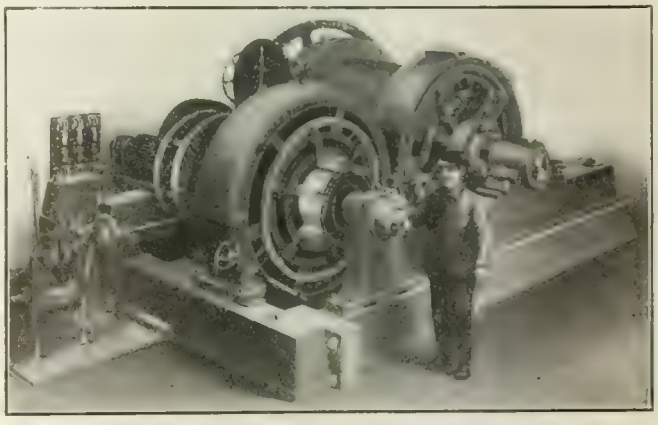
The Western Electric Company's composite telephones are used in the stations, and its portable set is used on the wrecking train. These sets are shown in the illustrations. It is reported that first-class service is obtained with this equipment.

It will be readily seen that the above system enables additional service to be obtained at a very small cost, as an existing telegraph wire may be used for this service without interfering with the operation of the telegraph service.

Electric Mining Hoist.

The Washington Coal & Coke Company, at Dawson, Pa., has recently installed an electric hoist for use in hauling 35 mine cars, averaging 3800 lb. each when loaded, up a maximum grade of 8½ per cent, 8000 ft. long, at a speed of 600 ft. per minute. The loaded cars start at the bottom of the slope on a 4 per cent grade, which gradually increases till the maximum grade of 8½ per cent is reached near the top, where the loaded cars are pulled in on a landing on a grade of about 6 per cent and on a curve of 150-ft. radius. The empty cars will be allowed to drift down the slope by gravity, controlled by a brake on the hoist drum.

The hoisting drum is 6 ft. in diameter and 5 ft. wide between flanges. It is fitted with a hand brake on one end and a hand-operated friction clutch on the other end. The hoist is driven through a flexible coupling by a 500-hp, direct-current, non-reversing, compound-wound Westinghouse motor, and controlled by a standard semi-automatic Westinghouse magnetically controlled unit switch controller. These switches are operated from the controller shown in the illustration, the controller carrying only small currents while the main motor current is



ELECTRIC MINING HOIST

handled by the magnetically operated switches, thus doing away with the difficulties from arcing.

This controller has an accelerating relay which prevents the starting switches from closing too rapidly and thereby prevents too large starting currents. Thus the second switch cannot close until the current allowed to flow by the closing of the circuit has fallen to a predetermined value. As soon as this value is reached, the second switch closes, thereby short-circuiting a resistance section and the current rises, but the third switch cannot close until the current has again fallen to the predetermined value. This not only prevents injury to the motor from careless handling during acceleration, but also insures the most rapid starting possible.

The controller also has a safety relay which opens the resistance switches in cases of excessive overload, and thereby protects the motor while running. If this relay operates while the motor is running, the motor does not stop, but is automatically brought up to its full speed again. This is a particularly valuable feature in an installation of this kind, where the cars may strike some obstruction, as it affords perfect protection to the apparatus.

When it is remembered that this hoist is installed some 800 ft. below the surface of the ground, the advantages of the electric transmission of power are evident. In no other way could this large amount of power be transmitted as economically nor as easily. The hoist was supplied by the Connellsville Manufacturing & Mine Supply Company.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The general improvement in business conditions continues. There are only good signs in every line of trade. The actual sales of wholesalers and jobbers may have receded somewhat from former figures, but this is only because the August rush of buyers is over and the immediate period is one in which small orders are the rule and reorders have not begun. It is in the industrial department that the wonderful records are being made. It is hardly going too far to say that manufacturing has never in the history of the country been more active. Operations are expanding in every line, and in the iron and steel trades record outputs are the rule. All the principal plants are now said to be working at full capacity and in many instances night shifts have to be employed. It is also noticeable that many plants which have not heretofore been active are beginning to look up and wheels are turning in many quarters where there has been long inactivity. Already complaints are being made that there is a scarcity of skilled labor, and the wage situation is distinctly better. The railway traffic is increasing and earnings are growing larger with each succeeding report. It is enough for the crop situation to say that it is not unsatisfactory. The yield of cotton will be short—15 per cent less than last year, but this has been known for months and the advance in prices has practically offset for the producers the falling off in volume. The corn crop will not be up to the first estimates but will still be liberal, and other crops will be above the average. Collections are distinctly improving, and in the Central West, where the crops are generally better than elsewhere, they are very satisfactory. Business failures for the week ended Sept. 9, as reported by *Bradstreet's*, were 191, as against 166 the previous week, 191 in 1908, 172 in 1907, 164 in 1906, and 188 in 1905.

THE COPPER MARKET.

The feature of the copper market last week was the publication of the figures of the Copper Producers' Association for August. These showed a record-breaking production, smaller exports and domestic deliveries, with a consequent increase in stocks. The figures are: Production, 120,597,234 lb.; exports, 48,382,704 lb.; domestic deliveries, 59,614,207 lb.; stock Sept. 1, 135,196,930 lb.; increase in stock during August, 12,600,323 lb. Before the publication of these figures the market had been dull and prices had shown a disposition to sag and since the report was given out that tendency has been accelerated. It has been quite generally recognized that the heavy takings in July, which made such a surprising reduction in the stock on Aug. 1, did not all go to the melting pot, and that in second hands and in the hands of consumers large quantities of copper were being carried. This adds to the difficulty of sustaining prices, and last week it was understood that actual sales were generally made at concessions from asking prices. The increase in the visible, in Europe, for August, was 26,203,200 lb., which added to the increase here made a total increase of 38,803,523 lb. Exports for the month, including Sept. 13, have been 6,806 tons. The daily call on the Metal Exchange, at 12:30 o'clock Sept. 13, quoted standard copper as follows:

	Bid.	Asked.	Settling price.
Spot	12.40	12.60	.....
September	12.45	12.65	12.55
October	12.50	12.70	12.60
November	12.55	12.75	12.65
December	12.60	12.80	12.70

The London prices Sept. 13 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	58 5 0	58 5 0
Standard copper, futures	59 1 3	59 2 6
Market	Weak	Easy
Sales of spot		700 tons
Sales of futures		1,900 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.00	12.62½
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6

CONTRACTS FOR WINNIPEG (MAN.) MUNICIPAL PLANT.—Last fall the city called for tenders for general equipment in connection with the civic power plant now under construction at Point du Bois. The tenders were considered too high and this summer new tenders were called with the result that a saving of approximately $157,000 to the city was effected. The following tenders were accepted at the last meeting of the City Council: Turbines, Jens, Orten, Baving & Company, London, England, $97,150, including $11,000 for erection; generators and exciters, Vickers Sons & Maxim, Ltd., Sheffield, England, $93,000, including price of erection; transformers, switching and protective apparatus, Canadian Westinghouse Company, Ltd., Hamilton, Ont., $150,800, including spare parts; light, heat and power system, generating system, Canadian General Electric Company, Toronto, Ont., $11,600; traveling cranes, Canadian Fairbanks Company, Ltd., Winnipeg, Man. (Niles-Bement-Pond Company), $14,900, including estimated cost of erection; auxiliary apparatus, Canada Foundry Company, Ltd., Toronto, Ont., $27,520; Canadian Fairbanks Company, Ltd., Winnipeg, Man., $6,901, and allowance for contingencies and spare parts, $25,049. At the present time there is a credit of $316,606.67 under the original estimate in the cost of the plant, which will be ready for operation by the end of 1911.

McCALL FERRY POWER COMPANY.—Work on the great dam of the McCall Ferry Power Company is being pushed forward rapidly and about 225 men are now employed on the work. A contract has been made by J. Edward Aldred, receiver for the company, with the Empire Engineering Company, of 60 Broadway, New York. Beverly R. Value, of this firm, will have immediate charge of the work. The Empire Engineering Corporation will construct the dam and the water power station, but will not construct the transmission lines into Baltimore or some other city. William Barclay Parsons is president of the Empire company. It is understood that a new company is in process of formation to purchase at receiver's sale the entire property of the McCall Ferry Power Company, but in the meantime the work of construction will go on under the receiver's contract. It is expected finally to develop 50,000 hp, which will be divided between five units. It is understood that the first market that will be sought by the McCall Ferry Power Company will be Baltimore, when its charter gives it a right to sell power in competition with the Consolidated Gas, Electric Light & Power Company.

NEW IBERIA (LA.) SUBURBAN RAILWAY.—A proposition has been submitted to the Municipal Electric Light & Water Works Board of New Iberia, La., offering to lease the plant for a term of 25 years for the purpose of operating a suburban line of railways which it is proposed to construct from that city to Jeanerette. The syndicate that is back of the scheme is headed by H. A. Mentz, of New Orleans. He agrees to furnish the city free of cost the quantity of water and electricity it is now using, and to charge only $6 per year for each additional 16-cp incandescent lamp required; $75 for each additional arc lamp, and $50 for each additional water plug. He also agrees to have the plant entirely renovated and running within nine months, and the electric system within two years. Rates for electricity to domestic consumers will not be increased.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in the present issue are announcements of proposed new plants or considerable extensions of present plants at Portland, Me.; Monterey, Mex.; Alamogordo, N. M.; Meridian, Miss.; Central City, Col.; Wilmington, Del.; Golden, Col.; Rockville, Conn.; Montgomery, Ala.; Rochester, Minn.; Mohawk, N. Y.; Monterey, Cal.; Salt Lake City, Utah; Milwaukee, Wis.; Hartsells, Ala.; Sarasota, Fla.; Cordova, Alaska; Lone Wolf, Okla.; Norwich, N. Y.; Clinton, Okla.; Chicago, Ill.; Central City, Neb.; Blackwell, Okla.; Pittsburgh, Pa.; Guadalajara, Mex.; Westville, Okla.; Shelley, Idaho; Monmouth, Ill.; London, Ont., and Anderson, S. C.

GENERAL ELECTRIC IN JAPAN.—Announcements have been made in the daily newspapers that the General Electric Company has acquired a controlling interest in the Shibaura Engineering Company, of Tokio, which is owned by the Mitsui family. When this statement was presented to one of the vice-presidents of the General Electric Company he said that it was entirely erroneous. While he was willing to admit that negotiations had been pending between the Shibaura Engineering Company and the General Electric Company, there had so far been nothing done which would mean the control of the Japanese company by the American company. The goods of the General Electric Company have been sold heretofore in Japan by the Mitsui company, which is the holding organization of the Shibaura company. This arrangement has not been disturbed, and will not be disturbed. The business of the General Electric Company has amounted to more than 3,000,000 yen a year in Japan, and it is claimed that it will hereafter be much greater.

ASSOCIATION OF EDISON PURCHASING AGENTS.—At a meeting of the Association of Edison Purchasing Agents, which recently took place at Briar Cliff Lodge, Briar Cliff Manor, N. Y., the following officers were elected: H. C. Lucas, president, purchasing agent, Philadelphia Electric Company; W. H. Francis, first vice-president, purchasing agent, Edison Electric Illuminating Company of Boston; J. W. Brennan, second vice-president, purchasing agent, The Edison Illuminating Company, Detroit, Mich.; H. F. Frasse, secretary, purchasing agent, Edison Electric Illuminating Company of Brooklyn; Andrew Banks, Jr., treasurer, purchasing agent, Consolidated Gas, Electric Light & Power Company of Baltimore; J. J. Miley, stock controller, purchasing agent, Minneapolis General Electric Company.

WESTINGHOUSE INSTALLATIONS.—The Monarch Lumber Company, of Portland, Ore., has installed two 500-kw Westinghouse steam turbines in its mill at Stockdale, Ore., which will be employed to drive 2300-volt, three-phase, 60-cycle, alternating-current generators supplying the local lighting and power load. The sheet and tin-plate mill of the new Aliquippa works of the Jones & Laughlin Steel Company, on the Ohio River below Pittsburgh, will be served with power to operate a number of direct-current motors, through a rotary converter, from a 500-kw, 6600-volt, three-phase, 60-cycle Westinghouse turbo-alternator. The fuel used in the boiler plant will be coke-oven gas, and the turbine will operate on a steam pressure of 150 lb., exhausting into a vacuum of 28 in.

INCREASE IN SUBWAY TRAVEL.—The full report of the Interborough Rapid Transit Company shows that the subway division is the one that is growing in popularity. During the year that ended June 30, the subway earnings increased 2.81 per cent and the earnings of the elevated lines decreased 1.58 per cent. The number of passengers carried on the subway increased 18.95 per cent, while the number carried on the elevated decreased 2.33 per cent. The total number of passengers carried on the subway during the year was 514,680,342 and the average daily record was 89,631 greater than last year. Much of the subway increase is attributed to the rapid settlement of recently opened up territory.

WESTERN ELECTRIC BUSINESS EXPANDING.—Returns for August show that the business of the Western Electric Company ran 60 per cent ahead of the same month last year and also show a gain of about 5 per cent over July. It is said that the August sales were at the rate of about $53,000,000 per year, which was approximately the amount of business done in 1907. The first nine months of the company's fiscal year, which ended with Aug. 31, show that the business for the year will run about $47,000,000. A very large part of the company's business at this time is for telephone apparatus. The company is also doing a good trade in small motors for mill service.

APPLICATION FOR ELECTRICAL AGENCY IN THE LEVANT.—An American consul in the Levant reports that all manner of electrical appliances are freely admitted and large quantities have been imported into that region. He states there is no reason why American-made goods should not be introduced in considerable quantities, as an active local agent is alone needed. The name of a business man who desires to act in such a capacity and would like to get in touch with houses in the United States is given in the report. Further particulars may be obtained on application to the Bureau of Manufactures, Washington, mentioning report No. 3838.

ALLIS-CHALMERS COMPANY'S EXTENSIONS.—With reference to rumors recently circulated to the effect that large shop and foundry extensions are to be undertaken this fall by the Allis-Chalmers Company, it is authoritatively stated by President W. H. Whiteside that no further additions to the West Allis works are contemplated. However, an extension to the Cincinnati works of the company is being made which will give employment to about 1000 additional men. Construction work and the installation of new equipment were commenced there some weeks ago.

TO ERECT A BIG ELECTRIC SIGN.—J. H. Hallberg has been commissioned to design two enormous electric signs for the Jacob Ruppert ice plant to be erected at Third Avenue and 132d Street, New York. These two signs are each to be 140 ft. long and 100 ft. high, and together will contain more than 5500 four-cp tungsten lamps. One of them will face west and the other south, and they will be illuminated alternately. The signs will be operated on a 20-kw, 115-volt service, using Hallberg economizers.

ELECTRICAL APPARATUS WANTED.—The Sanitary District, American Trust Building, Chicago, which operates the Drainage Canal hydro-electric plant, advertises for proposals for copper and aluminum conductors, high-tension insulators, a high-pressure pumping unit and induction motors. All proposals must be on blank forms furnished by the Sanitary District and must be in accordance with plans and specifications on file in the office of E. B. Ellicott, electrical engineer of the district. Bids will be received until noon on Sept. 22.

ELECTRIC LOCOMOTIVES FOR JAPAN.—The contract for 12 50-ton electric locomotives, which was under consideration by the Imperial Government Railways of Japan for some months, has finally been awarded to Siemens-Halske Company, of Germany. Both the Westinghouse and the General Electric companies made bids for this contract, but the German prices proved more attractive to the Japanese Government.

ELECTRICAL SUPPLIES FOR ISTHMIAN CANAL.—The Isthmian Canal Commission has invited proposals until Sept. 20 for a long list of miscellaneous electrical supplies, including wire, conduit, line fittings, electric bells, lightning arresters, insulators, etc. Bids should be forwarded to Capt. F. C. Boggs, U. S. N., general purchasing officer, Isthmian Canal Commission, Washington.

NEW MEXICO HYDRO-ELECTRIC PLANT.—The Blue Water Development Company, operating 100 miles west of Albuquerque, on the main line of the Santa Fé, will have its dam completed by the middle of the winter. The dam will be designed to irrigate 21,000 acres, and will also be used to operate the power plant furnishing power for Central New Mexico.

NEW ELECTRIC RAILWAY FOR ALBUQUERQUE, N. M.—A stock company has been formed by the citizens in the eastern section of Albuquerque, N. M., which will construct a second electric street car line in that portion of the city. The stock is practically all subscribed and the franchise is applied for. Construction will be started without delay.

Financial Intelligence.

THE WEEK IN WALL STREET.

The week in Wall Street was all Harriman. There was no other talk and no other interest that had any effect on the market. On Sept. 7 and 8, when the condition of the great leader was in doubt, the market was inactive and waiting; on Sept. 9 when it became generally known early in the morning that certain death was hovering over Arden the market broke violently and became almost demoralized. On Friday morning when there had been 18 hours' reflection and it was realized that the financial world was not coming to an end, even though such a leader had passed away, stocks opened stronger and there was really a better tone to the trading than there had been for many days. It was evident, even before the market opened, that strong hands were at the helm. The ever present bears who had been preaching disaster found themselves up against a stone wall of support. Their few feeble efforts at selling were met by such positive buying orders that their only recourse was to fly to cover and in their haste they piled over each other to such an extent that prices jumped up with remarkable suddenness. There have been no more efforts to raid the market, and no more talk of disaster. There is

no doubt that Harriman properties are in first class physical shape and that they are not largely held on speculative margins. There will be no necessity for an unloading, there will be no occasion for any financing to carry long lines. Outside of this uncertainty over the Harriman issues there has been absolutely nothing to disturb the serenity of the Street. The crop and industrial conditions are all that could be desired. Money continues to be easy and the demand for bonds both here and abroad is as insistent as ever. Quotations for money Sept. 13, were: call 2½ @ 2½ per cent, 90 days 3¼ @ 3½ per cent. The quotations in the table are those of the close on Sept. 13.

NEW YORK.

	Sept. 3.	Sept. 13.	Shares sold.		Sept. 3.	Sept. 13.	Shares sold.
All.-Ch.	15¼	15⅜*	1,300	Int.-Met., pfd..	46½	46	12,400
All.-Ch., pfd...	53	51	1,400	Mackay Cos...	84	80¾*	800
Amal. Cop....	84	78¾	127,800	Mackay Cos.,p.	75⅛	74*	300
Am. D. T....	20½*	20½*	———	Man. Elev....	143*	141½	750
Am. Loc.....	59⅜	59	7,545	Met. St. Ry...	23*	20*	200
Am. Loc., pfd.	115	115	455	N.Y. & N.J.Tel	139¼*	139¼*	———
Am. Tel. & Cbl.	76*	83½*	100	Steel, com....	80⅛	78½	878,483
Am. T. & T...	141⅞	141½	24,319	Steel, pfd.....	127¼	124¾	17,400
B. R. T.....	79	76⅝	14,200	W. U. T.....	75¼	79	16,220
Gen. Elec.....	166½	164	4,400	West'h, com...	86	84½	5,000
Int.-Met., com.	14⅛	14½	5,725	West'h, pfd...	130	130*	———

PHILADELPHIA.

	Sept. 3.	Sept. 13.	Shares sold.		Sept. 3.	Sept. 13.	Shares sold.
Am. Rys.....	46*	46	———	Phila. Elec....	12⅛	12¼	———
Elec. Co. of A.	12¼	12⅛*	———	Phila. R. T...	30¼	30*	———
Elec. St. B'ty..	63¼	62	———	Phila. Trac...	91*	91⅛*	———
E. S. B'ty,pfd.	30*	30*	———	Union Trac...	53¾	54	———

CHICAGO.

	Sept. 3.	Sept. 13.	Shares sold.		Sept. 3.	Sept. 13.	Shares sold.
Chi. City Ry..	180*	180*	———	Chi. Tel. Co..	136	135¼*	———
Chi. Rs.,Ser.1.	110*	110*	———	Met. El., com.	17¾*	15⅛	———
Chi. Rs.,Ser.2.	37½*	36¾	———	Met. El., pfd.	49*	49*	———
Com. Edison..	120½*	120½	———	Nat'l Carbon..	95*	96¾	———
Chi. Sub'ws...	18⅝	10½	———	Nat'l C., pfd.	120*	119¼*	———

BOSTON.

	Sept. 3.	Sept. 13.	Shares sold.		Sept. 3.	Sept. 13.	Shares sold.
Am. T. & T...	141⅞	141½	———	Mex. Tel.....	2¼*	2¼*	———
Cum. Tel.....	144*	145*	———	Mex. Tel., pfd.	6*	6*	———
Edison E. Ill..	256	255	———	N. E. Tel....	136	134*	———
Gen. Elec.....	167½	164¾	———	W. T. & T....	12½*	10⅞	———
Mass. E. Ry...	17	16	———	W. T. & T., p.	89*	89*	———
Mass E. R., p.	77	77½	———				

*Last price quoted.
Shares sold are for week Sept. 6 to Sept. 11.

DIVIDENDS.

Butte Electric & Power Company, preferred, quarterly, 1¼ per cent, payable Nov. 1; common, quarterly, 1½ per cent, payable Oct. 1.

Canadian General Electric Company, preferred, quarterly, 1¾ per cent, payable Oct. 1.

Canadian Westinghouse Company, Ltd., quarterly, 1½ per cent, payable Oct. 11.

Carolina Power & Light Company, preferred, quarterly, 1½ per cent, payable Oct. 1.

Cincinnati & Suburban Bell Telephone Company, quarterly, 2 per cent, payable Oct. 1.

Columbus (Ohio) Railway & Light Company, quarterly, ¾ per cent, payable Oct. 1.

Cumberland Telephone & Telegraph Company, quarterly, 2 per cent, payable Oct. 1.

Fonda, Johnstown & Gloversville Railroad, preferred, quarterly, 1½ per cent, payable Sept. 15.

Houghton County (Mich.) Traction Company, preferred, semi-annual, 3 per cent; common, initial, 2 per cent, both payable Oct. 1.

Laclede Gas Company, common, quarterly, 1½ per cent, payable Sept. 15.

Louisville Traction Company, common, quarterly, 1 per cent, payable Oct. 1.

Manila Electric Railway & Lighting Company, common, quarterly, 1 per cent, payable Oct. 1.

Safety Car Heating & Light Company, common, quarterly, 2 per cent, payable Oct. 1.

St. Joseph (Mo.) Railway, Light, Heat & Power Company, quarterly, 1¼ per cent, payable Oct. 1.

Syracuse Rapid Transit Company, preferred, quarterly, 1½ per cent, payable Oct. 1.

Toronto Railway Company, quarterly, 1¾ per cent, payable Oct. 1.

Twin City Rapid Transit Company, preferred, quarterly, 1¾ per cent, payable Oct. 1.

Union Traction Company, of Indiana, preferred, semi-annual, 2½ per cent, payable Oct. 1.

United Gas Improvement Company, of Philadelphia, quarterly, 2 per cent, payable Oct. 15.

United Traction & Electric Company, of New Jersey, quarterly, 1¼ per cent, payable Oct. 1.

West Jersey & Seashore, semi-annual, 2½ per cent, payable Oct. 1.

Western Union Telegraph Company, quarterly, ¾ per cent, payable Oct. 15.

Wilkes-Barre Gas & Electric Company, 1 per cent, payable Oct. 1.

WESTERN UNION TELEGRAPH EARNINGS.—A preliminary estimate of the earnings of the Western Union Telegraph Company for the quarter which will end Sept. 30, 1909, has been issued, and shows an increase in net revenues of about $135,000. In giving out these figures President Clowry says that the figures estimated for the present quarter, which do not include the cost of construction or betterments, show a net profit of 1.57 per cent, or at the rate of 6.28 per cent per year. Including the cost of construction and betterments the net profit for the quarter is 1.11 per cent, or at the rate of 4.44 per cent per year.

ALBANY & HUDSON RAILROAD.—At the sale of the property of the Albany & Hudson Railroad on Sept. 8, under foreclosure in court, the purchaser was I. W. Day, of New York, who is the secretary of the Bond and Stockholders' Reorganization Committee. The price which Mr. Day paid for the property was $50,000, which is merely nominal, as the sale was considered simply a legal method of preparing the way for the reorganization plans. There is now no obstacle to the carrying out of the reorganization of the Albany & Hudson as originally outlined by the committee, full details of which have been given in these columns.

ECONOMIC POWER & CONSTRUCTION COMPANY.—At the hearing in Albany last week before the Public Service Commission of the Second District on the application of the Economic Power & Construction Company for authority to continue to supply electricity for light, heat and power purposes, the commission announced that it intended to go into the financial affairs of the company, and also its connection with the holding company, the New York Power Securities Company. It will be remembered that the Economic Power & Construction Company received a remarkable charter from the Legislature in 1893, which gave it a right to enter upon any street or public place in the State of New York without securing the consent of the local authorities. These charter powers were declared unconstitutional by the Court of Appeals in May last, and the company is now attempting to operate subject to the Public Service Commission, the same as other public utility companies.

AMERICAN TELEPHONE STOCK EXCHANGE.—It is announced that fully 90 per cent of the stockholders of the New York & New Jersey Telephone Company, the Bell Telephone Company of Pennsylvania, the Central District & Printing Telegraph Company, of Pittsburgh, and the Bell Telephone Company of Buffalo, have turned in their stock for exchange for certificates of the American Telephone & Telegraph Company. It is also stated that many stockholders now abroad have written that it would be impossible for them to take their stock from the safety deposit vaults until later, and in cases of this kind the time for exchange, which expired Sept. 1, has been extended. Upon delivery of the stock certificates and payment of cash for the fraction, if any, which the shareholders desire to buy, negotiable receipts have been issued by the American company showing the number of shares to which the depositor is entitled. Such receipts are convertible into stock on or before Dec. 31. On Oct. 15 the holders of these receipts will be paid the regular quarterly dividend of 2 per cent.

BRONX GAS & ELECTRIC COMPANY.—The Bronx Gas & Electric Company has applied to the Public Service Commission for permission to issue bonds to the amount of $1,500,000, to be secured by a mortgage on the company's property. There is already an outstanding issue of $500,000 covered by a mortgage, and there are also small mortgages amounting to $30,100. It is stated that the purpose of the new issue is to retire these obligations. The outstanding stock of the company is $486,500, upon which dividends of 5 per cent have been paid for the past four years. A public hearing will be held on the application.

INTERNATIONAL TELEGRAPH CONSTRUCTION COMPANY.—An order has been granted in the Chancery Court at Trenton, N. J., requiring the International Telegraph Construction Company, which has a plant for the manufacture of wireless telegraph apparatus at 72 York Street, Jersey City, to show cause on Sept. 18 why a receiver should not be appointed. Philip C. Kullman, a minority stockholder, who owns 225 of the 1000 shares, and John Firth, to whom the company owes $2,203.80, made the application. The tangible assets, consisting of machinery and stock in trade, are stated not to exceed $30,000. The bill of complaint recites that the majority of the stock is owned by the United Wireless Telegraph Company. On Aug. 10 the United company recovered judgment against the International Telegraph Construction Company for $34,266.44. Under this judgment the sheriff of Hudson levied on the property of the International company and advertised it for sale Sept. 9. In addition to the application for the appointment of a receiver, Kullman and Firth petitioned for an order restraining the sheriff from proceeding with the sale under the judgment levy, and this request Vice-Chancellor Stevenson also granted. The United Wireless Company owns 70 per cent of the stock of the International, and, according to statements made by one of the officials of the former company has been putting up the money necessary for the company's operation. There has been some misunderstanding with the minority stockholders and the United Wireless has been anxious to have the company wound up at receiver's sale. It is stated that the United Wireless Company intends to purchase the property of the International whenever it is sold and that the plant will be continued in the manufacture of apparatus as heretofore.

AMERICAN RAILWAYS COMPANY.—The report of the American Railways Company for the fiscal year ending June 30, 1909, shows that the gross earnings of its subsidiary companies were $2,865,229, a decrease of $62,207. After paying the fixed charges, interest and taxes the net income of these companies was $310,728. After disbursement to the stock holders of the company of the regular 6 per cent dividend, there was added to the surplus account $5,022. The American Railways Company, of which Jeremiah J. Sullivan is president and William F. Harrity is first vice-president, is a Philadelphia concern, and owns a number of public service corporations throughout Pennsylvania and the Middle West. The companies owned entirely are: Home Electric Light & Steam Heating Company, Tyrone, Pa.; Bridgeton (N. J.) Electric Company; Bridgeton & Millville Traction Company; People's Railway Company, Dayton, Ohio; Altoona (Pa.) & Logan Valley Electric Railway Company; Du Page Construction Company, Joliet, Ill; Dellwood Park Company, Joilet, Ill.; Franklin Real Estate Company, Blair Electric Company, Bellwood, Pa., and all but a few shares of the Scranton (Pa.) Railway Company and the Springfield (Ohio) Railway Company. The balance sheet of the holding company shows total assets of $12,610,882.

CHANGE IN PHILADELPHIA RAPID TRANSIT.—President John B. Parsons, of the Philadelphia Rapid Transit Company, has resigned his position to take effect Sept. 15. It is generally expected that Mr. Parsons will remain with the company as chairman of the board of directors, and that the general manager, Charles O. Kruger, will succeed him as president. Mr. Parson's resignation was not a surprise to financial circles, as it had been known for a number of months that he was anxious to be relieved of the responsibilities of his office. Mr. Kruger has been with the company for many years, and is thoroughly identified with its upbuilding. The August passenger receipts of the company showed an increase of about $91,000 over August, 1908. This follows an increase in July of $139,767, so that the first two months of the current fiscal year show that the gross earnings have gone up $231,000 over the same period last year. It is particularly interesting to note that the improvement in the earnings of this company has been marked since the abolishment of strip tickets.

CLEVELAND ELECTRIC ILLUMINATING COMPANY.—A mortgage for $30,000,000 in favor of the Citizens' Savings & Trust Company has been filed by the Cleveland (Ohio) Electric Illuminating Company to cover a bond issue of that amount. The bonds will be issued only as money is needed for extensions and improvements and the sale will be restricted so as to make them sell at a premium. The starting price has been made 103 by Spencer Trask & Company, of New York, who will handle the issue. The $1,700,000 first mortgage 5s and $1,500,000 general mortgage 6s will be replaced by bonds of the new issue. This year $4,000,000 bonds will be issued, including those used to take up the present bonds. After the sale of the first $4,000,000, the bonds may be issued in the proportion of $800 to $1,000 cash put into the property by the company after it has earned, during the preceding year, twice the amount of interest on all outstanding bonds.

SOUTHERN CALIFORNIA EDISON COMPANY.—The recently organized Southern California Edison Electric Company, which will own and operate the Edison Electric Company of Los Angeles, has filed a certification for the issue of $30,000,000 of capital stock, and gives Chino, San Bernardino County, as its principal place of doing business. Details of this incorporation, with the names of the promoters, were given in our issue of July 22. The officers of the Edison Electric Company state that the business of the corporation has been increasing at the rate of 35 to 40 per cent a year and that increased capital was absolutely necessary to care for the growth. President Miller and his sons, with George A. Bachelor, vice-president of the E. H. Rollins Company, of San Francisco, have gone to Santa Ana Canyon and Bear Valley to inspect the power houses of the company.

KENTUCKY RAPID TRANSIT COMPANY.—The Kentucky Rapid Transit Company was incorporated in Delaware last week by Samuel M. Clement, Jr., of Philadelphia, with a capitalization of $10,000,000, $2,500,000 being preferred and $7,500,000 common. The principal operations of the company, it is said, will center about Louisville, Lexington and Frankfort, Ky., but it is the purpose of the company to absorb other traction companies in that State. Besides the operation of railway lines, the charter granted privileges of operating electric light, power and gas plants. At the office of George S. Graham, 42 Broadway, New York, one of the incorporators and chief attorney for the new company, it was stated that as yet the organization of the company was of a confidential nature and that no statement as to the properties to be absorbed could be given out.

BECK FLAMING LAMP COMPANY.—In the auction of securities in New York last week there were a number of notes and claims issued by the Beck Flaming Lamp Company put up and sold. It is understood that these sales were made simply in order to fulfill a legal formality, and have nothing to do with the condition of the company. At the same time 182 shares of the Beck Flaming Lamp Company stock, par value $100, were sold at $100 per share, and there were also 250 shares of the New York Beck Lamp Company stock, par value $100, sold for $50 a share. The latter company, it is said, was simply the selling concern for the Beck lamps, and that it will go out of existence. All of these sales were made to the original parties offering the shares for sale, and were simply of a technical character.

MEXICO STEEL & CHEMICAL COMPANY.—A new organization has been formed in Mexico City with a capital of $1,000,000 to be known as the Mexico Steel & Chemical Company. The new concern is organized for the purpose of making, it is said, a high-grade steel by an electrical process, and of also making calcium carbide. Dr. F. S. Pearson, of New York, the head of the Mexico Light & Power Company, is the moving spirit in this new corporation. R. C. Brown, who is the managing director for the Pearson interests in Mexico, will be in charge of the new company.

CUMBERLAND TELEPHONE COMPANY'S EXTRA DIVIDEND.—The directors of the Cumberland Telephone & Telegraph Company, in addition to the regular quarterly dividend of 2 per cent, have declared an extra dividend of 2 per cent payable on the stock of the American Telephone & Telegraph Company. The East Tennessee Telephone Company recently reduced its indebtedness to the Cumberland company by turning over to it 3800 shares of the American company, and it is this stock that is now being distributed as a dividend.

MICHIGAN & CHICAGO RAILWAY COMPANY.—A mortgage for $3,000,000 in favor of the Chicago Title & Trust Company has been filed in Kalamazoo, Mich., by the Michigan & Chicago Westbound Railway Company. The mortgage is to cover an issue of bonds of the same amount. The company proposes to construct a railway between Kalamazoo and Grand Rapids.

GENERAL NEWS

Construction News.

HARTSELLS, ALA.—Plans are being made to establish an electric light plant in connection with the proposed cottonseed-oil mill to be erected in Hartsells. For further information address J. H. Corsbie, Mayor.

MONTGOMERY, ALA.—The Citizens Light, Heat & Power Company has filed a deed of trust in the office of the Judge of Probate to secure an issue of $500,000 in bonds, of which $200,000 has been sold, the proceeds to be used for improvements and extensions to the plant. Plans are being made by the company to install a 500-hp steam turbine and a 2000-kw generator direct-connected. The balance of the bonds will be held for future extensions.

CORDOVA, ALASKA.—Plans are being made by the Cordova Power Company to extend its pipe lines to Crator or Summit Lake, which will involve an expenditure of about $50,000. About three miles of pipe will be needed.

LITTLE ROCK, ARK.—C. E. Hart, of Joplin, Mo., has been in the city recently making investigations pertaining to the project of erecting transmission lines to Little Rock, Hot Springs and Pine Bluff, to supply electricity in the three named cities, in connection with a large power plant to be erected at a cost of $1,000,000, in Southern Arkansas. Messrs. Paret & Beard, Dwight Building, Kansas City, Mo., it is said, can furnish further information.

CHICO, CAL.—F. P. Bergen, general superintendent of the Sacramento Valley Power Company, it is reported, has been in Chico making investigations to determine if sufficient business could be secured to warrant the extension of a transmission line to Chico. The company generates 16,000 hp on Snow and Cow creeks, and its line would be brought to Chico by the way of Anderson and Red Bluff.

ELMHURST, CAL.—The Board of Trade, it is said, will recommend the installation of a new street lighting system in Elmhurst.

LOS ANGELES, CAL.—The Bureau of Los Angeles Aqueduct Power to operate under the direction of the Board of Public Works has been formed to take charge of the development of the Owens River water power in connection wth the aqueduct. E. F. Sattergood, who has been employed by the aqueduct department in connection with the development of the water power to generate electricity for use in connection with the construction of the reservoir, has been retained by the bureau, and will have the title of chief electrical engineer. According to the present plans it will cost about $4,500,000 to develop the power and transmit it to Los Angeles.

MARYSVILLE, CAL.—The chairman of the hospital committee of the Board of County Supervisors has been authorized to advertise for bids for the installation of an electric pumping plant for the county infirmary, plans and specifications for which are now being prepared by Robert Hunter and the chairman of the committee.

MARYSVILLE, CAL.—R. E. Cranston, a well-known civil and mining engineer, is said to be interested in a power plant and gold-dredging enterprise projected on the Yuba River, a few miles above Marysville. The plant will have an ultimate output of 75,000 hp. It is proposed to run a ditch for 20 miles north of Marysville for the dual purpose of supplying a sufficient fall and also to provide water for irrigation to lands adjacent. The Yuba River will be diverted from its course and the bed will be mined for gold by the dredger process. Mr. Cranston expects to start actual work on his project early next spring.

MILL VALLEY, CAL.—A company has been formed by local capitalists to construct an electric railway from Locust Avenue Station to the Muir Woods and thence to the Lagoon. The officers of the company are: John Dias, president; James V. Chase, secretary, who with Judge Conlon and D. C. Braid are directors.

MONTEREY, CAL.—Extensive improvements are contemplated by the Monterey County Gas & Electric Company, which include the installation of a new electric distributing system in Pacific Grove, a new transmission system to Salinas, and the purchase of five new cars.

NEVADA CITY, CAL.—Pending the construction of its new large power plant, it is reported that the Yuba Power & Hydro-Electric Company would purchase electricity from the Alaska mine for transmission into the Alleghany mining district and surrounding camps.

OAKLAND, CAL.—At a meeting of the Board of Supervisors, held recently, the Fruitvale lighting district board was organized. Arrangements have been made for the erection of 136 lamps in the district. The cost of maintenance of the lamps for the ensuing year is estimated at $9,000. Plans have also been completed by the Pioneer lighting board, which is to have 30 lamps, and the cost of maintaining the same is estimated at $2,000. Fourteen lamps are to be installed in the Homestead lighting dstrict, the cost of which is estimated at $1,000 for the ensuing year.

SALINAS, CAL.—W. H. P. Hill, manager of the Monterey County Gas & Electric Company, states that the company has just installed a modern steam turbine plant at Monterey with an output of 3000 hp, that only about 800 hp is required to serve Pacific Grove, Monterey and the street car line, and that Salinas will be connected with the Monterey works sooner or later. It is said that the Salinas plant will be overhauled and placed in first-class condition and will be held in reserve in case of emergency. One of the reasons given for this move is that the company could obtain its fuel cheaper in Monterey than in Salinas and also that on account of the large quantity of water used by the works it would be more economical to erect a transmission line to Salinas than to make the required alterations in the local plant.

SANTA ROSA, CAL.—The Sonoma & Lake County Railroad Company, it is said, has secured the right-of-way through Alexander Valley and on to Preston for its proposed electric railway, which is to extend from Santa Rosa to Lakeport. J. E. Fulton, of Lakeport, is manager.

SAN FRANCISCO, CAL.—The Sunset Telephone & Telegraph Company has filed a notice with the county clerk that the indebtedness of the company has been increased from $3,000,000 to $15,00,000 for the purpose of securing funds for improvements and extensions to its property.

SAN FRANCISCO, CAL.—The directors of the Mojave Water & Power Company, capitalized at $20,000,000, have voted to increase the bonded indebtedness of the company by $15,000,000. Among those interested in the company are Julian Mathieu, Harry C. Mack, Francis C. Van Deinse, Charles F. Metteer, Chauncy S. Goodrich and A. E. Boynton. The company is said to have vast holdings in the southern part of the State and is in a position to furnish water to the counties of Fresno and Kern. Attorney A. E. Boynton, one of those interested, states that the company increased its bonded indebtedness at this time, not to sell bonds, but for the purpose of being in readiness to do so in after years.

STOCKTON, CAL.—A contract has been entered into between the trustees of Reclamation District No. 348 and the Pacific Gas & Electric Company, San Francisco, by the terms of which the corporation will furnish power to the district to operate pumping plants for a period of ten years, the contract price being $30,000. There will be installed on the 15,000-acre tract three 100-hp centrifugal pumps and two 350-kw transformers. The introduction of electricity to operate pumping plants in the delta region is an innovation, and it is stated that other tracts will follow suit.

TROPICO, CAL.—A public highway lighting district has been formed in Tropico to provide illumination, the expense to be borne by the district.

YREKA, CAL.—The Siskiyou Power & Electric Light Company, which is erecting a transmission line from its plant at Fall Creek to Dunsmuir, expects to have its line completed within two months, when it will be ready to supply electricity for lamps and motors to all points between Hornbrook and Dunsmuir.

YUBA CITY, CAL.—It is proposed to form a distributers' organization to secure electrical service from the new transmission line now being erected from Yuba City to Meridian, by the Pacific Gas & Electric Company.

CENTRAL CITY, COL.—The Maumee Gold Mining Company, which owns a group of claims near the War Dance, is reported to be considering the installation of a large power plant to furnish electricity for the mines.

GOLDEN, COL.—The American Smelter & Mines Company has purchased the smelter at Golden owned by the Clear Creek Mining & Reduction Company. It is said that the purchasing company proposes to make improvements to the plant which will involve an expenditure of about $25,000. Plans are being made to introduce electricity for motive power, which will be furnished by the Central Colorado Power Company.

TELLURIDE, COLO.—Owing to a washout at Trout Lake, the storage reservoir of the Telluride Power Company, Sept. 6, practically every mine in the San Miguel district was obliged to close down. The property of the company was damaged to the extent of many thousands of dollars. The flume feeding from the lake to the lower plant was destroyed. The Illium power plant was entirely washed away and part of the Butterfly mill. The Ames power plant, located in Telluride, was not materially injured, but is helpless for lack of water. The Ouray plant is supplying electricity for lamps. The Smuggler Union mine, which generates its own power, is the only mine in operation in this vicinity.

CANAAN, CONN.—At a recent meeting of the Canaan fire district it was voted to renew the contract for street lighting with the Berkshire Power Company for a term of five years at a rate of $15 per lamp per year.

ROCKVILLE, CONN.—Arrangements are being made by the New England Company to replace the old wooden water wheel in its plant with a new turbine wheel, which, when installed, will drive an electric generator to provide electricity to operate the mill.

WILMINGTON, DEL.—The Wilmington & Chester Traction Company is planning to install a 1500-kw, alternating-current generator and turbine.

WILMINGTON, DEL.—The Trustees of the Poor have appointed a committee, consisting of A. V. L. George, Dr. John Ball and T. A. D.

Houston, to look into the matter of establishing an electric light plant on the county's Farnhurst property. The annual cost of lighting the almshouse is more than $1,200 per year.

WASHINGTON, D. C.—Bids will be received until Sept. 21 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Brooklyn, N. Y., Schedule 1654—Motor-driven tool room lathe; motor-driven tool room shaper; motor-driven radial drill; motor-driven universal milling machine; motor-driven sensitive drill; motor-driven, two-wheel emery grinder or column; motor-driven portable cylinder boring machine, etc. Schedule 1655—30,000 ft. incandescent lamp cord. Schedule 1663—1000 lb. aluminum; 10,000 lb. ingot copper, etc. Norfolk, Va., Schedule 1657—5000 ft. lighting wire. Schedule 1667—11,160 lb. hard-drawn seamless brass tubing. Boston, Mass., Schedule 1667—Ammeters, voltmeters and wattmeters. Applications for proposals should designate the schedules desired by number.

SARASOTA, FLA.—The city is reported to have granted a franchise for the construction of an electric light plant.

DALTON, GA.—Plans are being considered by the City Council for improvements and extensions to the municipal electric light plant, including the installation of an engine and generator, the cost of which is estimated at $10,000.

HAGERMAN, IDAHO.—It is reported that plans are being considered by H. A. Stroud for the installation of an electric power plant with an output of 75,000 hp and the construction of an electric railway.

SHELLEY, IDAHO.—The Gem State Power Company has commenced work on its power site, located about two miles north of Shelley. It is said that bids are being asked for the construction of the dam and headgate on the Snake River, the cost of which is estimated at approximately $25,000. N. N. Holm is engineer.

WEISER, IDAHO.—At a meeting of the residents of Malheur county, a committee, consisting of R. A. Atwood, Stuart French and J. W. Stoneman, was appointed to investigate the question of installing an electric pumping plant to take water from the Snake River for irrigation, and also to take up the matter of securing electricity to operate the same from the Idaho-Oregon Light & Power Company, of Boise, Idaho.

ABINGDON, ILL.—The local electric plant, owned by the Abingdon Electric Company, is reported to have been purchased by a new company organized by local business men.

CHICAGO, ILL.—Bids will be received by I. J. Bryan, clerk of the Sanitary District of Chicago, Ill., until Sept. 22 for furnishing the following material, for which proposals may be made on any or all of the divisions, as follows: Division A, high pressure pumping unit; division B, induction motors. Delivery and installation must be made in accordance with the detailed specifications and completed within six months after the award of the contracts. Proposals will also be received at same time and place for furnishing copper and aluminum conductors and high-tension insulators. All proposals must be made upon blank forms furnished by the Sanitary District and in accordance with plans and specifications and contract form on file in the office of the electrical engineer of the Sanitary District, Room 1500, American Trust Building, Chicago, Ill., and which can be obtained upon application therefor. Robert R. McCormick is president of Board of Trustees.

EAST MOLINE, ILL.—The plant of the United Light & Power Company was destroyed by fire Sept. 1, causing a loss of about $10,000. The plant has not been in use since Aug. 1, when the company was consolidated with the People's Power Company, of Moline, and electricity for operating the East Moline system furnished from the power station at Moline.

MOLINE, ILL.—The Moline Plow Company, of Moline, is changing its plant from steam power to electric drive. The switchboards, panel boards, switches, etc., were furnished by the Trio Manufacturing Company of Rock Island, Ill., and the motors and circuit breakers by the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa. The Electric Construction & Machinery Company, of Rock Island, has the contract for the installation of the entire equipment.

MONMOUTH, ILL.—Plans are being made by the Rock Island Southern Railroad Company for the construction of a power house at Edwards River. Contracts for the equipment have been awarded to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa. The equipment will include two turbine units complete with generators rated at 15,000 kw.

OBLONG, ILL.—The capital stock of the Oil Belt Traction Company has been increased from $100,000 to $500,000. The company is constructing a railway from Charleston to Mt. Carmel, passing through Casey, Bellaire, Oblong, Hardinville and Bridgeport. N. L. Upson is manager.

FORT WAYNE, IND.—The Fort Wayne-Bryan Electric Railway Company has petitioned the County Commissioners for a franchise to construct an electric railway from the State line to Reed's Corner. The company proposes to build an interurban railway from Fort Wayne to Bryan, a distance of about 48 miles. Edgar A. Tennis, of Fort Wayne, Ind., is interested in the project.

PLYMOUTH, IND.—The commissioners of Marshall and St. Joseph counties have granted franchises to the Citizens' Mutual Telephone Company, of Marshall and St. Joseph counties to erect telephone lines through the respective counties.

VINCENNES, IND.—Surveys are being made by the Vincennes, West Baden & Louisville Traction Company, under the direction of Jerome Johnson, for its proposed electric railway between Jasper, Petersburg and Vincennes, 48 miles in length. Subsidies to the amount of $50,000 have been voted for the company and a permit has been granted by Congress to construct a bridge across the White River one mile north of Petersburg.

CENTERVILLE, IA.—The Centerville Light & Traction Company is reported to have awarded contracts for the construction of a seven-mile extension from Centerville to Mystic, as follows: For overhead material, to the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., and the Ohio Brass Company, of Mansfield, Ohio; for wire, to the American Steel & Wire Company, of Chicago, Ill., and the Wasco Supply Company, of St. Louis, Mo. Kaye & Carter, of Minneapolis, Minn., and Lee, Lord & Company, of Peoria, Ill., will furnish poles and ties.

DAVENPORT, IA.—The Town Council of Bentendorf is considering the question of installing water works and lighting system.

SIGOURNEY, IA.—The plant and holdings of the Sigourney Electric Light & Power Company have been purchased by J. F. Bray. It is said that the new owner will enlarge and double the output of the plant.

STERLING, KAN.—The City Council has entered into a contract with the Morris Electrical Company to furnish electricity for lighting the town for a period of five years. The company is to furnish 30 lamps of 60 cp, 58 lamps of 32 cp and sufficient number of incandescent lamps to light the city hall, water works and other public property, for $135 per month on an all-night, moonlight schedule.

WICHITA, KAN.—The plants and holdings of the Edison Electric Light & Power Company and the United Gas Company are reported to have been purchased by the Electric Bond & Share Company, of New York, N. Y., the consideration being $2,000,000. F. G. Sykes, of New York, N. Y., it is said, will be president of the new company.

LOUISVILLE, KY.—Plans have been completed by D. X. Murphy & Brother, of Louisville, for the proposed factory building to be erected by Udolpho Snead at a cost of about $200,000. They provide for a building eight stories high to cover an area of 185 ft. x 90 ft. and will be used for manufacturing purposes, the tenants to be supplied with light, heat and power. Bids for construction of the building will soon be opened.

PORTLAND, MAINE.—It is reported that the Portland Electric Light & Power Company will develop the water power of the Saco River at Bonney Eagle, and has contracted to supply 4000 hp for operation of the mills at Sanford.

ROCKLAND, MAINE.—The City Council has entered into a contract with the Rockland, Thomaston & Camden Railway Company for lighting the streets of the city for a term of five years, under which the company agrees to furnish 62 4-amp magnetite arc lamps, at $85 each per year, and 12 tungsten incandescent lamps of 60 cp on an all-night, moonlight schedule, at $28 per lamp per year. The company also agrees to substitute three 60-cp tungsten lamps for one arc lamp, and three 40-cp incandescent lamps for two series 60-cp tungsten lamps, if desired by the city; also to furnish ten 40-cp incandescent lamps between Lindsey and Park streets on Main Street, on the moonlight schedule, without charge.

SANFORD, MAINE.—The Sanford Light & Power Company is making extensive improvements to its plant, which, when completed, will double the output of the plant. The new equipment includes a 350-hp engine, direct-connected to a 250-kw generator and new switchboard. Two new boilers, rated at 125 hp each, will also be installed. The cost of the work is estimated at about $10,000.

CONWAY, MASS.—The Conway Electric Street Railway Company is reconstructing the dam on South River near Conway Junction. The dam will furnish power to generate electricity, which will be utilized for operating the street railway system and for lighting. It will be 125-ft. high and will provide a storage capacity of 120,000,000 gal.

ERVING, MASS.—At a special meeting held recently it was voted to accept the act of the legislature establishing an electric light district in precinct No. 1 and to establish a lighting system. The commission was authorized to purchase electricity to supply to street lamps at a cost not to exceed $300. Noah Rankin, Henry D. Reynolds, William T. Richards and Charles F. Clark are members of the commission.

FITCHBURG, MASS.—The State Gas and Electric Light Commission has authorized the Fitchburg Gas & Electric Light Company to issue 3623 additional shares of capital stock at $85 per share, the par value being $50 per share. The money received from 3000 shares to be used to pay off promissory notes and $10,000 of coupon notes, and the proceeds of the remainder to be used to pay for improvements made to the plant previous to June.

LYNNFIELD, MASS.—An agreement has been reached between the New England Telephone & Telegraph Company and the officials of the Reading municipal electric light plant, providing for joint ownership in the line of poles that extends from Reading to Lynnfield Center, by the way of Pine, Main, Sumner and Chestnut streets. Electricity for lighting the village of Lynnfield will be furnished from the municipal electric plant at Reading. The transmission line will be strung on the same poles as the telephone lines.

DETROIT, MICH.—The Detroit, Lansing & Grand Rapids Railway Company has filed a mortgage in favor of the Union Trust Company, of Detroit, Mich., as trustee, to secure an issue of $5,000,000 in bonds. The company proposes to construct an electric railway from Detroit to Grand Rapids, via Lansing, a distance of 135 miles.

KALAMAZOO, MICH.—The Michigan & Chicago Westbound Railway Company has filed for record at Kalamazoo a $3,000-000 mortgage in favor of the Chicago Title & Trust Company. The company proposes to construct an electric railway between Kalamazoo and Grand Rapids. Alfred H. Brown is said to be interested in the project.

ST. LOUIS, MICH.—Preparations are being made by the Union Telephone Company for improvements to its system, which will involve an expenditure of about $20,000.

FAIRFAX, MINN.—The proposition to issue bonds for the construction of an electric light plant will be submitted to the people in the near future.

FERGUS FALLS, MINN.—The City Council is considering the question of extending the street lighting system on Lincoln Avenue and Hill Street, the cost of which is estimated at $1,500.

GRAND RAPIDS, MINN.—The proposition to replace the present street arc lighting system with tungsten incandescent lamps is under consideration.

JANESVILLE, MINN.—Plans are being made by the Cannon Valley Telephone Company for extensive improvements to its system in Janesville, Minn.

MINNEAPOLIS, MINN.—Dr. P. M. Hall, health commissioner, it is stated, will apply to the Board of Tax Levy for an appropriation of from $50,000 to $75,000 to install an electric light plant at the crematory, to furnish electricity for lighting the entire and northeast portions of the city. The cost of the equipment is estimated as follows: Engine and dynamo, $16,000; distributing system, $60,000, and 600 lamps at $25 each, $15,000.

ROCHESTER, MINN.—The Council has voted to make improvements and extensions to the municipal electric light plant, which will include the installation of a 500-kw generator, steam engine and switchboard.

JACKSON, MISS.—Arrangements are being made by the Cumberland Telephone & Telegraph Company to erect a new long-distance telephone line from Jackson to New Orleans along the right-of-way of the New Orleans Great Northern Railroad.

MERIDIAN, MISS.—The Meridian Light & Power Company is making extensive improvements and extensions to its system, which will involve an expenditure of from $45,000 to $60,000. Contracts have already been let and work is under way. J. N. Eley, of Atlanta, Ga., is engineer in charge of the work.

CENTRAL CITY, NEB.—Bids will be received by C. E. Newmeyer, city clerk, until Sept. 27 for the construction of power house for electric light plant.

FAIRFIELD, NEB.—We are informed that bids will be opened Sept. 21 for the construction of an electric light plant and water works system. H. E. Underkofler is city clerk.

LINCOLN, NEB.—It is stated that the Omaha, Lincoln & Beatrice Railway Company will resume work on its electric railway, which is to connect Lincoln, Bethany Heights, University Place, Omaha, Papillion, Springfield and Waverly, 56 miles in length. The railway has been completed between Lincoln University and Bethany Heights, a distance of five miles. E. C. Hurd is secretary.

PLATTSMOUTH, NEB.—The Railway Commission has granted the Plattsmouth Telephone Company permission to issue additional capital stock to the amount of $45,000, the proceeds of which will be used to take up outstanding obligations and for improvements to its plant at Weeping Water, Louisville and other places.

FALLON, NEV.—It is reported that the Nevada Wonder Company is contemplating the construction of an electric power plant in Fallon to supply electricity in Fallon.

MANHATTAN, NEV.—Arrangements are being made by the Manhattan War Eagle Mining & Milling Company for the installation of an electric pump at the 240-ft level on the Stray Dog Station.

LITTLETON, N. H.—The commissioners of the municipal electric light plant have contracted for a 280-hp Rollins engine to be installed in the upper electric light station to be used as an auxiliary for the power plant. It is understood that the installation of the new engine is the beginning of a movement to establish a day service in Littleton.

IRVINGTON, N. J.—The Reading Electric Company, of Reading, Pa., has submitted a proposition to the Irvington Town Council offering to install a high-tension electric lighting plant with sufficient output to supply seven arc lamps of 2000-cp and not more than 800 incandescent lamps of 32 cp for $55,000. The estimate submitted includes the erection of the power house, the installation of equipment, including engine, boiler, and other apparatus and the erection of distributing system and placing of street lamps ready for operation. A bid has also been submitted by the Public Service Corporation for a renewal of its present contract for street lighting, which expires Jan. 1., for terms of one, three and five years as follaws: For one year contract, not less than 570 incandescent lamps of 32 cp, $17 per lamp per year; not less than five arc lamps of 2000 cp, $100 each per year; three-year contract, not less than 570 incandescents, first year, $15 each, second year $16 per lamp, third year $17 per lamp; arc lamps $95 each per year; five-year contract, not less than 570 incandescent lamps, first and second year $15 per lamp per year, third and fourth year $16, fifth year $17 each; arc lamps $90 each per year. The estimates for one year stipulate that carbon filament incandescent lamps will be used. On three and five-year contracts the company agrees to furnish tungsten lamps. At present the town is using 581 incandescent lamps and three arc lamps at a flat rate of $15 each per year, and arc lamps at $100 per lamp per annum. In the offer made the company stipulates that after January 1, 1910, no free lamps would be allowed the town. Under the present contract about 40 lamps are furnished free of charge in the municipal building.

JERSEY CITY, N. J.—The Hudson & Manhattan Railroad Company has been granted permission by the Jersey City street and water board to extend its Cortlandt Street tunnel system under Railroad Avenue to Summit Avenue.

SOUTH AMBOY, N. J.—The City Council has granted the Jersey Central Traction Company, of Keyport, N. J., a franchise to construct its proposed extension through South Amboy to Perth Amboy.

ALAMOGORDO, N. M.—Arrangements are being made by the High Mills Rolls Company for the construction of a large power plant, which is to furnish electricity for a new electric railway and for several pumping stations in the valley.

ALBUQUERQUE, N. M.—A stock company has been formed by residents of the eastern portion of Albuquerque for the purpose of constructing an electric street car line in that portion of the city, for which a franchise has already been applied for. The proposed line will give that part of the city two street car systems.

ALBUQUERQUE, N. M.—The Blue Water Development Company, which is operating about 100 miles west of Albuquerque, on the main line of the Santa Fe Railroad, expects to have its dam completed by the middle of the winter. The dam will impound water enough to irrigate 21,000 acres and operate the power plant furnishing electricity for Central New Mexico.

CLINTON, N. Y.—Bids will be received by the Board of Trustees until Sept. 21, for furnishing electricity sufficient to supply 27 street arc lamps of 2000 cp, on an all-night schedule, and not to exceed 10 incandescent lamps of 32 cp, as per specifications, which can be seen at the office of Louis M. Martin, Village President. The bids are to be based upon the supplying by said bidder of the incandescent service to private consumers at 8 cents per kw-hour, as per specifications on file at the office of the Village President. W. H. Brockway is Clerk of Board of Trustees.

CLOVIS, N. M.—E. J. Howard, J. D. Hammett and A. R. Hammett, of Moberly, Mo., have been granted a franchise by the City Council to construct and operate an electric railway in Clovis.

DEKALB, N. Y.—The Public Service Commission, Second District, has granted the Rensselaer Falls Electric Light & Power Company permission to construct and operate a distribution system in the town of DeKalb, and in the village of DeKalb Junction, for the purpose of furnishing electricity for lamps, heat and motors.

FRANKLINVILLE, N. Y.—New equipment is being installed in the plant of the Empire Electric Company, including an engine, boiler and generator, which will increase the output of the plant by 500 hp, making the total output 1000 hp. The company furnishes electricity for operating the cutlery plant of the Ontario Knife Company, and will now supply energy to the Empire Flour and Planing Mills, the G. R. Warren sawmill and other local industries, as well as for street lighting and residential lighting. Arrangements are being made to establish a day service, and in another year the present street lamps will be replaced with tungsten lamps.

FULTON, N. Y.—Arrangements are being made by the Fulton Light, Heat & Power Company to secure electrical energy from the Syracuse, Lake Shore & Northern Railroad Company to help out during the low-water period. The company has recently installed a 250-hp motor, which will be connected with the transmission system of the railroad company.

HUDSON, N. Y.—The Public Service Commission, Second District, has approved the plan and agreement for the reorganization of the Albany & Hudson Railroad Company submitted by the reorganiztion committee, representing a large number of stockholders and bondholders of the company. The plans provide for the issuance of $3,275,000 in stock to be exchanged for the present outstanding stocks and bonds. The new company also asks for authority to issue a mortgage of $1,500,000, the greater portion of which is to be used in double-tracking the third-rail system between Rensselaer and Kinderhook; the purchase of the bridge connecting Albany and Rensselaer; the improvement of the power houses and completion of the railway to Pittsfield. Myron T. Herrick, of Ohio; Clinton L. Rossiter, vice-president of the Long Island Loan & Trust Company, and R. A. C. Smith, president of the American Mail Steamship Company, are members of the committee. The property was sold at auction, Sept. 8, to I. W. Day, of New York, secretary of the reorganization committee, for $550,000.

JAMESTOWN, N, Y.—The American Metal Door Company is in the market for a new or slightly used 125-hp, vertical, two or three-cylinder gas engine, available for use on or before Oct. 1.

MOHAWK, N. Y.—The committee appointed to investigate the question of installing an electric light plant in Mohawk states that a plant can be established in the town and maintained at a saving of from $2,000 to $3,000 a year. The citizens have instructed the committee to have plans prepared, after which the village will ask for bids. Frank DuBois, Jay Brackett, D. C. Ford and Ralph Devendorf are members of the committee.

NEW YORK, N. Y.—The Bronx Gas & Electric Company has petitioned the Public Service Commission for permission to issue $1,500,000 in bonds, the proceeds to be used to retire outstanding obligations.

NEW YORK, N. Y.—Bids will be received by the Board of Park Commissioners at the office of the Department of Parks, Arsenal Building, Fifth Avenue and Sixty-fourth Street, Borough of Manhattan, New York, N. Y., until Sept. 30 for furnishing and installing electric lighting fixtures in the new addition of the Metropolitan Museum of Art. Plans may be seen and blank forms may be obtained at the above office. Henry Smith is president of Board of Commissioners.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent school buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, New York, N. Y., until Sept. 20 for installing electric equipment in vocational school at Public School 100, located on One Hundred and Thirty-eighth and One Hundred and Thirty-ninth streets, Borough of Manhattan. Blank forms, plans and specifications may be obtained at the office of the superintendent, estimating room, ninth floor, Fifty-ninth Street and Park Avenue.

NORWICH, N. Y.—Plans have been approved by the Norwich Gas & Electric Company for improvements and extensions to its gas and electric plants, including the installation of a 150-kw generator and 200-hp engine. About four miles of gas mains will be laid. F. W. Somers, of Ithaca, is general manager.

PATCHOGUE, N. Y.—The Public Service Commission, Second District, has authorized the Patchogue Electric Light Company to exercise its franchises granted by the Town of Brookhaven to furnish electricity for public and commercial purposes in that town.

RIVERHEAD, N. Y.—The Public Service Commission, Second District, has issued an order requiring the Hallett Light & Power Company and the Riverhead Electric Light Company to improve their transmission lines immediately in the streets of Riverhead.

ROCHESTER, N. Y.—The contract for wiring the Convention Hall addition and for the installation of an electric elevator was awarded by the Board of Control to the Rochester Electric Construction Company, for $6,438.

ROCHESTER, N. Y.—The Rochester Railway & Light Company has awarded contracts to the Allis-Chalmers Company for two water wheels to be placed in stations No. 5 and 15 before the first of the year. The larger of the two wheels, which has a rating of 2400 hp, will be placed in the plant at the lower falls. The 1200-hp wheel will be installed in station No. 15 at the middle falls. A new penstock 150 ft. long and 11 ft. in diameter will also be placed at the No. 5 station. Thomas H. Yawger is superintendent.

INKSTER, N. D.—It is stated that an electric lighting system will be installed at Inkster.

BUCYRUS, OHIO.—The Bucyrus Telephone Company has decided to install an automatic telephone service in this city. The system will be installed by the Automatic Electric Company, of Chicago, Ill., and is to be completed by May 1, 1910.

CANAL DOVER, OHIO.—The contract for the construction of the new electric plant and power house, it is reported, has been awarded to Harry B. Saxe. The cost of the plant is estimated at about $35,000.

CROOKSVILLE, OHIO.—Plans are being considered by the Independent Telephone Company to improve and extend its local plant, which will involve an expenditure of about $3,000. J. B. Rhodes is local manager.

FREMONT, OHIO.—The contract for the construction of the new plant of the Fremont Power & Light Company to be erected on the Sandusky River, in Ballville Village, one mile south of Fremont, has been awarded to Robert R. Lysle, of Chicago, Ill. The proposed plant will cost about $600,000 and will have an output of about 2500 hp. In addition to erection of the large power plant the company is interested in one or two railway projects. The dam will be 27 ft. high and about 260 ft. long; the water from the dam will be carried to the power house through a steel pipe 14 ft. in diameter, 3000 ft. long and will give a fall of 42 ft. In addition to the hydro-electric plant a 1000-hp steam plant will be installed, which will be located in a separate building, to be used in emergencies and during low water periods. Walter Putnam, of Chicago, Ill., is associated with Mr. Lysle in construction of the plant.

MANSFIELD, OHIO.—G. A. Bartholomew, president and general manager of the Sandusky, Norwalk & Mansfield Railway Company, and Sherman Culp, of Norwalk, Ohio, are interested in a project to construct an electric railway from Mansfield to Bucyrus, a distance of about 30 miles. It is said that the Sandusky, Norwalk & Mansfield Company will issue $750,000 in bonds, the proceeds to be used to build the new railway. The company also contemplates building an extension from Mansfield to Shelby, 10 miles in length.

OBERLIN, OHIO.—The City Council has granted the local telephone company a franchise to place its wires and cables underground on certain streets in the city.

WATERVILLE, OHIO.—A company has been organized in Waterville for the purpose of furnishing electricity for lamps and motors. As yet no plans have been prepared or machinery purchased. Delmar J. Farnsworth, G. D. Dedrich, C. J. Stickney, H. F. Van Fleet, G. G. Schwin and J. H. Bennett, all of Waterville, are interested in the enterprise.

ARDMORE, OKLA.—It is reported that J. T. Dickerson will make application to the City Council for a franchise to install an electric light system in Ardmore.

BLACKWELL, OKLA.—Bids will be received at the office of the city clerk, Blackwell, Okla., until Sept. 20, for furnishing material and constructing an electric lighting system and extending water works and sewerage systems and for construction of city hall as follows: 1—For furnishing material and labor (except cast-iron pipe, hydrants and valves, electrical machinery, pumping machinery, steam engine) and constructing electric light and water works systems. 2—For furnishing cast-iron pipe and special castings. 3—For furnishing hydrants and valves. 4—For furnishing one 700-gal. per minute vertical volute pump and motor. 5—For furnishing generators, switchboard and transformers. 6—For furnishing one high-speed engine, 75-kw unit. 7—For furnishing one Corliss engine, rated at 150 kw. 8—For furnishing all material and installing one filter in two units of 500,000 gal. each daily capacity. 9—For furnishing all materials and erecting settling basins and filter house. 10—Bidders may also submit bids on filtration system of their own design, subject to engineer's approval. 11—For furnishing and building sewer extensions. 12—For furnishing and building a city hall. All material is to be delivered f. o. b. cars Blackwell, Okla. All of the above material and work to be furnished and done in accordance with the plans and specifications on file at the office of A. Sparks, city clerk, Blackwell, Okla., and at the office of Burns & McDonnell, engineers, 821 Scarritt Building, Kansas City, Mo. Any one desiring extra copies of the plans and specifications may obtain the same by making payment of five dollars to cover the cost of the prints.

CLINTON, OKLA.—The citizens are reported to have voted to issue $40,000 in bonds, the proceeds to be used for purchasing an electric light plant.

ERICK, OKLA.—The citizens, it is reported, have voted to issue $10,000 in bonds, the proceeds to be used to establish an electric light plant.

LONE WOLF, OKLA.—Bonds to the amount of $45,000 have been sold by the city, the proceeds to be used for an electric light plant and water works.

TULSA, OKLA.—The Oklahoma Union Traction Company has commenced work on the construction of its electric railway from Tulsa to Orcutt's Lake, a distance of three miles. The railway will eventually be extended to Sapulpa.

WESTVILLE, OKLA.—The Westville Electric Light & Power Company, recently organized, contemplates the construction of an electric light plant to cost about $8,000. W. T. Tipton is acting secretary.

BAKER CITY, ORE.—The City Council has granted a franchise to the Eagle River Power Company to erect transmission lines for the distribution of electricity in this city.

DAYTON, ORE.—The Yamhill Electric Company has been granted a franchise by the City Council to construct and operate an electric light plant in Dayton.

EUGENE, ORE.—The City Council has awarded the contract for the construction of the transmission line of the city's new power plant on the McKenzie River to J. B. Morris, of Eugene, for $3,642. The transmission line will be about 15 miles in length.

OSWEGO, ORE.—The Oregon Iron & Steel Company, it is reported, is interested in a project to erect a power plant of sufficient output to supply electricity for lamps and motors for public, private and industrial purposes.

PORTLAND, ORE.—The Portland Railway, Light & Power Company contemplates building a branch railway, starting at Milwaukee and extending through Clackamas county, which will be used primarily for transporting officers and men of the Oregon National Guard to the rifle range recently purchased by the State near Clackamas.

SALEM, ORE.—The Portland Railway, Light & Power Company, of Portland, Ore., has been granted a franchise by the Marion County court for the erection of a high-tension transmission line from Mt. Angel to Woodburn. The cost of the line is estimated at about $7,000 and when completed will materially improve the electrical service in Salem as well as in Woodbury, Mt. Angel and other towns in this vicinity. Rollin K. Page is local manager.

HARRISBURG, PA.—The City Council on August 30 rejected the second time the bids submitted by the local electric lighting companies for furnishing electricity for lighting the subways, city department buildings, offices and the Mulberry Street Bridge. Bids were first rejected because the companies submitted bids for furnishing electricity alone, placing the cost of the new lamps and repairs on the city. The second bids were made in such a manner that the cost of the service could not be estimated, and it was decided to readvertise and require bids to be submitted in such form that the cost could be reckoned. The Harrisburg Light, Heat & Power Company offered to furnish electricity on all but the bridge for seven cents per kw-hour, and on the bridge for five and one-half cents per kw-hour. The bid of the Paxtang Company was six and one-half cents per kw-hour on all the buildings but the filter plant, as it has no wires to the Island, and six cents per kw-hour for lighting the bridge.

HOLLIDAYSBURG, PA.—Application has been made to the town officials by the Juniata Electric Light, Heat & Power Company for a franchise to establish an electric light plant in Hollidaysburg.

KUTZTOWN, PA.—It is understood that a petition will be presented to the Town Council asking that a 24-hour service be furnished by the municipal electric light plant.

McCALL FERRY, PA.—A contract has been awarded by J. Edward Aldred, receiver of the McCall Ferry Company, to the Empire Engineering Company, of New York, N. Y., for the construction of the dam and

hydro-electric power station. It is reported that a new company is being formed to purchase the entire property of the McCall Ferry Company at a receiver's sale. The company proposes to transmit electricity to Baltimore and other cities. William Barclay Parsons is president of the Empire Construction Company.

PITTSBURGH, PA.—Sealed proposals will be received at the office of the controller of Allegheny County, Pittsburgh, Pa., until Sept. 21, for the installation and completion of the electric lighting fixtures for the Allegheny County Soldiers' Memorial. Plans and specifications can be seen at the office of the county engineer. Information and blank forms can be secured at the same office. R. J. Cunningham is county controller.

PITTSBURGH, PA.—The Duquesne & Dravosburg Street Railway Company has decided to increase its capital stock from $18,000 to $180,000 and commence work on the construction of its proposed railway at once. The railway will be about three miles in length.

READING, PA.—The Metropolitan Electric Company is reported to have awarded a contract to George S. Charles, of Wilmington, Del., for the installation of 16 Edge Moor boilers rated at 625 hp each in its new power plant at Reading. The cost of the power plant is estimated at $2,000,000.

PEACE DALE, R. I.—Preparations are being made by the Peace Dale Manufacturing Company, of Peace Dale, to equip a portion of its mill for electric drive. Orders have been placed by the company with the Westinghouse Electric & Manufacturing Company, through Lockwood, Green & Company, of Boston, Mass., for a 750-kw, low-pressure, steam turbine, which will be driven by the exhaust steam of the main engine. A generator will be connected with the turbine, which will furnish electricity to operate a large part of the worsted mill, while the dyehouse, wool-scouring mill, combing and drawing departments will be driven by motors placed in the different departments.

ANDERSON, S. C.—The Anderson Water, Light & Power Company contemplates extensive improvements to its power plant located at Portman Shoals, which will increase the output of the plant by 700 hp. The cost of the work is estimated at $20,000. H. A. Orr is president and manager.

HURON, S. D.—Arrangements are being made by the Dakota Central Telephone Company for the erection of a new exchange building. F. H. Ellerbe, of St. Paul, Minn., is architect.

LEXINGTON, TENN.—Plans are being considered for organizing a company to install an electric light plant in Lexington. H. E. Graper, C. G. Gathings, N. R. Barham and others are interested.

FLORENCE, TEX.—The Bartlett-Florence Railway Company has let the contract for the construction of a railway between Bartlett and Florence, 20 miles in length. In the beginning this road will be operated by steam, but later it will be converted into an electric traction line. G. W. Hubbard is president of the company and W. J. McDaniel, first vice-president and general manager.

FORT WORTH, TEX.—A. M. Hyatt, of Kansas City, Mo., is promoting the building of an interurban electric railway between Fort Worth and Cleburne, by way of Dallas. The proposed road will be about 70 miles long. The preliminary surveys were recently completed under the direction of B. G. Leake, chief engineer.

FORT WORTH, TEX.—The Fort Worth, Mineral Wells & Western Railroad Company has been organized with principal offices at Fort Worth, for the purpose of building a railroad between Fort Worth, Texas, and Roswell, N. M., a distance of about 375 miles. Paul Hurley and L. C. Cole, of Fort Worth, are among the incorporators. It is planned by the company to first build the railway between Fort Worth and Mineral Wells, a distance of 60 miles, and to operate that division as an interurban electric line. A number of wealthy Arkansas men are associated with Messrs. Hurley and Cole in the present project.

AMARILLO, TEX.—Preparations are being made for the construction of a telephone line between Amarillo and Wildorado, 21 miles in length. With the completion of the proposed line into Wildorado, it is expected that an extension will be made to Tucumcari, N. M. C. C. Tabor, of Amarillo, and associates are interested in the enterprise.

SAN ANTONIO, TEX.—The contract for the power plant for the Southwestern Insane Asylum at San Antonio has been awarded to the Allis-Chalmers Company, of Milwaukee, Wis., by Charles B. White, state purchasing agent. The plant is to be installed at once and the equipment will include boilers, engines and electrical machinery.

UVALDE, TEX.—The Uvalde Street Railway Company is preparing to build an extension of its railway from Uvalde to Batesville, a distance of 20 miles. This company now operates a four-mile line at Uvalde. Gasoline motor cars are used instead of electric traction. The route of the proposed extension is down the valley of the Leona River, through a section that is being settled rapidly by farmers.

SALT LAKE CITY, UTAH.—Plans have been completed by the Salt Lake & Ogden Railway Company for the construction of a new power plant, to be located at Farmington, which will supply electricity to operate the trains between Salt Lake City and Ogden. The power plant now under construction at Lagoon is expected to be ready for operation by Nov. 1. H. A. Strauss is consulting engineer.

MONTPELIER, VT.—The Corry-Deavitt Frost Company has placed a contract with D. W. Cooley, of Waterbury, Vt., for the construction of another dam about 2000 ft. from the present plant at Kinney's Mills, in East Montpelier. The dam will be 150 ft. long x 12½ ft. high, and will cost about $30,000. With a fall of 30 ft. it will develop about 1000 hp, which will nearly double the output of the present plant. The company now furnishes electrical energy for operating the cars of the Barre & Montpelier Traction & Power Company between Barre and Montpelier. When the dam is completed the company will erect a transmission line to the Barre quarries, having closed a contract to furnish electricity for a term of five years for the Wetmore & Morse quarries at Graniteville.

BUENA VISTA, VA.—The Buena Vista Light & Power Company is making improvements to its plant, including the installation of new machinery for the purpose of extending its service.

FREDERICKSBURG, VA.—Preparations are being made by the Fredericksburg Power Company for the construction of a new power house in this city. The new dam has been completed and is in use, the old dam having been abandoned. It is expected that the electric railway will be extended from Ashland to this city and Washington as soon as the power plant is completed.

LURAY, VA.—The Shenandoah River Light & Power Company has awarded the contract for constructing a large concrete dam to replace the present wooden structure across the Shenandoah River, one mile below Luray, to Lane Bros.

COSMOPOLIS, WASH.—Application has been made by the Grays Harbor Railway & Light Company for a franchise to furnish electricity in Cosmopolis.

INDEX, WASH.—Work has commenced on the construction of the proposed power plant to be erected by J. A. Soderburg, owner of the Index granite works, at Sunset Falls, two miles south of Index. The plant will furnish electricity for the granite works, and also for lamps and motors in Index and neighboring towns.

SPOKANE, WASH.—The Spokane, Walla Walla & Western Railway Company is reported to have completed surveys for its proposed power plant. It is stated that the company has secured a site where 4500 hp can be developed which will be sufficient to operate its proposed railway. L. C. Goodwin is engineer.

MADISON, WIS.—Plans are being considered for the construction of a new interurban railway along the Wisconsin River to be known as the Chicago & Wisconsin Valley Railway, to connect Madison and Wausau, via Portage, Lodi, Stevens Point and Grand Rapids. Work will soon commence on the survey of the route. Madison capitalists are interested in the project.

MENOMONEE FALLS, WIS.—The Milwaukee Electric Railway & Light Company has applied to the Board of Trustees for a franchise to extend its electric railway through Menomonee Falls. The company proposes to build an extension from Milwaukee to Beaver Falls.

MILWAUKEE, WIS.—In an estimate submitted to the Council joint committee on street lights and health by S. A. Greeley, Milwaukee representative of Hering & Fuller, of New York, N. Y., consulting engineers for the city, the cost to build an annex to the garbage crematory at the foot of Erie street to utilize the steam power created by the incineration of the city refuse to generate electricity is estimated at $60,000, exclusive of the distributing system. It is stated that the new incineraor will provide sufficient power to generate 500 kw of electricity daily. It has not been decided whether to utilize the energy for street lighting and commercial purposes or to transmit it across the river to operate the sewage pumping station. The estimated cost of the equipment is as follows: For three generators, $26,250; boilers, $15,250; building, $8,500, and coal handling and storage apparatus about $2,000. If the plant is used for street lighting exclusively, storage batteries would have to be used.

PESHTIGO, WIS.—It is reported that work will soon begin on the construction of the power house at High Falls for the Hydro-Electric Company, the contract for which has been awarded to the Bates & Rogers Construction Company, of Chicago, Ill. The penstock will be erected by the Lyons Boiler Company, of De Pere, Wis.

WASHBURN, WIS.—The city is reported to have awarded a contract to the Ashland Power Company, of Ashland, Wis., to furnish electricity in Washburn. A transmission line will be erected from the power plant on the White River to Ashland.

KINGSTON, ONT., CAN.—Robert A. Ross, of Ross & Holgate, consulting engineers, of Montreal, has been appointed by the city to inquire into the cost of power supplied by the Kingston Street Railway Company to the city.

LONDON, ONT., CAN.—The Board of Aldermen has instructed E. I. Sefton, electrical engineer, to prepare plans for an underground system for the transmission lines of the Hydro-Electric Commission power system and to procure estimates of the cost of the same. The cost of the underground system is estimated at approximately $70,000.

PORT ARTHUR, ONT., CAN.—The City Council is considering the formation of a company to work in conjunction with the municipal street railway system and build electric lines through the townships of Oliver and Shuniah. For further information address J. J. Carrick.

PRINCE ALBERT, SASK, CAN.—C. E. Mitchell, C. E., Toronto, Ont., retained by the City Council to report on the available water power to the north of Prince Albert, estimates there is 10,000 hp in close vicinity to the city and easy of development. It is probable the City Council will at once make arrangements to utilize this power to generate electricity.

RENFREW, ONT., CAN.—John B. McRae, consulting engineer, has been engaged by town officials to report on the advisability of installing a municipal hydro-electric power plant.

WATERLOO, ONT., CAN.—The Board of Trade is discussing the establishment of an independent telephone system.

WINNIPEG, MAN., CAN.—The tender of the Westinghouse Company for 50 arc lamps with cut-offs, for $1,637, has been recommended to the City Council for acceptance.

WINNIPEG, MAN., CAN.—The City Council has voted to accept the recommendation of the Board of Consulting Engineers for awarding the contracts for equipment of the power pant at Point du Bois, as follows: Sections 5 and 6, turbines, to Jens, Orten, Baving & Company, of London, Eng., for $97,150, including erection; sections 7 and 8, generators and exciters, to Vickers, Sons & Maxim, Ltd., Sheffield, Eng., for $93,080, including erection; sections 10, 11, 13, transformers, switching and protective apparatus, to the Canadian Westinghouse Company, of Hamilton, Ont., for $150,800, including spare parts; section 12, light, heat and power system generating station, to the General Electric Company, of Toronto, Ont., Can., for $11,600; section 25, traveling cranes, to the Canadian Fairbanks Company, Winnipeg, Man. (Niles-Bement-Pond Company), for $14,900, including erection; auxiliary apparatus to the Canada Foundry Company, of Toronto, Can., for $27,520, and the Canadian Fairbanks Company, of Winnipeg, Man., for $6,901. Prof. L. A. Herdt, William Kennedy, Jr., and Col. H. N. Ruttan are members of the board of consulting engineers.

GUADALAJARA, MEX.—The Chapala Hydro-Electric & Irrigation Company has made arrangements wtih the Caja de Prestamos, of Mexico City, for a loan of $2,200,000. The proceeds will be used as needed in connection with the construction of the new power plant at Puente Grande, on the Santiago River, the erection of transmission line to the Etzatlan and Hostotipaquillo mining districts, and for pumping plants and irrigation canals. The company recently entered into a contract with the Department of Fomento for a loan of $3,000,000, the proceeds of which will be used for building the proposed dike across a portion of Lake Chapala from La Palma to Jamay. Work has already commenced on the erection of the iron towers which will carry the transmission lines to the mining districts of Etzatlan and Hostotipaquillo. It is stated that electricity will be furnished in the former district by the first of the year and the last named by March, 1910. Electrical energy will be furnished from the company's plant near Las Juntas, near this city, pending the completion of the Puente Grande power plant. The new company has formally taken possession of the street railways, light and power systems in Guadalajara. At a recent meeting held in Mexico City the local company was consolidated with the Chapala Hydro-Electric & Irrigation Company.

MONTEREY, MEX.—Plans are being prepared by the Mines of Mexico Company, of Denver, Colo., for extensive improvements for its mines in the Alamos district, which include the erection of a large hydro-electric plant on the Mayo River for furnishing its mines in the State of Sonora with electricity for both mining and milling purposes. The company some time ago obtained a concession from the Mexican Government for water rights on the Mayo River. Surveys have just been completed of 135 miles of the river and three different sites have been located suitable for building dams. The company owns mines in western Chihuahua and it is expected that electricity will be transmitted to its mines in that section.

New Industrial Companies.

THE AUTOMATIC ELECTRIC IGNITER COMPANY, of New York, N. Y., has been incorporated with a capital stock of $40,000 to manufacture gas and electric fixtures, by Nicolo Candelora, Eugene De Feo and Vincenzo Blasio, all of New York, N. Y.

THE BRANDER SUPPLY COMPANY, of Pelham Manor, N. Y., has been incorporated with a capital stock of $5,000 by Thomas W. Brander, John A. Brander and Charles H. Talbott, Jr., all of New York, N. Y., for the purpose of dealing in railway supplies.

THE COOPER-SNELL COMPANY, of Little Falls, has been chartered with a capital stock of $5,000 by Roswell Cooper, of Little Falls, N. Y.; Lewis J. Snell, of Dolgeville, N. Y., and Frank H. Shall, of Little Falls, N. Y. The company proposes to do a general engineering, construction and contracting business.

THE DIAMOND ELECTRIC COMPANY, of Binghamton, N. Y., has been chartered with a capital stock of $100,000, by S. J. Hirschmann, J. Schwab and H. C. Price, all of Binghamton, N. Y. The company proposes to manufacture electric devices and appliances.

THE ELECTRIC TRACTION CONSTRUCTION COMPANY, of Kansas City, Mo., has been incorporated with a capital stock of $100,000, by John J. Freunlich, Frank Avery, N. C. Vannatte and others. The company proposes to do traction construction work.

THE INDIANA AUTO PARTS COMPANY, of Marion, Ind., has incorporated with a capital stock of $75,000, to build and operate a plant to manufacture automobile parts, supplies and electric equipment. G. R. Stewart, Richard Rudell and J. D. Kennedy are incorporators.

THE JOHNSON-BONE SWITCH THROW COMPANY, of Decatur, Ill., has been chartered with a capital stock of $40,000 for the purpose of manufacturing railway appliances. The incorporators are: A. R. Scott, Max H. Hurd and J. L. Bones.

THE MEXICO STEEL & CHEMICAL COMPANY, of Mexico City, Mex., has been organized with a capital stock of $1,000,000. It is said that the company proposes to manufacture a high-grade steel by an electrical process, and also to make calcium carbide. F. S. Pearson, vice-president of the Mexico Light & Power Company, Mexico City, is interested in the enterprise. R. C. Brown will have charge of the new company.

Company Elections.

BRIDGETON, N. J.—At the annual meeting of the Bridgeton & Millville Traction Company and the Bridgeton Electric Company, held Sept. 2, J. J. Sullivan, of Philadelphia, Pa., was re-elected president of both companies, H. J. Crowley vice-president, and C. L. S. Tingley secretary and treasurer, both of Philadelphia, Pa.

JAMESTOWN, N. Y.—At the annual meeting of the Jamestown Lighting & Power Company the following named officers were elected: Harry F. Sheldon, president; John T. Wilson, vice-president, and Albert S. Price, secretary and treasurer.

New Incorporations.

LOS ANGELES, CAL.—The Long Beach Electrical Manufacturing Company has been incorporated with a capital stock of $20,000 by T. J. Corbrey, W. H. Tidmarsh, S. F. Estell, J and C. Gleason.

SAN FRANCISCO, CAL.—The Sierra Pacific Electric Company, capitalized at $5,000, has been incorporated by C. F. Eells, Hugh Goodfellow and J. Eells.

DENVER, COL.—Articles of incorporation have been filed with the Secretary of State for the Inland Empire Irrigation & Power Company. The company is capitalized at $1,000,000 and proposes to furnish water and power in the states of Colorado, California, Utah, Nevada and Arizona. Elmer Bisbee, W. H. Dixon and Charles N. Miller are directors.

DECKER, IND.—The White River Valley Telephone Company has been chartered by James F. Breithaupt, Daniel Lane and Richard Ready. The company is capitalized at $10,000 and proposes to operate a telephone system in Decker.

PERU, IND.—The Peru Gas & Light Company has been incorporated with a capital stock of $60,000 to establish, equip and operate plants to furnish light, heat and power to the City of Peru and adjacent towns and villages by means of natural and artificial gas, electricity, steam and hot water. George M. Dolby, Oscar Ridenour and Otto Sample are directors.

CORNETTSVILLE, KY.—The Cornettsville Telephone Company has been organized with a capital stock of $1,000 to construct an independent telephone system in Cornettsville. It will also construct telephone lines to Hyden, a distance of 39 miles, and from Cornettsville to Tillie and Gourd, 25 miles in length. William Cornett is manager of the company.

HAZELDEAN, ONT., CAN.—The Hazeldean Rural Telephone Company has been incorporated with a capital stock of $30,000 and the following named directors: W. T. Shirriff, J. J. Hodgins, R. H. Grant, R. H. Steacy, H. G. Allen, T. A. Bradley, A. Bradley and W. W. Mann.

Legal.

APPLICATION FOR RECEIVER FOR THE DESCHUTES IRRIGATION & POWER COMPANY.—Application has been made for the Deschutes Irrigation & Power Company, of Bend, Ore., in a suit filed in the United States court in Portland, Ore., by John G. Deshler, of Columbus, Ohio. Conspiracy, mismanagement and breach of trust is charged against the directors of the company, which is alleged to be in arrears for the last three interest payments on a bonded indebtedness of $359,000. With the exception of $20,000 the entire bond issue is owned by capitalists, of Columbus, Ohio. The company has a contract to reclaim about 250,000 acres in Eastern Oregon of which about one-fourth has been placed under irrigation up to the present time.

Personal.

MR. JOHN B. McRAE has been engaged as consulting engineer by the town of Renfrew, Ont., to report on the advisability of installing a municipal hydro-electric plant.

MR. JULIUS BERNSTEIN, formerly with the Leeds & Northrup Company, has joined the department of electrical measuring instruments of Queen & Co., Philadelphia.

MR. C. E. MITCHELL, C. E., of Toronto, Canada, has made a report to the city of Prince Albert, Saskatchewan, on the water-power available in the neighborhood. He found that 10,000 hp can be easily developed.

MR. LOUIS COHEN has resigned from the staff of the Bureau of Standards, Washington, D. C., to accept a position with the National Electric Signalling Company as mathematician and experimental engineer.

MR. JAMES WOLFF, sales agent for the New York Insulated Wire Company in Chicago, has been appointed Chicago manager for the American Circular Loom Company, of Boston. Mr. Wolff will manage both agencies.

PROF. L. A. HERDT, of McGill University, and Mr. W. A. Lamb, of the Canadian General Electric Company, have been appointed a board to examine candidates for the position of electrical inspector of the Canadian Inland Revenue Department.

MR. R. F. HAYWARD, formerly general manager of the Mexican Light & Power Company, with headquarters at Montreal, Canada, has been appointed general manager of the Western Power Company, with headquarters at Slave Lake, B. C.

MR. SAMUEL INSULL, president of the Commonwealth Edison Company, of Chicago, sailed for England on the steamship *Cedric* on Sept. 4. He accompanied his father, mother and sister on their return to London after a visit to this country. It is expected that Mr. Insull will be back in his office in Chicago about Oct. 1.

MR. J. C. HENDERSON, who has been for the past two and one-half years Indianapolis representative for the Westinghouse Electric & Manufacturing Company, will sever his connection with that office on Sept. 15 to accept a position as Eastern sales manager for the Waverley Company, Indianapolis, Ind. Mr. Henderson expects to make his headquarters in New York City.

MESSRS. SMITH, KERRY & CHACE, engineers, whose main office is in Toronto, have just opened a branch office at Vancouver, B. C., for carrying on British Columbia and Pacific Coast work, with Mr. H. J. Haffner (McGill, 1904), in charge. Mr. Haffner is experienced in railway, municipal and irrigation engineering. It is proposed to do general business, including in particular hydro-electric development.

MR. RODMAN GILDER, secretary of the Crocker-Wheeler Company, was one of the wounded during the recent "war" in Eastern Massachusetts, receiving a severe kick from his horse while on active duty. He is now at the country home of his father, Richard Watson Gilder, at Tyringham in the Berkshires, studying the more gentle arts of peace and convalescence. While no bones were broken, the doctors have insisted on a period of quiet and rest.

PROF. GEORGE C. SHAAD, who for the past three years has been connected with the electrical engineering department of the Massachusetts Institute of Technology, has resigned his position as associate professor there to become head of the department of electrical enginering at the University of Kansas. Prof. Shaad is a graduate of the Pennsylvania State College. For several years he was a member of the electrical engineering department of the University of Wisconsin.

MR. JOHN F. TINSLEY, for the past three years assistant to the manager of the American Steel & Wire Company's plants at Worcester, Mass., and New Haven, Conn., has been promoted to be superintendent of the electrical cable works of that company. Mr. Tinsley is a graduate of the electrical engineering department of Rutgers, 1900, and has previously been connected with the Western Electric Company and the electrical engineering staff of the Signal Corps, United States Army.

MR. EDWARD D. ADAMS has received from the Emperor of Germany the decoration of the Prussian Crown order. Mr. Adams is well-known in electrical circles from his reorganization of the Allis-Chalmers Company, and the leading part he has taken in the electrical development of Niagara power, having been one of the founders of the Niagara Power Company. In financial circles he has been a prominent figure for the past 25 years, particularly in connection with the reorganization of railroads, the last including the West Shore in 1886, the Central Railroad of New Jersey in 1887 and the Northern Pacific in 1896. Mr. Adams is one of the chief patrons of the Metropolitan Museum of Art, to which he has made valuable donations.

MR. W. M. ARNOT, who for the past five years has been connected with the Siemens Brothers Dynamo Works in London, having charge of their foreign department, has been appointed manager of the whole Siemens interests in Australia, and recently sailed to Sydney, where their office is situated. Mr. Arnot, previous to coming to London, represented for many years the interests of the Allgemeine Elektricitats-Gesellschaft in Australia, and was for two years connected with the same company at their Johannesburg office. He is therefore returning to the country where he has spent the better portion of his life, and is well acquainted with the whole of the electrical field in Australia, Sydney having been his home for many years in the past.

Trade Publications.

TRANSFORMERS.—Stationary transformers, rated at from 0.5 to 50-kw, are outlined in a folder of the Vindex Electric Company, Aurora, Ill.

WEATHERPROOF SIDING.—The H. W. Johns-Manville Company, 100 William Street, New York, has issued a mailing folder dealing with asbestoside, a material which has been designed to take the place of clapboards, shingles and metal sidings on factories and buildings of this nature.

STEAM TURBINES.—The British Thomson-Houston Company, Rugby, Eng., is distributing neatly printed bulletins devoted to exhaust and mixed pressure turbines of the Curtis type. It is stated that turbines of this type have been built for a total rating of more than one million kilowatts without a single instance of buckets being stripped.

FEED WATER HEATERS.—The three-colored catalog of the Harrison Safety Boiler Works, 3159 North Seventeenth Street, Philadelphia, Pa., serves to present in a striking manner the advantageous features of the Cochrane steam stack and cut-out valve heater and receiver, and describes its application in connection with commercial systems of exhaust steam heating.

TRUMP TURBINES.—The Trump Manufacturing Company, Springfield, Ohio, has issued a catalogue describing its line of high and low-head water turbines, in which a number of important improvements have recently been introduced. A number of installations are interesting and much information given of interest to engineers and owners of water powers.

RECORDING THERMOMETERS.—Bulletin No. 111 of the Bristol Company, Waterbury, Conn., has for subject Bristol's Class II. recording thermometers as especially adapted for feed-water temperature and similar applications. Of particular interest are three record charts giving records of actual feed-water temperatures on pages 5, 6 and 7, and showing very strikingly that far greater uniformity of operation was secured after the Bristol feed-water recording thermometer was installed.

Business Notes.

THE PHILADELPHIA STORAGE BATTERY COMPANY has removed its offices to its new factory, Ontario and C streets, Philadelphia, Pa.

THE GARWOOD ELECTRIC COMPANY reports taking a number of orders recently, among others, for a slow-speed engine type 150-kw generator, 17 motors of various sizes for ventilating work, and a 25-kw engine-type generator for export.

ROTH BROS. & COMPANY.—By the recent renumbering of the greater part of the streets of Chicago the address of the office and factory of Roth Bros. & Company has been changed from 461 to 1400 West Adams Street, Chicago. At this location the firm has a modern motor shop, light, clean and airy, fitted with electric drive, where it manufactures its electrical machinery.

THE CENTURY ELECTRIC COMPANY has opened a New York office, Room 315, Hudson Terminal, 30 Church Street, New York, in charge of Mr. H. B. Steele, district sales manager, in order that it may be in a better position to care for the rapidly increasing demand for Century single-phase, self-starting motors. The line embraces sizes from ¼ hp to 30 hp for any commercial voltage and any frequency between 25 and 140 cycles. Mr. Steele is a graduate of Pratt Institute, and is well known to the New York trade, having been for several years connected with the New York office of the Robbins & Myers Company.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED SEPT. 7, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector Street, N. Y. City.]

933,019 CONTROL SYSTEM FOR ELECTRICAL HOISTS; J. H. Hall and J. F. Schnabel, New York, N. Y. App. filed May 3, 1909. For securing a smooth and even lowering of the load, the speed of lowering being under the control of the operator by means of a magnetic brake. (Reissue.)

933,084. TROLLEY; J. Ledwinka, Philadelphia, Pa. App. filed Nov. 11, 1905. Trackless trolley with improved flexible connection between the vehicle and the trolley utilizing two trolley wires and cross arm, with wheels arranged tandem on each wire.

933,094. ART OF TREATING GASES ELECTRICALLY; I. Moscicki, Gambach, Switzerland. App. filed Aug. 6, 1907. For electrolytically producing oxides of nitrogen by a furnace having an electrodo extending across the furnace chamber and perforated for the exit of the treated gases.

933,133. PROCESS OF TREATING ZINC ORES; F. T. Snyder, Oak Park, Ill. App. filed June 23, 1905. For treating zinc lead ores by smelting with carbon and then heating in a closed electric furnace from which air and gases are excluded.

933,137. ELECTRIC FLASHER; D. D. Swem, Chicago, Ill. App. filed June 27, 1908. A knife switch is operated by a blade and lever by means of a camshaft driven by a motor, and means are provided for varying the rates of speed.

933,144. PORTABLE DRILL DRIVER; T. S. Watson, Milwaukee, Wis. App. filed Sept. 1, 1906. The tool chuck is aligned with the motor shaft and a thrust bearing receives the resistance of the chuck and drill.

933,157. ELECTRIC CONTROLLER; T. V. Buckwalter, Altoona, Pa. App. filed Jan. 20, 1909. An electric controller has a reciprocating part of insulating material with which carbons engage and a rack and spring are connected to the reciprocating and fixed parts to operate the controller.

933,169. ELECTRIC TRANSFORMER FURNACE; O. Frick, Saltsjobaden, Sweden. App. filed March 20, 1908. Leakage fields around the primary coil as well as around the secondary formed by the melting bath are suppressed by placing around the field core a short-circuited conductor having two coils placed at a distance from each other and wound in opposite directions.

933,195. ELECTROLIER; J. McGavin, Springfield, Ill. App. filed Sept. 9, 1908. An adjustable light which when pulled down may be used as a drop light and when raised may form one of the groups of the lights of the electrolier.

933,197. SIGNAL SYSTEM; J. G. Nolen, Chicago, Ill. App. filed May 4, 1903. For a fire or burglar alarm system in which a main circuit runs from the central office to the area to be supervised; a supervisory shunt is arranged in said area and signalling make and break devices are provided in each of the main and shunt circuits, together with means controlled by the conditions of the shunt for actuating the make and break devices.

933,238. TROLLEY POLE, S. Speer, Pittsburgh, Pa. App. filed March 29, 1909. A trolley pole made in sections, the upper section telescoping into the lower section, and a parallelogram is used in connection with the pole to support and guide the wheel.

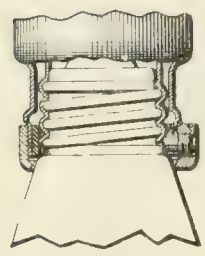
933,251. SYSTEM OF DISTRIBUTION, H. L. Van Valkenburg, Norwood, Ohio. App. filed June 22, 1908. Makes use of a plurality of mains, a translating device, leads therefor, a transfer switch for connecting the leads to any set of the mains and an electro-magnetically operated oil switch for completing the circuit of the translating device with an interlock between the switches.

933,285. DANGER ZONE SIGNAL FOR TURRETS, F. W. Wood, Newport News, Va. App. filed June 8, 1908. For use with the gun turrets of battle ships in which a signal automatically notifies the gunners in any turret when their guns are turned so as to endanger any other turret.

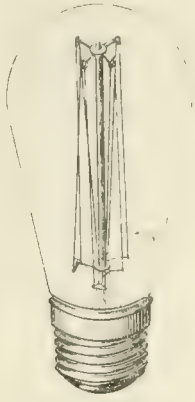
933,299. DYNAMO-ELECTRIC MACHINE, A. H. Wouters, Norwood, Ohio. App. filed Nov. 3, 1906. Turbo-generator in which all parts of the armature projecting beyond the core are held against centrifugal action by means of a ring having a shoulder.

933,316. DYNAMO MACHINE CONSTRUCTION, B. A. Behrend, Norwood, Ohio. App. filed May 17, 1906. For high-speed turbo-generators, cooled by air in which the oil for the bearings is prevented from being drawn into the rotor by the air current by a special construction of oil guard.

933,246. IGNITION DEVICE FOR GAS ENGINES; A. F. Gifford, J. J. Burns and B. S. T. Bishop, Worcester, Mass. App. filed Nov. 6, 1908. Combines a bracket with the dash of the vehicle and a spark receptacle connected to the bracket, the parts being arranged to be accessible by moving them bodily rearwardly from the dash



933,296.—Locking Device for Incandescent Electric Lamp Bulbs.



933,539. — Incandescent Electric Lamp.

933,263. OSCILLATION DEVICE; G. W. Pickard, Amesbury, Mass. App. filed March 25, 1909. A rectifying oscillation detector mounted in a holder consisting of a metallic cup. The detector consists of iron pyrite and a leaf spring is arranged to present its broad side to the surface of the pyrite.

938,267. DYNAMO-ELECTRIC MACHINE; W. I. Richards, Norwood, Ohio. App. filed Jan. 31, 1907. A field magnet having a pole piece with a pair of concentric shunt coils adjacent to the armature end of the pole and a superposed series coil with T-shaped spacing members, channel shaped in cross section.

933,296. LOCKING DEVICE FOR INCANDESCENT ELECTRIC LAMP BULBS; Levi Davis, Alton, Ill. App. filed March 15, 1909. For preventing the theft of lamp bulbs by locking them to their sockets by means of a ring.

933,369. ELECTRIC ALARM SIGNAL; H. J. Hover, Chicago, Ill. App. filed July 18, 1908. An alarm bell sounded at a railroad crossing. The improvement is in the bell mechanism.

933,412. ELECTRIC CALL AND ALARM SYSTEM; O. O. Barker, Allegheny, Pa. App. filed March 23, 1907. For telephone switchboards for hotels to sound an alarm in any room at a predetermined time. Controlled by a clock.

933,450. ELECTRIC IGNITER FOR GAS STOVES; R. Hofmeister, St. Louis, Mo. App. filed Feb. 9, 1909. The igniter comprises a pair of electrodes with contacts which are connected to a source of electrical energy and normally separated from the contacts, and means for moving the electrodes into engagement with the contacts that are connected to the source of electrical energy.

933,456. PROCESS FOR WELDING AND BONDING RAILS AND OTHER METAL PIECES; C. F. Jacobs, Chicago, Ill. App. filed June 28, 1907. Process of uniting metal rails by heating them by a flux passing a current through them and the flux, the resistance of the flux generating the heat.

933,457. PROCESS FOR UNITING RAILS AND OTHER METAL PIECES; C. F. Jacobs, Chicago, Ill. App. filed Oct. 11, 1907. Process of uniting rails by supporting a splice bar at a distance from the base of the rails, applying a molten flux and metal between the splice bar and the rails, then passing an electric current therethrough to heat the parts.

933,458. PROCESS FOR BONDING RAILS, C. F. Jacobs, Chicago, Ill. App. filed May 28, 1908. For electrically uniting rails by means of bonds by holding a quantity of flux in contact with the rails, heating the parts by means of the flux and an electric current, introducing a bond into the flux, passing an electric current therethrough so as to heat the same, and then forcing the parts together.

933,459. PROCESS FOR UNITING METAL PIECES, C. F. Jacobs, Chicago, Ill. App. filed May 28, 1908. For electrically uniting rails by placing two parts together, putting molten flux between the spaced apart portions, passing an electric current through and forcing the pieces into intimate contact.

933,480. ELECTRIC SWITCH; Henry E. Reeve, New York, N. Y. App. filed May 12, 1908. An electric switch for lamps having a spring contact arm with a tongue, a spring catch with a portion entering said tongue to support the arm and a cam for operating the parts.

933,499. HEAD GEAR FOR SUPPORTING LIGHTS; D. E. Taylor, Willimantic, Conn. App. filed Oct. 30, 1908. For holding a headlight when used by surgeons by means of a spring metal band extending over the head from front to back with means for adjusting the position of the light.

933,[illegible] TROLLEY BASE, F. Volk, Pittsburg, Pa. App. filed Nov. 3, 1908. An anti-frictionless spring connection for trolley poles employing roller bearings which engage a movable spring housing.

933,506. ELEVATOR; B. M. Walpole, Providence, R. I. App. filed Feb. 2, 1909. A duplex system of motors for operating electric elevators which motors rotate in opposite directions and are connected through a system of differential gearing to a driving drum to which the rope is connected.

933,525. PRIMARY BATTERY; W. M. Brodie, East Orange, N. J. App. filed April 7, 1909. For primary batteries in which two elements are used in an exciting fluid, to avoid injury by shock as when jarred on automobiles. The cell comprises a sheet metal body section and a resilient metal support welded to the bottom.

933,529. INCANDESCENT ELECTRIC LAMP; Herman J. Jaeger, New York, N. Y. App. filed Aug. 24, 1908. For lamps containing a long metallic filament which may be burned horizontally in which flat mica supports are provided so that the free ends of loops may be cemented thereto.

933,557. ELECTRICAL SIGNALING APPARATUS; Owen L. Harrison, Coleta, Ill. App. filed April 2, 1908. For operating harmonic call bells by means of a rotary pole chamber supplying current of different frequencies to a number of lines.

933,577. TEMPERATURE CONTROLLING DEVICE; W. B. D. Pennimaker, Baltimore, Md. App. filed Nov. 20, 1905. Makes use of a main conduit, conveying the refrigerating medium, such as brine, with a second conduit leading into it and carrying a medium of higher temperature; a third conduit also leading into it and carrying a medium of lower temperature with valves controlling the second and third conduits and a motor controlled by a thermostat for operating the valves.

933,507. APPARATUS FOR TESTING RAIL BONDS; C. R. Sturdevant, Worcester, Mass. App. filed March 31, 1909. To test the conductivity of a railbond by means of a differentially wound measuring instrument combined with a bar having a contact point adapted to engage the flat rail, another bar with contact point and a measuring tape for giving the distance between the two contacts.

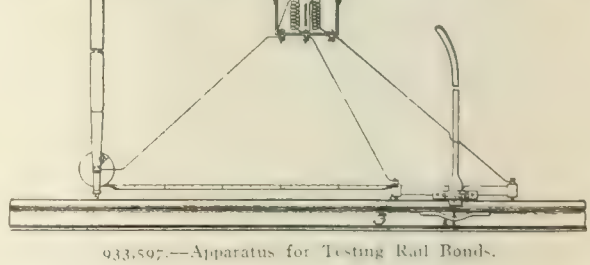
933,622. ELECTRICAL COOKING APPARATUS; T. M. Caven, Kansas City, Mo. App. filed Sept. 24, 1907. For toasting or broiling, in which the heating units are removably held by means of spring clips.

933,644. WEATHERPROOF SOCKET FOR ELECTRIC LAMPS; Gilbert W. Goodridge, Bridgeport, Conn. App. filed June 1, 1908. Includes an insulating body with lamp holding terminals, terminal plates having binding screws, and enclosing a supporting cap for the back, electrical connections and an insulating compound, filling the space in the back of the lamp socket.

933,661. WALL CABINET FOR ELECTRICAL APPARATUS; H. T. Paiste, Philadelphia, Pa. App. filed March 24, 1908. For containing switches and the like, the cabinet being made up of end units and intermediate units, each unit consisting of a fixed and a removable section confining a bushing between them, the removable section having a keyhole slot and the stationary section having a screw entering the slot.

933,662. TRAIN DISPATCHER'S SIGNALING AND CONTROLLING SYSTEM; G. E. Patrick, Salem, Va. App. filed May 22, 1908. The dispatcher has entire control of the road by means of a board that includes a miniature railroad and tell-tale trains thereon, equipped with propelling devices automatically operated by the train or trains on a main road.

933,697. ELECTROLYTIC CONDENSER COMBINED WITH AUTO TRANSFORMER, F. E. F. Creighton, Schenectady, N. Y. App. filed July 13, 1907. An aluminum electrolytic condenser with which a transformer winding is used. A plurality of aluminum condenser cells are connected, each in shunt with a portion of the winding



933,597.—Apparatus for Testing Rail Bonds.

933,[illegible] MOTOR ATTACHMENT FOR SEWING MACHINES AND THE LIKE; C. E. Johnson, Los Angeles, Cal. App. filed April 10, 1909. The circuit for the electric motor is operated by the treadle and the speed of the machine will be varied by varying the pressure on the treadle.

933,716. SWITCHBOARD; R. C. Livingston, Spring Valley, Minn. App. filed Nov. 2, 1908. For telephone systems in which two parties on a line may converse without being interfered with by other parties. Uses a switching mechanism which ordinarily does not interfere with the transmission of signals, but when calling the switch transmits the call without passing through central.

933,[illegible] PROCESS OF TREATING ORES; A. A. Lockwood and M. R. A. Samuel, London, Eng. App. filed Jan. 11, 1909. For treating ores by mixing it with particles of a magnetic material becoming liquid so that the magnetic substance adheres to some constituent part of the ore in preference to the others, thus permitting magnetic separation of the mixture.

933,722. COMPOSITION MATTER AND METHOD OF MAKING THE SAME; William A. Phillips, St. Louis, Mo. App. filed Feb. 20, 1906. For electric conductors in rheostats, consisting of a combination of asbestos and iron fused together.

933,723. COMPOSITION OF MATTER AND THE METHOD OF MAKING THE SAME; William A. Phillips, St. Louis, Mo. App. filed Feb. 18, 1907. For electric conductors for rheostats, comprising a composition of a metallic electric conductor and carbonate of lime fused together.

933,726. TELEGRAPH KEY; F. W. Smith and DeWitt C. Conkling, New York, N. Y. App. filed June 6, 1908. Makes use of separate keys for sending dots and dashes and varies the periodicity of the interruptions of the circuit.

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Convention of Illuminating Engineering Society.

The annual meeting in New York next week of the Illuminating Engineering Society promises to score a success that will even overtop the high record set by the Philadelphia convention of last year. While the Hudson-Fulton celebration is not a negligible factor in the anticipations of large attendance, the program of papers, which is printed elsewhere, fixes in advance the high character of the meeting. The reports to be presented of the several committees dealing with nomenclature and notation, unit of light and photometric units are looked forward to with much interest. The young society scored a distinct triumph through the recent adoption by this country, France and Great Britain of a common unit of candle-power, which was the result of a movement initiated by it. There remains, however, a great field of work in setting in order the nomenclature and notation of illuminating engineering, and in placing on a satisfactory basis both the scientific and practical sides of photometry. Among the papers to be presented, at least four promise to be contributions of high interest to their several subjects, namely, the light of the firefly, by Drs. Ives and Coblentz; shades and reflectors, by Dr. Bell; heterchromatic photometry, by Mr. Preston S. Millar, and factory lighting, by Messrs. Marks and Woodwell. The lecture by Dr. Steinmetz on the physiological aspect of illumination will round out a program of exceptional interest and merit.

A Hydroelectric Plant at Low Head.

The Kilbourn (Wis.) transmission plant, described elsewhere in our columns, is chiefly notable as a successful attempt to deal with a relatively low head in a necessarily variable stream. As rivers go, the Wisconsin is fairly steady, but it suffers from floods to an extent that has made it necessary to resort to considerable reduction of head. The normal head is 17 ft., and the desirability of using large generator units—in this instance 1500 kw—compelled the employment of a multiplicity of wheels—six, in fact—on each of the horizontal generator shafts, each giving about 450 hp at the full head, or about 270 hp at the reduced head of 12 ft. which may now and then be encountered. This arrangement implies a rather elaborate hydraulic plant, but the multiplicity of wheels was required to get even the required 100 r.p.m. of the driving shaft. A somewhat unusual feature is the construction of the penstock from reinforced concrete, forming vaulted structures in which the runners are submerged. Above each pair of runners is a sort of umbrella, a curved steel roof so shaped as to give steady admission of water to the wheels without the formation of vortices and the entraining of air thereby. By this device the horizontal turbines can be set higher, so that the power-house design is simplified. Extra powerful governors are applied to control the turbines, so that even at this low head good regulation is attainable. In this particular the extremely free delivery of water to the wheels goes to compensate for the masses to be handled.

The concrete dam has a movable crest consisting of vertical steel sliding gates operating between concrete piers rising above the normal crest of the dam. There are 12 of these gates operated from a long motor-driven shaft by independent clutches. The power house itself, aside from its turbine equipment, is of rather canonical design with its four 1500-kw three-phasers and pair of water-wheel driven exciters. The transmission line proper is 70 miles long, joining, however, another 50-mile line into Milwaukee. It is at present worked at 44,000 volts, although provision has been made for going to 70,000 later. The line is in duplicate, but carried on a single tower line with suspension insulators, having three bells in series and tested at 75,000 volts dry and 53,000 volts under spray test. The towers are spaced 10 per mile, and the wires of each circuit are spaced vertically at 72 in. between wires. The periodicity is 25, much of the power being intended for delivery to the Milwaukee Electric Railway & Light Company. The plant is a capital instance of exceptional hydraulic requirements met with great resourcefulness, coupled with a good but utterly commonplace electrical equipment. Ten years ago a 44,000-volt plant would have attracted great attention, but so rapid has been the progress of power transmission that such an outfit has degenerated into the ordinary and hardly draws a paragraph outside of the local newspapers. Truly the world has been moving rapidly of late.

The Synthesis of White Light.

An article by Dr. Ives, printed elsewhere, gives the result of some experiments on the synthesis of white light from the mercury arc and divers other illuminants. The mercury arc is so lacking in red that no practicable kind of screening can possibly produce from it white light without blocking off a very large proportion of the total luminous radiation. Even the quartz-mercury arc, which to the eye is far nearer to white than the ordinary form, is quite hopeless for proper color vision, and all attempts to modify the radiation by additions to the active material in the tube have thus far ended in failure. The expedient tried by Dr. Ives is in general a familiar one, consisting in adding to the mercury light rays from a source rich in red. The ordinary incandescent lamp has been tried in this function by various experimenters, and the especial interest of Dr. Ives' work lies in his application of tungsten lamps and Welsbach burners to the same service. The Maxwell color triangle in the form given, by the way, must be considered as merely diagrammatic except for the conditions of the Ives experiments. As ordinarily given it is neither equilateral nor really bounded wholly by straight lines. When one forms, however, his equations for white in terms of the primaries, the corresponding color triangle is a very convenient way of getting at graphical results.

It must be remembered in this connection that there is very little agreement as to what constitutes normal white. Abney, Nichols and Ives disagree widely in their "white" equations, and in reading this paper it should be noted that Ives' white would be called bluish white by the others. This word of explanation is necessary in order to understand the possibility of getting anything approximating "white" from a combination of a mercury arc and a Welsbach burner, both of which are relatively weak in red. Ives himself states that the "white" thus obtained is a little greenish, while in terms of Nichols' results it would be conspicuously blue-green. It is quite evident that the variations in defining white are large compared with the quantities here dealt with. The tungsten lamp gives, from Dr. Ives' figures, a somewhat pinkish-white, but evidently either tungsten or Welsbach is a valuable addition to the mercury arc in ameliorating the color, which is the important practical consideration. Such mixtures gave fairly good color-rendering results, with some deficiencies apparently due to the still rather discontinuous character of the combination spectrum. In trying to use such a combination it would probably be best to put both sources behind the same diffusing screen, or otherwise in such relation that the two lights would not act upon the eye as independent sources, else one would expect some bizarre subjective effects. In fact, when a mercury arc is used with ordinary incandescents, both being visible, the former seems quite to dominate the latter, perhaps from attracting undue attention to itself. It seems likely that a mercury arc with slight selective screening would give a still better result with tungsten lamps, while still possessing a high working efficiency. Tungsten lamps alone are distinctly deficient in blue, and the combination would certainly give much higher efficiency than any selective screening of the tungsten.

Illumination Obtained from Luminous Tubes.

The relation existing between the rated candle-power of a tube lamp and the illumination obtained from such a lamp upon a plane lighted by it, is well discussed in an article by Mr. M. D. Cooper which appears elsewhere in this issue. The author assumes that the radiating section of the lamp is composed of an infinite number of lines of light parallel to the axis of the tube, and that the candle-power of each line is proportional to its length. On the basis of this assumption, the density of illumination in foot-candles over the whole reference plane is explored by means of the well-known inverse-square and cosine relations. In the application of the author's conclusions it should be kept in mind that he has tacitly assumed black ceiling, walls and floor. Having ignored the light that will be reflected from the walls and ceiling to the reference plane, his error is on the safe side, but would evidently be very large in the case of white walls and ceiling frequently used with tube-lighting installations.

Attention should be called to a method of treating the problem relating to tube lamps which may prove more convenient than the one explained by Mr. Cooper, and will usually involve less error when practically applied. The lamp may be treated as the source of a certain number of lumens per foot, there being, of course, 4π lumens per mean spherical candle-power. Depending upon the mechanical arrangement of the lighting equipment, a certain portion of these lumens are directed toward the walls, another portion toward the ceiling, and the remainder toward the floor. When all of the surfaces can be considered black, the average intensity of illumination on each in foot-candles can be found by dividing the value of lumens directed toward this surface by the area in square feet. When only the floor is black, and the other surfaces are perfect reflectors, the floor illumination equals the total value of lumens from the lamp divided by the area of the floor. Neither the former condition nor the latter is found in practice, but the actual illumination will frequently have a value nearer that determined from the latter assumption than that from the former

The true value for the total lumens reaching the floor can be determined by subtracting from the amount last stated the lumens absorbed by the walls and ceiling. The absorption of light by the latter surfaces can be calculated at once when the value of the incident lumens is multiplied by the proper absorption coefficient. In many cases the effective illumination can most conveniently be determined with a good degree of accuracy by using the absorption-of-light method of calculation, and dealing with the output from the lamps as a certain number of lumens, rather than employing the more laborious methods based upon candle-power measurements and neglecting the large amount of reflection from the ceiling and walls.

Luminosity and Temperature.

The complications encountered when one attempts to express in the form of an equation the relation existing between luminosity and temperature will be appreciated when consideration is given to the involved relation between temperature and total radiation, and the even more complex relation between total radiation and visible radiation, or luminosity. The desired equation would represent the product of a radiation-temperature equation and a luminous-efficiency value, radiation being the common term connecting the two expressions. At the present time the laws interconnecting radiation with temperature and with luminosity are so imperfectly understood that the only equations available must be considered largely empirical as to form and wholly so as to constants. However, during the last few years a large amount of experimental work has been done with radiation phenomena, and many of the data have been interwoven into intelligible expressions of actual relations. The better understood relation, and the one based more nearly on facts that may for a time be considered fundamental, is that dealing with temperature and total radiation; on the other hand, the luminous efficiency depends upon many imperfectly understood phenomena, such as selective emission and color sensation. In the article by Dr. P. G. Nutting, which appears in this issue, there is given an outline of the equations that have thus far been developed and the most reliable constants that have been ascertained by careful investigations. It is encouraging to find that the resultant equation indicates values that accord closely with facts as they exist with commercial luminous radiators, such as the filaments of carbon, tantalum, tungsten and osmium lamps. In this connection it is interesting to make note of certain relations that have not been established as fundamental but have a direct bearing on the facts discussed above—namely, that the substances that transmit light readily are non-conductors of electricity, while metals that possess a high electrical conductivity possess also a high reflecting power.

Some Phenomena of the Incandescent Filament.

It was discovered by Edison nearly thirty years ago that when a metallic plate is supported in the bulb of an incandescent lamp, and a sealed-in wire brings out electric connection with the same, an electric current tends to flow from the plate to the negative end of the filament during the incandescence of the latter. In other words, when the filament is cold, the plate remains insulated by the vacuous space within the bulb, but when the filament incandesces, this space conducts in one direction. It is now regarded that the glowing filament discharges negative electrons in all directions, and that if the metallic plate is suitably connected outside, a considerable number of these electrons can be made to impinge upon and bombard the plate, delivering up their negative charges as they strike, and so keep up a steady electric current. This curious property of an incandescent cathode in a vacuum tube has been applied in wireless telegraphy to the production of a receiver. Incoming electric oscillations at the receiving mast are led to the anode of a vacuum tube so as to produce additional bombardment of the same from a steadily incandescent cathode. The accompanying charge of electric current is manifested to the senses in a telephone or other appropriate receiver.

The August number of the *Physical Review* contains a paper, by Mr. Orin Tugman, on this subject, as illustrated by laboratory investigation. The incandescent lamp was of a special form, which permitted the anode metallic plate to be advanced toward or receded therefrom within a fairly considerable range. The anode could be maintained at a constant potential, with respect to the filament. Adjustable up to 110 volts and, superposed upon this constant potential, was an oscillatory potential of high frequency from a sort of wireless telegraph apparatus. The conditions of the experiment permitted of variation in regard to several independent variables. The degree of incandescence of the filament could be varied by altering the local current through the same. The degree of vacuum could be varied. The distance between anode and filament could be varied at will, and the potential steadily impressed on the anode and cathode could be changed. The results indicate, as might be expected, that the phenomenon is a complicated one, and far from being completely explained or predicted at present. In general, however, it appears that as the potential-difference between anode and cathode is increased, the cathode-ray current increases up to a saturation point beyond which but little increase of current occurs with any moderate increase in potential. If electric oscillations are superposed, they tend to increase the current if the latter is below the saturation value, but to decrease it if saturation has been passed. Consequently, for one particular value of impressed potential difference near saturation, the effect of superposed electric oscillations is nil.

The effect of distance between anode and cathode is reported as being very marked. The current increased with distance up to a rather sharp maximum at about 1 cm, and then fell off rapidly. In some instances a second maximum developed. Curiously enough, all effects were observed to dwindle as the age of the filament increased. This suggests that a new incandescent filament produces more electrons and cathode-ray discharge than an old incandescent filament operated at the same temperature. If that is the case, chemical as well as physical changes may be expected to occur in the external layers of filamentary material. These changes would seem to complete themselves on the development of a high temperature and to become exhausted as time goes on.

The Standard of Light.

Sufficient progress with an international candle has now been made to justify some attempt at a uniform terminology among writers on photometric subjects. With Great Britain, France and the United States in full accord on a common unit of light, and one that bears a very simple relation to the customary German unit, the time is ripe for further steps. The reply of the German Committee of the International Electrical Com-

mission to the general body on the proposition gives promise of friendly co-operation. Their objection to a formal adoption of the proposed candle, however, seems to arise from a fundamental misunderstanding. It would probably take 10 years at least to get the various official laboratories into accord on an international candle, and 10 years more of confusion is an intolerable proposition. Our German friends seem again to have confused the question of unit with that of a concrete physical standard. The laboratories of various countries could well spend years in attempted settling of the latter affair and then fail to come to an agreement. There was no intention in the proposals now adopted of forcing the German hand. The situation was merely this, that the legal so-called candles of the three great countries acting were not in accord, but still were near enough together to be brought to a common basis without serious commercial difficulty. So the thing was done and, in fact, the common value was that of the *bougie decimale*, the only unit that has ever had anything like international endorsement, and the first scientific unit adopted in photometry.

The common German unit, which happens to be the equivalent of the usual German primary standard, was obviously too different from the units of the three other powers concerned to permit of any compromise value, but it fortunately led to a very simple ratio, which is the next best thing to agreement. And with the German committee adopting provisionally this ratio, the whole affair is left in good working shape for practical purposes. We are most heartily in accord with the German's criticism of the heterogeneous units of length that appear in photometry. We never heard of the yard-candle to which they refer being used, but some advocate of ancient mythology may have at some time been guilty of it. The meter-candle is undeniably the only one for international purposes, and while the foot-candle may die hard, its days are numbered. We do not hesitate to say that the American photometricians will be found a unit for the meter-candle when the time comes for action. Our German confrères can on their part do sterling service to the cause of progress by straightening out the confusion which now exists in their use of *kerze* in such connection. Meter-kerze and meter-hefner are now often used without proper distinction among the less careful writers. There was a German candle not long ago to which *kerze* properly belonged, and careful writers quite generally write H.K. when the hefner is employed as a unit. When this difficulty is cleaned up, the matter of units can be considered as in fairly good practical condition.

Rather recently some German writers have fallen into the quite inexcusable custom of adopting the term *lux* for the meter-hefner. Now, as a matter of scientific propriety based on the origin of the term and its coming into use, lux can rightfully mean but one thing, i. e., the *bougie-meter*, as laid down by Professor Blondel in 1893, when for the first time a systematic system of photometric units was set forth. The term lux now applies rightfully, therefore, also to the international meter-candle, which is the same thing as the *bougie-meter*. It would be highly desirable to confine, therefore, the unqualified use of the word lux to this value and to use hefner-lux (H.L.), like H.K., if that is the unit meant. There is not any serious objection to the use of hefner, or carcel, whenever convenient, and it must be realized that the German lamp industry has so grown up with the hefner as a unit that a change involves some difficulties. But there is no reason for confusing it with the larger candle unit through the slipshod use of terms, and there is no especial difficulty in keeping the terms to their proper uses. We would, therefore, suggest as perhaps the first step toward a proper nomenclature, that *lux* be from now on used, in so far as is possible, as the working unit of illumination, and that when unqualified it shall mean just what Professor Blondel specified, and nothing else. We think that British and American engineers can be counted on quite generally to lay aside the foot-candle, and German engineers should be willing to help by writing H.L. when they are using the hefner as a unit. Incidentally, the general use of the lux would put a final end to the somewhat sophistical discussion regarding "foot-candle" and "candle-foot" with their respective plurals. This is not in the least a proposal for international action, which will come in due time from the proper sources, but an appeal to the common sense of technical writers in order to promote simplicity and exactness of statement.

U. S. Magnetic Tables and Charts for 1905.

The Department of Commerce and Labor has recently published, through the office of the Coast and Geodetic Survey, a fine set of magnetic tables and charts for the United States and adjoining countries, reduced to the year 1905. The work has been prepared under the supervision of Dr. L. A. Bauer. There have been over 3000 stations at which magnetic observations have been taken in arriving at the results published in this book. The results have been tabulated by States and countries, giving the latitude and longitude of each station, the declination, inclination and horizontal intensity, reduced to the year 1905. The angles of declination and inclination of the needle are tabulated to the nearest minute of arc. We are glad to see that the horizontal intensity is tabulated in c.g.s. units, so that the earth's horizontal magnetic force is read off directly in gilberts per centimeter, or the earth's magnetic flux density in gausses. An extra table is given for magnetic observations made at sea on specially equipped ships. These observations were made in the Atlantic Ocean, the Pacific Ocean and the Gulf of Mexico. Such tables are of particular interest to navigators.

It used to be supposed not long ago that the lines of equal magnetic declination made smooth, graceful curves on the map. That is, if we connect by a line all places on the map of North America where the magnetic needle points, say, 5 deg. east of the true meridian, or has an easterly declination of 5 deg., it used to be supposed that the line so drawn would be a smooth curve. In a similar manner, it used to be believed that ocean depths varied smoothly and gradually, so that ocean contour lines or marine charts used to be graceful curves. Now we know that, in both cases, the smoothness was the smoothness of ignorance. As more observations have been accumulated, it has come to light that in lines of equal magnetic declination, as in contour lines of ocean depths, there is a very erratic and zigzag progression. The agone, or line of zero declination—that is, the line connecting points in North America where the magnetic needle points geographically north—commences at the top of Lake Michigan, passes near to Dayton, Ohio, Winchester, Ky., Knoxville, Tenn., and Charleston, S. C., thence following the Bahamas to San Domingo. At all places in North America east of this line, the

needle deflects to the westward of the meridian, and at all places west of this line the needle deflects to the eastward of the meridian. The line itself, like the street in Damascus "which is called straight," wanders from side to side as the meandering brook. At Nova Scotia, in the east, the declination amounts to some 25 deg. W.; while at Vancouver in the west the declination reaches 25 deg. E. Consequently an observer traveling across the American continent, from Nova Scotia to Vancouver, would find the compass needle describing a total angle of 50 deg. with respect to his meridian.

Curiously enough, the agonic line of 1905 is not far from being a line of no annual change in declination, so that the agone is at present substantially at rest. As we travel east and west from the agone, the declination of the needle is found changing with time more and more. In New England the declination of the needle is increasing at the rate of about 1 deg. in 20 years. On the Pacific Coast the declination is increasing at the rate of about 1 deg. in 15 years. Consequently, where the needle in North America points westward of true north, it is tending slowly to point yet further westward; where it points east of true north, it is tending to point yet further eastward; while at places where it points nearly due north, there is but little change. As to what causes all these remarkable changes, recent inquiry tells us but little. Complexities have thickened with increasing observations thus far. Part of the change appears to be due to slow variations in the magnetization of the earth, and part to variations external to the earth's crust, possibly residing in the atmosphere. There is still much to be learned before explanation arrives on the scene. The rate of increase of knowledge has, however, grown rapidly in recent years, and it would not be surprising if generalization soon set in.

Wireless Telegraphy as a Business.

Bulletin 102 from the Bureau of the Census gives a merciless reckoning of the conditions of wireless telegraphy up to the end of 1907. It includes such data as were available from the six companies actually doing a commercial business at the time, and, while it is likely that the present situation is a trifle better, the figures are enough to show the necessity of earnest effort directed toward putting the work on a more conservative basis. To summarize the situation briefly, the companies are trying to carry liabilities aggregating on paper some $33,000,000 on gross receipts of $122,000, faced by expenses of nearly $170,000. On closer analysis, however, the case is not quite so bad as it looks, since more than $26,000,000 of the total stands for patents and such value as may attach to "good will" and other stuff that dreams are made of. The actual physical assets of the six companies were a little in excess of $400,000 at the date named, to which sum the earnings do not bear so absurd a proportion, although the operating expense still looms large. An analysis of the operating expense brings out the fact that the general expense as shown by the salary list is not excessive, amounting to less than $6,000 per company, and the bulk of the outgo is for legitimate wages and material account. The deficit for the year is clearly chargeable to lack of business rather than to excessive expenditures.

This is the hopeful feature of the situation. It means that while the whole wireless art is in that formative condition of exploitation that makes for large stock issues at all sorts of prices, it would not take any extraordinary increase of actual messages sent to show earnings quite big enough to cover expenses and up-keep, or even to pay some return upon the actual money paid for stock. In order to get earnings, however, an increase of the number of stations, particularly long-distance stations, must be made, and there has been a gratifying increase of these since the date of the Census report. At the date of the report the receipts for the year amounted to only about $1,000 per station in service. Three or four times this amount would not be an unreasonable expectation for well-chosen stations, without material increase of operating expense, so that, in spite of the deficit shown, the chance of converting it into a good profit is not remote, assuming careful management. Of course, the capitalization is fanciful and not to be taken seriously, but we see no reason why the business in general cannot be put on a reasonably profitable basis when it is reasonably well-handled. Every new and sensational industry has to go through a period of wild exploitation before it settles down, and the wireless business has merely been sowing its wild oats a little more flamboyantly than is usual. Of course, nobody can consider that the $26,000,000 patents and good-will item is much more than a joke, but, on the other hand, nobody seriously expects profits to be paid against that sort of thing. Of the capital stock some $5,600,000 was still in the treasury and should not come out except with the result of increasing earnings. So absurd as the whole financial statement looks, it is not going to imply that wireless is going to the dogs.

It does imply, however, that it is high time for the various wireless "systems" to settle their differences, stop fighting among themselves and get down to a permanent *modus vivendi,* if not actual complete consolidation. The possibilities of wireless working are as yet scarcely touched, and they will never be fairly opened so long as those who should do the work are wearing out their energies in internecine strife. There is a wireless business amounting certainly to a few million dollars a year awaiting a serious united effort to obtain it. Once the plants are established, the operating expenses should be far lower than in any ordinary telegraph system. In 1907 there were 29,000 ordinary telegraph offices in operation from which the receipts were some $45,000,000. The vast majority of these offices are in small towns and contribute only a trivial proportion of the total receipts. There is business enough to enable the wireless systems to establish a profitable showing at any time they are willing to come down off their high horses and get to work, and we hope and believe they ere long may. The secret of success lies in such united action as will establish commercial chains of stations in places that will furnish a paying traffic. Never mind about that imposing $33,000,000—the water will come out without much squeezing and leave something really coherent. The patent squabbles should be settled out of court by a board of adjudication, the stations standardized as far as may be, and suitable relations with the Government wireless interests established. Then get after regular commercial work, particularly the transatlantic and coastwise work, which promises the largest and most immediate profits. Wireless telegraphy is now all ready for this task, while it has not yet shown ability to compete in the general small work of telegraphic communications. But it is time to take potent remedies against the exploitation fever, which we trust has nearly had its run.

A Patent-Office Abuse.

As an illuminating illustration of the manner in which the U. S. Patent Office can be used to the detriment of the public and of the development of an industry, the following history of the Selden gasoline automobile patent is reprinted from the *Evening Post* of Sept. 17. The patent, which has recently been sustained by Judge Hough, but whose decision will be taken on appeal before a higher court, is essentially a "paper patent," which has not had the slightest influence on the art, but has rather acted to deter its development in this country. Were it not for the existence of this patent, most probably the United States and not France would have taken the leading part in the technical development of the gasoline motor-vehicle. With a "fundamental" patent covering any improvement that might be added to the art, inventors naturally have had no incentive to labors, the fruits of which would be confiscated; and the litigation which has attended the patent and the commercial combinations to which it has given rise, have still further handicapped originative gasoline motor-vehicle work in this country. Following is the extract from the *Evening Post:*

"In view of the interest aroused over the unexpected turn in this case, the story of Selden's adroitness in filing his claim to the now famous patent was recalled by men who have followed the litigation from the start. Selden was far-sighted enough to see the wonderful development of the horseless carriage of the future, and he realized at the same time that his patent rights would only last 17 years, a period which he knew would be far too short for him to reap any reward from his ideas. Selden believed that the horseless carriage of the future would take time to perfect, and he therefore went immediately about setting his patent ahead as far as possible, so that it would still be in force when the horseless carriages were in general use.

"George B. Selden was a patent attorney of Rochester when he filed an application on May 8, 1879, for a 'road engine' driven by a hydrocarbon motor, and he received his patent for the same on Nov. 5, 1895, a period of more than 16 years having elapsed before his rights of 17 years began, and also a period throughout which his patent was protected just as safely as if he already had letters on it.

"Selden, by his skilful manœuvring, virtually made his patent rights cover a period of almost 34 years, and as it turned out, it was in effect at the right time when the motor car was reaching its highest stage of development. Selden's patent, as a matter of fact, still has about three years more to run.

"When Selden applied for his first papers he knew, as a patent attorney, that under the law which was then in force (amended in 1897), an application for a patent could not be considered to have been abandoned if prosecuted within two years after the last official action. By complying with the letter of the law, Selden managed to delay the granting of this patent just 16½ years.

"An authority on patent procedure, in commenting on this case, said to-day:

"'The record of the case in the Patent Office shows that application was rejected on May 31, 1879, and that an amendment was filed on May 26, 1881, nearly two years later, but still good within the law. A second rejection on June 17, 1881, was followed on May 15, 1883, by another amendment, and a third rejection on May 26, 1883, was met by an amendment filed on May 18, 1885. An official letter sent to Mr. Selden on June 15, 1885, was not acted upon until June 13, 1887, only two days before the expiration of the two years of grace allowed by statute.

"'Another rejection on June 21, 1887, was answered by a letter dated April 13, 1889, and an amendment filed on June 10, 1889. Mr. Selden was required on June 14, 1889, to furnish "smooth copy" of the specifications prior to the issue of the final letters, but although the application was otherwise ready for issue, it was not until June 5, 1891, nine days before the statutory limit, that the substitute specifications were sent in.

"'An official letter of July 1, 1891, demanded a new oath prior to issue, but it was not until June 28, 1892, that Mr. Selden obeyed this order. The case was transferred to another examiner by whom some of the claims previously allowed were rejected on July 29, 1893. The next amendment was filed on April 1, 1895, and the patent finally granted on Nov. 5, 1895, just about the time when the horseless carriage, as it was first called, began to make its first appearance on the streets of the large cities.'"

As an indication of the character of the Selden patent, we reprint below the first claim, which Judge Hough in his opinion states is the principal claim in suit:

"The combination with a road locomotive, provided with suitable running gear, including a propelling wheel and steering mechanism, of a liquid hydrocarbon gas engine of the compression type, comprises one or more power cylinders, a suitable liquid fuel receptacle, a power shaft connected with and arranged to run faster than the propelling wheel, an intermediate clutch or disconnecting device, and a suitable carriage body adapted to the conveyance of persons or goods, substantially as described."

Convention of Car-Lighting Engineers.

The Association of Car Lighting Engineers will hold its second annual convention in the southeast corner room on the second floor of the new Hotel LaSalle, Chicago, on Oct. 4, 5, 6 and 7. This young association, consisting of steam-railroad men interested in electric car lighting, has been remarkably successful, and a large attendance is expected. The program includes papers on the "Application of Electricity to Railroad Shops," "Electrification of Steam Railroads" and "Storage Batteries as Applied to Train Lighting." In addition there will be the president's address, reports of standing committees, including the committee on standards, and ample opportunity for discussion. Among the subjects to be brought before the meeting is a change of name to "Association of Railway Electrical Engineers." The work of most of the electrical engineers of railroads extends beyond car lighting, and the proposed name will more nearly characterize the membership of the body. There will be a banquet on the evening of Oct. 6. Mr. A. J. Farrelly, electrical engineer of the Chicago & Northwestern, Chicago, is president of the association, and Mr. G. B. Colegrove, chief electrician of the Illinois Central, Chicago, is secretary. The list of names of committees, with their respective chairmen, is as follows:

Standards, Mr. L. V. Cartwright, electrical engineer, Lehigh Valley, South Bethlehem, Pa.—Data and Information, Mr. W. A. Hopkins, electrical engineer, Wabash, Decatur, Ill.—Publicity, Mr. E. W. Jansen, chief electrician of telegraph department, Illinois Central, Chicago.—Subjects for Discussion, Mr. E. M. Cutting, engineer of car lighting, heating and ventilating, Southern Pacific, West Oakland, Cal.—Improvements, Mr. J. H. Shaw, electrical engineer, Canadian Pacific, Westmount, Canada.—Lamps, Mr. H. C. Meloy, chief electrician, Lake Shore & Michigan Southern, Cleveland.—Auditing, Mr. J. A. Andreucetti, assistant to electrical engineer, Chicago & Northwestern, Chicago.

Convention of Illuminating Engineering Society.

Following is the final program of papers of the annual convention of the Illuminating Engineering Society to be held in New York City Monday to Wednesday of next week. Among the social features will be an automobile tour of the city on Wednesday for the visiting ladies, in 20 seven-seated touring cars. In the evening of that day there will be a reception in the Machinery Club in the Hudson Terminal Buildings, from which an excellent view may be obtained of parts of the spectacular Hudson-Fulton illumination.

The meeting on Monday morning will be opened by an address of welcome by Mr. T. C. Martin and response by Dr. Louis Bell. The address of President W. H. Gartley will follow, after which reports will be presented on nomenclature and

standards, on unit of light and on photometric units. The papers contributed will be presented on Monday afternoon and the mornings and afternoons of Tuesday and Wednesday. On Tuesday evening Dr. C. P. Steinmetz will deliver a lecture on "The Physiological Effects of Radiation." Following is a complete list of the papers:

The Ethics of Illuminating Engineering, by Mr. E. L. Elliott.—The Work of Dr. Carl Auer von Welsbach in the Field of Artificial Illumination, by Mr. Geo. S. Barrows.—The Progress of Illuminating Engineering in Europe, by Mr. W. T. Owens.—Diffusing Mediums, by Mr. A. J. Marshall.—Illuminating Engineering from the Educational Standpoint, by Mr. F. K. Richtmyer.—Photometrical Laboratory of the United Gas Improvement Company, by Mr. Chas. O. Bond.—Physical Laboratory of the National Electric Lamp Association, by Dr. Edw. P. Hyde.—Notes on Chemical Luminescence of Rare Earths, by Dr. Angelo Simonini.—The Light of the Firefly, by Drs. H. E. Ives and W. W. Coblentz.—Allowable Amplitudes and Frequencies of Voltage Fluctuations in Incandescent Lamp Work, by Mr. H. E. Ives.—The Principles of Shades and Reflectors, by Dr. Louis Bell.—Standard Relations of Light Distribution, by Mr. A. J. Sweet.—The Problem of Heterchromatic Photometry, by Mr. Preston S. Millar.—Some Results Obtained Through Illuminometry, by Mr. Norman Macbeth.—Factory Lighting, by Mr. L. B. Marks.—Operating Efficiencies of Some Commercial Installations of Lighting Systems, by Mr. A. L. Eustice.—Tests of Moore Tube Installations—New York Post Office, by Dr. E. P. Hyde and Mr. J. E. Woodwell.—Tests of a Moore Tube, by Dr. C. H. Sharp and Mr. P. S. Millar.

Educational Plans of the Baltimore N. E. L. A. Section.

The Baltimore Section of the National Electric Light Association have arranged through the courtesy of the management of the Consolidated Gas, Electric Light & Power Company, of Baltimore, for a course of experimental lectures on electrical engineering to be given to its members the coming winter. The lectures will be given on Tuesdays, commencing Oct. 5, and will extend for 20 successive weeks under the direction of Prof. Sydney W. Ashe. The lecture course will be similar to the successful first season's courses given to the New York, Brooklyn and Boston Edison companies in past years. While the lectures will be given primarily to members of the local section, arrangements will be made to accommodate non-members who are sufficiently interested. A small fee will be charged to limit the attendance to those interested and to make the course as far as possible self-supporting.

Chicago Street-Railway Labor Dispute Settled.

By a decisive vote the unions of street railway men in Chicago agreed on Sept. 16 to accept the settlement in the matter of the wage dispute proposed by President Mahon, of the International Union, and accepted by President Roach, of the Chicago Railways Company, and President Mitten, of the Chicago City Railway Company. Mr. Mahon recommended that the new proposition be accepted rather than to submit the dispute to an unpromising arbitration. There was considerable opposition to the proposal by the more radical union men, but the vote was very largely in favor of acceptance. The new wage scale will result in a substantial increase to all employees and will provide a graded scale for men taken on after Aug. 1, 1909. The contract between the companies and men will run for three years from that date. The plan provides that men who have been two or more years in the service shall be paid 28 cents an hour for the first year of the agreement, 29 cents for the second year and 30 cents for the third year. Similarly, men now employed, but who have not completed two years of service will be paid on the same ascending scale after the expiration of two years from the date of entering the service of the company. New men employed subsequent to Aug. 1, 1909, are to receive 23 cents an hour the first six months, 25 cents an hour for the second six months, 26 cents an hour for the second year and so on, increasing a cent an hour until they receive 30 cents an hour in the sixth year of service. The contract also contains provisions for increased wages for barn men and shop men. It is asserted that the increase of wages will amount to $1,800,000 for both companies during the contract period of three years. The first offer made by the companies and rejected by the men was based on an increase of about $1,000,000 over the present payroll for a contract period of five years. The controversy has lasted several months, and on two or three occasions it has appeared that a strike was inevitable.

Water-Power Development at Oregon, Ill.

Work is progressing on the wheel pits for the new water-power plant of the Oregon Power Company on the Rock River at Oregon, Ill., which has been previously mentioned in these columns. While the Rock River is a stream of very variable flow, it is calculated that with a reasonable steam auxiliary—say 50 per cent—a development of 4000 hp may be had the year around at Oregon. A dam 975 ft. long has been built, and the company will probably erect a deflection dam also. Three 66-in. Leffel turbine water-wheels have been ordered, and they will be placed in line on one shaft and drive a 600-kw, General Electric, 2300-volt, 60-cycle, three-phase generator. At one end of this shaft, connected by a clutch, will be a Cluse four-valve engine serving as the steam reserve for this unit. A clutch will also be placed in the shaft between the water-wheels and the generator, of course, so that the electrical unit may be driven by either source of power. The Oregon Power Company will supply electricity to a number of nearby towns and villages. Nearly 100 miles of transmission lines will be built ultimately in various directions, 35 miles being now in existence. The voltage of transmission will be 13,200, and there will be substations at Amboy, Franklin Grove, Sublette, Lee Center and Shaw's. Kuhlman transformers are used. Mr. Frank F. Fowle, of Chicago, consulting engineer, worked out the hydraulic details for this plant.

Proposed Unification of Railroad Terminal Facilities in Chicago.

Mr. F. A. Delano, president of the Wabash Railroad, was the speaker at the meeting of the Electric Club in Chicago on Sept. 15. His subject was, "A Plan for a New Union Passenger Railway Terminal for Chicago." Mr. Delano originated the proposal for a union passenger terminal in Chicago, or at least a clustering together of such terminals, five years ago, and he has given much attention to the subject since then. He was greeted at the Electric Club by an audience of over 100, and he explained to the gentlemen present that his interest in the topic was rather that of a citizen of Chicago than of a railroad president.

The rapid growth and interlacing of the 26 railroads entering Chicago has resulted in a confused condition of affairs. Of these railroads all except two enter the city at or south of Sixteenth Street. It would, therefore, seem feasible to construct a series of terminal units at some point just south of the "downtown" business district, and Mr. Delano suggests Twelfth Street as such a location. He recommends a series of terminal station units, the passenger traffic to be handled on one level and freight cars on a lower level, or possibly on two lower levels, making a three-decked construction. This arrangement would greatly facilitate the interchange of both passengers and freight. There are six main terminal stations in Chicago now, including the Northwestern terminal in course of erection at an expense of $20,000,000. The Illinois Central terminal is already placed on Michigan Avenue, at Twelfth Street, and

need not be disturbed. Perhaps the other four terminals could be built on Twelfth Street, side by side, and possibly the railroads interested would be willing to spend $20,000,000 on each.

The intramural transportation facilities between the existing terminals are unsatisfactory and the transfer of passengers, baggage and freight would be greatly simplified if the stations were placed as suggested. The speaker would be glad to see engineers study the subject and he presents the plan suggested merely for mature consideration and not as necessarily the only solution to the problem. A further possibility is that the existing railroad property north of Twelfth Street be used for warehouse purposes, connected with the terminals by elevated or underground railroads.

The matter of electrification of the railroad terminals was brought up in the brief discussion following the address, and Mr. Delano said that the details of the plan he suggests could be carried out more readily with electrical operation than with steam operation of trains. This would be particularly true in the case of the two-deck or three-deck track construction. Any tendency to the electrification of railroad terminals would help the plan suggested. If such electrification is found to pay in a city like New York, it may be expected to do so in a city like Chicago.

Joint Convention of Northwest Electric Light and Power Association and Seattle Section of A. I. E. E.

The second annual convention of the Northwest Electric Light and Power Association was held in connection with the Seattle Section of the A. I. E. E. in the Fine Arts Building at the Alaska-Yukon-Pacific Fair in Seattle, Sept. 7 to 9. There were present delegates representing approximately 85 per cent of the central stations operating in Washington, Oregon and Idaho, together with practically the entire Seattle section of the A. I. E. E., and a number of guests, including Messrs. W. Natori, secretary of the Tokio Electric Light Company; Ralph W. Pope, secretary, A. I. E. E.; Charles F. Scott, past-president, A. I. E. E.; P. M. Lincoln, of the Westinghouse Company; Frank H. Gale, of the General Electric Company; A. W. Ballard, Los Angeles branch General Electric Company; Sir James Ward, Dublin, Ireland; J. R. Geary, of the Yokohama branch, General Electric Company.

The Northwest Electric Light and Power Association was formed a year ago by a few companies at a meeting held in Seattle, and since that time has grown until at this meeting delegates were present, as stated above, from about 85 per cent of the central stations doing business in Washington, Oregon and Idaho, the States embraced in the association. The body is an association of central stations formed for the purpose of bettering the service and business by closer relationship with each other, and for the mutual exchange of ideas and information. It is modeled after the National Electric Light Association and with the same classification of members. A complete file of forms from all the member companies is kept by the secretary, including accounting, operating, legal, etc., which records are at the service of the members upon request, thereby enabling them to learn and, if desired, adopt for their own use the best methods of other companies. The conventions are more in the line of "experience meetings," where questions as to operation and business methods are freely discussed and personal experiences exchanged.

Each member and guest was supplied with a coupon book containing coupons for a reception and dance on Tuesday evening, a pass for sight-seeing trolley cars, a steamer pass for a trip around Lake Washington, a steamer pass for a Sound trip and a pass for a vaudeville entertainment.

After the usual addresses of welcome and the proper responses, Mr. John Harisberger, president of the Seattle Section, A. I. E. E., took the chair to preside over the technical session, which was entirely in charge of the members of the A. I. E. E. Mr. Ralph W. Pope delivered an address upon the administration of the Institute, dwelling with particular emphasis upon its growth in the West, and congratulating the Seattle section upon its enterprise and the success of the present convention. Mr. Pope visited the convention primarily to investigate the policy of joint sessions of the A. I. E. E. with other organizations, and before the close of the meeting expressed himself as more than pleased with the results accomplished.

Mr. Pope was followed by Mr. C. E. Fleager, of the Pacific Telegraph & Telephone Company, who read a paper upon "Modern Central Telephone Stations."

Mr. Paul M. Lincoln then presented a paper on "Protection of Electrical Equipment," which provoked the fullest discussion of the first day's session, with special reference to his theory of an electric "surge."

Mr. Lincoln in opening his paper illustrated the principle of electrical surges by a hydraulic analogue consisting of pipes perfectly flexible made of india rubber. In discussing the protection of high-tension systems by grounding the neutral, it is stated that this may be done either by connecting solidly to the ground or by putting in a greater or less resistance between the neutral point and the ground. The question of a grounded neutral may be considered, first, from the viewpoint of protection to the equipment, and, second, from protection to the service. As to the protection of apparatus, the advantage in solidly grounding the neutral is that the normal voltage to ground can under no conditions rise to more than 58 per cent of the normal voltage between conductors, which is of the utmost importance when considering insulation strengths to ground of the various apparatus involved. On the other hand, the disadvantage is that every ground which occurs develops immediately into a short-circuit, which in turn causes severe mechanical stresses to be set up in the windings of the transformers and the generating apparatus. It is the opinion of Mr. Lincoln, so far as the protection of apparatus is concerned, that the advantages of the grounded neutral very much outweigh the disadvantages. As to protection of the service, the development of the short-circuit noted above will in high-tension transmission cause the resulting arc to continue until the power to that particular section of the line is cut off; consequently, many engineers prefer to ground through a resistance instead of connecting solidly to ground. A satisfactory type of resistance for this service is difficult to secure; cement columns have been used for the purpose, but Mr. Lincoln was of the opinion that a metallic form of resistance is the best. Following is a recapitulation of the means for protection against the effects of electrical surges:

First, the overhead guard wire which keeps down the quantity of electricity which a given lightning discharge is capable of superposing upon a transmission line. In practice it has shown itself to be a valuable device in many instances of high-tension transmission.

Second, lightning arresters of a type which will allow a free discharge of static electricity from the transmission line whenever the voltage of the charge exceeds normal by a certain predeterminable amount. With a proper equipment of such lightning arrester the size of the surge which may enter electrical apparatus is limited.

Third, the grounded neutral. Grounding solidly prevents the potential of a neutral point of a transmission line from departing from ground potential, which in turn prevents the normal operation of this line from causing more than about 58 per cent of line voltage appearing between any conductor and ground. Grounding through a resistance has the same effect to an extent depending upon the amount of resistance used.

Fourth, insulating between turns. It is highly essential to insulate electrical apparatus between turns so that it will stand a momentary potential many times the normal. This consideration shows the enormous advantage of using transformers upon a transmission line in distinction to connecting generators direct. The amount of insulation that can be used between turns in a generator is limited by the necessity of placing the winding in relatively small slots. In a transformer this consideration does not operate to nearly so great a degree owing to the fact

that the space occupied by the windings is, so to speak, in one piece instead of being divided up into a large multiplicity of small slots. Moreover, the presence of oil in the case of the transformer gives it an advantage which the generator cannot have under any conditions.

The afternoon session was devoted to the following papers: "Electrical Illumination from the Central-Station Standpoint," by Mr. W. M. Hamilton, Portland Railway, Light & Power Company; "High-Efficiency Lamps," by Mr. E. W. Sherwood, General Electric Company; "The Trend in Electrical Development," by Mr. Charles F. Scott, Westinghouse Electric & Manufacturing Company.

These three papers all bore out very well the central theme or purpose of the convention, to wit, the increase of the load factor, giving to the central station an additional revenue without raising of rates or the addition of more generating apparatus. Mr. Sherwood's paper was well illustrated by lantern views.

The session of Wednesday was presided over by Mr. Arthur Gunn, president of the Northwest Electric Light and Power Association, and was devoted to commercial papers. The report of the rate committee by its chairman, Mr. M. C. Osborne, was of special interest to the members of the convention and led to a general discussion. While no attempt is being made to fix rates, at the same time a common basis for arriving at a rate schedule is the object and purpose of the rate committee. The readiness-to-serve charge received special attention, and Mr. Osborne gave an exceedingly comprehensive schedule, showing the income to the central station per kw-year worked out with reference to the connected load and the load factor of the consumer. Mr. Frank Dabney, chairman of the committee on uniform accounting, strongly advocated the system proposed by the National Electric Light Association with such modifications as necessary to fit the needs of the small companies.

Mr. J. H. Whitaker, of the Seattle-Tacoma Power Company, then presented a paper upon methods of handling complaints, giving his personal experiences of many years in the central-station business.

Mr. Whitaker urged promptness in giving attention to every complaint, and making a record of each case, setting forth all details and final disposition. He urged that the expression, "I complained, but got no satisfaction," should not gain a foothold in one's territory. A great aid in minimizing complaints is to instruct customers, so far as possible, how to read meters and to compute the bills. All meters should be inspected at least once a year, or in cases of large installations, every six months, and customers should be advised of a test and informed of the result. In taking care of what might be called mechanical troubles, such as are incident to arc and Nernst lamps, the blowing of fuses, etc., a printed form will be found of value. Such a form should include the time a call was received, when attended to and by whom, nature of the trouble and its remedy, and, above all, the signature of the customer showing that his complaint had been cared for.

A paper upon "Electrical Appliances and Their Influence on Load Factor," by Mr. A. G. Jones, of the General Electric Company, followed. This paper aroused vigorous discussion, in which Mr. F. H. Gale, of the General Electric Company, took an active part. The delegates were very desirous of obtaining definite figures as to the cost to the consumer of electricity in comparison to gas at $1 per 1000 cu. ft. or coal at $6 per ton for the purpose of cooking and heating. The trend of the discussion seemed to be that while the electric flatiron, toaster, chafing dish and other small appliances were beneficial to the central station, the larger cooking devices were a good thing to let alone.

The next paper, entitled "The Electric Vehicle as a Correction of Poor Load Factor," was presented by Mr. R. V. Daggett, president of the Pacific Coast Electric Vehicle Association, and was well received by the delegates, as indicated by the numerous questions propounded, which showed a live interest in the topic treated.

Mr. Daggett said that while the gasoline automobile has had a phenomenal growth and has come to stay, the electric vehicle is better adapted for use in cities, and especially in congested districts. It is less noisy, requires fewer repairs and has a lower cost of maintenance. Repairs on the battery may be made without putting the vehicle out of service, which is not so in the case of repairs to the machinery of a gasoline machine. The electric vehicle is most easily operated, requiring less skill and knowledge of mechanics. The author estimated that there are fully 10,000 electric vehicles in use in this country. Southern California and Seattle show the greatest development along the coast. Los Angeles has in use about 575 electric vehicles. The charging rate in Southern California varies from 2 cents to 6 cents per kw-hour, according to the amount of current and whether the supply is for a private or a public garage. The average income per month from an electric vehicle from private garages is about $5.50, and from public garages the total varies from $50 to $200 per month. If it is estimated that while the income per vehicle is only $3 per month, the total income per year for 575 vehicles would be $19,500. In Los Angeles one company operates about 12 electric trucks, but should all of the trucking be done with electric vehicles it can be readily appreciated what an enormous increase in power consumption would result. In Seattle there are about 100 electric vehicles, including both those used for pleasure and commercial purposes. Seattle has steep grades, but experience has shown that with proper design the electrical vehicle is as well adapted to high hills as any form of automobile.

Wednesday afternoon and Thursday morning were devoted to the executive business of the association. The report of the secretary showed that in the single year's growth the body had drawn to its membership rolls practically 90 per cent of all the companies operating in the territory embraced, while the treasurer reported a balance for the fiscal year of $1,015.88.

The president, in his address, thanked the members for their support during the year, and congratulated the member companies for their willingness to aid each other in the matter of forms, information and data regardless of the keen commercial rivalry existing between some of them. He also presented an able paper upon "Employers' Liability and Employees' Indemnity," in which he urged upon the members the importance both from the commercial and humanitarian standpoint of the employer and employee getting together upon common ground in the settlement of cases of personal injuries without the intervention of lawyers and courts. He dwelt upon the German and English method, and recommended that the employer surrender his defenses in law, namely, the doctrines of assumed risk, contributory negligence and negligence of a fellow servant, provided the employee would in turn consent to a schedule to be paid for injuries which would be fair to both. Under this plan every injured employee would receive compensation, and all the money now paid by the employer and the employee for lawyers and litigation would go direct to the employee.

The election of officers resulted as follows: President, Mr. Arthur Gunn, Wenatchee, Wash.; vice-president for Oregon, Mr. H. V. Gates, Hepner, Ore.; vice-president for Idaho, Mr. D. C. McKissick. Vacancies on executive committee: For three-year term, Mr. O. B. Caldwell, Portland, Ore.; for one-year term, Mr. C. H. McNary, Clarkston, Wash.; secretary-treasurer, Norwood W. Brockett, Seattle, Wash.

The entertainment features of the program were in charge of Mr. W. E. Best and were exceedingly well carried out. Every possible courtesy was extended to the delegates and their families, and a rising vote of thanks was extended by the convention to Mr. Best and his assistants, Mr. Winter and Mr. Kollock.

Annual Meeting of the Vermont Electrical Association.

The annual meeting of the Vermont Electrical Association was held at the Van Ness House, Burlington, Vt., on Sept. 15 and 16, with an excellent attendance, reaching about 100. The

association now includes 17 of the operating light and power companies in the State and its meetings are rapidly developing in interest and importance, as evidenced, in one way, by the influx of supply men every year.

The meeting was called to order on Wednesday afternoon, Sept. 15, by President F. H. Parker, of the Burlington Light & Power Company. It had been intended to precede this by a business meeting in the morning, but this plan was abandoned on account of a parade of the U. S. Cavalry and of the local fire brigade. The afternoon meeting was opened by an excellent address from Mr. V. R. Lansingh, of New York, on "The Need of Educational Work in Illumination." He treated his subject under two heads—store lighting and house lighting. With regard to the latter division he argued strongly for the tungsten lamp as emphatically the one best suited to household purposes. To-day in most household lighting the lamps were often black or of high wattage, and were generally placed in wrong positions or at a wrong angle. Very often the only means of turning them on or off was an awkward key socket, and there was too much use of inefficient glassware aiming at artistic colored effects. The placing of the lamps in the kitchen, he insisted, was, if anything, of more importance than their location in the dining-room. He then went into details as to the proper lighting of every part of the house, and claimed that it was the duty of the central station to educate its solicitors and the public in dealing with these matters. As to porch lighting, he noted that less than 1 per cent of porch lamps were used, probably because they were of too high candlepower; but the suggestion was offered that a good deal of effective street lighting could be done from porches. All the rooms of the house were then taken up in turn, and practical hints were given as to the proper papers and coloring for ceilings and walls. Mr. Lansingh then took up store lighting, in regard to windows and interiors. The former was lighting to show off goods or attract attention, and was sometimes a combination of the two. The points as to interior lighting were also dealt with.

Mr. Walter Jones then gave a very interesting account of his experiences in New Haven, Conn., in developing a campaign of education in illumination, where a vacant store was taken for free lecturing purposes. The result of the first effort was 72 applications for advice, from business men, and then the next effort brought 200 applications, making the campaign a very successful one in its additions to the central-station load in improved lighting.

Mr. C. H. Scott, of Boston, presented an interesting paper on "The Extension of Power Business for Central Stations." In was an incisive analysis of power conditions in the State, the *Central Station Directory* showing a population of 185,000, or 51 per cent of the total population of the State, served by 45 plants and a horse-power per capita of 15. He suggested that the association should ascertain to what exact extent electrical energy had been utilized in farm and dairy, as well as in other industries. He took up also the items of lumbering and stone quarrying, and pointed out the growing importance of the Vermont textile mills as a market for energy. He emphasized the idea that the extension of the day load is to be sought particularly among small users, especially in the homes. Mr. Scott made a number of pertinent suggestions as to general publicity methods and urged strongly the use of newspaper advertising.

Mr. T. C. Martin addressed the association as to the desirability of becoming affiliated with the National Electric Light Association, preferably as part of the existing New England section, though not of necessity giving up the present organization. He alluded to the interesting fact that the National Association owed so large a part of its remarkable success to the extraordinary ability of a Vermont woman, who had devoted 20 strenuous years of her life to its upbuilding, and whose work gave her high rank among the notables of her sex in this country. He felt that Vermont companies might well emulate her noble enthusiasm in regard to the national body. Of the 17 companies in the Vermont Association, 14 were already members in the National organization, so that it would be very easy to "line up" as a State. Mr. Martin also described the work of the "N. E. L. A." in its relation to public questions, such as insurance, conservation, freight, tariff, corporation taxes, and public-service commissions, and gave an outline of the association work in its annual convention, its transactions in three large volumes this year, its bulletins, its solicitors' handbook, its "Question Box" and other respects in which it served as a clearing house for information relative to an industry that touched modern American life at all its vital points. All this data and work were at the command of State organizations cooperating with the National body in an intelligent, unselfish but protective movement for the good of all.

During the day the members and visitors were generously entertained by the local company and its staff, both at the office headquarters and at the Ethan Allen Club. The company has a beautiful stone and brick building of its own put up for the purpose, complete in all departments, and in keeping with the tone and air of a city where, with a population of 20,000, one of the local banks has 30,000 depositors and deposits of $11,000,000. The Burlington Light & Power Company has about 1700 electric customers and 3000 for gas.

At the evening session, Mr. T. C. Martin read a paper on "The Unevenness of Electrical Development," in which the argument was made that the central-station service was uneven and unequal that did not include everybody within its reach. In advocating the importance of the diversity factor and of the heterogeneity of patronage he pointed out that while in 1902 the average income from a public arc lamp was $83.20, it had fallen in 1907 to $69.57. The yield of a commercial arc in 1902 was $48.88, while in 1907 it was $39.99. In incandescent lighting, in the same period, public lamps fell off from $6.06 to $3.80 and commercial lamps from $2.40 to $1.98. Mr. Martin then discussed various sources of income, and enlarged on the importance of power-plant records and of checks on supplies and materials as one way of preventing the curious unevenness of development and of financial yield in central-station work.

Mr. F. W. Willcox then followed with an admirable paper on "Results from Tungsten Lamps" with reference to central-station service during the past year, and with this pregnant premise: "It is the history of all great inventions designed to save valuable time and labor that they have been criticised and condemned because they threatened ancient industries or 'threw people out of work.' The succeeding history of such inventions, however, shows that labor has invariably found more profitable employment, and that conditions have rapidly adjusted themselves so that the benefits of successful ingenuity can be fully realized." The paper was a brilliant expansion of this theme, and showed how the tungsten lamp by its new economic values had revolutionized favorably the conditions of illumination, from the central-station standpoint. Mr. Willcox gave a table showing sales by his company of 1,579,593 tungsten lamps in the last six months, of which 35 per cent was in 25-watt lamps, and 17 per cent in the 40-watt, "small-bulb" lamp, which is rapidly coming to the front as more durable than the 25 unit and a better competitor with the Welsbach. "A noticeable fact about the sizes of lamps is that the lamp which is most popular in any given city is the one which is most aggressively pushed in that city." It also appeared that where a central-station company handled the lamp the units sold were uniformly larger than when they were sold by a local supply company. The paper entered also into questions of maintenance, and cited the Rochester (N. Y.) company which makes a small charge for four inspections a month, cleaning the lamps and the glassware. Details were also given as to features of introduction, charging for service, etc., and the effect on revenue.

The following officers were elected: President, J. E. Davidson, Montpelier; first vice-president, C. E. Parker, Vergennes; second vice-president, Frank Barney, Jr., Springfield; secretary and treasurer, A. B. Marsden, Manchester; executive committee: F. J. Royce, Bellows Falls; C. C. Wells, Middlebury;

G. S. Haley, Rutland; W. H. Vorce, St. Albans; W. M. Hughes, Bristol.

On Thursday the members and guests made an excursion on the *Ticonderoga* to Bluff Point, across Lake Champlain, where luncheon was served, the boat returning at 3:15 p. m.

At an adjourned meeting of the association, held on the boat on Thursday afternoon returning from Bluff Point, the association, by formal resolution, decided to become affiliated with the New England Section of the National Electric Light Association.

MR. J. E. DAVIDSON.

Mr. James Edward Davidson, the new president of the Vermont Electrical Association, was born at Flint, Mich., Nov. 10, 1879. He is the son of Mr. W. F. Davidson, of Port Huron, a pioneer in central-station installation and operation in the State of Michigan, in which State he represented the Thomson-Houston Company for some years as agent. After passing through the public and high schools of Port Huron, Mr. Davidson took a course at the Detroit Business University. As a boy his vacations were spent in the power house at Port Huron, and after leaving school he went at once to work in that plant, of which he became superintendent in 1899. During Mr. Davidson's superintendency a 1500-kw Curtis turbo-generator was installed, this being the first steam turbine of this make put into commercial operation. In 1902 he was appointed city electrical inspector of Port Huron, a position which he held until his removal to the East. In the spring of 1905 a syndicate of Port Huron and New York capitalists purchased the plant of the Consolidated Lighting Company, of Montpelier, Vt., and invited Mr. Davidson to take the management of the business. Upon his acceptance he was made a member of the board of directors, secretary of the company and general manager of the plant. He is now president of both the present underlying properties, each capitalized at $1,000,000. The plant includes a water-power station at Bolton Falls and a steam plant at Montpelier. These stations supply lighting and power to Montpelier, Barre, Waterbury and surrounding towns, and power is also supplied to the Montpelier & Barre Traction Company. In Barre and vicinity are some of the largest quarries and finishing sheds in the United States, and the Consolidated plant furnishes a large amount of electrical energy for quarrying and manufacturing granite. Mr. Davidson is an associate member of the American Institute of Electrical Engineers, and was secretary and treasurer of the Michigan Electric Association up to the time he left Port Huron. He has taken an active part in the creation of the New England Section of the National Electric Light Associaion, and is altogether a typical man of "light and leading," and an ideal representative of the progressive younger element in the art. Besides being president of the Vermont Association, he is vice-president of the New England Section, N. E. L. A.; member of the Illuminating Engineering Society and member of the Wireless Institute. He has been a frequent contributor of papers and articles.



PRESIDENT J. E. DAVIDSON.

Public Service Commission Hearing on Meter-Test Reports.

The Public Service Commission of the First District held hearings on Aug. 30 and Sept. 13 at 154 Nassau Street, New York, in the matter of standard forms of reports on tests of electric meters; the substance of the order appeared in our Aug. 26 issue. All of the electric light companies under the jurisdiction of the commission were represented at the hearings, and Mr. J. W. Lieb, Jr., of the New York Edison Company, embodied in his remarks the general sentiment of the various companies relative to the proposed order. Objection was made to the determination of the ratio of transformers used in connection with instruments on consumers' premises, where it was stated a proper test is impossible. It was also suggested that instead of annual laboratory tests of each transformer, periodic tests be made every five years, since there is little tendency to variation in present ratio transformers. Mr. Lieb stated that if indicating wattmeters are excluded from alternating-current meter tests it would make it obligatory to use only rotating standards, which are not available in the capacities required to test the larger installations. It was pointed out that for many tests indicating wattmeters are the only available and satisfactory instruments. With reference to the order of the commission calling for tests at one-tenth, normal and full rating of meter, it was suggested that inasmuch as it is not always practicable to pick out exactly a 10 per cent or full load, the word approximately be used, or at the nearest load obtainable. The classification given by the commission in percentage of installation to be used in determining normal load should, it was pointed out, be selected so that the percentages will be general averages, which, once fixed, should be adhered to, leaving nothing to the judgment of the person who makes the tests. All companies expressed the desirability of having two classifications in reporting the results of non-complaint meter tests; they favored only two tests in all: one, called periodic tests, which would also include tests made at the instigation of the company itself, and the other designated complaint tests, which would include only those tests ordered on the complaint of a consumer. The advisability of making public the details as to efficiency, etc., of various makes and type of instruments was questioned as detrimental to manufacturers.

Massachusetts Commission News.

The full bench of the Supreme Judicial Court of Massachusetts has dismissed the petition of Edmund Codman and others for an injunction to restrain the Boston Transit Commission from building a tunnel from Cambridge under a part of Boston Common to the vicinity of the present Park Street station of the Tremont Street subway. The starting of this work, which is the easterly terminus of the subway now under construction to connect Boston with the Harvard Square district of Cambridge, has been delayed several months by the opposition which developed in certain quarters to the construction of the tunnel under the Common. The commission has lost no time in signing the contract for this section of the subway since the unanimous decision of the court was handed down, and it is now expected that this important work will proceed steadily toward completion. The Boston Elevated Railway Company is building the portion of the subway that lies within the city of Cambridge, and active excavation is in progress at several centers along the route. The Railroad Commission has given its final approval to the plans for the stations, and the rest of the work appears to be largely a matter of engineering. It is noteworthy that the Supreme Court recognized the public importance of the project and refused to

permit further delay sought by the opponents of the Park Street terminus.

The Massachusetts Railroad Commission has approved the proposed changes of the Boston Elevated Railway Company at its stations at Dudley Street, Dover Street, and the South Station, to adapt the service at these points to the running of eight-car trains. A hearing was given by the board Sept. 13 on the petition of Councilman O'Bryan, of Boston, asking for an investigation of the transportation facilities at the Dover Street elevated station in Boston. Vice-President Sergeant presented conclusive figures showing that the company maintains an ample service through this portion of the system, which is one of the busiest points outside the immediate downtown commercial center of Boston, upward of 2500 cars per day passing the station in question. On the same day a hearing was given upon the petition of residents of Lynn asking that the fare on the Lynn & Nahant Street Railway be reduced from 8 cents to 5 cents. Although the petition was signed by a large number of persons no one appeared to press the matter before the board, in relation to the fare reduction asked in general relation to the railway, or in the matter of increased service during the winter months.

The Massachusetts Gas and Electric Light Commission postponed until the early part of October the hearing assigned for the petition asking for a rate reduction in Leominster, which was set for Sept. 16. Several hearings on gas matters are assigned for the latter part of the present month.

New York Public Service Commission News.

At last a trolley car has been run across the new $20,000,000 Queensboro Bridge. This was accomplished last week by the Board of Estimate authorizing the bridge commissioner to operate a temporary line with rented equipment. The consent of the Public Service Commission was not asked nor needed. The Board of Estimate also granted a franchise to the New York & Queens County Railroad Company to operate a line across the bridge, but this will have to be approved by the commission and may be turned down. Already the commission has refused to sanction the franchise for the South Shore Traction Company which was granted by the Board of Estimate, and, last week, the commission refused to give a franchise to the Third Avenue Bridge Company—the company organized by Receiver Whitridge, of the Third Avenue Railroad Company, for bridge service. The commission disapproved of the form of the South Shore and Third Avenue franchises.

It was announced last week that the Public Service Commission of the First District had prepared plans for a new subway route starting at the Battery and running up the west side under Hudson Street and Eighth Avenue to Fifty-ninth Street, under that street to the East River over the Queensboro Bridge to various sections of Queens Borough.

The commission sent a request to the Board of Estimate and Apportionment for an appropriation of $150,000 additional to pay for drawing and printing plans and specifications for new subway lines. The board made an allowance of $100,000.

The commission has appealed to the Attorney-General of the State for instructions and advice as to how to proceed to compel the removal of the tracks of the unused car lines from the streets of New York. There are 20.22 miles of this track involving 13 separate companies.

The Public Service Commission, Second District, has authorized the Cataract Power & Conduit Company, of Buffalo, to issue $149,000 5 per cent gold bonds, payable in 1927, to be sold at not less than 95. The proceeds are to be used for the acquisition of property and the extension and improvement of the plant of this corporation. The commission has also authorized the Cataract Power & Conduit Company to issue $4,000 in 5 per cent gold bonds to be sold at not less than 95, the proceeds to be used in paying indebtedness incurred in acquiring property and improving its plant and distributing system.

The Pawling Electric Light, Heat & Power Company has been authorized to begin construction of its proposed plant and exercise rights and privileges conferred by the village of Pawling, Dutchess County. The commission has also authorized the Pawling Electric Light, Heat & Power Company to issue its capital stock to the amount of 800 shares at the par value of $25 each, the proceeds to be used for the acquisition of its site and construction of its plant and generating system.

Electric Freight Locomotive for the New Haven Railroad.

In the accompanying illustrations are shown outline views of a freight locomotive being erected by the Baldwin Locomotive Works and the Westinghouse Electric & Manufacturing Company for the New York, New Haven & Hartford Railroad. It differs from the passenger locomotives now in use in that the motors are geared to the axles instead of being flexibly mounted directly thereon.

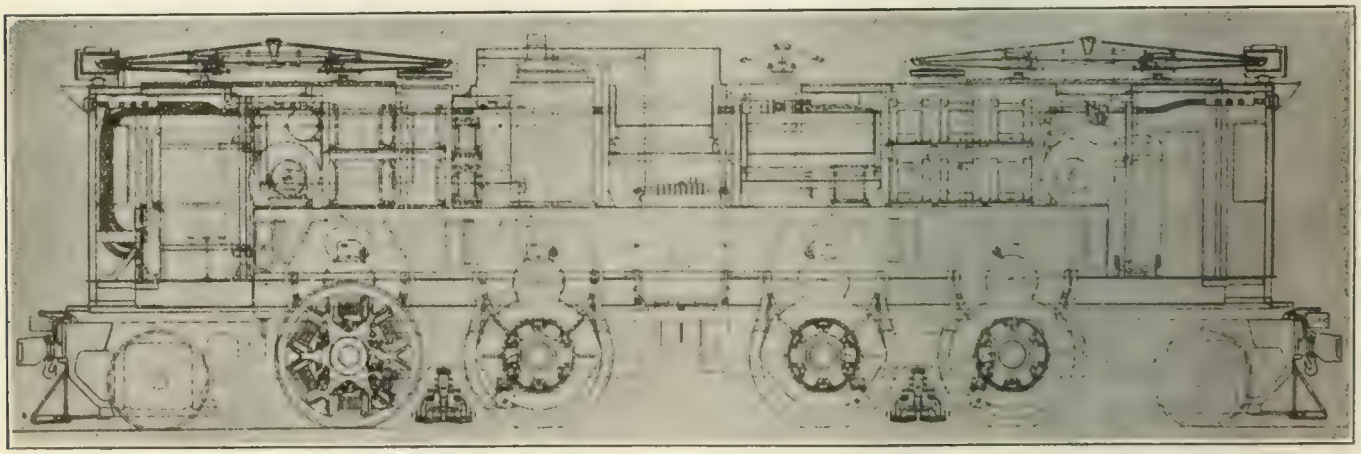


FIG. 1.—LONGITUDINAL SECTION OF ELECTRIC FREIGHT LOCOMOTIVE.

The motors are placed directly over the axles and are mounted solidly on the truck frames. Each end of the armature shaft is provided with a pinion; these mesh with gears mounted on a quill surounding the axle and carried in bearings on the motor frame, similar to the usual axle bearings. The quills are provided with six driving arms on each end, which project into spaces provided between the spokes in the driving wheels. Each of these arms is connected to an end of a helical spring, the other ends of the spring being connected to the driving wheels. This arrangement of drive smooths out the torque pulsations, and at the same time allows for vertical movement of the axles. In addition to the spring connection between the quills and drives, flexibility is provided between the pinions and motor shaft to equalize the torque on the gears. The quills are of large diameter, thus permitting unrestricted mo-

tion of the wheels and axles. The center of gravity of the motors, as well as that of the entire locomotive, is high, thereby avoiding the transmission of strains and shocks from the track and roadbed to the motors.

The motors are of the Lamme conductively compensated single-phase series type, similar to the motors on the earlier New Haven locomotives. They have 12 poles built into a solid frame, and are designed for forced ventilation. When operating on 25-cycle, alternating current, with forced ventilation, each of the four motors will carry continuously a load of 300 hp. An air-blast transformer is provided for lowering the trolley-line voltage to that required by the motors. The control apparatus is of the electro-pneumatic type, designed for use with 11,000-volt alternating current, or 600-volt direct current. When operating on alternating current, all four motors are connected in multiple and the control is obtained entirely by changing the connections to various voltage taps on the main transformer. On direct current the motors are first grouped all in series, and then two in series and two in parallel, in combination with various resistance steps. Provision is made for

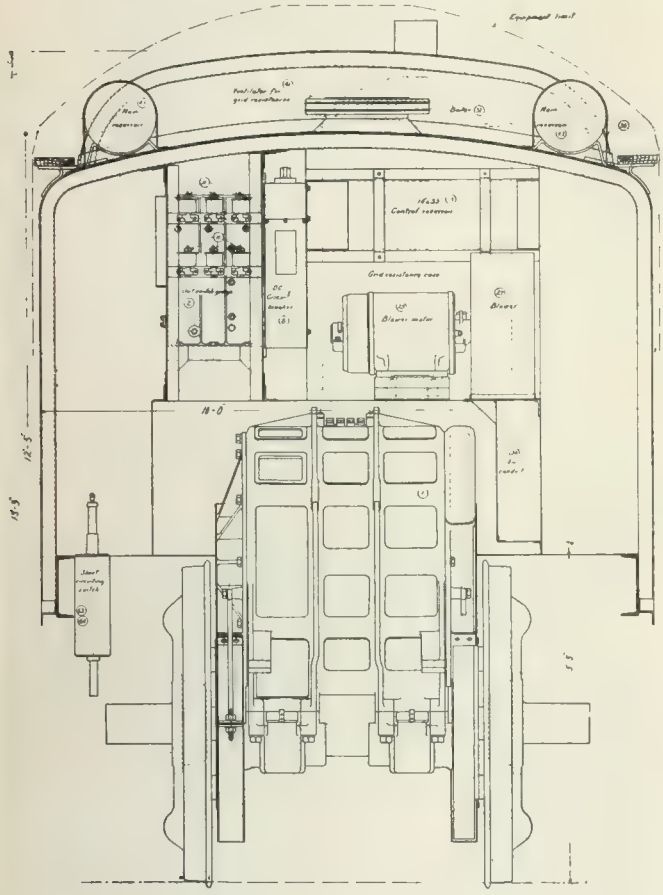


FIG. 2.—TRANSVERSE SECTION, ELECTRIC FREIGHT LOCOMOTIVE.

cutting out any one of the four motors singly on either alternating current or direct current.

A master controller and brake valve are located in each end of the cab so that the locomotive can be operated from either end, and the system of control is such that two or more locomotives of this type can be coupled together and operated from one master controller. The pneumatically operated pantograph trolleys are provided for collecting current from the 11,000-volt overhead alternating-current line. Pneumatically operated third-rail shoes are used to collect current on the direct-current third-rail section.

The locomotive will weigh approximately 260,000 lb., of which 188,000 lb. will be upon the driving wheels. It will be capable of hauling a freight train having a maximum weight of 1500 tons at a speed of 35 miles per hour. When used in passenger service, 800-ton trains will be hauled at a maximum speed of 45 miles per hour. A steam-heater outfit is provided on the locomotive for heating the cars of the trains when used in passenger service.

The drawings of the locomotive show the arrangement of control apparatus which, as will be seen, is located in the center of the cab with a passage on each side. The manufacturers expect to have the locomotive ready for service in the month of October.

CURRENT NEWS AND NOTES.

A. I. E. E. MEETING.—At the next meeting of the American Institute of Electrical Engineers, to be held on Oct. 8, Mr. John B. Taylor will present a paper entitled ""Telegraph and Telephone Systems as Affected by Alternating-Current Lines."

GEORGIA WATER-POWER.—The September issue of the *National Magazine* contains an article by Garnault Agassiz on the water-powers of Georgia. A number of these are described and the estimate given that the available water-powers of the State aggregate 500,000 hp at mean low water and 800,000 during the greater part of the year.

SAG IN TRANSMISSION LINES.—In an article by Mr. H. J. Glaubitz in our issue for March 25, 1909, entitled "A Quick Method for Determining Sags and Tensions in Transmission Lines," the definitions for the symbols x and x^1 should be interchanged. In the formulas derived, the former is the deflection in feet of the center of the cable at the temperature of erection, while the latter is the deflection in feet of the center of the cable when under the maximum stress.

CHARCOAL VS. ELECTRIC FLATIRONS.—A warrant has been sworn out for the arrest of an agent for a patent charcoal iron, who has created a peculiar situation in Clinton, Ind. A number of women who gave him orders for irons have been called up by the office of the local electric-light company, saying they want to exchange their charcoal irons for electric ones, declaring the agent told them "positively" that if they did not want to keep the iron he had arranged with the central-station company to take them in exchange for electric ones.

THE TELEPHONE FOR TRAIN DISPATCHING.—The Atchison, Topeka & Santa Fé Railroad has recently installed the telephone for train dispatching between Chicago and Newton, Kan., a distance of 659 miles. This equipment is but a small portion of what will be installed, it being the intention of the railroad company to extend this service over its entire system. At the present time there are 18 different divisions upon which the trains are dispatched by telephone. In this way 380 stations are reached in a total distance of 1925 miles. The Western Electric Company, which furnished the above equipment, has alone supplied over 50,000 telephones to various railroads throughout the United States.

PROPOSED BAVARIAN HYDROELECTRIC DEVELOPMENTS.—According to a consular report, the Bavarian Government will probably within the next few years commence the use of electric traction on its railroads. It is estimated that the water-powers of all the Bavarian rivers aggregate about 790,000 hp, of which about 425,000 hp would be needed if all the railway lines of the country should be electrified, and 600,000 if the lines it is proposed to build within the next 12 years are included. The introduction of electric traction will be gradual. Two plans for obtaining electric power in large quantities have recently been proposed. One is to take water from the Alz and conduct it by canal for 12½ miles for discharge into the Salzach, by which means a fall of 330 ft. would be secured, which would develop 25,000 hp for the whole year, or about 50,000 hp for about 200 days in the year. According to another plan, the waters from the Isar and the Riss would be conducted by separate canals into the Walchensee, a lake in the Bavarian Alps.

"THE GENERATOR."—The students of the New York Electrical School, 39 West Seventeenth Street, have begun the publication of a school organ named *The Generator.* Among the matter in the first issue is an article on dynamo and motor troubles.

BALTIMORE N. E. L. A. SECTION.—At the September meeting of the Baltimore Section of the National Electric Light Association Mr. Dorsey Smith, who has charge of the lamp room department of the Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., read a paper entitled "The Incandescent Lamp." The meeting was one of the most successful of the season.

CHAIR OF ENGINEERING AT MELBOURNE.—The British consul-general at New York asks us to announce that the Registrar of the University of Melbourne invites applications from the United States for appointment to the chair of engineering in that university. The salary attached is £1,000 per year. Applications for the vacant chair should be made to the British consul-general at New York, and all papers, etc., required must be received not later than Oct. 15.

SELDEN GASOLINE AUTOMOBILE PATENT SUSTAINED.—On Sept. 15 Judge Hough, of the U. S. Circuit Court in New York City, handed down an opinion sustaining the Selden patent, which broadly claims the combination of a gasoline engine with a vehicle. The decision does not affect steam motor-vehicles, which were entering largely into use just before the advent of the steam locomotive, nor electric automobiles, as no one appears to have thought of covering the latter with a combination patent. The decision will be appealed.

BRITISH ILLUMINATING ENGINEERING SOCIETY.—It is announced that Prof. S. P. Thompson has consented to become first president of the British Illuminating Engineering Society, recently organized. Among the vice-presidents are Drs. Louis Bell, A. H. Elliott and E. P. Hyde, of this country; Sir William Crookes and Profs. J. A. Fleming and Vivian Lewis, of England; Profs. A. Blondel and St. Claire Deville, of France; Drs. Emil Budde, H. Bunte and W. Voege, of Germany. The society will hold its opening session in November. The secretary is Mr. L. Gaster, 32 Victoria Street, London.

WINNIPEG (MAN.) ELECTRIC LIGHT SITUATION.—The controversy between the city of Winnipeg and the Winnipeg Electric Company is in much the same position as reported last week. It is understood the city is still refusing to issue permits for the erection of electric-light poles and the company has not made any application for permits, but is erecting the poles on its own responsibility. It is reported that the city electrician will be instructed not to issue any permits for wiring done in houses connected with pole lines which have been erected without civic permits.

GROWTH OF TELEPHONE BUSINESS IN CHICAGO.—Improvement in general business conditions seems to be indicated by the increasing number of new telephones installed by the Chicago Telephone Company. During August, 1909, the company put in 3770 telephones as compared with 3334 instruments for the corresponding month in 1908. The total number of telephones now in service in Chicago is 195,744, as compared with 173,472 a year ago. The total number of telephones connected to the whole system of the Telephone Company, both city and suburban, is 248,669, an increase for the year of 26,756.

A GREETING BY SCHOOL CHILDREN.—Sept. 16 was "Taft Day" in Chicago, so named from the visit of the President. One feature was the assembling of school children on the streets traversed by the distinguished guests in entering the city. It is said that 150,000 children greeted Mr. Taft in this manner. About 16,000 of the pupils were carried by the Chicago City Railway Company to and from their assigned destinations on the line of march without payment of fare at the time on showing their school badges. Afterward the Board of Education paid 5 cents each for the round trip of the school children, the teachers collecting the fare from the boys and girls.

PROPOSED MUNICIPAL PLANT FOR BALTIMORE.—Mr. Robert J. McCuen, superintendent of lamps and lighting, of Baltimore, Md., has for some months past been actively engaged in securing data of municipal lighting plants as operated in other cities, and will presently make a lengthy report on the advisability of erecting such a plant in Baltimore in view of the expiration of the present contract which the city has with the Consolidated Gas, Electric Light & Power Company. Under the present contract Baltimore is getting the benefit of very low rates, paying now $67.49 per street lamp that at one time cost as high as $125. Should the present rate be continued the installation of a city plant will probably not be considered.

ELECTRIC PUMPING FOR NIAGARA FALLS.—The board of water commissioners of Niagara Falls, N. Y., has decided to accept the offer of the Niagara Falls Hydraulic Power & Manufacturing Company to supply electric current necessary for the operation of its proposed new municipal water-pumping station for a term of 76 years. A part of the agreement is to be that the city will sell the power company the property in the lower milling district on which the municipal station now stands for $20,000. Over 800 hp will be acquired, the price to be $10 per horse-power. The engineer of the water board will see what arrangement can be made with the Niagara Falls Power Company for a breakdown power service. The city is engaged in building a new water system, the supply of which is to be taken from the upper river, whereas in the past the municipal plant has been supplied from the hydraulic canal.

TUNGSTEN VS. NAPHTHA STREET LAMPS IN BALTIMORE.—The Department of Lamps and Lighting, of Baltimore, Md., has announced that it is considering the installation of incandescent electric lamps in sections of the city now lighted by naphtha lamps. A report favoring the substitution has been made to the board of awards, and is now being held under advisement. It is recommended that the gas and electric company be given a five-year contract for energy for tungsten street lamps, which the company has offered to supply at $27.45 a lamp per annum from overhead wires, and $52.45 per lamp connected with the underground service, offering, however, to take off $20 per lamp if allowed to use the present arc cables in providing the incandescent service. In cases where the city owns the fixtures and has its own cables in the conduits, the company will furnish the service at $27.45 per lamp. This applies to the parks and boulevards.

BRITISH PATENTS ACT.—A U. S. consular report states that the result of the first year's working of the British patents act has been that $2,500,000 of foreign capital has been introduced into the United Kingdom, as the following indicates: The value of the land and premises acquired by foreign firms who have decided to carry on their manufactures in this country in order to maintain patent rights is estimated at $635,000. The expenditure for buildings was $880,000; plant and machinery, $895,000, making a total of $2,410,000. The annual local assessments on these new enterprises is estimated at $135,692. In addition, it is stated that a great many firms have arranged for English factories to manufacture their patented articles on a royalty basis. A specialist in factory property stated in a recently published interview that his firm was in negotiation with several German and American firms for the acquisition of sites and factories, principally in the chemical, engineering, electrical, and rubber-making trades, and that a French firm of pottery makers are seeking a site for a model village. He estimated that 24 firms are already manufacturing in Great Britain as a result of the act.



FIG. 1.—DOWNSTREAM SIDE OF SOUTHERN WISCONSIN POWER HOUSE FROM OPPOSITE BANK.

Hydroelectric Development on the Wisconsin River Near Kilbourn, Wis.

FOR many years the Dells of Wisconsin on the Wisconsin River near Kilbourn, Wis., have attracted many visitors by the beauty of the scenery. The river is contracted between rocky walls, and the shore formation, the curious rock shapes, the caves, and the rushing waters are decidedly picturesque. The water-power possibilities of the locality have also long been recognized, but it is only recently that a modern plant utilizing the volume and head of water for the generation of electricity has been placed in service by the Southern Wisconsin Power Company. The plant is rated at 6000 kw, and a brief description of it was published in the June 24 number.

It is expected that about 84,000 kw-hours per day will be delivered from this development over a 70-mile transmission line extending to a connection to the system of the Milwaukee Electric Railway & Light Company at Watertown, Wis. The latter company in turn will transmit the electrical energy about 50 miles farther to its center of distribution in Milwaukee, thus making the total length of transmission 120 miles. The new plant will be operated in parallel with the existing steam stations of the Milwaukee company. Considerable electrical energy will also be sold locally and along the transmission line. It is proposed to increase the size of the plant at a later date.



FIG. 2.—INTERIOR VIEW OF THE POWER STATION.

The character of the Wisconsin River is such that this stream is one of the most favorable in the Middle West for power development. The drainage basin above the site at Kilbourn covers approximately 7800 square miles and contains numerous lakes and large tracts of sandy country, while most of it is wooded. A steady run-off with a comparatively limited variation between the minimum and flood flows is consequently produced. The ordinary minimum flow is between 4000 cu. ft. and 5000 cu. ft. per second, and flood discharges of 40,000 cu. ft. to 45,000 cu. ft. per second may be expected in ordinary years, with an exceptional volume of 80,000 cu. ft. per second, or more, at long intervals. The minimum and maximum conditions are usually of comparatively short duration, however, and the average flow is well maintained.

A 90-deg. bend in the river, where a series of rapids formerly existed, forms a favorite location for the hydraulic development. A dam has been built across the channel, which was about 350 ft. wide at the power site, to develop a head of 17 ft. The power house with its headrace and penstocks is in an excavation made in solid rock on the left-hand, or east bank, of the stream entirely outside the channel. With the head, volume of water and pondage available, the present generating equipment can be operated throughout the year on a 10-hour or 14-hour basis, and during the most of the year the flow is such that a much greater output can be obtained. Hence, the installation of the proposed additional units is quite desirable, since the existing dam is sufficient to provide for them, and the expense involved in extending the head-works would be relatively small. At the same time these units would be of advantage as reserve. Furthermore, not only can all of the equipment of an enlarged plant be operated much of the year, but the existing steam plants in Milwaukee also are available for auxiliary power during periods of low flow.

At the site the stream flows through a continuous formation of Potsdam sandstone, the bed and both banks being of this material. The original depth of the river at the site of the dam ranged from 25 ft. to 35 ft., and its width was 350 ft., with both banks rising straight up to a height of 50 ft. to 70 ft. from the edge of the water. These conditions, combined with the large volume of flood discharge, required the full width of the channel to be utilized as a spillway. The power house, therefore, had to be placed in the excavation in one bank, where it is protected from flood. This location of the power house at the angle of the bend of the stream also secured considerable advantage in head by separating the tailraces from the discharge over the spillway.

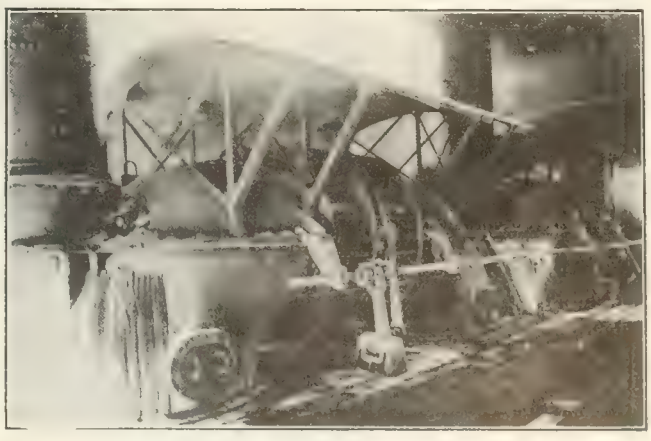


FIG. 3.—UMBRELLA COVERS OVER THE PAIRS OF TURBINES.

The dam across the river is a concrete structure on a rock-fill timber crib base. It has a total length of 400 ft., extending from a wide abutment wall adjoining the head works of the power house to an abutment built into the rock face of the opposite bank, and rises to a maximum height of 55 ft. above the bed of the stream. The dam is 48.5 ft. wide at the bottom. The concrete superstructure of the dam is built as a spillway, with its crest 6 ft. below the level at which the headwater in the pond above it will be maintained. Concrete piers placed 25 ft. 10 in. apart in the clear rise from this spillway to a height of 24 ft. above the latter, thus providing 12 large openings, with a total clear width of 300 ft., through which is passed all of the flow not utilized in the power house. Each of these openings contains a large vertical steel gate designed as a crest of adjustable height by means of which the water above the dam will be held at the stage desired. The lowering of the gates also will permit flood flows to be passed without raising the level of the pond beyond certain limits.

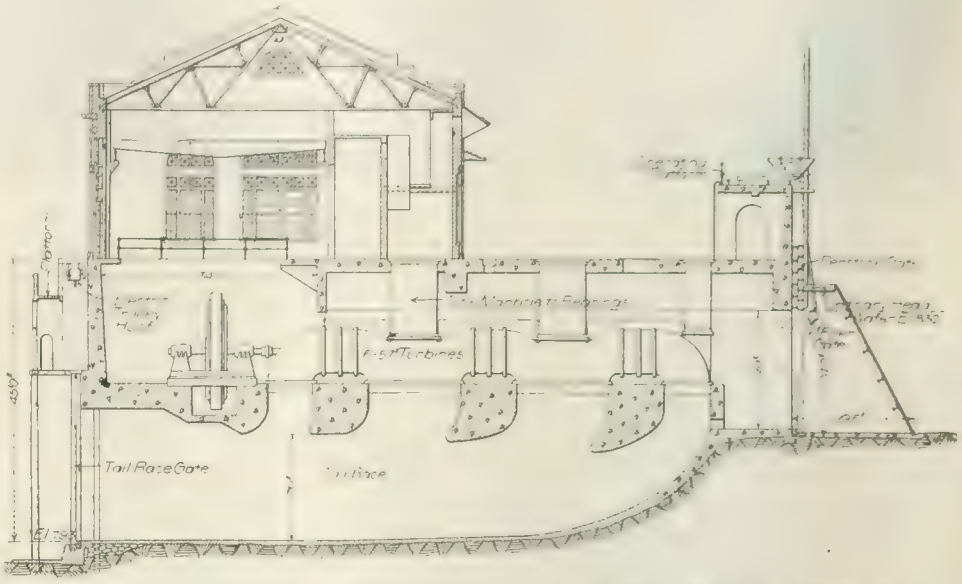


FIG. 5.—CROSS-SECTION OF GENERATING STATION THROUGH ONE MAIN PENSTOCK.

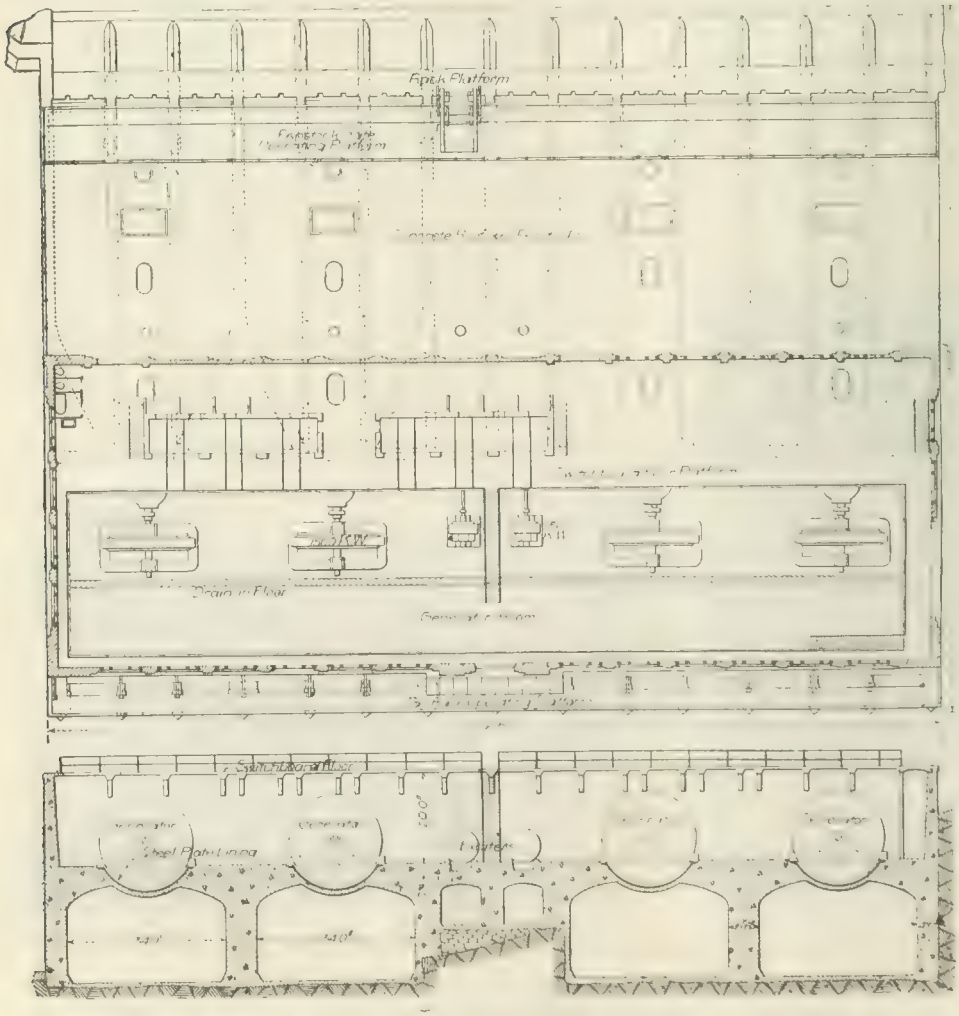


FIG. 4.—PLAN VIEW AND PART ELEVATION OF GENERATING STATION.

All the hoisting gears of the gates are arranged to be driven independently or collectively from a lineshaft 350 ft. long that extends the full width of the dam. This shaft, 2 13/16 in. in diameter, is geared to a 15-hp electric motor placed in a small brick house at the power house end of the dam. It is divided into 12 sections, and each of these sections, by means of friction clutches, can drive an intermediate shaft 24 ft. long. On these intermediate shafts are mounted the operating gears of two hoists to each gate. The hoists also are built so they can be operated by hand in an emergency.

Gates of this type were installed in preference to the bear-trap or any other movable-crest design on account of the large amount of sand carried by the stream. The accumulation of sand under the bear-trap gate has been found to cause much difficulty in other places where force enough to scour it out is not available.

Such parts of the spillway section as are exposed to ice are protected against damage. In order to cause cakes of ice to rise and ride over the dam, the upstream side of the gate openings are stepped, and in these steps are placed 12-in. x 12-in. timbers beveled and shod with steel plates. The crests of the gates are considered to be amply strong for any conditions that may arise. The curved face of the concrete on the downstream side of these gates is protected by 14-ft. lengths of old rail embedded in it, 2 ft. apart on centers, and following its curve. Beyond the end of the rails a plane of reinforcement consisting of ½-in. round rods, spaced 2 ft. apart in both directions, is designed to prevent damage to the concrete, and to provide for any stresses due to unequal settlement or other causes. Provision is made to shut off any one of the openings by means of vertical needles, in order that the gates may be reached and repaired.

A head-gate section, 120 ft. in length, extends upstream from the abutment at the power-house end of the dam, as shown in the accompanying general plan. The penstocks and the power house of the development occupy together an area 143.25 ft.

wide by 191.5 ft. long at the downstream end of the head-race, and are in an excavation that is a continuation of the one made for the latter. The penstocks and the substructure of the power house, which includes the tailraces, are built entirely of concrete on a foundation of solid rock. The power house

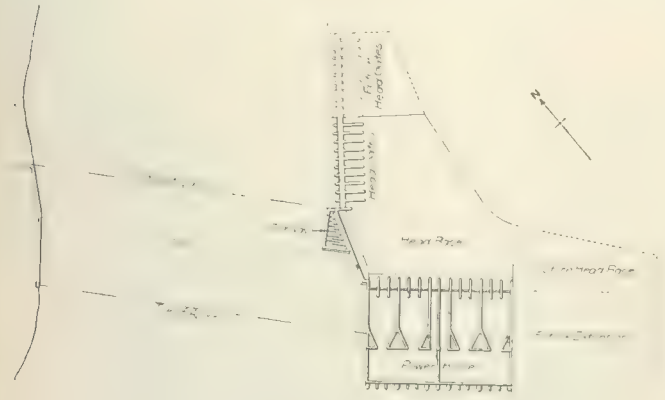


FIG. 6.—GENERAL PLAN OF DEVELOPMENT.

contains four main generators and two exciter units, waterwheels for each unit being placed in an individual penstock. The six separate penstocks thus provided are all built together in a row with concrete division walls between them. Two exciter penstocks, each 11 ft. wide in the clear, are at the middle of this row, with those for two main units, each 38 ft. wide in the clear on both sides of them. The gates controlling the entrances to the penstocks are in a continuous row along the upstream ends of the latter. Each of the small penstocks has a single gate, while three separate gates are provided for each of the larger ones.

The penstock gate openings are 19 ft. high by 11 ft. wide, and are each controlled by a steel grate in two parts; the lower leaf is 10 ft. 3 in. high and the upper left 9 ft. 10½ in. The lower gate seats on the bottom of the opening, and at the top overlaps the upper one 3 in. Stems attached to the outer side of the lower gate of each pair provide for the operation of the two by means of a rack and pinion driven through gears on a platform carried by the piers. The lower gate is raised until brackets on the inside of the bottom of it engage the bottom of the upper gate, and then the two are drawn up together. The rock-and-pinion mechanism is operated by means of a motor-driven crab traveling along the platform over the ends of the penstocks. A 16-in. inlet to each penstock is provided, in order to permit the pressure on the gates to be balanced before an attempt is made to open them. This inlet is fitted with a sluicegate controlled by hand from the operating platform.

The penstocks are 78 ft. long and extend 21 ft. inside the power house. They are covered 8 ft. above the ordinary level of water in the headrace with a tight reinforced concrete roof. The portion of the substructure of the power house not included in the penstocks also has tight reinforced concrete walls built to this height. The superstructure of the building is of pressed brick trimmed in stone and covered with a roof of red Ludowici tile carried by steel trusses. Skylights of glass tile placed in the roof provide, together with ample windows, good interior lighting.

On the downstream side of the interior of the building is the generator room, 34 ft. wide, that extends the full length of the building, with a clear height of 44 ft. under the roof trusses. The flat roof of the penstocks forms the floor of the remainder of the building at the rear, with a clear height of 24 ft. between it and the roof trusses. On this floor are placed the transformers, switching connections, switchboards and various auxiliary apparatus of the plant.

The waterwheels are of a modified McCormick type turbine, built and installed by the Wellman-Seaver-Morgan company, of Cleveland, Ohio. Each main generator is driven by six 57-in. turbines arranged in pairs on a single horizontal shaft. The six wheels of each set are designed to be capable of driving a 1500-kw generator at 25 per cent overload at 100 r.p.m., the generator having an efficiency of 90 per cent. The design provides that each six wheels will develop a maximum of 2778 hp when running 100 r.p.m. under 17 ft. effective head, and when operating under 12 ft. effective head will produce 60 per cent of the full capacity. The wheels at the two ends of the shaft discharge outwardly through separate quarter turns and draft tubes, while the other four wheels are arranged so the quarter turns for each two adjacent are combined into one draft tube. Four of the latter thus enter the tailrace, and the wheels are operated so that the thrust of each two is counter-balanced. For emergencies one thrust bearing is provided next to the generator, but it has been found in operation that there is always play in both directions at this bearing.



FIG. 7.—SPILLWAY SECTION OF DAM BEFORE GATES WERE PLACED.

The turbine shaft extends through a packing gland in a bulkhead in the downstream end of the penstock, and is direct-connected to the shaft of its respective generator. It is in three



FIG. 8.—HEADGATES AND SPILLWAY SECTION OF DAM DURING CONSTRUCTION.

sections, with one pair of gates mounted on each of the latter. The end section is of open-hearth steel, the middle one of nickel steel, and the one next to the generator of annealed nickel steel. This difference was made to obtain the greater

strength required to transmit the power of each additional pair of turbines without increasing the size of the shaft.

The gates of each set of turbines are controlled by a Lombard governor placed on the floor of the generator room. Power is transmitted from the governor to the gates by means of two cold-rolled steel draw rods connected to the shifting ring by cast-steel links and segments. These rods pass through packing boxes in the bulkhead at the end of the penstocks and are connected to the driving mechanism of their governor, which is located on the floor of the generator room.

Over each pair of runners is a curved steel umbrella cover designed specially for this installation, to prevent the formation of a vortex in the water over the turbine and the consequent admission of air to the latter. Each of these umbrella covers is carried by a light steel frame seated on the quarter turns of the turbines, and has a minimum clearance of 18 in. over the latter. Before the covers were adopted extensive experiments were made in the hydraulic laboratory at Holyoke, Mass., to determine their value. These investigations indicated that the use of covers of this type would permit the turbines to be placed much nearer the surface of the water, without reducing their efficiency, than if the covers were omitted. In this particular installation the wheels accordingly have been set between 3 ft. and 4 ft. above the limiting height for turbines of this type that operate without protection against the formation of a vortex above them. The results of the tests also showed that the employment of such covers will allow horizontal turbines to be installed for lower heads than have heretofore been considered practicable.



FIG. 9.—CROSS-SECTION OF DAM AND FISHWAY.

Each shaft is provided with six oil-ring bearings, one in each of the quarter turns and one in connection with the thrust bearing of the generator. These bearings are all supplied with oil from a pipe line under pressure from pumps at the generator floor level. Steel inspection tubes extend from manholes in the floor over the penstock down to each bearing in order that any one of the latter may be reached at all times.

Each exciter unit is driven by a pair of 33-in. Jolly-McCormick turbines set on one shaft. These turbines are designed to develop 250 hp when running at 200 r.p.m. under a 17-ft. head. Their efficiency is guaranteed not to drop more than 2.5 per cent from a full gate to a three-fourths gate opening. The operation of each pair of these turbines is controlled by a Lombard governor.

The tailraces of the main units are 34 ft. wide and have arched tops which span between the division walls of the penstocks. These arches form the floor of the generator room and carry to the sidewalls the heavy loads on that floor. The division walls between the adjacent tailraces are extended 9.25 ft. beyond the downstream face of the power house, and between the projecting ends of each two of these walls that are adjacent are placed two intermediate piers spaced equal distances apart. The downstream end of each main tailrace is thus divided into three openings, each 10 ft. wide and 21 ft. high in the clear.

Two-part gates very similar in design to those used to control the entrance to the penstocks are provided to close the ends of the tailraces. The tops of the intermediate piers and the projecting ends of the division walls are connected by a continuous concrete slab, on which piers are erected to carry the track of an electrically operated traveling hoist used in raising and lowering the gates. A continuous platform from which the hoist is operated also is placed on these piers.

The main generators are 1500-kw, 2300-volt, three-phase, 25-cycle General Electric machines designed to operate at 100 r.p.m., with a 90 per cent power factor. They are separately excited and Y-connected with the neutral brought out. The design provides for a 25 per cent continuous overload and 50 per cent overload for a period of one hour without an excessive rise in temperature. The shaft of each machine is mounted on two bearings carried by a base seated in the concrete floor of the room. A pit 5.75 ft. wide, and with a curved bottom giving it a maximum depth of 5 ft., is placed in the floor under each generator, in order that the shaft might be set at the proper height. This pit is lined with steel plates embedded in the concrete to make it water-tight.

Trenches are built in the floor of the generator room to collect and deliver to a sump any water that may reach that floor. Two motor-driven 3-in. pumps have been installed to lift the water from this sump and discharge it outside the building. These pumps are placed in niches provided on the upstream side of the generator room by the converging ends of the penstocks.

Two motor-driven 10-in. submerged centrifugal pumps are installed to unwater the tailraces in case the latter have to be entered. One of these pumps is placed in the sump in a niche between the penstocks of the two main units, and the second is in a similar location between the other two main penstocks. Both pumps can draw from the race on either side of them and discharge through a pipe laid in the floor to a point on the downstream side of the power house.

The operation of the generators, switching connections and auxiliary electrical apparatus installed in connection with them is governed from a remote-control switchboard. The latter is on the floor formed at the rear of the generator room by the roof of the penstocks, and is placed toward the river end of the building, where it will be located about midway between the two ends of the final building when the proposed extensions are made. The floor is carried 6 ft. over the wall of the generator room, and the board faces on this gallery, from which all of the equipment in the room can be seen.

Leads from the generators are carried to niches in the rear wall of the generator room in conduits embedded in the floor, and are thence connected to 2300-volt buses on the second floor at the rear of the building. Two complete sets of these buses with separate oil switches are installed on this floor directly over the switchboard. These buses are arranged so either of them may be operated entirely independent of the other, and both of them have sufficient capacity to serve all four main units. The current from each of the generators can be delivered to either set of buses independently.

Two banks of single-phase, 1000-kw, water-cooled General Electric transformers are installed to step the potential up to the transmission voltage. The three transformers in each of these banks are placed in adjacent separate compartments having concrete walls and tops with their front ends opening on the operating gallery. Each transformer is mounted on a four-wheeled truck on rails laid in the floor so it can be run out on the gallery under the range of a 30-ton hand-operated traveling crane that commands the entire floor of the generator room.

Cooling water for these transformers is furnished by pumps installed in the niches off the rear of the generator room. These pumps are in duplicate, and are arranged so they can draw a supply from any one of the four main penstocks. They discharge into separate piping systems, which are interconnected to permit any one of the three pumps provided to deliver to either or both of the two banks of transformers.

The 2300-volt current is delivered to the transformers from the buses through varnished cambric cables. The latter, reaching to the more remote bank, are placed together in a pipe suspended from the roof trusses, but only a short length is required to reach the other bank. The transformers are at present designed to step the voltage up to 44,000 volts, but in the future this voltage will be raised to 70,000 volts. Two transmission lines lead out of the station, and the connections for both banks of transformers are arranged so either or both of them can deliver to either or both lines.

All of the 2300-volt and 44,000-volt buses, oil switches and auxiliary apparatus are placed in separate fireproof compartments. The compartments for the 2300-volt buses with their corresponding oil switches are placed together, but are so separated that either set of them can be operated entirely independent of the other.

The duplicate transmission lines of this company, extending a distance of 70 miles to Watertown, are carried on one set of steel towers, built by the Aermotor Company, of Chicago. The towers range from 60 ft. to 90 ft. in height, and under normal

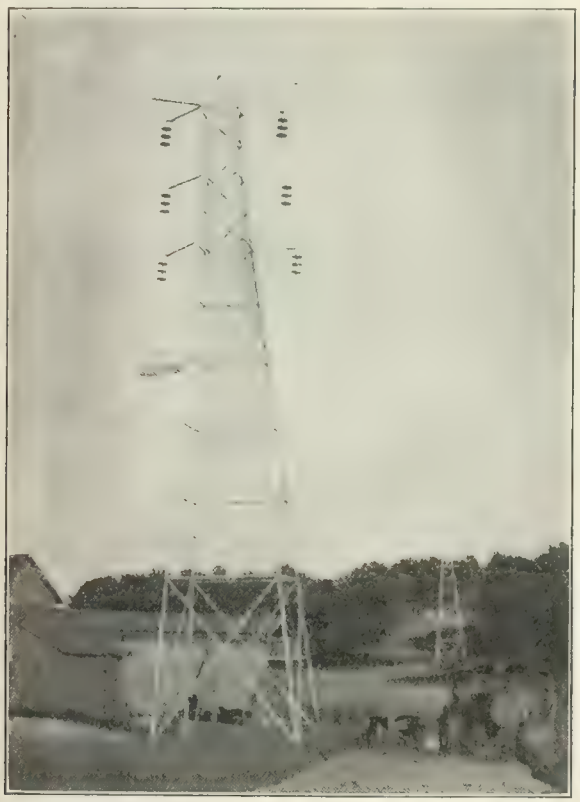
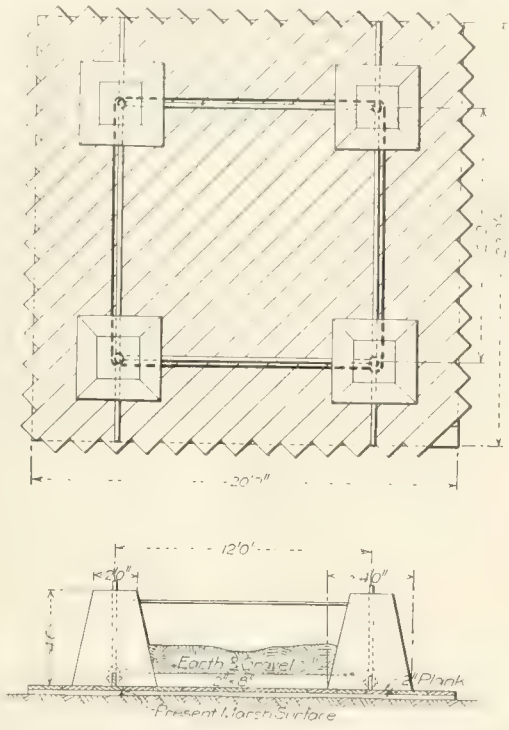


FIG. 10.—A VIEW OF THE TRANSMISSION LINE.

conditions are spaced 10 to the mile. The base of the leg of each tower is anchored to a concrete pedestal 2 ft. square at the top, 4.5 ft. high and 4 ft. square at the bottom. As the line crosses a large number of swamps, the provision of a satisfactory foundation for the base of these tall, heavy towers involved serious difficulties. The pedestals are placed at the corners of a 12-ft. square, and where marshes were encountered a platform, consisting of two layers of 2-in. plank placed diagonally with respect to each other, was laid on the existing surface of the marsh. The anchor bolt to which the bottom of each tower leg is fastened was then attached to a 2-in. x 8-in. plank spiked on edge to this platform, and each extending the width of the latter. Then the concrete pedestals were built up around these anchors. The pedestals also were tied together around the sides of the square by ½-in. rods warped around the anchors 6 in. below the top of the concrete.

The transmission wires are hung from brackets on opposite sides of the tops of the towers by means of suspension insulators. The three wires of each line are in a vertical plane in



FIGS. 11 AND 12.—PLAN AND SECTIONAL ELEVATION OF TOWER. PLATFORM IN MARSHES.

which they are spaced 72 in. apart. Stranded Roebling cables, consisting of six No. 0 hard-drawn copper wires around a hemp center, are used. The insulators are of the Thomas petticoat suspension type, 12 in. in diameter, and are designed to withstand pressures up to 75,000 volts. They also were built to stand a test of 53,000 volts with water dropping on them at the rate of 1 in. in five minutes at an angle of 45 deg. In strength they were required to stand a direct pull of 5000 lb.

The officers of the Southern Wisconsin Power Company are: President, Mr. M. Swenson; Mr. H. P. Broughton, chief engineer; Mr. Daniel W. Mead, chief engineer. The power development was designed and built under the immediate direction of Mr. Mead, and Mr. C. V. Seastone, as principal assistant engineer, had charge of the design and construction. Mr. R. C. Walter was resident engineer during the construction of the plant. The electrical equipment of the entire development was furnished and installed by the General Electric Company. Mr. George M. Brill, of Chicago, was consulting electrical engineer.

Self-Starting Single-Phase Motor.

A patent issued Sept. 14 to Mr. B. G. Lamme describes a resistance-lead arrangement and short-circuiting scheme for starting a single-phase motor as an eight-pole commutator machine and operating it as a four-pole induction motor. The stator winding is arranged to produce either eight or four magnetic poles, as desired. The pitch of the armature coils is intermediate the polar pitches for the larger and smaller number of field poles, and is of such a value that the maximum obtainable e.m.f. is given in the armature for both number of poles. In order to reduce the amount of sparking when starting or running at low speed as an eight-pole commutator machine high-resistance leads are inserted between the commutator segments and the armature coils, which are closed upon themselves. For the purpose of short-circuiting the rotor winding upon itself when operating at high speed with four poles, cross-connectors join together the terminals of armature coils that have equipotential position when operating with eight poles.

Oakland (Cal.) Steam Auxiliary Station for Great Western Power Company.

THROUGH an affiliated corporation, the Great Western Power Company, of San Francisco, has almost completed a steam-operated power station for generating electricity at Oakland, Cal., across the bay from San Francisco. As described in the Aug. 26 and Sept. 16 issues, the Great Western Power Company operates about 180 miles of transmission lines for bringing to San Francisco and other cities power developed from water-powers in California. Although installed primarily as a reserve plant, there being also a terminal station in Oakland, no effort has been spared to secure a high standard of efficiency and reliability to meet the severe requirements of operation that are imposed on a plant of this kind. It is expected that the first unit will be ready for service about July 1, the remainder of the initial installation coming into use later.

In the choice of equipment apparatus has been selected which represents the principles of late development in central-station practice. The station will contain three 3500-kw horizontal Curtis turbo-generators, with space for a fourth unit of the same size. Electricity at 11,000 volts, three-phase, 60-cycle will be generated, and part of it will be transmitted to the Oakland substation of the Great Western Power Company, the remainder being distributed directly from the generating plant. Simplicity is a marked feature of this plant. The general arrangement may be seen by reference to the accompanying drawings, showing a plan and cross-section. Fuel oil will be burned under the boilers, and although it is expected that at first the plant will be operated only a part of the time, as needed, it may be run continuously or quickly put into operation or shut down, as the demands of the business may require.

Several features in the design of the station building are unique, and it is believed that the structure is well adapted for the purpose for which it is planned. The building is nearly square and is about 155 ft. x 134 ft. in ground dimensions. The foundation consists of a reinforced-concrete monolith, 6 ft. thick, supported on piles driven about 3 ft. apart throughout the entire building area. The machinery may be placed on this concrete foundation in any position desired. The superstructure is of steel-frame construction, with reinforced-concrete walls. Very large windows are used, and these, together with the skylights and monitors, will give an abundance of light and air. The windows, doors, skylights, etc., are constructed entirely of metal and wire-glass, there being no wood or other inflammable material used in the entire structure. A light steel framing is placed in all walls between the main columns. This framing conforms to the outline of the building, and furnishes a support for the metal-lath reinforcement. The concrete was put on in the form of plaster and applied from both sides.

It will be noted that the boilers are laid out in a line parallel to and occupying the same relative space as the turbines. The arrangement of machinery is such as to make each unit independent. The condenser auxiliaries, boiler-feed pumps and the feed-water heater serving two units are grouped together, thus reducing the necessary operating attendance. As shown in the cross-section drawing, there is a basement under the turbine-room, and the floor of this basement is on the same level as the floor of the boiler-room. The condenser for each turbine is located immediately beneath it in an opening provided in the foundation, making a very compact arrangement. As the plant is located on San Francisco Bay, salt water is used for condensing purposes. The arrangement of the circulating water tunnels, especially in the construction of the center partition, is such as to minimize the amount of excavation and concrete work.

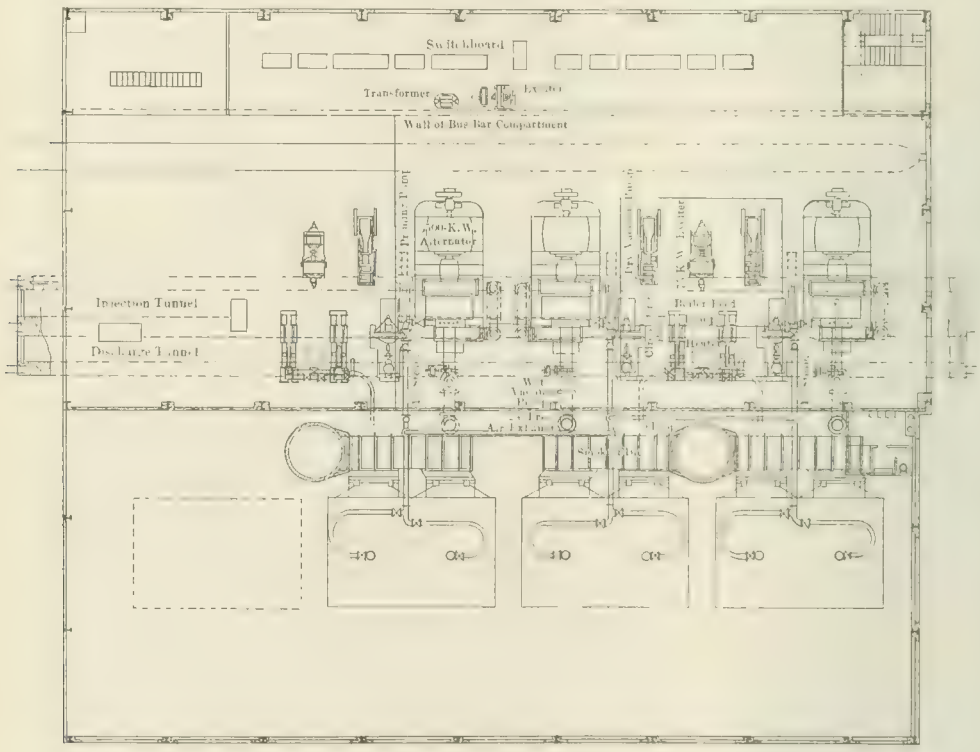


FIG. I.—GENERAL PLAN OF OAKLAND POWER STATION.

Fuel oil will be relied upon exclusively for the operation of the station. The main storage tank will have a capacity of 10,500 bbl., and will supply auxiliary storage tanks immediately adjacent to the building. From these tanks the oil is piped to the boiler furnaces, and there are four Hamill oil burners for each boiler. Six Babcock & Wilcox boilers will be installed. They will have 6000 sq. ft. of heating surface each. These boilers will be of the vertical-header type, of steel construction throughout, and designed for a maximum operating pressure of 225 lb. per square inch. Superheaters will be provided with sufficient surface to maintain 125 deg. Fahr. when the boiler is operating at or near the rated output.

Two self-supporting steel smokestacks will be installed, each of sufficient capacity for four boilers. These stacks are 9 ft. 6 in. inside diameter and 150 ft. in height above the boiler-room floor. The smoke flues, which are of steel construction, are provided with sliding cut-off dampers, in addition to the butterfly damper at the outlet of the boiler, for cutting down the standby losses.

Three horizontal Curtis turbo-generator units are furnished by the General Electric Company. These machines have a maximum continuous rating of 3500 kw each, and are designed for operation at a steam pressure of 210 lb. with superheat at 110 deg. Fahr. The steam turbines are five-stage machines. The generators have six poles and are wound for delivering three-phase, 60-cycle current at a potential of 11,000 volts. Ventilation of the windings is provided by a small blast fan mounted on the end of the shaft. The field rheostat and the governor of the turbine are both arranged for remote electrical control. Lubrication of the bearings will be accomplished by means of an oil pump geared to the main shaft. An oil reservoir is arranged in the face of the turbine and provided with the necessary cooling coils. The principal dimensions

of the turbo-generator are as follows: Length over-all, 30 ft.; width, 14 ft.; height, 12 ft. The total net weight is 250,000 lb. Special interest attaches to these units from the fact that they are the largest horizontal machines of the Curtis type which have been installed up to this time. The speed of operation is 1200 r.p.m.

Three 75-kw exciters are to be provided. Two will be driven by small Curtis steam turbines, and the third by an induction motor. The electrical energy for this motor, as well as for the motors for an overhead traveling crane in the turbine-room, will be supplied from a 110-kw, 11,000/400-volt transformer.

The condensing equipment for the plant will consist of three 8000-sq. ft. Alberger counter-current condensers. Each condenser will be furnished with auxiliaries as follows: One 16-in. centrifugal circulating pump, designed for a capacity of 6800 gal. per minute, and driven by a vertical enclosed Blake engine; one rotative single-stage dry-vacuum pump, and one turbine-driven centrifugal wet-vacuum pump. Connection between turbine and condenser is made by means of a corrugated copper Wainwright expansion joint, which provides for the expansion and contraction due to changes of temperature. One rather interesting feature of the condenser arrangement consists in the location of the atmospheric exhaust, which is connected directly into the upper part of the condenser shell, thus obviating the necessity of allowing the extra clearance space for a separate exhaust connection.

All the auxiliaries are designed for operation under the conditions of pressure and superheat mentioned for the turbines. Independent pumps have been provided for priming the condensers, so that no salt water will enter the boilers. As an additional safeguard against fouling the boilers, the closed type of feed-water heater has been selected, thereby eliminating the possibility of oil finding its way into the boiler. The arrangement of the plant is such that one heater will take care of the supply for two of the turbines. These heaters are of cast-iron construction and cylindrical in shape. The heating surface consists of 1600 sq. ft. of brass tubing, ¾ in. in outer diameter. The arrangement is such that the water makes two passes through the heater.

The boiler-feed pumps will be of the duplex outside-end-packed type, designed for a capacity of 250 gal. a minute. The water ends of these pumps are of steel construction and provided with bronze plungers. These pumps are supplied by the Epping-Carpenter Company.

Although not shown on the drawings, the station will be equipped with a 30-ton, four-motor, overhead traveling crane, with 5-ton auxiliary hoist. The Niles-Bement-Pond Company, contractors for the crane, will equip it with three-phase, 440-volt induction motors.

Simplicity characterizes the piping layout. In the arrangement of the live-steam piping, a 10-in. header serves to connect each turbine with two boilers. These headers are tied together by 6-in. loops. Four-in. auxiliary steam headers are connected directly into the main headers adjacent to the throttle valves on the turbines. The arrangement of the steam piping to auxiliaries is such that all the water of condensation will drain through the cylinders of the boiler-feed pumps, which will do away with the necessity for high-pressure steam traps in the station. The steam supplied to the small oil pumps will be throttled through a reducing valve, cutting the pressure from 210 lb. to 100 lb. The flanges on all live-steam piping are of steel. All flanges 3 in. in diameter and over will be welded to the pipe. All fittings on live steam lines will be annealed steel castings.

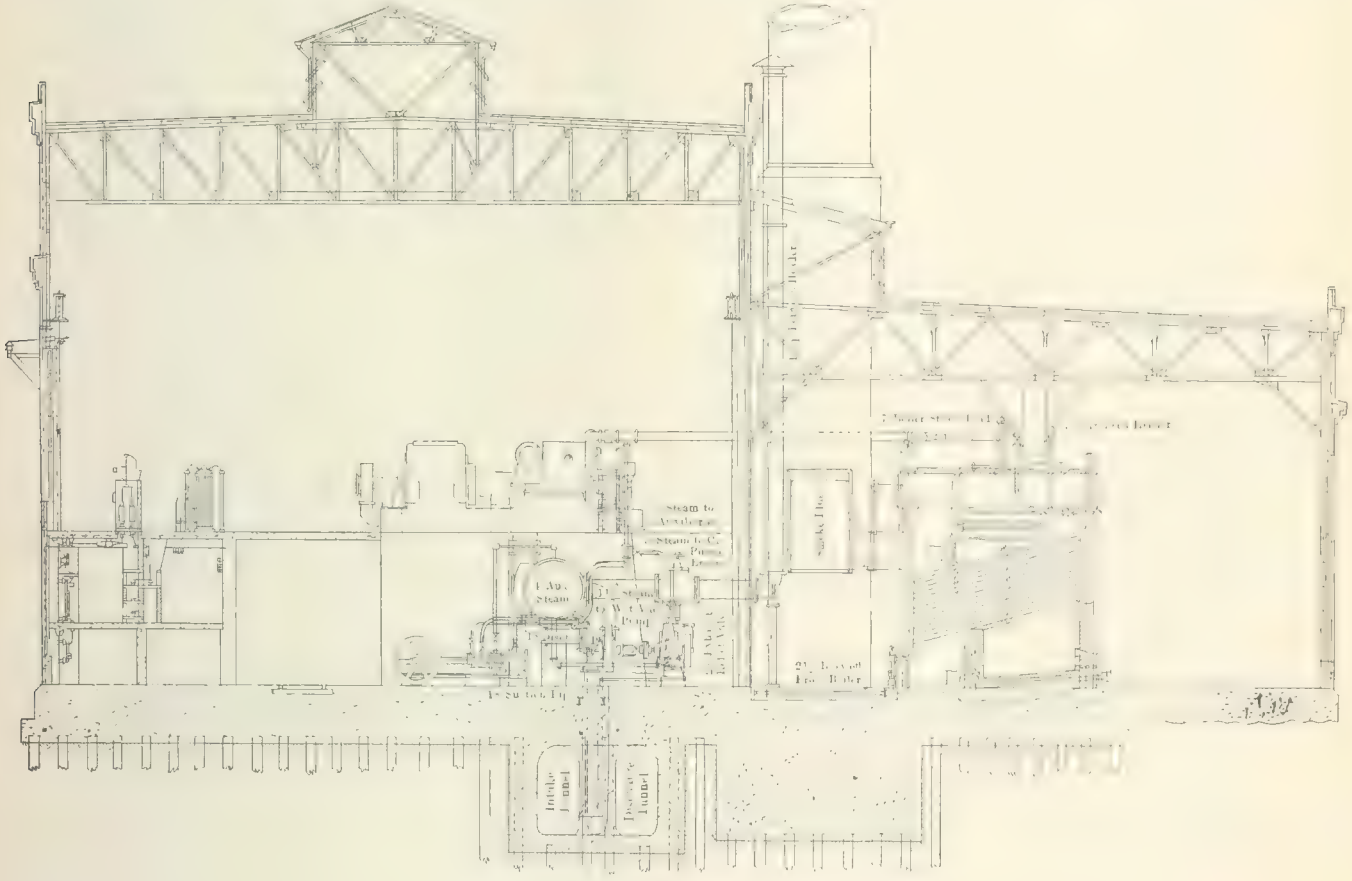


FIG. 2.—CROSS-SECTION OF OAKLAND POWER STATION.

The switchboard is of the remote-control benchboard type. The busbars will be located in compartments beneath the oil-switch cells. The switchboard will consist of three generator panels, three exciter panels, one station panel, six feeder panels and one bus-sectionalizing panel. The lightning-arrester equipment will be of the multi-gap type, and will be located beneath the operating floor of the turbine-room. Viele, Blackwell & Buck, of New York, are the engineers in charge of the development of the Great Western power system, Sargent & Lundy, of Chicago, being retained as consulting engineers for the design of the steam-power plant.

White Light from the Mercury Arc and Its Complementary.

By Herbert E. Ives.

ATTEMPTS have been made to modify the color and unpleasant illuminating characteristics of the mercury-vapor arc by the addition of yellower light sources. The first light used for this purpose was that from the carbon-glow lamp. More recently, in an article which appeared since the present investigation was started, the use of a tungsten lamp was described.[1]

In the present paper is recorded an experimental investigation of the proper light source to be combined with the mercury arc in order to imitate average daylight, following which is a determination of the relative intensities of mercury-arc light and the added light to secure the best effect.

In another article,[2] the writer has considered the question of producing white light by screening some of the more common illuminants. The problem of combining lights to produce white can be treated by use of the same data and in a similar manner. As, however, the only case at present occurring of lights suitable for this purpose is that of the mercury arc and its complementary, this was reserved for separate detailed discussion and experimental test.

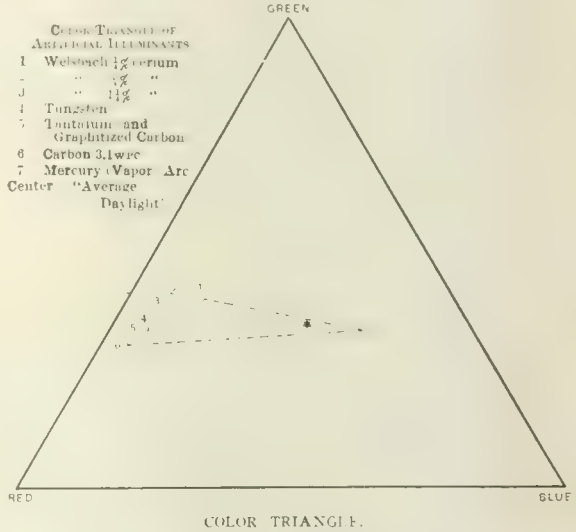
The complementary of the mercury arc may be determined by direct application of color theory to experimentally obtained color values, as, for instance, spectrophotometer data. First, find the spectrum hue of the mercury arc; secondly, find the complementary hue, or hue to be added to produce white; then select a light having that dominant hue. From the color sensation values of the light from the two sources, and the intensity values of the sensations, the candle-power relations of the two to give white are calculable. On carrying through this work the rather unexpected result was obtained that the best combination was that of the mercury arc with a Welsbach gas lamp; unexpected, because the usual criticism of both illuminants is on the ground of their green color, or illuminating effect.

In the present investigation a method similar in principle to the above outlined theoretical discussion was used, differing from it, however, in that it affords an opportunity to make an exact experimental comparison of the combination decided upon with the standard white it is desired to imitate. The Ives colorimeter was employed, together with Maxwell's color triangle.

The Ives colorimeter, designed by Frederic E. Ives, is essentially a color-mixing machine, mixing red, green and blue lights to produce a visual match with the color measured. White being taken as equal parts red, green and blue, other colors are numerically described by the proportionate parts of the three primaries which mix to match them. The lights from various sources have been measured by the writer, among them daylight of various qualities, and the light of the artificial illuminants compare with the average of the daylight measurements as a standard.[3] By means of the light of several of the illuminants which were measured in that investigation it is possible, at any time, to determine the setting of the instrument to give "average daylight," and then compare any artificial white light with it. This possibility made available a verification of the correctness of the work here outlined; had there been no more scientific method of attaining the end, a purely experimental mixing of the light from various sources could have been tried and the best mixture selected. As stated above, use was made of Maxwell's color triangle to guide to the proper selection of complementary to the mercury arc. As the color triangle and its properties are not widely known, a paragraph may be devoted to it.

If the red, green and blue, which, when mixed make white, be represented by the vertices of an equilateral triangle, then all points within the triangle can represent mixtures of red, green and blue in various proportions. Use is made of the property of an equilateral triangle that the sum of the perpendicular distances of any point from the three sides is constant and is equal to the altitude. The red, green and blue representing a color are so expressed that their sum equals the altitude of the triangle, in convenient units. If, then, the vertical distance of a point from the side opposite, say, the red vertex, represents the amount of red, and similarly for green and blue, every color is represented by a point in the triangle. Colors matched by mixing two primaries lie on the sides; white (equal parts of the three primaries) lies at the center. The most important property for the present investigation is this: Mixtures of two colors are represented by points on the line joining the two, therefore two colors which lie on opposite ends of a line through the center are complementary—that is, will mix to produce white.

The illustration shows a color triangle in which the red, green and blue are the primaries of the Ives colorimeter when used



COLOR TRIANGLE.

as described in the paper referred to. The lights from the various sources measured are plotted from the values in the accompanying table, where the values are expressed so that their sum = 100 = altitude of triangle. These figures are from new measurements made for this paper.

COLORIMETER MEASUREMENTS OF THE LIGHTS OF ILLUMINANTS.

	Red.	Green.	Blue.	Candle-power to 1 c.p. of mercury light	Specific consumption of combination
1—Welsbach, ¼ per cent cerium	48.7	38.3	13.0	...	...
2—Welsbach, 1% per cent cerium	54.0	37.4	8.6	.57	..
3—Welsbach, 1¼ per cent cerium	57.5	35.5	7.0	...	...
4—Tungsten incandescent lamp, 1½ wpc	61.3	31.7	6.9	.54	0.8 wpc
5—Tantalum incandescent lamp, 2.0 wpc	64.6	30.4	5.0	...	...
(Similar in color to Gem 2.5 wpc)					
6—Carbon incandescent lamp, 3.1 wpc	68.7	29.8	4.5	.50	1.4 wpc
7—Mercury arc lamp	24.1	31.4	44.5	...	...

An interesting fact brought out by this diagram is that all of the ordinary light sources, from 3.1-watt carbon lamp to the "greenest" Welsbach (¼ per cent cerium), lie so nearly opposite the mercury arc that a respectable white may be produced by mixing any one of them with it in the proper proportion. The light lying most nearly opposite the mercury arc is the Welsbach mantle as supplied for residential lighting, namely with ¾ per cent cerium; of the incandescent electric lamps the tungsten is nearest the ideal complementary.

The results obtained from the diagram were checked experimentally for the three cases considered of most interest—the

[1] A. J. Marshall. *Transactions* of the Illuminating Engineering Society, April, 1909.

[2] *Illuminating Engineer*, August, 1909.

[3] *Transactions* of the Illuminating Engineering Society, November, 1909.

Welsbach, the tungsten and the 3.1-watt carbon lamp. The first two not only come the nearest to the proper hue, but because of their efficiency and cheapness are distinctly practical possibilities. A mercury-vapor lamp was provided with an adjustable cardboard shutter so that more or less mercury light could illuminate the plane of measurement. The Welsbach and the incandescent electric lamps were placed, in succession, directly before the tube and immediately below the opening in the shutter. In this way it was possible to vary the mixing proportions at will. The colorimeter was adjusted by measurements on incandescent electric lamps of known color values, so that one-half its field showed "average daylight," then the shutter over the mercury tube was raised or lowered—the intensity match being preserved by opening or closing the comparison slit of the colorimeter—until the nearest match was found. With the Welsbach and tungsten it was found possible to obtain an extremely close match, the Welsbach match tending slightly toward green and the tungsten toward pink, but by such small amounts that the slight differences of adjustment in several such experiments made simultaneously at one time one and at another time the other mixture appear a perfect match with the standard. The light from the carbon lamp formed, with that of the mercury arc, a decidedly pinkish mixture. The indications of the color triangle were, therefore, borne out.

For practical purposes the important information to be derived from such an experiment is the candle-power relations between the two lights to be mixed. To ascertain these it was necessary to measure the relative intensity of each component illumination as actually obtained on the surface observed during the measurement. The most convenient method was to extinguish each of the two lamps used for a mixture in turn and measure the illumination from the remaining one. As unit of intensity, the green light of the colorimeter was taken; that is, the red and blue slits were closed, the green slit opened until an intensity match was found and the opening of the slit was read. This, of course, involved comparison of two fields of widely different colors. By taking numerous readings and checking the results by the fact that the sum of the two intensities agreed closely with the intensity of the mixture measured in the same way, sufficient accuracy was obtained, it is believed, for the present purpose.

The values found were as follows: To 1 cp from a mercury-arc lamp should be added, to make white, 0.57 cp of Welbach, 0.54 cp of tungsten, 0.50 cp of 3.1-watt carbon. Practically therefore, one may say that to the light from a mercury arc a little over half the candle-power of Welsbach, tungsten or carbon lamp must be added to secure white.

It is interesting to compare these figures with those given by Mr. A. J. Marshall in the installation above referred to. There the proportions were: Mercury vapor, 200 cp; tungsten, 80 cp; a smaller proportion of tungsten than here found best.

Several points in connection with the character of this composite white light should be emphasized. It must not be forgotten that daylight is extremely variable in color and that the combination of lights here investigated can only claim to be a more definite guide than has hitherto been given to the proportions for a match of the integral color to an average daylight. Further, it is, of course, only the integral color that appears white to the eye; analysis reveals the mercury line spectrum superposed on a continuous background strongest in the red. Because of the partly non-continuous character of the spectrum of such compound light, one must expect some deficiencies when it is used as an illuminant of colored objects. The chief defect of the mercury arc alone—its entire deficiency in red—should, however, be largely overcome. Because of the peculiarity of the eye that it quickly adapts its scale of color values to the color of the illuminant, it is much more important, in the writer's opinion, that the illuminant should preserve certain color values to which the eye is sensitive than that its integral color should be a perfect subjective white. In other words, the eye quickly adjusts itself to the belief that a light is "white" even if the light is measurably yellower or pinker than a standard, such as average daylight or sunlight, but rebels at a distortion of its new scale of color values. Therefore, preference should be given to that illuminant of this character which favors preservation of color values to which the eye is particularly sensitive, such as the color of flesh, lips and other commonly observed objects.

The combinations under discussion were investigated for their color-rendering values by observing their effect on various colored silks, plaids, colored prints, flesh, etc. The color values were, on the whole, found to be very well preserved; immeasurably more so than with the mercury arc alone, and much better for blues than with the yellower sources alone. A slight accentuation of purples and a spraying of very deep reds was observable with both combinations—Welsbach and tungsten—but ordinary reds, browns, yellows, greens and blues behaved excellently. The tungsten lamp, with its larger proportion of deep red, is appreciably better in this combination than is the Welsbach, judged by this criterion. For the best results in color rendering, apart from the integral color of the mixture, a larger proportion of the tungsten light, rather than a smaller, might be recommended, because, as remarked above, the resultant pinkish character of the white would be less noticed by the eye than the disturbance of the scale of color values which occurs with a deficiency of continuous spectrum background. The behavior of the carbon lamp is similar to the tungsten, although the integral color is too pink to be called a good white.

The results of the above investigation are as follows: The lights from the Welsbach gas and the tungsten electric lamps are shown to be most nearly complementary in color, of the ordinary illuminants, to the mercury arc; the proportions in which their light should be added to the light of the mercury arc to produce white are determined; study of the color-rendering values of the resultant mixtures indicates that the tungsten combination is the more desirable, and that the proportions given may be considered a lower limit to the amount of tungsten light to be added for satisfactory illumination of colored objects. The incandescent carbon lamp was also investigated and compared with the others in this combination.

An approximate idea of the efficiency of the combination of mercury-arc and incandescent lamps is easily obtained. The power consumption for the tungsten-mercury combination, assuming 1.25 watts per candle for the tungsten and 0.55 watt for the Cooper Hewitt, is 1.22 watts for 1.54 cp, the specific consumption being, therefore, 0.80 watt per candle. For the 3.1-watt carbon-lamp combination the specific consumption is 1.4 watts per candle. Therefore, the tungsten-mercury combination is not only nearer white, but much more efficient than the carbon-lamp combination used at first. A comparison of the Welsbach-mercury combination cannot be made on a specific consumption basis, but consideration of expense causes this combination to compare closely with the mercury-tungsten combination.

Luminosity and Temperature.

By P. G. Nutting.

With light expressed in terms of radiation and radiation a given function of temperature and wave-length, light or luminosity is expressible directly in terms of temperature. These relations of light to radiation and of radiation to temperature have recently received considerable attention. Assuming them to be known, it is well to ascertain what may be done toward establishing the direct relation of luminosity to temperature. The numerical values of some of the constants involved are not known with sufficient precision to permit of very precise numerical deductions, but the general relations developed below show the interrelations of the various quantities involved. The relation of greatest practical interest is that of luminous efficiency to temperature.

Previous work has been limited to portions of the general problem. There are some good experimental determinations of the amount of light (monochromatic and total), but no one appears to have attacked the general problem directly.

Paschen and Wanner[1] in 1899 used a photometric method for determining the second constant of the Wien-Paschen radiation function.

$$J = c_1 \lambda^{-n} e^{-c_2/\lambda T}$$

c_1, c_2 and n being constants, λ wave length and T absolute temperature. Working at constant wave-length they wrote this in the form,

$$\log J = r_1 - \frac{r_2}{T}$$

or for two different temperatures, T_1 and T_2,

$$\log \frac{J_1}{J_2} = r_2 \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$$

r_1 and r_2 being constants. Assuming light proportional to radiation they computed r_2 for four different wave-lengths from their data. The limitations of this assumption will be discussed lated on.

Lummer and Kurlbaum[2] studied the photometric brightness of a hole in a heated opaque envelope as a function of the temperature. They compared the total light with that from a constant source. They expressed their results in the form

$$\frac{H_1}{H_2} = \left(\frac{T_1}{T_2} \right)^x$$

H being brightness, T temperature and x an unknown variable having the following values:

$T =$	900	1000	1100	1200	1400	1600	1900
$x =$	30	25	21	19	18	15	14

They state that x approaches the value 12, but this is not apparent from the plotted curve, and later Rasch showed that their equation was essentially defective, as noted below.

Lummer and Pungsheim[3] then took up the absolute measurement of the total light in hefners emitted by a square mm of a perforation in such an opaque envelope. They found:

Temp.	Hefners per sq. mm.
1175° C	0.0042 H
1325	0.0220
1435	0.0635

and extrapolated

1500° C	0.1 H (about)
1700	0.5
1800	1.0

but did not attempt any theoretical foundation for their results. This work was later greatly extended by Nernst[4] using an iridium furnace cross-checked by an auxiliary heated rod of oxide. He obtained for the light in hefners per square millimeter:

Temp. absolute.	Light.	Temp. absolute.	Light
1464	0.005	2357	4.0
1524	0.01	2446	6.0
1685	0.05	2516	8.0
1764	0.1	2571	10.
1982	0.5	2619	12.
2092	1.0	2680	15.
2217	2.0	2763	20.

His measurements extended to about 2290 abs. The above values were obtained from the relation

$$\log H = B - \frac{A}{T}$$

where H is hefners per square millimeter, T is absolute temperature, $B = 5.367$ and $A = 11{,}230$, the constants being determined from observations between 1400 and 2200. Temperature measurements were made with a Wanner pyrometer, an instrument based on the monochromatic Paschen-Wanner relation mentioned above. His observations then indicate that the monochromatic and total light emission of a complete radiator between 1400 and 2200 differ only by a constant factor.

Rasch[5] appears to have been the first to attempt a rational foundation for the relation of luminosity to temperature. Since retinal action is essentially a chemical process, he reasoned that the thermal equation of chemical equilibrium should apply, the luminous sensation being related to retinal temperature and this again to the rate of absorption of energy. In Van't Hoff's reaction isochore

$$\frac{dK}{K} = -\frac{q}{R} \frac{dT}{T^2}$$

he replaces the equilibrium constant K by brightness H, and the constants $-q/r$ by κ. Hence, by integration,

$$\log H = c - \frac{\kappa}{T}$$

$$\log \frac{H_2}{H_1} = \kappa \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$$

This indicates that the quantity x in Lummer's equation above is $x = \kappa/T$, and hence is not a constant nor does it approach a constant value. It will be noticed that Rasch's equations are the same in form and but slightly different in interpretation from those of Paschen and Wanner.

Rasch computed a mean value of $\kappa = 26{,}750$ from Lummer and Kurlbaum's data. Lucas,[6] from the relation $\kappa = c_2/\lambda$ and c_2 (the second constant of the Wien-Paschen equation) $= 14{,}500$, finds for λ the value 0.542μ, an equivalent mean wave-length in dealing with total light.

Goldhammer,[7] from the data of König on visual sensibility, and the work of Rasch just mentioned, derived the function,

$$V = \left(\frac{\lambda_0}{\lambda} e^{1 - \frac{\lambda_0}{\lambda}} \right)^m$$

to represent the ratio of light to radiation at each wave-length, λ_0 being the wave-length of maximum sensibility and m a constant varying from 150 to 300 for different individuals. Both λ_0 and m are found to vary somewhat with the intensity of the radiation. Goldhammer recognized that it was necessary to introduce this auxiliary function visibility of radiation (V) to convert radiation into light. He multiplied the above function V by the Wien-Paschen function $J = c_1 \lambda^{-5} e^{-c_2/\lambda T}$ and thus obtained for the total light from a complete radiator

$$H = a \left(\frac{T}{T + b} \right)^n$$

a, b and n being constants. He did not attempt to construct a visibility function to represent the average human eye. The one he did construct contains the large exponent m, and is always steeper on the blue side of the maximum, while the experimental curves are steeper on either side in about equal numbers. It differs only in its constants from the Wien-Paschen function for non-selective radiation.

The writer[8] has developed a visibility function of the form

$$V = V_0 e^{-\kappa (\lambda - \lambda_m)^2}$$

to represent the sensibility of the average human eye. Here V_0 is a constant depending upon the units employed, κ is 4.6 at low intensities (<0.05 meter-candle) and 2.0 at high (>10 meter-candle), while λ_m, the wave-length of maximum sensibility, is similarly 0.511μ at low intensities (rod vision) and 0.565μ at high (cone vision).

If the light is expressed in meter-candles and the radiation in meter-watts per unit wave-length, then V_0 is the number of candles per watt at the wave-length of maximum sensibility, $\lambda = \lambda_m$, for here $L = EV$ becomes $L = EV_0$. To find this ratio of light to radiation it is only necessary to measure the same monochromatic radiation as light and as power. This ratio the author found to be 13.5 candles per watt, while Drysdale[9] found 16.7. König's data on visual sensibility indicates that this ratio is a constant except for intensities ranging from about 0.3 meter-candle up to 30 meter-candles, which is the range during which the transition from rod to cone vision occurs.

Visibility then is the constant of proportionality between radiation and light. It varies enormously with the wave-length, but at constant wave-length is constant at very high and very low intensities with an uncertainty slightly larger than the pos-

[1] *Sitz*, Berlin, Ak. 2, 5-11; 1899.
[2] *Verh. Ph. Ges.*, 2, 89-90; 1900.
[3] *Ph. Zeit.*, 3, 97-100; 1901.
[4] *Ph. Zeit.*, 7, 380-383; June 1, 1906.
[5] *Ann. Physik*, 14, 193-203; May, 1904.
[6] *Ph. Zeit.*, 6, 19-20; Jan. 1, 1906.
[7] *Ann. Physik*, 16, 621-652; April, 1905.
[8] *The Electrical World*, June 27, 1908. *Bulletin*, Bureau of Standards, Vol. 5, 261-305; 1908.
[9] *Proc.* Royal Society, 80, 19-25; 1907.

sible curve in its determination through a small range of moderate intensities. By light is here meant not visual sensation, but photometric brightness, something that is constant when the sensation is constant, the quantity dealt with in ordinary photometry.

The visibility function may now be applied to known types of radiation. The best known is the non-selective radiation from the interior of a nearly closed cavity having opaque walls. This is known to be related to wave-length and the temperature of the radiator by the Planck function.

$$E_\lambda = \frac{c_1\lambda^{-n}}{e^{c_2/\lambda T} - 1}$$

This is difficult to handle, but if it is expanded in a power series, the first term is the Wien-Paschen function

$$E_\lambda = c_1\lambda^{-n}e^{-c_2/\lambda T} \qquad (1)$$

which is sufficiently accurate in dealing with the short wave-lengths of the visible spectrum. Multiplying this by the visibility function,

$$V = V_0 e^{-\kappa(\lambda-\lambda_m)^2} \qquad (2)$$

the product is the desired relation between luminosity and temperature.

$$L = EV = C_1V_0\lambda^{-n}e^{-c_2/\lambda T - \kappa(\lambda-\lambda_m)^2} \qquad (3)$$

Hence the isochromatic relation (λ constant) is of the form

$$\log L = A - B/T, \qquad (4)$$

where

$$A = \log(C_1V_0\lambda^{-n}) - \kappa(\lambda-\lambda_m)^2,$$

and

$$B = C_2/\lambda.$$

The value of the constant B is seen to be independent of the form of the visibility function, while the constant A is not. Moreover, the form of (4) does not in any way depend upon the form of the visibility function, but only upon the form of the emission function, $E(\lambda,T)$.

From (4) may be deduced the relative temperatures at which the various spectral colors appear. For $L = 1$, the temperatures at which complete radiators will attain a specific luminosity of one light unit (the threshold value in this case) per unit wave-length will be given by

$$T_0 = \frac{B}{A} = \frac{c_2/\lambda}{\log(C_1V_0\lambda^{-n}) - \kappa(\lambda-\lambda_m)^2}$$

from which T_0 may be calculated for each wave-length.

Equation (4) assumes a constant wave-length, hence it can apply only to a limited spectral region at a time. The reason that it has been found (by Nernst and others) experimentally to hold approximately for total light emission is that for a complete radiator 90 per cent of the light is confined to a spectral region only 0.1 μ broad, because of the narrow form of the visibility curve. The fact that both κ and λ_m vary considerably with intensity is of no consequence so long as the product $\kappa(\lambda-\lambda_m)^2$ remains constant.

The relation between total light emission and temperature is obtained by integrating $EVd\lambda$ from zero to infinity. In the form (3) above it is not readily integrable, but using the alternative form[10] of visibility function,

$$V = V_0\left(\frac{\lambda_m}{\lambda}\right)^\gamma e^\gamma\left(1-\frac{\lambda_m}{\lambda}\right) \qquad (5)$$

the product, EV, may be easily integrated in the form

$$L = \int_0^\infty EVd\lambda = C_1V_0\lambda_m^\gamma e^\gamma\,\Gamma(n+\gamma-1)\left(\frac{c_2}{T}+\gamma\lambda_m\right)^{-(n+\gamma-1)} \qquad (6)$$

which is of the simple form

$$L = A\left(\frac{B}{T}+1\right)^{-p} \qquad (7)$$

where

$$A = C_1V_0\lambda_m^\gamma e^\gamma\,\Gamma(n+\gamma-1)(\gamma\lambda_m)^{-p} = C_1V_0\left(\frac{B}{c_2}\right)^{n-1}\sqrt{2n\gamma}\,\frac{\Gamma(n+\gamma-1)}{\Gamma(\gamma+1)}$$

$$B = c_2/\gamma\lambda_m.$$

$$p = n+\gamma-1$$

[10] *Bulletin*, Bureau of Standards, Vol. 5, p. 277.

This expression for the light emitted applies to any body whose radiation is expressible by equation (1) viewed by any eye whose chromatic sensibility may be represented by equation (5); that is, it is of general application to incandescent elementary solids.

Defining luminous efficiency F as the ratio of the total light emitted to the total power radiated from the same area, from (1) and (7),

$$F = \int_0^\infty EVd\lambda : \int_0^\infty Ed\lambda = A\left(\frac{B}{T}+1\right)^{-p} : aT^{n-1} \qquad (8)$$

Since

$$\int_0^\infty Ed\lambda = c_1\left(\frac{T}{c_2}\right)^{n-1}\Gamma(n-1) = aT^{n-1},$$

Equation (8) may be reduced to

$$F = V_e\sqrt{2\pi\gamma}B^{n-1}\,\frac{\Gamma(n+\gamma-1)}{\Gamma(\gamma+1)\,\Gamma(n-1)}\,\frac{T^\gamma}{(B+T)^{n+\gamma-1}}$$

by means of the relation

$$\Gamma(x+1) = x^xe^{-x}\sqrt{2\pi x}\left(1+\frac{1}{12x}+\frac{1}{288x^2}+\cdots\right)$$

a form more convenient for computation.

Since γ is greater than 100, the series in parentheses has the value unity to within 0.001. The luminous efficiency has a maximum value

$$F_m = V_0\left(\frac{n-1}{n+\gamma-1}\right)^{1/2} \qquad (9)$$

at a temperature

$$T_m = B\,\frac{\gamma}{n-1} = \frac{C_2}{(n-1)\lambda_m} \qquad (10)$$

The numerical values of all the constants in (6) and (8) have been determined, but in no case with great precision. From König's data on visual sensibility,[11] γ may be calculated to be 120 ± 10, a pure number with an uncertainty of about 10 units. The wave-length of maximum visual sensibility is $0.565 \pm 0.005\mu$. General average values of γ and λ_m for a large number of individuals might lie outside even those limits of uncertainty, but it is hardly probable. The values here quoted apply to cone vision. For low intensities (rod vision) γ is about 300, while $\lambda_m = 0.511\mu$, but the value of V_0 has not been determined, so that one is unable, at present, to compute the luminosity of very faint sources and weak reflected light.

For enclosed radiators of the "black-body" type $C_2 = 14{,}500 \pm 300$ when wave-lengths are in microns (μ) and temperatures in Centigrade degrees absolute, $n = 5$, an integer, so far as known. For other bodies n varies from 5.5 to 7. Coblentz[12] for an untreated carbon filament found n to be from 5.2 to 6.5 (decreasing with increase in temperatures), for platinum $n = 6$ to 8, "metallized" carbon $n = 5.8$ to 6.0, silicon carbide $n = 6.4$. For lamps run at normal voltage, he found for:

"Metallized" carbon	$n = 6.1$
Tantalum	$n = 6.3$
Tungsten	$n = 6.6$
Osmium	$n = 6.9$

For radiation from a cavity or "black body," then, the temperature of maximum luminous efficiency is

$$T_m = \frac{14{,}500}{(5-1)\times 0.565} = 6420 \text{ deg.} \pm 200 \text{ deg. abs.}$$

the value of the corresponding specific output in candles per watt being

$$F_m = 15\left(\frac{5-1}{5+120-1}\right)^{1/2} = 2.7 \pm 0.2.$$

The value of $V_0 = 15.0$ is the mean of the values of Drysdale (16.5) and the author (13.5), and the uncertainty in the result

[11] *Bulletin*, Bureau of Standards, Vol. 5, p. 279.

[12] *Bulletin*, Bureau of Standards, Vol. 5, p. 339.

is due chiefly to the uncertainty in this value. This result indicates that such a radiator could give at best (6420 deg.) only about 18 per cent as much light as it would if all its radiation were confined to yellow-green.

At a temperature of 2000 deg. abs. (1727 deg. C.) the computed luminous efficiency is

$T = 2000°$ abs. $C_2 = 14{,}500$ $\gamma = 120$ $V_0 = 15.0$

n	5.0	6.0	7.0
Spec. output.....	.055	2.09	5.05

The first case ($n = 5$) corresponds to a perfect radiator or black body. This table is made on the assumption of C_2 constant. Very little is known as to its variation with temperature and with the substance radiating. Lummer and Pringsheim's results indicate that for a given substance C_2 varies in proportion to n, so that

$$\lambda_{max} T = C_2/n = \text{constant}$$

and they give for platinum $C_2 = 15{,}600$. For platinum then at 2000 deg. abs. = 1727 deg. C., just below the melting point, the specific output is 0.121 candle per watt.

The variation of luminous efficiency with temperature

$$\frac{\delta F}{\delta T} = F\left(\frac{\gamma}{T} - \frac{n+\gamma-1}{B+T}\right)$$

is not very rapid at high temperatures, so that (8) could hardly be applied to advantage to the measurement of temperatures nor could it be applied to the determination of the visual constant γ. The variation of F in candles per watt with γ is for

$n = 5$, $T = 2000$ deg. abs., $V = 15.0$

$V =$	120.	110.	100.
$F =$	.051	.058	.062

Its most useful field appears to be in the determination of C_2, with which F varies rapidly

The agreement of the above-calculated efficiencies with observed values are sufficiently close to give formula (8) considerable weight. The rapid increase in computed efficiency with the constant n, shown above, is quite in accord with experience with the new incandescent electric lamps and Coblentz values of this constant for such lamps.

Design of Illuminating Installations Using Luminous Tubes.

By M. D. Cooper.

IT is of importance to the illuminating engineer to be able to predetermine with a considerable degree of accuracy the amount and distribution of the illumination produced by a given system of lamps. In the case of concentrated light sources, such as arc, incandescent and gas lamps, the methods of predetermination are well known. Given the polar candle-power distribution curve of the lamp, the illumination produced at a point on the reference plane can be determined as the candle-power in the direction of the point divided by the square of the distance to the point and multiplied by the cosine of the angle of incidence of the ray of light on the reference plane.

The above method of calculation assumes the validity of the two fundamental laws of photometry, namely, the inverse square law, which states that the illumination produced by a point source is inversely proportional to the square of the distance from the source; and Lambert's cosine law, which states that the intensity of radiation from a radiating surface varies as the cosine of the angle of emission. The truth of the first law is self-evident if the rectilinear propagation of light is assumed. Lambert's cosine law was deduced from the observation that a uniformly bright sphere, when viewed at a distance, appears to be a uniformly bright disk. This law is applicable only to small elements of a surface. Lambert's law of intensity of radiation from a surface applies with the same restriction to the illumination of a surface by incident light. Hence, in the above method of computing illumination, the cosine law holds, for it is only an element of the reference plane that is under consideration. The error introduced by the use of the inverse square law can usually be neglected, for experiment proves that when the distance from a lamp is greater than 10 times the maximum dimension of the light source, the actual illumination always differs by less than 2 per cent from that computed by the inverse square method.

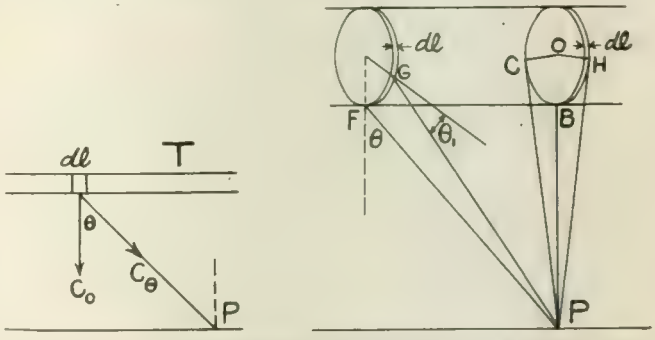
It becomes evident, therefore, that the ordinary method of illumination calculation cannot be applied to distributed light sources, such as Moore tubes and long mercury-vapor lamps. In the present article there will be derived a method of calculation which can be applied to such illuminants.

In Fig. 1 let T represent a section of a luminous tube and P be a point at which it is desired to find the illumination. If the candle-power of the element dl in the direction $dl—P$ is known it will be a simple matter to write an expression for the illumination produced at P by the element dl. Integration over the length of the tube would then give the total illumination at the point P.

Theoretical Considerations.

At first glance it would appear that the cosine law could be applied to the cylindrical element, or that $C_\theta = C_0 \cos \Theta$, C_θ being the candle-power in the direction $dl—P$, and C_0 the normal candle-power of the cylindrical element.

The assumption of the cosine law would be warranted if the tube could be considered equivalent to a flat radiating strip of



FIGS. 1 AND 2.—DETERMINING ILLUMINATION AT A GIVEN POINT.

a width equal in diameter of the tube, but the curvature of the tube surface tends to make such an assumption inaccurate.

If, however, the tube is considered as a solid radiating cylinder, the relations are more involved. Inspection of Fig. 2 will show what results can be anticipated in this case. To calculate the normal candle-power of an element dl at B, a summation would be made of the luminous intensities in the direction of P of elementary areas of the strip dl. As the summation would be carried over only the arc HBC, the computed normal candle-power, C_0, would be less than when considering the tube equivalent to a flat strip. For an element dl at F, C_θ will be less than $C_0 \cos \Theta$, because at all points other than F, Θ_1 will be greater than Θ. This consideration leads to the conclusion that C_θ, Fig. 1, will be somewhat less than $C_0 \cos \Theta$.

The tube is not, however, a solid radiating body, but gives light by the luminosity of a gas, hence consideration on this latter basis will lead to more correct conclusions. Experiment proves that an open gas flame gives nearly the same candle-power in all horizontal directions, indicating that the luminous intensity of a radiating gas depends primarily on the number of luminous particles contributing light, and only in a very secondary degree upon the alignment of these particles. This fact would seem to indicate that the intermolecular spaces are so great compared to the size of the molecules that there is practically no interference with free radiation from each and every molecule.

This line of reasoning affords another method of ascertaining C_θ. The candle-power along any line can be assumed to be proportional to the length of this line inside the tube. Refraction need not be considered, as the rays of light will suffer merely a slight lateral displacement and will not be changed in direction on passing the walls of the tube. With these facts

in mind, inspection of Fig. 2 will now show that C_θ will be at least equal to $C_o \cos \Theta$, if not actually greater.

Assuming, as a fair approximation, that the cosine law can be applied, the integration for the total illumination at P, Fig. 1, will be performed.

APPLICATION OF COSINE LAW.

Let Fig. 3 represent a length of tube and P be the point at which it is desired to determine the illumination. Furthermore, let

C = total candle-power of tube, interpreted physically as the candle-power measured at an infinite distance.
L = length of tube, in feet.
h = height above reference plane, in feet.
s = slant distance from P to tube, in feet.
l = distance (parallel to tube) from P to element dl.
ω = angle between ray P-dl and normal to reference plane.
Θ = angle between ray P-dl and normal to tube.
ϕ = angle subtended at P by the tube.
β = angle between s and h.

Assuming the cosine relation, $C_\theta = C_o \cos \Theta$, to be correct

$$C_o = \frac{C}{L}\, dl$$

$$C_\theta = \frac{C}{L}\, dl \cos \Theta$$

The element dl of the tube will contribute to the illumination at P an element

$$dY = \left(\frac{C}{L}\, dl \cos \Theta\right)\left(\frac{1}{z^2}\right)(\cos \omega)$$
$$= \frac{C}{L}\, dl\, \frac{s}{z}\frac{1}{z^2}\frac{h}{z}$$
$$= \frac{C}{L}\, \frac{sh}{z^4}\, dl$$

Noting that $x = \sqrt{s^2 + l^2}$, the illumination at P due to the part l_1 of the tube becomes

$$Y_1 = \frac{Csh}{L}\int_o^{l_1} \frac{dl}{(s^2 + l^2)^2}$$
$$= \frac{Csh}{L}\left[\frac{l}{2s^2(s^2 + l^2)} + \frac{1}{2s^3}\tan^{-1}\frac{l}{s}\right]$$
$$= \frac{Ch}{2Ls^2}\left[\frac{sl_1}{s^2 + l_1^2} + \phi_1\right]$$

Putting l_2 for l_1 there would result Y_2 due to the part l_2 of the tube, whence addition gives the total illumination at P as

$$Y = \frac{Ch}{2Ls^2}\left[\phi_1 + \phi_2 + \frac{sl_1}{s^2 + l_1^2} + \frac{sl_2}{s^2 + l_2^2}\right]$$
$$= \frac{Ch}{2Ls^2}\left[\phi + \frac{s}{L}\left[\frac{\frac{l_1}{L}}{\left[\frac{s}{L}\right]^2 + \left[\frac{l_1}{L}\right]^2} + \frac{\frac{l_2}{L}}{\left[\frac{s}{L}\right]^2 + \left[\frac{l_2}{L}\right]^2}\right]\right]$$

Let $m = \frac{s}{L}$, the ratio of the slant height from P to the total length of the tube, and let $p = \frac{l_1}{L}$, the fractional distance from the end of the tube. It will be well at this point to emphasize the significance of these two ratios, as they appear throughout all the later work and furnish a key to its complete understanding. Substituting in these ratios,

$$Y = \frac{Ch}{2Ls^2}\left[\phi + m\left(\frac{p}{p^2 + m^2} - \frac{1 - p}{(1 - p)^2 + m^2}\right)\right] \qquad (1)$$

Then

$$Y = \frac{Ch}{2Ls^2}K = \frac{C}{2L}\frac{h}{s^2}K \qquad (2)$$

in which expression the constant K depends for its value only on the relative, rather than the actual, dimensions of the tube installation. $\frac{C}{2L}$ is half of the candle-power per foot, $\frac{h}{s^2}$ is constant for any line on the reference plane parallel to the tube, and K varies for different positions along such a line.

It becomes then a simple matter to explore the reference plane in investigating the illumination produced by the tube. A line can be taken parallel to the tube, $\frac{C}{2L} \cdot \frac{h}{s^2}$ determined for this line, and values of K can be obtained from Fig. 4 for points along the line; multiplication of these two quantities will give the value of the illumination at the points selected. The curves of Fig. 4 are plotted from data computed from equation 1. Different values of m were assumed, ϕ was ascertained from a graphical construction, and the remainder of the expression for K was computed by slide rule. As K is the

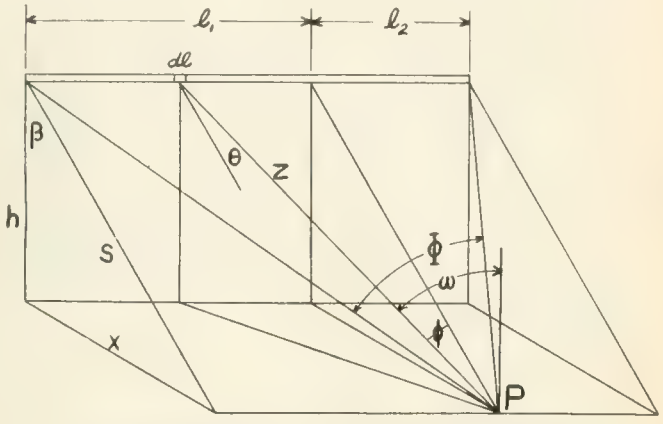


FIG. 3.—SPACE DIAGRAM OF ILLUMINATION RELATIONS.

only variable in equation (2) when a line parallel to the tube is under consideration, the curves of Fig. 4 show the variation of illumination along such a line. The curves of Fig. 5 are derived from those of Fig. 4, p being the variable parameter instead of m. With the two sets of curves, double interpolation is made possible, and K can be determined for any and all values of p and m. In order to facilitate extended computations, values of the expression $\frac{h}{s^2}$ may be derived for various heights of tube h and various distances x out from a line directly underneath the tube. These values can be arranged for reference in the form of a table.

It is interesting to consider the case of the illumination on

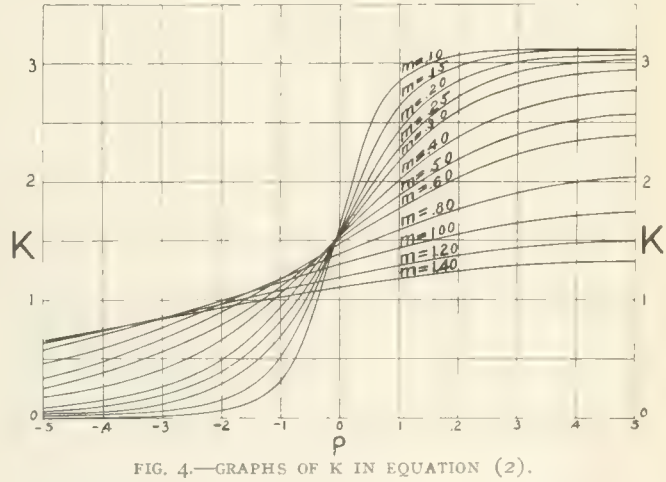


FIG. 4.—GRAPHS OF K IN EQUATION (2).

the line directly beneath the tube. For this condition $s = h$ and equation 1 becomes

$$Y = \frac{C}{2Lh}\left[\phi + m\left(\frac{p}{p^2 + m^2} + \frac{1 - p}{(1 - p)^2 + m^2}\right)\right]$$

Apparently the general formula (1) can be derived from the above by multiplication by $\frac{h^2}{s^2}$, or $\cos^2 \beta$. As the point P moves out from a position directly underneath the tube, however, m and ϕ change and the corresponding curve of K becomes of lower value (beneath the tube; perhaps higher beyond the tube ends), and more nearly horizontal. Thus, by

moving out from positions beneath the tube the illumination is decreased somewhat more than by the multiplier $\cos^2 \beta$.

PHOTOMETRY OF TUBULAR LAMPS.

In order to apply formula (1) it is necessary to know the candle-power per foot of the tube to be considered. To determine this quantity experimentally the tube might be covered with black cloth or paper, leaving exposed a length of a

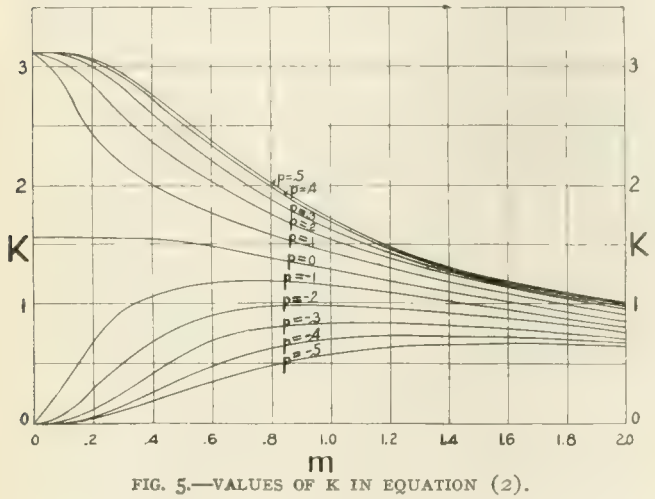


FIG. 5.—VALUES OF K IN EQUATION (2).

foot, say. Any ordinary photometer could then be used to determine the candle-power of the exposed section.

If the tube is at right angles to the photometer bar, p in equation (3) becomes 0.5 and the equation reduces to

$$Y_a = \frac{C}{2Lh}\left[\phi + m\left(\frac{1}{m^2 + .25}\right)\right]$$

$$= \frac{C}{2Lh}\left[2\tan^{-1}\frac{L}{2h} + \frac{h}{L}\left(\frac{1}{m^2 + .25}\right)\right] \qquad (4)$$

the subscript a under Y signifying that the actual illumination produced is meant.

Applying the inverse-square law to the same case, the theoretical illumination, Y_t, at distance h is given by the expression

$$Y_t = \frac{C}{h^2} \qquad (5)$$

For equation (5) to hold it is necessary that all the light

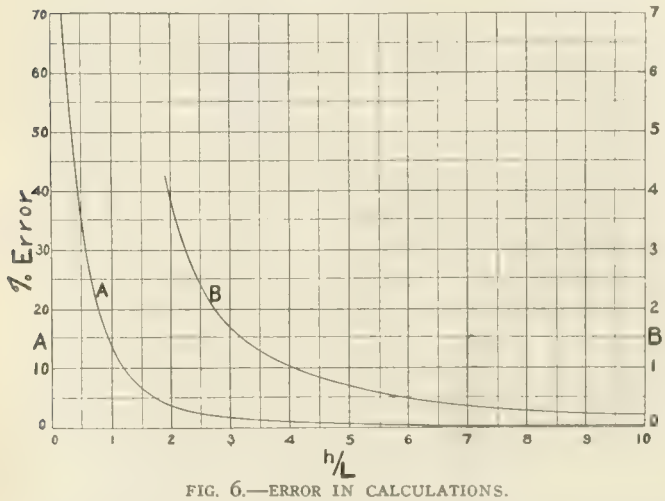


FIG. 6.—ERROR IN CALCULATIONS.

strike the photometer normally, but since with a tube source this condition is not realized, it is evident that Y_a will be less than Y_t. The percentage error in Y_t— that is, the percentage by which Y_t must be decreased to give Y_a—is

$$\text{Percentage error} = 100\,\frac{Y_t - Y_a}{Y_t} \qquad (6)$$

Fig. 6 shows the values of this percentage error for various values of $\frac{h}{L}$. A practical application of this curve would be its use in the derivation of a correction factor to be applied to candle-power measurements of tube sources. The candle-power could be determined in the ordinary manner by the application of the inverse-square relation, then multiplication by the correction factor would reduce the erroneous result to the right one.

In the equation of the photometer, $C = C'\frac{h^2}{h'^2}$, $\frac{C'}{h'^2}$ is the illumination of the photometer screen produced by the comparison standard, which at a balance is the same as the illumination produced by the unknown source. With the same notation as before, $\frac{C'}{h'^2}$ is Y_t, the subscript meaning that the inverse-square relation has been assumed, then the equation for C above could be written $C = Y_t h^2$. An illumination Y_t would not be produced on the screen by a tubular source of candle-power C at a distance h, for it has been shown that Y_a is less than Y_t. In order to make the above equation usable for computation it will be necessary to introduce a factor changing Y_t to Y_a.

Now from equation (6), letting e represent the error (decimal, not per cent)

$$e = \frac{Y_t - Y_a}{Y_t}, \text{ or } Y_t = \frac{Y_a}{1 - e}, \text{ and substituting above}$$

$$C_a = \frac{Y_a}{1 - e} \cdot h^2$$

As $\frac{C_a}{h^2}$ gives Y_t, the erroneous illumination computed on the assumption of the inverse-square relation, so $Y_a h^2$ gives C_t,

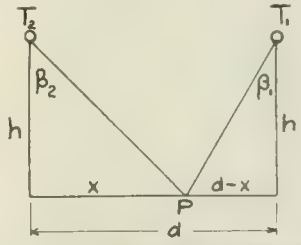


FIG. 7.—LIGHT FROM TWO TUBE LAMPS.

the erroneous candle-power computed on the same assumption. Thus, substituting C_t for $Y_a h^2$, there results

$$C_a = \frac{C_t}{1 - e} \qquad (7)$$

In other words, the candle-power computed by the inverse-square method will, when divided by $(1 - e)$, give the actual candle-power.

CONDITIONS FOR UNIFORM ILLUMINATION.

It was shown above that, aside from the variation of K, the illumination at any point, as the point moves out from beneath the tube, varies as $\cos^2 \beta$, where β is the angle between the slant line from the point to the tube and the normal to the reference plane. If the length of a tube is large compared to its height above the reference plane (m being, therefore, small), and only points near the center of the tube are considered, K will remain nearly constant. If, then, in Fig. 7 T_1 and T_2 are two similar tubes spaced a distance d apart, and Y_o denotes the illumination produced by one tube directly beneath its center, it can be written that

$$Y_p = Y_o \cos^3 \beta_1 + Y_o \cos^3 \beta_2.$$

Dividing by Y_o,

$$\frac{Y_p}{Y_o} = \cos^3 \beta_1 + \cos^3 \beta_2$$

$$= \frac{h^2}{h^2 + x^2} + \frac{h^2}{h^2 + (d - x)^2}$$

$$= \frac{1}{1 + \left[\frac{x}{h}\right]^2} + \frac{1}{1 + \left[\frac{d}{h} - \frac{x}{h}\right]^2} \qquad (8)$$

If now a value of $d \div h$ can be found that will give a constant value of $Y_p \div Y_o$ for all values of $x \div h$, the problem of so spacing the tubes as to secure uniform illumination is solved. The exact solution for this condition by calculus is rather complicated, hence a solution by trial will be given. The accompanying table shows what variation in resultant illumination is encountered when $d \div h$ is 2, 1.5 and 1.0. This table shows that when $d = 2h$ the illumination half-way between the two tubes is only 83.3 per cent of that directly beneath a tube; when $d = 1.5h$ there is a variation of 2 per cent above and below the mean; and when $d = h$ there is an increase of 6.7 per cent. It is seen that with a separation of tubes of 1.5 times their height above the reference plane the most uniform illumination is secured, and also that under this condition the average illumination between tubes is about 1.3 times that produced by one tube directly beneath its center.

VARIATION IN RESULTANT ILLUMINATION.

$d \div h = 2$			$d \div h = 1.5$			$d \div h = 1.0$		
$x \div h$	$Y_p \div I_o$	Per cent	$x \div h$	$Y_p \div Y_o$	Per cent	$x \div h$	$Y_p \div Y_o$	Per cent
.0	1.200	100.0	.0	1.308	100.0	.0	1.500	100.0
.2	1.198	99.8	.2	1.333	102.0	.1	1.553	103.5
.4	1.143	95.3	.4	1.315	100.5	.2	1.572	104.7
.6	1.073	89.8	.6	1.288	98.5	.3	1.589	105.9
.8	1.020	85.0	.75	1.282	98.1	.4	1.597	106.4
1.0	1.000	83.3	..	....	....	.5	1.600	106.7

METHOD OF DESIGN.

The conclusions of the preceding paragraph lead to a very simple method of designing installations of lighting tubes. In most cases the room to be illuminated will be rectangular in shape, so that the parts of the installation which are hung along the length of the room will contribute most of the required illumination. The correct placing of the tubes on the longer sides of the room is then the main point to consider.

The side tubes must be near enough to the sides of the room to give a reasonable illumination at the edges of the reference plane. If the distance from the tube to the wall is from one-quarter to one-third of the distance between tubes, this condition will generally be amply fulfilled. Approximating, then, the distance apart the tubes are to be spaced, the condition for uniform illumination is that the height shall equal the spacing divided by from 1.5 to 1.2, the former being the preferable divisor. Spaced in this manner, the average illumination will be very nearly 1.3 times that given by one tube alone; hence, dividing 1.3 into the required foot-candles of illumination will give that required of one tube beneath its center. Substitution in equation (2) will give the candle-power per foot required of the tube to furnish this illumination, and the voltage of supply can be adjusted to give the necessary candle-power. The luminosity of a tube lamp can be varied from nothing to 30 cp per foot by changing the applied voltage, hence adjustment over a wide range is possible. For best operating conditions, the luminosity should be about 10 cp per foot. Other luminosities are obtained at a slight sacrifice of efficiency.

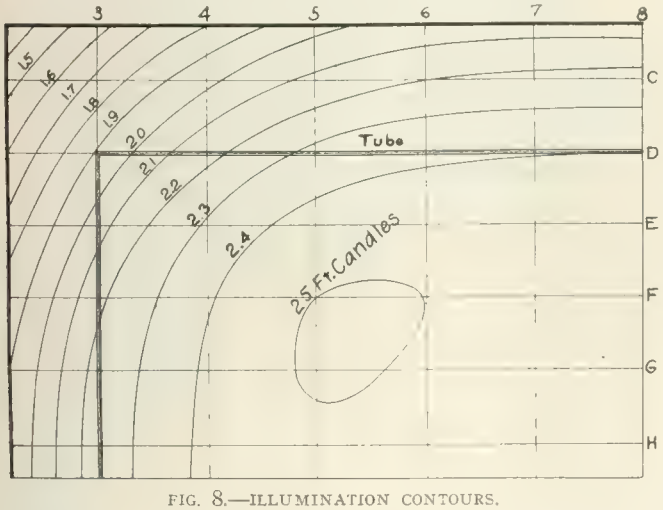


FIG. 8.—ILLUMINATION CONTOURS.

TRIAL INSTALLATION.

Specifications.

Room, 35 ft. x 25 ft.; 2 foot-candles illumination required on reference plane 2.5 ft. above the floor.

Calculations.

$2 \div 1.3 = 1.54$ foot-candles required of one tube.

The first trial spacing will be 15 ft. Height of tubes above reference plane $= 15/1.5 = 10$ ft. Under the center of the tube

$$I_o = \frac{C}{L}\frac{K}{2h}$$

Let $L = 30$, $h = 10$, then $m = 0.33$ and at $p = 0.5$, $K = 2.88$

$$1.54 = \frac{C}{L}\frac{2.88}{2 \times 10} \text{ or } \frac{C}{L} = 10.7, \text{ a satisfactory value.}$$

With this spacing the necessary candle-power per foot proves satisfactory, but the tubes will be 5 ft. from the edges of the room, and the illumination there might prove insufficient. Accordingly, the spacing will be increased to 18 ft. This value will leave only 3.5 ft. between the side tubes and the wall, and will undoubtedly prove more effective. Leaving the length unchanged, $L = 30$ ft., $h = 12$ ft., $m = 0.4$, and at $p = 0.5$, $K = 2.77$,

$$1.54 = \frac{C}{L}\frac{2.77}{2 \times 12}, \text{ or } \frac{C}{L} = 13.35, \text{ which is higher than customary, but easily securable.}$$

An exploration of the reference plane may now be made on lines perpendicular to the tubes. For assigned values of x, s is obtained from the equation $s = \sqrt{h^2 + x^2}$. The value of $\frac{h}{s^2}$ is computed and multiplied by $C \div 2L = \frac{13.35}{2}$ for use in formula No. (2). The value of K is read from Fig. 5 for various values of P, whence $Y = K\frac{6.67h}{s^2}$ gives the foot-candle illumination. A similar calculation may be made for the same points on lines perpendicular to the end tubes, whence addition of the illuminations produced at a point by the tubes on the four sides of the room will give values from which illumination contours can be plotted, as shown in Fig. 8. It is necessary to consider only one-quarter of the room, because the illumination at symmetrical points is the same. The lower right-hand corner in Fig. 8 represents the center of the room.

Inspection of Fig. 8 will show that the tube system of lighting can be designed to yield excellent results as regards the uniformity of illumination. In the case of this trial installation the results are better than the contour plat shows, because multiple reflection from the walls and ceiling will increase the illumination at the edges of the room more than in the middle; furthermore, near the ends of the tube, or beyond, there is actually more illumination than is computed on the assumption of the validity of the cosine law.

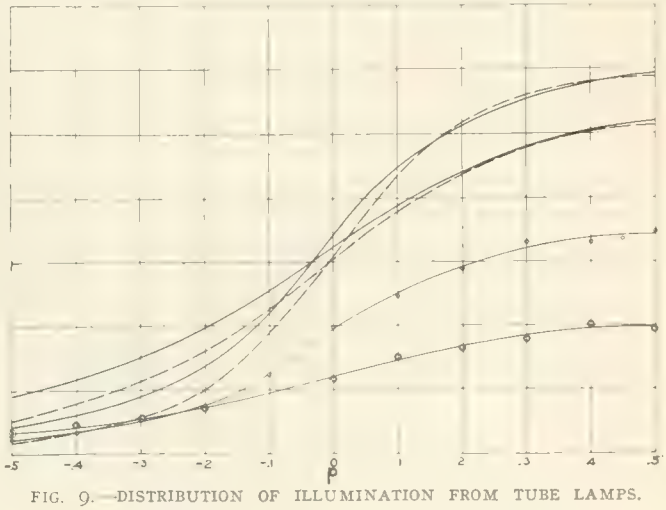


FIG. 9.—DISTRIBUTION OF ILLUMINATION FROM TUBE LAMPS.

EXPERIMENTAL VERIFICATION OF RESULTS.

In investigating the subject of radiation from tubes at the University of Wisconsin, the author secured some curves show-

ing the distribution of illumination along a short tube, and these curves serve as an admirable verification of the results deduced above. The tube used was 10 ft. long, and curves were taken with it mounted parallel to a photometer track, on the carriage of which was placed a Sharp-Millar illuminometer. By balancing this illuminometer at various points along the track, data were obtained for the lower curves of Fig. 9. The ordinates of these curves, multiplied by the constant of the instrument as used, would give the actual illumination at various points; but, as drawn, show only the *distribution* of illumination along the tube. The curves of Fig. 4, derived on the assumption of the cosine law, also show the distribution of illumination along the tube; hence, an agreement in shape between the two lower curves of Fig. 9 and the curves of Fig. 4 having the same values of m will show that the cosine law is applicable to the case in hand. The effective length of the tube used was 250 cm, and the distances to the reference plane were 75 cm and 125 cm, hence the values of m for the two lower curves of Fig. 9 are 0.3 and 0.5, respectively. The dotted curves are copied from Fig. 4 for the above values of m. To test for similarity of shape the ordinates of the lower curves were increased proportionately till they coincided at $p = 0.4$, the result being the upper full lines of Fig. 9.

The curves show that under the tube—that is, over the range from $p = 0.5$ to $p = 0.0$—the cosine law is verified almost exactly, and that beyond the tube ends (for negative values of p) the actual illumination is greater than computed on the assumption of the cosine law. This relation would have the effect of improving the uniformity of illumination produced by an installation of the tube, as mentioned in connection with the design of the trial installation.

The very good verification of the cosine law shows that entire dependence can be placed on the method of illumination design derived and outlined above. The divergence of the checking curves for negative values of p shows that the computed illumination near the edges of a room may be in error, but as the actual value will be greater than the computed, the error will be on the safe side.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Producer Gas Plant at St. Joseph, Mich.

The street lighting of St. Joseph, Mich., for the past four years has been operated from a producer-gas engine located at the municipal water works. The engine is a three-cylinder Nash of 115 hp. It is supplied with producer gas by an R. D. Wood & Company suction producer, which uses anthracite coal for fuel. The load on the engine is constant, as it consists of nothing but street lighting. The load consists of 125 series alternating-current, 6.6-amp arcs operated from a 75-kw, single-phase, 60-cycle alternator. For a run of 13.5 hours with this load, about 1400 lb. of fuel is required. If the load is counted as two lamps per kilowatt, this would make a total load on the engine and generator of 52.5 kw. A 13.5-hour run would, therefore, call for 844 kw-hours, which would make the coal consumption 1.66 lb. per kw-hour. The operators of this plant had the usual amount of trouble which seems inevitably to be experienced with a gas-producer plant the first six months of its operation before the operators learn how to manage the plant. Since then, however, the operation has been very reliable and satisfactory in every way, and, on the whole, it appears to be less work than a steam plant.

Central-Station Exhibits at the Canadian National Exhibition.

The Toronto Electric Light Company, Limited, was represented by an interesting exhibit at the Canadian National Exhibition held at Toronto, from Aug. 28 to Sept. 11. This exhibition is perhaps the greatest annual fair held on the North American continent, and is visited by fully 100,000 people daily.

A space 43 ft. x 13 ft. was occupied under the dome of the Industrial Building, a great iron and concrete structure. The exhibition was in two parts, devoted, respectively, to power and industrial heating appliances and to illumination and domestic heating specialties. Motor manufacturers and dealers in Toronto were invited to display their machines in the booth, and the co-operation was secured of the cash-register and adding-machine dealers, as well as many manufacturers of heating appliances.

The booth was brilliantly illuminated with tungsten lamps and holophane reflectors. Electric signs were installed, with appropriate mottoes, and the exhibit as a whole received much favorable criticism on the part of the visiting public.

Figures from the Iola (Kan.) Central Station.

By Guilford Cresse Glynn.

Iola, a southern Kansas town of about 10,000 people, was the first city in the West to develop its natural gas in large quantities. This resulted in the location of numerous zinc smelting plants and the use of gas in rotary kilns and large gas engines in plants engaged in the manufacture of Portland cement. With the growth of the city, Iola promptly adopted municipal ownership of its gas, water and electric plants. At first the city had no adequate accounting methods, but this condition of affairs was remedied in 1907 by an inventory of the city's holdings and placing proper valuations thereon.

In establishing the present value and fixing the proper depreciation rates (see tables), the writer had recourse to the expert advice of Gunn, Richards & Company, of New York, and also to the local accountants of the Portland cement companies, together with that of the Hunt Engineering Company. It will be noted that the rates of depreciation are rather above than below those generally given for like equipment in current engineering literature, the risk from obsolescence being considered greater where natural gas is used, for the reason that a change in the price of fuel would change radically the nature of an equipment for efficiency. A modern system of municipal accounting was then put in practice and the benefits were almost immediately apparent.

A brief comparison of data from this plant with that from the Marquette (Mich.) municipal plant, published in the *Electrical World* of Feb. 11, 1909, is made in the accompanying tables. The Marquette plant has water-power; the Iola plant uses natural gas under its boilers and has a very ordinary steam plant, having an efficiency less than half that of a modern well-conducted steam plant.

The investment per kilowatt is unusually low in both plants. At Iola this is for the reason that the capital charge for land and buildings is divided in proportion to the bonds issued for water and light (water, $70,000; light, $10,000). The installation has been increased very economically by exchanging existing equipment for other equipment without proportionate increase in cost, the low fuel charge making the simplest kind of installation the most profitable from an investment standpoint.

The present equipment consists of two horizontal tubular boilers and three marine boilers rated at 80 hp. The day load is carried by a 120-kw Warren alternator, direct-connected to an Ideal high-speed engine running at 255 r.p.m. The night

load is carried by a 200-kw Warren alternator, belted to a Monarch Corliss engine, which also drives the two 80-light arc machines (moonlight schedule). The latter engine is capable of developing over 400 hp. The pumping plant is operated as nearly as possible off peak and only rarely is the entire boiler equipment used.

The plant has been hampered in its revenues heretofore by insufficient charges and non-payment of its service for street arcs. This has been changed, and proper credit is now given the plant for service rendered. This credit is $3 per month for each 500-watt, enclosed, direct-current arc lamp and $1.25 for each 100-watt tungsten used in street lighting. Competition with the gas plant for lighting has also affected the revenues. Gas burned in Welsbach gas lamps, at a 10-cent meter rate, furnishes a stiff competition and the city's gas superintendent is as keen for business for his department as if it were a private plant.

It was only with the advent of the tungsten lamp that serious inroads were made on the gas mantle with 4-cent energy as the competitor. These lamps became immensely popular, displacing gas lamps and commercial arcs for store lighting. In addition, the city has placed over 90 100-watt tungstens with prismatic reflectors upon cables, suspending them 10 ft. above the 20-ft. cement walks every 25 ft. The first cost is borne by the merchants, and repaid by the city in light at the rate of 75 cents a lamp a month. It has proved profitable to the city and satisfactory to the merchants, and the breakage, which has been slight, is borne by the latter.

The fuel charge for gas is low, but the writer is convinced that it is practically correct. The measurements were carefully made for a period of some months, and are supplemented by the experience of other gas users in local plants. In addition to the separation on capital cost, the operating cost was also computed from the steam used (boiler horse-power) based on the average of several extensive tests, made by switching the load for pumping water alone, arc lighting alone, incandescent circuit alone, etc. The method of burning gas has some little effect toward economy; not startling, but still distinctly of advantage. The burners are arranged beneath checker work of brick, much after the manner of exaggerated Bunsens. The flow of air and its control is much better than in the numerous "cannon type" of Bunsens, such as the Kirkwood, Equitable, etc., which have been tried in competition and which are still retained in two of the marine boilers. Boilermen can regulate the amount of air through the ashpit to the burners to a nicety, maintaining the same stack temperature day after day, with but little change.

The rates for energy are 4 cents per kw-hour for lamps and from 3½ cents to 2 cents for motors. The latter rates are based upon the hours of guaranteed use per kw-rating of connected load. For example: Two hours' use a day of each kilowatt connected commands a rate of 3½ cents, and for each hour added a reduction of ¼ cent is made in the rate until eight hours' use is reached per kw rating of connected load, when no further reduction is made. There is also a proviso allowing the city to shut off motor users should the load infringe on the lighting load. It is not probable that this right will be exercised. The rates were designed to meet gas-engine competition, and the campaign for day motor-load business is already improving the finances of the plant. The year's surplus of $8,500 is largely due to this aggressive policy.

TABLE I.

	Iola.	Marquette.
Population served	3,000	10,000
Kw-rating of station	280	850
Total liabilities per kw of station equipment	$93	$82
Gross yearly income per kw of station equipment	$35	$65
Gross yearly income per $100 liabilities	$38	$79
Yearly operating expenses per kw of equipment, exclusive of interest and depreciation	$20	$20 50
Per cent of gross yearly income spent for operation	54	39
Yearly operating expense per $100 invested	$40	$32
Average income per consumer	$45	$37
Total connected load per kw of station equipment	1 25	2 6
Yearly load factor, per cent	20	30
Gross yearly income per capita	$1.10	$5.51
Investment per capita	$3.00	$6.95
Watts station equipment per capita	20	85
Number of customers per 100 of population	3	14 8
Number of residence customers per 100 of population	12	10.4
Number of residences lighted	50	1,040
Number of business places lighted	205	375
Number of motors installed	22	70
Flatirons	12	540

TABLE II.

	Capital Invested.	Depreciation, Per Cent.
Land and water-rights	$1,500	
Buildings	381	5
Engines	6,000	7
Boilers	3,850.23	10
Power transmission	2,200	
Dynamos	3,043.09	7
Alternators	2,024.25	7
Switchboard and accessories	741 31	8
Pole lines	1,804.84	12
Wires	7,405.32	7
Arc lamps	2,169.80	20
Equipment	938.28	
Transformers	3,046.86	8
Meters in service	570.27	15
Motors	102.22	10
Incandescent lamps (City)	88.54	

TABLE III.

Showing the unit cost per kw-hour, based on 352,000 hours, load factor of 20.

Maintenance items shown in Table II	$.0014
Operation:	
*Fuel (5-cent gas)	.0035
Oil and waste	.0011
Wages	.00317
†Water	.....
Fixed Charges:	
Office expense	.00114
Salaries	.00306
Interest	.0007
Depreciation (12%)	.0047
	$0.0197

*Seventy cubic feet of gas burned per kw-hour.

†Water plant in connection. No charge has been made for water. The costs for pumping complete against 200-ft. head is 4 cents per 1000 gal.

Recent Extensions of Central-Station Service in Chicago.

After the summer vacation the campaign for new business for the Commonwealth Edison Company, Chicago, is proving remarkably successful, and a number of notable additions to the load on the central station are reported. Among these is the large new building of Hart, Shaffner & Marx, clothing manufacturers, at Monroe and Market Streets. There was a decided tendency toward the installation of a private plant in this building, but the Commonwealth Company secured the business, which will amount to 910 16-cp lamps, 607 5-amp arcs, 239 hp in motors for general purposes and 240 hp in elevator motors. Another interesting new customer of the Commonwealth Edison Company is the Palmer House on State Street, probably one of the best-known hotels in the United States. Notwithstanding the prominence of this hotel, it is rather surprising to find that up to this time only two floors have been lighted by electricity, gas being used on all upper floors. The whole building is now to be wired and rewired, and the isolated plant which formerly supplied electricity for the two lower floors will be abandoned. About 4500 50 watt equivalents in lamps and motors will be needed in this large hotel. Another hotel recently added to the central-station service is the Plaza Hotel at North Clark Street and North Avenue, overlooking Lincoln Park. Here also a private plant will be discontinued and electricity from the central-station company will be relied on exclusively. It is interesting to note, also, that the hydraulic elevators in this hotel will be changed over for electric operation, and the elevator load will form a considerable portion of the demand for electricity in the whole building

Twenty-Four-Hour Constant House Load.

An English central-station engineer has proposed an electrical supply system, according to which a definite amount of electrical energy—such as 50 kw-hours per month—would be sold to a householder, to be paid for in advance and to be utilized in an equipment supplied by the central station, consisting of lamps and cooking and water heating apparatus. By means which it is proposed to devise, the current would have a constant value during the 24 hours. When not used for light or cooking the energy would be used for water heating.

Power Used in the Manufacture of Lumber.

Mr. C. H. Scott, of the General Electric Company, read a paper at the annual convention of the Michigan Electric Association at Detroit in August on the subject of the electric drive in wood-working, which is of interest to the large percentage of the central-station companies in towns where there are wood-working establishments. Mr. Scott said that the company with which he is connected started several months ago to investigate the installation of its motors for wood-working machinery. While the tabulation undertaken is not yet complete, he is in receipt of advices from 256 customers taking central-station power, 64 of whom report installations aggregating 3000 hp. He expects later to have available accurate and complete figures bearing on the use of central-station power for the wood-working industry.

CENSUS FIGURES ON THE WOOD-WORKING INDUSTRY.

The United States census reports for 1905 show that the industry engaged in the remanufacture of lumber ranked second in the number of establishments, fifth in capacity, third in the number of wage earners, sixth in total cost of material and fourth in value of products. Prior to 1880 New York and Maine led in value of lumber products. In 1896 the tide of business flowed to the Lake States, Michigan, Wisconsin and Minnesota. In 1905 the seven most important lumber-producing States in the order of their production were Washington, Wisconsin, Michigan, Louisiana, Minnesota, Pennsylvania and Arkansas. The total horse-power devoted to remanufacture of lumber in Michigan was 25 per cent of that used for all purposes. The power rented from central stations was only 0.06 per cent of the total and 2.3 per cent of the central-station output. Present-day statistics would undoubtedly show more favorably as regards the central-station proportion of the total. Still, the writer believes the situation is capable of much improvement from the central-station standpoint.

SOLICITING POWER.

In soliciting power for wood-working, as well as other industrial establishments, success depends on the aptitude of the central-station power solicitor to analyze correctly operating expenses and fixed charges of existing plants. The ability to do this will go far to demonstrate definitely and convincingly to a prospect the waste and general field for improvement in his power layout. Much good power business has been lost by the use of rule-of-thumb or hit-and-miss methods. Specialized knowledge is indispensable. The solicitor should possess sufficient knowledge as to the design and operation of electrical apparatus in general and motors in particular, and also practical training, so that he may understandingly approach on equal ground the managers, engineers and foremen of the lumber plants. It is a good plan for the solicitor to familiarize himself with the names, operations and functions of the machines ordinarily used in lumber manufacture, since a knowledge of the driven tool is essential if a proper motor is to be selected for it. In addition, the superintendent or owner will be impressed favorably if the solicitor can converse understandingly regarding the remanufacture of lumber and the machinery used for that purpose, and will be apt to assume that such knowledge presupposes an equal facility in applying the proper electric drive. The solicitor should tabulate for record the essential figures in connection with each installation, since the value of the accumulated knowledge thus obtained will prove invaluable in the solution of future power problems. The solicitor himself will each year profit by the experience gained and become a better business getter. Central-station managers should make it obligatory that solicitors make out for filing a permanent record of the data suggested. While this is done by most large central stations, the practice often prevails of keeping information properly belonging to the employer under the hat of the employee. A high-grade solicitor should accumulate working data concerning steam and internal combustion isolated plants, and should be able to estimate promptly the numerous items which make up fixed and variable charges. He should also know the water rates of different types of steam engines and pumps commercially used, the cost of coal, lubricants, water and supplies and the cost per horse-power installed for complete small plants.

The power engineer should, in company with the customer or his engineer, first consider carefully whether the existing grouping of machines is the best possible to secure the most convenient handling and advantageous sequence of operation throughout the various processes of manufacture, effecting whatever changes may be conducive to better light, greater cleanliness, more ample passageways, less danger to operators and the exclusion of losses between the power source and the cutting edge of the tool.

The paper gives alternative methods of laying out the drive for a typical wood-working shop consisting of one or several buildings. There are several ways of applying electrical power, each varying in the amount of first cost, the advantages in operative economy, etc., being proportionate to the capital investment decided upon.

(1) The most elementary method would be to install a single motor of sufficient capacity to run all the machinery operated. This would do away with the existing engine plant, but would permit little or no change in the arrangement of tools or shafting or the abolition of main, jack and counter shafts. The importance of reducing to a minimum all unnecessary friction losses is apparent if we consider the yearly cost of power if constantly used. For example, a loss of horse-power 3000 working hours per year at a 4-cent rate is equivalent to $90 per year. The arrangement suggested is also defective in that all the driven machinery is dependent upon one unit, whose breakdown might occasion the complete stoppage of the plant.

(2) A modification of the first method, by applying group drive in each shop or for separate departments or by connection to economical sections of the main line of counter shafting. This method, however, like the first, might not permit any more favorable arrangement in location of tools than method number one.

(3) A rearrangement of the tools with reference to departments and locations, providing for the best sequence of work through the shop, and a combination of group or individual drives such as to place tools constantly used so far as possible in groups, and providing individual drives for machines which are more or less isolated and used intermittently.

(4) An individual motor for each machine except in particular cases where groups or machines may be so operated as to give a high load factor, or in other cases where the instantaneous demands for power may make it advisable to draw upon the "diversity factor" of a motor operating more than one machine and where maximum demands for power do not come simultaneously.

The last method suggested offers so many superiorities, both from an operating standpoint and as regards the cost of metered current, that in the majority of cases the additional capital outlay is justified to secure the advantages entailed. A carefully prepared report would allow the solicitor a chance to demonstrate the successive advantages of the four methods outlined.

POWER REQUIRED TO DRIVE.

The power required to drive wood-working machinery varies widely according to the hardness and relative humidity of the wood used, the speed and depth of the cut, the physical condition of the knives, saw teeth, or other cutting tools. New and stiff machines, such as triplet drum sanders, may take considerably more power than after a few weeks' limbering up. Dull or wrongly adjusted knives may result in a drain of 200 to 300 per cent on the power source over what would be required if the machines were in the very best order.

Particular care should be taken in recommending motors for large planers, matchers, surfacers, band re-saws, etc., where a wide variety may exist between the classes of lumber remanufactured and the feed and speed used. With light machines, such as dado, variety and combination saws, jointers,

tenoning machines, column and drum sanders, bench borers, etc., the general character of the work and margin of power usually allowed by manufacturers in specifying horse-power to drive minimize to some extent the danger of under-motoring.

The majority of wood-working establishments are devoted to certain classes of work, and those working soft wood seldom work the harder varieties. When in the former case there is a small amount of hard wood to be remanufactured the overload capacity of a good motor is usually ample to take care of such occasional overloads on the driving unit. It is well to remember in this connection that the power required by wood-working machines varies directly with its speed, so that the load is diminished by not forcing the material through the machine at so fast a rate. Where machines are constantly to work very hard wood, such as lignum vitæ, the motors should be at least twice the ordinary horse-power employed for soft wood remanufacture.

Again, the load on a wood-working machine is under most conditions of an intermittent character and the driving motor may often be rated at its temporary overload capacity, since the rapidity of feed and the consequent quick completion of cut allow frequent intervals of rest before another piece of work can be fed in or made ready.

DETERMINATION OF POWER.

Power required to drive a given machine or machines may be obtained with exactitude or approximately estimated as follows:

(1) Guarantees from manufacturers on the performance and power of a given machine with stated feed, cut and material.

(2) By the use of a temporarily installed motor with proper indicating or graphic recording instruments to record the wattage input to the motor and therefrom the power required by the working machine. As a means of obtaining a continuous and exact record of the performance of a given machine or machines the graphic or curve-drawing wattmeter is for many reasons usually preferable to instruments of the recording or indicating type.

(3) The power to drive may be roughly calculated by observing the speed, diameter and width of the belt to the driven pulley of the machine. This method involves, however, a decided chance for error, since the pulleys are usually proportioned so that the driven machine may, if necessary, be belted for the maximum duty. However, for ordinary service, wood-workers estimate that a belt 1 in. wide will transmit 1 hp at 1000 r.p.m., and double belting 1½ hp under the same conditions.

(4) When group drive by engine or a single motor is used, indicator cards on the former and meter readings on the latter may be taken on one or a number of driven machines doing actual work. By repeating the test "running light"—that is, with belts on loose pulleys—the friction loss may be recorded and a subtraction of the result from the full-load reading will show approximately the useful energy expended by the machines themselves. This method, due to the increase of friction with increase of load, and the introduction of other variables, is liable to error and consequently incorrect deductions, especially where the friction load may be as great or greater than the useful load. Still the results may assist in predetermining the net power required, as well as often showing great waste in the existing transmission system.

The wide difference in power required to drive may be illustrated by taking at random several cases of machines actually tested in a wood-working plant.

A motor driving a 24-in. buzz planer with a cut 2½ in. wide x ⅛ in. deep took 2.1 hp, or with a cut 13 in. x 5/16 in., 4½ hp.

A motor driving a 24-in. cylinder planer with a cut 6 in. wide and 3/16 in. deep (in dry spruce) took 4.1 hp; and with a cut double the width and only ⅛-in. depth (but with the same wood wet) required 18 hp.

A 10-in. circular saw with ½-in. cut and easy feed took 2.7 hp, and in 2½-in. hard wood required 8 hp.

A 15-in. tandem scraper (in rock maple), one knife cutting, material 6¾ in. wide with shaving 0.0035 in. thickness, required 3¼ hp. With two knives cutting material 13½ in. wide and 0.009 in. thick, 9 hp was required.

A 42-in. single scraper (in rock maple), with feed 82 ft. per minute width of material, 29 in., thickness of shaving 0.004 in., took 5½ hp. With the same width of material and double the thickness of shaving 9½ hp was required.

A 30-in. single surfacer (in soft pine), with feed of 34 ft. per minute, cutters running at 4200 r.p.m., material 10 in. wide, 1/16 in. cut, required 4½ hp. With the width of material increased to 29 in. and the depth of cut to ½ in., 36.5 hp was required.

A 30-in. double surfacer (in soft pine), with feed of 34 ft. per minute and cutters at 3800 r.p.m., required, with cut 8 in. wide and ¼ in. at the top and ⅛ in at the bottom, 11½ hp. With feed of 60 ft. per minute, cutters running at 4200 r.p.m., width of material 29 in., depth of cut at top 3/16 in. and at bottom ⅛ in., required 38 hp.

All the above shows the necessity of studying the requirements of each machine. Cases have been noted where data taken from pattern shops were wrongly applied to other shops where the machinery is employed for heavy cuts on hard wood. In such cases machines may require double or triple the capacity of the pattern shop.

SELECTION OF MOTORS.

Owing to the high speed and light moving parts of wood-working machines and the frequent violent application of the load, it is desirable to use the belt drive rather than gears or chains, especially as the speed of the driven pulley is usually too high to permit of other than direct or belted connection. The direct drive is coming into vogue in many up-to-date wood-working plants and is giving excellent results where the motor has a sufficiently generous rating to accelerate rapidly and to withstand overloads. As the average depreciation of belting averages 36 per cent per year, it is important to reduce this wastage and, furthermore, do away with any source of slippage between the driving unit and the working pulley.

If belts are used, it is strongly recommended not to run them vertically or with so decided a vertical component as to minimize the arc of contact on the driving pulley and also prevent the use of the belt tension adjustment on the motor base. Motors may often be conveniently located in an inverted position beneath the floor bearing the machine. If this method is adopted, the belt between the motor and the machine should be boxed in and the drive arranged as above stated, at a sufficient angle to be able to make use of the belt-tightener arrangement. There is a wide opportunity for the solicitor or power engineer to use his ingenuity in the layout and novel methods of drive for wood-working machinery.

One of the most difficult loads for the central station to handle is that of the large exhaust blowers which are used to exhaust the refuse material from the machines. Depending upon the size of the shop, one of these blowers may take from 20 hp to 150 hp, and the load is naturally constant throughout the working hours of the plant; therefore, the resultant bill, if central-station energy is used, is liable to be a serious obstacle to the customer's adoption of motor drive. In the plant of the Haffner Furniture Company an innovation was used which promises amelioration of this difficulty. In this installation only one small pipe is used, leading from each individual machine direct to a special cyclone dust and shaving separator, a small direct-driven blower being installed in the pipe of each machine. The important fact to be noted is that under ordinary conditions not more than two machines in any special group are in use at the same time. Hence abnormally large blowers and ducts are not required and the economy of the blowing system is very marked.

The solicitors should be prepared with data which will allow them to estimate, at least roughly, the cost of the apparatus necessary and the fuel required to heat properly the building where the exhaust from the steam power plant is not used for this purpose. On this subject as well as steam needed for

kiln drying the writer is also collecting data which he believes will be of considerable value to the central-station interests.

SALE OF WASTE PRODUCT.

The argument is frequently offered that waste material cannot be used, and therefore it would be poor economy to discard the existing isolated plant for central-station power. In one case an arrangement has been made for utilizing the mill refuse in a small town where the local central station furnished electric power to a planing mill half a mile from the generation station, and also to a sawmill about 1000 ft. away. In part payment the refuse from these two mills is taken by the central station for fuel. The electric company made a rate to each mill of $50 per horse-power per year and allowed the half of this charge as a rebate for fuel supplied. In the case at hand, which involved the use of 40 hp in motors, it is calculated that the wages of one man is saved, aside from productive economies and other advantages. In the case of a sawmill which used 100 hp, it is estimated that a saving of about $5 per day was made. Another case is that of a large box-making factory taking power from the central station, there being 40 motors installed totaling 470 hp. This company disposes of about 2500 cords of kindling wood per year, retailing at about $5 per cord, and in addition about 70,000 bales of shavings per year, retailing at about 40 cents per bale. While local conditions will have to be taken into account, the above would serve to refute the argument so frequently offered that it is impossible to dispose of waste wood, shavings, etc., which may best be burned under the boilers of the isolated plant.

COST OF OPERATING BY CENTRAL-STATION SERVICE.

While undoubtedly there may be cases where the arguments of the central station may not irrefutably prove that the use of metered power will be most economical or advantageous, there is very great chance to add largely to the central-station load for this class of service if all the salient talking points are properly marshaled to the front and the solicitor prepares himself to handle understandingly all phases of the situation. Records from a large number of central stations where woodworking plants form a goodly portion of the load indicate that the load factor of such establishments make the use of metered power decidedly feasible. For instance, one of the largest central stations in the West, with 3522 connected horse-power, employing 234 motors (most of these group driven), found that the load factor was 33 per cent. With individual drives the average in many cases will be as low as 8 or 10 per cent, and seldom exceed 20 per cent.

INTERIOR WIRING AND ILLUMINATION

Care of Tungsten Street Lamps.

Mr. Fred T. Masterson, of Grand Rapids, gave the following information at the convention of the Michigan Electric Association, Aug. 17, on the maintenance of lamps used on the Grand Rapids street arches:

The first arch installation consisted of 270 60-cp, 6.6-amp, series tungsten lamps operated 18 in series across 220 volts. Each series of lamps was suspended from a messenger wire stretched across the street and placed about 100 ft. apart. The distance between lamps is 5 ft. and the distance of each lamp below the messenger wire was regulated so as to give an arch effect. This system of lighting for business streets has become so popular in Grand Rapids that at the present time 1103 of these lamps are in service and contracts for 270 more, making a total of 1373. The contract price for each lamp is $7 per year, which makes an income of $9,611 per year.

Considerable trouble was experienced at first in renewing burned out lamps, as it was necessary to draw the arches to one side of the street so that the lamps could be reached from a ladder placed against a building. This system was quite expensive, as it required the services of four men to handle the extension ladders, and also shortened the life of the lamps and did considerable damage to the wiring of the arch.

Some time ago the power company had a wagon built for use in renewing lamps, consisting of an ordinary one-horse dray with a tower built on it. The top of this tower is 15 ft. from the ground, and a three-piece extension ladder is fastened to the side of it. All that is necessary is to drive this wagon below the lamps, raise the extension ladder and change the burned-out lamps. This operation requires about five minutes for each lamp and requires two men, one to drive the horse and the other to raise the ladder and change the lamps. This wagon has been the means of saving the company considerable money both for labor, lamps, and repairs to the wiring.

On June 8 of this year, the first installation of 270 lamps had been in operation one year. During this time the lamps burned 1920 hours and consumed 41,000 kw-hours of energy. The number of lamps renewed was 196, which cost the company $225. This makes the cost of renewals 0.55 cent per kw-hour for lamps only. The labor necessary to care for 1100 lamps will not exceed $200 per year, or $50 for 270 lamps, which makes the total cost of lamp renewals $275 per year, or 0.67 cent per kw-hour.

The one drawback to the series tungsten lamp operating from a constant potential circuit is the extinguishing of all the lamps in the arch when one lamp burns out. This, however, is not very serious if the lamps are inspected each morning, as the defective lamps can be immediately replaced, and it is very seldom that an arch has been out two nights in succession.

On one street in Grand Rapids the multiple tungsten lamp has been tried with very good results. This installation consists of 60 100-watt lamps which have been in operation six weeks, burning on an average of three hours per night, and so far only two lamps have been renewed. This speaks very well for the multiple lamp, as during that time there was two quite severe wind storms.

Albany Park Ornamental Street Lighting.

Albany Park is a large subdivision in the northern part of Chicago which has recently been cut into lots and offered for sale. As one of its attractions a sort of parkway entrance gate effect, something like a court of honor, has been arranged on the various streets, marking the boundaries of the subdivision, in the manner shown by the accompanying illustrations. The concrete structure is built between the sidewalk and the curb, extending across the parkway. At each end of this structure are posts of unequal height. The one on the side next to the curb supports a tungsten 60-watt lamp enclosed in an opalescent glass globe mounted in an ornamental iron holder. The smaller column on the sidewalk side of the concrete structure is surmounted by a stone ball. Both columns have cut-stone capitals,



ALBANY PARK, CHICAGO—ORNAMENTAL STREET LIGHTING.

and the fine curved sweep of the concrete structure between them is finished by a cut-stone coping enhanced by a grill of ornamental iron work. There is a concrete post corresponding to the smaller one of the concrete structure just described on the other side of the sidewalk from it, and bordering on the lot line. An ornamental iron fence leads back across the lawn to

the building line from this post. The structure is placed on the corner of an alley, so that the alleys as well as the streets are lighted. The post, surmounted by the lamp, contains a hollow space 8 in. in diameter through which the wires are led to the lamp. To it is fastened a handsome bronze plate giving the

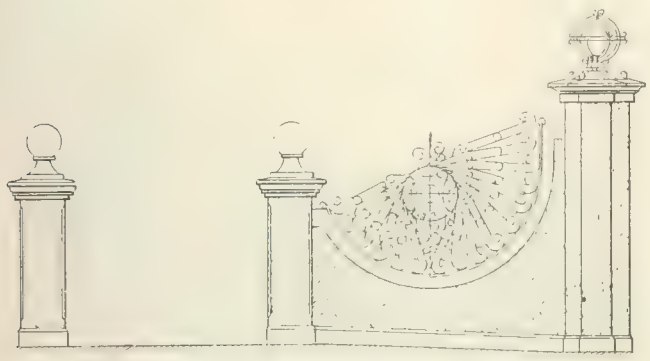


FIG. 2.—ALBANY PARK, CHICAGO, ORNAMENTAL STREET LIGHTING.

name of the subdivision and the particular street on which the structure is placed.

Across the street is a corresponding section of this street decoration, but reversed so that each "entrance gate"—if the expression is the correct one—has two lamps, the higher pillars opposing each other on each side of the curb line, as shown in one of the illustrations. The post supports the lamp about 10½ ft. above the street level. The smaller posts topped by the stone balls are 6 ft. 8 in. high, and the horizontal dimension of the concrete structure across the parkway varies from 10 ft. to 11 ft. 6 in. The lamp posts are octagonal in section, while the smaller posts are square with chamfered corners. Thirty-two



FIG. 3.—ALBANY PARK, CHICAGO, ORNAMENTAL STREET LIGHTING.

of these ornamental sets, containing 64 lamps will be placed on the property. The structures were designed by Messrs. Bostrom & Olson, contractors, Chicago, following suggestions made by the owners of the property. The lamps will be controlled from one central point at the corner of Kedzie and Montrose avenues, where the office of the subdivision is located. The Commonwealth Edison Company will supply the power for the lamps in these ornamental structures, 14 of which, with 28 lamps, are already in place. All houses in the subdivision are being wired for electricity, and the central-station company is laying its mains all through the district, which is witnessing a notable development. By an arrangement with the Commonwealth company made by the proprietors of the subdivision, the lamps will be maintained for three years without expense to the lot owners. After that, an arrangement may be made with the city for maintenance.

An Experimental Study of the Globe Photometer.

By A. A. Perrine.

MUCH attention has been given in the last few years to the development of photometers designed for the measurement of mean spherical and mean hemispherical intensities of light sources.

The method used by the early experimenters was the well-known point-to-point method—that is, the measurement of candle-power in a large number of directions distributed uniformly over an imaginary sphere surrounding the lamp. This method has been frequently resorted to; it is very laborious, but leads to substantially accurate results.

Several forms of integrating devices have been developed at different times, but none has been as simple in construction or as satisfactory as the globe photometer. The globe photometer is a simple instrument intended for the measurement of mean spherical candle-power of a source at one reading.

Slowness has characterized the investigation of the globe photometer in this country, possibly because the Matthews integrating photometer has been used in the leading photometric laboratories, although its simplicity and other meritorious features have been appreciated.

The study of the photometer here recorded was made in the laboratories of Armour Institute, Chicago, by the writer and Mr. George G. Goheen. The globe photometer used was made in the form of a sphere, 120 cm in diameter. The frame of the globe is made in two hemispheres, being formed of office netting. The interior of the frame thus formed was lined with a thin coating of asbestos 0.1587 cm thick, cut into segments so that they would fit readily into place, and secured to the netting by small wires. A second coating of asbestos segments 0.1587 cm thick was placed upon the first and secured to it by a silicon compound. The hemispheres were then placed together and rigidly secured by metal clamps.

The interior of the sphere was coated with a white paint called "Naples Velvet Finish." An opening was provided in the upper portion of the sphere 46.356 cm in diameter for the purpose of inserting lamps and repairing the inner surface. One observation window, covered with a diffusing glass, was provided in a central, horizontal position, from which readings could be taken conveniently by the measuring instrument.

The brightness of illumination of the observation window was determined by the application of a photometrical bench, located outside of the window, in line with the beam of light from it.

The walls, ceiling and floor of the room where the investigation was carried on, and all objects within the room, were either painted black or screened from the light of either source by black cloth, all external light being excluded.

The mean spherical candle-power of a carbon lamp, bare and with Holophane reflectors B, C and D, was found by determining the actual candle-power of the lamp in a large number of positions in a vertical plane. These values were then plotted on polar-flux paper, from which the mean value could be determined.

The lamp used was balanced against a standard 110-volt, 16-cp lamp secured from the Electrical Testing Laboratories. The potential over the lamp was maintained constant at the required value by means of resistance.

A 7.49-cp Buckeye carbon lamp was used as a standard when the test lamp, which was a 21.2-cp Edison, was inserted in the sphere, care being taken to insert the lamp as near the center of the globe as possible. The position of the lamp within the globe was then changed by raising it vertically from the center by increments of 10 cm until the maximum distance above the center of the sphere was reached, care being taken to keep the lamp in the center of the upper hemisphere. The screen which was used in this case to prevent the direct rays of the lamp from falling upon the window was 12.3825 cm × 20 cm in size and made of sheet iron, and coated with the same white paint previously used; it is spoken of hereafter as a white screen. The screen was adjusted until the luminous filament of the lamp could not be seen from the window. The position of the Lummer-Brodhun box used with the photometrical bench was changed at each position until a balance was obtained to measure the candle-power.

The general theory of the globe photometer, according to Dr. Black, is given in Barrow's "Electrical Illuminating Engineering," page 50, and elsewhere, so it is unnecessary to review it here. The illumination on the window is multiplied by a constant to obtain the mean value of the spherical candle-power.

The effect of different distributions upon the constant by the use of prismatic reflectors was investigated and the results obtained are shown in the accompanying diagram. The bare carbon-filament lamp, which was a well-seasoned Edison 21.2 cp, was first inserted in the center of the sphere, care being taken to arrange the white screen so that none of the lamp filament was visible through the observation window, and the same relative position of the screen to the lamp was maintained throughout the investigations. The lamp was then moved vertically upward by increments of 10 cm until the maximum distance above the center was reached, and the intensity of the illumination at the window was noted in each instance. From this data was determined the constant, or the number by which the illumination observed at the window must be multiplied to give the actual candle-power.

The values of the constant which were obtained with the bare lamp are given by curve *A*. This curve shows that the value of the constant decreased as the distance above the center of the sphere increased up to about 28 cm above, and then increased again. The variation in the value of the constant is attributable largely to the error caused by the screen between the source of light and the window and will introduce a different error for different positions of the lamp, because in some positions more of the direct rays from the lamp will strike the screen than in other positions. It is also evident that for some positions of the lamp the screen will interfere with the reflected flux of light from the part of the lamp where the intensity is a maximum, while in others it will interfere with the flux of light from a less intense part. This interference of the screen with the flux of light will cause the fluxes of maximum intensity to be reflected a greater number of times before they reach the window than will be necessary for them to be reflected at some other position. A certain per cent of the flux of light is absorbed every time it is reflected, consequently reducing the intensity at the observation window and affecting the value of the constant. The effect of the screen will vary with the distribution of the flux of light and probably to some extent with the color of the light emitted by the luminous source.

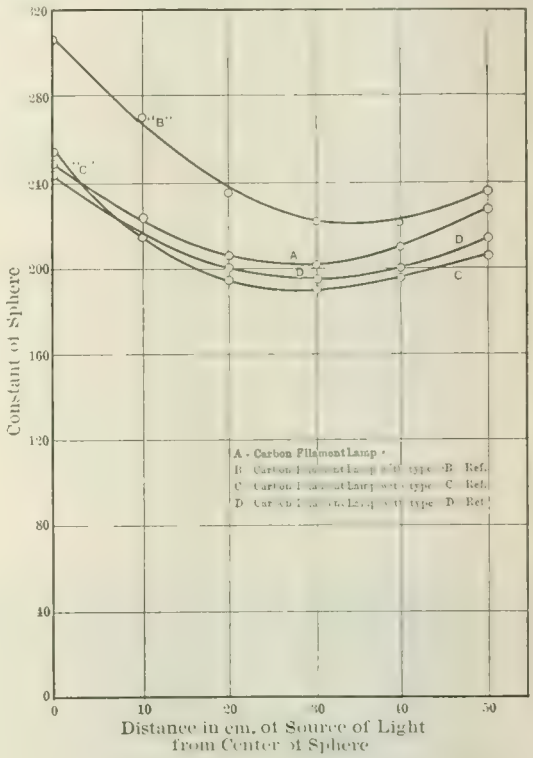
Curve *D* shows the values of the constant obtained when using the carbon-filament lamp with "Type D" reflector. The values of the constant in this case are slightly less than those for the bare lamp, thus showing a distribution favorable to the illumination of the window. It is evident that the absorption of light in this case is less than in the previous case.

Curve *C* shows the values of the constant obtained for the carbon-filament lamp with "Type C" reflector. The value of the constant in all but the central position is less than that obtained for any of the distributions studied.

Curve *B* indicates the values of the constant obtained by using "Type B" reflector. This curve shows a marked increase in the value of the constant over those indicated by curves *A, C* and *D*.

It is evident from a consideration of these curves that the distribution of the flux of light has a marked effect upon the values of the constant obtained. Type B reflector gives a nearly uniform distribution of light over a solid angle of 45 deg. on each side of the vertical.

Since the values of the constant obtained for the same position above the center with the different distributions varied greatly, especially in the case of curve *B*, it may be stated that the distribution of the flux of light has a marked influence



EFFECT OF DIFFERENT DISTRIBUTIONS UPON CONSTANT.

upon the constant in some cases. This result is attributable to the greater number of reflections a distribution like that given by the Type B reflector must undergo, and a relatively smaller portion of the illumination contributed to the window is by singly reflected light than in the case of distributions like those of *A, C* or *D*. This variation is probably due, to a great extent, to the irregularity in the reflective power of the interior surface of the sphere, and it is also probable that the reflecting power of the reflectors is not the same.

It may well be stated that when the convenience of the globe photometer and the ease with which the mean spherical candle-power of a source can be determined are considered, and knowledge is had of the conditions under which its "constant" varies, one is justified in asserting that it is worthy of more serious attention than it has yet received.

New Telephone Patents.

Semi-automatic exchanges involve a combination of the manual and automatic systems, these being interwoven in various ways. In a system recently patented by Mr. H. G. Webster, of Chicago, Ill., for which he has obtained three patents, all assigned to Mr. M. G. Kellogg, the origination of a call by a subscriber automatically selects a non-busy operator having before her a full jack multiple through which she can complete the call.

When a call arrives upon a connecting machine, the latter at once selects a trunk, this being the first non-busy trunk or the first non-busy operator. The factor used to determine this latter condition, for a non-busy operator, is that of a

non-answered call existing before her. The trunk circuits terminate before the operator's plugs, and the operator having a multiple can readily call, supervise and disconnect. The system is so arranged that the apparatus required is not complicated.

NEW APPARATUS AND DEVICES.

With party lines on the selective basis it frequently becomes necessary to equip each cord pair with several different ringing keys. Where the talking circuit is carried through all these in series with a break contact, the chance for trouble becomes rather great. This may be overcome if an extra key be used which responds to all plungers and breaks the talking circuit for all. Other applications of this same system also suggest themselves, and Mr. J. L. McQuarrie, of Oak Park, Ill., has obtained a patent for such a combination key. His patent is assigned to the Western Electric Company.



SCHREEVE RECEIVER HANDLE

A sort of handle for a watch-case type telephone has been patented by Mr. H. E. Schreeve, of Wyoming, N. J., which the American Telephone & Telegraph Company has obtained by assignment. It is shown herewith. A back strap of sheet metal forms a supporting hook at one end and a handle line at the other.

Patents for two antiseptic devices have recently been issued. One of these is a sheet metal extension mouthpiece slipped over the rubber mouthpiece from the rear. A bead is then spun in it, which clamps the rubber mouthpiece in position and at the same time secures a screen and antiseptic pad. This is the invention of Mr. Geo. H. Reed, of New York City. The other consists of a threaded nipple to be placed between the mouthpiece and transmitter, clamping at the joint on an antiseptic screen. This latter is patented by R. E. Miller, of Dayton, N. M.

LETTERS TO THE EDITORS.

Alternating-Current Waves.

To the Editors of Electrical World:

SIRS:—In the article by Prof. Charles S. Slichter, entitled "Graphical Computation of Fourier's Constants for Alternating-Current Waves," which was printed in your issue for July 15, it was pointed out that the analysis of distorted waves may be accomplished either with the aid of a mechanical analyzer or some purely mathematical method may be resorted to.

With the purely mathematical method one might distinguish between two typical cases of wave-form analysis, as indicated below. In the first case the harmonic components of the curve and their relative time-phase displacements are to be determined such that the value found by the expression

$$\frac{1}{\pi}\int_{o}^{\pi} | F(x) - N(x) |^{2} dx$$

becomes a minimum or possibly zero.

In this equation $F(x) = Y = A_1 \sin \omega t + A2 \sin 2\omega t + A_3 \sin 3\omega t + \ldots An \sin n\omega t + B_1 \cos \omega t + B_2 \cos 2\omega t + B_3 \cos 3\omega t + \ldots Bn \cos n\omega t$. $N(x)$ represents the actual instantaneous ordinate of the curve. An analysis of this kind will be required by the mathematician and physicist.

In the second case the determination of the fictitious components of the curve is confined to that of the fundamental wave and to higher harmonics, the amplitudes of which exceed a certain value expressed in terms of that of the fundamental wave. An analysis of this kind is what the practicing electrical engineer requires. In other words: For engineering work it suffices to determine the amplitudes of the fundamental wave and of those higher harmonics from which disturbances are to be expected.

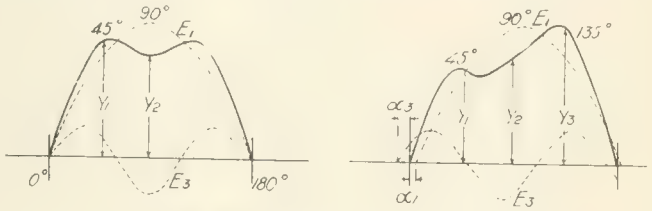
There are instances where the determination of only the value $E \div E_1$ is required, where E = amplitude of complex wave, E_1 that of the component of fundamental frequency.

Whatever the problem in heavy current work may be, it always suffices to determine the amplitudes of the fundamental wave and of one or two members of higher order.

The application of Professor Slichter's method undoubtedly possesses advantages, when an analysis as outlined under the first classification is to be obtained.

For engineering work, however, it would seem that the method which embodies the employment of specially prepared co-ordinate paper and that of a planimeter is too complicated.

Methods of wave-form analysis which meet the requirements of the engineering profession have been developed by various engineers. Mention may be made of the methods of Houston and Kennelly and Fischer-Hinnen. In each of these two methods the amplitude of the fundamental wave can be arrived at only after those of the components of higher order have been determined. The writer has developed a method, published elsewhere, in which the amplitude of any harmonic component is determined in the following manner: Measurement is made of as many ordinates as the complex wave contains harmonic components. The application of a simple formula for each individual component then furnishes the amplitude of the harmonic component under consideration independently one from another.



FIGS. 1 AND 2—ALTERNATING-CURRENT WAVES.

For example, in the case of a symmetrical wave, as shown in Fig. 1, with the equation $y = E_1 \sin \omega t + E_3 \sin 3\omega t$, E_1 and E_3 the amplitudes of the fundamental wave and the third harmonic, respectively, are found in the following manner:

Erect and measure the ordinates Y_1 and Y_2 as shown.

There are then obtained:

$$E_1 = 0.71\ Y_1 + 0.50\ Y_2; \quad E_3 = 0.71\ Y_1 - 0.50\ Y_2$$

Similarly for a curve of the unsymmetrical type, as shown in Fig. 2, the equation of which may be written: $Y = E_1 \sin(\omega t - \alpha_1) + E_3 \sin 3(\omega t + \alpha_3)$.

$$A_1 = 0.354\ (Y_1 + Y_3) + 0.50\ Y_2$$
$$A_3 = 0.354\ (Y_1 + Y_3) - 0.50\ Y_2$$
$$B_1 = B_3 = 0.354\ (Y_3 - Y_1)$$ thus:
$$E_1 = \sqrt{A_1^2 + B_1^2}$$
$$E_3 = \sqrt{A_3^2 + B_3^2}$$

where A_1 A_3, B_1 B_3 are the sine and cosine members of the components E_1 and E_3, shown in dotted lines.

In a similar manner there may be developed simple formulas with the aid of which the fictitious components of any distorted wave can be determined with a minimum expenditure of time.

CHICAGO, ILL. HENRY HERMANN.

Movement of Magnetic Material in a Rotating Field.

To the Editors of Electrical World:

SIRS:—In connection with my letter in your issue of Sept. 9, commenting upon a letter in your issue of July 22, it seems well for me to state in more detail the reasons for my belief concerning the movement of magnetic material in a rotating field as outlined in the former issue.

The revolving action of the magnetized iron pieces is practically continuous, due to the fact that as they turn they alternately present to the passing rotating field that portion of their edge which is opposite in polarity to that of the rotating field,

and, therefore, the tangential pull of the rotating field on the iron pieces is practically unidirectional and in its own direction as applied to that portion of the iron pieces which is next to the rotating field.

My statement that the hysteretic action is not directly the cause of the rotating action of the iron pieces, and that the hysteretic action is probably slight and incidental is based on the assumption that the hysteretic action is simply the result of the lagging action of the revolving iron pieces—with respect to the rate of charge of the rotating field—and the consequent gradual reversal of polarity in the iron pieces. My contention is that the hysteretic action is an effect rather than a cause.

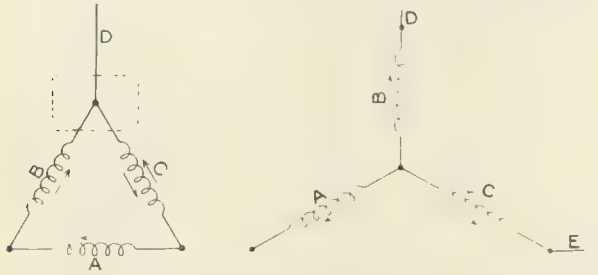
MADISON, WIS. C. W. LANGE.

Time-Phase Relations in Three-Phase Systems.

To the Editors of Electrical World:

SIRS:—The articles by Prof. A. S. Langsdorf and Mr. F. Conrad in the Aug. 12 and 19 issues of the *Electrical World* give some attention to the time-phase relation and sum of the currents in the line wires of a three-phase delta system. These relations may be made clear to the beginners in the way shown below.

In considering the delta of Fig. 1, the positive direction of voltage may be taken in clockwise direction around the circuit, as shown by the arrows inside the delta of Fig. 1; that is, the voltage in each phase will make an alternation in the direction of the arrows 120 time-degrees in advance of that of the phase immediately following. If the arms *A*, *B*, *C* of the delta have similar characteristics the currents will flow around the delta 120 time-degrees apart in exactly the same relation to each other as the voltages.



FIGS. 1 AND 2.—VOLTAGE RELATIONS IN DELTA-CONNECTED AND STAR-CONNECTED SYSTEMS.

Considering phases *B* and *C*, phase *B* may be taken as 120 and *C* 240 time-degrees behind *A*, but *C* will flow in a negative or counterclockwise direction 180 deg. in advance of its positive value, or 240 deg. — 180 deg. = 60 time-degrees behind *A*; as *B* is 120 deg. behind *A*, it follows that *C* reaches its negative maximum 60 deg. in advance of the positive maximum of *B*. The negative direction of *C* is shown by the arrow outside the diagram, and considering the junction point of *B*, *C*, and line wire *D*, there are flowing toward *D* two currents 60 time-degrees apart. It should be remembered that in considering the current in any wire at a junction point the same law holds in direct or alternating current; namely, the sum of the currents at any instant is zero, assuming the flow into and away from the junction as positive and negative, respectively.

The sign given the in-flowing or out-flowing current, of course, does not matter as long as the signs are the opposite of each other. In considering the current in the line wire *D* then the attention should be concentrated on the point of junction, as shown enclosed by the dotted lines in the diagram, and the proper sign should be given to the two currents *B* and *C* as meeting at a junction point rather than their sign as regards their direction in the delta. In fact, the problem as regards line current is distinctly that of currents at a common junction point, and to try to carry their delta signs into the problem is confusing rather than otherwise to one not familiar with such circuits.

In a circuit as here outlined, it is plain from the above considerations that the currents of phases *B* and *C* are 60 time-degrees apart as regards their junction on line wire *D*, and, therefore, the current in *D* is 1.732 times that in either *B* or *C*. In adding vectors of *B* and *C* it is generally stated in textbooks that the vector of *C* is reversed, which is, of course, the same thing as the foregoing.

In considering the voltage between line wires in a star system, as Fig. 2, the same considerations may be said to apply. The voltages are considered as directed from or into the junction point displaced 120 deg. in time-phase from each other; taking phase *C* it would then have an outward direction from the junction point 120 deg. after *B*, but would be directed into the junction—that is, be negative, as shown by dotted arrow, 60 deg. in advance of the positive or outward direction of *B*. Considering then the voltage between line wires *D* and *E* it is evident that voltages *B* and *C* will add when they have opposite sign—that is, *B* outward, *C* inward, or vice versa—and, therefore, there is between line wires the sum of two voltages 60 deg. out of time-phase, rather than 120 deg., as would be true if their signs as regards the junction point were considered.

TOLEDO, OHIO JOHN GILMARTIN.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Rectifier.—An illustrated description of a rectifier specially intended for the charging of ignition batteries from alternating-current mains. It comprises a set of vibrating contacts which connect the load circuit alternately to two portions of the secondary winding of a transformer, the connection being so made every half period that a succession of rectified half-waves is delivered into the circuit. An efficiency of 90 per cent is claimed. In Fig. 1 *A* is the primary winding of the transformer, which is connected to the supply mains through a switch. *B* and *C* are the two secondary windings, connected together at *D*. *E* and *F* are two electromagnets wound oppositely and connected in series across one (or both) of the secondary windings. The pivoted steel bar *G*, which is given a permanent polarity by means of the two coils *H* and *J* supplied with energy from a storage battery, is set in vibration by the mutual action of the two alternating-current magnets *E* and *F*. This vibrating system is adjusted to suit the frequency of supply by varying the distance of the magnets from the bar and the tension of the springs *K*. Rigidly attached to the bar is a stiff cross-piece *L*, which carries platinum contact pieces on springs at its extremities. These contact pieces are electrically connected to the nut *M*, which forms one terminal of the direct-current circuit. Opposite to the two contact pieces are two platinum-tipped studs *N* and *O*, connected, respectively, to the free ends of the transformer secondaries *B* and *C*. When the bar *G* is moving toward *F* contact is established at *N*, and the current-impulse corresponding to the half-wave is sent into the direct-current circuit. At the instant when the current passes through zero, the bar *G* has moved to such a position that contact is broken at *N* and made at *O*, so that the current-impulse corresponding to the next half-wave is sent, reversed, into the direct-current circuit. Although the current in the magnet coils *E* and *F* may differ in time-phase slightly from the main secondary current, thus causing the contacts to be made and broken just before and after the current has passed

through the zero point, this has little effect on the working of the apparatus and any tendency to sparking is counteracted by the small condensers *P* and *Q*, which discharge a useful current into the circuit. If desired, an auto-transformer can be substituted for the two-coil transformer, the point *D* being made the middle point of the winding, and tapings being taken off at equidistant points in the winding at either side of *D* for connection to *N* and *O*. Among the advantageous features claimed for this apparatus is that it acts as an automatic minimum cutout, because if the supply of current should fail the

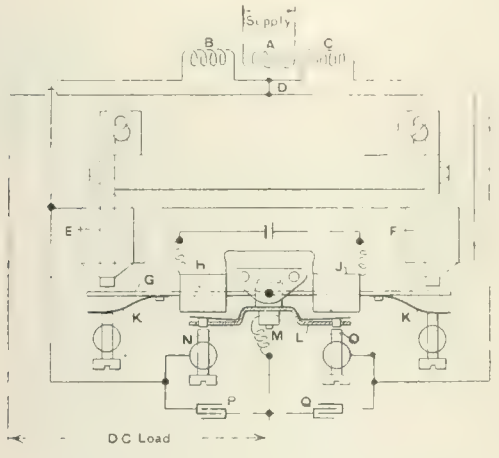


FIG. 1.—DIAGRAM OF RECTIFIER CONNECTIONS.

rectifier will stop and all the contacts in the secondary circuit will be broken so that it will be impossible for the accumulators to discharge through the apparatus. Moreover, the device can work on any load from no load up to full load, an advantage that the mercury-vapor rectifier does not possess.—Lond. *Elec. Eng'ing*, Sept. 2.

Reliability of Electrical Machinery.—Some notes on last year's report of M. Longridge (chief engineer of the British Engine, Boiler & Electrical Insurance Company) on failures of machinery. A considerable increase is shown in the number of failures of gas and oil-engine shafts, such failures amounting to 9.1 per cent of the total failures, compared with 4.7 per cent in 1907 and 5 per cent as the average for 24 years previous to 1907. The rate of break-down among electric motors shows some improvement, the figures for the year 1908 being 1 in 9.2 for continuous-current and 1 in 11.3 for alternating-current motors, compared with an average figure for the two types of machines of 1 in 7.9 for 1908 and 1 in 8.2 for 1906. The figures given above for electric motor break-downs in 1908 compare favorably with the figures of 1 in 9.1 for gas engines and of 1 in 9.4 for steam engines. Dirt and neglect are responsible for at least 30 per cent of the failures, while the manufacturers must be held accountable for fully 11 per cent of the total break-downs. Oil-throwing is probably the most fruitful source of trouble, but not enough care has been exercised to secure efficient locking of spiders, core plates, pole-pieces, etc.—Lond. *Electrician*, Sept. 3.

Stranded Conductors.—A note on a recent British patent of C. A. Parsons, J. H. Greaves and A. R. Hemsted (16,620, 1908; Aug. 26, 1909). Flattened, stranded, coreless conductors, particularly suited for high-speed, smooth-core armatures, and also for slotted alternating-current armatures, are manufactured by twisting wires round a fixed dummy core by means of a revolving drum carrying the spools, and then passing the wire tube so formed between two rollers, which flatten it into the required flat conductor. The wire tube may be formed inside a tubular die instead of round a dummy core. Additional layers of wire may be placed over the flattened cable. The flattening process does not damage the insulation of the individual strands, which may be of cotton or enamel.—Lond. *Elec. Eng'ing*, Sept. 2.

High-Speed Direct-Current Machines.—A note on a recent British patent of C. A. Parsons and A. H. Law (16,704, 1908; Aug. 26, 1909). The conductors are only partly embedded in the iron, so that the self-induction of the windings is not appreciably increased over that of a smooth-core armature, while the use of binding wires is avoided. To increase the magnetic path round the conductors they are made flat and thin, one edge being expanded or shaped so that they can be locked in the slots by wedges or other suitable means. If cable, stranded as described above, is used, it can be previously shaped so as to be held easily in dovetailed slots by passing it between specially formed rollers.—Lond. *Elec. Eng'ing*, Sept. 2.

Damping Coils for Direct-Current Magnets.—K. W. WAGNER.—A sudden disconnection of a magnet coil from its circuit produces high voltages. In order to obviate this difficulty an auxiliary short-circuited coil (damping coil) may be placed on the magnet, so that the magnetic energy which disappears can be transformed into joulean heat in this secondary coil. The author begins to discuss this problem mathematically.—*Elek. und Masch.* (Vienna), Aug. 29.

Constant-Current Motor-Generator Sets.—A note on a recent British patent (5,209, 1909; Aug. 26, 1909) of the British Thomson-Houston Company (General Electric Company of this country) for constant-current motor-generator sets. The armatures of the two machines are connected in series. Each has one set of short-circuited brushes on a line at 90 electrical space-degrees to the main field, and a set of brushes displaced 90 electrical space-degrees to the first set, through which the armatures are connected in series. The load circuit to which constant current at varying potential is to be supplied is connected across one armature.—Lond. *Elec. Eng'ing*, Sept. 2.

Lamps and Lighting.

Incandescent Lamps.—H. L. IRELAND.—An account of tests on the comparative operation of metallic-filament and carbon-filament lamps, with respect to variation of candle-power during life, the temperature coefficient of resistance, and the effect of variations in voltage.—*Jour. of Engineering*, University of Colorado, No. 5.

Photometry.—S. NOWACKI.—An illustrated article making suggestions on the use of photometers in practice, with special reference to some details of the use of the Bunsen and Brodhun photometers.—*Elek. Anz.*, Aug. 19.

Mercury-Arc Rectifier.—A. S. STREAMER.—An illustrated article on the commercial applications of the mercury-arc rectifier.—*Jour. of Engineering*, University of Colorado, No. 5.

Generation, Transmission and Distribution.

Electric Cranes.—H. H. BROUGHTON.—A continuation of his long illustrated serial on electric cranes. The author here deals with the mechanism required for effecting the traversing and traveling cranes. The article opens with a brief discussion of the determination of the size of motor required for each motion, and "constants" of American cranes are given. Then follow notes on slipping drives, axles, axle boxes, roller bearings and track wheels. Constants are given in order to enable the several parts to be proportioned correctly. Traversing and traveling mechanism arrangements are also described.—Lond. *Electrician*, Sept. 3.

Power in Paper Mill.—A. PALME.—An illustrated description of the electric equipment of a paper mill in Toscolano, on the Garda Lake, in Italy. Water-power is utilized, the generating plant containing three 650-hp alternators giving three-phase currents at 6300 volts and 42 periods. The transmission line has a length of three miles. The chief part of the energy is utilized for driving three 300-hp induction motors.—*Elek. und Masch.* (Vienna), Aug. 22.

High-Head Development.—L. ELLIOTT.—A brief illustrated description of hydroelectric development, beginning with the preliminary investigations and touching on surveys, designs and construction work, leading to the completed power plant. The discussion covers the various divisions of the development in the order of the actual occurrence on the stream, from the upper waters to the plains below.—*Jour. of Engineering*, University of Colorado, No. 5.

Installations, Systems and Appliances.

Water Heater.—An illustrated description of a compact electric water heater, in which the electric current passes through the water itself and raises its temperature simply by joulean heat. The apparatus (Fig. 2) consists of a porcelain cylinder *A* with porcelain caps screwed in at each end, the intermediate space being filled up with a series of very thin platinum

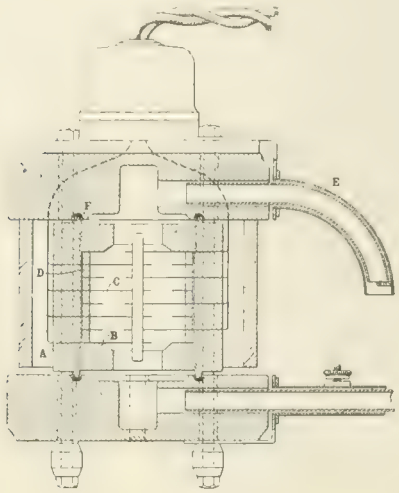


FIG. 2.—WATER HEATER.

diaphragms *C* separated by porcelain rings *D*. The water enters at the bottom and flows upward between the diaphragms through circular apertures cut in them on alternate sides of the center so as to give a zig-zag flow. Alternate diaphragms are connected together, and the two sets of diaphragms are connected to the supply circuit. Current passes between opposite plates when water is flowing through the apparatus and thus heats the water. A certain amount of electrolysis takes place when continuous current is used, but "the oxygen evolved is dissolved in the water and purifies it, while the hydrogen is liberated into the atmosphere." The inner cyclinder is clamped between two thick earthenware end plates by brass rods passing through both these, and outside of the cylinder. The inner edges of the cylinder bear against rubber rings *F* let into grooves in the end plates to make the apparatus water-tight. An outer earthenware cylinder surrounds the whole. The pipes and other external metal parts of the apparatus are earthed to prevent any shock from being received from the apparatus. The water being in direct contact with the pipes also, it is necessary to reduce the leakage current to earth to a minimum. This is done by making the water columns between the diaphragms and the inlet and outlet pipes as long as possible, by providing inner pipes of porcelain, as shown at *E* in the sketch. Moreover, to prevent anyone from receiving a shock from the outcoming stream of hot water a small screw is placed at the end of the pipe. This effectually earths the water as it leaves the apparatus. All the metal parts of the apparatus are in direct contact with the inlet pipe, but in cases where this is connected to the supply system with a rubber pipe, a special earth wire is connected to this terminal. The number of platinum diaphragms to be used with a certain voltage depends on the conductivity of the water.—Lond. *Elec. Eng'ing*, Sept. 2.

Electric Heating.—E. R. Ritter.—An illustrated paper read before the Electrical Society of Karlsruhe. When wires are used as resistors they are liable to be destroyed by oxidation. For this reason a German company uses for resistors very thin mica strips covered with a film of a noble metal. The mica films are about 0.01 mm thick. The thickness of the layer of the noble metal is not more than 1/4000 mm. The author then describes the applications of the new electric furnace product, silundum, which has already been noticed in the *Electrical World*. He then reviews the principles of electric heating and gives some data on cost in comparison with gas.—*Elek. Zeit.*, Aug. 19 and 26.

Lightning Arresters.—A. Garnier.—A theoretical article on lightning arresters containing a number of air-gaps in series. The author first treats with the change of potential along a series of cylinders insulated from each other and separated by air-gaps, if an e.m.f. is impressed on the two ends. He then deals with the effect due to resistors connected in parallel, and finally discusses the physical conditions of the extinction of the arc.—*L'Industrie Elec.*, Aug. 10.

Tariff.—L. Bernard.—The author argues that not only in water-power plants, but also in steam plants, the endeavor should be to use a flat rate in order to make electric lighting more popular. For steam plants he recommends the use of a flat rate for certain hours during the day, which include the chief hours of lighting, say, the time from 9 o'clock in the morning to 9 o'clock in the evening. For service beyond this time the energy should be metered.—*Elek. und Masch.* (Vienna), Aug. 29.

Charging of Storage Batteries.—R. Edler.—An article on the method of Micka and Cisneros for charging a storage battery without increasing the voltage by dividing the battery into three parts. The author describes three methods by which the charging can be carried out with the aid of two ordinary three-pole switches without any technical complications.—*Elek. Zeit.*, Sept. 2.

Wires, Wiring and Conduits.

High-Tension Insulators.—M. Vogelsang.—For the design of high-tension insulators, etc., the author makes use of the curves in Fig. 3, giving the perforation voltages in air and oil. The abscissas are kilovolts. The ordinates give the distance in millimeters which will be perforated. Curve *a* refers to the perforation voltage between horns in air, *b* between points in air, *c* between the plates in air, and *d* between points in oil. If, for instance, the object is to design an apparatus for a perforation e.m.f. of 68,000 volts in air, corresponding to a height of porcelain of 150 mm, then the minimum distance of metallic parts of the apparatus in oil should be at least 36 mm, as this figure corresponds to 68,000 volts in oil. For determining the height of the insulators of high-tension apparatus, the author gives an empirical formula which takes into consideration the voltage and the rating of the central station. If *h* is the height of the

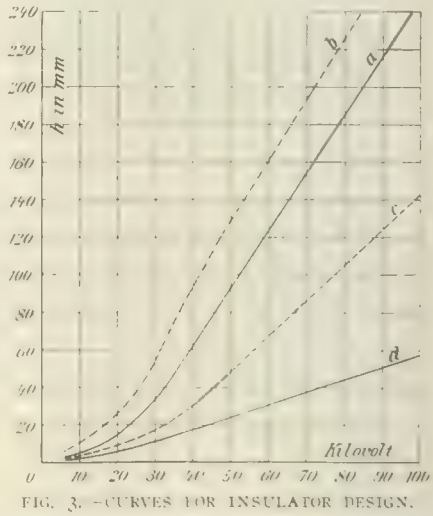


FIG. 3.—CURVES FOR INSULATOR DESIGN.

porcelain insulators in millimeters, *k* the voltage, and *L* the rating of the central station in kilowatts, the empirical formula is:

$$h = \sqrt{k}\left(0.8 + \frac{L}{80}\right)$$

The author recommends marking high-tension apparatus with the perforation voltage for which they are designed.—*Elek. Zeit.*, Aug. 26.

Ionization of Air by High-Tension Lines.—Houllevigue.—The effect of a thunderstorm following the direction of a high-tension transmission line has called the attention of physicists to the part which transmission lines play in meteorology. One

of the theories advanced is that high-tension lines emit streams of ion which rise and take along enormous electric charges. The author has investigated experimentally whether this is true along a certain transmission line in France. He found that along this line the number of ions positive and negative was almost zero, in any case less than at other places in the neighborhood. Thus it would seem that high-tension lines do not produce ions, but rather capture those which are in the surrounding air.—*L'Industrie Elec.*, Aug. 10.

Traction.

Current Clocks.—Several years ago the Berlin street railways began to install wattmeters on some of their cars to see whether the automatic control thus imposed on the motormen would lead to better running and decreased energy consumption. By the end of 1907 the Berlin company had over 250 wattmeters in service, but since February, 1908, all wattmeters have been removed and every car on the system has been equipped with a clock which runs only when energy is passing through the controller. The change from the complex wattmeter to this simple clock was made after experiments with both instruments on the same car had proved that those with the lowest watt readings also had the lowest current-time reading. In fact, the clock was considered superior to the wattmeter as a gage of the skill of the motormen in using energy for several reasons. The connections of the clock are shown in Fig. 4. It is

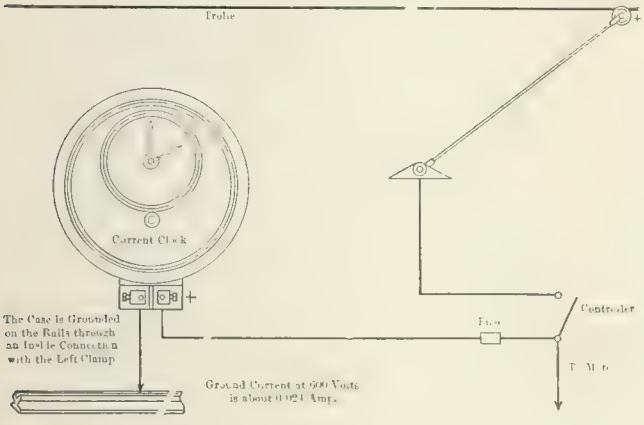


FIG. 4.—DIAGRAM OF CURRENT CLOCK CONNECTIONS.

operated by a spring, like any clock, and will run for more than a month without further attention. It is connected in parallel with the controller. The clock is equipped with a pair of coils, which, when magnetized by the shunt current, pull up the armature which holds the balance wheel. As soon as the balance wheel is released the clock begins running and continues to do so until the interruption of the current causes the armature to stop the balance wheel, as before. The entire timepiece is of simple construction and can be grounded for potentials up to 600 volts.—*Elec. Railway Jour.*, Sept. 11.

Electrophysics and Magnetism.

The Ions in Gases.—W. SUTHERLAND.—A theoretical paper in which the author gives the fundamentals of a theory "wide enough to contain the chief phenomena now known." The simplest theoretical ion in a gas is an atom charged with an electron, just as in electrolytic solutions. But the calculations of J. J. Thomson, Langevin and others seem to show that the smallest ions in gases consist of a few molecules, say, two or three. P. Phillips in his experiments on ionic velocities in air with a wide range of temperature finds the number of molecules in a gaseous ion to vary apparently with the temperature. The present author shows, however, that this variation of the size of the small ion in gases is only apparent, that the experimental ion is the simple ion of theory and electrolysis, and that the seeming change of size is due to the same cause as the seeming change of size of molecules with temperature in the viscosity of gases and allied phenomena before the effects of cohesional force were allowed for in the kinetic theory of gases. The mathematical theory of the author is divided into three parts, dealing with three kinds of ions, a small one and two large ones. In his dynamical theory of the ions of gases the two new types of viscosity previously investigated for ions in electrolytic solutions are found to be of paramount importance.—*Phil. Mag.*, September.

Radium.—A paper by J. Joly deals with the radium contents of sea water, bringing out the very wide range of radio-activity at different points of the ocean. W. M. Watts calculates the atomic weight of radium from spectroscopic data by means of an interpolation formula. He finds it to be 226.5.—*Phil. Mag.*, September.

Units, Measurements and Instruments.

Standard Cells.—C. J. J. Fox.—A paper presented before the British Association for the Advancement of Science on a new and simple method of preparing mercurous sulphate for standard cells. There is no difficulty in purchasing Hg_2SO_4, which is quite free from foreign metals. If commercially pure Hg_2SO_4 be heated together with a little pure Hg and dilute H_2SO_4 for a day or so at from 120 deg. C. to 150 deg. C. in either a sealed tube (1-mm to 2-mm walled tubing) or bottle with wire-bound stopper, and occasionally agitated, a white crystalline preparation will be obtained even from a specimen of Hg_2SO_4 which is initially discolored almost black. The Hg_2SO_4 obtained in this way is itself free from nitrate; it is also quite free from basic salt. It is filtered off, ground up in a mortar with one or two successive quantities of diluted Hg_2SO_4, and then with several quantities of saturated cadmium sulphate solution; it is filtered off in a Büchner funnel after each washing. In this way it is possible with very little trouble to prepare quite large quantities of very reliable, well crystallized, white Hg_2SO_4 in every respect suitable for standard cells.—Lond. *Electrician*, Sept. 3.

Alternating-Current Galvanometer.—M. GUINCHANT.—A paper presented before the French Academy of Sciences. The measurement of resistance by the method of Kohlrausch becomes difficult when one of the arms of the bridge introduces a phase difference. A self-induction or a capacity insufficient to produce an appreciable difference between the ohmic and apparent resistances may produce parasitic sounds which will render the fixation of the minimum difficult. In a study of solid electrolytes the author has replaced the telephone by a galvanometer constructed as follows: A piece of iron is suspended by a silk thread in the center of two coils placed at right angles. One coil (with thick wire) is supplied with constant alternating current, the other (with thin wire) replaces the telephone. The first coil is placed perpendicularly to the magnetic meridian, consequently perpendicular to the piece of iron as directed by the magnetic field of the earth. The earth field is almost annihilated by an external magnet, so that the alternating magnetic field provides almost all of the directive force. Any alternating current of the same period passing through the coil of thin wire produces a field perpendicular to the first and gives a deflection to the piece of iron. The direction of the deflection is different according to whether the phase difference of the two coils is greater or smaller than 90 deg. In making bridge measurements one gets, thus (as with direct current), a deflection, the direction of which changes on passing through the equilibrium position. The value of resistance found by this measurement is the apparent resistance and not the ohmic resistance. The instrument operates equally well with direct current.—*L'Industrie Elec.*, Aug. 10.

Comparing Self-Inductance and Capacity.—C. H. LEES.—A mathematical paper on Vaschy's or Pirani's method of comparing the self-inductance of a coil with the capacity of a condenser.—*Phil. Mag.*, September.

Alternating-Current Instruments.—J. VON STUDNIARSKI.—The first part of a mathematical article illustrated by diagrams on the power consumption of alternating-current instruments.—*Elek. Zeit.*, Sept. 2.

Meter.—An official communication of the Reichsanstalt by which a direct-current motor meter of the Bergmann Com-

pany is admitted for calibration, its construction and method of calibration being described.—*Elek. Zeit.*, Aug. 26.

Oscillograph.—G. W. Smith.—An illustrated description of the principle and construction of the oscillograph.—*Jour. of Engineering*, University of Colorado, No. 5.

Calibration of Meters.—F. Orlich and G. Schulze.—An account of an investigation carried out in the German Reichsanstalt. The errors of electricity meters are generally determined with constant current, while in practice the meters are often subjected to varying load. The authors, therefore, investigated how far the errors found by calibration with constant current hold good also for varying load. They show theoretically that the readings of meters at varying load cannot be verified on account of the inertia of the movable system. These theoretical results are confirmed by tests of meters of three German companies.—*Elek. und Masch.* (Vienna), Aug. 29.

Telegraphy, Telephony and Signals.

Multiple Telegraphy.—E. Mercadier.—A paper presented before the French Academy of Sciences. The author, together with Magunna, has formerly shown that several telegrams can be transmitted simultaneously along the same line consisting of two wires by means of superposing alternating currents of different frequencies upon each other and also superposing at the same time direct-current impulses upon the different alternating currents. They have now studied whether the same results could be obtained with a line consisting of a single wire earthed at both ends. This experiment was made between Paris and Lyons. They were successful and could annihilate the effect of the earth currents at Lyons, where they are particularly strong. —*L'Industrie Elec.*, Aug. 10.

Microphone.—W. Muenchenhagen.—The author suggests the utilization of the fact discovered by Righi that a coil of bismuth wire changes its resistance in a varying magnetic field in such a way that the resistance increases with increasing field intensity. Instead of the copper coils, coils of bismuth wire are placed on the pole-shoes of the permanent magnet. The telephone changed in this way is used as a microphone. By speaking into it the vibrations of the iron diaphragm change the field intensity of the permanent magnet and therewith the resistance of the bismuth-wire coils. (It seems that the author has not yet made such an instrument.)—*Elek, Anz.*, Aug. 8.

Wireless Telephony and Telegraphy.—E. Nesper.—The conclusion of a long serial giving a review of the present situation of wireless telegraphy and telephony.—*Elek. Anz.*, Aug. 21.

Miscellaneous.

Canadian Development.—William N. White.—His address to Section G of the British Association for the Advancement of Science. The speaker first emphasized that the governing authorities of Canada have appreciated the fact that bold enterprise and generous financial provision are essential to the progress and prosperity of the country. He then gave a review of the great progress made in railway building in Canada. As to electric traction, he stated that in 1901 there were 553 miles of electric railways and 815 miles in 1907. He then took up the building of canals and the development of water-powers. It has been estimated that on the line from Lake Superior, through the chain of lakes and rivers leading to Niagara, and thence through the St. Lawrence to the sea, 11,000,000 hp may be developed. Langelier has estimated that in the Province of Quebec the water-power aggregates more than 18,000,000 hp; other provinces all possess large resources of the same kind as yet untouched.—Lond. *Electrician*, Aug. 27.

Educational.—The presidential address of Rev. H. B. Gray to the Educational Science Section at the recent Canadian meeting of the British Association for the Advancement of Science His object was "to force upon the attention of English educationalists certain imperial factors which should occupy an indispensable place in the educational curricula of the great schools in the mother country." He would give a prominent place to the scientific teaching of geography, and particularly to historical geography, with special reference, of course, to the origin, growth and progress of the British empire. He would enforce an elementary knowledge of science on every boy who passes through the stage of secondary education. But, above all, he urges the bringing into the foreground a co-ordinated study of English language and English literature. He criticises severely the old mediæval system of education which has prevailed in England till comparatively recent years, and thinks the time has come when the study of two ancient languages should be reduced to one for all except scholastic specialists. He emphasizes "the necessity of a closer touch educationally (in the sense of 'academically') between the secondary schools and colleges of the mother country and similar institutions in the great Dominion and commonwealths which own her parentage." He criticises severely the usual system of examinations. He recommends an interchange of university students among English-speaking peoples. He finally emphasizes "the importance of what the educationalists of the United States call 'civics' as the binding power which should fasten together all the separate educational faggots in any imperial scheme of education —the duty of personal service to the state, the positive obligation which makes us all members incorporate in one imperial system."—Lond. *Electrician*, Sept. 3.

Electric Welding.—The first part of an article giving a review of various electric welding apparatus of recent construction.—*Elek. Anz.*, Aug. 29.

Laboratory Appliances.—W. Ikle.—A long description of details of a great many useful appliances, such as supports, clamps, burners, pipes, etc., for use in a physical laboratory. Mention was made chiefly of such appliances as are not generally known.—*Phys. Zeit.*, Sept. 1.

British Universities.—An article giving particulars of the courses of instruction in electrical engineering which are given at the various British universities, colleges, technical institutes, etc. Particulars are given of the electrical engineering courses at Cambridge and Oxford, and the leading universities, colleges and technical schools in the provinces, indicating, where possible, the previous education expected, the length and nature of the course, the fees and the degrees or certificates that can be taken.—Lond. *Elec. Eng'ing*, Aug. 19. The universities and colleges in London are dealt with in Lond. *Elec. Eng'ing*, Aug. 26.

Autogenous Welding.—C. B. Auel.—An illustrated description of welding by means of the oxy-acetylene flame and its application to welding various metals, with special reference to the methods of oxygen and acetylene supply. Reference is also made to the cutting of metals by means of the oxy-oxy-acetylene flame.—*Elec. Journal*, August.

Logarithmic Curves.—M. U. Day.—The first of a series of articles on the use of exponential and logarithmic functions as employed in connection with problems of self-induction of magnets, acceleration of armatures, etc.—*Gen. Elec. Review*, September.

Reichsanstalt.—A translation of the recent German report, already noticed in the Digest, of electrical work at the German Reichsanstalt in 1908.—Lond. *Electrician*, Aug. 27.

BOOK REVIEW.

Switchboard Measuring Instruments. By John C. Connan. New York: Spon & Chamberlain. 150 pages, 117 ills. Price, $2.

This volume deals with the design and construction of direct-current and alternating-current switchboard instruments, the substance having been collected by the author from various sources. Exact information of any particular make has been avoided and only meager details of construction are given. The treatment is far from lucid, and the equations and principles given are often confusing owing to a mixture of symbols; C, for instance, representing current in one case, a constant in another and capacity in another. The types of meters chosen are principally from foreign markets so that the text does not reflect American practice.

NEW APPARATUS AND APPLIANCES

Metal Reflector for Incandescent Lamp.

Fig. 1 herewith shows the application and Fig. 2 gives the distribution curve of the "Radio" reflector built by the Radio Reflector Company, of New York, and intended for incandescent electric lamps. The device is made of steel and given a polished nickel finish on the inside or corrugated reflecting surface. The

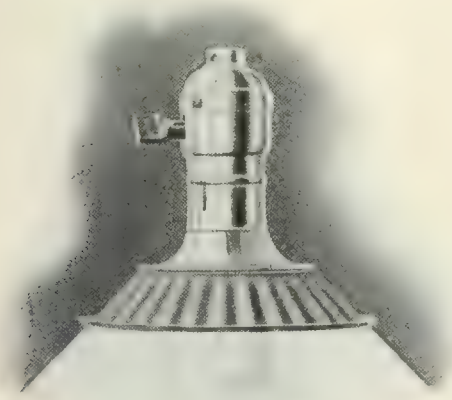


FIG. 1.—RADIO REFLECTOR ON LAMP.

diameter of the lower portion is 5 in. and the depth of the shade about 1 in. The upper part of the reflector is built on the iris-diaphragm principle so that the shade can be adjusted to any incandescent lamp in any place and any position without a shade holder. It is merely slipped over the lamp and remains where placed. The curve shows that the greatest amount of

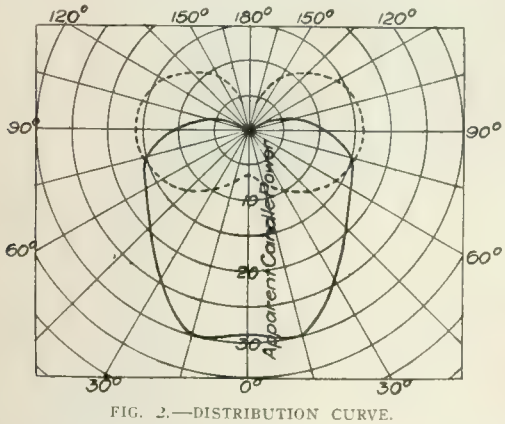


FIG. 2.—DISTRIBUTION CURVE.

light is obtained at an angle of about 15 deg., the candle-power ranging from about 1 cp at 120 deg. to 30 cp at 15 deg. The results plotted in the curve show the light obtained with and without the reflector in apparent candle-power at 10 ft.

The Western Electric Sign.

The Western Electric Company will within a few months mount on the sideboards of all trucks used by its various houses in the United States its striking sign. The sign is the well-known "Consult the Map" trade escutcheon of the company, but will in each location bear the address of the local house instead of the phrase "Consult the Map." The signs are black, the lettering being embossed and silver leafed. The wholesale labeling of the hauling and delivery departments of the company signalizes the rounding out of the company's wide-sweeping advertising campaign.

Electric Vulcanizers for Automobile Tires.

The vulcanizing of pneumatic tires requires for good work a steady heat at a predetermined temperature. Electrically heated vulcanizing apparatus with proper thermostatic control is nearly an ideal apparatus because it does not require the skill in operation required by flame-heated vulcanizers, is small and easy to apply, and is much more likely to give definite and satisfactory results, owing to the positive control of the heat. The C. A. Shaler Company, of Waupun, Wis., makes two types of electric vulcanizers for automobile tires. One of these is for alternating current only, and the other has a rheostat control and can be operated on alternating or direct current. They are both portable and can be taken in the automobile tool box and used wherever electric lighting current is available by plugging into any lamp socket. For use in garages they do away with the uncertainty and fire risk of flame-heated vulcanizers.

110,000-Volt Porcelain Insulator.

The suspended type of high-tension insulator shown in the accompanying cut has been developed and placed on the market by the Ohio Brass Company, of Mansfield, Ohio. This insulator is the one recently chosen by the Hydroelectric Power Commission of Ontario for operation on its transmission line at 110,000 volts.



HIGH TENSION INSULATOR.

The design of the lower surface of each porcelain shell is such as to confine the static discharges to an area immediately surrounding the forged stud, until the voltage impressed has approached that of flash-over. The operation of the insulator is exceedingly quiet up to flash-over. The electrostatic capacity is small, as each unit consists of a single porcelain shell (in place of several shells), a malleable iron cap and forged steel pin. The mechanical breaking strain of this insulator is approximately 10,000 lb., which allows ample factor of safety for normal conditions. The weight of each unit complete, with cap and forged stud, is 10¼ lb., and when assembled the distance between the edges of adjacent porcelain shells is 6¼ in. The length of two assembled units, from center of eyes in top unit to lower edge of forged pin in lower unit, is 13 9/16 in., and each unit added increased the length by 6¼ in.

Each assembled unit tested dry will flash over at approximately 95,000 to 100,000 volts, and under a heavy precipitation of 0.3 in. to 0.4 in. of water per minute, at an angle of 45 deg., will flash over at approximately 50,000 volts to 55,000 volts, and when tested under oil, punctures at approximately 120,000 volts to 150,000 volts. Each insulator is tested to 6000 lb. before packing and is given a flash-over test after the mechanical test, which is in addition to a severe electrical test, before assembling. In an assembled condition of two units, with a separation between the porcelain shells of 6¼ in., the flash-over dry is approximately 175,000 volts, and each unit

added increases the flash-over approximately 75,000 volts; two units under 0.3 in. to 0.4 in. precipitation per minute, flash over at approximately 110,000 volts, and each additional unit increases the flash-over by approximately 45,000 volts. The insulator is known as the "O. B. Hi-tension porcelain insulator."

Improvements on High- and Low-Head Water Turbines.

In the accompanying illustrations, Fig. 2 shows a new "scroll-type" high-head turbine made by the Trump Manufacturing Company, of Springfield, Ohio. This turbine has been designed for heads ranging from 20 ft. to 400 ft., and is so designed that the water is guided to the turbine runner in uniform rotary motion, which is obtained by a special construction



FIG. 1.—LOW-HEAD TURBINE.

of the crown plate of the turbine proper. This crown plate is cone shaped with spiral vanes cast on it. The water is delivered onto the turbine parallel to the shaft. Where water is delivered to a turbine at right angles to the discharge, or at right angles to the shaft passing through the turbine, there is more or less eddying, and more or less indirect pressure on one side of the turbine casing, the result being that the water enters the gates direct on one side and indirect on the opposite side. This objectionable feature has, it is claimed, been eliminated from the turbine illustrated.

The gate mechanism in this wheel and the gates are made of phosphor bronze, and are operated by a ring passing entirely around the outside of the water-wheel casing proper, or, in other words, around the periphery of the gates, and is so constructed that the gates are operated without the use of any link connections, which, in practice, have been found to be a continuous source of trouble, and in which there is always more or less lost motion.

The end thrust in this type of turbine has been eliminated through the use of the Trump patented water cushion, which is claimed to be practically frictionless, and is automatic in its operation. Through the use of the water cushion no wooden thrust blocks or other mechanical thrust bearings are required.

In Fig. 1 is shown the horizontal draft-chest type of Trump turbine for open penstock setting. This has been designed for use under low heads, where it is preferable to use the horizontal rather than vertical setting, which latter, as a rule, necessitates the transmission of power through bevel gearing. The turbine illustrated is 44 in. in diameter, and was designed to operate under a head as low as 9 ft. These turbines have been brought out and are manufactured by the Trump Manufacturing Company, Springfield, Ohio.

Exhibits at the Vermont Electrical Association Convention.

There was quite a large attendance of manufacturing and supply representatives at the convention of the Vermont Electrical Association, a report of whose proceedings is given elsewhere.

General Electric Company made a small but interesting exhibit of its complete line of tungsten lamps, and also used a number for illustrative lighting of the Armory in which the sessions were held. It was represented by Messrs. F. W. Willcox, T. J. Brown, H. W. Brown, R. B. Hampson, J. S. Butler, D. G. Brokaw, A. W. Ives, Chas. Burleigh, H. Schroeder, W. J. Newcomb, J. Starr Button, C. H. Scott, W. M. Watkins.

Westinghouse Electric & Manufacturing Company was represented by Messrs. G. M. Bates, C. P. Wahn, A. F. McCarthy and I. P. Sprague. A number of excellent posters about the hotel called attention to the nature and quality of the company's apparatus. Mr. H. P. Childs was present on behalf of the Westinghouse Machine Company.

Mr. C. F. Gilliatt made a very interesting exhibit in full operation of the instrument now being put on the market by the Excess Indicator Company, of Lynn, Mass.

Holophane Company was represented by Messrs. V. R. Lansingh, C. Walter Jones, W. F. Miner and H. C. Jones. The address of Mr. Lansingh on illumination education created a most favorable impression, and led to a great deal of inquiry as to "how to be saved" from wasteful methods in the future.

Miscellaneous representatives were as follows: W. H. Merrill, Edwin C. Lewis Company, Boston; Harvey Bozarth, Fort Wayne Electric Works; F. L. Mullock, S. P. Thieman, Stuart-Howland Company; D. F. Beattie, Fairbanks Company, Albany, N. Y.; T. P. Bedford, Electric Storage Battery Company; W. J. Griffith, John A. Roebling's Sons Company; H. W. Savage, H. P. Brown, Wetmore, Savage Company, Boston; N. I. Allen, Jr., McKinney & Waterbury Company, Boston; H. H. Russell, Vulcan Electric Heating Company; R. P. Smith, Lombard Governor Company; Joseph Couilliard, New England Insurance Exchange; P. G. Detweiler, Franklin Electric Manufacturing Company; W. F. Abely, C. F. Howes, Western Electric Company; W. F. Peterson, Pettingell-Andrews Company; John J. Myer, American Circular Loom Company; H. P. Moore, Chase-Shawmut Company; M. Falk, T. C. Sias Company, Boston; F. Booth, L. Kemper, H. T. Paiste Company; H. E. Stover, Stackpole Battery Company, St. Mary's, Pa.; R. P. Ingalls, Simplex Electric Heating Company; E. E. Larrabee, W. S. Kilmer, Green Mountain Electric Company, Burlington; T. C. Martin, *Electrical World*.

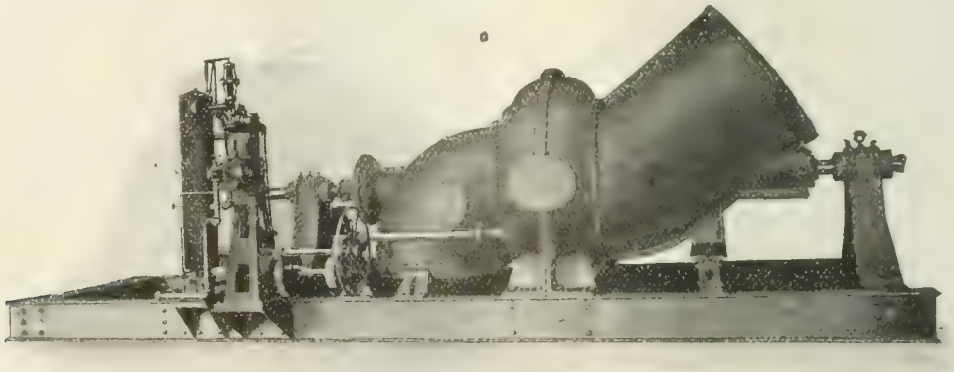


FIG. 2.—HIGH-HEAD TURBINE.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Reports from every branch of trade during the past week were so much improved that it might not be out of line to call them enthusiastic. From all parts of the country, especially from the Central West and the Mississippi Valley, there is reported large commercial and industrial advancement. Wholesalers and jobbers throughout the central section are doing an extremely satisfactory business, collections have very materially improved, and retailers report a larger trade than at any time within the past two years. Satisfactory reports also are received of the crop condition, and, while there will be no bumper yield, the turn-over of the producers will be large, and the prices received therefor will be higher than usual. Even in the South, where the shortness of the cotton crop has caused some disturbance, the advance in prices has offset to a large degree the ill effects of a small yield. One feature of the crop situation is the rapidity with which it is being moved to market. This is reflected in the railroad reports, and the list of idle cars is rapidly decreasing. In fact, some railroads have reported within the past week that at this time they had no good-conditioned cars which were not in service. The industrial situation continues to expand, and especially in the iron and steel industries the mills are kept busy. In many places prompt deliveries are being refused. During the past week heavy orders for steel rails have been received, which practically insures active operation of the rolling mills for months to come. The demand for structural material is a trifle quieter than earlier in the season, but there are many deliveries yet to be made. In the electrical industry the activity is not as marked as in other branches of the metal trade, but all of the big electrical concerns are doing a fair business, especially in small apparatus. Business troubles are not numerous; the number for the week ended Sept. 16, as reported by *Bradstreet*, were: 198 against 191 the week previous; 266 in the same week in 1908; 197 in 1907; 171 in 1906, and 173 in 1905.

THE COPPER MARKET.

Although there has been but little actual business done in the copper market during the past week prices have remained firm and are slightly higher. In addition to this there is a distinctly stronger tone and evidence that preparations are being made to put prices up through the instrumentality of manipulation in the London market. This will probably not be a difficult matter as the reduced exports last month have had the effect of limiting the increase in the visible stocks abroad. It is estimated that on Sept. 15, the foreign visible was 202,473,600 lb. It is said, as indicating an advance, that the lots of copper held by second hands, both here and abroad, which were pressing for sale a few weeks ago, have been taken up, thus relieving the market of a demoralizing influence. It is also said that manipulators on this side have sent buying orders to London for the purpose of strengthening the domestic market and possibly inducing a buying movement from actual consumers. It is hardly probable that these tactics will be conspicuously successful. The consumers are not uninformed about the actual conditions of the market and have little faith in the legitimate advance of prices. Many actual melters have already on hand considerable stocks and are not inclined to purchase except at bargain prices. Production continues at record rate and this is also well known by the actual users of copper. Exports continue to be rather light. Since the beginning of the month, including Sept. 20, they have been 10,508 tons. The daily call on the Metal Exchange, at 12:30 o'clock Sept. 20, quoted standard copper as follows:

	Bid.	Asked.	Settling price
Spot	12.50	12.63	.....
September	12.50	12.63	12.57½
October	12.50	12.75	12.62½
November	12.75	12.75	12.62½
December	12.50	12.85	12.67½

The London prices Sept. 20 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	58 17 6	59 0 0
Standard copper, futures	59 15 9	59 17 6
Market.	Steady.	Firm.
Sales of spot		300 tons
Sales of futures		900 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.00	12.62½
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 0

EMPIRE DISTRICT ELECTRIC COMPANY.—The Empire District Electric Company, the new holding concern organized by H. L. Doherty & Company, to take over the several plants in the neighborhood of Joplin, Mo., which that firm recently acquired, has let contracts for its new power station at Riverton, Kan., which is only a few miles from Joplin. The contracts were made with the Westinghouse Electric & Manufacturing Company for two 6000-kw steam turbines and for the necessary switchboards and transformers. The current will be generated at 6600 volts and stepped up to 33,000 volts for transmission. There will be 15 substations throughout the district, and the energy will be delivered to customers at 2300 volts. A contract has also been let to the Babcock & Wilcox Company for Stirling boilers. The new plant will be in operation early in 1910, and will be used as additional and auxiliary to the several water-power plants already in operation.

MORE HUDSON TUNNEL TRAINS.—The Hudson & Manhattan Railroad Company has put on a service through the Hudson River tunnels of a minute and a half headway during the rush hours. Heretofore the trains have been running at two and a half minutes headway, and the service could not be improved on account of the shortage of equipment. In speaking of its plans, a representative of the company said that the recent publication that it was contemplated to extend the railroad out into New Jersey and eventually to Philadelphia was absolutely absurd. He said that Newark was the farthest point in New Jersey that was considered at present by the railroad's managers, and Newark would be reached from Jersey City over the Pennsylvania Railroad tracks. The company still has under consideration the plan for building a tunnel from the Pennsylvania station in Jersey City to the station of the Central Railroad of New Jersey in Communipaw.

WESTINGHOUSE STORAGE BATTERY COMPANY.—Reports from the Westinghouse Storage Battery Company, the newly organized concern which took over the battery department of the Westinghouse Machine Company and also the General Storage Battery Company, are to the effect that orders are very plentiful, and that the plant at Boonton, N. J., is as busy as it could well be. The work of amalgamating the working forces of the two concerns is practically completed, but it is said that there will be no change in the personnel of the management of the new company from that announced in our issue of Aug. 12.

NEW CALIFORNIA WATER-POWER PROJECT.—J. H. Logan, of Santa Cruz, Cal., has filed notice of an appropriation of 250,000 cu. in. of water in the Pitt River, California, near the mouth of the Burney River. This water is to be conveyed a distance of 30 miles through a canal and tunnel, the tunnel, under a mountain range, being six or seven miles in length. When the water-power plant is completed it is estimated that it will be capable of developing 400,000 hp. It is said also that the water will be available below the power plant for the irrigation of lands in the upper Sacramento Valley.

BALTIMORE & OHIO ELECTRIC LOCOMOTIVES.—Among a lot of equipment recently ordered by the Baltimore & Ohio Railroad Company were two electric locomotives from the General Electric Company. These locomotives, it is said, will be for use in the Baltimore tunnel, and will be similar to those now in service at that terminal.

INSULATED WIRE CONTRACTS.—The Habirshaw Wire Company has been awarded contracts for "Red Core" insulated wire for the interior of the New Theater, New York; Gimbel Brothers' department store, New York, and the new City Hall, Chicago.

MONTGOMERY (ALA.) CITIZENS' LIGHT, HEAT & POWER COMPANY.—Mr. Fred. S. Ball, attorney and counsellor, Montgomery, Ala., calls our attention to what he states are errors in a note entitled "Bond Issue Enjoined," which appeared in these columns in our issue of Sept. 9, page 634. He says: "The statement that 'a temporary injunction has been issued' is incorrect, as nothing but a preliminary restraining order was issued, and the defendant was given the right to move for its dissolution on the same day. That restraining order was not against the Citizens' Light & Power Company, but against the Citizens' Light, Heat & Power Company. It is stated that the action 'was brought by Daniel A. Cullinam, a stockholder.' The bill filed is not against the Citizens' Light & Power Company at all, but against the Citizens' Light, Heat & Power Company, and the complainant stated only in ambiguous terms that he held the 'legal title' to one share in the latter company and that he was not otherwise interested, except as the holder of certain voting trust certificates representing shares in the Citizens' Light & Power Company, a 'holding company,' owning the stock of the Citizens' Light, Heat & Power Company. The restraining order was issued on Aug. 28 and upon argument promptly dissolved and the preliminary injunction absolutely denied on Sept. 2. The same publication refers to a suit brought by C. E. White, which has been pending ever since last May, to which demurrers interposed by the company were promptly sustained, and after amendment demurrers were again filed and submitted and the decision has not yet been made by the court. That suit is not brought by White as a stockholder, but as a relator, nor does it allege that the Citizens' Light, Heat & Power Company was 'the predecessor of the present company;' on the contrary, it admits the legal existence of the Citizens' Light, Heat & Power Company, and attacks the formation of the Citizens' Light & Power Company. Even if that action was successful, it could not affect the Citizens' Light, Heat & Power, which owns the plant, operates the business, and has issued the bonds referred to in the other suit."

LORD ELECTRIC COMPANY CONTRACTS.—The Lord Electric Company, of New York, has been awarded contracts for the roadways, railings, lamp brackets and wiring of the new Manhattan Bridge across the East River. These contracts embrace the construction of a roadway of creosoted wooden blocks and of two sidewalks to be made of concrete and artificial stone. Along these ways there are railings with ornamental posts. There will be six of these railings on the lower deck of the bridge and four on the upper deck. The bridge will carry eight tracks, four for trolleys and four for third-rails. The company will also do the entire wiring for the lighting and traction work on the bridge. This includes the wiring and bonding of the four tracks on the lower deck. The lighting equipment, which is a portion of the contract, includes ornamental brackets for both arc and incandescent lights, and the fixtures for the latter. There are 54 of these arc brackets and 198 incandescent. The company will also construct two switchboards, one on each end of the bridge. It is proposed that the energy for lighting will be divided midway of the bridge between the Manhattan and Brooklyn Edison companies. All this work is expected to be completed by Dec. 15, as it is now proposed to have the bridge ready for opening in January.

MILLION-DOLLAR ARC CARBON PLANT.—The Wilckes-Martin-Wilckes Company, the largest manufacturers and dealers in lampblack in this country, has prepared plans for the construction of a large manufactory for lighting carbons. A new company is to be organized with a capital of $1,000,000, which, it is promised, will go into the manufacture of all kinds of lighting carbons. Definite plans of the new company cannot be fully stated at this time, but will be ready for publication within a few weeks. Mr. Wilckes in speaking of the new enterprise said that he thought the field was a promising one for the investment of capital, and that as he was already in the lampblack business he felt that a good market for this product would be found in the manufacture of carbons. He said it is the intention of the new company to make all kinds of high-grade lampblack carbons, including flaming-arc, searchlight, moving-picture and enclosed-arc carbons, and in addition to this to manufacture the ordinary petroleum coke carbons, which are still used to a considerable extent in street lighting. He said that he was not ready to announce the location of his plant, but that several pieces of real estate had been tentatively looked over, and that the plant when constructed would be in every way up to date.

MUNICIPAL ELECTRICAL PLANT FOR MILWAUKEE.—Hering & Fuller, consulting engineers, of New York, have submitted to the city of Milwaukee an estimate of the cost of building a generating station in connection with the garbage crematory which is now in operation. This crematory was built by Hering & Fuller, and the steam generated in the destruction of the garbage will be used to generate energy. The plans submitted provide for sufficient power to generate 500 kw, and the cost of such an installation is figured to be about $60,000. The firm suggests that this energy be used for pumping, lighting or for power in the sewage pumping station.

GENERAL ELECTRIC CONTROLS BERGMANN TUNGSTEN PATENTS.—A deal has been made between the General Electric Company and the Bergmann Electric Works, of Berlin, by which the latter has sold to the former all of the American patent rights covering its tungsten lamps for a period of 10 years. The Bergmann company will not establish a lamp factory in this country as proposed, and the Bergmann lamp will not be imported except under license of the General Electric Company within that period. This following upon the acquirement by the General Electric Company of the Just and Kusel patents practically gives that company a strong grasp of the tungsten lamp situation.

PENNSYLVANIA TUNNELS OPENED.—The officials of the Pennsylvania Railroad Company have issued a statement correcting the impression that the East River tunnels would be opened to the public before the end of the year. It is stated that these tunnels will probably be used in December for the operation of construction cars, and that it may be possible that by February, 1910, passenger trains will be running to some sections of Long Island. The new station, however, will not be completed until May or June, and full service from the East and from the West will not be attempted before that time.

STORAGE BATTERY "SMOKER."—The Electric Storage Battery Company, through Mr. Godfrey H. Atkin, manager of the Chicago office, has issued invitations to a smoker to be held at the rooms of the Western Society of Engineers, Monadnock Building, Chicago, on the evening of Sept. 23. Mr. H. M. Beck, one of the engineers of the company, will give an illustrated talk on "Care and Operation of Storage Batteries." A supper will be served after the meeting.

NEW PUMPING PLANT FOR CHICAGO.—Plans have been prepared for installing two new pumping engines in the Roseland power station at Chicago with a capacity of 50,000,000 gal. per day. It is expected to have the new pumps in operation within a year. These pumps will be operated by electricity. Energy will be furnished by the Sanitary District of Chicago, and the Commonwealth Edison Company will be prepared to furnish an emergency service.

NIAGARA FALLS CONTRACTS.—The John A. Roebling's Sons Company has received the contract for cable to transmit electric power for pumping from the works of the Niagara Falls Hydraulic Power & Manufacturing Company to the new city pumping station. The order is for 18,000 lin. ft. of cable. The J. Ellwood Baird Company, of Buffalo, will supply and install 18,000 ft. of 4-duct conduit.

CATALOGS WANTED.—Sanford & Cia, Monterey, N. L., Mexico, dealers in mining machinery and supplies, including electrical apparatus and material, write that their establishment was completely destroyed by fire several weeks ago, and that they would like catalogs and price lists from manufacturers of electrical equipment of all kinds.

EXTENSION OF ELECTRIC POWER IN REMINGTON FACTORY.—Owing to increase of business it has become necessary for the Remington Typewriter Company to enlarge the capacity of its factory at Ilion, N. Y., and orders are to be placed for an additional power unit and for machine-tool equipment amounting to about $50,000.

FORT WAYNE ELECTRIC COMPANY.—The business of the Fort Wayne Electric Company, Fort Wayne, Ind., has recently assumed such proportions that the regular force is inadequate and the company is advertising for labor, which is needed in every department.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in the present issue are announcements of proposed new plants or considerable extensions of present plants at Carson City, Nev.; Mandeville, La.; Dayton, Ohio; Colville, Wash.; Sebastopol, Cal.; Cosmopolis, Wash.; Ryan, Okla.; Moline, Ill.; Clifton, Ohio; Iowa City, Ia.; Thurmont, Md.; Brownsville, Pa.; Cuyahoga Falls, Ohio; Floydada, Tex.; Le Suer, Minn.; Plaistow, N. H.; Gloversville, N. Y.; Alexandria, La.; Santa Rosa, Cal.; Fresno, Cal.; Fort Meyer, Va.; Tyndall, S. D.; Richwood, W. Va.; Omaha, Neb.; Marshall, N. C.; Erie, Kan.; Lake Charles, La.; Elmira, N. Y.; Port Byron, N. Y.; Glasgow, Mo.; Durant, Okla; Wells, Mich.

ANOTHER NEWFOUNDLAND CABLE.—Upon the return from Europe last week of George Gray Ward, vice-president of the Mackay Companies, announcement was made that the Commercial Cable Company would cut into Newfoundland another one of its Transatlantic cables sometime during the fall. Last summer one of the cables running from England to Nova Scotia was tapped 270 miles east of St. Johns, N. F., and carried to that port, a new cable being laid from St. Johns to New York. It is now the purpose of the company to do the same thing with a second cable.

STANLEY EMERGENCY HOSPITAL.—The Stanley G. I. Manufacturing Company is erecting at Pittsfield, Mass., a building 40 x 60 ft., three stories high, of reinforced concrete, which will be used as a garage, emergency hospital and quarters for the Stanley fire brigade.

Financial Intelligence.

THE WEEK IN WALL STREET.

The New York stock market during the past week has been one of considerable activity, extreme strength of tone and advancing prices. The settlement of all the Harriman uneasiness, by which the stock market has been unnecessarily alarmed, merely means that the interests that Harriman dominated will continue in the same line in which they have been operated for the past several years. The selection of Judge Lovett to the leading positions on the Union Pacific and Southern Pacific boards, and the selection of Kuhn, Loeb & Company, as representatives, means that the Harriman policies are to be carried out. Exactly what the Harriman policies were has never been disclosed, but the present changes mean that the Harriman policy of advancement will certainly not be set backward. This has been reflected in the stock market during the past week by the steady advance in prices, and the general strength of the issues in which Mr. Harriman was interested. Other issues have been correspondingly strong, especially United States Steel, which during the week reached the top price of 84¾, the highest since the stock was issued. The whole market in Wall Street is strong, and every issue that shows any indication of earning dividends is advancing in price. Even Amalgamated Copper, which at the present price of the red metal is not a very inviting proposition, advanced during the week between five and six points. All of the industrials that are connected with the iron and steel trade show reasonable advances, and the traction stocks, which have for a number of weeks been almost dormant, were relatively strong. It is hardly proper to say that these advances are speculative. The industrial condition of the country warrants advances, and, while the prices of stock have been recognized generally to be higher than conditions warranted, it is not remarkable that further advances were made when business so materially improved. The bond market is hardly as active and strong as it has been when stocks were less active; money has been in greater demand, and loans have been more freely made. On Sept. 20 quotations were: Call 2¾ @ 3 per cent, 90 days 3¾ @ 4 per cent. The quotations in the table are those of the close Sept. 20.

NEW YORK.

	Sep. 13.	Sep. 20.	Shares sold.		Sep. 13.	Sep. 20.	Shares sold.
All.-Ch.	15⅜*	15⅜*	4,600	Int.-Met., pfd.	46	48⅜	10,510
All.-Ch., pfd.	51	54*	4,300	Mackay Cos..	80¾*	88½	3,300
Amal. Cop...	78¾	84½	235,075	Mackay Cos..p.	74*	75½	330
Am. D. T....	20½*	20½*	——	Man. Elev....	141½	143¾	235
Am. Loc.	59	61	12,400	Met. St. Ry..	20*	20*	
Am. Loc., pfd.	115	118½	870	N.Y.&N.J. Tel	139¼*	139¼*	——
Am. Tel.&Cbl.	83½*	84¾*	300	Steel, com....	78½	84	909,740
Am. T. & T..	141½	143	57,980	Steel, pfd....	124¼	128¼	29,961
B. R. T.....	76⅝	80⅛	61,800	W. U. T.....	79	78¾	49,301
Gen. Elec....	164	167¾	5,000	West'h, com..	84½	87	8,000
Int.-Met., com.	14½	14⅞	3,850	West'h, pfd..	130*	130*	-

PHILADELPHIA.

	Sep. 13.	Sep. 20.	Shares sold.		Sep. 13.	Sep. 20.	Shares sold.
Am. Rys.....	46	46	——	Phila. Elec....	12¼	12½	
Elec. Co.of A.	12⅛*	12¼*	——	Phila. R. T...	30*	27	——
Elec. St. B'ty.	62	62	——	Phila. Trac....	91⅛*	88½*	——
E. S. B'ty,pfd.	30*	30*	——	Union Trac...	54	52¾	——

CHICAGO.

	Sep. 13.	Sep. 20.	Shares sold.		Sep. 13.	Sep. 20.	Shares sold.
Chi. City Ry..	180*	180*	—	Chi. Tel. Co..	135¼*	138*	-
Chi. Rs.,Ser.1.	110*	110*	——	Met. El., com .	15⅝	16	
Chi. Rs.,Ser.2.	36¾	36¾*	——	Met. El., pfd .	40	40½	-
Com. Edison..	120½	120	——	Nat'l Carbon..	96¼	96¾	—
Chi. Sub'ws...	10½	9⅞	—— -	Nat'l C., pfd..	119¼*	118½*	-

BOSTON

	Sep. 13.	Sep. 20.	Shares sold.		Sep. 13.	Sep. 20.	Shares sold.
Am. T. & T...	141½	143⅜		Mex. Tel.....	2¼	3	
Cum. Tel....	145*	145*	-	Mex. Tel., pfd.	6*	6	
Edison E. Ill..	253	252	-	N. E. Tel.....	134*	139	
Gen. Elec....	164¾	168	-	W. T. & T....	10⅞	11	
Mass. E. Ry..	16	15*		W. T. & T., p.	80*	90	—
Mass. E. R.,p.	77½	79½	- -				

* Last price quoted.
Shares sold are for week of Sept. 13 to Sept. 18.

PHILADELPHIA RAPID TRANSIT COMPANY.—The annual report of the Philadelphia Rapid Transit Company for the year which ended June 30, 1909, shows gross earnings of $18,317,529, which is a gain over 1908 of $17,449. The operating expenses were $9,364,737, a reduction over the previous year of $429,769. The improvement in net earnings which was thus brought about has been more than offset, however, by the increase in charges, and the fiscal year ended with a deficit of about $132,221 more than that of 1908. At the annual meeting, John B. Parsons, who resigned as president of the company, was elected chairman of the board of directors, and Charles O. Kruger was chosen president. The following resolution of regret at Mr. Parsons' retirement was adopted: "Resolved, That, in view of Mr. Parsons' insistence upon retiring from the presidency, the board desires to express its high appreciation of his long and devoted services to the company, and his unfailing courtesy to and co-operation with the board as president of the company, and further to express its satisfaction that he will remain as chairman of the board." In addition to electing Mr. Kruger president, the board also elected the following officers: First vice-president, Clarence Wolf; second vice-president, Alexander Rennick; secretary and treasurer, R. R. Selfridge; assistant secretary, James J. Springer; assistant secretary and treasurer, A. D. Hallman. The directors also announced that Drexel & Company have been selected as the fiscal agents of the company.

GENERAL MOTORS COMPANY INCREASE. — An amendment has been filed at Trenton to the charter of the General Motors Company, increasing its capital stock from $12,500,000 to $60,000,000. The stock is to be divided into $20,000,000 preferred, bearing 7 per cent cumulative, and $40,000,000 common. The General Motors Company is the holding company which has taken over several large automobile manufacturing concerns, and which it is said has in contemplation the absorption of several more. It was incorporated in September, 1908.

PAWLING (N. Y.) ELECTRIC LIGHT, HEAT & POWER COMPANY.—The Public Service Commission of the Second District has authorized the Pawling Electric Light, Heat & Power Company to issue 800 shares of capital stock at $25 per share, and to construct a plant and operate in the village of Pawling, Dutchess County, N. Y.

CATARACT POWER & CONDUIT COMPANY.—The Cataract Power & Conduit Company, of Buffalo, has been authorized by the Public Service Commission of the Second District to issue $154,000 5 per cent bonds, to be sold at not less than 95, to be used for extensions and the payment of $4,000 of present indebtedness.

CLEVELAND RAILWAY COMPANY'S DEBT. — The United States Court has granted an order allowing the receiver of the Cleveland Railway Company to use $600,000 out of the street car funds to pay floating debts. An order has also been made providing for the purchase of 25 new cars.

GETTYSBURG (PA.) TRANSIT COMPANY.—C. F. Kraft, of Philadelphia, representing the Central Trust Company, has purchased at foreclosure sale the property of the Gettysburg (Pa.) Transit Company. The price paid was $60,000.

WESTERN UNION TELEPHONE STOCK SOLD.—A deal has been made by which the Western Union Telegraph Company will sell to the American Telephone & Telegraph Company its holdings in the New York Telephone Company, amounting to about $16,000,000 par value. The New York Telephone Company is regarded as one of the most important subsidiaries of the American company, which owns, since the acquirement of the Western Union holdings, all but about $2,000,000 of the $50,000,000 capital stock. The deal was made through Kuhn, Loeb & Company, and will bring the Western Union about $25,000,000. In this connection it is said that the capital of the New York Telephone Company is to be increased from $50,000,000 to $100,000,000. This increase is to be made in order to allow the New York company to take over all the other Bell companies now operating in New York territory. Of the Western Union holdings some $9,733,100 had been pledged as collateral for $10,000,000 series "A" Western Union convertibles, which cannot be called for payment before May 1, 1912. It is said that the remainder of the Western Union holdings had only been half paid for. This transaction is said to have nothing to do with the settlement of the suit which has long been pending between the Western Union and the Bell company, and which was recently decided in favor of the former. There are still rumors in Wall Street to the effect that the American Telephone & Telegraph Company is endeavoring to acquire control of the Western Union, but no official statements have been made. It is said that the holdings of George J. Gould and of the late Russell Sage have actually been transferred to the American company. This report could not be confirmed at the office of either corporation. It is recognized that the rights-of-way now possessed by the Western Union Telegraph Company would be of great value to the telephone company.

PUBLIC SERVICE CONSOLIDATION AT MONMOUTH, ILL.—The Monmouth Public Service Company, of Monmouth, Ill., has been organized, and has purchased the capital stock and property of the Monmouth Gas & Electric Company, of which Mr. William Mainland, of Oshkosh, Wis., was president, and Mr. W. J. Ferris, of LaCrosse, Wis., vice-president. The officers of the new company are: President, Mr. W. H. Schott, Chicago; vice-president, Mr. F. W. Harding, Monmouth; secretary, Mr. J. W. Clendening, Monmouth; treasurer, Mr. W. D. Brereton, Monmouth. These gentlemen, with Mr. Fred E. Harding, will compose the first board of directors. The capital stock of the old company was $200,000, and there was a bonded indebtedness of the same amount. The capital stock of the new company will be $600,000, with a bond issue of $400,000. The Monmouth Public Service Company will take over the J. F. Searles plants and franchises, and will operate the ice plant now controlled by these interests. In addition, a district steam heating plant will be established, and it is promised that it will be ready for business early in November. Extensive improvements will be made on all the plants now in operation. New boilers and machinery will be installed in the electric light plant, and there will also be betterments in the plant and mains of the gas department. The company will be prepared to furnish electricity, gas, heating and refrigeration, so that its list of public service utilities will be comprehensive, justifying its name. It is said that a few large factories will give it a connected load of 2000 hp. The Schott Engineering Company, of Chicago, will do the engineering work.

ANOTHER WIRELESS TELEGRAPH SUIT.—Suit has been begun in the United States Circuit Court of New York by W. Scott Sims, the inventor of the Sims torpedo and other electrical devices, against the United Wireless Telegraph Company, the International Telegraph Construction Company, C. C. Wilson and Henry Schoemaker. Mr. Wilson is president of the United Wireless company and Mr. Schoemaker is chief consulting engineer. The suit alleges a conspiracy in violation of the Sherman anti-trust act. Mr. Sims asserts that the International Telegraph Construction Company, in which he is a stockholder to the extent of 125 shares, has been deprived of its business and is about to be put out of existence by the United Wireless Telegraph Company, which owns a controlling interest in it. This suit is an outgrowth of the one referred to in our issue of Sept. 16, in which a receiver for the International company was asked for. It is understood that the United Wireless Telegraph Company is anxious to wind up the affairs of the International company, and measures taken for this purpose are the basis of Mr. Sims' suit.

ALBION (N. Y.) POWER COMPANY SOLD.—The property of the Albion Power Company, at Albion, N. Y., which includes the plant of the Brockport Electric Company, which is owned by the Albion company, have been sold under foreclosure proceedings brought by the People's Bank & Trust Company, of Passaic, N. J., to Lucien H. Tyng, of Philadelphia, who represented the committee of bondholders. The purchase price was $38,250 and the assumption of the outstanding indebtedness, which amounted to about $120,000. It is understood that the property is to pass into the hands of the A. L. Swett Electric Light & Power Company, of Medina, N. Y. The plant and holdings of the Middleport (N. Y.) Gas & Electric Company, which also belonged to the same interests that owned the Albion Power Company, were sold to George F. Thompson, of Middleport, and it is understood that this property also will pass into the hands of Mr. Swett. It is understood that the Swett company at Medina will connect its transmission lines with the lines of the Albion and Brockport plants.

PUBLIC SERVICE CORPORATION OF NEW JERSEY.—The directors of the Public Service Corporation of New Jersey have increased the quarterly dividend rate of the company from 1 to 1¼ per cent, thus putting the stock on a 5 per cent basis. The company has also formally authorized the issue of $4,750,000 additional capital stock and $8,000,000 of new bonds. This new stock will be offered to the present stockholders at par. The present market price of the stock is 107. The bonds were issued under the general mortgage of $50,000,000, will run 50 years and bear 5 per cent. They have already been sold to J. P. Morgan & Company and Drexel & Company. It is proposed to use the proceeds of the bond issue to retire the collateral gold notes due Nov. 1 and the proceeds of the stock sale to make extensive improvements.

SLUMP IN CHICAGO SUBWAY STOCK.—The heavy selling of the stock of the Chicago Subway Company has continued during the past week, and the price has declined still further. While it is rather definitely known that insiders have been liquidating extensively, the reason for their selling has not been made public. One large holder is reported to have disposed of 10,000 shares of stock and to have invested the proceeds of the sale in the bonds of the company. A. G. Wheeler, president of the company, declares that there is no cause for the decline, and says that the earnings are increasing and that the company has just ordered 2000 additional cars and 100 additional locomotives to care for its extra business.

INTERNATIONAL TRACTION COMPANY.—It is reported in Buffalo that there will soon be a readjustment of the financial affairs of the International Traction Company. This does not mean that there will be an immediate payment of the back dividends. The International Traction Company owns the entire capital stock of the International Railway Company, which operates the street railways in Buffalo and vicinity. The traction company has now due and unpaid accumulated dividends amounting to about 40 per cent.

ELMIRA WATER, LIGHT & RAILROAD COMPANY.—The Public Service Commission of the Second District has authorized the Elmira Water, Light & Railroad Company to issue bonds to the amount of $196,000. The proceeds of about $60,000 of these bonds will be used to pay the outstanding indebtedness, and the balance will be used for future improvements and extensions. It is expected to install a new steam turbine plant at the Madison Avenue power house and to make an extension of the street railway on Maple Avenue.

EXTRA DIVIDEND ON WESTINGHOUSE AIR BRAKE STOCK.—The directors of the Westinghouse Air Brake Company, in addition to declaring the regular quarterly dividend of 2½ per cent, have declared an extra dividend of 1½ per cent on the capital stock of $14,000,000. The present business of the company warrants this payment. It is said that the Wilmerding plant is crowded with orders and that the full complement of employees, 3800 men, is now at work.

QUEBEC RAILWAY, LIGHT & POWER COMPANY.—The report for the year ended June 30, 1909, of the Quebec Railway, Light & Power Company shows gross earnings of $724,648, and net earnings of $280,348; the latter compares with net earnings of $236,461 of the previous year. The customary dividends on the stock were paid, and at the annual meeting the old board of directors was elected.

GENERAL ELECTRIC COMPANY'S DIVIDENDS.—While it is generally admitted that the business of the General Electric Company is gradually increasing, and that the big concern is now operating with about 85 per cent of capacity, it is positively denied that the board of directors has in any way considered an increase in the regular dividend. It is stated that the directors believe that the 8 per cent rate is a fair return, and that any surplus above this amount should be reinvested rather than given to the stockholders at present. It is intimated that with the next few years continuously prosperous a stock dividend might be advisable in two or three years.

WILMINGTON GAS COMPANY'S BONDS.—Drexel & Company, of Philadelphia, and Brown Bros. & Company, of New York, are offering $2,000,000 of 5 per cent bonds of the Wilmington Gas Company to the public. These bonds mature in 1949, and are a portion of a $5,000,000 issue. They are being offered at 98 and interest. The franchises of the Wilmington Gas Company are perpetual, and the company has the right to manufacture and distribute electricity as well as gas. Since the property was taken over by C. H. Geist, last August, its physical condition has been greatly improved, and the plant is now thoroughly equipped with modern appliances.

BRUNSWICK (GA.) TERMINAL & RAILWAY SECURITIES COMPANY.—Circulars have been issued by Dick Brothers & Company, New York, announcing that the Brunswick (Ga.) Terminal & Railway Securities Company has taken over all the property of the Brunswick Dock & Improvement Company, the Brunswick & Suburban Railroad Company and the Mutual Light & Water Company. The two latter companies have been earning good dividends while the first named company has large holdings of valuable city lots and suburban real estate. The new holding company has capital stock of $7,000,000 with no bonds.

SCRANTON ELECTRIC COMPANY.—The stockholders of the Scranton (Pa.) Electric Company, a subsidiary of the American Gas & Electric Company, have voted to increase the capital stock from $3,000,000 to $7,000,000. The new stock will be divided into $5,000,000 common and $2,000,000 6 per cent cumulative preferred. This increase, it is said, is made for the purpose of paying for several plants which have been acquired recently and to make adequate provision for future development on them.

OHIO LIGHTING COMBINATION REPORT.—A report has recently been in circulation in the Wall Street district to the effect that the Standard Oil Company is behind a project involving the Columbia Gas & Electric Company, which has for its purpose the organization of a $20,000,000 concern to manage a number of other important gas and electric lighting concerns in that State. No information would be given out by the financial concerns supposed to be interested.

DIVIDENDS.

American Cities Railway & Light Company, preferred, quarterly, 1½ per cent, payable Oct. 1.

Bell Telephone Company of Canada, quarterly, 2 per cent, payable Oct. 15.

Chicago City Railway Company, quarterly 1½ per cent, payable Sept. 30.

Duluth Edison Company, preferred, quarterly, 1½ per cent, payable Oct. 1.

Electric Boat Company, preferred, quarterly, 2 per cent, payable Oct. 1.

General Motors Company, preferred, semi-annual, 3½ per cent, payable Oct. 1.

Massachusetts Lighting Companies, quarterly, 1½ per cent, payable Oct. 15.

Otis Elevator Company, preferred, quarterly 1½ per cent, payable Oct. 15.

Public Service Corporation of New Jersey, quarterly, 1¼ per cent, payable Sept. 30.

Scranton (Pa.) Electric Company, preferred, quarterly, 1½ per cent, payable Oct. 1.

Shawinigan Water & Power Company, Montreal, quarterly, 1 per cent, payable Oct. 20.

Tri-City Railway & Light Company, Davenport, Ia., preferred, quarterly, 1½ per cent, payable Oct. 1.

Washington Water Power Company, Spokane, quarterly, 1¾ per cent, payable Oct. 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Light & Traction					
August, 1909	$538,440	$8,214	$528 195		
August, 1908	194,872	4,000	190,872		
American Telephone & Telegraph Company:					
August, 1909	2,405,953	194,096	2,211,557	$511,404	$1,700,072
August, 1908	2,059,133	151,335	1,907,798	614,253	1,293,544
Binghamton Railway Company:					
Year ended Aug. 31, 1909	337,090	189,674	147,416	108,533	38,883
Year ended Aug. 31, 1908	311,626	187,413	124,213	101,308	22,905
Boston Suburban Electric Companies:					
August, 1909	89,057	56,535	33,434	13,499	19,935
August, 1908	90,522	54,926	35,595	13,015	22,580
Economic Light & Power Company, Joliet, Ill.:					
Year ended April 30, 1909	310,402	138,739	171,663	65,324	106,339
Year ended April 30, 1908	276,881	119,892	156,989	64,145	92,844
Edison Electric Illuminating Company of Boston:					
Year ended June 30, 1909	4,111,342	2,766,029	1,345,313		
Year ended June 30, 1908	4,229,239	2,690,419	1,538,820		
Ft. Wayne & Wabash Valley Traction Company:					
June, 1909	115,986	70,687	45,298		
June, 1908	110,034	65,442	44,592		
Pacific Telephone & Telegraph Company:					
July, 1909	1,635,518	701,113	334,396	103,793	230,603
July, 1908	1,012,967	698,746	314,223	99,771	206,508
Paducah Traction & Light Company:					
June, 1909	18,101	10,613	7,488	6,631	856
June, 1908	18,496	12,049	6,447	5,847	574
Pensacola (Fla.) Electric Company:					
June, 1909	20,135	11,201	8,834	4,283	4,551
June, 1908	19,020	14,020	5,000	4,314	685
Philadelphia Rapid Transit Company:					
Year ended June 30, 1909	18,317,539	9,854,757	8,462,782		
Year ended June 30, 1908	18,300,080	9,794,508	8,505,572		
Rutland Railway Light & Power Company:					
Year ended Aug. 31, 1909	252,876	132,099	120,777	90,777	30,000
Year ended Aug. 31, 1908	254,527	132,111	122,416		
St. Joseph (Mo.) Railway, Light, Heat & Power Company:					
July, 1909	85,392	43,766	41,626	21,636	19,990
July, 1908	80,439	38,785	41,654	21,249	20,405
Savannah Electric Company:					
June, 1909	50,134	33,385	16,748	15,343	1,405
June, 1908	50,807	30,498	19,507	17,322	2,185
Seattle Electric Company:					
June, 1909	522,450	313,013	209,435	105,072	104,363
June, 1908	388,200	202,874	185,326	123,689	61,637
Tampa Electric Company:					
June, 1909	46,638	28,473	18,165	4,719	13,446
June, 1908	41,000	25,028	15,972	4,719	11,253
United Railways of St. Louis					
August, 1909	957,240	599,641	357,601	252,420	105,181
August, 1908	911,500	572,864	338,636	234,551	104,085
Westinghouse Air Brake Company:					
Year ended July 31, 1909	5,286,021	3,246,748	2,039,273	118,540	1,920,557
Year ended July 31, 1908	5,308,016	3,293,260	2,014,756	43,960	1,970,796

*Deficit.

GENERAL NEWS

Construction News.

DADEVILLE, ALA.—The Dadeville telephone system has been sold to the Southern Bell Telephone Company, the property to change hands not later than Jan. 1, 1910. The City Council had revoked the franchise of T. B. Griffin, the present owner, on account of poor service, but owing to the sale he will be allowed to continue operating the system until the new owners take possession.

MONTGOMERY, ALA.—The City Council has granted the Montgomery Traction Company a franchise to extend its electric railway along Jeff Davis Avenue from Holt Street to Oak Street, for which the company paid the city $2,000.

HELENA, ARK.—The Helena Street & Interurban Railroad Company has awarded the contract for the construction of the proposed electric railway between Helena and West Helena, a distance of four miles, to R. L. Leonard, of Helena. The cost of the railway, not including power plant, is estimated at $40,000. The power plant will be located in West Helena.

NASHVILLE, ARK.—Leo Loeb and George Schmial, of Hot Springs, Ark., are interested in a project to erect an electric light plant in Nashville.

COALINGA, CAL.—The San Joaquin Light & Power Company, of Fresno, Cal., it is reported, is planning to install an electric light and water system in Coalinga, the cost of which is estimated at $1,000,000.

COLMA, CAL.—At an election held recently the residents of Colma, Hillcrest, Crocker tract and Vista Grande, voted to form a lighting district to be known as the Colma lighting district.

FRESNO, CAL.—It is understood that contracts will be let soon for the machinery and equipment for the addition to the hydro-electric plant of the San Joaquin Light & Power Company, increasing the output by 10,000 hp. The work will include the enlargement of the Crane Valley dam and reservoir and extension of flume lines. Plans and specifications, it is said, for the machinery and pipe lines can be secured upon application to J. G. White & Company, 43 Exchange Place, New York, N. Y., who have charge of the work.

KENNETT, CAL.—W. R. Conant and W. D. Pratt have appropriated 1000 cu. in. of water of Castle Creek, to be diverted near the head of the creek, which is the outlet of Glacier Lake, five miles west of Castella. It is proposed to utilize the water for the development of electricity, which will be transmitted to Delta, Lamoine and Castella. The plant will have an output of about 2000 hp.

LOS ANGELES, CAL.—The Board of Public Works has made application for an issue of $3,500,000 in bonds, the proceeds to be used in connection with the power development project of the Los Angeles aqueduct.

OAKLAND, CAL.—The Central Oakland Light & Power Company has filed a mortgage in favor of the First Federal Trust Company to secure an issue of $800,000. The mortgage is signed by A. M. Hunt, president of the company, and Clyde M. Beal, secretary.

ORLAND, CAL.—At a special election held recently the citizens of Orland voted to form a lighting district in accordance with the new law passed by the last Legislature.

OROVILLE, CAL.—Notice of appropriations have been filed by R. Leo Van Wormer in Butte County. One for 50,000 in. of water from the Middle Fork of the Feather River, and the other for 1000 in. from Mosquito Creek, a tributary of the Middle Fork. It is proposed to use the water for power development.

REDDING, CAL.—Notice of appropriation of 250,000 cu. in. of water in the Pitt River, near the mouth of the Burney River, has been filed by J. H. Logan, of Santa Cruz. The water is to be conveyed through a canal a distance of 30 miles, six or seven miles of which will be through a tunnel penetrating a mountain range, where power plants will be erected capable of generating 400,000 hp. The water will be available below the power plants for irrigating the land in the upper part of Sacramento Valley.

SAN BERNARDINO, CAL.—A movement is on foot to install an ornamental illuminating system for lighting the business section of the city similar to the system now in use in Los Angeles. H. J. Hanford is interested in the project.

SAN DIEGO, CAL.—The San Diego Electric Railway Company has been granted a franchise by the City Council to extend its system over certain streets in San Diego.

SAN JOSE, CAL.—The Pacific Telephone & Telegraph Company contemplates extensive improvements to its local system, which will involve an expenditure of about $300,000 and will include the erection of a new exchange building, installation of new switchboard and telephone equipment and additional underground conduits, cables and outside wires.

SANTA ROSA, CAL.—Application has been made to the County Board of Supervisors by the Russian River Light & Power Company to furnish electricity for lamps and motors in the towns of Guerneville, Forestville, Occidental, Freestone, Monte Rio, Duncans Mills, Camp Meeker, Monte Cristo, Mesa Grande, Cazadero, Molino, Graton and other summer resorts in Western Sonoma.

SEBASTOPOL, CAL.—The Board of Supervisors has granted H. C. Eastman a franchise to erect a transmission line from Sebastopol to the towns of Graton, Forestville, Guerneville, Monte Rio, Camp Meeker, Occidental, Freestone, Duncans Mills, Markhams and Cazdero, to supply electricity for lamps and motors in the above towns. Electricity for the system will be supplied from the plant of the Pacific Gas & Electric Company in Sebastopol. Contracts have already been secured by Mr. Eastman for lighting the towns mentioned.

SALIDA, COL.—Preparations are being made by the Colorado Telephone Company for extensive improvements to its system in Salida, which will involve an expenditure of about $35,000. The present overhead wires will be replaced with cables.

SUGAR CITY, COL.—The Sugar City Electric Light & Power Company, recently organized, has applied for a franchise to construct and operate an electric light and power plant in Sugar City. R. F. Bornschien, W. F. Bornschien and H. P. Bornschien are incorporators.

JEWETT CITY, CONN.—Negotiations have been completed between the Borough Electric Light Commissioners and the Nashewaug Electric Power Company whereby the latter will supply electricity for lamps and motors in Jewett City. It is understood that the service will begin in about six months and a 24-hour service established. The plant of the new company has not yet been built. It is thought that it will be located in Chaplin. The present plant will be held for use in emergencies. The charter of the company gives it the right to supply electricity in the towns of Canterbury, Chaplin, Plainfield and Griswold. S. M. Taber, of New Bedford, Mass., is president of the new company, and Frank Perry, of Boston, Mass., secretary.

SUFFIELD, CONN.—The Connecticut Company has sold five steam boilers, two pumps and two steam engines at the Mapleton power house in order to make room for improvements to be made soon. The company proposes to rebuild a portion of the building and install new machinery. Electricity for operating the system is supplied from the Springfield plant and the local plant will be converted into practically a substation.

SOUTH MANCHESTER, CONN.—The incandescent lighting system of the South Manchester Light & Power Company has been extended to include Edgewood tract.

WILMINGTON, DEL.—The West Chester & Wilmington Electric Railway Company will soon commence work on the construction of its proposed electric railway between West Chester, Pa., and Wilmington, for which surveys have been made and the right of way secured. The railway will be 17 miles in length.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Oct. 5, to furnish at the navy yards and naval stations the following supplies: Mare Island, Cal. Schedule 1625—One 40 and one 10-ton overhead traveling crane, one 40 and one 10-ton crane runway extension to 40-ton crane runway. Newport, R. I. Schedule 1685—Twelve geared head motor-driven engine lathe with spare parts. Pensacola, Fla. Schedule 1681—Machinery for central power plant. Washington, D. C. Schedule 1686—Furnishing and installing a complete outfit of tank pumps and piping for an oil storage and distributing system. Schedule 1683—Two motor-driven centrifugal pumps. Schedule 1684—Complete equipment for oxygen and acetylene generating and compressing machines. Brooklyn, N. Y. Schedule 1671—1500 lb. magnet wire. Schedule 1678—130 generator and circulating tubes. Applications for proposals should designate the schedules desired by number.

WASHINGTON, D. C.—The contract for furnishing motor generator sets for the Philadelphia navy yards, bids for which were opened July 10, was awarded to the Allis-Chalmers Company, of Milwaukee, Wis., for $18,125.

WASHINGTON, D. C.—The Washington, Baltimore & Annapolis Railway Company has awarded the contract for the construction of a substation in Ardmore, Md., to Edward Waters & Company, to cost $8,000.

WASHINGTON, D. C.—The contracts for furnishing one 1000-kw and two 1500-kw turbo-generators for the New York, Philadelphia and Boston navy yards have been awarded to the Westinghouse Machine Company, for $64,750.

FORT PIERCE, FLA.—The proposition to issue $10,000 in bonds for the installation of a municipal electric light plant will be submitted to the people at an election to be held soon. The proposition to grant a franchise to the St. Lucie Ice Company to establish an electric light plant was defeated.

PENSACOLA, FLA.—The Suburban Railway Company has made application for a charter for the purpose of taking over the electric railway of the East Pensacola City Company, extending from Sixteenth Street across Bayou Texar to Magnolia Bluff Park at East Pensacola, a distance of about two miles. The company is capitalized at $50,000, and the

incorporators are: John E. Stillman, Knowles Hyer, Henry M. Yonge and W. A. Blount, Jr.

PENSACOLA, FLA.—Application has been made to the City Council by the East Pensacola City Company for a franchise to extend its electric railway to the business district of Pensacola.

ATHENS, GA.—The Atlanta Power Company has purchased the water-power rights at Tallulah Falls of Moss Brothers, of Athens, Ga., for $100,000. It is said that the Atlanta Power Company will develop 18,000-hp, the greater part of which will be used in Atlanta.

CUTHBERT, GA.—At an election to be held Oct. 12 the proposition to issue bonds for improvements to the municipal electric light plant and water works systems will be submitted to the people.

PECK, IDAHO.—D. E. Peck is reported to be contemplating the installation of an electric light plant in connection with his mill.

SAINT MARIES, IDAHO.—Unless the village officials can make satisfactory arrangements with individual corporations for lighting the town, a municipal electric light plant may be installed in the near future.

CARTERVILLE, ILL.—The Interurban Electric Company, recently incorporated, contemplates acquiring a plant and increasing the output by the installation of a 300-kw turbine and also proposes to erect transmission lines from Herrin, Ill., to Cartersville and Reeves. A day service will also be established, it is said. The company is capitalized at $150,000 and F. W. Richart, E. E. Denison and H. B. Cassel are the incorporators.

CHAMPAIGN, ILL.—The Illinois Traction System, it is said, is planning to erect a power station at Venice, Ill., which will have an output of 10,000 hp. The cost of the plant is estimated at $500,000 and it will furnish electricity to operate the southern division of the system.

CHICAGO, ILL.—Plans have been prepared for installing two pumping engines in the Roseland pumping station with a capacity of 50,000,000 gal. per day, to be operated by electricity. The energy will be furnished by the Sanitary District of Chicago, the Commonwealth Edison Company furnishing emergency service. It is expected to have the station in service within a year.

ELBURN, ILL.—Work has commenced on the construction of the new electric plant for Elburn, the contract for which was awarded to the International Harvester Company, for about $5,500. The contract includes the construction of the plant complete and calls for the erection of 43 street lamps of 80 cp, and for equipment of sufficient output to supply the street lighting system and 600 incandescent lamps for commercial purposes. It is expected to have the plant in operation by Nov. 15.

MOLINE, ILL.—Franchises have been granted by the Bettendorf Village Board to the Bettendorf Improvement Company to operate an electric light plant and water works system for a period of 25 years. Work is to be started on the electric light plant within three months and is to be completed in six months, and the water works within one year. The streets of the village are to be lighted with 20 arc lamps. W. P. and . W. Bettendorf are principal stockholders of the company.

OTTAWA.—ILL.—W. D. Boyce, of Marseilles, Ill., has applied to the City Council for a 50-year franchise to construct transmission lines in the streets of the city for the distribution of electricity. The company now has its transmission line erected from its hydroelectric plant in Marseilles to Ottawa.

PARIS, ILL.—The City Council has granted the Paris & Northern Traction Company a 50-year franchise to build its proposed electric railway on West Washington Street east to connect with the Terre Haute & Western Railway at Paris. The railway will connect Ridgefarm and Paris, a distance of 26 miles. W. M. Bridgett is president.

TREMONT, ILL.—The capital stock of the Farmers Mutual Telephone Company has been increased from $20,000 to $40,000.

WATERTOWN, ILL.—Application has been made to the Board of Trustees by the Tri-City & Northeastern Interurban Railway Company, of Port Byron, Ill., for a franchise to operate its proposed electric railway in Watertown. The railway will extend from Albany to Watertown.

BLUFFTON, IND.—The City Council is asking for bids for the construction of twenty arches for lighting the city streets.

COLUMBIA CITY, IND.—The contract for installing boilers in the municipal electric light plant was awarded to the Wickes Boiler Company, of Saginaw, Mich.

ELKHART, IND.—Plans have been completed for the installation of the "gooseneck" lighting system in this city, similar to that now in use in Mishawaka. Nearly all the business houses have agreed to pay their share of installing the system in the business section.

KINGMAN, IND.—The Covington & Southeastern Railway Company has filed a trust deed in favor of the Union Trust Company, of Indianapolis, Ind., for $825,000, to secure an issue of bonds, the proceeds to be used for the construction of an electric railway to penetrate Parker County coal fields, and which will probably be extended to Crawfordsville from Covington.

NEW CASTLE, IND.—It is reported that arrangements have been made for the installation of electrical equipment and machinery in the power house of the Indianapolis, New Castle & Toledo Railway Company in New Castle at once. This equipment was partially installed previous to the appointment of the Union Trust Company, as receiver, and was subsequently removed.

NEW CASTLE, IND.—The Union Trust Company, of Indianapolis, Ind., receiver of the Indianapolis, New Castle & Toledo Electric Railway Company, of New Castle, Ind., has been authorized by the superior court to issue $460,000 in receiver's certificates. The first contract for the construction of the proposed railway has been awarded by the receiver to W. C. Miller, of Indianapolis, Ind.

SOUTH BEND, IND.—Franchises have been granted by the Commissioners of St. Joseph County to the Citizens' Mutual Telephone Company to construct and operate telephone lines in four townships of St. Joseph County. Work will soon be started on the lines in the towns of Union, Greene, Liberty and Lincoln.

HARLAN, IA.—A franchise has been granted to the Farmers' Mutual Telephone Company, of Portsmouth, to construct and operate a telephone line in Harlan.

IOWA CITY, IA.—The Interstate Power Company has applied to the City Council for a 25-year franchise to establish an electric light plant and street railway in Iowa City. It is said that the company proposes to erect a large power plant in this city and has secured options on the mill property and water rights owned by Harp & Roberts. It is proposed to erect a dam 30 ft. high across the Iowa River below the Oak Street bridge. It is estimated that from 2500 to 3000 hp can be developed. The company offers to furnish electricity for lamps at a maximum rate of 10 cents per kw-hour and for power at 8 cents per kw-hour, and to furnish 40 arc lamps of 2000 cp for street lighting at the rate of $2 each per month, and also to furnish electricity to light all the city buildings free of charge. It is reported that the company has secured options on plants in Hampton, Eldora and other towns. M. G. Albrook, of Delhi, Ia., is representing the company in this city.

MARSHALLTOWN, IA.—The Iowa Light & Traction Company, through its local representative, J. H. McBride, has submitted a proposition to the City Council to construct an interurban railway from Marshalltown to Grundy Center and from Marshalltown to Ames, Ia., within three years, providing the company is granted a franchise by the city. The company also proposes to purchase the property of the Marshalltown Light, Power & Railway Company, and to extend the local railway to the city park and fair grounds. Andrew Stevenson, 153 La Salle Street, Chicago, Ill., is president and general manager. Headquarters of the company are located at Chicago, Ill., and Eldora, Ia.

RED OAK, IA.—Preparations are being made by the Red Oak & Northeastern Railway Company to commence work on the construction of its proposed electric railway from Red Oak through Greenfield to Des Moines, a distance of 110 miles.

STRAWBERRY POINT, IA.—B. W. Newberry and J. C. Flenniken, of Strawberry Point, are interested in a project to construct an electric railway next season from Oelwein to Strawberry Point, a distance of 20 miles.

WATERLOO, IA.—Extensive improvements are contemplated by the Iowa Telephone Company to its local system, which will involve an expenditure of about $100,000 and include the installation of a new switchboard and the erection of additional cables.

ERIE, KAN.—Plans are being prepared by Burns & McDonnell, Scarritt Building, Kansas City, Mo., consulting engineers, for the construction of an electric light plant and water works system to cost about $50,000.

WAKEENEY, KAN.—Contracts for the equipment of the municipal electric light plant, bids for which were opened Sept. 15, were awarded as follows: For machinery to the Fairbanks, Morse Company, of Kansas City, Mo., for $4,550, and for transmission lines to Charles Steinberger, of Wakeeney, Kan., for $4,150. George P. Taylor, of Stockton, Kan., is engineer.

ALEXANDRIA, LA.—We are informed that bids will be opened about Oct. 27 for extensions to electric light plant and water works system, for which bonds to the amount of $40,000 were recently voted. I. W. Sylvester is city engineer.

LAKE CHARLES, LA.—Arrangements are being made by the Longville Long Leaf Lumber Company for the construction of a telephone line from this city to Longville.

LAKE CHARLES, LA.—Plans are being considered by the City Council for making extensions to the electric light and water service.

MANDEVILLE, LA.—The Town Council has granted A. D. Piaggio, of New Orleans, La., a franchise to install an electric light and ice plant in Mandeville. Under the terms of the franchise, the company is to furnish six street lamps and electricity for lighting the town hall free of charge. It is expected to have the plant in operation by June, 1910.

NEW IBERIA, LA.—H. A. Mentz, Hennen Building, New Orleans, La., has withdrawn his application from the City Council for the purchase of the electric light and waterworks plant, as a stipulation to build a street railway in New Iberia, and an interurban railway to Jeanerette The franchise for the construction of an interurban railway was accepted by Mr. Mentz.

BELFAST, MAINE.—The Penobscot Bay Electric Company, of Bucksport, Maine, has taken over the property of the Belfast Gas & Electric Company. It is said that the new company will install a 24-hour service.

SANFORD, MAINE.—Negotiations have been closed whereby the Portland Electric Light & Power Company is to furnish the Sanford Mills with electrical energy to the amount of 2000 hp from its power plant at West Buxton. At present the plant has an output of 3000 hp, all of which is distributed in Portland, Maine, and the additional contract means the development of the great water privilege at Bonny Eagle. It is also said that the company will install an auxiliary steam plant at West Buxton, for use, during the low-water periods. At present the Sanford Mills have a contract with the Atlantic Shore Line Railroad Company calling for 1600 hp, which is conditional, and only part of the contract is furnished during the summer when the water is low.

THURMONT, MD.—John R. Rouzer, P. N. Hammaker, J. W. [illegible], M. A. Birely and others are interested in a project to organize a company to establish an electric light plant to be operated by water power. It is said that the city will eventually purchase the plant.

THURMONT, MD.—The citizens have decided to establish an electric light and power plant to furnish electricity for street lighting and for commercial use, work on construction of which will begin immediately.

CHICOPEE, MASS.—The report of the committee on electric lights, submitted to the Board of Aldermen recently, favors the installation of an electric lighting system in Fairview as well as Willimansett. The plan proposed by the committee is to take over the system in Fairview, now operated by the South Hadley Company, for which the city at present is paying $750 per year, and to extend the proposed transmission line from Willimansett to Fairview, by which electricity could be furnished to operate the pumping station of the Fairview water system. The cost of the proposed extension is estimated at from $15,000 to $18,000, and would require the installation of a new generator in the electric plant at the Center and also a motor at Fairview. It is estimated that about 200 hp would be available for manufacturing purposes.

FALL RIVER, MASS.—The Fall River Electric Light Company has applied to the Land and Harbor Commission for a license to lay and maintain a submarine cable for the transmission of electricity in Taunton River from Fall River to and near the Fall River-Somerset Bridge.

FITCHBURG, MASS.—Contracts have been signed whereby all electrical energy furnished to consumers by the Connecticut River Transmission Company in Fitchburg will be distributed over the transmission lines of the Fitchburg Gas & Electric Light Company. Negotiations are also under way for the purchase of electricity by the Fitchburg Gas & Electric Light Company from the Connecticut company for its own service. The Connecticut company now has contracts to furnish 1800 hp to the Parkhill Manufacturing Company to operate its three mills; the contract with the DeJonge Mills calls for 1200 hp and 800 hp for the Crocker, Burbank & Company. Under the terms of the contract all consumers using more than 300 hp will deal directly with the Connecticut River Transmission Company, which will pay rental to the local company. The smaller consumers will deal with the local company, who, under the contract not yet signed, will purchase energy from the Connecticut company.

HOPKINTON, MASS.—It is reported that the Middlesex & Boston Street Railway Company is contemplating the construction of a power house on East Main Street in Hopkinton.

OAK BLUFFS, MASS.—The Vineyard Lighting Company, which furnishes electricity for lamps and motors in Oak Bluffs and Vineyard Haven, is planning to extend its service to Edgartown, Mass. Arrangements are being made to increase the output of its plant, and orders have been placed for an additional generator direct connected to a compound condensing engine. It is expected to furnish electrical service in Edgartown by the first of November.

SOMERSET, MASS.—The Fall River Electric Company is making arrangements to extend its transmission lines into Somerset to furnish electricity for street lighting. The company agrees to furnish incandescent lamps of 40 cp at the rate of $20 each per year, or a 60-cp incandescent lamp for $25 per lamp per year, and asks for a guarantee of 100 lamps. At present there are about 90 gasoline lamps in the town.

SOUTH ROYALSTON, MASS.—J. V. Twitchell has been awarded the contract for the construction of three greenhouses and power plant for E. B. Hanson, of South Royalston, Mass.

WARE, MASS.—The Board of Overseers of the Poor is contemplating lighting the almshouse with electricity. At present the building is lighted by an acetylene gas plant. It is stated that it may be necessary to install an electric plant, as the Ware Electric Light Company is unwilling to stand the entire expense of extending its transmission line to the almshouse. It is estimated that the cost would be between $500 and $600.

WEST STOCKBRIDGE, MASS.—At a special town meeting held recently the citizens voted to install about 30 electric street lamps.

WORCESTER, MASS.—Arrangements are being made to change the plants of Loring Coes & Company, located on Coes Square, and Coes and Mill Streets, from steam to electric drive. Electricity for operating the plants will be furnished by the Worcester Electric Light Company. Frank L. Coes is president and treasurer of the company.

BAD AXE, MICH.—All the telephone lines in Huron and Sanilac counties have been merged under the name of the Consolidated Telephone Company. The company is capitalized at $250,000 and the main office will be located at Bad Axe.

BAUDETTE, MICH.—The contract for the installation of the electric light plant and pumping station is reported to have been awarded to J. G. Robertson, of St. Paul, Minn., for $15,240.

FLINT, MICH.—The Michigan Telephone Company has been granted permission by the City Council to extend its pole and conduit system in various streets in the city. The company is planning to erect a new exchange building and making extensions and improvements to its local system which will involve an expenditure of about $100,000.

THREE RIVERS, MICH.—The Sheffield Car Company, it is reported, will install a 500-kw, alternating-current generator in its plant in the near future.

WELLS, MICH.—It is reported that the Escanaba Extract Company, of Wells, Mich., is contemplating the installation of a power plant, bids for which will be asked in the near future. The equipment, it is said, will include six boilers of 125 hp each, a Corliss engine and an electric generator rated at 200 kw, feed pumps, heater, alternating-current motors and other machinery.

ADA, MINN.—Plans are being considered by the City Council and the Water and Light Board for installing a heating plant to furnish heat for buildings located in the business district. If it is decided to install the plant an addition will be required to the municipal power house and an additional boiler will be installed; a day electrical service may also be established.

DETROIT, MINN.—All bids opened Sept. 14 for the construction of a light, power and water plant in Detroit were rejected. W. L. Taylor is president of the lighting committee.

LE SUEUR, MINN.—Bids will be received by James A. Morgan, city clerk, until Oct. 1, for a Corliss heavy duty engine, to drive an alternating-current generator.

COLUMBIA, NEB.—The capital stock of the Platte Independent Telephone Company has been increased from $40,000 to $100,000.

OMAHA, NEB.—Plans are being prepared by the Cudahy Packing Company for the erection of a new plant for the manufacture of one of its products. A power plant will be erected, the equipment to include boilers, engines, electrical machinery, etc., for which it is understood that orders have not yet been placed.

CARSON CITY, NEV.—Bids will be received by the State Board of Commissioners for Care of the Indigent Insane, Carson City, Nev., until Oct. 11, for furnishing and installing at the Nevada Hospital for Mental Diseases material and equipment as follows: Pole lines, waterwheels, generators, exciters, switchboard, pumps, motors, wells, pipe lines, etc.

GORHAM, N. H.—The Cascade Light & Power Company, whose plant was recently damaged by fire, has resumed its service in Gorham. The customers of the Cascade company were supplied with electricity by the Berlin Mills Company, while its plant was out of commission.

PLAISTOW, N. H.—Plans are being made to install an electric light plant between Plaistow and Newton to furnish electricity for lighting the streets and residences in both villages.

BOONTON, N. J.—The Morris County Traction Company, of Morristown, N. J., has been granted a franchise by the Common Council to extend its railways through Boonton.

ALBION, N. Y.—The property of the Albion Power Company, of Albion, which included the Albion power plant, the plants at Rockport, Clark's Mills and Waterport, was sold under foreclosure proceedings by the People's Bank & Trust Company, of Passaic, N. J. The property was purchased by Lucien H. Tyng, of Philadelphia, Pa., a member of the committee of the bondholders of the Albion Power Company, for $38,250, the purchaser assuming the outstanding indebtedness of $120,000. The plant and holdings of the Middleport Gas & Electric Company were purchased by George F. Thompson, of Middleport, for the Middleport company, which is to assume the previous encumbrances. It is understood that the property is to pass into the hands of the A. L. Swett Electric Light & Power Company, of Medina, N. Y. As soon as the court confirms the sale the Swett company will connect its transmission lines with the lines of the Albion and Brockport plants. For the present Clayton C. Blood will be retained as business manager and Paul West as electrical engineer.

BATAVIA, N. Y.—The property of the Genesee County Light, Power & Gas Company was sold Sept. 8 to Rudolph C. Rabe, of New York N. Y., representative of the bondholders and reorganization committee for $100,500. The company distributes Niagara power in Batavia and elsewhere. It is proposed to continue the operation of the plant.

BUFFALO, N. Y.—The Public Service Commission, Second District has authorized the Cataract Power & Conduit Company to issue $149,000 in bonds, to be sold at not less than 95, the proceeds to be used for the acquisition of property and for extensions and improvements to its plant.

ELMIRA, N. Y.—The Public Service Commission, Second District has authorized the Elmira Water, Light & Railroad Company to issue bonds to the amount of $196,000. The proceeds of $59,874 will be used to pay outstanding indebtedness and the balance for future improvements, which will include the installation of a steam turbine at the Madison Avenue power plant, extension of the street railway on Maple Avenue to connect with the Waverly line and for water meters.

GLOVERSVILLE, N. Y.—Mortimer Everest, of Albany, N. Y., is reported to be seeking a franchise to furnish electricity in Gloversville and Johnstown. Mr. Everest is at the head of a company which proposes to furnish electricity for manufacturing purposes in both towns.

NIAGARA FALLS, N. Y.—John A. Roebling's Sons, of New York N. Y., have been awarded the contract for furnishing and installing 18,0[illegible]

. of transmission cable in conduits furnished by the city, for $10,285. ıomas H. Hogan is city clerk.

PORT BYRON, N. Y.—The Board of Village Trustees has engaged . B. Sweet, of Utica, N. Y., engineer, to prepare plans for a municipal ectric light plant to cost about $15,000.

WATERTOWN, N. Y.—Arrangements have been made by the Shaugh- ssy Knitting Mills, of Amsterdam, N. Y., to move its plant to Water- wn. The company for the present will occupy one floor in the James . Wise building in this city and will construct a new plant as soon as ıssible on land donated by the Watertown Light & Power Company.

FORT LINCOLN, N. D.—Bids will be received at the office of the nstructing quartermaster, Fort Lincoln, N. D., until Oct. 19, 1909, for rnishing labor and material for wiring buildings at Fort Lincoln, ac- rding to plans and specifications; also for furnishing and erecting poles ıd wires around garrison and down to the end of the reservation road. formation will be furnished on application to above office. Lieut. J. D. liott, U. S. A., is constructing quartermaster.

LANGDON, N. D.—Arrangements are being made to erect a tele- one line from Langdon to Waterloo by the farmers along the route, ıich will be connected with the Langdon exchange.

MANDAN, N. D.—The Mandan Electric Company, which was for- erly owned and operated by the Missouri Valley Milling Company, has en reorganized with a capital stock of $20,000. The company is con- ·ucting a new plant, including the installation of new boilers, engines ıd generators, and is changing the system from single to three-phase d from 1100 to 2300 volts. Equipment for the plant has been pur- ased. B. K. Skeels is superintendent.

CLIFTON, OHIO.—The Village Council has granted the Cedarville ght & Power Company, of Cedarville, Ohio, a franchise to furnish ectricity for lamps in this village. It is expected that the company will pply incandescent lamps for street lighting in the near future.

CUYAHOGA FALLS, OHIO.—Plans are being prepared by the Falls ver & Machine Company for the construction of a power plant. E. edhouse is president.

DAYTON, OHIO.—In a report submitted to the City Council by City ıgineer Cellarius the cost of installing the boulevard lighting sys- n in the district outlined by the Council is estimated at about $32,742. ıe total amount is to be assessed against the abutting property owners

MT. HEALTHY, OHIO.—The capital stock of the Mt. Healthy Light Power Company has been increased from $10,000 to $45,000. Paul M. ›oven, of Hamilton, Ohio, is president.

NEW WASHINGTON, OHIO.—The local telephone company has been anted a new franchise by the Village Council, under which it may erect les to carry its cables. It is said that there will be considerable ex- ısions to the system.

ORRVILLE, OHIO.—Announcement has been made by Councilman rville that he will introduce an ordinance in the Council to provide for bond issue of $100,000 for the erection of a municipal electric light ant. so that the question may be submitted to a vote of the people at e November election. The street lighting costs the city about $50,000 year at present.

SANDUSKY, OHIO.—E. A. Bechstein, superintendent of the San- sky Gas & Electric Company, writes that during October the company ll install one 750-kw Westinghouse, three-phase, 60-cycle, 2300-volt rbo-generator; one Westinghouse 450-kw, belted, three-phase, 60-cycle, 00-volt generator; one 150-kw motor-generator set consisting of nchronous motor driving a 500-volt direct-current generator. Line volt- e will be changed from 1100 to 2300 volts; also from 133 to 60 cycles. All the present electrical machinery will be discarded, except one 113-kw, 0-volt, direct-current generator, and all engines except one 600-hp Allis d a 125-hp Ball. No change will be made in boiler equipment.

DURANT, OKLA.—The city is reported to have sold $50,000 in bonds, e proceeds to be used to establish a municipal electric light plant and her public improvements. Plans are being made by the city for the con- ·uction of a municipal electric light plant. It is said the proposed plant ll be erected in Armstrong, six miles northwest, on the Blue River. is also proposed to supply Caddo with water and electricity.

EL RENO, OKLA.—It is reported that the plant and holdings of the Reno Gas & Electric Company have been purchased by H. M. llesby & Co., of Chicago, Ill. The new owners, it is said, will tend the electric service throughout the city and suburbs. H. H. ephens will be retained as local manager.

LAWTON, OKLA.—J. S. Danneck and D. L. Sleeper have applied to e City Council for a franchise to construct and operate an electric ilway in Lawton.

MUSKOGEE, OKLA.—The Muskogee Electric Traction, it is reported, ntemplates making extensions to its system in Muskogee. R. D. Long general manager.

RYAN, OKLA.—We are informed that bids will be opened Oct. 4 for construction of an electric light plant and water works and sewer stems. The cost of the electric light plant is estimated at $6,000 and e water works $45,000. J. W. Borum is city clerk.

PORTLAND, ORE.—It is reported that the Seventh Street Improve- nt Club will soon award contracts for furnishing lamp posts with a ster of five lamps every alternate 50 feet on each side of Seventh Street, between Couch and Jefferson Streets. Charles A. Malarkey is interested in the project. It is expected that similar lamps will soon be placed on other streets.

VALE, ORE.—R. C. Carter, manager of the Idaho Electrical Company, of Boise, Idaho, is reported to have purchased the plant and holdings of the Vale Light & Water Company. The council has granted Mr. Carter a franchise to lay pipes to furnish water to the town.

WOODBURN, ORE.—The City Council has granted the Oregon Electric Railway Company a franchise to construct and operate an electric railway in Woodburn.

PANAMA.—Sealed proposals will be received at the office of the general purchasing officer of the Isthmian Canal Commission, Washington, D. C., until Sept. 28 for furnishing articles as per circular (No. 537-A) as follows: Locomotive coaling cranes, iron and steel castings, motors, transformers, searchlights, arc lamps, die blanks, rubber belting, etc. Blanks and general information can be obtained from the above office or at the offices of the assistant purchasing agents, 24 State Street, New York, N. Y., and 55 National Realty Building, New Orleans, La.; also from the U. S. engineer offices in the following cities: Philadelphia, Pa.; Pittsburg, Pa.; Boston, Mass.; Chicago, Ill., and St. Louis, Mo. Captain F. C. Boggs is general purchasing officer.

BROWNSVILLE, PA.—John Wolfe, of Homestead, Pa., has secured the contract for the construction of a power house for W. Harry Brown, in Brownsville. The cost of the building is estimated at about $20,000.

GETTYSBURG, PA.—The property of the Gettysburg Transit Company was sold at a trustees' sale for $60,000 to C. F. Kraft, of Philadelphia, Pa., representing the Central Trust Company.

HARRISBURG, PA.—Bids will be received at the office of the city clerk until Sept. 27 for lighting the Herr and Market Street subways, containing respectively 16 and 10 incandescent carbon filament lamps of 16 cp from Oct. 10, 1909, to July 4, 1910, and from Oct. 10, 1909, to June 1, 1912, which shall include maintenance and replacement of all lamps; for lighting the Mulberry Street bridge with 10-watt tungsten lamps from Oct. 10, 1909, to July 4, 1910, and from Oct. 10, 1909, to June 1, 1912, to include maintenance and replacement of all lamps and the ground glass enclosing globes; for furnishing electricity for the lighting of the municipal filtration plant, the pumping station and fire engine houses, the bids to state the rate per kw-hour on a meter basis from Oct. 10, 1909, to July 4, 1910, and from Oct. 10, 1909, to June 1, 1912, which shall include the maintenance and replacement of all lamps.

SCRANTON, PA.—The Scranton Electric Company, of Scranton, Pa., a subsidiary of the American Gas & Electric Company, of Philadelphia, Pa., has increased its capital stock from $3,000,000 to $7,000,000, the proceeds of part to be used to finance the purchase of a number of plants which have been acquired during the past year and the remainder for future developments. Of the new stock $250,000 will be issued at once.

TOWANDA, PA.—A charter will soon be applied for, asking for permission to construct a dam in the Susquehanna River near Towanda. The proposed dam will cover nearly 1800 acres, land for which has nearly all been secured. It is expected to have the dam completed in three years and to furnish power in Towanda, Athens, Sayre and other towns. Meikleham & Dinsmore, of New York, N. Y., are interested in the project.

WEST NEWTON, PA.—The City Council has granted the Pittsburgh, McKeesport & Westmoreland Railway Company a franchise to construct an electric railway in West Newton.

ANDERSON, S. C.—We are informed that the Anderson Water, Light & Power Company has awarded the contract for improvements to its power plant at Portman Shoals to the General Electric Company, of Schenectady, N. Y. H. A. Orr is president and manager.

MARION, S. C.—The plant and holdings of the Marion Water, Light & Power Company have been purchased by Martin Maloney, of Philadelphia, Pa. It is understood that the company will be reorganized and improvements made to the system.

ROCK HILL, S. C.—Application will be made at the next meeting of the City Council for a franchise for a proposed electric railway to extend from Rock Hill north to the Catawba River. J. M. Cherry, of Charleston, S. C., is reported to be interested in the project.

ABERDEEN, S. D.—The stockholders of the Dakota Central Telephone Company have authorized an expenditure of $300,000 for improvements and extensions to its system during 1910.

LAKE PRESTON, S. D.—The new electric light system has been completed and put in operation. The plant is owned and operated by the Lake Preston Milling Company.

TYNDALL, S. D.—Plans are being considered for the construction of a municipal lighting system and pumping station, and also the installation of a gas producer engine.

WATERTOWN, S. D.—It is reported that Ferris Brothers, owners of the local electric lighting plant, contemplate reconstructing their plant, and will be in the market for electrical machinery this fall.

MEMPHIS, TENN.—The Southern Steel Company is reported to have awarded a contract to the Northern Electric Company for electrical equipment amounting to $75,000, and has also awarded a contract for electric cars valued at $65,000.

AMARILLO, TEX.—William O. Miller, Jr., of Amarillo, is reported to be interested in a project to construct an electric railway between Amarillo and Canyon City.

ELGIN, TEX.—The question of establishing an electric light plant in Elgin is under consideration. W. H. Kannedy is mayor.

FLOYDADA, TEX.—Plans are being made to establish an electric light and ice plant in Floydada. Robert Hailey, of Matador, Tex., is interested in the project.

HASKELL, TEX.—Application has been made to the City Council for a franchise by M. R. Hemphill to construct a street railway three and one-half miles in length.

TEMPLE, TEX.—The plant of the Temple Electric Light Company is being remodeled and enlarged in order to meet the increased demands made upon it. The cost of the improvements is estimated at about $30,000.

WALNUT SPRING, TEX.—The construction of an interurban railway from Walnut Springs to Glenn Rose is under consideration. Judge Sadler and J. H. Farr, of Glenn Rose, are interested in the enterprise.

BURLINGTON, VT.—The City Council has appropriated $6,000 for the installation of a new boiler in the municipal electric light plant.

FORT MYER, VA.—Bids will be received by Captain Warren W. Whiteside, constructing quartermaster, until Oct. 14 for interior electric wiring of 44 buildings, including fixtures and the installation of a complete outside distributing system for the post. Alternate bids are asked for underground and overhead distributing system. Plans and specifications will be furnished upon application. A deposit of $10 will be required to insure their safe return.

COLVILLE, WASH.—The Board of County Commissioners has granted the Ione Water & Light Company, of Ione, Wash., a 25-year franchise to install an electric plant in Colville.

COSMOPOLIS, WASH.—The Grays Harbor Railway & Light Company has been granted a franchise to furnish electricity in Cosmopolis for lamps and motors. In extending its lines to Cosmopolis it will be necessary for the company to lay a cable across the Chehalis River.

SEATTLE, WASH.—Frank McKeen, manager of the Ranier Power & Irrigation Company, of Seattle, is reported to have secured control of several power plants along the Columbia River, from which it is estimated that 45,000 hp can be developed. He has secured water rights on the lower 160 ft. at Chelan Falls on the Chelan River, for $150,000, where it is estimated that 15,000 hp can be developed. Three power plants on the Methow River have also been secured; one at Black Canyon, where 8000 hp can be developed, one near Winthrop, capable of developing 10,000 hp and one at Twisp, which is larger than the other two.

SEATTLE, WASH.—Contracts have been awarded for the installation of cluster lamps on First Avenue, between Virginia Street and Don Way, as follows: To the Olympia Foundry Company, for lamp posts, at $3,440, and for conduits to the Agutter & Griswold Company, for $24,658.

RICHWOOD, W. VA.—It is reported that the Cherry River Paper Company is planning to install two exhaust steam turbines and alternators with a rating of 750-hp each, with exciters, switchboards, etc.

LA CROSSE, WIS.—Negotiations are under way for the purchase of the La Crosse Telephone Company's system by the Wisconsin Telephone Company.

LA CROSSE, WIS.—The La Crosse Telephone Company is contemplating extensive improvements to its system and proposes to increase its capital stock to $100,000.

MADISON, WIS.—The Constantine Manufacturing Company is contemplating the erection of a new factory in Madison, the equipment of which will include a producer gas plant and engine, motors, etc. A blower for dust-collecting system will also be installed.

MILWAUKEE, WIS.—The Koehring Machine Company, it is said, will require new equipment for its new machine shop, including a 50-kw engine, engine-driven generating unit and a line of small motors for both individual and group drives, and other machinery.

CALGARY, ALTA., CAN.—The City Council will soon submit a by-law to the ratepayers to provide for a sale of bonds amounting to $40,000, the proceeds to be used for street railway purposes. The street railway bylaw originally was for $476,000, but this amount has been found to be insufficient.

LETHBRIDGE, ALTA., CAN.—Hon. W. H. Cushing, minister of public works for Alberta, states the government telephone system will be extended from here to connect with the several independent telephone companies operating across the border in British Columbia.

FORT WILLIAM, ONT., CAN.—The City Council has decided to extend the municipal telephone system throughout the Township of Paipoonge. Tenders for the work will be called as soon as the surveys have been made.

FORT WILLIAM, ONT., CAN.—It is the intention of the Canadian Pacific Railroad Company to have its lines between Fort William, Ont., and Brandon, Man., handled entirely by telephone within a year. At the present time the company is erecting about 531 miles of wire, and as soon as these are completed other lines will be installed.

HARTLAND, ONT., CAN.—John E. Stewart and A. B. Donworth are reported to be interested in a project to construct an electric railway from Hartland to Foreston, N. B.

LONDON, ONT., CAN.—The entire plant, franchise and equipment of the Southwestern Traction Company will be sold by auction on Oct. 2 at the London & Western Trust Company's offices. The company has 2 miles of track in operation.

ST. CATHERINES, ONT., CAN.—The Niagara, St. Catherines & Toronto Railway Company is in the market for material for its proposed extension from Welland to Port Colburne, which will require eight miles of single track. E. F. Seixas is general manager.

LONGUEIL, QUE., CAN.—The Montreal & Southern Counties Railway Company, of Montreal, has been granted a 24-year franchise to construct a street railway in Longueil. The railway will be 24 miles in length and will connect Montreal and St. Johns and intervening owns. Marcus S. Hill, 112 St. James Street, Montreal, is secretary of the company.

SWIFT CURRENT, SASK., CAN.—F. W. Laidley, of this town, is organizing a company to be known as the Saskatchewan Light, Heat & Power Company, and hopes to be able to start operations early next month.

New Industrial Companies.

THE AUTOMATIC COMPOUND ELECTRIC VEHICLE COMPANY, of Camden, N. J., has been chartered by L. E. Johnson, of Philadelphia, Pa., E. C. Waddington, of Woodstown, N. J., and L. Starr, of Woodbury, N. J. The company is capitalized at $100,000, and proposes to manufacture automobiles, etc., and deal in trade-marks, patents, etc.

THE BARR & CREELMAN COMPANY, of Rochester, N. Y., has been chartered, with a capital stock of $100,000, by J. A. Creelman, W. J. Creelman, of Rochester, N. Y., and H. B. Fairman, of Victor, N. Y. The company proposes to do gas, electrical heating, ventilating and heating work.

THE CATARACT MOTOR COMPANY, of Paterson, N. J., has been chartered, with a capital stock of $350,000, for the purpose of manufacturing motor vehicles, engines, etc., by Louis A. Plaget, William H. Sherman, Forester W. Freeman, Harris J. Westerhoff and George E. Hannah, all of Paterson, N. J.

THE CLARK ENGINEERING COMPANY, of Wilmington, Del., has been incorporated with a capital stock of $100,000 by F. M. Shive, S. E. Roberson and H. W. Davis, of Wilmington, Del.

THE EUREKA SALES COMPANY OF CHICAGO, of Jersey City, N. J., has been incorporated to manufacture hand and electrical vibrators etc. The company is capitalized at $100,000 and the incorporators are F. R. Muenzenberger, C. J. Muenzenberger and A. J. Muenzenberger.

THE GURNEY BALL BEARING COMPANY, of Jamestown, N. Y. has been incorporated, with a capital stock of $600,000, to manufacture machinery, bearings, ball bearings, etc. The incorporators are: A. W. Kettle, F. W. Gurney and W. H. Kidder, all of Jamestown, N. Y.

THE LEADER-BEERS ENGINEERING COMPANY, of Rochester, N. Y., has been incorporated by Roland E. Presinger, of Decatur, Ill. Leroy F. Beers and Arthur Berman, both of Rochester, N. Y. The company is capitalized at $10,000, and proposes to manufacture engines, boilers, machinery and tools, etc.

THE McCANN BROTHERS' CONSTRUCTION COMPANY, of Murphysboro, N. Y., has been incorporated for the purpose of doing general construction work. The company is capitalized at $40,000 and the incorporators are: P. S. McCann, J. McCann and C. McCann, of Murphysboro, Md.

THE MECHANICSVILLE SPECIALTY SUPPLY MANUFACTURING COMPANY, of Mechanicsville, N. Y., has been incorporated, with a capital stock of $1,000, by James R. Smith, Stephen Lee and Melvill L. Welling, all of Mechanicsville. The company proposes to manufacture mechanical devices, exploit patented articles, etc.

THE MILLER MOTOR COMPANY, of New York, N. Y., has been incorporated by C. Miller, L. H. Cummings and G. W. Scheafer, all of New York, N. Y. The company is capitalized at $30,000 and proposes to manufacture the Miller rotary engine.

THE NOHE ELECTRIC RENOVATOR COMPANY, of Chicago, Ill. has been incorporated, with a capital stock of $25,000, for the purpose of manufacturing electrical devices. The incorporators are: G. Lanhenry, A. W. Nohe and J. V. Crane.

THE OHIO ELECTRIC COMPANY, of Toledo, Ohio, has been incorporated with a capital stock of $75,000 by Henry P. Dodge, Rathbun Fuller, Henry E. Marvin, James Brown Bell and Robert E. Lee. The company will take over the business of the Ohio Electric Carriage Company, which has been in operation for some time.

THE RAILWAY AUTOMATIC MAIL DEVICE COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $10,000, to manufacture railway supplies, by J. H. Dunn, R. W. Waugh and Percival Steele.

THE TRACTOR ENGINEERING COMPANY, of Trenton, N. J., has been incorporated with a capital stock of $60,000 for the purpose of doing a mechanical engineering business and to manufacture trucks, motor trucks, tractors, etc. The incorporators are. W. Balderson, J. W. Watt and J. E. Mosher, all of Trenton, N. J.

THE VAN BUREN ENGINEERING COMPANY, of New York, N. Y., has been incorporated by George G. MacCracken, Daniel J. Haner and C. Raymond Weaver, all of New York, N. Y. The company is capitalized at $15,000 and proposes to manufacture machinery, power and excavating machinery and metal products used in arts and sciences, etc.

THE WARNER MANUFACTURING COMPANY, of Muncie, Ind., has incorporated, capitalized at $250,000. The company proposes to establish and equip a large plant to manufacture automobiles, automobile parts, engines, motors and electrical equipment of all kinds. Thomas W. Warner is president, and E. S. Janney, secretary of the company.

THE WASHINGTON ENGINE WORKS, of New York, N. Y., has been incorporated, with a capital stock of $50,000, by William A. White, Ada A. White, of West Hoboken, N. J., and Benjamin H. Oliver, of New York, N. Y. The company proposes to do an engineering business, manufacturing engines, boilers, etc.

Company Elections.

OZARK, ARK.—At the annual meeting of the Altus Gin Manufacturing & Improvement Company the following-named officers were elected: A. D. Reynolds, president; A. Berghler, vice-president; William Hill, secretary; L. R. A. Wallace, treasurer, and C. A. Gochenous, manager.

GARNETT, KAN.—At the annual meeting of the Garnett Electric Light Company, held recently, all the officers were re-elected.

New Incorporations.

WILMINGTON, DEL.—The Bullock Service Corporation has filed articles of incorporation with the Secretary of State. The company is capitalized at $1,000,000 and proposes to generate, buy, sell and deal in electricity, gas, water and other public commodities.

CARROLLTON, ILL.—Articles of incorporation have been filed for the Carrollton Electric Company by Orman Pierson, S. Elmer Pierson and Stuart Pierson. The company proposes to furnish light, heat and power. Orman Pierson was at one time treasurer of the Carrollton Heat, Light & Power Company.

MONTICELLO, IND.—The Tippecanoe & Monticello Interurban Railway Company has been chartered with a capital stock of $100,000 to construct and operate a system of suburban railways to connect Fowler, Lafayette, Battle Ground, Ash Grove, Delphi, Idaville, Burnettsville, Buffalo and Logansport. The incorporators are: Thomas W. O'Connor, Willis White, of Monticello; Charles E. Turner, of Detroit, Mich.; Joseph A. C. Blackburn and William B. Felker, of Rogers, Ark.

REDDINGTON, IND.—The Redding Township Mutual Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is placed at $3,000. The company proposes to build and operate a telephone system throughout the counties of Jackson, Jennings and Bartholomew in the State of Indiana. Thomas Gillespie, John Fox, William Rossett and John A. Maelimo are incorporators.

SOUTH BEND, IND.—The South Bend & Logansport Traction Company has been incorporated by Thomas P. Moredock, Virginius Nicar and P. J. Haulihan, of South Bend, Ind.; Henry F. Coleman, of Logansport, Ind., and David Pepper, Jr., of Philadelphia, Pa. The company is capitalized at $400,000 and proposes to construct an electric railway from South Bend to Logansport, via Plymouth and Rochester, 69½ miles in length.

DES MOINES, IA.—The Adel City Railway Company has been incorporated with a capital stock of $10,000 to construct an interurban railway from Des Moines to Adel, by D. A. Blanchard, L. M. Macy, W. B. Kinnick, Robert Pilmer, F. F. Flynn, B. J. Flynn, R. L. Parrish and H. A. Smith.

LOUISVILLE, KY.—The Kentucky Rapid Transit Company has been incorporated under the laws of Delaware for the purpose of taking over various traction companies and interurban railways in Kentucky. It will operate in Louisville, Lexington and Frankfort. The capital stock of the company is placed at $10,000,000. Samuel M. Clement, Jr., West End Trust Building, Philadelphia, Pa., and George S. Graham, of 42 Broadway, New York, N. Y., are interested in the company.

PORTLAND, MAINE.—The General Light & Power Company has been organized with a capital stock of $500,000 for the purpose of constructing and operating lighting and power plants, etc. The officers are: A. G. McPherson, president, and James R. Parsons, treasurer, both of Portland, Maine.

DALTON, MICH.—The Dalton Telephone Company has been incorporated to establish a telephone system in Dalton. The company is capitalized at $5,000 and E. F. Plunkett and C. C. Plant are directors.

GRAND RAPIDS, MICH.—Articles of incorporation have been filed for the three power companies as follows: The Little Muskegon Water Power Company, with a capital stock of $125,000; the Montcalm Electrical Company, capitalized at $75,000, and the Western Hydro-Electrical Company, with a capital stock of $500,000. Bruce Goodfellow, of Detroit, Mich., is trustee of the companies.

LANSING, MICH.—Articles of incorporation have been filed with the Secretary of State for the Kalamazoo Valley Hydraulic Power Company. The company is capitalized at $300,000 and proposes to furnish electricity for lamps and motors in the Kalamazoo Valley. E. W. Stone and H. J. Aldworth, of Allegan, Mich., are incorporators.

STEPHEN, MINN.—The McMahon Telephone Company has been incorporated with a capital stock of $25,000 by Richard McMahon, E. E. Johnson, Thomas B. McMahon and John Peterson.

LOUISVILLE, MISS.—Articles of incorporation have been filed for the Winston Telephone Company with a capital stock of $10,000 by G. W. Jones, J. D. Fulton and others.

GLASGOW, MO.—Preliminary plans are being prepared by Burns & McDonnell, consulting engineers, of Kansas City, Mo., for electric lighting, water works and sewerage system for Glasgow, Mo.

MILES CITY, MONT.—Articles of incorporation have been filed for the Buffalo Rapids Power Company by George Burt, Della M. Burt and H. E. Fearnall. The company is capitalized at $300,000 and proposes to utilize the waters of the Yellowstone River, by means of a ditch, to generate electricity, which will be transmitted along the Yellowstone River between Billings and Glendive for lamps and motors. Electricity will also be furnished to farmers along the route. A dam will be built in the Yellowstone, to cost about $250,000.

ALBANY, N. Y.—The Hudson Valley Telegraph Company of New York has been chartered to construct and operate telephone and telegraph lines throughout the State of New York, northward to Canada and through the Eastern States, Pennsylvania and New Jersey. The capital stock is placed at $25,000 and the directors are: James H. Ryan, P. F. Graue and Edward Kelly, of New York, N. Y.

PORT JERVIS, N. Y.—Articles of incorporation have been filed for the Port Jervis Traction Company to construct an electric railway about four miles in length in Port Jervis. The company is capitalized at $43,000, and the incorporators are: John E. Dilly, James Torney, of New York, N. Y., and Thomas H. Milson, of Paterson, N. J.

MARSHALL, N. C.—The W. T. Weaver Company, of Asheville, N. C., is reported to be planning the erection of a hydro-electric plant on French Broad River, near Marshall, where it is proposed to develop 5000-hp to be transmitted by electricity.

BARTON, N. D.—Articles of incorporation have been filed for the Barton Farmers' Telephone Company, with a capital stock of $25,000, by E. Erickson, C. Myhran, James Scott and others, all of Barton, N. D.

MUNICH, N. D.—The Rosehill Farmers Telephone Company has been chartered with a capital stock of $5,000 by John M. Enns, Isaac P. Toews, D. H. Unran, all of Rosehill.

CLEVELAND, OHIO.—Articles of incorporation have been filed for the People's Street Railway Company by Thomas Dolan, Miles Dodd, Hugh McConaghy, Robert Johnstone and Francis E. Cottier. The company is capitalized at $10,000 and proposes to construct an electric street railway in Cleveland.

FOREST, OHIO.—The Consumers' Electric Company has been incorporated, with a capital stock of $35,000, by E. B. King, A. K. Nier, C. B. Horn, M. S. Wilcox and A. C. Bowser.

WATERVILLE, OHIO.—The Waterville Light & Power Company has been chartered with a capital stock of $10,000 by Delmar Farnsworth and others.

ASHER, OKLA.—The St. Louis Rural Telephone Company has been incorporated with a capital stock of $2,500 by C. E. Boardman, W. S. Carson, J. W. Anthony, C. W. Williams and others.

CARNEGIE, OKLA.—The Spring Valley Rural Telephone Company has filed articles of incorporation with a capital stock of $2,000. The incorporators are: Charles Lunsford, S. A. Van Cleve, H. Kindblade, E. Okeson, of Carnegie, and Isaac Johnson, of Alden.

FEATHERSTON, OKLA.—The Featherston Telephone Company has been incorporated with a capital stock of $2,000 by M. J. Daniels, R. N. Daniels and William A. Daniels, all of Featherston.

MARSHFIELD, ORE.—Articles of incorporation have been filed for the Catching Inlet Telephone Company, with a capital stock of $500, by William I. Bonebrake, James S. Masters and Alfred Gunnell.

CLEONA, PA.—The Cleona Rural Telephone Company has been organized to construct a rural telephone line about 11 miles long, to erect a rural telephone system to connect with Bell telephone system at Lebanon. The officers are: G. Holzappel, president; H. S. Fegan, secretary, and A. H. Horst, treasurer and agent.

ALLENDALE, S. C.—The Farmers' & Merchants' Telephone Company has been chartered with a capital stock of $500.

SMITHVILLE, TENN.—The Smithville Home Telephone Company has been incorporated with a capital stock of $3,000 by T. W. Wade, J. H. Christian, W. H. Davis, W. T. Hayes and E. G. Dawson.

MEXIA, TEX.—The Mexia Telephone Company has been chartered with a capital stock of $12,500 by H. O. Cravens, Jack Womack and J. S. Smith.

GRUNDY, VA.—The Sandy Valley Telephone Company has been chartered with a capital stock of $4,000 and the following named officers: John A. Looney, of Grundy, Va., president; B. Belcher, of Artia, Va.,

vice-president; R. E. Elswick, of Mouth Card, Va., secretary and treasurer.

NEWPORT NEWS, VA.—The Newport News & Yorktown Railway Company has been chartered with a capital stock of $25,000 to construct a railway from Yorktown to Newport News, a distance of 20 miles. The officers are: W. T. Chapin, of Newport News, president; Alvah H. Martin, vice-president, and C. P. Jones, secretary and treasurer.

MADISON, WIS.—The Twelve Corner-Mackville Telephone Company has filed articles of incorporation with the Secretary of State with a capital stock of $10,000, to erect a telephone line from Appleton to Black Creek. The incorporators are: Martin Striegel, of Mackville; C. F. Tiedt and John L. Parkers, both of Twelve Corners.

Legal.

ADMISSIBILITY OF EVIDENCE IN ACTION AGAINST ELECTRIC LIGHT COMPANY.—The plaintiff in an action for damages against an electric light company testified that on the evening on which the injuries complained of were received he went upon a bridge over which one of the company's wires was strung for the purpose of getting the air. While there he was attracted by the sound of a graphophone, and went to the south side of the bridge, and while standing on the floor of the bridge, leaning on the rail, a puff of wind blew his hat off. He grabbed for it, and in so doing his hand came in contact with the wire. He was permitted to testify at the trial that he examined the wire early next morning and found it to be uninsulated and sagging about 18 in. The general rule is well settled that evidence of the subsequent condition of the place where the accident occurs is not admissible to show a negligent condition at the time of the injury, because the question of negligence is to be determined by the actual condition at the time of the injury. There are certain well-recognized qualifications and exceptions to this rule, but the facts of this case did not bring it within any of those exceptions. There was no evidence upon the part of the plaintiff or the other witnesses to the effect that the insulation of the wires was defective or sagged down from a foot or 18 in. at the time of the alleged injury at the point or place where the accident is alleged to have happened. It was clearly incumbent upon the plaintiff to show by competent evidence that the wire sagged or slacked at the time of the accident—otherwise there could be no recovery in the case. The condition of the wire on the day after the accident under the facts of this case was not legally sufficient proof of its location and condition at the time and at the point or place of injury. The testimony, therefore, was too remote and misleading, and presented an issue of negligence not involved in the case. For this and other errors the judgment against the company was reversed.—Annapolis Gas & Electric Light Company vs. Fredericks, Court of Appeals of Maryland, 72 Atl. Rep., 534.

POLE-LINE ACCOUNT AND CONCURRENT NEGLIGENCE.—A telephone company negligently maintained a telephone pole along a county road for 15 years, and until the part imbedded in the ground had become decayed. The wire which had been used to strengthen the pole had been cut and not replaced, and as plaintiff was driving along the road a third person cut a tree on adjoining land, which fell against the wires, putting a strain on the pole, which broke off at or near the surface of the ground and fell on plaintiff, causing injuries. It was held that the negligence of the telephone company in maintaining the pole in such condition concurred with the negligence of the person who felled the tree on the wire, within the rule that where an injury is the result of the concurrent negligence of two or more persons all are liable, jointly or severally, for the damage. A verdict for $3,750 was rendered against the company.

In Johnson v. Northwestern Telephone Exch. Co., 48 Minn., 433, 51 N. W., 225, the action was for an injury caused by the falling in a street in Minneapolis of one of the poles of the defendant, on which were suspended its line wires, which fall was, as alleged, due to the rotten and unsound condition of the pole (permitted to be so by the defendant's negligence, rendering it of insufficient strength to bear the weight of the wires suspended upon it. For the purpose of sustaining the pole and preventing it from falling, the defendant had extended a guy wire from the top of the pole to a building, to which the other end of the wire was attached with the license of the owner of the building. The owner of the building revoked the license and required the removal of the wires from the building. The defendant failed to remove the wires, and thereupon the owner of the building cut them, and the pole, deprived of the stay afforded by the guy wires, broke off near the ground and fell into the street, injuring the plaintiff. At the close of the evidence the trial court directed a verdict for the defendant, upon the apparent assumption that between the negligence of the defendant and the injury of the plaintiff there intervened an independent, adequate cause of the injury, to wit, the act of a third person, which it was said was what is termed in law the proximate cause of the injury. The Supreme Court held that it was a case of concurrent negligence, in which case each party guilty of negligence was liable for the result, and that the negligence of each as the proximate cause for the injury would not have occurred but for that negligence.—Pacific Telephone & Telegraph Company v. Parmenter, United States Circuit Court of Appeals, 170 Fed. Rep., 140.

Personal.

MR. T. C. MARTIN, editor of the *Electrical World*, has been appointed by Mayor McClellan as a member of the Hudson-Fulton Celebration Commission.

MR. W. A. SAWYER, recently manager of the Buffalo office of the Western Union Telegraph Company, has been appointed superintendent of the fourth district of the Eastern division of the Western Union Telegraph Company, with headquarters at Philadelphia.

MR. F. V. HENSHAW, the consulting electrical engineer, sailed last week on the *Mauretania* to look into various matters of technical interest on the other side. He will be in London two or three weeks.

MR. J. B. CRAWFORD has been appointed superintendent of the Winona Interurban Railway Company and will have charge of the operating department and the property controlled and leased by that company.

MR. GEORGE GRAY WARD, vice-president of the Commercial Cable Company, accompanied by Mrs. Ward, has just returned from a prolonged stay in Europe, where he has been engaged on important work connected with the interests of his company.

MR. FREDERICK SARGENT, of Sargent & Lundy, consulting engineers, and Mr. Frank J. Baker, vice-president of the North Shore Electric Company, both of Chicago, have returned home after a summer spent in Europe. Mr. Sargent, accompanied by Mr. Baker, examined a number of foreign electrical plants, and both gentlemen obtained much information and pleasure from their trip.

MR. FRANKLIN W. KOHLER, of Kohler Brothers, Chicago, will sail from New York on Oct. 1 for London, after a brief vacation spent in his native land. Mr. Kohler had been 15 months abroad before this flying trip homeward, and he has been successful in introducing the Kohler electric system of printing-press control in England, Germany, France and Austria. He is returning to this work, which will demand his attention for several years to come.

MR. CHARLES A. S. HOWLETT, president of the Electric Club, of Chicago, announced his resignation at the meeting of Sept. 15, owing to his removal to New York. Mr. Howlett has been president of the club since its organization, a year and a half ago, and the members received the news of his retirement with genuine regret. In submitting his resignation Mr. Howlett reviewed the history of the club briefly and urged a higher sense of personal responsibility on the part of the members. He predicted a bright future for the organization and made a number of recommendations, including the publication of stenographic reports; the adoption of a club emblem; co-operation with other societies in matters of public interest; correspondence with similar clubs with the idea of the formation of a federation of electric clubs with membership cards mutually recognized; permanent quarters; an increase in membership from 375 to 1000 by the efforts of a special subcommittee of the membership committee; co-operation with the city electrician to secure a substantial portion of the proceeds of the proposed issue in Chicago for street lighting extensions; reduction of the club's bank surplus by using a part of the money to further the membership campaign and to give more benefits to members; the formation of a glee club; an occasional debate instead of set address; meetings of committees at least twice a month with monthly reports, and the formation of a publicity committee to secure reports of meetings in the daily as well as the technical press. Mr. Howlett's resignation was accepted and he departed for his new field of labor with the best wishes of the members of the club. At a meeting of the board of managers of the club on Sept. 17 Mr. Howlett was voted a life membership as a token of appreciation for his efforts in behalf of the organization.



MR. C. A. S. HOWLETT

Trade Publications.

FUSE WIRES.—The Harvard Electric Company, 60 West Van Buren Street, Chicago, Ill., has issued a booklet giving specific information relating to fuse wire strips and lengths. These devices are constructed in accordance with Underwriters' specifications.

WEIGHTED PUSH-BUTTON—GUY ANCHORS.—The Central Electric Company, Chicago, has issued a new circular descriptive of the new Central type weighted push-button for which several advantages are claimed. Its base is well protected so that it will not mar the desk and by means of a special name-plate the various buttons are readily selected. The same company is also sending out a new folder descriptive of guy anchors. This guy anchor is of the harpoon type, being driven in position by means of the ordinary sledge.

SIGN LIGHTING WITH TUNGSTEN LAMPS.—Probably no other branch of illumination has taken more rapid strides in the last few

years than sign lighting, and in this connection the tungsten lamp shows to especially good advantage. In Bulletin No. 4680, of the General Electric Company, this subject is discussed at considerable length and detail. The comparative cost of sign lighting with carbon and tungsten lamps is shown by means of curves, and the great superiority of the tungsten over the carbon lamp is clearly proved.

MOTOR STARTERS AND CONTROLLERS.—In a new edition of its perpetual catalog, the Ward Leonard Electric Co., Bronxville, N. Y., devotes Sections A 12 and A 13 to motor starters with no-voltage release, equipped with steps of resistance for speed control by field regulation with either 5 steps of field resistance or 16 steps of field resistance, and the same with overload circuit-breaker attachment. This is a new line of apparatus. Sections B 6, B 7, B 8 and B 9 apply to machine tool controllers, both reversing and non-reversing types, with face plate and resistance combined, or mounted separately, with armature control alone or armature and field control. These are also new designs.

"DRYING IN INDUSTRIAL PLANTS."—With this title the Green Fuel Economizer Company, Matteawan, N. Y., has issued a pamphlet describing a new method for calculating drying equipments. The first part of the treatise discusses the elementary theory of drying and then describes drying equipments as used in various industries. The latter contains a chapter on drying engineering and gives an original method for calculating the amount of air and steam required for drying a given material under prescribed conditions, which does not require an elaborate system of special tables, the calculations being performed with the aid of the ordinary steam tables and a table of humidity, both of which are included. The book should be of interest, not only to manufacturers who have drying work to do, but also to engineers who design and construct plants of this character.

Business Notes.

THE J. M. CARPENTER TAP & DIE CO., Pawtucket, R. I., announces that it has prepared and will furnish lists of the new A. S. M. E. standard taps and dies, of the U. S. Standard in other than regular pitches, and of V-thread taps and dies other than the U. S. Standard.

BRISTOL PITTSBURGH OFFICE.—The Bristol Company, Waterbury, Conn., has established an office in the Frick Building Annex, Pittsburgh, in order to look after the large trade that has developed in the Pittsburgh manufacturing district, particularly in connection with temperature and pressure recorders used in the iron and steel industry.

CRESCENT WIRE.—General C. Edward Murray, treasurer of the Crescent Insulated Wire & Cable Company, of Trenton, N. J., was in Chicago last week and made a call upon his representatives, the Metropolitan Electrical Supply Company, which carries large stocks of Crescent wire. General Murray is well satisfied with the business outlook for the fall and winter, and thinks everything looks favorable for rushing business all along the line.

THE ARROW ELECTRIC COMPANY, of Hartford, Conn., which recently purchased the plant and business of the Marshall Electric Company, of Hyde Park and Boston, Mass., is making arrangements to move the plant to Hartford. The Arrow Company has leased the ground floor and one-third of the upper floor at Capitol Avenue and Laurel Street, and now practically controls the whole building. The company will take possession of its new quarters in November, when it will move the equipment of the Marshall Company to Hartford. The company manufactures electrical goods, including switches, wires and other supplies.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED SEPT. 14, 1909.

[Conducted by W. F. Bissing. Patent Law, 2 Rector St., N. Y. City.]

933,737. VENTILATING PLATE AND SPACING BLOCK FOR ELECTRIC APPARATUS; J. A. Baird, Pittsburgh, Pa. App. filed Nov. 3, 1906. The plate has groups of holes with spacing blocks having dove-tailed projections, and a locking device is provided consisting of a portion of the plate adjacent to one hole, which may be deflected to permit the dove-tailed projection to enter the ventilating hole.

933,746. OVERLOAD AND REVERSE CURRENT RELAY DEVICE; F. Conrad, Edgewood Park, Pa. App. filed May 8, 1905. Operates the circuit protective apparatus when the direction of the drop of potential becomes reversed or when the current exceeds a certain amount by providing a governor consisting of an electro-magnet operating a rotatable member, the magnet being provided with a series of windings so as to be actuated by electric forces proportional to the current, voltage and certain other factors of the circuit.

933,747. OVERHEAD LINE MATERIAL FOR ELECTRICAL RAILWAYS; H. P. Davis, Pittsburgh, Pa. App. filed Nov. 8, 1907. A section break insulator comprising an insulating bar having end brackets with wire-clamping devices and switch jaws, intermediate members and switch blades pivotally mounted thereon and adapted to engage the switch jaws on either end bracket.

933,756. ELECTRIC SIGNAL; W. K. Howe, Rochester, N. Y. App. filed March 18, 1908. Makes use of two lights with an oscillating disk to cover and uncover the lights, a counterbalanced arm, driven by a gear and pinion from an electric motor with a friction clutch member in the train of connections.

933,765. WINDING FOR ARMATURE OF DYNAMO-ELECTRIC MACHINES; B. G. Lamme, Pittsburgh, Pa. App. filed Nov. 3, 1906. A dynamo with a variable number of poles having a winding for the armature with a pitch between the coils which is intermediate that of the polar pitches for the respective different numbers of poles.

933,766. VENTILATING PLATE FOR LAMINATED STRUCTURES; P. A. Lange, Manchester, Eng. App. filed Feb. 20, 1907. Spacing ribs are secured to the ventilating plates by a special construction of rivets.

933,767. ALTERNATING-CURRENT TRANSFORMER REGULATOR; A. C. Lasher, Wilkinsburg, Pa. App. filed Nov. 26, 1906. The ventilator contains a movable coil whose weight is used to bring the movable coil adjacent to the fixed coil in opposition to the electromagnetic repelling force between the coils.

933,769. ARC LAMP HAVING MAGNETIZABLE ELECTRODES; G. M. Little, Pittsburgh, Pa. App. filed May 10, 1906. The electrode contains magnetizable material and a magnet winding surrounds it and is connected in series with it.

933,770. ARC LAMP; G. M. Little, Pittsburgh, Pa. App. filed May 10, 1906. The electrode has an enclosing casing with vanes for directing a draft of air upon the inner surface of the casing, at the same time rotating the air.

933,787. FUSE RECEPTACLE; B. P. Rowe, Wilkinsburg, and S. M. Kintner, Pittsburgh, Pa. App. filed Sept. 20, 1906. For high-potential circuits in which a hollow insulator containing insulating fluid also contains an enclosed fuse located in the fluid.

933,702. COIL-WINDING APPARATUS; H. B. Smith, Worcester, Mass. App. filed May 9, 1907. The coil winder has a cylindrical form mounted on a horizontal axis and a removable sleeve, with a ring fitted over the sleeve.

933,800. SECTION-BREAK INSULATOR; T. Varney, Pittsburgh, Pa. App. filed June 4, 1906. For bow trolleys in which end clamps and parallel sectional side bars of insulating material are used, the sections being clamped together and the conductors being connected to the end clamps and extending along the side bars.

933,802. RAILWAY LIGHTING AND SIGNALING DEVICE; C. A. Ward, Forestville, Conn. App. filed June 19, 1907. Safety devices for railway trains and for lighting the roadway adjoining the track during the travel of the train. Uses separate lighting wires alongside of the main wire with lights connected with each lighting wire and a trolley pole having supplementary wheels for engaging the lighting wire.

933,815. ELECTRIC FURNACE; T. F. Baily, Alliance, Ohio. App. filed Oct. 13, 1908. A furnace with non-metallic walls, electrodes and a resistance body located at the bottom of the heating chamber. Specific construction of walls.

933,824. TELEPHONE STAND; C. S. Coom, Rockledge, Pa. App. filed April 8, 1909. For handling a receiver, freeing the hands, by providing a bent arm controlling the switches and carrying a round socket in which a fork is mounted, the fork holding the receiver.

933,826. INTERMITTENT LINE SWITCH; E. E. F. Creighton, Schenectady, N. Y. App. filed Oct. 31, 1907. A lightning arrester made up of a plurality of aluminum cells, spark gaps in series therewith and switch blades adapted to close the gaps, with means for simultaneously and periodically actuating the blades.

933,827. ADJUNCT FOR ALUMINUM CELL LIGHTNING ARRESTERS; E. E. F. Creighton, Schenectady, N. Y. App. filed Aug. 7, 1907. An electrolytic condenser lightning arrester having a resistance in series with it and a high resistance shunt in parallel with the resistance.

933,843. METALLURGICAL CONDENSER; W. McA. Johnson, La Harpe, Kan. App. filed Nov. 30, 1903. The walls of the condensing chamber are heated by carbon heaters electrically actuated.

933,845. ARRANGEMENT FOR INDICATING AND RECORDING PERMANENTLY THE MAXIMUM DEMAND FOR ELECTRICAL ENERGY ON ANY CIRCUIT; W. W. Lackie and D. J. Steele, Glasgow, Scotland. App. filed Jan. 31, 1908. The indicating means include a solenoid operating wheel and provided with a weight for resisting its rotation and a pivotally mounted cross-bar upon which the wheel is mounted with a magnetic plunger within the solenoid moving the cross-bar to bring the wheel into engagement with the meter.

933,861. ART OF WATERPROOFING FIBROUS MATERIALS; A. O. Tate, Toronto, Canada. App. filed June 1, 1907. Permeates the interior fibers with a saponaceous substance and electrolytically coats the surface of the material with palmate of aluminum.

933,871. RAILWAY TRACK INSTRUMENT; H. M. Abernethy, Cleveland, Ohio. App. filed Jan. 16, 1907. Has a box in which electric contacts are supported and a disk which is rotated by the movement of the railway switch for connecting and disconnecting the contacts.

933,887. CLUSTER FIXTURE FOR ELECTRIC LIGHTS; J. H. Caldwell, Philadelphia, Pa. App. filed Oct. 21, 1908. A hanger and base with lamp sockets on the base, a switch on the base and a shade surrounding it.

933,899. ELECTRICALLY OPERATED CLOCK; H. Gillette, Chicago, Ill. App. filed March 11, 1908. An electrically actuated clock comprising a master clock and a secondary clock with a rotating circuit-closer, electrical means controlled by the master clock moving the circuit-closer to close the circuit and means actuated by a motor to impart another movement to the circuit-closer to open the circuit.

933,930. ELECTROMAGNETIC SEPARATOR FOR GRAIN CHUTES; B. M. Sypher, Toledo, Ohio. App. filed June 22, 1908. For separating out the magnetic particles which may be mingled with the grain by arranging an electromagnet within a chute. Details.

933,944. METHOD FOR MAKING PURE UNCTUOUS GRAPHITE; Edward Goodrich Acheson, Niagara Falls, Ontario, Canada. App. filed May 10, 1909. Electrically heats a body of carbonaceous material, surrounding the mass by an envelope of sand and carbon.

933,956. ELECTRICAL SWITCH; F. H. Buffehr, Millers, Nev. App. filed May 3, 1909. All the parts are mounted inside of a casing which has a cover and in which is placed a drum provided with a plurality of contacts, an operating handle, and apertures in the cover for the terminal wires.

933,989. ELECTRIC HEATER: C. E. Johnson, Los Angeles, Cal. App. filed Jan. 22, 1909. A continuous blast of air is forced by a fan against a set of heating wires, heated electrically, in front of the fan.

934,024. INCANDESCENT LAMP; E. H. Smith, Aberdeen, Wash. App. filed Nov. 30, 1908. A multiple-filament lamp with a switch lever operated by two strings so as to throw in either filament. Details.

934,085. SYSTEM FOR BRAKING MOVABLE PLATFORMS; C. C. De Mocomble, Paris, France. App. filed Dec. 22, 1906. The platforms are moved by rollers on rails and the trucks are joined to form a continuous platform. The platform is stopped when an obstacle gets in the way by means of a solenoid which actuates an interrupter that breaks the motor circuit.

934,097. CONTROLLER FOR ELECTRIC MOTORS; F. L. Sessions, Columbus, Ohio. App. filed Jan. 31, 1908. A series of stationary contacts, a series of movable contracts, rocking holders for the latter mounted on swinging arms and a series of rotary cams each arranged to engage directly with one of the rocking holders.

934,104. CONTROLLING MEANS FOR ELECTRICAL CLUTCH-DRIVING MECHANISM; A. P. Stekel, Buffalo, N. Y. App. filed Dec. 11, 1908. For elevators using several drives from one line shaft. Makes use of two electric clutches with means for exciting either clutch and means operated by the motion of the machinery when the current is cut off from the driving clutch for exciting the other clutch whereby the latter clutch retards the motion.

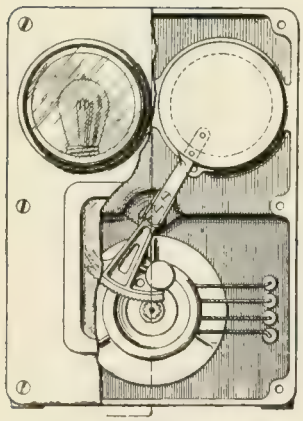
934,108. ELECTRIC BURGLAR ALARM; M. Trautmann, Dresden, Germany. App. filed Nov. 21, 1908. A curtain is suspended in front of the entrance to be guarded and consists of conductively connected flexible members, with two series of contact elements.

934,119. CIGAR LIGHTER; F. J. Wildemann, Newark, N. J. App. filed Feb. 10, 1909. Comprises a base, a lamp on the lid, together with a swinging arm whose end engages the lamp to form a spark.

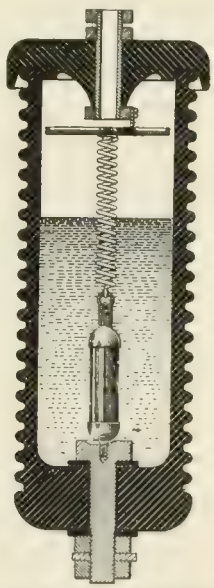
934,170. METHOD OF REDUCING ORES; Karl Albert Fredrik Hiorth, Christiana, Norway. App. filed Feb. 10, 1908. Mixes the ore with graphite rock containing silica and a basic material and subjects the mixture to an electric current.

934,210. DYNAMO-ELECTRIC MACHINE; W. D. Pomeroy, Norwood, Ohio. App. filed March 6, 1905. The dynamo has a laminated core with dove-tailed connection between the core and frame and clamping bolts holding the laminae together.

934,211. SPEED-LIMITING DEVICE; W. D. Pomeroy, Norwood, Ohio, and A. L. McHugh, Cincinnati, Ohio. App. filed March 9, 1905. The dynamo has a circuit-breaker and a speed-limiting device comprising a switch controlling the circuit breaker and operated by a centrifugal device.



933,756—Electric Signal.



933,787—Fuse Receptacle.

934,212. KNOCKDOWN ARMATURE; E. W. Presbrey, New York, N. Y. App. filed May 19, 1908. Made up of soft iron pole cheeks arranged about a common axis, a soft iron laminated core between the cheeks secured by a screw extending between the cheeks and core.

934,225. FIRE AND TEMPERATURE ALARM OR INDICATOR; C. Smith, South Croydon, England. App. filed Sept. 11, 1908. An automatic alarm in which the burning of a cord permits a weight to drop and close the circuit.

934,232. CONTROLLER HANDLE; E. W. Stull, Norwood, Ohio. App. filed June 22, 1905. Controller handle carries a pawl and a notched member with which the pawl engages with means for causing the pawl to engage one of the notches when the handle is moved forward and releasing it when moved slightly backward, together with means for preventing the pawl from engaging the same notch when the handle is moved forward.

934,233. CONTROLLER HANDLE; E. W. Stull, Norwood, Ohio. App. filed June 22, 1905. See 934,232. A form of controller which can be moved forward at any desired rate of speed in case of an emergency.

934,236. PULL SOCKET; G. B. Thomas, Bridgeport, Conn. App. filed May 15, 1909. A rotary insulating block carries a switch mounted on a spindle, which spindle is operated by a cord so as to rotate the block.

934,255. WALL DISTRIBUTING RING FOR TELEPHONE CONSTRUCTIONS; J. H. Wilson, Rome, Ga. App. filed Dec. 2, 1908. For carrying wires from cable terminals to subscribers' stations, consisting of a ring for holding the cables made of a bent piece of wire, one end provided with a screw to screw into the wall and the other with a loop to carry the cable.

934,256. DYNAMO-ELECTRIC MACHINE; A. H. Wouters, Norwood, Ohio. App. filed March 1, 1907. The stator winding of a multipole polyphase alternating-current machine has connectors for certain of the coils made of arc shaped strap conductors side by side, insulating members between the conductors and axial bolts for securing the parts together.

934,278. METHOD OF MANUFACTURING NICKEL AND NICKEL-COPPER ALLOYS; David Henry Browne, Copper Cliff, Ontario. App. filed Feb. 11, 1909. Fuses sulphur compounds of nickel by electric heat in the presence of lime.

934,281. AUTOMATIC TEMPERATURE INDICATOR; W. E. Campbell, Chester, S. C. App. filed April 14, 1909. For exposed water pipes to prevent freezing in which a contractable wire closes the circuit at certain temperatures to give an alarm.

934,284. ELECTRIC SIGNALING DEVICE; R. V. Cheatham, St. Matthews, Ky. App. filed March 31, 1908. A warning signal for tracks on railways operated by an electromagnet and having a time movement for automatically interrupting the signal-operating circuit after a predetermined interval.

934,296. TUNER FOR WIRELESS TELEGRAPHY; H. Dunwoody, United States Army. App. filed July 5, 1907. Combines a plurality of pairs of coils with an aerial, one pair slidingly and the other angularly adjusted, relatively to the other, the number of turns remaining constant.

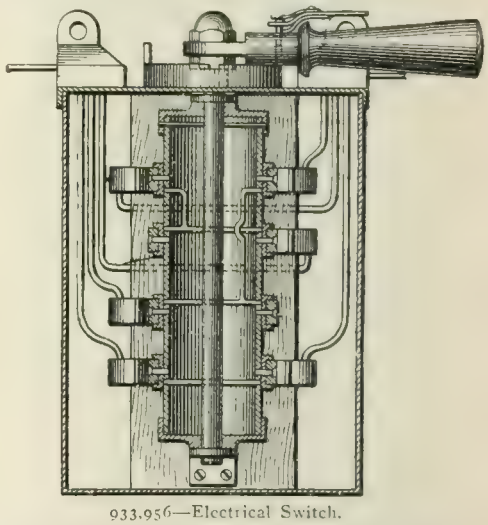
934,298. OUTLET BOX; T. J. Fagen and Samuel C. Thomason, Baltimore, Md. App. filed Sept. 25, 1908. The casing is formed of sections with a central collar within the casing and openings in its walls.

934,301. CONTROLLING DEVICE FOR ELECTRIC MOTORS; E. H. Geist, Cologne, Germany. App. filed Nov. 16, 1908. For cranes in which a field winding on the generator is in series with the armature, the armature of the motor to be regulated being in series with the generator armature. Uses a shunt field on the generator, a switch and connections for throwing the field and armature circuits of the generator into circuit and for inserting and removing the resistances from the circuit of the second field.

934,352. LINE WIRE CONNECTOR; J. S. Pratt, United Sates Army. App. filed Nov. 24, 1908. Comprises a curved strip providing terminal hooks with a lateral rib on the curved portion of the strip.

934,369. VENTILATING PLATE AND SPACER FOR ELECTRIC APPARATUS; H. D. Summers, Wilkinsburg, Pa. App. filed Oct. 24, 1906. The plate has oblong holes and carries ribs projecting from the sides of the plate to produce the spacing and ventilating action.

934,379. PROCESS OF PRODUCING CALCIUM SILICID; T. L. Willson and M. Hadd, Ottawa, Canada. App. filed April 2, 1909. Subjects calcium carbon, silica and carbon to an electric arc.



933,956—Electrical Switch.

934,385. APPARATUS FOR ELECTROLYSIS OF ALKALI CHLORIDS; J. Billitzer, Vienna, Austria-Hungary. App. filed June 17, 1908. Arranges an anode above a cathode horizontally with a horizontal diaphragm between them, thus forming layers and diminishing the density of the anode solution. Causes the lower heavier layer to flow out by means of a dam.

934,390. OVERLOAD AND REVERSE CURRENT RELAY DEVICE; F. Conrad, Swissvale, Pa. App. filed Oct. 24, 1906. A relay operated by a reversal of the drop of potential or when the current exceeds a certain amount. It consists of a magnetizable core having a yoke and polar faces adjacent to the conducting member, a magnetizing winding located on the yoke of the core, with a second winding located on the yoke, and a third winding located on the polar extremities of the core, the last named being supplied with a voltage proportional to that of the supply circuit.

934,391. OVERLOAD AND REVERSE CURRENT RELAY DEVICE; F. Conrad, Swissvale, Pa. App. filed March 15, 1909. See 934,390. Combines a movable conducting member, a magnetizable core having a yoke and pole pieces, a winding located on the yoke of the core, a winding surrounding the reduced portions of the pole pieces and closed-circuit windings surrounding the pole-piece projections.

934,396. SIGNAL BELL; H. W. Eden, Detroit, Mich. App. filed Dec. 7, 1908. A frame for electric bells by means of which the spool may be interchanged with either of two varieties of bell brackets. Combines a pair of spools with independent frame members.

934,405. DYNAMO-ELECTRIC MACHINE; L. J. Hunt, Sandycroft, near Chester, England. App. filed May 20, 1907. Combines upon a single stator and rotor the windings of an induction motor and those of an alternating-current commutator motor, which may be either a series motor, a repulsion motor or a series repulsion motor.

934,421. INDICATOR FOR SWITCHES; C. A. Clark, Hartford, Conn. App. filed Sept. 21, 1908. An indicator for switches of the snap switch type, so as to visually indicate the position of the switch. Details.

13,020. APPARATUS FOR REFINING COPPER; F. L. Antisell, New York, N. Y. App. filed April 3, 1908. For electrolytically refining copper and saving the silver, by providing a diaphragm suspended in the electrolyte with a removable wooden panel carried by the frame. (Reissue.)

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This is the last issue of *Electrical World* with which it will be my privilege to be associated as an editor of the journal; and on Oct. 1 I take up new duties as executive secretary of the National Electric Light Association. The severance of the relationship with the component papers, which has endured from before the first issue of *Electrical World* in 1883, is not made without deep regret. My connection with electrical journalism, dating back to its very beginnings, has given me the opportunity to aid in upbuilding the great modern arts and industries based on electrical energy, and to assist in developing certain ideals of public service. There never was a time when the loss of any individual personality could have less effect upon the standing of *Electrical World* as the great organ of electrical development in America. The paper has enjoyed the direction of many brilliant men, but its staff was never so large, so competent, so experienced as now; while the proprietors were never more jealous of the place won by this publication for impartiality, promptness, and representative contact with the entire field of readers and advertisers. Many who read this farewell know that from time to time flattering inducements have been addressed to me from other lines of occupation. Gratifying as they were, in none of them did I hear the call of duty until now; and in the service of the National Electric Light Association I can employ to the full whatever of constructive skill and driving power yet remains to me. The Association, about to enter on its second quarter century, has reached a point of splendid growth, where the care of its numerous membership and the study of its wide variety of industrial and corporate aspects might well appeal to any man's ambition. Bringing to bear upon these matters the experience given me on *Electrical World*, I hope to be worthy of the selection made. The many letters of goodwill that have reached me recently are hereby acknowledged with profound thanks as further evidences of the confidence of the leaders in the art, whose friendship toward the paper has ever been recognized as a valuable asset, and whose continued esteem I hope to merit in my new sphere of labor.

T. C. Martin.

The End of a Would-Be Reform.

The so-called Daylight Saving Bill, which has been a source of international merriment for the past year or so, has again been turned down by the Parliamentary committee to which it had been solemnly referred. The similar effort in our own country has also been quite effectively buried and the chances are that the whole subject will be soon forgotten like many another queer scheme that has been brought forward by owlish

reformers. It is not, of course, the idea of utilizing daylight that amuses one, but the notion of legislating people out of their ordinary modes of life. It is like passing a law that everybody must get up at 5:30 a. m. and breakfast at 6:15 on near-cereal and bogus coffee. Anyone who wants to go in for daylight saving can do so now without any hindrance save that interposed by the Imperial Order of Kitchen Manipulators. An alarm clock can be purchased at anywhere from 99 cents to $1.37 which, if set upon an overturned tin pan, is guaranteed to arouse the ambitious Daylight Saver at dawn. He can then get his own breakfast, if the cook allows her kitchen to be disordered. This program should remove all danger of overeating. He can then take the first train to town, get into his building by a trivial bribe to the night watchman, climb 8 to 20 flights of stairs (capital exercise, this) and settle comfortably down to work in quiet if his is any ordinary professional career. There is not the slightest need of setting the clock ahead or struggling to get bills passed on the subject. Merely a little real individual initiative will turn the trick for anyone who feels that it is a sin to waste daylight. There is a small chance that the first experimenters would be run in as suspicious characters, but the police on the beat would soon come to know them and the reform could go on unimpeded.

Convention of the I. E. S.

From the report of the convention of the Illuminating Engineering Society, held in New York during the present week, as printed elsewhere in this issue, it will be noted that the papers and discussions proved to be of much interest and importance. The attendance at the sessions of this, the third, convention of the society was decreased rather than increased by the Hudson-Fulton celebration, with which it came in competition as an attraction for the members of the society. However, the registration of about 300 compares very favorably with that reported for many of the national bodies that have been in existence for a much longer period, and exceeds that of the recent Frontenac A. I. E. E. meeting. The program included a classic lecture by Dr. C. P. Steinmetz, together with 18 papers dealing with both the scientific and practical sides of illuminating engineering. Brief abstracts of these papers are to be found in this issue.

The profession must again record its debt to Mr. L. B. Marks for placing before the society much valuable practical data relating to illuminating engineering practice, while Dr. Louis Bell has rendered good service in giving a practical view of the types of shades and reflectors now in use. The paper by Mr. P. S. Millar calling attention to the confusion which exists in heterchromatic photometry justifies definite action in order to eliminate misunderstandings and misrepresentations when the merits of the various illuminants are discussed with reference to the color of the light produced. Glances into the past for ascertaining what to expect for the future are afforded in a paper by Dr. Angelo Simonini, while the imagination is carried along to the far distant future by a paper dealing with the light of the fire-fly presented by Drs. Ives and Coblentz. The fact that an output of 50 candles per watt is not theoretically beyond the range of possibility shows the immense improvements that may be introduced into present lighting methods wherein an output of one candle per watt is considered highly satisfactory

Movement of Magnetic Particles in a Magnetic Field.

In our issue of July 22 last, Professor Boleman described, in a communication to the editors, on page 204, a remarkable phenomenon relating to the movement of iron filings, and of iron disks, in a certain rotating magnetic field. We commented upon the matter in our editorial columns at the time, and offered an explanation for the curious observed behavior of these iron particles, based on magnetic hysteresis. In a communication to the editors, which appeared in our issue of Sept. 9 (page 622), Prof. C. W. Lange took exception to this explanation, and offered instead one based upon pure magnetic tractive forces, although in a subsequent communication printed on page 729 of Sept. 23 Prof. Lange expanded his suggestion to cover magnetic tractive forces on poles created and displaced by the last preceding rotating field-pole, thus introducing at least the influence of magnetic history. In this number appears, on page 788, a communication on the same phenomena, by Prof. H. J. De Laak. This communication attributes the behavior of the iron filings to yet another action, namely, to couples exerted on "elongated bodies" or little prisms of iron. It is interesting to notice how different appear the explanations that different observers have thus far offered for these curious movements. In fact, the original communication of Professor Boleman suggested that iron filings could be represented on an enlarged scale by buttons, or that filings behaved like little iron disks, whereas the explanation of Professor De Laak is apparently based upon the virtual behavior of iron filings as rods or ellipsoids, as distinguished from disks or spherical particles.

It is evident that more experimental or mathematical evidence must be adduced on these phenomena before we can have a consensus of opinion. Possibly the actions involved are mixed and do not lie entirely along any one line of explanation. At all events, there is room for interesting research on what looks at first sight like a very simple question, namely, why filings scattered over a wooden plate move with the rotating field of a polyphase stator when the plate is below but against the rotating field when the plate is above.

If iron sphericles are substituted for iron filings, and the phenomena disappear, it might be inferred that Professor De Laak's explanation of elongated bodies is the clue to the action. If, on the contrary, the phenomena persist with spherical particles, or iron shot, then some other cause would be indicated. The actions of eddy currents have to be watched and eliminated in such an inquiry, because various kinds of mechanical forces may be set up, as is well known, by the electromagnetic cross-sections of rotating magnetic fields and the eddy currents they may create. Certain facts are at hand to define the starting-point of such an investigation. It will be generally conceded that, in Professor Boleman's originally described experiment, the friction of the buttons with the horizontal plate has a very prominent influence on their behavior, for with the plate above the stator, the buttons roll against the movement of the field, but when a button is suspended by a thread, so as to take its gravitational pressure off the plate, it goes round with the field. Again, the forces involved are to be magnetic, without sensible assistance from eddy currents. Finally, pure magnetic tractions must be distinguished, in some way, from tractions which are displaced by hysteretic action or by the lagging of polar axes in

the particles behind the rotating line of magnetizing force. We hope the matter will be investigated by some of our readers and reported upon at a later date.

Dampers for Synchronous Machines.

The varous types of dampers that have been adopted or proposed for use with synchronous machines are interestingly discussed in an article by Mr. Warren H. Miller in this issue. While the performance of the squirrel-cage type of damper advocated by the author doubtless justifies his conclusions as to its merits, yet his course of reasoning appears to be at variance with the accepted electromagnetic relations applying. The implication that the m.m.f. of the wattless component of the armature current tends to distort the main field contradicts the well-established principle that it is the power component alone which causes distortion, the wattless component tending merely to increase or decrease the field magnetism. Moreover, it cannot be assumed that any damper can so act as to neutralize "the back ampere-turns due to strong armature reaction," for the reason that the only action of the damper is to oppose any rapid change in the flux which it surrounds, and this without any reference whatsoever to the absolute value of that flux, while the so-called "armature reaction" in a polyphase machine is the result of a m.m.f. of practically constant value and space-phase position.

During the normal operation of a generator at, say, 100 per cent power factor, and without hunting, the field-circuit m.m.f. tends to produce flux in line with the field poles, while the armature m.m.f. is directed along a line in electrical space-quadrature with the direction of the former m.m.f. The reluctance in line with the armature m.m.f. is relatively very high in comparison with that of the main magnetic circuit, so that very little flux is produced between the main field poles; the most pronounced result is a distortion, or shifting, of the main field flux across the pole faces. A change in the load on the generator without a variation in the power factor alters the amount of field distortion, while a change in the power factor of the load increases or decreases the actual value of the main field flux. During "hunting" there are rapid changes in both the power factor and the load. The so-called grid type of damper, being in such a position that opposing currents are produced in it by either a rapid shifting of the field flux or change in its value, tends to prevent any rapid change in the value or power factor of the load, and hence is of assistance in preventing hunting. When end-rings, or the equivalent, are used to interconnect the grid dampers on adjacent field poles, the damping effect is increased by reason of the currents produced in the end-ring circuits by the rapid change in the value of the magnetism between the field poles. As noted above, the reluctance of the path for this magnetism is relatively very high, so that the flux is small in value and the currents produced thereby are correspondingly weak. However, to the extent that any currents are produced in the end-ring circuits, their effect is exerted in the proper direction to prevent hunting. The combination of the end-rings with the grid dampers results in the squirrel-cage type of damper, which may well be considered somewhat more effective than the grid type, as pointed out by Mr. Miller. However, the advantage of the squirrel-cage type can be lost by an improper design of the circuits or can be overcome by the use of extra conductivity with the grid type.

The Kapp-Hopkinson Test on a Single Direct-Current Machine.

The August number of the *Journal* of the (British) Institution of Electrical Engineers contains a paper, by Dr. W. Lulofs, on the extension of the Hopkinson circulation of power test to a single direct-current machine. Hopkinson in 1886 brought out the method of measuring the efficiency of two similar machines by connecting them both mechanically and electrically, in such a manner that their two rotors formed a single joint rotor, one machine being over-excited to act as generator, while the other was under-excited to act as motor. The system was then driven mechanically by a small auxiliary prime-mover that mechanically supplied the joint power losses—that is, the losses were supplied through a transmission dynamometer. The generator could thus be operated at rated load on the motor, which was also operated at rated load, while the auxiliary power consumed might be from 30 to 10 per cent of the rated load according to the size of the machines. Later on, a test-motor, whose behavior was independently known, was substituted for the transmission dynamometer, and in this form the test is well known to-day. Kapp introduced, in 1890, the further simplification that the auxiliary machine supplying the power losses could be a generator instead of a motor, in which case all the powers measured were in terms of volts and amperes. More recently, the Hopkinson method has been applied to the testing of a single alternator by Behrend and Mordey, the windings of one and the same machine being divided into two groups having respective motor and generator characteristics, with the result that rated-load current could be supplied through the armature winding, while only the rated-load losses had to be supplied to the machine.

In the present paper, Dr. Lulofs takes a multipolar direct-current machine with a lap-wound multiple-path armature devoid of equalizing connections, and separates the positive and negative brushes into two groups, so as to make half of the armature act as a generator and the other half act as a motor. The required difference of behavior between the two armature portions is obtained by giving some of the field poles a preponderance of excitation over others. Certain precautions have to be taken to offset and allow for armature reaction and spurious losses due to power-circulation in armature coils. The method is ingenious, but appears to be rather complicated. Its limitations to multipolar machines capable of being divided up into two opposing halves are serious. For example, the method does not appear to be applicable to wave-wound or to series connected armatures, to cross-connected armatures, or to bipolar armatures. Whatever the practical limitations of the method may be, it seems to complete the series of Hopkinson tests, which now embrace not only pairs of direct or alternatory-current machines, including converters and transformers, but also single machines of each class, whenever the single machine permits of being divided against itself. In matters of statesmanship, the proverb has been "divide and govern"; but in matters Hopkinsonian, the proverb becomes "divide and load." There is something fascinating in the spectacle of two large machines, tied together Hopkinsonically, running under full load with the aid of a mere pigmy machine to keep them going. It is perhaps the nearest parallel to a man lifting himself by his own boot-straps that electrical machinery furnishes.

Niagara Falls Electric Power City Pumping Contract.

Last week a brief note was made of the recent contract between the city of Niagara Falls and the Niagara Falls Hydraulic Power Company for the supply of electric power for city pumping purposes. Below are given further details, which also account for the low rate under the contract for power, namely, $9 and $10 hp-year.

According to the contract the city transfers and releases to the Hydraulic Company all its power and water rights under two agreements, one dated Sept. 1, 1878, and the other dated Dec. 12, 1906. The first-mentioned agreement provided that the city may take and use water from the hydraulic canal for the purpose of developing power for the operation of the present pumping station, upon the lands upon which such station is located, for a period of 99 years, with the exception of 40 hp, the lease for which is for a period of 99 years from the first day of January, 1886. This water-power was to be furnished at $10 per horse-power per annum. The agreement of Dec. 12, 1906, is a lease of electric horse-power for the operation of the electrical power pumps at the present pumping station, at an annual rental of $16 per horse-power.

In consideration of the city releasing its power and water rights, the Hydraulic Company now agrees to furnish power for the operation of the new pumping station until Jan. 31, 1984, at the following terms and prices:

Eight hundred horse-power continuously at $9 per horse-power per annum. Fifteen hundred additional continuous horse-power as the same may be called for by the city, in blocks of not less than 50 hp at $10 per horse-power per annum. Emergency power, which is to be furnished only in the contingencies of fire, fire drills conducted by members of the fire department, or tests of water mains, fire hydrants, pumps, pumping station and electrical apparatus, to an amount equal to continuous power then being used and paid for by the city, at the rate of $10 per horse-power per annum. Power used in excess of the amount of continuous power purchased and paid for at any time by the city, which is designated "optional power," to be at the rate of $16 per horse-power per annum. Neither emergency power nor excess power is to be paid for unless the same is used continuously for a period of 10 minutes or more.

It is provided that in case any tax, fee, rental or charge shall be levied, assessed or imposed by Federal, State or other Governmental authority upon the development, generation, sale or transmission of power or the right thereto of said company, such proportion of such tax, rental or charge, as the amount of continuous power then being purchased and paid for by the city, bears to the total amount of power developed by the Hydraulic Company, shall be added to the price of continuous power and paid by the city as a part thereof.

The city also agrees to maintain its mains in the private right-of-way along the hydraulic canal basin during the term of this contract, and to allow the Hydraulic Company and its tenants on the canal basin the use of water for the purposes of protection against fire, without charges, as specified in an agreement between the city and the Hydraulic Company and its tenants, dated Oct. 30, 1894, which agreement is continued in force until Dec. 31, 1984.

The city also agrees to supply water to the private water-pumping system maintained by the Hydraulic Company having a rated capacity of 200 gal. per minute, in case of accident or temporary shut-down of such private system, without charge, up to 5,000,000 in any calendar year, beginning Jan. 1, 1910, and at usual rates for any excess over said amount in any calendar year.

The city agrees to construct and maintain all apparatus, cables and machinery necessary to take electrical power from the point of delivery to the premises where the city shall use the same. The contract provides for arbitration in the event of disputes or misunderstandings between the parties. Finally, the premises on which the present pumping station is located is to be transferred to the Hydraulic Company for the sum of $20,000.

As will be seen from the foregoing, the contract gives valuable considerations to the Hydraulic Company in return for the low rate for power accorded.

Change in Chairmanship of Accounting Committee.

Mr. H. M. Edwards, auditor of the New York Edison Company, has resigned as chairman of the accounting committee of the National Electric Light Association and is succeeded in this position by Mr. John L. Bailey, treasurer of the Consolidated Gas, Electric Light & Power Company, of Baltimore. Mr. Edwards withdrew from the office of chairman because of the pressure of other duties and the feeling that he had devoted three years to the position and also because of a desire that others should be active in the work; he continues, however, as a member of the committee.

Under the chairmanship of Mr. Edwards the committee presented reports at the Washington, Chicago and Atlantic City conventions, held during the years 1907 to 1909 inclusive. There had not been a committee for several years previously to consider the accounting problems, and meager attention had been paid in the proceedings to questions of this nature. At the 1908 convention the committee presented a classification of operating accounts, which is the standard classification of the association. A classification of capital accounts was presented at the 1909 convention and has since been adopted by the executive committee. Permanent organization for the accountants has been effected by the creation of an accounting section of the association. The committee is recognized by the New York Public Service Commissions in the interpretations of the classification of accounts prescribed by the commissions.

Baltimore Electric Service Contract Controversy.

A large crowd of representative men met in the First Branch City Council Chamber, of Baltimore, Md., last Friday afternoon, to voice their objections to the "electric clause" of the natural gas ordinance, which is now the question of the day in that city. The hearing took place before a committee representing both branches of the Council, and many of the men who addressed the meeting claimed that they echoed the sentiments of the various improvement associations throughout the city. The portion of the clause which is arousing the most contention is as follows: "That during the period aforesaid (20 years) the Consolidated Gas, Electric Light & Power Company, of Baltimore, shall have the right to sell electricity at the rates established by it as shown in the schedule published by it under date of March 1, 1909, as filed with the superintendent of city lamps and lighting of the city of Baltimore and with the chief engineer of the City Electrical Commission and such amendments thereto as may have been made; provided, that if at any time during said period any of the rates for electricity as established and filed by the company as aforesaid or as the same may be adjusted under the terms hereof, for any of its various classes and conditions of service, shall be found to be higher than the average of the scheduled rates in force Jan. 1 of the current year, for the same class and conditions of service in the 10 cities of largest population of the United States, exclusive of Baltimore, adjusted to similar manufacturing conditions, then and in that event, the said company shall adjust its said rate or rates the average as aforesaid, but shall have the right to adjust its rates for its various other conditions and classes of service, so as to make all of such rates for electricity not higher than the average of the scheduled rates in force Jan. 1 of the current year, for the like classes and conditions of service in the said 10 cities, adjusted to similar manufacturing conditions. Nothing in this section shall prevent the company from at any time re-

vising its various rates for electricity, fixed as aforesaid, so that said rates shall be as high as the average of the scheduled rates for the same classes and conditions of service, in the 10 cities of largest population in the United States, exclusive of Baltimore, adjusted to similar manufacturing conditions. All adjustments made under this section shall be effective on and after the date when filed as aforesaid."

The Consolidated Gas, Electric Light & Power Company has spared no effort in convincing the public of the advantages that would attend the introduction of natural gas; and just as the ordinance is gaining in public favor, strong opposition has developed in connection with the clause quoted above. It will be noticed that this clause stipulated that the company shall have a 20-year contract from the city to furnish energy at the same rate which it is now charging; but should the average rate in 10 of our largest cities be at any time less than that which is being paid in Baltimore, then the company agrees to reduce its charges to meet those of the other cities. Again, if the company can bring the rate down to a still lower figure owing to lower manufacturing conditions, or by reason of new inventions or any other cause, then it is compelled to do so. Thus, the city would not be tied up for a period of 20 years to a definite rate, but the prices would adjust themselves in the satisfactory manner just noted.

The phrase in the electric clause concerning which there is greatest discussion is "like manufacturing conditions," and the meaning of these three words has been the bone of contention ever since the ordinance was first introduced. The controversy has caused the creation of a public utility commission to be brought forward, and the authorization of such a body may be made the subject of continued agitation.

In reply to those who hold that the provisions of the ordinance are complicated, it is pointed out that these provisions are all subject to the interpretation of a board of three engineers, only one of whom represents the company; on the particular clause here considered, and over which there has been so much discussion, this board will alone act, and as the company is only represented thereon by one member, it is pointed out that no possible unfair advantage of the clause can be taken.

Control of Worcester (Mass.) Electric Light Company Sought.

It is reported that an active campaign is under way in Massachusetts to secure the control of the Worcester Electric Light Company, which serves the second largest city in the State, and which has long had a high reputation as a prosperous central-station organization. Stone & Webster, of Boston, have sent out a message to all the stockholders of the company through Kinsley & Adams, brokers, of Worcester, offering $300 per share. The company is capitalized for $800,000, and the stock is quoted at $250 per share, very little of it being on sale in the open market. The company belongs in the 8 per cent to 10 per cent dividend class. In opposition to the offer of the Stone & Webster interests several of the largest stockholders of the company have sent out circulars announcing the formation of a holding company to keep the control in the city of Worcester. The holding company is to be named the Worcester Electric Securities Company, and the trustees of it offer $100 a share cash and two shares of the stock of the holding company, par value $100, for each share of the present electric light stock, the new stock to pay 5 per cent dividend. The capital of the holding company is set at $2,000,000. The interests that propose to keep the control of the company in Worcester claim to have in hand stock to the amount of $350,000, and are represented by Lincoln N. Kinnicutt, William E. Rice, Homer Gage, Charles M. Thayer, Frank A. Drury, T. Hovey Gage, Alexander H. Bullock and C. Henry Hutchins, of Worcester, and J. G. White, of New York. They announce that their intention is to give cheaper rates and to change entirely the policy of the company from the commercial standpoint.

On Sept. 27 President A. B. R. Sprague sent a letter to each stockholder urging that the holding company plan be rejected as untrustworthy. He pointed out the strong financial position of the company as evidenced by its record and the high prices offered for the stock, and stated that the company has always been well managed and now has large plans for expansion, its rates for both lighting and power comparing favorably with those of any other similarly situated central station. He stated that the disposition of the company's future rests with the stockholders, but that if any one of the offers is accepted that of Stone & Webster is the most desirable. The latest news indicates that the stockholders are in no haste to dispose of their much-desired securities.

Edison Cement Plant Visited by Baltimoreans.

A large party of Baltimoreans, including several city officials, journeyed to Trenton, N. J., last week and inspected the big plant of the Edison Portland Cement Company at Phillipsburg, which is operated entirely by electricity. The trip was arranged by the company for the purpose of showing the operation of its plant to city officials and those in the building and construction business in Baltimore, Washington and Philadelphia. In all there were about 325 in the party, which traveled in a special train from Philadelphia to Trenton and return, the train being run directly into the plant. Luncheon was served on the train and at the mill, where the party had the pleasure of meeting Mr. Thomas A. Edison, who made a witty speech of welcome, and wrote his autograph for each of his guests. The great use of electric power in the plant was particularly interesting to Baltimoreans in view of the present discussion there of the electric ordinance now before the City Council. The party saw great boulders of rock taken from the quarry, passed into the mill at one end and come out as cement at the other end. Each man was given a linen duster and cap as he entered the mill, and the costuming proved to be a source of endless merriment to the visitors. The city officials in the party were City Comptroller Harry F. Hooper, Mr. George M. Munson, president of Second Branch City Council; and all of the commissioners for opening of streets. The Builders' Exchange, of Baltimore, was also well represented in the party.

Illinois Central Electrification Progress.

For a long time the engineering department of the Illinois Central Railway has been engaged in studying the problem of the electrification of this company's tracks within the city of Chicago and the nearby suburban district. As the result of this study Mr. L. C. Fritch, consulting engineer of the Illinois Central Railroad, has just issued a preliminary report to the special commission appointed by the city to look after the suppression of the smoke nuisance. No definite announcements regarding electrification have, however, been made by the Illinois Central Railroad to the city commission, and it should be understood that the plans submitted so far are only tentative, because decisions on the method of generation and distribution of power and on the choice of motive-power equipment have not been made.

The present track facilities of the Illinois Central Railroad within the city and suburban district include eight tracks from Randolph Street to Sixty-seventh Street, 8.5 route-miles; six tracks from Sixty-seventh Street to Kensington, 6.5 route-miles; four tracks from Kensington to Riverdale, 2 route-miles, and two tracks from Riverdale to Flossmoor, 8 miles. The foregoing trackage comprises the main trunk line of the Illinois Central Railroad from its northern terminus in Chicago to the southern end of the suburban district. In addition to this trackage there are three branch lines also to be considered for electrification—the single-track line from Kensington to Blue Island, four miles; the double-track line from Sixty-seventh Street to South Chicago, five miles, and the double-track Omaha division from the Park Row station to Hawthorne, eight miles. The completion of the electrification project would include the re-

arrangement of the track system and the redistribution of local and express suburban trains and through freight and passenger trains. This work would require the reconstruction of the switching yards at the downtown terminal and south of Sixty-seventh Street. Suggested plans for carrying on the work of electrification progressively are as follows:

First, electrifying the local suburban district from Randolph Street to Sixty-third Street without rearranging the tracks, and, second, the following plans, which would require the rearrangement of tracks:

1. Local suburban service from Randolph Street to Sixty-third Street. 2. Local and express suburban service to Sixty-seventh Street and on the South Chicago branch. 3. Local and express suburban service to Kensington, South Chicago and Blue Island. 4. Local and express suburban service to Flossmoor, South Chicago and Blue Island, and through passenger service to Burnside. 5. Extension of electric service to freight trains to Burnside and all service to Hawthorne and in the Chicago switch yards. 6. Complete electrification for all service to Riverdale, South Chicago, Blue Island and Hawthorne; electrification for passenger service to Flossmoor.

At the present time the Illinois Central Railroad operates about 250 scheduled trains in and out of Chicago daily. With the electrification project completed it is tentatively estimated that the number of trains operated daily would be approximately as follows:

Suburban trains (proposed schedule)	396
Through passenger	82
Freight trains	190
Switching movements (estimated)	400
Total train movements daily	1,068

According to present estimates the daily ton-mileage of these trains will be as follows:

Suburban trains (proposed schedule)	895,440
Through passenger trains	431,610
Freight trains	1,789,776
Switching service	1,915,800
Total ton-mileage daily	5,032,626

The city commission was furnished with estimates for the maximum hourly demand on the power station which would be required for the six successive stages in the electrification work. The train service for the electrified local suburban tracks between Randolph and Sixty-third Streets is estimated to have a maximum hourly demand on the power station of 3500 kw and the complete electrified terminal to have a maximum hourly demand on the power station of 20,000 kw.

Details are not available regarding the motive-power equipment proposed and the method of power distribution. A map of the territory under consideration submitted to the city commission shows a tentative plan for the use of direct current delivered to the cars over a third rail. This power distribution arrangement includes six substations fed with high-tension current carried for the greater part of the way in conduit laid between the tracks and partly on a steel-pole aerial line. Supplementary feeders are carried similarly. The South Chicago and Blue Island branches are shown on the map to be operated with bracket-supported trolley lines.

New Interurban Railway Near Chicago.

The Chicago, Wheaton & Western Railway Company has just opened to traffic a portion of its line, four miles in length, extending from Pleasant Hill to West Chicago, in Du Page County, Illinois. The road is being extended to Geneva, Ill., on the Fox River, and the whole line will be 10 miles long. At Pleasant Hill it forms a connection with the Elgin branch of the Aurora, Elgin & Chicago Railway, and at Geneva it will connect with the Fox River division of the same electric railway system. It is expected that the complete line will be in operation by Nov. 1. The Aurora, Elgin & Chicago Railroad Company is operating the new road, and on its completion to Geneva through cars will be run from that city direct to the center of Chicago, passing through West Chicago, Pleasant Hill, Wheaton, Lombard and Elmhurst. The new road is operated by means of a third-rail, and is substantial and well built. Over the Fox River, at Geneva, there will be a seven-span reinforced-concrete bridge 50 ft. wide and 500 ft. long. At West Chicago, over the Elgin, Joliet & Eastern and Chicago & Northwestern steam railroads there is a steel through-truss bridge with two spans, each 126 ft. long. There are three cars, uniform with those used on the Aurora, Elgin & Chicago, now in operation on the completed portion of the new road, and they meet all trains at the Pleasant Hill junction with the older interurban system. The officers of the Chicago, Wheaton & Western Railway Company are: President, Mr. H. C. Wood; secretary, Mr. J. Sidney Condit; treasurer, Mr. W. F. McSwiney; chief engineer, Mr. I. W. Troxel. The office of the company is at 711 Rookery, Chicago.

Boston Edison Company's Annual Report.

Brief reference was made in the issue of Sept. 16, 1909, page 652, to the return of the Edison Electric Illuminating Company, of Boston, as filed with the Massachusetts Gas and Electric Light Commission for the year ending June 30, 1909. The following additional facts are of interest in connection with the operations of this company, which is much the largest central-station organization in New England.

The total capitalization of the company was 136,034 shares outstanding June 30, 1909, amounting to $13,603,400 at a par value of $100. The latest issue of stock was 9598 shares, offered to stockholders Dec. 18, 1908, at a price of $215 per share as approved by the Board of Gas and Electric Light Commissioners in 1907. There are 3295 stockholders.

In the year covered by the return the company supplied electricity to 23,588 customers in the districts of Boston, Milton, Dedham, Natick, Framingham, Somerville, Woburn and Medfield. In Boston proper there were 16,849 customers. The total cost of entire plant to June 30 was $22,158,254.22, there being additions of $1,536,432.44 to the property during the year. The principal items of addition were steam plant, approximately $423,000; electric plant, about $364,000; underground lines, approximately $240,000; lines, about $229,000, and buildings, about $125,000. The company's investment in plant June 30, 1909, was made up as shown in Table I, the largest item being underground lines, with buildings, electric plant and steam plant each about the same for second place in the investment.

TABLE I.—COST OF PLANT, JUNE 30, 1909.

Land	$1,372,821.97
Buildings	3,796,391.08
Steam plant	3,582,900.06
Electric plant	3,650,787.90
Lines	2,552,884.17
Underground lines	5,838,206.63
Transformers	292,556.50
Meters	748,903.03
Arc lamps	322,802.88
Total	$22,158,254.22

The cost of the plant was over $6,000,000 more than its total capital and loans. An interesting point in the itemized list of plant cost is a reduction of about $1,700 in the arc-lamp investment during the year.

The total energy manufactured during the year was 90,877,123 kw-hours, compared with 88,535,490 kw-hours in the preceding year. The cost of production is shown in Table II, exclusive of fixed charges.

TABLE II.—COST OF MANUFACTURE, YEAR ENDING JUNE 30, 1909.

Fuel	$346,660.06
Rentals of real estate	22,049.55
Oil and waste	5,257.78
Water	19,544.19
Wages at stations	170,686.10
Station repairs	10,137.26
Steam plant repairs	58,466.16
Electric plant repairs	48,120.47
Total	$680,921.57

The net cost of manufacture per kw-hour was 0.75 cent, compared with 0.822 cent in 1908. Continued improvement in the handling of the system is evident in the saving of nearly $50,000 in manufacturing expense with an increase of over 2.3 million kw-hours generated.

The total output sold is given in Table III:

TABLE III.—SUBDIVISION OF ENERGY SALES.

	Kw-hours.
Street lighting sales, estimated	8,052,307
Light and power by meter	35,464,748
Power only, by meter	12,129,804
Railways, by meter	907,370
Other companies, by meter	5,623,089
Total	62,177,318

Compared with the preceding year, the total sales increased by about 1,400,000 kw-hours, the principal gain being about 1,000,000 kw-hours in power sales.

The company's cost of distribution for the year was $432,048.09, or 0.695 cent per kw-hour sold. The details are shown in Table IV:

TABLE IV.—COST OF DISTRIBUTION.

Wages for linemen, care of lights, clerical labor in this department, salary or commission of collectors	$10,388.93
Repairs and renewals of lines	187,739.38
Repairs and renewals of meters, lamps and motors	41,497.55
Carbons	40,117.31
Incandescent lamps	152,304.92
Total	$432,048.09

The distribution cost per kw-hour sold was substantially the same as in 1908, and the ratio of kw-hours sold to manufacturers was practically the same, 68.5 per cent.

During the year the company burned 95,350 tons of bituminous coal costing $3.63 per ton. There was a saving of about $60,000 in coal cost during the year as compared with 1908. The maximum load was 36,324 kw, occurring on Dec. 22, 1908. The average number of men employed was 895, against 887 in 1908. The subdivision of employees was as follows: Generating steam division, 120; electric generating division, 104; distribution department, 292; offices and supply department, 287; construction department, 34; transportation department, 28; laboratory, 21; steam-heating service, 9. During the year there was a reduction in the steam-generating force of 16 men, due probably to the increasing use of very large turbo-alternators at the L Street station.

The company's income for the year is shown in Table V.

TABLE V.—INCOME.

Lighting	$2,753,854.87
Public street arc lights	402,889.96
Public street incandescents	100,971.03
Electric power for railways	57,008.43
Electric power for other uses	636,508.39
Energy sold other companies	160,110.02
Total	$4,111,342.70

On account of a 20 per cent rate reduction the income for 1909 fell below that for 1909 by about $118,000. The expenditures for the year 1909 were as shown in Table VI.

TABLE VI.—EXPENSES.

Manufacture	$680,921.57
Purchased electricity	498.27
Distribution	432,048.09
Office expenses and management	433,105.35
Miscellaneous, taxes, insurance, legal, etc	1,219,456.01
Total	$2,766,029.29

The company declared dividends of $1,424,389 during the year.

The equipment on June 30 had a total steam-generating capacity of 89,500 engine and turbine horse-power, the largest unit being a 16,000-hp Curtis turbine, located at the L Street station. Five turbines and 24 engines are listed, and there were installed 73 boilers having an aggregate rating of 33,889 hp. Practically all the apparatus in service is of the direct-connected type.

The total incandescent lamps (16-cp equivalents) installed on the company's circuits were 1,040,713 on June 30. There were 10 storage batteries, having a total rating of 50,740 amp on the one-hour discharge rate, all but one of these batteries having from 140 to 150 cells, the exception being an exciter battery of 82 cells and 1000-amp capacity on the one-hour rate located at the L Street station. There were 1626 direct-current arc lamps operated on overhead lines, 1075 arc lamps on alternating-current lines, 4300 arc lamps on Edison underground-tube lines and 1964 arc lamps on other underground lines. On June 30 there were 27,466 meters in use.

The total amount of wire on the system was 18,133,570 ft., the principal sizes used being Nos. 4, 6 and 0 B. & S. There were 2114 transformers on the system on June 30, the 20-light size being the most commonly used. The company had 26,641 poles set in streets or public ways and 2593 poles set elsewhere. The total length in streets or public ways occupied by overhead lines was 3,175,495 ft. There were 517,898 ft. of conduits installed on June 30, including 5,981,083 ft. of cable.

Change in Boston Elevated Power System.

The Boston Elevated Railway Company has begun to build a substation in the Forest Hills district of the city of Boston, for use in connection with the opening of the new elevated line from Dudley Street. It will be supplied with current from a turbo-alternator at the company's Dorchester power station and will contain the usual complement of step-down transformers and rotaries. This equipment will be the first alternating-current apparatus ever supplied from a power plant of the Boston Elevated system, the service having been exclusively direct current from scattered stations of high economy in the past, with the exception of a small amount of energy which has been purchased from central stations in times of emergency and extra heavy load. It is probable that as the Boston system expands, the use of alternating-current transmission will become more necessary, and the initial installation will be watched with interest. The turbo set will be rebuilt for alternating service at Dorchester, several years of experiment with a 2000-kw, direct-current turbine having indicated little success with the latter apparatus in railway work.

Completion of Chicago Quarry Street Station.

There is no end to the extensions of the generating equipment of the Commonwealth Edison Company, Chicago. Hardly has the first half of the new Quarry Street station, across the South Branch of the Chicago River from the Fisk Street station, been completed before work is under way to build the remaining half of the plant as originally planned. Plans described in the illustrated article describing this station, published in these columns in the issue of Jan. 2, 1909, will be followed out in the completion of the station. The finished building will be 463 ft. long and 208 ft. wide. The portion now in service is something over half of this and the new portion will be about 200 ft. x 208 ft. In the finished structure there will be six 14,000-kw turbo-alternators, and three of these are now in use. Figures are now being taken from contractors for the erection of the extension, and it is expected that the first of the three additional units will be placed in service early next summer.

In the Fisk Street station there are now 10 turbo-alternators in service with an aggregate maximum rating of 120,000 kw. The present rating of the adjacent Quarry Street station is 42,000 kw, making a total of 162,000 kw for the two plants at the present time. When the Quarry Street station is extended to its ultimate capacity, as designed, it will have a rating of 84,000 kw, which will bring the aggregate of the two stations, probably before the close of next year, to 204,000 kw. It is likely that the next step in the extension will be the completion of the Fisk Street station to its maximum capacity of 14 units, which will bring the rating of that station up to 168,000 kw, and when that is done, the two stations will have a combined rating of 252,000 kw.

Edison Power Improving Trolley Service Near Boston.

The recent purchase of power from the Edison Electric Illuminating Company of Boston by various trolley lines in the western suburban district has resulted in a decided improvement in the service. The Boston Suburban Electric Companies organization operates electric railway lines extending from the Newton-Waltham district westward to South Framingham and vicinity, and until recently the power supply has been derived

from a number of separate stations located at convenient points in the territory. Among these stations were the Homer Street plant at Newtonville, the plant of the Waltham Gas Light Company at Waltham, a station at Lexington, and another at South Framingham. The South Framingham and Homer Street plants were of antiquated design, but were necessarily operated on account of the layout of the system and the difficulty of furnishing power over long distances from the other and more modern stations. A few weeks ago it was decided to purchase energy from the Boston Edison Company, an equipment of rotary converters being installed in the Natick substation of the latter organization. The old plant at South Framingham was then shut down, being practically worn out as it stood, and immediately the improvements in the current supply were evident. There were a number of motors burned out before the motormen became used to the steady power on grades. In the Natick district the maintenance of normal line voltage under load has resulted in a much better movement of the cars, and it is proposed to discontinue the Homer Street station before it wears out on account of the high quality and efficiency of the Edison service. This station feeds one of the most important lines of the railway system, running from the Chestnut Hill terminus of the Boston Elevated Railway Company through the Commonwealth Avenue Boulevard to Norumbega Park and Riverside. It is probable that the Edison service will be still further extended on the Boston Suburban Electric lines within the near future. A substation will soon be built in Hopkinton for applying Edison service to the local trolley lines. By the terms of a recent consolidation, the Waltham station is now Edison property, and it is probable that it will be utilized in part for railway supply on the northern lines of the Suburban system. The bulk of the energy, however, is drawn from the main L Street generating plant of the Edison Company.

Development of a Suburban Electric-Service System.

Mr. George H. Lukes, general superintendent of the North Shore Electric Company, was the speaker at the regular weekly luncheon of the Electric Club, of Chicago, on Sept. 22. His subject was: "The Development of a Suburban Electric Light and Power System." He remarked on the number of families moving from the city to the suburbs in the vicinity of Chicago, and said that as these people were accustomed to city conveniences, it followed that there was a demand for electricity for lighting and other purposes in the suburban towns. The North Shore Electric Company was organized seven years ago by Mr. Samuel Insull and his associates. Mr. Insull had been impressed with the advantages of consolidating the electrical utilities over a considerable area, as demonstrated in England and elsewhere. He thought that the suburban territory around Chicago offered an opportunity for such a district electrical system, and the event has proved that he was right.

About 12 small central-station properties belonging to existing companies were purchased by the North Shore Company. These companies had been established and were owned by local people, as a rule, who were not familiar with the characteristics of central-station electrical supply, thinking that the business was subject to the same laws as an ordinary mercantile establishment, which is not the case, as experienced plant managers are well aware. The men in charge discovered that it was difficult to secure money to make necessary improvements, and as a result the properties depreciated and needed extensions were not made. The 12 plants were of the most diverse types, and if a dynamo had been taken from each one of them and preserved the collection would make the nucleus for an interesting electrical museum.

In the rehabilitation process undertaken by the new owner uniformity was necessary, and the first two or three years were devoted to designing and installing a standard system of distribution. Old transformers by the carload were taken out and larger and more modern ones were substituted. Uniform equipment for distribution on modern lines was developed, and the 60-cycle, four-wire, three-phase system was adopted as standard. The territory covered by the company was divided into three divisions. The northern division extends north from Chicago to Waukegan and northwest to Park Ridge; the western division extends west from the city limits to Elmhurst and southwest to LaGrange; the southern division lies south of the city proper and extends to Chicago Heights and Harvey. Single-phase distribution is used for lighting and small motors.

A modern generating plant was built in each of the three divisions. The northern station is at Waukegan, the western plant at Maywood and the southern one at Blue Island. In addition, the existing plant in Evanston in the northern division was retained and improved, being operated in connection with a district heating system. The new generating plants are of the most modern description, with water-tube boilers, automatic stokers and steam turbines. They supply electricity to centers of distribution by means of transmission lines designed for operation at 20,000 volts to 25,000 volts, but temporarily in service at 11,000 volts. There are three substations in the northern division, one in the western division and two in the southern division. Each substation receives a supply of electricity from at least two possible sources, one of these ordinarily being a connection with the network of the Commonwealth Edison Company of Chicago. In LaGrange the substation supplies electric energy for operating the local water works, and here there is a steam reserve, but it is very seldom used. In the southern division, in addition to the Edison relay, there are two duplicate transmission lines from the generating station to the substations.

A more rapid growth has distinguished the electric service in the suburban area than in the city of Chicago proper. Six years ago, when the North Shore Electric Company entered upon its campaign, it had 4000 customers, and now it has 14,000 The present generating capacity is about 14,800 kw. There is a considerable railway load. The Chicago Southern Traction Company, operating the interurban line to Kankakee on the south, takes all its electrical energy from the North Shore Electric Company, and the Chicago & Milwaukee Electric Railroad Company, operating between Evanston and Milwaukee, on the north, takes 2000 kw. The combination of a railway load and a lighting and power load helps the load factor materially, and also assists in effecting economies due to the great increase of output. The load factor of the North Shore system varies, in various localities, from 25 to 50 per cent.

The territory covered by the North Shore Electric Company surrounds Chicago on all sides. Its extreme length from north to south is 65 miles, and its extreme width 22 miles. The area served is about 600 square miles, although, of course, there are considerable portions of this district which are not as yet reached by the company's lines. The estimated population of the area is 150,000, and the number of inhabitants is increasing very rapidly—more rapidly, in fact, than in the city of Chicago itself. Mr. Lukes recalled a statement made by Mr. D. W. Roper, of the Commonwealth Edison Company, in a recent address before the Electric Club, in which that gentleman said that in a distance of half a mile on State Street the maximum consumption of electricity was 5000 kw. Contrasted with this, Mr. Lukes pointed out that the maximum load of the entire North Shore system was only about 5500 kw, so that nearly as much electricity is used in a distance of four or five blocks on State Street as in the entire territory of the suburban company. This fact, the speaker said, showed that it was manifestly impossible to sell electricity in suburban towns as cheaply as on State Street in Chicago. Nevertheless, the North Shore Company has about 1 customer in 10 out of the population in its area, while the Edison Company has only 1 in 20 in the city. The area of Chicago is about 190 square miles, and the density of the electric-service business is about 20 times as great in the city as in the suburban area. This condition is also an argument against the possibility of making rates as low in the suburbs as in the city proper.

Around Chicago the suburban population is clustered mainly along the lines of railroad which pay particular attention to suburban business. There are not many of these railroads—perhaps four—and, therefore, the suburban population radiates in streaks with wide territories between that are comparatively thinly settled. In these areas there is a great deal of property, much of it having good natural advantages that are comparatively undeveloped owing to the lack of good transportation facilities. Within a distance of from 8 to 12 miles from the city hall there are excellent suburban residence sites awaiting development. The speaker is of the opinion that something will have to be done to open these areas to suburbanites if the development around the city is to be symmetrical and well balanced.

There was little discussion following Mr. Lukes' address. The principal speaker was Mr. Dana Pierce, electrical engineer of the Underwriters' Laboratories of Chicago, who confined his remarks, however, principally to a cordial invitation to the members of the club to visit the laboratories and examine the work being done there in the way of testing electrical devices and materials.

Proposed Massachusetts Electric Railway Consolidations.

The Massachusetts Railroad Commission and the Boston Transit Commission sitting jointly gave a public hearing at the State House, Boston, on Sept. 27, in regard to the question of permitting the Boston Elevated Railway Company to acquire the securities of other street railways, as ordered by a resolve of the Legislature of 1909. The joint board is to report the results of its findings to the next General Court. Frederic E. Snow, counsel for the Boston Elevated Railway Company, urged the joint board to recommend legislation authorizing the company to acquire a controlling interest in other street railways, notably the connecting systems of the Boston & Northern, the Boston & Worcester, the Old Colony, the Blue Hill, the Lexington & Boston, and the Middlesex & Boston. If these systems could be thus controlled the operation would be centralized and a single physical transportation organization of about 1500 miles of track could be operated much more efficiently than the separate lines now composing the scattered roads. Mr. Snow said that the Boston Elevated charter forbids charging over a 5-cent fare, and for this reason actual consolidation would be out of the question, but the assumption of control by the legally authorized purchase of securities would enable the system to give first-class service and save money through operating economies. The gross assets of these companies are about $100,000,000. The hearing was continued to Sept. 28, when representatives of the Public Franchise League, of Boston, were to be heard in opposition.

On Oct. 5 the joint board will consider the need of new rapid transit lines in Boston and the proposition of the Boston & Eastern Electric Railroad Company to build a tunnel under Boston Harbor to Post Office Square, in connection with a proposed high-speed electric interurban line between Beverly, Salem, Lynn and Boston.

Hearings have been continued during the past week by the Railroad Commission on the Boston, Lowell & Lawrence Interurban Railroad project, the testimony being mainly that of citizens favoring the road.

Truckee River Water-Power Controversy.

Mention was made in these columns recently of the contract signed between the United States Reclamation Service and the Truckee River General Electric Company, covering certain rights and privileges on Lake Tahoe and its outlet, the Truckee River, in California. The contract was brought prominently before the general public by reason of a protest lodged with President Taft by William Kent, the well-known naturalist. After making a close study of conditions at Lake Tahoe, Mr. Kent has made the following statement: "After reading the proposed Truckee General Electric contract and after having studied its pedigree, I am led to believe that it was drawn by the company for the company and that Secretary Ballinger, acting for the Reclamation Service, signed it. To make it valid it remains that it should be given the endorsement of Mr. Ballinger, as Secretary of the Interior, or the endorsement of the President of the United States. It is now held up. In my detailed criticism of this document, sent to the President, which criticism was compiled only after careful consultation with a lawyer of high standing and an expert in hydroelectric power, I made the following charges against it:

"First, that, ostensibly intending to promote the cause of irrigation in the Truckee-Carson project, it resulted in an actual curtailment of prospective development of water for irrigation purposes; second, that the clause permitting control of the Truckee dam by the Government specifically stated that for any breach of the contract the United States could be ousted from such control; third, that the point of second diversion might be the ruin of much valuable property on the shores of Lake Tahoe, in which event the Government would incur the liability for damages and the company would reap the benefit; fourth, that the guarantee of an amount of water at all times rendered the Government further liable to the company for damages, should it be impossible to yield such flow; fifth, that to grant a roving commission to take anything the company might find of value, over a vast territory, was hostile to all ideas of reasonable concession; sixth, that the perpetual ownership of this power, without control in any way of the rates to be charged, or service to be yielded, was abhorrent to any just conception of public rights in the public domain; seventh, that the Government, by granting such rights, puts itself in the position of making an immense present to the beneficiaries, the magnitude of which gift can be seen should the Government turn around and endeavor to obtain its property back by condemnation. I further believe, after consultation with men knowing the details of the former power rights existing on the Truckee River, that these rights were not of any great value, first, because their title is subject to doubt, and second, because the amount of power that could be developed from the Truckee River would not amount to much or be an expensive thing for the Government to take back without injustice to the present holders."

A dispatch from Reno, Nev., states that Mr. W. P. Hammon, who, with other capitalists, now owns the Truckee River General Electric Company, has been making, in company with Mr. F. G. Baum, his engineer, and others, an inspection of the company's plant and the dam now being built by the Hammon interests and the Government. "We cannot talk of the Tahoe deal with the Government," says Mr. Hammon. "I can say, however, that the farmers will be protected. We intend to build more plants and extend our lines as the State advances Further than this I have nothing to say."

German-American Patent Treaty.

The American Association of Commerce and Trade in Berlin has issued an announcement on the effect of the new patent treaty between this country and Germany. This treaty, which went into effect on Aug. 1, places American citizens on a decidedly better footing in regard to the utilization of patent protection in Germany, as it frees them from the obligation to work their patented inventions in Germany within three years from the granting of the German patent. Heretofore any failure to comply with this working obligation would, in the case of an action for revocation of the patent being brought against the patentee, result in the loss to him of his German patent.

This is no longer to be the case with the German patents of United States citizens, as the new treaty provides that the working of a patent in the territory of one of the contracting parties shall be considered as equivalent to its working in the territory of the other party. Hence, an American citizen who works his United States patent in the United States will no longer be required to work his corresponding German patent

in Germany in order to avoid loss of the German patent in case of an action for revocation being brought against him.

The question as to whether the provisions of the treaty are to apply also to existing German patents in regard to which the three-year term allowed for working already expired before the date on which the treaty went into effect is not decided yet; but many persons are of the opinion that even such patents will now be entitled to the benefits of the treaty, provided that no action for revocation was actually entered prior to that date. At any rate, it may be assumed that, in addition to all German patents applied for after that date, such older patents in regard to which the three-year term extends beyond that date will enjoy the benefits of the treaty. The new treaty, abolishing, as it does, a condition of affairs that has been felt as a hardship by American inventors, will no doubt induce many American inventors to apply for German patents where they would otherwise have abstained from so doing.

Patent Litigation Procedure.

In his opinion upholding the Selden gasoline automobile patent, Judge Hough took occasion to protest vigorously against the abuse in patent litigation arising from the methods of taking and printing testimony, exemplified in this case by a printed record of 36 huge volumes of record. A significant part of the protest is the intimation conveyed in favor of the submittal in patent cases of evidence orally before the trial justice. Following is the passage, which appears in the form of a footnote:

"It is a duty not to let pass this opportunity of protesting against the methods of taking and printing testimony in equity, current in this circuit (and probably others), excused if not justified by the rules of the Supreme Court, especially to be found in patent cases, and flagrantly exemplified in this litigation. As long as the bar prefers to adduce evidence by written deposition, rather than *viva voce* before an authoritative judicial officer, I fear antiquated rules will remain unchanged and expensive prolixity remain the best known characteristic of equity.

"But reforms sometimes begin with the contemplation of horrible examples, and it is, therefore, noted that the records in these cases, as printed, bound and submitted, comprise 36 large octavo volumes, of which more than one-half contain only repeated matter—i.e., identical depositions with changed captions and exhibits offered in more than one case. In reading the testimony of one side in one set of cases there were counted over 100 printed pages recording squabbles (not unaccompanied with apparent personal rancor) concerning adjournments—and after arriving at this number it seemed unnecessary to count further. In many parts of the record there are not five consecutive pages of testimony to be found without encountering objections stated at outrageous length, which may serve to annoy and disconcert the witness, but are not of enough vitality to merit discussion in 2000 pages of briefs. Naturally tempers give way under such ill-arranged procedure, and this record contains language, uncalled for and unjustifiable, from the retort discourteous to the lie direct. And all this lumbers up the court record room, while clients pay for it.

"Even when the evidence in equity was taken up by written answers to carefully drawn interrogatories, the practice was not marked by economy or celerity; but stenography and typewriting, the phonograph and linotype have become common since our rules were framed, have made compression and brevity old-fashioned, increased expense, and often swamped bench and bar alike by the quantity rather than the quality of material offered for consideration.

"Motions to expunge and limit cross-examination should have been made in these cases, though they are feeble remedies exposing counsel to personal reproach, and rendering judges afraid of keeping out of evidence what they cannot (on motion at all events) understand. But the radical difficulty of which this case is a striking (though not singular) example will remain as long as testimony is taken without any authoritative judicial officer present, and responsble for the maintenance of discipline, and the reception or exclusion of testimony."

Convention of the I. E. S.

Amid decorations that indicated the simultaneous existence of the Hudson-Fulton celebration, the Illuminating Engineering Society opened its third annual convention, on Monday, Sept. 27, in the Engineering Societies Building, New York, with an attendance that showed plainly the effect of the extra work in connection with the celebration upon the local members of the society, a large portion of the small assemblage being out-of-town members and guests. The registration at the close of the first session showed 100 members and 45 guests, but it is expected that more than 300 members will register before the closing session on Wednesday afternoon.

In presenting Mr. T. C. Martin, by whom the address of welcome was delivered, Mr. E. L. Elliott stated that not only was Mr. Martin a charter member of the society, but he was one of those to whom its formation was due, having been energetic in creating a sentiment in favor of its organization and in crystallizing this sentiment into action.

In his address of welcome Mr. Martin called attention to the prominent part taken by illumination in the present Hudson Fulton celebration and also referred to the dependence of present-day civilization on artificial lighting. He stated that the celebration is one intended to recognize the victories of peace rather than war, and on behalf of the Hudson-Fulton Committee and as a member of the New York Section of the Society, he welcomed the members to the City of Illumination, as New York may rightly be called during the peace celebration.

The response to the words of welcome were made by Past-President Dr. Louis Bell, of Boston, who congratulated the New York members on the wide-awake appearance of their city, which from an illuminating engineering point of view is at present the most important place in America.

The presidential address of Mr. W. H. Gartley dealt with the physical and physiological aspects of visual perception, and outlined the elements which enter into the complicated process of seeing. The address was largely of a technical nature and was reserved for appearance in the *Transactions,* only a brief reference being made to it by Mr. Gartley. In discussing the work of the society, the president said that it receives hearty support from the two rival industries, electric and gas lighting, and has brought forth a higher standard of illumination since its formation. He expressed the opinion that courses in illuminating engineering will soon be commonly offered to students in technical colleges. It is significant that at the present convention two of the papers deal with photometric laboratories, one being for gas and the other electric lighting. Immense improvements have recently been made in lighting, especially by means of gas lamps. It is the object of the society to advance the science of illumination, and in this it is meeting with success.

The report of the Committee on Nomenclature and Standards, of which Dr. A. C. Humphreys was chairman, was submitted in the form of reports from two sub-committees. Dr. Louis Bell, as chairman of the sub-committee on the unit of light, mentioned the effective work of Dr. E. P. Hyde in having adopted by France, England and the United States an international candle. He called upon Dr. Hyde for a report of the work of the sub-committee. This report gave an outline of the history of the unit adopted and the steps leading to its adoption. The unit is the equivalent of the bougie decimale, is equal to the pentane candle and is equal to the present United States candle, which is now 1.6 per cent less than it was previously, the adoption of the international unit having taken place on April 1, 1909. The hefner is equal to nine-tenths international candle. Germany has recognized this ratio, but has not adopted the international candle, largely because the standard by which it is to be maintained or compared has not been thoroughly defined.

Dr. C. H. Sharp, as chairman of the sub-committee on photometric units, stated that the international candle, as specified

by Dr. Hyde, had been endorsed, as had also the lumen based on this candle.

In discussing the work of the former sub-committee President Gartley expressed his great satisfaction with the result. Dr. A. H. Elliott said that the method of employing incandescent electric lamps for candle-power comparison gives surprisingly good results, as shown by his personally submitting certain lamps to laboratories in Berlin, London, Washington and New York, the agreement in the various ratings being remarkably close. Dr. E. B. Rosa remarked that many of the countries that have as yet not adopted the above candle are merely postponing action until the meeting of the International Photometric Commission in Zurich next year. He suggested that the United States send a strong representation to that meeting so as to present properly the advantages of adopting this candle.

The discussion of the report of the sub-committee on photometric units was opened by Dr. A. E. Kennelly, who called attention to the increasing importance of the unit "lumen" in illuminating engineering, and entered a plea for the use of the e.g.s. system of units as a basis for the photometric units. Dr. Louis Bell claimed that by means of the slide-rule one can readily convert from the English to the metric system of units, and he indorsed the suggestion relating to the use of the latter. Dr. A. S. McAllister called attention to the fact that when the lumen is defined as the total flux produced by an international spherical candle divided by 4π the unit of length is not involved. Moreover, a flux density of 1 ft.-candle over 1 sq. ft. requires one lumen of flux, as does also a density of 1 m-candle over 1 sq. m. This same relation is true quite independent of the unit of length that may be chosen. Dr. C. H. Sharp argued that illumination should be expressed in neither foot-candles nor meter-candles, but should be stated as a certain number of lumens per unit area, according to unit of length selected. However, he doubted the advisability of an attempt to abolish the foot as the practical unit of length. Prof. E. B. Rosa thought that the metric system should be adopted in illumination calculations just as it has been introduced into magnetic calculations, while Mr. L. B. Marks said that much practical opposition is encountered when one attempts to use the metric system in engineering undertakings. Mr. C. O. Bond remarked that the mysteries of illuminating engineering as viewed by the layman will be increased neither by the substitution of the lumen per unit area for the foot-candle nor by the use of the meter for the foot as the unit of length.

"The Ethics of Illuminating Engineering" was the title of a paper by Mr. E. L. Elliott in which were outlined the relation of the engineer to his client and the relation of the engineer to his fellow engineer. The author stated that in military government there is one law which is made to cover all others, namely, "conduct becoming a gentleman and a soldier." If "engineer" be substituted for "soldier" there will be obtained combined ethics of illuminating engineering.

Mr. L. B. Marks expressed his admiration for the spirit which permeated the paper. Mr. Jno. Campbell directed attention to the relation of the engineer to his client, especially in the matter of the bearing of cost of installation upon the results obtained. He thought that the paper would form an excellent basis for a code of ethics for illuminating engineers. In commenting upon the fact that no reference was made in the paper to the illuminating engineers employed by manufacturing companies, Mr. H. T. Owens said that such engineers are of much assistance in educating the public regarding the proper installation and operation of lighting equipments. Mr. Norman Macbeth regretted the prevalence of the numerous salesmen who, claiming to be illuminating engineers, give advice on subjects concerning which their information is very limited. Such men cause the title "illuminating engineer" to be discredited in many quarters. In closing the discussion Mr. Elliott remarked that since the consulting engineer should be free from even the suspicion of biased opinion, an engineer employed by a manufacturing company is competent to do consulting work only when the problems involved relate to the particular types of devices marketed by this company.

In a paper entitled "The Work of Dr. Carl Auer von Welsbach in the Field of Artificial Illuminants," Mr. Geo. S. Barrows outlined the discovery of the remarkable properties of rare earths, the development of the methods for obtaining the desired elements in large quantities, the invention of the incandescent gas mantle, the invention of the osmium incandescent electric lamp and the production of pyrophoric substances suitable for the ignition of gas. The author said that Dr. Welsbach was the pioneer in the field of metallic-filament lamps, his work with the osmium lamp having led to the development of the other metallic-filament lamps.

In discussing Mr. Barrows' paper Dr. Angelo Simonini said that Dr. Welsbach should be ranked among the greatest of chemists for his work with the rare earths, which he has been able to produce by the tons, while formerly only minute quantities could be obtained. Dr. A. H. Elliott called attention to the great commercial importance of the pyrophoric substance, which will mean much to the gas industry. The stone-like substance when scratched with a sharp piece of iron will give off sparks capable of igniting gas jets, thus doing away with the pilot flame.

Dr. Geo. P. Scholl stated that patents obtained by Dr. Welsbach on tungsten lamp filaments are now held by the Westinghouse Lamp Company, which is developing his processes of manufacture. Dr. C. H. Sharp remarked that just as the electric lighting industry ows its present standing to Mr. Edison, the gas-lighting industry is equally indebted to Dr. Welsbach. Dr. Louis Bell outlined the influence of Dr. Welsbach on modern science, and expressed the opinion that he has proved to be the best chemical investigator of the past 50 years. He has been of especial service for his painstaking, thorough work with the rare earths.

In a paper entitled "The Progress of Illuminating Engineering in Europe" Mr. H. Thurston Owens outlined the street-lighting systems which were employed in the principal European cities.

Dr. A. H. Elliott said that in comparison with Europe, America has a much poorer system of maintenance for its public lamps. He entered a plea for the use of side-brackets for suspending street lamps from the side of buildings in order to allow the posts to be removed from the streets. Mr. G. S. Barrows explained the large ratio of gas to electric lamps in European cities by referring to the fact that gas was used there before electricity was introduced, while in this country electricity was used before gas became common.

In a paper by Mr. Albert J. Marshall, entitled "Diffusing Mediums," the prevailing use of ground-glass balls for covering lamps was condemned. The author attributed the use of such balls to their cheapness and low light-absorbing quality. They fail to produce the results desired because, instead of having a ball of light, say, 6 in. in diameter, there appears to be merely a spot of light at the center of the ball. Where conditions will permit, one of the most generally effective results may be obtained by the use of white or straw-colored opal globes, the exteriors of which have been sand-blasted or otherwise depolished.

Mr. L. R. Hopton defended the use of spheres on lighting fixtures for locations where the proper proportions are obtained. The parts of the equipment should be considered as a whole and not separately. He urged the necessity of so designing the installation as to permit it to be cleaned readily. Mr. P. S. Millar stated that the importance of using definite specifications for glassware is meeting with increasing recognition. Mr. L. B. Marks said that frequently custom dictates the selection of ground-glass balls. When the intrinsic brilliancy is not too great it is proper to use ground glass when it is preferred by the person paying for the equipment.

Illuminating engineering from the educational standpoint was discussed in a paper by Mr. F. K. Richtmyer, in which was given a list of experiments in photometric measurements which will be performed as college work during the coming year. The experiments are intended to give a working knowledge of several standard photometers, the use of primary and sec-

ondary standards, the errors to be avoided, illumination measurements, etc.

In the absence of the author, this paper was read by Mr. E. L. Elliott, who called attention to the fact that courses in illuminating engineering are now offered at Cornell, Armour, Massachusetts Institute of Technology and Swarthmore. He thought the time ripe for the colleges to give instruction to its architectural students in the elements of illuminating engineering. Mr. C. O. Bond said that the Illuminating Engineering Society could do good work by suggesting proper subjects for investigation by colleges along the lines of illumination, etc., the colleges being willing to undertake almost any investigation suggested. Prof. S. W. Ashe expressed the opinion that the 30 three-hour periods which the author proposed to devote to experiments with photometers could more profitably be spent in investigating of physiological phenomena, etc. Lectures relating to illuminating engineering practice should be delivered by visiting specialists and not by the regularly employed professor at the college.

The photometrical laboratory of the United Gas Improvement Company at Philadelphia was described in a paper by Mr. C. O. Bond. Use is made of incandescent lamps for comparison standards in photometric tests.

Dr. Edw. P. Hyde, director of the National Electric Lamp Association, presented a paper outlining the organization of the work of the physical laboratory of the association. The problems to be investigated in the laboratory are those that have to do with the production of luminous energy, those that have to do with the utilization of luminous energy, and those that have to do with the effects of luminous and attendant radiation. Under the first class will come the investigation of the laws of radiation and of the radiating properties of matter; the problems in this class are purely physical. Under the third class will come the investigation of the effects of light and the attendant radiation on the eye, on the skin, and on microscopic organisms; the problems in this class are purely physiological. The problems in the second class touch, on one side, the physical production of light, and, on the other side, the physiological effects of light; this division of the work will cover investigations on the absorbing, reflecting and diffusing properties of matter, photometry, color sensation and other color phenomena.

The papers by Messrs. Bond and Hyde were presented consecutively and discussed together, the discussion being opened by Dr. C. H. Sharp, who noted the trend of development in the science and practice of illuminating engineering as evidenced by the building of these two laboratories by commercial gas and electric interests. It argues well for the future when such interests are willing to expend much money for investigations from which the returns are as indefinite as those from photometric laboratories. In the past the development of illuminating gas has been along chemical lines, but in the future much will be done to utilize the gas to produce better illuminating effects. The laboratory described by Mr. Bond is well equipped for the photometry not only of gas lamps, but electric lamps also. The existence of the laboratory outlined by Dr. Hyde shows the effect of the change in attitude of financiers toward purely theoretical investigations, no small part of which may be attributed to the work done by the Illuminating Engineering Society. Dr. Sharp remarked that there is more than enough work to keep all of the laboratories busy, and entered a plea for co-operation to the extent that no two laboratories will be duplicating each others investigations. Mr. P. S. Millar recalled that about five years ago there were described before the American Institute of Electrical Engineers two photometric laboratories devoted to the interests of electrical engineering relating to lamps, while the present papers describe two laboratories organized to further the interests of illumination, for which the Illuminating Engineering Society stands. This fact shows the rapid development of illuminating engineering in this country. Although intended for purely scientific investigations, both of the laboratories are supported by companies organized for commercial purposes. President Gartley expressed the opinion that the opening of the above-mentioned gas laboratory represents a new era in gas-lamp photometry, and will result in the construction of laboratories for a similar purpose by numerous other gas companies. Mr. T. J. Litle, Jr., said that the many recent developments in gas lighting, especially in Europe, show that the illuminating gas business is on the verge of a revolution representing immense progress.

A paper by Dr. Angelo Simonini reported some experiments on the luminescence of incandescent bodies as carried out about 15 years ago in the factory of Dr. Carl Auer von Welsbach near Vienna. The author expressed the opinion that the cause of the high incandescence of the gas mantle is the alternating oxidation and reduction, or the changes from a higher oxide to a lower one and back again.

In a paper entitled "The Light of the Fire-Fly" Drs. H. E. Ives and W. W. Coblentz reported the results of an investigation of the physical properties of the light of the fire-fly. The spectrum of the light was photographed on plates sensitive to the whole visible spectrum. The spectrophotometric curve of the fire-fly, as compared with a carbon glow lamp, was obtained by comparison of the photographic densities of the negatives of the fire-fly and of the glow lamp. The distribution of radiant energy in the carbon glow lamp was determined, and by means of the spectrophotometric relationship the distribution of radiant energy of the fire-fly was derived. The light is found to consist of an unsymmetrical structureless band in the yellow-green of the spectrum, with a maximum at 0.57μ, and extending to 0.5μ and 0.67μ. The luminous efficiency of the fire-fly is calculated as 96.5 per cent as compared with 0.4 per cent for the carbon glow lamp, and about 4 per cent for the most efficient artificial illuminant. This value is obtained on the assumption that there is no infra-red radiation other than "animal heat." The authors' assumptions as to efficiency are equivalent to assigning to a 100 per cent efficiency electric lamp a specific output of 48 candles per watt. Such a lamp would give a single spectral line in the green. A lamp giving white light—and no other radiations—would have a specific output of 22 candles per volt.

The discussion on the paper on chemical luminescence and that on the light of the fire-fly was opened by Dr. C. H. Sharp, who mentioned the fact that the guess made many years ago by Dr. E. L. Nichols that the light from the Welsbach mantle is attributable not alone to the temperature of the flame, but also and more largely to the phenomenon of luminescence seems to be supported by the results recorded by Dr. Simonini, assuming that the alternating chemical changes furnish evidence of luminescence. The photographic method of investigating the spectra of light from weak sources as used by Drs. Ives and Coblentz is of great importance in spectro-photometry, while the results of the investigation of the light from the fire-fly shows the possibilities of immense improvements over present methods of producing light artificially. Dr. Louis Bell expressed his regret that the authors had not used a bolometer to ascertain what radiations, if any, are given off by the fire-fly beyond or within the spectrum recorded photographically. It is probable that numerous chemical reactions are accompanied by the production of radiations throughout limited ranges similar to that of the light from the fire-fly, and these should be investigated.

The session on Tuesday morning closed with the papers of Drs. Simonini, Ives and Coblentz still under discussion. It was arranged to continue the discussion on Wednesday morning.

The whole of the session on Tuesday evening was devoted to a lecture by Dr. C. P. Steinmetz on "The Physiological Effects of Radiation."

"The Allowable Amplitudes and Frequencies of Voltage Fluctuations in Incandescent Lamps" was the title of a paper by Dr. H. E. Ives, reporting the results of tests made upon carbon and tungsten incandescent lamps in which observations were made of the frequency at which flicker just disappeared. The flicker was produced by superposing an alternating e.m.f. upon a direct e.m.f. The results were recorded by means of

curves, which showed that there is a very large change in the permissible frequency with a slight change in the voltage.

Dr. Louis Bell presented a paper discussing some of the general principles upon which the use of shades and reflectors for artificial illuminants depends. The author stated that the actual loss of light flux in passing through diffusing balls may range from hardly more than 10 per cent where the surface roughening is very slight, up to 50 or 60 per cent in the case of very dense sand blasting or a globe of milky glass. With such globes the change in distribution is not material for practical purposes, but the sole function is to reduce the intrinsic brilliancy and thus increase the visual usefulness of the light as it is actually applied. The ordinary distributing reflector does not distribute to any considerable extent in the sense of changing the distribution, but merely somewhat increases the volume of light below the plane of the shade; obviously unless the lamp is provided with a ground-glass bulb, the glare is in no way reduced.

When wide distribution of light is desired it can best be obtained by a combination shade and reflector which will more effectively screen the lamp. As regards the coefficients of reflection of surfaces used for shades or reflectors, they are usually rather low, even a first-class mirror silvered on the back and kept clean seldom gives as high as 80 per cent, except under laboratory conditions. Metals, paints and enamels fall far below this, some of them down to 50 per cent or less. Diffusing coatings which tend to scatter the light over a wider surface than is given by the same shape of non-diffusing reflector, may have absolute coefficients of reflection quite as large as substances which reflect regularly. Prismatic glass acts, so far as it serves as a reflector, in virtue of total reflection in the prisms into which the glass surface is subdivided. The total effect of a plate of prismatic glass is to act as if it were slightly translucent, like a very thin silver film reflecting a large proportion of the light and letting some through. As a reflector its virtual coefficient is not widely different from that of other reflectors, but the absorption if the glass is clean is comparatively small, probably between 10 and 15 per cent only, so that the light which is not reflected gets through with this comparatively small loss. Etching decreases the direct element of illumination, so that pure diffusion is increased thereby relatively, so that excessive etching produces a result similar to that obtained when no prisms are used. Any diffusing surface given to a prismatic shade should be merely dense enough to avoid the brilliant streaks due to the proportion of rays that get through the shade without total reflection.

The problems encountered in heterchromatic photometry were outlined in a paper by Mr. P. S. Millar. In commercial practice serious discrepancies are encountered when the illuminants tested differ in color from available standards of luminous intensity. The author voiced the need for the consideration of standardization of methods in heterchromatic photometry.

Mr. Norman Macbeth presented a paper outlining some results obtained through illuminometery of lamps with various reflectors placed at different distances above the plane illuminated in a room having dark and light walls. Use was made of a four-lamp fixture placed within a room 12 ft. x 20 ft. Observations were made at heights of 4 ft., 6 ft. and 8 ft., the effective lumens being 1200.2, 1419.5 and 1464.2, respectively. The mean apparent candle-powers for the three heights were 382.4, 452.2 and 468.1, respectively. The variation in these values is attributable to the fact that the inverse-square relation is not accurately applicable to lamps with reflectors.

Much interesting specific information relating to factory lighting was given in a paper by Mr. L. B. Marks. Complete illumination data were given for five factories, four of which are devoted to the manufacture of typewriting machines and the fifth to the manufacture of ribbons, etc., for use in these machines. Measurements were made of the illumination at the machines and other working spaces under actual operating conditions in the daytime and at night, the measurements for artificial light having been made in exactly the same location at machine, bench, etc., as the respective measurements made under daylight conditions. Use is made throughout the factories of one 16-cp lamp at each machine and for each bench hand. The illumination produced by each lamp is confined to a very small zone, which is brilliantly illuminated, while contiguous parts of the working space are in comparative darkness. The author found that the intensity of artificial illumination is excessive, and in many cases greater—in some cases from 10 to 20 times—than the intensity of the natural illumination that is adequate for the same work. He suggested the introduction of suitable general illumination, proper location of the lamps, reduction of intrinsic brightness of the light sources, improved diffusion and direction of light and a moderate intensity of illumination.

The operating efficiencies of some commercial installations of lighting systems were treated in detail in a paper by Mr. A. L. Eustice. Reports were given on 66 tests made by the author. The results showed that the conditions under which lighting systems are installed—employing the same type of unit—are so varied that it is almost impossible to lay down or establish definite specific consumption factors to be used promiscuously, and particularly by the layman or one lacking a great amount of practical experience in the field. The author expressed the conviction that in all cases it is essential to provide additional wattage above the amount calculated in order to take care of depreciation, not only of the candle-power of the units employed, but also of the system between cleaning periods. The depreciations of various systems due to accumulations of dirt differ largely, since a unit which does not depend primarily upon reflecting glassware will naturally suffer least in application of the unit to commercial systems.

A paper by Dr. E. P. Hyde and Mr. J. E. Woodnell gave the results of tests upon vapor-tube lamps in the New York Post Office. The lamps operated at power factors of 63 and 69 per cent and consumed 2.42 watts per mean spherical candle.

The results of tests made upon a vapor-tube lamp 176 ft. in length and 1⅞ in. diameter installed in a room 65 ft. long, 29 ft. wide and 18 ft. high, were reported in a paper by Dr. C. H. Sharp and Mr. P. S. Millar. The tube used 21.5 amp at 220.3 volts, or 3451 volt-amp; the power factor was about 73 per cent, the real watts being 3451. The lamp was found to produce a total of 17,400 lumens, or 5.5 lumens per watt, which is equivalent to a specific consumption of 2.49 watts per mean spherical candle-power. Of the total lumens produced by the lamp, 41.2 per cent were effective on the illuminated plane.

Annual Meeting of the Rejuvenated Sons of Jove.

The seventh annual meeting of the Rejuvenated Sons of Jove will be held in Cleveland, Ohio, on Oct. 14 and 15, 1909, with headquarters at the Hollenden Hotel. According to the old Grecian mythology on which the ritual of the order is built up, the fifteenth day of October in each year was sacred to the ranking deity and was called Jupiter's Day. Mr. J. Robert Crouse, No. 260, of Cleveland, Ohio, is the reigning Jupiter of the Sons of Jove, and has decreed that the convention be concentrated so far as possible into the one day, Oct. 15. Meetings of the standing committees will be held on Oct. 14, and a reception to visiting Jovians will be given at the Hollenden Hotel on the evening of the 14th. On Jupiter's Day the business session will be held in the morning; in the afternoon a class of 100 or more initiates will be led from darkness into light. The Joviation in the evening will consist of a dinner and vaudeville entertainment in charge of Messrs. H. H. Cudmore and H. C. Rice, of Cleveland.

A quarter of a million clever envelope fliers advertising the order and its annual meeting are being distributed by over 300 electrical firms throughout the country. Over 500 new members have been added during the year, making a total membership of about 2500.

New York Public Service Commission News.

The Public Service Commission of the First District of New York has denied the application of the bondholders' committee for approval of the proposed reorganization of the Third Avenue Railroad Company. The opinion as given is a lengthy one, and was written by Chairman Willcox and Commissioner Maltbie. Among the reasons given for refusing to sanction this reorganization plan are that the assets of the property are not of sufficient value to justify the proposed capitalization of $68,516,000; that the present company is overcapitalized, and the outstanding stock and bonds are not represented by actual property; that the net earnings will probably be less than the estimate given by the receiver; that there is no evidence that the company would earn a sufficient net income to pay the interest on the adjustment bonds, amounting to $32,000,000; that there is no likelihood that there would ever be any dividend earned on the $20,000,000 of proposed common stock; that it is unwise to issue securities on probable earnings; that such overcapitalization would lead to inferior service and unwarranted exactions; that the control of the corporation would pass from the stockholders to the bondholders, and that the reorganization plan involved the capitalization of taxes, unpaid interest, repairs, renewals and other improper capital charges. The announcement of this refusal had little effect upon the Third Avenue stock in Wall Street, as it was quite generally understood from the beginning that the commission would refuse the application.

In a letter addressed to the Public Service Commission of the First District of New York on Sept. 22, T. P. Shonts, president of the Interborough Rapid Transit Company, offers to build a four-track subway up Madison Avenue, to be connected with the four existing subway tracks on Park Avenue at about Thirty-eighth Street, and continuing the four tracks up Madison Avenue to 149th Street, connecting two tracks with the existing subway tracks and continuing the other two tracks northerly on Jerome Avenue to 194th Street; also to construct two tracks from the present West Farms division of the subway, commencing at about Simpson Street, running over Westchester Avenue to Pelham Bay Park. If the Pelham Bay Park route and Jerome Avenue route are built they will be of elevated construction. This line, if constructed, will open up a new area along Jerome Avenue in the Bronx and a new area along Westchester Avenue to Pelham Bay Park in the Bronx.

A hearing has been ordered for Oct. 6 on the application of the Nassau Electric Railway Company for permission to issue $730,000 in bonds. The purpose of this issue is to retire an equal amount of the consolidated mortgage bonds of the Atlantic Avenue Railroad Company. These bonds fall due on Oct. 1, 1909.

The commission has held several hearings upon the application of the Bronx Gas & Electric Company for approval of a bond issue of $1,500,000. President Rosenquest, of the company, explained at a hearing that only $740,000 of this amount would be issued against a first mortgage on the company's property. He also stated that the $486,500 of capital stock of the company had been paying 5 per cent dividend during the years 1904 to 1908, inclusive.

The Public Service Commission, Second District, of New York, has announced, in an opinion by Commissioner Decker, its decision in the case of C. E. Wheaton against the Elmira, Corning & Waverly Railway Company. This company charges a 10-cent fare for about 3 1/7 miles between Holbert's crossing and Waverly, equal to 3 2/5 cents per mile. It charges the same fare between Waverly and all points west of Wilson's crossing, including Holbert's crossing. Between Wilson's crossing and Chemung village (west end) it charges a 5-cent fare for a distance of 2 4/5 miles and has fixed this fare limit to accommodate travel to and from Chemung. The same reasons that induced the company to put its Chemung 5-cent fare limit at Wilson's exist for placing its Waverly 5-cent fare limit at Holbert's. The opinion states that assuming the 10-cent fare between Waverly and Chemung (west end), 4 2/3 miles, is not unreasonable, it is apparent that a 10-cent fare to or from the town of Waverly becomes too high a short distance east of Chemung.

The commission does not disturb the 5-cent fare from Wilson's to Chemung or return, but it does hold that on passenger traffic between Holbert's and Waverly and between points east of Holbert's and Waverly, where a 10-cent fare is charged, the fare of 10 cents is unjust and unreasonable and must not, during a period of at least one year, exceed 5 cents per passenger. The order is limited to one year on account of the company's present poor financial condition, and it has leave to apply and show cause for modification or abrogation of the order at any time during that period. When the company's contemplated extension of service to the center of Waverly shall be effected the question whether the fare limit for Waverly traffic should be brought eastward a short distance may be raised. It appeared in this case that the complainant is trustee of a school district and that he applied originally to the company for a school commutation rate between Waverly and Holbert's crossing and intermediate points, but his application was refused, and he then brought complaint to this commission against the 10-cent fare applying on all passengers.

Massachusetts Commission News.

The Clinton Gas Light Company, operated by the Massachusetts Lighting Companies of Boston, has appealed to the Board of Gas and Electric Light Commissioners from the decision of the Selectmen, of Clinton, dated Aug. 31, 1909, upon the petition of the Connecticut River Transmission Company for the right to erect and maintain poles and wires in that municipality's territory.

The Clinton authorities granted the Transmission Company's petition for various locations specified in the order, requiring that the lines be protected by lead or other suitable covering between Nashua Street and the Lancaster Mills, and recommending that so far as practicable the Transmission Company and the Clinton Gas Light Company shall use the same poles; that the lines of the Transmission Company shall be located at least 20 ft. above the highway, and that the maximum potential shall not exceed 14,000 volts under normal working conditions. It was further ordered in the franchise that the Transmission Company shall not refuse to deliver electricity for power or manufacturing purposes to any applicant for the sole reason that the applicant is a small user of electricity; that it shall not furnish power for reselling at a rate higher than the Transmission Company could furnish energy directly to consumers; that the wires must be placed under ground at such time as the Clinton Gas Light Company puts its own lines below the surface; and that if the town establishes a municipal plant the Transmission Company must furnish on request of the Selectmen energy to a maximum of 800 hp at the company's Fitch Street substation. The life of the franchise is twenty-eight years.

The Clinton Gas Light Company submits that it is aggrieved by the action of the Selectmen, and the board will give a public hearing upon the matter on a date not yet assigned. The appeal resembles those of the Fitchburg Gas & Electric Light Company and the Worcester Electric Light Company, lately heard before the full board in public sessions, the respondent in all three cases being the Connecticut River Transmission Company. In the Fitchburg case the commission authorized the latter to sell power in blocks of 300 hp and over, restricting the sale to smaller users to the established central-station organization. Arrangements are now under way and an agreement is now before the commission for approval whereby the Transmission Company will sell energy to the local company. Power is now being supplied to the Park Hill Mills, of Fitchburg, by the Transmission Company under the terms of the order issued by the board in the Fitchburg appeal. The Worcester decision is now pending in the board.

Wisconsin Rate Commission.

An important decision has just been rendered by the Wisconsin Rate Commission which affects every public utility operating in the State. In the case of Oscar J. Berend vs. the Wisconsin Telephone Company, the right of any public utility to exact a penalty for the non-payment of bills within a certain specified time has been definitely settled pending only a possible adverse decision by the Supreme Court.

The Wisconsin Telephone Company's contract contains the following clause: "This company reserves the right to require the subscriber to keep on account with it a sum not exceeding $10 to guarantee payment of bills rendered on this contract." The plaintiff refused to satisfy the foregoing requirement and upon the telephone company's refusal to give service he petitioned the commission for an order.

In its decision the commission has recognized the reasonableness of the respondent company's rule providing for a cash deposit. For every public-service corporation is required by law to furnish adequate and efficient service to the public according to the development and state of the art at the time the service is performed and to exact therefor only reasonable compensation. It must keep its plant in proper state of repair and continue its service without cessation whether profitable or not. It is by statute subject to public supervision as to the extent and capacity of its service as well as the charges it may lawfully exact therefor, and it is imperative that just compensation be promptly returned to the company for all service rendered by it to the public.

Consequently, the commission has laid down the following rules for the protection of a public utility against loss of operating revenues because of uncollected accounts, and for securing the prompt receipt of all moneys due for service performed or product furnished, which rules may be lawfully prescribed and enforced by any public utility:

1. It may require of any patron the deposit of a reasonable sum as security for the prompt payment of bills when due.
2. It may require satisfactory security to be furnished in lieu of such deposit.
3. It may allow a discount upon bills paid on or before a stated day or exact a penalty for failure to make payment within a certain time.
4. For neglect or refusal on the part of any patron to comply with any of the legal rules and regulations established it may discontinue service to such patrons.

CURRENT NEWS AND NOTES.

AURORA AFFECTS TELEGRAPH SERVICE.—On Saturday of last week the telegraph throughout eastern United States, and in Europe throughout Germany and over a greater part of the Continent, was seriously disturbed by magnetic effects accompanying an aurora borealis.

ELECTRICAL ENGINEERING AT RUTGERS.—The department of electrical engineering of Rutgers College, New Brunswick, N. J., has moved from its former quarters to the new Engineering Building, which it occupies jointly with the departments of civil and mechanical engineering.

TWENTY-ONE HUNDRED MILES BY WIRELESS.—According to a San Francisco telegram, wireless telegraph communication is being maintained between the wireless tower of the *Chronicle* and the Oceanic steamship *Alameda* at Honolulu, the distance separating the two stations being 2100 miles.

"TELERADIOPTICON."—A dispatch from the City of Mexico states that Alberto Sanchez, an electrical engineer, who is an inmate of Belem prison, declares that he has invented an apparatus whereby light waves as well as sound waves may be transmitted over a telephone wire. The prison officials vouch for the claims made by the inventor.

HIGH-SPEED WIRELESS.—According to the London *Times,* wireless messages were recently sent by the Poulsen system from Great Britain to Denmark at the rate of 200 words per minute, the distance being 600 miles, of which 200 miles are overland. According to the new Poulsen system the message is transmitted from a perforated tape, and received on photographically sensitized paper.

GERMAN AUTOMATIC TELEPHONE EXCHANGE.—The first automatic telephone exchange system in Germany has been installed at Hildeshein. The Siemens & Halske Company has taken up the American automatic telephone system for exploitation in Germany, as the result of a visit some months ago of a number of its engineers to this country to report upon the success of the system as installed here.

FRENCH TECHNICAL STUDENTS IN AMERICA.—M. Millerand, the French Minister of Public Works, is an advocate of a measure to send graduates of French technical schools to the United States for further study. He says he wishes to create in the United States for French engineers an institution analogous to the art school maintained at Rome for artists, the students to remain in the United States for 18 months or 2 years.

GOVERNMENT OWNERSHIP OF TELEGRAPHS.—The Congress of the Chamber of Commerce of the British Empire, now in session at Sydney, N. S. W., has given a strong endorsement to the proposal that the British Empire should own the telegraph services within its bounds, and passed a resolution requesting the various Governments to form a combined scheme for complete State ownership of electric communication between Great Britain, Canada, Australia and New Zealand.

BRITISH MARCONI AGREEMENT.—As noted in a previous issue, the British Government has purchased the seven land stations in the United Kingdom of the Marconi wireless system. The company will, however, retain the transatlantic stations at Poldhu and Chifden, and, of course, the installations worked by it on board steamers. The operators at present employed by the Marconi land stations will for a time remain in the service of the Post Office, and probably a number of them will be taken permanently into the Government service.

WARSHIP SPECTACULAR LIGHTING.—In an interview printed in the New York *American,* Mr. Thomas A. Edison, in reply to a question as to what feature of the electrical display on the Hudson on last Saturday evening struck him most favorably, said: "That by the British warships. It's a shame that our warships made so poor a showing in comparison to that of the British. I never saw a more brilliant display or more intelligent management of electric light than that by the British Saturday night. I felt ashamed of our failure. I thought we would lead the world's navies in that respect, as we lead the world in so many other things."

CHRISTIAN SCIENCE TREATMENT OVER THE TELEPHONE.—It is reported from Los Angeles, Cal., that Christian Science absent treatment over the telephone is assuming such large proportions in that place as to increase very materially the business of both of the telephone companies there, and sometimes to conflict seriously with traffic over long-distance lines. It is stated that healers in Los Angeles and Pasadena give treatment by wire to patients in Riverside, Santa Barbara, San Bernardino and all over southern California. At first operators were nonplused in cases where the patient called up a healer and held the connection in absolute silence while the long-distance treatment was proceeding over the wires; hearing no sound the operators would cut in, and getting no response they pulled the plugs, thus leading to complaint as to the service.

SALE OF BELL HOMESTEAD.—The city of Brantford, Canada, has purchased for park purposes the homestead where Alexander Graham Bell began work on the invention of his telephone.

AMERICAN ELECTROCHEMICAL SOCIETY.—The next meeting of the society will be held in New York on Oct. 28, 29 and 30. The headquarters will be at Hotel Chamberlain, while sessions for the reading and discussion of papers will be held at the Chemists' Club and at Columbia University.

ALTERNATING-CURRENT RECTIFIER.—Prof. John J. Montgomery, of Santa Clara College, has invented a type of alternating-current rectifier which, according to California newspapers, will revolutionize the use of electricity. No information in detail is given beyond the statement that a rectifier for charging an automobile battery is only 4 in. square in horizontal section and 8 in. high. An illustration in the newspaper accounts indicates that the apparatus is a revolving brush or commutator rectifier.

THE CHICAGO "UNION LOOP" MUST GO!—At a recent public dinner in Chicago, Mr. Edward J. Brundage, corporation counsel, spoke of the Union Loop in the central business district of Chicago, used by the elevated railways, as a makeshift which has contracted the heart of the town "so that it has been for many years too congested to pump the streams of prosperity through the arteries of the city." Mr. Brundage was emphatic in saying that the loop must go and that a system of subways must be built to take its place. He added that the citizens and city officials must get together and decide on the type of subway, its route and the manner of building and operating it.

CANADIAN ELECTRIC SMELTERS.—Dr. Eugene Haanel, director of mines for the Dominion Government, has announced that arrangements are being made for the establishing of the first electric smelter in Canada in connection with the iron and steel industries at Sault Ste. Marie, Ont. Arrangements are now being made for the construction of a number of furnaces similar to those in use in Sweden. A second electric smelting enterprise, involving the investment of about $7,000,000, is contemplated for treatment of iron ores on the Ottawa River at Chats Falls, Ont., where a great power site has been secured by a company headed by Mr. Louis Simpson, of Ottawa. Dr. Haanel is convinced that this is but the beginning of an electric smelting industry in Canada which will grow to immense proportions.

THE WINNIPEG ELECTRIC LIGHTING CONTROVERSY.—The fight between the city of Winnipeg and the Winnipeg Electric Company, details of which have previously been given, has been brought to a crisis by the city taking out an injunction to restrain the company from erecting any more poles without civic permits. In the injunction the city declares that the company owes $127,000 with interest on taxes on its power plant, and further declares that the company has no electric light plant in Winnipeg apart from poles and wires. The company has 16 days from Sept. 21 in which to answer the city's claim. The whole question will develop into an issue as to the legal status of the company within the city of Winnipeg. That it will be a long law suit there is no doubt, as both sides to the controversy are prepared to carry the question to the House of Lords, in England, the supreme court of judicature in the British Empire.

BUFFALO INDUSTRIAL SHOW.—The 1909 Buffalo Industrial Show will run from Oct. 6 to 16, and it is planned to have it eclipse all previous efforts. Street illumination will be the prominent feature. At Lafayette Square a large arch is being erected which will be illuminated and decorated with thousands of electric lamps, the arch to form a gateway leading to Broadway, on which street the old Sixty-fifth Arsenal is located, in which the show will be held. Large columns bearing clusters of lights will lead to another illuminated gateway at the entrance. Room for a band will be provided over each gateway. Main Street will be illuminated as well, the total number of lamps to be used outside being about 10,000. The interior will also be beautifully illuminated with large electroliers. The Buffalo General Electric will have a large exhibit showing tungstens, cooking devices, flatirons, etc. The Cataract Power & Conduit Company will show something interesting in the power line.

ACCIDENT TO COLORADO HYDROELECTRIC PLANT.—The United Hydraulic Company's plant at Georgetown, Col., which furnishes power throughout Clear Creek and Gilpin Counties, was disabled Sept. 20 by the breaking of a flange on one of the waterwheels. This puts a number of large mining companies of the two counties out of commission, which will suffer heavily, as their pumps cannot be operated. Upon the breaking of the flange the station was flooded to a depth of 6 in. over the floors, which in places were lifted several inches by the pressure. The water did no great damage in Georgetown, but the storage reservoir was practically drained before water could be shut off, and it will be several days before full supply will be available. No mine working, so far as known, has been flooded by the escaping water. A delay of about two days in operation will be caused. The Georgetown plant has capacity of about 4000 hp and has been supplying electric power for Clear Creek and Gilpin Counties for years.

AUTOMATIC SWITCH FOR SINGLE-PHASE MOTOR.—A patent issued on Sept. 21 to Mr. Harold B. Scheibe covers a switch arrangement for automatically opening the auxiliary starting circuit of a single-phase induction motor when the rotor has attained a predetermined speed. Centrifugal force is not utilized, the device being actuated by the cross magnetizing flux produced in the primary core by secondary magnetomotive force when the rotor has reached the proper speed. Use is made of a plunger electromagnet for operating the switch for disconnecting the auxiliary starting circuit. This magnet is located within the primary field core with its plunger ends at points of equimagnetic potential so far as concerns the magnetomotive forces of the main and auxiliary starting circuits. However, as the rotor accelerates from rest there is produced, in space-quadrature with the main field flux, a flux which exerts a pull on the plunger of the electromagnet. This pull is sufficient to open a switch in the auxiliary starting circuit when the rotor speed has reached the desired value.

TELEPHONE SUBSCRIBER SUES FOR 20 CENTS.—Mr. H. L. Strom, a lawyer, has brought suit against the Chicago Telephone Company to recover 20 cents which he asserts was collected by the telephone company from him in excess of the rate provided by the ordinance. The telephone company has many thousands of residence customers who have nickel-in-the-slot instruments with a minimum guarantee of $1.50 a month. The arrangement is that where the actual number of calls during a month does not equal 30 and the customer has to make up the deficiency, this amount may be applied on any excess charge over the $1.50 in succeeding months within a three-month limit. The telephone company's arrangement for making collections under this provision is somewhat complicated, unless carefully explained, and many disputes have arisen under this clause of the ordinance. Mr. Strom's suit seems to have grown out of this difficulty, and a number of his fellow subscribers have expressed their admiration for his resolution in suing the company, and have extended offers of financial assistance. Mr. B. E. Sunny, president of the telephone company, has promised to investigate the claim made by Mr. Strom, and declares that the company has no intention of violating any provision of the ordinance.

Wireless Telegraphy in the U. S. Navy.

UPON the first introduction of wireless telegraphy the U. S. Navy grasped its possibilities and was among the foremost to utilize it aboard ship. From the crude sets of the first days the navy has kept abreast of the times and now possesses installations on most of its ships that are second to none as regards efficiency, reliability and work accomplished. The navy has no standard set as yet, and among the ships may be found nearly all the prominent makes except that of Marconi. The only Government vessel at the present time having the latter installation is the revenue cutter *Seneca*.

Up until the latter part of the year 1904 the German Slaby-Arco outfit was the only set used to any extent. It was of the coherer and Morse writer type and gave fair service, although being, of course, far inferior to the present-day sets. The Slaby-Arco transmitter, however, survived and is to be found to-day on a great many of the smaller ships. Its compactness—the spark-gap, condenser jars, sending inductance and ventilating motor being all contained in one—makes it very desirable for small cruisers and gunboats. But the receiver, with its coherer so unreliable and unworkable when there was atmospheric disturbances, soon gave place to the electrolytic detector. On many of the ships the operators made detectors of their own by using a small incandescent lamp bulb, knocking off the tip and after breaking off the filament filling it half full of a 20 per cent solution of sulphuric or nitric acid, one of the platinum leading-in wires being broken off flush and the other one bent over toward the broken off one. This detector, with a potentiometer, a couple of dry cells and telephones in multiple around it, was good for reliable work from 75 to 125 miles. The DeForest electrolytic soon replaced this form of detector and was much more sensitive; up until the spring of 1908 it was as sensitive and as reliable a detector as was in use. On shore stations a bare wire was used, but on board ships the wire had to be encased in glass on account of vibration and rolling of the ship, the wire and glass being ground off flush so that the depth of immersion in the electrolyte made no difference in its sensitiveness. The bad feature about it was, however, that unless the operator was extremely careful a strong spark close by would burn the point off and it then had to be taken out and the point and glass again ground flush by rubbing on a whetstone. The carborundum and perikon detectors are now used

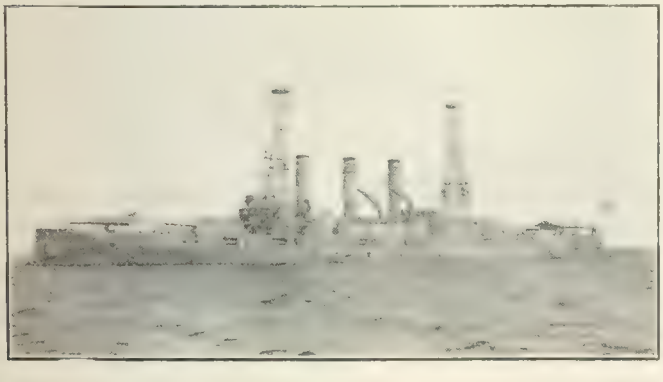


FIG. 1.—BATTLESHIP WITH TWO CAGE MASTS.

almost exclusively in the navy on the large ships, and at a great many of the naval shore stations.

In the present-day installations there are six principal makes of wireless sets represented on board naval vessels, namely, the Shoemaker, DeForest, Fessenden, Stone, Telefunken and Pierce; with the exception of the Telefunken all are of American make. The Pierce is used on the three scout cruisers, *Salem, Birmingham* and *Chester;* the firm making this set has since gone out of business.

The "capacity" of these different makes ranges from 2 kw to 5 kw and most of them are capable of standing a 50 per cent overload. The *Connecticut* at the present moment is having installed a 25-kw Fessenden outfit in connection with the high-powered stations the Fessenden Company is erecting for the navy on shore. This set has yet to be given a thorough trial, but the present indications are that the power is too great to be successfully handled on shipboard unless some radical changes are made to allow more clearance from the transmitter to the antenna. Thus far the 3-kw sets have been doing the most satisfactory work and reaching the longest distance, nearly all of them having a higher power factor than the 5-kw sets. Most of the small cruisers and gunboats use the old Slaby-Arco transmitter with its rotary turbine interrupter (a very efficient piece



FIG. 2.—VIEW OF ONE CAGE MAST AS SEEN FROM THE OTHER.

of apparatus, by the way) and a 25,000-volt induction coil. In most cases use is made of a Shoemaker or DeForest receiver.

In the North Atlantic battleship fleet are also quite a number of composite sets, but instead of the Slaby-Arco the transmitter is a Shoemaker or DeForest with a 3-kw or 3.5-kw Cutler-Hammer or Holtzer-Cabot 60-cycle, 110-volt motor-generator and 20,000-volt step-up transformer; this set is as near a standard as any in use. The new copper-coated Shoemaker jars give splendid service, and no more trouble is encountered from blistering. The spark-gap in most cases is a modified one made at the navy yards. It consists of a ¼-hp blower with rubber hose attached to the lower spark-gap, which is a piece of brass pipe about ¾ in. in diameter, the other spark point being a blank piece of zinc of the same diameter and about ⅝ in. in thickness. The blast of air across the spark-gap increases the radiation to a considerable extent, and by keeping the sparking points cool prevents fluctuations in the spark and gives it a higher pitch and clearer sound. By making the leads from the alternator to the primary of the transformer as short and straight as possible and by increasing or decreasing the power by field regulation rather than by the use of impedance or resistance a very high power factor is obtained. The aerial is directly connected to the transmitting inductance and with a loading coil in the antenna and a coupling around 15 per cent seems to give better results and radiation than the inductive connection.

The motor-generator is brought up to speed by simply closing a switch which operates an automatic starter, the operator taking about five seconds. The transmitting key is usually a standard telegraph key, but its function is only to close the circuit through an electromagnet which operates the main key, which is in series in the primary circuit of the transformer. Protective devices, made of condensers or of high-resistance carbons, protects the motor-generator set as well as the ship's lamp and motor circuits from kick-backs.

The detector used almost universally now on the battle ships is the carborundum or perikon, or both. The electrolytic type of detector, while being very sensitive, is not adapted for fleet work. The carborundum gives splendid results when properly

handled, it being impossible to destroy its sensitiveness by strong sparks or static electricity; on the contrary, it seems to improve; however, for long-distance work it cannot come up to the perikon. The perikon and a very fine wire electrolytic detector are of about the same sensitiveness. The perikon soon becomes dead, however, from strong sparks or static electricity, although recovering by being given a short rest. The best combination seems to be the carborundum for short distance and the perikon for long distance. The telescopic transformer type of tuner, with variable condenser, gives splendid results as to selectivity and in bringing in the maximum strength of signal.

Flat-top loop aerials of the L-shape are used almost exclusively, the grid being made up from 4 to 10 phosphor-bronze wires strung 18 in. apart. The new cage masts have not affected the radiation or receiving to any noticeable extent, although the construction of the new masts necessitates running the antenna through and parallel to the after-mast mainly.

The Continental Code is used for official work and the American Morse for general work. There being considerable work between the navy and commercial ships and shore stations, the navy operators must be skilled in the use of both codes.

Test of Electromagnets.

By C. P. Nachod.

The tests below, which may be of interest to magnet designers, were made to determine the most suitable form of magnet of given external dimensions, and, although not rigorously exact, they still indicate the quantitative variations among several possible forms. Figs. 1 to 6, inclusive, show the magnet

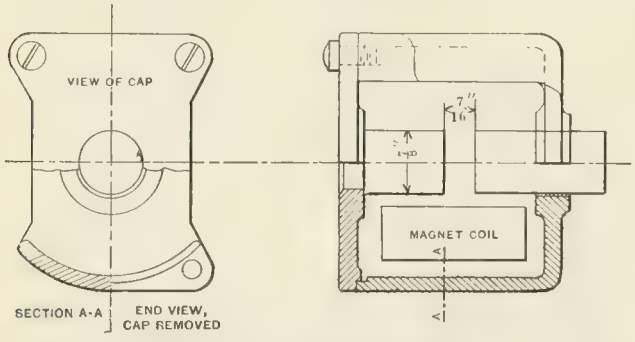


FIG. 1.—ELECTROMAGNET PARTIALLY ENCLOSED IN IRON FRAME.

and the changes wrought upon it; and being reproduced to the same scale, may readily be compared. The tests were made to show the effect of locating the air-gap in different parts of the same magnetic circuit, the variation in exciting power for the same initial pull and length of gap being measured; to show the effect of changing the position of the magnetizing coil with respect to the air-gap; and to show the effect of variation of the diameter of the magnet core.[1]

The magnet, shown in Fig. 1 partly in section, consists of a partially enclosing cast-iron frame to which is secured a cast-iron cap by four screws. A Norway-iron core is riveted to the cap, and a cylindrical plunger or armature of the same material slides in the frame, actual contact therewith being prevented by a brass tube having a 1/32-in. wall. The same frame and cap were used in all the tests. The area of the poles in this case is 0.6 sq. in. To lift the given weight, 3.4 lb., with the given air-gap, 7/16 in., 2400 amp-turns are required in the magnetizing coil.

In Fig. 2 the frame was cut through approximately mid-way, and a single long core riveted to the cap. This has the effect of substituting for the single air-gap inside the coil two air-gaps in parallel outside it and through the frame, the polar area now being increased to 1.09 sq. in. It was found to require 3610 amp-turns, an increase of 50 per cent to give the same pull with the same gap.

[1] See Design of Plunger Magnets, *Elec. World*, Sept. 21, 1907, p. 563.

In Fig. 4 the cap screws were removed and the air-gap placed between the cap and the frame, the coil remaining *in situ* with the frame, the area at the end of the frame being 2.16 sq. in.; 3720 amp-turns were found necessary, which is slightly greater than in the preceding example.

In Fig. 3 the coil was kept against the cap; and the effect of placing the coil nearer the air-gap evidently greatly reduced

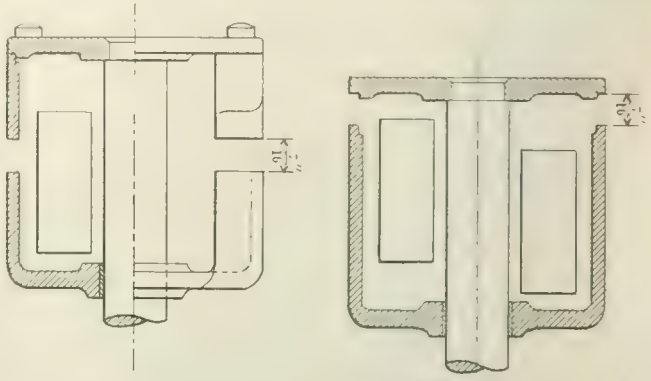


FIG. 2.—AIR-GAP MIDWAY IN FRAME. FIGS. 3 AND 4.—AIR-GAP BETWEEN CAP AND FRAME.

the leakage flux; for only 2890 amp-turns, instead of 3720, were required.

In Fig. 5 the diameter of the core was increased to 1 15/32 in., the plunger remaining 7/8 in., the air-gap being internal to the core as in Fig. 1. This requires only 2150 amp-turns, as against 2400 in Fig. 1. The mean polar area is 1.08 sq. in., and is regarded as a mid-way section of the frustum of the cone determined by the pole faces.

Finally, in Fig. 6 the only change over the preceding case is

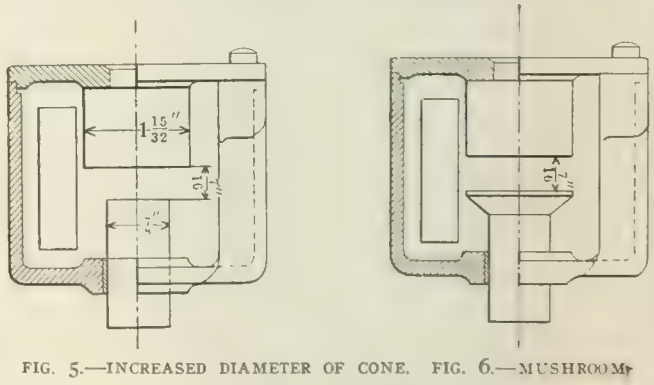


FIG. 5.—INCREASED DIAMETER OF CONE. FIG. 6.—MUSHROOM-SHAPED ARMATURE.

the substitution of a mushroom-shaped armature having the same polar area as the core, 1.69 sq. in. This form required a minimum excitation of only 1790 amp-turns, and is best adapted to the purpose; while Fig. 4, with 3720 amp-turns, is the poorest of the various forms tried.

Electrical Coal-Cutting in Great Britain.

According to our London contemporary, *Electrical Times*, despite the prejudice that exists, even in official quarters, against electric power in mines, the electric coal-cutting machine is making steady headway in Great Britain. Its great mechanical rival is the cutter worked by compressed air; but, although compressed air had a big start, electricity is gradually creeping up and bids fair in a few years to take the lead. Last year, according to Government statistics, the electric coal cutters in use increased from 643 to 737, while the compressed-air machines moved from 850 to 922. The electric coal cutter has made the greatest strides in Scotland; *per contra*, it is hardly known in South Wales, where hand work is almost exclusively used. As only 5 per cent of the coal output is machine-cut, the vastness of the field open to electricity may be realized.

Niagara Energy in Buffalo.

THE energy transmitted from Niagara Falls to Buffalo is distributed in the city over the lines of two companies, namely, the Cataract Power & Conduit Company and the Buffalo General Electric Company. With the exception of a small amount of energy used for lighting in an outlying district, which is purchased from the Niagara, Lockport & Ontario Power Company, all of the energy utilized by the Buffalo General Electric Company is obtained from the Cataract Power & Conduit Company and reaches the city by way of transmission lines from the two stations of the Niagara Falls Power Company on the New York side and the station of the Canadian Niagara Power Company on the Ontario side of the Niagara River. The former two stations are practically two parts of one station, being separated by only the width of a canal, while the last-named station is joined electrically to the other two by 10 three-phase underground cable tie lines. Thus the three stations operate as a unit to assist one another electrically, but they are physically separated so that the possibility of all being out of service simultaneously may be said to be infinitesimal.

The energy obtained by Buffalo from the three stations just named is transmitted at 22,000 volts over four separate pole lines, two on either side of the Niagara River. There are two terminal houses in Buffalo, one supplied by three separate three-phase circuits on the American side of the river, the other supplied by three similar circuits on the Canadian side of the river, the two terminal houses being interconnected by three-phase tie lines. From these two terminal houses the Cataract Power & Conduit Company distributes energy to its Buffalo customers. The rate at which the energy is employed and the character of the service can be judged from the fact that the electric railway load reaches 15,000 hp; the city's motor-driven pumping load, 2400 hp; the industrial load, 16,800 hp, and 13,000 hp is often taken by the Buffalo General Electric Company. The industrial load represents the demand of more than 160 customers, whose motors vary in rating from 75 hp to 1200 hp.

On account of the great daily and seasonal variations in the load on a lighting system, it is impossible to assign definite values to the loads. However, the loads on the system of the company often reach the following values:

Three-wire, 220-110-volt direct-current load, 4000 hp; 60-cycle, single-phase load, 4000 hp; 25-cycle, polyphase motor and lamp load, 1300 hp; 500-volt, direct-current motor load, 1600 hp; Brush arc-lighting load, 2700 hp; mercury-rectifier arc-lighting load, 65 hp. These maxima do not occur simultaneously, so that the maximum load on the station cannot be found as the sum of these values. The character of load and its variation can be judged from the accompanying curves showing the load for the longest and shortest days of the year, respectively.

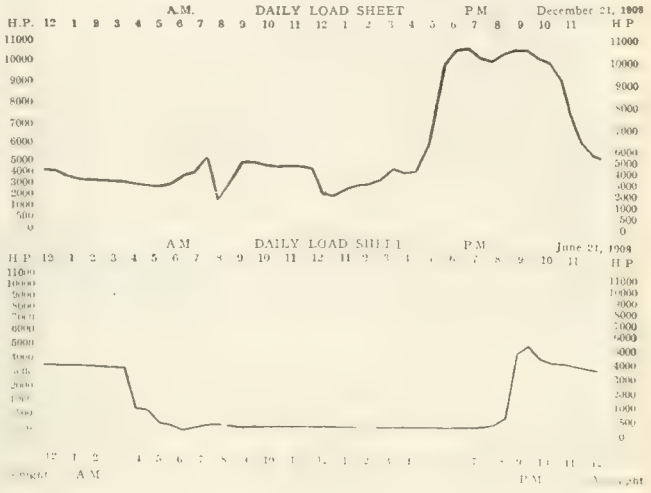


FIG. 2.—LOAD CURVES FOR DEC. 21 AND JUNE 21, 1908.

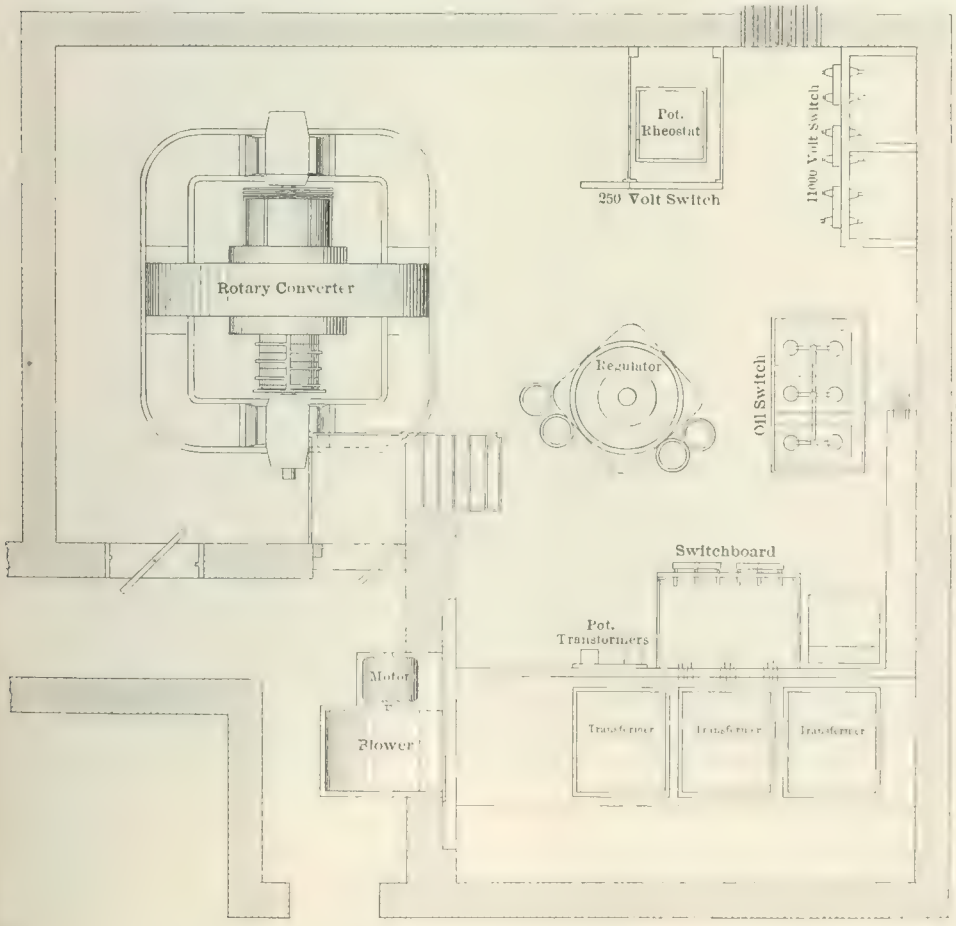


FIG. 1.—GROUND FLOOR PLAN OF SUBSTATION, COURT AND MAIN STREETS, BUFFALO.

In order to carry the above load the company has erected five substations in addition to its main station on Wilkeson Street, which in itself is a substation. In this station, which contains a 14,000-hp equipment in transformers, rotary converters, frequency changers and motor-generator sets, there is an emergency storage battery rated at 800 kw-hours. The Babcock Street substation contains 2700 hp, the Ferry Street 2000 hp, the Swan Street 1350 hp, the Court Street 670 hp, and the West Seneca substation 600 hp. Of these substations the one at the corner of Court and Main Streets is probably the most interesting. It contains a single six-phase rotary converter, with the necessary 11,000-volt switches, transformers, regulators and distributing switchboard, which occupy a flood area of less than 400 sq. ft. in a concrete-lined room dug beneath the sidewalk. This substation equipment, which is located in the heart of the business district, delivers energy to the network of distributing cables less than 10 ft. away. It is used only for peak loads, and is operated by one of the attendants regularly employed at the Wilkeson Street station.



FIG. 1.—ILLUMINATION OF GRANT'S TOMB, RIVERSIDE PARK, NEW YORK.

The Hudson-Fulton Celebration in New York City.

THE Hudson Fulton celebration, commemorating the three hundredth anniversary of the discovery by Henry Hudson of the river that bears his name and the one hundredth anniversary of the beginning of steam navigation on the Hudson by Robert Fulton, began in New York City on Saturday, with the most notable and picturesque marine spectacle yet seen in this country. The celebration will cover a period of two weeks, eight days of which will be devoted to parades and ceremonies, dinners, receptions and various exercises in and about New York City; while the remaining days of the celebration will be taken up with pageants and exercises in the various cities along the Hudson.

For the naval pageant on Saturday, the greatest fleet of war vessels ever gathered in American waters was brought together in the Hudson, forming a line nine miles long. The American navy is represented by 52 war craft, of which 16 are battleships. Besides these there is a squadron of British vessels, and warships from Germany, France, Italy, Holland, Argentine, Mexico and Cuba. The parading fleet of vessels, 40 miles long and divided into 10 squadrons, escorted the facsimiles of the *Half Moon* and the *Clermont* from Staten Island up the Hudson to the water gate or landing at 110th Street, and then circled the battleships and cruisers of the international fleet at anchor off Riverside Drive.



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FIG. 2.—A VIEW OF FIREWORKS AND ILLUMINATIONS.

At night the entire city was transformed. The Hudson River, from the Statue of Liberty on Bedloe's Island to Spuyten Duyvil, was ablaze with light. The entire Jersey coast, from a point opposite the Battery to where the last of the line of warships is stationed, was illuminated. Lamps had been strung along the hulls and rigging of the big liners at their docks and

the fronts of manufacturing concerns abutting the shore were a mass of incandescent lamps. As the light of day faded and the millions of incandescent lamps flashed into view, the outlines of towering skyscrapers and bridges were merged into the night and became magic structures painted into the sky by slender ribbons of fire.

It is impossible to describe the view on the Hudson at night. Promptly at 8 o'clock there gleamed against the dark Palisades the forms of all of the warships outlined in light. Skeleton warships they seemed as the night grew blacker, for nothing of them could be seen except the glowing outlines that were traced against the night. Photographs can give no idea of the splendor of the sight, for it is almost impossible to obtain night pictures of ships owing to the length of exposure necessary and to the movement of the vessels with the waves and with the tide. Those shown herewith give but a faint impression of the actual scene. Besides the warships at anchor were yachts, tugs, steamships and pleasure craft gorgeous in incandescent lights; the *New Amsterdam,* Holland's great steamship, was one of the most exquisite sights in all the brilliant display. Coupled with the electric illumination on the river the fireworks display was beyond doubt the grandest ever given in New York. As far as the eye could see the vast expanse of water seemed to be glowing crimson and gold, a liquid mass of fire.



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Although interest on the opening day was centered on the display in the Hudson River, the East River, which separates the Boroughs of Brooklyn and Queens from Manhattan, was not neglected. As is well known, this river is spanned by four of the largest suspension bridges in the world—the Brooklyn, Manhattan, Williamsburg and Queensboro—and each of these bridges will be lighted throughout the celebration. From anchorage to anchorage, following the catenary curve of the cables and also the lines of the towers, driveways and walks, ⅛-in. steel stranded messenger wires hold, by means of porcelain cleats spaced every 3 ft. or 4 ft., electric conductors of No. 10, No. 12 and No. 14 wire to which the lamp sockets are attached. The greater part of the circuits are of No. 10 wire and these are fed on the Brooklyn, Manhattan and Williamsburg bridges from direct-current, three-wire cables run from the Brooklyn and Manhattan shores, while the lamps on the Queensboro Bridge are fed from transformers spaced along the structure. The lamps used on the bridges are rated at 8 cp, spaced 2 ft. apart, and the Underwriters have given permission to connect from 60 to 100 lamps on a circuit, or as many lamps as the wires will carry current for. Although rubber-covered wire is employed, the current-carrying capacity of weatherproof wire is permitted. In this way it was possible to use made-up circuits in lengths of 1000 ft. and to insert cutouts after the installation was completed and at convenient points. Approximately 13,000 lamps are in circuit on the Brooklyn Bridge and slightly less on each of the other bridges. The electricity for lighting the bridges is furnished by the New York and the Brooklyn Edison companies.

ILLUMINATION OF PUBLIC STRUCTURES.

In addition to the lighting of the bridges across the East River, the committee having the illumination in charge has contracted with the various illuminating companies in the five boroughs to light various public buildings during the celebration. These include the City Hall, Washington Arch, the Viaduct Bridge on Riverside Drive, the Soldiers and Sailors' Monument and Grant's Tomb in Manhattan; the Borough Hall in Richmond; the Borough Hall, Flushing Town Hall and Jamaica Town Hall in the Borough of Queens; the Borough Hall, the Soldiers and Sailors' Monument, Water Tower, Institute of Arts and Sciences and the Martyrs' Monument in Brooklyn; the Borough Hall in The Bronx. With the exception of the tomb of General Grant in Riverside Park, all the buildings are outlined with 8-cp incandescent lamps. It was considered most appropriate to illuminate Grant's Tomb by means of searchlamps. The incandescent lamps are spaced 18 in. apart on the Viaduct and 1 ft. apart on the public buildings. The same general scheme is employed as on the bridges, the circuits and lamps being held by steel messenger wires.



FIG. 4.—FULL SIZE "HALF MOON," JERSEY CITY.

The lighting in the boroughs of Queens, Richmond and The Bronx in connection with the celebration is naturally limited, inasmuch as the seat of the event is in the boroughs of Manhattan and Brooklyn, where the parades will occur. The Borough Hall in Long Island City is outlined and supplied with electricity in the ordinary way by setting a transformer upon a neighboring pole and running the necessary service wires to the lamps. The latter are switched into and out of circuit by means of an oil switch located on the pole at the transformer. At Flushing the old Flushing Town Hall is outlined with lamps and supplied in a manner similar to that in Long Island City, and the same is true of the Jamaica Town Hall. The number of lamps on the three structures in the order given is 650, 415 and 686, respectively.

The chief item of illumination on Staten Island, or the Borough of Richmond, and the most spectacular is a large electric sign with the word "Welcome." This sign is erected on what is known as Pavilion Hill, which commands a view of the entire harbor of New York from Manhattan to the Narrows. The letters are 20 ft. high and the sign contains approximately 1000 16-cp lamps. The sign will be lighted from the evening of the twenty-fifth to and including the second of October. Aside from this sign, the Borough Hall is outlined in a manner similar to that in the other boroughs, the Tucker Electrical Construction Company, of New York, the contractors for the commission, doing the work.

The public illumination in Brooklyn is quite striking. The Soldiers and Sailors' Monument, the Water Tower and the Institute of Arts and Sciences are all situated at the entrance to Prospect Park, one of the most beautiful spots in the country. The section is also the highest in the borough, so that the three monuments of art can be seen for some distance. The Martyrs' Monument is also located on the crest of a hill at Fort Greene Park. On the tripod at the top of the shaft is an enormous urn in which red fire is played. The shaft itself is lighted by means of arc lamps at its base. The Borough Hall basking in the reflected light from illuminated skyscrapers surrounding it is strikingly bedecked with varicolored flags and with incandescent lamps. There are about



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FIG. 5.—NEW YORK CITY HALL.

3600 lamps used to bring out the classic lines of the structure.

In Manhattan the City Hall has lines of electric lamps stretched across the front and sides of the building, up and down the pillars and encircling the dome. All its lines are brought out by the style of decoration employed and the effect is very pleasing. The Washington Arch shows up splendidly under the festoons of fire and every detail of the Sailors and Soldiers' Monument is likewise brought out by simple treatment with incandescent lamps. In addition to the public build-

ings, the line of parade in Manhattan is lighted from one end to the other by incandescent lamps fed from the multiple arc circuits and fastened to 25-ft. iron poles spaced three to the block on each side of the avenue. The line of parade extends from 110th Street and Eighth Avenue to Fifty-ninth Street,

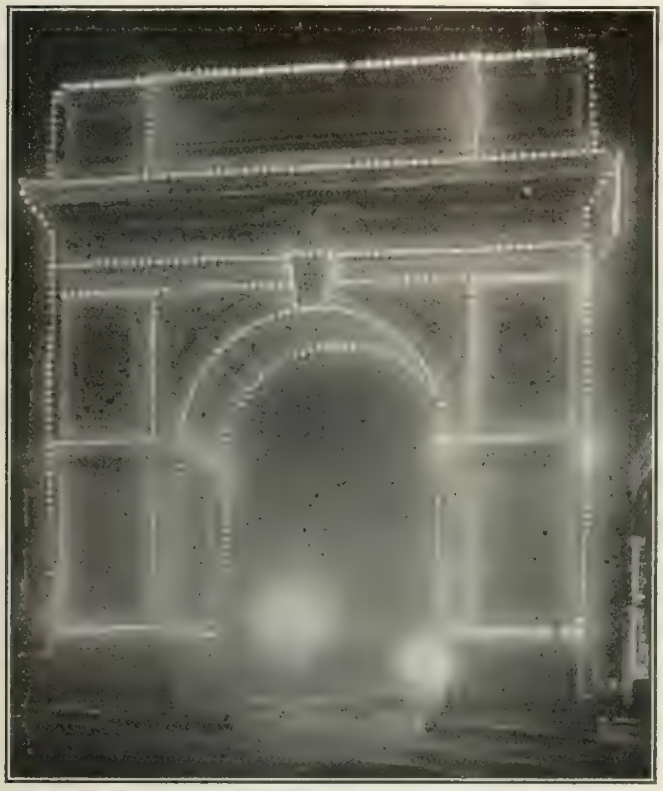


FIG. 6.—WASHINGTON ARCH, WASHINGTON SQUARE, NEW YORK.

thence across to Fifth Avenue and south to Fourth Street. The lamps are spaced 2 ft. apart and approximately 30,000 lamps are distributed along the line. On Fifth Avenue between Fortieth and Forty-second Streets, facing the Public Library, is the Court of Honor. Here 36 pillars of white stucco work, surmounted with Corinthian caps and huge gilded balls, tower



FIG. 7.—HOTEL ASTOR, NEW YORK.

55 ft. above the sidewalk. There are 18 columns on each side of the street and three rows of lamps joining in a circle at the center extend between columns, which are 32 ft. apart. A row of lamps is also placed around the gilded balls and at the two ends and corners the rows of incandescent lamps cross diagonally in addition, being joined in bisecting rings at the center. The lamps are spaced 6 in. apart and besides being looped from column to column parallel with the avenue are also looped across the roadway. The pillars rest on pedestals 7 ft. square at the base and the columns are cylindrical in shape and



FIG. 8.—PLAZA HOTEL, NEW YORK.

5 ft. in diameter. The incandescent lamps are for the most part hidden by foliage. There are over 7000 lamps in the Court of Honor and these were placed in position by means of two 50-ft. movable scaffolds.

The crowning feature of the public lighting is the battery of searchlamps on Riverside Drive and 155th Street overlooking the Hudson. This is the same battery of scintillators designed by Mr. W. D'A. Ryan, of the General Electric Company, for use at Niagara Falls, and the New York Edison Company had



FIG. 9.—VIADUCT, RIVERSIDE DRIVE, NEW YORK.

to install two 200-kw rotary converters near by to supply the direct current for the 40 lamps. The beauty of the scene, especially when the riot of color is mixed with rays of the powerful scintillator, actually beggars description; it must be seen. The battery of searchlamps is located on one of the

highest points along the river front, extending out over the railroad tracks 120 ft. below and commanding a view of the Hudson River from Staten Island to a point opposite Riverdale. The searchlamps are placed in a row north and south and occupy a space more than a block in length. Beside them are large circular disks subdivided into sections containing colored screens, by the use of which fantastic color effects are produced. One hundred feet in front of the searchlamps are steam pipes ranging in height from 25 ft. to 100 ft. The pipes are fed from a 200-hp boiler and the steam forms the curtain upon which the line of scintillators is thrown, as a picture is thrown upon a canvas screen. To give body to this curtain of steam, large quantities of black powder are burned and bombs exploded close to the steam outlets so that the smoke from both the powder and the bombs will mix with the steam. The aerial curtain made by the plumes of steam and smoke mounts nearly 100 ft. There is a great number of color combinations obtainable and various effects which are visible for miles.

LIGHTING ON THE WATER FRONT.

Along the river at the water gate at 110th Street, where the distinguished visitors and guests were gathered on Saturday,



FIG. 10. UNIVERSITY CLUB, NEW YORK.

there is another display of color and light. The two huge pillars of the water gate are snow white in the blaze of light at this point from which naval officers and attachés put out to the ships at anchor in the river.

At various points along the river and on the bay lighting of special interest is visible. On the Shore Road, which skirts the bluff on the Brooklyn side from Fort Hamilton to Owl's Head, three large electric signs are visible. Facing New York Bay is a sign consisting of the American and Hudson-Fulton flags crossed and the years "1609-1909." The flags are in colors and are 25 ft. long, there being 900 lamps in the design. Farther along the road is a sign reading "Welcome" in 12-ft. letters and a huge flagstaff at this point is outlined with lamps. At Owl's Head the Edison Electric Illuminating Company of Brooklyn has erected a sign with 20 ft. letters reading "Brooklyn Edison" in front of its generating station at that point. In the bay the Statue of Liberty is also ablaze with lamps around the pedestal besides the usual torch and presents a magnificent appearance.

On the Jersey shore of the Hudson the Hamburg-American Line and the North German Lloyd have decked the ends of the six piers with 6000 lamps. The former company has its coat of arms and streamers outlining its three large piers at Hoboken and the latter company has the same style of decoration with the addition of the American and German flags in incandescent lamps. The Holland-American Line has the same style of decoration as the Hamburg-American Line and uses 1500 lamps. The various amusement parks on the Palisades are also making quite an elaborate display.

One of the most striking electric signs in the vicinity of Greater New York is the well-known Colgate clock sign in Jersey City. This sign, which is observed by the multitude crossing the Hudson River ferries every day, has been remodeled especially for the Hudson-Fulton celebration, the main feature of novelty being a "life-size" representation of Henry Hudson's *Half Moon*, with waves dashing against it and flags fluttering in the wind. The magnitude of the remodeled sign is shown graphically in the accompanying view, giving the night appearance of the ship with the whole effect



FIG. 11.—SOLDIERS AND SAILORS' MONUMENT, RIVERSIDE DRIVE.

turned on at once. In actual operation the words "Colgate 1806" and the clock, made up of 1000 4-cp lamps, are flashed alternately with the ship and the date 1609, made up of 5000 4-cp lamps. The size of the two-way oil-immersed flasher installed may be appreciated when it is stated that two barrels of transformer oil are required to fill it.

The running rigging of the ship consists of "stringers"—a simple pair of wires, with receptacles connected on 10-in. centers. The shrouds, or ratlines, on the contrary, are of "trough work," as also are the other lines of the design—this construction holding the light localized. The brightness of the whole sign is enhanced by the use of plain lamps with blue, amber and red color-caps. The inside of each trough is painted the same color as the color-cap, so as to reflect only that color. The detail flashing of the ship is by a method giving a good imitation of the motion of the waves and the flapping of the

flags. There are always three adjacent lamps burning and the fourth one extinguished, and this effect progresses from the staff to the free end of the flag. The second row of lamps is staggered, and in it the wave is made to lag behind the wave in the top row; and so on down the vertical width of the flag. The lamps are not arranged in vertical rows, one above another, but in parallel rows following curved lines struck from the common center. This gives the natural slanting wave to the flag. Other refinements in wiring and flashing are the producing of a short wave of the flag near the staff, winding up with a long wave at the end of the flag.

The same wave motion obtained by this method of flashing is applied to the representation of the to-and-fro motion of a pendulum actuating the clock that forms part of this sign. The pendulum consists of a stem and a bob. The figure of the stem (which is three lamps wide) and of the bob (which contains 31 lamps) is in effect moved to and fro across the travel of the pendulum by the operation of the flasher. Thus in the stem, three lamps are always glowing, one being lighted ahead, in the simulated swing of the pendulum, just as the one in the rear is extinguished. The lamps, of which there are 388, arranged on 10-in. centers, are cut in and out of circuit in such a way as to progress the figure of the pendulum from one side to the other. The complete sign is 200 ft. long by 50 ft. high and contains about 5000 lamps. The clock face is 38 ft. in diameter and the name of the manufacturer occupies a space 160 ft. x 20 ft. The dates are in 11-ft. figures and the ship is 58.7 ft. long on the water line and 78.9 ft. long over all.

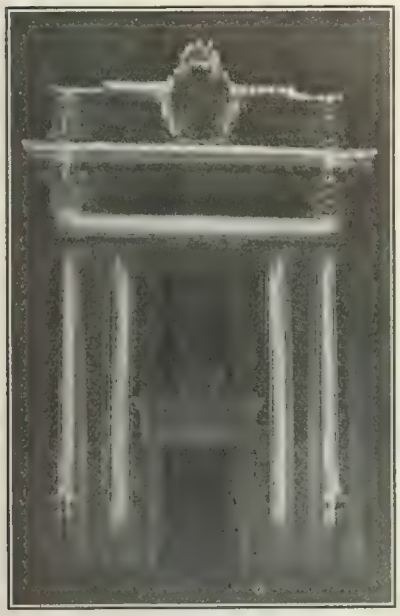


FIG. 12.—DIME SAVINGS BANK, BROOKLYN.

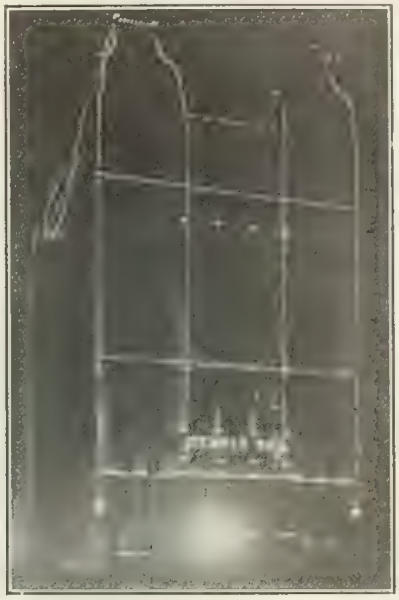


FIG. 13.—TEMPLE BAR, BROOKLYN.



FIG. 14.—BROOKLYN EDISON COMPANY'S BUILDING.



FIG. 15.—BROOKLYN AND MANHATTAN BRIDGES.

One of the most brilliant displays in the entire city was the illumination of the New York Edison Waterside station at Thirty-ninth Street and the East River. Every portion of the huge station was outlined and even the chimneys were enhanced by spiral lines of light.

GENERAL ILLUMINATION IN THE CITY.

During the celebration Fifth Avenue vies with Broadway as a new "White Way." The two continuous lines of lamps supported over the sidewalk light up the thoroughfare brilliantly. Towering high above Madison Square the lofty spire of the Metropolitan Life Insurance Building may be seen for miles.

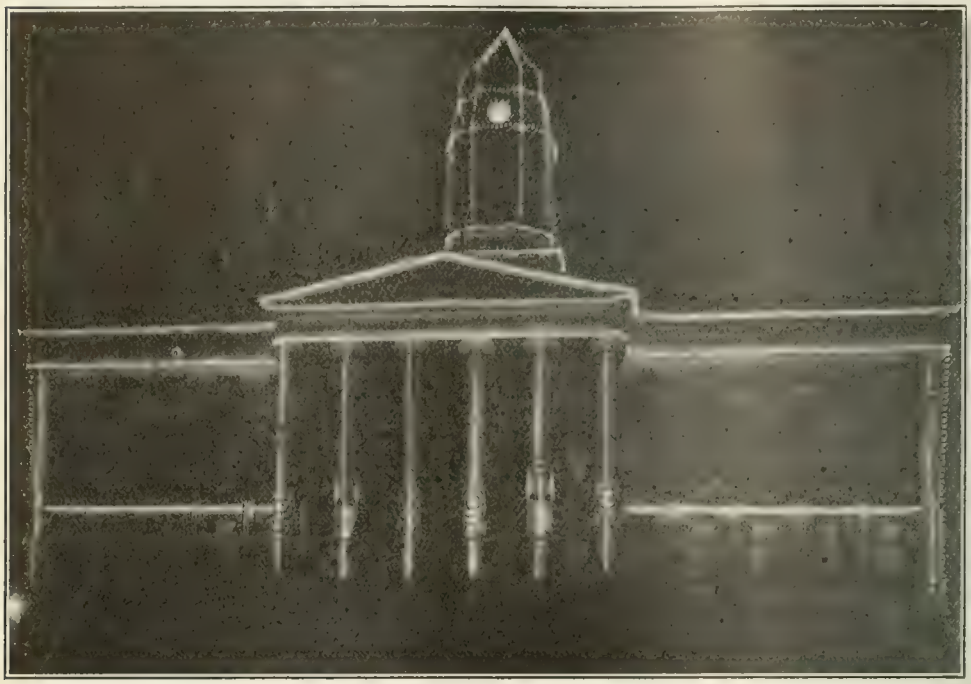


FIG. 16.—BOROUGH HALL, BROOKLYN.

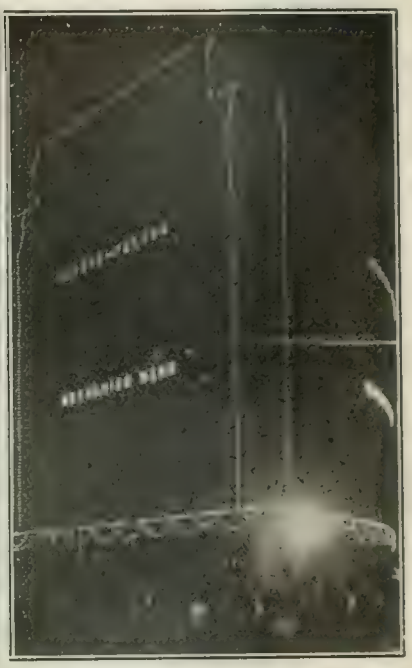


FIG. 17.—MECHANICS' BANK, BROOKLYN.

The 26-ft. dial of the clock is illuminated, together with the 17-ft. hands and 4-ft. figures, and every room in the 46 stories is a blaze of light. Not a shade is drawn at night and each room is lighted so that the massive tower stands out prominently. Surmounting the tower, more than 700 ft. above the ground, is a ball radiant with electric light. At the northern end of the Fuller Building at Twenty-third Street a model of a Dutch windmill is set up. The sails, bright with light, revolve slowly and by their beams a typical Dutch house can be seen behind a grove of trees.

A number of stores have marked out on their arcades large squares of light, but the Holland House is more elaborately decorated. Colored lamps are fitted to the corners of the structure and over the entrance blazes a large red and blue star, and the front is festooned in white lamps.

The Waldorf-Astoria has long chains of lamps arranged in the form of a pyramid and across the street the Knickerbocker Trust Company's handsome structure is shown off to advantage. The same is true of the Gorham Building. Tiffany's, across the avenue, features a clock surrounded by several hundred lamps arranged in floral design. The Union League Club, the Union Club, the Democratic Club and the University Club are all outlined and decorated. From between the towers of St. Patrick's Cathedral is suspended a large electric streamer. The Plaza Hotel emphasizes its graceful lines by lamps. Between the windows from above the fifteenth floor strings of lighted incandescent lamps are suspended and behind them shines the white marble walls. On the roof the *Half Moon* and other appropriate designs are outlined in colors. The Netherland Hotel is also outlined and a number of private residences.

On Broadway every restaurant and theater is lavishly bathed in light. The Knickerbocker Hotel, with its curious cornices

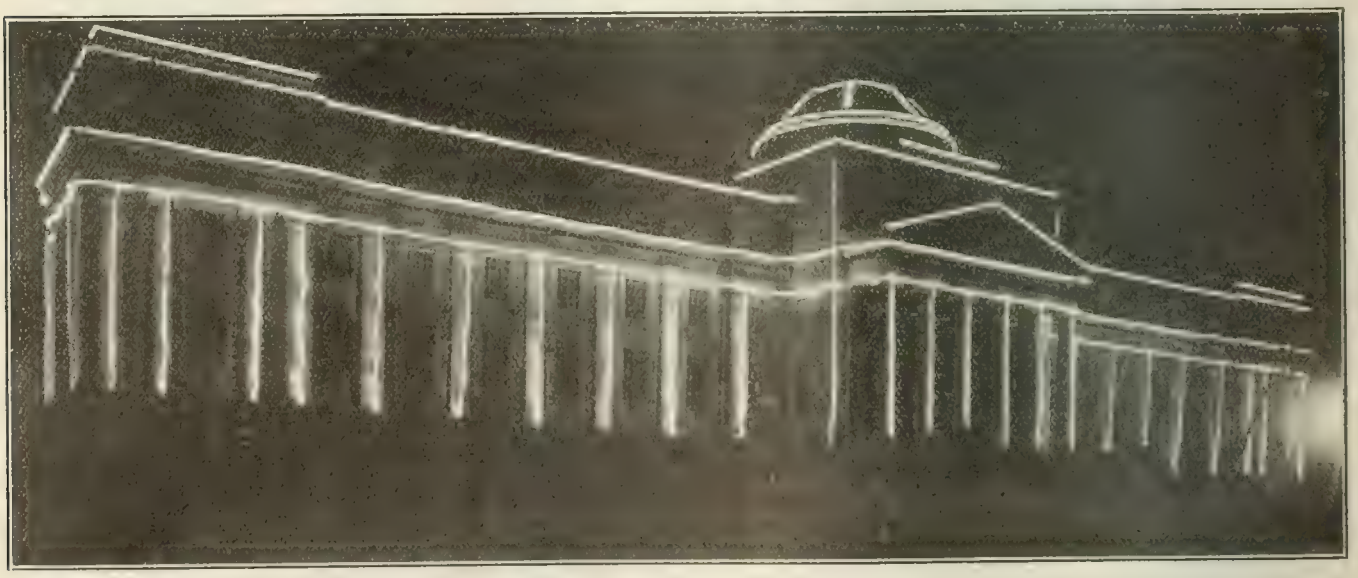


FIG. 18.—BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

and quaint pinnacles, makes a striking appearance, but not more so than the Hotel Astor with its front hidden beneath masses of green foliage. The evergreen mingles with string upon string of incandescent lamps and the balcony at the third floor is hidden by the prow of a copy of the *Half Moon*. The



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FIG. 19.—TOWN HALL, JAMAICA.

boat projects from the wall of the building and extends over the street about 30 ft. Electric lamps outline the hull, rigging and mast. The new grand ballroom in the hotel was lavishly decorated for the banquet, which took place there on Wednesday night.

Many of the large apartment houses and office buildings are making their presence known by means of electric lamps. In Brooklyn the Edison Company has lighted a number of sky-scrapers around the Borough Hall, notably the Temple Bar and the Mechanics' Bank Building. Its own office in Pearl Street is outlined with light and makes a handsome and striking appearance.

The week beginning Oct. 3 will be devoted to celebrations in the Hudson River towns above New York City. On Monday, Oct. 4, there will be celebrations at Yonkers and Poughkeepsie.



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FIG. 21.—TOWN HALL, FLUSHING.

Tuesday exercises will be held at Nyack and at Kingston. Catskill will be visited on Wednesday, and on the same day Tarrytown will hold its official celebration. Hudson will act as host for the fleet on Thursday, and Friday the fleet will reach Albany. Peekskill will celebrate on Friday also, and on Saturday the fleet will reach Troy. On Oct. 1 the naval parade will start from New York for Newburgh and the celebration in New York City will close with a carnival on the evening of Oct. 2.

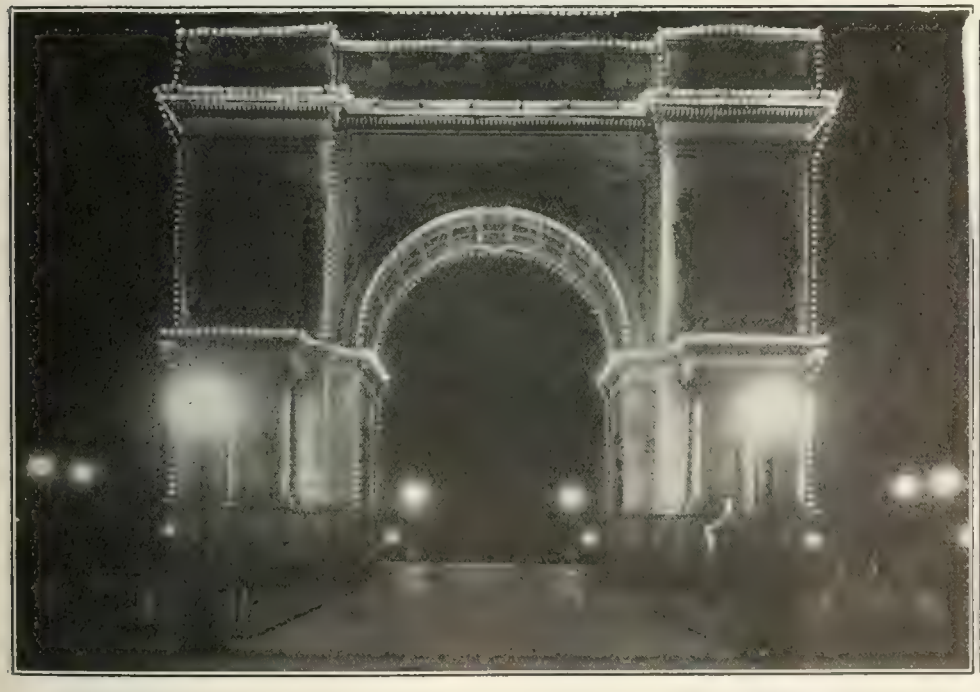


FIG. 20.—PLAZA ARCH, ENTRANCE TO PROSPECT PARK, BROOKLYN.

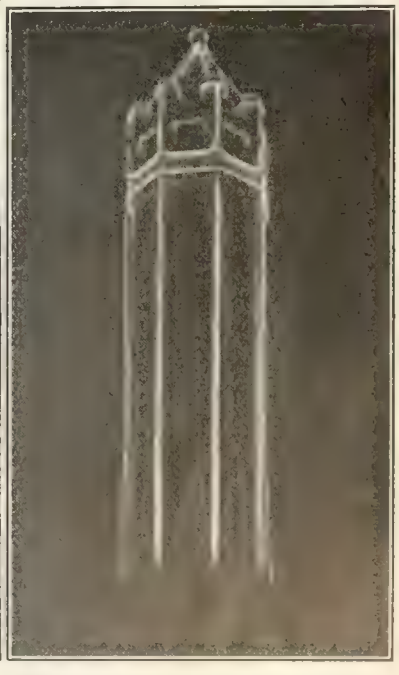


FIG. 22.—WATER TOWER, BROOKLYN.

Some Casual Remarks on Dampeners.

By Warren H. Miller.
Electrical Engineer, Standard Oil Company.

LIKE most subjects in which but very little is really known and settled upon, the battlefields of the dampener question are still lurid and sulphurous, and bid fair to remain so until shall ensue that holy calm which only broods

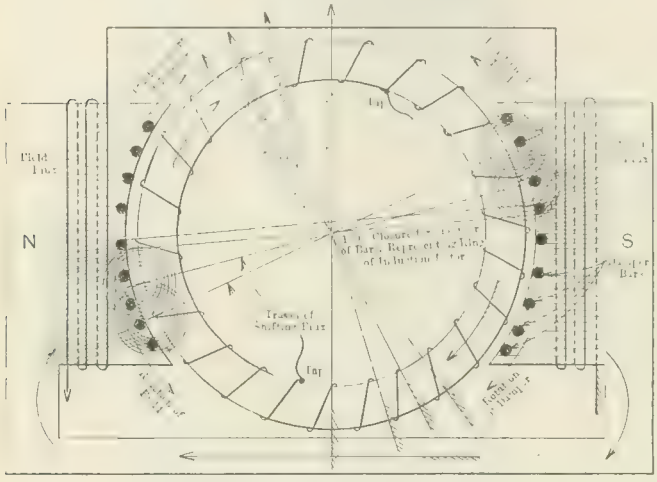


FIG. 1.—ACTION OF ELEMENTARY DAMPER.

o'er the stricken field when all the bewhiskered combatants are dead.

Briefly stated, the *casus belli* is as follows: Given an alternating-current generator or synchronous motor with a revolving field whose prime mover has a tendency to hunt, lag and overtravel, such tendencies will not only distort this field, but displace it mechanically from the true position of synchronism.



FIG. 2.—POLE-PIECE SLOTTED FOR DAMPER GRIDS.



FIG. 3.—GRID DAMPERS IN PLACE ON POLE-PIECES.

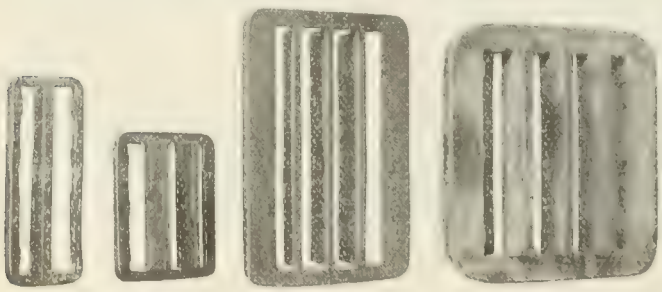


FIG. 2A.—GRID DAMPERS.

As this impulse is oscillatory and cumulative, what will be the best means for providing an electrical discourager, so to speak, of these tendencies to fly off the handle?

Obviously something placed on the pole-piece, in which currents would be induced by any change or distortion of the lines of force, will resist such changes, as its current will always be counter-active. This thing has a name, and many queer shapes, wild visions of demented brains, almost more weird than those strange, tortured cries published in current literature as "magazine poetry." The French call it an amortisseur or deadener; we name it a dampener or damper.

There is no questioning the efficacy or utility of the damper, and its importance is at present vastly increased in view of the rise of the large gas engine as a prime mover for alternators. For, in the present state of the art of governing gas engines, parallel operation is nowhere really satisfactory—compared to a first-class steam-engine plant with flywheel governors. Plant after plant tells the same story—ammeter and wattmeter needles swinging like pendulums, continuous overtravel and lag of governors, generators hot on half loads under heavy cross-currents traveling from one alternator to the other to pull them back into synchronism. These currents are *not* wattless as some would fondly imagine; they are real energy expended alternately on each machine, the fast one trying to bring the other up to its speed and in doing so slowing itself down so that it in turn becomes the slow machine. This action is oscillatory, as the flywheel becomes the reservoir of these impulses; and, unless the governor is prompt to interfere and dampeners are present, it is only a question of time when the two machines will throw each other out of step. With three machines in parallel this action becomes less violent, and with four still less so. With governor and flywheel properly designed so as to play into each other's hands, and dampers on the pole-pieces further to deaden any tendency to hunt, parallel operation becomes satisfactory and desirable.

But at present gas engine governors are far too sluggish to give anything like the practice of good Rites or other types of steam-engine flywheel governors, and two of the largest gas-engine manufacturers, recognizing this defect in parallel operation, are already in the field with a time-cut-off mixing valve which renders the governing far more prompt and efficient. The other aid to good parallel operation is the electric damper. It has been used for years and found indispensable in operating rotary converters, which are exceedingly prone to hunt. There are some 600,000 kw of these rotaries in New York City alone provided with dampening devices. Their use on slow-speed Corliss engines has been comparatively undeveloped, and on high-speed engines not at all, as there is no need; but on gas-engine units they have proved of great value wherever introduced.

Fig. 1 shows the action of a primitive damper. In a three-phase machine with 100 per cent power factor there is no tendency at all on the part of the armature to disturb the existing magnetic flux, which is, of course, the resultant of the field and armature flux acting approximately at right angles to each other, but at any leading power factor there is always a component, dependent on the angle of lead opposing the field flux and tending to crowd it over to one side. With a damper on the pole-piece, currents are at once set up in the damper if any

change is thus made in the field flux which counteracts this distortion and forces the field flux to remain practically as before the disturbance. Further, if these currents are given direction parallel to the revolving shaft, the currents flowing in the damper will also cause instantaneous rotation of the field pole itself in a direction opposite to the acceleration and thus tend mechanically to resist displacement of the field pole.

Now observe how beautifully these two theoretical phenomena are provided for in practice in the field of damper designed by the various combatants. Knight No. 1 vows that neither theory is worth a whoop, mounts his hobby and spurs into the arena with *his* damper, which turns out to be no damper at all, just a plain steel pole-piece in which eddy currents are set up. It works all right, but the temperature of the poles reminds you of John Chinaman's way of roasting a pig by burning his house down. He swears there's nothing the matter with it, though, but if you turn your back he will fill the shoe full of copper rods to give the eddy currents something to take hold of, and if you kick at the ventilation he will cheerfully bore it full of radial holes for you.

Knight No. 2 just puts a plain copper shoe on the pole-piece. It may bother him some to keep it there and the magnetic flux has to hunt for fresh air to get into the stator at all, but he is sure to hatch out a proper crop of "eddy currents" when the engines surge, so he speaks contemptuously of the steel-pole caitiff and bowls him out of his saddle. Knight No. 3 is content with a copper collar 2 in. thick around the pole-pieces. It doesn't worry him at all that this copper is 'way off at the edge of all the really important lines of force and has no iron back of it to provide a magnetic conductor—the flux is the thing, man, he argues, and he has *that* cinched in the middle of the pole-piece where it can't be distorted! So he lays about him lustily with this invention, and the other two varlets flee for

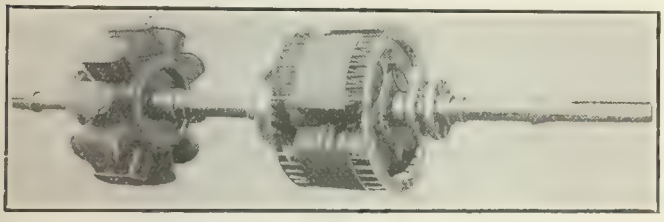


FIG. 5.—AMORTISSEUR WINDING APPLIED TO MOTOR-GENERATOR SET.

their lives and are later overtaken by the vengeance of God for their sins.

And now enter the lists the two heavy-weights. They have given this damper question some thought and have, forsooth, built all the known dampers at present in existence that anybody ever heard of. Ye knighte of the copper collar retires under the grandstand to think out how he's going to hold his collar on with no head atop of it, and we now have heralded dampeners that *are* dampeners. Figs. 2, 3 and 4 show very clearly the admirable construction of the Westinghouse dampener; Figs. 5, 6 and 7 that of the General Electric. You see at a glance they are considerably at variance. One company has thrown the induction rotor idea to bosh and scorn and is going in strong for field flux anti-distortion alone. The other sees your field distortion *and* the "eddy currents," and goes you a complete squirrel-cage rotor better!

Poor purchaser! Here are five valiant knights, each on his own hobby, all riding at him at once. He is told with considerable warmth by the engineer of each company that "those other fellows" have been filling him with hot air, not to say downright heresy, and he is given no credit at all for doing any of his own thinking. He eats a dinner with all of them in turn, and boils down all the facts which he marshals and numbers and sets out in a row as follows:

1. The best anti-hunting device is one that will always *drag* behind any sudden change of rotation.

2. The best electrical device to do this is the rotor of a squirrel-cage induction motor because it always lags behind a rotating field. At synchronism it does no work. The more it slips the greater its torque.

3. The best rotor for a squirrel-cage induction motor is the one which gives the induced currents direction parallel to the rotating shaft, and the more subdivided within well-known design limits, the better is its effective torque.

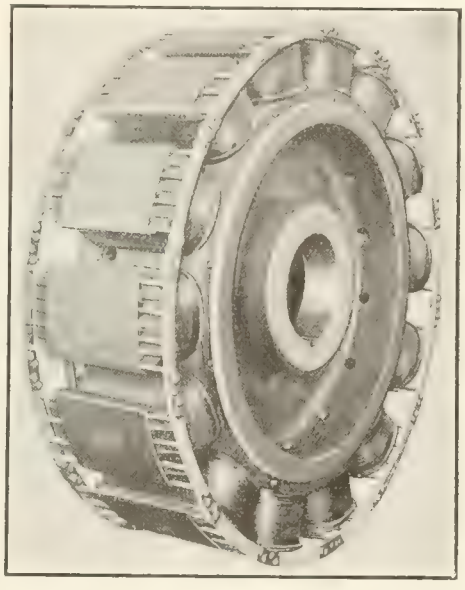


FIG. 6.—AMORTISSEUR WINDING FOR GAS-ENGINE GENERATOR.

4. Each rotor bar must have 180 electrical degrees of closure in order to enclose the maximum lines of force. This can only be done by a complete short-circuiting ring at each end, so that any given bar can have a continuous circuit to and through the corresponding bars on both adjacent poles, thus getting 180 electrical degrees of closure each way.

Now, while other considerations affect the ideal rotary converter dampener, for gas engines in parallel the above facts admit of no modification. If one engine's governor gives it too much momentary power, it speeds up, and its frequency and that of the other machine instantly rise above synchronism. Both dampers are now dragging behind the three-phase rotating fields in the stators (don't confuse this with the revolving-field pole-pieces), and, the greater the acceleration, the stronger the drag of the dampers. The momentarily fast machine, having spent so much energy in trying to bring up the other, becomes in a few seconds the slow machine itself, and drops below synchronism, taking the other machine electrically with it. Both dampers are now too fast and strive to go after their respective stator fields, with the result of pulling them back to

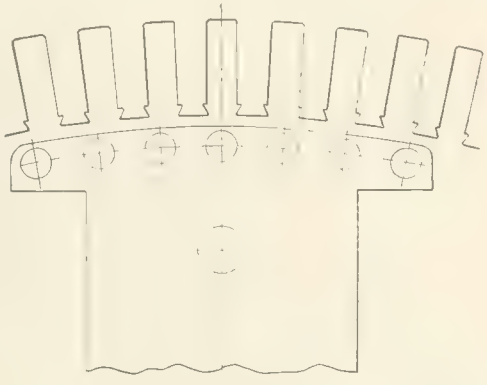


FIG. 7.—AMORTISSEUR FOR 500-KVA MACHINE.

speed, since the damper is tied to the engine and takes the engine with it. No matter what the disturbance, whether change of gas, backfire or premature, too much governor or too little governor, a big motor going on or off the load, the damper is always "agin'" it, like the unreconstructed Confederate soldier.

For maximum anti-hunting power, then, the damper design which most nearly approaches an ideal squirrel-cage rotor is the best. If a copper grid is used, conducting wedges, well-machined to provide good electric contact, are an absolute necessity, or else the two inner bars of the grid are practically worthless since they neutralize each other in one position, and have no complete closure in the other. The man with the copper collar has a very primitive rotor, practically without short-circuiting rings on the ends, and the parties with copper shoes and steel pole-pieces have gone still further back, almost to the copper cylinder of the original induction motor, which was very feeble and prone to heat owing to absolutely undirected induced currents and exceedingly poor magnetic flux. One can dismiss these types as primitive, except that the permanence of the steel pole will cause it to be heard from again in the paralleling of alternators.

There, then, remains the grid and amortisseur types of dampeners. While the amortisseur is undoubtedly the ideal, the strong construction and good ventilation of the grid type will always make it a formidable competitor, since the interpole wedges, if well machined, will give in effect a continuous short-circuiting ring for the bars of the rotor. It also permits of easy removal of the field coils, and, of course, by putting in somewhat more copper than with the amortisseur design one can secure an equal quantity of mechanical dampening effect. Regarding the effect of the damper in neutralizing the back ampere-turns due to strong armature reaction, the grid type possibly accomplishes this better than the armotisseur, but a careful consideration of its action will bring you right back to an elementary pair of bars of a squirrel-cage rotor. What is wanted in gas-engine paralleling at present is something mechanically strong to assist the governor and flywheel of the gas engine to resist the disturbing effects of change of gas and load, and above all to smother out periodic hunting. Specifications for gas-engine-driven generators are usually drawn calling for 2 per cent regulation from no load to full load, and a maximum of not more than 2½ electrical degrees of displacement of the pole-piece from either side of mean position of synchronism.

Now, the gas-engine builder can easily fulfil both of these conditions, and yet the paralleling may be wretched. In a machine of, say, 500 kw, a 60,000-lb. flywheel at 150 r.p.m., will provide ample rotative steadines for even 60-cycle work, and the 2 per cent regulation is largely a matter of getting the engine big enough, and a little more. But when two engines fulfilling both these conditions are put in parallel, the usual result has been, to date, continuous hunting over a considerable range on either side of synchronous speed, the ammeters of both machines swinging restlessly up and down the scale, stopping at brief periodic intervals at the true load current for the output, and the wattmeters weaving uncertainly across the load-point, varying about 35 kw on either side of a 100-kw load. The generators, running at half load, are hotter than they should be at full current, and the station men prefer to run the machines separately, and will run them separately if there is any possible combination on the switchboard which permits them to do so. They do not dare load the engines up, experience having taught them that any disturbance on the line, such as starting up some large motor, is quite likely to throw them out of step, if well loaded, and shut down the plant.

Obviously this is poor paralleling, yet the engines fulfil both regulation guarantees of the specification. The cause is simple enough. If you shut down the generators you will very probably find the pole pieces provided with some very primitive type of damper, or else a simple interpole copper wedge. The designer either has not calculated his damping effect (which can easily be done by the well-known laws governing induction-motor design) or else he has been unwilling to sacrifice a little efficiency, with the result that the machines are sacrificing something like 25 per cent of their output to hold each other in step. And the prime cause of it all is almost invariably too sluggish a governor. The control must be prompt, strong and able. If there is a change in the load, or in the gas, or a backfire, the governor must be quick to readjust the quality and quantity of the mixture. It will not answer to let the governor do this three or four strokes after the change. By that time the flywheel has slowed down or speeded up, and altered the governor out of all proportion to the disturbance, with the result of corresponding overmuch admission of gas and undue acceleration. The other machine, of course, has to bear the brunt of this, hence the surging, as precisely the same overtravel of governor follows on it. The gas and air must be varied right at the inlet valve and it must not be done by sliding ports which will wire-draw the gas at light loads, but by complete opening of both air and gas ports, the *time* of which can be varied by the governor, so that the gas and air are always placed in the cylinder without being disturbed by any change in the shape of the orifice. The amount of the charge is determined by the time of cut-off, which is varied to suit the load by the governor.

This form of valve gear has already been put on the market for alternators in parallel by two of the largest gas-engine manufacturers in the country, and, assisted by powerful dampers on the pole pieces and a correct proportion between armature reaction and field strength, should enable us to run gas-engine stations in parallel with the clock-like smoothness of any good steam plant.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

"Seeing Denver" Illumination.

By C. H. Stannard.

Denver is, as *Electrical World* readers know, termed the "City of Lights," this name having been suggested by Mr. Henry L. Doherty. At the present writing, Seventeenth Street is being equipped with eight constant potential arcs to the block, similar to the installation recently made on Fifteenth Street and Sixteenth Street.

This addition to Denver's street lighting, in connection with the many new electric signs, has brought our city into such prominence as the "City of Lights" that one of the "Seeing Denver" companies, operating large "Seeing-Denver" auto cars having a seating capacity of about 30 passengers, has found it to its advantage to inaugurate a night service, the object in view being to show Denver as the "City of Lights," giving tourists and others a splendid opportunity of seeing what has been accomplished by the Denver Gas & Electric Company in developing its window, sign, display and street lighting.

It is particularly interesting to observe that many people are glad to take advantage of this opportunity, which makes it on the part of the "Seeing Denver" Company a most popular enterprise.

One noticeable feature of our sign lighting is the fact that there is no danger of a tourist going out at night expecting to see some specially attractive sign, and finding it dark, for the reason that all signs are on the flat rate, burning from dusk until midnight, and some of them all night.

When we explain to our sign prospects that tourists are taking such an interest in viewing our night signs, we find that the prospect is much more easily approached in connection with installing a sign than before this evening service was inaugurated.

Wallingford (Conn.) Municipal Plant.

The report of Superintendent A. L. Pierce, of the Wallingford, Conn., municipal plant, for the year ending July 31, 1909, shows an income of $29,751 and operating expenses of $18,205. Five per cent appreciation and 5 per cent capital charge were charged off on a total investment of $79,976. Further deductions were made on account of incandescent lamps ($2,891), arc lamps ($228), automobiles ($250), etc., aggregating $3,528, the net gain being $15.50. The present total valuation of the plant is $121,559.

The total capacity of the steam and water-power plant is 505 kw, that of the former being 385 kw and of the latter 120 kw. The total connected load is equivalent to 15,000 16-cp lamps. The total output was 490,055 kw-hours, of which 59 per cent was generated by steam and 41 per cent by water. Electric irons to the number of 160 are in use, and 70 motors. The basic residence rate is 10 cents per kw-hour, but if 35 per cent of the lamps connected are used two hours or over daily, the rate is reduced to 8 cents. The flat rate for sign lighting is 9 cents per month for 2-cp lamps and 16 cents for 4-cp lamps. In case connections are made to a building with an isolated plant, there is a standby charge of $5 per year per kilowatt of transformer installed, and the rate for any current used is 10 cents per kw-hour.

Useful Figures from Practical Power-Plant Operation.

Mr. P. H. Palmer, of the Kokomo, Marion & Western Traction Company, Kokomo, Ind., read an interesting paper entitled, "Central Power-Station Practice" at the meeting of the Indiana Electric Light Association at French Lick on Aug. 18. Remarking that from 60 per cent to 80 per cent of the total cost of central-station lighting is traceable to the power station itself, Mr. Palmer said that an effort toward greater economy, particularly in the boiler plant, is well worth while. So far as coal is concerned, dealers' guarantees are usually based on ideal test conditions, seldom taking into account the numerous losses due to auxiliaries, condensation, etc., met with from day to day. This often accounts for apparently poor records of coal in the station.

In the plant with which the writer is connected there are two 1000-kw steam turbines, one being held in reserve. With a 27-in. vacuum and a 50 per cent average daily load factor, the feed water required is 30½ lb. per kw-hour. This consumption was found to be distributed approximately as follows: 24½ lb., or 81.7 per cent, to operate the turbines; 3.2 lb., or 10.7 per cent, to operate the condensers; 1.1 lb., or 3.6 per cent, to operate feed, tank and cooling-water pumps, and 1.2 lb, or 4 per cent, for moisture, condensation, leakage, blowing out boilers, etc. As will be seen, 18.3 per cent of the steam is not used by the generating units themselves. The curve of steam consumption for the turbine rises quite rapidly on very light loads, bringing the average to 24.5 lb. per kw-hour during the 24 hours. The efficiency of boilers and furnaces works out at 57.5 per cent—a fair average for an every-day result.

To obtain a higher evaporation, better grades of coal were used, but it was found that the improvement did not compensate for the increased cost of coal. The coal used is Illinois slack. In the matter of selecting coal it is difficult to make a definite rule. Apparently the central-station manager could afford to pay for coal in proportion to the heat units contained, yet some coals are exceptions to this rule and some plants are also exceptions on account of certain conditions. One can learn much about the combustion in his plant by testing for CO_2 in the different passes of the boilers. If the gases contain only 5 per cent or 6 per cent of CO_2 the manager has an opportunity to increase efficiency by trying different manipulations of draft and thickness of fires and stopping leaks in boiler settings. In buying coal there should be an investigation to determine definitely what is best for that particular plant. For one thing, it should be determined whether the coal deteriorates rapidly from exposure to weather in storage.

Direct-acting feed and tank pumps almost invariably consume a great deal of steam. In plants where the exhaust steam cannot be used in the feed-water heater, it will usually pay to use electric pumps for every purpose except boiler feeding.

In the engine-room intelligent and skillful help is needed as well as in the boiler-room. The engine-room attendants should not be kept steadily on the same shifts, but should be changed about so that each one will learn each "run" in the plant. Each man should be taught the value of observation and of records made from observation, which are the source of all improvements. He should be taught that power-plant daily records should be kept as correctly as the bookkeeping accounts in the office. Automatic devices should not be relied upon too much, but should be inspected at regular intervals.

The switchboard attendants should be taught to appreciate fully the value of uniformly correct voltage at the center of distribution. A pair of pressure wires connecting the secondary of a transformer carrying an average lighting load near the center of distribution with a voltmeter in the plant, is of great assistance in maintaining the voltage right with hand regulation.

In keeping the daily log sheet, the total load, at least in kilowatts, should be plotted in a curve. The daily log sheet should contain the principal records of station operation, but should not contain too many details. The total results of the boiler-room and engine-room should be kept separate, and in obtaining these the greatest difficulty is the accurate measurement of the feed water. This is somewhat simplified if it can be done before the water enters the heater, as hot-water meters are well known to be unreliable for continuous use, according to Mr. Palmer.

The writer gave some interesting comparisons of average economies effected during some of the stages of growth passed through by many stations. In a small lighting plant, furnishing 400 kw-hours to 800 kw-hours each night from belt-driven, simple, non-condensing engines and horizontal tubular boilers, the plant being shut down during the day, the cost per kw-hour, with $1.50 slack coal, will average about as follows: Coal, 1.5 cent; labor, 0.65 cent; lubricants, waste and miscellaneous supplies, 0.1 cent; repairs, 0.06 cent; total station operating cost, 2.31 cents per kw-hour at the switchboard. On the other hand, the large, well-regulated, modern station with well-developed day load, furnishing 40,000 kw-hours or more per day, with equipment operating at 70 per cent load factor, will produce a kw-hour at the switchboard for the following operating costs, using the same coal as in the case of the smaller station: Coal, 0.38 cent; labor, 0.13 cent; lubricants, waste and miscellaneous supplies, 0.01 cent; repairs, 0.02 cent; total, 0.54 cent, or only 22 per cent of the cost of the small station.

In the Kokomo station, which furnished an average of 12,083 kw-hours in 1908, a medium between the two cases cited is reached, the station operating cost being 0.72 cent per kw-hour. This is made up as follows: Coal, 0.47 cent; labor, 0.20 cent; lubricants, waste and miscellaneous supplies, 0.02 cent; repairs, 0.03 cent; total, 0.72 cent. This station has been improved by the addition of new equipment during the last three years, and a decrease in operating cost from 1.1 cent per kw-hour for 1906 to 0.72 cent per kw-hour in 1908 is due about equally to more efficient equipment and to increased output.

In this particular plant the cost of conveying coal and ash by mechanical means would be about 5 cents per ton. Doing this work by hand costs 12 cents per ton. The changes in the equipment of the plant so far made have reduced the steam consumption from 42 lb. to 30½ lb. per kw-hour. The principal change was the replacing of reciprocating, direct-connected condensing engines by turbo-generators and jet condensers.

In some plants it is deemed desirable to generate alternating current only and convert to direct current in order to maintain

an already established direct-current power service. Mr. Palmer said that the loss in his company's motor generators and storage batteries operating with a 40 per cent load factor and supplying railway energy is 32 per cent.

It is often good policy in making changes in equipment to utilize some of the old equipment for short-hour peaks and for reserve, providing this equipment is reliable. In order to cancel a 12 per cent interest and depreciation charge on a $50 investment per kw-hour installed for improvements, a saving of 0.82 cent per kw-hour would have to result from the investment if the equipment were only operated for an equivalent of two hours at full load each day. If this equipment should generate enough energy each day to equal its full load for 10 hours the saving required to cancel the interest and depreciation would be reduced to 0.16 cent per kw-hour, and 24-hour, full-load service would reduce this required saving to 0.07 per kw-hour.

In discussing this paper, Mr. Fred Leslie, of Muncie, Ind., asked for a comparison of Indiana screenings and Indiana mine-run coal in plant operation. Mr. Palmer answered that the latter gave an increase of 5 per cent in evaporation, but the difference in price more than overcame this economy. Mr. C. C. Perry, of Indianapolis, called attention to the fact that the figures given covered only station cost and not interest, depreciation, administration and other overhead expenses which must be added in determining the true cost of producing electrical energy by the central station.

Increasing the Central-Station Profits at Geneva, Ill.

The central-station situation at Geneva, Ill., is specially interesting for two reasons. This station, which is municipally owned and combines electric light and water-works service, is now giving all-day electric service and pumping city water for a lower fuel bill than before the introduction of the day electric service. The day service resulted in taking on a motor load of single-phase, 133-cycle motors amounting to 87 hp connected and the motor service is as satisfactory as in any plant of this size.

In the summer of 1908 the electric plant was being operated at night only. The water works were operated continuously because of the possibility of fire and the limitations of the pumping apparatus. The conditions as regards water pumping were fatal to economy. To lift water but a few feet out of a deep well an air compressor with 14-in and 16-in. cylinders by 16-in. stroke was operated. This air-lift system was installed because of the mistaken idea of those previously in charge of the plant as to the requirements. As is well known, the air lift is not an economical method of raising water from a well. There are many cases where its use is proper because it increases the output of a well over and above the output which could be obtained with a deep-well pump. It also has the advantage of requiring no moving machinery in the well, as does a deep-well pump. However, the well from which the Geneva water works is supplied has the water so near the surface when being pumped that the use of the air lift is unnecessary.

The operation of this large air compressor for such a short lift seemed so obviously uneconomical to Mr. Olof Peterson, the superintendent of the plant, that he began to investigate by pumping from the well with one of the boiler-feed pumps to determine the amount the water would be lowered if the well were pumped continuously at a rate sufficient to supply the city. As a result, he found that the water remained within easy suction reach of a pump placed at the surface. This indicated that the water might be pumped much more economically by a small power pump taking by suction from the well and discharging directly into the mains against standpipe pressure. The air lift was discharging its water into a surface reservoir, from which the water was pumped by a compound, non-condensing direct acting Dean steam pump, 12 in. x 18½ in. x 11 in. x 18 in., which is much too large for ordinary requirements.

About this time the people of Geneva began to ask for day electric service. Mr. Peterson realized that to add this service and continue the existing water-pumping conditions would be to add much more to the operating expenses of the plant than would be added to the gross receipts. He reported to the Mayor and Aldermen, however, that if it could be arranged to change the ordinary pumping of the city water to an electrically driven power pump operated 20 or 24 hours per day, the plant would probably run on the same or less coal than the two plants were then consuming with the electric plant operating nights only. The electric generating plant contained 133-cycle, alternating-current apparatus. The usual objection was raised by several electrical men who were consulted that 133-cycle apparatus is not suited to power service. Mr. Peterson, however, learned of a number of single-phase plants operating 133-cycle, single-phase motors, and after a visit to Logansport, Ind., where a number of such high-frequency motors are in service, reported to the City Council in favor of the installation of a motor-driven pump for water-works service; the starting of 24-hour electric service to supply this pump, and whatever else was offered in the shape of daylight business. At that time the demand for motors was apparently secondary to the demand for day service for flatirons, fans and basement lamps. Inside of a year, however, a motor load of 87 hp was connected.

One of the most interesting facts in connection with this was the saving in fuel which resulted. For a period of eight months under the new arrangement the coal bill was $300 less than for the corresponding months of the previous year, using the steam-pumping machinery. The results, therefore, prove that Mr. Peterson's estimates that the day service would be operated for the same amount of coal were very conservative. The reason for the saving is the economical use of steam in the automatic cut-off engine used for driving the electric generator as compared to the uneconomical use of steam in the large air compressor and large fire-pressure pumps, plus the wastefulness of the old methods of pumping by air lift.

The pump which now does all the water-works pumping except in case of fire, is a triplex 6-in. x 8-in. Dean, with a capacity of 150 gal. per minute. It pumps direct from the well into the mains against standpipe pressure with a suction lift of 19 ft. and a discharge pressure of 65 lb. It is driven by a 12-hp, 110-volt, 133-cycle Wagner motor, and during the summer is operated 20 hours per day. It has been steadily in service since installed. In order to get the necessary speed reduction a 60-in. pulley is placed on the pump and driven from a 9-in. pulley on the motor. As a 60-in. pulley would be likely to cause vibration of the pump if dependent upon the pump foundation entirely an outboard bearing has been placed on the end of the pump shaft, which carries the pulley.

The comparative size of the pumping machinery formerly used for every-day service and that which now performs the same service is an amusing example of what can be accomplished with the application of engineering knowledge to a problem of this kind. The steam pump formerly used had a daily capacity of 1,500,000 gal., as against 216,000 for the present electric pump, to say nothing of the air compressor which was operated.

As another result of the day service, 75 flatirons have been connected to the lines during the past summer.

Single-phase, 133-cycle Wagner motors have been connected as follows: City water, 12 hp; two sawmills, 10 hp and 25 hp, respectively; ice-cream factory, 3.5 hp; grain elevator, 7.5 hp; centrifugal pump, 10 hp; centrifugal pump, 5 hp; concrete mixer, 12 hp; printing plant, 1.5 hp; monument works, 5 hp; a total of 87 hp. An electric welding machine also uses 25 hp when operating. The day load at the time the writer visited the plant was fairly steady at 40 amp. At starting-up time morning and noon this load occasionally rises to 80 amp at 1100 volts.

The electric plant has been recently enlarged and now has

a capacity of 240 kw in alternating-current apparatus and one 45-light, 6.6-amp Wood arc-dynamo. The unit ordinarily operated to carry the day load is a 100-kw alternator driven by a Ball high-speed engine. A 60-kw alternator driven by a 50-hp engine is not usually sufficient to carry the day load. The last unit installed consists of a Ball engine of about 200 hp belted to a 120-kw alternator and the arc-dynamo. The boiler plant consists of two horizontal, return-flue boilers, 60 in. x 16 ft., and one boiler of the same type, 72 in. x 18 ft. The usual practice has been to operate two boilers continuously without regard to the amount of load to be carried.

The switchboard, which was built at the plant, was equipped with double-throw oil switches for each feeder and generator In this way the load can be distributed between the generators. Each feeder has a watt-hour meter attached for measuring the output. There is one meter for each of the following services: City water pumping, constant-potential street lamps, series street arcs, direct-current and miscellaneous light and power service.

There are 45 6.6-amp, direct-current series arcs and 30 6-amp, 110-volt, constant-potential arcs for street lighting, making a total of 75 arcs, which indicates unusually good street lighting for a city of only 3000 population.

The accompanying table shows the kw-hour output for various purposes, and the coal consumed by months from Feb. 1 to Aug. 1, 1909. The switchboard watt-hour meters were not installed previous to this period. The coal consumed is taken from a record of the amount received with reductions for the amount apparently on hand at the end of each month. While this is not exact for any one month, for a period of seven months it is probably sufficiently accurate for practical purposes. In the case of July the actual coal consumption was estimated to be 366,270 lb., instead of 300,000 as given in the accompanying table.

COAL AND OUTPUT RECORD

Month, 1909.	Total Coal, Pounds	City Water Pumping.	Alternating Cur. Arc.	Direct-Current Arc.	Commercial Light and Power	Total.	Coal Per kw-hrs lbs.
February	360,000	3,782	1,220	2,722	16,190	23,914	15.1
March	366,000	4,132	1,050	2,095	15,590	24,867	14.7
April	310,000	4,591	1,130	2,220	14,660	22,601	13.7
May	300,000	4,929	1,050	1,960	12,250	20,189	14.9
June	300,000	4,677	930	1,715	12,320	19,642	15.3
July	300,000	5,042	970	1,900	14,620	22,532	13.3
August	300,000	4,680	1,290	1,632	15,940	23,542	12.7
Total	2,236,000	31,833	7,640	14,244	101,570	167,487	
Average							14.2

During this month, however, the air compressor of the water plant was operated temporarily to supply compressed air to the contractor for drilling in the construction of a new bridge near the plant. It has, therefore, been considered fair to deduct 66,270 lb. from the July consumption as chargeable to the air compressor, which makes the July electric plant consumption the same as the preceding and following months. Coal costs $2.58 per ton, delivered.

The plant is operated by one man, except during the first half of each night, from 6 p. m. to 12, when there are two men. The men work in 10-hour shifts. This requires three men for the entire operation of the power plant. There is one electrician for outside work in addition to the superintendent. No other men are employed. The books are kept by the city officers.

Meters are tested once a year, and all consumers are meter-connected. The city, however, allows free one lamp in front of each store for street-lighting purposes. The City Hall is also lighted without a meter. Including the electricity used on these unmetered lamps the percentage lost and unaccounted for is 25. The consumers' meters are tested in place with the use of a Westinghouse portable watt-hour meter.

The lighting rates are 15 cents per kw-hour, with a discount of 5 cents per kw-hour for payment before the twentieth of the month. The power rate is 5 cents per kw-hour, with a discount of 1 cent per kw-hour. The minimum bill is $1 per consumer.

INTERIOR WIRING AND ILLUMINATION

Old-Time Wiring.

The accompanying illustrations are reminders of the state of the electric wiring art in the early days of electric lighting. Above 100 of the connection blocks for pendant cords, which then answered the purpose of rosettes, were installed some 20 odd years ago in the Cheyenne Industrial Club Building, of Denver, at that time belonging to the Cheyenne Club. The greater part of these are still in use and no serious fires have resulted. In fact, aside from some local scorching, so far as can be learned, there has been no fire, all of which goes to prove to some members of the club that the fire hazard of electricity is greatly overrated.



AN EXAMPLE OF OLD-TIME WIRING.

Denver Theater Electrical Installation.

An interesting stage equipment has just been placed in the Denver house of the Orpheum Theater circuit. This equipment was installed as a part of the general effort on the part of the management to assure its patrons of the safest possible conditions in the building. The stage is wired entirely in conduit with standard steel borders and foots and with continuous flexible feeds to the borders, which latter are supported by steel cables with strain insulators. The dressing-rooms are lighted by fixed lamps on the side walls, with the guards locked



FIG. I.—ORCHESTRA AND STAGE, DENVER THEATER.

to the receptacles. The signal circuits, including circuits to annunciating boards, are also run entirely in conduit and have an independent marble switchboard. This board also contains the signals to various parts of the stage and the general fire alarm of the building. The annunciator panel is of all steel construction, with the wiring circuit in conduit. All wires are soldered to the receptacle terminals. The stage boxes are watertight, and located under the stage, being connected through

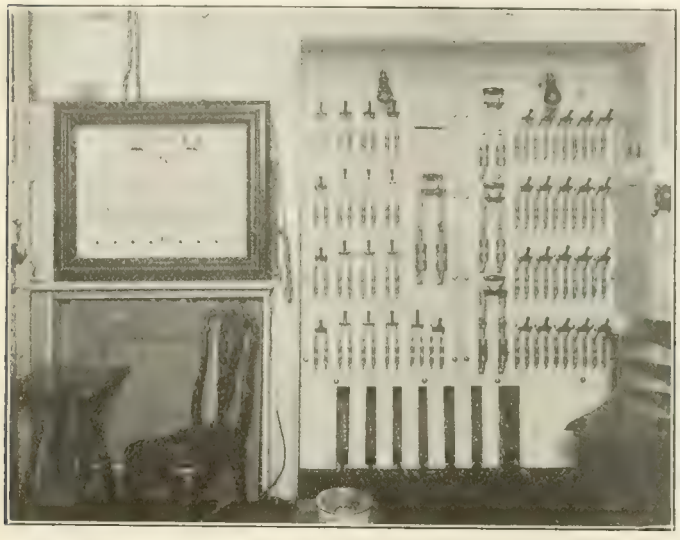


FIG. 2.—SWITCHBOARD, DENVER THEATER.

lead-covered armored cable to plugging boxes on the stage floor. The moving-picture booth, which is entirely of steel, has a skeleton of 2-in. angle iron and spring-operated shutters held open by fusible links.

This is the first of the older theaters in Denver to be rewired in accordance with modern construction methods. The signal boards and booth arrangements were designed and constructed by the Commercial Switchboard Manufacturing Company, of Denver.

Industrial Plant Illumination with Tungstens.

By Arthur Gillman.

In spite of their frailty and recent development, tungsten lamps are already used to a surprising extent for industrial-plant illumination. It would naturally be assumed that because of the fragile filament they would be unsuitable for shop and mill conditions, but advantages offered as to better light, economy, reliability, simplicity and convenience are so alluring that devices have been developed to protect the delicate tungsten filament against the jars and shocks incident to factory installations.

It should be understood that tungsten lamps are recommended for general illumination only, and then where the units can be located out of danger of contact with adjacent bodies and out of reach or in lock sockets. They are not recommended for specific illumination, such as that provided by bench lamps or lamps arranged around machinery on flexible cords. The carbon-filament lamp is best suited for these conditions. The best results for general illumination seem to be provided by the utilization of high-power lamps (250 watts) or the grouping of several lower-power lamps into a cluster.

In some instances it will prove economical to replace enclosed-arc lamps by the new rival, selling the old arc lamps for what they will bring. Certainly no new factory-lighting system should be installed without first considering tungstens. The average actual life of a tungsten lamp is in the neighborhood of 1000 hours. This means that under ordinary factory conditions, when used for general illumination, each lamp should last about a year without renewal or attention. Enclosed-arc lamps require frequent adjustment, trimming and repairs, each with its probable interference with production. Considering the cost of these items, cost of electricity consumed and interest on investment as against cost of electricity and any operating and annual charges for a tungsten-lamp installation, providing as satisfactory an illumination, it will be found that the yearly cost will be less with the tungsten lamps

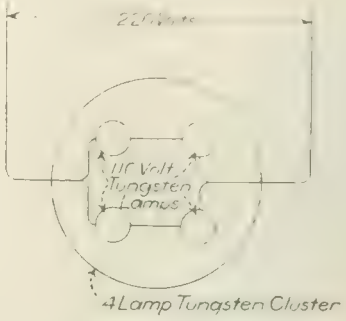


FIG. 1.—DIAGRAM OF CONNECTIONS.

than with the enclosed-arc lamps. On alternating-current circuits the low power factor inherent to alternating-current arc lamps is wholly avoided where tungsten lamps are used.

The flaming-arc lamp has its own field in the illumination of wide areas, where it can be located high above the plane to be lighted or for advertising. It is not suited to a majority of industrial-plant conditions where the ceilings or roof trusses are comparatively low. The function of this paper is to describe some methods whereby the difficulties inherent to tungsten lamps installed under factory conditions may be overcome and whereby these efficient illuminants may be made available for industrial-plant installations.

In plants where current at a tension of 220 volts is available 110-volt tungsten lamps may be wired across 220 volts two in series, as shown in Fig. 1. Manufacturers have for some time advertised as being prepared to furnish 220-volt tungsten lamps, but very few have been made and deliveries have been slow. Recent developments indicate, however, that the problem has been solved and that it will be shortly possible to secure 220-volt tungsten lamps with reasonable promptness. It is claimed that the 220-volt tungsten lamp has the same specific

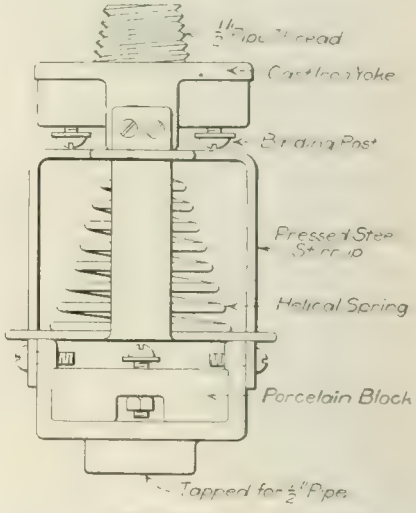


FIG. 2.—COMMERCIAL JAR ABSORBER.

consumption (1.25 watts) and life as the 110-volt lamp. It should be noted that the specific consumption of a 220-volt carbon-filament lamp is somewhat below that of the 110-volt and also that the useful life is shorter.

Local conditions determine whether, in designing a tungsten installation, clusters or single lamp units should be used. It costs less to wire for a few clusters than for, say, four times (assuming four-lamp clusters) as many single lamp units;

but if uniformity of illumination is essential, the latter scheme must be followed. Four-lamp clusters have gained much favor for factory lighting. Each is usually equipped with four 60-watt or with four 100-watt lamps. It is difficult to see why it would not be better from all standpoints—simplicity, economy and appearance—to use one 250-watt lamp with a suitable reflector than four 60-watt lamps. It is probable that the movement in favor of the four-lamp cluster started before 250-watt

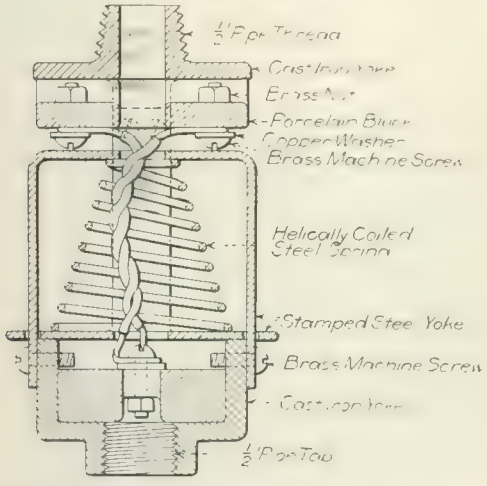


FIG. 3.—LONGITUDINAL SECTION OF JAR ABSORBER.

lamps were obtainable and that its inertia is carrying it forward. If 110-volt lamps are used on 220-volt circuits, a cluster is desirable to avoid complications in wiring. Arc lamps consuming 400 watts have been replaced by 250-watt tungstens equipped with prismatic glass reflectors and the illumination bettered thereby. As a general rule it is well to install as few lamps as possible, each of as high a power as conditions will allow.

When a tungsten lamp is installed in a location where it is subject to jars and shocks it must be hung from some vibration-absorbing device to insure against breakage. Anything that will prevent vibrations in the supporting member from reaching the lamp will do. If the disturbances are not excessive, a piece of lamp cord or a rope interposed between the lamp and its support will answer; but if sudden shocks occur a spring appears to be the only solution. A commercial device for supporting tungsten clusters in factory installations is shown in Fig. 2 and a section of the same appliance is given in Fig. 3. The weight of the cluster is taken by a helical steel spring under compression and the appliance is manufactured in four different strengths for supporting clusters of any weights from 4 lb. to 15 lb. In installing the "jar absorber" it is interposed in the conduit stem to the cluster and the leads to the cluster are clamped under the brass machine screws and washers mounted on the lower porcelain block. Electricity is conveyed by two conductors, carried in the length of conduit supporting the absorber, to the two binding posts on the upper porcelain block and thence, by a piece of duplex lamp cord furnished with the absorber, to the binding posts on the lower porcelain block. The spring is helically coiled with the small end uppermost to secure a maximum of resilience. The threadings at the two ends are for ordinary conduit and may be obtained for either ½ in. or ⅜ in. The device is 5 in. long over all and weighs about 1 lb. In locations where appearance is a factor the upper nipple can turn into a crow-foot fastened to the ceiling and the absorber concealed with a canopy. In order to conform to National Electric Code regulations an insulating joint should be interposed between the absorber and the supporting surface if it be grounded metal work or a plastered ceiling.

Wiring of High-Grade Apartment House.

By N. M. Schoonmaker.

The apartment house recently erected at 636 Fifth Avenue, New York, stands as a type of the high-grade work which the city is getting in its new buildings. The old phrase, "all modern conveniences," has been stretched till it embraces service such as, even 10 years ago, it was not thought possible to get outside of the best hotels. Besides the usual conveniences, the owner of this new building supplies to his tenants an unusually elaborate system of telephones, a Holmes protective system, messenger calls, a clothes drier, a plate warmer, a refrigerated box, a vacuum sweeper and thermostat compressors in each apartment.

The ground floor of the building (Fig. 1) is taken up with two large stores which open upon Fifty-first Street, the main entrance to the apartments on Fifth Avenue, a reception hall and a bedroom for the use of the superintendent of the building. The basement beneath the stores is let with the stores, and is connected to them by means of stairways. There are also two sidewalk lifts, one for each store. The remainder of the basement, which is taken up with the laundry, lockers and toilets, is entirely cut off from the store basements. Excavation for the sub-basement was made only under a portion of the building, and here is located the boilers, tanks, pumps and main switchboard.

The Edison 240/120-volt service enters the building through the basement from Fifty-first Street, the feeder for the lamps being three-wire, 1,200,000 circ. mil cable and for the motors two-wire, 500,000 circ. mil cable. These feeders drop to the sub-basement and run thence in straight lines to the switchboard.

The switchboard is of marbleized slate, 1½ in. thick, with the usual angle-iron frame and pedestals and with a polished copper molding 2 in. wide around the front. The lamp and motor circuits are on separate slabs. Below the board to the floor the

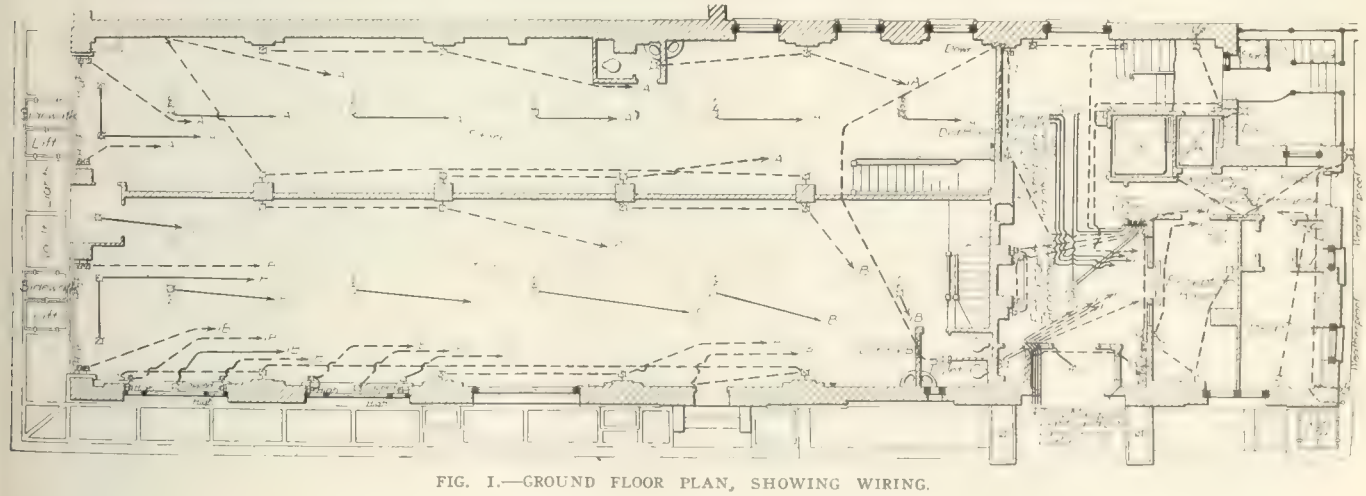


FIG. 1.—GROUND FLOOR PLAN, SHOWING WIRING.

space is enclosed in 1-in. slate, while at the top and ends of the board electro-bronze grille work is used. The feeders run to the top of the switchboard, and there are on the board 50 all-copper knife switches for lamps and motors. Rigid iron conduit is used, running into slate-lined distribution boxes, which have a trim that matches the interior finish. The outlet boxes are of iron, enameled inside and out with white porcelain. The wires for all the electrical work are of the best quality copper, 98 per cent conductivity, and the wiring and conduit work throughout are such that either direct current or alternating current may be used. The meters for the tenants' lamps are located on the switchboard, and thus the occupants of the various apartments are spared the visits of the meter readers. The heating receptacles in the laundry, which will be more fully described later on, are also wired so that they can take energy through the respective meters.

The panel boards are 1-in. slate, with three busbars connected through double-pole knife switches and open-link fuses. The busbars run up the center and have fuse-posts on either side, with the main lugs and switch at the end. Each panel has a main switch of 25 per cent greater capacity than the entire panel, and a "goose-neck" and key socket for a possible lamp. This latter is placed on a separate circuit switch with a white handle, placed in the same position on all panels. Each circuit is numbered and the distribution boxes are provided with diagram and scale-plan, showing the lamps controlled and the size of the fuses.

The switches for local control in the various rooms are placed on the knob-side of the door and are of the push type. Where there is more than one switch, engraved gang-plates are provided, the switch which each push controls being marked above it.

The following motors were wired for:

1 sump pump	3 hp	1 freight elevator	10 hp
1 sump pump	2 hp	1 ash hoist	8 hp
2 house pumps	5 hp each	2 sidewalk lifts	8 hp each
1 vacuum cleaner pump	12 hp	2 thermostat compressors	2 hp each
1 refrigerator compressor	15 hp	1 clothes dryer fan	½ hp
2 circulating pumps	3 hp each	2 outlets in sub-basement	5 hp each
1 passenger elevator	20 hp		

Among the special features already enumerated in the apartment house is the plate-warmer which was installed in each butler's pantry. There plate-warmers are constructed with a cast-iron frame, nickel-plated, and a Russia iron body and door. The triple walls are asbestos filled, with a thermometer on each door. Each warmer is provided with the proper switches for three heats, and is connected to the wiring by means of a heating plug and receptacle. The warmers are 3 ft. 2 in. wide, 16 in. deep and 24 in. high, outside measurements, and have one shelf.

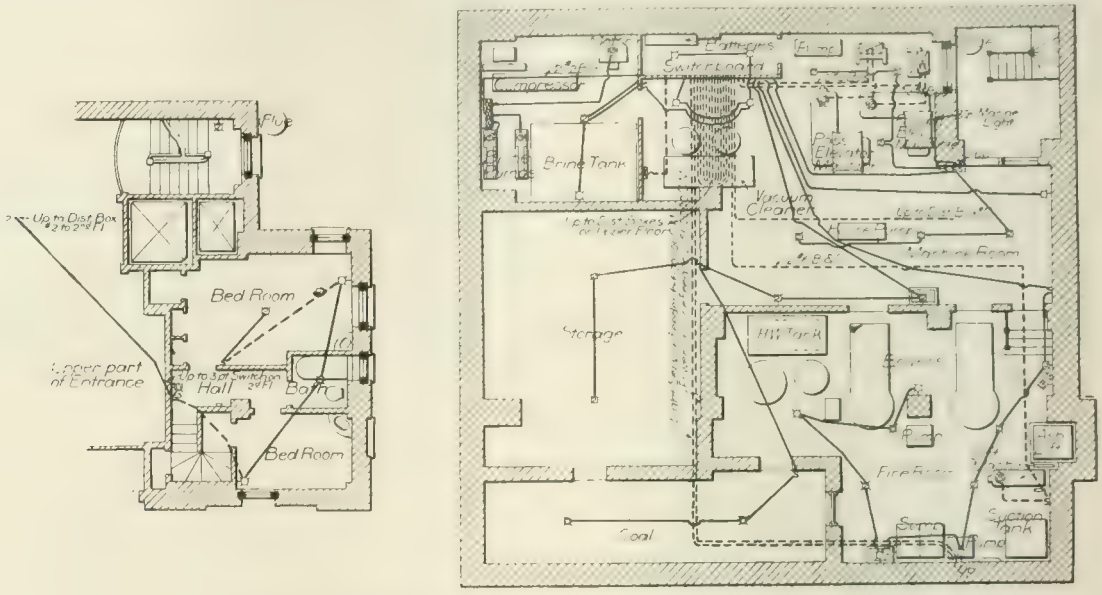


FIG. 2.—METHOD OF FEEDING BASEMENT LAMPS AND MOTORS.

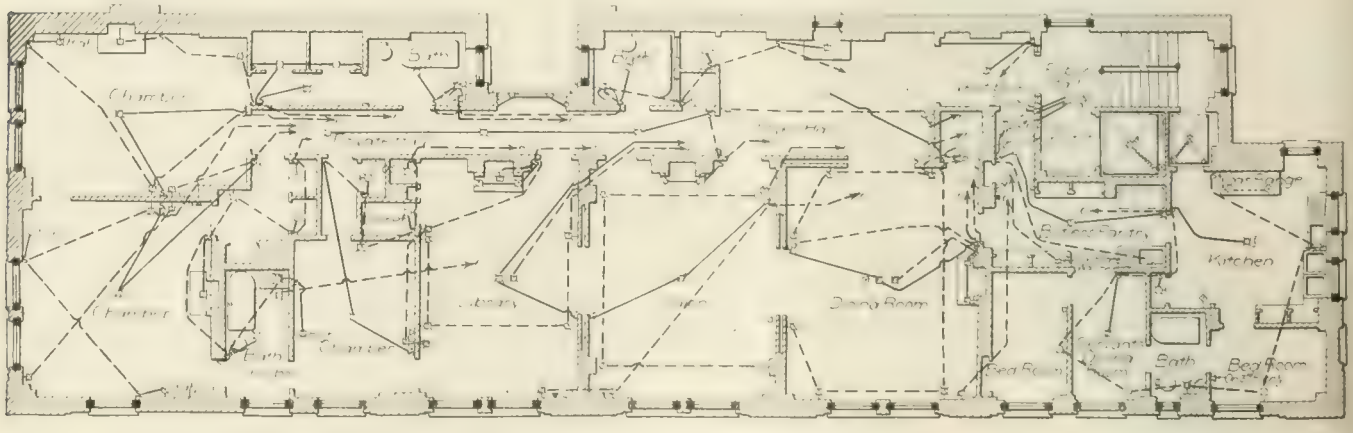


FIG. 3.—PLAN VIEW OF SIXTH FLOOR.

The laundry conveniences are another feature which is more than commonly elaborate. Besides the clothes dryer, equipped with electrical fan, there are also in this basement laundry, special arrangements for the use of electric irons. Above each of the five ironing-boards there are two outlets, each one closed with a strap or hasp which locks on and to which the

respective keys are held by the tenants. Thus the energy is charged the proper meter.

An unusually elaborate low-potential system was also installed, consisting of call bells, three telephone systems and a Holmes protective system. The connection boxes for this work in each apartment are built like distribution boxes, with one compartment for the public telephone, one for the Holmes system and one for all other wires. The public telephone system has outlets in the stores on the first floor, in the public entrance hall, in the superintendent's apartment and in the butler's pantry of each apartment. Each of the two messenger call companies also has a call box in the butler's pantry of each apartment.

There are two systems of private telephones in the house, one for use throughout the building and an intercommunicating one in each apartment. The former of these has outlets in the boiler-room, laundry, tradesmen's entrance, in the twelfth floor hall, in the superintendent's office, and in the butler's pantry of each apartment. The switchboard for this system is of the hotel drop annunciator type rearranged so as to be set in a table and is located in the main hall. Twenty stations are provided for, with all the devices and attachments which make a durable and reliable telephone switchboard.

The intercommunicating system is very complete, the outlets varying slightly on the different floors. The sixth floor plan which is shown is fairly typical, and here the outlets are in the library, the butler's pantry, kitchen, and the servants' bedroom. But on this floor all the servant's quarters, except the additional bedroom with each apartment, which is supplied on the twelfth floor, are in the apartment. On the second and eleventh, the servants' quarters are arranged on mezzanines, connected to the apartments through private stairways. The twelfth-floor arrangement is elaborate; besides the bedrooms, mentioned above, there are four living-rooms and baths connected with the servants' bedrooms.

The call-bell system includes an annunciator in the boiler-room, connected to the ash lift on the sidewalk, the entrance of the machine-room and the main entrance, this latter being also wired to the annunciator in the hall. The sidewalk pushes ring in the respective stores and the push at the service entrance is connected to a bell at the foot of the service elevator shaft. Each apartment has an annunciator in the kitchen which is connected to push buttons at the front door, hall, service elevator shaft, salon and each bath. Each dining-room has a combination floor and extension push connected to a buzzer in the butler's pantry.

As will be seen from the above description, neither the architect, Mr. Alexander M. Welch, nor the engineers, Pattison Brothers, have spared any pains to bring the apartment house up to the level of the highest modern demands. It gives to its occupants all the conveniences of the hotel and yet preserves the privacy of the home.

New Telephone Patents.

WIRELESS TRANSMITTING CIRCUIT.

An arrangement of circuit for associating a telephone transmitter with a radiating conductor forms the subject of a patent granted to Mr. Harry Shoemaker, of Jersey City, N. J., and assigned by him to the International Telegraph Construction Company. An electric arc is supplied with current of a frequency above the limit of the ear.

A shunt circuit is then put around the arc, this shunt containing capacity and inductance and including one winding of an induction coil. A telephone transmitter is then arranged to effect the shunt circuit, either by direct inclusion in it, or by subjecting the arc to a magnetic field controlled by the transmitter. The primary circuit thus formed is adjusted to a natural period above the limit of the ear, yet low compared to an oscillating frequency such as exists in the radiating conductor, and the induction coil winding of the primary circuit is associated with a secondary winding connected to the radiating circuit. By this means there is impressed upon the radiating circuit the current fluctuations set up by the transmitter.

AUTOMATIC SELECTOR.

The automatic selector always consists of two main elements, namely, the contact bank to which is connected the various circuits, and the wipers with their selecting motor or motors.

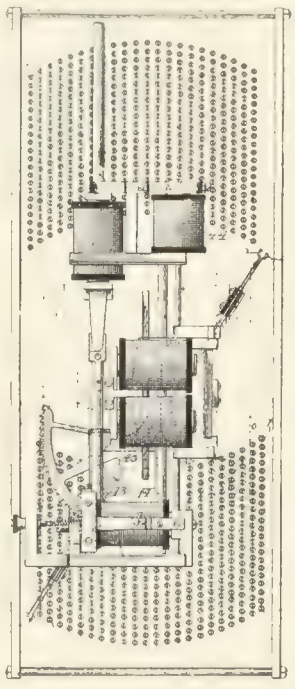


FIG. 1.—LOVERIDGE SELECTOR.

These two are, of course, interdependent, as the wipers must operate to conform to the terminal scheme of the contact bank. Heretofore the terminals have most often been arranged in horizontal rows upon a cylindrical surface, the terminals projecting radially inward. These wipers, therefore, have a vertical motion longitudinal of the axis of the cylinder and a rotary motion about this axis.

Mr. F. K. Loveridge, of Chicago, Ill., has patented a selector with another arrangement of terminals which can be reached by one vertical and one rotary motion. This is shown in Fig. 1. It will be seen that the vertical motion moves the carriage carrying the horizontal rotating shaft. This latter, with its arm, may then swing over the circular contact row. The arm swings free of the contacts and is then drawn home by a connecting magnet. The patent for this selector is assigned to the Western Electric Company.

TELEPHONE CIRCUITS.

Common battery switchboard circuits of the two-wire and three-wire types are frequent, but the one-wire circuit recently patented by Mr. J. L. McQuarrie, of Oak Park, Ill., is quite novel. The circuits are so arranged that the cords are of the

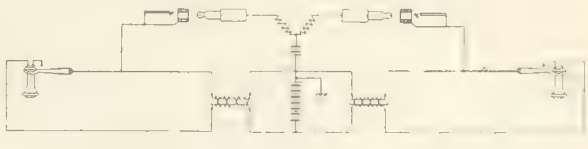


FIG. 2.—M'QUARRIE SWITCHBOARD CIRCUIT.

single-strand type and but one wire per line need be carried through the jacks. The rudimentary circuit is shown in Fig. 2. It will be seen that for currents originated at any station the double-wound coil—in reality that of the line relay—is cumulative in its effects so that the talking current prefers the jack branch. For received currents the double winding is differen-

tial and, therefore, offers little obstruction. The patent for this system is assigned to the Western Electric Company.

Two other patents assigned to this same company refer to a combined intercommunicating and exchange system, or what might be called an intercommunicating private branch exchange. Both refer to key arrangements to secure the proper operation of the trunks. Mr. J. L. McQuarrie's patent provides contacts such that after an exchange call has been answered and the answering station has called the desired station, a relay will operate to hold the trunk against disconnection at the exchange until the called station may respond. With the response of this station the relay is released to pass the control to this called station.

The second patent, granted to Mr. N. H. Holland, of Chicago, Ill., provides similar protection against disconnection of the trunk during the period when the desired station is being rung from the answering station.

Letters to the Editors.

Movement of Magnetic Particles in a Rotating Field.

To the Editors of Electrical World:

Sirs:—The lines of a magnetic flux rotating pivotally around the stator of a polyphase induction motor from which the rotor has been removed—as indicated in the experiments which Professor Boleman describes in your issue of July 22—are not confined in direction to planes perpendicular to the stator axis except at the mid-section of the ring. About the upper and lower rim of the short cylinder which forms the stator, the rotating field passes from side to side diametrically, not in a plane, but strongly convex outward.

Discrete particles of magnetic material disposed in a plane tangent to the stator rim will, if they are small, be subjected to a couple tending to rotate them about their mass centers and in the same sense as the field rotation when the field passes over them. The action is directive like that of the earth on a magnetic needle.

It is immaterial whether the particles are above or below the stator; so long as they are within an area bounded by a section or projection of the ring, their rotation is always with the field. They may, therefore, be used to determine the direction of motion of the latter.

In addition to this rotation of the particles themselves there is a drift, or vortex, about the central axis of the stator. The vortex motion is due to friction and is with the field or counter to it, accordingly as the material plane upon which the particles move is below or above the stator mid-section. In this section there is no drift. Though not the same thing, the phenomenon bears some analogy to the precessional motion of a gyrostat.

Consider a clockwise field, with the particles in the upper plane. Iron filings being, as a rule, elongated bodies and readily assuming the direction of the lines of force; near the stator rim they are tilted obliquely, the outermost end—reckoning from the axis of the ring—being held in close contact with the supporting plane by the magnetic force. In this position they are caught by the clockwise couple, but owing to the interference of friction at the point of contact the mass center swings toward the approaching field. The particle executes a partial clockwise rotation, but, as a whole, advances by approximately a length against the field owing to the resultant pull of the latter. No other motion is possible consistent with clockwise rotation and frictional reaction applied at the outermost end of the particle.

Similar conditions obtain below the stator. Here, however, the oblique tilt results in the application of friction to the innermost end of the particle. The reaction has changed ends, and, therefore, interferes with the other element of the couple. The particle again rotates clockwise, but pivots on the inner end, and hence the action on the mass center is resolved into a push driving the particle ahead with the field.

Above and below the particles drift in opposed spirals, ultimately piling up at the center. This phenomenon is again largely mechanical. Both rotation and drift depend upon the shape and size of the particles and upon the character of the surface upon which they move. The experiment readily lends itself to projection for observation. A low field rate, say, a few cycles per second, permits observation of drift and rotation better than the usual frequencies.

The rotation of disks of magnetic material with free, or more or less constrained axes—the latter passing through the mass center—form an interesting study. A free iron "button" tends to spin on a diametral axis. This axis is approximately coincident with the direction of the lines of force. With such a figure, however, gyrostatic action combines with the play of magnetic and frictional forces, and tends to right the disk relatively to the stator plane. There will be, on the whole, the same sort of tilt as with the filings and the phenomena are similar to those described by Professor Boleman.

A constrained iron disk, for example, one pivoted on a fixed axis, will, if its plane is parallel to the tangent plane of the stator, and is within the limits of its bore, run with the field as regards direction of rotation. If this were not the case, above and below, it is not apparent how the regular rotor could run at all. The rotation will not be reversed if the outer end of the disk's axis—that is, the upper, when the disk is above, and the lower end when it is below—is gradually drawn away radially from the stator center until the axis is turned into a horizontal position. Evidently two disks, if thus manipulated, will show opposite rotation when the axes become parallel and are viewed from the same side. Were this translation of the axes continued the disks would come to a stop, as the magnetization would become purely transverse, thus resulting in no torque. With a further advance, rotation would begin once more; really in the previous direction, but apparently reversed because of the inversion of the physical axis. Since the induction is, in general, not parallel to the magnetizing force, the speed of rotation and the azimuth in which apparent reversal occurs, depends on a number of factors involving physical qualities and conditions.

In the communication of Professor Boleman it is not stated, in connection with the experiment of the partially constrained disk, what relation the latter bore toward the thread shown in the illustration as extending from the disk's center toward some fixed point located well up the stator axis. If the thread was in the plane of the disk, the latter would be simply an element of a larger mass with an axis coincident with that of the stator. An upward component of centrifugal force here counteracts frictional resistance. The disk skids along the plane and follows the field. Should the thread be perpendicular to the plane of the disk, the latter would stand with its upper edge tilted outward. The constraint being less than in the previous case, and one freedom being gained, the disk would now be free to roll. Since the magnetic induction would mainly follow the contact diameter, there would be a resultant push on the mass center—as upon filings placed below the stator—even though the tilt of the magnetizing field itself were directed toward the stator.

The entire phenomena constitute a neat illustration of the composition and resolution of rotations, as well as of the properties of magnetic fields.

St. Louis University,
St. Louis, Mo. H. J. De Laak.

The Atlantic Cable of 1858.

To the Editors of Electrical World:

Sirs:—Before replying to the second, and more lengthy, article of Mr. William Maver, Jr., I desire to say that having now re-read his first article I recognize that it has many merits, notwithstanding the disadvantages under which it was put together. Moreover, on again reading my letter commenting thereon, I regret that I expressed myself in the precise terms I did. It seemed to me, however, at the time that Mr. Maver was taking up a somewhat critical, and scarcely justified, posi-

tion regarding a great pioneering work, for I must admit that I was not familiar with his name in connection with submarine telegraphy. I find, however, that Mr. Maver is a leading authority on land telegraphy, and is the author of several authoritative works and papers dealing with this subject. I was partly misled by the letters "Jr." after his name, which in our country would suggest youthfulness rather than anything else! My original view of Mr. Maver's first article was accentuated, as I explained, by the misspelling of names. I had thought that this feature was common to the article in your journal and also to its appearance in *Telegraph Age,* but I now find that the name "Elliott" is the only name misspelled in both. This should be spelled with one *t* only, for Sir George Elliot, of Glass, Elliot & Company, should not be confounded with Eliott Brothers, though working somewhat in the same sphere.

In my comments on Mr. Maver's first article I should have added that the ultimate failure of the first Atlantic cable might, of course, be largely due—as suggested by Mr. Maver—to "the inexperience in cable making at that time," though the high-tension electricity, with induction coils, employed during the working of the cable was, in my opinion, more directly the cause. Before leaving this previous letter of mine, and in view of a suggestion made by Mr. Maver, I would repeat what I previously implied—i.e., that this first letter was written as soon as I happened to see Mr. Maver's first article.

Turning to his second article, I observe that Mr. Maver has taken occasion to examine some of my books as well as much else connected with the subject; but I regret that it will not be possible for me to deal with all he has to say in detail in the course of his second article. I must, indeed, confine myself to the general trend of his views—more especially concerning the points I touched on in my previous letter.

First of all, with reference to some of Mr. Maver's early suggestions—for which I bear him no ill will under the circumstances—I would mention that my father was knighted on Sept. 4, 1858 (a fact which can be verified at the Lord Chamberlain's office in London), exactly a month after he had completed his work of laying the first Atlantic Cable. I would point out, too—in view of the line now openly taken by Mr. Maver—that my father would scarcely have been offered a baronetcy in connection with subsequent work if the suggestions now made by Mr. Maver were borne out by facts. (The further honor referred to was refused for pecuniary reasons.)

Mr. Maver speaks of the repeated "coiling and uncoiling" and also of the "cutting and hacking to which the cable was subjected before its submersion in the effort to localize and remove defects." It should, however, be remembered that neither coiling, uncoiling nor cutting a cable is seriously debarred in submarine cable work. I agree with Mr. Maver to a great extent in regard to his remarks on the heating of the cable by exposure to the sun. He is perhaps, however, unaware of the conditions of the contracts and the circumstances under which the work was carried out. Insufficient capital and time (for which none of the technical officials was responsible) explains the non-adoption of a number of my father's recommendations, including not only a much larger cable (ultimately adopted on the second and third Atlantic lines), but provision for the line being kept constantly under water. Still, it has to be remembered that if a cable contains incipient faults such as do not reveal themselves ashore, its defective condition is soon made evident on submergence at the depths of the ocean. In the case in point, however, the failure of the line was a gradual one. The cable appeared, indeed, to be fairly healthy—comparatively speaking—up to the time when it was handed over for working from each end.

I regret to find that Mr. Maver considers that I have been unfair to Dr. Whitehouse, a very able physician who took up the subject of ocean telegraphy warmly, though only temporarily. This was very far from my wish, for he was a man of many charms, notwithstanding ill health. It has, however, to be borne in mind that the apparatus he applied to the cable when handed over to him for working through from shore was entirely opposed to the strongly expressed views of Professor Thomson, as well as of my father, both at the time and previously in the course of a correspondence which followed on some letters published in *The Athenæum.* (These letters revealed the fact that Dr. Whitehouse favored a small conductor for a long length of cable.)

Mr. Maver considers that I have misquoted the sense of Professor Thomson's and Mr. Varley's views on this point; but with all deference to him (Mr. Maver), I cannot see that my abridgment of their views constitutes a material difference in their actual nature. Moreover, Professor Thomson had previously expressed himself sufficiently definitely in the correspondence already referred to, as well as later—if not actually when giving evidence. Further, if there was then any doubt on the suitability of high-tension currents and induction coils for working cables, there is certainly not now.

I do not think Mr. Maver quite followed my point in his reference to what I say in my books about the breaking down of the 1865 and 1866 cables shortly after they had been laid. Faults soon appeared in these lines, but the faults—at specific points—were of a nature that could be repaired; whereas there was every appearance of a gradual and more or less uniform breaking down of the first Atlantic cable throughout its length, as it received its increasing doses of high-tension electricity. Mr. Maver seems to favor the idea that the break-down was mainly due to the application of tar outside the cable; but, without denying that this might well have been a contributory cause, it may be pointed out that, with the exception of the 1865 Atlantic line, every cable laid has since been covered with a tarry compound as a preservative against decay. On the other hand, the Whitehouse transmitting and receiving apparatus has never been employed for working any cable since that of 1858.

Mr. Maver comments on the fact that, in my books, I have not quoted Mr. W. T. Henley's views as to the cause of the failure. I would, however, mention that—like Mr. Maver, apparently—I have sifted the evidence to the best of my ability and have quoted that which most appeals to me as a result of the sifting. Whether Mr. Maver's views or my own are correct I am not prepared to say, though I think I may claim that my views are, at any rate, equally well backed up by other authorities and by subsequent experience. I am, of course, fully aware of the importance of a cable being tested under water during manufacture, and can scarcely be accused of ignoring Mr. Henley's opinion for filial reasons, seeing that this was one of the first precautions pressed for by my father. It should perhaps be added that Messrs. Glass, Elliot & Company, on the one hand, and Messrs. R. S. Newall & Company, on the other, were responsible for the manufacture of most of the pioneer submarine cables—with greater experience than their rival, Mr. Henley—and that the former firm (subsequently the Telegraph Construction & Maintenance Company) has manufactured more of the succeeding cables, now at the sea bottom, than any other firm. Though I do not think it is a point of much importance, I would mention—as Mr. Maver raises the question in this connection—that Mr. C. V. Walker (an honored name in telegraphy) was not a director of the Atlantic Telegraph Company.

Mr. Maver, quite naturally, draws attention to the fact that in "Submarine Telegraphs" I mainly attributed the failure to faulty metallic joints rather than to the apparatus employed for signaling through the line when laid; but when I wrote the book in question I had not an opportunity of examining all the official papers now in my possession. Mr. Maver also quotes from the report of the committee appointed to inquire into the construction of submarine telegraph cables, and remarks that it is strange that I have not done so in any of my books. I have, however, made several references to this inquiry, without actually quoting the particular passage in the report to which he draws special attention. In case anyone attaches special significance—such as appears to be suggested—to my not setting forth in my works this particular clause of the report, I would ask him to consider, or inquire, who had most to do with the laying of subsequent marine cables, whether for Government

or otherwise. In this connection it may be worth quoting a distinguished telegraph engineer and electrician, Sir Henry Mance, C. I. E., past-president of the Institution of Electrical Engineers, in the course of an address regarding submarine telegraphy in 1897. Sir H. Mance remarked: "If we, as engineers, desire to do honor to any one individual who pre-eminently distinguished himself in the development of oceanic telegraphy we have simply to refer to the list of our past-presidents and select the name of Charles Tilston Bright."

I cannot quite follow Mr. Maver's meaning where he says: "By the way, my critic's chief witness, Mr. Varley, joined in signing this verdict." I am entirely with Mr. Maver in his high regard for Varley as an electrician—indeed, next to Lord Kelvin, no man did more for the satisfactory electrical working of cables than Varley, on the one hand, and Willoughby Smith, on the other. But Varley, like Galton, Wheatstone, Fairbairn and Bidder, was not associated with ocean cable laying or with the manufacture of cables. The electrical members of this committee, especially Varley and Latimer Clark, would, however, be excellent authorities on the effect of the Whitehouse apparatus on a cable; and they were certainly unfavorable to high-tension electricity for working the Atlantic cable.

As regards the joint experiment of Varley and my uncle to which Mr. Maver alludes, this seems to me to point rather in favor of my view than otherwise. In a word, I still beg leave to differ with Mr. Maver respecting the cause of failure, and while recognizing the importance of much that Mr. Maver sets forth, I venture to think that a study of the entire evidence, including that of Professor Hughes and Professor Wheatstone, could be turned in favor of my views as much as his. The complete abandonment of the Whitehouse apparatus (together with personal reasons) was, perhaps, sufficient reason for the committee omitting to set forth the unfavorable effects of such apparatus on an insulated wire of this character. However, I quite recognize that faults of manufacture—due to lack of experience—are very likely to have existed in the cable before it was actually worked through, though, in my opinion, no cable of similar dimensions would have stood the operation for long with the said apparatus in use. Moreover, from the particulars I have available, it certainly appears probable that the cable would have worked satisfactorily for a considerable time but for these high-tension currents.

Mr. Maver is critical about the paying-out gear on the *Agamemnon* and *Niagara*. With all due deference to his opinion, I cannot see that it is substantially supported by Sir Samuel Canning (my father's chief assistant), while Captain Moriarty, the distinguished navigator whom Mr. Maver also quotes, had nothing to do with the working of the apparatus or the laying of the cable.

Mr. Maver takes me to task for stating that Brett and my father had preceded Cyrus Field in projecting the Atlantic cable. Let me assure Mr. Maver, however, that whatever I said on the subject was not at all from the point of view that he attributes to me, but was intended rather to show that others besides Mr. Cyrus Field had been working at the idea when the latter gentleman, a famous American merchant peculiarly gifted with intense energy and industry, came over to this country and sought Brett and my father. Still, here again, I must admit I had not done justice to Mr. Maver's original article which was, I see now, quite temperately expressed in this matter, as compared with what I have often seen. On the other hand, I am afraid I cannot quite fall in with the view adopted in Mr. Maver's further article in this regard, i.e., where Mr. George Saward's evidence is quoted in reference to the origin of the Atlantic Telegraph Company, if only for the reason that the formation of the company followed long after a good deal of investigation and other preliminaries in this country, as well as in North America, where Gisborne was especially forward in the matter. Mr. Saward was not in a position to speak with authority regarding the work that I refer to in his own country, for his connection with the subject commenced when he became secretary of the Atlantic Telegraph Company, with Mr. Cyrus Field (the general manager) as his immediate chief. But Mr. Field's energy was turned to account in a way that will never be forgotten in England, any more than in America, and though the capital (so far as it went) was mainly raised in England, this was not for lack of strenuous effort and noble support on the part of Field.

Mr. Maver avails himself of the opportunity in his second article to recount the important services of Mr. W. E. Everett, U. S. N., in regard to the first Atlantic cable, and I am sorry to find that he also takes occasion to express the view that I have not done that distinguished officer proper justice in my books. Mr. Maver has evidently arrived at the conclusion that Mr. Everett was in "sole and responsible charge on the *Niagara* of the successful laying of one-half of the cable in 1858," and he gives his reasons. These are quite in keeping with the records of Mr. Mullaly (a well-known American journalist and author), a glance at whose writings would lead a reader to suppose that Mr. Everett was the engineer-in-chief and my father only an assistant. Mr. Maver also, quite properly, quotes from official correspondence, which tends to give color to the idea. It is made clear, however, from further correspondence, as well as from the reports of the expedition to the board, that Everett acted in the capacity he did on the *Niagara* under instructions from my father, the engineer-in-chief of the whole undertaking (who obviously could not be on both ships at once), as did Mr. Woodhouse also, and in precisely the same way that Mr., afterward Sir Samuel, Canning and Mr. Henry Clifford did on the *Agamemnon*. That clever engineer, Mr. F. C. Webb (one of my father's staff on the 1857 expedition), was not available subsequently, and it was in this way that, at the instigation of Mr. Cyrus Field, Mr. Everett joined the engineering staff.

Mr. Maver also considers that I have not done Mr. Everett proper justice in my books in regard to his association with the paying-out apparatus. I can only say that I dealt with the subject to the best of my ability—based on a great many official documents, and have certainly had no such intention as appears to be suggested. Through his countryman, Mr. Field, Mr. Everett (who had been the chief marine engineer of the *Niagara* on the 1857 expedition) became a member of the advisory committee relative to the proposed paying-out gear for the 1858 expedition. Of the other three members, one was the chief of the steam department in Her Majesty's Navy, and the other two leading engine makers. The design of this apparatus (fitted to both vessels) was worked out by my father (as the responsible engineer-in-chief) in conjunction with Mr. C. E. Amos, of Messrs. Easton & Amos, who constructed the gear. It was arranged that Mr. Everett should supervise the construction and fitting of the gear, in view of the fact that it would be under his charge on the *Niagara;* and it was on this latter account, as well as owing to his knowledge of machinery connected with ships, that he was attached to the said committee for reporting on the new designs. If, however, any of your readers prefer to consider that this distinguished naval officer (Mr. Everett) was as much in charge of the laying of the first Atlantic cable as my father, or that he (Everett) was solely responsible for the design of the paying-out apparatus, he is welcome to do so; just as they are also welcome to a preference for the version of Mr. H. M. Field and Mr. Mullaly to my own. The perfectly natural rivalry of nations would in itself be sufficient explanation, no doubt. I can assure you, however, that any words of mine on the subject in my various works have been the result of a dispassionate and laborious sifting of evidence from official documents—published and unpublished.

Though I cannot agree with several of Mr. Maver's conclusions, I desire to repeat that on a second reading I realized his original article was a fair summary, and that I should have expressed my previous letter—regarding certain portions of Mr. Maver's remarks—in more moderate terms. Further, I quite recognize now (notwithstanding some of his unfavorable criticisms) that he has closely studied the subject as far as was possible for him to do. I see that in using the term "exclusive"—in reference to the basis of my writings—he puts that word in inverted commas. I would, however, say that this

phrase has never been employed by myself in that connection, though certainly my contributions to the literature on the subject are based on official documents, many of which have never been published.

I am much obliged to Mr. Maver for pointing out an apparent discrepancy in my "Submarine Telegraphs." I am far away from that somewhat ponderous volume at present, and can only account for the discrepancy by the fact that different batteries were employed at different times during the 1857-8 expeditions, the particulars of which I had, as it happens, from Lord Kelvin himself, the previous Professor Thomson that Mr. Maver quotes.

Finally, I am sorry to find that Mr. Maver and myself are at "loggerheads" in the distinction between an "engineer" and an "electrician." I cannot help thinking, notwithstanding what Mr. Maver says, that this must be due to a difference in American and English usage of the words. In submarine telegraphy, at any rate, we do not speak of "electrical engineers." Aboard a telegraph ship there is the engineering staff and the electrical staff, those on the latter being termed "electricians"; and I venture to submit it was always so. I note, by the way, that further on Mr. Maver, seemingly, apologizes for confusion between engineers and electricians—i.e., between those who "merely laid" cables and others. While, of course, endorsing Mr. Maver's views of Lord Kelvin and Cromwell Varley, I do not think that Lord Kelvin himself was inappreciative of those who "merely laid" cables—such as my father—judging from his Lordship's remarks regarding the latter at executive meetings of the International Memorial to the Inception and Extension of Submarine Telegraphy, as well as on other occasions when speaking of the Atlantic cable and subsequent enterprises with which my father was responsibly associated. Sir Henry Mance's views in the same regard I have already quoted.

Permit me to conclude this communication by cordially re-echoing the wish of her late Majesty, Queen Victoria, in regard to the Atlantic cable being "a bond of perpetual peace and friendship between the kindred nations," hoping that any difference of opinions between Mr. Maver and myself may be happily smoothed over, if only on the principle that "it will be all the same a hundred years hence!"

LONDON, ENGLAND. CHARLES BRIGHT.

P. S.—The above has been written while on holiday in the wilds of Surrey. Thus, like Mr. Maver's original article, it is put together under some disadvantage. On the other hand, but for the conditions I fear it would have been impossible for me to make any adequate reply to Mr. Maver's more lengthy article. This I was anxious to do, if only out of courtesy, and in justice to Mr. Maver. Realizing that the last word would, by right, rest with me, I have made a point of expressing myself this time in moderate terms and in a way, I think, that no answer would be called for. But if Mr. Maver is intent on the last word, he certainly will have the advantage of me, for in a week or so I expect to be fully engaged on more important matters than a discussion concerning the pioneer days of submarine telegraphy, and this expedition will probably take me out of touch with post or papers for some time to come. C. B.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Silicon Steel.—E. KOLBEN.—An account of an investigation of the influence of silicon on the electric and magnetic properties of iron. Some of the results are given in the following table, from tests of sheet steel of 0.5 mm thickness. Five different silicon steels were tested.

		A	B	C	D	F
Per cent silicon.....	min...	0.026	1.07	2.28	——	3.50
	max...	0.30	1.84	3.18	3.25	3.53
"Watt loss coefficient"	min...	3.5	2.6	2.3	2.3	—
	max...	3.8	3.0	2.6	2.6	1.85
Specific resistances in ohms per cc.		0.118	0.287	0.355	0.500	0.595
Increase of resistivity per 100 deg. in per cent.....		41.0	19.0	14.0	7.5	5.0
Tensile strength for minimum per cent of silicon.....		30.8	35.1	47.3	——	61.0
Hysteresis coefficient for minimum per cent silicon.....		0.0015	0.0014	0.0010	0.0009	0.0009
Hysteresis watts per kilogram silicon		2.5	2.2	1.65	1.45	1.45
Eddy-current watts per kilogram silicon		1.3	0.8	0.7	0.6	0.4
Total watts per kilogram silicon.		3.8	3.0	2.35	2.05	1.85
Magnetic induction B for magnetizing force H = 140.....		17,000	17,300	17,000	16,700	16,400

A silicon content of 3.5 per cent is specially suited for starting and regulating resistors. The mechanical strength of the steel is increased by a certain content of silicon, while simultaneously the elongation decreases, but the material is somewhat unreliable and subject to great differences; this is probably due to the method of manufacture. The silicon steels are specially suitable for transformer construction, but since high-silicon steels are very brittle, the steel F cannot be used for rotating armatures of turbo-generators. However, the B and C brands can be usefully employed for dynamo construction. Permeability is very slightly influenced by the high content of silicon. The aging of steel at higher frequencies and at a temperature of 100 deg. C. disappears completely in high-silicon steels. With a 3.5 per cent content of silicon the aging coefficient is zero.—*Elek. Kraftb. u. Bahnen,* July 3.

Motor with Mixed Windings.—A note on a motor built by a Danish company. It is arranged for starting at full load without resistances and its direction of rotation can be reversed without difficulty. This result is obtained by fitting every second pole core of the magnet frame with a series winding, the other poles on the frame being provided with a winding which is in parallel with the armature. These two exciting windings are so arranged that the m.m.f. of the series windings opposes that of the shunt windings. The relation of the two windings can be so adjusted that the speed of the motor will vary in a definite manner according to the load. For instance, the motor can be designed to run at the same speed at any load or to run at higher speed when the load is reduced. A motor of this kind is said to be specially suitable for working cranes, hoists and, in fact, all machinery which is frequently started, stopped and reversed.—Lond. *Electrician,* Sept. 10.

Rotary Field of Induction Motors.—R. E. HELLMUND.—In a paper read before the St. Louis Congress, Prof. C. A. Adams called attention to certain differential fields in the rotary field of an induction motor. Their effect is somewhat similar to that of stray fluxes. In the present article the author gives graphical methods and shows how the effect of the differential fields on the operation of induction motors can be taken care of theoretically by an increase of the stray-flux coefficient. He also gives a brief note on a simple practical method for calculating the coefficients.—*Elek. Zeit.,* Sept. 9.

Lamps and Lighting.

Tungsten Lamp.—An article stating that the firm Wolfram (tungsten) Metal Filament Lamps, Ltd., has been given permission by the British Patent Office to amend the specification of the fundamental British patent for the manufacture of pure tungsten filaments, in three important respects. All references to the metal molybdenum have been taken out; a description of a chemical process for substituting tungsten for carbon has been eliminated; and a disclaiming clause taking note of three prior patents relating to metal filaments has been added. The patent now covers a process for manufacturing pure tungsten filaments by mixing a powdered tungsten compound with an organic binding agent, squirting this mass into filaments, carbonizing and then removing the carbon by raising them to a high temperature in an atmosphere of steam and hydrogen.—Lond. *Elec. Eng'ing,* Sept. 9.

Automobile Head Lamps.—A note on the use of gold mirrors

for search lanterns with reference to recent tests of motor car head lamps. It has always been taken for granted that the whiter and more powerful the light, the more perfect the illumination obtained. This, however, is not the case, for the rays of low refrangibility—that is, the red and yellow rays—are far less absorbed by the atmosphere than are the violet rays. Again, the red color exhibited by the sun at its setting is due to the fact that the violet rays are largely absorbed by the greater thickness of atmosphere, which must be penetrated by the sun's rays. To achieve the desired results a long series of experiments have been made with glass mirrors coated with gold instead of the usual silver deposit. The resulting beam of light is practically devoid of the blue and violet rays of the spectrum, being composed of red, yellow and green rays only. At the same time its range or penetrative power is not reduced by the elimination of the violet rays, while the dazzling effect is greatly decreased. —Lond. *Electrician*, Sept. 10.

Generation, Transmission and Distribution.

Electricity in Coal Mines.—J. PAUL.—An illustrated paper read before the Mining Institute of Scotland on electric energy generation and distribution at the collieries of the Lochgelly Iron & Coal Company, Fife. There are two triple-expansion engines directly coupled to two three-phase alternators with a frequency of 50, having exciters on the same shaft. Each of the combined sets is designed for a continuous output of 420 kw at 0.8 power factor (and for 25 per cent overload for periods of two hours at clear intervals of six hours) at from 3000 volts to 3300 volts when running at 375 r.p.m., either exhausting into a condenser with a vacuum of 26 in. or into the atmosphere. Some notes are given on the construction of the transmission line, and especially the design of the wooden poles. In transformer stations the voltage is reduced to 525. For haulage, pump and fan drives use is made of induction motors, including both the slip-ring and squirrel-cage types. As to the outlay, it is stated that the generating costs, based on the load diagram, plus the capital charges, namely, interest on capital and sinking fund to redeem the capital in 20 years, will enable the company described to deliver electrical energy at any point in the coal field for something less than 0.6 cent per kw-hour; with an increased load the cost per unit will be even cheaper, owing to the fact that much of the capital expenditure already incurred really belongs to the possible and probable extensions. —Lond. *Electrician*, Sept. 10.

Power in Mines.—L. PASCHING.—The first part of an illustrated description of the Castelnuovo-Valderno power plant of the Societa Mineraria ed Elettrica del Valdarno, in Italy. This company has extensive brown coal mines, but the brown coal contains from 40 per cent to 50 per cent water. Instead of mining and transporting the coal elsewhere, it was decided to use the coal at the spot in a power plant, since there is a sufficient market for electrical energy in the neighborhood. Three-phase currents are generated at 33,000 volts and transmitted by five high-tension lines to Florence, Prato, Fignile, Sienna and Valdarno. There are three 1800-kw generators, producing three-phase currents at 6000 volts and 50 cycles. For transmission the voltage is raised to 33,000. The paper is to be concluded.—*Elek. Zeit.*, Sept. 9.

Steam Turbines.—A. CEYTRE.—The first part of an illustrated article on the principal features of different commercial steam turbines. The author begins with a discussion of the Parsons turbine.—*L'Industrie Elec.*, Sept. 10.

Traction.

Control of Traction Motors.—A note on a recent British patent (16,997, 1908; Sept. 2, 1909) of the British Thomson-Houston Company and F. W. Carter. Compound-wound traction motors, adapted to be run as generators while the vehicle is coasting or reducing its speed so as to return energy to the line, are so controlled that when an overload occurs the motor will be provided with a full series field m.m.f. so as to bring down the speed, but that the shunt-field m.m.f. will be opposed by a full series-field m.m.f. when the motor begins to generate. This result is accomplished by arranging reverse-current and overload relays in the exciting circuit of a contactor, which, when closed, completes a shunting circuit about the series-field coils of the motor. During normal operation the contactor is closed and the series-field coils are shunted. Should an overload occur, or the motor begin to generate, the contactor is operated and the shunting circuit broken.—Lond. *Elec. Eng'ing*, Sept. 9.

Brakes.—R. BRAUN.—An article on the importance of electromagnetic track brakes and the correct method of using them. The author emphasizes that the combination of a short-circuit brake with an electromagnetic track brake (the latter being excited from an independent source of current), is superior to any other known combination, with respect to quickness, force, reliability, even on wet rails without sanding. The braking effort of the track brake is not restricted like that of the wheel brake. For electric railways which are already provided with short-circuit brakes, the best method is to combine them with a track brake excited either by a series or a shunt winding. It is of fundamental importance for the track brake always to remain independent of the wheel brake.—*Elek. Kraftb. u. Bahnen*, Aug. 4.

Energy Consumption of Railways.—P. HEINZE.—A mathematical article in which the author gives a method of calculating the energy consumption of an electric train, and especially the method of determining approximately the speed at the beginning of the braking period. A graphical method is used to show the work during acceleration and the amount of the heat produced. A numerical example is added.—*Elek. Kraftb. u. Bahnen*, Aug. 4.

Electric Propulsion of Ships.—A note on a recent paper by W. P. Durtnall. The author took as an example the *Lusitania* and showed that by adopting the electrical drive a saving in steam of no less than 31 per cent could be obtained, his figures being based on the test figures published in connection with the trials of that vessel, namely 12.77 lb. per shaft hp-hour and a steam consumption of 11 lb. per kw-hour for the five 10,480-kw turbo-alternators which he would propose to install, while two 8188-hp induction motors, having an efficiency of 93 per cent, would be used on each propeller shaft. In addition to the above saving in fuel, he estimated an equivalent reduction in boilers, stokers, pumps, fans, bunkers, etc. Further, the author stated that quotations he had obtained from manufacturing firms showed that the total weight of the machinery, was, if anything, slightly in favor of the electrically driven ship. He also referred to the use of internal-combustion engines for marine purposes, and mentioned that in the near future, he hoped to be able to publish some tests on a 500-hp vessel to be equipped with the "Paragon" system of electric propulsion in combination with a suction-gas plant.—Lond. *Electrician*, Sept. 10.

Copper Wire.—E. W. LAKE.—A critical discussion of the new specifications for trolley wire submitted by Committee W. of the American Society for Testing Materials.—*Elek. Rail. Jour.*, Sept. 18.

Installations, Systems and Appliances.

Belgium.—Statistical data on electricity works in Belgium. There are 108 plants with equipment ratings down to 10 kw. Forty-one plants have a rating of over 100 kw. The three largest plants are two in Brussels, one of 20,000 kw and the other of 10,000 kw, and one in Antwerp of 10,000 kw. There are 48 plants manufacturing electrical machinery or apparatus in Belgium, chiefly dynamos and telephone and telegraph apparatus. —*Belg. Electrotechniker Kalender*, 1909; *Elek. Kraftb. u. Bahnen*, Aug. 4.

Combined Lighting and Traction Plants.—B. THIERBACH.—An article discussing the great advantages of adding a traction load to an existing lighting and industrial load, with special reference to the city of Cologne, in Germany. Electric traction was introduced there in 1902, and a comparison is given of the financial results of four years before and after the traction load was added. The lighting station generates single-phase current at 2000 volts, which is converted for traction purposes

in an underground substation in the center of the city into 600-volt direct current. The following table gives the financial results in marks (1 mark = 24 cents).

	Before opening of tramways.	After tramways.	Increase in per cent.
Gross income in four years	1,881,800	3,907,500	
Average per year	470,500	976,900	108
Net gain (after subtracting interest and amortization) in four years.	1,391,000	2,958,300	112
Average per year	347,800	739,600	

It is to be considered, however, that the traction plant had to pay more than the real cost for the energy. The excess cost was in four years 407,000 marks, or 100,000 marks per year. If this sum is subtracted from the figures given above, there still remains an increase of gross income of 87 per cent and an increase of net gain of 84 per cent. The chief factor which contributed to this good result was that as soon as the tramways were started, the tariff for lighting and for industrial service was reduced by the introduction of a fair double tariff. This was possible because the considerable amount of energy sold for traction resulted in a great reduction of capital cost and of cost of generation per kw-hour. The author gives detail figures and also a general formula which may be used by lighting plants desiring to add a traction load.—*Elek. Kraftb. u. Bahnen,* July 3.

Alternators in Parallel.—J. W. ANSON.—Some practical notes on the operation of alternators in parallel. After a discussion of synchronizing methods, the author shows how to insure steady running in parallel. There is a great tendency to run plants 2 r.p.m. or 3 r.p.m. over the designed speed, and this is one of the greatest causes of unsteady running in parallel, especially with engines having Corliss or drop-valve gears, which run most steadily and quietly at the correct speed. The reason for the tendency to run fast is due to the inductive nature of the loads now often dealt with. In order to obtain the full output of power from a machine, at the correct voltage of supply, running on an inductive load it becomes necessary to do one of two things: either increase the field current to an excessive amount or increase the speed of the engine. The former method is the better. The author then discusses generators running on loads with a false power factor. He considers the case of an engine-driven alternator carrying the night load on a system where it is necessary for a number of large induction motors to run lightly loaded. When the power-factor meters on the various feeder panels range between 0.3 and 0.5, with perhaps one or two meters reading unity for substations with synchronous machinery, it would be expected that if a reading was taken on the generator power-factor meter, the result would be a power factor of about 0.6 or 0.65, after making allowance for the synchronous plant; instead of that, it is quite probable that the generator power-factor meter will be reading 0.9 or 0.92, and the operator at the switchboard congratulates himself on the good power factor of the generator. If, however, one examines the engine tachometer it is at once seen that the plant is running under false conditions, probably 5 per cent too fast, and with a very light field current; hence the good power factor showing on the generator instrument. These conditions just stated are the worst for withstanding a sudden short-circuit or earth on the system. The correct way to run a plant of this type on a light but inductive load is to slow the engine down until it is running at the designed speed, at the same time increasing the field strength until the machine is maintaining the correct voltage at the correct speed. The generator power-factor meter will then be registering the correct power factor of the system. It is especially difficult to operate two large machines in parallel on light load with any degree of steadiness. The question of speed is of great importance. In this case the r.p.m. should be kept well down, even a shade under correct speed, say, 1 per cent, rather than over, and when the load is falling off the wattmeters should be watched carefully, so that every time the load eases down definitely the engine speed can be kept constant, either by switchboard governor control or by hand. The field current is also of great importance. With the speed kept low, as advocated above, just sufficient field strength should be kept on the machine to maintain the exact line voltage.—Lond. *Electrician,* Sept. 10.

Electric Water Heater.—An illustrated description of, and an editorial on, the "Therol" electric water heater, the special feature of which is the use of heat storage. One of the difficulties of electric heaters hitherto has been the fact that if water is to be heated rapidly a comparatively large current is necessary. In the "Therol" heater this difficulty is overcome by storing the heat in a block of iron which is cast round a spiral tube and carefully lagged. Thus, if only a small amount of power, say, 200 watts, is used continuously for heating the iron, the heat produced is stored until hot water is required. When that is the case, the cold water is drawn through the spiral, and as this, through prolonged heating, may be at a much higher temperature than that of boiling water, hot water is at once obtained and may be drawn continuously until the temperature of the iron block is so far reduced that it cannot supply heat quickly enough to maintain the temperature of the water at what the householder may regard as "hot." The heater is shown in Fig. 1. In its simplest form the apparatus consists of a block of

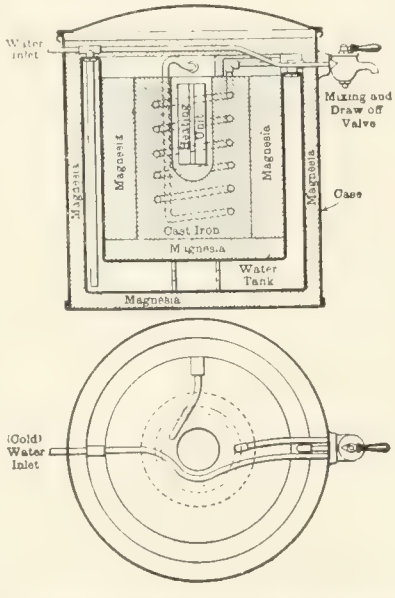


FIG. 1.—PLAN AND SECTION OF ELECTRIC HEATER.

iron cast round a coil of pipe. This block is embedded in and covered with a layer of magnesia lagging about 2 in. thick. The top of the block is hollowed out into a cylindrical form, and in this hollow is placed the heating element, consisting of four coils of iron wire insulated with mica. Further economy is effected by introducing between the lagging and the outer cover a small reservoir, which is in turn protected by lagging from the outermost surface of the heater, and which serves for raising slightly the temperature of the incoming water before it is introduced to the heater proper. Since the coil of pipe through which the water passes must have sufficient surface for heating the water when the block is comparatively cool, it follows that when the block is very hot the water will be converted into steam. It is necessary, therefore, to mix the issuing steam with water, and thus reduce it to a suitable temperature. The total energy required for heating a given quantity of water is not less than by other methods; it might even be greater. But while former electric heaters cannot give a big flow of really hot water, unless a considerable current is employed, the new heater is able to supply a comparatively large quantity of hot water with a small current, the power required for a heater giving 25 qt. per day being only 200 watts. The heaters are of importance to central-station engineers, because while the consumer will have to pay for the same number of kw-hours as with other heaters, yet the maximum demand is greatly reduced and the load factor is improved. It is proposed to connect the heater up so that it is automatically cut out of circuit when light is required, so that the total load can be maintained more or less constant. If a heater is made with, say, 10 coils, and these are connected so that they can be

switched out as desired, then if electrical energy is required for any other purpose at any time, a certain number of coils are switched out and the required fan, griller or lamp, as the case may be, is switched on in their place. In this way the load factor of an installation can be greatly improved, and if lighting can be combined with heating to give a really high load factor, the cost of lighting (to the consumer) may be reduced to so low a figure that it is economical to spend more on heating water than would otherwise be the case.—Lond. *Electrician*, Sept. 10.

Electricity on Board Ship.—J. McLaren.—A paper read before the (British) Association of Marine Engineers. The author considers a suction-gas plant and alternator for supplying the electrical energy for operating the auxiliaries on board ship, and shows the great saving which can be effected by such an installation, compared with the usual donkey boiler with its long lengths of steam piping.—Lon. *Electrician*, Sept. 10.

Regulation for Mines.—An account of quite drastic electric mining regulations in force in New South Wales. Reports are to be kept of such accidents as overheating and the appearance of sparks outside enclosing casings of apparatus, and any cases of apparatus becoming live are to be recorded. Trailing cables are to be tested once a month after six hours' immersion in water, the results are to be logged, and no trailing cable must be taken into use if the insulation is less than 1 megohm. The machineman in charge of a coal-cutter must be competent to examine the roof and sides, and to detect the presence of gas. —Lond. *Elec. Eng'ing*, Sept. 9.

Wires, Wiring and Conduits.

Calculation of Transmission Lines.—A. Blondel.—The conclusion of his paper giving a simple graphical method of determining the constants of alternating-current transmission lines by means of diagrams. In the present installment the author discusses the calculation of various transmission lines starting from one common center of distribution.—*La Lumière Elec.*, Sept. 4.

Insulators.—M. Gerstmeyer.—An article discussing the best design of insulators for overhead lines, with respect to high mechanical strength and prevention of perforation. Special attention is paid to the action of rain drops on the insulators.—*Elek. Kraftb. u. Bahnen*, July 3 and 14.

Electrophysics and Magnetism.

Anode Rays.—A. Reichenheim.—An abstract of a paper presented before the British Association for the Advancement of Science on anode rays and their specter. The author demonstrated experimentally the main features of recent researches made by Gehrcke and himself. The experiments are an outcome of Goldstein's researches on canal rays. The ordinary fall of potential at the anode is only about 30 volts, but in the presence of the vapor of a halogen compound, like lithium chloride, the fall is much greater and anode rays are then produced, which show the spectrum of the metal Li with which the halogen Cl is combined. The bulb exhibited had an aluminum cathode at the top, and an anode in a lateral tubular protrusion. The anode consisted of a small cylinder of lithium chloride, mixed with graphite, so as to render it conductive, contained in a glass tube; a wire passed along the tube and entered the fragment of salt. When the current was turned on, the salt melted and evaporated, and the anode rays appeared red; with sodium chloride as the salt they looked yellowish red; with strontium chloride, not deep red, as might be expected from the characteristic color of strontium flames, but rather violet. These anode rays can be deflected both by electric and magnetic fields, their e/m has been determined, the velocity of the rays in centimeters per second is 1.76×10^3 for sodium, 2.4×10^3 for lithium, and 7.08×10^3 for strontium. When the e/m calculated is divided by the e/m for hydrogen, the atomic weights of the metals result, so that the rays consist of metallic atoms. In further experiments the author made use of two glass bulbs connected by a glass tube, of which the ends projected into both bulbs; this tube he called a "bridge." The first bulb contained the anode, an aluminum spiral, placed within a short vertical tube; the second contained the cup-shaped cathode. The bulbs were filled with hydrogen or helium and iodine; the iodine, like other halogens, has a very high absorptive power for electrons. Pencils of helium rays were seen to issue both from the anode and from one opening of the bridge tube. Again, in another apparatus more like the original Goldstein bulb, the cathode was on the upper portion of the bulb, which was provided with a lateral tube, and ended in a chamber containing a wire-gauze cylinder; this tube was closed on the bulb side by the perforated anode, and there was another vertical perforated partition further on. The bulb was charged with a mixture of hydrogen and iodine. Cathode and anode rays and canal rays (in the ordinary sense) were seen to pass in both directions through the tube between the two partitions, the grouping of the rays being symmetrical. The spectra of the anode rays resemble the electric arc spectra, but are simpler than the arc spectra. The spectrum of the strontium rays shows the characteristic red strontium line and two pairs of lines, while on the surface of the anode itself only the first line is visible. The carriers of the anode rays being the charged atoms, it is possible to decide which of the spectrum rays are due to the atom. The Doppler effect is determinable in all the rays.—Lond. *Engineering*, Sept. 10.

Secondary Radiations.—J. C. McLennan.—An abstract of a paper read before the British Association for the Advancement of Science on secondary radiations excited by alpha rays. In order to simplify his study of secondary radiations, he stated he had taken the alpha rays emitted by polonium as his source. But polonium also emitted delta rays, and the research proved that the delta rays were in excess of the alpha rays, as previous experiments had already indicated. He had coated a copper plate with a thin film of polonium and placed a brass plate opposite to it. That brass plate became negatively charged and sent out secondary negatively charged rays. The charge on the brass plate represented the algebraic sum of the delta rays and of the secondary radiation, and the experiments concerned the alterations effected by putting an additional positive or negative charge on either of the plates, and by varying the material of the plate. He had substituted plates of zinc, lead and aluminum for the copper plate, and of lead, silver, zinc, copper and aluminum for the brass plate. One of the chief results of the research was finding that the secondary radiations are little influenced by the material of the (second) metal from which they emanate. Professor Rutherford thought this result remarkable; commenting further upon some peculiar features of the changes in the phenomena, he said that the nature of those positive and negative charges is not understood, and it is best not to trouble about them at present.—Lond. *Engineering*, Sept. 10.

Bar Magnets.—S. P. Thompson and E. W. Moss.—A paper giving the results of an experimental investigation of the self-demagnetizing factor of bar magnets.—Lond. *Electrician*, Sept. 10.

Units, Measurements and Instruments.

Slip-Meter.—F. Horschitz.—An illustrated description of a slip-meter which is quite similar to a speed meter in construction and method of handling. It is attached to the shaft of an induction motor and after a certain time it is taken off. It indicates both the number of revolutions during the time while it was operated and the number of certain galvanometer oscillations during the same time, and from these two readings the slip can be easily determined. The principle is shown in Fig. 2. S and S^1 are two slip rings, and K is a commutator, which has as many segments as the motor has poles. The different segments of the commutator K are connected alternately to the slip rings S and S^1, as shown in the illustration. One brush is provided for each slip ring and two brushes for the commutator. The two brushes of the two slip rings are connected to the two poles of the alternating-current network, while the two commutator brushes are shown to be connected to a Deprez-d'Arsonval voltmeter, which has the zero point in the center and gives equal oscillations on both sides. For a given slip of the induction motor, the needle of the galvanometer will oscillate

regularly, and the slip of the induction motor is a simple function of the number of oscillations of the needle during a certain time and of the number of revolutions which the motor has made during the same time. Both numbers are counted mechanically on the slip meter. Instead of the d'Arsonval galvanometer, a magnetic system, similar in principle, may be used. This slip meter is equally suitable for single-phase or

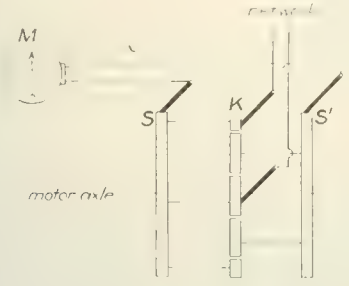


FIG. 2.—DIAGRAM OF SLIP METER

polyphase motors and permits one to measure slips within a very wide range. It is not more bulky than modern tachometers, but is somewhat longer.—*Elek. Kraftb. u. Bahnen,* Aug. 28.

Analysis of Periodic Waves.—O. MADER.—An illustrated description of a simple and comparatively inexpensive mechanical device for the analysis of periodic waves. It is designed to be used instead of mathematical or graphical analysis. The device combines simple construction with ease of operation and sufficient accuracy for use in practice.—*Elek. Zeit.,* Sept. 9.

Telegraphy, Telephony and Signals.

Non-Uniform Circuits.—DE PIRRO.—The conclusion of his mathematical paper on non-uniform telegraph and telephone circuits. The author shows how the general formulas developed in former experiments can be simplified for special cases. As one of the chief results of his paper he concludes that the consideration of the single constant of attenuation is not sufficient and that all the constants of the circuit must be taken into consideration. He emphasizes the importance of standardization of telephone apparatus and lines.—*La Lumière Elec.,* Sept. 4.

Loading Coils.—With reference to the opposition to the grant of a British patent, two similar systems of loading coils for telephone and telegraph cables are described. In both cases the coils are wound longitudinally, practically parallel to the length of the cable, and there is an iron core between the inner and outer turns of the coils. In one case this iron core is made up of a layer of iron wires, and in the other it is described as an iron cylinder and flexible distance-pieces are inserted between adjacent coils.—Lond. *Elec. Eng'ing,* Sept. 9.

Selective Call.—An illustrated description of a selective-call system in telegraph stations used by a British company. It is employed to call up any distant station, up to a certain number, without ringing up all the intermediate stations. The apparatus is so arranged that it will not respond to ordinary Morse signals. In order to operate it, the circuit must be closed for at least three to four seconds; after that, short current impulses are given, corresponding in number to the number of the station required; finally, the circuit is closed again for about 10 seconds. The last operation causes the bell to ring at the selected station. The current impulses which are then given, being ordinary Morse signals, restore all the selective calls on the line to their normal condition.—Lond. *Electrician,* Sept. 10.

Inductance and Resistance.—J. W. NICHOLSON.—A mathematical paper giving formulas relating to the inductance and resistance of telephone and other circuits.—*Phil. Mag.,* September.

Miscellaneous.

Laboratory Appliances.—W. VOLKMANN.—An illustrated description of various appliances for use in physical laboratories, including cheap series resistor (essentially an asbestos and German silver wire netting) for arc lamps, for optical experiments. —*Phys. Zeit.,* Sept. 15.

NEW APPARATUS AND APPLIANCES

Transmission Circuit for Telephone Train Dispatching.

The use of the telephone for the handling of trains is not by any means new. For several years a number of railroads have been using the ordinary local battery, bridged telephone for this purpose, the various stations being called by code ringing. This arrangement was found to serve very well for short lines

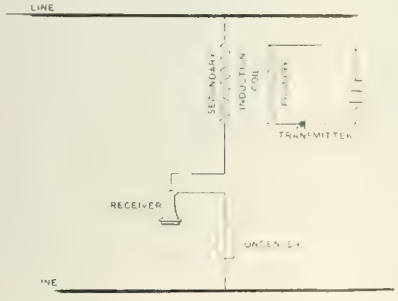


FIG. 1.—ARRANGEMENT OF LOCAL-BATTERY TELEPHONE.

with not very many stations. When the attempt was made to use this arrangement on longer lines with a larger number of stations, it was found that the transmission would be seriously impaired when one or more of the receivers were off from the hook at the same time. This difficulty was very noticeable later on, when selectors began to be used and the telephone was introduced upon the more important and busier roads.

Fig. 1 herewith shows schematically the usual arrangement of a local-battery telephone. Originally this arrangement was used at both the dispatcher's and way stations. From the sketch it will be seen that the bridge during conversation consists of a condenser, receiver and secondary of the induction coil in series. The total impedance of this bridge to talking currents is approximately 600 ohms, about 300 ohms of which are in the receiver and, therefore, active for receiving pur-

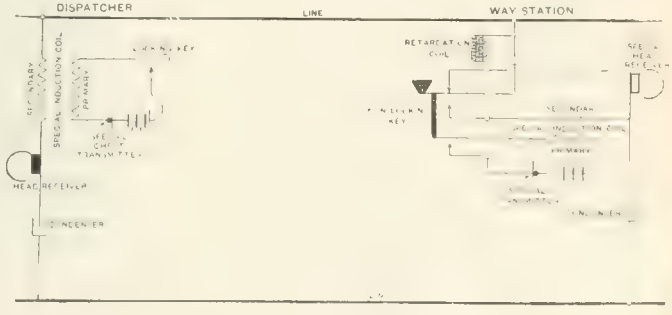


FIG. 2.—CIRCUITS FOR TELEPHONE TRAIN DISPATCHING.

poses. It is obvious that when a number of these sets are bridged across the line at once the joint impedance of the bridges in parallel is very low and the transmission correspondingly difficult between terminals or widely separated stations.

An improvement on this arrangement, so far as transmission is concerned, was effected by using a larger induction coil having a low-impedance primary and a high-impedance sec-

ondary. The larger coil improved the outgoing transmission considerably, but this arrangement is not so efficient for receiving, so that the gain resulting was not great.

To meet conditions imposed by this class of service, the circuit shown schematically in Fig. 2 has been devised. The dispatcher's equipment is substantially the same as shown in Fig. 1, except that special apparatus is used. The dispatcher is provided with instruments of fairly low impedance. Use is made of a head receiver in series with the induction coil; the latter is specially designed to give the best transmission consistent with good receiving. A locking transmitter key is provided, inasmuch as the dispatcher will ordinarily require both hands for his work. The transmitter itself is of the chest type, especially designed for this purpose.

It will be noted that the way-station circuit is radically different from that shown in Fig. 1. In order that a number of stations may be listening at once without serious detriment to the transmission, it is apparent that each must constitute, when listening takes place, a bridge of very high impedance. Further, in order to give efficient receiving, a large proportion of this impedance must be in the receiver itself. This precludes the possibility of having the receiver in series with the induction coil, because when transmitting all the secondary talking current passes through the receiver. The high impedance of the receiver would cut down the transmitted current, and, in addition to this, there would be the serious objection of excessive side tone.

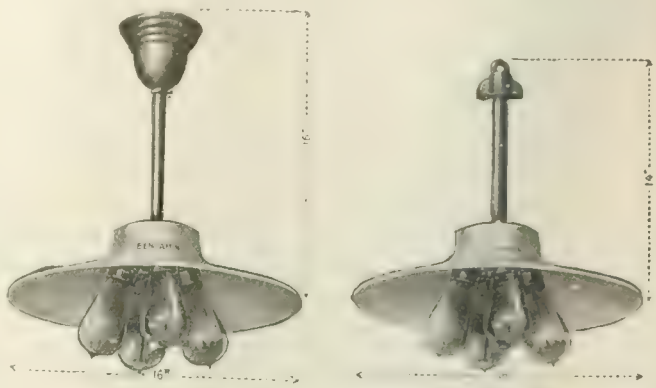
A study of these conditions led to the conclusion that the use of a push button or key which in its normal position gives the best possible receiving conditions and in its operated position gives the best possible transmitting would be advisable. By referring to Fig. 2 it will be noted that in the listening condition there is a circuit through the receiver and condenser in series directly across the line. When the key is thrown to the talking position it is seen that the receiver in series with a retardation coil (normally short-circuited) is put in parallel with the secondary of the induction coil, and these are bridged across the line through the condenser.

When the key is normal the receiver is directly across the line through a condenser, which gives the best possible receiving conditions. The receiver is specially wound and the impedance of the bridge at this time is about 2400 ohms to talking current, practically all of which is in the receiver, and consequently active for receiving. When the key is operated the induction coil, being bridged directly across the line through the condenser, gives the best possible condition for transmitting. The function of the retardation coil is to prevent excessive side tone in the receiver when talking, also by raising the impedance of the receiver circuit, more of the transmission is forced upon the line. This retardation coil is so designed that in case the dispatcher wishes to break in, a sufficient volume of the dispatcher's voice current will pass through the receiver to attract the operator's attention.

This circuit is said to be in use on circuits up to over 200 miles in length, with as many as 45 stations; 20 of these stations can be listening simultaneously without seriously impairing the transmission on the line. The circuit arrangements described above were designed by the Western Electric Company. In the issue of the *Electrical World* for Sept. 16 the circuits were illustrated in connection with a composite telephone set used by a steam railroad. The circuits are intended for train dispatching, but have no direct bearing on composite operation with telegraph lines.

Tungsten Fixtures with Hooded Enameled Steel Reflector.

The illustrations herewith show a new tungsten fixture with hooded enameled steel reflector, now being placed on the market by the Benjamin Electric Manufacturing Company, Chicago. The fixtures are, as will be seen, built up around a Benjamin cluster. They have a 16-in. white-enameled steel reflector, deeply hooded to receive the cluster in such a manner that the lamps are in proper relation to the reflecting surface. The outlets are at an angle of 16 deg. to the vertical. This slight angle not only does not endanger the filament of the lamps but adds materially to the lighting efficiency of the fixture inasmuch as one-half of the light of each lamp is directed downward and the other half at the same angle upward, to be redirected by the



FIGS. 1 AND 2.—TUNGSTEN FIXTURES.

reflector. Thus very little of the light of one lamp passes through the other lamps.

The cluster body is attached to the reflector by means of a flange. A water-tight joint is secured by the use of two rubber gaskets. These flanges are furnished for ⅜-in. or ½-in. pipe, the former for indoor, the latter for outdoor work. Two-light and four-light fixtures take 100-watt lamps, and five-light fixtures, 40-watt or 60-watt lamps. They are made for either multiple or series use.

Test of Moore Tube Lamp.

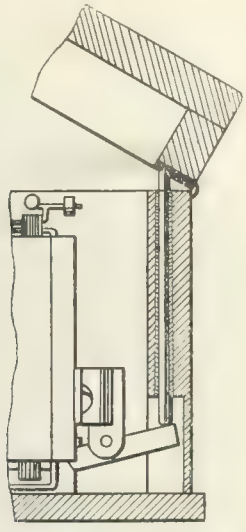
The Moore Electrical Company, Newark, N. J., has received the following report from the U. S. Bureau of Standards on tests made at the Bureau of the Moore carbon dioxide tube lamp: "Tests that were made by Dr. Ives during June showed that the light of this tube contained relatively more blue than the light from the sky near the horizon, and very much less blue than the light from the zenith when the sky is clear. It follows from this that the Moore carbon dioxide tube would be found to contain the same proportion of blue to red as the light from the sky at some altitude between the horizon and the zenith when the sky is clear, the particular altitude depending upon how dry the atmosphere is at the time of the measurement. In other words, the carbon dioxide tube is nearly the average of the light from the clear sky, but as this varies from time to time, according to the clearness of the sky and the dryness of the atmosphere, it is impossible to give the value of average daylight in exact figures."

Power Equipment for Drawing-in Cables.

The Cleveland Electric Illuminating Company, Cleveland, Ohio, has in use a power equipment which has been found especially convenient in drawing cables through conduits in the streets. It is built upon a short, heavy truck which may be coupled to a wagon when going from one point to another. In the front of the enclosure a Lincoln compound-wound motor is bolted to the heavy underframe. This has a speed range of 825 to 500 and sufficiently shunt to prevent its running away. The motor is geared to a shaft, which in turn is geared to a speed shaft which operates the drum. From the gear mesh, two speeds, 25 ft. and 50 ft. per minute, are obtained, a shifting lever being used to make the change. With the winch a speed of 30 ft. per minute drawing a 2,000,000-circ. mil cable may be obtained. Direct-current energy is obtained from the manholes in districts thus supplied, but where the territory is furnished with alternating current, energy is obtained from a battery.

Galvanometer Protecting Device.

The accompanying illustration shows an automatic clamp for the delicate suspension of a portable testing instrument. The clamp is so arranged that when the lid of the containing case is closed the moving element is lifted entirely free from contact with the pivot point and jewels, but as the cover is opened the system automatically returns to its initial position, thereby

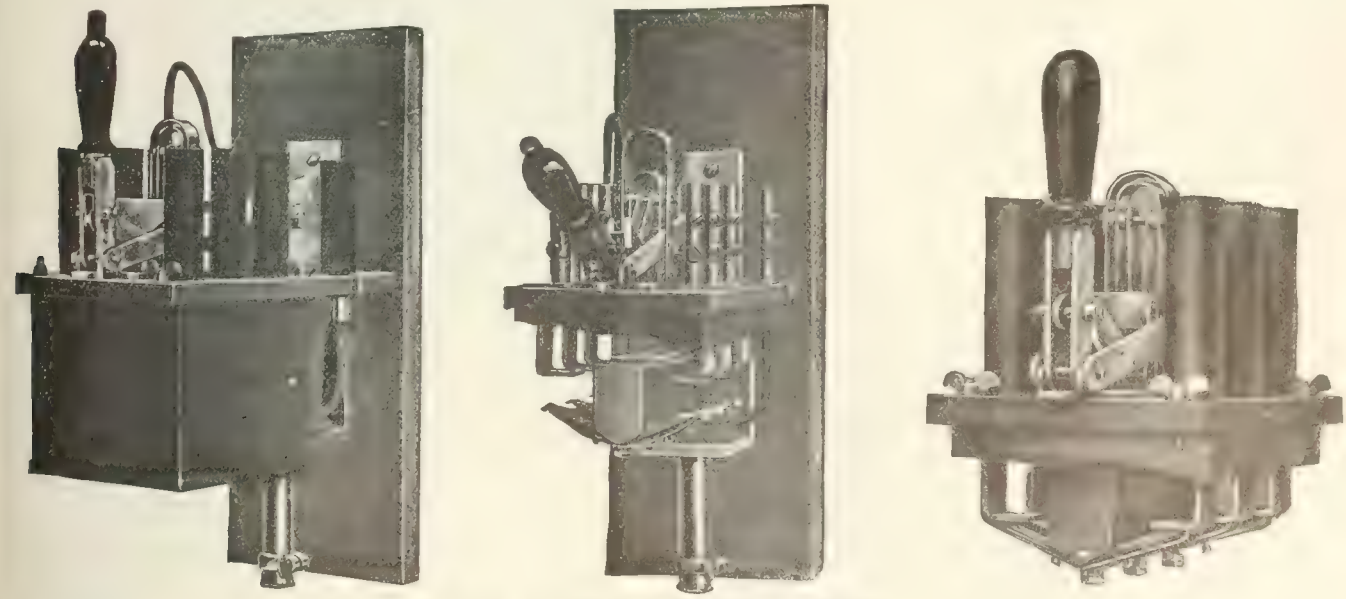


GALVANOMETER PROTECTING DEVICE

maintaining its initial sensibility and retaining the pivots and jewels uninjured, regardless of the mechanical treatment to which it is in the meantime subjected. This clamp has been devised by Queen & Company, Philadelphia, Pa. It can be applied to many of the existing types of galvanometers constructed by this firm

Automatic Oil-Switch.

Due to the inherent quality of a three-phase motor to run single phase when once started, the custom of protecting such motors by some device which is sure to open all poles in case of an overload has rapidly grown. Such a device in the form of an automatic oil switch is shown in the accompanying illustrations, made by the Condit Electrical Manufacturing Company, of Boston, and being known as an "LS" switch. This is provided with a coil and automatic release from the handle mechanism and is so arranged that an overload will open all of the poles. Referring to the mechanical features of the switch, it will be noticed that the current-carrying parts are laminated brushes. These have become a standard on direct-current circuit-breaker work, and are equally suited for carrying current in oil switches. It is recognized that nothing is superior to a laminated brush as a current-carrying member, and, when properly protected with secondaries, a current-breaking member. The switch is rugged and substantial and is so arranged that it is impossible to hold it closed on an overload.



FIGS. 1, 2 AND 3.—AUTOMATIC OIL SWITCH

Pliable Insulating Material for Floors.

The Electrose pliable insulating flooring, recently invented by Mr. Louis Steinberger, and placed on the market by the Western Electric Company, is a new development and is being used extensively in connection with high-tension switchboards. It is also used as a protective covering for floors and walls adjacent to high-tension apparatus. This insulating flooring possesses not only high dielectric properties, but also has a uniform composition. On an official test, a slab 12 in. x 12 in. x ⅜ in. arced over at 89,000 volts without puncturing, which gives an idea of its dielectric strength. The material is permanently pliable, very tough and strong, thoroughly waterproof and possesses a dull surface which will not become smooth or slippery from wear. It is made in various colors and of practically any size or thickness.

The material conforms to any inequalities of a floor upon which it is laid, and while the standard form of the material is pliable, it can be made, if desired, very hard and inflexible. When installing the covering, the slabs are placed on the floor or secured to a wall and spaced about ¼ in. apart. A cement, made of the same material, is then poured, or otherwise applied, between the slabs. When this cement "sets" (which will occur within 10 minutes of the time of application) a homogeneous mass is formed which becomes an integral part of the slab.

The Electrose flooring may be sawed, planed or drilled, and nails may be driven through it without danger of cracking or otherwise injuring it. The material naturally clings to the floor or other surfaces upon which it is laid, and does not curl at the edges or corners, thereby not making it necessary to secure the material to the floor, except under certain conditions, as when the slabs are small and it is necessary to keep them from moving along the surface of the floor. It is stated that in those cases where the Electrose pliable insulating flooring has been laid in power stations having high-tension switchboards, it has given thoroughly satisfactory results.

Small Motors.

The General Electric Company has recently placed on the market a new line of alternating-current and direct-current fractional horse-power motors. These have been termed the "drawn-shell" type, due to the fact that they have their field and stator iron securely bound in shells drawn from plates of steel.

The fields of the direct-current motors are built up of punchings, a construction which secures much smaller diameters than is possible with the usual cast-steel or iron magnet frames. The field and stator punchings are assembled under compression, with thick punched rings to serve as spacers for the end turns of the winding, and the whole is pressed into a steel shell. The edge of the shell is spun over securely, holding the iron in place. This construction is shown in Fig. 2.

These steel shells or frames for both direct-current and alternating-current motors are cylindrical, and have no lugs or projections whatever. They are placed on an arbor and the rim is trued and grooved to receive the heads, which are made of cast-iron. The heads are machined on centers to fit the frame, consequently the whole structure of the motor is correct, and accurate air-gap and alignment of bearings are the result.

The standard base is shown in Fig .1, and this is securely held in place by two screws tapped into the magnet frame. The shafts of all motors are of ample size, and the bearing linings are of bronze. The induction motors have a high power factor, efficiency and liberal overload capacity, with moderate heating. This is evident from the curves in Fig. 4. The windings are of the concentric type, and the starting coils are automatically cut out by a switch when the motor has reached a suitable speed. A centrifugal clutch is furnished when necessary.

Since the frames are cylindrical and without lugs and projections, they may be fitted with ease to any form of support, and the heads may be turned through any angle to permit of the motor being inverted or attached to a wall or vertical bracket. This method of construction eliminates the outside frame of cast iron that is usually employed, as well as the necessity for all holes through the active iron. It also makes possible accurate methods of manufacture, which ensures perfect concentricity of parts and an alignment not usually found when the common cast shell is used.

These motors are supplied to meet all commercial circuit conditions of voltage, and, in the case of the induction motors, are supplied for the various frequencies with either single or polyphase winding. If one wishes to have direct-current and alternating-current motors of the same dimensions so as to use them interchangeably, it will be necessary to interchange an alternating-current with a direct-current motor of the next larger capacity. Their electrical characteristics are clearly shown by the curves in Figs. 3 and 4.

The motors are very compact, light in weight and of fine workmanship. They are adapted to such service as driving sewing-machines, small lathes, automatic musical instruments, air pumps, small blacksmith forges, dental instruments, jeweler's tools, pumps, buffing and grinding tools and a large variety of small special machines.

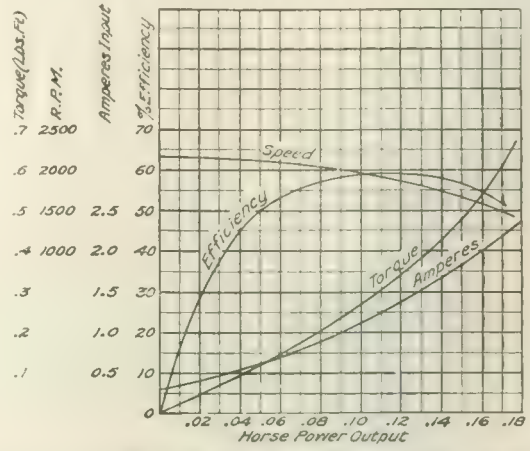


FIG. 3.—TYPICAL CURVES OF DIRECT-CURRENT MOTORS

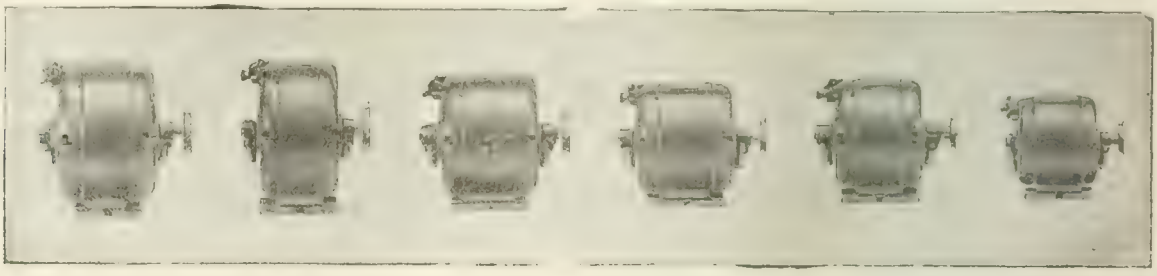


FIG. 1.—COMPLETE LINE OF ALTERNATING-CURRENT MOTORS.

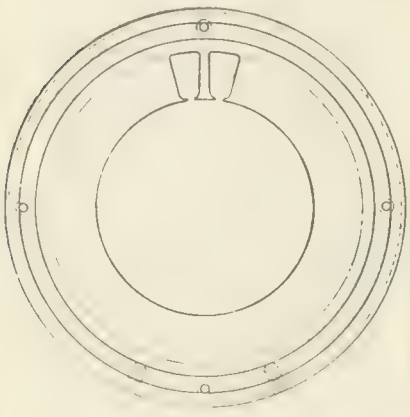


FIG. 2.—MOTOR FIELD STRUCTURE

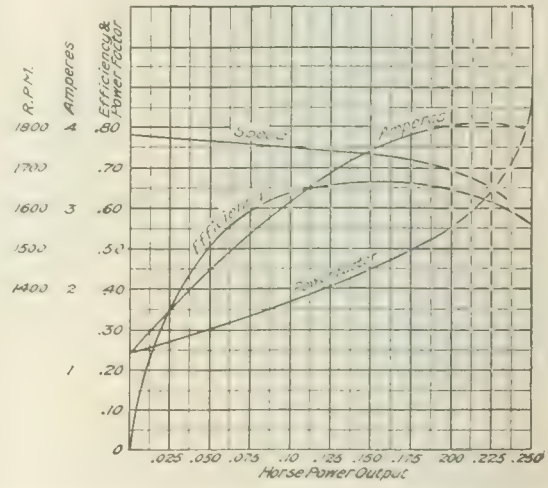


FIG. 4.—TYPICAL CURVES OF ALTERNATING-CURRENT MOTORS.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

General improvement in trade continues throughout the country, and this is especially noticeable in the retail business. The shipments of crops have been heavy in many sections of the West, producers have received their money and the natural consequence is active buying from the retail stores. Among the wholesalers and jobbers orders are not particularly plentiful, but as this is a season at which orders are always slack there is no discouragement felt upon this account. The spring orders that are being placed continue to show that spirit of conservatism which was so noticeable when the orders for fall goods were placed. It is evident that business men of the country are determined not to overstock. The industrial lines continue to lead in activity, and especially in the iron and steel industry orders are almost too numerous to be filled. One result of this is that there are few skilled workmen now idle, and the general employment of all kinds of labor continues to expand. All of this is adding to the prosperity of industrial sections. The crop situation is unchanged, and it is still figured that the producers of the country will receive about eight billions of dollars for their product. Collections are very much improved, and, in fact, are entirely satisfactory. Business failures for the week which ended Sept. 23, as reported by *Bradstreet,* were 171 against 198 of the previous week; 267 in the like week of 1908: 166 in 1907; 165 in 1906, and 185 in 1905.

THE COPPER MARKET.

There has been more activity in the copper market during the past week and prices are distinctly stronger. Such an advance was predicted in the market 10 days ago when there began to appear artificial stimulation in copper speculation in London. This manipulation was especially directed toward November and December deliveries, but it also had a distinct effect upon the spot and October market. Quite a number of liberal contracts from exporters and from domestic consumers have been reported. The domestic buying was rather spasmodic and gave no indication of a desire on the part of consumers to accumulate stocks. Indeed, it is generally understood in the market that the principal users of copper are fairly well stocked and are not much afraid of any dangerous boosting of prices. The statistical position, which is perfectly well understood by the consumers, continues to deny the possibility of a marked advance. Production goes on at a record-breaking rate and actual consumption is below normal. Stocks are accumulating in warehouses and in consumers' hands as well as with the producers. Regardless of "sales" and the shifting of holdings, the discrepancy between production and consumption continues. Exports for the month, including Sept. 27, were 13,593 tons. The daily call on the Metal Exchange, at 12:30 o'clock Sept. 27, quoted standard copper as follows:

	Bid.	Asked.	Settling price.
Spot	12.65	12.75	.....
September	12.65	12.7	12.70
October	12.70	12.8	12.77½
November	12.80	12.8	12.85
December	12.90	13	12.95

The London prices Sept. 27 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	59 13 0	59 10 0
Standard copper, futures	60 6 3	60 7 6
Market	Firm.	Steady.
Sales of spot		600 tons
Sales of futures		800 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.90	12.62½
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6

CALIFORNIA ELECTRIC FUSE FACTORY.—The Long Beach Electrical Manufacturing Company, Long Beach, Cal., is erecting machinery for the manufacture of a new type of electric fuse.

CENTRAL LABORATORY SUPPLY COMPANY, PURDUE, IND., CHANGES NAME.—On account of the greatly increased scope of the business done by the Central Laboratory Supply Company, the directors voted at their August meeting to change the name of the company to the Esterline Company. The Central Laboratory Supply Company was organized in 1903 by J. W. Esterline, and began manufacturing a line of electrical, mechanical and physical laboratory apparatus. In 1906 the company was incorporated, with J. W. Esterline, W. Bent Wilson, Thomas Duncan and E. S. Ferry as the principal stockholders. The company has been prosperous and has had a rapid growth, numbering among its customers nearly all the leading technical and commercial laboratories in the United States and Canada. In addition to its manufacturing work the company has continued the consulting engineering work formerly conducted by Mr. Esterline, and has been successful in the design and construction of lighting and power plants and modernizing of manufacturing establishments. On account of the increasing volume of business in this line, the directors have decided to change the name of the corporation, and also to increase the engineering staff of the company. J. W. Esterline, president and manager, will continue at the head of the consulting engineering staff. It is the purpose of the company to enter more largely into construction work, and to this end has secured the services of B. W. Bissell, an engineer of ability in contracting and construction work, now in the employ of the Government at Highland Falls, N. Y. Mr. Bissell will take up this work Oct. 1. Mr. Berdon, an electrical engineer and expert in switchboard and instrument design, has been appointed assistant manager. A. J. Webber is at the head of the design and drafting department. Mr. Webber was also until recently in the Government service, and is experienced in machine and power plant design. E. L. Ogle, a graduate of Purdue University, class of 1903, engaged since graduation in electrical construction work, has also been recently engaged by the company. With a staff of five experienced engineers, headed by Mr. Esterline, this company is in a position to handle successfully its rapidly growing business in engineering and construction. The company has just completed a 1000-kw combined steam and water-power plant for the city of Logansport, Ind.; a 1000-kw station for Frankfort, Ind., and has recently closed the following contracts: Indiana Springs Company, Kramer, Ind., power plant and motor equipment; Indiana State Soldiers' Home, electric lighting plant and motor equipment; C. H. Campbell Furniture Company, Shelbyville, Ind., electric generating plant and motor equipment; DePauw University, Greencastle, Ind., heating system and lighting plant. The company has recently been employed to design and construct a large hydroelectric plant and transmission system. The Esterline Company will continue manufacturing the well-known line of electrical instruments, graphic meters and special apparatus which have been marketed by the Central Laboratory Supply Company.

NEW HIGH-POWER WIRELESS PLANT.—Marconi announces that he has recently superintended the reconstruction of the wireless station at Glace Bay, N. S. The plant when completed will be one of the most powerful wireless telegraph stations in the world, and new instruments have been devised for its equipment. It is believed that when it is ready for operation there will be no interruption in the service between Nova Scotia and Europe.

TUNNEL UNDER THE CHICAGO RIVER.—Geo. W. Jackson, Inc., of Chicago, has put in a bid offering to build the main section of the proposed Washington Street street-railway tunnel under the South Branch of the Chicago River for $590,000. It is said that this bid was much lower than that of the next lowest bidder, and that Mr. Jackson's company will undoubtedly get the contract as soon as the necessary papers are made out.

GENERAL ELECTRIC TOLEDO PLANT.—Work has been commenced on a $100,000 addition to the Toledo lamp plant of the General Electric Company.

ALLIS-CHALMERS ORDERS.—The Allis-Chalmers Company has recently received orders for steam turbines aggregating a total of 25,255 kw, and the large numbers of "repeat orders" received by the company testify to the economical and reliable operation of the units in service. Recent contracts for new machines comprise turbines ranging from 300 kw to 3000 kw for generating current in a great variety of industries. Among the purchasers of large units are the Wilmington (Del.) City Electric Company, 1500 kw, and the Paine Lumber Company, Oshkosh, Wis., 1000-kw and 500-kw turbines. The Diamond Rubber Company, of Akron, Ohio, has purchased a 1250-kw, low-pressure turbine. Sales of 500-kw turbines have been made to Byron Weston Company, Dalton, Mass.; Sheffield Car Company, Three Rivers, Mich.; E. J. Du Pont De Nemours Company, Wilmington, Del.; Coventry Company, Anthony, R. I.; Alexandria Electric Company, Alexandria, Va., and two units for the Casparis Stone Company for operation in its plants at Patterson's Creek, W. Va., and Harve de Grace, Md. The National Conduit & Cable Company, Hastings-on-Hudson, N. Y., has bought a 750-kw turbine, and the Ponemak Mills, Taftville, Conn., have contracted with Allis-Chalmers Company for a 600-kw turbine. Two 375-kw low-pressure turbines are to be installed in the plant of the Cherry River Paper Company, Richmond, Va., and one in the plant of the Virginia Electric Power & Water Company, Virginia, Minn. The Taylor Iron & Steel Company, Highbridge, N. J., will put in operation a 300-kw Allis-Chalmers steam turbine. Sales for turbines of the same capacity have also been consummated with the Noblesville Heat, Light & Power Company, Noblesville, Ind.; Citizens' Lighting Company, La Salle, Ill.; Huntington Valley Light & Power Company, Jenkintown, Pa., and the Pacific Lumber Company, Wilmington, Cal.

CROCKER-WHEELER COMPANY'S ORDERS.—Several large orders for direct-current apparatus have recently been received by the Crocker-Wheeler Company. Among these is one from the Southern Iron & Steel Company, of Roger, Ga., calling for two 250-kw, engine-type, 550-volt, direct-current generators and 275 hp in 500-volt, direct-current motors. This is in addition to a recent order for 1450 kw in engine-type generators and 1200 hp in slow-speed motors from the same concern. The Republic Iron & Steel Company, Youngstown, Ohio, placed an order for a 600-kw, engine-type, 250-volt, direct-current generator, which will be added to a plant consisting of two 300-kw Crocker-Wheeler generators. Another order has been booked from the Nonquit Spinning Company, New Bedford, Mass., covering 375 kw in 250-volt, type-D, direct-current generators. One 250-kw, 250-volt, engine-type, direct-current generator, and two 50-hp motors are to be installed in a woolen mill for the Southwark Mills Company, of Philadelphia. Two 75-kw, engine-type, 125-volt, direct-current generators will be installed in the factory building of Goodman, Loeb & Company, Philadelphia, Pa.

CONDITION OF PLATINUM MARKET.—Cyrus Osborne Baker, president of Baker & Company, dealers and refiners of platinum, has recently returned from abroad. While Mr. Baker's trip was largely in search of health, and not for business, he says that he found the situation of the platinum market in Europe to be about the same as it has been for some months past, and that the price of platinum, which is quoted at from $26 to $27 an ounce, has not changed for several months. Mr. Baker says that a proposition is before the Russian Government for an arrangement by which the Imperial Bank of Russia will advance money up to a certain limit upon platinum for the benefit of the miners. Such a policy as this would be beneficial to the dealers and consumers of platinum in this country, in so far that it would steady the price, fixing a limit below which it would not be likely to go. Mr. Baker returns after a rather serious illness, very much improved in health.

ELECTRICAL PROGRESS IN EUROPE.—E. W. Rice, vice-president of the General Electric Company, returned from Europe last week and declared that electrical development abroad was progressing very satisfactorily. "Progress is not so great as in this country," said Mr. Rice, "and the adoption of electrical appliances is slower. I expected to find railroad terminals, especially in the large cities, applying electricity, as is being done in this country, but such is not the case. The application of electricity for terminal purposes must come sooner or later in such cities as London, Manchester, Birmingham, Glasgow and other large cities. The smoke nuisance is terrible in those cities, and in some of the long tunnel approaches. It is more a disinclination to depart from the old custom than a question of expense that delays the change, but it will surely come soon."

BERLIN AMERICAN EXPOSITION.—Secretary Nagel, of the Department of Commerce and Labor, has sent out a circular to manufacturers, boards of trade, etc., asking their support of the American Exposition, to be held in Berlin, Germany, from May to July, 1910. As the exposition is to be confined strictly to American products, it becomes, he says, a matter of national interest to have the exhibits thoroughly comprehensive and of exceptional merit, so that the exposition may serve to strengthen the prestige of American industries abroad. The office of the exposition is at 50 Church Street, New York.

ILLINOIS CENTRAL ELECTRIFICATION.—Within a short time all of the Illinois Central tracks within the city limits of Chicago will be ready for electrical operation. The electrification will proceed in six sections, namely: First, suburban tracks, Randolph Street to 63d Street, from steam to protector third rail; second, express tracks to South Chicago, third rail; third, electrification Kensington tracks; fourth, electrification suburban and through passenger tracks to Burnside; fifth, passenger and freight tracks between Park Row station and Burnside; sixth, passenger and freight tracks to Riverside.

DILG MANUFACTURING & TRADING COMPANY.—The Dilg Manufacturing & Trading Company, 401 East 163d Street, New York, has organized an electrical department for the manufacture and sale of motors, dynamos and electrical sundries, and to furnish expert engineering advice and designs. C. H. J. Dilg, formerly of the Eck Dynamo & Motor Company, will be in charge, and has already introduced a number of labor-saving devices and improvements. H. O. Allen, electrical engineer, also formerly with the Eck Company, will be on the staff of the new department.

GOOD DEMAND FOR INSULATED WIRE.—Dealers in insulated wire for interior use report that the demand has become quite active, and that there are many inquiries, which indicate that the business will be even better later in the fall. There has been a great amount of building done during the present season, and these buildings are now nearing a point where wire contracts are in order. Building of this sort has been largely of the better class, and iron and steel construction and all of this kind of work add to the trade in insulated wire.

NIAGARA FALLS HYDRAULIC POWER & MANUFACTURING COMPANY.—The Water Commission of Niagara Falls has accepted the offer of the Niagara Falls Hydraulic Power & Manufacturing Company for the municipal water works pumping plant. The purchasing company agrees to supply energy up to 800 hp, for a term of 76 years, to the city at a rate of $9 per horse-power per year, and all above that amount at $10 per horse-power. The offer from the Niagara Falls Power Company was $20 per horse-power.

HEANY LAMP COMPANY.—The Heany Lamp Company is just completing the equipment of its new factory at Flint, Mich. The capacity at the start will be 10,000 tungsten lamps per day, which will be increased as rapidly as new machinery can be installed. The Heany Company will shortly begin the erection of another lamp factory in the vicinity of New York, to have a like capacity. These various increases in plant are rendered necessary by the enormous demand for Heany tungsten lamps.

CITIZENS' RAILWAY & LIGHT COMPANY, MUSCATINE, IA.—A contract has been placed with the Westinghouse Electric & Manufacturing Company by the Citizens' Railway & Light Company, of Muscatine, Ia., for one 750-kw turbine and one 300-kw rotary converter. These are to be installed in the generating plant of the company at Muscatine.

CATALOGS WANTED.—The Madison County Gas & Electric Company, Oneida, N. Y., writes that in a fire which recently destroyed its offices all files of catalogs were consumed, and it would like to receive trade literature from manufacturers of electric and steam apparatus and specialties.

NEW PLANT IN LOUISVILLE, KY.—The Bradford Worsted Spinning Company, of Louisville, Ky., has drawn plans for a new power plant which will include four 200-hp tubular boilers and a 700-hp Hamilton-Corliss engine direct connected.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in the present issue are announcements of proposed new plants or considerable extensions of present plants at Crowley, La.; Willard, N. Y.; Bear Creek, Mont.; Sweetwater, Nev.; Weston, Ore.; Dayton, Ore.; Denison, Ohio; St. Catherines, Ont., Can.; Jefferson, Ga.; Dillon, S. C.; Orangeburg, S. C.; Bellingham, Wash.; Tyndall, S. D.; Washtunca, Wash.; Hoboken, N. J.; Detroit, Mich., Point Richmond, Cal.

Financial Intelligence.

THE WEEK IN WALL STREET

After a more or less irregular market during the days that preceded the Wall Street holiday of Sept. 25, there was considerable strength developed Sept. 27, although trading was not active. The market in this instance seemed to be carried up by the tremendous desire to buy Steel common. There is apparently an abiding faith in the prediction that this stock will reach par. The price on Sept. 27, the last day under review, was pushed up to 87⅛, a new high record. Although the stock market during the week had been irregular with an inclination to weakness, this has been the result of general liquidation by long holders rather than of any discouraging features in the situation. As a matter of fact there is nothing discouraging in sight. The crop situation is entirely satisfactory and industrial conditions, especially in iron and steel, are better than ever before in the history of the country. Railroads as well as industrials are doing splendidly and money continues to be easy enough to make the carrying of securities easy. The record of dividend disbursements for October is in itself an indication of conditions. The total increase over last year is figured at $13,274,000, and this of course only represents a limited number of the principal corporations. The demand for bonds, while good, is not so heavy as it was when stocks were less attractive for investment purposes. Money continues easy. Quotations Sept. 27 were: Call 2¾ @ 3 per cent, 90 days 3¾ @ 4 per cent. The quotations in the table are those of the close Sept. 27.

NEW YORK.

	Sep. 20.	Sep. 27.	Shares sold		Sep. 20.	Sep. 27.	Shares sold
All.-Ch.	15⅜*	15⅜	2,100	Int.-Met., pfd.	48⅛	48⅛	14,448
All.-Ch., pfd.	54*	53½	1,525	Mackay Cos...	88½	91⅛	12,900
Amal. Cop....	84½	82	115,750	Mackay Cos.,p.	75½	76	3,470
Am. D. T....	20½*	20½*	——	Man. Elev....	143¼	142	410
Am. Loc.	61	59½	5,400	Met. St. Ry..	20*	143¾*	——
Am. Loc., pfd.	118½	117	750	N.Y.&N.J. Tel.	139¼*	139¼*	——
Am. Tel &Cbl.	84¾*	85*	100	Steel, com....	84	86½	837,400
Am. T. & T..	143	144⅛	37,450	Steel, pfd....	128¼	128½	75,260
B. R. T.....	80⅛	79¾	55,175	W. U. T.....	78¾	79¾	16,500
Gen. Elec.....	167¾	168	3,150	West'h, com..	87	86¾	5,800
Int.-Met., com.	14⅞	14¾	7,865	West'h. pfd...	130*	135	200

PHILADELPHIA.

	Sep. 20.	Sep. 27.	Shares sold		Sep. 20.	Sep. 27.	Shares sold
Am. Rys.....	46	45⅞	——	Phila. Elec....	12½	12⅜	——
Elec. Co.of A.	12¼*	12¼*	——	Phila. R. T...	27	28⅛	——
Elec. St. B'ty.	62	59½	——	Phila. Trac....	88½*	90	——
E. S. B'ty,pfd.	30*	30*	——	Union Trac..	52¾	53½	——

CHICAGO

	Sep. 20.	Sep. 27.	Shares sold		Sep. 20.	Sep. 27.	Shares sold
Chi. City Ry..	180*	180*	——	Chi. Tel. Co..	138*	138	——
Chi. Rs.,Ser.1.	110*	109¾*	——	Met. El., com..	16	17¾*	——
Chi. Rs.,Ser.2.	36¾*	36½*	——	Met. El., pfd..	49½	51	——
Com. Edison..	120	120¾	——	Nat'l Carbon..	96¾	96½	——
Chi. Sub'ws...	9⅛	9¼	——	Nat'l C., pfd..	118½*	119*	——

BOSTON.

	Sep. 20.	Sep. 27.	Shares sold		Sep. 20.	Sep. 27.	Shares sold
Am. T. & T...	143⅜	144½	——	Mex. Tel.....	3*	2¼*	——
Cum. Tel.....	145*	140*	——	Mex. Tel., pfd.	6	6*	——
Edison E. Ill..	252	252	——	N. E. Tel.....	139	138½*	——
Gen. Elec.....	168	167¼	——	W. T. & T.....	11	11⅝	——
Mass. E. Ry..	17*	16¼*	——	W. T. & T., p.	90	88	—
Mass. E. R.,p.	79½	78¼	——				

*Last price quoted.
Shares sold are for week of Sept. 20 to Sept. 24.

DENVER GAS & ELECTRIC COMPANY.—Plans for an issue of $25,000,000 in 40-year 5 per cent bonds by the Denver Gas & Electric Company have practically been matured, and the bonds will probably very soon be ready for the public. It is not contemplated, however, making at the present time any offering of these bonds for sale. The Denver Gas & Electric Company has a large surplus in actual cash, and is not in need of money, and further than the bonds that are necessary to take up the outstanding liabilities there will be no issue at this time offered to the public. H. L. Doherty & Company, who are back of this company, and who have planned the present refinancing, are merely building for the future, and the bonds will be disposed of as money for additions and extensions is needed. It has not been announced as yet what the capitalization of the reorganized company will be, but as the present company is in splendid shape this is not material. In this connection it is said that a merger of the Denver Gas & Electric Company, the Central Colorado Power Company, the Northern Colorado Power Company, the Denver Tramway Power Company, the Pueblo Light & Traction Company and the Colorado Springs Hydro-Electric Company is being planned. At the present time no definite information regarding this merger is being given out. Frank W. Frueauff, general manager of the Denver company, has denied some of these rumors, but he would not deny the possibility of such a combination in the future. The Denver company is now taking part of its power from the Shoshone plant of the Central Colorado company, and will take another large portion of its power from the Nederland plant, near Boulder, Col., when that is completed. The reliability secured from having two water-power sources as well as a steam station, which will be maintained, is expected to be very valuable to the service.

WORCESTER ELECTRIC LIGHT COMPANY.—Stone & Webster, of Boston, sent out last week through Kingsley & Adams, brokers, offers to pay $300 cash for each share of stock of the Worcester Electric Light Company. This is one move in a big struggle that is now going on for control of this property. Since the New Haven railroad took over the Worcester Consolidated Street Railway Company there has been a contest as to the ownership of the light company. Opposed to the Stone & Webster offer, a committee of the largest stockholders of the company has sent out circulars announcing the formation of a new holding company to secure control of the stock and prevent it from being bought by outsiders. Named with these interests is J. G. White, of the well-known financial and engineering firm of J. G. White & Company, New York. They argue that it is better to keep the company in the possession of the citizens of Worcester. This committee offers $100 cash and two shares of stock in the holding company, par value $100, for each share of the present stock, and guarantees that the new stock will pay a 5 per cent dividend. The capital of the holding company will be $2,000,000. The Worcester company has outstanding $754,800 of capital stock and has no bonds. It has been paying 8 per cent for some years.

PITTSBURGH, McKEESPORT & WESTMORELAND RAILWAY.—A meeting of the stockholders of the Pittsburgh, McKeesport & Westmoreland Street Railway Company has been called for Nov. 22 to vote on a proposition to spend $2,000,000 on extensions and improvements next spring. George D. Cook, of 25 Broad Street, New York, has undertaken to finance this project, and is now offering for sale at 95 and interest $1,000,000 of 5 per cent gold bonds of this company. A representative has been sent abroad who, it is said, has been successful in placing not less than $500,000 of these bonds in Europe. This company now has a line in operation from McKeesport, on the Ohio River, to Irwin, Pa., in the heart of the coal and gas belt. This line is 11 miles long. It also has under construction a line from Donora to Herminie, which will be connected with the line now in operation by the use of a short branch of electric railway already constructed. These new lines run through a very densely populated and very active industrial section.

PACIFIC GAS & ELECTRIC COMPANY.—A recent financial statement of the Pacific Gas & Electric Company of San Francisco, which is a combination of the California Gas & Electric Corporation and the San Francisco Gas & Electric Company, discloses that, based on actual earnings for six months of the year 1909, the company will show a balance applicable to common dividends of approximately $2,249,373, or a percentage of 12.31 on its $18,725,000 of that class of stock. This compares with 6.82 per cent in 1908, 6.32 per cent in 1907, and 2.62 per cent in 1906, the first year after its organization. This company has expended, in the last five years, more than $9,000,000 out of surplus earnings for improvements, betterments and extensions. Independent engineers set the present value of the purely physical property at $90,000,000, an amount $33,000,000 in excess of the entire bonded debt of the company and its subsidiaries.

CHICAGO RAILWAY EARNINGS.—The Chicago Railways and the Chicago City Railway Companies have issued their joint statement for the year ended Jan. 31, 1909, in accordance with the ordinance of the City of Chicago. The combined income accounts of the two companies show gross earnings of $18,823,094, and net earnings of operation of $5,646,928. After deducting the interest on the capital invested the net earnings are $2,844,761. Of this amount the City of Chicago receives $1,564,618, and the balance goes to the stockholders of the company.

NEW YORK TELEPHONE COMPANY.—At a special meeting of the stockholders of the New York & New Jersey Telephone Company, Sept. 22, authorization was given for the sale of the company's property to the New York Telephone Company. This is in accordance with the policy of administrative consolidation recently announced by the American Telephone & Telegraph Company, the holding company of the Bell system. The New York Telephone Company on the same day filed a certificate of capital increase at Albany, raising its capital from $50,000,000 to $100,000,000, and at the same time a certification was filed of the merger of the Central New York Telephone & Telegraph Company with the New York Telephone Company. This is a part of the program of consolidation which will eventually result in every Bell subsidiary in the State being under one management. The entire outstanding issue of the New York Telephone Company's stock is now owned by the American Telephone & Telegraph Company. This, of course, includes the recent acquisition of about $16,500,000, par value, of the stock which was taken over from the Western Union Telegraph Company.

NEW YORK & NEW HAVEN'S NEW STOCK ISSUE.—The stockholders of the New York, New Haven & Hartford Railroad Company have been called to meet Oct. 27 for the purpose of ratifying an issue of $40,000,000 new stock, the proceeds of which will be used partly for retiring $14,000,000 of maturing obligations and partly for betterments. Among the other things for which this new money will be used is the extension of the electrical zones. These are to be extended from Stamford to New Haven, a distance of 39½ miles. The new stock will be offered to shareholders and convertible bondholders at $125 per share, and will be issued as needed during the next two years.

ALBION POWER COMPANY IMPROVEMENTS.—With regard to the purchase of the property of the Albion Power Company by the A. L. Swett Electric Light & Power Company, which was announced in our last issue, A. L. Swett, president of the latter company, says that the Albion property will be put in good condition and operated with energy from the Medina, N. Y., water-power plant. This plant, which belongs to the Swett company, is said to be a model of efficiency. Mr. Swett says that it is expected to develop about 5000 hp and to serve a territory with 30,000 inhabitants.

INDIANA UNION TRACTION COMPANY.—It is understood that the Indiana Union Traction Company, with headquarters at Anderson, Ind., has purchased the new power dam and electric generating plant which is just being completed on White River, near Noblesville. This construction has been done by the Noblesville Hydraulic Company, and it is understood that the traction company intends to use the plant as an auxiliary for its present system, and also to sell and distribute energy.

DIVIDENDS.

American Telephone & Telegraph Company, quarterly, 2 per cent, payable Oct. 15.

Bangor (Me.) Railway & Electric Company, quarterly, 1 per cent, payable Oct. 1.

Buffalo General Electric Company, quarterly, 1½ per cent, payable Oct. 1.

Central & South American Telegraph Company, quarterly, 1½ per cent, payable Oct. 8.

Consolidated Gas & Electric Company, Baltimore, preferred, semi-annual, 3 per cent, payable Oct. 1

Detroit Edison Company, quarterly, 1 per cent, payable Oct. 15.

Electric Securities Corporation, preferred, semi-annual, 2½ per cent, payable Nov. 1.

Electric Storage Battery Company, preferred and common, quarterly, ¾ per cent, payable Oct. 1.

Mexican Telegraph Company, quarterly, 2½ per cent, payable Oct. 15.

Michigan Light Company, quarterly, preferred 1½ per cent, common 1 per cent, both payable Oct. 1.

National Light, Heat & Power Company, preferred, quarterly 1¼ per cent, payable Oct. 1.

New England Telephone & Telegraph Company, quarterly, 1½ per cent, payable Oct. 15.

Pope Manufacturing Company, preferred, quarterly, 1½ per cent, payable Nov. 1.

Stark Electric Company, Cleveland, quarterly, ¾ per cent, payable Oct. 1.

Union Railway, Gas & Electric Company, preferred, quarterly, 1½ per cent, payable Oct. 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus
Aurora, Elgin & Chicago Railroad Company:					
August, 1909	$163,698	$76,448	$87,250	$29,351	$57,899
August, 1908	153,844	71,174	82,720	27,624	55,096
Birmingham (Ala.) Railway, Light & Power Company:					
August, 1909	181,079	100,036	81,043	.....	..
August, 1908	172,068	105,630	66,438	.....	...
Central & South American Telegraph Company:					
Quarter ended Sept. 30, 1909	371,000	163,000	208,000	143,565	66,637
Quarter ended Sept. 30, 1908	365,000	165,000	200,000	143,565	60,935
Chicago Railways Company:					
July, 1909	1,057,603	700,697	356,725	510,187	136,426
July, 1908	962,559	614,263	348,295	439,411	147,122
Cumberland Telephone & Telegraph Company:					
August, 1909	622,514	300,979	321,564	41,938	179,625
August, 1908	489,511	287,636	201,875	37,724	164,151
Dallas (Tex.) Electric Corporation:					
July, 1909	106,340	68,107	38,233	25,070	10,162
July, 1908	101,397	71,129	30,267	26,469	3,779
Detroit United Railway Company:					
July, 1909	771,453	466,319	305,134	162,050	155,754
July, 1908	678,447	417,867	261,578	135,978	132,061
Edison Electric Illuminating Company, Brockton, Mass.:					
July, 1909	25,026	11,013	6,612	3,072	3,540
July, 1908	14,473	8,472	6,130	2,435	3,694
Lake Shore Electric Railway Company:					
August, 1909	134,673	55,822	78,851	33,852	41,318
August, 1908	119,674	54,749	64,925	33,749	31,175
Lowell (Mass.) Electric Light Corporation:					
July, 1909	26,208	14,732	11,494	3,554	7,940
July, 1908	23,315	13,116	10,199	3,621	6,577
Milwaukee Electric Railway & Light Company:					
August, 1909	374,956	171,187	203,069	111,230	91,838
August, 1908	343,510	161,888	182,621	101,154	81,467
Minneapolis General Electric Company:					
July, 1909	77,543	37,263	40,279	20,562	19,716
July, 1908	73,884	32,925	41,863	32,400	9,463
Montreal Street Railway Company:					
Eleven months, 1909	3,492,976	2,078,393	1,414,372	418,801	995,576
Eleven months 1908	3,329,059	1,978,659	1,350,400	423,021	927,379
Northern Ohio Traction & Light Company:					
August, 1909	231,061	115,724	115,337	43,703	71,634
August 1908	210,741	107,356	102,385	43,381	59,004
Seattle Electric Company:					
July, 1909	502,586	305,027	287,559	95,074	192,484
July 1908	366,481	209,949	156,531	87,515	69,016
Twin City Rapid Transit Company:					
July, 1909	641,094	277,570	363,523	140,250	222,272
July, 1908	606,323	278,234	328,234	128,361	199,873

GENERAL NEWS

Construction News.

BURDETTE, ARK.—The Three States Lumber Company is installing an electric light plant to furnish electricity for lighting the town, equipment for which has already been purchased. F. G. Proutt, Randolph Building, Memphis, Tenn., is engineer in charge.

CARLISLE, ARK.—Messrs. Allain & Crow are reported to have purchased the electric light plant, owned by J. E. Tunis, of Carlisle. The new owners, it is said, will install new machinery and make other improvements.

WALNUT RIDGE, ARK.—Plans are being made by the Lawrence County Telephone Company to extend its telephone line to Alicia. The company also proposes to make further extensions to Pocahontas and Jonesboro.

GRASS VALLEY, CAL.—It is reported that plans are being considered to equip the property of the Gold Mound, which is under bond to Edward I. Field, of Telluride, Cal., to be operated by electricity and to install a compressor.

LOS ANGELES, CAL.—Work has commenced on the installation of a power plant for the irrigation of the lands on the Armstrong tract in Riverside and San Bernardino Counties. The cost of the plant is estimated at $50,000. George H. Ennis and J. H. Barbour, and F. C. Finkle, consulting engineer, of Los Angeles, Cal., are interested in the enterprise.

OROVILLE, CAL.—Work has been started by the Pacific Telephone & Telegraph Company in rebuilding its Oroville system. The changes will consist largely in rewiring the city with cables, and later in installing an underground cable in the business portion of the city. The cost of the work is estimated at about $11,000.

PLEASANTON, CAL.—The Spring Valley Company is reported to be making arrangements to commence work on the construction of its power plant, on a site located south of Pleasanton.

POINT RICHMOND, CAL.—The Richmond Light & Power Company has arranged to establish a substation at Second Street and Nevin Avenue, moving its present substation from the Standard Oil works. The change in location will be made to meet a demand for electricity on the east side. The station will be of reinforced concrete, to cost from $6,000 to $10,000.

REDDING, CAL.—The Northern California Power Company has made application to the Superior Court asking that the injunction issued Sept. 4 be modified. The injunction, made at the request of eight Shingletown farmers, restrains the company from diverting any water from North Battle Creek. Since the action was begun the Northern California Power Company has bought the water rights of W. H. Donaldson and Robert Madghson, and it now asks to be allowed to take this water from the creek. It holds, also, that by measurement made Sept 4, the creek contains 1725 in. of water and the farmers' ditch carries away only 1400 in., 100 in. of which is wasted. The power company wants permission to pick up all the surplus and waste.

SAN FRANCISCO, CAL.—Information received from Washington, D. C., is to the effect that the E. D. Crowley Company, of this city, has been awarded the contract for constructing a power plant at the Mare Island Navy Yard, at $50,894.

SAN JOSE, CAL.—The Board of Supervisors will receive bids until Oct. 18 for a franchise to build an electric railway along the county highway between Palo Alto and Mayfield, application for which has been made by the Peninsular Railway Company, of San Jose.

SONORA, CAL.—The transfer of the properties of the Toulumne Water Power Company and the Stanislaus Electric Power Company to the Sierra & San Francisco Power Company has been completed in the United States' district court. The recent sale of the properties was officially confirmed. The new company is capitalized at $20,000,000. It is said that work on the large storage reservoir at Camp Relief will be pushed as rapidly as possible.

HAVANA, CUBA.—The Cuban Telephone Company has recently been granted permission to extend its telephone lines in all parts of the island. The company is planning to install an automatic system in Havana, and will place its wires underground in this city within a few months.

DELAWARE CITY, DEL.—The City Council has granted the Delaware Water Improvement Company, of New Castle, Del., a franchise to erect a transmission line in Delaware City for the distribution of electricity. It is expected that the city will install electric street lamps. It is paying $800 per year for the lamps now in use.

WILMINGTON, DEL.—The construction of an electric light plant in Gordon Heights, just north of Wilmington, is under consideration, according to a statement made by Ernest B. McNair. The citizens are building a water works system, and it is already proposed to enlarge the plant in connection with the proposed electric light plant, and to operate the pumps by electricity.

WASHINGTON, D. C.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Oct. 16, for installing two electric passenger elevators at the U. S. Naval Medical Hospital, Washington, D. C., plans and specifications for which can be obtained on application to the above bureau. William M. Smith is acting chief of bureau.

DALLAS, GA.—Arrangements are being made by the Paulding County Power Company to commence work on the construction of its proposed dam across Pumpkinville Creek, about Oct. 1, where it is estimated that about 1,000 hp can be developed.

JEFFERSON, GA.—The Jefferson Cotton Mills Company, of Jefferson, Ga., has entered into a contract with the City Council for the construction of an electric light plant to furnish electricity for lighting the town and for operating the water works pumps. Work on construction of the plan will commence in the near future. E. P. Taylor, of Athens, Ga., is engineer.

MACON, GA.—Application has been made for a charter for the proposed street car line from Tharpe's crossing in East Macon to the grounds of the Recreation Club. The project is capitalized at $150,000, and franchises have been secured. Frederick Kauffman is at the head of the enterprise.

SAVANNAH, GA.—Bids will be received by the Committee on Streets and Lanes until Nov. 8 for furnishing electricity for arc and incandescent lamps for lighting the streets of the city and also for electricity to be used for lamps, heat and power, specifications for which can be secured at the office of Harry Willink, director of Public Works. At present there are about 570 arc lamps in use on the city streets.

WAYCROSS, GA.—At an election to be held Oct. 15 the citizens will vote on the proposition to issue $45,000 for the construction of an electric light plant.

MURRAY, IDAHO.—The construction of an electric light plant in Murray is under consideration. A. H. Featherstone and C. F. O. Merriam, of Wallace, Idaho, are interested in the project.

BURNT PRAIRIE, ILL.—Surveys have been started by the Carmi-Fairfield Traction Company for its proposed electric railway to connect Carmi, Sumpter, Liberty and Fairfield, a distance of about 25 miles. E. S. Lawrence, of St. Louis, Mo., is engineer.

CHICAGO, ILL.—It is reported that plans have been completed by Shepley, Rutan & Coolidge for the construction of a large addition to the power plant of the Commonwealth Edison Company at Quarry Street and the river, at an estimated cost of $1,000,000.

MOLINE, ILL.—The Tri-City & Northeastern Interurban Railway Company of Port Byron has been granted a franchise by the Board of Supervisors to construct an electric railway from Port Byron to Rapids City. The company proposes to build an electric railway from Watertown to Albany. J. W. Simonson, of Port Byron, is president of the company.

STREATOR, ILL.—Improvements are being made to the power house of the Illinois Light & Traction Company, which will include the installation of two 312-hp Heine boilers, stokers, grates and a coaling trestle.

DECATUR, IND.—The directors of the Citizens' Telephone Company have decided to make extensive improvements to the plant.

FORT WAYNE, IND.—The Toledo, & Fort Wayne Electric Railway Company has been granted a franchise to construct an electric railway along the public highways. The proposed railway of the Toledo & Fort Wayne Railway Company will connect with the Toledo & Indiana Railway at Bryan.

GREENE CASTLE, IND.—The work of rebuilding the entire toll line system of the Greene Castle Telephone Company is almost completed. Some new equipment will be installed in the principal exchange.

INDIANAPOLIS, IND.—The Indianapolis Telephone Company is pushing the work of improving and extending its plant, which includes a new exchange building, automatic switchboards, underground and aerial construction, a new automatic substation on the west side entailing an expenditure of $100,000. The company has nearly 15,000 subscribers and is making new contracts at the rate of 450 to 500 per month.

INDIANAPOLIS, IND.—The Board of Control of Public Buildings, consisting of the Governor, Secretary and the Auditor of State, is asking for bids for supplying electricity for lamps and motors at the State House for the ensuing two years. The Governor is now gathering data concerning the cost of erecting and operating a plant to supply light, heat and water to the capitol. If the report of the engineer employed to prepare this data indicates the advisability of erecting such plant the Governor will recommend the same to the next Legislature. The total cost of heat, light, power and water for the State Capitol last year amounted to $17,266.

INDIANAPOLIS, IND.—Bids will be received until Oct. 15 by the Commission of the Indiana State School for the Deaf, Room 54 State House, Indianapolis, Ind., for material and labor to complete and install

the mechanical equipment of the institution located in Indianapolis, Ind., including boilers, stokers, heaters, pumps, generators, switchboards, refrigerating machinery, well, trenches, water lines, pipes and various supplies, etc., according to plans and specifications on file at the office of Rubush & Hunter, architects, American Central Life Building, Indianapolis, Ind. James Bingham is secretary of commission.

MONROE CITY, IND.—The exchange building of the Monroe Telephone Company was entirely destroyed on Sept. 13 by fire, causing a loss of about $18,000. A new building will be erected and modern equipment installed.

NOBLESVILLE, IND.—It is reported here that the Indiana Union Traction Company has purchased and will take over and operate the new power dam and electric generating plant just being completed on White River near this city by the Noblesville Hydraulic Company. It is said to be the purpose of the Traction Company to use the power plant as a feeder for its system and also to sell and distribute electricity to towns and cities.

PAOLI, IND.—The Board of Commissioners of Orange County has granted Charles D. Kelso and J. H. Fawcett a franchise to construct an interurban electric railway over the county turnpike from Paoli to New Albany.

PORTLAND, IND.—The Central Union Telephone Company has sold its exchange and rural lines in this city and Jay County to the Home Telephone Company. An underground system will be installed combining the two plans.

RICHMOND, IND.—The City Council has passed an ordinance providing that it shall be unlawful for water or gas companies to charge patrons rent for meters. Charges of from 50 cents to $1 a month for meter services have been exacted and the ordinance will be resisted in the courts. The city is planning to purchase the waterworks plant, to be operated in conjunction with the municipal lighting plant.

SPICELAND, IND.—The Spiceland Telephone Company has increased its capital stock from $10,000 to $20,000, the proceeds to be used to rebuild the plant and extend its lines.

WARSAW, IND.—The Commercial Telephone Company of Warsaw, Ind., has decided to construct a new No. 10 copper toll line from this city to Wabash, and another toll line from this city to Goshen and Ligoniter.

WINONA LAKE, IND.—Plans are being considered by the Winona Interurban Railway Company for the construction of an extension of its system in Goshen from the station to the hydraulic plan, for which a franchise has already been secured.

DES MOINES, IA.—The Des Moines & Sioux City Railway Company has secured more than 100 miles of right of way for its proposed electric railway, and has also made arrangements for terminals in Sioux City and Des Moines. M. H. Miller is vice-president and general manager.

KEOKUK, IA.—The Mississippi Valley Telephone Company is planning to make improvements to its system which will involve an expenditure of about $10,000.

MUSCATINE, IA.—Orders have been placed by the Citizens' Railway & Light Company for a 750-kw Westinghouse turbine and a 300-kw rotary convertor to be installed in its power house within a few weeks.

OELWEIN, IA.—The Oelwein Light, Heat & Power Company is making extensive improvements to its plant, including the erection of a 100-ft. smoke stack, and the installation of a new engine and generator.

SHEFFIELD, IA.—The property of the Mutual Telephone Company with exchanges at Sheffield, Thornton, Swaledale, Meservey, Latimer, Alexander, Coulter and Chapin, has been sold to G. A. Leonard, of Waterloo, and Daniel Murphy, of Greene, Ia., for about $100,000. It is said that repairs and improvements will be made to the lines at once.

LOUISVILLE, KY.—Plans are being made by the Bradford Worsted Spinning Company to erect a new plant, for which contracts for machinery have been placed. The equipment of the power plant will include four 200-hp return tubular boilers, a 700-hp Hamilton Corliss engine direct connected to generator, and motors.

LOUISVILLE, KY.—The Louisville Railway Company is building an addition to its power plant in Louisville, the cost of which is estimated at about $70,000.

NEWPORT, KY.—The City Council has passed the ordinance authorizing the sale of the telephone franchise in Newport.

CROWLEY, LA.—The power plant of the municipal electric light and water works system was destroyed by fire Sept. 18, causing a loss of about $15,000. At present the streets of the town are in darkness; the dynamo and engine being ruined by the fire. There will be no inconvenience with the water supply, as the pumps of several factories are connected with the stand pipe, which can furnish water to the town.

FRANKLINTON, LA.—The Board of Trustees has granted a franchise to the Cumberland Telephone & Telegraph Company to erect a telephone system in Franklinton.

SHREVEPORT, LA.—The plant and holdings of the Shreveport Telephone Company were sold recently at auction to a committee representing the bondholders. It is said that the sale was brought about for the purpose of getting the affairs of the company in such shape that arrangements could be made for extensive improvements. No change is contemplated in the management and the service is to be extended and improved in the near future.

BELFAST, MAINE.—The Penobscot Bay Electric Company, which has taken over the property and holdings of the Belfast Gas & Electric Company, expects to be able to furnish electricity from its plant in East Orland, within 60 days, when the plant in East Belfast will be closed down, but which will be kept in readiness for use in emergencies. The company will extend its transmission line to the Northport line this fall or early next spring.

BALTIMORE, MD.—It is said that Robert J. McCuen, superintendent of lamps and lighting, is considering the installation of electric lamps in sections now lighted by naphtha lamps, and a recommendation to that effect will be made to the Board of Awards. The Consolidated Gas, Electric Light & Power Company has offered to supply electricity for a term of five years for $27.45 per lamp per year, through overhead wires. For underground service the company's bid was $52.45 per lamp, offering to take off $20 per lamp if allowed to use the present arc cables in providing the incandescent service. In cases where the city owns the fixtures and has its own cables in the conduits the company will furnish the service at $27.45 per lamp. This offer applies to the parks and boulevards.

AMHERST, MASS.—Surveys are being made by the Connecticut River Power Company for the extension of its high-tension transmission line from the power house of the Amherst Gas Company through South Amherst and Hadley across the river near the Ox Box to Easthampton.

ATHOL, MASS.—The Athol Gas & Electric Light Company has applied to the State Gas and Electric Light Commissioners for permission to issue 1748 shares of additional capital stock, par value of $100, the proceeds to be used to pay the cost of additions to its plant. The company also proposes to take over the plant and holdings of the Orange Electric Light Company, including water power and power plant, at a cost of $71,816.

BRIDGEWATER, MASS.—At a special town meeting held Sept. 23 the citizens voted to instruct the committee to enter into a five-year contract with Bridgewater Electric Company for lighting the streets of the town. Under the new contract the present ac lamps will be replaced with 14 incandescent lamps of 60 cp and 172 incandescent lamps of 25 cp.

CLINTON, MASS. The Connecticut River Power & Transmission Company has completed its transmission line to Clinton, and is now furnishing electricity to operate the Lancaster Mills in Clinton, which will require about 2000 hp.

FALL RIVER, MASS.—The Fall River Electric Light Company has submitted a proposition to install boulevard electric lamps of 40 cp for $20 per lamp per year, and 60-cp lamps at $25 each per year, which includes the erection of poles, lamps, fixtures, and entire cost of equipment and maintenance. The city has been paying about $27 each per year for gas lamps for the boulevard.

MARBLEHEAD, MASS.—It is reported that negotiations are under way for the consolidation of the Marblehead Gas & Electric Company and the Lynn Electric Company.

MARLBORO, MASS.—The Marlboro Electric Company has connected its system with the transmission lines of the Connecticut River Power & Transmission Company and electricity for operating the local system is received from the hydroelectric plant at Vernon, Vt. The Florence Street station will be held in readiness for use in case of emergency. C. L. Davis is superintendent.

QUINCY, MASS.—Negotiations have been completed whereby the Quincy Electric Light & Power Company will furnish electricity for lighting the streets of the city for a term of three years, beginning from July 1, 1909. Under the terms of the new agreement the company is to furnish arc lamps at the rate of $70 each per lamp, and incandescent lamps for $15 per lamp per year. Under the old contract the price for arc lamps was $75 each per year, and incandescent lamps $16.50 each per year. Under the new arrangements the city will save about $100 per month in the cost of street lighting.

WESTBORO, MASS.—Negotiations have been closed whereby the Westboro Gas & Electric Company will secure electricity for operating its system from the Connecticut River Power & Transmission Company, through the Marlboro Electric Light Company. Work will soon commence on the construction of the transmission line from Westboro to Northboro, for which a franchise has already been secured from the State Highway Commissioners.

WORCESTER, MASS.—The Worcester Electric Light Company has made a reduction of about 25 per cent in its price for electricity for lamps and motors. The new schedule, which went into effect Sept. 1, is as follows: For the first 150 kw, 6 cents per kw-hour; from 150 to 300 kw, 5.7 cents; from 300 to 400 kw, 5.5 cents; from 400 to 700 kw, 5.2 cents; from 700 to 800 kw, 5 cents; from 800 to 1000 kw, 4.7 cents; from 1000 to 1300 kw, 4.5 cents; from 1300 to 1500 kw, 4.2 cents; from 1500 to 1700 kw, 4 cents; from 1700 to 1900 kw, 3.7 cents; from 1900 to 2500 kw, 3.5 cents; from 2500 to 3500 kw, 3.3 cents; from 3500 to 4500 kw, 3.2 cents; from 4500 to 5500 kw, 3.1 cents; from 5500 to 6500 kw, 3 cents; 6500 to 7500 kw, 2.9 cents; 7500 to 8500 kw, 2.8 cents; 8500 to 9000 kw, 2.7 cents; 9000 to 10,000 kw, 2.6 cents; 10,000 to 12,500 kw, 2.5 cents; 12,500 to 15,000 kw, 2.4 cents; 15,000 to 17,500 kw, 2.3 cents; 17,500 to 20,000 kw, 2.2 cents; 20,000 to 25,000 kw, 2.1 cents, and for 25,000 kw and over, 2 cents.

DETROIT, MICH.—Plans have been prepared by the Detroit United Railway Company for the construction of a new substation at Milwaukee Avenue and Dubois Street, and for placing underground all wires con-

necting the main station with the new one. The cost of the improvements is estimated from $150,000 to $200,000.

GRAND RAPIDS, MICH.—The stockholders of the Citizens' Telephone Company, of Grand Rapids, have voted to increase the capital stock of the company from $3,500,000 to $5,000,000, the proceeds to be used for extensions and improvements to its system.

AURORA, MINN.—Application has been made to the town officials by the Hartley Electric Company, of Virginia, Minn., for a 20-year franchise to construct and operate an electric light plant in Aurora.

BEMIDJI, MINN.—The City Council has refused to grant a renewal of the franchise of the Warfield Electric Company, which will soon expire.

WELLS, MINN.—The contract for a new generator and appurtenances for the municipal electric light plant was awarded to the General Electric Company for $1,275.

WINONA, MINN.—The Winona Railway & Light Company contemplates purchasing boilers and coal handling outfit for its plant. C. A. Bernier is electrical engineer.

LOUISVILLE, MISS.—The Town Council is reported to have granted E. Grover a franchise to erect transmission lines for the distribution of electricity in Louisville.

MOUNT OLIVE, MISS.—Work has commenced on the construction of the municipal electric light plant, machinery for which has already been purchased. The cost of the plant is estimated at about $8,000.

HILLSBORO, MO.—The citizens are considering the question of issuing $15,000 in bonds, the proceeds to be used for the construction of an electric light plant.

KANSAS CITY, MO.—The construction of the proposed electric railway of the Interstate Railway Company from Kansas City to St. Joseph has been placed in charge of the Electric Traction Company, Kansas City, Mo. Bids for the construction of the railway will be opened at once. The cost of the railway is estimated at $2,000,000. N C. Van Natta, Corley Building, St. Joseph, Mo., has charge of the work.

LEE'S SUMMIT, MO.—Marcus A. Bogie, of Kansas City, Mo., is reported to have applied to the City Council for a franchise to construct an electric light plant in Lee's Summit, or to purchase the plant already established.

MARYSVILLE, MO.—We are informed that the contract for installing power plant, heating, ventilating, and plumbing at the Fifth District Normal School, has been awarded to MacMahon & Co., of Kansas City, Mo A. Rickenrode is secretary of board of regents.

SAVANNAH, MO.—An election will soon be held to vote on the proposition to issue $7,500 in bonds, the proceeds to be used for improvements to the municipal electric light plant. It is said that J. H. Van Brunt, general manager of the St. Joseph Railway, Light, Heat & Power Company, has submitted a proposition to furnish electricity for operating the municipal lighting system, which is considered favorably by the Council, but a special election will be required to approve of the proposed plan. The transmission line will also furnish electricity for the Savannah interurban railway. R. L. Limerick is city clerk.

BEARCREEK, MONT.—The City Council has granted the Bearcreek Water & Electric Light Company a franchise to construct and operate an electric light plant and water works system in the Bearcreek. The company is capitalized at $30,000, and proposes to erect a power plant about a mile above the town. The water will be utilized to generate electricity and for domestic purposes. Chris Yegen, George Lamport, Robert Le Gens, James Ash and N. S. Poole are interested in the enterprise.

BILLINGS, MONT.—Plans have been completed for the construction of an electric railway between this city and Laurel, work on which will commence within a few weeks. A. H. Bowne is promoter of the railway.

FAIRFIELD, NEB.—The contract for the construction of an electric light plant and water works system has been awarded to F. C. Brooks Sons Company, of Jackson, Mich. W. E. Underkofler is city clerk.

SEARCHLIGHT, NEV.—The Memphis Mining & Milling Company has secured the Weeks ground, near Searchlight, and is installing a power plant, preparatory to sinking its shaft. A. L. Hill is manager.

SWEETWATER, NEV.—The Walker River Electric Power Company is planning to install a large electric plant on the East Walker River, near Sweetwater. The cost of the plant is estimated at about $750,000. George S. Costigan and Dr. A. L. Pollard, of Denver, Col., are interested in the project.

HOBOKEN, N. J.—The Common Council on Sept. 22 passed the ordinance granting the Citizens' Light, Heat & Power Company a franchise to construct and operate an electric light plant in Hoboken. Work will commence on construction of the plant, building of conduits, etc., as soon as possible. The company expects to have its plant in operation and furnish electrical service within two years. It will furnish arc lamps for street lighting at the rate of $70 each per year, and electricity for commercial purposes at a maximum rate of 8 cents per kw-hour. In case the city decides to establish a sewerage pumping plant the company to furnish electricity for operating the pumps at cost.

IRVINGTON, N. J.—The Town Council has adopted a resolution authorizing the committee to engage an electrical engineer to prepare plans for a municipal electric light plant and invite estimates for cost of the same. The Council also adopted a resolution directing the Fire and Water committees to take under advisement the purchase of the plant of the Clinton Water Company, which now controls the water supply of the town.

MORRISTOWN, N. J.—It is reported that the Morris County Traction Company has secured funds to the amount of $1,000,000, for the construction of its proposed railway. It is said that the company will commence work at once on the construction of its road from Morris Plains to Mount Tabor, connecting there with a direct route to Lake Hopatcong.

ORANGE, N. J.—Only three bids were received Sept. 20 by the Orange Council for the construction of the proposed municipal electric light plant. According to the figures submitted, the work will cost at least $109,500, and $14,500 additional if an underground conduit is laid in Main Street, which is about $50,000 more than the cost estimated when the plant was projected, about two years ago, and bids secured on the plans of James Seymour, Jr. The total cost of the plant was $47,400. Runyon & Carey, who prepared the present plans, state that no comparison should be made between the estimates under consideration and the bids received two years ago, as the former plans were incomplete and would have necessitated large expenditures above the original costs had the contracts been awarded at that time. The bids submitted provide for a plant with sufficient output to supply 500 magnetite arc lamps at a cost of $51.78 each per year, and 95 tungsten lamps at $20 per lamp per year, for which the city now pays the Public Service Corporation at the rate of $85 each for 500 arc lamps and $20 each for tungsten lamps. The bids submitted are as follows: W. M. Sheehan & Company, of New York, N. Y., for general construction and installation, $111,278, and for Main Street conduit $14,500; L. K. Comstock & Company, of New York, N. Y., for general work, $109,500; for Main Street conduit, $14,500; Storms & Company, of Newark, N. J., $111,714; for Main Street conduit, $16,604. The original plans provided for the erection of the plant in connection with the water works system, and provided for only 37 miles of wiring, while the present plans call for 67 miles of wiring.

DEMING, N. M.—It is reported that the Northern Construction Company, of Kansas City, Mo., has submitted a proposition to install an 800-hp electric power plant in Deming, which, it is said, is being favorably considered.

FRENCH, N. M.—A franchise has been granted to the French Town Company to erect poles and wires for the distribution of electricity in the town of French.

ALBANY, N. Y.—The Public Service Commission, Second District, has authorized the Colonie Electric Company, of Colonie, to transfer all its property rights, franchises and privileges, excepting its generating station and equipment, to the Municipal Gas Company of Albany, N. Y. The commission also authorized the Municial Gas Company to construct and operate a distributing system on and along the Troy Road from the Albany city line to the Schuyler Bridge and Van Rensselaer Avenue, Menands Road, Loudonville Road, Lyon Avenue and Ward's Lane in the town of Colonie for the distribution of electricity, in accordance with franchise granted by the Town Board Sept. 4, 1909.

BALDWINSVILLE, N. Y.—Owing to the Village Trustees and the officials of the Seneca River Power Company being unable to come to an agreement in regard to the price for street lamps, the electric street lighting service has been discontinued. The company has offered to furnish 65 arc lamps at $75 each per year, but the trustees are not willing to pay more than $70 per lamp per year. A committee, consisting of Carl Lager, John C. Miller and W. H. Tappin, has been appointed to investigate the matter and report at a later meeting. Many of the taxpayers are in favor of establishing a municipal plant if better terms cannot be made with the local company. The old contract expired last April and has been renewed from month to month in hopes of an agreement being reached. Simon B. Storer, president of the Seneca River Power Company, states that the company would proceed with its plans to erect a new power plant to supply manufacturers and others with electricity for lamps and motors The company has a perpetual franchise in Baldwinsville.

BUFFALO, N. Y.—The Buffalo Southern Railway Company announces that it will soon commence work on an extension to East Aurora, which it expects to have completed about Jan. 1, 1910. The company has about five miles of the railway in operation and it will require an addition of about eight miles to complete the route.

EDWARDS, N. Y.—Arrangements are being made by U. O. Webb to install an electric light plant in connection with his grist mill. Transmission lines are now being erected for the distribution of electricity. It is expected that the town will enter into a contract with Mr. Webb for lighting the streets. Contracts have already been placed for lighting many of the business places and residences in the village.

NAPLES, N. Y.—A rural telephone company has been organized at Boswell's Corners, in the town of South Bristol, a settlement seven miles northwest of Naples. The officers of the company are: Hiram Reed, president; Frank Greenman, vice-president; Albert Worden, secretary; Henry Loos, treasurer, and Albert Andrews, manager.

NEW YORK, N. Y.—Justice O'Gorman of the supreme court, has authorized George W. Linch, receiver of the Second Avenue Railroad Company, to issue $500,000 in receiver's certificates, bearing 6 per cent interest and maturing in one year. The proceeds will be used to rebuild its car barns, laying new tracks and to utilize the unused tracks in Worth Street between Chatham Square and Broadway as a terminus for the road by replacing the old horse tracks with electrical equipment, the cost of which is estimated at $125,000.

NEW YORK, N. Y.—The New York, Westchester & Boston Railway Company is reported to have purchased all of the right of way for the branch line which it proposes to build to White Plains.

NIAGARA FALLS, N. Y.—The Water Commission has decided to accept the offer of the Niagara Falls Hydraulic Power & Manufacturing Company to purchase the property in the lower milling district on which the present municipal waterworks pumping plant stands for $20,000. In consideration of the sale the company agrees to supply electricity for the new pumping station up to 800 hp for a term of 76 years at $9 per horse-power per year and all above that amount for $10 per horse-power. The Niagara Falls Power Company offered to furnish electrical power for the pumping station at the rate of $20 per horse-power per year.

NIAGARA FALLS, N. Y.—The J. Ellwood Baird Company, of Buffalo, N. Y., was awarded the contract for furnishing 18,600 ft. of four-hole duct for the transmission line cables to the pumping station for $2,976, and the contract for laying the conduit in Ferry Avenue, Portage Road, Welch Avenue, Sugar Street, Buffalo Avenue and Columbus Avenue, for $[illegible].

ROCHESTER, N. Y.—Bids will be received by the Board of Education, Municipal Building, Rochester, N. Y., until Oct. 4, for material and labor required for electric wiring and fixtures for Public Schools Nos. 4, 5, 9, 13, 17, 18, 30, 36 and all of the ground floor halls not included in the foregoing, according to plans and specifications of the architect, J. Foster Warner, which may be seen at the office of the board. J. S. Mullan is secretary.

WILLARD, N. Y.—Sealed proposals will be received by the State Commission in Lunacy, State House, Albany, N. Y., until Oct. 6, for furnishing and installing one direct-connected engine and 75-kw, direct-current dynamo at the Willard State Hospital, Willard, N. Y. Plans and specifications may be seen and blank forms of proposals secured at the Willard State Hospital, Willard, N. Y., or at the office of the state architect, Albany, N. Y. Complete set of plans will be furnished upon application to F. B. Ware, state architect.

TOWNER, N. D.—The Board of County Commissioners has granted a franchise to the Turner Telephone Company to erect telephones over the county roads.

COLUMBUS, OHIO.—The Board of Managers of the penitentiary has revoked its action in granting the contract for the construction of the power house to John Hina, of Columbus, Ohio, and has ordered the work readvertised. The contract will be awarded at a special meeting to be held in October.

DAYTON, OHIO.—The Dayton Street Railway Company has increased its capital stock to $300,000. The proceeds of the sale will be used to construct the proposed extension between Athletic Park and Carrmont. W. L. Smith is general manager.

DENNISON, OHIO.—The United Electric Company expects to purchase a 150-kw, direct-current generator for railway service within a few weeks. The company has closed a contract with the C. & G. Cooper & Company for a 400-hp Corliss engine, heavy duty type.

LOGAN, OHIO.—Arrangements are being made by the Logan Home Telephone Company for extensive improvements to its system, which will involve an expenditure of about $10,000. The common battery system will be installed. A contract has been awarded to the Kellogg Switch-Board & Supply Company, of Chicago, Ill.

YOUNGSTOWN, OHIO.—Contracts have been placed by the Mahoning & Shenango Railway & Light Company for one 600-kw motor-generator set with the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., and one 200-kw motor-generator set with the General Electric Company, of Schenectady, N. Y. It is stated that two additional boilers will be installed in the North Avenue power station about Nov 1, which will increase the output of plant by about 1000 hp.

OKLAHOMA, OKLA.—The County Commissioners have granted Homer S. Hurst, of Holdenville; Alfred Hare, of Shawnee; W. F. Harn and J. F. Winans a franchise to construct an electric railway over certain highways in Oklahoma County.

ALBANY, ORE.—A deed and mortgage have been filed with the county recorder of Linn County, which practically transfers all of the property of the Willamette Valley Company to the Northwestern Gas & Electric Company, and the latter company has issued a mortgage for $5,000,000 in favor of the Germantown Trust Company, of Philadelphia, Pa., to secure an issue of $5,000,000 in bonds, the proceeds to be used in the development of the properties acquired and for extensions which may be necessary. The property covered by the mortgage includes the street railway system of Walla Walla, the interurban railway from Walla Walla to Milton and Freewater, the power ditches, water rights and power plant in Umatilla County, for transmission of electricity to Walla Walla and Pendleton; the water system, electric light plant and power plant in Albany; the electric system in Corvallis; the power plant, water system, electric system and gas plant in Eugene; the electric plant in Dallas and Monmouth; the water system and electric light plant in Independence; the gas plants at North Yakima, Wash., and Lewiston, Idaho. The officers of the company are: Isaac W. Anderson, of Philadelphia, Pa., president; Clyde W. Hellar, of Philadelphia, Pa., secretary, and Alvadore Welch, of Portland, Ore., treasurer and general manager.

DAYTON, ORE.—The Yamhill Electric Company, of Newberg, Ore., which was recently granted a franchise in Dayton, will extend its transmission line to this town and install a distributing system, at a cost of between $5,000 and $6,000. C. J. Edwards, of Newberg, is general manager.

EUGENE, ORE.—The contract for the erection of the transmission line for the municipal power plant was awarded to J. B. Morris, of Eugene, Ore., for $3,642. The line will be about 15 miles in length.

PORTLAND, ORE.—Arrangements have been made by the Seventh Street Improvement Association for the installation of 100 ornamental lamp posts on Seventh Street, from Couch to Columbia Street, at a cost of about $10,000.

PORTLAND, ORE.—W. W. Purdy, chief engineer of the Oakland & Tidewater Railway Company, is reported to have completed a survey from Oakland across the mountains to Coos River and down to Marshfield, for the proposed railway of the company, which is to extend from Oakland to Empire. C. A. Pengra and H. D. May, of Portland, Ore., are interested in the project.

WESTON, ORE.—Plans are being drawn by J. M. Ashworth, of Weston, for a large irrigation system. The project includes the installation of an electric power plant and the irrigation of 12,000 acres of land tributary to Weston. It is proposed to erect a dam 200 ft. high, creating a large storage reservoir. The cost of the plant complete is estimated at $250,000.

HARRISBURG, PA.—The Merchants Telephone & Telegraph Company has filed amendments to its charter increasing its capital stock from $100,000 to $400,000.

HAZLETON, PA.—The Wilkes-Barre & Hazleton Railway Company has placed contracts for the following apparatus: Three 150-kw, single-phase, 16,000-183 step-down transformers; one 400-kw converter; two 350-hp boilers, and three 375-kw, single-phase, 390-16,000 step-up transformers.

McKEESPORT, PA.—A meeting of the stockholders of the Pittsburgh, McKeesport & Westmoreland Street Railway Company has been called for Nov. 22 to vote on the proposition to spend $2,000,000 on extensions and improvements next spring. It is understood that provision has been made for obtaining money, and it will be available as soon as the stockholders approve the proposed plan.

PHILADELPHIA, PA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Oct. 16, for alteration in power plant at the Naval Home, Philadelphia, Pa., plans and specifications for which can be obtained on application to the above-named bureau or to the commandant of the navy yard, Philadelphia, Pa. William M. Smith is acting chief of bureau.

ROARING CREEK, PA.—The capital stock of the Roaring Creek Valley Telephone Company has been increased from $5,000 to $10,000.

DILLON, S. C.—It is reported that the municipal electric light plant has been purchased by Wade Stackhouse. Mr. Stackhouse would like to receive estimates on the cost of the installation of a three-phase, alternating-current plant, or improvements to the present direct-current plant, which includes about 10 arc lamps and 1,000 incandescent lamps of 16 cp.

ORANGEBURG, S. C.—Investigations are being made by the Edisto Power Company for the construction of its proposed hydroelectric plant on the Edisto River, where it is estimated that from 5,000 to 10,000 hp can be developed for electrical transmission. For further information address Wolfe & Berry, of Orangeburg, S. C.

RAMONA, S. D.—We are informed that plans are being considered for the construction of a municipal electric light plant in Ramona. J. S. Stevens is town clerk.

TYNDALL, S. D.—We are informeed that the City of Tyndall is contemplating the installation of a municipal electric light plant to cost from $10,000 to $12,000 It is proposed to install an alternating-current system and a Fairbanks gas producer.

BROWNSVILLE, TENN.—The Brownsville Cotton Oil & Ice Company, which recently purchased the plant of the Brownsville Light & Power Company, is making improvements to the plant, including the installation of a 300-kw, three-phase 2300-volt, direct-connected equipment, machinery for which has already been purchased. The company is also arranging to operate two cotton gins by electricity instead of steam power. F. G. Pioutt. Randolph Building, Memphis, Tenn., is engineer in charge.

ERWIN, TENN.—Arrangements are being made by the Unaka Traction Company for the construction of its proposed power plant. I. R. Roberts is general manager.

BEEVILLE, TEX.—The citizens are considering the question of issuing bonds for the construction of an electric light plant and waterworks system.

MARLIN, TEX.—The plant of the Marlin Electric Light & Power Company was destroyed by fire Sept. 17, causing a loss of about $60,000.

OGDEN, UTAH.—The Telluride Power Transmission Company has completed the construction of its steel tower line between the North Ogden Canyon and Salt Lake City; the pole line toward Logan has been extended from Ogden as far as Eden, in the upper Ogden Valley. Work will now commence on the erection of the wooden tower line between Ogden and Salt Lake City, which, when completed, will give the company two transmission lines from North Ogden Canyon to Salt Lake City.

PARK CITY, UTAH.—The Daily-Judge Mining Company, of this city, has decided to increase its compressor capacity and to operate its compressors by electricity instead of steam power.

PROVO, UTAH.—The Snake Creek Power Company, of Provo, Utah, has applied to the State engineer for the use of 24 cu. ft. per second of water in Snake Creek, a tributary of the Jordan River, to be utilized to generate electricity. The length of the diverting canal will be 15,000 ft. The plant will operate under a head of 720 ft. The company proposes to distribute electricity for lamps and motors in the cities, towns and mining camps of Wasatch County.

SILVER LAKE, UTAH.—J. A. Kusk, of Silver Lake, Utah, has applied for two water rights in Big Cottonwood Creek to be utilized to generate electricity. One application is for 12 cu. ft. per second and the other for 22 cu. ft. per second, the diverting canals to be 900 ft. and 700 ft respectively.

BEDFORD CITY, VA.—The City Council has voted to subscribe to 326 shares of capital stock of a company to be organized by citizens of Bedford City, to develop a hydroelectric power plant, subject to a vote of the citizens, in accordance with the plan outlined in a resolution passed by the City Council Oct. 26, 1908. It is proposed to utilize the water power of the James River at Snowden, where a dam was constructed eight years ago, which, it is estimated, is capable of developing 1200 hp.

EMPORIA, VA.—O. L. Housel, manager of the Emporia Electric Power Company, writes that work is progressing rapidly on the construction of its dam, located one mile west of the town. Work has commenced on the erection of the distributing system, and the company expects to be ready to furnish electrical service in the early part of December, when it will take over the business of the Emporia Light & Power Corporation and establish a 24-hour service.

MARTINSVILLE, VA.—At an election to be held Oct. 2 the proposition to issue $35,000 in bonds, the proceeds to be used to enlarge the municipal electric light plant, will be submitted to the voters.

RICHMOND, VA.—Preparations are being made by several of the Virginia railroads, including the Southern Railway Company, the Seaboard Air Line, the Chesapeake & Ohio Railroad, the Atlantic Coast Line Railroad, and the Richmond, Fredericksburg & Potomac Railroad Company, to install telephones to replace the telegraph in dispatching trains. It is said that the Atlantic Coast Line will erect its first telephone line between Richmond, Va., and Rocky Mount, N. C.; the Richmond, Fredericksburg & Potomac Railway contemplates the installation of a telephone system between Richmond, Va., and Washington, D. C.; the Seaboard Air Line will establish a route between Raleigh and Munroe, N. C., and the Chesapeake & Ohio will establish a telephone service between Russell, Ky., and Cincinnati, Ohio.

ABERDEEN, WASH.—The Anderson & Middleton Lumber Company is planning to change its mill from steam to electric drive.

BELLINGHAM, WASH.—Plans are being considered by the Whatcom County Railway & Light Company for extensive improvements and extensions to its York Street station, which will double the output of the plant. The present output of the plant is 2000 hp. It is proposed to close down the Eureka power house when the improvements on the York Street station are completed. The cost of the work is estimated at about $140,000. A new water wheel will be installed immediately in the Nooksack power plant to replace the wheel now in use, at a cost of $35,000. L. H. Bean is local manager.

BLAINE, WASH.—The city is reported to have placed an order with the Sumner Iron Works, of Everett, Wash., for a boiler, engine and heater, to cost $3,500.

CHELAN FALLS, WASH.—It is stated that instructions have been given by the Great Northern Railroad Company to commence work on the construction of its proposed power plant at Chelan Falls, Wash., which, it is understood, will furnish electricity to operate the Great Northern Railway between Brewster and Oroville. It is estimated that 30,000 hp can be developed.

NORTH YAKIMA, WASH.—Notice has been received at the local land office that all power sites along the Yaki, a river in the vicinity of North Yakima, have been withdrawn from entry for the present.

SEATTLE, WASH.—The Board of Public Works has awarded the contract for furnishing the city with electric incandescent lamps to the Forbes Electrical Supply Company for the ensuing year. The contract, it is estimated, will amount to about $40,000.

SPOKANE, WASH.—Bids will be received by the Board of Public Works until Oct. 8, for three 5,000,000-gal. centrifugal pumps; one 650-hp horizontal water wheel; three induction motors, switch-board and connections.

WASHTUCNA, WASH.—The City Council has accepted the proposition of Mr. Gildersleeve to install an electric lighting system, to cost from $5,000 to $6,000. He proposes to furnish seven arc lamps of 2000 cp for lighting the streets, and to furnish electricity for lighting the town hall and hose house for $624 per year, under a five-year contract.

CLARKSBURG, W. VA.—The Consolidated Telephone Company has applied for a franchise to erect a telephone system in Clarksburg.

DODGEVILLE, WIS.—Many of the mines in the southwestern Wisconsin mining regions are equipping their plants to be operated by electricity. The Southwestern Electric Power & Light Company is furnishing electrical power for the mills and the Kennedy mines at Hazel Green. The transmission lines are being extended from Boston to Shullsburg. The Rodhams' new mill and mine are being equipped for electric drive. The Dark Horse and the Rajah mines at Linden are planning to secure electricity to operate the machinery at the mines from the plant at Mineral Point, which is now extending its transmission line into Linden, by the way of the Ridge Road.

INDEPENDENCE, WIS.—The power house of the municipal electric light plant is being enlarged. The old boiler will be reset to make room for a new boiler and a new smokestack erected. The Winona Boiler Company has the contract for the work.

NEW LONDON, WIS.—The Wausau Telephone Company contemplates the erection of a new exchange building in New London, to cost about $25,000.

PORTAGE, WIS.—Work has commenced on the construction of the substation of the Southern Wisconsin Power Company. The building will be 85 x 35 ft. and two stories high.

SCHLESINGERVILLE, WIS.—The Washington County Telephone Company has purchased the plant and holdings of the Cedar Lake Telephone Company for $15,000. The capital stock of the Washington County Telephone Company has been increased from $5,000 to $25,000.

LACOMBE, ALTA., CAN.—The ratepayers have voted in favor of purchasing the plant of the Blindman River Power Company, which supplies this town with electricity for light and power, for $25,000.

ARMSTRONG, B. C., CAN.—It is reported that plans are being considered for improvements to the light and water plants, which will involve an expenditure of about $10,000.

KAMLOOPS, B. C., CAN.—It is reported that a local development company, headed by Walter U. Homfray, has secured water rights on Louis Creek and proposes to organize a company to be known as the North Thompson Power & Development Company.

VANCOUVER, B. C., CAN.—The British Columbia Electric Railway Company has made an application for 30,000 miners' in. of water from Indian River and proposes to construct an auxiliary plant there. R. H. Sperling is general manager.

HAMIOTA, MAN., CAN.—The plant of the Hamiota Power & Electric Light Company has reached the stage where the company is able to supply electricity for 14 street lamps for the town.

WINNIPEG, MAN., CAN.—The Manitoba Government Telephone Commission will at once proceed with the erection of a branch exchange in the western portion of Winnipeg, plans for which were prepared by A. S. Hooper.

WINNIPEG, MAN., CAN.—J. J. & J. M. Kelly, of Winnipeg, have been awarded the contract for construction of the new branch telephone exchange, for $43,000. The Northern Electric Company will install the switchboard for $150,000. F. S. Patterson is chairman of telephone commission.

FORT WILLIAM, ONT., CAN.—The Kaministiquia Power Company is increasing the output of its power plant from 14,000 to 21,000 hp. H. S. Holt, of Montreal, Que., is president of the company.

GALT, ONT., CAN.—The Galt Gas Light Company has submitted a proposition to the Town Council offering to sell its electric light plant to the town for $67,000, which does not include the water-power at the dam. The Council has engaged E. B. Merrill, civil engineer, to make investigations in regard to the value of the plant.

HAILEYBURY, ONT., CAN.—The power plant of the High Falls Power Company, at High Falls, on Wabi Creek, has been put into operation. The plant will supply electricity to the mines in this vicinity. Harlan Brown is manager.

PORT ARTHUR, ONT., CAN.—The city has commenced to lay its telephone wires underground with the intention of placing all overhead wires in conduits.

PORT ARTHUR, ONT., CAN.—The City of Port Arthur has received an offer from the Ontario Hydro Electric Commission to supply electricity in Port Arthur. The Council has been considering a proposition made by James Conmee to supply electricity and was on the point of accepting it, but under the circumstances no agreement will be signed until the offer of the commission has been received. For further information address City Solicitor Keefer.

ST. CATHARINES, ONT., CAN.—Plans are being made by the Niagara, St. Catherines & Toronto Railway Company to construct a rotary transformer station with an output of 500 kw.

TORONTO, ONT., CAN.—The contract for the conduit work in connection with the city's transmission system has been awarded to Golden & Lansing, of Troy, N. Y., for $65,800.

TORONTO, ONT., CAN.—The McGuigan Construction Company is making rapid progress on the erection of transmission lines for the Ontario Government. So far over one hundred towers have been erected and they are being placed in position at the rate of eight per day. When completed the system will carry 110,000 volts and will be the longest transmission line in the world.

WELLAND, ONT., CAN.—The Commissioners of Queen Victoria Niagara Falls Park have granted the Ontario Power Company permission to lay another pipe through the park from the gatehouse to its power house, at a cost of about $1,000,000.

FARNHAM, QUE., CAN.—The by-law authorizing the construction of a municipal electric lighting plant was not voted on, as G. Poulin, who owns the local electric power plant, has reduced his offer from $14,000 to $8,500, and the town will probably purchase the plant at the last named figure.

VERDUN, QUE., CAN.—The municipality has retained Charles Brandeis, consulting engineer, of Montreal, Que., in connection with the proposed extensions to the municipal electric light plant.

WEYBURN, SASK., CAN.—The Weyburn Electric Company has offered to sell its plant to this town for $28,000. The Council is now considering the offer.

New Industrial Companies.

THE AMERICAN POWER & LIGHT COMPANY, of Augusta, Me., has filed articles of incorporation with a capital stock of $15,000,000. The company proposes to manufacture machinery and electrical apparatus. The incorporators are: Harry M. Durning, George J. Anderson, H. B. Squiers and E. W. Hammonds, all of New York, N. Y.

THE AMERICAN UNDERCURRENT COMPANY, of Pittsburgh, Pa., has been chartered with a capital stock of $250,000 by O. E. Longdorf, Paul I. Gundley and M. J. Dain, all of Pittsburgh, Pa. The company proposes to manufacture a new underground trolley apparatus, recently patented by Mr. Longdorf.

THE AUTO & AERONAUTIC SUPPLY COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $20,000 for the purpose of manufacturing and selling automobiles and flying machines. The directors are: Percy A. Larter, Glenn Ethridge, of New York, N. Y., and H. Chandler, of Westbury, N. Y.

THE ELECTRIC CLEANING COMPANY, of Fayetteville, N. C., has filed articles of incorporation with a capital stock of $25,000 for the purpose of operating electrically-driven renovating machines, etc. F. H. Bradley and associates are incorporators.

THE ELECTRIC SUPPLY COMPANY, of Richmond, Va., has been chartered with a capital stock of $5,000 and the following named officers: F. J. Whybrew, president; H. T. Walker, vice-president, and R. A. Burnett, secretary and treasurer. The company proposes to install power plants, motors, and deal in electrical supplies.

THE GENERAL SPECIAL ELECTRICAL COMPANY, of Los Angeles, Cal., has been incorporated with a capital stock of $100,000 by O. A Hansen and F. T. Broiles.

THE INVISIBLE LAMP & GLASS LETTER SIGN COMPANY, of Seattle, Wash., has been chartered with a capital stock of $50,000 by O. H. Frederickson and others.

THE KEISEL TELEPHONE & ELECTRIC SUPPLY COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $9,000 by Henry Kuhlmann, Fred Gent and L. Rompel, of St. Louis, Mo. The company proposes to do a general electric business.

THE LONG BEACH ELECTRICAL MANUFACTURING COMPANY, of Long Beach, Cal., has been incorporated by T. J. Corbrey, W. H. Tidmarsh, S. F. Estell, J. Gleason and G. Gleason. The company is capitalized at $25,000, and proposes to manufacture gas and electric fixtures.

THE MAYER-SLOTKING MANUFACTURING COMPANY, of New York, N. Y., has been granted a charter to manufacture cars, carriages, boats, motors, engines, machinery, etc. The company is capitalized at $50,000, and the incorporators are: Samuel Slotkin, Samuel Goldstein, Jacob Burnstone, all of New York, N. Y.

NATIONAL SAFETY APPLIANCE COMPANY, of New Orleans, La., has been incorporated with a capital stock of $300,000 by John Day Nix, L. M. Dalfarn and S. Wexler. The company proposes to manufacture the John Day Nix block signaling and stop system.

THE NEWSTETTER ELECTRIC SYSTEM COMPANY, of Dover, Del., has been incorporated with a capital stock of $3,000,000 by M. A. Noble, T. C. Corwin, of New York, N. Y., and J. Ebbs, of Englewood Cliffs, N. J.

THE PACIFIC BATTERY & ELECTRIC NOVELTY MANUFACTURING COMPANY, of Seattle, Wash., has been incorporated with a capital stock of $100,000 by E. Earl Jaeger and Charles Heinze.

THE SERVICE STANDARD COMPANY, of New York, N. Y., has been chartered with a capital stock of $30,000 to deal in lighting, heating, coaling, cooking and ventilating apparatus. The incorporators are: W. T. Smith, of Rockaway, N. Y.; H. R. Weller, of Roseville, N. J.; A. Bykeefer, of Brooklyn, N. Y., and J. C. Francis, of Yonkers, N. Y.

New Incorporations.

ST. LOUIS, MO.—The Home Co-operative Telephone Company has been chartered with a capital stock of $2,000 by John R. Gay, Truman B. Barnes, Le Roy Gay, J. W. McCormick, all of Maplewood, Mo., and T. A. O'Connor, of St. Louis, Mo.

ST. LOUIS, MO.—Articles of incorporation have been filed for the St. Louis County Belt Railroad Company by James D. Houseman, of Clayton, Mo.; Thomas M. Gallagher, of Webster Groves, Mo.; James E. Hereford, of Ferguson, Mo.; Edward W. Rannells, of Maplewood, Mo.; George B. Bowles, of Afton, Mo.; Charles A. Autenreith, of Clayton, Mo., and Albert Wehmeyer. The company proposes to construct an electric belt railway through St. Louis County from north to south, and circling St. Louis. The railway will be 30 miles in length, extending from Jefferson Barracks on the south to O'Neil on the north. The cost of the railway is estimated at $2,000,000.

BELLEFONTE, PA.—The Center County Traction Company has applied for a charter to construct a street railway from Bellefonte to State College by W. C. Hagan, William H. Furey and L. T. Munson.

FORT WORTH, TEX.—The Fort Worth, Mineral Wells & Western Railroad Company has been incorporated, with a capital stock of $100,000, to construct an electric railway from Fort Worth to Mineral Wells, via Weatherford, a distance of 54 miles, and later to Roswell, N. M. The incorporators are: L. C. Cole, of Fort Worth; N. M. James, and J. S Hanford, of Beaumont, Tex.

HAMLIN, TEX.—The Hamlin Electric Light & Power Company has been chartered with a capital stock of $15,000 by C. Thompson, G. E Spurling and Walter E. Morris.

WELLINGTON, TEX.—Articles of incorporation have been filed for the Wellington Water, Light & Ice Company by T. S. Atkinson and others.

SALT LAKE CITY, UTAH.—The Thor Power Company has been incorporated, with a capital stock of $500,000. The company proposes to erect power plants in Salina and Six-Mile Canyons, and will erect transmission lines to supply electricity in Manti, Richfield and other southern Utah towns. A. G. Burritt is president and Mark Anderson secretary, both of Salt Lake City.

VANCOUVER, WASH.—Articles of incorporation have been filed for the Tum Tum Mountain Railway Company by A. Aronston, H. J. Hener, and others. The company proposes to construct an electric railway to connect Chelatchie, Prairie, Amboy, View, La Center and Ridgefield, a distance of about 40 miles.

CIRTSVILLE, W. VA.—Articles of incorporation have been filed for the Pocahontas Connecting Railway Company by John C. Reading, Robert F. Allen, of Williamsport, Pa.; O. P. Fitzgerald, V. L. Black and G. S. Couch, Jr., of Charleston, W. Va. The company is capitalized at $200,000, and proposes to construct a railway between Girtsville and Jarrold's Valley, a distance of 20 miles.

POINT PLEASANT, W. VA.—The Old Town Mutual Telephone Company has been incorporated, with a capital stock of $5,000, by John R. Stewart and John Clendenin, of Point Pleasant, and others. The company proposes to construct and operate a telephone system in Mason and other counties.

WHEELING, W. VA.—The Dunkard Valley Railroad Company has filed articles of incorporation both in West Virginia and Pennsylvania The company proposes to build electric railways from Waynesburg to Washington, Pa., and from Mannington to Blacksville, W. Va., thence to Waynesburg, Pa. John L. Johnson, of Wheeling, W. Va., is said to be interested in the project.

KAMLOOPS, B. C., CAN.—The North Thompson Electric Power Company has been incorporated to develop power on Louis Creek. The head office is in Kamloops, and the capital stock of the company is placed at $[illegible].

Personal.

MR. THEO N. VAIL is the subject of an appreciative biographical notice by Mr. James B. Morrow in the Indianapolis *Star* of Sept. 12.

MR. M. V. WATSON, formerly assistant electrical engineer of the Central Colorado Power Company, has been appointed general manager of the Arizona Power Company, at Prescott, Ariz.

MR. JAMES B. YEAKLE, superintendent of the Fire Alarm Telegraph Department of Baltimore, Md., has been re-elected president of the International Association of Municipal Electricians.

MR. JAMES WHALEY, superintendent of the electrical zone of the New York Central Railroad, will succeed Mr. W. G. Bierd as general superintendent of the New York, New Haven & Hartford Railroad about Oct. 1.

MR. ED. HERD has resigned as manager of the Morgantown & Southern Railway, Morgantown, W. Va., to join, as secretary and manager, The Herd Plumbing Company, of Morgantown, which will extend its business to the electrical field.

MR. W. A. O'MEARA, general constructing engineer of the British Telegraph and Telephone Service, is on a three months' visit to this country during which he will examine into our telegraph systems and inspect the telephone plants of some of the larger cities.

MR. L. D. ROWELL, who has for several years had charge of the experimental and development work of the Cutler-Hammer Manufacturing Company at its Milwaukee works, has resigned that position to accept an offer from the Case School of Applied Science.

MR. WILLIAM MARCONI passed through New York City last week, en route from England to Glace Bay, where he is renewing the wireless power plant recently destroyed by fire, and is putting in an equipment of much larger capacity for work across the Atlantic.

PROF. GUSTAVE F. WITTIG, of the electrical engineering department of the University of Maine, has resigned to become head of the electrical engineering department of the University of Alabama. Prof Wittig was graduated from Columbia University three years ago, and immediately after went to the University of Maine.

MESSRS. ERICH MOLLENDORF and Oskar Kahle, who are prom

inently connected with the Siemens-Halske interests at Berlin, Germany, are visiting this country, and are very much interested in its electrical development. While here they will take an opportunity to inspect the latest improvements in street lighting, particularly that done with arc lamps.

MR. W. H. VAN LEEUWEN is here with his father, the Mayor of Amsterdam, Holland, both being members of the Dutch delegation in attendence at the Hudson-Fulton celebration. Mr. Van Leeuwen is greatly interested in mechanical matters, and has visited several plants in the city, including those of the New York Edison Company and the *Electrical World*.

MR. F. H. BANBURY, engineer of the Acheson Oildag Company, of Niagara Falls, sailed for Europe on the steamship *St. Louis*, Saturday, Sept. 25. Mr. Banbury, who has the degrees of electrical, mining and mechanical engineer, is an Englishman by birth, and upon his arrival in America about five years ago became connected with the Commonwealth Edison Company, of Chicago. Somewhat over a year ago he became connected with the Oildag Company, and his trip to Europe is in the patent interests of that company.

VICE-PRESIDENT MATTHEW C. BRUSH, of the Boston Suburban Electric Companies, who leaves this week for Buffalo to take charge of the Buffalo & Lake Erie Traction Company as general manager, was given a complimentary dinner at the Algonquin Club on Sept. 21 in Boston by 65 prominent street railway men of New England and New York. The speakers were Hon. S. L. Powers, Boston, toastmaster; Mr. J. C. Calisch, Buffalo; Mayor George Hutchinson, Newton; Alderman Palmer, Newton; Mr. Sidney Harwood, Newton; Mr. C. Loomis Allen, Syracuse, N. Y., and Mr. Russell A. Sears, Boston, who presented the guest of honor with a solitaire diamond ring on behalf of his assembled friends.

MR. W. E. WICKENDEN has been appointed Assistant Professor of Electrical Engineering to assume the duties vacated by Prof. George C. Shaad, who has gone to the University of Kansas to take charge of its electrical-engineering department. Mr. Wickenden was graduated from Dennison University after following a course strong in mathematics and physics. He then taught a year in Rochester, New York, and followed that by a year of graduate study of physics at the University of Wisconsin. He is now in the electrical-engineering staff of the University of Wisconsin, where he has made a record both in teaching and in research work. Professor Wickenden is author of a book, now on the press, on "Photometry and Illumination."

PROF. J. W. ESTERLINE, president and manager of the Esterline Company, Lafayette, Ind., until recently known as the Central Laboratory Supply Company, will hereafter devote the major part of his time to the work of his company, but will continue to give a course of lectures at Purdue University on the design of electrical machinery. The change in name of the company has been due to the growing amount of consulting engineering business which has been coming to Prof. Esterline. Mr. Esterline was born at Fort Wayne, Ind., and received his early training there. He prepared for university work at Fort Wayne College, and entered the Purdue School of Electrical Engineering in 1893, completing the work in 1897. From 1898 to 1907, Mr. Esterline was successively instructor, assistant professor and associate professor of electrical engineering at Purdue, and in 1905 and 1906, during the illness and absence of the late Dr. C. P. Matthews, he was in charge of the work of the department. Mr. Esterline is a member of the American Institute of Engineers, the Society for the Promotion of Engineering Education and the American Society for Testing Materials. For several years he has served as chairman of the committee of the latter society on the magnetic properties of iron and steel. Mr. Esterline has been a frequent contributor to the proceedings of engineering societies and the technical press, and is the author of several works on engineering and electrical design.



PROF. J. W. ESTERLINE

Obituary.

MR. M. G. KELLOGG.—As we go to press word comes from Chicago that Mr. Milo G. Kellogg, founder and president of the Kellogg Switchboard & Supply Company, Chicago, died Sunday, Sept. 26. The funeral took place Sept. 28. Mr. Kellogg was born at Rowman, N. Y., in 1849. A biographical notice will appear in our issue of next week.

MR. LAWRENCE GUSTAV GOETZ, of 207 East Fifty-fifth Street, New York City, was accidentally killed through coming in contact with a 2300-volt circuit in the Bronx Station of the New York Edison Company, Rider Avenue and 140th Street, on Thursday, Sept. 23. At the time of the accident Mr. Goetz was engaged, together with two other men, in setting up recording instruments on the wall in the rear of the arc light switchboard, a space accessible only to the station operatives. He was not working with live wires, nor, in fact, with any part of a circuit. There is a space of over 5 ft. between the back of the board and the wall, and a heavy rubber mat was on the floor upon which Mr. Goetz was standing at the time of the accident. The men were fully aware that the board was alive and that contact with any part of the circuit would be fatal. In fact, Mr. Goetz only a few minutes before the accident had warned his colleagues to be aware of the live circuits. From all that can be gathered it seems that in a moment of possible absent-mindedness he stepped backward and in such an unfortunate way that the calves of his legs came in contact with two projecting fuse receptacles from the 2300-volt lines, completing the circuit through his body, forming an arc which set his clothing on fire. His fellow worker, Kingsley Martin, tried to rescue him and rolled the victim in a heavy blanket to extinguish the flames. He remained conscious and was quickly removed to the Lebanon Hospital where it was found that practically his entire body had been charred; he died two hours after reaching the hospital from the effects of the burns. Mr. Goetz was a student in the Junior Class of Stevens Institute of Technology, and had been prepared for Stevens in the College of the City of New York. He had taken a position in the Test Department of the New York Edison Company for the summer in order to obtain practical experience, and expected to go back to college on the day following the accident. Mr. Goetz was 25 years of age, and was a student ranking high in scholarship. He leaves both parents and a brother and sister.

Business Notes.

THE G. & W. ELECTRIC SPECIALTY COMPANY has changed its address from 128 West Jackson Boulevard to 627 West Jackson Boulevard, Chicago.

THE HERD PLUMBING COMPANY, Morgantown, W. Va., will add a complete line of electrical supplies to its stock and enter the electrical contracting and supply field. Mr. Ed. Herd has resigned as manager of Morgantown & Southern Railway Company, to take charge of the electrical part of the business.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, of Plainville, Conn., manufacturer of electrical supplies, is increasing its plant by the erection of a brick building, 50 x 50 ft., four stories, to be used for manufacturing and storage purposes. The building will be completed this fall.

THE AJAX LINE MATERIAL WORKS have moved their factory into much larger quarters at South Milwaukee, Wis., where their outdoor lighting specialties will be made hereafter. The management remains with Mr. Albert Scheible, who will divide his time between South Milwaukee and a new Chicago office at 525 Van Buren Street.

R. P. WEIFORD & BRO. have organized to conduct business as electrical and illuminating engineers, contractors, manufacturers' agents and supply dealers, at Huntington, W. Va. Mr. R. P. Weiford was connected for several years with the Westinghouse Electric & Manufacturing Company, and is a member of the New York section of the Illuminating Engineering Society.

MESSRS. EDWIN B. PIKE AND ARTHUR B. LEBENBAUM, San Francisco, have sold their interests in the Butte Engineering & Electric Company and will conduct a manufacturers' agency business in the city, handling fixtures, lamps, heating appliances, electrical novelties and fixture glassware. Mr. Paul Butte and his brother will continue the business of the Butte Engineering & Electric Company.

SPRAGUE ELECTRIC COMPANY'S NEW ORLEANS OFFICE—Mr. A. W. Lewin has been advanced to the position of manager of the New Orleans office of the Sprague Electric Company, with which office Mr. Lewin has been connected for some time. He is a member of the American Institute of Electrical Engineers, and has had extensive commercial and engineering experience in the electrical business in both North and South America. This experience, combined with his command of the various languages spoken in his territory, promise a successful career in his new position.

THE RIDGWAY DYNAMO & ENGINE COMPANY announces the opening of a district office at No. 1311 Schofield Building, Cleveland, Ohio. Mr. H. C. Hale, who has been the Cleveland sales agent for Ridgway apparatus during the past two or three years, will be in charge of this office as local manager. Mr. Hale is well and favorably known in Cleveland as an able engineer and has been connected with several of its important engineering and manufacturing enterprises. While his experience has thus been varied, he has had special opportunities for observation and study of the many problems connected with the mechanical and electrical equipment of coal mines in the bituminous fields of Ohio, Pennsylvania, West Virginia and Kentucky. The Ridgway Dynamo & Engine Company supplies a large proportion of such power house equipment for the mines in these districts and considers itself fortunate in having Mr. Hale on its staff. He will be glad to have prospective purchasers of power plant machinery for any service confer with him in regard to their needs.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED SEPT 21, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector Street, N. Y. City.]

934,462. ELECTRIC MOTOR; A. A. Prevost, Mount Clemens, Mich. App. filed March 13, 1909. Direct-current motor in which the armature has radial poles divided into groups, each group comprising two like poles and an intermediate unlike pole.

934,463. CLEAT FOR ELECTRIC WIRES; W. F. Ritter, Cincinnati, Ohio. App. filed May 13, 1907. For supporting wires in open work on ceilings consisting of an elongated block with holes passing therethrough.

934,466. STARTING DEVICE FOR ELECTRIC MOTORS; H. M. Schiche, Wilkinsburg, Pa. App. filed Sept. 9, 1907. Single-phase induction motor having an auxiliary winding for starting, which is cut out at a speed, and actuated by the cross-magnetizing flux produced in the primary core of the motor by the reaction of the secondary member at speed.

934,470. SYSTEM OF ELECTRIC MOTOR CONTROL; H. C. Soule, Wilkinsburg, Pa. App. filed Jan. 10, 1908. Governs the speed of alternate-current motors by means of a transformer with two or more windings connected in multiple circuit, non-corresponding independent taps in each winding, constituting a series of substantially equal voltage steps and means for interconnecting the taps for producing steps other than those of the independent taps.

934,474. ELECTRIC CIRCUIT INTERRUPTER; H. R. Stuart, Wheeling, W. Va. App. filed July 9, 1906. A circuit interrupter having fluid containing tanks, stationary members in each tank, movable bridging members co-operating therewith, an insulating cross-bar connecting upright rods, which are attached to the bridging members and means for moving the cross-bar.

934,482. CIRCUIT BREAKER; C. A. Tucker, Edgewood Park, Pa. App. filed Sept. 3, 1907. Circuit interrupter in which the movable members are held open and a starting spring tends to close them, and an electromagnet withdraws a latch which holds the movable member in a position of maximum separation and then supplements the action of the starting spring.

934,538. ELECTRICALLY HEATED SOLDERING MACHINE; M. H. Johnson, Utica, N. Y. App. filed June 1, 1908. A soldering machine with a rotary soldering iron carrying a cylindrical case, a heating coil in the case, collector rings on the end of the case and a base.

934,539. ELECTRICALLY HEATED SOLDERING IRON FOR CAN CAPPING MACHINES; M. H. Johnson, Utica, N. Y. App. filed Aug. 31, 1908. A soldering iron suspended from a frame and rotated by gears and having an internal electric-heating coil in a cavity at the lower end.

934,541. CLUSTER SOCKET; W. C. Jones, Chicago, Ill. App. filed Oct. 20, 1906. Insulating bushings of rubber or porcelain surround the threaded shells but do not extend through the openings in the casing so that the bushings do not interfere with the rotation of the casing.

934,542. CLUSTER LAMP SOCKET; W. C. Jones, Chicago, Ill. App. filed Oct. 20, 1906. A cluster lamp socket in which the structure after leaving the factory may be rearranged as to the circuit arrangement between the lamps. Makes use of a pair of conductor clamps for each socket element.

934,562. SUSPENDING DEVICE FOR TROLLEY WIRES; W. A. McCallum, Cincinnati, O. App. filed May 14, 1908. Includes a two-part ear, a compression ring for holding them clamped upon the trolley wire, a stem rotating in the ear and engaging an annual edge of the socket.

934,573. MAGNETIC ARC EXTINGUISHING MEANS; O. A. Sandborgh, Swissvale, Pa. App. filed Dec. 4, 1905. A plurality of independent switches with a magnetic blow-out located between adjacent switches.

934,596. ELECTRICAL SYSTEM; Frank Conrad, Swissvale, Pa. App. filed Sept. 3, 1907. For connecting electrical circuits in parallel. Provides a measuring instrument for giving the difference of voltage between the circuits.

934,628. AUTOMATIC PRISON SIGNAL; J. E. Rhoads and H. C. Fashbaugh, Canton, Ohio. App. filed May 10, 1909. Includes a grating with intercommunicating pipes supplied with compressed air and a signal valve connected therewith to control an electric circuit when the grating is broken.

934,631. RAILWAY SIGNAL; W. W. Salmon, Rochester, N. Y. App. filed June 3, 1909. A semaphore and spectacles adjustable with relation to each other and independently supported so that if the semaphore breaks the spectacles are operative, and if the spectacles break the semaphore remains operative.

934,670. JOINT FOR ELECTRICAL DEVICES; J. Keefe, Boston, Mass. App. filed Aug. 31, 1907. A joint having a coupling member to connect two conductors, a fixed fastener holding the coupling to the support and a screw extending into and engaging the hollow end of a stud for connecting one of the two conductors to the coupling member.

934,682. FLEXIBLE CONDUIT; G. A. Lutz, New York, N. Y. App. filed Aug. 21, 1907. A flexible conduit of fabric in spiral form with a spiral insulating lining within the tube and a spiral winding surrounding the tube, the edges of the winding coinciding.

934,711. SOLDERING DEVICE; F. S. Chapman, Kenton, Ohio. App. filed Oct. 16, 1908. A metallic tube with a coating of inflammable material on the outside of the tube and a lining of soldering material on the inside.

934,714. ELECTRIC CONDENSER; E. Denicport, Suresnes, France. App. filed May 23, 1908. A series of superimposed annular metal sheets, a metal sleeve extending within the sheets, a metal casing surrounding them, one set of alternate sheets connected with the sleeve, the remaining set with the casing.

934,754. REGULATOR FOR INCUBATORS; W. B. Porter, Aberdeen, Miss. App. filed March 5, 1908. A series of heat coils in a circuit arranged in the incubator with a second circuit for short circuiting one of the coils by means of a thermostat, which controls a circuit closer in the second circuit.

934,760. MEANS FOR LOCKING ELECTRIC LAMPS WITHIN THEIR HOLDERS; H. W. Roy and A. Weber, Wellington, New Zealand. App. filed June 7, 1909. To prevent stealing the lamps. Provides a band or collar encircling the holder, the ends of which are forced together by a key so as to firmly hold the lamp in place.

934,781. CALORIC CIRCUIT BREAKER; C. C. Woodworth, Portland, Ore. App. filed March 9, 1909. The expansion of a wire traversed by the main line current opens the main line and the arc is extinguished by a mica disk supported on a rocking arm.

934,796. ARC LAMP; H. E. Davies, Weehawken Heights, N. J. App. filed Oct. 1, 1907. The lamp has downwardly projecting electrodes, and their ends project into a chamber whose constricted size keeps it at a high temperature and retards the condensation of the vapors, thus increasing the life of the arc. The walls of the chamber are impregnated with a compound of a rare earth rendered incandescent by the arc.

934,808. CABLE HANGER; W. J. Hiss, Jr., New York, N. Y. App. filed Oct. 9, 1905. For supporting cables from guy wires by means of a wire clip bent upon itself to form a loop, the ends of the clip forming an eye and hook to receive the suspending cord.

934,811. MEANS FOR REDUCING THE REACTANCE OF ELECTRO-MAGNETIC DEVICES FOR TELEPHONE CIRCUITS; W. K. Howe, Rochester, N. Y. App. filed April 13, 1909. A tubular copper sheet surrounds the core of the magnet and a source of current energizes the magnet, the current being connected with the telephone circuit.

934,820. CONTROLLING APPARATUS FOR ELECTRICAL MACHINERY; L. Krieger, Colombes, France. App. filed Oct. 16, 1907. For electrical vehicles having an electric drive including a generator with a shunt winding and a series winding, of a demagnetizing winding of greater power opposed to the said series winding with means for short circuiting it.

934,839. IRON ELECTRODE; Max Roloff, Hagen, Germany. App. filed Oct. 28, 1904. Consists of magnetic oxide of iron magnetically derived from forge scale and free from non-magnetic ingredients of the scale.

934,854. PROCESS OF ELECTRICALLY WELDING METALS; Chas. R. Sturdevant, Worcester, Mass. App. filed April 1, 1909. Heats metal surfaces to be united by coating them with fusible material, placing an intermediate body of fusible material between them and passing a current therethrough.

934,865. MICROPHONE DESK STAND; A. H. Weiss, Chicago, Ill. App. filed Nov. 26, 1906. A microphone desk stand in which the weight of the telephone set controls the contacts by means of a reciprocating set supporting rod which passes through the stand



934,711.—Soldering Device.

934,874. FAULTFINDER; T. E. Anderson, Superior, Wis. App. filed Nov. 25, 1908. A portable device for finding faults in electric cables, in which a line of resistance wire is mounted in zig-zag relation on the support, has contact points suitable distances apart and a set of indicating numerals carried by the support adjacent to the contact points.

934,875. WIRELESS TELEGRAPH TRANSMITTER; C. D. Babcock, New York, N. Y.—App. filed June 11, 1908. Includes a transformer, a condenser, an impedance calibrated to wave lengths, a spark gap, a lever and a series of contacts corresponding to the calibrations over which the lever plays, the contacts jointed to the impedance. A scale shows the length of sparks.

934,878. FIRE ALARM ATTACHMENT; W. J. Bastedo, Flint, Mich. App. filed April 19, 1909. An attachment for fire alarm boxes acting as a safeguard against false alarms in which the detent mechanism is set for each booth and releases the booth door at about the time the fire apparatus would reach the booth in response to an alarm. The person operating the alarm is locked in until the officials are on the spot.

934,883. WIRELESS TELEGRAPHY; S. G. Brown, London, Eng. App. filed June 3, 1904. A sensitive receiver consisting of electrically deposited peroxide of lead.

934,895. RAILWAY TRAFFIC CONTROLLING DEVICE; F. L. Dodgson, Gates, N. Y. App. filed July 21, 1903. A railway switch operated by a motor with a controlling and indicating circuit.

934,896. SAFETY RELAY; F. L. Dodgson, Rochester, N. Y. App. filed Oct. 12, 1908. A relay which avoids fusing of the contacts acting to maintain a circuit. Automatic means produce and maintain a break in the circuit when the contacts are fused.

934,908. SELF-ANSWERING SIGNAL SYSTEM; E. R. Gill, Yonkers, N. Y. App. filed Jan. 13, 1909. When the distant circuit is closed the operator is instantly notified by means of an electro-magnet which operates a circuit including a signal device.

934,920. CENTRIFUGAL SWITCH; C. L. Kennedy, Braintree, Mass. App. filed June 14, 1909. Opens or closes a circuit at a predetermined speed of a split-phase induction motor by means of two levers on a rotary support connected by parallel springs.

934,950. LOCKING ATTACHMENT FOR FUSE BOXES; W. R. Vanaman, Atlantic City, N. J. App. filed Feb. 26, 1909. For electric railway cars. A handle is connected with locking bolts so as to enable the box parts to be locked or unlocked.

934,973. RHEOSTAT; H. T. Jones, Bellevue, Pa. App. filed Oct. 19, 1908. A rheostat for a resistance which consists of a column of carbon disks having a sweep arm, an arc-shaped series of contacts and a connection between the block above the disks and the arm so that the arm compresses the column.

934,977. ELECTRICAL SIGNALING AND SWITCHING APPARATUS; R. H. Manson, Elyria, Ohio. App. filed Sept. 10, 1906. For a combined annunciator drop and jack. The electro-magnet has a frame with a spool carrying the winding supported in or on said frame and a spring latch detachably securing the parts together.

934,979. SELECTIVE DEVICE FOR PARTY LINE TELEPHONES; F. J. and J. Mersman, Ottawa, Ohio. App. filed May 29, 1907. A selective device for party lines including a magnet with a pivoted armature, a second armature, a ratchet wheel, a normally closed contact, the pivoted armature moving the ratchet wheel when the magnet is energized by low voltage and the second armature breaking the contact when the magnet is energized by a high-voltage current

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The Car Lighting Convention.

The Association of Car Lighting Engineers will, at its second annual meeting, in Chicago next week, return to the various subjects which are sadly in need of straightening out in steam-railroad car-lighting work. As we have before pointed out, chaos reigns in this country with regard to car-lighting systems and voltages, and an association of this kind was sorely needed to clear up the confusion. In the past the higher railroad officers have too frequently looked on electric train lighting as such a small detail in the great work of transportation that it has received scant attention. In the illuminating engineering of car lighting there is also more room for improvement than in almost any other class of lighting. One trouble in the past has been that the men in the employ of a railroad who know something of illuminating engineering are not consulted sufficiently, if at all, as to the fixtures, lamps and glassware for new cars. The car builders and general managers settle such matters in an off-hand way without a thought of anything but the appearances of the fixtures and glassware. Fortunately, this has been changed on several important railroads. Taken as a whole, however, at the present time the electric lighting arrangements in railroad coaches and sleeping cars are atrociously uncomfortable, wasteful and insufficient. Lamps are unshaded and offend the eyes of the passengers, as well as violate all laws of economy, by the lack of proper diffusing and directing appliances to prevent excessive light absorption by dark walls and ceilings. Illuminating engineering is, however, but a small part of the field of useful work of the society, and the proposed change of name to Association of Railway Electrical Engineers appears to be a wise measure.

Steam Heat from Central Stations.

Elsewhere will be found several articles on steam heating as auxiliary to central-station electrical supply—a subject again coming to the front and which merits the careful attention of every central-station man. The question is a broader one than at first sight might appear, for aside from direct profit to be realized in the utilization of the heat in steam exhausted from engines operating electrical generators, are further considerations of broad policy. One of the most forcible arguments presented in favor of the isolated electric lighting plant is that a steam equipment being necessary for heating purposes, the added cost of an electric lighting plant and the additional cost of operation of the combined plant are fully justified by the great saving that should result in the cost of lighting as compared with probable central-station charges for that service. While the fallacy of this position has in numerous cases been indicated by the abandonment of isolated lighting plants in favor of central-station service, the argument is to the average business man plausible, and its effect difficult to eradicate. If, however, a central station also conducts a steam-heating business, the menace of the isolated plant vanishes. Moreover, if there is a demand for a central steam-heating plant in a community, the company conducting the electric lighting station there is particularly qualified to seize the opportunity, even

though a live-steam system is involved, owing to the nature of its organization and the character of its personnel.

It is surprising that so few central stations have embarked in the exhaust steam-heating business, in view of the success of the plants which have added that service. The reason, we believe, is to be found rather in the apathy which formerly characterized the central-station industry, than due to any economic weakness in the combination of electric lighting with exhaust steam heating. Perhaps in some cases the complexity of the engineering problems presented by such a combination has had a discouraging effect, especially if one not versed in the principles of thermodynamics has endeavored to arrive at a conclusion without expert advice. The simple non-condensing engine central-station plant could almost obviously add an exhaust heating plant with profit, but considerations involving the addition of back pressure to a condensing engine equipment require more technical steam knowledge for their elucidation than many central-station managers possess or can command in their organization. The importance of the subject demands, however, that, once taken up, it should not be dismissed lightly. Visits should be made to a number of central-station plants operating profitable steam-heating systems, and the special problems of the case under consideration should be presented to a competent steam-heating engineer for study and report. Under such a procedure or a similar one, taking account of all factors involved, we believe that central-station steam heating would make rapid advances.

Cost of the Kw-Hour.

Elsewhere we print an article which enumerates no less than 143 items as entering into the final cost of the kw-hour of electrical energy delivered to the consumer. The popular idea of the cost of electrical energy generally does not extend much beyond the fuel item. Even engineering estimates are sometimes put forward under the vague term "kw-hour cost at switchboard," which include merely the expense for power-house labor, fuel, water and minor items. In view of the disparity between this figure and the corresponding central-station rate, there is little wonder that the public is suspicious of *ex-parte* statements of kw-hour cost, and that central-station men themselves have in public proceedings become much tangled in testimony on the subject, to the detriment of their cause. Probably the article referred to enters into greater refinement than is necessary or desirable, but a good purpose will be accomplished if it directs attention to the ambiguity that now exists as to the real significance of the term, "cost of the kw-hour." Our own difficulty in answering frequent questions as to such cost—usually now asked in the interest of the central station—would be much relieved could inquirers be referred to an authoritative tabulation giving all of the items that should be considered in making up the total cost necessary to consider in making comparisons. In particular, a tabulation of items that should be considered in determining the real cost of isolated electric lighting service would be of inestimable value to present owners of such plants, and to those contemplating the installation of an isolated electric light plant.

An Electrical Gearing.

We note from abroad an account of a form of electromagnetic gearing that would appear to have some very interesting properties. It consists of a driving gear, of which the teeth are strongly magnetized by suitable windings, and a driven gear of which successive pairs of teeth serve as armatures to the driving teeth. The gear ratio may be anything required, and the teeth are of the ordinary helical form, but they actually run out of physical contact, the only meshing being that of the common magnetic induction. The clearance is about 1/32 in., more or less, as may be necessary. Friction of gears in the ordinary sense is absolutely eliminated, likewise the necessity of lubrication of the teeth, so that the system can run dry. The sole equivalent of gear friction is the hysteretic and parasitic current loss in the teeth, which is stated to amount to very little, indeed—less than 3 per cent of the power transmitted. As a substitute for ordinary gearing the device is perhaps not particularly important, since no ordinary magnetic intensity can give the powerful grip of meshed teeth, and gears running in oil show wonderfully little tooth friction. But there are purposes for which such a magnetic drive is singularly well adapted, as when it is necessary to drive a light spindle with a minimum of vibration and friction. A pair of driving gears of this sort would give almost perfect compensation of bearing pressure, and in the case of a vertical spindle could be made to relieve the thrust of almost all the weight as well. Moreover, one could very easily drive a spindle *in vacuo* by such gearing with almost complete absence of friction, and at any required speed. The speed, too, is very easily varied, and the drive is quite without slip, save in the case of overloads. A quite similar arrangement could be made to give a very strong and steady magnetic drag of an amount capable of very close regulation. Altogether the device is a very interesting example of magnetic force, and whatever its commercial application may be, it certainly promises well in miscellaneous scientific work in which regular and nearly frictionless drives through containing walls may be important.

Illumination at the Hudson-Fulton Celebration.

The Hudson-Fulton celebration just ended had many striking features, but in no respect was it more distinguished than in the brilliancy of the illuminations, which turned night into day to an extent unwonted in New York. Under normal conditions New York is the most resplendent in unofficial lighting effects of any city on the globe. It has several streets that may claim to rank among the very best in point of their ordinary illumination, and in particular the use of electric signs has reached a point in New York completely unapproached in any foreign city. During the Hudson-Fulton celebration the lighting effects, which are always striking, were enhanced by a splendor of temporary lighting which has never been equalled in the history of the world. Some of it was almost grotesquely flamboyant. In other cases very beautiful results were obtained quite simply and with admirable taste, but everywhere the city was ablaze, and those who designed the illumination displayed a resourcefulness which has seldom been equaled and never excelled in obtaining always brilliant and oftentimes very beautiful results.

Fifth Avenue from Fifty-ninth Street to Washington Square was a blaze of glory and presented on the whole the most effective piece of street illumination yet attempted. The Plaza fairly dripped incandescent lamps from every available eminence, and from that point the whole length of the great street was a long vista of brilliant bulbs. The long lines of incandescents down the avenue produced an effect of extreme brilliancy, which was at the same time entirely in keeping with the re-

quirements and in admirable taste. Many of the buildings along the way were themselves beautifully illuminated, but sank into insignificance in comparison with the general effect of the avenue itself. Particular mention should be made, too, of the two or three immense towers in the city which were illuminated with most beautiful striking effects, and especially of the beautiful effect of the outlined soldiers' and sailors' monument. Second only to the display on Fifth Avenue was the illumination of the bridges spanning the East River. It was certainly a very happy thought to carry out in such completeness and such brilliancy the line of the bridge members of these four colossal structures, forming a blazing tracework against the darkness of the sky. From the East River, too, the illumination of the Waterside Edison station was extremely beautiful, perhaps the most effective piece of building illumination in the entire city, although many other structures were singularly fine. One hundred and Twenty-fifth Street was a marked example also of an immensely telling use of incandescent lamps stretching across the street in brilliant lines as far as the eye could see. Broadway is always flooded with light from electric signs, but during the celebration it rose to an unusual stage of brilliancy. Signs are nothing but signs at best, however brilliant, but Broadway showed a resourcefulness in new and dazzling effects that were altogether unusual.

One of the very gratifying features of the illumination was the relatively small amount of bad work that was in evidence. Occasional buildings were very badly lighted, merely picked out in crude lines of light as a child might draw them upon a slate, while swaying and ragged vertical strings of lamps marred some effects otherwise good. Upon the whole, however, the especial illumination upon the buildings was in excellent taste. The judicious use of colored lamps can produce very admirable results, and did so in a large number of buildings along the upper stretches of Broadway. Colored effects in such illuminations deserve far more attention than they have generally been given. It is easy to overdo them, and yet the colored lamps are capable of giving effects of great beauty and delicacy. Several of the prominent hotels were notable for the striking and novel effects which they displayed. Along the Hudson River there was a lost opportunity. The long line of battleships anchored from Seventy-seventh Street up was beautiful indeed, and on some occasions indulged in special illumination that was admirable, particularly in the case of the British vessels; but the shores, except for some of the huge electric signs in the lower reaches of the river, were in comparative darkness. Of course, the opportunity given by the bridges on the East River was here lacking. There were some fine individual effects along the shores without, however, full use being made of the natural advantages of the situation. Far up the river the electric scintillator produced at times results of wonderful beauty. It is a great pity that it could not have been located further down on the Jersey side of the river, where its real magnificence could have been better appreciated. Skilfully handled as it was, the scintillator, which is a marvel of brilliancy and beauty despite the unfriendly winds that at times drive its blazing steam clouds aside, is certainly one of the most striking and startling methods of festal illumination that has ever been devised. The difficulty with all these great illuminating effects has been, and probably always will be, lack of unity in design. This is perhaps a necessary result of the imperfect coordinization of individual effort. Unquestionably, the total expenditure for the temporary lighting during the celebration could have been utilized with greater unity of purpose than was evident; yet on the whole the city is to be congratulated on having so much that was good compared to the little that was indifferent or bad.

Natural Gas Competition.

To the central-station man who has never had competition with cheap natural gas or to the one who has had such competition and has met it in a half-hearted way with poor service, the mention of natural gas at 30 cents per 1000 cu. ft., which is a common price, is likely to cause consternation. Nevertheless, it is not a matter of record that natural-gas competition has caused bankruptcy of the electric lighting stations located in the large territories of the United States in which such gas is available. On the contrary, some of the largest per capita gross earnings of electric-lighting companies are reported from places where natural gas competition exists. It is not to be denied that natural gas has been used considerably in some territories as an illuminant, but it has not seriously affected electric lighting companies. This only goes to prove that no matter how cheap some commodities may be they cannot occupy a field alone in competition with others offering more convenience and comfort. Natural gas is far from being the satisfactory illuminant which is frequently assumed when it first enters a field. It is not even able to hold its own against private gasoline plants, and it is well known that private gasoline plants are being rapidly displaced by tungsten lamps. The first trouble which the user of natural gas experiences is excessive breakage of mantles. Broken mantles mean unsatisfactory light, and frequently the attempt is made to get along with defective mantles. One reason that mantle renewals are likely to be excessive is that on most natural-gas systems pressure variations are considerable, and at times so excessive as to shorten the life of mantles. Of course, there are natural gas systems where pressure regulation is looked after too carefully to permit of this, but methods of handling natural gas make considerable pressure variations likely. Very high pressures are carried on main pipe lines from gas wells to distributing points, which pressure is reduced by automatic regulators or reducing valves, and a sticking of any of these valves may cause abnormal pressure on the consumers' pipes.

Added to the above consideration is the further one that natural gas has all the disadvantages of artificial gas as to inconvenience of lighting and extinguishing, heat and disfigurement of ceilings. As has been many times pointed out, artificial gas is too expensive to use as compared with electric light in the average American city, for the simple reason that gas requires more frequent decorating of ceilings; and the expense and trouble of frequent redecoration in rooms where gas is used costs far more than the difference in price of gas and electric light. As far as the companies supplying natural gas are concerned, the amount consumed for lighting is so small that their efforts are usually concentrated on gas for cooking and heating purposes. The natural gas-lighting consumer without a gas range is hardly worth a service connection and a meter, from the gas company's standpoint. We know of some central-station men who would prefer territory in which there is cheap natural gas to one in which it is absent. They argue that it gives the small central station an opportunity to generate at a low fuel cost by the use of gas engines, and that the use

of gas mantle burners in the community tends to raise the general standard of illumination by making consumers dissatisfied with the amount of illumination formerly considered sufficient. The general effect on the community is, therefore, to stimulate a desire for more light, so that the total electric-lighting receipts will be larger than if this competition were not present.

Electric Clubs.

Within the last few years a number of electric clubs, designed to further a happy combination of technical discussion and social fraternization, have been organized in various American cities. Clubs of this character exist in New York, Dayton, Chicago, St. Louis, Omaha, San Francisco and perhaps other cities. Probably the largest and most conspicuous of these organizations is the Electric Club of Chicago, which has 375 members and holds a weekly meeting following a mid-day luncheon, at which the attendance usually ranges from 30 to 100. In this case the members take lunch together from 12:15 to 1 p. m. at the grill-room of the Chicago Automobile Club. Some member or invited guest then talks on a subject of general interest, usually, though not always, of an electrical nature, for half an hour, or less. An opportunity is given for discussion, and adjournment is reached between 1:30 and 2 p. m., never later than the latter hour. By this means members are taken away from their business but a few minutes more than at an ordinary luncheon, and, knowing the plan in advance, many members are able to attend with tolerable regularity, while there are some who seldom miss a meeting. Notices giving the name of the speaker are sent to all members a day or two in advance of each meeting. Those who attend feel well repaid. They lunch with friends, and while enjoying their cigars afterward, have the benefit of a helpful address, not infrequently by a speaker of prominence. The dues are small, and the combination of business and pleasure, the informality, and the relief from evening meetings have so far made the plan popular and the club successful. A more pretentious electric club, with expensive quarters and all the features of a regularly established social club, was very successful in Chicago for a considerable period some years ago, but finally it came to grief. It is hoped that the present organization, more modest and proceeding on a different plan, will have a long life.

In the other cities mentioned, the plan is varied to meet local requirements. In Omaha a special invitation is extended to visiting electrical salesmen to attend the weekly luncheon as the guests of the club and talk of the conditions of the industry as they find them. Other cities have their own methods of procedure. In all an effort seems to be to avoid a too cumbersome organization and to get along with just enough administration to hold the organization together. Mr. C. A. S. Howlett, on the occasion of his recent retirement from the Electric Club of Chicago, owing to removal from the city, made the interesting suggestion that the club correspond with similar clubs in other cities with the view of forming a federation of electric clubs wherein cards of membership in the associate clubs should be mutually recognized. As a preliminary he recommended that a club emblem be prepared and that it be displayed on membership cards good for one year. Mr. Howlett's plan also contained a provision whereby subjects of special interest brought up in one club might be referred to the others for discussion and action. These and a number of other recommendations made by the retiring president at Chicago had not been passed on by the board of managers at the time this was written, but they are interesting as revealing the increasing importance which seems to be attached to a comparatively new class of organizations in the electrical field. Perhaps, however, it will be wise not to attempt to direct the growth of these clubs by too much organization or "red tape," for much of their present attractiveness is due to their comparative informality, with a degree of comradeship not found in more elaborately developed societies.

The British Electric Lighting Acts.

When the history of the electric-lighting industry shall be drawn up and presented, it will probably be shown that, in Great Britain, the development of this industry was long thwarted by over-legislation on the principle of the proverb that "too much care killed the cat." The nineteenth century had already witnessed in England another great public industrial development—the steam railroad. The early days of steam-railroad development were stormy. An era of speculation and rash promotion of wild railroad schemes set in, followed by a severe commercial panic, languishment of railroad construction and lament. The fault of these misdeeds lay, perhaps, in inadequate legislative control of corporations. When, about the year 1882, the advent of a new public industrial development of electric lighting seemed imminent in England, good resolutions were borrowed from the history of the steam locomotive, and it was determined that there should be no napping this time on the part either of Parliament or of the nation. It was imagined that capital was massing impetuously to invest in electric lighting for the spoliation of the worthy taxpayer, and that stringent legislation was necessary to protect the shorn lambs of consumers from the tender mercies of raging electric-lighting capitalists.

Unfortunately then, the reactive movement was carried too far. The Electric Lighting Act of 1882 was passed by Parliament apparently in the belief that private electric-lighting enterprise was a dangerous and vicious policy, to be hampered and restricted; while municipal electric-lighting enterprise was a safe and meritorious policy to be permitted and encouraged. The terms under which the Act of 1882 permitted private companies to engage in electric lighting were so severe that capital held aloof, and hardly any companies were able to enter the field. Moreover, the municipal corporations were new to the undertaking and also held aloof; so that after all this legislative precaution very little happened. A new act of Parliament was passed in 1888, by way of amendment, and of easing the burden on enterprise in electric lighting. This gave partial relief, and most of the electric lighting of Great Britain has been carried out by companies taking Provisional Orders under this act. Even then, however, the wretched companies were beset with all manner of hampering restrictions, in the sale of lamps for instance; so that they were virtually limited to being electric-energy distributing companies and could hardly be called electric-lighting companies.

As a result of much protest and complaint, a new bill of amendment was brought into Parliament in 1903 and 1904, with the object of removing useless burdens on electric-lighting

activity; but partly owing to municipal opposition it failed to pass. At the present time, substantially a repetition of the proposed 1903 amendment bill is now pending, and has already passed the House of Lords, with certain amendments. It vests increased power in the Board of Trade for the potential benefit of private electric-lighting companies. The moral to the long tale of woe is, firstly, that although electric lighting is certainly capable of being effectively carried out by municipalities, yet it can ordinarily be carried out with greater economy and commercial success by private enterprise. Human nature is such that the prospect of winning dividends stimulates to increased exertions, and leads to the selection of the best administrative talent. Secondly, private enterprise should be encouraged and not discouraged, by legislation, to make all reasonable profits. It is sufficient if the customer is protected against dishonesty.

The Fuel Problem.

In many directions the steam-railroad companies of the country study the problems which confront them in such a thorough and systematic manner that their procedure may well be imitated, or at any rate carefully scrutinized, by the electrical interests. Specialization in the organization of societies to consider the varied subjects that enter into railroad work has been carried out to a remarkable degree by railroad men in the many departments into which the work of a great railroad system is divided. There are societies, many of them strong in membership and of high character, which have to do with general problems of management and various questions of standardization and improvement which arise in the conduct of the accounting, mechanical, purchasing, operating, car-service and other departments. The railroads of the United States are vitally interested in the fuel question, for they spend approximately $190,000,000 a year for coal at the mines. Adding $90,000,000 to cover the expense of conveying the coal from the mines to the point of consumption and for transferring it from cars to engine tenders, with the further item of accounting and general-supervision expense, it will be seen that the total fuel bill of the United States steam railroads will amount to nearly $300,000,000 in a year when general business is prosperous. It is, therefore, quite natural that the fuel question should have led to another addition to the long list of railroad specialized societies, in a recently organized body called the International Railway Fuel Association. This body was organized last November and held its first annual meeting in Chicago, June 21 to 23, 1909. The object of the association is the "improvement of the interests of its members in an educational way, advancing the interests of the employer by recommending the adoption of the best methods of purchasing, inspecting, weighing, distributing, handling and accounting for fuel." The active members include officers of railways and their assistants, but associate members may be coal producers or men connected with the manufacture and sale of coal-handling equipment or specialists whose general knowledge of fuel economy may be of value to the association.

With a membership of about 170, the body represents over 50 per cent of the total railway mileage of North America, for it embraces the railroads of Canada and Mexico as well as those of the United States. In his annual address at the recent Chicago convention, the president of the association, Mr. Eugene McAuliffe, of the Rock Island-Frisco Lines, said that, in his opinion, the study of the fuel problem has been much neglected. He said that the manager of the average railroad is never very much surprised when the fuel bill jumps up a few thousand dollars; he looks at the matter as a sort of "guess proposition." This condition does not obtain to the same extent that it did three or four years ago, and one of the purposes of the new organization is further to increase the interest of railroad officials to the end that the fuel bill of American railroads may be reduced. Another object is to work in harmony with the coal operators and specialists in the transportation, handling and economical use of fuel, so that out of a combination of coal purchasers, engineers and railroad men there will be gained a better understanding of the whole problem of fuel utilization to the general advantage of all concerned. One practical suggestion made by Mr. McAuliffe relates to the purchasing of coal by the railroads. The president of the association believes that the railroad people should keep in close touch with the coal producer, to the end that in some instances a compromise grade of coal, possibly somewhere between lump and run-of-mine, may be purchased and burned in locomotives, thus obviating the necessity of the coal operator dumping fine coal or screenings on the ground. In the majority of cases the value of this coal is practically lost, for the revenue that the coal operator subsequently derives from the sale of it barely offsets the expense of dumping it and picking it up again. Furthermore, coal stored on the ground deteriorates rapidly. Mr. McAuliffe's idea is that it would be a very practical example of conservation of natural resources if the railroads, at certain seasons of the year when the operators have hundreds of thousands of tons of screenings on hand, would arrange to take this fuel off the hands of the producers. Another subject discussed at the convention was the briquetting of coal, while other topics of more restricted interest to railroad men were discussed at considerable length.

Electrical central-station interests producing electrical energy in thousands of steam-power houses in the United States are interested to a great extent in exactly the same questions to which the International Railway Fuel Association addresses itself. Now that special sections are provided for by the amended constitution of the National Electric Light Association, it may be wise perhaps to establish a fuel section of the parent organization. Or if the A. I. E. E. should be broadened in scope to embrace commercial as well as technical engineering, that body might take cognizance of the subject. In either case, no doubt the example and methods of the new fuel association of the steam railroads would be of much value to the electrical organization. Furthermore, the two bodies might co-operate and exchange information and experiences. The broad subject of prevention of fuel waste in this country is really of great importance, and any movement anywhere tending to the more economical use of fuel is worthy of serious attention, not only by electrical men, but by all public-spirited citizens, for apparently the time is coming, if the present rate of consumption is kept up, when the supplies of coal known to exist in the territory of the United States will be so deeply encroached upon as to cause serious apprehension for the future. Of course, increasing use will be made of water-power, but nevertheless the possibility of a great curtailment or possible cessation of the coal supply of this country in a few hundred years is one to be viewed with concern. Such organizations as the International Railway Fuel Association should do much toward postponing such a direful day of reckoning.

National District Heating Association.

The first annual convention of the recently organized National District Heating Association will be held in the Southern Hotel, Columbus, Ohio, on Nov. 10 and 11. This organization was formed for the benefit of those engaged in district heating from central stations and to supply a medium for the interchange of information on the progress of that art, both technically and commercially, as is done by the electrical associations for central-station electrical service. The association was organized at the time of the meeting of the Ohio Electric Light Association at Toledo on July 15, 1909. The present officers are: President, Mr. A. C. Rogers, Toledo; secretary and treasurer, Mr. W. A. Wolls, Columbus; chairman of executive committee, Mr. E. F. Gwynn, Delaware, Ohio; chairman of finance committee, Mr. A. N. Cope, Springfield, Ohio; chairman of program committee, Mr. D. J. Hard, Cleveland, Ohio.

Cleveland Electrical Organization.

At a dinner of representatives of electric lighting, manufacturing and supply companies at the Euclid Hotel, Cleveland, Ohio, on Oct. 2, a temporary organization was formed for that city, and on Oct. 16 another meeting will be held, when it is expected that a permanent association will be established. Over 200 invitations to this dinner were sent out, and about 125 responded, almost every branch of the business being represented.

Mr. H. H. Cudmore was chosen chairman of the temporary organization, and will have much to do with the preliminary work that is to be done before the next meeting. Among those who took part in the discussions at the dinner were: Messrs. J. Robert Crouse, of the National Electric Lamp Association; A. W. McIntyre, superintendent of the municipal electric lighting plant, and C. W. Chappelle, of the General Electric Company. All voiced their approval of the movement and expressed their belief that it will prove of benefit to all.

The association will be patterned after those in many other cities, and its aim will be to bring about a closer relationship of the various interests through the medium of good fellowship and acquaintance. The work before the organization will be to increase the market for electrical products by every means possible, discuss trade conditions and pursue such a course as to advance the common interests of the members. By securing a clear understanding of the policy pursued by each, all others will be able to work in harmony. Little differences will be done away with and it is believed greater harmony will result in every way.

Mr. J. Robert Crouse will co-operate with Chairman Cudmore in the appointment of a committee to frame up a plan of operation and at the next meeting there will be material to work on in the way of completing the organization.

Colorado Power Development Controversy.

First Assistant Secretary Frank Pierce, of the United States Interior Department, has recommended that the Department of Justice take steps to have the reservoir claims of the Denver Power & Irrigation Company set aside. It seems probable that early action will be taken to cancel the patents of the company to the site of the proposed plant in the South Platte Canyon. The patents were issued a number of years ago, and the Interior Department claims that the present holders are obstructionists, as there are a number of other persons asking for rights and promising immediate work. Among those who have filed subsequent applications for reservoirs are Messrs. C. P. Allen, J. E. Maloney and William E. Bates. If the patent of the Denver company is canceled these parties will proceed to attempt to secure similar rights.

Investigations have shown that large quantities of power can be developed by building dams at proper points in the canyon. Mr. J. E. Rhodes is president of the company now holding the patent, and it is said that of the $100,000 or more spent on the project, not more than $3,000 to $5,000 was spent for actual digging or construction. The company claims that it was interfered with by injunction proceedings instituted by the Colorado & Southern Railway.

Denver 100,000-Volt Substation.

The Denver substation of the Central Colorado Power Company is now complete, with its auxiliary repair shop, connected by tracks with the transformer room. The oil switches and lightning arresters for the incoming 100,000-volt lines are located some distance from the main building, and the pumps for the transformer oil cooling are also in a separate building at the edge of a small creek.

The main building is used for purely substation purposes, and is in two sections. This building has brick walls and a concrete-slab roof. The windows throughout are wired-glass in metal frames, approved by the Underwriters' Laboratories. The doors are standard partition fire doors, also approved by the Underwriters. The transformer room proper is cut off from switchboard room, containing auxiliary apparatus and a storage battery, by a brick fire-wall with one opening protected by a standard automatic fire-door. The transformers are fed by hollow brass busbars through condenser-type roof bushings. The bushings in the transformer covers are also of the condenser type.

The low-tension buses are for 11,000 volts, which voltage is handled in the other division of the building through ordinary board arrangements for that voltage. Auxiliary transformers step down to 110 volts for switch control and instruments, and the 11,000-volt circuit leads direct to the Denver Gas & Electric Company, at present the only Denver customer.

The main building is without a pound of combustible material in its structure, and a transformer oil fire is the only possible damage. This, however, is safeguarded against by every possible precaution, and the tanks are so arranged that the transformer room can be flooded with carbonic acid gas in case of necessity.

The present source of supply is Shoshone, near Glenwood Springs, Col., but upon the completion of the hydroelectric development near Nederland, Boulder County, the substation will be extended and will care for a large share of the Denver Gas & Electric Company's demand.

Another Subway Proposition in Chicago.

The M. H. McGovern Company, by Mr. M. H. McGovern, its president, submitted a brief proposal to the City Council, of Chicago, on Sept. 27, in which it offered to enter into a contract to build a subway system for the city of Chicago in accordance with plans and specifications to be prepared by the city and the company. Mr. McGovern said that he is prepared to give any necessary assurance of the financial backing of his company to the extent of $100,000,000 or more. In his letter he said: "We will accept an ordinance that will give municipal ownership as soon, practically, as present financial and legal conditions will permit, and without delay." The proposal was referred to the committee on local transportation.

It is said that this proposal comes from interests allied with the late E. H. Harriman. Mr. McGovern is reported to have declared that if awarded the contract his company will guarantee to complete a subway and turn it over to the city ready for immediate use within two years.

Mr. Hereley, the city traction expert, has sent a communication to the City Council in which he says that the Union Loop for elevated railways should be abolished and that a "downtown" subway should take its place. According to Mr. Herely a subway is indispensible to a correct solution of the transportation problem in Chicago. Mr. B. J. Arnold, president of the Board of Supervising Engineers, Chicago Traction, has suggested that rails twice as long and weighing not less than

90 lb. to the yard be substituted for the present rails on the Union Loop, thus eliminating half of the joints at which most of the noise is created. But Mr. Herely thinks that it would be a mistake to attempt at this time to rehabilitate the Union Loop. He is of the opinion that the structure should be razed entirely within a few years.

Chicago Underwriters' Laboratory.

At the regular weekly mid-day luncheon of the Chicago Electric Club held Wednesday, Sept. 29, 1909, Mr. Dana Pierce, electrical engineer with the Underwriters' Laboratories in Chicago, gave a summary of the objects and general work of the laboratories, referring in particular to the electrical department. He stated that the founding of the laboratories was the outgrowth of original work done by Mr. W. H. Merrill about sixteen years ago. Since that time the laboratories have developed to such an extent that from 35 to 40 men are employed, 25 of whom are technical engineers. In a brief way Mr. Pierce referred to the principal function of the laboratories, which is to afford protection to the public against loss by fire through preventing the marketing and installation of faulty devices, electrical and otherwise.

Impregnation of Field Coils.

In a report of the committee on equipment, submitted on Oct. 6, to the convention of the American Street and Interurban Railway Engineering Association, the impregnation of both new and old field coils was highly recommended. In carrying out the impregnation process with wire-wound field coils the wire is insulated with asbestos, the asbestos being held on by a thin cotton covering. The coil is wound in a form of definite dimensions. After winding, the coil is taken out of the form and wrapped with porous tape. The coil is then filled with asphaltum compound by the vacuum process. The vacuum process consists of putting the coils in an air-tight pot or kettle, the same being heated; while the coil is hot the air is exhausted from the kettle, thus taking the air out of the coil. When a good vacuum is obtained, hot melted asphaltum is allowed to flow in from another kettle, and as soon as the coils are covered with asphaltum, it is turned off and air pressure is applied on top of the asphalt in the compounding kettle and thus the asphalt is forced into all the spaces in the coil. When cooled down slightly, the coils are taken out and allowed to become fairly cool. Then clamping plates are placed on the coil, both back and front, to bring the compounded coil to the exact dimensions desired. After the coil is cold the clamps are removed, the first taping is removed and varnished cambric insulation is put on the coil. This treatment makes a compact coil of definite dimensions which, when bolted up in the motor, will maintain its dimension and is not liable to become loose.

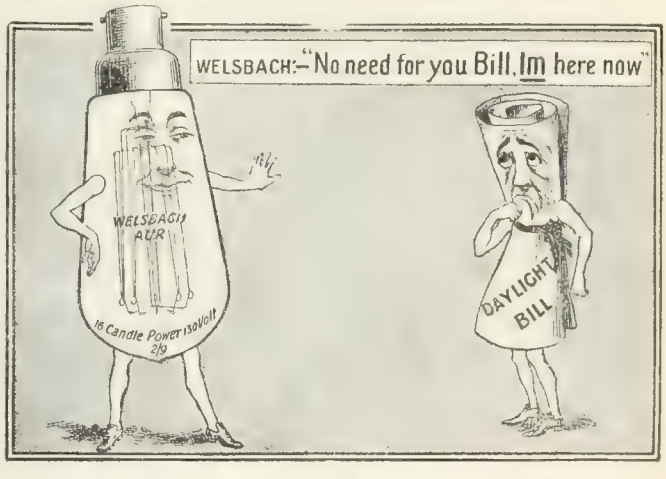
Chicago Railroad Electrification May Be Compulsory.

At a meeting of the City Council of Chicago, on Sept. 27, Alderman B. W. Snow, of the Seventh Ward, introduced an ordinance providing that after Jan. 1, 1912, every railroad company in Chicago shall operate all its cars or trains within a radius of eight miles from the city hall by electric energy. Within one year after the passage of the ordinance all railroad companies in Chicago shall submit to the commissioner of public works plans and specifications for operating all of its cars in the city of Chicago by means of electric energy. If the commissioner approves these plans the railroad company presenting them shall proceed within six months to begin to electrify its road and shall continue the work with reasonable diligence. No railroad company shall operate its cars within a radius of eight miles of the city hall after one year from the date of the passage of the ordinance unless at that time it shall have submitted plans and specifications for the electrification. The penalty provided for violating any of the provisions of the ordinance is a fine not exceeding $200 for every day the railroad company continues to disregard the provisions of the measure. The proposed ordinance was referred to the committee on local transportation without discussion. As will be seen, its provisions are drastic. They apply to all the railroads in the city, although more particularly, no doubt, directed against the Illinois Central, whose dilatoriness in submitting working plans of electrification has provoked the city officials. It is probable that the railroad companies will make a bitter fight to prevent the adoption of this measure. The position of the railroads seems to be that the proposed electrification will be exceedingly expensive, and many of them would prefer, perhaps, to abandon their suburban service altogether rather than to make the improvement within the short space of time provided by the ordinance. The cost of making the electrification proposed is roughly estimated at not less than $50,000,000. In a newspaper interview Alderman Snow is reported to have intimated that details in the ordinance such as the eight-mile limit may be subject to discussion and change in the strenuous contest which is sure to rise before the local transportation committee.

Gas Company Introduces New Incandescent Electric Lamp in Great Britain.

The British Welsbach Company has created a stir by publishing full-page advertisements in London dailies announcing its entry into the electric lighting field with a new metallic-filament lamp, the invention of Baron Auer von Welsbach. A long list is given of dealers in London from whom the lamp can be purchased, and of gas-light corporations in other cities by which it will be supplied. The advertisements include the illustration reproduced herewith.

The advantages claimed for the new lamp are longest life, strongest metallic filament and highest efficiency; also, that



LONDON ADVERTISEMENT OF NEW ELECTRIC LAMP.

the lamp will burn in any position and can be used with both direct and alternating current, and for series as well as parallel lighting. Prominent position is given in the advertisements to the statement, "Remember that the electric metallic-filament lamp was invented by Baron Welsbach." A special offer made for the introduction of the lamp is as follows:

"To enable users to satisfy themselves without any additional outlay, of the great superiority of Welsbach filament electric lamps over other types on the market, as regards efficiency, strength and economy, we have pleasure in making the following offer: We will remove the whole of the carbon electric lamps from any existing installation and will replace these with our standard Welsbach filament electric lamps of at least equal candle-power and will accept as settlement in full of our account the difference saved by the consumer in his

electric energy bill as ascertained by comparison with the corresponding quarter of last year. This offer stands good for acceptance, and for free installation by us through our agents, anywhere in the United Kingdom up to and including the quarter ending December, 1909, so that the test shall terminate in the March quarter at latest."

The Welsbach Company has not divulged under what patents its lamp is manufactured. It is stated that the British General Electric Company owns the fundamental British Welsbach patent of 1905, as well as a number of other patents issued to the Welsbach interests, and also owns the Just-Hanaman tungsten lamp patents, which latter are claimed to anticipate the Welsbach invention. Apparently the object of the gas company in taking up the exploitation of an electric lamp is to reduce the meter income of central stations.

Kansas Gas, Water & Electric Light Association.

The twelfth annual meeting of the Kansas Gas, Water & Electric Light Association was held at Wichita on Sept. 23 and 24. The address of welcome was delivered by Mayor C. L. Davidson.

In outlining the work of the association Mr. W. A. Scothorn stated that during 1907 there were in Kansas 67 private lighting plants and 26 municipal, while at the present time there are 75 private plants and 36 municipal. The relatively larger percentage increase in the municipal plants may be attributed to their being installed as a matter of convenience and local pride in towns that are too small to be attractive to capital.



MEMBERS OF THE KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION.

During the meeting papers were presented by Mr. B. F. Eyer on "Notes on Transformers"; Mr. F. I. Benson on "Tungsten Lamps"; Mr. W. E. Sweezey on "Series Tungsten Lamps for Street Lighting"; Mr. W. R. Murrow on "Gas-Engine Features in the Central Station"; Mr. A. L. Moe on "Oil Engines"; Mr. P. B. Chancy on "Sizes of Single-Phase Motors"; Mr. J. C. Nicholson on "Duties and Liabilities of Electric Companies," and by Mr. Johnston Haywood on "Scientific Illumination." Talks were given on the operation of municipal plants by Messrs. J. H. Rathert, J. G. Pease, W. B. Foshay and W. A. Scothorn, and a talk on electric washing-machines was given by Mr. E. E. Strafford.

The following officers were elected: President, Mr. M. T. Flynn, Kansas City; first vice-president, Mr. J. H. Rathert, Junction City; second vice-president, Mr. Charles D. Bell, Independence; third vice-president, Mr. W. R. Murrow, Independence; secretary-treasurer, Mr. J. D. Nicholson, Newton; executive committee, Mr. W. B. Foshay chairman, Wichita; Mr. T. F. Cole, Pittsburg, and Mr. B. F. Eyer, Manhattan.

It was decided to hold the next meeting at Kansas City, at some date not yet determined. Abstracts of papers presented are given below.

The paper by Mr. W. R. Murrow dealt with some of the features which experience has shown to be essential with any gas engine from which economy in operation, ease in making necessary repairs and long, steady running qualities are to be expected. For the cleaning of scale, the writer recommended the use of one part of muriatic acid to four of water, which acts quickly and effectively, doing no damage to iron, steel or copper, and only slightly attacking brass.

Several builders in this country are marketing gas engines that, so far as fuel economy and general excellence in mechanical detail are concerned, leave comparatively little to be desired, but the question of reliability hinges most largely upon one of the smallest details of the engine, namely, the ignition system. In Europe the jump spark is in use on more large engines than is any other system, and, judging from the results said to have been attained, the jump-spark system has reached a much higher development there than in this country. Considered as a whole, the most reliable system in use in America to-day is the electro-magnetic make-and-break, which has been greatly improved since its introduction a few years ago. The buyer of a gas engine should insist upon at least two spark plugs in the working end of each cylinder. There should be installed on every engine safety stops which will open the ignition circuit in case of excessive rotative speed, and as a further precaution a hand-operated switch in the same circuit should be placed at some convenient point away from the engine which it controls.

The paper by Mr. Johnston Haywood outlined the methods now in use for determining the watts required for illuminating a certain area when tungsten lamps are employed. He remarked that good illumination consists in having the light on the object and not in the eye. Where lamps are to be placed high above the range of vision, it is proper to use clear lamps, but when they are placed low enough to be seen casually, bowl frosted lamps should always be installed. The author called attention to a certain store window having a white enamel ceiling from which were hung, without reflectors, tungsten lamps in plain view from the sidewalk. The equipment consumed 60 watts per square foot of illuminated area. If only 3 watts per square foot had been used and the lamps had been hidden from view by means of reflectors, a first-class illumination would have been obtained, and the goods would have been advertised instead of the lamps.

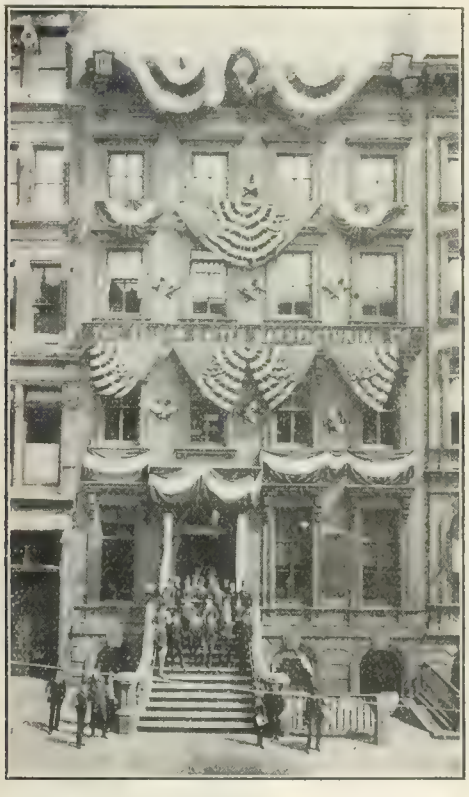
The meeting was addressed by Mr. W. L. A. Johnson, commissioner of labor and state factory inspector, on the reporting of accidents to the State inspectors. The speaker dis-

cussed fully the law passed on March 12, 1909, relating to accidents, which, he said, had two purposes in view, namely, the reporting and classifying of accidents to determine in which class of industries accidents occur most frequently and to what extent, and the enabling of competent authorities to determine what recommendation should be made to prevent the recurrence of such accidents. On the whole, it has specially called attention to the grave necessity of constructing mills, factories, workshops, industrial plants of all kinds, on the latest pattern and most up-to-date methods and systems, with the primary view of safety to citizens and employees. Mr. Johnson asked for the co-operation and support of the members in the execution of the laws that concern their plants.

Electrical Illuminations.

Accustomed as New Yorkers are to the electrical splendors of the "Great White Way," with its magnificent nightly display of many colored sparkling and brilliant signs and decorations, the profuse and beautiful illuminations that have been specially prepared for the Hudson-Fulton celebration have eclipsed all previous records, providing in the whole a spectacle that should fill the hearts of citizens of the metropolis with justifiable pride.

Decorative electric lighting has made such marvelous progress within a few years as to have become an integral part of the life of the community—so much so that one is apt to forget that, as an art, it has only just come to its majority. The present generation cannot remember the time when night was not turned into day by the brightness of innumerable electric lamps on signs and decorations whose brilliant and sparkling surfaces not only advertise their owners but also contribute a cheerful radiance to the surroundings.



HEADQUARTERS OF EDISON COMPANIES, 1889

Those of more mature years, however, have recollections of times in a not very remote background when the streets of New York took on a more sedate and sombre hue after sundown. But with the advent of Edison's incandescent lamp came more ardent and glowing possibilities which have since been developed into the magnificent practicabilities that are now visible on every side.

From the apex of the present illuminations it is interesting to glance backward a few years to see the humble beginning of exterior electrical decoration on buildings. The illustration herewith is a reproduction of an original picture showing the first of these decorations in New York at the historic headquarters of the Edison Companies at 65 Fifth Avenue. It was installed in the spring of 1889 on the occasion of the Centennial celebration of the inauguration of George Washington as President of the United States. The suggestion for this illumination emanated from Mr. W. H. Meadowcroft, who had been affiliated with Edison interests for some years, and who afterwards became prominently identified with decorative lighting as a separate branch of the company's business, in which it was succeeded by the General Electric Company. It will be seen from the illustration that compared with the elaborate illuminations of modern times this pioneer one was simple and meagre, consisting only of a number of stars draped with red, white and blue bunting, and each mounted with thirteen 16-cp lamps, together with a row of similar lamps on top of the sign. In the doorway, sheltered from the weather, was a small sign, "Edison," made up with miniature lamps mounted in primitive and specially hand-made receptacles.

There were only two other electrical illuminations in the city at this celebration, one being of the Washington Arch (which was then a wooden structure designed and erected for this celebration), and the other the Union League Club. The beautiful illumination of the arch by incandescent lamps was designed by, and carried out from, the Edison office under the direction of the late Luther Stieringer, and was the pioneer of his many subsequent magnificent productions, such as the decorative illuminations at the Chicago World's Fair of 1893, and the Pan-American Exposition at Buffalo a few years afterward.

The electrical decorations of the Union League Club in 1889 consisted of festoons of red, white and blue lamps, arranged with switches so as to produce alternate and complete lighting effects, which at that time were unique. This illumination was planned by Mr. Edward H. Johnson, of the Edison Company.

These illuminations were lighted in the evenings, not only during the celebration, but also for a while afterward, and the novelty attracted crowds of people. Strange to say, however, it was two or three years after that time before the idea of electrical exterior decorations seemed to make headway, but in the early nineties there began the great advertising movement that has grown by leaps and bounds until it has assumed its present ample dimensions.

It is interesting to note that as far back as 1883 incandescent lamps were used in signs. In that year Messrs. Pottier & Stymus, of New York, had an electric sign built advertising a fair for a hospital. The wording of the sign, which was executed in Roman letters, was "St. Valentine's Market."

The Hudson-Fulton Carnival Parade in New York City.

The Hudson-Fulton celebration was brought to a close in New York City last Saturday night in an immense carnival parade. As a fitting climax to the week of celebration the 35 warships lying at anchor in the Hudson River, the public buildings and all of the spectacular effects installed for the occasion were lighted. From the northernmost extremity of Manhattan Island to the far-away Jersey coast the city was one wide banner of light. The illuminations which stood out in striking contrast to the tall buildings, streets, etc., and even the fantastic carnival procession, were the array of battleships in the Hudson River and the bridges spanning the East River.

The carnival parade, arranged by the German, Austrian and Swiss Societies of New York, which closed the New York Hudson-Fulton celebration was by no means the least attractive feature. Fifty picturesque floats, and marchers gorgeously arrayed, traveled from 110th Street to Fifty-ninth Street and Central Park West, and from Fifty-ninth Street to Washington Square on Fifth Avenue. The entire route of the parade was

illuminated by strings of incandescent lamps. The spectators seated on the stands in the Court of Honor, extending from Forty-second Street to Fortieth Street on Fifth Avenue, included the Governor of the State and distinguished foreign visitors, while the entire route was peopled by strangers from cities and towns outside of New York, whose number was estimated at over 2,000,000. Much to the regret of the marching societies, none of the floats could be lighted up as had been intended. Completely surrounding each float were to be a number of stalwart torch bearers carrying gasoline torches, but this scheme had to be abandoned at the last moment by order of the police.

The electrical illumination planned by the Hudson-Fulton Celebration Commission, originally announced to continue during the eight days of the celebration in New York City, will be continued up to and including the night of Saturday, Oct. 9. This includes the electrical illumination of the streets marking the line of the land parades during the celebration, as well as the Borough Halls in the five boroughs, Washington Arch, the Soldiers' and Sailors' Monument, Brooklyn Academy of Arts and Sciences, the Martyrs' Monument in Brooklyn, the Water Tower in Brooklyn, the East River Bridges, the Viaduct and Extensions at Riverside Drive, the large battery of 20 searchlamps at 153d Street and Riverside drive and the battery of searchlamps used to illuminate the tomb of General Grant. During the present week the various cities and towns along the Hudson will continue the celebration, and on Saturday the festivities will be brought to a close by a carnival parade in the Borough of Brooklyn.

Convention of the I. E. S.

The third annual convention of the Illuminating Engineering Society, held in New York during the Hudson-Fulton Celebration, on Sept. 27, 28 and 29, proved successful from all points of view. Even the registration, which was decreased somewhat by reason of the counter attraction of the celebration, reached the large total of 454, which is 54 in excess of the registration at the Philadelphia convention. A large number of these were guests, there being 83 ladies and 112 gentlemen thus registered, but the membership registration of 259 compares favorably with the corresponding registration of 242 at Philadelphia.

Among the features of entertainment provided, special mention should be made of a musical and reception in the Engineering Societies Building on the evening of Sept. 27, and a reception and view of the carnival lighting effects at the Machinery Club, on Sept. 29, by the Holophane Company. Automobile trips also furnished diversion for the visiting ladies during the convention. In connection with the convention, there was held a historical and educational exhibit, where there were shown various commercial types of electric and gas lamps and accessories representing the latest developments in the production and utilization of light.

PHYSIOLOGICAL EFFECTS OF RADIATION.

A noteworthy lecture was delivered on the evening of Sept. 28 by Dr. C. P. Steinmetz. The title of the lecture was "The Physiological Effects of Radiation," but the speaker announced that his task would be limited to those radiations external to the visible spectrum, and that he would discuss such methods as could be employed to avoid the disadvantageous results from such radiation, or to take advantage of such advantageous features as might be found to exist.

The history of investigation of the effects of ultra-violet light is similar to that connected with resonance in electric circuits. It has been the practice in the past to attribute to resonance any effect in the electric circuit which could not be explained by well understood laws. In the same way, any misunderstood effects of radiation have been attributed to ultra-violet light. The statement has frequently been made that short wave lengths are harmful to the eyes, and it has often been said that lamps which produce short wave lengths necessarily have an injurious effect on the eyes. The fact of the matter is that daylight contains proportionately even more ultra-violet light than any of the light from the common artificial sources. Beyond any doubt, harm has been produced as a result of the introduction of artificial lighting, but such harm is attributable more to the fact that humanity now makes use of the eyes for more hours per day than formerly, rather than to any injurious effect produced by artificial light itself. That is to say, on account of the fact that artificial light is now available, humanity continues for probably 18 hours work which could in past ages be conducted for only about 12 hours.

The harmful effects due to radiation which does not fall within the visible spectrum may be classified as indirect, direct and specific. One of the indirect effects is that connected with the attempt of the eye to match colors when the light is of an improper tint. In such a case there is an over-straining of the eye which attempts to overcome the deficiency by adjusting itself to the abnormal conditions. As a direct effect may be noted what may be called a "power blow" upon the eye. Such a blow is produced when energy reaches the eye at a rate considerably greater than that for which the eye is momentarily adjusted. The mechanism of the eye is so arranged that the pupil contracts in order to reduce the light reaching the retina to the proper value. When radiations suddenly impinge upon the eye at an excessive rate, the mechanism is unable to act instantaneously, and the eye receives a damaging blow; such a blow is caused by the light from an electric arc in the case of a short-circuit. Exposure to an explosion of this nature produces temporary blindness, but the recovery of the eye is relatively quite rapid. In regard to such power blow, artificial light is much more harmful than is natural light. The blow can be said to be due almost exclusively to the infra-red radiation.

Certain specific effects can be attributed to radiations of various frequencies. Moderate frequency radiations are somewhat harmful, while high-frequency ultra-violet light in considerable quantity is very harmful. The harm produced by such radiations becomes apparent at a very slow rate, and the recovery therefrom is extraordinarily gradual. For example there may be cited the case of an investigator who subjected his eyes to the unshielded mercury vapor arc; the recovery from the injury to his eyes required practically eight years. The symptoms of trouble from high-frequency radiations are headaches and a blurring of the vision.

The radiations from the commercial form of incandescent electric lamps contain practically no ultra-violet light. The common carbon arc lamp gives forth a limited amount of ultra-violet radiation. Arc lamps of the flaming and luminous types give a considerable amount of ultra-violet light. Such lamps must be provided with enclosing globes. For this purpose even clear glass is quite effective, because it is opaque to ultra-violet light. The common low-temperature mercury-vapor lamp produces ultra-violet light in considerable quantity, but is harmless on account of the fact that the arc is surrounded by glass. The high temperature mercury-vapor lamp is provided with a quartz tube, through which the ultra-violet light, if produced, would pass readily. However, the high temperature lamp gives forth almost no ultra-violet radiations. An effective method of detecting the presence of ultra-violet light is by noting the odor of ozone, which is either caused by, or produced simultaneously with, such light. As a matter of fact, it is not improbable that the destruction of organic tissue by ultra-violet light represents the tearing apart of oxygen molecules in the production of ozone.

Among the advantageous characteristics of radiation not found within the visible spectrum may be mentioned the beneficial effect upon plant life, and the destructive effect upon certain germs. It may safely be stated that all of our energy comes from the sun. Even the energy found in animals may be attributed indirectly to the rays from the sun, in that such rays are necessary to plant life, and animals obtain chemical energy from plants either directly or indirectly. Along the line of electrotherapeutics, considerable use is being made of

radiations for the cure of disease. A study of the harmful and beneficial effects of all types of radiation will, therefore, become of predominating importance to the medical profession.

In the discussion of a paper by Dr. H. E. Ives on the allowable amplitudes and frequencies of voltage fluctuations in incandescent-lamp work, Mr. G. S. Merrill outlined a certain series of experiments made upon lamps under actual service conditions and stated that the heavy filament series tungsten lamp can be operated at a frequency of 25 cycles without producing any objectionable flicker. Mr. B. F. Fisher, Jr., called attention to the relation of the environment upon the value of the frequency below which flicker becomes perceptible, and remarked that the surroundings must be taken into consideration when specifying the critical frequency. Dr. C. H. Sharp said that, on account of the extra sensitiveness of the periphery of the retina to flicker which may not be observed when the sight is directed toward the lamp, a higher frequency is required for peripheral vision than is necessary for direct observation. He expressed the opinion that a frequency of 25 cycles is too low for a large number of purposes. Dr. E. P. Hyde discussed the fact that in certain cases where flicker is not perceptible a moving object is seen as a series of separate objects. Such a case exists even when a frequency as high as 60 cycles is used with vapor-tube lamps.

In discussing the paper by Dr. Louis Bell on "The Principles of Shades and Reflectors," Mr. V. R. Lansingh remarked that even when a polished-metal surface is used as a mirror the absorption is never less than 15 per cent, and may be much more. The mirror reflector possesses an advantageous feature in that the curve of light distribution can be varied at will by easily understood changes. With prismatic reflectors there is a combination of reflection and refraction which is difficult to follow completely. However, by proper designing methods almost any desired distribution curve can be obtained with a small amount of light absorption.

Mr. Bassett Jones, Jr., explained the observed fact that the light distribution produced by a flat reflector does not differ greatly from that produced by a conical reflector on the basis of the radiation from illuminating surfaces. For example, assuming a uniform normal surface brilliancy the light emitted from an aperture of an irregular body whose interior surface gives forth luminous radiations is the exact equivalent of the light given by a plane surface equal in dimensions to the aperture itself. Mr. Jones described a rearrangement of reflectors and diffusing plates by which the apparent absorption by the glass plates was decreased from 38 per cent to 9 per cent. The decrease was attributable to the counter reflection when the surfaces were properly placed with reference to the source of light.

Mr. A. A. Wohlauer showed in what manner polar co-ordinate paper can be used in the solution of complex illuminating engineering problems.

In reply to a question by Mr. H. T. Owens, Dr. Bell stated that the absorption of light by a globe surrounding a lamp is independent of the diameter of the globe when the source of light is at its center. He remarked that the reflection from a good mirror in the best condition amounts to from 82 per cent to 84 per cent of the incident light.

In presenting his paper entitled "Standard Relations of Light Distribution," Mr. A. J. Sweet stated that in a very large number of cases it is possible to obtain the desired density and uniformity of illumination by installing the proper one of a few definite styles of reflectors and lighting units, provided only that the units are correctly spaced for the reflectors employed. The simple rules for installing the lighting units could well be distributed in leaflet form with each shipment made by the manufacturers.

Mr. J. E. Woodwell expressed his agreement with the author as to the advantages to be derived from standardizing lighting units and the methods of installing them, but called attention to the undesirable results accompanying the attempt on the part of an uninformed person to design illuminating installations by means of rules the significance of which he cannot understand. He thought it best not to carry standardization too far.

Mr. L. R. Hopton claimed that uniformity of illumination is often undesirable, especially in homes. He said that the reflectors described by Mr. Sweet as suitable for giving uniform illumination possess the disadvantageous feature of subjecting the eye to too high a brilliancy.

Mr. E. L. Elliott outlined the need for standardization and stated that efforts along this line encounter opposition on the part of almost all of the fixture manufacturers.

HETEROCHROMATIC PHOTOMETRY.

In his paper on the problems of heterochromatic photometry, Mr. P. S. Millar called attention to the fact that while the candle-power of a tungsten lamp or of a mantle gas lamp may be stated with fair accuracy, yet tests of illuminants whose color values differ largely from the color values of standard lamps are uncertain to a degree which is beyond the limits allowable in good engineering practice.

The problem of heterochromatic photometry is a big one—too difficult of solution for one man or for one laboratory. There may be no thoroughly satisfactory solution—all may be compelled to adopt some compromise method calculated to yield at least consistent results, but before anything can be done all pertinent facts must be considered and a large amount of investigation must be completed. More or less desultory experimentation has been undertaken in various laboratories. The results should be co-ordinated and further experimentation in various laboratories should be conducted along lines best designed to promote a solution of the problem. Before practice can be standardized we must have authoritative action of some kind. Before standardization can be arrived at it must be determined which is the best or most practicable method to use in transferring from the present standard to one of another color. All of these matters require concerted and vigorous action on the part of those qualified to assist in arriving at a best solution.

The discussion of Mr. Millar's paper was opened by Dr. C. P. Steinmetz, who remarked that it is impossible to express the value of green light, for example, in terms of red light. By means of photometry the actinic effects can be compared, while a bolometer may be used for showing the relative values of the heating effects. In one case a certain ratio will be obtained, while in the other case a different ratio will be shown, neither ratio being a correct one as concerns the visual effects. A good method of comparison is one based on the reading distance—that is, the distances at which certain print of meaningless words can just be read when illuminated with first the one and then the other light.

Dr. Louis Bell stated that in conducting heterochromatic photometric experiments it is essential to eliminate all observers having defective color vision.

Prof. S. W. Ashe remarked that the mere fact that the flicker photometer gives results which differ from those given by several other photometers should not be taken as a proof of the inaccuracy of the former, because the latter, although agreeing among themselves, may be subjected to similar errors.

A motion by Mr. Millar that the convention request the president to commend to the attention of the council the need for the consideration of standardization of methods in heterochromatic photometry, being seconded by Dr. Steinmetz, was carried unanimously.

FACTORY LIGHTING.

The disadvantageous features of localized and highly concentrated illumination as commonly used in many factories were discussed at length in the paper by Mr. L. B. Marks. In installations of this kind the illumination produced by each lamp is confined to a very small zone which is brilliantly illuminated, while contiguous parts of the working space, where good light is needed, are in comparative darkness. The actual intensity of illumination directly underneath the lamps is in most cases several times as much as is desirable to secure the best vision.

With the localized system of illumination as installed in fac-

tories, there is a maximum of direct reflection of light from the working parts of the machines. Owing to the location of the lighting source with reference to the object illuminated, a considerable percentage of light from the lamp is reflected directly from the work to the eye of the operator. The direct reflected light does not increase the ability of the operator to see the object, but, on the contrary, decreases his visual acuity and necessitates the use of a far greater amount of localized light than would be needed if there were no direct reflection. Measurements made by the author at five typewriter factories showed excessive reflection of light, especially from the typewriting machines in the aligning department. The illumination measurement at one of these machines showed that fully 10 per cent of the incident light was directly reflected from the machine into the eyes of the operator. This abnormal reflection reacts on the eyes of the operator and albeit the high intensity of concentrated light on these machines, accounts in a large measure for the complaint of inadequate illumination in the aligners' department.

In a system of localized illumination, such as is employed in these factories, it is necessary to readjust frequently the height and position of the lamps to suit the requirements of the work. The drop lamps are necessarily placed quite close to the work. Each operator adjusts the position of his lamp close enough to his work to give an illumination which is satisfactory to him. As a result of this practice it sometimes happens that the operator, in order to secure suitable illumination on his work, may so adjust his lamp that part, or all, of the light therefrom shines directly into the eyes of his neighbor.

There appears to be a natural tendency on the part of the operator to place his lamp as close as possible to the field which is to be illuminated. The operator may be content for a while with the localized lamp 2 ft., or even 3 ft., above his work, but experience shows that when the matter of adjustment is left to him, he will, as a rule, ultimately lower the lamp to a position as close to the work as it is possible to locate the lamp without actual physical interference with the operation of the machine or the performance of the work.

The frequent handling of the lamps by the operators to adjust the height and position of the lighting units results in soiling the lamps and reflectors. It is not unusual, in most of the departments, to find finger marks on the glass bulbs and on the reflecting surface of the shades, which latter are in many instances so smutted from handling that they are practically worthless as reflectors. The proximity of the lamps and reflectors to the machines accounts in some cases for the rapid accumulation of gritty and oily material on the former. This is especially true of the grinding, the buffing and the automatic-screw machine departments, in which the lamps and reflectors are begrimed and oil-spattered. The measurements showed that almost double the amount of light was given on the working plane when a clean reflector was substituted for a deteriorated reflector.

The handling of the lamps by the operators and the disposition of the latter to place the lamps as close as possible to the work sometimes lead the operators to bend the reflectors and force them into some convenient part of the machine close to the work. In some instances where it is impossible to lodge the lamp in a convenient part of the machine because of the large size of the reflector, the reflector is removed by the operator and the bare lamp used.

The frequent adjustments and readjustments of the lamps unnecessarily occupy the time of the operator and to some extent distract his attention from his work. The multiplicity of dangling wires from the drop lamps presents an unsightly appearance. Moreover, those wires are apt to be in the way of moving parts of the machinery, etc.

In some cases the eyes of the operator are very close to the reflector and are affected by the heat of the lamp. Objectionable shadows are cast by the reflectors, lamp supports, drop cords and hangers. The shops present a gloomy appearance at night. Even when all of the local lamps are in operation, the intensity of the general illumination on the working plane in locations outside of the restricted field illuminated by the drop lamps is at best only about 0.25 foot-candle, being less than 0.15 foot-candle in most of the departments, and in some less than 0.03 foot-candle. The extremely low degree of general illumination in the shops makes it difficult, if not impossible, for the foreman to exercise the same character of supervision at night as he does in the daytime, and makes it more difficult to guard against factory accidents.

With the present system of localized illumination in the shops, advantage cannot be taken at night of the reflecting and diffusing value of the walls and ceilings, whereas in the daytime the walls and ceilings are used to great advantage in reflecting and diffusing natural illumination.

A remedy for the objectionable features of concentrated factory lighting lies in the use of a suitable degree of general illumination and moderate intensity of localized lighting.

Of the two papers dealing with vacuum-tube lamps, that of Dr. E. P. Hyde and Mr. J. E. Woodwell gave considerable information concerning the advantages of using two-phase currents in two lamps in order to overcome the objectionable flicker. When a single lamp is employed the illumination reduces to zero twice per cycle, while when two tubes were connected on separate circuits of a two-phase system the illumination reduced to only 50 per cent of its maximum value during each cycle.

Calorimeter tests of the tube using carbon dioxide showed that the light has a color somewhere between daylight at midday and twilight. Moreover, it possesses a fine-line spectrum which is almost continuous, thus showing that all colors are represented in the light.

In discussing the paper on the vacuum-tube lamp by Dr. C. H. Sharp and Mr. P. S. Millar, in which a specific consumption of 2.48 watts per mean spherical candle-power was assigned to the tube using nitrogen vapor, Mr. C. D. Warner claimed that the tube when properly adjusted has sometimes given an efficiency 50 per cent greater than the value indicated in the paper.

Care and Operation of Storage Batteries.

A large audience, composed principally of steam-railroad men, gathered at the rooms of the Western Society of Engineers in Chicago on the evening of Sept. 23 on the invitation of the Electric Storage Battery Company to attend a smoker at which Mr. H. M. Beck, one of the Chicago engineers of the company, delivered an illustrated lecture on "Care and Operation of Storage Batteries." Mr. Godfrey H. Atkin, manager of the Chicago office of the company, presided, and in welcoming his guests he explained the necessity for careful and intelligent operation of storage batteries. Mr. Atkin, in referring to the automobile situation, made the interesting remark that his company has distributed over a million instruction books relating to the care of batteries. He also said that representatives of the signaling, maintenance and telegraph departments of all the railroads in the Chicago territory were in attendance at the meeting.

Mr. Beck's address, illustrated by diagrams and photographs thrown on the screen, was an interesting and original contribution to a subject that has received much attention. Among other things the speaker said that the space where the battery is installed should be suitable for the purpose in accessibility, ventilation and light. As the escaping fumes of a storage battery may be explosive under some conditions, the matter of ventilation is particularly important. An exposed flame should not be brought near the battery. In installing the battery care should be taken to see that the cells are properly connected as to polarity. This is, of course, self-evident, but the speaker remarked that it is astonishing how many people, including battery men themselves, sometimes neglect this fundamental precaution. Another point is to be sure that the wood separators are always kept wet.

Initial charging of a battery should be long and thorough, and should last at least 60 hours. After setting up, the batteries

should be charged at once, as the plates are liable to sulphate if left standing before the initial charge. It is of prime importance to have the initial charge complete; it is better to have it too long than too short.

In regular operation the charging of the battery is the most important feature in connection with its use. There should be occasional overcharges—that is, prolonging the charge beyond the time when the voltage and specific gravity reach the maximum—and these overcharges should last from one to four hours after the maximum capacity of the battery has been reached. To determine when the cells are fully charged, gravity tests are to be recommended in preference to the use of the voltmeter, wherever practicable. Mr. Beck showed a number of recent improvements in hydrometers, including hydrometer syringes and signaling hydrometers—that is, hydrometers arranged to give a signal by ringing a bell when a predetermined gravity has been reached.

It is very important to keep the height of the electrolyte permanent. For this purpose automatic cell fillers are used in large installations. Charging is complete when the maximum gravity or voltage is reached. In discharging the principal precaution to be observed is not to discharge the battery too far; the discharge limit of the manufacturer should never be exceeded. Test readings are valuable, and it is well to keep a record of them.

In inspecting the batteries the operator should look out for falling off in gravity or voltage. Notice whether there is a lack of gassing in charging or a change in the color of the plates. All these symptoms are indications of trouble. Sediment should never be allowed to collect in the jars till it reaches the plates. In cleaning the cells the plates should not be allowed to get dry. To replace evaporation distilled water should be used if pure rainwater or satisfactory spring or river water (by analysis) cannot be obtained.

Some of the practical precepts of Mr. Beck were as follows: Avoid incomplete charging. Do not replace the evaporation with electrolyte instead of water. The cadmium test is not recommended for general use, and if used should be employed with care and intelligence. However, if properly used it is sometimes a help in determining the relative condition of different cells in a battery. The new mercury type of amp-hour meter is promising for use in determining the input and output of a battery under certain conditions. It is to be remembered that the efficiency of a battery varies with the amount of work it does. If a battery is to be kept in good condition, it must be overcharged occasionally, at, say, two-week intervals, and, by means of the amp-hour meter, readings should be kept of these overcharges and also of the regular charges to observe the conduct of the battery compared with its own previous record.

In conclusion, the lecturer explained a number of pictures designed to illustrate more particularly the use of batteries for railway signaling and car lighting. In the discussion Mr. Beck answered a number of practical questions. He said that in overcharging the rate of charge should never be below one-half of the normal rate, and probably the normal rate is preferable. Glass covers for battery jars or tanks are a good thing where wood separators are used; they cause some trouble where it is necessary to remove them for inspection. The use of wood separators is recommended in old cells, and they should be put in at the time of cleaning. There is little objection to continuous charging at a low rate of charge.

In case the battery is not going to be used for a number of months it is best to charge it at intervals of, say, two weeks, and for the rest of the time allow it to remain on open circuit. An alternative is to take the battery apart entirely, but this requires considerable trouble and on reassembling the battery is to be subjected to a long initial charge, as in the case of a new battery. It is not necessary to discharge a battery not in use if kept on open circuit. In ordinary operation the deterioration of positive Planté plates due to gassing is not apt to prove very serious; there is a greater possibility of danger from this cause in the use of pasted plates.

In high temperatures, batteries are unfavorably affected in efficiency in several ways. Low temperatures, on the other hand, have no permanent effect on storage batteries. The freezing point of 1200-point electrolyte is 25 deg. below zero Fahr. An electrolyte of 1250 points will not freeze at 55 deg. below zero Fahr., although it will become thick. The life of any plate depends entirely on how it is used. Rolled-lead negative plates have given steady service for five years. A small amount of blistering on plates is not alarming, as it is normal in some types of batteries. Lake Michigan water, as obtained from the municipal water works in Chicago, is a safe water to use in batteries if it is filtered.

At the conclusion of the discussion Mr. Atkin led the way to a near-by restaurant, where all the gentlemen present were entertained at supper.

Massachusetts Commission News.

The Massachusetts Railroad Commission has decided in favor of the street-railway companies in the petition of citizens of New Bedford asking for a fare reduction of from 10 cents to 5 cents between the center of the city and the Freetown line. There was little doubt as to the outcome of this case, since no evidence was submitted at the recent public hearing to show upon what legal grounds the fare could properly be decreased. The Union Street Railway Company operates a line in New Bedford as far as Lund's Corner, and the Old Colony Street Railway Company operates from this point to the Freetown line and northward. Each company collects its own 5-cent fare on the track owned by it in the city, regardless of whether the car operated is on a local or a through trip. The board states in the decision that if the petition were granted it would cause in many instances a reduction in the cost of a single ride and would bring about a return of less than 5 cents to one or both of the companies. It also states that there is no present occasion for a recommendation that the companies reduce the unit of fare, in view of the limited amount of travel on the Old Colony Street Railway and the maximum distance of a single ride on the two lines of railway.

A hearing was given on Sept. 28 by the Masaschusetts Gas and Electric Light Commission upon the joint petition to allow the consolidation of the East Boston Gas Light Company and the Chelsea Gas Light Company. The East Boston company asks the right to issue additional stock to the value of $300,000 in connection with the consolidation. Chairman Barker asked the company's representative, Counsel Hunt, what has been done in relation to the selling of the electric business of the Chelsea Gas Light Company to the Edison Electric Illuminating Company of Boston. A detailed account was promised, and in addition a statement of the value of the franchise of the Chelsea company, which is to be turned over to the East Boston company in connection with the deal. The hearing was adjourned to Oct. 5, to give Counsel Hunt an opportunity to present the additional information desired.

The Fitchburg Gas & Electric Light Company and the Connecticut River Transmission Company have filed a 28-year distribution agreement with the Massachusetts Gas & Electric Light Commission. Under the terms of the order of the board, dated July 2, 1909, the Transmission Company is permitted to supply energy to large consumers in Fitchburg, provided each of such customers has an equipment rating of at least 300 hp in his installation, and an annual consumption of at least 450,000 hp-hours. The gas company and the transmission company have therefore entered into an agreement covering the distribution of electrical energy in this territory, and the points enumerated below are of interest on account of this being the first case in which such an agreement has been reached after proceedings before the board between an established central station in Massachusetts and a company transmitting hydro-electric energy into the State on a large scale.

The agreement provides that the gas company shall at its own expense procure locations, build and maintain pole lines and conduits necessary for distributing electrical energy at

6600 volts from the Beech Street substation of the transmission company in Fitchburg to such customers in the city as the latter may procure, whose equipments and consumptions are as stated above. The locations and specifications are to be subject to the approval of the transmission company, and the latter is to bear any expense in the distribution system occasioned by any future removal of the substation. Temporary distribution lines desired by the transmission company are to be built at its expense by the gas company. All energy furnished to customers of the transmission company of the 300-hp rating or over is to be supplied directly from the transmission company's substation unless by agreement it may come from the power house of the gas company. For this service the transmission company is to pay to the gas company 0.05 cent per kw-hour for all energy transmitted over these lines and measured at the former's substation. The minimum annual compensation to be 12 per cent of the cost to the gas company of building such distribution lines. If more than 4,000,000 kw-hours in any year are transmitted to the 300-hp customers, so-called, the maximum payment to the gas company is not to exceed 15 per cent of the cost of construction of distribution lines. The records of meter readings and of the ratings of motors and other connected apparatus are to be open to the inspection of the gas company. Monthly meter readings are to be furnished to the gas company for energy delivered to customers of the transmission company. The agreement provides for the right to cut off the hydroelectric service in case the transmission company defaults the payment of bills beyond 30 days. In case of a dispute between the companies, the agreement provides for the selection of a board of three arbitrators to settle the matter. Either company may require the testing of meters. The cost of construction mentioned is the cost of original construction only, but due allowance is to be made in case the present pole lines are used in part or in case of future underground construction by the gas company. The transmission company is to deal directly with all its customers, and the price is in each case to be outside the participation of the gas company. Competition between the two companies is permitted among the customers eligible for contracting for service with the transmission company. The transmission company is to provide all transformers, switches, lighting arresters and other apparatus located on the property of its customers, and is to be wholly responsible for the erection, maintenance and operation of its transmission line and substation, including damages, while the gas company is responsible in a similar manner for the distribution system, unless the damage is due to negligence of the transmission company in delivering alternating current to the distribution lines of the gas company. The gas company assumes no liability to transmission customers for service interruption. If the city of Fitchburg purchases the plant and property of the gas company the latter may be relieved of performing its part of the agreement without prejudice to the right of the transmission company to require the city to assume and comply with the terms of it. The agreement took effect on Oct. 1, the board having taken no action of disapproval within 15 days of the date of filing.

New York Public Service Commission News.

The Public Service Commission of the First District has continued its hearings upon the application of the Bronx Gas & Electric Company for permission to issue $1,500,000 of bonds. Although the company only desires to issue $740,000 of these bonds at the present time the commission hesitates to grant the application because it has been shown that the brokerage firm engaged to underwrite the bonds expects to receive a commission of $30,000.

The Public Service Commission has approved the application of the Nassau Electric Railway Company for permission to issue $730,000 bonds to refund the same amount of bonds which fell due Oct. 1.

The Public Service Commission of the Second District has given a public hearing upon the application of the Poughkeepsie Light, Heat & Power Company to issue $100,000 bonds remaining under a first mortgage executed in 1901. The company plans to erect a new gas plant.

Milo G. Kellogg.

Mr. Milo G. Kellogg, founder and president of the Kellogg Switchboard & Supply Co., died at his home in Chicago, Sept. 26. Mr. Kellogg had been in comparatively poor health for some years, and was unable to reassume the active direction of the Kellogg Company when control was restored to him last spring. He was born in 1849 at Rodman, N. Y., and soon after graduating from the University of Rochester in 1870 joined Elisha Gray and E. M. Barton in the manufacture of electrical apparatus. In 1872 the business was organized as the Western Electrical Manufacturing Company, which eventually made arrangements for the exclusive manufacture of telephones under the Bell patents. The Western Electrical Manufacturing Company was succeeded in 1882 by the Western Electric Company, with which Mr. Kellogg remained as general superintendent for several years. In 1885 declining health forced him to retire, and the following two years were spent in Europe, where he made a careful study of telephone conditions. Realizing that the telephone abroad was not meeting the same appreciation as in this country, and believing that there was a great field for its expansion if proper methods of manufacture and development were introduced, he started at Antwerp a factory for the Western Electric Company, which grew to be a great establishment and led the way to the erection of similar Western Electric branches in Europe.



During his connection with the Western Electric Company Mr. Kellogg was unceasingly active in developing telephone exchange circuits and apparatus, and also took a leading position in matters affecting the general policy of the Bell telephone organization. He played a prominent part in the organization of many companies operating under license for the American Bell in the Middle West, and was a director in the Central Union, Great Southern and several other large operating companies. At a very early period Mr. Kellogg conceived the idea that telephone service would be of immense utility to the public and would reach its highest value if widely and intensely developed. The fact that this opinion was not at the time supported by persons in authority in the Bell organization is undoubtedly largely responsible for his eventual separation from the interests with which he had so long been allied, and finally for the conviction that only by active competition was the only means to the desired end.

Soon after Mr. Kellogg's return to this country, in 1887, he began to file applications for patents upon telephone circuits

and apparatus, having conceived the idea of starting a large telephone factory upon the expiration of the fundamental Bell patents. In 1897, having learned that an independent company —the Kinloch—had been formed at St. Louis and was planning to erect a large exchange, he at once appeared before the directors and presented a proposition. At this time he had no organization, no drawings, no factory and no financial backing. Being successful in securing the contract, he took Elisha Gray's old shop at Highland Park, Ill., got together men and materials, and designed and built in St. Louis a central which was the largest erected up to that time in this country and had a capacity greater than that of any existing exchange in the world. Between the signing a contract and the manufacture of an equipment, the granting of new patents frequently introduced possibilities for improvement, and Mr. Kellogg was always eager to give customers the benefit of the accruing advantage; and his standing was such that changes involving departure from contract were accepted without question. As an inventor Mr. Kellogg was prolific, his telephone patents aggregating several hundred. In 1897 a single week's issue of patents to him numbered no less than 128, which probably yet remains the highest Patent Office record.

Mr. Kellogg's name became familiar throughout the entire United States by the leading part he played in the famous litigation which finally resulted in the practical invalidation of the Berliner telephone patent. Indefatigable in his opposition to the Bell Company, he spared neither time nor money in attacking its patent monopoly, either directly or as an active agent in litigation instituted by others. During the years spent in this campaign he acquired such a grasp of the legal technicalities involved that latterly many of the legal papers in the litigation were, initially, at least, drawn up by him. In 1891 the Berliner transmitter patent, after remaining for 14 years in the United States Patent Office, was issued and Mr. Kellogg immediately perceived that were it installed the telephone industry would be closed to competition for a further period of 17 years. Without loss of time he inaugurated active opposition, and as a final result the United States Government brought suit against the Bell Telephone Company to annul the Berliner patent. Although the Supreme Court refused to cause the cancellation of the patent, the suit developed grounds which, at a later date, when the Bell Company attempted to enforce the patent against others, rendered it harmless. Mr. Kellogg's activity in the litigation continued until use of telephone transmitters was thrown open to the public.

Shortly after the issue of the Berliner transmitter patent another transmitter patent, likewise held in the U. S. Patent Office for about 14 years, was issued to the Bell Company. This was the Edison carbon transmitter patent, and had it been broadly sustained would also have extended the telephone monopoly. The validity of this patent, however, depended upon what Mr. Kellogg considered to be a construction of a United States statute contrary to its plain meaning. The famous Bate refrigerator case involved the interpretation of this statute, and when it was argued before the Supreme Court Mr. Kellogg intervened and presented, through his attorney, a brief before said court. The court decided along the lines of the brief and sustained the plain interpretation of the statute, thus killing the Edison patent.

In the early part of the year 1902, while Mr. Kellogg was incapacitated by illness, the Bell Telephone Company acquired his stock in the Kellogg Company and for several years controlled the policy of that company. Mr. Kellogg and other stockholders were not advised of the purchase until some months later, whereupon the minority stockholders brought suit to recover the stock, which they alleged was illegally acquired by the Bell Company. After years of litigation the Supreme Court of the State of Illinois found that the alleged purchase was illegal, caused the stock to be restored to its original owners, and Mr. Kellogg resumed control of the Kellogg Company in the spring of this year.

The accompanying portrait was taken at the time of Mr. Kellogg's great activity in telephone patent litigation.

CURRENT NEWS AND NOTES.

SIBERIA-AMERICAN WIRELESS.—The Russian Government is sending an official of the Telegraph Department to the United States for the purpose of making arrangements for establishing communication between the United States and the wireless station to be built at Kamchatka, the Siberian peninsula extending into the Bering Sea and opposite Alaska.

LEWIS INSTITUTE EVENING CLASSES.—Registration week for the evening classes at Lewis Institute, Chicago, will be from Oct. 4 to 8. Evening-class work will be begun on Oct. 11. There is a regular four-year evening course in electrical engineering as complete as the daytime instruction, but intended for more mature students, many of whom are employed during the day. Last year there were 381 students in the evening classes. Prof. P. B. Woodworth, professor of electrical engineering, is the dean of the evening schools.

LARGE GIFT TO PRATT INSTITUTE.—Mr. Charles M. Pratt, his five brothers and a sister have given to Pratt Institute, Brooklyn, $1,750,000 as an endowment fund. The Institute was founded 22 years ago by his father, who donated $2,000,000 for the purpose. Since the foundation several large gifts have been made by Mrs. Charles Pratt, wife of the founder, one alone amounting to $700,000, and annual deficits have from time to time been met by the Pratt family. It has been announced that a further fund will be donated to pension institute teachers.

COST OF MARCONI TRANSATLANTIC SERVICE.—In an interview in Montreal, Marconi said that he hoped to have the Glace Bay transatlantic station operating by Jan. 1, and added that his company has an agreement with the British Post Office under which, when the Government authorities are satisfied as to the regularity of the service, it will give the company its transatlantic business and handle the company's business in Great Britain. It is stipulated that the rate shall not be more than 10 cents for commercial and 5 cents for press messages, and Marconi stated that an intermediate rate of 6 cents a word on commercial messages sent in plain English is under consideration.

BALTIMORE ELECTRICAL SHOW.—At a meeting held Oct. 7 at the Hotel Caswell, Baltimore, attended by the leading electrical men of the city, the advisability of holding an electrical show during the late winter or early spring months was discussed and decided affirmatively. Baltimore has been making great progress in attracting Southern business, but the electrical trade thus far has not participated in the resulting prosperity. It is intended that the show shall be one of the most elaborate of its kind ever held outside of New York and Chicago, and already the general features of the exhibition are being outlined. A working committee will be appointed immediately, and will have instructions to proceed at once to arrange the details of the affair.

OREGON HYDROELECTRIC PLANS.—If all the projects that are reported to be in contemplation are carried to completion the Clackamas River will be lined with hydroelectric plants and a large amount of power will be developed from the flow in that stream. In addition to the station of the Portland Railway, Light & Power Company at Cazadero, the Southern Pacific Company is planning the development of water-power 15 miles farther up the river. It is proposed to construct a power station there, and nine miles farther a dam is to be built, and a race made down to the power plant. This project will supply 50,000 hp, with a possibility of 150,000, according to the statement of an engineer connected with the plans. Another project is under way about two miles below Estacada, backed by Fred S. Morris, who was at the head of the Oregon Water Power Company before consolidation with the Portland Railway, Light & Power Company.

WATER-POWER TRUST.—In a recent interview Forester Pinchot reiterated his opinion that a water-power trust is in process of formation, but cited no facts to support this assertion.

AGAINST PERPETUAL WATER-POWER FRANCHISES.—The American Mining Congress, in session at Goldfield, Nev., last week, adopted a resolution calling upon the National Government to pass laws against granting perpetual franchises for water-power and water-rights, and urged that similar State legislation be passed without waiting for congressional action.

CHICAGO ELECTRIC CLUB.—Mr. F. P. Vose has been elected president of the Chicago Electric Club, to succeed Mr. C. A. S. Howlett, resigned. Mr. Homer Niesz at the same meeting was elected vice-president. The speaker at the meeting of the club on Oct. 6 will be Mr. C. L. Batty, of the Arnold Company, and for the following week Mr. E. B. Warner, of the Western Electric Company.

MEETINGS OF THE A. I. E. E.—A paper entitled "Telegraph and Telephone Systems as Affected by Alternating-Current Lines" will be presented at the meeting of the American Institute of Electrical Engineers to be held on Oct. 8. At a meeting to be held on Nov. 12 Dr. Cary T. Hutchinson will present a paper entitled "The Electric System of the Great Northern Railway Company at Cascade Tunnel." The meetings will be held in the Engineering Societies Building, New York City.

BALLOON PUTS A TRACTION LINE OUT OF COMMISSION.—Probably the first case on record where a balloon put a railway out of commission occurred to the Indianapolis, Columbus & Southern Traction Company Oct. 1. A balloon sent up from the Speedway Park after traveling 26 miles descended so near the earth as to collide with the high-tension wires of the company near the power house at Edinburg. The anchor caught and snapped the wires, after which the balloon ascended and made a successful flight into Kentucky.

GROOVED COMMUTATORS.—As the result of an inquiry by letter submitted to various electric railways by a committee of the American Street and Interurban Railway Engineering Association it has been ascertained that practically all of the larger companies now make use of high-grade carbon brushes and grooved commutators. During the past year the brush manufacturers have made decided improvement in the quality and uniformity of their product. As a result of the use of grooved commutators and high-grade brushes, commutator troubles have been reduced by about 50 per cent.

PITTSBURGH A. I. E. E. SECTION.—At the September meeting (Sept. 14) of the Pittsburgh Section of the American Institute of Electrical Engineers, papers on the subject of "Industrial Motor Applications" were presented by Messrs. H. C. Specht, F. A. Rew and W. O. Peale. At the next meeting a paper on "Electric Welding" will be presented by Mr. C. B. Auel. At the September meeting the following officers were elected: President, Mr. C. B. Auel; secretary, Mr. E. B. Tuttle; Executive Committeee, Messrs. W. E. Reed, W. E. Moore, H. M. Muller, Ludwig Hommel, R. A. L. Snyder and B. P. Rowe.

CLEVELAND TRACTION ARBITRATION.—Judge Taylor, of the United States Circuit Court, has been selected by the Cleveland City Council and the street railways to act as a final arbitrator in questions involving Cleveland street railway valuation and maximum fares. Following the decision of Judge Taylor on these two questions the matter will be submitted to the people for vote at a special election. Recently Judge Taylor submitted an ordinance for the settlement of the traction troubles to the City Council at the request of the street-railway companies, which provides for a 3-cent fare for a period of eight months; and if in this period 6 per cent be realized on the valuation of the property, the 3-cent fare was to be continued indefinitely; otherwise it is to be raised to seven tickets for a quarter with a 1-cent charge for a transfer.

BALTIMORE MUNICIPAL CONDUITS.—A meeting of the electrical commission of Baltimore, Md., was held on the last day of September and the budget for 1910 was formally approved. This calls for an appropriation of $354,000 for construction and $18,800 for salaries, the same as for 1909. The items aggregating the first-mentioned sum are: trunk-line conduit (300,000 ft.), $66,000; service and distribution conduit (200,000 ft.), $50,000; conduits for alternating current (600,000 ft.), $168,000; other conduit, $70,000. This is the first year that the last item has been specified. Approximately this amount was spent the present year in laying conduit pipe in advance where paving was to be improved. The conduits in several sections of the city have been completed.

BALTIMORE METER REGULATIONS.—Beginning with Oct. 1 no electric meter can be installed in Baltimore without having been previously inspected by the city department of lamps and lighting. The ordinance, which was drafted by this department, and approved by the city solicitor, fixes a charge of 10 cents each for the examination of the meters. It further stipulates that any consumer of electric light or electric power who is of the opinion that the meter installed by the company registers wrongly can at any time have the meter inspected; for this inspection a charge of $1 is to be made, to be borne by the consumer should the test prove that the meter is in good working condition, but if found defective the charge is imposed upon the company. Should the examination of the meter show that the consumer has been overcharged, the company is required to credit the consumer for the overcharge, the rebate to cover the four months preceding the examination of the meter.

AN ELECTRICAL EXPERT ON HIGH-TENSION TRANSMISSION.—A North Carolina electrical expert is educating the public in Spartansburg and vicinity through the local press, to the dangers of high-tension transmission, and calling on the "common people" to rise and compel the Southern Power Company to reduce its line voltage from 88,000 to a reasonable figure, such as 25,000 volts. An advantage of the latter voltage is stated to be that "it may not charge the towers dangerously." The writer says the question is one which the public "should decide after the fullest investigation, assisted by experts known to have a comprehensive knowledge of electrics, not the class of electricians who build and operate power plants, lighting plants, railways, etc., dealing with manifestations, not principles." Expert knowledge, he proceeds to explain, "is simply experience in any art or science. It is not theory in any form, but experience only. It follows, of course, that the art or science in question has been fully demonstrated and the principles fully understood, and have been applied practically, else experience could not be obtained." Then, after a statement that the science of electricity is in a transition stage, comes the remarkable conclusion: "Manifestly there can be no expert knowledge in electrical science." Yet the writer does not entirely ignore electrical science. "A high voltage," he says, "has a definite striking distance in accordance with the hygrometry of the atmosphere and is as deadly as a 13-in. projectile," and he lays down the law that "the cross-sectional area of any conductor of electricity limits the voltage for any amperage." Moreover, he says that while office, station and linemen "can talk with apparent profundity in explaining electrical phenomena, believing what they say, describing in some detail a sine wave and the lead and lag of the voltage and amperage, but most likely snuffed out with the fundamental, superimposed harmonics, induced currents, etc., in alternating-current analysis; yet it requires all this and enough more to make an ordinary person dizzy to determine limitations and comprehend the hazard in such undertakings."

Electric Light and Exhaust Steam-Heating Station at West Chester, Pa.

WEST CHESTER, PA., has a population of approximately 11,000. It is a typical Quaker town whose inhabitants are not given to manufacturing pursuits. The city is within 28 miles of Philadelphia, and being chiefly a residential town, the electric lighting conditions are not startling and the possible day load obtainable is rather limited. Up to the year 1902 the Edison Electric Illuminating Company, which began operation in 1885, was furnishing electricity only; but it was decided that maximum return on investment could be realized by selling the exhaust steam, which heretofore was permitted to go to waste, for heating purposes. As a result of the addition of the heating load, the company finds that the income from heating is sufficient to pay for the fuel and water as well as boiler-house labor for the year. The heating season extends from November to May, and it will be understood that the exhaust steam is obtained from engines driving electric generators, so that not all the heat in the steam is used for heating purposes.

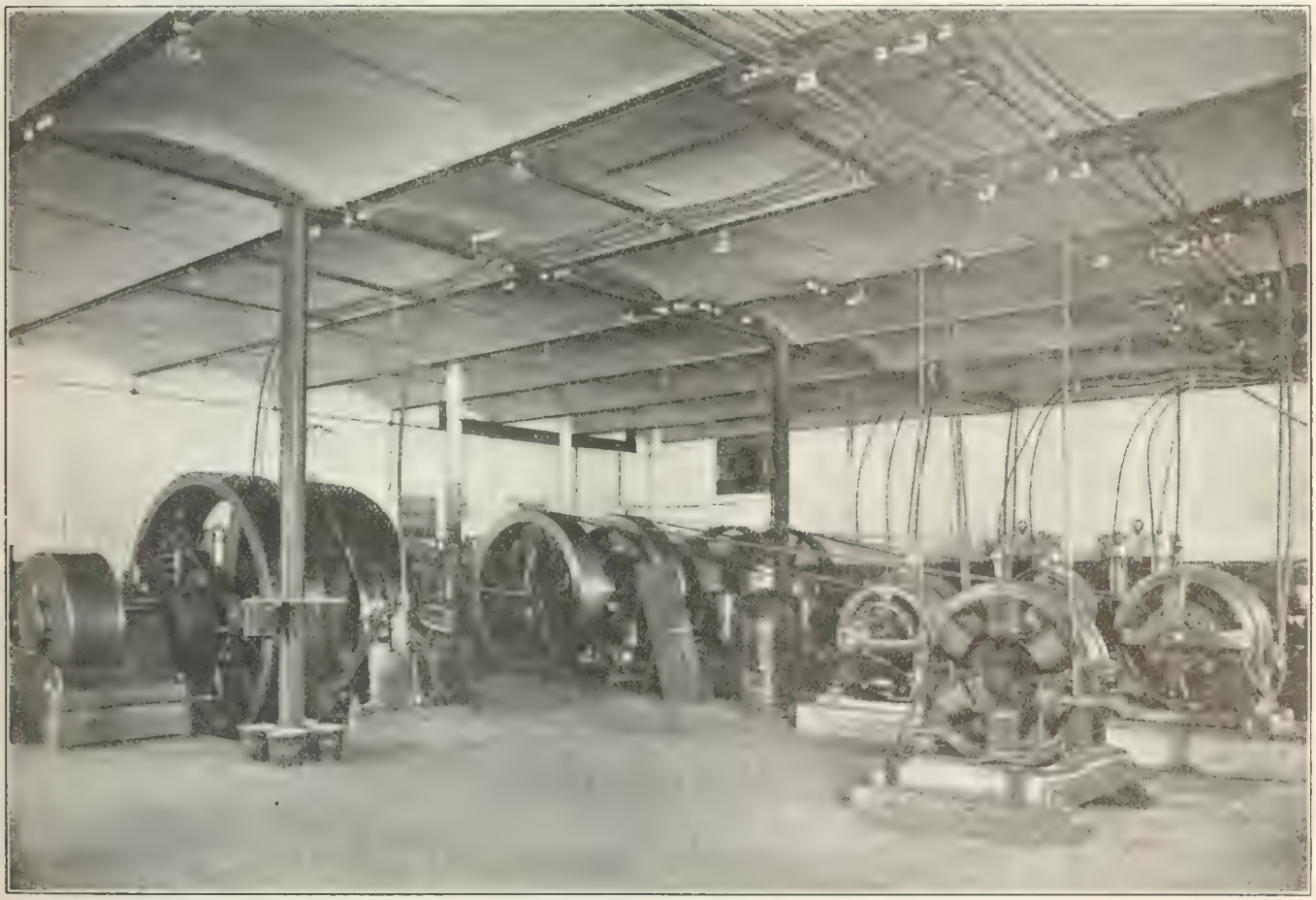


FIG. 1. GENERAL VIEW OF GENERATOR ROOM IN WEST CHESTER STATION

The generating station and office of the company are situated on opposite corners of Walnut and Chestnut streets. The electrical equipment consists of a 160-kw, 250-volt three-wire generator, direct-connected to an Ames Iron Works engine; a 200-kw, 250-volt three-wire generator, direct-connected to a Ball engine; a 120-volt, 45-kw direct-current generator and a 2200-volt, 60-cycle, two-phase alternator belt-driven from an Ames tandem-compound engine, which also drives through belts a Brush arc machine and a 45-kw, 120-volt direct-current generator from the opposite side; another Ames engine drives a 45-kw, direct-current machine and a double-current generator, the tension of the latter on the alternating-current side being stepped up to 2300 volts by means of transformers. Held in reserve are two 60-kw Edison bipolar machines belted to a 150-hp straight-line engine and a 15-kw Edison arc machine driven from a 20-hp motor. The latter unit is used chiefly for testing lamps. A day and a night service are maintained on both the direct-current and alternating-current circuits.

In the boiler-room are four Stirling water-tube boilers, fitted with Murphy stokers for burning bituminous coal. Three of the boilers are rated at 250 hp and one at 200 hp, and all are fitted with Dutch-oven type of furnaces. The ovens at one time extended out from the boilers, but recently two were placed within the boilers and better results are said to be obtained with this arrangement under the conditions of operation which obtain. Feed water is taken from the city mains and passed through meter and feed-water heaters before reaching the boilers. A Cochrane open-type and a Berryman closed-type of feed-water heater are used.

Coal is fed automatically to the boiler furnaces, through conveying machinery built by the Link Belt Engineering Company The railroad cars empty their fuel into a hopper below the tracks, whence it is conveyed to storage bins or to the bunkers above the boilers. Each bunker holds 25 tons, and from it the coal is carried by gravity through chutes to the magazines of the stokers. Storage space is provided in a separate room for 1000 tons of coal, and in order to guard against spontaneous combustion of the fuel, ventilating pipes are spaced 8 ft. center to center. Holes, protected by hoods of cast iron, are drilled in the pipes about 3 ft. apart and the tops of the pipes, which are 2 in. in diameter and of wrought iron, are arranged for attaching a fire hose by means of which the coal pile can be flooded with water should it ignite.

The products of combustion pass off through a 5½-ft. stack 150 ft. high, which furnishes natural draft. The latter is regulated by an automatic draft regulator attached to the dampers. In order to prevent the device from throwing the dampers to the extreme position too rapidly use is made of an ingenious de-

vice. This consists of a chain hung above the weight lever to which a pan is attached. When the lever rises, the pan picks up the links of the chain, thus increasing the counterbalance and causing a slower movement of the dampers, resulting in a smoother action in the furnace. A carbon-dioxide recorder is used for analysing the flue gases. In arranging the blow-offs of the boilers, each boiler is fitted with a Y-valve and an angle valve in series. When blowing down the boilers, the inner valve is opened first and then the outer valve. The latter valve is closed first so as to bring all cutting and wear from wire-drawing on it and thus keep the inner valve tight at all times.



FIG. 2.—VIEW OF OFFICE AND STATION.

The steam piping is arranged so that any boiler can be shut off from the engine side of the dividing wall between the engine and boiler-rooms, and it is possible to repack all valves in the piping system, except four in the exhaust pipe, without shutting down any engine. All the engines or only two can discharge their exhaust into the heating system, an arrangement which permits any back pressure to be carried on the engines needed to supply the heating load in warm weather and which allows the other engines to operate without back pressure. Steam may be fed through reducing valves to the heating mains at times when the exhaust from the engines is insufficient for the heating load. An adjustable back-pressure valve in the exhaust line holds the pressure required to supply steam to the ends of the heating mains. The maximum pressure carried is 5 lb. at the station, and this gives a pressure of about 2½ lb. at the extreme points of the system. An oil separator is inserted between the station exhaust piping and the heating system. The entire underground work for the heating system was installed by the American District Steam Company, of Lockport, N. Y.

For the benefit of those who may not be familiar with the system of this company some data on the piping scheme are given. Wrought-iron pipe is used, and this is insulated against heat losses in a thorough manner. Asbestos paper is first wrapped about the pipe and held in place by spirally wound copper wire. A wooden casing, the inside diameter of which is about 2 in. larger than the outside diameter of the covered pipe, is built around the pipe. The staves of the casing are held tightly by spirally wound galvanized wire bound under tension, and the inside of the casing is lined with bright tin to increase the insulating effect by reflecting the heat from the steam pipes. The outside of the casing has a covering of tar and sawdust to prevent moisture from coming in contact with the wood and wire and in order to draw away seepage and moisture from the heating mains, porous drain tiles are placed in sub-trenches filled with coarse gravel or broken stone. The tiling is connected with the sewerage system.

As a further protection tarred paper is placed on top of the casing to a point below the center line. To allow for expansion in the pipes, a variator is employed. This consists of a cast-iron frame securely anchored to a pier or box holding the outer edge of an annular corrugated copper disk, the inner edge of which is fastened to the free end of the pipe. These devices are placed about 100 ft. apart with an anchorage fitting midway between. The boxes which surround the variators are filled with soft wood shavings. Services to the buildings are taken from the top of the anchorage fittings and the stationary part of the variators at a point above the top of the steam main so as to insure dry steam. The mains are graded to low points so that the water of condensation may be trapped off. The company has 8777 ft. of underground steam mains installed, varying in size from 4 in. to 12 in. From these 230 customers are supplied at a rate of 40 cents per 1000 lb. of condensation as measured by a meter. The greater part of the buildings are equipped with the atmospheric system.

The electrical load comprises about 450 hp in motors of all sizes, 113 street arc lamps, about as many commercial arc lamps, approximately 200 flatirons and a considerable number of fans, sewing-machines, coffee-mills, etc. The company has 600 customers attached to its lighting circuits, and the rates vary from a net 10-cent rate to a 3-cent rate for power. The circuits are all overhead and direct-current and two-phase alternating current are available 24 hours a day. In order to acquire lighting load the company has found it necessary to do wiring, which is charged for at cost. A very complete line of electrical supplies is also carried.

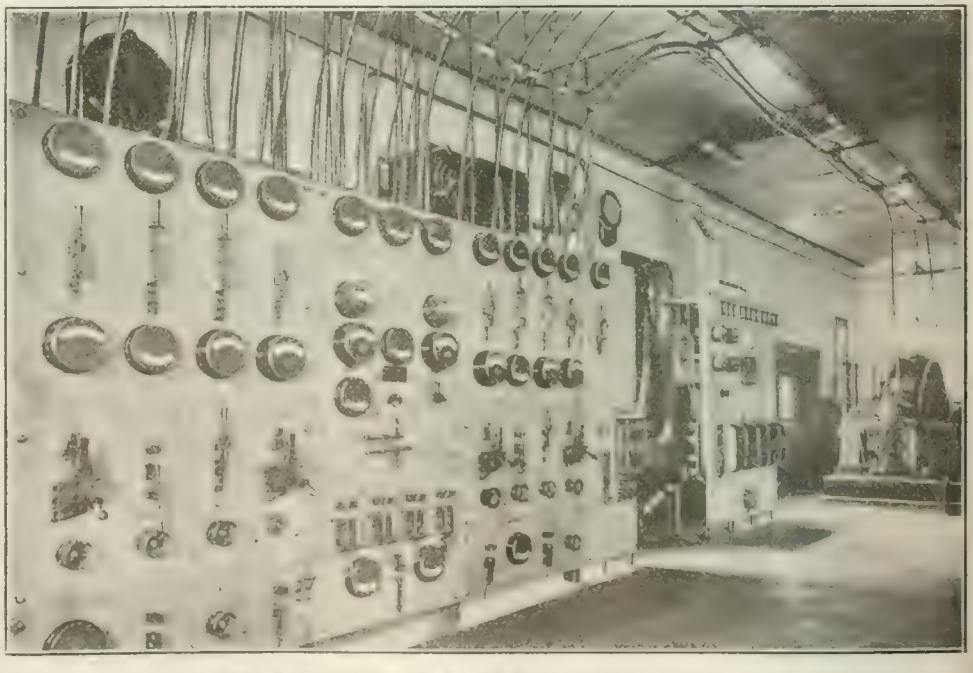


FIG. 3.—SWITCHBOARDS AND THREE-WIRE GENERATOR.

As indicative of the results obtained by the operation of the combination system during the heating season, the following figures showing the cost of fuel, the income from steam heating

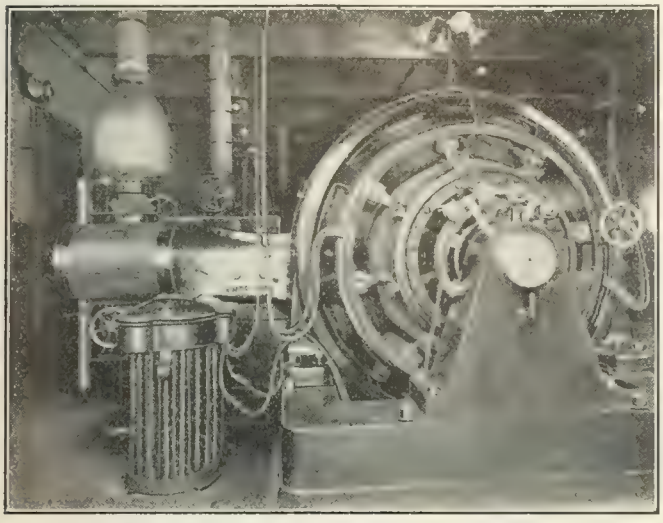


FIG. 4.—THREE-WIRE DIRECT-CONNECTED SET

and the income from electricity are of interest. The figures are for the past season.

	Cost of Fuel.	Income from Heat.	Income from Electricity.
November	$1,209.72	$1,643.28	$4,733.76
December	1,433.57	2,491.83	4,713.33
January	1,465.19	2,350.64	4,262.33
February	1,217.21	2,073.32	4,040.54
March	1,225.34	2,527.72	3,935.77
April	763.55	1,358.22	3,614.64
May	699.94	637.06	3,313.66
Total	$8,014.52	$13,082.07	$28,614.03

The last inventory of the company shows the valuation which it places on its system, as follows:

Generating Plant	$11,636.65
Real Estate	22,610.29
Steam Plant	30,518.48
Street Steam Mains and Services	32,306.52
Steam Meters	2,435.32
Electric Meters and Fans	5,061.00
Electric Distribution System, Including Lamps, etc.	4,821.70

Fortunately, West Chester is very compactly built in the business section, and, like all Edison plants, the station of the lighting company is in the heart of the city. The system of

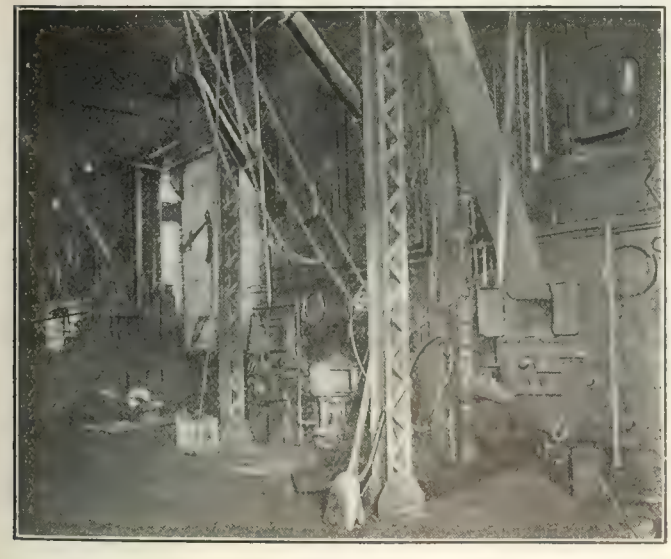


FIG. 5.—BOILER ROOM IN WEST CHESTER STATION.

feeding steam to customers varies somewhat in West Chester from ordinary practice, and the result obtained is said to be very satisfactory. The pipes from the street are raised to the highest point in the basement, where the pressure is reduced by a valve to 5 oz. and held there. Each radiator is equipped with ¾-in. pipe and has an indicating valve at the top. Water radiators are used exclusively, and it is calculated that they give 20 per cent more radiation than those of the ordinary single-pipe system. The valve is fitted with an index which shows whether there is enough steam being admitted to heat one-quarter, one-half or three quarters of the radiator. When the valve is at point 1 the top of the radiator is heated and the water of condensation goes to the bottom of the radiator, where almost all its heat is given up. The pipe from the radiator is connected to a small pipe in the basement which has no connection whatever with the steam pipe, except through a water loop that may drain the steam pipe. From there it is conducted to coils for the purpose of cooling the water condensed in the piping system only. Thence it goes to the meter. This gives the customer the advantage of regulating the amount of steam in the rooms independently to suit outside requirements. At the present time the day load on the electrical system is not sufficient to yield enough exhaust steam from the engines to feed the heating load, so that live steam is used through a reducing valve. Efforts are being made by the manager of the plant, Mr. Pyle, to acquire a greater motor load so that all of the day heating load may be carried with exhaust steam.

The Edison Electric Illuminating Company, of West Chester, is capitalized at $60,000. The officers are as follows: President, Mr. R. T. Cornwall; treasurer, Mr. B. W. Haines; secretary, Mr. J. Rupert, and superintendent, Mr. J. E. Pyle.

Heating Buildings in Groups by Contract in Chicago.

WHILE there is no district heating from central plants, as the term is commonly understood in Chicago, there is a company doing a heating business after a method entirely its own and of considerable interest to central station managers in the larger cities. This is the Illinois Maintenance Company, which has been in existence for seven years, and which takes over existing steam-heating plants in large buildings and supplies steam for heating by contract.

It often happens that when the owner of an office building is considering whether he should use central-station service to secure his electrical energy the question arises as to the heating of the building. The owner or his engineer may argue that the

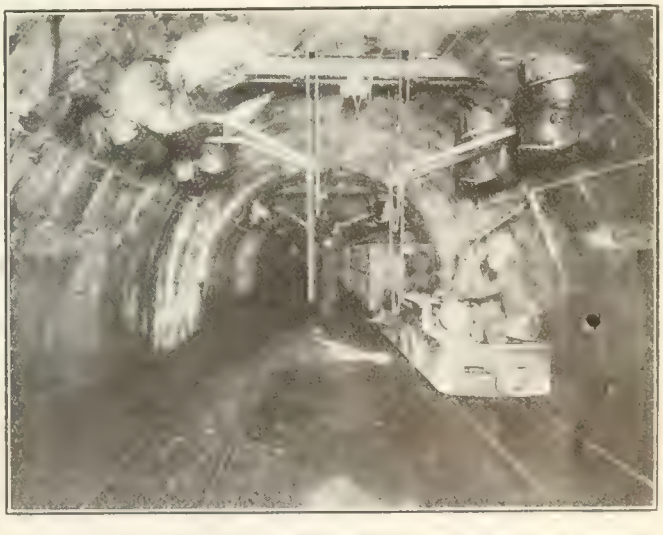


FIG. 1.—DISCHARGING COAL FROM TUNNEL HOPPERS INTO TUNNEL CARS.

building must be heated, and that, therefore, it will pay him to install an isolated plant to produce electricity and use the exhaust steam for heating purposes. At this juncture the Illinois Maintenance Company steps in and says that as it is

profitable for the building owner to use electricity from outside sources, so the heating company, with its facilities for buying coal cheaply and inspecting the operation of numerous heating plants, can effect a saving in the heating end of it by taking over the operation of the boilers and accessories.

The company now heats 30 buildings in Chicago, including such well-known structures as the Railway Exchange, University Club, Merchants' Loan & Trust Building, Cook County Building and Siegel, Cooper & Company's store. Steam-heating

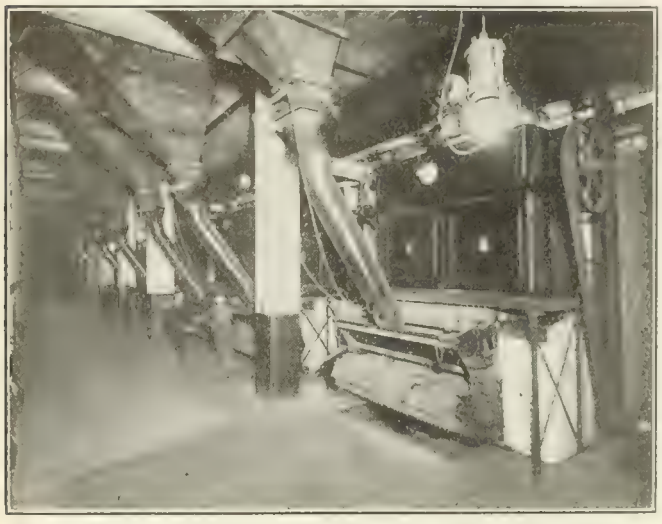


FIG. 2.—BOILER ROOM, COOK COUNTY BUILDING, CHICAGO.

plants are operated in all of the buildings named, but in several cases these plants supply steam to nearby buildings, and the company makes a particular effort to establish groups or centers of buildings heated from one plant. This is often permissible from an existing plant where a portion of the load has been taken off by the substitution of central-station service for the generation of electricity on the premises. In all cases where contracts are closed the privilege of supplying heat to outside buildings is sought.

The Maintenance company buys the coal and water, supplies the labor and operates the plant, charging either a flat price under yearly contract or a flat price per 1000 lb. of steam. Most of the contracts are on the straight yearly plan. The company agrees to furnish at the boiler header from Oct. 1 to May 31 for 18 hours a day or less, the amount of steam necessary for the heating of the building under contract to a temperature of 70 deg. Fahr., and for heating all water for lavatory and scrubbing purposes. It is provided in the contract that the steam furnished by the company shall be sufficient for the purposes mentioned only so far as the adequacy and efficiency of the plant will permit. The company agrees to use its best efforts to avoid violation of the city ordinances in relation to the prevention of smoke, and agrees to indemnify the consumer from all fines and costs levied on him by the city on account of violation of the smoke-prevention ordinances during the life of the contract. The advantage of limiting the contract to the furnishing of steam at the boiler header lies in the elimination of possible misunderstandings. The company does not operate electrical or power plants, nor does it build plants, although its advice is sometimes asked by owners when building heating plants.

Two men are employed as visiting engineers, and they keep a constant supervision of all the plants, hiring the men and buying all the supplies. The visiting engineers and their assistants are held responsible for the successful operation of the plants, and they are given a free hand in employing engineers and firemen.

In estimating the cost of steam for heating a building the company uses a formula based on the heat units of the coal and the radiation from windows and walls, and also from actual experience. This formula is:

$$C = 0.2\,S + e$$

Where C = tons of coal required, S = glass surface plus one-tenth of wall surface (north and west exposures being increased 10 per cent), and e = evaporation per pound of coal. Where an automatically regulated heating system is installed it is customary to figure a reduction of 15 per cent in fuel required.

To determine the amount of steam required for heating water for lavatory and scrubbing purposes an approximate formula is

$$C = \frac{0.01\,A}{e}$$

A being the area of the floor in square feet.

Suitable methods of calculating the steam required by house pumps, hydraulic elevators, steam elevators, boiler-feed and return pumps are also employed, while the company uses occasionally an approximate schedule for estimating the steam required for cooking and laundry purposes.

Practically all of the plants are operated in buildings in the central downtown district, and wherever possible the coal for the plants is brought in through the tunnels of the Illinois Tunnel Company. The coal is bought by the carload direct from Illinois mines, or, in some cases, from the railroads, and it is delivered to the receiving hoppers of the Illinois Tunnel Company. Below the 200-ton receiving hoppers at the surface are the tracks of the Illinois Tunnel Company, as shown in Fig. 1. Each of these hoppers is provided with two chutes with clam-shell openings controlled by levers. In the background in Fig. 1 may be seen an attendant in the act of opening one of these clam-shells in order to deliver coal into the small tunnel cars. These cars are drawn by electric locomotives through the tunnels beneath the streets of Chicago to hoppers at the numerous buildings that require the coal. In the Cook County Building the coal runs from the hoppers through two small gates into a traveling conveyor which, at this point, runs just beneath the floor level. This conveyor carries the coal up and dumps it into the hoppers shown in front of the boilers in Fig. 2. This same conveyor runs along in front of the boilers and can be used to transfer the ashes to a chute, from which they are delivered to the cars and are carried away through the tunnel. The tunnel cars are provided with hinged sides so as to dump the coal easily. When desired the conveyor will deliver ashes to the ash hoist, which is located to the right of the weighing hopper, whence they can be deposited in wagons on the street, 38 ft. above the boiler-room floor of this plant.

In the handsome new University Club, on Michigan Avenue, heated by the Maintenance company, the boiler plant (Fig. 3)

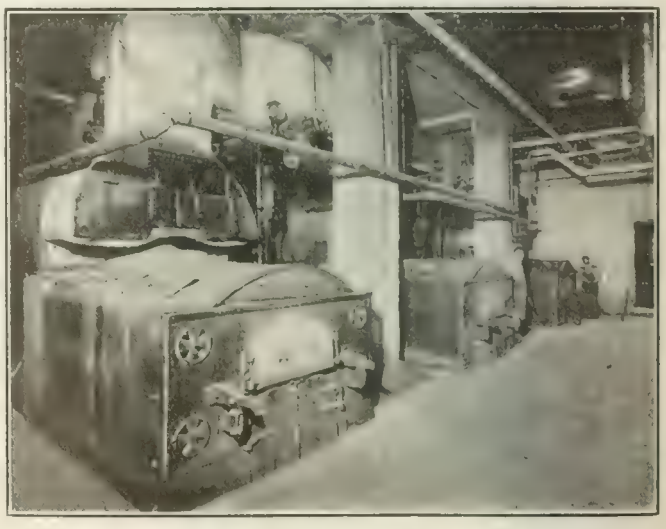


FIG. 3.—BOILER PLANT, UNIVERSITY CLUB, CHICAGO.

is very simple, consisting of three 100-hp Scotch boilers with Burke hand-fired furnaces. No doubt tunnel connections with this building also will be arranged before long. By securing coal through the tunnels the objectionable presence of teams and teamsters in the alleys, with the accompanying dust from

the unloading of coal, is done away with. Furthermore, there is provided a quick and sure method of securing coal directly from the railroad cars without any possibility of interference due to weather conditions or labor troubles on the streets. Coal can be delivered from the railroad bunkers through the tunnels to a building in the "Loop" district on 15 minutes' notice, whereas, with the ordinary wagon service, from two to four hours' notice is required. The company pays much attention to weighing its coal, of course, and has a street scale on Plymouth Court, as well as two scales in the tunnels. These three scales weigh about 1000 tons of coal a day during the busy season. The company also maintains a laboratory for testing coal.

The heating plant in the Railway Exchange, at Michigan Avenue and Jackson Boulevard, is of particular interest because it illustrates the "group" idea, to which the company attaches much importance. It supplies steam for several outside buildings, including Orchestra Hall and the Wellington Hotel. A pipe line has been run, by virtue of a city ordinance, for two blocks in the alley directly west of the building and extending from Adams Street, across Jackson Boulevard to Van Buren Street. In the Railway Exchange there are four 300-hp Babcock & Wilcox boilers equipped with Roney stokers. The steam comes from them at a pressure of 160 lb. and, passing through a reduction valve, is delivered to the pipe line at from 30 lb. to 40 lb. Each building heated has a suitable reduction valve where connection is made with the outside main, so that the steam is delivered to the heating systems of the buildings at the required pressures.

From the plant in the Merchants' Loan & Trust Building steam is furnished to heat not only that building, but four other buildings. Here there are four 100-hp internally fired fire-box locomotive-type of boilers. To insure more complete combustion and to do away with the production of smoke, the engineers of the Illinois Maintenance Company made considerable alterations in this plant. Two of the boilers were turned completely around, making a combustion chamber of the original firebox, and an ordinary type of furnace was installed under what was formerly the rear end of the boiler. In this way the particles of carbon are fully consumed under ordinary circumstances before reaching the boiler tubes, and the plant is operated practically without smoke. Boilers of the original type are held as reserve.

Cordial relations are maintained with the smoke inspection department of the city government. Mr. Paul P. Bird, the smoke inspector, has said that centralized heating will prove to be a great help in the abolition of the smoke nuisance in Chicago, because it will mean larger plants with automatic furnaces and a higher grade of men operating the plant. Furthermore, the number of chimneys will be reduced by the growth of the group system. It is difficult to run small boiler plants, with the grade of firemen usually employed, without producing smoke. In this respect the plants of the Illinois Maintenance Company have an excellent record, and, indeed, it is to their interest not to produce smoke, because they are under contract to pay all fines imposed on account of any negligent operation of the plants under their charge. It may be remarked that the Chicago Smoke Abatement Commission is making an active campaign against the production of smoke. This commission wishes to see a Chicago that will attract women with its cleanliness as it does men by its manufacturing and commercial opportunities. Furthermore, it is desired that people who make their money in Chicago shall live in the city and not move to the suburbs, with a loss, not only of taxes, but of desirable citizenship.

By buying its coal cheaply and by employing exact scientific methods, a heating company can, in many instances, operate a steam-heating plant in a building more cheaply than can the owner. In Chicago the central-station company supplying electricity is not discouraged by the local conditions of any possible user of electrical energy, either on a large or small scale; it goes after them all. Similarly the heating company believes that the time is coming when the scientific operation of heating plants by an outside company will be much more common in the large buildings in cities than it is at present. The business is increasing, and the idea is being taken up in Boston, New York and Philadelphia. Mr. S. Morgan Bushnell is manager of the Illinois Maintenance Company. He has made an exhaustive study of the commercial possibilities of the steam heating of buildings where much original work had to be done in an untrodden field.

Engineering Aspects of District Steam Heating.

By H. C. Eddy.

THAT steam-power plants are essentially uneconomical in the conversion of heat energy contained in fuel (raw material) into mechanical work (finished product) is generally admitted. This condition is not alone confined to plants producing power, but is often found in other manufacturing processes. The more specialized lines of industry have eliminated this inefficiency to a great extent, and with a corresponding increase in profits. Witness the meat-packing plants of to-day, whose dividends are earned from the utilization of what was formerly accounted unavoidable waste.

The manufacture of electricity in a commercial sense has been of relatively recent accomplishment, and notwithstanding the extremely rapid development of electrical apparatus and consequent changes of type, the conversion of mechanical into electrical energy is now accomplished with a degree of efficiency which leaves little to be desired. The conversion of heat energy into mechanical work is, on the contrary, not of recent growth, and the types of apparatus involved are not materially changed from the earlier forms. The conversion of heat energy into mechanical work, too, has progressed but little in efficiency over earlier days, and the attendant waste has been accepted as unavoidable.

Of recent years, however, earnest efforts have been made to utilize in some way and to good purpose these stray heat units. The problem has been approached from many different directions, such as the multiplication of power-producing cylinders in reciprocating engines and the corresponding stages of the steam turbine, heating of feed-water by means of waste steam or stack gases, the application of exhaust turbines operating at low pressure, with or without heat regenerators, and the utilization of exhaust steam for heating purposes. This last-named application is not a particularly new idea. The heating of individual buildings by this method has long been considered sound engineering, but the enlargement of the idea to the point of circulating low-pressure steam over considerable areas has met with opposition from many sources. Some of this opposition has arisen from commercial considerations and some of it from a possibly circumscribed idea of the function of a generating plant.

In designing any plant with a sole view to producing a kw-hour with a minimum of fuel burned, an engineer fails to fulfill his principal obligation to his client, which is so to design a manufacturing process and select the necessary equipment that the greatest possible net revenue will be produced from any given unit of raw material, which in the present case is a ton of coal or its equivalent.

Generally speaking, 80 per cent of the heat contained in steam remains unconverted when exhausted from the engine, and this remaining heat constitutes a potential asset which should not be overlooked. It is in many cases apparently out of the question to apply commercially this source of possible income. That the apparent impossibility is more or less artificially created is also true. It is not unlike the situation where a man deliberately locks himself in a cell and throws away the key, and then complains of lack of liberty. Many electric plants have been so located as to have access to a supply of water for condensing purposes, when the results obtained from condensing are not equal in dollars and cents to even a fraction of the income which would have been produced from the sale of ex-

haust steam for heating from a plant centrally located. Likewise the cost of delivering fuel has often times been given an undeserved importance in determining the location of a generating plant with a consequent loss of much greater opportunity for profit. These conditions, of course, are not always true, but unfortunately they are so common as to call forth serious criticism of the economic waste, and the engineering, or more properly lack of it, which has permitted and still permits them to exist.

In the past the development of district heating was retarded by a lack of knowledge, on the part of those most interested, of the requirements of any given situation, and many plants were unfortunately installed without any better guide in design than pure guesswork. The laws of chance have permitted some of these to be mechanically and financially successful. With the advent of a reasonably accurate meter applied to each customer's installation, it became possible to secure data covering the consumption of steam per unit of space heated under varying conditions of climate and use. With these facts in hand, and a better knowledge of the flow of steam in pipe lines, a very definite and marked advance in engineering design was made, so that at the present time it is possible to design a layout for underground steam distribution under given conditions and to provide for any specified percentage of increase of business which will be so accurate as to impose no undue burden of hazard in the investment required, or uncertainty in the matter of furnishing adequate service.

It does not follow, necessarily, that with an advantageous location of a generating plant, and a properly designed underground system, financial success is assured to the purchaser of a central-heating plant. There are certain elements of varying degrees of importance, but all quite essential, which should have careful consideration, and which should ultimately determine whether an adequate and satisfactory return can be expected from an investment of this character.

These elements may be either debits or credits in the formation of what may, for lack of a better name, be called an engineer's balance sheet. These factors can be determined with such approximate accuracy as to enable the prospective purchaser to form a clear idea as to the extent of the investment necessary to secure the greatest percentage of return. There have been cases of financial failure arising from insufficient investment and vice versa. Each proposition has its local conditions which affect the result and which call for careful and intelligent study.

INVESTMENT FACTORS.

The investment factors referred to in the preceding paragraph are as follows: (1) Geographical or climatic location which will determine generally the quantity of heat required and the length of the heating season. (2) The initial area to be served with heat and the probable additional area which will require heating service subsequent to the first installation. (3) The volume of business. The determination of the ratio of the buildings requiring heat to the total number of buildings in any given area. The character of this business—whether composed of residence or business buildings, or both. (4) The volume of business available per lineal foot of street mains to be installed. (5) The probable extensions required. The location of such extensions, and whether these extensions can be most economically made by providing an excess of steam-carrying capacity in the street mains included in the first installation, or by additional street mains laid direct from the power station. (6) The location of the power station. If the power station is not located adjacent to any heating territory, a determination should be made to ascertain whether it can profitably be removed. (7) Ratio of the capacity of the motive power in the station delivering exhaust steam to heating mains to the same delivering exhaust steam to atmosphere or to a condenser. This ratio is particularly important in condensing plants and in non-condensing plants where there is but little reserve power available in the station beyond the peak-load demands. This factor has to do with the capacity only and not with efficiency. (8) The possibility of providing for winter loads with generating equipment of low cost which will operate efficiently in connection with a heating plant as compared with equipment of much higher initial cost remaining idle during light-load periods.

OPERATING FACTORS.

The operating factors are as follows: (1) Determination of the time or times of maximum demands for heat. The time and extent of peak loads will vary with the class of business served. (2) Determination of the relation of maximum and average demand for steam heating to the maximum and average quantity of exhaust steam available. (3) Determination of approximate average consumption of steam for heating for each month during heating season. (4) Determination of total quantity of steam required to be supplied directly from boilers during the heating season by reason of non-coincidence of heating and power load curves. (5) Determination of approximate boiler load curve with and without heating service. (6) In large cities where more than one power plant is continuously or intermittently operated, it is sometimes possible to secure admirable economy in the operation of auxiliary generating stations in connection with heating installations by reason of the ability to vary the load on such substations so that it will correspond with the demand for heat. It such cases, in the matter of accounting, the electric energy produced at the auxiliary station should be considered as a by-product. (7) Determination of adaptability of existing motive power to changed operating conditions.

GENERAL FACTORS.

The general factors may be summed up as: (1) Rates permissible for steam-heating service, considering local fuel costs plus a charge for desirability of central-station heating service. (2) Probable or possible increase of electric load by the elimination of isolated plants and by reason of power business secured at rates which without steam-heating income would be unprofitable. (3) Determination of cost of furnishing heating service. An apportionment of cost of operation between heating and power. (4) The extent to which heating business should be taken on. This is closely related to some of the factors given in the two preceding paragraphs. (5) Determination of approximate gross and net revenue from sale of steam for heating for one, two and three years after the service is established.

Assuming that the location and conditions, after having been carefully considered, justify an investment in a heating plant, it should not be considered that because of the general popularity of heating service the enterprise may be allowed to run itself, or that it will find its own customers. The advantages of central-station heating service, while generally known, can profitably be brought to the attention of prospective customers by devoting a certain amount of the company's advertising appropriation to this branch of its service. By the exercise of discrimination and tact upon the part of the solicitors and management of the company it will be found possible, in many cases, to add very materially to the connected load through the ability of the company to supply heat. A well-organized and well-operated heating department has great value in insuring freedom from competitive electrical installations. Competitive heating installations of any extent are extremely rare, but three cities being known to the writer where such conditions have existed—or will exist.

Reference has been made in this article to the fact that financial failures of heating plants have been brought about by both too little and too great investment. A certain amount of heating business is required to meet the cost of operation and the fixed charges of such an installation, and it has happened that operators have become timid at the time when they should have become bold and have defeated their own ends by not making extensions of their underground lines which would have been not only very profitable themselves, but would have made the entire installation profitable instead of barely self-supporting. On the other hand, because of the very great popularity of central-heating service, pressure has sometimes been brought to bear upon companies supplying this service which has caused them to make unwise extensions into sparsely settled sections where the load per lineal foot of mains is inadequate to produce

a proper revenue. In a well-designed and well-laid out system of distribution, the efforts of the operating company should be to secure the maximum possible load upon the mains already installed before making any extensive additions thereto for the purpose of securing other business of no more profit than that which already exists upon the lines, but which, for one reason or another, has not been secured.

The extent to which heating business should be taken on has much to do with the ultimate profitableness of the investment. Under certain conditions, live steam-heating plants—that is, those using steam taken direct from the boilers—will be successful, and under certain local conditions it is good business policy to dispose of a considerable quantity of live steam in addition to the available exhaust steam; but these conditions are by no means universally true. It is quite within the power of every plant, at but slight expense, to secure and keep reasonably accurate data as to the cost of steam, and if this record is kept, it is not a difficult matter to determine just how far a company may go in the matter of furnishing heating service, and still maintain a definite ratio of operating expense to gross income.

It may seem absurd, but is nevertheless absolutely true, that in one case a company furnishing steam-heating service informed its customers generally that its rates were quite nominal because the company was utilizing exhaust steam which cost it nothing, and that for that reason no restrictions would be placed upon the use or waste of the steam by the consumer. It is perhaps unnecessary to add that this particular installation was not profitable. Happily, such conditions are being gradually rectified, and the companies now engaged in furnishing heating service are becoming keenly aware of the fact that their rates must be based upon the cost of vaporization of steam at their plants, without reference to whether a portion or all of it is exhaust steam.

It has been held by some companies that they are essentially electric-lighting and power companies, or street-railway companies, as the case may be, and that their functions should be limited to furnishing such service as might be included within their corporate title. But recently these ideas have been subject to some modification. Many of the companies are now endeavoring to fulfill more nearly their general rôle of public-service companies, and to these more progressive and broader-minded corporations, heating service should appeal as being well within the limits of their functions, as well as constituting a most attractve source of income under proper conditions.

Steam-Heating in Connection with Central Stations.

At the recent convention of the Pennsylvania Electrical Association at Eagles Mere, Pa., some interesting facts were given relative to steam heating in connection with central stations in a paper compiled by Messrs. Paul Mueller, Erie, Pa., James E. Pyle, West Chester, Pa., F. M. Noecker, Renovo, Pa. and L. O. Meachan, Scranton, Pa. It was pointed out that in starting a steam-heating system in connection with an electric light plant, a steam-heating company should be organized and merged with the electric light company, so that the right to sell live steam cannot be questioned if live steam is necessary to supply the demand. Thus merged, the company is well equipped to meet competition and to obtain business from office buildings, theatres, apartment houses, hotels, municipal and school buildings, etc., which otherwise could not be prevented from operating or installing isolated plants of their own. The advantages of the central steam-heating plant are obvious. Dwellings are much more desirable and clean; coal and ash carts on the streets are reduced to a minimum, and the smoke nuisance is abated, leaving the community much improved and cleaner than without such a system.

Street installation is quite easy and inexpensive to care for if complete and laid out by careful and experienced engineers. The method of construction of mains accepted as the best practice to-day is to lay the pipe in sections of from 100 ft. to 250 ft. in length. Each section is firmly anchored in the center to substantial brick or concrete foundation. Where two of these sections meet, a joint is effected by the use of a double variator or expansion joint, into each side of which is inserted the end of the sections of pipe extending from the anchorage in the middle. These expansion joints have a slip of from 3 to 4 in. and readily take care of the expansion and contraction of that amount of pipe. The center or stationary part of the expansion joint is also securely anchored, and from the top of this is taken out a service pipe to supply the various customers nearest to that point. Bottom service connection to the expansion joints was an old custom of construction, but has been changed to top connection that drier steam may be obtained and the condensation kept out of the service, which is particularly essential in the case of meter installations. As each length of pipe is threaded on it is wrapped with asbestos paper, and 8-ft. sections of heavy stave pipe, lined with tin and heavily impregnated on the outside with creosote, are slipped over the end onto the iron pipe close up against each other, making a tight joint. This joint is sometimes filled with tar, and is almost always covered over with tar paper to keep out ground moisture. This stave pipe has an inside diameter sufficient to leave a dead-air space of from 1 in. to 2 in. between it and the main, and it is held concentric on the main by guides or runners, some of which, for the larger sizes of pipe, have rollers on them to facilitate the slip of the pipe back and forth as it expands or contracts inside the stationary wood stave insulation. This dead-air space is the most efficient part of the insulation of the pipe. Each expansion joint is housed in with a brick or concrete wall around it, and a relief pipe is carried to the surface of the street. At important junction points, where there may be tee or cross expansion-joint connections, and possibly valves located, a regular manhole is constructed. The work must all be done very carefully to grade so that the whole system will drain its condensation to points where it may be readily trapped off. There must be no low spots without traps, where the condensation will accumulate. The bottom of the trench also requires special attention and should consist of broken stone or coarse gravel in which one or two drain pipes should be laid that the ground around the main shall have a good drainage and be as dry as possible. In some installations an effort has been made to get a return of the trapped condensation to the plant, but the cost of this is prohibitive in anything but a small, very compact system located in close proximity to the plant. At the plant the exhaust steam should be passed through a separator before entering the mains, for the purpose of removing the condensation and oil that passes with it from the engines.

In hilly districts the mains should be carefully trapped at frequent intervals to do away with a downhill rush of condensation, which would fill the services to houses at the foot of the hills with water. Great care must be taken in locating these main traps, or serious difficulty will be encountered with the city, due to the hot water trapped off cracking the sewers. It is therefore essential they should be placed only where there are sewers of sufficient size and flow of sewerage to adequately cool the condensation removed by traps.

Services are usually installed from the mains into buildings at cost. The company usually furnishes at cost the reducing valves, cooling or economy coil, and trap, all of which are necessary. It is always best, particularly in meter installations, to get consumers to install a separator at entrance to keep out any condensation from mains. With separators on all meter customers, there will be much less complaint and adjustment of bills necessary later.

In the opinion of the committee, flat rates should be avoided, and if given at all should apply to office buildings where the maximum demand for heat is for only 12 hours. Rates are based on the total square feet of radiation connected, or else on the cubical space heated. From 30 cents per square foot up for direct radiation and from 40 cents per square foot up for indirect radiation per year are the usual bases for flat rate charge. The differences arising in different localities are due principally to the cost of fuel. Where steam heat is metered the

charge is made at so much per 1000 lb. of water condensed. The rates in Pennsylvania vary from 40 to 75 cents, and a number of companies use a sliding scale rate, notably the Citizens Light, Heat & Power Company, of Johnstown, Pa. This company's basic rate is 40 cents for the first 10,000 lb. of condensation per month, with a reduction of 5 cents for each 10,000 lb. used in addition until 50,000 lb. or more are condensed. The lowest rate is 15 cents per 1000 lb. of condensation.

The opinion of the various companies in Pennsylvania from which information was received is favorable to the use of the condensation meter. The benefit of the change from flat rate to meter basis is best illustrated by a plotted curve of steam consumption of a plant before and after meters are installed. There will be gradual peaks in the morning and evening, and some falling off at night on the flat-rate chart. In comparison with this the same curve with meters will show a marked decrease in total steam consumption with much more frequent peaks. There will be a sharp rise in the morning as people turn on steam to warm the house after it has cooled during the night, and this will gradually fall off by ten o'clock; it will gradually pick up again after three o'clock when the sun goes down and the cold of the evening begins, and from this peak it will fall off rapidly as the steam is shut off before people retire for the night. The meter system at Johnstown, Pa., showed an increase in earnings of 22 per cent, with a 7 per cent decrease in coal consumption. Of the 140 customers at Scranton on whose mains meters were installed last year the earnings per 1000 cu. ft. of space heated were increased from $4.35 to $5.40, and there was also a reduction in the amount of coal consumed.

The successful and most economical operation of a power-house using its exhaust steam for heating is a matter which must be carefully worked out for each individual case, the point aimed at, of course, being to generate both steam and electricity as cheaply as possible. The demand of one must be balanced against the demand of the other and a happy medium arrived at by operating only the equipment best suited to the conditions, with no aid, or as little as possible, from live steam. As an illustration the experience of a certain plant is cited. This station was furnishing, besides electricity, steam for heating purposes. On a winter day, with the thermometer 10 deg. above zero, two engines were running, which, by reason of the electric load, developed 200 hp, and this necessitated the use of a certain amount of live steam to keep the pressure on the steam-heating mains constant. A third engine was started and a portion of the electric load transferred to its generator. Seemingly strange, the pressure at once increased on the steam mains, and one boiler could be shut down. The value of the back pressure load on the engines at Erie, Pa., is rated so high that Mr. Mueller claims that an electric light plant furnishing steam heat can afford, as a matter of economy, to run simple engines belted or direct-connected to the generator, and dissipate or throw away, through the medium of a large rheostat, into a stream of water the electric output of said generator, and use the exhaust steam for heating purposes.

At the same convention Mr. J. W. Reeves, of the Citizens Light, Heat & Power Company, of Johnstown, Pa., in discussing the subject of the value of off-peak business, said that he considered any load that can be obtained which will not be coincident with the evening lighting peak, off-peak business. He said that the additional expense of operating a day circuit is confined chiefly to fuel and labor, and that the real cost of off-peak business is so slight that every customer of this class added results in greater revenue. After showing how his company had increased its output, he gave a brief statement as to the economy and the effect on the load factor of an exhaust-steam-heating plant operating in connection with a central station. Mr. Reeves said that one of the features of particular interest, and one which appears on first thought to the experienced as contrary to natural conditions, is that an increase in output resulting in an increase in exhaust steam utilized in heating, and a reduction in the amount of live steam which would have been otherwise required, decreases the total amount of fuel burned. As a basis for his statement he gave the following data from his station during certain months of the heating season:

Date.	Output kw-hrs.		Fuel consumed, lbs.	
Nov., 1905	297,020		3,222,040	
Nov., 1906	322,[illegible]	Inc. [illegible]%	2,788,500	16% dec.
Dec., 1905	317,888		3,051,010	
Dec., 1906	353,934	Inc. 11%	3,277,080	11% dec.

The boilers in the Johnstown station evaporate from 7 to 8.15 lb. of water per pound of fuel burned. The underground mains comprise about 13,918 lin. ft., exclusive of service pipes, and the district served extends about 3200 ft. from the station. Steam is sold on a sliding scale meter basis, ranging from 40 to 15 cents per 1000 lb. of condensation, and the growth of the heating business has been quite rapid. At the present time the Citizens Company is heating 300 business blocks, residences and buildings, containing about 16,343,830 cu. ft. of space.

Central Station Electric Motor Service.

By Walter Stuart Kelley.

IT is intended to develop in this paper, with as much clearness as space will permit, the underlying principles that should govern the design for an electrical energy distribution system.

Experience with electrical motor service has shown that few motor users appreciate or understand the correct principles upon which the distribution of electrical energy should be based, nor how, nor why it lodges with a central supply station very decided advantages in supplying energy. Nor have central stations—letting that name personify the managing power—had a proper appreciation of their natural supremacy in this field; but somewhat of an awakening to the importance of the situation seems to be in evidence.

The treatment of any topic depends in no small degree on the point of view; not as to facts, but as to their interpretation. This discussion is from the viewpoint of the central station; if this is kept constantly in mind, no misconception of statements will result.

In planning the technical details of any electrical distribution system an engineer must know two things if he would achieve the full measure of success in the operation of the plant—namely, he must know what cannot be done, from a technical standpoint, and he must know what it is not wise to do, from a commercial or business standpoint. Wasteful engineering results from a lack of knowledge on these two points, or from a reckless disregard of it. Instruction and study will give a knowledge of many things that can be done and of ways to do them, but the things that cannot be done are less clearly set forth in writings.

The knowledge required is mainly the result of experience; occasionally it results from especially good engineering sense; the former may be designated as wisdom, the latter as genius.

It is scarcely necessary to say that the ordinary central station must be content to tie up with the former, and is fortunate if it does even that. All of which is summed up in the statement that the more it appreciates the paramount importance of good engineering for its motor service, and, so doing, provides it for its motor users, the more profitable will this branch of the central-station supply business become.

Not a few may find this a new proposition and ask in some surprise, "Should a central station provide competent engineering services for its motor users, present and prospective?" Most assuredly and emphatically, yes. Nor is this proposition in the slightest degree altruistic in its motive; it can be defended from the solid basis of self-interest—dividends.

Central stations cannot afford to develop a crop of dissatisfied and disgruntled motor users because of poor machines installed, or motors ill adapted to the situation, or from a haphazard distribution, or quite likely from a combination of all of them. The average motor user is not sufficiently technical to protect himself from such abuses, and the prospective central station customer will not hire an engineer, arguing to himself

that the engineer's fee represents so much additional investment.

The central station, to protect itself from the disastrous aftereffects of such a situation, must step into the breach and provide engineering that will assure satisfactory service and minimum use of cost for a given output.

The ultimate aim of this, as of other features of the central-station supply business, is dividends, which can only result from doing a profitable business; to this end it is necessary to have satisfied customers who feel that they are getting value received and who at the same time pay a good profit on what they use.

It is necessary at this point to distinguish clearly between the watts really necessary to do a given amount of work and the watts that may be used in doing the same work. For example, a customer of a central station that had retained the writer to put his views on this subject into practice was using a 5-hp motor most of the time for 18 hours a day, where no one machine required as much as 1 hp to drive, and where for considerable intervals the motor had nothing more to do than to turn the shafting. The customer was paying from $18 to $20 per month and grumbling about the size of his bills.

After careful examination of the plant it was evident that energy would be greatly economized by installing three small motors at a total cost of about $125, with which the estimated energy consumption was $6 per month. The party was assured that at an expense of $125 for new motors his bills would not exceed $12 per month; he hesitated about making the additional investment; besides, he was skeptical as to the motive of the central station and seemed to think the scheme was more to sell additional electric motors than anything else.

After many calls and much discussion the following trade was concluded: The central station agreed to install the new motors and to take the customer's old motor at a fair valuation; the net cost to the customer was to be liquidated by his continuing to pay so long as necessary the average monthly bill for the preceding six months.

During the next six months the bill never exceeded $6.00 and frequently the meter reading amounted to less than the minimum charge, namely, $5 per month.

The gain to the central station by the above transaction was three-fold. First, it gained a satisfied customer, always ready to say a good word for electric service, in place of a disgruntled one. Secondly, the energy actually delivered under the new arrangement netted from 20 to 30 per cent more; that is, the customer actually used not over one-fifth of the watt-hours that he did before, but he paid rather more than one-fourth of what he had paid previously. Thirdly, the difference in energy used was saved by the station to sell to someone else, thus by so much deferring investment in new generators.

The first of the three things gained by correct engineering of motor service—and the case is typical—is so important as to warrant some elaboration, with "the satisfied customer" as the topic.

The time has passed when corporations that exploit public utilities can afford to play fast and loose with the public that has granted them the opportunity to do business; indeed, their very existence today depends on giving the public—their customers—the utmost consideration. Dissatisfaction with the service rendered to the public is grist for the agitator's mill. A campaign for a municipal plant will smoulder and go out if it has not the fuel of public dissatisfaction with the service rendered to develop sufficient flame for a very effective movement.

So, too, if there is no dissatisfaction with rates or service there can be no effective appeal to the public service commission for a change in the method of charging or for a reduction in the rates.

Solicitude for the interests of its customers, and that solicitude given practical effect by proper methods and organization, must therefore be a cardinal business principle with corporations or public service companies exploiting public utilities.

The principle applies to lighting as well as to motor service, but in less degree, because with the luxury of electric lighting (except in the case of public lighting) a little difference in cost, more or less, has less effect on the public mind than does high cost of motor service; for on the continuity and cheapness of this depend the business and income of the motor user.

Assuming a maximum charge by meter of 10 cents per kw hour for energy, with discounts as high as 60 per cent or even 70 per cent, or a scale equivalent to this, competent engineering furnished by a central station (without cost) to its customers, which never had been furnished before, would be roughly equivalent to a reduction in the existing rate scale of 20 per cent. Consider the case of a station having an income from motor service of $50,000 a year where no engineering has been furnished, and the different motor installations have been made in the usual haphazard way characteristic of central station customers. If now a competent engineer should plan each of the motor installations connected there would be an average reduction in bills rendered of at least 20 per cent, but owing to the reduction in quantity of energy, the discount in each case would be less than before; therefore, although the gross output would be reduced, the ratio of profit would be increased.

The reduction in bills with competent engineering in place of none would represent among motor users equivalent satisfaction to what would result from a reduction of 20 per cent in rates, whereas there has been no reduction in the rate scheduled, and the customers are paying a higher price per kw-hour.

A reduction of 20 per cent in rates would represent the same reduction in income on the next month's bills, assuming an average net charge of 6 cents per kw-hour, while the cost of competent engineering service ought not to represent over 5 per cent on the net income from motor service. Stated in another way, by introducing a competent engineering service where none existed, a central station having a power income of $50,000 from motor service will distribute $10,000 worth of satisfaction among its motor users for an actual outlay (at the moment) of $2,500, and will get this back as soon as the gross business equals $50,000 again.

"But," remarks some one who does not stop to look beyond his nose, "the result of your engineering, according to your own claim, will effect a reduction of 20 per cent in gross income for motor service." "Yes." "And the engineering will cost another 5 per cent." "Yes." "Then you have in reality reduced your former motor service by 25 per cent." "Not by any manner of means. Oh, no. Not 10 per cent, not even 5 per cent—in all probability, no reduction whatever." "How do you make that out?" "Listen; let us continue our assumption of a central station with a motor service income of $50,000; on Jan. 1, engineering for motor users is introduced, adding a charge of 5 per cent to the motor service. Not the 10 per cent of the customers connected will want to avail themselves immediately of the offer of engineering services; again, the proposition is up against human nature doing business at the same old stand; most of the customers are skeptical; they want to wait and see how it affects the other fellow, and as a consequence not 20 per cent of the old customers have made any change the first year. The new method, however, has stimulated electric motor service business, and new customers have been taken on as fast as the engineering involved could be taken care of. A statement at the end of the year would appear something like this."

Motor service, 1909			$50,000
Increase for 1910		$10,000	
Cost of engineering, 1910	$2,500		
Net loss of energy with old customers, through changes recommended	1,000		
Total cost of change		3,500	
Net increase for 1910			6,500
Motor service 1910			$56,500

Speaking of the rate schedule, some variable discount scale seems to be the only equitable manner of charging for electrical energy supply so long as it is impossible to store electricity;

but the less a rate schedule is presented or discussed in exploiting motor service the better; indeed, it is questionable policy to publish and distribute a schedule of rates. Probably they can not be dispensed with entirely, but with a properly constituted force for handling motor service the necessity for handing out such schedule would rarely arise. It is not the rate that concerns the prospective customer so much as what it will cost him per month or per annum to operate with electric motors; he asks for the rates in order to figure this out; not once in a hundred is he technically competent to apply a schedule of rates correctly, and much harm is done by their being applied incorrectly.

Much argument and evidence is sometimes necessary to disprove an erroneous impression as to the cost of service, because of the rate having been wrongly applied. Rates should be applied to a specific case only by an expert, and after the motor distribution has received due consideration and the time element has been carefully determined.

In exploiting motor service, the equivalent horse-power cost should be ignored so far as possible. The actual horse-power of the motor varies with the load and the rating of the motor may or may not mean anything. Moreover, between brake, indicated and electrical horse-power the average solicitor is at sea.

The solicitor should mention unit costs and unit prices very guardedly, as neither of these concerns the prospective customer particularly; what he needs to know is what the motor service necessary to do his work will cost him. To put this one thing up to a prospective customer correctly—that is, the necessary cost of electric service for his work, and then to carry through the installation and make good on the estimates prepared—is the sum total of the requirements of motor service engineering for a central electrical supply station.

In reality the whole ground has to be covered in arriving at a correct estimate, although details do not require to be worked out as in the case where the installation is to be made.

Where it is absolutely necessary, in order to close a contract that otherwise would be lost, such estimates must be guaranteed; and the work of preparing an estimate should be done with sufficient thoroughness and care to justify a guarantee. Guarantee estimates should be given only where necessary to save a contract, for otherwise it is an unnecessary responsibility and consequent strain on the engineer.

The writer recalls a typical case that will serve to illustrate this feature. A manufacturer whose product required the operation of machinery for working both wood and iron, and who depended for service upon an adjoining steam plant, decided to put up a building for himself and move his plant. When the central station became aware of the proposed move the man was on the point of buying a gas engine. When approached he admitted that electric service would probably be cheaper for him than steam, but had made up his mind that on the score of cost electric motor service was not equal to service with a gas engine.

He consented reluctantly to postpone the purchase of a gas engine until estimates could be made and a proposition submitted.

The distribution system was carefully laid out for 13 motors combining individual and group drive, the largest single motor being a 5-hp machine. The estimated average cost of energy was $50 per month.

To secure the man's signature to a contract the central station agreed to install the plant (electric) complete, let him use it for one year, and if at the end of the year he was not satisfied with the service and with its cost, it—the central station—would remove the motors and the wiring, without expense to him for installation, for motors or for their removal. The cost of the motor plant installed was about $2,000, of which one-half would be sacrificed if the motors had to be removed. At the end of six months' operation the plant was accepted and paid for.

The bills rendered, based on the published discount scale, during that time averaged $47.76 per month. The average price per kw-hour was about 5.25 cents.

If the central station had not been willing to show confidence in the estimate, as made by the engineer, it would not have obtained the business; and if the distribution system and the character of the individual motors had not been such as to turn out the product with the minimum use of energy—the shafting even was put up with roller bearings—the cost of energy would have overrun the estimate guaranteed, which would have been far more disastrous than losing the coveted contract.

A troublesome bogey of the electrical supply business, and one growing like the beanstalk of nursery fame, is the competition of internal combustion engines. The incident just related will go far to substantiate the statement that the most effectual way to forestall such competition is for the central station to assume the responsibility of laying out the motor distribution systems for customers, so as to assure minimum cost of energy for any given service or product. Were there not other equally weighty reasons this alone would warrant the inauguration of such engineering service by central electrical supply stations.

The incident above serves also to show the fallacy of the argument that occasionally encumbers the columns of the technical press on individual versus group drive; it is of about as much moment as the old theological controversy as to how many devils could dance on the point of a pin.

As a matter of fact, there can be no general argument for or against one as regards the other, any more than there can be between steam and water power. The character of the situation in each case should afford ample evidence to decide which is the better to use. Group drive will best fulfill requirements with one set of conditions and individual drive will prove to be preferable under certain other conditions. It is not a situation that can be compassed by specific rules, but certain principles properly brought to bear will afford a key to the solution of any combination of conditions.

The determining principle in almost every case will be to develop a distribution system and application of motors that will turn out a certain product with the least number of kw-hours through the meter; or that will turn out the maximum product of which the machinery is capable. In one case the basis of the engineering plan is efficiency, in the other, product; in the former case a careful study of partial, quite as much as of full load, conditions is required.

In any shop with a number of motors run intermittently the running load factor—that is, the ratio of the power developed to the motor rating in operation during any given period while the latter remains constant—may be high, although the load factor of the shop may be quite low. It is quite essential to distinguish carefully between efficiency, load factor and running load factor.

The primary object of the engineer in planning any motor distribution system is to have the running load factor maintained at the highest possible point.

The conditions in one case may dictate that the lines of effort shall concentrate on high efficiency, in another on maximum output; properly executed effort in either case will result in a high running load factor.

The engineer must not lose sight of the fact that in the last analysis his work will be judged by manufacturing cost, and that technology must bow to "horse sense." Furthermore, the engineer must approach every installation with an absolutely open mind. While knowing so far as possible the characteristic features of different makes of machinery, he can have no favorites; specifications must be prepared with an eye single to operative results, not to favor some particular make of machine. Theories and technical prejudices must be barred out. Hard facts as disclosed by study of each particular case should determine the principle of development which must be followed in that instance.

In so far as the principles of technology, business and ethics herein enunciated for the handling of central-station electric motor service are departed from or transgressed, just so far will results fall short of what on the average it is quite possible to attain.

Gas Engine Driven Electric Plants Versus Electric Motors Fed from Central Stations.

By R. D. Donaldson.

THE argument presented herein is on the costs, reliability and general running conditions of small gas engines generating electricity for manufacturing purposes versus the purchase of the necessary electrical energy from a central station. The figures given on gas-engine performance are not the results that can be obtained under best conditions and expert care, but those obtained in practice in the majority of cases to-day, where the care given the gas engine may not be all that it should be, but is such as is usually accorded it.

The comparison is based on the operation of a printing establishment which requires 23 hp in motors. The load conditions of this installation, which, at the present time, is fed from 220-volt, direct-current, central-station mains, are known very accurately. Table I gives the energy consumption per month

TABLE I.—ACTUAL ENERGY CONSUMPTION FOR EIGHT MONTHS.

Month.	Kw-hours.	Equiv. hp-hours.	Bill.
August	630	845	$37.85
September	884	1,185	53.04
October	1,374	1,845	78.74
November	1,342	1,800	77.12
December	1,184	1,590	69.22
January	1,233	1,655	71.68
February	1,250	1,675	72.54
March	1,261	1,690	73.08

for eight months and the cost of that energy at motor rates. Table II gives the rating of the different motors, the machines driven, the hours operated per day and the percentage of the average actual load on the individual motors to their rated output. Table III gives the actual hp-hours consumed by the motors per day.

TABLE II.—PRESENT INSTALLATION.

Percentage of actual load to rated load.	Horse-power in motors.	Machines driven.	Average hours use per day.
70	1—5 hp	Line shaft (6 Gordons and 1 Cutter)	7 hours
65	2—5-hp	2 Babcock Optimus No. 7	4 hours
55	1—3-hp	Pony Press	4 hours
50	1—2-hp	2 Wire Binding Machines	3 hours
90	1—2-hp	Pony Press	1 hour
70	1—1-hp	Folder	3 hours

The energy consumed in an average day is 64 hp-hours, or 47.7 kw-hours, which for 26 days a month equals 1240 kw-hours per month. The total maximum demand of the installation is 23 hp, or 17.5 kw. In figuring the cost of gas engines the following expenses must be taken into account: (a) Interest on plant; (b) depreciation of plant and building; (c) insurance; (d) fuel cost; (e) cost of cooling water; (f) lubricating oil and waste; (g) attendance; and (h) maintenance and repairs.

TABLE III.—DAILY ENERGY CONSUMPTION.

Actual load.				Time.		Hp-hours.
.70	× 5 hp	= 3.5	×	7 hours	=	24.5
.65	× 10 hp	= 6.5	×	4 hours	=	26.0
.55	× 3 hp	= 1.65	×	4 hours	=	6.6
.50	× 2 hp	= 1.	×	3 hours	=	3.0
.90	× 2 hp	= 1.8	×	1 hour	=	1.8
.70	× 1 hp.	= .7	×	3 hours	=	2.1
Total						64 hp-hours

If a private plant were installed, allowing a small increase in installation, a generating unit rated at 20 kw would have to be used. To run this generator a gas engine of 40 hp rating would have to be used, and for this size gas-engine plant the cost of engine with generator would be $65 per horse-power, everything installed, and for the installation as suggested the cost would be $2,600. On such a plant the fixed charges would be as follows:

Interest on plant 5 per cent (.05 × 2600)	$130.00
Depreciation on plant 12½ per cent	325.00
Insurance 2 per cent	52.00
Per year	$507.00

The fuel consumption per hp-hour varies with the load. Under usual conditions the rate for a gas engine of the size under consideration, using illuminating gas having a heat value of 630 b.t.u., would be 24 cu. ft. of gas per hp-hour at full load. This increases as the load decreases, so that at 0.2 of full load the fuel consumption is 2.5 greater than this. The following table shows how great is the increase in fuel consumption per horse-power as load decreases:

	Max. load.	Variation of fuel consumption with load: .9	.8	.7	.6	.5	.4	.3	.2	.1
Gas engine.										
Hit and miss regulation	1	1.03	1.08	1.14	1.23	1.35	1.50	1.8	2.5	3.0
Throttling regulation	1	1.06	1.13	1.21	1.33	1.50	1.75	2.2	3.0	5.0

The motor installation requires an average of 64 hp-hours per day in an eight-hour day. This gives an average load of 8 hp all day, but from careful analysis of the load conditions by figuring on 75 per cent of the maximum load part of the day and 20 per cent part of the day and averaging the two rates gives the fair average rate per hp-hour. At 20 per cent of the rated load the fuel consumption is 2.5 times that of the normal load rate, or $2.5 \times 24 = 60$ cu. ft. per hp-hour. At 75 per cent of normal load the fuel consumption is $24 \times 1.11 = 26.4$ cu. ft. per hp-hour. By averaging the two readings, the consumption is found to be 43.2 cu. ft. per hp-hour.

It was shown that the energy consumed per month was 1240 kw-hours, or 1660 hp-hours. With a consumption of 43.2 cu. ft. of gas per hp-hour, the monthly consumption is 71,712 cu. ft., which with gas at $1 per 1000 cu. ft. will cost $71.71. The approximate quantity of cooling water required may be ascertained from the following: Figuring on 1 hp and assuming an engine efficiency of 20 per cent at the cylinder, $2545 \div 0.20 = 12{,}725$ b.t.u. per hp-hour are required. The jacket loss approximates about 40 per cent of the heat expended, or the cooling water must carry off $0.40 \times 12{,}725 = 5090$ b.t.u. per hour. Assuming the inlet temperature 70 deg., the outlet at 150 deg., the number of pounds of water required is $5090 \div (150 - 70) = 64$ lb. per hp-hour. The amount of cooling water is practically independent of the load, so that the rated capacity of the engine should be taken in computing this. 40×200 (hours per month) $= 8000$ hp-hours. 8000 (hp-hours per month) $\times 64 = 512{,}000$ lb. per month. 512,000 lb. $= 8200$ cu. ft. (1 cu. ft. $= 62.4$ lb.) at 3 cents per 100 cu. ft. $8200 \div 100 \times 0.03 = \$2.50$ per month.

A gas engine running light takes nearly the same amount of oil as when loaded, so a 40-hp engine running 200 hours per month, or 8000 hp-hours, will at the usual rate of 0.008 pint of lubricating oil per hp-hour require $8000 \times 0.008 = 64$ pints, or 8 gal. of oil. If this costs 30 cents per gallon, the cost $= 8 \times 0.30 = \$2.40$ per month for oil and an allowance of $1 per month should be made for cotton waste.

In the matter of attendance half of one man's time at $60 per month should be charged to this engine, or $30, and the maintenance at 5 per cent per year on $2,600, the price of engine and generator, etc., is $130 per annum, or $10.80 per month. Inasmuch as this installation would take up a space approximately 10 ft. × 15 ft. = 150 sq. ft., and supposing that 3000 sq. ft. of floor space rents for $500 a year, the rental to be charged for the space is $150 \div 3000 \times \$500 = \$25$ a year, or approximately $2 per month. This brings the total cost per month as follows:

Due to fixed charges	$42.25
Fuel	71.71
Water	2.50
Oil and waste	3.40
Attendance	30.00
Maintenance	10.80
Rent	2.00
Total cost per month by gas engine	$162.66

The cost of energy for this installation from the central station, 1240 kw-hours per month, is as follows:

1,000 kw-hours, at 6 cents	$60.00
240 kw-hours, at 5 cents	12.00
Total	$72.00

This gives a saving per month of $90.66, or a yearly saving of $1,087.92.

The above figures show a saving of approximately $1,100 per year by the use of central-station energy over a gas-engine-driven generating plant. These figures have not included "outage," which is a large item in itself. With such a generating plant, not duplicated, the number of hours in a year during which the plant would be shut down would mean a large loss to the company. Thirty hours "outage" per year would be a

conservative estimate, and if 12 men are employed at 50 cents an hour, the loss would amount to $12 \times 0.50 \times 30 = \$180$ in labor alone. The loss in time during a busy season would perhaps be double this. Besides the money considerations that can be figured on there are several items which must be considered.

The installation of a gas engine always means a considerably higher fire risk. Motors and wiring which pass the Fire Underwriters' inspection will practically never be the cause of fire, while no matter how close is the inspection on the gas engine and apparatus, the fire risk is large and increases as the engine and apparatus become worn. Morever, odor and vibration nearly entirely belong to the gas engine.

Economically a gas engine is built for its rated load. The overload capacity of such an engine is very small; when that point is reached the engine stalls. When run underloaded the efficiency is poor. By breaking up the total power requirements into two or more units the initial cost is increased greatly and the operating expense is also increased. With a proper arrangement of motors the same efficiency is maintained no matter what part of the total load is carried when fed from central-station mains.

The excessive strain on a gas engine, combined with the many and delicate parts, makes such an apparatus impossible to run continuously. The overhauling necessary may extend into the hours when the engine is needed. Such occurrences make the ease of starting and operation of the central station fed motors very pronounced. An interesting item in connection with a discussion on gas engines and motors is the fact that the gas engines have some 80 parts and the direct-current motor 15. More parts always mean more trouble.

Transmission and Maintenance of Electric Service for Industrial Plants.

By C. T. Maynard.

THERE are many conditions to be met around industrial plants driven by electricity that make engineering for such a plant different in a great many respects from that for a power, lighting or railway company. Consequently the plant engineer does not necessarily follow the methods that the public-service man does to get just as satisfactory results. The latter has more obstacles to overcome than the former in his work of maintenance, but the plant engineer has, if the plant is a few years old, a great many different kinds of apparatus and installations which he must not only maintain, but operate well and economically, for owners of central stations are much more willing to invest in improved electrical apparatus than are owners of plants that manufacture some other product than electric power.

In an industrial plant, naturally, the first point to be considered is the source of power. This source may be steam, gas, water, water with steam auxiliary, or some power company's lines. Water-power with steam auxiliary will be discussed in the present article, with special reference to mill and shop work.

Many industrial plants are the outgrowth of several small plants combined, each of which has its own power plant and when united are supplied with power from a main plant. If the main station is of the water-power type, the several small engines are used as auxiliaries during the low-water period, or a large engine that formerly drove a group of mills may be connected to a generator for the same purpose. In any case it is unfortunate for an industrial plant to be encumbered with a lot of small, inefficient steam plants. It is not a condition for which the owners are to blame, as these plants were very serviceable in the early days when they had constant care and attendance. The equipment remains, and as only a few weeks' or months' run on them is necessary during the year, it seems inadvisable to scrap them or sell them for a mere nominal sum. The usual result is that the plants may lay idle nine months or perhaps the whole year if the season has been wet. During this time it is not practical to keep a regular engineer and fireman, so when the water-power begins to give out suddenly, and the plant is in danger of shut down, the mill foreman rushes out and gets a mill mechanic to start up the steam equipment with the assistance of ordinary laborers as firemen. This unfortunate state of affairs exists in many large industrial plants. The only remedy seems to be to wait until depreciation and breakage are so rapid that the owners will consent to build an auxiliary plant near the main generating station, where it will always have first-class care and attendance. Once the plant has its main station, the engineer's efforts can be directed with much better results. In the case of the many small plants, the attendants are usually under the shop or mill foreman, while in the central plant, where the engineer has direct charge, the discipline is better, and the whole system runs smoother, more economically and in every way more satisfactory. After the engineer has his main generating station equipped and running well it devolves on him to keep it so, and the following suggestions may be of service:

Unless the plant is a very large one, the 24 hours' run will be divided into two shifts, the change taking place at 6 or 7 in the morning and evening. This enables the engineer to give orders and talk over conditions early in the evening with the shift foreman who is to be on all night. In some places the shifts change at midnight and noon. This works out very unsatisfactorily in practice. It is usually the case that the men on the two shifts clash as to the amount of cleaning and repairs to be done. This can be stopped by allotting all cleaning and repairs to be done for one calendar month, to one shift. Then the first man on the shift is personally responsible for the maintenance of the power house during his month, and if there is evidence of carelessness at any time the engineer knows at once whom to blame. Furthermore, if the men have any pride each will try to have the power house look its best on his shift of cleaning.

A record of readings and events that occur each day should be kept, and these reports should be filed at the office. A station log book should be written up each day giving all events of the slightest importance, and a receipt book should show the date of receiving all supplies. These records allow the engineer to see how the plant has been running at any time. The engineer should occasionally perform the various operating functions about the plant. This will keep him well posted and win him the respect of the power-house operators. If a spare unit is available, occasional drills in starting up, phasing in, cutting out and shutting down, under the engineer's eye, should take place, and by this method the second man can soon be taught to take the first man's place should the latter in any way become incapacitated. Operators should be encouraged to study the theory of electricity and mechanics, and should thoroughly understand the station wiring.

Next in order comes the means of transmitting the electrical energy from the station after its generation, and the kind of current and voltage is naturally thought of first. The matter of using alternating or direct current is a problem that local conditions largely govern. Each system has some advantages over the other; but for a large system with lines scattered over an area of several miles it is undoubtedly best to use alternating current exclusively, even if direct-current motors are more desirable for traveling cranes, etc.

For distributing energy to mill and shop motors and running lines through yards scattered with derrick guys, buildings, etc., the limiting tension seems to be 500 volts. Three-phase, 440 volts, makes a very satisfactory system. To go below this voltage means much heavier lines and to go higher means danger to life. Where direct current is to be used 250 volts work out very well for crane service. The use of either of the above two voltages and systems means much heavy wiring in a plant having several hundred or more horsepower in motors, and consequently there must be a great deal of heavy line construction. Copper is generally used around such plants, but aluminum can be used to good advantage where the pole line is already heavily loaded. However, stringing copper is better understood and for various reasons

copper seems to be the proper metal to use for most work. Strain insulators are much used for dead ends and right angle turns, and are the best that are offered for this class of work. For straight line work the saddle or cable type insulator is much better than those that require the wire to be tied at the side, although these should be used at turns and for No. 1 wire and under.

The metal fittings, such as bolts, lag screws and braces should always be galvanized, as the cost is but slightly greater. Wood cross-arm pins are not expensive, and the very best locust should be specified. In buying cross-arms it is best to purchase unpainted and untreated arms, so that the buyer is able to tell what kind of wood his arms are made of. After inspection the arms should be painted or treated. Creosoted arms oftentimes split and show a lack of strength. Such arms should never be used where the continual dripping of the creosote will injure or spot white stone work and buildings. In damp, steamy places, such as quarries, where the strain of the wire is not great, creosoted arms are the best kind to use.

The subject of poles is common to all electrical transmission work, and is not discussed in this article except as they are especially used in industrial work. Junction poles, poles in important lines and large transformer poles should be filled around the butt with concrete reinforced by short pieces of guy wire. Poles that have been set some time can be strengthened and their lives extended by digging down about 18 in. around the butt and filling up with reinforced concrete, bringing the concrete above the ground level, and tapering up to the pole. A circular wood form made in two halves about 2 ft. long can be used for this purpose. Before filling in the concrete all rot and dirt should be removed from the pole that is to be in contact with the concrete. Lag screws partly driven around the butt before filling in makes the job even better.

For guying poles stranded galvanized guy wire is the best, especially for head guys. Solid guys may be used for side guys where a break is not of any great importance. The spacing of pins on cross-arms is often greater than necessary. The cross-arms should be as short as is practical for any given number of pins. Small wires and high-tension wires should always be placed on the top arm, with the largest conductors on the lowest arm. As a general rule arms should not carry more than six pins, and if it is necessary to do so two poles should be set a few feet apart with the cross-arms supported by both poles. All junction poles should be equipped with pole steps, so that the continual climbing by the lineman will not badly cut up the pole with spur marks.

One of the most common errors in heavy line construction is in the method of dead ending wires. Many linemen take a 2/0 or 4/0 solid weather-proof wire and after turning it around the glass insulator or strain insulator eye, wrap it several times around itself. Anyone who has seen a 4/0 wire dead ended in this way realizes the great amount of hard work necessary to do a fair job. When the job is done that part of the wire in the turns is useless if ever taken down, as the insulation and wire are badly bruised by the hammering and twisting. A better and quicker way, and one that works very successfully, consists in taking up the wire with tackle blocks in the usual manner, turning it around the insulator or eye, and after doubling it back on itself clamp it with one or two galvanized Crosby clips. Practice has demonstrated that this method is the best in every respect.

Quarry wiring is not often to be considered, but what applies to a quarry applies also to any work around damp, steamy places. The maximum safe voltage seems to be 250 volts, excepting transformer primaries which are well put up. Cross-arms can easily be fastened to stone, brick or concrete walls by means of lag screws, which are screwed in expansion shields placed in a hole drilled in the wall. Of necessity, primaries for lighting transformers must be run on the same poles as the lines supplying the motors, and the generator voltage of 460 to 480 will answer very well for transformers stepping down to 220 and 110, three-wire, with the neutral grounded, for shop and mill lighting. A system such as this can be worked on by linemen at all times without danger.

The interior wiring of an industrial plant should be put up in the best of shape even in buildings that are not insured. Every wire should be fastened mechanically as strong as possible, because as a rule there are a great many workmen around wires and motors that know nothing of electrical work, and in the performance of their own duties are apt to tear down wires that are not up in good shape. Many mills and shops have conduit wiring, but if the wires have a suitable rubber covering, are put up well and have a pressure not exceeding 500 volts, it seems unnecessary to put wires in conduit except in places where they are exposed to acids, etc. Open wiring is always the easiest to inspect and keep up in repair. All motors should be protected by lightning arresters and fuses or circuit-breakers. The motors should be inspected and cleaned once a week, and special attention should be paid to keeping the lightning arresters free from pits and dirt, and looking them over after each lightning storm. The question as to whether to install a fuse or circuit-breaker is a perplexing one. Neither is fool-proof and both have their advantages For large motors circuit-breakers should always be used, but for small motors up to 50 hp the fuse protection generally gives satisfaction. Near each motor a card should be placed with blank spaces to be signed by the motor inspector on his weekly trips. This enables the engineer to note at a glance when the motor was last cleaned and oiled, and its present condition.

No very large industrial plant is complete without its repair shop. There should be a competent head repair man who is a generally handy man. He must be able to rewind any armature in the plant and repair any of the many damages that occur on motors, transformers, generators or apparatus that is part of the electric equipment. Having acquired the handy man, it is necessary to fit him with a shop and tools to work with. Almost every plant has its machine shop and store house, and these are usually near together. The electric repair shop should be near both. The repair man can then easily get his supplies from the store house and his help from the machine shop. He should have a large work bench, a lathe, wood horses to rest his armatures in, a large baking oven, some kind of small overhead crane and all the small tools that can be used in repair work. Energy should be available for testing every motor and lamp in the plant. Instruments should be accessible, and above all a testing set and Wheatstone bridge are very necessary. A very good baking oven that will take any armature up to about 75 hp can be built for about $20.

Such an oven may be built of sheet iron 2 ft. 2 in. wide, 3 ft high and 5 ft. long. The top is made of two single sheet-iron covers sliding together and the sides and bottom are double with a sheeting of ⅛-in. asbestos between the two iron walls The bottom has cross stays of heavy wrought iron, and there are six heavy castors in these iron stays raising the oven 6 in from the floor. To heat this oven six porcelain tubes 18 in. long and 1½ in. outside diameter, covered with two layers of thin sheet abestos, and each wound with about 40 ft. of No. 22 German-silver wire, should be used. The ends of the wire should be securely fastened by passing them through small holes in the porcelain tube, and then knotting them back on themselves. Through each tube a long rod is passed, and on each end of the rod, which had been threaded a few inches on each end, a washer, nut and set nut are placed. These six rods may then be bolted to an iron frame to raise the heating coils 1 in. from the bottom. These coils should be connected in series for 110 volts and arranged in three pairs, so that three heats are available. Three indicating snap switches should be placed on the end of the oven. A maximum heat of 200 deg. Fahr. is available. A few ½-in. holes should be bored in the bottom of the oven to permit the entrance of air and the covers at the top can be opened any amount to allow the fumes to pass off. Two wrought-iron horses in the oven allow any armature to be revolved and carried with its shaft 1½ ft. from the bottom. An oven of this type has been used very successfully

for baking armatures and coils. The maximum consumption is 1500 watts.

To carry on repairs a stock of various tapes, compounds, binding wire, magnet wires, fibers, etc., must be carried. Of course the size of the repair shop depends a great deal on the size of the plant, and for very small plants repairs that cannot be done by a fair machinist should be done at some regular electrical repair shop, because the amount of electrical repair work will not warrant keeping up a regular repair shop. There are a few other points in connection with an industrial plant that deserve mention. In buying electrical apparatus an effort should be made to use duplicate units as far as possible. Parallel feeders should be on separate pole lines. This can be done with no added expense, because there are usually enough wires to load one pole line, and instead of putting all 220-volt, direct-current lines on one pole and all 440-volt, alternating-current on another pole, the circuits should be arranged so that each pole will have 220-volt direct-current and 440-volt alternating-current lines.

As a constant check on the condition of the equipment, the electrical engineer should personally inspect, twice a year, all the inside and outside lines, the apparatus and details of the whole system. He should take, or have taken, voltage readings at different points to be sure that there is no excessive drop of the feeders. After making his inspection all the improvements and repairs to be done should be tabulated and given to the different head wiremen, who should check off each job as it is done, and when all are completed return the list to the engineer, so that he may in turn check up the repair work. As a further assurance of maintenance, the different wiremen should be worked at different times on all the parts of the system so that if emergency demands all the force at one point, the men from the other section, being somewhat familiar with the entire system, can work much more rapidly than if they were strangers to that particular branch of the plant. The engineer should keep a general information book on rating of different motors, location and size of lines, power taken by different motors, and in fact everything pertaining to the system. This will greatly assist others in doing his work should the engineer be absent. Lack of continuity of service will quickly bring down the wrath of shop and mill superintendents who hardly think of the electric service until it is held up, so that the industrial plant engineer's motto should be "uninterrupted service."

Experimental Method of Adjusting Interpole Windings.

By Howard M. Nichols.

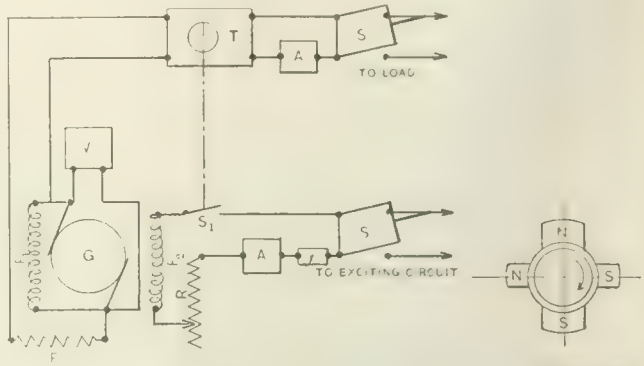
WHEN designing interpoles for a new line of motors or generators the best method of procedure is to calculate approximately the flux that the interpoles will be required to furnish and to postpone designing the interpole winding until the first machine has been built and tested. With a new line of machines it is difficult to calculate with any degree of accuracy, the number of turns required by the interpole coils; in fact, there will be considerable variation in the number of turns required by individual machines all of the same design, due to differences in the iron, air-gap, etc.

The interpole cores and the winding spaces should be designed with a good margin over the values called for by the rough calculation, and when the first machine is being assembled it should have temporary windings, of small-sized wire, placed on the interpole spools. This winding should be designed so that it can be separately excited at whatever voltage is available in the test room. There should be the same number of turns on each spool, and all the spools should be connected in series so as to insure having the same number of ampere-turns at each interpole.

After assembling, the machine should be connected to run as a generator according to the diagram of Fig. 1, and a test should be run from no load to 25 per cent overload.

In the diagram of connections, G is the generator armature, F is series-field coil, F_1 is shunt-field coil, F_2 is temporary interpole-field coil, f is a fuse, S is a double-pole knife switch, S_1 is a single-pole knife switch, T is a circuit-breaker, A is an ammeter, and V is a voltmeter.

The single-pole knife switch shown in the interpole-field circuit is connected by means of a string with the tripping device of the main circuit-breaker, so that when the main breaker



FIGS. 1 AND 2.—WIRING DIAGRAM AND POLARITY OF INTERPOLES.

opens it will open this switch and thus disconnect the interpole-field coils. If this arrangement were not employed and the main breaker were to open at full load, thus causing the generator to return to the no-load conditions, the heavy field flux in the interpoles (required for sparkless commutation at full load) would be likely to cause the generator to flash over; in any event, it would spark very viciously.

To insure that the proper direction is used for the current in the interpole coils, one should observe the commutation with a weak field in both directions, or test the polarity of the interpoles with a pocket compass. Fig. 2 shows the proper polarity for a generator revolving clockwise. The polarity would be reversed for a motor revolving in the same direction.

Readings should be taken at 10 loads distributed about equally. At each reading the interpole-field current should be carefully adjusted to give the best possible commutation, and readings should be made of the armature current and the interpole-field current. Check the armature voltage so as to be sure that speed is constant. In the case of a compound machine the series-field current should, first, be adjusted to give the desired amount of compounding. While running this test sparking should be prevented by manipulating the rheostat in the interpole-field circuit.

The load amperes should now be plotted against the interpole-field amperes, as shown in Fig. 3. These points should lie approximately on a straight line, and a straight line should be drawn that will pass nearest the majority of them. At full load armature amperes should be read off the interpole amperes required. This value multiplied by the number of turns on the interpoles will give the total number of ampere-turns required

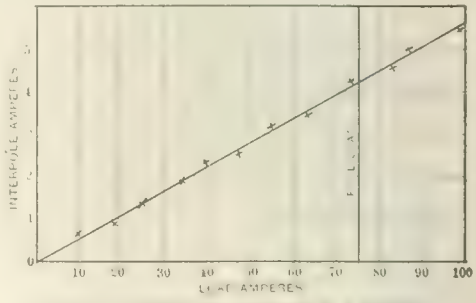


FIG. 3.—CURVE OF INTERPOLE AMPERES.

for the interpole-field m.m.f. To find the number of series turns required per interpole core, this value should be divided by the full-load armature amperes and by the number of poles.

The series-interpole windings should now be made up, having a slightly greater number of turns than called for by the preceding calculation in order to allow for variations in the individual machines.

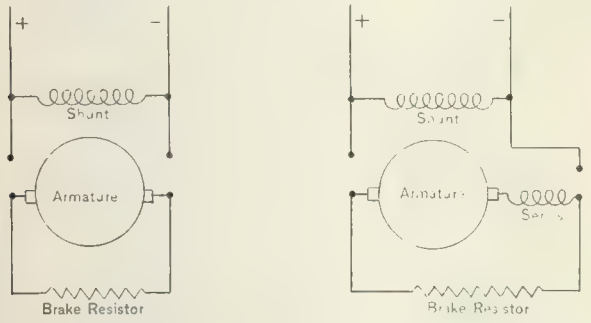
When the final interpole spools have been put in place, an adjustment of the interpole-field current should be made by shunting a part of the current around the interpole coils by means of a German silver shunt. In making this final adjustment the machine should be hot and should be run either as a motor or a generator, depending on which it is rated as.

High-speed interpole motors are sometimes troubled by surging when running near full load. The surging effect is sometimes severe enough to open the motor circuit-breaker, thereby causing a shut-down. The remedy for the surging is to shunt a greater portion of the current around the interpole-field coil, even at the expense of slightly poorer commutation.

Dynamic Braking.

By C. E. Daniells.

IF the driving energy of a direct-current motor is withdrawn while the motor is operating, and the connections are changed so that the machine will act as a generator driven by its own momentum and that of the driven machinery, a strong braking effect will be obtained. This principle is utilized to decrease or control the speed of motors in railway and industrial service and the action is called dynamic braking. The motors

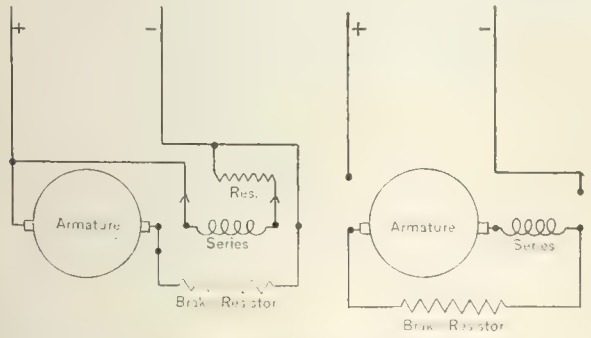


FIGS. 1 AND 2.—BRAKING WITH SHUNT AND COMPOUND MOTORS.

absorb the mechanical energy stored in the moving cars or machinery and convert it into electric energy which is dissipated in local circuits or sometimes returned to the supply circuit. In electric railway work the braking current is frequently used for heating the cars by leading it through suitable resistors under the car seats.

Dynamic braking is used in connection with motors for elevators, hoists, cranes, coal and ore-handling machinery, railway cars, etc.; the object may be either to reduce the speed preparatory to stopping or to control the speed of moving objects, as in lowering loads on cranes and hoists, retarding the speed of cars descending grades, etc.

The generator action which causes the braking effect depends on the speed and on the field strength. With constant field



FIGS. 3 AND 4.—BRAKING WITH SERIES MOTORS

strength the strongest braking effect occurs when the motor armature is rotating at high speed, and the effect decreases with the speed. For this reason dynamic braking alone cannot be depended on for stopping electric cars, elevators, hoists, etc., where the load torque is active. For such applications some form of mechanical brake is also necessary.

The principal advantages of dynamic braking are the practical absence of all wear on the apparatus, the convenience of application, and the ease, accuracy and certainty of control. In dynamic braking with a properly selected motor, active deterioration is limited to the controller contacts, which can be arranged for easy and inexpensive renewal. No special or additional apparatus is required for such braking, except the additional controller contacts and the necessary resistor for dissipating the generated braking energy. This resistor can be placed in any convenient location to which it is practical to lead a circuit from the motor and the controller. The braking effect can be adjusted with great accuracy over a wide range

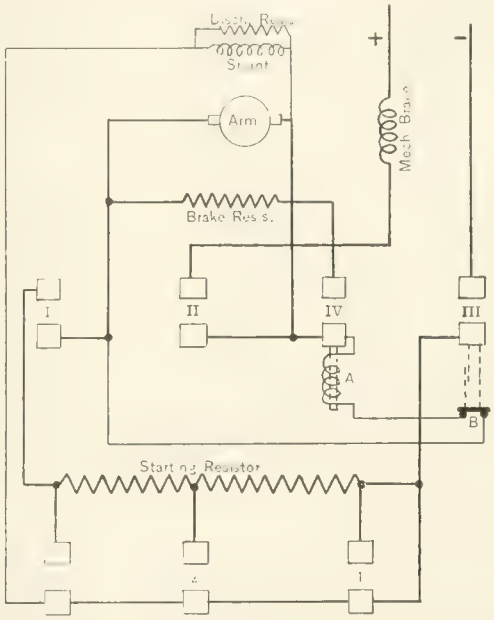


FIG. 5.—SHUNT-WOUND ELEVATOR MOTOR ARRANGED FOR DYNAMIC BRAKING.

either by varying the current through the motor armature by adjusting the braking resistance or by adjusting the motor field strength.

The heating effect of the braking current on the motor armature may sometimes be considerable, as is the case when retarding the lowering speeds of crane and hoist loads, and when the speed of electric cars down grade is so controlled. This heating effect being added to that of the machines when operating as motors must be considered in selecting the apparatus. If dynamic braking is used only intermittently for checking the speed when preparing to stop, the additional heating effect of the generated braking current is inconsiderable.

The accompanying diagrams, Figs. 1 to 4, inclusive, show, in a simple manner, some of the methods of applying the dynamic braking principle. Fig. 1 shows a shunt-wound motor with the armature disconnected from the line and short-circuited through a brake resistor. The field circuit is in this case directly across the line, thus giving full field excitation; if desired, a field rheostat can be used to adjust the field strength. Fig. 2 shows a compound-wound motor with the armature, the series-field coils and a brake resistor forming a circuit independent of the line, while the field is fully excited. This method gives a very powerful braking effect, causing a sudden stop unless applied with care. In Fig. 3 a series motor is shown with the field circuit in series with a protecting resistor across the line, while the armature and a brake resistor form a parallel path across the line. This method assures building up as a generator, after which provision is usually made to disconnect the motor completely from the line, leaving the armature, series-field coils and resistor, and brake resistor in series. In Fig. 4, which also represents a series motor, the armature, series-field coils and brake resistor form an independent circuit.

Dynamic brakes can be applied by manual or automatic controllers; that is, the changes in the motor connections can be the immediate primary result of controller movements by an operator or the operating controller can be merely a master

switch to set in motion a train of automatic electromagnetically operated switches which make the brake connections depend on the operating conditions. The operation of these magnet switches can be made almost entirely automatic or it can be placed more or less under the control of a master switch. Interlocking connections can be arranged so as to eliminate errors. The arrangements depend on the class of service, but in general one or more automatic switches make the brake connections and adjust the resistance.

In the automatic control of elevator motors, for example, dynamic braking is often used to good advantage for checking the speed when stopping, so as to relieve to some extent the

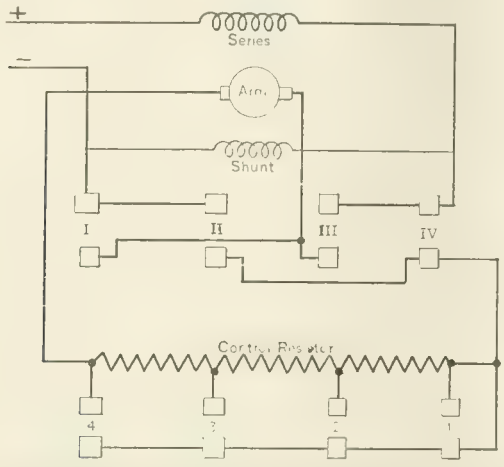


FIG. 6.—COMPOUND-WOUND HOIST MOTOR ARRANGED FOR DYNAMIC BRAKING.

stress on the mechanical brake. Fig. 5 shows enough of the connections to indicate the arrangement of the dynamic braking circuit and show the braking action of the automatic switches with a direct-current shunt-wound elevator motor. The switches are represented at *I, II, III, IV* and 1, 2, 3, the first three being for making the line connections and the last three for short-circuiting the starting resistor. Switch *IV* acts in applying the dynamic brake action. For sake of simplicity of diagram, many of the essential refinements of control and all control circuits affecting the switches are omitted except for switch *IV*.

In starting, switches *I, II, III* and 1, 2. 3 close automatically in proper sequence and time in response to the movement of the master switch in the elevator car. In stopping the elevator these switches drop open. Switch *III*, in opening, closes a contact at *B* and the counter e.m.f. of the armature causes current to flow through coil *A* and contacts *B*, thus closing switch *IV*. This action places the brake resistor across the armature terminals and checks the speed while the shunt field slowly dies away through the field discharge resistor. As soon as the counter e.m.f. has decreased sufficiently, switch *IV* opens, leaving all connections ready for starting again. The motor is equipped with a mechanical brake also, which sets automatically as soon as the master switch is moved to the "off' position.

Fig. 6 shows connections for dynamic braking with a compound-wound direct-current hoist motor and an automatic controller. Each line switch, *I, II, III, IV*, and each resistor switch, 1, 2, 3, 4, is controlled by independent notches on the master controller. In hoisting, switches *II* and *III*, and possibly some or all of the resistor switches, according to the hoisting speed desired, are closed, while switches *I* and *IV* remain open. In lowering, only switches *I* and *II*, and possibly some of the resistor switches, are closed, short-circuiting the armature through some or all of the control resistor, according to the lowering speed desired. The shunt field current produces a magnetic field of constant strength. Thus the load can be lowered steadily at any speed without the wear and stress accompanying the use of friction brakes. If the load fails to start downward the operator can turn his master controller momentarily to a notch that will cause switches *I* and *IV* to close, while *II* and *III* remain open, thus reversing the direction of current through the armature. It is a simple matter to interlock the switches so that *I* and *III* or *II* and *IV* cannot close simultaneously. It will be noticed that while lowering a load in this manner the series-field coils of the motor are out of circuit, the shunt-field current alone providing enough excitation m.m.f. Provision can also be made if desired for regulating the shunt-field current to adjust the lowering speed. The hoist motor is also provided with a mechanical brake for stopping; this brake acts automatically when the controller passes to the "off" position.

The Prevention and Removal of Boiler Scale—V.

By W. H. Wakeman.

Fig. 1 illustrates a device for feeding boiler compound into a receiver under pressure. Hot water passes into the receiver is drawn out through the suction pipe shown, by a duplex pump, and is forced through the delivery pipe to the boilers. The following directions enable the engineer to secure satisfactory results in feeding the compound and also show the steam user how it is accomplished: All valves shown are closed. The tank 2 is filled with the liquid compound and the plug 3 screwed in to make a tight joint under boiler pressure. By opening valve 4 full boiler pressure is secured on top of the compound. Valve 5 is opened to afford a clear passage for the liquid, and the check valve 6 prevents it from blowing back into the sight-feed glass. The required feed is obtained by adjusting valve 7 and the compound drops into the mixing chamber below it. If it fills this until the drops cannot be distinguished, it can be cleared by opening the valve 8 and adjusting the feed of clear water by the cock 9. When all of the compound is taken out of the tank 2 all valves should be closed and valve 10 opened to draw off the clear water, taking out the plug 3 to admit air. When all of the water has run out of the tank 2 the valve 10 may be closed and the tank filled again with compound.

For many years kerosene oil has been used for removing dirt that has become firmly attached to machinery of all kinds, to loosen nuts that have rusted fast on bolts, etc., but the idea of using it for loosening scale was not thought of until a

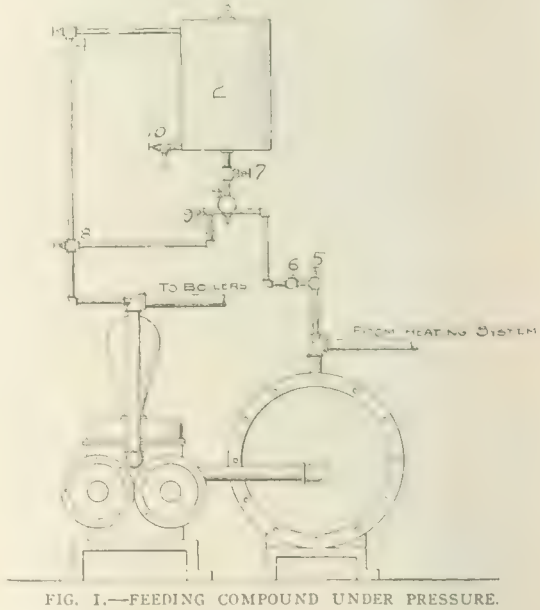
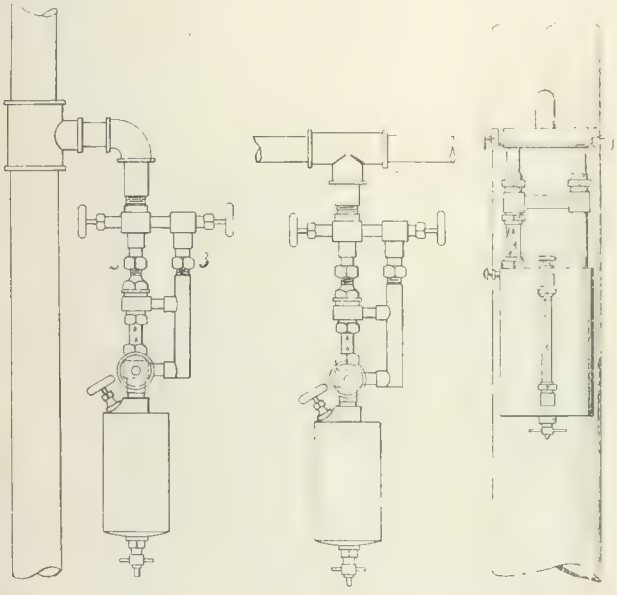


FIG. 1.—FEEDING COMPOUND UNDER PRESSURE.

long time after the penetrating quality of kerosene oil became well known to every mechanic, although it was probably used in isolated cases for such purposes.

More than 20 years ago Mr. F. L. Lyne made experiments to determine the value of kerosene oil as a scale remover and preventer, and as the results secured were widely advertised it created a great demand for this low-priced resolvent and for

devices for feeding it. In applying the oil it is necessary to have a cool, dry boiler and a tin squirt gun is used to throw it to the remote parts where it trickles down to the lower tubes and shell. When a boiler is given this treatment it ought to stand empty for at least two days. The partially loosened pieces of scale should then be removed, and by tapping the tubes, braces, etc., with a light hammer more can be loosened. Some of this will lodge between the tubes, but all ought to be taken out before putting on the manhole cover. There are two objections to this



FIGS. 2, 3 AND 4.—BOILER-COMPOUND FEEDERS.

method, one of which is the danger of serious accident to the boiler cleaner. Under certain conditions an inflammable gas rises from the oil and this, mingling with air, forms an explosive mixture. The other objection is that the principle involved is wrong. Kerosene oil is only a palliative; the cause remains. Another method of applying the oil is to allow the boiler to cool and then to fill it with water and put 2 gal. or 3 gal. of oil on the surface. The water is then run out slowly and as the oil is thus brought into contact with the internal parts after the water has left them, they will be covered with oil, hence the scale will be softened and dislodged. In every-day practice, however, there is not always time to let boilers cool every time that it is necessary to clean them, and in some plants there are only just enough boilers to furnish the required steam, hence the engi-

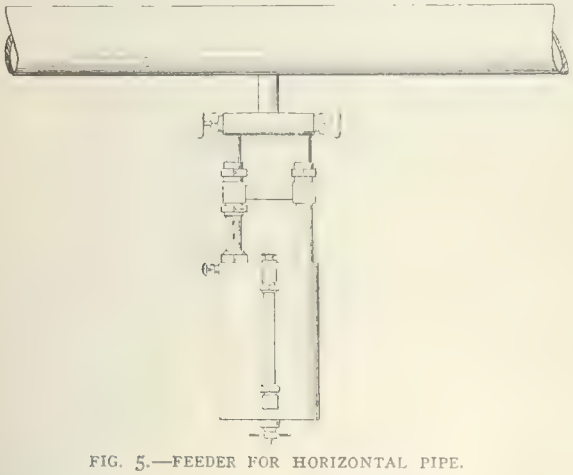


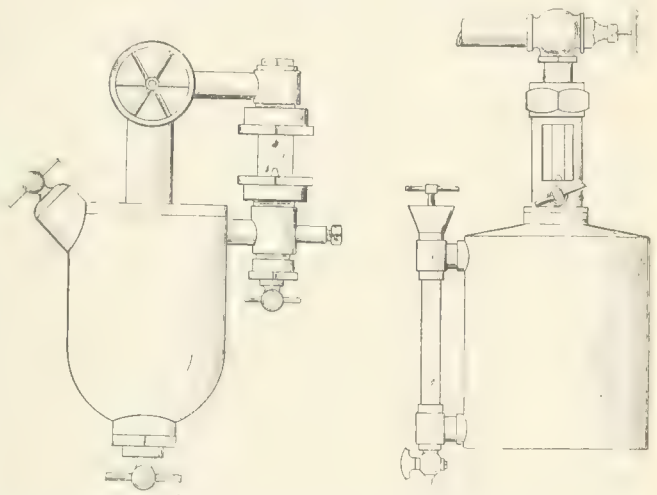
FIG. 5.—FEEDER FOR HORIZONTAL PIPE.

neer must clean them when an opportunity presents itself and not when his better judgment tells him the work ought to be done. A better method is to inject a boiler compound or a scale preventer every day, then clean the boiler at the first opportunity. After this has been accomplished, fill it with hot water by the use of an injector that is supplied with steam from another boiler and build a fire in the furnace when required. Fig. 2 illustrates the application of a device for feeding kerosene oil drop by drop into a vertical-feed pipe, through which water may travel in either direction without detriment to its operation.

Fig. 3 shows the same device feeding into a horizontal pipe which conveys water to the boilers. It must be connected to feed into the lower side of the pipe as otherwise it will not work. Ground joint unions are shown at 2 and 3 in both illustrations, by means of which the feeder can be disconnected when shipped to a purchaser, or at any other time, but whenever the two parts are connected care must be taken to join them as shown in order to secure satisfactory results in operation. This precaution is necessary because the parts will fit when the body is given one-half revolution from the position shown in the illustrations, hence it is easily possible to make a mistake in assembling the device.

Fig. 4 shows another device for feeding kerosene oil into a vertical pipe, while Fig. 5 presents an application of the same device to a horizontal pipe. Both are fitted with a sight-feed glass to regulate the feed and a gage glass to indicate the amount in the feeder. The latter is sometimes considered a luxury rather than a necessity, but this is a mistake because the engineer can see at a glance the amount left in his feeder and that informs him concerning the quantity used in a given time. It is a good plan to have a regular time for filling the sight-feed compound feeder.

In many cases the use of kerosene oil has been discontinued because it made boilers leak. While this effect is not always desirable, and sometimes is dangerous, the fact that leaks appear



FIGS. 6 AND 7.—FEEDERS OF KEROSENE OIL.

shows that the oil is doing the work for which it was put into the boiler, hence in a majority of cases it is a good plan to have repairs made and continue to feed the oil. If it acts on rubber manhole gaskets, etc., metallic gaskets can be substituted, and asbestos can be used on flange unions, etc., if soft packing does not prove durable.

Fig. 6 illustrates a cheap but useful kerosene oil feeder. Only one connection is provided in accordance with the usual design of these feeders. The sight-feed glass appears as an addition to the main body, rather than a necessary part of it, and no glass gage is provided. Fig. 7 shows another feeder which gives good results in practice. The sight-feed glass appears as a central part of the device, and a glass gage is attached to the side of the body.

While kerosene oil has worked wonders in some cases and is fairly satisfactory in others, it has not proved a universal panacea for all troubles arising from the accumulation of scale in boilers, which confirms the well-known claim of chemists that no compound can be successful unless it is adapted to the scale-making impurities on which it is desired to act. A compound can be varied to suit various conditions, but kerosene oil is always the same, hence if it does not give good results in a given case the remedy is to try something else and note the results secured.

LETTERS ON PRACTICAL SUBJECTS

SOME EXPERIENCES WITH THREE-PHASE MOTORS.

The writer's experience with motors may be of some interest to readers. After having rewound a 2000-volt, 35-hp, three-phase motor and shipping same, word was received that the motor could not be made to work properly. It should be mentioned in this connection that the motor was belted to a triplex pump which was always under full load. The distance from the power house to the pump was one mile, and a 50-hp generator supplied electricity to the motor only. Investigation showed that the motor started in good order on the first four contacts of the rotor rheostat, but when the fifth and last contact was reached, the motor suddenly stopped. The motor was started a number of times, but with the same result, so that seemingly the fault was in the starting rheostat, made of iron wire immersed in oil. The latter was taken to pieces and tested for bad connections, etc., but no fault was found. The slip-ring connections and rotor winding were next inspected, only to be found faultless. Not being able to discover anything wrong with the motor attention was given to the generator in the power house. This machine was belted to a main shaft and the trouble was found to be due to the belt slipping. After a dust storm much sand and dust had been deposited on the belt and when the last part of the rotor short-circuiting rheostat was cut out, it caused a rise in current and the generator being only a trifle larger than the motor was easily pulled up. After the belt had been put in good condition again, no further trouble was experienced.

Another machine that caused trouble was a 2000-volt, 300-hp, three-phase motor. The motor had been stopped and six new ropes put on the pulley for driving purposes. The ropes were pulled quite tight, and the machine would not start. When the switch was thrown in and resistance cut out of the rotor circuit, there was a humming noise. Upon measuring the clearance between the rotor and stator in the air-gap it was found that the clearance was less on one side than on the other. As the stator was placed on a bedplate entirely separate from the bearings, it was easily shifted a little and when the clearance was made equal the switch was again closed. This time there was a groaning and humming and the motor turned once or twice and stopped again. The bearings were then examined and it was found that between the top part of the bearing and the rotor shaft was a clearance nearly equal that between the rotor and stator. When the motor was running with slack ropes the pull on all sides of the rotor being nearly equal, the shaft rested on the bottom parts of the bearings on account of gravity. The tight ropes counteracted this and pulled the rotor sidewise, the transmission being horizontal. As the rotor shaft was slightly lifted in the bearings, the clearance became minimized and the magnetic attraction too great, thereby causing the rotor to "hang up." No time was allowed for fixing bearings, so the only way out of the difficulty was to take off some ropes. It was found that the motor would work satisfactorily with three ropes and the remaining three were put on when the other ropes had time to slacken.

Johannesburg, South Africa. John Stuart.

SCALE AND BOILER COMPOUNDS.

The engineer and power-plant owner are often warned to be careful in the use of boiler compounds. No one should use a compound until a sample of the water employed is sent to some reliable house that makes compounds, where the water may be analyzed, and a compound prepared that will suit it. The engineer will then be safe in using the preparation, but the results obtained should be closely watched. The engineer should see that the scale or sediment is removed and should also examine the surface of the plates to see that the compound is not affecting the surface of the boiler. Should the plates appear too bright or clean, one can rest assured that the compound contains too much acid and will soon prove ruinous to the boiler. Here is where these preparations become dangerous. When a boiler starts to corrode it is difficult to stop it. It has been stated that some compounds cause leaks, and in one sense of the word this is true. In many instances a flue head becomes coated with scale, impervious to water or heat. The coating may be from 0.5 in. to 0.75 in. thick and insulates the head from the water, and consequently the latter becomes overheated. When compound



FIG. 1.—CLOGGED FEED PIPE.

is used to remove the scale by dissolving it, the flues will begin to leak. This leak is not caused by the compound, but by the heat, and the former having removed the scale, allows the water to strike the head, where the flues have been loosened by expansion. On the other hand, should a preparation that shows any sign of causing a leak in a clean seam be employed, it should be abandoned, as it contains acid and is dangerous. More boilers have been ruined by not using compounds, however, than otherwise, since there are so many cases of scale formation. Some water forms a thin, hard, dense scale that is more dangerous than the soft, thick formation, which is easily removed and allows water to penetrate. It is best when water forms a scale to commence using a compound at once, as it is easier to prevent a scale forming than to remove it afterward. Cases have been known where it has required many months to remove a coating. A compound that works too quickly had better be watched, as it will likely attack the plates. It requires a close and careful inspection to see the action of a boiler compound. If a boiler has a heavy coating of scale, too much of the compound should not be used at first. The writer not long since saw a boiler upon which a patch had to be placed from this cause. The scale formed in a pile over the front end, away from the blow-off, and soon the boiler was bagged down and it was necessary to put a patch on it. This was a practical example of using too much compound at the start. One should use it gradually, and see that all loosened scale is removed. It is better to open the boiler oftener until the greater portion of the formation is taken away, so as to prevent the accumulation of sediment, as some boiler scale will settle on the bottom sheet and adhere so closely that it will allow the sheet to be overheated. Many plants are running with a heater which is useless, for if one-half of it were opened, a heavy scale would be found on the tubes. In many cases the scale-forming properties of the water will cause a heater to become almost solid

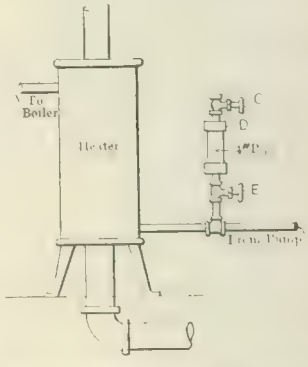


FIG. 2.—FEED WATER HEATER CONNECTIONS.

with sediment, as this is the first place where the water comes in contact with the heat, and the benefit of the heater is lost. This is one reason why the boiler compound should be pumped through the heater so as to prevent scale forming in it and the feed pipes. In the example shown in Fig. 1 the feed pipe is almost clogged up, a 1½-in. pipe having only about ⅜-in. hole to feed a 150-hp boiler. This condition can usually be detected by leaks appearing around the heater joint, showing that an extra pressure is thrown on the feed pipe, causing the pump that

is feeding the boiler to labor and leak. Feed pipes in this condition have been found. One could easily fit up a small cap to feed the compound through the heater, as shown. This could be made from a short piece of 4-in. pipe and two caps. By having the valve *E* closed one can open valve *C* and fill the pipe, and by closing the valve *C* and opening valve *E*, the compound can be pumped into the heater. This should be done when stopping the pump, as it will allow some of the preparation to remain in the heater and take effect on the scale. This same arrangement could be put on the side of the water end of the pump, as all pumps have an opening on the two sides. It is quite important to feed the compound through the heater. The heater should be examined to see that a scale or deposit is not forming in it, and if blown down often the heater will not fill up with scale.

Richmond, Va. Richard Gorman.

Increasing the Temperature of Feed Water Before Entering Boiler.

All things being equal, the higher the temperature of the feed water entering the boiler, the greater the economy realized in fuel. Various methods have been tried from time to time in order to obtain high temperature feed water involving the least possible expense, and without incurring any serious changes in the furnace or engine equipment. The ability of the

William Kavanagh.

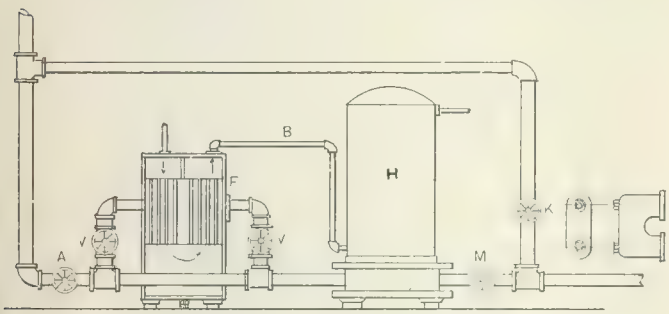


FIG. 1.—TWO FEED-WATER HEATERS IN SERIES.

average heater to raise the feed-water temperature above 208 deg. is questionable; there may possibly be heaters that will elevate the temperature higher, but in such cases the heater must be clean and sufficiently large to store heated water before allowing it to pass outward to the boiler. Poor economy is obtained from the use of a small heater because the flow of water through a small heater is generally rapid, and since water must take time to absorb heat, it follows the larger the heater the greater will be the amount of stored hot water ready for use. The fact that warm water will absorb heat from a hot surface faster than cold water has induced many plant owners

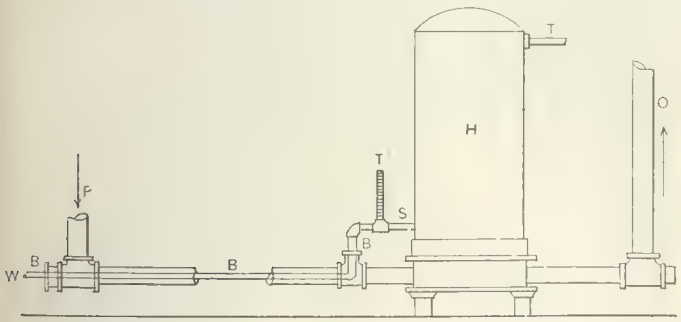


FIG. 2.—HEATING WATER BEFORE IT ENTERS MAIN HEATER.

to avail themselves of this principle and install two or more heaters, the use of which materially assists in elevating the feed-water temperature above the boiling point, thus adding to the economical operation of their plants. The heaters are connected along the exhaust line, the feed water first entering the heater farthest from the boiler and then flowing under pressure to the next heater; in this way the temperature of the feed water is increased without requiring any further expenditure of fuel.

Fig. 1 illustrates this principle and the manner of connecting the heaters. The water enters the heater *F* at *A*, where it passes down through tubes in one compartment and up through the tubes in the other compartment, as shown by the arrows. The water now flows out at *B*, then into the main heater *H*, where its temperature is raised above that of the water in *F*. The exhaust steam is passed directly through the heater *H*, while the exhaust steam through *F* is supplied by means of a leg or

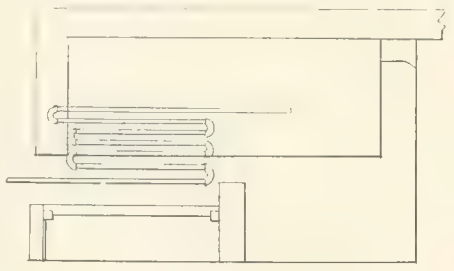


FIG. 3.—COIL IN FURNACE.

by-pass, as shown. The amount of exhaust steam flowing through *F* can be varied by opening or closing the valves *V V*, and the steam can be by-passed from all of the heaters by closing valves *A M* and opening valve K. By adopting this plan of by-pass it enables a continuance of operation while the heaters are being cleaned.

Fig. 2 shows another and very simple plan to raise the feed-

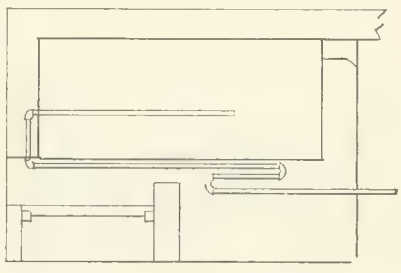


FIG. 4.—COIL IN BACK CONNECTION.

water temperature before it is forced into the main heater. The exhaust steam enters the exhaust pipe at *P*, flows through heater *H* and out at *O*. There is a heavy brass or copper pipe fixed within the exhaust pipe, as shown at *B*. The feed water from the pump enters the brass or copper pipe at *W* and then enters the heater at *S*. Here, it will be seen, the inner pipe is surrounded by exhaust steam, and the temperature of the feed water is raised considerably before it enters the main heater *H*. A thermometer placed at *T'* will indicate the number of degrees the water was raised in its passage through the pipe *W*, and a thermometer placed at *T* will show the number of degrees of heat the water absorbed in its passage through the main heater *H*. When the

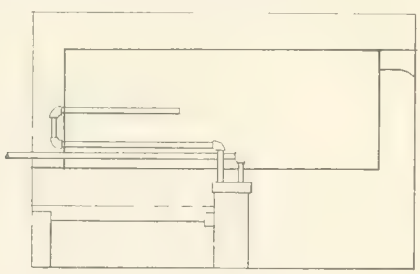
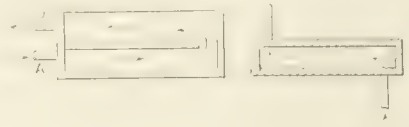


FIG. 5.—HEATING COIL ON BRIDGE WALL OF FURNACE.

exhaust pipe is used to carry the foreheater it is usually made one size larger than called for by the engine connection and it is also well dripped to carry off condensation. In order to allow for contraction and expansion, the ends of the pipe acting as the foreheater are passed through stuffing boxes, as shown at *B B* and are not rigidly connected. It is not absolutely necessary for the connections to be made exactly the same as shown in Fig. 2; the exhaust steam could enter the heater at first and afterward flow around the foreheater pipe as before mentioned.

Whenever a coil or other apparatus is used as a feed-water heater, and such apparatus is placed in the furnace of a steam boiler, it requires extra fuel because the coil or apparatus becomes a part of the boiler, exposing more heating surface, and the use of such apparatus is, therefore, not economical. The



FIGS. 6 AND 7.—HEATER AND WATER ARCH.

greatest economy is to be derived by extracting all of the heat units possible from the exhaust steam, and this heat must be extracted without an unnecessary increase of back pressure. Fig. 3 illustrates a coil placed within the furnace through which the feed water is pumped before it enters the boiler. The great objection to coils like this is that it not only abstracts heat from

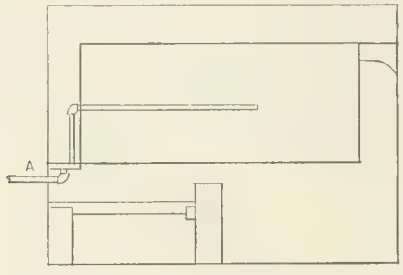


FIG. 8.—WATER ARCH.

the furnace that would otherwise be employed in the boiler, but it also fills with scale and is difficult to clean. In some cases the bends are fitted with cleaning plugs as shown to the right of Fig. 1. Fig. 4 shows a coil located in the back connection for the purpose of raising the feed water temperature. It has the same defect as the coil shown in Fig. 3 in that it extracts heat from the gases that would otherwise flow through the tubes, and it fills with scale and is difficult to clean. Fig. 5 shows another type of feedwater heater that is placed on the bridge wall of the furnace. This heater is made flat after the manner of a flat water arch, but is constructed differently. Fig. 6 shows the heater with the lid removed. It is divided in two compartments as shown by the middle plate. Water is pumped into it at *A* and it travels down to the end and around this division plate and out at *O*, as indicated by the arrow. The object of doing this is to hold the water in the heater as long as possible before it enters the boiler, and the hottest water will meet the hottest gases; hence it will be seen the water always enters the heater at the end remote from the furnace. Fig. 8 shows at *A* what is called a "water arch." It is similar to the heater shown in Fig. 6 except that it has no division plate. The water enters the arch at or near one of its ends, then travels along the arch and out at a point near

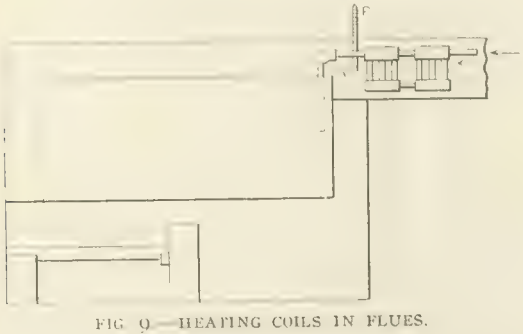


FIG. 9.—HEATING COILS IN FLUES.

the opposite end, as shown in Fig. 7, the arrows indicating the direction in which the water travels before entering the boiler. Fig. 9 shows coils situated in the flue or uptake of the stack. Here the hot gases, after doing their work on the heating surface of the boiler are rejected at the point *R*. The heat contained in the rejecting gases is now used for maintaining a column of heated air in the chimney, causing a draft. If now, the hot gases be passed around or through a coil containing water, the temperature of the water will be increased without incurring any extra cost of fuel. Coils situated as indicated at *R* are called economizers, and in order to keep the surface of those coils free from dust they are fitted with brushes or scrapers, and by moving the scrapers for a few minutes daily the surface of the coils remain free from dust and become better conductors of heat. The economizer will not be of much account from an economical point of view if allowed to become covered over with dust and ashes, hence in order to realize the best results the coils must be kept clean. A pyrometer fixed in the stack breeching, as shown at *P* will give an idea of the temperature of the gases as they pass out to the chimney. It will be found that their temperature is higher than the temperature of the steam within the boiler, and the closer these temperatures approach each other the greater will be the economy realized. It will be evident, therefore, that the water in the economizer is surrounded by gases somewhat higher than the temperature of the steam, and its temperature is increased considerably before it enters the boiler, requiring less fuel to raise steam to the required pressure. Hence the economy obtained from the use of an economizer. If now the feed water is heated to the highest point possible by means of the exhaust steam and then afterwards discharged through an economizer the highest economical results, under proper conditions, will be obtained in supplying steam boilers with feed water.

New York. William Kavanagh.

PLACING CROSS-ARMS ON POLES IN BACK ALLEYS.

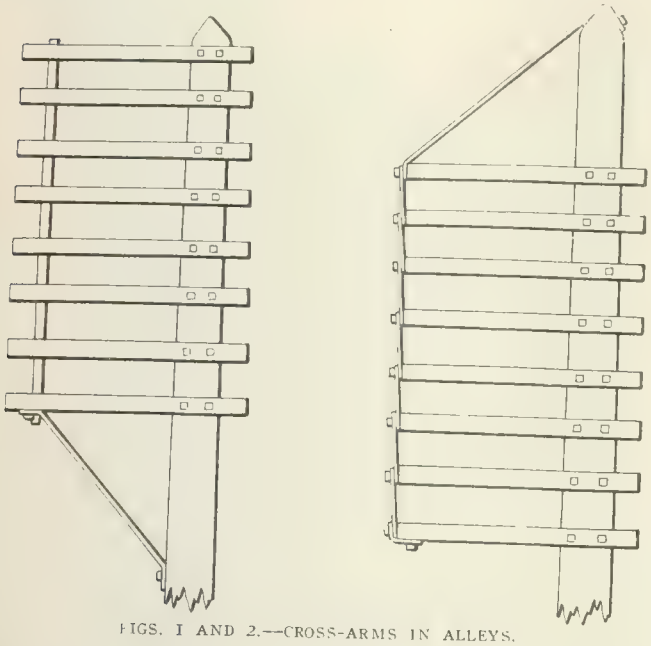
In small cities where the wires have not yet been placed underground some queer problems have to be met by the engineers, and many a problem, perhaps equally perplexing, never gets up to the engineers but is solved by the linemen. Parallel cases are shown by the engravings herewith presented. Fig. 1 shows a case of "back alley" line construction where it was necessary to place a line of poles close to some high buildings. As 48 wires had to be carried by the poles, and as there was not room in the alley to set the poles far enough from the buildings to permit the use of the usual cross-arms, the expedient of using "one-handed" cross-arms was used. Short cross-arms which projected to the right of the pole only far enough to permit the stringing of a single wire on that side of the pole were used, as shown in the engraving. Then, to prevent the one-sided load from sagging the cross-arms, the lower one was braced with ½-in. by 1½-in. flat iron, which was lag-screwed to the pole and to the lower cross-arm. To support the other arms, the vertical stay was put on. As it is on the far side of the cross-arms, the lag-screws which fasten it to the arms are not visible, but a single ½-in. lag screw in each arm does the business.

The other poles on this line—where they do not stand close to high buildings, carry four cross-arms each, but the short ones shown by Fig. 1 require double that number to accommodate the 48 wires that are strung along this line of poles. It was necessary to use extra heavy poles for the "short-arm" stretches. It happened that another pole with this form of cross-arm construction had to be erected quite unexpectedly. At least so unexpectedly that the engineers had failed to provide the necessary braces and vertical strap necessary. There was no time to notify the engineer, so the lineman took stock of his possessions and evolved the scheme illustrated by Fig. 2.

He had nothing whatever except plenty of lag-screws and a short piece of cable, such as is used for attaching poles to "dead-men" anchorages. But this meager material proved sufficient, and the pole was rigged up and set and wired, as shown in Fig. 2. A lag-screw was let into the top of the pole on the side away from the cross-arms, then the cable was passed over the top of the pole and given a half-turn around a lag-screw in the outer end of the upper arm.

Considerable puttering was necessary to bring the arm to a

level position, but it was finally accomplished, and the winding of the cable around the lag-screw practically fastened the arm in that position for a period only limited by the life of the cable or the pole. It was quite easy to bring the next, and all subsequent, arms to a dead-level position. This was done by means of a board which had been cut to the exact distance between the upper arm and the one just below it. When the cable was being wound around any lag-screw, the board was placed between the arm to be stayed and the one immediately above it. It was then only necessary to pull on the cable until the board was pinched tightly between the two cross-arms, then wind the cable around the lag-screw, pull it taut until the board was pinched fast, then give the finishing touch to the turn around



FIGS. 1 AND 2.—CROSS-ARMS IN ALLEYS.

the cross-arm, knock out the board distance-piece and proceed to fasten the next lower cross-arm.

When the lower arm was reached the wire cable was given a twist around an extra lag-screw placed on the underside of the cross-arm. This prevented the possibility of the cable becoming unfastened. This arrangement is better than the engineer's lay-out, as shown by Fig. 1, and it permits the brace to be in tension instead of in compression. It also gives for use the full length of the cross-arms and the cable, being fully galvanized, will not rust as the braces will unless well protected with paint.

Scranton, Pa. John Dixon.

TRUING COMMUTATORS AND BRUSHES WITH SANDPAPER.

After noting many fearful and many wonderful methods and results from the attempts made to true commutators and brushes with sandpaper, it is very welcome, indeed, to find even one man who is doing such things in a workmanlike and mechanical way, and, what is better, is obtaining first-class results from the sandpaper method. It is a very common and a very bad practice as well to hold a piece of sandpaper in the hand and let it cut away at the commutator in the mistaken idea that the commutator is being trued up by the action of the sandpaper. The method is given below.

If possible, procure some form of commutator-truing device whereby the segments may be turned by a regular cutting tool held in a side rest by suitable mechanism, and which may be fed across the commutator by a screw movement, either hand or automatic. Failing to procure such a machine, the attendant in a certain power station rigged up the arrangement shown by Fig. 1, in which *A* represents a commutator in process of being trued; *B* is a pulley or roll which is hung in the frame *C*, and which is so arranged that it may be adjusted at will in relation to the commutator *A*. The roll is very true, its face having been carefully turned or ground.

The adjustment toward the commutator may be preferably by means of a screw, or with a hammer, tapping the frame *C* so as to bring the roll *B* to the distance required from the commutator. A strip of sandpaper is then cut to the exact width of the pulley face and is threaded between the commutator and the roller *B*, as shown. The ends of the paper are grasped between the thumb and fingers of each hand; then the sandpaper is drawn slowly back and forth between the roll and the commutator until the sand has cut itself free. Then, provided the commutator needs more taken off it, the roll is moved slightly closer to the commutator and the action repeated until the commutator has become perfectly round and smooth. By this method the commutator can be made as smooth and as true as

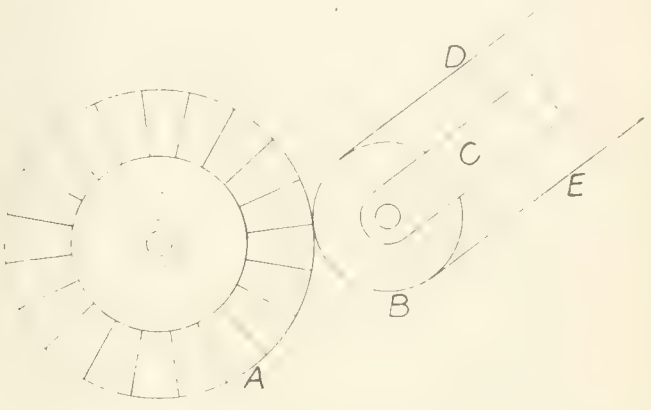


FIG. 1.—TRUING A COMMUTATOR.

if it were turned in a lathe or by the best automatic commutator-truing attachment ever made.

To fit the brushes the method is used by the party in question, which is represented diagrammatically by Fig. 2, in which *A* is the commutator, *B* a piece of heavy and strong paper which has been cut to reach almost around the commutator, but not quite, as indicated by the space *B C* between the ends of the strip of paper. The strip of sandpaper *D* is then cut to fit around the commutator, and so accurately fitted that the ends are apart only a very small fraction of an inch, as shown between *D* and *E*.

To put this rig in place upon the commutator, the inner paper is brushed over with shellac from *B* to *D*, and the sandpaper laid upon the shellacked surface, as shown at *D E*, and rubbed

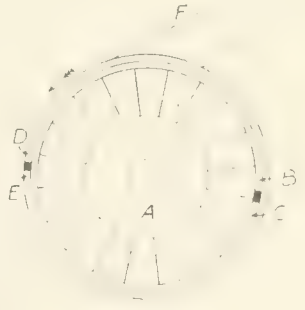


FIG. 2.—FITTING BRUSHES.

firmly together. This may be done with the sandpaper spread out upon a smooth flat surface. Next, the rest of the inner paper is shellacked from *D* to *C*, then the whole is wrapped around the commutator.

The brushes are now carefully adjusted, as shown at *F*, to fit square and true against the sandpaper. The commutator is then started, preferably at a slow speed, if possible, and the brushes are fed lightly down against the sandpaper until they have been fitted accurately against it. This method, when carefully worked, forms a most excellent way of truing both the brushes and the commutator at very slight expense.

New York. James Francis.

QUESTIONS AND ANSWERS

What advantage does the series incandescent lamp system of street lighting possess over the multiple system? G. D.

Street lighting circuits are usually very long, and the distribution cost for lines is much less for the series system than for the multiple system. Transmission losses are also lower, owing to the higher voltage used.

What are the essential conditions for the satisfactory parallel operation of alternating-current generators? F. O.

Alternators to be operated in parallel must be running at precisely the same frequency; the frequency must be constant; the voltages of the machines must be in precisely the same phase and the terminal e.m.fs. of the machine must be equal.

What is the current-carrying capacity of solder and brass? R. H. F.

The conductivity of metals is greatly affected by chemical impurities and mechanical treatment. Therefore, it is impossible to give values which will be absolutely reliable. Brass and solder are two very general words without definite meaning. By varying the proportions of copper and zinc various brasses may be obtained; the same is true of solder. Brass with 35 per cent of zinc has about one-fifth the conductivity of copper. We have no information on the conductivity of solder.

Various companies in the West, in giving information on their lighting circuits, state that they operate on the Philadelphia moonlight schedule. I have been unable to find out exactly what this schedule is and would be obliged for any information on the subject. S. B.

What is known as the Philadelphia moonlight schedule is usually expressed as follows: "Light one-half hour after sunset and one hour before moonset. Extinguish one hour after moonrise and one hour before sunrise." The schedule as outlined gives about 2200 lighting hours per annum. The various phases of the moon can be obtained from any almanac and from most of the ordinary calendars.

What alteration should be made in the design of the high-frequency apparatus described by Mr. Hanchett in the July number so as to make it useful for 10 amp instead of 40 amp? Would a different size of wire on the primary with a longer or larger core give the required effect? I wish to get a 6-in. spark at the Tesla coil terminals. W. L.

If 10 amp are used instead of 40 amp, as specified in the article, the apparatus will work, but the discharge from the Tesla coil will be much shorter than that given in the article. With 40 amp the discharge would strike the full distance between the terminals of 11½ in. With a current of 10 amp a spark 5½ in. long could be obtained. It would not be advisable to make any alterations in the apparatus.

In power house descriptions frequent reference is made to selector switches in the diagram of switchboard connections. What kind of switches are these, and wherein do they differ from the ordinary knife switch? G. T.

A selector switch is usually defined as one which will throw a circuit on any of two or more sources. It may be used, for instance, for generators, transformers, lines or busbars. With duplicate busbars and single-throw switches, two are necessary to allow a circuit to be thrown on either busbar. If it is not necessary to throw them under load, air-break disconnecting switches are used. Selector switches are often automatic in their action with an inverse time element giving practically instantaneous trip under severe short-circuiting conditions.

I am in charge of some electric generators and have been thinking of repainting them. Could you advise me of a color that is easy and restful on the eyes of the operator or attendant? W. B.

Unless there are very strong objections to its use, black paint is the best to employ in painting any electrical apparatus where heat is to be dissipated. The radiation is greatest from black or dark bodies and least from silvered, glossy and light tinted bodies. This is a physical fact not often appreciated. Oil and varnish will be found to transmit the heat better than turpentine or other volatile liquids, so that the heat transmission of the paint may be affected by the vehicle for carrying the pigment. The amount of heat dissipated by radiation, however, is small compared with the heat dissipated by convection in rapidly moving electrical machinery.

I am in search of information regarding blow-off tanks for boilers. How large a tank is necessary for a 500-hp boiler? What is the usual arrangement of connecting the tank with the sewer and how can the sediment be best removed? I. F. B.

Ordinarily the boiler mud drums of a 500-hp boiler are fitted with 2½-in. blow-off valves and pipes which discharge into a 4-in. header. This header may run directly to the blow-off tank or be connected to a 6-in. main leading to the tank. A 6-in. pipe will pass approximately 500 gal. of water a minute, and if it is not desired to blow-off a boiler quickly a 4-in. pipe will suffice. The size of the tank is determined in many cases by the following rule: twice the horse-power rating of the boiler equals the capacity of the tank in gallons. Thus a tank for a 500-hp boiler would hold 1000 gal. The upper part of the tank should be connected to the stack by an 8-in. vent pipe to pass off the vapor, and it is usual to employ a syphon connection which will empty the tank of water into the sewer when it is full or nearly so. By this means the sediment is retained in the tank whence it may be removed at convenient times through a sludge opening.

I would like to construct the high frequency apparatus described in the July issue and would be obliged for the following information: What change in winding of the step-up transformer will be necessary if a tension of 220 volts is used instead of 110 as described? Will not transformer oil have an injurious effect on the hard rubber spools of the step-up transformer or on the paraffin in which the coils are boiled? Where can the various insulating materials be procured? F. O. S.

If the number of turns in the primary of the step-up transformer is doubled and the section reduced one-half the same result will be obtained with 220 volts as the arrangement called for gives with 110 volts. The apparatus as described can be used on 220 volts, but the action will be very violent, and if continued for any length of time the transformer is likely to overheat. Transformer oil will not have any injurious effect on hard rubber spools. It slightly dissolves the paraffin and tends to make it soft and mushy; but as the object of the paraffin is merely to hold the coils together and exclude the air until they are submerged, this is not a serious drawback. The insulating materials cannot be obtained from one company. It will be necessary to purchase the glass jars from some dealer in glassware; the fiber jars from dealers in that material, and the hard rubber sheets from almost any one of the hard rubber companies. Paraffin can be purchased from any grocer or from a dealer in oils, while the glass, shellac, tinfoil, etc., may be procured from local dealers.

The series transformer has bothered me somewhat and I can find nothing in my books on the subject. I would like to know what is the principles of the series transformer. Why is it necessary to short-circuit the secondary when left in the line? What causes the voltage to rise to a dangerous point if the secondary circuit is left open? E. M. W.

The chief function of the series transformer is to furnish to the measuring or indicating instruments a current proportional to the line current in a certain ratio. In general these transformers consist of only two coils built up with an iron core. One coil, the primary, is connected in series with one of the line wires; and the other coil, the secondary, is connected to the terminals of the instrument, thus being closed through the coils of the latter. The coil connected in the line, which in most cases is merely the line wire itself, is necessarily at line potential, which may be thousands of volts above ground potential; hence, if this coil has sufficient insulation to prevent a breakdown between coils the instruments are effectually insulated from the line potential. With the secondary open-circuited, the back e.m.f. of the transformer is that due to the flux produced by the current in the primary. This back e.m.f. is considerable, since there are no amp-turns to oppose the magnetization. When the secondary is short-circuited or closed through the coils of the instruments, the current in it opposes the production of flux, which therefore assumes a value such as to give an e.m.f. in the secondary large enough merely to produce a current only slightly smaller than the primary current divided by the ratio of secondary to primary turns.

would remove all wiring and fixtures without cost to him, except for the actual electricity used during the trial.

No such plan was attempted in the residence districts, but as thorough a canvass was made of all unwired houses as was carried on among the stores. The owners and renters of these houses were seen and solicited for electric lights. At the same time a half-page advertisement was placed in the daily papers offering a flatiron free for all houses wired up and contracts made for lights during a limited period of two weeks. The records of connections and disconnections passes to the office through the commercial department, and all such places are looked up at once. If the people moving into these places have not contracted for electric lights, we arrange for its use, if possible. On the other hand, if they have the lights connected, we show them the advantages of electric-heating devices.

Early last spring, to stimulate interest in electric flatirons, we bought 500 stands for holding the irons with bottom side up. We then advertised that the first 500 customers possessing flatirons, who paid their bills that month, would receive free of charge one of these stands.

Up to July this year about 150 irons were placed on a two-weeks' trial, of which 95 were accepted and paid for at the price of $3.50 each. These irons were placed by a solicitor and the meter reader. The minimum rate charged by this company is $1 per month, and if the customer has not used his dollar's worth of electricity it is easy for the meter reader to place an iron.

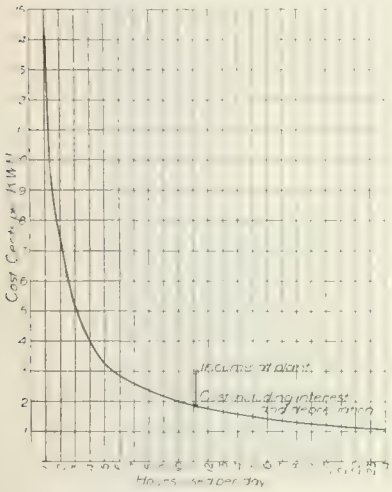


FIG. 2.—STREET LIGHTING CURVE.
Maximum demand, 100 kw.
Average use of maximum per day, 11.2 hrs.
Receipts per kw-hr. at plant, 3 cents.
Cost per kw-hr. at plant, including 5% depreciation and interest, 1.83 cents.

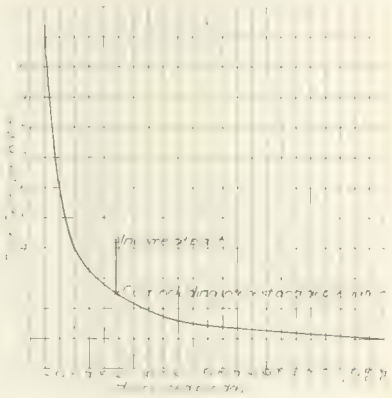


FIG. 3.—COMMERCIAL-LIGHTING CURVE.
Maximum demand, 315 kw.
Average use of maximum per day, 5.77 hrs.
Receipts per kw-hr. at plant, 4.27 cents.
Cost per kw-hr. at plant, including 5% interest and depreciation, 2.45 cents.

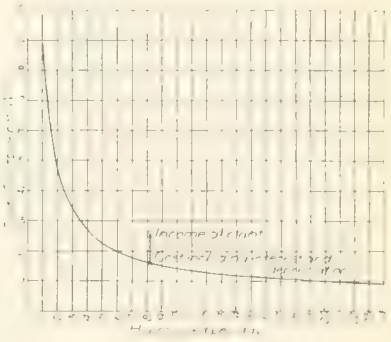


FIG. 4.—POWER CURVE.
Receipts per kw-hr. at plant, 2.57 cents.
Cost per kw-hr. at plant, including interest and depreciation, 1.6 cents.

A Chautauqua meeting is held at one of our parks every summer, and space was this year engaged on the grounds for an exhibition and demonstration of electric appliances of all kinds, and the feature was well advertised by the Chautauqua Association. One of the large electrical manufacturing companies furnished an experienced demonstrator who gave lectures on domestic science at 10:30 a. m. and 4:30 p. m. each day for seven days, samples being served of the electric cooking. In addition to a regular cooking outfit, we exhibited electric hair curlers, massage vibrators, washing machines, vacuum cleaners, etc. The attendance at these demontsrations varied from 50 to 100 in mornings and from 250 to 300 in afternoons.

The greatest gain effected by the commercial department was in the sale of power. Two main causes are assigned for this increase—namely, that the changes from gas or steam to electricity were taken up with our new customers along practical lines that appealed to them, and further, that the business was asked for in such a way as to convince these people that we had entire confidence in the proposition ourselves.

When making our first call to a plant our object was to obtain permission to make an investigation of the power costs, etc. We explained that if we made a test of the plant and found that we could operate it to the advantage of the proposed customer, we would guarantee to prove this advantage as follows: The motors would be installed by us at a certain named price. However, a 60-day trial would be allowed on them and if at the end of that time they were not satisfactory in operation or in cost, we would remove the outfit without charge except for the electricity used. This procedure as outlined has proved a very profitable one for our company. The 536.5 hp in motors installed this spring was obtained at a minimum rate of $1 per month per horse-power, the electricity being figured at a rate which varies from 5 cents to a little less than 3 cents per kw-hour.

Accurate records are kept of all our soliciting by means of the card index system. On these cards are placed the remarks of the prospect, any prices that may have been named to him, and whatever is learned regarding the present costs of light, power, etc. This data is quite useful when the subject is again taken up, especially where such data as indicator cards, operating costs, etc., have been obtained.

We do not believe we have taken any contracts on which our company is not making money, as we have figures always at hand to show just what any class of service costs. The accompanying cuts show examples of our cost curves for different services. To obtain these curves it is necessary to have the following data separate for each service: Maximum kilowatt demand. Investment in power plant. Investment in distribution. Power-plant wages. Output at plant in kw-hours. Coal and water. Lubrication, waste, supplies, main plant. Main lines, transformers and meters. General offices and clerks. Office expenses and supplies. Advertising. Legal and damages. Insurance and taxes. Depreciation. Receipts from service.

The Cost of a Kilowatt-Hour.

By R. A. Day.

In the construction of a building the expenditure for the erection of the steel frame bears about the same relation to the cost of the edifice as the labor and material charge of generating bears to the actual cost of a kw-hour. The skeleton of the building, left bare and barren, would yield just as much revenue as the kw-hour generated, but neither distributed, sold or accounted for. Just as essential and vitally important as are the brick, stone or contract fronts and walls—the heating and plumbing—the decorative finishings, to make the steel pillars and beams revenue-bearers for the building, are the meter reading, distributing, billing, collecting and accounting, to the generating station, in order to accomplish the income from the kw-hour.

An incomplete building yields no revenue—a kw-hour is valueless unless generated, distributed, sold and accounted for. Each being of vital importance, in order to provide the income from the kw-hour generated, each must equally go to make up

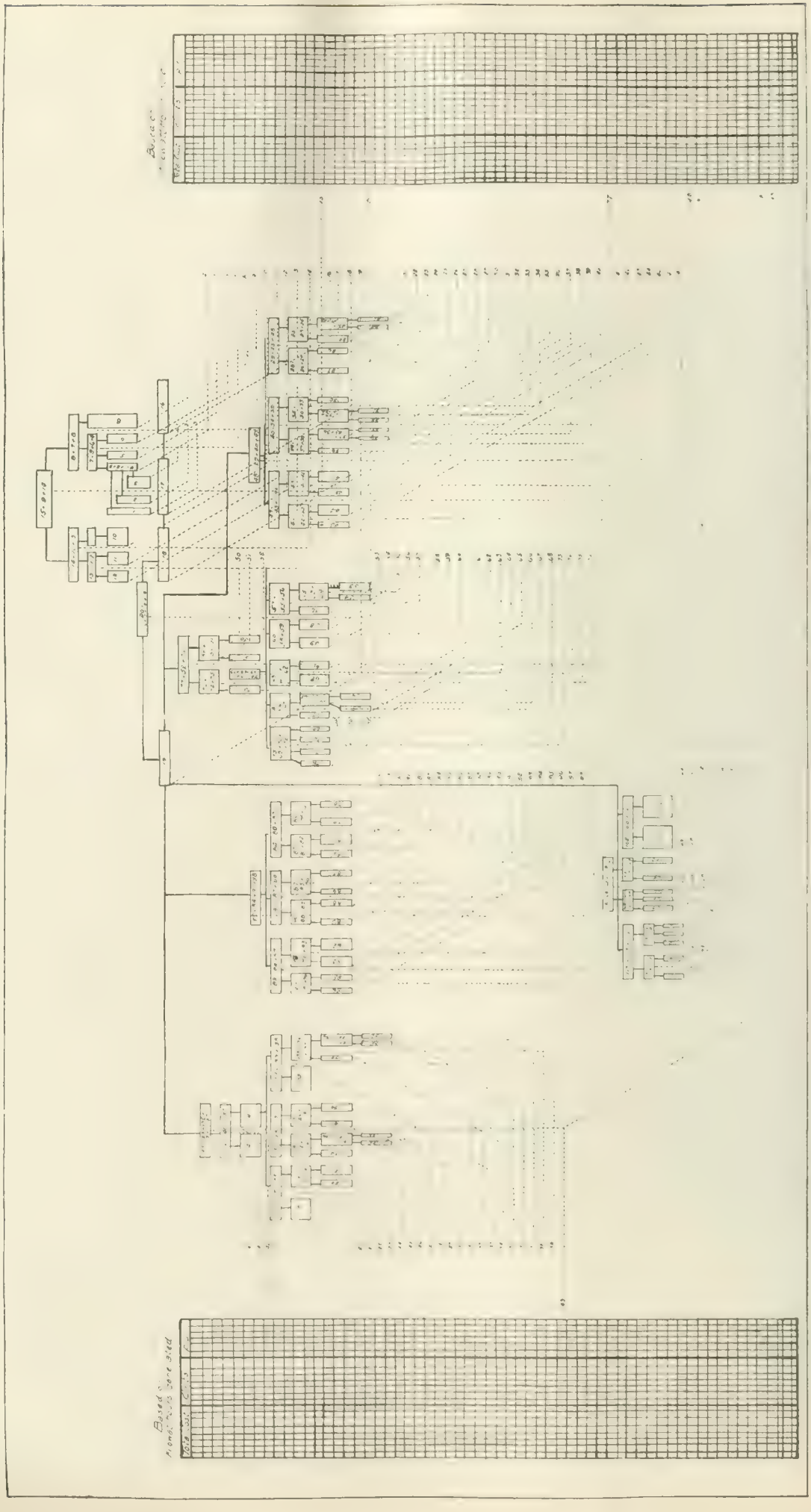


CHART SHOWING THE ITEMS WHICH ENTER INTO THE COST OF A KW-HOUR OF ELECTRICAL ENERGY.

the cost of a kw-hour sold, and, to any successful manager, one branch of cost is of no greater importance or worth than any other. There is no value in economically generating the kilowatt-hr and then either badly selling, distributing, billing or collecting it; there can be absolutely no value to advantageously selling a kw-hour and either badly generating, distributing, billing or collecting for it. In a well-managed power corporation, therefore, equal value must be granted to each branch, and the efficiency of the whole can never be greater than that of the weakest section.

The product delivered at the point of consumption and sold information and guidance to the efficiency of equipment and the line and transformer losses, an exhibit of the kilowatt-hrs. generated (and the generating cost only in relation to the generated power) can be made of the very greatest value, although the true cost can bear actual relation to no more nor less than the product sold as appearing on the consumers' ledger or register.

There exists at all times as grave a danger of voiding the value of cost gathering, through inefficient and expensive forms or systems or clerks, as there is of depriving the manager of his greatest assistance through no cost gathering at all. There

THE KEY.

(Start at the Top.)

CAPITAL CHARGES,

15 = and is said to equal 9 plus 14.
9 = Maintenance and insurance, and is said to equal 7 plus 8.
8 = Insurance.
7 = Maintenance, and is said to equal 4 plus 5 plus 6.
6 = Maintenance of real estate and buildings.
5 = Maintenance of transmission and service lines.
4 = Depreciation, and is said to equal 1 plus 2 plus 3.
3 = Depreciation on buildings.
2 = Depreciation on equipment (machinery).
1 = Depreciation on equipment (service).
14 = Interest and Sinking Fund, and is said to equal 10 plus 13.
10 = Commissions and organization expenses.
13 = Interest and Sinking Fund, and is said to equal 11 plus 12.
12 = Interest on bonded debt.
11 = Sinking Fund requirements under mortgages.

MANAGEMENT,

20 = and is said to equal 16 plus 17 plus 18 plus 19.
19 = General manager.
18 = Local directors.
17 = Secret service department.
16 = Legal department.

SELLING,

48 = and is said to equal 47 plus 40 plus 29.
47 = Billing and collecting and equals 46 plus 43.
46 = Billing, and is said to equal 44 plus 45.
45 = Chief biller and billing clerks.
44 = Bill checkers and ledger keepers.
43 = Collecting, and is said to equal 41 plus 42.
42 = Chief collectors and office collection force.
41 = Itinerant collectors.
40 = Meter readings, revisions and inspections and equals 34 plus 39.
39 = Meter readings, and is said to equal 37 plus 38.
38 = Meter readers.
37 = Meter reading recording, and is said to equal 35 plus 36.
36 = Recording to permanent records.
35 = Recording to billing department sheets.
34 = Meter revisions and inspections, and is said to equal 30 plus 33.
33 = Meter revisions, and is said to equal 31 plus 32.
32 = Revisions in the shops.
31 = Revisions in service.
30 = Inspectors.
29 = Contracting, demonstrating and complaints, and is said to equal 25 plus 28.
28 = Contracting, and is said to equal 26 plus 27.
27 = Light contracting.
26 = Power contracting.
25 = Demonstrating and complaints, and is said to equal 23 plus 24.
24 = Electrical engineers or demonstrators.
23 = Complaints, and is said to equal 21 plus 22.
22 = Complaint clerks and correspondence.
21 = Work and contract order clerks.

ACCOUNTING,

77 = and is said to equal 52 plus 76.
76 = Auditing, and is said to equal 74 plus 75.
75 = General auditor and staff.
74 = Assistants and staff, and is said to equal 57 plus 60 plus 63 plus 68 plus 73.
73 = Timekeeping, and is said to equal 69 plus 70 plus 71 plus 72.
72 = Chief timekeeper.
71, 70, 69 = Timekeepers and inspectors.
68 = Stores accounting, and is said to equal 66 plus 67.
67 = Branch stores.
66 = General store, and is said to equal 64 plus 65.
65 = General storekeeper.
64 = Clerks and helpers.
63 = Cash department, and is said to equal 61 plus 62.
62 = Cashiers.
61 = Paymasters.
60 = Freights and claims, and is said to equal 58 plus 59.
59 = Freights.
58 = Claims.
57 = Receipts and expenditures, and is said to equal 55 plus 56.
56 = Stores and materials (audit of).
55 = Sales and collections (audit of), and is said to equal 53 plus 54.
54 = Billing (audit of).
53 = Collections (audit of).
52 = Statistical department, and is said to equal 50 plus 51.
51 = Chief statistician.
50 = Assistants and staffs.

DISTRIBUTING,

99 = and is said to equal 84 plus 91 plus 98.
98 = Contract, disconnection and work orders and is said to equal 94 plus 97.
97 = Contract (connection) orders, and is said to equal 95 plus 96.
96 = Shop work.
95 = Outside work (connections at customer's premises).
94 = Disconnection and work orders and is said to equal 92 plus 93.
93 = Shop work.
92 = Outside work.
91 = Underground system, and is said to equal 87 plus 90.
90 = Contract work, and is said to equal 88 plus 89.
89 = Shop contract work.
88 = Exterior contract work.
87 = Company work on underground system and equals 85 plus 86.
86 = Shop work.
85 = Exterior work.
84 = Overhead system, and is said to equal 80 plus 83.
83 = Public lighting, and is said to equal 81 plus 82.
82 = Shop work.
81 = Exterior work.
80 = Private lighting, and is said to equal 78 plus 79.
79 = Shop work.
78 = Exterior work.

GENERAL EXPENSE,

118 = and is said to equal 102 plus 105 plus 109 plus 117.
117 = Correspondence and communication, and is said to equal 113 plus 116.
116 = Correspondence, and is said to equal 114 plus 115.
115 = Stationery.
114 = Postage.
113 = Communication, and is said to equal 110 plus 111 plus 112.
112 = Telephones.
111 = Telegrams and telegraph offices.
110 = Messengers.
109 = Judgments and damages, and is said to equal 106 plus 107 plus 108.
108 = Maintenance of hospitals.
107 = Sick benefits.
106 = Damages and injuries.
105 = Rents, and is said to equal 103 plus 104.
104 = Rents of offices.
103 = Rents of substations and buildings other than offices.
102 = Traveling and commissary, and is said to equal 100 plus 101.
101 = Traveling expenses.
100 = Maintenance of officers' and employees' quarters.

GENERATING,

143 = and is said to equal 123 plus 132 plus 139 plus 142.
142 = Chief operating engineer and assistant operating engineers, and is said to equal 140 plus 141.
141 = Chief operating engineer and clerks.
140 = Assistant operating engineers and clerks.
139 = Water storage and transmission, and is said to equal 133 plus 138.
138 = Water storage, and is said to equal 134 plus 137.
137 = Reservoirs, and is said to equal 133 plus 136.
136 = Dams.
135 = Weirs and valves.
134 = Canals.
133 = Transmission lines.
132 = Generating and substations, and is said to equal 128 plus 131.
131 = Substations, and is said to equal 129 plus 130.
130 = Dynamos.
129 = Transformers and switchboards.
128 = Generating stations, and is said to equal 124 plus 127.
127 = Equipment, and is said to equal 125 plus 126.
126 = Electrical equipment.
125 = Hydraulic equipment.
124 = Switchboards and transformers.
123 = Transportation (to power plants), and is said to equal 119 plus 122.
122 = Railroads, and is said to equal 120 plus 121.
121 = Operation.
120 = Equipment.
119 = Cartage (other than rail).

—and not the product generated and received at the station—must be the vital cost item for consideration from the commercial or financial viewpoint of any power corporation. In a manufacturing enterprise, the cost must be based on the finished product—not on the raw material purchased; a mine must base its cost on the value of the bullion extracted—not on the tons of crude ore mined; and a hydro-electric or steam power plant permits of no distinction to this rule of costs. Included in a well-planned cost sheet, however, in order to render valuable are two ideally perfect justifications for detailed cost sheet—speed and economy in its compiling; absolute certainty of unequivocal, auditable correctness. A cost sheet produced at too great a cost in itself, or at a protractedly delayed date, or a cost sheet with a single erroneous or misleading item, is worse than no cost sheet at all.

There are three vital requirements of the production of successful cost sheets: A good time-keeping system, a good warehouse system, and both strongly backed by a well-drawn

and carefully kept voucher record. Cost gathering under any other circumstances is a hopeless undertaking and a useless labor.

The result of a well-planned, clearly-drawn and properly-prepared cost sheet is to place on the manager's desk the data and information which enable the successful operation of the corporation. Commercial competition of the present age has placed the liability of the success or the failure of an enterprise on the one pivotal point—the cost sheet.

The managing head of a successful corporation, however, must rely on the head of each of the various departments for the detailed efficiency of each and every branch. Failure to have realized that there is grave danger of voiding the value of cost gathering through the forced recognition by the manager of the too numerous details, has spoiled many a cost system and cost sheet. There can be speedily traced along the whole organization of a corporation those interests which appeal to the several individuals and governing bodies and heads; the stockholders' viewpoint is focused within the lines of the range of dividends; the board of directors care to study the totals of the cost sheet and the production schedule; the local management centers its interest in the cost, generating, distributing, selling, accounting, and general expense; the chief operating engineer proves his worth by his knowledge of the details of the generating cost, and the head of each department is, in turn, of value through his cognizance of every detail in his own branch, until we find the keeper of the stables earning his salary through his ability to confirm whether the mules require more feed. In successful corporations the demand for detail inverses the importance and relative positions of supervision of the management and stockholders. A successful cost sheet must evidence each and every one of the facts cited; the failure to have founded it on the requirements of a good timekeeping and warehouse system and voucher record, and on an understanding of the requirements of organization, means the compiling of a useless cost sheet as far as actual value and true merit are concerned.

The scope of this article prevents any comment or suggestions as to the timekeeping or warehouse system or voucher records, but on the chart of the kw-hour, which is illustrated herewith, can be clearly traced the organization requirements of the supply company for which the chart was prepared, and the proof of the inverse ratio of detail called for by the supervising heads in the various positions of management. The board of directors receive the final total figure; the manager receives the totals of generating, general expense, distributing, selling, accounting; and the heads of each branch receive from a cost sheet compiled in accordance with the suggestion of this chart each and every detail in each branch.

There are no innumerable sheets of typewritten instructions to the accounting department as to how to prepare the sheet; the chart is before the accounting department; the timekeepers, storekeepers and foremen have a distribution of accounts record with the corresponding number to fit the proper place in the key; the voucher record is prepared to match, and the cost sheet comes out on the second day of each month, compiled from the voucher record by an inexpensive clerk and is subject to simple, inexpensive and easy auditing whenever the auditor turns his attention toward it.

The key to the chart takes one into the details which go to make up the cost of a kw-hour, and, while there might be found particular instances requiring changes to meet the requirements of local conditions, the foundations will, no doubt, remain the same for all hydro-electric plants. Perhaps a little study would lead to the belief that the chart is not far from being a correct solution for submission to those bodies which are endeavoring to arrive at some form of uniform accounting for gaging the taxable value of power plants. Little or no comment is passed on the detail of the key, as set forth in this article, inasmuch as the chart, likewise, covers the local requirements of organization.

Now it will be found that the chart is so arranged that, when the figures are placed as directed, by a clerk who may know little more than how to add, that he has 1 to 14 placed in complete order to sum, and has the simplest task to foot up the total and have the first item of "capital charges" totaled and ready for passing to the report that goes to the general manager. Notwithstanding the endeavor to limit this article to data on a "cost sheet," it seems potent to state that a good voucher record will have only the operating columns shown as headings on this chart—that is, Capital Charges, Management, Selling, Accounting, Distributing, Generating, and General Expense—and an auxiliary ledger will carry the subdivisions.

Thus, again, 16, 17, 18 and 19 will be found to be in place by reference to the figures in the management group on the chart for a simple addition to reach the total of 20. The billing and collecting shown in the selling division (48 to 21) are put under the commercial or selling branch not because it is thought judicious to do so, but in order to meet the peculiar local conditions. A better class of organization would be to place the billing and collecting directly under the accounting department.

Here, then, we have 143 subdivisions or items which properly and honestly go to make up the "cost of a kw-hour," arranged in an exceedingly simple manner to produce a cost sheet clearly evidencing operation and organization. The study of technical requirements has been so great that the importance of good accounting and cost-sheet gathering has been overlooked up to this age, in which commercial competition forces the recognition that, through the assistance of good accounting alone can good results be accomplished from any enterprise in which even the very gravest of engineering and manufacturing requirements have been overcome.

The fact stands out boldly and indisputably that a cost sheet or a production schedule, prepared and submitted to the manager on the day following the closing of the regularly established period—be it weekly, monthly, semi-annually or annually means a correct accounting exhibit—delays invariably and undeniably mean errors and inefficiency. A good cost sheet, economical, efficient and prompt, is dependent on well-drawn timekeeping, warehouse and voucher systems; a good production schedule relies on the properly drafted consumers' ledger; the success or failure of any enterprise of to-day rests to an extent equal (if not more than) to well-organized technical departments, on a well-systematized accounting department. Technical men have apparently been bred to be so naturally inimical to the accountant that they will not read the hand writing on the wall.

INTERIOR WIRING AND ILLUMINATION

Illumination for Irrigation Congress at Spokane, Wash.

The accompanying illustration shows the special illumination erected at Spokane, Wash., for the National Irrigation Congress, held in that city Aug. 9 to 14. The set piece and festoons cover in all some 5500 running feet. Suspended by a cable running diagonally across the street, and 85 ft. from the pave-



ILLUMINATION ON SPOKANE STREET.

ment, was the set piece containing 1715 8-cp lamps. The decorations created very favorable comment by the throng of visitors who were in Spokane during the congress, and the festoons had some 2736 8-cp lamps, making a total load of 133 kw in the entire installation. The scheme of decoration was promoted by the civic organizations of the city, who induced the Board of Public Works to donate $5,000 for its erection. The installation was made in a manner to permit of its removal and replacement for special occasions. By popular subscription the merchants donated sufficient funds to keep the special lighting in force until Oct. 1.

The Electrical Contractor and the Central Station.

Mr. James R. Strong, former president of the National Electrical Contractors' Association, gave an expression of his views on the subject of co-operation with contractors from the standpoint of the contractor at the recent convention of the Pennsylvania Electric Association. On this question Mr. Strong said:

Co-operation, much to be desired, certainly possible and the aim of all men who are thinking earnestly, has a most fruitful soil in which to labor when applied to the relations between the central station and the contractor. The field is fruitful for the reason that under normal conditions the interests do not clash, and it is only when one or the other departs from the natural course of the business for which it was organized that they become competitors.

It is unnatural and poor advertising from an economic standpoint for the lighting company to give away motors and wiring in order that it may sell electricity to a new customer. In the early days of gas and electricity, such practices were considered good, but with the development of the science of engineering and the growth of young men trained in the electrical profession there is no lack of opportunity to carry out construction propositions of all kinds, and the lighting companies who have given the subject most thought have concluded that the best results are obtained by legitimate publicity advertising coupled with the good will of the other branches of the industry.

On the other hand, it is equally unnatural and poor business for the contractor, because of unpleasant relations with the lighting company persistently to urge his customers to install their own plants, when conditions are such that it is unquestionably for the best interests of the customer that the central station service be used. In many cities throughout the country where the strife between these two interests has been fierce and furious, and where, because of such strife, business has suffered, wonderful results have been accomplished by only one or two meetings between the parties in interest, or, in other words, by co-operation. Why should not every lighting company gather round it all contractors of the district and meet with them at least every two months and discuss matters of mutual interest? Why should not the lighting company abandon the sale of supplies and apparatus and construction work at prices which mean a loss to them and arrange with contractors a set of fair prices at which such supplies should be sold or work done?

If the rate charged for energy is so high that the lighting company feels it must make some concession to obtain a customer, there are two alternatives—either reduce the rate or let the company give the work to a contractor after competitive bidding, and share the cost with the contractor in such ratio as may be desired. It is to be noted with satisfaction that the discussion of this subject during the past two years at various gatherings and in the electrical press, has produced excellent results in many localities, and it is well to bear in mind the slogan of the contractors' association, which is working for harmony in the electrical industry, "All together, all the time for everything electrical."

In concluding, Mr. Strong intimated that if the lighting companies would co-operate with the contractors in their respective districts on a fair basis, they could increase their business and extend their lines at less cost. By this means the contractor could make a reasonable profit on his business and the central-station company could annex him as a salesman to whom it would pay no salary, but who could probably get better results than a salaried salesman because he is in closer touch with the customer desiring to make use of the product of central stations.

Street Lighting at Fall River, Mass.

Since April, 1908, the street lighting of the city of Fall River, Mass., has been changed over from the old 9.6-amp, direct-current series open-arc system to the 4-amp magnetic equipment of the General Electric Company. The Fall River Electric Light Company controls the central-station service for this city. It has 832 luminous-arc lamps in operation upon an all-night and every-night-in-the-year schedule at a contract price to the city of 25 cents per lamp per night. The contract is a five-year agreement, with about three more years to run. The lamps have been installed in the locations of the superseded units, the height above the street being about 20 ft. The first circuit was operated about 16 months ago. A representative view of the illumination provided in the residential districts by the magnetite lamp is shown in Fig. 1. The lamps are carried upon mast-arms hung from wooden poles in such a manner that the lamp is located well out in the street toward



FIG. 1.—4-AMP MAGNETITE ARCS, FALL RIVER, MASS.

the intersection of the thoroughfares, giving each avenue of travel nearly an equal amount of illumination.

The standard pole adopted for Fall River is shown in the accompanying drawings. A special feature, which was designed by Mr. A. H. Kimball, general manager of the Fall River Electric Light Company, is found in the pole base, which is entirely free from wood, and which consists of a set of angle irons forming a hollow square in horizontal cross-section, inside which is deposited a concrete filling. The entire structure below the level of the ground is decay proof and the angle irons are tied together by ½-in. bolts. The wooden pole proper sets into the angle-iron socket with the bottom of the pole about 30 in. above the ground. The angle irons are each 3 in. x 3 in. x ⅜ in. and 7 ft. long, four being used for each pole. Ordinarily they are set 4 ft. deep in the earth, two sets of reinforcing bolts or stiffeners being provided below the ground line and four sets above. Two bolts are included in each set, one set being used for each pair of angles. The base of the pole structure is 9 in. square at the bottom, this size holding above the ground level, where the wooden pole is set into the angles. A special pipe elbow is attached to the angle-iron structure, usually about 2 ft. below the ground, and a pipe of this diameter is carried up to the inside bore of the wooden pole for the lighting conductors. The location of the elbow can be easily changed. It is expected that by thus avoiding

the use of wood below the ground level the life of the poles will be enormously increased, and the safety of the public will be greatly enhanced, since the falling of a pole will be wellnigh impossible. A drawing is shown of the entire pole, with another

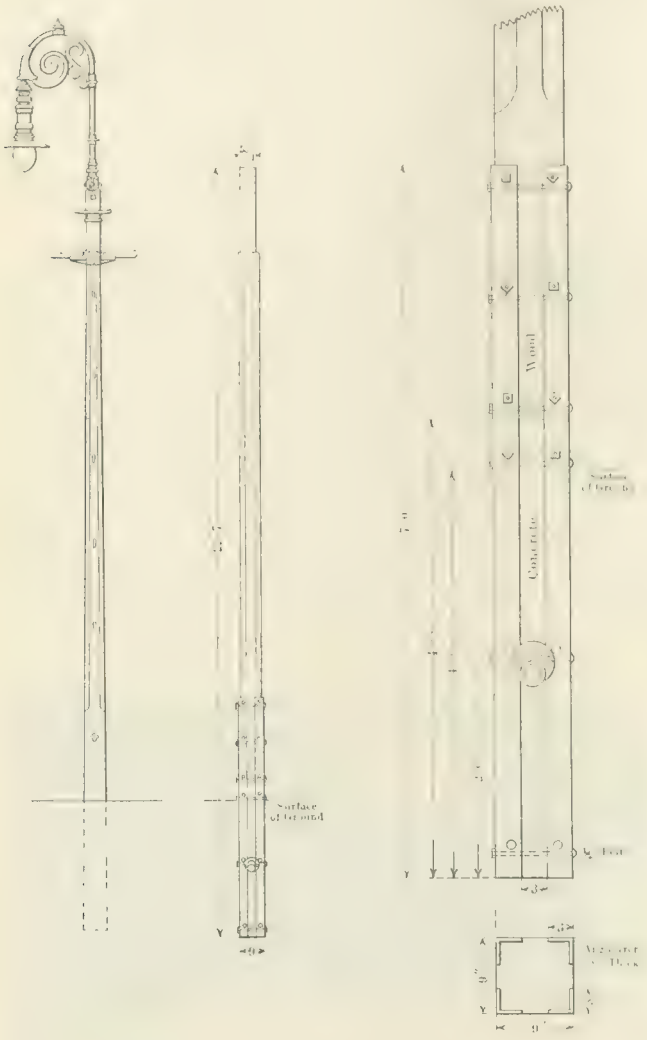


FIG. 2.—DETAILS OF LAMP POST.

of the wooden portion. The lamps are hung from the poles upon ornamental cast-iron scrolls coated with aluminum paint. About 50 of the poles, which were manufactured by the Lundin Electric Manufacturing Company, of Boston, are to be installed within the next few weeks. A positive cut-out switch is provided in the top of each pole, above the trimming bracket.

The energy for the operation of the street-lighting system is supplied by the company's new power station, located on Hathaway Street, and distributed from a substation located on Hartwell Street, near the business center of the city. The lamps in Fall River are run in connection with mercury-arc rectifiers and 100-lamp tub transformers installed in the substation. The rectifier tubes are oil cooled. There are 18 circuits at present, No. 6 B. & S. wire being used except in the underground lines of most recent construction where a special No. 8 lead-covered, 10-conductor concentric cable is used. At present about one mile of street north of the substation is provided with this type of cable, which consists of a central core of No. 8 copper surrounded with nine smaller conductors. Each conductor is surrounded with taped rubber insulation about ¼ in thick, and the group of conductors is imbedded in a jute body 1½ in. in diameter, on the outside of which is a layer of varnished cambric. The outside of the cable is lead sheathing and the outside diameter of the structure is about 2 in. It is estimated that by the use of this cable the company saved upward of $2,500 in 6000 ft. of duct construction, on account of the economy in ducts through the use of five circuits in each, the compactness of the layout and the estimated higher expense of separate pairs of cables. This cable passed an insulation test of 17,500 volts, alternating current. The company is obtaining a tube life of at least 1000 hours, and a run of about 200 hours per trim on the lamp electrodes. In the substation a meter is provided to measure the entire output of the street-

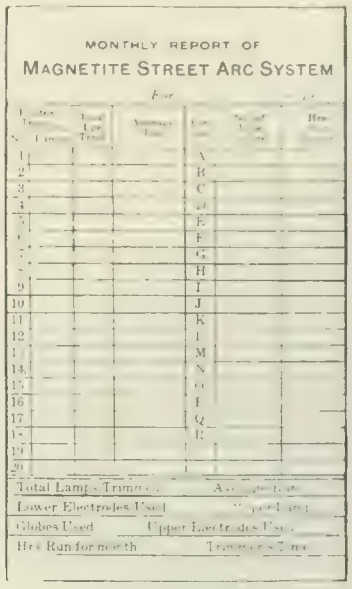

MONTHLY REPORT OF
MAGNETITE STREET ARC SYSTEM

FIG. 3.—BLANK FOR REPORTING CONDITION OF LAMP.

lighting system between the main alternating-current busbars and the arc-circuit controlling board. An ammeter and a pilot lamp are provided in each circuit.

Records of the performance of the magnetite lamps, circuits and tubes are kept monthly on cards about 3 in. x 5 in., as shown in Fig. 3. Each card indicates the number of lamps installed on each route, the total number trimmed in the month, the average run per trim, the number of hours run of each rectifier tube, globes used, life of electrodes, outages of lamps, rectifier-tube renewals, dates of tube installation and removal, and other points of interest in the maintenance of the system. A space is also provided on the reverse side of each monthly card for the troubles which may be reported, including welds, failure to start, burned-out electrodes, circuit difficulties, broken globes and other defects which may cause trouble. The cards are unusually complete considering their compactness. The entire overhead system is undergoing rehabilitation; the substation is being altered to enable a part of it to be used for office service, and plans are under way to introduce economies in the distribution system by shortening the lengths of run between the generating plant and certain districts where the consumption of energy is centralized.

The Installation of Tungsten Lamps for Factory Illumination.

By Arthur Gillman.

As is well known, tungsten lamp filaments are susceptible to breakage from shocks, and inasmuch as the conditions for damage to lamps in factories are good it is necessary to provide against breakage and outages due to vibration or other causes. There is no reason, if proper precautions are taken when making an installation of tungsten lamps in a factory, why they should not give as good service as carbon-filament lamps with the added advantages of better light and greater efficiency. A good type of jar absorber which can be easily construction is shown in detail in Fig. 1 and as applied in Fig. 10. It consists of a spiral spring having an internal diameter such that it will slip over the conduit stem into which it is to be inserted. A few of the last turns at each end are soldered together and the spring is held on the conduit with spring cotters. Either brass or steel wire may be used for the spring, but brass is preferable in that it will not corrode. The spring cotters should be of brass—or a short piece of brass wire will do. Cotters of steel rust quickly, are difficult to remove and

in exposed locations might in a short time rust entirely in two. In selecting wire from which to wind a spring to support a cluster of a given weight, the table by J. Bergtrup in Kent's "Mechanical Engineers' Handbook" will be found of

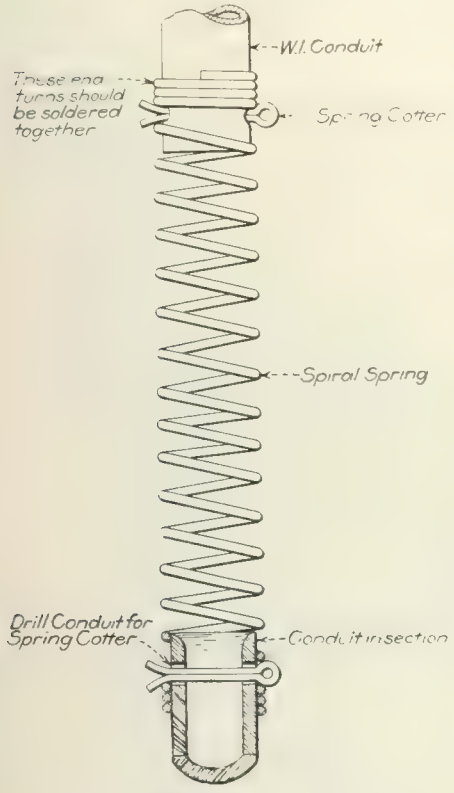


FIG. 1.—HOME-MADE JAR ABSORBER.

assistance. The values therein given are for steel, and the strength of brass springs will be about one-third the values tabulated. Wind a spring from the smallest wire that will safely sustain the load and use enough turns to prevent any shock from reaching the tungsten lamps. The determination

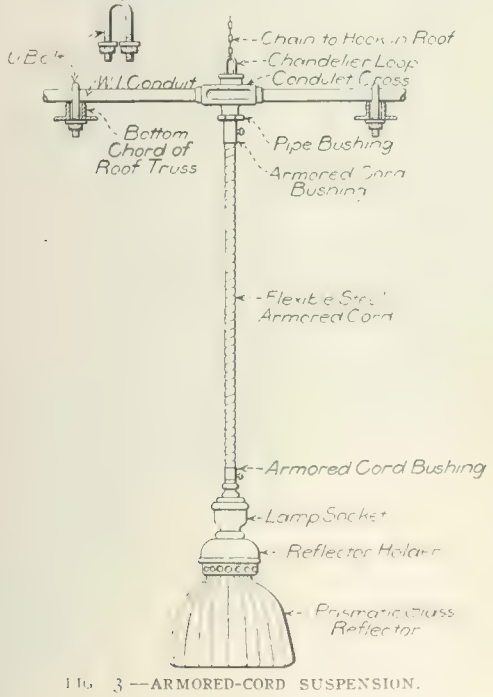


FIG. 3.—ARMORED-CORD SUSPENSION.

of the correct number of turns is somewhat a matter of experiment, but 25 is ample in most cases. The spring should be wound with adjacent turns close together. When the load is applied it will extend to the form shown in Fig. 1, which shows a spring under tension.

Flexible steel-armored cord and conduit, where shocks are not too severe, make a good supporting member for tungsten lamps or clusters. These commodities (flexible armored cord and conduit) of themselves form a spring-like structure, being made from strips of metal, coiled spirally, with their edges so formed as to constitute a bond between adjacent turns. Fig. 2 shows a photographic reproduction of an installation of 250 watt tungsten lamps in the Cumberland (Md.) Steel Company's mill. These lamps were hung somewhat after the manner indicated in Fig. 3. The space illuminated is 260 ft. x 84 ft., and the lamps hang 12 ft. 6 in. above the floor. There are 76 units used and an approximate even illumination of 2½



FIG. 2.—TUNGSTEN LAMPS IN A STEEL MILL.

foot-candles is claimed at the plane of illumination. The area illuminated comprises (260 × 84) 21,840 sq. ft. and the power expenditure is 5 (rows) × 11 (lamps) × 250 (watts) = 13,750 watts, which gives a power consumption of 0.62 watt per square foot. Prismatic glass reflectors of the "extensive" type were used. The installation of this type of reflector in a steel mill appears to be a rather bold departure. It is pretty generally accepted that dirt on the outside of prismatic reflectors does not impair the efficiency of the unit to any great extent as regards the useful downward light and there is less liability of breakage to such a reflector, installed up out of reach, than to the enclosing globes of an arc lamp which are subjected to the action of heat and the operations of a trimmer. Mr. George A. Eyler, chief electrician of the Edison Company, of Cumberland, under whose direction the installa-

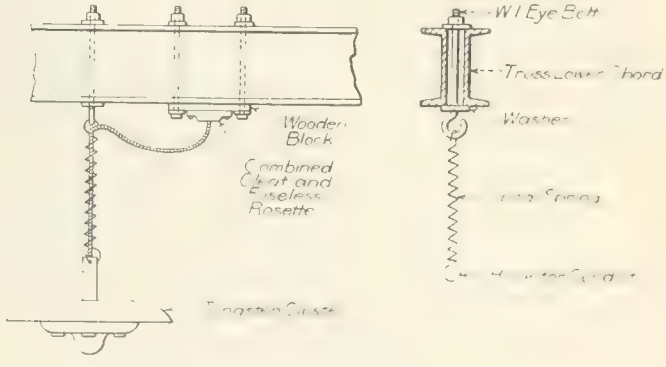


FIG. 4.—OPEN-WORK CLUSTER INSTALLATION.

tion was made, states that Greenfield armored cable, No. 18, suspended from regular "Condulet" outlet boxes was used. (See Fig. 3.) As this material is rather stiff and springy, the weight of the shade and lamp is sufficient to pull the kink out and yet leave sufficient resiliency to protect the delicate tungsten filament. The photograph from which Fig. 2 was re-

produced was taken at night with 45 minute's exposure with a 32nd stop.

All of the methods thus far described for damping filament-destroying vibrations have been in connection with conduit installations. Where conductors are "run open" less elaborate devices can be used. Fig. 4 illustrates how a tungsten cluster may be carried on a spring from the bottom chord of a roof

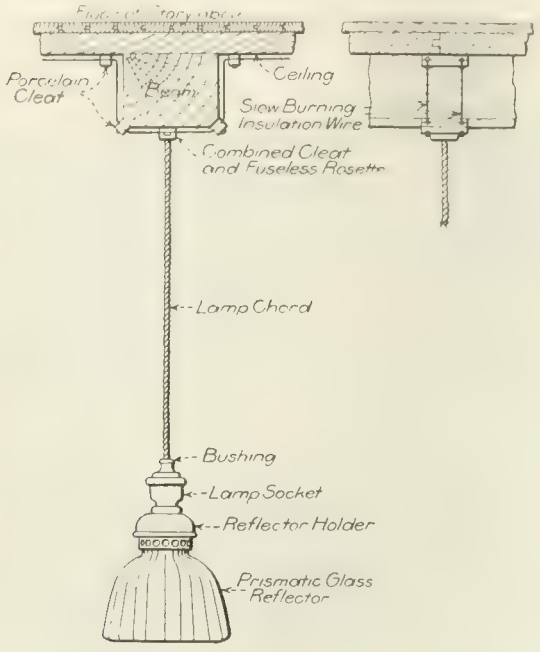


FIG. 5.—LAMP CORD SUPPORTING TUNGSTEN LAMP.

truss. The lower end of the spring wire is passed through a hole in the cluster stem and the upper end hooks through an eye-bolt clamped between the two steel channels forming the chord. Although a trifle more complicated, the method of attaching a spring to a conduit, shown in Fig. 1, is preferable to that in Fig. 4. Some bending of the spring wire is necessary to effect a positive engagement of the hole (Fig. 4) and there is a possibility of the wire being broken off in the operation, whereas with the cotter (Fig. 1) there is every assurance of a substantial job. In Fig. 4 the conductors to the cluster are tapped, in a combined cleat and fuseless rosette (detailed in Fig. 8) from the branch wires. The rosette is held on a wooden block, which is secured to the chord with bolts, with wood screws.

In buildings of slow-burning mill construction the method of open-work wiring delineated in Fig. 5 is sightly and inexpensive. The branch conductors are supported on porcelain cleats and fuseless rosettes and are made to follow the contour of the ceiling instead of being carried on wiring boards spanning from beam to beam. Where wiring boards are used dust collects on their tops and drops down when an unusual jar occurs. Furthermore, disagreeable shadows are cast on the

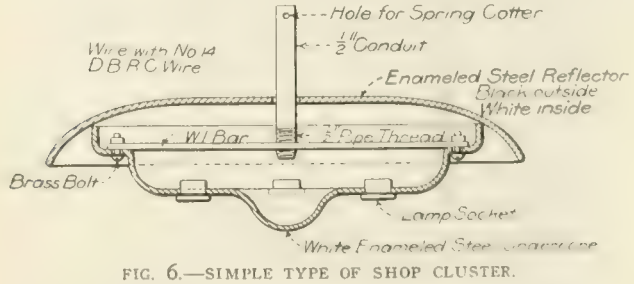


FIG. 6.—SIMPLE TYPE OF SHOP CLUSTER.

ceilings, interfering with the effect of a general illumination. Resiliency is supplied in Fig. 5 by the lamp cord carrying electricity from the rosette to the tungsten unit. This method of suspension has proven quite satisfactory in buildings wherein the vibration is due to the operation of light machinery. It may be pretty safely asserted that a lamp-cord suspension will protect a tungstent filament in any building where the floor and floorbeams are of wood. The wooden construction of itself absorbs tremors due to the operation of machines, and, furthermore, it is very likely that any shocks that would rupture a filament after being transmitted through a length of lamp cord would be too severe for wooden construction to withstand long.

The socket shown in Fig. 5 is keyless, as should be all sockets holding tungsten lamps. Obviously the sudden snap of the ordinary socket switch is very undesirable. All such units should be controlled, either singly or in groups, by wall switches. Prismatic glass reflectors, due to the reasons outlined in connection with Fig. 2 give much better results when exposed to dirt and when not kept very clean, than would be expected and they, arranged as shown in Fig. 5, will find many applications in industrial-plant lighting.

An excellent type of tungsten cluster for interior factory installations is illustrated in Fig. 6. Attention is called to it because of its simple, common-sense construction. There are but two pieces to the cluster proper: the shade and the undercone. Both are of unbreakable enameled steel. The undercone is all white and the reflector is white inside and black outside. Support is provided by means of a wrought-iron bar, held to the undercone with two brass bolts (brass so as not to rust)

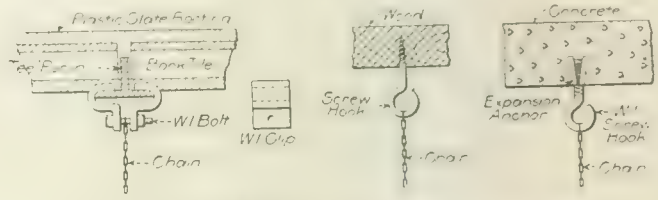


FIG. 7.—THREE METHODS OF SUPPORTING CLUSTERS.

into which the wrought-iron conduit stem turns. This conduit stem may be short, as shown in the drawing (Fig. 6), with a hole in it for spring suspension or it may be supplied of any length for direct attachment to a non-vibrating ceiling. The reflector is held to the undercone merely by its own weight and is free to slide up and down on the conduit stem. Some manufacturers thread the hole in the reflector to mesh into a thread on the conduit stem so that undercone and reflector can be rigidly clamped together. This seems unnecessary for interior clusters and renders access to the interior of the undercone for inspection, rewiring or repairs difficult.

In ordering clusters it is well to specify that they be wired with No. 14 wire. If the usual No. 16 or No. 18 is used it may be difficult to secure the approval of the underwriters for the installation of a number of lamps on one cut-out requiring jointly more than 660 watts. If the rule, limiting the power consumption of incandescent lamps dependent on one cut-out to 660 watts, be adhered to, an individual cut-out would be necessary for each cluster of four 100-watt lamps or for each pair of 250-watt units. To satisfy these conditions it is necessary either to locate cut-outs on ceilings and above roof trusses or carry a great many branch circuits to the panel box or distribution center from which they feed. The first arrangement is undesirable as good practice dictates that every cut-out should be so located that it can be re-fused by a wireman standing on the floor. It should not be necessary to use a ladder to re-fuse a cut-out. The second arrangement is undesirable because of its excessive cost and complication. Some industrial concerns wire all lighting circuit branches with No 14 wire and install clusters on each branch up to the carrying capacity of the No. 14 wire. On this basis three 400-watt clusters may feed from one No. 14 branch at 110 volts and six 400-watt clusters at 220 volts, the only cut-out on the branch being at the panel box or distribution center. Tungsten clusters and single-lamp lighting units are so simple and reliable that this practice appears to be well justified, but special authorization should be secured from the underwriters and all fixture wiring should be of No. 14 before an installation is made on this basis. The Code rule requiring a separate cut-

out for each arc lamp or series of arc lamps is a wise one to follow, inasmuch as a sticking carbon or a disarrangement of the involved arc-lamp mechanism frequently causes a short-circuit which would, by blowing fuses, extinguish several arc lamps unless each one or series has its own cut-out. Short-circuits in tungsten cluster wiring, particularly if the wire is

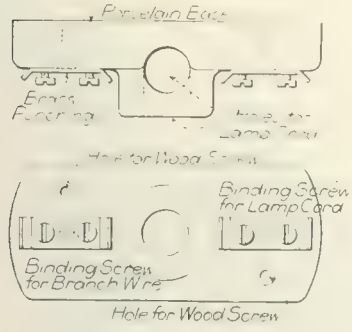


FIG. 8.—FUSELESS ROSETTE

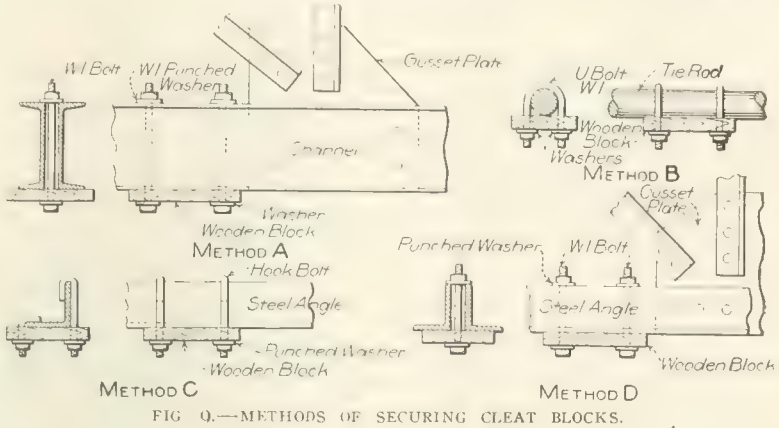


FIG. 9.—METHODS OF SECURING CLEAT BLOCKS.

No. 14, or in the wiring of single-lamp high-power tungsten units, are extremely exceptional.

A cluster, such as that shown in Fig. 6, may, in an open-

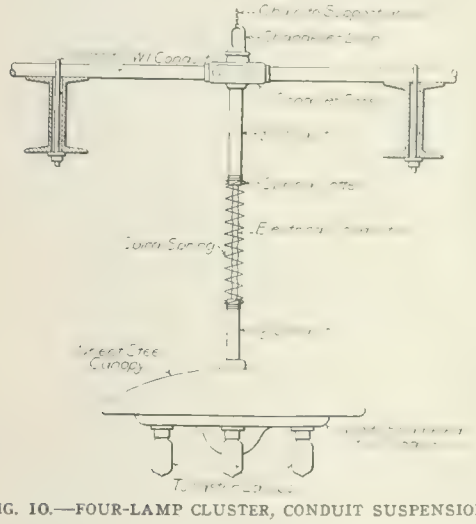


FIG. 10.—FOUR-LAMP CLUSTER, CONDUIT SUSPENSION.

work installation, be hung as indicated in Fig. 4 from the hook at the end of a spring, or in a conduit job arranged with a spring and cotter (Fig. 1) as outlined in Fig. 10. In either case it may be necessary to support spring and unit from a ceiling or roof high above the plane where the unit should hang. In such cases the end of the spring or a loop in a conduit fitting (see Fig. 10) can be made fast to a galvanized-steel chain extending vertically upward to the roof or the ceiling and there hook is turned into a wooden roof or ceiling and the supporting chain suspended therefrom. A good method of supporting from concrete is provided through the use of a lead expansion anchor let into a hole drilled in the concrete. Sometimes such an anchorage is not as strong as it appears to be and each one should be tested before use, with a load twice as great as it will ever be called upon to sustain. If it is possible to determine the location of lighting units in a concrete building before its construction, the logical procedure is to set eye-bolts in the proper locations in the forms before the concrete is poured. The concrete having set, a neat and reliable attachment is possible.

In open-work wiring installations for tungsten lamps the type of fuseless rosette mentioned in connection with Fig. 4, and shown in Fig. 8, is to be recommended. It consists simply of a porcelain block on which are mounted two small brass lugs. The supply wires clamp under the binding screws at the outer ends of the block and the wires to the lamp or cluster clamp under the inner ones. A good electrical connection is thus provided without soldering. If lamp cord is used between the rosette and the lighting units a knot can be made in it which will not pull through the hole in the block and all of the strain of supporting the unit will be taken by the knot, bearing against the block, and none transmitted to the binding screws.

Where the surface wired on is of wood the fuseless rosette (Fig. 8) and the cleats supporting the conductors are held thereto by wood screws, as shown in Fig. 5, but if the installation is in a building of steel construction small wooden blocks are fastened to the steel members intersecting the course of a circuit, and the porcelain cleats and rosettes are held to these

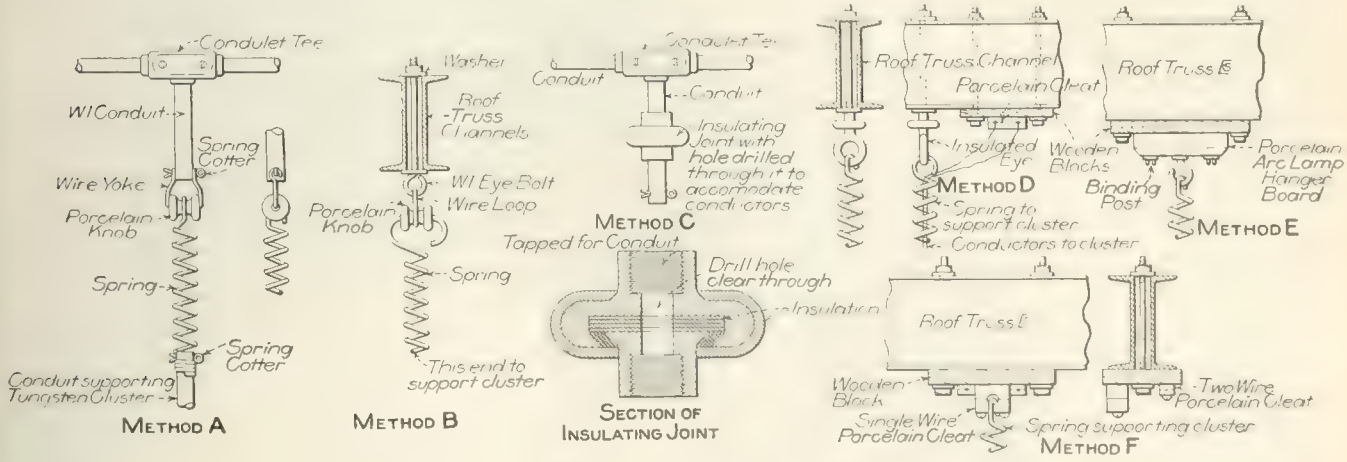


FIG. 11.—METHODS OF INSULATING CLUSTERS.

with wood screws. Fig. 9 details four methods of attaching wooden blocks to steel building members on which cleats, rosettes or lighting units can be mounted. The drawings and notes thereon render any further description unnecessary.

Fig. 10 illustrates a thoroughly satisfactory method of installing a four-lamp tungsten cluster in connection with a conduit installation. The spring and scheme of attachment are those shown in Fig. 1. The cluster hangs in the center of a bay and its weight is taken by the galvanized-steel chain running to the roof, where it is fastened by one of the methods outlined in Fig. 7. Wrought-iron U-bolts hold the conduit carrying the supply wires to the top of the roof-truss bottom chord. (See upper left-hand corner of Fig. 3 for details of U-bolt.) Use is made of a type of conduit cross which carries a porcelain connecting block by means of which the leads to a cluster can be electrically connected to the supply conductors without soldering. This connecting or tapping block is equipped with four stamped metal lugs similar to, though smaller than, those mounted on the fuseless rosette (Fig. 8). The cluster is of the type detailed in Fig. 6.

The National Electrical Code specifies that "fixtures must, when supported from any grounded metalwork of a building, be insulated from such metalwork by means of approved insulating joints." (Rule 26a.) Fig. 11c shows an arrangement whereby an approved insulating joint can be inserted in the conduit stem to a lighting unit. In order to provide for the complete enclosure of the conductors leading to the unit it is necessary to drill out the hole through the insulating joint to the diameter of the inside of the conduit. Method *D* (Fig. 11) shows how a lighting unit in an open-work installation may be insulated from the supporting metal work by an approved insulating eye. It should be noted that in some fireproof industrial buildings, on which no insurance is carried, or where it is possible to secure the authorization of the procedure from the inspection department having jurisdiction, the insulating joints are omitted altogether from fixtures or conduit stems carrying tungsten clusters and units. Methods *A*, *B*, *E* and *F* (Fig. 11) show schemes for insulating fixtures which can be used where insulation seems desirable in buildings where the underwriters do not have jurisdiction. The illustrations clearly indicate the construction in each instance.

Letter to the Editor.

Electricity in Construction Work.

To the Editors of Electrical World:

Sirs:—Since reading the article on electricity in construction work which appeared in the September number, I have taken pains to investigate the subject somewhat in order to satisfy myself that the opportunity for load from a central station viewpoint is promising. In the majority of instances which came under my observation there was a horizontal tubular boiler on wheels in the roadway which supplied steam to a number of steam drills or to hoisting engines.

I believe I am not exaggerating the case when I state that never have I seen such an inefficient lot of steam apparatus working under more adverse conditions. Coke is used for fuel so that smoke ordinances are not violated; but the boilers leak water, the pipe connections to the drills are anything but tight and the drills must consume enormous quantities of steam as well as the hoists. Coupled to all these disadvantages is the necessity for carting fuel and water and the added expense of an engineer or two to look after the apparatus. It would seem that no great amount of argument would be necessary to convince these contractors that motor-driven compressors and hoists would result in a great saving, even though the rate for electric service is comparatively high. With a fair rate, enough might be saved on a large job to pay for the motor equipment, which could be used over and over. Large contractors about New York evidently appreciate the value of electricity in their work, and it is the small contractor on whom much pressure is necessary. Usually the latter bids enough to scrap his equipment after the contract is finished, and if before he buys some more second-hand apparatus he be approached and interested in electrical equipment a day load is assured. It would pay in some instances for a central station to make an installation subject to acceptance if the results claimed materialize. A manager of a medium sized station informed me that he realizes about $25,000 yearly from such work, and that the load is increasing.

New York. Martin Hall.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Determination of Efficiency of Direct-Current Dynamos.—G. Brion.—Although the well-known Hopkinson test has become of great importance for railway motors and in recent years also for turbo-generators, it is often stated that this test is too inaccurate for exactly determining the phenomena in direct-current machines. But these criticisms are generally due to the fact that the method is often employed in unsuitable ways and the efficiency is calculated in an incorrect manner, especially at low loads. The author calls attention to the "excellent arrangements" of Hutchinson and Blondel, which are relatively little known. The author describes these two methods and gives the results of actual tests employing them.—*Elek. Zeit.*, Sept. 16.

Three-Phase Squirrel-Cage Motors.—M. Kloss.—An article, illustrated by diagrams, on the starting torque of three-phase motors with squirel-cage rotors. In order to produce a standard torque-slip curve for a three-phase motor, the slip at maximum torque is introduced as a characteristic constant of the motor. The equation of the torque-slip curve is obtained, and a simple diagram is given connecting the starting torque with the slip. Information is given concerning the normal slip to be provided for obtaining a given starting torque. Finally, the running-up torque is shown to be more important than the static starting torque. Points in design affecting the acceleration are considered.—Lond. *Electrician*, Sept. 16.

Voltage Drop of Alternators.—K. H. Haga.—A mathematical note on the experimental determination of the two armature reactions on which the voltage variation of alternators depends. *La Lumiere Elec.*, Sept. 11.

Heating and Cooling Curves.—An article illustrated by diagrams on the heating and cooling of electrical machines and on the reasons for differences between theoretical and experimental curves.—*L'Industrie Elec.*, Sept. 10.

Lamps and Lighting.

Candle-Power of Metallic-Filament Lamps.—An editorial note stating that it would be unfortunate if the term "candle-power," as applied to metallic-filament lamps, were to become merely a nominal expression, "but to judge from a considerable proportion of the metal lamps at present on the English market, this retrograde step appears to be rapidly taking place." The first metallic-filament lamps used in England were imported from Germany and were rated by hefner candles. But it seems that "some English manufacturers are now copying foreign lamps, even as regards their rating in hefner-candle-power." Moreover, it is stated that "metallic-filament lamps of English manufacture do not in some cases reach, even on the hefner basis, their stated candle-power. Thus, 100-volt lamps of so-called 16-cp frequently give, on being tested, only from 13 to 15 English, or international candles, although they should give about 14.4 if rated originally on the hefner basis. This latter delin-

quency cannot be defended on any grounds, and is likely to do harm by fostering the impression that electric lamps do not give sufficient light compared with incandescent gas lamps. The whole question shows the disadvantages resulting from the use of two standards, a state of things which we hope will be remedied by Germany deciding to fall into line with other countries and to adopt the international candle."—Lond. *Electrician,* Sept. 16.

Metallic Filament.—A note on a recent British patent of W. Schäffer (28,554, 1908; Sept. 9, 1909). Metal filaments produced by squirting a paste through a fine circular die are passed between a pair of rollers, immediately after the squirting, while they are still plastic, so as to be flattened and given a rectangular cross-section.—Lond. *Elec. Eng'ing,* Sept. 16.

Arc Lamps.—Heyck.—Some figures on the economy of various high-intensity lamps of Koerting and Mathiessen. A comparison is made between the "excello lamp" (a flame-arc lamp with electrodes arranged side by side); secondly, the "Axis lamp" (a flame-arc lamp with electrodes above each other); and thirdly, the quartz lamp (mercury-vapor lamp in a quartz globe). With alternating current at 110 volts the 8-amp to 10-amp excello lamp uses from 0.34 to 0.24 watt per lower hemispherical candle-power, with series resistors; and from 0.21 watt to 0.15 watt with series reactance coils. For the 110-volt "Axis lamp" the corresponding figures are 0.46 to 0.35 and 0.28 to 0.25 watt respectively. The total cost of operation (with a price of energy of 5 cents per kw-hour) for 1000 hours and 1 hefner of lower hemispherical candle-power is 1.4 cents for the excello yellow 12-amp lamp with opal globe; 1.9 cents for the excello white 12-amp lamp with diopter and opal globe; 2.0 cents for the 15-amp Axis lamp with three lamps in series; 1.8 cents for the 15-amp Axis lamp with two lamps in series; and 1.8 cents for the 220-volt quartz lamp.—*Zeit. Ver. Deut. Ing.,* Aug. 7, 1909; abstracted in *Elek. und Masch* (Vienna), Sept. 5.

Arc Lamp.—An illustrated description of the Thauma lamp for use in such cases in which, for hygienic or financial reasons a milder light is desired than that of intensive arc lamps. The Thauma lamp is a differential shunt-wound lamp with enclosed arc. In order to get a quieter light and higher efficiency the inner globe is not made absolutely air-tight and the electrodes are very thin. The lamp takes, therefore, an intermediate position between the ordinary arc lamp with pure carbon electrodes and the enclosed arc lamp with 200 or 300 hours life of carbons. In order to improve still more the quietness of the arc, the Beck regulator is used as a series resistor, whereby the current is maintained constant for any variations of the voltage. The lamp may be directly connected to a 110-volt or 120-volt network. It is also suitable for series connection. The construction of the lamp is described and illustrated.—*Elek. Zeit.,* Sept. 16.

Flame-Arc Lamp.—An illustrated description of a number of improvements which have been made in the Jandus enclosed flame-arc lamp. Both electrodes now contain chemicals, and the rocking lever is mounted on ball-bearings. A new pattern of automatic cut-out with a self-replacing mechanism has been introduced.—Lond. *Elec. Eng'ing,* Sept. 16.

Generation, Transmission and Distribution.

High-Tension Direct-Current Series System.—A note stating that the well-known series direct-current Thury transmission line from Moutiers to Lyons, in France, which has been in operation since 1905, has proved such a success that very important developments are about to take place. The generating station itself is situated near Moutiers (Savoy) and takes its power from the River Isere, the generating plant consisting of high-tension direct-current machines and high-tension alternators. The equipment of the high-tension direct-current plant at present installed is rated at 6400 hp and energy is transmitted at a pressure of 57,600 volts to Lyons, a distance of 180 km, by means of two conductors, each 9 mm in diameter. Parallel to the continuous-current lines is a three-phase line going to the same point. At Lyons the direct-current energy is transformed by a number of motor-generators. The series system has not only demonstrated its elasticity, but has proved to be so reliable and easy to operate that the companies have decided to carry out at once extensions on a large scale. A generating station is to be erected at La Bridoire (Savoy) in which three high-tension direct-current units will be installed, each of 2000 hp. These will operate with a current of 150 amp and at a pressure of from 8000 volts to 9125 volts. A second generating station, on the Roziers, at Bogel (Savoy), will consist of two generating groups, each consisting of two double machines, driven by the same turbine and capable of giving an output of from 3500 hp to 4000 hp and delivering a current of 150 amp at a pressure of from 16,000 volts to 18,250 volts. A corresponding amount of direct-current motor-generator plant will be placed in the Vaulx-en-Velin substation. The total rating of the direct-current high-tension generating plant, when the extensions are complete, will be 15,000 kw and the three generating stations connected in series will deliver 150 amp at 100,000 volts. This will be a notable development, since, for the first time in Europe, an operating pressure of 100,000 volts will be reached; and it is claimed that this pressure is not the limit which can be achieved on this system.—Lond. *Electrician,* Sept. 16.

Large Gas Engines.—P. R. Allen.—An illustrated lecture held on "Engineering Day" at the Imperial Engineering Exhibition in London. The history of gas engines was first briefly reviewed, followed by details of construction of the various parts of large engines. A comparison was made between steam and internal combustion engines from the technical and also the commercial point of view, and instances were given of large installations of gas plant. It was stated that the consumption of fuel in a gas engine is only about half that in a steam engine—that is, in the ratio 9.5 to 17.5. Installations of 20,000 hp and upward, driven by large gas engines, are now in use in several places. Most of the Continental steel works deem it unnecessary to provide any spare steam plant as a stand-by for their gas engines, so that the practicability of working a large gas-driven station may be taken as settled. At the present time it must be admitted that the large gas engine is a more expensive machine to construct than a steam engine, or especially a steam turbine. However, assuming for the moment that the capital expenditure on a large gas-engine plant with producers is too high, the moment that one begins to use the gas engine in connection with the waste gases from blast furnaces and coke ovens the position at once becomes quite different; in the blast furnace and coke oven the producer is already made; the gas is burned in the engine to the same advantage as under the boilers; the total space occupied by the plant is less, and the total capital cost works out as less.—Lond. *Electrician,* Sept. 17.

Power Plant at an Italian Coal Mine.—L. Pasching.—The conclusion of his illustrated description of the power plant Castelnuovo-Valdarno in which use is made of a brown coal which contains so much water that it cannot be sold to advantage. The power plant is adjacent to the brown-coal mine. At present three 1500-kva three-phase generators are installed. They are driven by 2400-hp reciprocating steam engines. For transmission the voltage is raised to 33,000 by means of three groups of single-phase transformers. The energy is transmitted to several places in the province of Toscana by means of five transmission lines having a total length of 120 km (72 miles) length. A description is given of the high-tension switchboard.—*Elek. Zeit.,* Sept. 16.

Condensers.—F. Hodgkinson.—In a continuation of his long illustrated article on the choice of a condenser the author discusses the construction of air pumps, air-pump rating, and the use of free exhaust valves.—*Elec. Journal,* September.

Traction.

Electric Railways in France.—The most prominent project for electric traction in France relates to the electrification of a large part of the railways du Midi de la France. Electric service is to be introduced on a length of 400 km (240 miles) on the road from Toulouse to Bayonne, with branch lines to the Pyrenees. The road is to be operated with single-phase current

generated in two stations. The energy is transmitted at 60,000 volts to substations, where the voltage is reduced to 12,000, which is the pressure at which the locomotives will be operated. The electric equipment of the first line from Montrejean to Pau is to be finished by July, 1912. The whole line is expected to be equipped electrically within six years. The trains are to be operated with 1200-hp locomotives and with 400-hp motor cars, each of 400 hp. No decision has yet been reached concerning the type of locomotive. Six different firms have declared their willingness to provide electric locomotives for experiments. Five of these will be equipped with single-phase commutator motors, while on the sixth the single-phase current will be converted to direct current, according to the Auvert system. The trial runs with these locomotives will be made during the next year, and thereupon the final decision will be reached about the type to be adopted. A small mountain road in the Pyrenees (27 km or 16 miles) will also be operated with single-phase current at 6000 volts; before deciding on the single-phase system, experiments had been made with direct current. An electric road 55 km in length (33 miles) is to be opened at the end of September from Ville Franche to Bourg Madame; it contains considerable grades passing over a mountain. It will be operated by the third-rail system with direct current at 850 volts. The energy is supplied from a water-power station at 20,000 volts.—*Elek. Zeit.*, Sept. 16.

Mountain Railway.—An illustrated description of the Monthey-Champery railway. This railway in the Savoy Alps is seven miles long, and is operated electrically with a combination of adhesion wheels and rack gears. It traverses some beautiful scenery in the mountains and to reach the summit at Champery grades as high as 13 per cent on the rack sections and 5 per cent on the adhesion sections are used.—*Elec. Rail. Journal*, Sept. 25.

Electrolytic effects of Earth Currents.—An editorial pointing out that in the United States occasionally considerable trouble is experienced from the stray currents from the rails of tramway systems, resulting in the corrosion of water pipes. In England there is no such trouble, since "the Board of Trade has very stringent rules on the question. Not only is the pressure between an earthed return and any neighboring pipe limited to a maximum of 4.5 volts if the return is positive, and to a pressure equivalent to that required for the electrolysis of water in case the earth return is negative, but the drop along the track is limited to 7 volts." These regulations have been found to be extremely effective in practice, notwithstanding the fears of many engineers that water pipes and gas pipes would suffer unduly through the advent of electric tramways. Reference is then made to the case of Peoria, Ill., which is "remarkable not merely from the electrolytic point of view, but as an example of the characteristic way in which legal matters are handled in America." Another case in Winnipeg is also referred to: "It is clear that the amount of money invested in a tramway system can be brought down to a minimum if electrolytic troubles are neglected, but in such cases the business of transportation is carried on irrespective of the rights of existing interests. This latter point seems not to be fully appreciated in America, or surely legislative steps would have been taken long ago to put electric traction on a proper basis so that no material harm should result."—Lond. *Electrician*, Sept. 17.

Electrolysis by Stray Currents.—L. Herdt.—His report on the causes of the electrolysis of water mains and telephone cables in Winnipeg, which has resulted in considerable trouble. The electrolysis is attributed to stray currents from the Winnipeg electric railway system consequent upon poor bonding of the rails, insufficient section of the return feeders, and the fact that the whole of the current is taken from a single substation fed from a large water-power station. The author recommends the immediate rebonding of the rails and the construction of three substations, besides an increase in the section of one of the return feeders. Frequent inspection in the track returns is also insisted on.—Lond. *Elec. Eng'ing*, Sept. 16.

Interpole Traction Motors.—An illustrated article on traction motors with commutation poles made by a British company. They are used in connection with a new controller which permits five instead of the usual two economical running positions, namely: first, full series, full field; second, full series, field shunted 50 per cent; third, full parallel, full field; fourth, full parallel, field shunted 25 per cent; fifth, full parallel, field shunted 50 per cent. It is claimed that with this system the driver has a better control over his car and that a considerable economy in consumption of energy is made possible.—Lond. *Electrician*, Sept. 17.

Three-Phase Locomotives.—Henry.—An illustrated description of the new three-phase four-speed locomotives for the Simplon tunnel.—*L'Industrie Elec.*, Sept. 10.

American Electric Railways.—E. Eickel.—A paper read before the Dresden Electrical Society giving a view of recent developments in the electrification of railways in the United States.—*Elek. Zeit.*, Sept. 16.

Installations, Systems and Appliances.

Automatic Voltage Regulation.—An illustrated article on the use of the automatic Thury regulator for the voltage regulation of the feeders in direct-current and alternating-current systems. The Thury regulator may also be used in connection with storage batteries. If a direct-current installation with varying load is to be operated at constant voltage and if the prime mover which drives the generator runs with constant load, a storage battery is connected in the usual way in parallel with the generator. But since this battery is alternately charged and discharged its voltage will increase or decrease, and in order to keep the voltage of the network strictly constant it is necessary to employ a booster, so that the sum of the voltage of the battery and of the booster remains always exactly equal to the constant voltage of the network. This voltage regulation of the booster is automatically carried out by the Thury regulator.—*Elek. Zeit.*, Sept. 16.

Electricity in Mines.—The second report of the Royal Commission on Mines in England, just issued, recommends the use of electricity in shot-firing. Miss-fires with electric detonators are constantly diminishing and hang-fires are rare; a 5 or 10 minutes' interval is recommended before a miss-shot is approached in the case of electric exploders. The report also deals with the locking and reignition of safety lamps, and in an appendix a strong opinion is expressed that the person in charge of electric power plant should have a certificate of qualification. Lond. *Elec. Eng'ing*, Sept. 16.

Battery for Crane Load.—An illustrated note on a 500-amp-hour battery of 245 cells which is used with a crane equipment at Southampton, supplied with energy by two 150-hp gas-engine sets. With a line load varying between 0 amp and 800 amp the generator load is maintained practically constant at 180 amp. —Lond. *Elec. Eng'ing*, Sept. 16.

Automatic Starter.—R. Edler.—The first two parts of a long mathematical paper illustrated by diagrams and by numerical applications on the load carried by the different resistors in an automatic motor stator.—*Elek. und Masch* (Vienna), Sept. 5 and 12.

Wires, Wiring and Conduits.

Coils of Bare Aluminum Wire.—R. Hopfelt.—An account of some experiments which show that the insulation resistance of coils made from bare aluminum wire depends greatly on the pressure with which the turns are compressed and on the thickness of the wire. The insulation resistance of thick wires is much higher than that of thin wires. This is thought to be due to the fact that the thin wires are hard drawn, while the thick wires are soft. Other experiments showed that in water the insulation resistance of the coils is considerably reduced. The author makes the following suggestions on the manufacture of reliable and durable coils: The different layers of the windings should be separated from each other by some non-hygroscopic layers. It is advantageous to wet the wire just before it is wound on the coil. After winding, the coil should be left for several days in air, so that in the presence of moisture the wires oxidize. They are then dried in vacuo. When dry, the coils

should be lacquered if they are to be subjected to moisture, or if they are to carry current only at intervals. Coils made in this way have the correct ohmic resistance, and this remains constant in service.—*Elek. Zeit.*, Sept. 16.

Armored Cables for Three-Phase Currents.—J. Sarolea.—An article describing experiments on the circulation of three-phase currents in armored cables. One of the chief results of his experiments is that the iron armature of underground cables has somewhat like a self-regulating effect on the currents which pass through the cable. He finally refers to a mistake which is often made in three-phase four-wire systems. It is often found that when a series of lamps connected to one phase is lighted there is a considerable voltage drop on this and another phase and a rise of voltage on the third phase. This effect is due not to the distributing network, but to an improper use of the transformers. They should be specially wound or simply connected in delta on the primary side and in star on the secondary side, but not in star on the primary and in star on the secondary.—*La Lumière Elec.*, Sept. 11.

Electrophysics and Magnetism.

Damping Windings on Direct-Current Magnets.—K. W. Wagner.—The conclusion of his mathematical paper on the way in which the damping winding placed on a direct-current magnet acts. In general, when the circuit of the magnet coil is suddenly broken, the current continues to oscillate for a certain time according to a law similar to that of a damped pendulum, so that the coil capacity which may be imagined to be concentrated at the two terminals causes alternating charges and discharges. The effect of the damping coil is that the frequency of the oscillations is higher than without damping coil, and it is the higher the less the stray flux.—*Elek. und Masch* (Vienna), Sept. 5.

Sulphur Insulation.—F. W. Bates.—An abstract of a paper read before the British Association on the effect of light on sulphur insulation. During a series of experiments on the ionization of the air in closed vessels the writer used an electroscope in which the leaf system was supported on sulphur insulators. In these experiments considerable amounts of leakage were found when intense light was falling on the leaf system. The conclusions of the author are that sulphur in the presence of light becomes to a slight degree a conductor of electricity, and the greater the intensity of the light the greater the conductivity. Further, the leak due to ionization is less than that due to the increase in the conductivity of the sulphur, even when exposed to ordinary daylight. It is necessary, therefore, that great care should be taken when measuring small electrical charges with instruments having sulphur insulation to keep light from falling on the sulphur. A series of preliminary investigations, in which amber and ebonite were used as insulators, indicated a slight increase in the conductivity of ebonite in strong sunlight, but amber did not show any effect.—Lond. *Electrician*, Sept. 17.

Radio-Activity.—Two papers read before the French Academy of Sciences. M. Kernbaum discusses the chemical action of the penetrating rays of radium on water, resulting in the formation of hydrogen peroxide. T. Bialobjeski discusses the action of alpha rays on solid dielectrics.—*L'Industrie Elec.*, Sept. 10.

Positive Electricity—An account of a discussion before the British Association, opened by an address of J. J. Thomson on the question whether there is a definite unit of positive electricity. In summing up the experimental results he dealt especially with canal rays. Rutherford and others participated in the discussion.—Lond. *Electrician*, Sept. 17.

Electrochemistry and Batteries.

Electrode Losses in Electric Furnaces.—C. Hering.—A long article in which the author develops the following laws of electrode losses in electric furnaces. There are two kinds of losses: the loss due to conduction from the hot to the cold end and the Joulean heat loss. The combined loss through the cold end of an electrode is equivalent to the sum of the loss by heat conduction alone (when there is no current), and half the I^2R loss. This combined loss will be least when the loss by heat conduction alone is made equal to half the I^2R loss; the total loss will then be equal to the I^2R loss and no heat will be conducted from the interior of the furnace. This minimum loss is dependent only on the material, current and temperature, but not on the absolute dimensions; it merely fixes the relation of the cross-section to the length, but leaves a choice of either. Hence, for economy of electrode material, the length should be made as short as practical considerations permit. The ratio of cross-section in square inches to length in inches for which the electrode loss becomes a minimum, is given by the formula

$$0.3456\, I \sqrt{\frac{r}{kT}}$$

where I is the current in amperes, r the electric resistivity in ohms per cubic inch, k the heat conductivity in grain calories per second per cubic inch, and T the temperature difference between the hot and the cold end. For each material there is a definite minimum loss of electrode voltage which depends only on the temperature and is independent of the dimensions or the normal current for which the furnace is designed. Hence, the best possible electrode efficiency for any material may be determined from the total voltage of the furnace, and this minimum voltage, due to the material and the temperature, is independent of the dimensions. The heat gradient of the combined flow is equal to the sum of the heat gradients of the individual flows. The theory is given in full and illustrated by diagrams. A numerical calculation is carried out for graphite and carbon.—*Electrochem. and Met. Industry*, October.

Electrochemistry at the British Association.—A report of a number of papers presented at the recent meeting of the British Association. Abstracts are given of the paper by C. J. J. Fox on the constancy of the hydrogen gas electrode; by T. M. Lowry on a new method of producing a cadmium arc for polarimetric work; and of a report of the committee on electro-analysis.—Lond. *Electrician*, Sept. 17.

Units, Measurements and Instruments.

Measuring Magnetic Fluxes.—Voege.—While the bismuth coil permits the measurement of magnetic fluxes above 1000 gauss in a relatively simple and exact manner, measurements of weaker fluxes, such as the stray fluxes of machines and apparatus, are more difficult. The author has devised an instrument in which the fluxes to be measured deflect a magnetic needle, but the latter is brought back to its original position by means of an auxiliary magnetic flux which is measured in a simple way. In Fig. 1, the short magnetic needle M is connected with a spiral spring S in such a way that the needle is held in a constant position irrespective of gravity and earth magnetism. The needle Z thus points always toward the zero point. The instrument contains a coil Sp through which the current i passes; the latter is regulated by the resistor w, and can be measured by the galvanometer G. The instrument is placed on a support as shown in Fig. 2, so that the instrument can be easily turned in any direction. It is so adusted that the black strip, and thereby the plane of the windings of the coil, is perpendicular to the direction of the flux F_1 to be measured. The magnetic needle, which is deflected by this flux, is now brought back to zero by means of an exactly opposite magnetic flux produced by the coil. In this case there is equilibrium between the forces acting on the magnetic needle and $c_1F_1M = c_2F_2M$, where M is the magnetism of the needle and F_1 and F_2 are the two fluxes intensities. We, therefore, get $F_1 = C_1F_2$, and since $F_2 = C_2i$, the flux to be measured is $F_1 = Ci$. That is, it is proportional to the current i measured by the galvanometer. The magnetism of the needle does not need to be constant and has no further effect on the measurement, while the directive force of the spiral spring permits an easy and quick adjustment. Without the same an adjustment to zero would be impossible, since with the slightest change of the auxiliary flux the needle is deflected to one or the other side. The constant C needs to be determined only once, since experiments have shown that the readings are proportional to the flux within the widest limits. By properly selecting the length of the magnetic needle and the dimensions of the coil Sp it is easy to render the instrument suitable for measuring fluxes from 1 to

100 gauss. The compensating currents corresponding to these fluxes are between 0.002 amp and 0.3 amp. A suitable measuring instrument, a regulating resistor of about 1000 ohms, and some storage cells are probably available in any laboratory. When such an instrument is to be used frequently for flux measurements, the galvanometer is suitably calibrated directly in gausses. —*Elek. Zeit.*, Sept. 16.

Standardization.—O. Higman.—A paper read before the En-

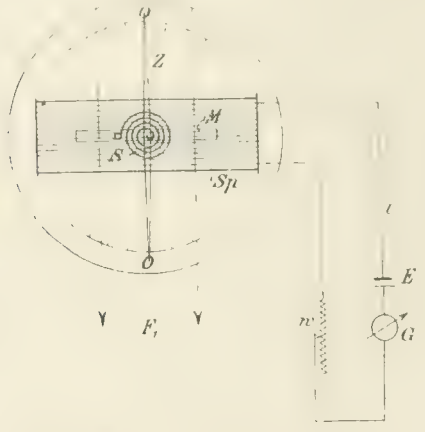


FIG. 1.—DIAGRAM OF CONNECTIONS.

gineering Section of the British Association on "International Electrical Standardization." The author gives a review of the program of the work of the International Electrotechnical Committee. "Although it would be an extremely difficult task to obtain an agreement upon an international system of symbols, there is no doubt that agreement on small general principles



FIG. 2.—INSTRUMENT FOR MEASURING MAGNETIC FLUXES.

can be arrived at and general agreement may even be reached upon a few of the fundamental letters employed in common use." Before any question of international agreement as to the tests of electrical machinery can be discussed, the different nations must agree upon the explanation of the terms in general use in the industry, and, therefore, nomenclature becomes a subject of great importance to the progress of the work. "The adoption of an international system of nomenclature will minimize the difficulties of distance and language and greatly assist in the comprehension of specifications and, consequently, increase economy and rapidity in production."—Lond. *Engineering*, Sept. 17.

Standards.—A report of the British Association committee on practical standards for electrical measurements. Concerning the use of a 12.5 per cent amalgam in the Weston standard cell, it is stated that the limits of temperature for the general use of a 12.5 per cent amalgam are very nearly 12 deg. C. and 62 deg. C. A 10 per cent amalgam may be used between 0 deg. C. and 51 deg. C. Figures are then given of a comparison between the resistance standards of the National Physical Laboratory in London, the Bureau of Standards in Washington, and the Reichsanstalt in Berlin.—Lond. *Electrician*, Sept. 17.

Electrical Units and Standards.—A. Roiti.—His official report to the Italian Minister of Commerce on the International Conference on Electrical Units and Standards, held last October in London. He speaks sarcastically about the two zeros added to the figure of the chemical equivalent of silver (0.00111800) and thinks that it is not necessary to put them into the law. He speaks of the London conference as the Two Zero Conference. In his opinion the absolute system should be mentioned, and the amount of tolerance permissible in standards supposed to conform with the decision of the conference should be defined.—Lond. *Elec. Eng'ing*, Sept. 16.

Reactance Coil.—R. Livingstone.—An article on a new type of reactance coil in which it is suggested to place the coil around the air-gap as shown in Fig. 3. Some values are given to show that when the coil is round the gap, there is no external leakage so long as the iron is not saturated; but when the coil is round

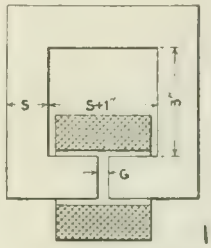


FIG. 3.—SECTION OF REACTANCE COIL.

the yoke and the iron unsaturated only 40 per cent of the lines go through the gap, and the remaining 60 per cent are leakage lines external to the iron core. Since the design shown in the illustration has practically no external field, the metal cases can be made quite small, and a case of iron will not increase the choking effect.—Lond. *Electrician*, Sept. 17.

Electrolytic Meters.—A note on a recent British patent of W. B. Thorpe (865, 1908; Sept. 9, 1909). In electrolytic meters of the type in which acidulated water is decomposed by the passage of the current into oxygen and hydrogen, which are recombined after definite amounts have been evolved, inaccuracies have been caused by the gases leaking past the mercury column in the center of the tube to the part beyond, and by air passing in the reverse direction, owing to the differences of pressure. In the present construction, one or more rings of platinum are fused into the wall of the tube, and these make a gas-tight joint with the mercury column. Further, the mercury column is connected to the negative pole of a source of e.m.f. to prevent oxidation of the surface, and to avoid the evolution of gas at the surface, the column offering a high resistance when electrically connected to the anode in the cell by a capillary thread of mercury. An electromagnetic device for registering the successive explosions is also described in this specification.—Lond. *Elec. Eng'ing*, Sept. 16.

Telegraphy, Telephony and Signals.

Telephone Transmission.—F. Breisig.—An article criticising a recent paper by L. Cohen on the influence which instruments at the ends of a telephone line have on telephonic transmission. The present author endeavors to show that the general formulas of Cohen are not new in principle. Though he admits that they are accurate, he thinks they are so complicated and unhandy that in their application by Cohen himself to numerical examples several mistakes have occurred. The author concludes that Cohen's calculations do not prove his conclusion that the connection of a telephone to the line has no influence on the transmission.—*Elek. Zeit.*, Sept. 16.

"Multitonic" Telegraphy.—Henry.—An illustrated article on the "multitonic" telegraph system of Raymond Barker. The system is based essentiallly on the use of two armatures vibrating with the different frequencies and thereby sending alternating currents of two different frequencies over the line. These are received in the form of two notes of high and low pitch, respectively, in a telephone receiver. They replace the dash and dot of the Morse system.—*L'Industrie Elec.*, Sept. 10.

C R Law.—B. Gati.—A mathematical paper on the "C R law" and high-speed cable telegraphy, with special reference to the general formulas of A. E. Kennelly. In making his numerical

calculations the author has used Taltavall's chart with good success.—*Elek. und Masch.* (Vienna), Sept. 12.

Miscellaneous.

College Graduates.—F. W. Taylor.—An address discussing the reason why some manufacturers dislike college graduates. The speaker insists that college graduates are "the finest kind of raw material. Take the average young man. He has some bad ideas, but all you have to do is to mold that young man to your needs, give him character and common sense, and when the shops begin to take these young men from our universities and colleges, particularly, if it becomes a regular thing, that every year from such and such a place we get eight or ten men, the supply will not equal the demand."—*Elec. Journal*, September.

NEW APPARATUS AND APPLIANCES

Motor-Driven Warning Signal.

Electrical supply dealers and contractors will doubtless be interested in the motor-driven signal for automobiles and motor-boats illustrated herewith. That such a small, inoffensive-looking piece of apparatus can produce such a disproportionate amount of rude, harsh, discordant noise is almost unbelievable. The mechanism of the "Klaxon" signal consists of a miniature motor of excellent construction, set vertically in the casing and having an axle running on steel balls in a bushed bearing. The



FIG. 1.—MOTOR-DRIVEN WARNING SIGNAL.

motor is provided with a lubricating system, simple and practically arranged to put the oil where it is needed and keep it away from the wiring. At the end of the vertical shaft of the motor is a wheel with 10 teeth of specially hardened steel, and it is these teeth striking against a shoulder on the diaphragm that produces the noise. The diaphragm, which is 5½ in. in diameter and is composed of prepared steel, is secured at its circum-

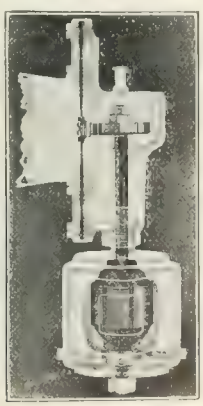


FIG. 2.—PHANTOM VIEW OF APPARATUS.

ference with six bolts with cork washers. The motor is said to revolve at the rate of 3000 r.p.m., which results in 30,000 vibrations of the diaphragm during that time. These vibrations pass out through the nozzle of the horn and break on the ear with an awful roar which compels attention. The horn itself is oval in shape with the long axis vertical, so that the sound is thrown forward. Another type with a shorter horn distributes the sound in the vicinity of the apparatus. The signal is entirely self-contained and the diaphragm shuts off the motor from the outside atmosphere. The wiring connections are made by two specially arranged binding posts on the base of the motor casing; and water, dust or dirt cannot reach the working parts. The motor casing is of mild iron, copper plated with a heavy brass finish. The brush holders are so arranged as to take up the wear automatically and the brushes are of copper gauze soaked in graphite so as to be self lubricating. The amount of friction between the revolving toothed wheel and the shoulder of the diaphragm is adjustable by a simple revolution of the eccentric sleeve through which the shaft revolves. The mechanism is shown in the phantom view given in Fig. 2. The energy is supplied by six dry batteries, giving 6 amp. The Lovell-McConnell Manufacturing Company, of Newark, N. J., is the manufacturer of the device.

Mill Motors.

The characteristic features of steel-mill power service are exceedingly heavy momentary overloads, severe shocks and vibration, abnormally rapid acceleration, application of power at several points remote from one another, high room temperatures, and dust-laden atmosphere. Certain operations necessitate a reversal when running at full speed. Reliability of service is absolutely essential, as the various processes form a practically continuous train of operations and a breakdown stops the whole train. This condition makes it imperative that replacement of damaged parts be made in the shortest possible time.

The General Electric Company now manufactures a complete line of both alternating-current and direct-current motors of especially rugged design for this type of service, the corresponding sizes of the two types having the same outline dimensions and are interchangeable on the same foundations. The alternating-current motors, known as MI motors, are standard at 220 and 440 volts, three-phase, 25 cycles, and are furnished in sizes from 3 hp to 150 hp inclusive.

These motors are built totally inclosed in horizontally split steel magnet frames of octagonal shape, the two halves being held together by a large bolt at each of the four corners. They are supported by four large substantial feet, each foot being drilled for one foundation bolt.

Each frame has a large opening over the collector which provides a quick and easy means of access for the inspection of the brushes and collector rings. There are other openings which provide additional facilities for inspecting the motor.

The most noteworthy feature of the motors is the construction by which the stator winding is entirely separate from the frame, resembling in this respect the field coils of a direct-current motor. This construction, together with a horizontally split frame, permits of replacing the rotor or stator very quickly and renders it necessary to keep only spares of the parts most liable to damage in stock. Fig. 1 illustrates the manner in which the upper half of the frame is removed and the rotor, stator and bearings lifted out for inspection or repairs. In making replacements it is not necessary to make any disconnections inside of the motor frame.

The stator is built up in the form of a hollow cylinder, form-

ing a unit entirely separate from the frame. The punchings are assembled on steel studs which pass through end flanges, by means of which the punchings are clamped tightly together.

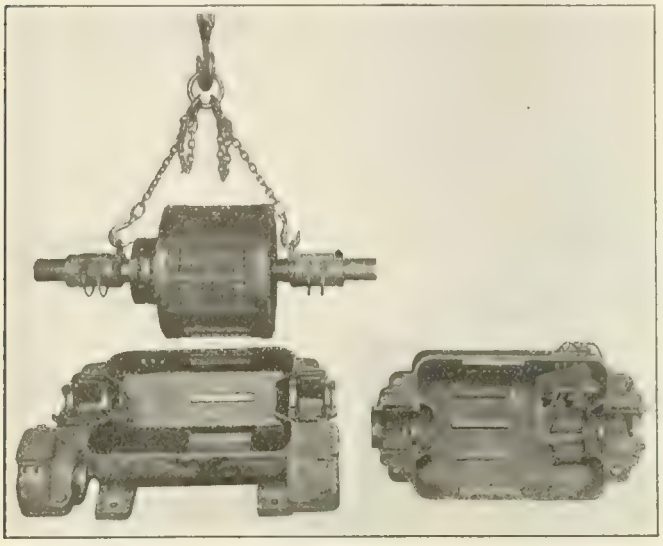


FIG. 1.—METHOD OF HANDLING ARMATURE AND FIELD STRUCTURE.

Each half of the frame has several ribs extending lengthwise which are bored to the diameter of the stator and are equal in length to the distance between its end flanges. When the stator is lowered into the frame and the upper half of the frame bolted on, these ribs automatically center it and prevent end motion. Rotation of the stator is prevented by ears projecting from the core.

End flanges are provided which ensure complete protection to the end windings and permit handling the apparatus freely without damaging the windings. The stator coils are form-wound, molded to exact size and thoroughly insulated before assembling on the core. The conductors are asbestos insulated and the completed coils are insulated with mica and woven asbestos. They are assembled in open slots and are held in place by non-combustible wedges. This construction makes it possible to replace a coil very easily and quickly. The rotor is built up on a heavy spider, the punchings being assembled between end flanges keyed into place under heavy hydraulic pressure. The rotors are bar wound, in all sizes except the 3 hp and 7 hp, in partially enclosed slots. In order that reversals may be accomplished in the shortest possible time and with a minimum loss of energy in acceleration, the diameter of the rotor has been reduced to a minimum.

The collector spider is carried on an extension of the rotor spider, to which it is keyed, making it unnecessary to disturb any connection if it is necessary to replace the shaft. The collector rings are bolted to this spider making their removal a very simple operation. The rings are of exceptional size and the collector throughout is ruggedly built.

The brush-holder studs are of steel, are exceptionally large, and are screwed into the frame. Heavy coiled phosphor-bronze springs maintain practically uniform tension over their entire working range and permit a large amount of wear of the brushes.

The journals are exceptionally large, affording ample bearing surface. The armature-bearing housings are a part of the frame castings. The bearings are furnished for either oil-ring or waste lubrication. To change from one form of lubrication to the other it is necessary to change only the upper half of the lining. The two halves of the lining are bolted together and a wrought-iron bail is cast in the upper half, providing an easy means of handling the armature, as shown in Fig. 1. The armature-end thrust is transmitted directly to the frame by a shoulder in the bearing lining.

The countershaft brackets are cast with the lower half of the frame and are heavily ribbed. The caps are bolted to the brackets. Linings for minimum standard countershaft diameter are cast iron babbitted, and for maximum standard diameter are malleable iron babbitted. Countershaft bearings are supplied for waste lubrication. Where motors are geared it is an advantage to use, where possible, a countershaft passing through brackets on the motor frame to prevent the gear and pinion from springing apart under heavy loads. The rotor shafts are exceptionally heavy and have pinion extensions at both ends. They can be replaced without disturbing connections. The pinions are made of the highest grade of hammered steel and gears of cast steel. The gear cases can be used at either end of the motor and are bolted to webs on the lower housing of the armature bearing and countershaft bracket.

In order to adapt this type of motor to crane service, the 3-hp, 7-hp, 12-hp and 20-hp machines have been designed with a view to facilitating the replacement of the armature in either of two ways. These machines have circular frame heads at both ends, the frame and frame heads both being split. This construction admits of the removal of the rotor by removing the upper half of the frame and lifting it out, or removing the head at either end and pulling the rotor out endwise. The heads may be shifted through an angle sufficient to permit of the motor being installed on the wall or ceiling. In these sizes the upper half of the frame is hinged to the lower half, the hinge block being bolted to the frame to permit of their removal if not desired. Fig. 2 shows the individual parts of these motors.

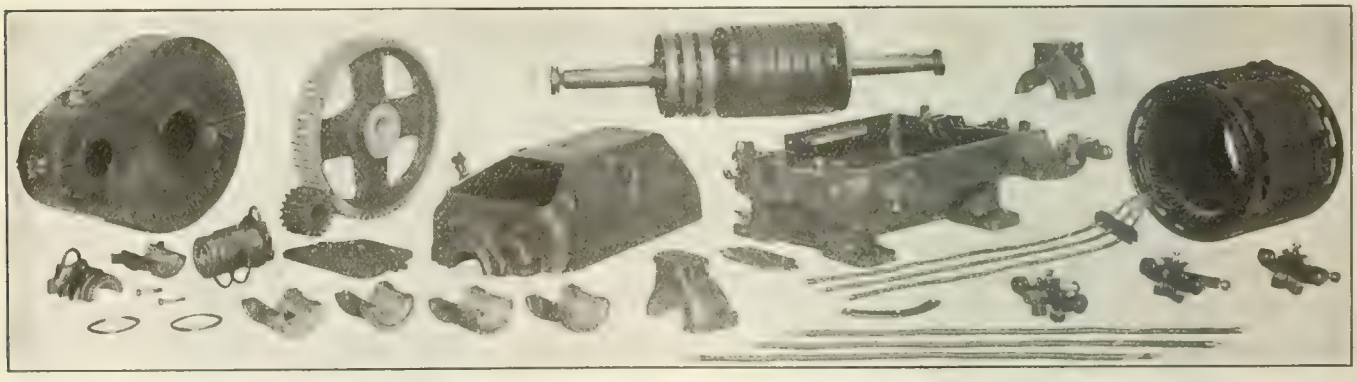


FIG. 2.—COMPONENT PARTS OF INDUCTION MOTOR.

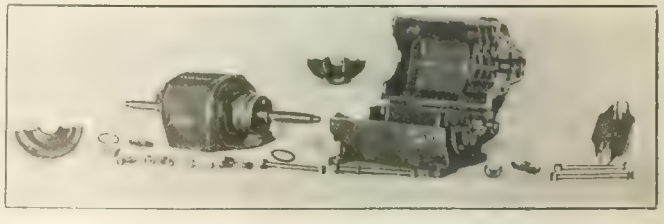


FIG. 3.—MOTOR PARTLY ASSEMBLED

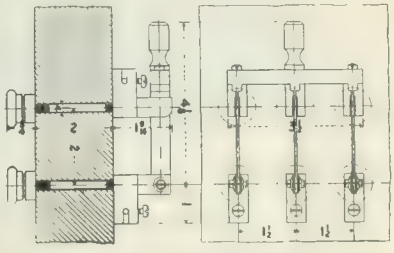
This type of motor is designed for control by a rheostat in the secondary or rotor circuit. By this means partial speed control can be obtained and the motor can be started and accelerated at practically the same torque per ampere as at full speed. The motors have a maximum torque of approximately 250 per cent of rated full-load torque, and are designed to carry loads varying instantaneously from maximum in one direction to maximum in the other, with stresses far within the safe limit. They can be stalled momentarily without injury.

Although these motors were designed primarily to meet steel-mill conditions, they are especially adapted to any service in which the cycle of operation is short and the rate of acceleration and braking high, and where the equipment is subjected to rough handling and forced to its maximum output.

Testing Switch and Testing Clips.

At one time it was considered sufficient to furnish an ammeter to indicate the amount of current given by a generator and a voltmeter to indicate the voltage. The practice has been steadily growing, however, of furnishing also wattmeters, power-factor indicators, frequency indicators and other instruments with generating and feeder equipments, until at the present time five or six different kinds of instruments are often found on one board. It becomes a matter of importance, therefore, that these numerous instruments be so arranged that they can easily be checked up and tested.





FIGS. 1 AND 2.—TESTING SWITCH AND TESTING CLIPS.

Realizing the necessity of being able to do this from the front of the switchboard without disturbing the permanent instrument wiring in any way, the Condit Electrical Manufacturing Company has developed a scheme of testing switches and testing clips for use with alternating-current instruments. As shown by the accompanying illustrations, these testing clips consist of a series of flat plates fastened with screws and connected in the secondary of the series transformers, these plates being so arranged that the instruments can be put in series with a portable instrument, or the series transformers can be short-circuited and the instruments supplied with current from an independent source. Potential switches with hard-rubber binding post also serve the same purpose in the potential leads. The combination of the potential switches and testing clips enables the station operator to test all of his instruments at any time easily and without disturbing any of the permanent wiring.

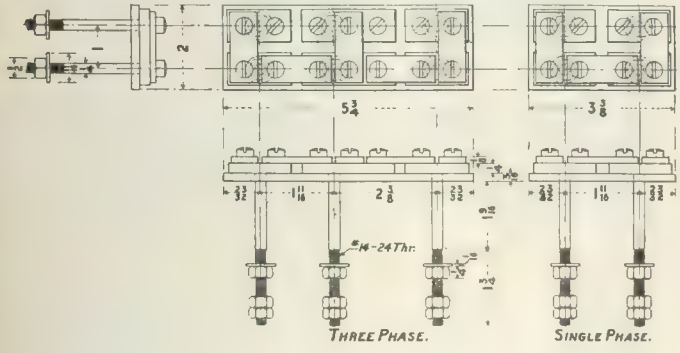


FIG. 3.—CONSTRUCTIONAL DIAGRAMS OF TESTING SWITCH AND TESTING CLIPS.

These devices were developed as the result of a wide experience with large central-station work. They are easily mounted either on a sub-base or the top panel of a switchboard.

Toy Transformer.

The toy transformer, shown herewith, made by the Thordarson Electric Manufacturing Company, Chicago, represents a notable departure from the old method of operating toy and like apparatus. The old system of using storage or dry batteries for operating toy and miniature lamps was very troublesome. Dry batteries are very easily short-circuited and thereby put out of commission at once, and the electrolyte of storage cells is apt to spill and ruin clothes, carpets and rugs. The Thordarson transformer, on the other hand, is merely connected directly to any alternating-current lamp socket and the construction is such that it is practically indestructible.

The toy transformer shown will give any one of 10 different secondary potentials, stepping down from 110 volts. These voltages may be used singly or all at one time, or two or more voltages may be used at the same time. As the secondary windings are, of course, entirely separate from the primary and are thoroughly insulated, there is no chance of disagreeable electric shock. Any inexperienced boy may readily use the transformer by following the instructions, and become familiar with the different circuits in a few moments.



FIG. 1.—TOY TRANSFORMER.

These transformers consume on an average less current than a 16-cp lamp, and are, therefore, operated at very slight expense. The arrangements for obtaining the different voltages are extremely flexible and simple. The plug contact makes a safe and sure connection and may be instantly disconnected. With reasonable care the transformer should last indefinitely. The windings are so arranged that it will run on a short-circuit for some little time without any harmful effects.

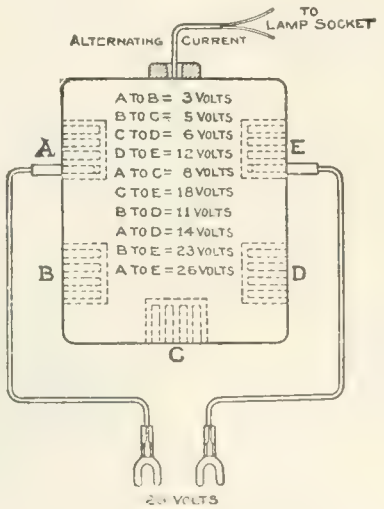


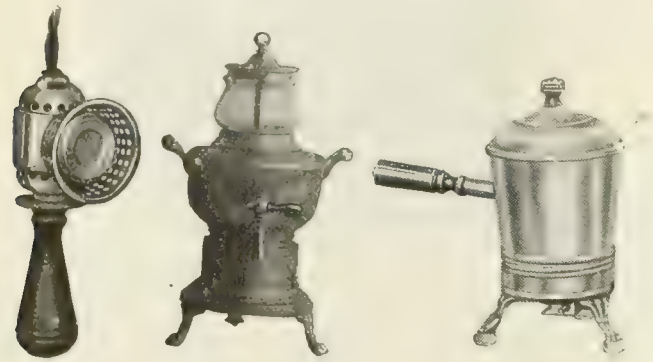
FIG. 2.—DIAGRAM OF TRANSFORMER CONNECTIONS.

The toy transformer will operate all classes of electrical toys, such as small motors, electrical trains, bells, buzzers, electric engines, miniature lamps, etc. Another feature is that all small direct-current battery apparatus that do not require more than 50 watts may be operated with a toy transformer on an alternating current without any change in the winding or connections.

The same company makes a similar transformer for Christmas tree-lighting, in small and large capacities, and for 6 volts or 14 volts. By using these transformers expensive series winding is eliminated, as the winding is arranged to cut down the 110 volts to a low voltage for multiple lighting, which any amateur can easily wire at a low cost.

Electrically Heated Devices for Holiday Trade.

Electrically heated devices have passed the experimental stage and are now well established as part of the equipment of a modern household, largely owing to their superiority as to cleanliness, convenience and attractiveness. An impetus has been given the sale of the popular household devices, such as percolators, chafing dishes, tea kettles, etc., owing to the large choice of designs now available. Hitherto manufacturers have taken one or two styles of heating devices and equipped them electrically. Arrangements have now been made with a large



FIGS. 1, 2 AND 3.—CIGAR LIGHTER, PERCOLATOR AND WATER HEATER

manufacturer to equip his most popular and attractive designs with General Electric units, and a choice of 30 designs and finishes of electric percolators, tea kettles and chafing dishes will be ready for the holiday trade.

There are a number of novelties in the electric heating line, prominent among which is the new radiant toaster, with which toast may be made on the dining table, at the bedside or wherever electricity is available and the whole operation is visible. Turn the switch and the wire heats up to a white heat immediately and the toasting process is at all times under control. The electric cigar lighter is a very attractive device. The continuous pendant type is intended for continuous service

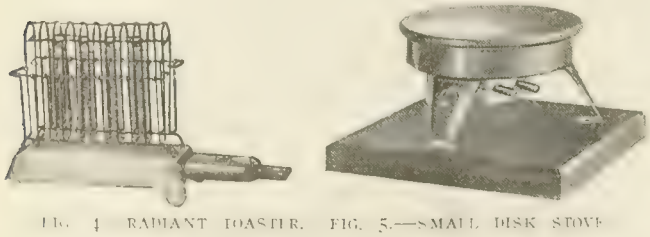


FIG. 4. RADIANT TOASTER. FIG. 5.—SMALL DISK STOVE

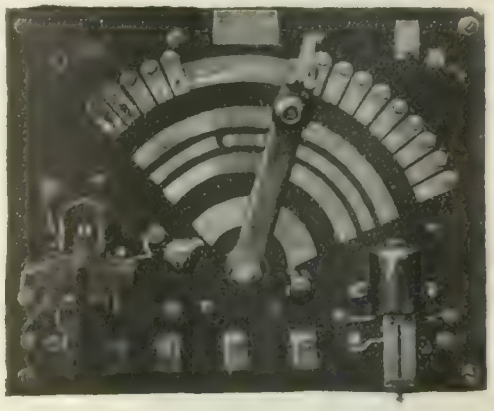
in cigar stands and similar places and operates an entire day at a cost of less than 2 cents.

The new design of General Electric water heater, shown in the accompanying illustration, will be found of great usefulness in a thousand different ways. It may be used as a milk warmer, egg boiler or for heating liquids generally. It is made of copper, heavily riveted and is available in pint and quart sizes. A larger size of heater for 2 qt., 4 qt. or 6 qt. is suitable for preparing an entire dinner. A range of three heats allows a satisfactory regulation of the thermal effect.

Disk stoves are rapidly being adopted for small households. These stoves are remarkably quick and efficient, being of the encased-disk unit type. These new stoves are able to operate at a much greater activity (watts per square inch) for a given size than has been possible heretofore with electric stoves. This is due not only to radical improvements in the design or application of the heating elements, but also to the material and construction of the heating element itself.

Armature Controller.

The accompanying illustration shows a Ward Leonard reversing armature controller with overload and no-voltage release. The circuit is not made or broken upon the sliding



ARMATURE CONTROLLER.

contacts, but always upon the self-closing switch shown in the lower left-hand corner of the cut. This rheostat is specially applicable to machine-tool or printing-press control.

Tantalum Lamp for Direct-Current Street Railway Service.

The engineering department of the National Electric Lamp Association, Cleveland, Ohio, realizing the great possibilities of the tantalum lamp for street-railway lighting, early began the development of this application, and many months ago placed trial installations in several large cities. The results of these tests fully demonstrated the value of the tantalum lamp for direct-current railway service, and its manufacture for this purpose has followed. In a recent editorial in these columns it was pointed out that the present commercial tantalum is decidedly purer than that obtained at first and also more uniform in quality; and that the tensile strength of the commercial wire now rises to 57 tons per square inch, which is comparable to the strength of the best steel wire. Improvements in the manufacture of tantalum metal such as above noted, as well as other advances in the art, have enabled the manufacture of a tantalum filament which now meets all of the severe requirements of railway service.



TANTALUM LAMP.

The development work done by the engineering department has been placed at the disposal of all the member companies of the National Electric Lamp Association, which advocates the new tantalum lamp as a substitute in direct-current street-railway service for the 4-watt carbon railway lamp. As now manufactured by the member companies of the association, the lamp operates at 2.3 watts per candle-power, and gives a satisfactory life even on fluctuating railway voltages. It is made in two sizes—16 cp and 32 cp

The chief advantages claimed for the new lamp over the carbon lamp are as follows:

1. Comparative freedom from flickering under varying voltage and from excessive dimming at points of low line potential.

2. Small cost of operation both in energy consumption and renewals.

3. Small current consumption, thus increasing the net efficiency of the generating apparatus, especially during rush hours when its full capacity is most needed; 27.2 watts are saved at every socket when a 16-cp carbon lamp is replaced by a tantalum street-railway lamp of equal candle-power.

4. The strength of the tantalum filament and the clamped joints of the lamp fit it admirably for withstanding the shaking-up which a railway lamp has usually to undergo.

Wood Strain Insulators.

The accompanying illustrations show a number of forms of wood strain insulators made by the Westinghouse Electric & Manufacturing Company. These insulators are designed for a working pull up to 4000 lb., and single insulators are adapted to

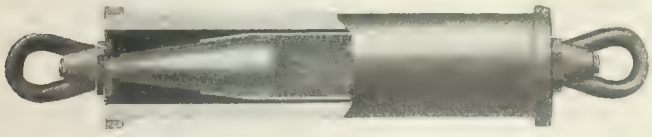


FIG. 1.—PART SECTION VIEW OF HIGH-TENSION STRAIN INSULATOR.

voltages ranging from 150 volts to 11,000 volts. For higher potentials, they may be connected end-to-end in series. The construction of these insulators possesses many inherent advantages, among which are low first cost and long life. The metal parts are furnished in a galvanized finish which will withstand any atmospheric conditions, and the wood parts are especially treated and sealed to render them thoroughly moisture-proof.

The end caps are secured to the body by being pressed around the taper sheets on the ends of the wood. This method of securing the caps insures a reliable joint whose strength equals that of the wood body or the metal eye. As the wood body is not fragile like most insulating materials, it is not subject to breakage from impact. The end caps are provided with eyes, clovises or tapped lugs, which adapt the insulator for dead-end, anchor guy or steady strain service.

For high-tension lines the Westinghouse "Type C" insulator is a new development. The insulator is tested at 40,000 volts

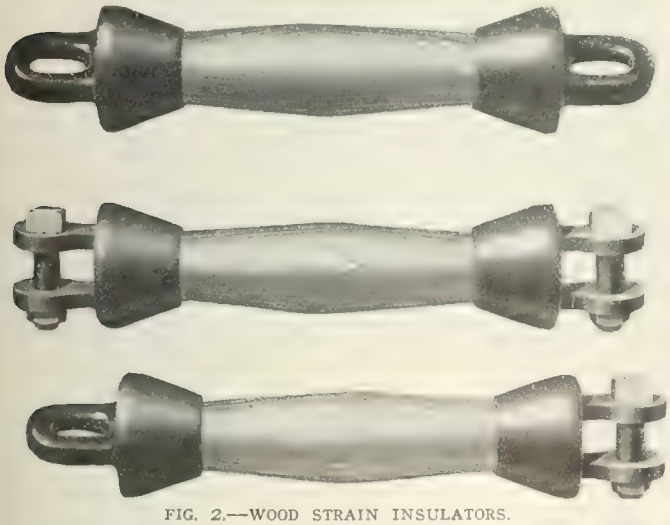


FIG. 2.—WOOD STRAIN INSULATORS.

before shipment, and its ultimate mechanical strength is upward of 30,000 lb. in tension. It is applicable for service voltages up to 12,000, and for mechanical strains up to one-third, or in special cases one-half, of the ultimate strength. The construction is shown in Fig. 1. A pull on the eyebolts acts directly on the insulating cone to produce compression. This cone is constructed of sheet mica under heavy pressure, and will withstand a heavy stress. The outside tube is of porcelain, and being 20 in. long, offers ample creepage distance in any weather. It has no fragile petticoats and is quite inconspicuous. The porcelain acts only as a weather seal and is relieved of any mechanical strain.

The line of high-potential insulators includes disk and skirt types which are claimed to excel all others in their respective classes. The line of low-voltage strain insulators includes "Globe," "Giant" and "Brooklyn" types, which have been found

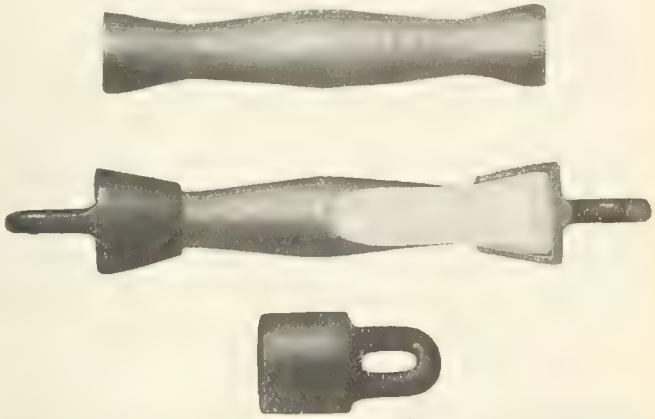
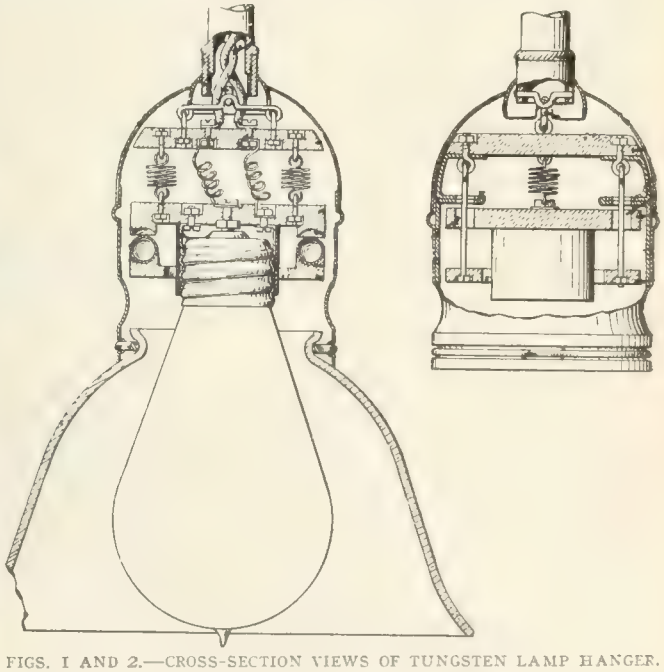


FIG. 3.—CONSTRUCTION DETAILS OF WOOD STRAIN INSULATORS

very efficient in their several classes of service. The adjustable ties include two insulated turnbuckles. One has a porcelain insulator and the other has its eye molded in a special compound. This is the same compound used on the above-mentioned types, and combines great insulating resistance with stable structure in the most extreme climates.

Tungsten Lamp Hanger

A flexibly supported socket or hanger for tungsten lamps has been designed by Mr. L. B. Hornbeck, New York Life Building, Minneapolis, Minn., of which cross-sections are shown in Figs. 1 and 2. From Fig. 1 it will be seen that the lamp receptacle is



FIGS. 1 AND 2.—CROSS-SECTION VIEWS OF TUNGSTEN LAMP HANGER.

hung on short spiral springs. Fig. 2 shows the manner in which the buffer plate which keeps the lamp socket in alignment is supported. Between this buffer plate and the plate which supports the lamp socket rubber balls are placed for a cushioning effect. The lamp support is, therefore, entirely independent of the outer shell which supports the reflector.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

It is hardly necessary to reiterate the good reports that are coming from all quarters in regard to the conditions of trade. The whole condition might be summed up with the statement that trade has at last resumed its normal status. In transportation, manufacture and commerce, activity has about re sumed the position occupied in 1907 and prior to that time. During the past week wholesalers and jobbers have been well pleased with the volume of trade. Orders have been coming in quite liberally, and there have been quite a number of retail buyers in the central markets. The crop movement from the West and the shipment from the East of goods bought in the spring for fall delivery have given the railroads so much to do that almost every available car has been called into service. Reports from the manufacturing centers show that developments in these lines continue to be almost without parallel. The iron and steel manufacturers have about all they can attend to. Many orders are now being placed for delivery next year, and premiums are still being demanded for early deliveries. Almost as many men are at work in the Pittsburgh section as were employed in the boom times of 1907. This fact, taken together with the prosperity of the farmer, insures a healthy retail trade for the coming season. The cooler weather, too, has added something to the volume of retail trade. The crop situation is practically a thing of the past. The maturity of the corn crop in Nebraska and other heavy corn-growing States without any damage from frost practically ends all uncertainty as to what the crop yields will be. The return in money for the farm products of the Middle West and the Northwest will be the greatest ever known; the buying power of these communities will therefore be greater than ever, and the outstanding indebtedness is smaller than ever before. The cotton crop, as has been known for many months, will be considerably short of those of the last two years, but the advance in price will bring to the planters just as satisfactory returns. It is true that the pickers and laborers who work by the pound may have less money to spend, but it is not anticipated that this will make much difference to the actual volume of trade. One of the individual features of the past week that is worthy of note was the order by the Pennsylvania Railroad of 200,000 tons of steel rails. This compares with an order last year of 135,000 tons. The delivery of these rails will be made early in the next year. Another great trunk line is said to be ready to contract for 250,000 tons, and these, with the small orders that have been already placed or are ready to be placed, will keep the rail mills busy until next summer. Collections are considerably improved, and business troubles are unimportant. Failures for the week ended Sept. 30, as reported by *Bradstreet's* were 195, as against 171 for the previous week, 225 for the same week in 1908, 177 in 1907, 136 in 1906, and 189 in 1905.

THE COPPER MARKET.

During the past week the domestic demand for copper has been quiet, although there has been more activity in Europe. Quotations upon the New York Metal Exchange have been practically unchanged, and actual sales have been light. The consumption of copper in the United States for the last nine months has been satisfactory, and at present is all that could probably be expected. The consumption abroad compares very well with that in this country. The trouble with copper has been the enormous production; this has far outgrown the demand. The movement for September will probably show an increase in the surplus supplies of the world of about 50,000,000 lb.; half of this will be in the warehouses abroad and half in this country, although the producers figures will probably show a less amount. The accumulations of stock in second hands and in the hands of actual consumers have been increasing. The imports for the month of September were about 13,000 tons, and the exports, which were heavily increased by the shipments of the last few days of the month, amounted to 20,057 tons. The total exports since the first of January have been 225,499 tons, as compared with 277,045 tons last year. The daily call on the Metal Exchange, at 12:30 o'clock Oct. 4, quoted standard copper as follows:

	Bid.	Asked.	Settling price.
Spot	12.40	12.65	.....
October	12.40	12.65	12.52½
November	12.40	12.65	12.52½
December	12.40	12.70	12.55
January	12.50	12.80	12.65

The London prices Oct. 4 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	58 16 3	58 13 9
Standard copper, futures	59 12 6	59 10 0
Market	Easy.	Easy.
Sale of spot		400 tons
Sales of futures		600 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.00	12.52½
Lake	14.55	12.55
Electrolytic	14.25	12.12½
Casting	14.12½	12.00
London, spot	£64 2 6	£54 12 6

AS TO ELECTRICAL TRADE AGREEMENTS.—A Philadelphia financial paper last week printed a story to the effect that new agreements had been made between a half dozen of the principal electrical manufacturing companies of the country which would practically eliminate competition in almost every branch of the industry. This statement was submitted to two of the high officials of the General Electric Company, with the result that a positive denial was made that any new agreements had been entered into. It was admitted that the well known patent agreements, which had been made with the Westinghouse and other companies, were still in force, and also that the General Electric Company had secured control of quite a number of German lamp patents; but, as one official expressed it, "we are not making any trade agreements, the Sherman Law would not permit it. We intend to do all the business we can, but we are not looking for any litigation." At the office of the Westinghouse Electric & Manufacturing Company, one of the vice-presidents made the statement that there was nothing in the report that new trade agreements had been enterd into. "We do not think such a thing would be legal," said he, "and if we did there is not at this time any necessity for a trade agreement. All of the electrical companies are doing a good business, we certainly are getting our full share of the orders and there could be no reason at this time for taking any risks in order to shut out the competition of small concerns. Just at present there seems to be enough business for everybody." The fact that the patent agreements, referred to above, which were entered into in 1896, expire next year probably gave rise to the present story.

HUDSON & MANHATTAN RAILROAD EARNINGS.—For the year which ended March 31, 1909, the Hudson & Manhattan Railroad carried 13,692,565 passengers. This was only on the detached line running from Sixth Avenue to Hoboken. It is estimated that for the full year of operation of the uptown and downtown lines the road will carry more than 80,000,000 passengers. The operating expenses are estimated at about 40 per cent, and the net earnings, together with the returns from the terminal buildings, are expected to show a handsome return on the capital invested. It is now given out that the statement that trains would be run into Newark over the Pennsylvania tracks is erroneous. It is proposed to run from Henderson Street, Jersey City, to Harrison, where the tracks will run on the opposite side of the platform to the Pennsylvania tracks, and passengers bound for Newark will have to change there to Pennsylvania cars.

INTERBOROUGH BREAKS ALL RECORDS.—The travel over the Interborough Rapid Transit Company's lines broke all previous records during the Hudson-Fulton celebration. On Saturday, Sept. 25, the first day of the celebration, the Interborough lines carried 2,140,521 passengers, and on the following Thursday they carried 2,157,989. Each of these records was far ahead of anything previously known on the lines. The business for the week which ended Oct. 2 was the heaviest week ever experienced by the company.

NEW INSULATING WIRE FACTORY FOR DIAMOND RUBBER COMPANY.—The growth of the insulated-wire business of the Diamond Rubber Company has necessitated the erection of a six-story factory building, 371 ft. long and 103 ft. wide, which will be used principally as an addition to the already extensive equipment of the insulated-wire and cable department of the company. Although this department is but three years old, the original capacity has been doubled already three times. The equipment is complete in every detail for the manufacture of all classes of National Electric Code black-core, red-core intermediate compound, 30 per cent Para and high-grade specification wires and cables; also lead-encased cables and a complete line of igniter cables for gasoline and other explosive engines. The equipment will include continuous wire-drawing machines and two lead presses—one now installed and the other in process of construction in Germany. The wire factory commands the resources of the Diamond Chemical Laboratories in the compounding of insulation for high-grade specification wire, such as is now sold for railroad signal service, to large manufacturers of high-grade electrical machinery, and to the United States Navy and the signal corps of the United States Army.

ELECTRIFICATION IN CHICAGO.—An ordinance has been presented to the Common Council of Chicago calling for the electrification of all of the railways within the city limits inside of two years. This is practically regarded by the railroad managers as impossible. President Harahan, of the Illinois Central, says: "Electricity has not yet been developed to the point where it is satisfactory in such service as is contemplated by this ordinance. No system has yet been shown to be perfect. It is certain that the railroads here would not attempt to do one-tenth of what this ordinance calls for until the court of last resort had made it compulsory." Presidents Ripley, of the Atchison, and Delano, of the Wabash, say that they will not attempt to electrify their Chicago city lines until they are forced to do so by the courts, or until it has been shown that electrical operation is cheaper than steam. It is estimated that the electrification of the lines within the City of Chicago would cost at least $200,000,000.

NEW TURBINE GEAR PATENTS.—The announcement has been made that Real Admiral Melville, retired, and John H. McAlpine, together with George Westinghouse, have perfected a reduction gear transmission by which the speed of a high power turbine can be reduced in marine service to the required speed of a steamship's propeller. It is claimed that this invention will perform greater service at a more economical rate than any that has yet been devised. The Westinghouse Machine Company, so it has been stated by one of the officials of the Westinghouse enterprises, will have the exclusive right to manufacture this new invention. This right includes not only this country but also Europe. The experiments which led to the patenting of the new gears were made at the shops of the Westinghouse company in Pittsburgh.

FULTON LIGHT, HEAT & POWER COMPANY.—The State Court of Claims at Albany, N. Y., has awarded to the Fulton Light, Heat & Power Company, of Fulton, N. Y., $299,000 damages for property and water rights in the Oswego River, which were appropriated by the State for a barge canal. The company sued for $3,428,028. The State contested the company's claim on the ground that the State had a right to take all of the water it needed from the Oswego River without compensating the power companies. The court decided against this contention, but, as is shown, very materially reduced the amount of damages claimed.

INCREASED OUTPUT OF ZINC.—W. A. Clark, Jr., son of former Senator William A. Clark, of Montana, has made the announcement in Los Angeles that, after three years of experimenting, he has succeeded in enhancing greatly the profits to be derived from the operation of zinc mines, and that he has done this in the very heart of the copper mining districts of Arizona and Montana. Mr. Clark declares that he can now extract zinc from the ores in such quantities that foreign competition will hereafter be virtually eliminated.

TRACTION EXTENSION IN KENTUCKY.—The Cincinnati, Louisville, Lexington & Maysville Traction Company, which proposed to construct an interurban railway between Cincinnati and Lexington, and between Maysville and Louisville, has arranged with the Reliance Engineering Company, of Cincinnati, to design and construct the entire system, the cost of which, it is estimated, will be about $3,000,000. The proposed lines will be about 200 miles in length, and work upon the surveys is now in progress.

NEW TENNESSEE TRACTION LINE.—Preliminary surveys have been completed and rights of way are being secured by the Westmoreland & Red Springs Railroad Company, of Lafayette, Tenn., for a new electric line which will extend from Westmoreland, via Lafayette, to Red Springs, a distance of about 36 miles. It is stated that the railway will later be extended into Kentucky, to connect with the Queens & Crescent route.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in our present issue are announcements of proposed new plants or considerable extensions of present plants at Lenoir, N. C.; Cheyenne, Wyo.; Cleveland, Ohio; Astoria, Ore.; Detroit, Mich.; Madison, Minn.; Malden, Mo.; Helena, Mont.; Clearfield, Pa.; Cranbrook, B. C., Can.; Orangeburg, S. C.; Crowley, La., and Galveston, Tex.

PULLMAN ORDER FOR ALLIS-CHALMERS.—The Pullman Company, which is building large shops at Pullman, Ill., for the construction of steel passenger cars, has placed an order with Allis-Chalmers Company for the power-plant equipment, consisting of two steam turbines and generators aggregating 5000 hp, with condensers, exciters, etc., auxiliary to them.

Financial Intelligence.

THE WEEK IN WALL STREET.

With the advance last week of call money to 4½ per cent, there seemed to be some prospect of a check in the continuous upward movement of the stock market. Although the course of the market during the week was steadily upward, and the tone very strong, only in Steel common and a few specialties were high records made. The latter on Oct. 4 reached 94⅞, its high record, and the advance to this point was accomplished so easily that it is not difficult to believe the promises of the market prophets that Steel will sell above par before November. It must be recognized, however, that as the price of money advances the value of stocks as dividend earners relatively diminishes. It is not hard to understand how a stock paying 4 or 5 per cent interest can sell at par or better when money is quoted at 2 per cent; with money, however, at 4 or 5 per cent such a stock would be held only for investment purposes, and any advance above par would be improbable. The upward movement of the stock market, which has been continuous for more than a year, it is now pretty thoroughly known has been the result of consistent buying by large interests, this being followed, of course, by speculators and small traders. Men of great wealth, who had faith in the future, have had no trouble in carrying long lines of stock when money could be obtained in

NEW YORK.

	Sep. 27.	Oct. 4.	Shares sold		Sep. 27.	Oct. 4.	Shares sold
All Ch.	15⅛	15⅝*	7,100	Int. Met., pfd.	48⅛	49	4,850
All-Ch., pfd.	53½	54⅜	8,775	Mackay Cos.	91¼	93½	9,750
Amal. Cop.	82	83¾	152,150	MackayCos.,p	76	76½*	600
Am. D. T.	20½*	20½*	——	Man. Elev.	142	142	——
Am. Loc.	59½	61	7,850	Met. St. Ry.	26*	26*	30
Am. Loc., pfd.	117	115¾	700	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & Cbl.	85*	85*	——	Steel, com.	86½	93⅞	1,175,013
Am. T. & T.	141⅛	143¾	37,398	Steel, pfd.	128½	130¼	9,775
B. R. T.	79¼	80⅞	41,095	W. U. T.	79¾	78½	7,310
Gen. Elec.	168	167	7,482	West'h. com.	86¾	87⅝	27,352
Int.-Met., com.	14¼	16	31,400	West'h. pfd.	145	144	1,600

PHILADELPHIA.

	Sep. 27.	Oct. 4.	Shares sold		Sep. 27.	Oct. 4.	Shares sold
Am. Rys.	45⅞	46	—	Phila. Elec.	12⅛	12½	——
Elec. Co. of A.	12¼*	12¼	—	Phila. R. T.	28⅛	28¾	——
Elec. St. Ry.	59½	60	—	Phila. Trac.	90	91	——
E. S. R'y. pfd.	30*	30*	——	Union Trac.	53½	53½	——

CHICAGO.

	Sep. 27.	Oct. 4.	Shares sold		Sep. 27.	Oct. 4.	Shares sold
Chi. City Ry.	180*	180*	——	Chi. Tel. Co.	138	138*	——
Chi. Rs., Ser. 1	109½*	109½*	——	Met. El., com.	17¾*	17¾*	——
Chi. Rs., Ser. 2	36½*	36½*	——	Met. El., pfd.	51	51	——
Com. Edison	150½	150	——	Nat'l Carbon	96½	98½	——
Chi. Subways	9½	9⅝	—	Nat'l C., pfd.	120*	120*	——

BOSTON

	Sep. 27.	Oct. 4.	Shares sold		Sep. 27.	Oct. 4.	Shares sold
Am. T. & T.	144	143¼	——	Mex. Tel.	23¼*	23⅜*	——
Dom. Tel.	4*	4*	——	Mex. Tel., pfd.	6*	6½*	——
Edison E. Ill.	258	258*	——	N. E. Tel.	138½*	137	——
Gen. Elec.	167	168	——	W. P. & P.	15⅝	14½	——
Mass. E. Ry.	6½*	8*	——	W. P. & P., pfd.	88	88	——
Mass. E. R., pfd.	38¼	38*	——				

*Last price quoted.
Shares sold are for week of Sept. 27 to Oct. 2.

any quantity desired below 3 per cent. When rates advanced to 5 per cent, however, the carrying of such amounts of stocks, unless they are large dividend payers, involves no profit. For these reasons there is considerable sentiment in the Street that a profit taking reaction is near at hand. It may be safely believed, however, that there will be no such hurry to sell as to bring any demoralization. The price basis for Wall Street to-day is high—too high many think—but it is not likely to react very seriously. Neither does it seem to be likely that there will be much further advance in the near future. The likelihood is that stocks will pause and permit commercial conditions to catch up. Loans are being made more freely, and money is a trifle more closely held. Quotations to-day were: call, 3½ @ 4½ per cent; 90 days, 4 @ 4¼ per cent. The quotations in the table are those of the close Oct. 4.

GREAT COMBINATION IN CHICAGO.—Rumors are again current concerning an enormous combination of public utility interests in the city of Chicago. The amalgamation, it is said, will represent a total capitalization of $300,000,000, and will include all of the traction companies, lighting companies, power companies and gas companies. This combination has been talked of, and has undeniably been considered for the past several months. It is difficult, however, to get any definite information, probably from the fact that no definite plan has yet been decided upon. The *New York Sun* has printed a story concerning the combination, which declares that the plans have been matured, and that they will in all probability play a part in the municipal campaign next spring. This publication is the most definite of any that has yet been made. The political portion of the project is that which may involve it in becoming a licensee of the city under the terms of the ordinances which have settled the traction difficulties in Chicago. Inquiry in New York elicited no definite information as to the combine. It is said, however, that the master hand behind the great amalgamation is that of J. P. Morgan, and that the estimate of $300,000,000 is probably a small one when all of the interests that are now being considered are brought together.

BOSTON RAILWAY MERGER.—The Boston Elevated Railway Company is planning, so it is said, to secure control of the Boston & Northern, the Old Colony, the Blue Hills, Boston & Worcester, Middlesex & Boston and the Lexington & Boston street railways, in order to consolidate the entire lot into one operating system. The initial step in this merger has been taken by the appearance of an attorney for the Boston Elevated before a joint commission consisting of the Massachusetts Railroad Commission and the Boston Transit Commission, submitting a tentative proposition for the consolidation. The Boston Elevated is slow to form a consolidation with the Boston & Northern until some modification of the law requiring a 5-cent fare on a through line is made. It is probable that the object will be to secure control of the latter road, but not to operate it as one system.

FEDERAL SIGNAL COMPANY.—The new financing plan of the Federal Signal Company, of Albany, has been put into operation, with the result that the company will have $75,000 of new capital to put into the business without increasing its bonded indebtedness. Under the plan the former bonded debt of $200,000 has been retired and the holders of the old bonds given first preferred stock, $275,000 of this issue having been marketed, the additional amount above the $200,000 exchanged for bonds having been paid for in cash. The former issue of $600,000 preferred stock has been made second preferred.

RECEIVER FOR ALBANY & HUDSON.—On application of the Trust Company of America, the Supreme Court at Kingston has appointed John W. Searing, of New York, as receiver for the Albany & Hudson Railroad Company, which formerly operated an electric railway between Albany and Hudson, and which was recently sold under mortgage foreclosure. The property was recently taken over by the reorganization company, known as the Albany Southern Railroad Company, and the receivership is intended to perfect a legal transfer of the road to the new company.

COLUMBUS, OHIO, CITIZENS' TELEPHONE COMPANY.—It is stated that the executive committee of the Columbus Citizens' Telephone Company is now considering a proposition for the purchase of the Lancaster, Ohio, Telephone Company. The latter company is the property of the United States Telephone Company, which is now disposing of its local plants in order to devote its attention to the long distance business and to the development of the independent system.

OREGON ELECTRIC RAILWAY COMPANY.—N. W. Harris & Co. and Moffat & White offered last week $2,000,000 of the 5 per cent bonds of the Oregon Electric Railway Company, Portland, Ore., and the offering was taken up by public subscription within a few hours. The offering was made at 96½ and accrued interest, and yielded the investor about 5¼ per cent. The bonds are secured by a first mortgage on the entire property of the company, which has cost so far more than $3,000,000.

TOLEDO & FT. WAYNE ELECTRIC RAILWAY COMPANY.—A franchise has been granted to the Toledo & Ft. Wayne Electric Railway Company to build along public highways. The company agrees to have its road completed by Dec. 1, 1910, and gives a bond of $5,000 to fulfill this contract. The road is designed to connect with the Toledo & Indiana Railway at Bryan, Ind. The construction of the roadbed between Maysville and Ft. Wayne, Ind., is now in progress.

MORRIS COUNTY, N. J., TRACTION COMPANY.—It is reported that a Pittsburg syndicate has agreed to underwrite $1,000,000 worth of bonds for the Morris County Traction Company, a concern which plans to build a line from Morris Plains to Mt. Tabor, connecting there with a direct route to Lake Hopatcong. The placing of these bonds will put the company financially on its feet, so that the work can be completed at once.

AMERICAN PNEUMATIC SERVICE COMPANY.—The American Pneumatic Service Company reports 100 per cent increase in its earnings for the four months which ended July 31 over the same period of last year. It is stated that the combined earnings of the company and its subsidiaries show a surplus for the four months, after all charges, of $44,716, which is an increase of $36,326 over the previous year.

NO NEW IMPROVEMENT BONDS IN LOS ANGELES.—The report that the city of Los Angeles, Cal., would shortly issue $3,500,000 bonds to develop the power project connected with the Aqueduct seems to have been premature. The city clerk writes that the matter has not yet been taken up and probably will not be considered until next year.

EASTERN OREGON LIGHT & POWER COMPANY.—The Grand Ronde Electric Company, of La Grand, Ore., has sold its property in Union County, Ore., to the Eastern Oregon Light & Power Company. This company represents the amalgamation of several Eastern Oregon concerns, and the sale of the Grand Ronde proper involved about $250,000.

PITTSBURGH, McKEESPORT & WESTMORELAND RAILWAY.—Word has been received in this city that the representative sent abroad has been successful in placing $500,000 of the 5 per cent bonds of the Pittsburgh, McKeesport & Westmoreland Railway Company. An outline of the plans of this corporation appeared in our last issue.

ROCKINGHAM POWER COMPANY.—The Rockingham, N. C., Power Company is said to be ready to resume work upon the Blewitt's Falls hydroelectric plant. The company is now in the hands of W. A. Leland, receiver, but work upon the plant will be pushed forward. It is stated that about 1000 men will be put to work upon the dam.

BLACK RIVER TELEPHONE COMPANY.—A special meeting of the stockholders of the Black River Telephone Company, of Lowville, N. Y., has been called for Oct. 15, to vote on the reclassification of the capital stock. Instead of having $25,000 preferred and $25,000 common, the company proposes hereafter to have $50,000 of common stock.

KENTUCKY ELECTRIC COMPANY.—The Kentucky Electric Company, of Louisville, has filed a deed of trust with the United States Trust Company to secure an issue of $1,500,000 of 5 per cent bonds. The proceeds of these will be used to cancel a previous issue of $500,000 and to make extensive improvements and extensions.

VIRGINIA SECURITIES LISTED.—Application will be made within a week or two by the Virginia Railway & Power Company to list its securities upon the stock exchanges of Philadelphia and Baltimore. The bonds of this company are now quoted at about 92, the preferred stock at 65, and the common stock at 17.

MINNESOTA TELEPHONE COMBINATION.—It is said that negotiations have been closed whereby the Northwestern Telephone Company has secured control of the lines owned and controlled by the Winona, Minn., Independent Telephone Company. The new lines acquired are almost 500 miles of wire.

NEW YORK TELEPHONE COMPANY DEAL.—In connection with the consolidation by the American Telephone & Telegraph Company of all of the Bell telephone interests in the New York territory, the announcement is now made that the New York Telephone Company will shortly ask its stockholders to authorize an issue of $75,000,000 first mortgage 4½ per cent bonds. It has already been determined that the capital stock of this company shall be increased from $50,000,000 to $100,000,000, and the unanimous consent of the stockholders has already been received to this increase. The new stock is for the purpose of taking over the various Bell lines in this territory, including those of the New York & New Jersey Telephone Company. At the present time the New York Telephone Company has no funded debt of its own, and the only bonds outstanding against it are $1,737,000 first mortgage bonds of the Metropolitan Telephone & Telegraph Company, which was absorbed some time ago. Just what use the proceeds of this new bond issue are to be put to has not been announced, but it is presumed that it will be for the purpose of extensions and betterments in the service. The Farmers' Loan & Trust Company is trustee of the mortgage. The stock issue was made to take up the stocks of other companies, and brought in no new capital. It is said that the bond issue will bring to the treasury of the American Telephone & Telegraph Company a large amount of cash, and this, it may be taken, is for the purpose of reimbursing that company for the expenditures that it has made in developing the various Bell subsidiary companies. The new deal gives the American Telephone & Telegraph Company absolute control of the Metropolitan district. In this connection it may also be said that rumors are still current concerning the absorption of the Western Union Telegraph Company by the American company. It is said that large blocks of Western Union stock have been quietly and privately picked up on the Stock Exchange, and it is thought that this buying has been by interests connected with the American company. The report is again reiterated that George Gould has disposed of his holdings to the American company, but this cannot be officially confirmed or denied. Whether these sales mean an absorption or simply operation upon a community-of-interest plan is not ascertainable, but it is understood that several American Telephone people are likely to go on the board of directors of the Western Union company at the stockholders' meeting, Oct. 13. The bonds were all sold immediately. Kidder, Peabody & Company taking $12,500,000, expressed in dollars, and Baring Bros. & Company, Ltd., London, taking a like amount, expressed in pounds. Private subscriptions were so far in excess of the amount allotted to this country that there will be no public offering. The price to the bankers was 95, making an interest return of about 4.80 per cent.

WESTINGHOUSE RESUMES PREFERRED DIVIDENDS.—The Westinghouse Electric & Manufacturing Company, at the meeting of the directors Sept. 29, announced that regular dividends upon the preferred stock would be resumed, and declared a quarterly dividend at that time of 1¾ per cent. There was also declared a dividend of 3½ per cent on account of the accumulations overdue since October in 1907 upon the preferred stock. This stock is entitled to 7 per cent per annum cumulative, and 12¼ per cent back dividends were due. There is outstanding $3,998,700 of this preferred stock. No information has been given out as to how soon the earnings of the company will permit a dividend upon the assenting stock, of which $56,000,000 is authorized and $37,000,000 is outstanding. It is believed that the back dividends upon the preferred stock will be entirely liquidated before the other matter is taken up. The Westinghouse concern announces a very satisfactory expansion in business, sufficient working capital and altogether a very good financial standing.

CHICAGO SUBWAY PROPOSITION.—A proposition was made to the city council of Chicago last week to build the extensive subway system, plans for which have already been approved. This proposal came through M. H. McGovern, a contractor and an associate of the late E. H. Harriman. He said that Mr. Harriman had at the time of his death in the process of formation plans for the building of Chicago's subway, and that since his death these plans would not be interfered with. He said that his proposal offered financial backing to the extent of $100,000,000 or more, and that he was ready to enter into a contract to build the subway system for the City of Chicago in accordance with the plans and specifications already adopted. He said that he was willing to accept an ordinance that will give municipal ownership as soon as the present financial and legal conditions will permit. The proposal was signed, The M. H. McGovern Company, by M. H. McGovern, President.

NATIONAL CARBON COMPANY.—The affairs of the National Carbon Company, according to an official who is in close touch, are in splendid shape, and the earnings are larger than ever before. It is understood that the financing plan which was considered by the directors some months ago has been abandoned, because the earnings have added sufficient working capital for all immediate needs. The increase in business within the past few months has been very large. It is also stated that the company is well sold ahead for deliveries in next year. The directors voted last week to put the common stock on a 5 per cent basis. The stock has recently been advancing in price, and is now rather high for a 4 per cent investment.

POPE MANUFACTURING COMPANY.—The first report that has been made by the Pope Manufacturing Company since its reorganization has just been made public. It covers a period of seven months, from Dec. 24, 1908, to June 30, 1909, and shows sales amounting to $2,397,000 and net earnings amounting to $483,000. There were also ample offset charges for depreciation and reserves. President Albert L. Pope, in his statement to the stockholders, called attention to the fact that the $800,000 of notes issued at the time of the reorganization of the company had been anticipated and all retired before July 1, 1909, without encroaching on the working capital of the company.

CHICAGO ELEVATED MERGER NEGOTIATIONS RESUMED.—It is expected that there will be a resumption of the negotiations looking toward a merger of the elevated railways of Chicago some time between now and the first of the new year. The Northwestern Elevated will soon declare an initial dividend of 1 per cent on its preferred, and the Metropolitan will declare a 3 per cent dividend on its preferred. The South Side Elevated earnings also promise an early resumption of dividends. All of these reports indicate a possibility of a merger into the hands of the holding company.

BUTTE ELECTRIC & POWER COMPANY.—During the first seven months of the present year the Butte Electric & Power Company has earned approximately 47 per cent more than during a corresponding period in 1908. It is estimated that if the present rate is kept up the gross earnings of the company for the year will be $1,866,000, which will be an increase of something like $600,000 over the previous year. Through the subsidiaries which this company owns or controls energy for light and power is furnished for six of the most important counties in Montana.

PORTLAND (ORE.) TRACTION DEAL.—The control of the United Railways Company and the Ruth Trust Company, of Portland, Ore., was purchased last week by J. H. Hulburt, of Fontanelle, Ia., and C. L. Dunbar, of Vancouver, B. C. It is stated that the purchase price of the two properties was about $5,000,000. It is understood that extensive plans for traction development are being perfected, but these have not as yet been made public.

ELIZABETHTOWN (N. Y.) TERMINAL RAILROAD COMPANY.—A new concern has been incorporated at Albany with a capital of $80,000, to be known as the Elizabethtown Terminal Railroad Company. The purpose of the new company is to operate a line by steam or electricity eight miles long in Essex County, N. Y. The proposed road is to run from the Delaware & Hudson station at Westport to Elizabethtown.

CITIZENS' TELEPHONE COMPANY, GRAND RAPIDS.—The shareholders of the Citizens' Telephone Company, at Grand Rapids, Mich., have voted to increase the capital stock from $3,500,000 to $5,000,000 in order to provide for extensions and improvements.

ISTHMIAN CANAL PROPOSALS.—The Isthmian Canal Commission, Washington, has issued invitations for proposals for the supply at the Isthmus, not later than Nov. 1, of a transformer, motor, searchlight and arc lights.

PROPOSED MUNICIPAL PLANT FOR TYNDALL, S. D.—We are informed by City Auditor T. J. Mans, of Tyndall, S. D., that the city proposes to install a municipal electric light plant, to cost $10,000 or $12,000.

KELLOGG SWITCHBOARD & SUPPLY COMPANY.—It is announced in Chicago that the Kellogg Switchboard & Supply Company has absorbed the Dean Electric Company, of Elyria, Ohio, thereby securing control of the manufacture of a large line of instruments and material used by the independent telephone companies. The Dean Electric Company had outstanding $3,000,000 of common stock and $655,000 of preferred stock. Dividends at the rate of 7 per cent have been paid on the preferred stock since March, 1908. The bonded indebtedness of the company was $249,000. It is said that the Kellogg company's stock will be increased to $7,000,000, half of which will be preferred.

MASSACHUSETTS ELECTRIC COMPANIES.—For the first time since the organization of the Massachusetts Electric Companies, ten years ago, that company and all of its subsidiary companies are now free from floating debt. The last note was paid off last week, and it is stated that the concern has $1,200,000 cash in the bank. P. F. Sullivan, president of the subsidiary companies and general manager of the concern, has gone to Europe for a month's vacation. It is now expected that the $20,557,400 of preferred stock will be placed on a 4 per cent basis in January.

PUBLIC SERVICE GAS COMPANY.—The gas companies which have heretofore been controlled by the Public Service Corporation of New Jersey have been formed into a new operating company, to be known as the Public Service Gas Company, the stock of which is practically all owned by the Public Service Corporation. The authorized capital of the new company is $10,000,000, of which $4,000,000 has been issued. The directors are the same as those of the Public Service Railway Company, which is the operating company for the traction lines.

THIRD AVENUE RAILROAD SALE POSTPONED.—Judge Lacombe, of the United States Circuit Court, has granted a motion of the Central Trust Company for a postponement of the foreclosure sale of the Third Avenue Railroad Company's property. The new date set for the sale is Nov. 30. There seems to be a disposition among the security holders of the road to permit this sale to proceed, as the Public Service Commission has entirely disapproved of the reorganization plan which the bondholders offered.

HEAVY LIQUIDATION IN CHICAGO SUBWAY.—Since the death of E. H. Harriman, on Sept. 9, almost 350,000 shares of Chicago Subway stock, the entire amount outstanding, have been traded in on the Chicago Stock Exchange. The price has gone down as low as 7, and the pressure to sell seems to be without end. It is pretty well understood that some of the large stockholders have been liquidating, but there is no evidence that any strong interest has been buying.

INDEPENDENT UNION TELEPHONE COMPANY.—The stockholders of the Independent Union Telephone Company, Albany, N. Y., which controls the Independent toll exchanges in that section of the State, have authorized the directors to sell the property to a new company, which it is expected will soon be incorporated and which plans to control all of the independent companies in the Eastern territory.

CHICAGO RAILWAYS BONDS.—Rehabilitation has absorbed most of the proceeds of the last issue of $5,000,000 of Chicago Railways bonds. It has not been decided as to whether another issue will be made before the end of the year or not. This is dependent upon whether or not the work can be continued during the winter weather and upon the rapidity with which the deliveries of new equipment can be made.

TRENTON, BRISTOL & PHILADELPHIA RAILWAY COMPANY.—The reorganization papers of the Trenton, Bristol & Philadelphia Railway Company have been filed with the State Department of Pennsylvania. The new company is to be capitalized at $325,000, and the directors are: Edward L. Toland, John Redwood, Carl N. Martin, George Blackstone, Joseph S. Clark, Grier Hersch and W. L. Chrisman.

DIVIDENDS.

Central District & Printing Telegraph Company, Pittsburgh, quarterly, 2 per cent, payable Oct. 15.

Chattanooga Railway & Light Company, preferred, quarterly, 1¼ per cent, payable Oct. 1.

Consolidated Power & Light Company of South Dakota, preferred, quarterly, 1 per cent, payable Oct. 1.

Gamewell Fire-Alarm Telegraph Company, quarterly, 1¼ per cent, payable Oct. 1.

Narragansett Electric Company, quarterly, 2 per cent, payable Oct. 1.

Philadelphia Company, quarterly, 1½ per cent, payable Nov. 1.

Winnipeg (Man.) Electric Company, quarterly, 2½ per cent, payable Oct. 1.

REPORTS OF EARNINGS.

	Gross earnings	Expenses	Net earnings.	Charges.	Surplus
El. Paso Electric Company:					
July, 1909	$46,361	$29,203	$17,157	$8,085	$9,072
July, 1908	40,820	29,351	11,469	7,208	4,260
Galveston Houston Electric Company:					
July, 1909	109,747	62,069	47,677	18,847	28,830
July, 1908	93,374	52,004	41,369	17,476	23,893
Houghton County (Mich.) Traction Company:					
July, 1909	30,652	14,701	15,590	5,741	10,209
July, 1908	26,300	12,712	13,587	4,634	8,952
Jacksonville Electric Company:					
July, 1909	39,290	22,352	16,946	8,325	8,621
July, 1908	35,559	20,691	14,867	8,324	6,543
Jamestown (N. Y.) Street Railway Company:					
Quarter ended March 31, 1909	37,110	24,627	12,083	15,725	*3,641
Quarter ended March 31, 1908	28,275	24,141	3,804	15,042	*11,238
Metropolitan West Side Elevated Railroad Company, Chicago:					
Year ended June 30, 1909	2,734,284	1,393,630	1,340,654	1,066,626	283,823
Year ended June 30, 1908	2,809,493	1,457,152	1,352,342	1,070,730	286,627
Mexico Tramways Company:					
August, 1909	469,473	232,008	237,465	.....	.....
August, 1908	463,701	244,717	218,984	.....	.....
Milwaukee Light, Heat & Traction Company:					
August, 1909	152,102	37,330	114,771	70,785	43,986
August, 1908	149,907	35,187	114,719	65,011	49,707
New York, New Haven & Hartford Railroad Company:					
Year ended June 30, 1909	54,347,630	36,080,306	18,267,324	...	...
Year ended June 30, 1908	53,050,147	38,213,557	14,836,590	...	...
Northern Texas Electric Company:					
July, 1909	109,212	59,834	49,377	17,186	32,188
July, 1908	98,982	58,786	40,196	18,033	22,163
Pensacola Electric Company:					
July, 1909	23,460	12,602	10,857	4,305	6,552
July, 1908	19,629	12,058	7,571	4,269	3,302
Puget Sound Electric Railway Company					
July, 1909	184,531	106,044	78,487	44,408	34,078
July, 1908	151,035	92,315	58,720	39,740	18,979
Rio de Janeiro Tramway, Light & Power Company					
August, 1909	673,220	388,965	284,255	.....	.....
August, 1908	641,807	373,847	267,933	.....	.....
Sao Paulo Tramway, Light & Power Company:					
August, 1909	193,208	77,610	115,593	.....	.....
August, 1908	179,0	68,072	110,940	.....	.....
Susquehanna Railway, Light & Power Company:					
Year ended June 30, 1909	612,362	.....	.....	247,656	364,706
Year ended June 30, 1908	551,479	.....	.....	244,980	306,499
Whatcom (Mich.) County Railway & Light Company:					
July, 1909	34,4[illegible]	18,303	6,12[illegible]	8,061	8,060
July, 1908	29,[illegible]	7,10[illegible]	[illegible]	8,165	3,761

*Deficit

GENERAL NEWS

Construction News.

GADSDEN, ALA.—Plans are being considered by the Alabama City, Gadsden & Attala Railway Company to extend its electric lighting system. G. H. Schuler is president of the company.

HOLLY GROVE, ARK.—The Clarendon Telephone Company has purchased the telephone plant of the Southwestern Company at Holly Grove and is planning to extend the line to Indian Bay.

ALHAMBRA, CAL.—The City Council has decided to purchase ornamental lamp posts to be placed on Main Street.

BAKERSFIELD, CAL.—Announcement has been made that the Power, Transit & Light Company contemplates extensive improvements to its plant and equipment within the next year which will involve an expenditure of several hundred thousand dollars. Harry A. Jastro is secretary and general manager.

CORONA, CAL.—Plans are under way for the installation of a local telephone system in Corona. J. B. Cooch is interested in the project.

ELSINORE, CAL.—A petition has been presented to the Board of City Trustees asking the board to call a special election to vote on the proposition to issue bonds to purchase the local electric light plant.

FRESNO, CAL.—Notice of appropriation of 15,000 cu. in. of water from Fish Creek has been filed by William S. Douglas and C. M. Russell, the water to be carried by a tunnel 2 1-3 miles in length from a diversion dam to the junction of the Great Bluffs with the middle fork of the San Joaquin River to be utilized for power purposes. Notice has also been filed of appropriation for a dam and reservoir site 150 ft. high and 900 ft. long to form a storage reservoir of about 200 acres, and water to flow to Fish Creek in connection with water rights there.

FRESNO, CAL.—Because of the low rates offered by the Pacific Gas & Electric Company for electricity through the lower San Joaquin Valley, assurance is given that this company may be induced to extend its transmission lines to Fresno, which is now supplied by the San Joaquin Power Company. The Pacific Gas & Electric Company has entered into a contract with T. W. Patterson to supply 1000 hp to develop an irrigating system for the Patterson ranch on the west side of the valley, which he is getting ready for colonization. Mr. Patterson states that the price was much below the rates for power being charged by the San Joaquin Power Company. The transmission line is tapped near Bethany, and a pole line has been built to the ranch and from there on to Newman. To continue the line to Fresno would be a matter of about 80 miles.

JACKSON, CAL.—Notice of appropriation of 20,000 in. of water of the Mokelumne River, location of reservoir site and ditch rights has been filed in Jackson by the General Electric Company of California.

LITTLE RIVER, CAL.—The Little River Redwood Lumber Company has awarded the contract for the installation of an electric light plant at its plant in Little River, to the Eureka Electrical & Construction Company, of Eureka, Cal.

LOS ANGELES, CAL.—Bids will be received by the Board of Supervisors until Oct. 11 for lighting certain streets in Arlington Heights lighting district, using electric street arc lamps.

LOS ANGELES, CAL.—The Los Angeles & Mt. Washington Railway Company is contemplating the construction of a power house, contracts for the construction of which will be placed within 60 days.

LOS ANGELES, CAL.—The Board of Supervisors has awarded the contract for lighting the new district of East Hollywood for a term of five years to the Pacific Light & Power Company, of Los Angeles, Cal.

LOS ANGELES, CAL.—The Board of Supervisors has authorized the sale of a 50-year franchise to construct a street railway on West Adams Street, from Washington Street to the city limits.

MARYSVILLE, CAL.—Arrangements are being made to extend the transmission line from the Colgate plant to the California Mother Lode Mining Company's plant at Indiana Branch, a distance of six miles, to furnish electricity for operating the new electric hoist and stamp mill.

RIVERSIDE, CAL.—The City Council has approved the recommendations for installing ornamental street illumination in the business section, covering 11 blocks. Reinforced concrete poles will be adopted.

SAN FRANCISCO, CAL.—The Central California Traction Company has commenced work on grading its 3½-mile extension between Sacramento and Agriculture Park. Following this work the company will commence work on the construction of the Sacramento-Lodi extension, for which bonds have been disposed and all the right of way practically secured.

SANTA MONICA, CAL.—The Sunset Telephone Company has submitted plans for improvements to its system to the City Council for approval, which will involve an expenditure of about $28,000. It is proposed to place the cables along the speedway underground.

WILLOW, CAL.—The Wilbur Springs Company is contemplating the installation of an electric light and power plant. Water power will be used to generate electricity.

GUNNISON, COL.—The Town Council has granted the Colorado Telephone Company a franchise in Gunnison. The company will commence work at once on the construction of a telephone exchange to cost $8,000, and will also erect a toll line from Salida, via Monarch Pass and White Pine, next spring, which will involve an expenditure of about $40,000. The Colorado Telephone Company recently purchased the property of the local concern.

AUGUSTA, GA.—The Georgia-Carolina Power Company is planning to construct a dam across the Savannah River about one mile above the city locks. The dam is to be 25 ft. high and about 8000 hp. will be devoloped. The company is capitalized at $500,000.

EAST POINT, GA.—The new municipal electric light plant and water works system has been completed and put into operation. The cost of the combined plants is estimated at $85,000.

JEFFERSON, GA.—Plans are being prepared by E. P. Taylor, engineer, of Athens, Ga., for the construction of an electric light plant for the Jefferson Cotton Mills Company, of Jefferson, and also for water works and sewer system for the town of Jefferson. The equipment of the electric plant will include a 75-kw, three-phase, 2300-volt generator direct connected to a 125-hp high-speed engine. The plant will furnish electricity to operate a 25-hp, 2300-volt, three-phase motor direct connected to a centrifugal pump for the water works system. Tungsten lamps of 80 cp will be used for street lighting.

SENOIA, GA.—At an election held Sept. 11 the citizens voted to issue $10,000 in bonds, the proceeds to be used for the construction of an electric light plant.

WHITESTONE, GA.—Plans are being considered by Frank Eastman, of Chicago, Ill., for the construction of a hydroelectric plant and to transmit 700 hp by electricity to the marble works near Whitestone. H von Schon, Detroit, Mich., is engineer in charge.

CHICAGO, ILL.—Arrangements are being made by the Simonds Manufacturing Company, of Chicago, Ill., for the installation of a new electric generating unit and auxiliary equipment.

CHICAGO, ILL.—Bids will be received by William Carroll, City Electrician, until Oct. 14, for furnishing the Department of Electricity with submarine telegraph cable in accordance with specifications on file in the office of the City Electrician as follows: 1600 ft. more or less, 4-conductor, rubber insulated, lead sheathed, wire armored; 600 ft. 3 conductor, rubber insulated, wire armored. Proposals must be made out upon blanks furnished by the City Electrician.

EAST ST. LOUIS, ILL.—Bids will be received by the City Council until Oct. 11, for lighting the streets of the city for a term of ten years The present contract expires Feb. 28, 1910.

GALENA, ILL.—The Interstate Construction Company, of Galena, Ill., it is reported, is constructing a new power plant, the equipment of which will include two direct-connected cross-compound condensing units one with a rating of 1000 hp and one of 1500 hp. The boiler plant will consist of four 400-hp Edgemoor water-tube boilers. The company has a power plant at Plattsville, Wis., which, it is understood, will be closed when the new plant is completed, and electricity for operating the system in that place will be transmitted from Galena.

ROCK ISLAND, ILL.—Plans are being considered by the Central Union Telephone Company for improvements and extensions to its local telephone system, which will involve an expenditure of about $45,000.

ST. CHARLES, ILL.—The lighting committee of the City Council has been authorized to purchase new machinery for the municipal electric light plant, at a cost of $1,200. C. E. Wallace is superintendent.

PENDLETON, IND.—The Town Board has granted a franchise to Holmes Brothers, of Indianapolis, Ind., to install an electric light plant in Pendleton. The plant is to be installed before July 1.

RICHMOND, IND.—The Pilot Motor Car Company has commenced work on equipping its new factory on East Tenth Street. The factory is to be equipped with electrical machinery and power throughout. The plant will be under the management of C. H. and H. M. Kramer and George Seidel. The company is capitalized at $100,000.

TERRE HAUTE, IND.—The Indiana Electric Transmission Company has changed its principal office from Lafayette, Ind., to Terre Haute, Ind. The company is preparing a bond issue to secure funds to carry out its proposed work. H. S. Hyatt is secretary.

NEVADA, IA.—Work has commenced on the reconstruction of the electric plant of the Nevada Electric Company which was recently destroyed by fire. F. E. Harris is owner of the plant.

SERGEANT BLUFFS, IA.—The capital stock of the Sergeant Bluffs Telephone Company has been increased from $20,000 to $40,000.

DRY RIDGE, KY.—The Cincinnati, Louisville, Lexington & Maysville Traction Company, which proposes to construct an interurban railway between Cincinnati, Ohio, and Lexington, Ky., and between Maysville and Louisville, Ky., has made arrangements with the Reliance Engineering Company, of Cincinnati, Ohio, to design and construct the entire

system, the cost of which is estimated at about $3,000,000. The proposed railway will be over 200 miles in length. Work has commenced on the preliminary surveys of the first section, which will extend from Dry Ridge to Owenton, Ky., and, when completed, a survey will be made from Dry Ridge to Cincinnati, Ohio. Work on construction of the railway will begin about Dec. 1. W. T. Blackburn, of Dry Ridge, Ky., is president.

CROWLEY, LA.—Warren B. Reed, of New Orleans, La., consulting engineer, has been engaged by the City Council to prepare plans for the installation of a temporary electric light plant and also to prepare plans and specifications for permanent plant to take the place of the one recently destroyed by fire.

NAPOLEONVILLE, LA.—The city is planning to rebuild the electric light and water plant recently damaged by storm.

NEW ORLEANS, LA.—The New Orleans & Seashore Railway Company has awarded the contract for its proposed electric railway from New Orleans to Grand Isle, La., a distance of 50 miles, to Black & Laird, of New Orleans, La. J. W. Stephens, 303 Cotton Exchange Building, New Orleans, La., is chief engineer.

WASHBURN, MAINE.—A company has been formed recently in Washburn to supply the village with electricity for lighting purposes. Electrical energy for operating the system will be furnished from the plant at Presque Isle, Maine.

BALTIMORE, MD.—Many of the places of amusements in River View Park, a large amusement resort owned and operated by the United Railways & Electric Company, of Baltimore, Md., were destroyed by fire Sept. 30, causing a loss of about $91,000, a greater part of which consisted of electrical apparatus and wiring. Preparations are already being made by the company to rebuild, and it is expected to have the resort ready for the next Summer season.

LOCH RAVEN, MD.—Plans are being made to install an electric power plant in the Maryland School for Boys.

ROCKVILLE, MD.—The Town Council is considering the question of establishing a municipal electric light plant to furnish electricity for lighting the streets and residences of the town and to operate the pumping station.

BOSTON, MASS.—Bids will be received until Oct. 30 at the U. S. engineer office, Boston, Mass., for motor generator sets, motors, centrifugal pumps, transformers and lightning arresters. For further information apply to Lt.-Col. Edward Burr, U. S. A.

BOSTON, MASS.—The Boston Elevated Railway Company is contemplating the construction of a substation in the Forest Hills district, at the intersection of Washington and Bray streets, to supply electricity for operating the Forest Hills elevated railway extension.

SHELBURNE FALLS, MASS.—E. N. Spinney and E. C. Frost are contemplating the installation of an electric light plant to furnish electricity to light their hotel and stable.

TURNER'S FALLS, MASS.—The Franklin Electric Light Company has petitioned the Selectmen for a permit to erect transmission lines on Montague City Road, Seventh, Fifteenth and G Streets.

WORCESTER, MASS.—Plans are being considered by the City Council and the Worcester Merchants' Association for installing an arch lighting system in the business district of the city. It is proposed to erect arches from Chandler Street to Lincoln Square on Main Street, and from Harrington Corner to Union Station, to burn on an all-night and every night schedule.

DETROIT, MICH.—The Everett-Metzger-Flanders Company, of Detroit, Mich., contemplates equipping its plant for electric motor drive, and it is said will install a large number of alternating-current motors, together with power-plant equipment.

ESCANABA, MICH.—The Escanaba Street Railway Company is reported to have commenced work on the construction of its proposed extension from Escanaba to Gladstone. P. L. Utley is general manager.

MENOMINEE, MICH.—The J. W. Wells Company, of Menominee, Mich., is planning to erect a new hardwood flooring factory this fall, for which the following equipment will be required: Furnace boiler, engine, electric motors, sawing machinery, blowers, etc.

PORT HURON, MICH.—The Common Council has instructed the city clerk to advertise for bids for furnishing electricity for lighting the streets of the city on a one, three and five-year contract commencing Jan. 1, 1910, on a moonlight schedule and an all-night and every-night schedule. The contract is to provide for 175 arc lamps of 2000 cp.

CLEAR WATER, MINN.—The question of establishing an electric lighting system in Clear Water is under consideration.

FERGUS FALLS, MINN.—Four dams, one a concrete structure completed by the city last fall to furnish power for operating the municipal electric light plant at a cost of $60,000, were destroyed Sept. 25 by a washout. The power station with all the equipment was wrecked, causing a total damage of about $200,000.

HIBBING, MINN.—Preparations are being made by the Shenango Furnace Company for the installation of a new Corliss engine and electric generator at Hibbing, Minn.

MADISON, MINN.—Bids will be received by J. C. Bang, manager of the municipal electric light plant, until Oct. 10, for the installation of a boiler, 72 in. x 18 ft., in the municipal electric light plant. Plans and specifications can be seen at the office of the Hartford Steam Boiler Inspection & Insurance Company, Minneapolis, Minn.

McKINLEY, MINN.—The citizens have voted to issue bonds to the amount of $5,000 for the construction of an electric light plant.

WINONA, MINN.—Negotiations have been closed whereby the Northwestern Telephone Company has secured control of the telephone lines owned and controlled by the Winona Independent Telephone Company, which consists of approximately 500 miles of lines.

VICKSBURG, MISS.—The Vicksburg Traction Company is planning to install coal-handling machinery in its power station within the next year.

CHILLICOTHE, MO.—A special election will be held Oct. 23 for the purpose of voting on the proposition of issuing $150,000 in bonds, the proceeds to be used for the installation of an electric light plant and water works system. Fuller-Coult Company, Chemical Building, St. Louis, Mo., are the engineers.

FESTUS, MO.—The proposition to issue $15,000 in bonds for the construction of a municipal electric light plant will be submitted to the voters.

MALDEN, MO.—Plans are being prepared by Arthur Rollins & Company, engineers, Beal Building, Kansas City, Mo., for an addition to the municipal electric light plant. It is proposed to increase the output of the plant at a cost of about $7,000.

WINDSOR, MO.—The stockholders of the Missouri Union Telephone Company has decided to issue $25,000 in bonds, the proceeds to be used to take up outstanding indebtedness and for extensions and improvements to its plant.

CULBERTSON, MONT.—The Montana Star Telephone Company will soon commence work on the construction of the telephone line to extend from Culbertson to Glasgow.

HELENA, MONT.—Sealed proposals will be received until Oct. 18 by J. A. Mattson, city clerk, for furnishing the city of Helena with equipment for an electric light plant, specifications for which may be seen at the office of the city clerk.

POLSON, MONT.—The Northern Idaho & Montana Power Company has commenced work on construction of its electric plant, the cost of which is estimated at $30,000.

COZAD, NEB.—The citizens have decided to establish a municipal electric light plant, bonds for which have been voted.

FAIRBURY, NEB.—The Council is considering the question of installing a municipal electric light plant or purchasing the lighting system of the Fairbury Light & Water Company. The local company is reported to have applied for a new franchise.

SUTTON, NEB.—At an election held recently the citizens defeated the proposition to issue bonds for the erection of an electric light plant.

ALBUQUERQUE, N. M.—The City Council has granted M. P. Stamm and associates a 50-year franchise to construct and operate a 2-mile electric railway in Albuquerque, and a 25-year franchise to furnish electricity for lamps, motors, etc.

DUNDEE, N. Y.—The managers of the Dundee electric light plant are contemplating replacing the present 25-cp incandescent street lamps with tungsten lamps of 80 cp. The owners of the plant have offered to install the new system and furnish the improved service for $1,8[illegible] per year, which is $300 more than the town pays for the present service.

NEW YORK, N. Y.—Bids will be received at the office of the Department of Parks, Arsenal Building, Fifth Avenue and Sixty-fourth Street, New York, N. Y., until Oct. 21, for furnishing material and installation of the electric light and power plant in the New York Public Library, Astor, Lenox and Tilden Foundations, Fifth Avenue, Fortieth and Forty-second Streets. Plans and specifications may be seen at the office of the Department of Parks, and also at the office of Carrere & Hastings, New York Public Library Building, New York, N. Y. Henry Smith is president of board of commissioners.

ROCHESTER, N. Y.—Bids will be received by the Board of Education, Municipal Building, until Oct. 15, for furnishing material and labor required for electric light wiring and fixtures for Public School No. 14 and the assembly halls of the following schools as follows: 6, 7, 19, 23, according to plans and specifications of the architect, J. Foster Warner, which may be seen at the office of the board. J. S. Mullan is secretary.

HIGH POINT, N. C.—The Town Council has closed a contract with the North Carolina Public Service Corporation to furnish 100 arc lamps for street lighting. The company will secure electricity for the service from the Southern Power Company.

LENOIR, N. C.—The Citizens' Light & Power Company is planning to enlarge its plant in order to meet the increasing demand for electricity for lamps and motors in Lenoir. The new equipment will include a new 100-kw three-phase, Allis-Chalmers dynamo. It is expected the company will establish an all-night lighting service in the town. E. C. Ivey is [illegible] and manager.

MONROE, N. C.—The Monroe Telephone Company is making arrangements to rebuild its entire telephone system, at a cost of about $10,000.

ROCKINGHAM, N. C.—The Rockingham Power Company is reported to be ready to resume work on the Blewitt's Falls hydroelectric plant, the works now being in the hands of W. A. Leland, receiver. About 1000 men will be required.

SALISBURY, N. C.—Plans are being considered for the construction of an electric railway from Salisbury to Winston, a distance of about

35 miles. Electricity for operating the proposed railway will be secured from the Southern Power Company's plants on the Catawba River.

SALISBURY, N. C.—The town has granted a franchise to L. D. Coltrane, of Concord, and J. F. Hayden, of High Point, to install a number of long distance telephone stations, Salisbury to be the central point for independent exchanges at High Point, Lexington and several other towns, of from 2000 to 10,000 population.

HAZLETON, N. D.—The installation of an electric light plant in Hazleton is under consideration. George Zerbes is reported to be interested in the project.

MINOT, N. D.—The Fisher Construction Company is reported to be making preliminary surveys for an electric railway to extend from Minot to Boscurvis, Sask. It is said that $150,000 has already been subscribed toward the project. H. F. Bartling, of Minot, N. D., is interested in the enterprise.

ASHTABULA, OHIO.—A contract has been placed by the Lake Shore & Michigan Southern Railroad Company with the Wellman-Seaver-Morgan Company, of Cleveland, Ohio, for four 15-ton Hulett unloaders for the new ore docks to be built at Ashtabula, Ohio. It is said that the railroad company expects to purchase a Hoover & Mason ore bridge to be erected in connection with the plant. A power plant will also be erected by the Lake Shore Railroad Company. The contract for the equipment will be placed in the near future. The cost of the plant complete is estimated at about $800,000.

CHESAPEAKE, OHIO.—The Town Board has granted A. E. Cox and associates a 25-year franchise to construct an electric railway through Chesapeake. The proposed railway will extend from Ironton to Gallipolis on the Ohio side of the river and from Point Pleasant to Guyandotte on the West Virginia side.

CLEVELAND, OHO.—Plans are being made by the Upson Nut Company, of Cleveland, Ohio, to enlarge its power house, which will include the installation of a boiler, contract for which has been placed. The company also contemplates installing a generating unit of about 500 hp, which has not yet been purchased.

COLUMBUS, OHIO.—The executive committee of the board of directors of the Columbus Citizens' Telephone Company is considering the proposition of purchasing the property of the Lancaster Telephone Company, of Lancaster, Ohio. The Lancaster Telephone Company is a subsidiary of the United States Telephone Company, which is now disposing of its local plants in order to devote its attention to the long-distance business and the development of the system.

DAYTON, OHIO.—Announcement has been made that the Cincinnati, Dayton & Fort Wayne Railway Company will be re-organized and will resume work on the construction of its electric railway. The company now proposes to construct a railway to Toledo, Ohio, with a branch to Detroit, Mich., instead of extending into Indiana, as originally planned.

FRANKLN, OHIO.—The Franklin Wheel Company, of Franklin, Ohio, is contemplating the installation of a direct-current generator with a rating of about 30 kw.

LIMA, OHIO.—The Western Ohio Railway Company is installing a 1000-kw turbine in its power house at St. Mary's to furnish additional power for its system.

SPRINGFIELD, OHIO.—An ordinance has been passed by the City Council awarding a contract to the Springfield Light, Heat & Power Company to furnish electricity for the street lamps at $68 each per year, for a period of ten years. About 500 lamps will be required.

STEUBENVILLE, OHIO.—The County Commissioners of Jefferson County have granted the Wheeling Traction Company, of Wheeling, W. Va., a perpetual franchise to operate its railway over the highway from Mingo to Brilliant.

YELLOW SPRINGS, OHIO.—The city is reported to have sold electric light bonds to the amount of $6,000, the proceeds to be used for improvements to the lighting system

KONAWA, OKLA.—Bids will be received by the Town of Konawa until Oct. 13 for material and equipment necessary for the construction of an electric light and water plant, to cost about $30,000, specifications for which may be secured from Mackintosh-Barbour Company, engineers, Bassett Building, Oklahoma City, Okla.

TULSA, OKLA.—The Mid-Continent Traction Company has awarded the contract for the construction of its proposed electric railway from Tulsa to Sapulpa, via Shawnee, a distance of 22 miles. J. Robert Burnham is chief engineer.

WEWOKA, OKLA.—It is reported that the citizens have voted to issue $60,000 in bonds, the proceeds to be used for the construction of an electric light plant, water works and sewerage system.

ASTORIA, ORE.—Arrangements are being made by the Hammond Lumber Company, of Astoria, Ore., for the installation of two 800-kw turbo-generator sets, with condensers, transformers and other auxiliary apparatus. It is said that the company proposes to use exhaust steam from the sawmill when in operation and direct steam when the mill is not working.

LA GRANDE, ORE.—At an election held recently the citizens voted in favor of the proposition to issue bonds for the construction of a municipal electric light plant.

LA GRANDE, ORE.—Negotiations have been closed whereby the Eastern Oregon Light & Power Company, which owns and controls the Fremont and Baker Light and Power Companies, has purchased the plant and holdings of the Grand Ronde Electric Company, which gives the company control of practically all the lighting facilities in Eastern Oregon, east of Pendleton. The headquarters of the company are located in Baker City, Ore.

BEDFORD, PA.—Application has been made to the Governor for a charter for the Bedford, Fulton & Franklin Street Railway Company to construct a double-track street railway from Bedford to Chambersburg, by M. J. Murphy, M. D. Tate, George W. Rook, John F. Fay, M. H. Sheets and I. Y. Daly.

BUTLER, PA.—The installation of motor-driven equipment is being considered by the Butler Engine & Foundry Company, of Butler, Pa.

CLEARFIELD, PA.—The Central Pennsylvania Light & Power Company is in the market for a 350-kw two-phase unit, direct-connected to a Corliss cross-compound engine, switchboards, motors and fans. The system will be changed from 133 to 60 cycles.

NANTY GLO, PA.—Conrad Brothers, of Nanty Glo, are installing a small electric light plant for the purpose of furnishing electricity for lamps for residences and business places in the town. A contract may also be made for the street lighting.

PITTSBURGH, PA.—The contract for installing three units in the power plant in the Pittsburgh Athletic Club Building, Pittsburgh, Pa., has been awarded to James E. McNary, Pittsburgh representative of the Clark Brothers Engine Company, of Belmont, N. Y. The contract calls for three high-speed engines with a rating of 75, 100 and 150 hp, respectively. These engines are to be direct-connected to Crocker-Wheeler generators.

BLACKSBURG, S. C.—The citizens have voted to issue $15,000 in bonds, the proceeds to be used for an electric light plant and for street improvements.

COLUMBUS, S. C.—Bids will be received by G. F. Cooper, city clerk, until Oct. 23, for lighting the streets of the city.

GREENVILLE, S. C.—The Monoghan cotton mills are being equipped for electric motor drive, at a cost of about $30,000. Electricity for operating the mills will be supplied by the Southern Power Company of Charlotte, N. C., electrical energy being transmitted from the Great Falls plant on the Catawba River.

ORANGEBURG, S. C.—It is reported that the Edisto Power Company is planning to install an emergency steam plant of from 1000 to 2000 hp, to be used until the hydroelectric plant is built. The cost of the hydroelectric plant is estimated at about $1,000,000. For further information address the Edisto Power Company, care of Wolfe & Berry.

ROCK HILL, S. C.—A movement has been started for equipping the local horse car line to be operated by electricity. J. M. Cherry, one of the owners of the old system, is interested in organizing a new company to build an electric railway in the town. It is likely that a railway will also be built to the Catawba River, where a pleasure park will be established by the company.

ROCK HILL, S. C.—R. T. Fewell, present manager of the Rock Hill Water, Light & Power Company, recently sold at a receiver's sale to Philadelphia capitalists, announces that a charter will be asked by himself and P. A. Wilcox, of Florence, S. C., for the Rock Hill Lighting & Water Company.

CENTREVILLE, TENN.—A petition is being circulated in Centreville asking the Board of Mayor and Aldermen to submit a proposition to the voters asking for a bond issue of $30,000, the proceeds to be used to establish an electric lighting system and water works.

ERWIN, TENN.—The Unaka Traction Company is installing new equipment in its plant, including a 50-kw, 60 cycle generator, a 75-hp automatic engine, a 100-hp return tubular boiler, and other improvements. I. R. Roberts is general manager.

LAFAYETTE, TENN.—Preliminary surveys have been completed and rights of way are being secured by the Westmoreland & Red Springs Railroad Company for its proposed electric railway, which will extend from Westmoreland, via Lafayette to Red Boiling Springs, Tenn., a distance of 36 miles. The railway later will be extended into Kentucky to connect with the Queen & Crescent Route. Bright Brothers Construction Company, of Nashville, Tenn., is the contractor.

DEL RIO, TEX.—The Del Rio Electric Light & Ice Company is contemplating reconstructing part of its pole lines and installing a new 25-ton ice machine. W. H. Wolff is president and manager.

GAINESVILLE, TEX.—The Gainesville, Whitesboro & Sherman Railway Company has 13 miles of its railway graded. The company would like to correspond with a construction or engineering company, with a view of completing the railway. Thomas M. Bosson is secretary.

GALVESTON, TEX.—Sealed proposals will be received by V. E. Austin, City Secretary, until Oct. 21, for furnishing one engine, direct-connected to generator, with a rating of not less than 150 kw, including switchboard and other accessories for the municipal electric light plant. Plans and specifications are on file at the office of the city secretary and in the office of W. D. Masterson, city superintendent of electricity, from whom copies can be secured upon application.

HOUSTON, TEX.—The Houston Light & Power Company has decided to place all its overhead wires underground in the business section of the city, at a cost of about $100,000. Ford, Bacon & Davis, engineers, of New York, N. Y., will have charge of the work.

MADISONVILLE, TEX.—A movement is on foot by the business men of the town to establish an electric lighting system and water works in Madisonville.

MARLIN, TEX.—It is reported that the Marlin Ice & Electric Company will rebuild its plant, which was recently destroyed by fire. I. J. Nathan is owner.

ORANGE, TEX.—The Yellow Pine Paper Mill Company has awarded the contract for equipment of its power house, costing between $35,000 and $40,000, to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa. The equipment includes an 800-kw turbo-generator set, Le Blanc condenser, turbine exciter, 40 or more motors, etc. The steam boiler equipment has been purchased. The plant will have an output of 1000 hp. The power plant is to be located on the banks of the Sabine River, between the two mills of the Lutcher & Moore Lumber Company, where fuel can be secured direct from the slab conveyors of either mill.

TERRELL, TEX.—The management of the municipal electric light plant is planning to establish a 24-hour service.

AMERICAN FORK, UTAH.—The Utah County Light & Power Company has filed amendments to its charter increasing its capital stock from $200,000 to $300,000.

FARMINGTON, UTAH.—The Davis County Light & Power Company is erecting an electric power plant on the hillside northeast of Farmington, at a cost of $30,000. It is expected to have the plant completed and in service by Nov. 1. The company will furnish electricity for manufacturing purposes and for the washing-machine motor.

FORT DOUGLAS, UTAH.—Sealed proposals will be received by Lieut. Kenneth P. Williams, acting quartermaster, U. S. A., Fort Douglas, Utah, until Oct. 26, for the construction of an electric lighting system at Fort Douglas. Plans and specifications may be secured on application to the above office on deposit of five dollars, which will be returned when plans are returned.

PITTSFORD, VT.—The Selectmen are considering the question of entering into a contract with the Rutland Railway, Light & Power Company to furnish electricity for lighting the streets of the town. If the project should go through the transmission line would be extended from the power station at Mendon and a substation would be erected in Pittsford.

APPOMATTOX, VA.—The Appomattox Telephone Company has filed amendments to its charter increasing its capital stock from $5,000 to $10,000.

CHARLES CITY COURTHOUSE, VA.—The Charles City Telephone Company, which has been in operation for sometime, has been formally incorporated, with H. S. Saunders, president; Dr. Ashton Harwood, vice-president; L. M. Nance, secretary-treasurer. The company has erected a telephone line from Roxbury to Granville, and contemplates other extensions.

BELLINGHAM, WASH.—Plans are being prepared by the Home Telephone Company of Puget Sound for extensions and improvements to its telephone system in Bellingham which will involve an expenditure of from $10,000 to $15,000. The work will include the erection of a new circuit between Bellingham and Seattle, and the installation of two new switchboards.

OLYMPIA, WASH.—The Olympia Light & Power Company is reported to be contemplating substituting tungsten lamps for the present street arc lamps.

WALLA WALLA, WASH.—Plans are being considered by the Portland Flouring Mills Company for the construction of a new plant in Walla Walla, Wash., including the installation of a power plant complete.

WASHOUGAL, WASH.—The Western Light & Power Company is installing a hydroelectric plant to supply electricity in Washougal and Camas. The company expects to have the plant ready for service by Dec. 1. C. W. Cottrell is interested in the enterprise.

WATERVILLE, WASH.—The Waterville Railway Company is reported to have awarded the contract for the construction and equipment of its proposed electric railway between Douglass and Waterville, a distance of 4½ miles, to Frank McKean, of Seattle, Wash., for $80,000. O. H. Rogers, of Waterville, Wash., is chief engineer.

St. JOSEPH, WIS.—The capital stock of the Moulton Rural Telephone Company has been increased from $3,600 to $6,000.

SHULLSBURG, WIS.—The City of Shullsburg, Wis., with a population of about 1200, will give a franchise to parties wishing to install an electric light plant in the city. The city owns its water system, which it would turn over to the electric company. For further information address W. S. Webb, City Clerk.

WEST ALLIS, WIS.—The Common Council has awarded a contract to the Milwaukee Electric Light, Heat & Traction Company for lighting the streets of the city for a term of ten years, at the rate of $75 per lamp per year.

CHEYENNE, WYO.—Bids will be received by Captain V. K. Hart, acting quartermaster, until Oct. 23 for electrical work in rear ward wings, including wiring and fixtures and installing intercommunicating telephone system. Blank forms of proposals and information furnished on application.

CHEYENNE, WYO.—The Cheyenne Light, Fuel & Power Company, of Cheyenne, Wyo., is contemplating the installation of a 500-kw. direct connected unit in its electric plant. Extensive improvements are also to be made to its gas plant, including the installation of a 600-hp Franklin water-tube boiler.

THERMOPOLIS, WYO.—George D. Miklejohn, of Omaha, Neb., is interested in a project to construct an electric railway from Thermopolis to Hot Springs. A company has been organized under the name of the Thermopolis & Hot Springs Street Railway Company. Col. S. A. Broadwell, of Thermopolis, is president of the company.

CALGARY, ALTA., CAN.—Work has commenced on the construction of dams, power plant, etc., of the Calgary Power & Transmission Company on Bow River, 45 miles from Calgary. Contracts have been awarded for two 2000-kw generators, 300 r.p.m., of the water-wheel type, to the Canadian General Electric Company, of Toronto, Can. The remainder of the tenders will soon be awarded. It is reported that the company has contracted with the Western Canada Cement & Coal Company, of Exshaw, to supply 3000 hp, which will be transmitted at 12,000 volts, 60 cycles.

EDMONTON, ALTA., CAN.—New equipment is being installed in the municipal electric plant, which will increase the output of the plant by 5000 hp, which will be utilized for street railway and electric lighting service. It is expected that a new power house will be erected during the next six months.

CRANBROOK, B. C., CAN.—The Cranbrook Electric Light Company is contemplating the installation of a new steam plant to cost from $30,000 to $50,000.

NELSON, B. C., CAN.—The Nelson Electric Tramway Company is reported to have closed an agreement with the city under which it is to resume the street car service, which has been suspended since the destruction of its plant, and to extend the existing lines. The city is to furnish electricity free of charge to operate the cars and to guarantee bonds of the company to the amount of $20,000.

VICTORIA, B. C., CAN.—The by-law ratifying the agreement with the British Columbia Electric Railway Company under which the city agrees not to enter the power business without first offering to purchase the company's plant, was recently carried. The company agrees to spend $1,500,000 for the installation of a power plant at Jordan River.

VICTORIA, B. C., CAN.—Preliminary work has commenced on the Jordon River project of the British Columbia Electric Railway Company.

VANCOUVER, B. C., CAN.—The Burrard Power Company has been granted 25,000 miners' in. of water of the Lilooet River, by the Dominion Government. The power plant will be located about 23 miles from Vancouver.

MORRISBURG, ONT., CAN.—The citizens on Sept. 25 voted to give the Canadian Sheet Steel Company a 60-year franchise for the construction and operation of a hydroelectric power plant and a right of way for an electric railway through the principal streets of the town.

OWEN SOUND, ONT., CAN.—Plans are being considered for the organization of a company to carry on the work started four years ago by the Georgian Bay Power Company. About $90,000 was spent by the company in purchasing rights and in constructing a tunnel 867 ft. long for the purpose of transmitting power developed at Eugenia Falls to Owen Sound, which was brought to a standstill through lack of funds. It is estimated that 2200 hp can be developed and delivered in Owen Sound at a cost of $20 per horse-power per year. About $200,000 will be required to carry out this project.

PERTH, ONT., CAN.—The power house of the Canadian Electric & Water Power Company, located at Badour's Mills, was destroyed by fire recently, causing a loss of about $15,000.

PETERBOROUGH, ONT., CAN.—The Otonabee Power Company is planning to combine its two dams, at a cost of about $250,000.

MEXICO CITY, MEX.—The Mexican Northern Light & Power Company has awarded the contract for the construction of its hydroelectric plant and 20 miles of railway on the Conchos River, to Sir Whitman Pearson, an English contracting firm, for about $5,000,000. The plant will be located about 17 miles from Santa Rosalia. G. F. Greenwood, of Montreal, Que., is president of the company.

MONTEREY, MEX.—Plans are being prepared by the Monterey Railway, Light & Power Company for extensive changes in its plant on [illegible] and Guerrero Streets.

New Industrial Companies.

THE CENTRAL ENGINEERING & CONSTRUCTION COMPANY, of Wilmington, Del., has been incorporated, with a capital stock of $500,000, by E. I. Squire, G. W. Dorsey, Jr., I. Rothstein, of Wilmington, Del.

THE CHESTER MANUFACTURING COMPANY, of Yonkers, N. Y., has been incorporated, with a capital stock of $4,500, by James Chester, of New York, N. Y.; James Donnelly and James W. Slade, both of Yonkers, N. Y.

THE ELECTRICAL CONSTRUCTION COMPANY, of New Orleans, La., has been incorporated, with a capital stock of $3,000, for the purpose of doing electrical construction work. The officers are: Gilbert L. [illegible], president; W. H. Gribble, secretary, and Charles Ahrens, [illegible].

THE FEDERAL ENGINEERING COMPANY, of New York, N. Y., has been incorporated, with a capital stock of $100,000, to do a general constructing and building business, by A. A. Bertini, J. M. Baum, J. P. Irwin, of New York, N. Y.

THE FISH SYSTEMS COMPANY, of Indianapolis, Ind., has incorporated with a capital stock of $50,000. The company proposes to establish and equip a plant for the manufacture and sale of electrical and power apparatus. George L. Fish, R. C. Davis, H. F. Huster and E. A. Leeson are directors.

THE FT. WAYNE MANUFACTURING COMPANY, of Ft. Wayne, Ind., has been incorporated to establish a plant for the manufacture of electrical machinery and supplies. The capital stock is placed at $10,000. F. L. Dulin, A. L. Sopshire, W. M. Fay and Perry Crawford are directors.

THE FROLICH STEAM TURBINE COMPANY has filed articles of incorporation with the Secretary of State. The company is capitalized at $100,000, and the incorporators are: R. C. Frolich, F. C. Frolich and W. F. Frolich, of Philadelphia, Pa.

THE GENERAL POWER COMPANY, of Augusta, Maine, has filed articles of incorporation for the purpose of dealing in machinery and engines, etc. E. M. Leavitt, of Augusta, Maine, is president and treasurer.

THE GEORGE M. BREWSTER CONSTRUCTION COMPANY, of Tenafly, N. J., has been chartered, with a capital stock of $100,000, by G. M. Brewster, J. W. Brewster, of Tenafly, N. J., and W. Scott, of Hackensack, N. J. The company proposes to do a general contracting, engineering and construction business.

THE HAYS RAPID TUNNELING & MINING MACHINE COMPANY, of Birmingham, Ala., has been incorporated with a capital stock of $1,000,000. The company proposes manufacturing mining machines, turbine engines, pumps, etc. The officers of the company are: E. W. Hays, president; A. C. Bruce, vice-president, and H. E. Sheldon, secretary.

THE HENRY THERMO-ELECTRIC COMPANY, of Portland, Maine, has been incorporated, with a capital stock of $100,000, to manufacture electrical instruments. J. H. M. Parker, of Lenoxville, is president, and C. W. Cate, of Sherbrooke, treasurer.

THE INTERNATIONAL ELECTRICAL MANUFACTURING COMPANY, of Portland, Maine., has been incorporated, with a capital stock of $1,000,000, for the purpose of manufacturing electrical machinery. The officers of the company are: C. E. Eaton, president, and T. L. Croteau, treasurer, both of Portland, Maine.

THE LE COMPTE COMPANY, OF CHICAGO, ILL., has been incorporated with a capital stock of $500,000, by E. S. Masterson, of Chicago, Ill. The company proposes to manufacture railway supplies.

THE LEONE ELECTRICAL IMPROVEMENT COMPANY, of New York, N. Y., has been incorporated by P. Leone, J. Coggiano, A. Castelli and F. Surianni, of New York, N. Y. The company is capitalized at $50,000, and proposes to do general contracting and electrical work.

THE TATE GAS ELECTRIC MOTOR VEHICLE COMPANY, of Jersey City, N. J., has been incorporated, with a capital stock of $100,000, for the purpose of manufacturing motor vehicles, motor boats and aerial machines. The incorporators are: J. L. Tate, C. E. Tate and J. L. Tate, Jr., of Jersey City, N. J.

THE NEWARK AUTO & ENGINEERING COMPANY, of Newark, N. J., has filed articles of incorporation, with a capital stock of $25,000, for the purpose of manufacturing motor vehicles, engines, machinery, etc. The incorporators are: Alex. Traudt, Sr., Alex. Traudt, Jr., and Jeanette Traudt, all of Newark, N. J.

THE NEW LAMP COMPANY, of New York, N. Y., has been incorporated by Frederick C. Timpkins, Henry Heinmeyer and Thomas Butt, all of New York, N. Y. The company is capitalized at $50,000, and proposes to manufacture lamps, lanterns and lighting devices.

THE NEW YORK IGNITER COMPANY, of New York, N. Y., has been chartered, with a capital stock of $40,000, by James C. Wormley, Charles R. Sherlock and Allen S. Curlett, of New York, N. Y. The company proposes to manufacture lighting and heating devices.

THE NEW YORK & NEW JERSEY FURNACE COMPANY, of Cranford, N. J., has filed articles of incorporation, with a capital stock of $100,000, to manufacture furnaces, steam boilers, steam generators, etc. The incorporators are: George H. Bates, of Cranford, N. J.; Daniel H. Chinery and John M. Braisted, both of Port Richmond, N. Y.

THE WESTERN INDIANA CONSTRUCTION COMPANY, of Hammond, Ind., has been incorporated, with a capital of $100,000, for the purpose of constructing and equipping electric railroads. Allen T. Russell, F. M. Zimmerman, C. F. Knowlton and F. W. Potts are directors.

THE WILSON & ENGLISH CONSTRUCTION COMPANY, of New Rochelle, N. Y., has been incorporated with a capital stock of $25,000 for the purpose of doing a general contracting business, building public works, bridges, roads, etc. The incorporators are: C. W. S. Wilson, A. S. Wilson, of New Rochelle, N. Y., and J. J. English, of Long Island City, N. Y.

WINDES & MARSH, of Winnetka, Ill., has been chartered, with a capital stock of $2,500, for the purpose of doing a general engineering business, by Z. F. Windes, of Chicago, Ill.

New Incorporations.

EMAUS, PA.—The Emaus Telephone Company has filed articles of incorporation. Following are the directors: C. F. Newcomer, of Coopersburg, Pa., treasurer; H. T. Wickert, H. M. Knauss, C. D. Brown, Isaac Neimeyer, of Emaus, Pa.; Ernest Ritter, of Allentown, Pa., and C. H. Stonebach, of Coopersburg, Pa.

NEW ALEXANDRIA, PA.—The New Alexandria Telephone Company has been incorporated with a capital stock of $5,000 and the following directors: R. A. Dorna, treasurer, of New Alexandria, Pa.; M. K. George, William Christy, of Saltsburg, Pa.; John D. McCurdy, of Livermore, Pa.; C. R. Beatty, John Moffat, Elmer Myers, William Latimer, S. U. Kepple, S. Patterson, D. Guthrie, J. C. Giffen, all of New Alexandria, Pa.

DARLINGTON, S. C.—Articles of incorporation have been filed for the Darlington Water & Electric Company with a capital stock of $50,000 by P. A. Wilcox and W. M. Haynesworth.

ETOWAH, TENN.—The Etowah Electric Light & Power Company has been chartered, with a capital stock of $10,000, by P. A. Kiner, W. C. Reynolds, C. A. Graham, J. B. Rose and G. O. Bicknell.

RIPLEY, TENN.—The Lightfoot Telephone Company has been incorporated with a capital stock of $4,000 by J. H. Coughlan, W. H. Foust, W. F. Roberson, Dr. S. M. Glenn and R. L. Dennie.

EL PASO, TEX.—The El Paso & Fort Hancock Railway Company has been incorporated by C. E. Kelly, Richard Caples, W. B. Latta, Felix Martinez, Thomas O'Keefe and Richard Burgess, of El Paso, Tex. The company is capitalized at $100,000, and proposes to construct an electric railway to connect El Paso, Ysleta, Socorro, San Elizario, Clint and Fabens.

FORT WORTH, TEX.—The Fort Worth, Mineral Wells & Northwestern Interurban Railroad Company has applied for a charter to construct an electric railway from Fort Worth to Mineral Wells, via Weatherford, a distance of 54 miles; later an extension will be built to Roswell. The company will be capitalized at $100,000, and the incorporators are: L. C. Cole, Paul S. Hurley, of Fort Worth, Tex.; J. S. Sanford, and James A. Watkins, of Little Rock, Ark.

EVANSTON, WYO.—The Castle Valley Railroad Company has been incorporated, with a capital stock of $100,000, for the purpose of constructing an electric railway from Price, Utah, to Cedar Creek Canyon. Windsor V. Rice, of Salt Lake City, Utah, is president.

KAMLOOPS, B. C., CAN.—The Kamloops Power & Irrigation Company has been incorporated with a capital of $250,000. The head office of the company is located in Kamloops.

Personal.

MR. I. W. FISK, B.S., University of Illinois, 1909, has been appointed assistant in electrical engineering at the University of Illinois.

MR. PAUL DILNY, who represented in this country the Marseilles International Electrical Exposition, will return to Paris on a steamer sailing this week.

DR. JAMES T. ROOD, lately professor of physics and electrical engineering at the University of Alabama, has been appointed professor of electrical engineering at Lafayette College, Easton, Pa.

MR. W. L. LOVELAND, who has been associated with the Allis-Chalmers Company for the past 19 years and, since 1904, manager of its mining machinery department, has accepted the position of general manager of the Mine & Smelter Supply Company.

MR. H. C. KENDALL, a graduate of the University of Missouri, 1904, and of Massachusetts Institute of Technology, 1905, for the past four years engaged in practical work, has been appointed instructor in railway electrical engineering at the University of Illinois.

MR. ARTHUR H. BOETTCHER has joined the staff of Brown & Williams, attorneys and counsellors in patent law, Chicago. Mr. Boettcher, who is a graduate of the Chicago-Kent College of Law, studied engineering at Lewis Institute and the University of Wisconsin, and has had six years' experience in practical work before the Patent Office.

DR. JACOB KUNZ has been appointed assistant professor of physics at the University of Illinois. Dr. Kunz is a graduate of the Polytechnikum of Zurich, Switzerland, from which he received the degree of Ph.D. in 1902. He remained at the Polytechnikum for three years as an instructor, and for one year was instructor in physics at the University of Michigan.

MR. H. C. HOLTHOFF, for many years identified with the mining branch of the Allis-Chalmers Company, and for the past two years manager of its Mexican office, will succeed Mr. Loveland, who has resigned to become general manager of the Mine & Smelter Supply Company, as manager of the mining machinery department of the Allis-Chalmers Company and be located in Milwaukee. Mr. Holthoff is expected to arrive in Milwaukee about Oct. 15.

MR. EDWARD C. BROWN, manager for the Dearborn Drug & Chemical Works in the Hawaiian Islands and the Orient, has been elected president of the Commercial Club of Honolulu. This club is similar to the chamber of commerce and associations of commerce organizations in the large cities of the States. Mr. Brown recently made a trip in the interest of the Dearborn Company to the Orient, spending several months in China, Japan, Korea and the Philippines.

MR. C. B. HUMPHREY has resigned as manager of the detail supply sales department of the Westinghouse Electric & Mfg. Co. to become a vice-president and director of the White Investing Company, 43 Exchange Place, New York City, which will undertake the financing, development and operation of enterprises based on natural resources, and deal in bonds and securities. Among the interests of the company are the Aguacate gold mines in Costa Rica, which are now being developed and will be in operation in the near future; the development and operation of a slate mine for the production of slate for roofing, electrical and industrial purposes will be undertaken at once, and a number of properties of other characters acquired. Mr. W. F. White, president of the company, was formerly manager of the Cincinnati Edison Electric Company and later vice-president of the North American Company. For a number of years Mr. Humphrey was district manager for the Westinghouse Company, with headquarters at Cincinnati, and was called to the home office in 1904 to take charge of the detail and supply department.

Obituary.

MR. EDWARD G. COCHRANE, formerly superintendent of the Postal Telegraph Company at New York, died at his home in Manchester, Vt., Sept. 27, at the age of 56 years. He had suffered from paralysis for a long time. He is survived by a son and a daughter.

MR. GEORGE W. MILLS, assistant sales manager of the Stackpole Battery Company, St. Mary's, Pa., died Friday night, Oct. 1, at Asbury Park, N. J., after an illness prolonged over several years. Mr. Mills was one of the pioneers in the carbon and battery business of this country, having been one of the organizers of the New York Carbon Works in 1889. Later he helped to organize the Eastern Carbon Works, and three years ago the company with which he was connected when he died. Mr. Mills had a wide circle of friends in his field, to whom he was endeared by traits that made him one of the most popular salesmen in the country. The interment was at Elizabeth, N. J., his former home.

Trade Publications.

BELL TRANSFORMER.—An alternating current transformer for operating the ordinary battery call bells, etc., is listed, described and illustrated in a pamphlet of the Vindex Electric Co., Aurora, Ill.

FIRE BRICK CEMENT.—An asbestos fire brick cement, intended for setting up bridge work and inner courses in steam boilers, is listed and briefly outlined in a pamphlet of the H. W. Johns-Manville Company, 100 William st., New York.

ADJUSTABLE SPEED MOTORS.—Bulletin No. 371, of the Triumph Electric Company, Cincinnati, Ohio, deals with direct-current motors designed for adjustable speed service. The change in speed is obtained by a variation of the strength of the magnetic field.

TUNGSTEN SIGN LAMPS.—The Central Electric Company, Chicago, is distributing a circular descriptive of Columbia tungsten sign lamps. The circular contains information of an educational nature intended to assist central station managers in increasing their load.

FUSE BLOCKS.—A 60-page booklet has been issued by the Harvard Electric Company, 60 W. Van Buren st., Chicago, Ill., for calling attention to its lines of fuse blocks, cable terminals, protective devices, sleeves and electrical specialties. This combined catalogue and price list is designated as No. 14.

COMPOUND METER BOARD.—Bulletin No. 4688, of the General Electric Company, describes a meter board made of molded material which is intended to replace the customary wooden board used in mounting meters. The advantages claimed for this board are economy, durability, interchangeability and appearance.

TANTALUM RAILWAY LAMP.—Bulletin 5B of the engineering department of the National Electric Lamp Association describes the new tantalum lamp for railway service recently developed by the engineering department, and which, on account of its superior efficiency and strength of filament, is being introduced as a substitute for the carbon filament railway lamp.

Business Notes.

MR. JOHN R. GIVEN, until recently with the Duplex Metals Company, will engage in the commission business. For the present his address is the Machinery Club, 50 Church Street, New York.

THE CONDIT ELECTRICAL MANUFACTURING COMPANY, of 76 Batterymarch Street, Boston, Mass., will, as selling agent, hereafter handle the entire line manufactured by the Chase-Shawmut Company. This includes the latter's well-known line of fuses, stage pockets, railbonds, boxes, bushings, etc.

THE BRILLIANT ELECTRIC COMPANY EXPANDING.—The Brilliant Electric Company, of Cleveland, Ohio, incandescent lamp manufacturers, has found it necessary to add to its quarters in the Electric Building, Cleveland, Ohio, and to increase considerably its force, both on the inside and on the outside. Special departments have been created for close co-operation with the trade, and a vigorous advertising campaign is already in action.

THE WETMORE SAVAGE COMPANY has recently moved into its new building at 76 Pearl Street, Boston. The company will occupy the building in its entirety, comprising six floors, with approximately 30,000 square feet of floor space. It will thus be one of the best appointed supply houses in the East. The company started in an humble way on Oliver Street about four years ago on one floor, and has constantly increased its business until now the demands upon it call for much larger facilities. The company carries a full line of electrical supplies, and its reputation for prompt shipments and careful attention has brought it the volume of trade that necessitates this increase.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

ALABAMA LIGHT & TRACTION ASSOCIATION. Secretary, Lloyd Lyon, Mobile, Ala. Next meeting, Birmingham, Nov. 15 and 16, 1909.

AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, St. Louis, Mo., Nov. 15-18, 1909.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Next meeting, New York City, Oct. 28, 29 and 30, 1909.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, 158 West 76th St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

AMERICAN STREET & INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, H. E. Weeks, Davenport, Ia.

AMERICAN STREET & INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, John W. Corning, Boston Elevated Railway Company, Boston, Mass.

AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Pine Bluff, Ark., 1910.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, G. H. Winslow, 509 Perry-Payne Building, Cleveland, O. Next meeting, October, 1909.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Los Angeles, Cal., May, 1910.

ASSOCIATION OF CAR LIGHTING ENGINEERS. Secretary, C. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, D. L. Huntington, Spokane, Wash.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

BOSTON ELECTRICAL SHOW. Secretary, Chester I. Campbell, 5 Park Square, Boston. Mechanics' Building, Nov. 15-25, 1909.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, A. L. Neereamer, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary J. C. Lawler, Colorado Springs, Colo.

EASTERN STATES INDEPENDENT TELEPHONE ASSOCIATION OF PENNSYLVANIA, NEW JERSEY, MARYLAND AND DELAWARE. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

ELECTRIC VEHICLE AND CENTRAL STATION ASSOCIATION. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

ELECTRIC CLUB, CHICAGO. Secretary, W. S. Taussig, 448 Commercial National Bank Building, Chicago. Meets every Wednesday noon at Chicago Automobile Club.

ELECTRIC CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, Nov. 4, 1909.

ELECTRIC TRADES ASSOCIATION OF PHILADELPHIA. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York. Next meeting, New York City, Nov. 17 and 18, 1909.

Florida Electric Light and Power Association. Secretary, G. F. Doig, Gainesville, Fla. Next meeting, Tampa, Fla., April 21, 1910.

Illinois State Electric Association. Secretary, H. E. Chabbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Light Association. Secretary, Fred. Leslie, Muncie, Ind.

Internal Combustion Engine Association. Secretary, Walter J. Sittig, 61 Ward St., Chicago.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

International Independent Telephone Association. Secretary, A. C. Davis.

Iowa Electric Association. Secretary, W. N. Keiser, Des Moines, Ia.

Iowa Independent Telephone Association. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting second Wednesday in March each year.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Sioux City, April, 1910.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, 1910.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

Maine Electrical Association. Secretary, Fred D. Gordon, Auburn, Maine.

Massachusetts Street Railway Association. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

Michigan Electrical Association. Secretary, A. P. Biggs, Detroit, Mich.

Minnesota Electrical Association. Secretary, B. W. Cowperthwait, Faribault, Minn. Next meeting, St. Paul, third week in March, 1910.

Mississippi Electric Association. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss.

Missouri Electric, Gas, Street Railway & Water Association. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, Jefferson City, Mo., April 14, 15 and 16, 1910.

Missouri Independent Telephone Association. Secretary, G. W. Schweer, Windsor, Mo.

National Arm, Pin & Bracket Association. Secretary, J. B. Magers, Madison, Ind.

National District Heating Association. Secretary, W. A. Wolls, Columbus, Ohio. Next meeting, Columbus, Ohio, Nov. 11 and 12, 1909.

National Electric Light Association. Executive Secretary, T. C. Martin, 33 West 39th St., New York.

National Electrical Contractors' Association of the United States. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Atlantic City, N. J., July 20, 1910.

National Electrical Inspectors' Association. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

National Electrical Trades' Association. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, San Francisco, Cal., June, 1910.

Nebraska Electrical Association. Secretary, Frank McMaster, Beatrice, Neb.

New England Street Railway Club. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

New England Electrical Trades Association. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

New Orleans Electrical Contractors' Association. Secretary, I. G. Marks, 312 Carondelet, St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

New York Electrical Show. Madison Square Garden, Oct. 11-21, 1909.

New York Electrical Society. Secretary, G. H. Guy, 33 West 39th St., New York.

New York State Independent Telephone Association. Secretary, R. M. Eaton, Niagara Falls, N. Y.

Northwest Electric Light & Power Association. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

Ohio Electric Light Association. Secretary, D. L. Gaskill, Greenville, Ohio.

Ohio Independent Telephone Association. Secretary, Ralph Reamer, Columbus, Ohio.

Ohio Society of Mechanical, Electrical & Steam Engineers. Secretary, David Gaehr, Schofield Building, Cleveland, Ohio. Next meeting, Lima, Ohio, Nov. 19 and 20, 1909.

Oklohama Public Utilities Association. Secretary, Galen Crow, Guthrie, Okla. Next meeting, Sapulpa, Okla., 1910.

Old Time Telegraphers' & Historical Association. Secretary, F. J. Scherrer, 195 Broadway, New York.

Pacific Coast Electric Automobile Association. Secretary, J. T. Halloran, 604 Mission St., San Francisco, Cal. Next meeting, Oakland, Cal., February, 1910.

Pennsylvania Electric Association. Secretary, E. L. Smith, Towanda, Pa.

Pennsylvania Street Railway Association. Secretary, Charles H. Smith, Lebanon, Pa.

Philadelphia Electrical Show. First Regiment Armory, Broad and Callowhill Sts., Feb. 15-27, 1910.

Pike's Peak Polytechnic Society. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings second Saturday of each month.

Society for the Promotion of Engineering Education. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

Society of Wireless Telegraph Engineers. Secretary, E. D. Forbes, 96 Franklin St., South Framingham, Mass. Monthly meeting, first Monday of each month. Next annual meeting, Feb. 28, 1910.

South Dakota Independent Telephone Association. Secretary, E. R. Buck, Hudson, S. D. Next meeting, Jan. 11 and 12, 1910.

Southwestern Electric & Gas Association. Secretary, E. T. Moore, Dallas, Tex.

Street Railway Association of the State of New York. Secretary, G. H. Pardee, care of J. G. White & Co., New York.

Vermont & New Hampshire Independent Telephone Association. Secretary, E. B. Seeley, St. Johnsbury, Vt.

Vermont Electrical Association. Secretary, A. B. Marsden, Manchester, Vt.

Underwriters' National Electrical Association. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass.

Western Association of Electrical Inspectors. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Detroit, Mich., Oct. 26, 27 and 28, 1909.

Western Society of Engineers. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Wireless Institute. Secretary, Sidney L. Williams,, 42 Broadway. New York.

Wisconsin Electrical Association. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis. Next meeting, Milwaukee, January, 1910.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED SEPT. 28, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

934,988. PROCESS OF MAKING DURABLE CARBON ELECTRODES FOR ELECTROLYTICAL PURPOSES; Gustav Adolph, Ammendrof, and Albert Pietsch, Magdeburg, Germany. App. filed April 27, 1907. Impregnates the carbon with a solution of platinum chlorid and heats the mass so as to decompose the salt and form conducting bridges of platinum, avoiding local action.

934,992. ADJUSTABLE ELECTRIC LAMP HANGER; L. Buendert, Chicago, Ill. App. filed Aug. 12, 1907. A spring actuated pulley is combined with a cable suspending lamp.

934,995. OUTLET BOX; L. H. Church, Stamford, Conn. App. filed March 31, 1906. A bushing for outlet boxes having a tapered split-body portion with an oppositely tapered bore to receive the cable.

934,996. RAILWAY SWITCH; C. W. Coleman, Westfield, N. J. App. filed Feb. 12, 1908. Improvement on C. J. Coleman system with an electrically continuous track supplied with currents at intervals, in which a conducting bond is connected to a point in one rail and a point in advance thereof in the other rail, each signal space having electromagnetic means for operating the signal with a coil inductively energized by the current in the adjacent rail.

934,997. ELECTRIC DISTRIBUTION; J. L. Creveling, New York, N. Y. App. filed April 16, 1909. For variable speed generators combined with a storage battery for supplying current to lamps in which the voltage is regulated by a variable shunt around the voltage regulating means, the resistance of the shunt depending on the number of lamps in operation.

935,023. SELECTIVE ALTERNATING-CURRENT, DIRECT-CURRENT SYSTEM; G. H. Hill, Schenectady, N. Y. App. filed Jan. 18, 1908. For electrically driven cars to be operated either on alternating-current or direct-current, the alternating of high, and the direct of low potential.

935,040. TROLLEY BASE; L. F. Mansfield and P. D. Smith, Minneapolis, Minn. App. filed June 15, 1908. A support for a trolley pole which when the pole jumps the wire prevents it from striking the wire and breaking the pole.

935,051. DEVICE FOR REGULATING THE SPEED OF GENERATORS TO SECURE CONSTANT POTENTIAL; A. L. Parker, Cleveland, O. App. filed Nov. 9, 1908. For driving a dynamo from the wheels of a car by inserting a differential gear between the car wheel and the generator and causing the differential to compensate to reduce the speed of the generator when its voltage exceeds a certain amount.

935,069. SELECTIVE ALTERNATING-CURRENT, DIRECT-CURRENT SYSTEM; J. F. Tritle, Schenectady, N. Y. App. filed Jan. 18, 1908. For alternating-current or direct-current cars in which a slow-acting relay is used whose coil is in series with the primary of the transformer and the actuating coil of the direct-current switch.

935,070. SELECTIVE ALTERNATING-CURRENT, DIRECT-CURRENT SYSTEM; J. F. Tritle, Schenectady, N. Y. App. filed Jan. 18, 1908. For cars driven either by alternating-current or direct-current, having a transformer with the primary connected to the power circuit, an alternating-current switch, an actuating coil therefor connected across the secondary of the transformer, a direct-current switch, an actuating coil therefor in series with the primary of the transformer and suitable contacts actuated thereby.

935,092. CIRCUIT CONTROLLING MECHANISM; M. W. Day, Schenectady, N. Y. App. filed Oct. 17, 1906. Automatically opens the circuit with excess current, and provides a common operating member, biased to a neutral position which may be thrown into operative relation to any one of the circuit breakers so as to close any one independently of the others.

935,097. OUTLET BOX FOR ELECTRIC FIXTURES; O. F. Erickson, Berkeley and R. H. Bradshaw, Oakland, Cal. App. filed June 11, 1908. For connecting outlet boxes to lath work by means of a crow foot which is prevented from working loose by a special construction of fastening mechanism.

935,109. APPARATUS FOR ELECTROLYSIS OF AQUEOUS SOLUTIONS; M. Huth, Charlottenburg, near Berlin, Germany. App. filed Jan. 5, 1909. For producing annodes of peroxide of manganese by mixing it with a binding agent, pressing into molds and heating.

935,136. SUSPENSION DEVICE FOR ELECTRIC ARC LAMPS; A. Wunderlich, Croydon, Eng. App. filed May 10, 1906. The lamp is operated by winch and chain and a set of cams are struck by projections on the lamp and are adapted to receive projections on the lamp carrier.

935,154. DYNAMOMETER THERMO-COUPLE FOR EXPLOSION ENGINES; N. M. Hopkins, Washington, D. C. App. filed July 28, 1908. Improvements in the thermo-couple shown in patent No. 903,000, the combination including a thermo-couple and a mili-volt meter connected to the couple.

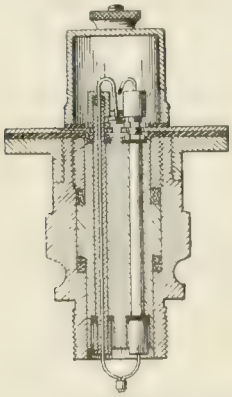
935,164. TELEGRAPH KEY; G. S. Perry, Branford, Fla. App. filed Jan. 28, 1909. Makes a plurality of dots with a single movement of the operating lever by means of a vibrator actuated by the lever.

935,180. GRAPHITE ARTICLE AND PROCESS OF MAKING THE SAME; Arthur M. Williamson, Niagara Falls, N. Y. App. filed July 19, 1909. Impregnates a previously formed electrode of carbon with a material yielding a carbonaceous residue and graphitizes the article.

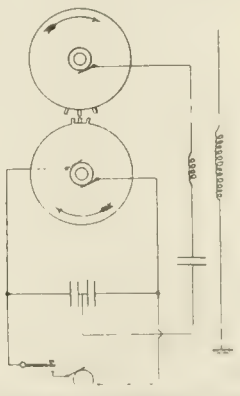
935,207. AUTOMATIC FLASHER FOR ELECTRIC LAMPS; J. O. Houser, Cincinnati, O. App. filed May 22, 1908. Makes use of a spring motor operating an interrupter with means for varying the speed of the motor.

935,215. RAILWAY SIGNAL; A. C. Mather, Chicago, Ill. App. filed July 3, 1907. A semaphore arm is operated by a relay magnet whose circuit is controlled by a train. Details.

935,226. ELECTRIC SWITCH; J. G. Peterson, Hartford, Conn. App. filed Dec. 28, 1908. A flush-door switch operated by the door for cutting lamps in and out. A push button struck by the door actuates



935,154.—Dynamometer Thermo-Couple for Explosion Engines.



935,381.—Transmitting Apparatus for Wireless Telegraphy.

a yoke and places a spring under compression which throws the yoke to actuate the circuit breaker.

935,250. ELECTROLYTIC WINNING OF ZINC FROM SOLUTIONS OF ZINC SULPHATE; V. Engelhardt and M. Huth, Charlottenburg, Germany. App. filed May 25, 1907. Obtains zinc from acid sulphate solutions by using as an annode electrolytic lead peroxide free from metal.

935,252. STORAGE BATTERY ELECTRODE; L. H. Flanders, Wilkinsburg, Pa. App. filed Dec. 15, 1905. Consists of a series of spaced unitary panels and expansion joints between longitudinally adjacent panels.

935,300. COMMUTATOR; W. A. Dick, Pittsburg, Pa. App. filed Nov. 8, 1907. A commutator neck having a plurality of hinged connected parts so as to uncover the cross connectors for repairs.

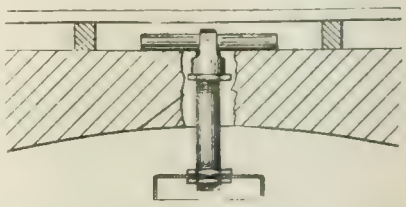
935,304. TROLLEY SWITCH PLATE; E. Heydon, Indianapolis, Ind. App. filed Feb. 13, 1909. For sidings in which the plate cannot become weather clogged. Consists of a plate having a wire receiving groove, a bar sliding therein, and a pivoted switch tongue operated by the sliding bar.

935,316. PROCESS OF PREPARING STORAGE BATTERY PLATES; W. Morrison, Chicago, Ill. App. filed Dec. 26, 1903. Immerses the plate in a series of different solutions of glycerin, sulphuric acid, formaldehyde and formic acid so as to improve the character of the plate and make it tougher and more adhesive.

935,319. HANGER FOR ELECTRIC OUTLET BOXES; A McMurtrie, New York, N. Y. App. filed Jan. 15, 1906. For applying a hanger to a floor of fireproof construction with means for securing the hanging members in an adjusted position.

935,320. ANNUNCIATOR; E. E. Nye, Los Angeles, Cal. App. filed Feb. 11, 1908. For notifying tradesmen that their services are needed, by means of an emergency signal including a transparent sign with a drop normally concealing it and an electric circuit operating the drop and closing the circuit of a lamp to illuminate the sign.

935,327. CONTROLLING ELECTRIC MOTORS; J. L. Routin, Lyons, France. App. filed Feb. 10, 1908. For controlling the rotors of turbines at a distance by means of a polyphase-generator and motor with an auxiliary generator whose excitation is controlled by the motor and another motor with constant excitation fed by the auxiliary generator, together with a differential gear whereby the motor reacts



935,319.—Hanger for Electric Outlet Boxes.

on the excitation of the auxiliary generator. A reverser controlled by relays comes into action when the auxiliary generator is excited.

935,346. ELECTRICAL WELDING MACHINE; W. C. Winfield, Warren, O. App. filed Aug. 17, 1908. The current-conveying member has a plurality of contact pins opposite the first contact member and a ball-jointed equalizing device adjusts the contacts to the metal to be welded.

935,352. ALTERNATING-CURRENT MOTOR; A. C. and T. R. Bell, Westfield, N. J. App. filed Nov. 23, 1908. A self-starting single-phase motor in which the commutator has an end recess carrying conducting segments and movable into short circuiting contact with the commutator bars by centrifugal action at speed.

935,363. ELECTRIC HOIST; A. A. C. Gese, Bremen, Germany. App. filed April 29, 1908. An electrically driven hoist in which a hoisting drum is mounted between a motor and controller and provided with gearing, and the supporting hook is connected in a line passing through the center of gravity of the hoisting drum.

935,381. TRANSMITTING APPARATUS FOR WIRELESS TELEGRAPHY; G. Marconi, London, Eng. App. filed Oct. 1, 1907. Provides mechanically operated means for completing and interrupting the circuit synchronously with the time period of Hertzian oscillations of definite frequency.

935,382. APPARATUS FOR WIRELESS TELEGRAPHY; G. Marconi, London, Eng. App. filed April 10, 1908. An oscillation generator consisting of a disk with a continuous rim located between two rotatable bodies so as to form a spark gap.

935,383. APPARATUS FOR WIRELESS TELEGRAPHY; G. Marconi, London, Eng. App. filed April 10, 1908. An oscillation generator in which a metal disk is rotated at high speed and is placed between two insulating conducting disks also rotated at high speed and provided with condensers so as to form a charging circuit.

935,386. WIRELESS TELEGRAPHY; W. W. Massie, Providence, R. I. App. filed Feb. 27, 1907. A magnetic detector, including a coil and magnets adjustable axially of the coil and also transversely of the axis.

935,397. ARMATURE; J. P. Nikonow, Evansville, Ind. App. filed Nov. 10, 1908. For improving the circulation of air in the armature and for holding on the leads, by means of a cap engaging the windings and an endless metal member encircling the leads next to the cap.

935,457. APPARATUS FOR ELECTRICALLY TREATING AIR AND OTHER GASES; J. H. Bridge, Philadelphia, Pa. App. filed April 30, 1907. An ozonizer comprising electrodes so arranged that the air under treatment passes through perforations in the walls of the electrodes so as to be brought into contact with electric discharges passing between the electrodes.

935,460. ELECTRIC THERMOSTAT; J. R. Carpenter, Hancock, Mich. App. filed Aug. 31, 1908. Actuates an alarm by the agency of a maximum and minimum thermometer, the alarm being sounded by each thermometer.

935,518. ELECTRIC ARC LAMP; A. D. Jones, Holloway, London, Eng. App. filed Sept. 16, 1907. An enclosed arc lamp having compound electrodes containing chemicals to increase the light of the lamp, and provided with draft chambers communicating with the upper and lower ends of the arc enclosing chamber, and a draft conduit outside of the outer globe and communicating with the chambers.

935,533. ATTACHMENT PLUG; Chas. J. Klein, New York, N. Y. App. filed Feb. 25, 1907. Connecting electric circuits with extension, the plug, having a body portion, a terminal carrying portion, the latter being swiveled upon and detached from the body portion.

935,542. METHOD OF TREATING SODIUM PEROXIDE; D. E. Parker, Niagara Falls, N. Y. App. filed Aug. 27, 1906. Treats alkali peroxide by subjecting a mass of it to an electric current so as to melt a portion and so as to produce a temperature in the melted portion, to liberate deleterious gases without freeing the oxygen.

935,548. ELECTRIC FURNACE; A. Reynolds, London, Eng. App. filed Feb. 10, 1908. A plumbago vessel is immersed in the furnace charge and an electric arc is maintained within the vessel, the vessel having an internal lining of electrically insulating but thermally conducting material.

935,605. SAFETY APPLIANCE; O. T. Howard and W. M. Stark, Muscatine, Iowa. App. filed Dec. 31, 1906. Automatically applies air brakes upon two trains approaching each other on the same track by means of electric circuits controlling the air brake system, and controlled by the trains.

934,614. BLOCK SIGNAL SYSTEM; H. H. Sims, J. M. Hatch and J. M. Turrentine, Raleigh, N. C. App. filed March 16, 1908. Compels the whistle of the locomotive to sound when approaching the end of a block and telephones the noise to the operator in the block station.

Rossiter, Mac Govern & Co.

ESTABLISHED 1893 (INCORPORATED)

Electrical Apparatus of All Kinds.

WEST STREET BLDG., 90 WEST STREET, NEW YORK TELEPHONE, CORTLANDT 8876

DIRECT CONNECTED D. C. UNITS—110-125 VOLTS

1—200 KW General Electric 235 R.P.M. direct connected to 20" x 18" Harrisburg Ideal engine.
1—120 KW Unit consisting of 2—60 KW General Electric direct connected to 11¾" & 20" x 14" Ames tandem compound engine.
1—120 KW Unit consisting of 2—60 KW General Electric direct connected to 12¾" & 20" x 14" Ames tandem compound engine.
2—100 KW Bullock direct connected to 10" x 20" Chuse auto. engine.
3—100 KW General Electric direct connected to Buckeye engines.
1—100 KW General Electric Marine, Set 350 R.P.M., U. S. Navy specifications engine 14" x 18".
1—75 KW Westinghouse direct connected to 14½ x 14" Harrisburg Ideal engine.
1—50 KW Walker direct connected to 8" & 13" x 12" McEwen tandem compound engine.

SEND FOR OCTOBER STOCK LIST

COMMONWEALTH EDISON CO.

REPAIR SHOPS

76 MARKET ST., CHICAGO. TELEPHONE RANDOLPH 1280.

FIRST-CLASS EQUIPMENT THROUGHOUT

DYNAMOS, ARMATURES, MOTORS, ARC LAMPS
INSTRUMENTS, HIGH GRADE MACHINE
WORK OF ALL KINDS

CORRESPONDENCE SOLICITED

SPARKING

reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All of this may be avoided if you use



The only article that will prevent sparking. Will keep the commutator in good condition and prevent cutting. Absolutely will not gum the brushes

It will put that high gloss on the commutator you have so long sought after

Send for Stick 50c. PER STICK $5.00 PER DOZ.

For Sale by All Supply Houses or **K. McLENNAN & CO.** Sole Manufacturers

Room 411—130 Dearborn St., CHICAGO

POSITIONS WANTED

The rate for "Positions Wanted" advertisements of forty words or less is one dollar an insertion; additional words two cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical World, 239 West Thirty ninth Street, New York, or 590 Old Colony Building, Chicago, as advertisers may desire.

ELECTRICAL DESIGN.—Electrical engineer, Cornell graduate, familiar with design of direct-current generators and motors, particularly commutating pole; assured results; excellent personal references; position with manufacturing concern or engineering firm considered. Address No. 6122, care of Electrical World, New York.

EXPERIENCED SWITCHBOARD OPERATOR for 14 years, operating storage batteries, rotary converters, frequency changers, high-voltage turbo-generators, hydro-electric high-tension transmission, wants to change from present position. Excellent record. Address No. 6104, care of Electrical World, New York.

EXPORT—Constructing and commercial engineer with long domestic and foreign experience, including exporting, selling and constructing of complete hydro-electric plant, steam engines and Diesel oil engines for agents of Westinghouse E. & Mfg. Co., desires suitable position, preferably as buyer or office manager with exporting firm. Eight years' practical work in Latin-American countries; proficient in English, German and Spanish and all office routine. Excellent references. Address No. 6083, care of Electrical World, New York.

EXPERIENCED CHIEF ELECTRICIAN, with 12 years' excellent record of results, invites correspondence. Specialized in operation and maintenance of hydroelectric and steam generation high tension transmission, railway lighting and power service. Present salary, $125.00 per month. Investigate my record. Address No. 6103, care of Electrical World, New York.

POSITION as assistant to superintendent of electrical plant of moderate capacity; 3½ years' experience with large electrical company; familiar with all kinds electrical machinery and power plant operation. Technical Graduate, Assoc., A. I. E. E., 28 years of age, married, and now employed. Address No. 6125, care of Electrical World, New York.

WANTED by man, age 36, 18 years' experience in central station, isolated plants and inside wiring, position as supt. At present supt. of plant covering 15 miles high tension lines; experienced with steam Diesel engines and water; best reference. Address No. 6123, care of Electrical World, New York.

GRADUATE Electrical Engineer, ten years' Canadian business experience, wide connection in Canada, invites correspondence relative to representation in Canada of high class products of all descriptions. References exchanged. Address "Agent," P. O. Box 598, Montreal, Canada.

WANTED.—Position as supt. of electric light plant in which operating expenses are too high for output. City of two to five thousand inhabitants, and option on plant at end of two years preferred. Address J., No. 6127, care of Electrical World, 590 Old Colony Bldg., Chicago, Ill.

WANTED.—Position as foreman in factory or head meter inspector electric lighting company. West or Southwest. Young man graduate E. E., with shop experience before entering college. Address No. 6129, care of Electrical World, New York.

WANTED—Position by asst. electrical engineer or electrician, technical training, six years' experience with all kinds of electrical apparatus. Prefer construction work or asst. central station manager. Best of reference. Address H. B., No. 31 West Neptune St., Lynn, Mass.

YOUNG MAN, 28, married, now employed, and wishing to specialize in power plant work, desires to correspond with construction company with view to taking permanent position in drafting, designing or construction. Technical Graduate, Assoc. A. I. E. E.; 3½ years' general experience with large electrical manufacturing company. Address No. 6124, care of Electrical World, New York.

PRODUCTION ENGINEER wants position. Specialty small electrical goods. Standardizing of equipments and products. Simplified construction. Low costs. New designs. Division and productiveness of labor. Address No. 6048, care of Electrical World, New York.

AMERICAN COLLEGE GRADUATE (Φ B K) 1908, with one year's graduate work in German Technical School, desires electrical situation. Steady, energetic worker. Thoroughly familiar with the German language. Particularly proficient in applied mathematics. Address M. ALBERT LINTON, 298 West Main St., Morristown, N. J.

POSITION WANTED.—By man 30 years of age, 9 years' experience as business manager of electric light and water company in city of 15,000; technical training; can give references from present employer. Address No. 6137, care of Electrical World, New York.

ELECTRICAL ENGINEER, graduate Mass. Inst. of Tech., competent to take charge of alternating and direct-current systems and machinery, power plant construction and operation, desires position. Lighting company experience. References. Address No. 6144, care of Electrical World, New York.

POSITION WANTED.—Young man, 24 years of age, technical education, experienced construction wiring, armature winding, desires situation with construction company, power plant or factory; New York or vicinity; reference. Address No. 6138, care of Electrical World, New York.

SALESMAN with five years' successful record with lamp manufacturer, at present employed by a supply house, wishes to change position. New York or vicinity preferred. Address No. 6140, care of Electrical World, New York.

SITUATION WANTED—Electrical sales engineer of good address open for contract with large reliable manufacturer of electrical machinery or good specialty. Am a thorough business getter, with ten years' experience, capable of handling large contract propositions. Good clear record; excellent references furnished. Address No. 6141, care of Electrical World, New York.

(Continued on page 96)

125-volt Direct Connected Units.

1–300 K.W. G.E. D.C. Corliss Engine.	1– 75 K.W. Triumph D.C. Harrisburg Engine.
1–150 K.W. G.E. D.C. Harrisburg Engine.	1– 50 K.W. Eddy and Watertown Engine.
1–100 K.W. C.W. D.D. Harrisburg Engine.	1– 50 K.W. Triumph and Harrisburg Engine.
1– 80 K.W. G.E. D.C. Watertown Engine.	1– 40 K.W. G.E. and Armington & Sims Engine.
1– 75 K.W. Westinghouse D.C. Westinghouse Engine.	1– 40 K.W. Sprague-Lundell D.C. Fitchburg Engine.

Belted

1–100 K.W. 6-pole Westinghouse.	1– 45 K.W. 6-pole G.E., form A.
1– 75 K.W. 6-pole G.E.	1– 40 K.W. 6-pole Westinghouse, type S.
1– 55 K.W. 6-pole G.E., form H.	
1– 50 K.W. 4-pole Westinghouse.	1– 25 K.W. 4-pole G.E., form H.
1– 45 K.W. 6-pole G.E., form H.	1– 25 K.W. 4-pole G.E., form A.

Large stock of Motors, all sizes and voltages, both D.C. and A.C. **Engines and Boilers.** Send for complete list.

Joseph H. Thompson, Jr., 17 BATTERY PLACE NEW YORK

BE INDEPENDENT

OWN AN ELECTRIC LIGHTING PLANT

We have a number of attractive opportunities to offer in different sections of the country. If you have $3,000 or more, write us.

THE GAS & ELECTRIC DEVELOPMENT CO.

1328 Chestnut Street, Philadelphia, Pa.

BARGAINS

Alternating and direct current motors, dynamos, also plating dynamos at bargain prices. All makes and sizes sold, bought and repaired.

EUGENE L. RICHTER ELECTRIC CO.

N. E. Cor. Ubera and Columbia Aves., Philadelphia, Pa.

HELP WANTED

(Continued from page 95)

The rate for "Help Wanted" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical World, 239 West Thirty-ninth Street, New York, or 590 Old Colony Bldg., Chicago, as advertisers may desire.

(In replying to a "Want" advertisement, original letters of recommendation should NOT be forwarded.)

METER MEN.—Wanted, men interested in meter and instrument work, to take up the course on "Electrical Measuring Instruments and Meters," as prepared by the Fort Wayne Electric Corresponding School, Fort Wayne, Ind. Write for free catalogue giving information on meter testing.

WANTED.—Manufacturers' agents and salesmen on commission by manufacturers of a high-grade incandescent electric lamp. Address No. 3320, care of Electrical World, New York.

WANTED.—Good draftsman with electrical experience, by large concern of middle West. State salary and particulars. Address No. 6114, care of Electrical World, New York.

WANTED.—First class electrician who has had experience and is competent in the field of printing telegraphy. Steady position, good salary and rapid advancement to right man. Address, giving references and experience, No. 6102, care of Electrical World, New York.

ELECTRICAL CONTRACTING COMPANY wants a capable man to manage their branch office in thriving city within fifty miles of New York. Position requires ability to solicit business, estimate, lay-out and superintend work. A good opportunity for an experienced man who wants to go ahead. Reply giving full information regarding past experience and salary expected. Contractors, No. 6143, care of Electrical World, New York.

DRAFTSMAN WANTED.—Familiar with electrical apparatus, A. C. switchboard and power house wiring connections. Past experience with G. E. Co. or W. E. & M. Co. desired. State experience, least salary expected at start, and give references. Address Construction Dept., Consl. G. Elec. Lt. & Pr. Co., Lex. & Liberty Sts., Baltimore, Md.

POWER SOLICITORS and superintendents of plants in the South to solicit repair work, on commission, for a dependable motor repair concern with reputation of standing back of its repairs. Address No. 6126, care of Electrical World, New York.

WANTED.—A man of technical training and some practical experience to fill a position as assistant instructor in electricity and its relative subjects in a well organized and rapidly growing school. Address No. 6128, care of Electrical World, New York.

WANTED.—Electrical traveling salesman to represent important manufacturer of rubber wires and cables. Familiar with Chicago City, Western and Northwestern trade. Address No. 6136, care of Electrical World, 590 Old Colony Bldg., Chicago, Ill.

WANTED.—Practical man with experience to take charge as general foreman on inside wiring construction. Steady position and chance for advancement to right party. State age, experience and salary expected. References required. Address No. 6139, care of Electrical World, New York.

MISCELLANEOUS

The rate for "Miscellaneous" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

WANTED.—To buy electric light plant in city of 5,000 to 10,000 population; investment to be not over $40,000. Address No. 6115, care of Electrical World, New York.

THE SALE OF CURRENT is my specialty. I am an advertising man with experience in one of the largest electric light corporations, familiar with incandescent lamps and the principles of illuminating engineering; can prepare copy that is bound to bring results. I want to locate with some lighting company near New York wishing to increase their business. High salary not required at start, but it must be advanced as I make good. Address No. 6080, care of Electrical World, New York.

CONCERN manufacturing electrical specialties is open to considering the manufacture of any specialty on royalty or otherwise. Address Frederic Greer, 525 West Van Buren Street, Chicago, Ill.

THE ADVERTISER would like to interest some manufacturer of electric switches in an improved remote-control electric switch. Would consider sale of patents, U. S. and Canadian, or manufacture of switch on royalty basis. Address J. S. BRISTOL, Decatur, Ill.

PROPOSALS

The rate for "Proposal" advertisements is 15 cents per line for one insertion. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

U. S. ENGR. OFFICE, Boston, Mass., Sept. 30, 1909.—Sealed proposals for motor generator sets, motors, centrifugal pumps, transformers and lightning arresters will be received here until 12 M., Oct. 30, 1909, and then publicly opened. Information on application. EDW. BURR, Lt. Col., Engrs.

THE CITY OF TORONTO, CANADA, will shortly call for tenders for pole line supplies, including poles, cross-arms, pins, braces, etc., etc. For information apply Electrical Department, City Hall.

ELECTRIC MOTORS.
EXTENSION OF TIME.

Tenders will be received by the City of Toronto, Canada, up till noon of Thursday, Oct. 28th (changed from Oct. 14th) for the following Electric Motors:

4—1500 H.P. Synchronous Motors.
2—1500 H.P. Induction Motors.
4— 500 H.P. Synchronous Motors.
4— 500 H.P. Induction Motors.
2— 225 H.P. Synchronous Motors.

With exciters, switchboards, connecting material, etc. The lowest or any tender not necessarily accepted.

For specifications and form of tender apply to the City Engineer.

TURBINE PUMPS.
EXTENSION OF TIME.

Tenders will be received by the City of Toronto, Canada, up till noon of Thursday, Oct. 28th (changed from Oct. 14th) for the following Turbine Pumps:

1—13½ million gallon pumps, 100 pounds pressure.
2—5 million gallon pumps, 300 pounds pressure.
2—10 million gallon pumps, 65 pounds pressure.
2—10 million gallon pumps, 110 pounds pressure.
2—6½ million gallon pumps, 90 pounds pressure.
2—6½ million gallon pumps, 160 pounds pressure.
2—1½ million gallon pumps, 65 pounds pressure.
2—1½ million gallon pumps, 110 pounds pressure.

With valves, piping, bed-plates, couplings, etc.

The lowest of any tender not necessarily accepted.

For specifications and form of tender apply to the City Engineer.

PROPOSAL.

Sealed proposals in duplicate will be received by the undersigned until 12 o'clock noon of Oct. 21, 1909, for the furnishing of one direct-connected engine generator set of not less than 125 kw capacity, including also the switchboard and such other accessories as set forth in the specifications, and all labor, tools and appliances necessary for the installation of same in the city power plant in the city of Galveston, Texas.

The above work to be in strict accordance with the specifications on file in the office of the City Secretary, or in the office of W. D. Masterson, City Supt. of Electricity, from whom copies can be had upon application, together with any further information that may be desired.

The proposals will be opened in public by the Board of City Commissioners. No permission shall be granted to withdraw any bid after filing same with the City Secretary.

A certified check for the sum of $500 must accompany each bid.

The Board of City Commissioners reserve the right to accept any bid that may in their opinion be to the best interests of the city, or to reject any or all bids.

Bids must be addressed to the undersigned and marked "Bids for the installation of an engine generator set in the city power plant."

V. E. AUSTIN,
Commissioner of Streets and Public Property.
JOHN D. KELLY,
City Secretary.
W. D. MASTERSON,
City Supt. of Electricity.

Frank MacGovern J. Warren Archer

MacGovern, Archer & Co.

114-118 Liberty Street Electrical and Steam Machinery **NEW YORK**

DYNAMOS AND MOTORS—ALL IN STOCK PHONE: CORT. 6577

WATER TUBE BOILERS—180 Lbs. Steam Pressure

12—300 H. P. Heine Water Tube Boilers—used only during construction of McAdoo Tunnel System, that is, less than 3 years. In perfect condition and we will furnish with each boiler a certificate of inspection and insurance, allowing 175 lbs. working steam pressure. Send for full details. Can ship immediately.

A. C. Direct-Connected Units (60-Cycle)

1—300 KW, G. E., 3 phase, ATB, 150 RPM, 2300 volts, with 14&28x30 in. C.C. McIntosh & Seymour engine.

2—250 KW, 2200-volt, 3-phase, 60-cycle Westinghouse alternators, each direct-connected to 16&27x16 in. Westinghouse compound vertical engine.

1—250 KW, G. E., 1 phase, 2300 volts, 200 RPM, with 15&28x18 Tandem Ideal engine.

1—150 KW, Westinghouse, 2 phase, 60 cycle, 220 volts, 341 amperes, 240 RPM, with 22x16 Ball & Wood 4-valve horizontal engine.

1—75 KW, West., 1 phase, 2200 volts, 257 RPM, with 13x12 Ames auto. engine.

Direct Current Direct-Connected Units

2—400 KW, Westinghouse, 10 pole, 250 volts, 150 RPM, each direct-connected to an 18&36x30 in. Porter Allen engine.

2—225 KW, Westinghouse, 8 pole, 575 volts, 250 RPM, each direct-connected to an 18&30x16 in. vertical Westinghouse engine (Rites governor).

1—150 KW, Crocker-Wheeler, 115-125 volts, 6 pole, speed 250, 160 RPM, each with a heavy duty 4-valve type horizontal McIntosh & Seymour engine.

1—100 KW, General Electric, 125 volts, 6 pole, speed 250 RPM, with 16x15 in. horizontal McIntosh & Seymour engine.

1—50 KW, Crocker-Wheeler, 6 pole, 125 volts, 275 RPM, direct connected to an 11x14 in. horizontal straight line engine.

1—30 KW, 125 volt, 6 pole, G. E., 305 RPM, with 10x12 Ideal engine.

Vertical Direct-Connected Units

2— 35 KW, Sturtevant, 115 volts, 325 RPM, engines 10x9 in.
2— 50 KW, Sturtevant, 115 volts, 275 RPM, engines 12x10 in.
3—100 KW, Sturtevant, 250 volts, 350 RPM, engines 10x18 in.
1— 50 KW, Sturtevant, 250 volts, 400 RPM, engine 8x14 in.
2— 30 KW, G. E., 125 volts, 305 RPM, engine 11x8 in.
2— 20 KW, G. E. 125 volts, 360 RPM, engine 9x7 in.

Turbo-Generator Sets

2—2000 KW, Curtis G. E., 3 phase, 25 cycle, 6600 volts.
1—1500 KW, Curtis G. E., 3 phase, 60 cycle, 2300 volts.
1— 500 KW, Curtis G. E., 3 phase, 60 cycle, 2300 volts.

Alternating Current Dynamos (Belted)

1—300 KW, 3 phase, G. E., 60 cycle, 2300 volts, 450 RPM, ATB.
1—200 KW, 3 phase, G. E., 60 cycle, 2300 volts, 600 RPM, ATB.
1—200 KW, 3 phase, G. E., 60 cycle, 480 volts, 600 RPM, ATB.
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1	2	220	C & C	2000	20.00
1	2.5	220	Jantz & Leist	1240	50.00
1	3	220	Elwell-Parker	1400	50.00
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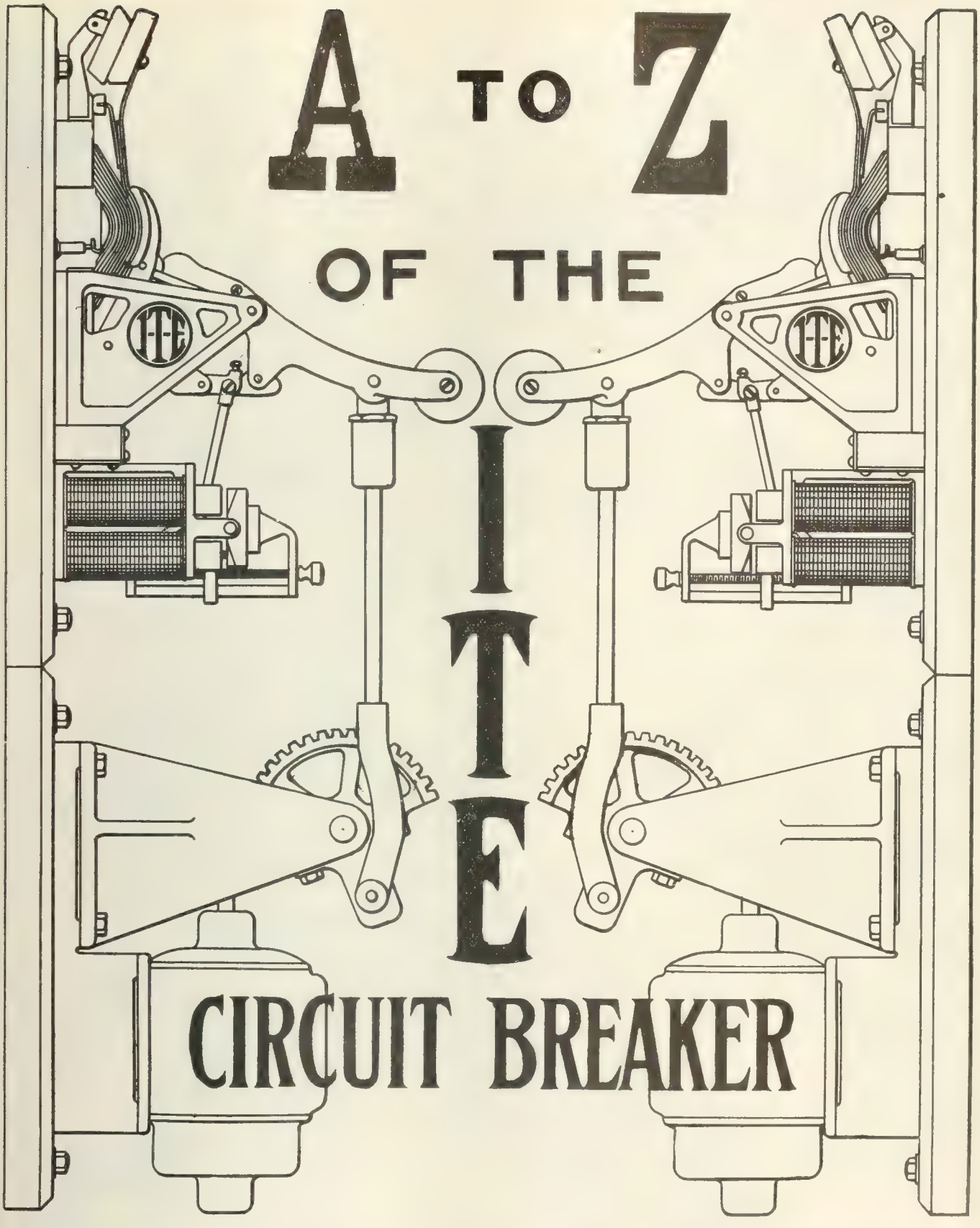
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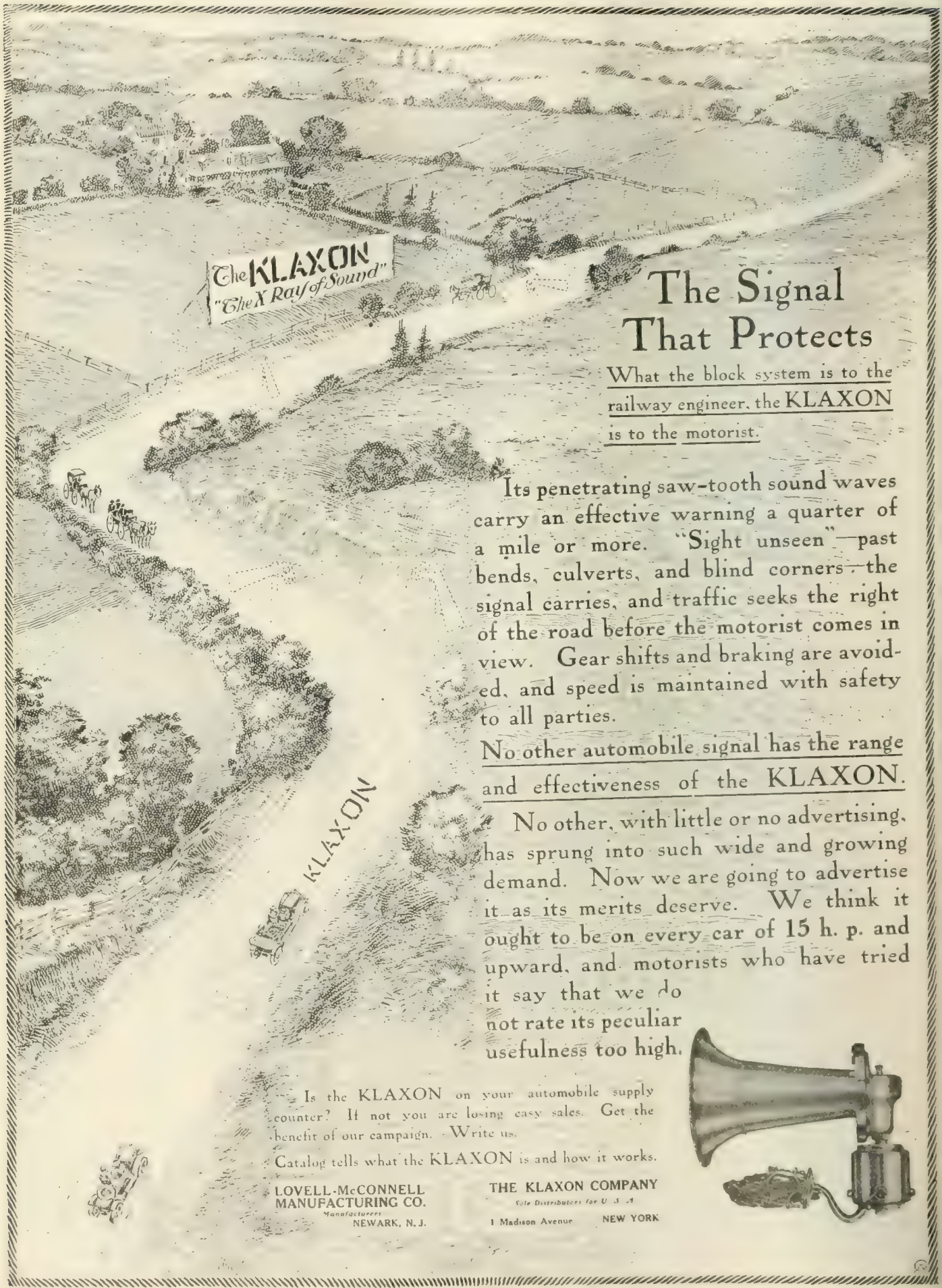
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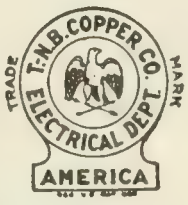
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The Export Trade.

The figures of electrical export trade for the month of July are, in the main, similar to those of the months more immediately preceding, and are in keeping with those of general commerce. The export of heavy electrical machinery reached a value of only $391,195, as compared with $523,355 in July, 1908. The export of electrical instruments and apparatus amounted to $567,795, as compared with $429,080. The two items make a total of $958,990 in 1909, as compared with $952,435 in 1908. This is an obvious gain, though very small, yet larger than appears on the surface if we consider the lower range of prices. At any rate, such figures encourage us to believe that, as was indicated a month ago, the tide has turned.

The detailed data are of interest. Just why there should be the steady decline in the foreign demand for heavy electrical machinery is not apparent, except on the ground of universal poor trade or else on that of inability to meet the market. But if there were still generally poor trade it would be hard to explain fully the briskness in electrical instruments. Possibly our foreign competitors have cut prices deeply. One of the odd features of the situation is that France increased its purchases from $13,346 to $125,018, the only really large amount in a somewhat insignificant total. The increase may have something to do with the new activity in electric railway work in the Republic. As for the remainder of the $391,195, North America with orders for $80,199 and Mexico with $48,486 remain our best customers.

The development in the miscellaneous trade is encouraging, and we hope it will keep up. There is an endless variety of electrical apparatus made here that ought to be advertised and pushed, especially in North and South America, Mexico, Australasia and Africa; and the figures certainly indicate that somebody is buying, even if someone is not hustling very energetically to find him out. The gains in this branch have been coming all the year, and July, instead of being a dull, dead month, was one of the best of the seven, with a gain of nearly $150,000, or almost 40 per cent, over July, 1908. This is "going some," and, if it can be kept up, will more than compensate for loss on machinery, should that be permanent. It would imply, anyhow, a demand of wider range and, therefore, safer from downward fluctuations. Once more, British North America looms up well with orders for $176,619, but our "next best friend" was Brazil with $134,517; while Mexico took goods worth $65,072. When we point out that of the total $567,795 for "instruments" no less than $462,614 went to countries north and south of us, the manufacturer may consider himself justified in looking on the Americas as his best customers; but there does not seem any good reason, save possibly in one or two European countries, why purchasers for such apparatus should not be waiting everywhere.

Convention of Railway Electrical Engineers.

An organization of engineers which has reached within one year a membership four times as large as the maximum predicted by its enthusiastic founders deserves more than a passing notice. Such an organization is the Association of Railway Electrical Engineers which came into existence somewhat more than one year ago as the Association of Car Lighting Engineers. Its membership enrollment of 400 was well represented at its second annual convention held in Chicago from Oct. 4 to 7, as noted elsewhere in this issue. Organized with the object of advancing the knowledge pertaining to the principles, design, construction, maintenance and operation of car-lighting and electrical appliances, the Association has already accomplished much good in securing recognition of the undesirability of numerous lamp voltages and car circuit interconnectors. By standardizing certain details which can well be similar in all types of electric car lighting equipments, the interchange of cars between railroads will be facilitated and thereby the introduction of electric train lighting will be hastened. Second in importance only to the work of standardization are the exchange of ideas and reports of experience concerning the various train lighting systems in service, in order that the best of each system may be retained for the several systems that will some day be looked upon as standard. The association has assigned to itself important tasks, and the record of the last convention indicates that the work will be accomplished in a highly creditable manner. We may point out, however, that haste should be made slowly in fixing standards, which remark applies particularly to railroad standards owing to the disinclination to change which characterizes railroad practice. For example, in adopting a lamp voltage, there should be very strong reasons for ignoring the 50-volt commercial standard as a basis, in favor of 64 volts as proposed.

Grounding the Secondary.

Elsewhere we print resolutions adopted at the recent annual meeting of the Association of Municipal Electricians in favor of grounding the secondary, and also an abstract of a paper on the subject of grounding presented last week by Mr. W. J. Canada before the annual convention of the Colorado Electrical Association. The first-mentioned body represents primarily the city electricians of the country and not those in charge of municipal lighting plants, as the name might seem to imply; and as the former has a prevailing voice in the formulation of municipal ordinances pertaining to electrical matters, its emphatic declaration in favor of legislation making mandatory the grounding of secondaries of 250 volts and under will most probably have important consequences. The paper by Mr. Canada embodies an able treatment of the subject of grounding, the presentation of the arguments pro and con being notably fair and judicial. It is interesting to observe the attitude of the underwriters on the subject as sketched by Mr. Canada. Beginning with hostility, after some years grounding was permitted on the score of humanity, notwithstanding the continued belief that the fire hazard would thereby be increased; finally, opinion has veered to the position—to quote Mr. C. M. Goddard—that "it is probable that the fire hazard from a grounded secondary may perhaps be less than from an ungrounded secondary." With the city electricians now arrayed in favor of grounding and a probability that the fire underwriters may in the future make the practice mandatory, the issue is becoming one which no central station can longer afford to ignore. As to the question of limiting voltage, that fixed by the American Institute of Electrical Engineers—250 volts—can, we believe, be safely accepted. To those who may consider that such a voltage is in itself dangerous to life—which opinion, we believe, has no foundation under conditions of normal health and in view of the nature of the contact apt to be made—it may be pointed out that while, to quote Mr. Canada, "We can insulate for almost perfect safety from voltages of 110 or even 220, and our new wiring insulations do this, we cannot insulate for 2200 volts, and we never attempt to do so."

Constant Current for Traction Purposes.

A paper by M. Dalemont, printed elsewhere, gives an interesting account of some recent proposals looking to constant direct-current traction system. There is, of course, nothing new in the general proposal, a system of this kind having been put into service about 20 years ago by the late Prof. S. H. Short. The scheme in its present form is worked out with considerable attention to detail and for the specific purpose of handling, not street car service as such, but somewhat heavy and long-distance traffic for which the single-phase system is now often recommended. The original Short system used practically arc machines with relatively small current. That suggested by M. Potterat is of somewhat more ambitious character, being based on the large and successful constant-current transmission systems in use on the Continent. The scheme for antomatic switching so as to maintain the motor units in series seems to have been very ingeniously worked out, and the series connection is undeniably advantageous in enabling energy to be recovered on down grades. Moreover, the control system of motors is of extreme simplicity, which is in general one of the strong points of the constant-current transmission system. The entire switchboard cost of one of the big continental transmission plants on this system is apparently only a minute fraction of the cost of the switchboard in an ordinary three-phase transmission plant as erected in this country. Nevertheless, there are objections to the series motor traction system so great that one may safely say that it will not commend itself to American engineers. In the first place, it requires the double trolley system which appears to be anathema on this continent Second, it requires the insulation of the motor structure itself from the earth, which is an extremely troublesome matter to arrange even with large units. Third, it requires a large multiplicity of automatic switches in order to preserve connections. From the standpoint of the engineer in this country, these three objections are fatal ones; and in fact any one of them alone would be given such great weight as to forbid experiments along this particular line. Nevertheless, it is a fact that continental engineers have a somewhat shocking way of taking methods and apparatus denounced as impracticable here and making them go with distinct success. We hope M. Potterat will get the opportunity to try out this system on a reasonably large scale, and he may very possibly be able to achieve with it results which will command the respectful attention, at least, of those who are firmly set against the use of single-phase motors.

The Light of the Fire-Fly.

The recent I. E. S. paper on investigation of fire-fly light is a valuable confirmation of the previous investigations of Langley, demonstrating as it does that the peculiar spectrum

given by fire-fly light is an objective and not a subjective phenomena. Langley's investigations showed that the fire-fly which he investigated, a large West Indian species, emitted light in the form of a single diffuse band lying fairly within the region of highest luminosity. His experiments further indicated, so far as his bolometer was capable of showing the facts, that the fire-fly gave substantially no radiation outside of this somewhat limited band, with its center in the yellow-green and shading off toward the red and blue over a comparatively narrow region. The difficulty of the investigation was such and the sensitiveness of the bolometer so moderate, that the absence of other than the visual radiation was established, perhaps, by presumption rather than by accurate proof. The particular position of the visible band found by Langley, corresponding as it does very closely to the spectrum which would be expected from an extremely faint light from any ordinary continuous source, was such as to leave possible the inference that its limitations were subjective and not objective. Drs. Ives and Coblentz, taking up the investigation with a native species of fire-fly by means of a spectrograph and color sensitive plates, which, whatever their limitations of sensitiveness, certainly do not have the same limitations as the eye, have established the fact that the fire-fly light is really of the character determined by Prof. Langley. Drs. Ives and Coblentz's experiments have not extended to a search for radiation outside the limits of sensitiveness of the plates they employed, so that Langley's statement regarding the absence of other than visible radiation was not confirmed. Such confirmation is highly desirable before jumping to the conclusion that so far as perceptible radiations are concerned the fire-fly produces visible light with almost theoretical efficiency. We trust that Drs. Ives and Coblentz will find time and patience to pursue the investigations further in this direction.

During the discussion of the paper the interesting point was raised that the chemical action to which the fire-fly's light is presumably due may as a whole still be inefficient as a light producer, a portion of the energy going into complex physiological processes rather than into radiation. Even if this should prove to be the fact, it is still sufficiently remarkable that any chemical processes whatever can produce visible radiation of so extraordinary a character, uncomplicated at least by any considerable amount of invisible radiation. Inasmuch as many so-called phosphorescent bodies, like decaying wood, stale fish and meat and the like, give light apparently of similar character to that of the fire-fly, it would seem that collateral investigation of these other things might go far toward showing the process by which such light may be produced. If we remember correctly, certain luminous bacteria also give a somewhat similar distribution of light. If it should turn out that certain processes in physiological chemistry result in radiation of the general type of that of the fire-fly, a long step toward the discovery of the fire-fly's secret will have been taken. As was pointed out in the paper, fire-fly light in the raw, so to speak, would be of very objectionable color even if it could be obtained in quantity; but there seems to be some difference in the color of light given by various species of fire-flies, or perhaps by various individuals, and it is not without the bounds of possibility that some of the forms of radiation thus obtained may promise more useful color than that of the ordinary fire-fly. At all events, the subject is one that should be pursued further and is deserving of much attention from the physiological as well as the purely physical side.

Sources of Error in the Alternating-Current Wheatstone Bridge.

An article by Herr Behne, in a recent number of *Elektrotechnik und Maschinebau* and abstracted in the Digest, calls attention to a source of error in Wheatstone-Bridge measurements using alternating currents. It is shown that, if this source of error is neglected the measurements may, under certain conditions, be very seriously vitiated. The error in question is due to the electrostatic capacity of different elements of the Wheatstone bridge, when used with an alternating-current source. If the potentials, with respect to ground, are materially different at different points in the bridge, dissymmetrical capacity currents will be set up, and will exercise a distorting influence upon the measuring currents. The result of the distortion, in particularly bad cases, may upset the measurement completely. This effect of capacity in the measuring apparatus, or in different parts thereof, becomes more noticeable as the frequency of the measuring alternating current is increased. At standard telephonic frequencies the effect may be very marked. In fact, bridge balances at such frequencies commonly call for electrostatic screens to be applied to the sensitive elements of the apparatus when precise measurements are required. If this precaution be not taken, the slightest working change in the dielectric medium near the instruments, such as might be due to the observer's changing his position, may have a distinct influence on the apparent measurement.

Some Errors in Testing Sources of Light.

Several recent papers on tests of light sources presented before the Illuminating Engineering Society, suggest anew some fundamental distinctions regarding the elementary geometry and physics of various sources of light. Most of the more commonly used illuminants, as the incandescent electric lamp, or the Welsbach mantle, are of such small dimensions that no appreciable error in practical work results from considering the source as a point to which the law of the inverse square of the distance applies. Such an assumption, however, applied to the calculation of the illumination produced by a tube lamp or to that produced by a skylight, or a bright wall, or even by incandescent lamps and Welsbach mantles when surrounded by reflecting and refracting shades, would frequently conduce to erroneous conclusions. Naked sources of light, stripped of all reflectors and diffusing globes, may be divided into three classes—*point, volume,* and *surface* sources. Elementary geometry, with the assumption of certain fundamental physical conceptions, shows the illumination from a luminous point to vary inversely as the square of the distance. Although, strictly speaking, there are no point sources in nature, the more common sources, when unaccompanied with shades and reflectors, fulfill the requirements of a point source for all ordinary practical purposes.

Volume sources are best illustrated by the Cooper Hewitt mercury-vapor lamp, or the Moore nitrogen or carbon-dioxide tube. Every infinitesimal volume of the gas is emitting luminous energy in every direction, much like a point source. But unlike a point source, there is an infinite number of these infinitesimal radiating elements which in the aggregate constitute a glowing

mass of quite large dimensions. Moreover, the radiation from one element must, in general, pass through contiguous and other elements, suffering possible absorption before it finally emerges from the tube. The application of the inverse square law to such a source, except at distances compared with which the dimensions of the tubes are negligible, would lead to erroneous results. Moreover, it is impossible to say *à priori* how the apparent candle-power of a unit length of such a tube would vary with the angle of emission in any plane of the tube. If there were no absorption by one element of volume of the transmitted luminous energy from another radiating element back further in the line of sight, the apparent candle-power would be the same in every direction. If, on the other hand, the absorption were so great that practically all the energy which was emitted by a unit length of the tube came from the elements lying on the surface of the cylinder, the apparent candle-power in any direction in a plane of the tube would be approximately proportional to the cosine of the angle between the given direction and the normal to the tube, the distribution being thus the same as that from a solid cylindrical radiating surface. As a matter of fact, as shown in the tests referred to above, in the actual case of a tube, the distribution of flux is much more nearly that from a non-absorbing gas than from an almost completely absorbing gas such as would give a cosine distribution. The apparent candle-power at increasing angles to the normal decreases relatively little, indicating some, but no great, absorption. This same general conclusion may be reached qualitatively by noting the bull's-eye effect on looking into an end of a tube light as at a bend or corner.

In a surface source of light all the radiation comes from the superficial elements of volume, as in the case of a completely absorbing gas. The intensity in any direction of an infinitesimal element of surface having the characteristics of a black body is proportional to the cosine of the angle between the given direction and the normal to the surface. Since no material substances are absolutely black, and no sources are, strictly speaking, of infinitesimal dimensions, the cosine law of emission is never realized in practical cases. Even neglecting the deviations from blackness, the problem of computing the distribution of illumination from extended surface sources, such as skylights, or bright walls, is not a simple one. Unfortunately, these fundamental distinctions have been completely overlooked in some of the current literature on this subject; and these omissions, together with an evident ignorance of the application of mathematics to physical problems, account for the remarkable results of some of the published theoretical investigations of light sources.

Third Harmonic Frequency E.M.Fs. in Three-Phase Alternators.

In single-phase alternators, having a single-path armature winding, the voltage at the terminals contains, in general, all of the harmonic frequencies that are developed in the individual copper bars or armature-conductors. It is possible, in a slot-wound armature, to have such a distribution of slots with respect to the pole that some particular harmonic frequency, or set of harmonic frequencies, may disappear in the resultant; but, in general, if harmonics are present in the e.m.f. wave of each individual conductor they will also be present in the open-circuit e.m.f. of the armature winding, after being connected up single-phase. When, however, three equally interspersed armature windings are arranged to form a three-phase armature there will be no triple-frequency harmonic e.m.f. presented at the armature terminals, nor any harmonic frequency in the terminal e.m.f. that is a multiple of three. This statement may be condensed into the proposition that no three-phase winding can deliver triplicate-frequency harmonic e.m.fs. It is assumed in this proposition that the slots are symmetrically spaced in the armature body, which is to say that the armature is correctly machined; but no reservation has to be made as to the connection of the armature, whether in star or in delta. The triplicate-frequency harmonics all vanish from the terminal e.m.fs. of a three-phase armature, whether delta-wound or star-wound. Consequently, since the triple-frequency harmonic is the first on the list in the rising order of harmonics, and since it is commonly the largest in amplitude, its elimination from the terminal e.m.fs. of three-phase machines often gives to the terminal e.m.fs. an approach to the sinusoidal wave-form that the individual copper bar e.m.fs. do not enjoy. The terminal e.m.fs. of a three-phase alternator thus often assume a degree of virtue, in respect to sine-wave form, that the individual bar e.m.fs. never attain; so that the motto of a three-phase winding might well be that in union lies virtue as well as strength.

We print this week two articles bearing on the above subject, by Mr. F. M. Denton and Mr. Shiro Sano, respectively. The former writer deals with the question from an oscillographic point of view, and the latter from an algebraic point of view. The oscillographic method has the advantage of resting upon, and resorting to, concrete impressions visualized from the photographic record. The algebraic method has the advantages of compactness and generality, but for those very reasons requires to be handled with greater caution to avoid pitfalls in deduction. The oscillographs accompanying Mr. Denton's paper are very interesting. The machine whose e.m.f. wave performance is there presented evidently had a marked triple-frequency e.m.f. harmonic—14 per cent of the fundamental in amplitude—so that the influence of the three-phase delta or star connection are clearly brought out. Fig. 14 indicates that the individual bar e.m.f. in this machine is kinkier than the e.m.f. of one phase winding with its 16 slots. In other words, the vector summation of the individual slot e.m.fs. has the effect of reducing all of the harmonic frequencies, and particularly the fifth-frequency harmonic e.m.f. The table indicates that whereas the fifth-frequency harmonic in each individual bar had an amplitude of 7.4 per cent of the fundamental, yet when all the bars of one phase winding are connected in series the vector summation brings down the fifth-frequency harmonic in the resultant phase e.m.f. to 1.4 per cent of the fundamental. When, however, the star-connection of the three phases is completed the terminal e.m.f. is nearly sinusoidal, there being only a 3.4 per cent quintuple-frequency ripple discernible in it, with only vestiges of other harmonics. The triple-frequency harmonics, present in each phase, has been nearly wiped out, and theoretically should have been completely wiped out. It is also interesting to see in the oscillographs that whereas the individual phase-winding e.m.fs. of the machine are dromedary-backed waves, or peaked waves of one hump, the open-delta

connection, such as might result by the disuse of one side of this armature, if delta-connected, produces camel-backed waves, or waves of two humps.

The Denton article contains a plea for star-wound armatures in three-phasers, as contrasted with delta-wound armatures. This is sound, provided the star-wound armatures have no grounded neutral point. If there be a grounded neutral point then it is well known that triple-frequency charging currents may manifest themselves in the cables connected to the machine. In considering the argument, however, in favor of star-winding versus delta-winding, it should be borne in mind that designers take care to reduce the triple-harmonic frequency e.m.f. in the bars of delta-wound armatures, whereas they usually omit this precaution in star-wound armatures without neutral connection. Consequently, while there may be some parasitic current and power waste in delta-wound machines, due to triple-frequency currents, yet it is not large in well designed armatures. The Sano article seems to develop a fallacy in one particular, if we understand its conclusions correctly. The algebraic reasoning appears to be sound, but the deduction from it at the last moment is open to adverse criticism. The delta-connected armature is shown to constitute a complete short-circuit for triple-frequency harmonic e.m.fs. The drop of pressure in each phase-winding, due to the short circuit triple-frequency current, is exactly equal to the triple-frequency voltage generated in the same. But the drop of pressure is opposite in direction to the said internally generated e.m.f., and consequently the latter is cancelled and destroyed, thus purifying the terminal voltage wave-form; whereas, it would seem that, according to the Sano article, the delta connection does not cause the terminal voltage to differ in wave-form from the phase-winding voltage.

International Electrical Standardization.

Among the papers presented before the recent British Association convention at Winnipeg is one by Mr. Ormond Higman on "International Electrical Standardization." This is a careful, full and nearly complete statement of the history and objects of the international electrotechnical commission since its inception. It may here be pointed out that the recommendation by the St. Louis International Electrical Congress, which led to the formation of this commission and also to the holding of regular conferences by Government representatives on questions relating to units, had its origin in the feeling that the Chamber of Delegates at international electrical expositions, which previously had considered matters relating to units and standards, had outlived its usefulness, and that the work of which it had taken cognizance should properly devolve on two permanent bodies, one to represent electrical engineering and the other to deal with questions involving Governmental approval. The plan for the formation of the two bodies when first broached met strongest favor with the foreign delegates to the St. Louis Chamber of Delegates, but it was finally presented as an American proposition. The Electrotechnical Commission has now been in existence for three years, and thus far it has only accomplished one piece of work, namely, the adoption of the international candle between England, France and America, with probably other endorsing countries to follow before long. But whether other countries formally endorse the action or not, the benefit obtained by the action has already been very marked in regard to the photometry and photometrical literature of the three co-operating countries. This successful piece of work would alone be sufficient to justify the existence and organization of the commission. It is, however, to be hoped that other practical accomplishments will steadily follow. There is much to be done, and while the American Institute of Electrical Engineers has thus far merely contributed to the financial support of the commission, it could, if it would, become a powerful factor in extending the usefulness of the body.

One of the important fields of work before the commission is the adoption of an international set of standardization rules. Such rules should control the specifications of electrical machinery in all countries. They should not go too far, and certainly not too far at the outset. Their initial province, as we conceive it, would be to define electric machinery and apparatus in such a manner that the title and definition of a certain electric machine, say, a direct-current motor, shall be the same in any or all civilized countries, and not be a function of geographical co-ordinates—one thing in one country and another in another. At present such a thing as, say, a 10-kw direct-current mtor is more or less a function of geographical co-ordinates, and so are, *a fortiori,* such things as a 10-kw direct-current series motor, a 10-kw direct-current shunt motor, a 10-kw direct-current intermittent-service motor, etc. The geographical differences are at present not merely in respect to definition of function, but also in respect to definition of capabilities, as determinable by tests of heating, overload, dielectric strength, etc. By reason of differences in requirements under the standardization tests of different countries, a 10-kw direct-current intermittent-service hoist motor, in its land of birth, might possibly be a 5-kw machine in a second country and a 15-kw machine in a third.

It is true that in order to arrive gradually at such a set of international standardization rules, it is necessary carefully to define the meanings of corresponding terms and names of machinery and apparatus as they exist in different languages. But it is, we think, an error to infer that, on this account, we need a whole glossary. An international glossary of electrical terms is no doubt a good thing, but it is of secondary importance to standardization. To construct an international glossary ahead of an international standardization is to put the cart before the horse. What is wanted is a start on standardization, and when the international standardization committee meets terms that are not clearly equivalent in the different languages it must pause to settle the definition of those terms. In this way there will be the minimum waste of labor on purely philological lines and the international glossary of words will grow *pari passu* with the international agreement upon things and physical actions. Another important duty before the commission is the gradual adoption of an international code of symbols for electrical engineering quantities in literature, so that when engineers discuss such fundamental things as e.m.f., current, resistance, power, etc., in equations the letters used to designate these various quantities shall be, as far as possible, the same. To complete this work may take many years, but there is no reason why it should not be started upon advantageously forthwith. The unifying power of an international table of symbols to bring engineers' writings into conformity increase, like a rolling snowball, at compound interest.

Autumn Meeting of the American Electrochemical Society.

The autumn meeting of the American Electrochemical Society will be held in New York City, Thursday to Saturday, Oct. 28 to 30. The convention will be opened by a professional meeting in the Chemists' Club in the afternoon of Thursday. Besides a number of papers to be presented and discussed there will be an experimental lecture by Prof. Edgar F. Smith, of the University of Pennsylvania, on recent developments in electro-analysis. On Saturday morning and afternoon, two sessions devoted to the reading and discussion of papers will be held at Columbia University.

The whole of Friday will be devoted to an excursion to Bayonne, N. J. Members and guests will meet in the waiting-room of the station of the Central Railroad of New Jersey in Jersey City, at 8:30 a. m. A special train will take the party to the Constable Hook section in Bayonne, where the forenoon will be spent. In the afternoon, plants in the Newark Bay section of Bayonne will be visited. At noon a lunch will be served at one of the shore resorts on the Kill von Kull. The Mayor of Bayonne, Hon. Pierre P. Garven, will there welcome the Society to Bayonne.

So far the following companies have given permission to visit their plants: Standard Oil Company, National Sulphur Company (refining of sulphur); Pacific Coast Borax Company (manufacture of borax and boric acid); Gröndal briquetting plant at the works of the General Chemical Company (this is the first American installation of the Gröndal process for briquetting ore, etc.); Babcock & Wilcox Company (water-tube boilers and adjuncts); Electro-Dynamic Company (interpole motors for wide-speed variation); Electric Launch Company (submarine vessels, etc.); Industrial Oxygen Company (oxy-acetylene welding and cutting apparatus).

While the above-named companies have given permission to the society as a whole to visit their works, it is under the condition that members interested in a process are expected not to visit a competitive plant. Thus, the Standard Oil Company has given permission under the condition that no one connected with the refining of oil will be allowed to visit its works. Similar conditions have been made by the Babcock & Wilcox Company and the National Sulphur Company. The different plants to be visited are, however, of such a diversified character that every member will find enough of interest to take part in the excursion. The party will return to New York by special train.

In the evening of Friday a banquet will be held at the Hotel Cumberland. On the evening of Saturday the society will be the guest of the New York Chemists' Club at a smoker in their club house. Arrangements are being made for the entertainment of visiting ladies.

Dr. Leo. H. Baekeland is president of the society and Dr. J. W. Richards, Lehigh University, South Bethlehem, Pa., is the secretary. In order to make detail arrangements for the special train and lunch on Friday members who wish to participate in the excursion should send early notice to Dr. Richards.

Grounding of the Secondary Endorsed by the Association of Municipal Electricians.

At the recent annual meeting of the International Association of Municipal Electricians the following resolution in favor of grounding the secondary was adopted:

"*Whereas*, one of the purposes of the International Association of Municipal Electricians is the protection of the lives and property of the people whom we represent from electrical hazards; and

"*Whereas*, alarming destruction of life and property has resulted from high voltages on alternating-current secondary systems by reason of the failure of the insulation between the primary and secondary circuits of such systems; and

"*Whereas*, the existence of the said high voltages may be prevented by properly grounding the alternating-current secondary systems;

"*Now, therefore, be it resolved* that the International Association of Municipal Electricians, deliberating as an international body, urges and demands the enactment of proper legislation requiring the grounding of all alternating-current secondary systems, when by so doing the voltage between the earth and any part of the said secondary system will not exceed 250 volts; and this body pledges the support and advocacy by its members of all legislative measures to that end."

A lengthy discussion preceded the adoption of the resolution One member referred to a number of serious accidents within his knowledge which occurred from contact with ungrounded secondaries, due to a cross with a high-potential circuit or to a defect in a transformer. He also mentioned a case where a man died from electric shock, but investigation did not reveal any defect in the secondary; upon a post-mortem examination, however, the physician found that man's heart was in such a condition, he said, even a slap on the face would perhaps have been sufficient to cause death. Another member said that in the course of a conversation on grounding with the superintendent of a large central-station company, the latter said that to ground the secondary would involve an expense to his company of from $15,000 to $20,000, and, although personally, "as man to man, I believe it is a good thing, there is the expense."

Referring to a statement that the matter of grounding the secondary was a life hazard and not a fire hazard, a member said he finds that many underwriters' inspectors agree that an ungrounded secondary is a fire hazard as well as a life hazard. A member asserted that many fires have, in fact, occurred from ungrounded secondaries, and that the expense from burned-out transformers is the reason why electric lighting companies do not want to adopt grounding. One central-station manager, however, had remarked to him that the loss of a few transformers is not as bad as the loss of a few lives. "We want to ground our secondaries because if we do not we will have some accident, and we will suffer more through damage suits than by the destruction of transformers by lightning or any other way." The same member remarked that the experience of the average inspector of fires is that nine out of every ten electrical fires are caused by a leaky transformer. In a particular case where the central station was much opposed to the grounding of secondaries he said he found that this company had two cases in court, one of a man killed and the other of a man injured from coming in contact with a secondary that had been crossed with a primary. There was some discussion as to the character of the grounds, and a suggestion was made that there should be a specification to cover this, but no action was taken.

Honorary Commercial Commissioners of Japan at Schenectady.

On Monday, Oct. 11, the party of 58 Japanese, including 6 women and 13 secretaries, and American representatives of the Government and various cities, arrived in Schenectady in their special train. The special train carrying the party was shifted into the General Electric Company's yards about 9 o'clock, and the party was escorted to one of the reception headquarters, where introductions were made to the officials of the company and civic officials of Schenectady.

A comprehensive tour of the factories was then made in which the party was divided in groups, each accompanied by interpreters and guides. An informal luncheon was served to the visitors and company representatives, totaling 125, in the new factory restaurant, which is a new concrete building with modern facilities for serving large numbers of employees daily. At this luncheon the visitors were welcomed by vice-president E. W. Rice, Jr., who referred to the international significance of the tour as indicating better relations between the two nations due to the opportunities it afforded for observation of indus-

operation at Aguas Calientes. Negotiations are pending for the purchase of the holdings of these two concerns by the Guanajuato Power & Electric Company. The smelter at that place is one of the largest in Mexico. It will obtain its electrical energy from the invading company as soon as the transmission line is finished. The new line will deliver electrical energy to a number of towns situated between Leon and Aguas Calientes.

At a recent meeting of the stockholders of the Mexican Northern Power Company held at Montreal, Canada, it was decided to let immediately the contract for the construction of the great dam across the Conchos River, 17 miles above Santa Rosalia, State of Chihuahua. This dam will form the water reservoir which will furnish the initial power for the hydroelectric plant. It is estimated by engineers who have reported on the project that 40,000 hp can be generated at the site selected for the dam. Considerable preliminary work has been done at the site of the proposed dam. In addition to furnishing power for operating the hydroelectric plant, the reservoir will afford a water supply for irrigating 200,000 acres of rich valley land which the company owns. The mining and industrial interests of that part of Mexico are elated over the prospects of the early consummation of the big enterprise. The electric energy will be transmitted to mining camps, towns and industrial centers situated within a radius of 150 miles, and will greatly lessen the cost of operating various kinds of enterprises.

Mr. S. W. Elkens, who is said to represent a syndicate of Canadians, has been investigating the situation at Durango with a view to installing a large electric light and power plant there and constructing a system of electric railway over a number of the streets of the city. It is reported that he is negotiating for the purchase of the electric light and power plant now operated there, and that if this deal is consummated the plant will be greatly enlarged.

Manuel Tamborel, of Mexico City, is preparing to install a hydroelectric plant on the Conchos River, State of Chihuahua. He has obtained a concession from the Federal Government for the purpose.

Jose Diaz Rubin, of Puebla City, will install a hydroelectric plant on the Nexapa River, State of Puebla. He will furnish electric energy to a number of industrial concerns. He lives at Puebla.

The introduction of electricity for operating the machinery and reduction mills of mining concerns in the Etzatlan and a number of other mining districts in the State of Jalisco will be accomplished about Jan. 1 by the Chapala Hydro-Electric & Irrigation Company, of Guadalajara. The hydroelectric plant and transmission lines are now being constructed. A number of the larger mining companies have contracted for electrical equipment for their respective properties, among them being the Amparo Mining Company, which has placed orders for $25,000 worth of electrical machinery, and contracted to take up 700 hp from the electric company. The fuel bill of the Amparo Mining Company now amounts to $100,000 per annum. With the introduction of electrical energy the amount will be reduced to $70,000 per annum and the power doubled.

The Hidalgo Cement Company is preparing to erect a hydroelectric plant on the Montezuma River, about three miles south of Dublan, State of Hidalgo, where its cement works and headquarters are situated. A large reservoir will be formed by the construction of a dam across the river, which will cost about $500,000. The hydroelectric plant will have a capacity of 1200 hp and will cost about $200,000 to erect. The surplus water will be used to irrigate a large tract of land. The electric energy will be used to operate the machinery and furnish lighting for the cement plant.

A large hydroelectric plant will be erected at the waterfall of El Salto, situated 50 miles west of Durango, by Charles von Brandis, of that city, who has obtained a concession from the Federal Government for the proposed enterprise. The electric energy will be transmitted to Durango and a number of mining camps in that State.

The concession which the Government granted four years ago for the construction of an electric railway between Autlan and the Pacific port of Chamela, a distance of about 200 miles, will expire Nov. 1, after being extended one month. The concession is owned by L. O. Harnecker. It is reported that a syndicate of Germans is investigating the situation with a view of taking over the concession and building the proposed road.

Proposed Arizona Hydroelectric Plant.

A syndicate of Denver and Colorado Springs capitalists have under consideration a project to build a dam across the Gila River, 14 miles below San Carlos, and establish a system of irrigating canals and ditches and a hydroelectric plant at an estimated cost of more than $1,000,000. This reservoir site was formerly controlled by the Federal Government, but was abandoned several years ago, the property passing into the hands of William Sparks. Recently Roy Davidson, acting as representative of a number of Denver and Colorado Springs men, obtained an option to purchase the property from Mr. Sparks. The proposed reservoir will furnish a water supply sufficient to irrigate 200,000 acres of land. The hydroelectric plant will transmit electricity to towns and mining camps in the surrounding territory.

Underground Wires in San Francisco and Oakland.

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Mr. Bain carried his listeners back to the time of the Civil War, when, as a boy, his ambition in life was to become a telegraph operator. He related how, when at school, he fitted up a crude telegraph instrument, made of wooden levers, and con-

Autumn Meeting of the American Electrochemical Society.

The autumn meeting of the American Electrochemical Society will be held in New York City, Thursday to Saturday, Oct. 28 to 30. The convention will be opened by a professional meeting in the Chemists' Club in the afternoon of Thursday. Besides a number of papers to be presented and discussed there will be an experimental lecture by Prof. Edgar F. Smith, of the University of Pennsylvania, on recent developments in electro-analysis. On Saturday morning and afternoon, two sessions devoted to the reading and discussion of papers will be held at Columbia University.

The whole of Friday will be devoted to an excursion to Bayonne, N. J. Members and guests will meet in the waiting-room of the station of the Central Railroad of New Jersey in Jersey City, at 8:30 a. m. A special train will take the party to the Constable Hook section in Bayonne, where the forenoon will be spent. In the afternoon, plants in the Newark Bay section of Bayonne will be visited. At noon a lunch will be served at one of the shore resorts on the Kill von Kull. The Mayor of Bayonne, Hon. Pierre P. Garven, will there welcome the Society to Bayonne.

So far the following companies have given permission to visit their plants: Standard Oil Company, National Sulphur Company (refining of sulphur); Pacific Coast Borax Company (manufacture of borax and boric acid); Gröndal briquetting plant at the works of the General Chemical Company (this is the first American installation of the Gröndal process for briquetting ore, etc.); Babcock & Wilcox Company (water-tube boilers and adjuncts); Electro-Dynamic Company (interpole motors for wide-speed variation); Electric Launch Company (submarine vessels, etc.); Industrial Oxygen Company (oxy-acetylene welding and cutting apparatus).

While the above-named companies have given permission to the society as a whole to visit their works, it is under the condition that members interested in a process are expected not to visit a competitive plant. Thus, the Standard Oil Company has given permission under the condition that no one connected with the refining of oil will be allowed to visit its works. Similar conditions have been made by the Babcock & Wilcox Company and the National Sulphur Company. The different plants to be visited are, however, of such a diversified character that every member will find enough of interest to take part in the excursion. The party will return to New York by special train.

In the evening of Friday a banquet will be held at the Hotel Cumberland. On the evening of Saturday the society will be the guest of the New York Chemists' Club at a smoker in their club house. Arrangements are being made for the entertainment of visiting ladies.

Dr. Leo. H. Baekeland is president of the society and Dr. J. W. Richards, Lehigh University, South Bethlehem, Pa., is the secretary. In order to make detail arrangements for the special train and lunch on Friday members who wish to participate in the excursion should send early notice to Dr. Richards.

Grounding of the Secondary Endorsed by the Association of Municipal Electricians.

At the recent annual meeting of the International Association of Municipal Electricians the following resolution in favor of grounding the secondary was adopted:

"*Whereas*, one of the purposes of the International Association of Municipal Electricians is the protection of the lives and property of the people whom we represent from electrical hazards; and

"*Whereas*, alarming destruction of life and property has resulted from high voltages on alternating-current secondary systems by reason of the failure of the insulation between the primary and secondary circuits of such systems; and

"*Whereas*, the existence of the said high voltages may be prevented by properly grounding the alternating-current secondary systems;

"*Now, therefore, be it resolved* that the International Association of Municipal Electricians, deliberating as an international body, urges and demands the enactment of proper legislation requiring the grounding of all alternating-current secondary systems, when by so doing the voltage between the earth and any part of the said secondary system will not exceed 250 volts; and this body pledges the support and advocacy by its members of all legislative measures to that end."

A lengthy discussion preceded the adoption of the resolution. One member referred to a number of serious accidents within his knowledge which occurred from contact with ungrounded secondaries, due to a cross with a high-potential circuit or to a defect in a transformer. He also mentioned a case where a man died from electric shock, but investigation did not reveal any defect in the secondary; upon a post-mortem examination, however, the physician found that man's heart was in such a condition, he said, even a slap on the face would perhaps have been sufficient to cause death. Another member said that in the course of a conversation on grounding with the superintendent of a large central-station company, the latter said that to ground the secondary would involve an expense to his company of from $15,000 to $20,000, and, although personally, "as man to man, I believe it is a good thing, there is the expense."

Referring to a statement that the matter of grounding the secondary was a life hazard and not a fire hazard, a member said he finds that many underwriters' inspectors agree that an ungrounded secondary is a fire hazard as well as a life hazard. A member asserted that many fires have, in fact, occurred from ungrounded secondaries, and that the expense from burned-out transformers is the reason why electric lighting companies do not want to adopt grounding. One central-station manager, however, had remarked to him that the loss of a few transformers is not as bad as the loss of a few lives. "We want to ground our secondaries because if we do not we will have some accident, and we will suffer more through damage suits than by the destruction of transformers by lightning or any other way." The same member remarked that the experience of the average inspector of fires is that nine out of every ten electrical fires are caused by a leaky transformer. In a particular case where the central station was much opposed to the grounding of secondaries he said he found that this company had two cases in court, one of a man killed and the other of a man injured from coming in contact with a secondary that had been crossed with a primary. There was some discussion as to the character of the grounds, and a suggestion was made that there should be a specification to cover this, but no action was taken.

Honorary Commercial Commissioners of Japan at Schenectady.

On Monday, Oct. 11, the party of 58 Japanese, including 6 women and 13 secretaries, and American representatives of the Government and various cities, arrived in Schenectady in their special train. The special train carrying the party was shifted into the General Electric Company's yards about 9 o'clock, and the party was escorted to one of the reception headquarters, where introductions were made to the officials of the company and civic officials of Schenectady.

A comprehensive tour of the factories was then made in which the party was divided in groups, each accompanied by interpreters and guides. An informal luncheon was served to the visitors and company representatives, totaling 125, in the new factory restaurant, which is a new concrete building with modern facilities for serving large numbers of employees daily. At this luncheon the visitors were welcomed by vice-president E. W. Rice, Jr., who referred to the international significance of the tour as indicating better relations between the two nations due to the opportunities it afforded for observation of indus-

operation at Aguas Calientes. Negotiations are pending for the purchase of the holdings of these two concerns by the Guanajuato Power & Electric Company. The smelter at that place is one of the largest in Mexico. It will obtain its electrical energy from the invading company as soon as the transmission line is finished. The new line will deliver electrical energy to a number of towns situated between Leon and Aguas Calientes.

At a recent meeting of the stockholders of the Mexican Northern Power Company held at Montreal, Canada, it was decided to let immediately the contract for the construction of the great dam across the Conchos River, 17 miles above Santa Rosalia, State of Chihuahua. This dam will form the water reservoir which will furnish the initial power for the hydroelectric plant. It is estimated by engineers who have reported on the project that 40,000 hp can be generated at the site selected for the dam. Considerable preliminary work has been done at the site of the proposed dam. In addition to furnishing power for operating the hydroelectric plant, the reservoir will afford a water supply for irrigating 200,000 acres of rich valley land which the company owns. The mining and industrial interests of that part of Mexico are elated over the prospects of the early consummation of the big enterprise. The electric energy will be transmitted to mining camps, towns and industrial centers situated within a radius of 150 miles, and will greatly lessen the cost of operating various kinds of enterprises.

Mr. S. W. Elkens, who is said to represent a syndicate of Canadians, has been investigating the situation at Durango with a view to installing a large electric light and power plant there and constructing a system of electric railway over a number of the streets of the city. It is reported that he is negotiating for the purchase of the electric light and power plant now operated there, and that if this deal is consummated the plant will be greatly enlarged.

Manuel Tamborel, of Mexico City, is preparing to install a hydroelectric plant on the Conchos River, State of Chihuahua. He has obtained a concession from the Federal Government for the purpose.

Jose Diaz Rubin, of Puebla City, will install a hydroelectric plant on the Nexapa River, State of Puebla. He will furnish electric energy to a number of industrial concerns. He lives at Puebla.

The introduction of electricity for operating the machinery and reduction mills of mining concerns in the Etzatlan and a number of other mining districts in the State of Jalisco will be accomplished about Jan. 1 by the Chapala Hydro-Electric & Irrigation Company, of Guadalajara. The hydroelectric plant and transmission lines are now being constructed. A number of the larger mining companies have contracted for electrical equipment for their respective properties, among them being the Amparo Mining Company, which has placed orders for $25,000 worth of electrical machinery, and contracted to take up 700 hp from the electric company. The fuel bill of the Amparo Mining Company now amounts to $100,000 per annum. With the introduction of electrical energy the amount will be reduced to $70,000 per annum and the power doubled.

The Hidalgo Cement Company is preparing to erect a hydroelectric plant on the Montezuma River, about three miles south of Dublan, State of Hidalgo, where its cement works and headquarters are situated. A large reservoir will be formed by the construction of a dam across the river, which will cost about $500,000. The hydroelectric plant will have a capacity of 1200 hp and will cost about $200,000 to erect. The surplus water will be used to irrigate a large tract of land. The electric energy will be used to operate the machinery and furnish lighting for the cement plant.

A large hydroelectric plant will be erected at the waterfall of El Salto, situated 50 miles west of Durango, by Charles von Brandis, of that city, who has obtained a concession from the Federal Government for the proposed enterprise. The electric energy will be transmitted to Durango and a number of mining camps in that State.

The concession which the Government granted four years ago for the construction of an electric railway between Autlan and the Pacific port of Chamela, a distance of about 200 miles, will expire Nov. 1, after being extended one month. The concession is owned by L. O. Harnecker. It is reported that a syndicate of Germans is investigating the situation with a view of taking over the concession and building the proposed road.

Proposed Arizona Hydroelectric Plant.

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nected it to a companion's desk by means of twine, and when later on he became old enough to be considered seriously as an operator and wanted to practice, how he constructed an instrument, using a Daniels' cell, old zinc from scrap heaps and iron wire.

Mr. Bain's first invention, a self-closing telegraph key, was made during the time he was employed as an operator on a Southern railroad. It consisted of a treadle located under the operator's bench and connected by means of hand-made levers. One night a dog came into the office and went to sleep on the treadle, thus putting the invention out of commission and ending the dream of the inventor. Mr. Bain later became interested in telephony and constructed the first telephone he ever saw. Subsequently he obtained a position as salesman for the Post Manufacturing Company, soliciting subscriptions and making his own installations.

A number of interesting experiences regarding incandescent lamp installations were related. A lighting plant having been installed in a hotel by Mr. Bain in those days, the guests spent the night in celebration of the event. Incidentally they could not sleep on account of the noise made by the generating units.

A few years later Mr. Bain was appointed electrical engineer of the Minneapolis Electric Railways, his duties being to install an electric traction system in St. Paul and Minneapolis. The difficulties encountered in this installation were many. The city ordinance of Minneapolis provided that on certain streets all electrical conductors must be placed underground, and to comply with this ordinance, Mr. Bain had to do considerable traveling in order to purchase the necessary materials. Probably the most interesting feature of this installation was the manner in which the conductor was laid under ground. A number of pasteboard tubes, heavily insulated, were first laid. The question then was, how to get the conductor through the tubes? To accomplish this a contrivance resembling the thumb of a glove was fastened to the end of a cord, and with the aid of a blower this arrangement was shot through the tubes, and later a cord fastened to the conductor and drawn through. Other difficulties met with in this installation were the fitting up and installing of new generating units. The speaker related a number of similar amusing experiences, and told of the many difficulties encountered by electrical men in the early days of electrical development.

Proposed Baltimore Municipal Lighting Plant

The Maryland Legislature in 1900 gave to the city of Baltimore authority to establish and maintain a municipal electric lighting plant, and further authorized the submission to the people of a loan of $1,350,000 for that purpose, which can be done at any time. The project for such a plant has recently been revived owing to the recent consolidation in that city of electric lighting properties which, it is asserted, removes all competition for street lighting by electricity. The Mayor has requested the superintendent of lamps and lighting to make an investigation and report whether the garbage-reduction plant, located at Fort Covington, is suitable for electrical generation. It is said that the report will state that the building was found well fitted to be converted into a lighting plant. It is located directly on the water front, where coal for the steam plant could be readily and easily obtained. The superintendent will, it is said, also report that the loan authorized in 1900 is adequate for the purpose of establishing such a plant, and that a lesser appropriation than the $152,640, now made annually for electric lighting, will not only maintain the plant, but will also furnish the lamps needed, pay the interest on the loan and provide a sinking fund to take care of the principal, and further defray the loss to the city from shrinkage in duct rentals and easement tax as a result of such a change.

It may be determined to ask for bids on the municipal lighting early next year, in order to have the plant in operation by September, when the present contract for electric street lighting expires.

Disturbances to Telephone and Telegraph Systems.

A paper entitled "Telegraph and Telephone Systems as Affected by Alternating-Current Lines" was presented by Mr. J. B. Taylor before the American Institute of Electrical Engineers in New York on Oct. 8. The author outlined the characteristic features of telephone and telegraph systems and explained the disturbances caused by alternating-current energy transmission systems operating in their neighborhood. He remarked that all working conductors are surrounded by electromagnetic and electrostatic fields. These fields induce e.m.fs. and charges in neighboring conductors. With an ideal metallic circuit, external fields are a minimum; similarly, an ideal metallic circuit may be in fields of any strength without being disturbed. Practical considerations prevent these ideal conditions from being realized. Hence currents will be induced in any closed-circuit conductors wherever placed as a result of currents and potentials on other conductors. Disturbance results only when these induced currents are of sufficient magnitude to be objectionable.

Commercial telephone lines have little margin to meet disturbing conditions more severe than normal. An increase of telephone currents to three or four times their present values would doubtless result in great disturbance to other wires in the same telephone system and require new standards of construction and maintenance. The same statement applies to telegraph systems. Theoretically a balanced telephone line can be operated in proximity to alternating-current wires. This is not true of a telegraph line, as there is no way of balancing a circuit using earth return. Where trouble is experienced on a telephone line it may be possible to clear same by putting the system in first-class condition. Where trouble is experienced on a telegraph line, some change in the apparatus or circuit arrangements will be necessary. For any given case, all the features of the energy transmission system and signaling system should be taken into account with a view to arriving at the proper procedure to reduce or to eliminate the disturbances.

In the discussion of Mr. Taylor's paper, Mr. C. F. Scott stated that the disturbances to signaling systems caused by energy-transmission systems can be grouped into three classes, namely, leakage, magnetic and electrostatic. He showed that the use of a current-neutralizing conductor, as described by Mr. Taylor, would result in many practical difficulties in single-phase railway installations.

Mr. A. W. Copley described the scheme used by the New York, New Haven & Hartford Railroad to minimize the disturbance upon neighboring signaling circuits, while Mr. W. S. Murray said that the troubles are even less frequent upon the telephone and telegraph systems near the single-phase railway circuits than is the case with the average system not installed near a single-phase circuit.

Dr. C. P. Steinmetz remarked that neither the intelligence-transmission system nor the energy-transmission system has exclusive right to the ether. When disturbance upon one system is caused by the operation of the other, the two systems should co-operate to eliminate or minimize the disturbance. Dr. Steinmetz expressed his regret that no convenient method has yet been devised for representing the electrostatic fields so that one can obtain a physical conception of the relations expressed by the equation dealing with electrostatic phenomena somewhat analogous to the Faraday conception of lines of magnetic force. A possible method of dealing with electrostatic quantities is to determine, first, the inductance and then calculate the capacity from the relation existing between the velocity of propagation and the product of the inductance and the capacity.

In closing the discussion, Mr. Taylor stated that, although the scheme criticised by Mr. Scott has not been adopted in America, it has been used successfully in many European installations.

The New York Electrical Show.

The third annual New York Electrical Show at Madison Square Garden was opened to the public on Monday evening, Oct. 11, and will continue until Oct. 21. The decorations and electrical scheme, as well as the general architectural features, are unquestionably the neatest and most pleasing ever witnessed in the immense arena. Some conception of the scheme of decorations can be obtained from the general view herewith. Over 38,000 yd. of golden and white bunting were used in the overhead canopy and set of hangings encircling the arena and the effect is carried out so that no part of the building proper, except the floor and a few stairways leading to the balcony, is exposed. The canopy ceiling is divided into 56 panels, and at each intersecting division, grouped in an oval, is a candelabra with 72 25-watt tungsten lamps and a circle of 40-watt lamps. The latter lamps are of an amber hue, while the others are clear white. Over the center of the exhibits are six chandeliers 10 ft. in diameter, made up of metal and art glass of pleasing colors which harmonize with the general color scheme. These chandeliers are about 15 ft. from the ceiling proper, while the candelabras hang down about 22 ft. on a white column decorated with artificial flowers and leaves. Over the mezzanine floor there are 28 glass chandeliers, with about 15 ruby and amber-colored lamps in each, which help materially to heighten the general effect.



GENERAL VIEW OF MADISON SQUARE GARDEN ARENA DURING ELECTRICAL SHOW

Down the center of the Garden there are two rows of white booths with a row of arches on the center of each block, dividing the booths and at the same time furnishing a sign to identify the various exhibitors. While this particular feature is essential to the exhibitors, Mr. M. A. Singer, who is responsible for the entire decorations, has arranged the sign scheme in such a manner that even this part, as well as the rest of the work, makes an attractive decorative feature of the show. The exhibits at the sides, which are up against the royal boxes, have an old-gold background with a white cornice relieved by a solid decorated pergola and artificial leaves and flowers. The entire Garden is surrounded with two rows of 25-watt tungsten lamps and the arches proper are lined with lamps of the same size and type. Between each arch there is a jardinière with a group of artificial lilies of the valley which are lighted up by 4-cp candelabra-base orange-colored lamps. Around the Garden and on the front of all booths are columns about 10 ft. apart surmounted by art glass tulip shades fitted with tungsten lamps. Taking the whole effect in consideration there seems to be nothing left undone to make the exhibition a pronounced artistic success.

Along the sides of the Garden and at the rear are the booths of the New York Edison Company, the United Electric Light, Heat & Power Company and the Edison Electric Illuminating Company of Brooklyn. Facing the entrance is the booth of the Public Service Corporation of New Jersey. In the first three booths there are very comprehensive exhibits of as many different electrical devices as can be crowded into the space, and the electric light companies have certainly very interesting displays. The Public Service Corporation uses its booth as a reception room and in addition to distributing literature shows a few photographs, including night views of Broad and Market Streets, Newark, which are illuminated in the business section by flaming arc lamps. Detailed descriptions of the exhibits of the lighting companies will be given in a later issue, and the other exhibits are described elsewhere in this issue.

The American Street and Interurban Railway Conventions.

The American Street and Interurban Railway Association and its allied associations held their 1909 conventions at Denver, Col., from Oct. 4 to 8. In addition to the controlling or parent organization there were present the following subsidiary associations: American Street and Interurban Railway Accountants' Association, American Street and Interurban Railway Engineering Association, American Street and Interurban way Engineering Asociation, American Street and Interurban Railway Claim Agents' Association, and American Street and Interurban Railway Transportation and Traffic Association. The usual large array of exhibits was made under the auspices of the American Street and Interurban Railway Manufacturers' Association. The exhibits and part of the convention sessions were held in the Denver Auditorium Building, which was enlarged temporarily by the addition of an annex of canvas tenting, which occupied a large part of two adjacent streets. Although far from Eastern centers, Denver is justly noted as an excellent convention city, because of its hotel accommodations, the natural attractions of Colorado and the hospitality of its people.

A number of special trains were run from various Eastern points. Most of these arrived in Denver on Sunday, the day before the opening.

The convention exhibits were opened Monday morning, and the registration began. Convention sessions began on Monday afternoon with meetings of the Claim Agents' and Transportation and Traffic Associations. The Claim Agents, after transacting some routine business, devoted the session to the discussion of the subject "What is the Best Means of Preventing Collisions of Cars with Vehicles and Pedestrians?" The Transportation and Traffic Association listened to the reports of its officers and discussed the report of its committee on passenger traffic, which brought out the advertising methods pursued by various companies.

On Tuesday morning both the Transportation and Claim Agents' associations held sessions. The claim agents in the morning discussed the advisability of having trainmen procure an increased number of witnesses to accidents; the practice of furnishing duplicate copies of the statements of injured parties to the injured parties, and the necessity for a school of instruction for trainmen in accident matters. In the afternoon the topical discussion was continued on the following subjects: Should information be furnished newspapers regarding the work of the claim department? What should be the relationship of the medical and claim departments? How can the medical best serve the claim department in the handling of accidents? The claim department and its relations to the operat ing department.

The Transportation and Traffic Association held one session on Tuesday, in the morning, and discussed the report of the committee on interurban rules. After a full session of discussion of the proposed rules, they were referred to the committee with instructions to confer with the committee on rules of the American Railway Association with the idea of making any changes that may seem desirable in either code, since it was not thought feasible to adopt the American Railway Association rules for electric railways.

The parent body, the American Street and Interurban Railway Association, held its opening meeting Tuesday afternoon. The session was presided over by President James F. Shaw, of Boston. The annual report of the executive committee was read by Secretary B. V. Swenson. President William G. Evans, of the Denver City Tramway Company, welcomed the convention to the city. Mr. B. V. Swenson read his report as secretary and treasurer. The annual address of the president was delivered. Reports were heard from four committees. These reports were on "Subjects," "Active Membership," "Associate Membership" and "Recommendations of Ex-President Goodrich."

A paper on organization from the standpoint of the smaller companies was read by Mr. Ernest Gonzenbach, president of the Sheboygan (Wis.) Light, Power & Railway Company. This paper was discussed at some length. The reading of the report of the committee on education concluded the work of the session, except as to some routine business.

The engineering association held its first session Tuesday afternoon. President Paul Winsor, of Boston, gave his address, which was followed by some routine business. The principal business of the session was the discussion of the report of the standing committee on "Way," which report had been in the hands of the members for a month.

On Wednesday morning the Engineering Association took up the report of its committee on equipment, which was noted in our issue for last week. Discussion of this occupied all of the morning and was continued over into the afternoon. Care of commutators and weights of cars were the subjects receiving the most time. The sizes of rolled-steel wheels recommended in the report were unanimously adopted and referred to the committee on standards. The committee recommendation for a change in the standard flange contour adopted in 1907 was rejected by unanimous vote. The gage recommended for pressing on steel wheels was not acceptable to the meeting and was referred back to the committee. A resolution was passed that the association take up the question of government and instruction of regular apprentices in the mechanical trades in connection with the maintenance of equipment of electric railways. On Wednesday afternoon the Engineering Association took up the subject of heat-treated axles, from which it appeared that the present requirements in specifications could be considerably increased. The report of the committee on generation was then taken up. The subjects most discussed were flue-gas analysis, steam meters and low-pressure steam turbines.

In discussing the report on equipment, Mr. John Lindall, of Boston, remarked that brush-holder defects cause excessive commutator wear, and that attention to the commutator alone with neglect of the brush holders is not wise. Mr. F. H. Lincoln, of Philadelphia, said that experience points to the advisability of adjusting the brush tension on motors by weight and adjusting the position of the brushes by measurement. Mr. William Roberts, of Akron, Ohio, said that brush tensions on his cars are tested with a small spring balance. This plan might be extended to rotary converters and generators. Considerable discussion followed on the practice which has become common for years of grooving out the mica between the commutator segments for a depth of about 1/32 in. when the mica proves to be too hard to wear down as fast as the copper of the commutator. The consensus of opinion seemed to be overwhelmingly in favor of such practise, and many are pursuing this method to the improvement of commutator life. Several are using slotting devices consisting of small circular saws for grooving out the mica between the segments.

Mr. Hugh Cowan, of Toronto, said that a pressure of from 7 lb. to 9 lb. is used on the motor brush-holders on his road. Much discussion was had of that portion of the committee's report which deals with car weights and the possibility of reducing them. All who discussed it endorsed the proposition that car weights could, and should, be reduced by more study of the matter. As one master mechanic pointed out, the Denver tramway system offers plenty of examples of substantial motor-cars weighing only 600 lb. per passenger, while, at the other extreme, some interurban cars weigh 1200 lb. per passenger. Standard wheels were discussed, and a standard tread for steel wheels was recommended to the committee on standards.

Following the discussion of the report of the committee on equipment, the report of the committee on generation was read by Mr. W. S. Twining. An abstract of this report, which dealt with flue-gas analysis, steam meters and low-pressure turbines, was given on page 849 of our issue for last week. In discussing the report, Mr. Charles Hewitt, of Philadelphia, presented the results of some interesting tests on flue gases. He said that the flue gases are sometimes erroneously assumed to be the result of combustion alone, whereas they are really the products

of combustion plus the air that has leaked in around the setting of the boiler. He presented four sets of continuous carbon-dioxide recorder records taken from the same boiler. The first chart showed 12 per cent carbon dioxide and was taken with the boiler setting and doors in the ordinary condition. The second chart showed 14 per cent, and was taken after the front and side doors were packed with a packing made of old pipe covering to reduce air leakage. The third chart showing 15 per cent was taken after the side doors had been bricked up to still further reduce air leaks, which were very apparent. The fourth chart showed from 17 per cent to 18 per cent, and was the result of further stopping of leaks through the setting by coating the brick work of the setting with three coats of liquid Portland cement and one coat of cold-water paint having a gypsum base. A chart taken from another boiler, which stood alone, and had not only front and side doors in the setting, but also back doors, showed 4 per cent carbon dioxide, which was increased to from 10 per cent to 12 per cent by packing the doors.

Mr. C. K. Durbin, of Denver, gave an interesting account of the experience of one of the small companies in his syndicate which had purchased a carbon-dioxide recorder, and, after considerable study and effort, had thought it hopeless to try to get results with it. After a little further study, however, resulting in the stopping of leaks of air, marvellous results were obtained. Now the company would not be without the instrument. The plant burns oil.

The chairman called for discussion of that part of the report devoted to steam meters. From the limited discussion that followed it is apparent that most steam meters are in somewhat of an experimental state. Mr. Hewitt, of Philadelphia, told of installing a St. John's steam meter on the auxiliaries in one power plant and finding it accurate within 3 per cent as checked by weighing the condensation. He found that the steam-blower engines were taking 10 per cent of the steam generated. It is intended to replace them with turbine blowers, which, it is hoped, will operate on 3 per cent of the steam generated.

In the discussion on exhaust-steam turbines it was brought out that the cost per kilowatt of the exhaust turbines and all other necessary appliances in the Philadelphia plant was about $80, which was lower than the cost of additional plant equipment secured in any other way. If condensing water had been available so as to render a cooling tower unnecessary, the cost would have been about $50 per kilowatt. These figures were given by Mr. W. S. Twining, of Philadelphia.

The Accountants' Association held its first session on Wednesday morning. President R. N. Wallis read his address. Mr. H. E. Weeks presented his report as secretary and treasurer, and also the report of the executive committee. A paper by Mr. S. C. Rogers, of Youngstown, Ohio, on "Interurban Statistics" was read by Mr. W. H. Forse, Jr. A long discussion on this took place. The remaining work of the session was the report of the standing committee on a standard system of accounts.

The Transportation and Traffic Association on Wednesday morning discussed the report of its committee on express and freight traffic. The operating expense of such traffic was talked over at length. The rest of this session was given to the discussion of the rules offered by the city rules committee, which was concluded Thursday.

The Claim Agents held their last sesison on Wednesday morning. Three papers were read on "The Unreported Claim; Its Evils and Remedy." Discussion of these, together with the election of officers and appointment of committees, completed the business of this association.

The parent organization met in executive session on Wednesday afternoon and discussed the report of the committee on Interstate Commerce Commission affairs and that of the committee on compensation for carrying United States mail.

On Thursday the Transportation and Traffic Association continued its discussion of city rules. The rules reported were adopted, subject to their further amendment. A paper on "The Chicago Transfer Crusade," written by Mr. J. V. Sullivan, of Chicago, was read by Mr. Beach. After discussion of this paper, the subject of "Training of Transportation Employees" was taken up, and a paper on the subject was read by Mr. Charles B. Wells, of Denver. This brought out a long discussion, which was continued until the election of officers, which closed the convention of this association.

At the Thursday session of the Accountants' Association, Mr. N. E. Stubbs, of Baltimore, read his paper on "Payrolls and Timekeeping." This was discussed at length. A paper on "The Electric Railway Auditor, His Duties and Relations to the Organization," by Mr. W. B. Brockway, was read in the absence of the author and drew out some discussion. "Stores Accounting and Inventory" was the subject of a paper by Mr. E. S. Pattee, of Minneapolis. After receiving the report of the committee to consider shop accounting jointly with a committee of the Engineering Association, and election of officers, this convention adjourned.

On Thursday morning the Engineering Association took up the report of its committee on standards and the report on energy distribution, the discussion of which occupied the entire morning session. On Thursday afternoon the joint committee on shop accounting reported. The report of the committee on energy distribution, of which Mr. James Heywood was chairman, dealt with the specifications for material used in energy distribution, including feeders, contact conductors, return systems and conduit systems.

For high-tension transmission lines the report gives favorable comments on steel towers and suspended insulators. It was stated that steel towers decrease the fire risk, are more portable than wood poles, and are cheaper when the extra durability is considered. In comparison with the pin-and-petticoat insulator, the suspended insulator possesses superior mechanical strength, a higher factor of safety in dielectric strength, greater accessibility for cleaning and observing and affords greater durability to the conductor.

For low-tension underground service the committee recommended the use of paper-insulated, lead-covered cable. Triple weather-proof braid is said to provide sufficient insulation on overhead low-tension cables to prevent crosses with telephone and other low-tension wires.

A short discussion was had on the two recommendations of the committee, one as to the adoption of a standard section of grooved trolley wire, and the other as to adopting a new wire table. The grooved trolley of 211,600 circ. mils cross-section, as recommended, was adopted. In regard to the wire table it was explained that the confusion arising from the various gages in use induced the committee to recommend that wire and sheet metal gage numbers be abolished in ordering material, as requested by some of the manufacturers, and that the diameter always be expressed in decimal parts of an inch. This recommendation was put to a vote and adopted and recommended to the committee on standards. By this recommendation also the size of stranded conductors should be stated in circular mils rather than by gage number.

On the subject of pole preservation Mr. Martin Schreiber, of the Public Service Railway of New Jersey, estimated the cost of treating poles by the brush method as from 20 to 30 cents for material and 5 cents for labor, and for the tank method as from $1.50 to $2 per pole. His company experimented recently to prevent the absorption of too much of the liquid in tank treatment around the butt of the pole where only a little is needed. A coating of cement had not been successful for this.

Mr. W. G. Matthews, of the Denver City Tramway, reported that after noting an experiment of the Colorado Telephone Company with the brush treatment with carbolineum his company began, in 1904, the treatment of poles in this way, and now has about 1300 poles so treated. Another plan being tried is to put 6 in. of concrete around the pole the entire depth of the hole and bring it up to a cone at the top. Another is to put concrete only 3 ft. below the ground and a few inches above.

Officers for the engineering association were elected as follows:

President, Mr. F. H. Lincoln, assistant general manager, Philadelphia Rapid Transit Company, Philadelphia, Pa.; first

vice-president, Mr. W. J. Harvie, chief engineer, Syracuse Rapid Transit Company and Utica & Mohawk Valley Railway Company, Syracuse, N. Y.; second vice-president, Mr. E. O. Ackerman, engineer maintenance of way, Columbus Railway & Light Company, Columbus, Ohio; third vice-president, Mr. J S. Doyle, superintendent of car equipment, Interborough Rapid Transit Company, New York: secretary-treasurer, Mr. John W. Corning, electrical engineer, Boston Elevated Railway Company. Executive committee: Mr. Martin Schreiber, engineer maintenance of way, Public Service Railway Company, Newark, N. J.; Mr. W. H. McAloney, superintendent of rolling stock, Denver City Tramway Company, Denver; Mr. John Lindall, superintendent of rolling stock and shops, Boston Elevated Railway Company, Boston, Mass.; Mr. Thomas Elliott, chief engineer, Cincinnati Traction Company, Cincinnati, Ohio.

The parent association on Thursday afternoon accepted the rules for city operation adopted and recommended to the parent association by the Transportation and Traffic Association. Officers of the American Street and Interurban Railway Association were elected by continuing those of last year in office, as follows:

President, Mr. James F. Shaw, chairman board of directors, Boston & Worcester Electric Companies, Boston, Mass.; first vice-president, Mr. Arthur W. Brady, president, Indiana Union Traction Company, Anderson, Ind.; second vice-president, Mr. Thomas N. McCarter, president, Public Service Railway Company, Newark, N. J.; third vice-president, Mr. George H. Harries, second vice-president, Washington Railway Electric Company, Washington, D. C.; and fourth vice-president, Mr. Charles N. Black, vice-president and general manager, United Railroads of San Francisco, San Francisco, Cal.

The entertainment features provided were too numerous to be mentioned at length here. Probably the event that will live longest in the memories of most of the delegates was the barbecue held at the White City. This was altogether of wild game from the Rocky Mountains served by "cow punchers," and was given by the Denver City Tramway Company. On one evening the Manufacturers' fifth annual vaudeville and theatrical performance was given. Most of the talent for this event was furnished by the conductors and motormen of the Denver Tramway. Some really excellent performances were given. The ladies were taken on sight-seeing trips over the city and interurban lines of Denver and on Friday, after all the sessions had been held, all took a trip up the Moffat Railroad to the continental divide where the snow stood deep and the thermometer registered 15 above zero. On Thursday evening the entire house at the Broadway theater was engaged for the convention to see Mrs. Leslie Carter in "Vastaherne."

Convention of Colorado Electric Light, Power and Railway Association.

The Colorado Electric Light, Power and Railway Association held its annual convention this year at Denver, beginning Oct. 7, the last business day of the American Street and Interurban Railway Association convention. The first session was held at the Hotel Auditorium on Thursday morning, at which time President J. F. Dostal, of Denver, delivered his address and a number of questions from the Question Box were taken up. Mr. Frank W. Frueauff, past-president of the association and president of the National Electric Light Association, gave a very interesting talk on the work which the present administration of the national association is carrying out. In the afternoon Mr. James R. Cravath, of the *Electrical World*, gave a talk illustrated with blackboard drawings on "Recent Progress in Illuminating Engineering."

The program included papers as follows: "Notes on Meters and Meters Operating with Series Transformers," by Mr. F. P. Cummings, of Denver; "Selling Electricity," by Mr. H. H. McConnell, of Colorado Springs; "Notes on Grounded Secondaries," by Mr. W. J. Canada, of Denver. An abstract of the paper on grounded secondaries is given elsewhere in this issue. Abstracts of other papers and discussions will appear in later issues.

Convention of Car-Lighting Engineers.

The Association of Car Lighting Engineers held its second annual convention in Chicago from Oct. 4 to 7. The report of the secretary, Mr. G. B. Colegrove, reported a total membership of 390, an increase of more than 100 per cent during the past year.

In his presidential address, Mr. A. J. Farrelly outlined the history of the association since its inception in May, 1908, the credit for its formation being given to Mr. E. M. Cutting, of the Southern Pacific. In explaining the present status of the organization, the president remarked that the objects of the association, the betterment of its members and the improvement in the service of the railroads, will surely result in the choice of the members to fill better positions and places of greater responsibility.

The fact that the name originally adopted for the association was not sufficiently comprehensive for the real objects of the organization having been brought to the attention of the members, it was voted to adopt the name "Association of Railway Electrical Engineers," proposed by Mr. A. J. Collett.

Mr. J. H. Klink addressed the convention on the subject of the application of electricity to railway shops. He remarked that there are now used two general kinds of electric systems, the alternating current and the direct current, while a combination of the two systems is coming into prominence. Experience shows the combination system, employing alternating current for generation and transmission and a certain amount of direct current for distribution, to be the preferable one for railway shops when the energy must be transmitted over a considerable distance. For shop tools direct-current motors, with some method of speed control, have been found necessary.

Many arguments might be advanced to show the superiority of electric drive for railway shops, and wherever it has been tried it has been found satisfactory. Although the first cost is a great consideration, the unit cost of production is decreased because the output is increased. The ability to locate the machinery wherever desired, and without regard to line shafting or the power plant, makes the electric motor ideal.

The choice between alternating-current and direct-current motors is still an open question. For wood-working and blacksmith shops and other places where the speed required is practically constant, the tools should be grouped with a short line shaft operated by an alternating-current motor. For individual tools a direct-current motor should be used. Motors are usually mistreated by the workmen until they burn out, so that alternating-current motors give less trouble than do direct-current motors. The majority of recent installations are with variable-speed motors, the ratios being 3 to 1 and 4 to 1, at 125 volts or 250 volts. Multiple-voltage systems are practically a thing of the past. Alternating-current motors will probably be used more generally in the future as better types are developed.

The discussion was participated in by Messrs. Pomeroy, Hutchinson, Farrelly, Gilman, Collett and Cartwright. Mr. Gilman remarked that both direct-current and alternating-current motors used in the shops of the Chicago, Milwaukee & St. Paul Railroad have given very little trouble. Alternating-current motors are very satisfactory. One man can take care of 150 alternating-current motors, while the same man can look after only 50 direct-current motors. However, the repairs to the direct-current motors are so slight that one spare armature is sufficient for 45 motors.

The report of a special committee on axle generators, which was read by Mr. J. R. Sloan, dealt with the design and construction of the axle generator proper and its auxiliary apparatus; the operation of the battery in connection with the axle generator, and the operation of the lamps. In regard to permissible voltage variation, good practice allows a variation

of 1½ per cent above or below normal, while fair practice will admit of a 3⅛ per cent variation; a variation greater than this value may be considered poor. The major portion of the report was devoted to details of design of axle generators and auxiliary devices. The committee recommended that the insulation be made heat, oil and moisture proof, and that the lamp voltage be controlled within 1.5 per cent of normal. The "floating" method of charging batteries was recommended.

The report was discussed by Messrs. G. B. Colgrove, N. E. Lemon, A. J. Farrelly, Alex. McGary, J. R. Sloan, O. W. Ott, G. W. Murray, D. J. Cartwright and W. L. Bliss. In reply to a question by Mr. Colegrove as to the use of a low-voltage release on the batteries, Mr. Bliss stated that it would be very dangerous to install such a device, because the circuit might be opened just at a time when it was most important to have light. However, some sort of a warning device, which would announce the approaching depletion of the battery, could well be utilized.

Mr. D. J. Cartwright read the report of the committee on standards. Among the recommendations offered were that the standard e.m.f. for head-end or straight-storage car lighting be made 64 volts; that the standard e.m.f. for axle car lighting be made 32 volts, and that all electrically lighted cars be provided with an overhead train line connection of three wires.

The report of the committee on lamps was read by Mr. H. C. Meloy. The committee recommended that the use of tipless lamps be avoided in all locations except berths, and that only round-bulb lamps be employed. This paper was discussed by Messrs. B. F. Fisher, W. L. Bliss, R. E. Schaulen, A. J. Farrelly, F. R. Frost and D. J. Cartwright. As a result of the discussion, it was recommended that train-lighting lamps exposed to view be so treated as to minimize the bad effects upon the eyes.

Storage batteries for train lighting were discussed in a paper by Mr. H. M. Beck. The author remarked that a battery should be given regular attention so as to prevent trouble before it occurs. In charging the battery it is important not to carry the regular charges too far and to keep below the temperature limit. The cells should not be over-discharged or allowed to remain completely discharged. The plates should always be covered with electrolyte, the strength of which should be within the proper limits.

In reply to questions by Messrs. Seymour, Hutchinson, Cravens, and Lunn, Mr. Beck stated that it is best for the specific gravity not to exceed 1.225. Temperatures higher than 100 deg. may injure the battery.

A committee, of which Mr. J. A. Shaw was chairman, submitted a report dealing with improvements in electric train-lighting systems, which was read by Secretary Colgrove. During the past year there has been a noticeable increase in the proportion of axle-generator equipments installed. This system is advantageous in that each car is individually independent of all other cars. For suburban trains the engines of which are not changed the head-end system employing steam turbo-generators has proved satisfactory; there are now 194 sets of this type in service in this country. Lighting directly from storage batteries has received a strong impetus with the development of the tungsten lamp.

In a paper entitled "Electrification of Steam Railroads," Mr. George W. Cravens stated that among railroad men it is quite generally recognized that the change from steam to electricity will eventually come. Under the conditions existing in Illinois, Indiana and Ohio, where there are about 5000 miles of electric lines as against about 30,000 miles of steam roads, the cost of operation by electricity averages 15.8 cents per car-mile. This cost is divided as follows: 3.7 cents for energy; 5.4 for operation; 1.3 for maintenance of cars and equipment; 1.7 for maintenance of a permanent way, and 3.7 for operation. The cost of operating steam railroads averages between 40 cents and 60 cents per car-mile. It will be seen, therefore, that the possible earnings under electrification are much greater than they are under steam.

In discussing Mr. Craven's paper, Mr. Pomeroy remarked that there exists on the part of steam-road managers a noteworthy thirst for real and definite information concerning electrification. In estimating the cost of operation by steam and electricity it is difficult to compare one road with another on account of the wide variation in conditions. The comparative cost per car-mile is not the only criterion, because in some cases it is possible to handle with electricity on two tracks traffic that requires four tracks with steam.

In reply to a question by Mr. Seymour, Mr. Craven stated that electrification has been adopted up to date principally for two reasons, namely, cleanliness and saving in operating expenses; incidentally there has been an increase in earnings from local short hauls due to the flexibility of the service.

A paper by Dr. Max Buttner entitled "Electric Train Lighting on European Railroads" was read by Mr. J. H. Klink. Nearly all of the Swiss, Danish and Italian State lines are equipped with electric train-lighting systems, and the Roumanian, Turkish, Hungarian, English, French, Belgian and Russian roads have a good many electrically lighted cars, although a large number of the Russian cars are still lighted with candles. Most of the cars on the German and Austrian lines still use gas lamps. Some of the privately owned lines in Sweden are electrically lighted, but few of the others are. The same thing applies to lines in Norway, Spain, Servia and Portugal. Turbo-generators are used in Europe; the steam is not taken from the locomotive, but is obtained from a boiler installed in the car. Axle generators are used in Prussia, France and England to some extent. Head-end systems, with batteries, are used in Germany, Denmark and Sweden, as are also straight batteries with charging stations at terminals of the lines; where batteries are used the practice of changing the batteries has not been adopted, but the cars are held long enough to recharge. Gasoline-engine-driven generators are used to some extent in Russia. It is the growing belief in Europe that an e.m.f. of 32 volts will be found suitable for all services.

The following officers were elected for the ensuing year: President, Mr. E. M. Cutting, engineer of train lighting, heating and ventilation, Southern Pacific Railway, Oakland, Cal.; first vice-president, Mr. J. R. Sloan, electrical engineer, Pennsylvania Railroad, Altoona, Pa.; second vice-president, Mr. F. R. Frost, electrical engineer, Atchison, Topeka & Santa Fé Railroad, Topeka, Kan.; secretary and treasurer, Mr. Geo. B. Colegrove, chief electrician, mechanical department, Illinois Central Railroad, Chicago.

The next annual convention will be held in Chicago on Oct. 4, 5, 6 and 7, 1910, and a semi-annual meeting will be held in Buffalo on June 7 and 8, 1910. As one of the phases of the activity of the association there was formed the "Car Lighting Club," which will meet informally for luncheon and discussion at times and places yet to be determined.

The chief entertainment feature of the convention was an informal banquet and dance held on the evening of Oct. 6, at which there were present 250, of whom 50 were ladies. The toastmaster was Mr. C. E. Brown, who introduced as the speakers President Farrelly and Messrs. M. E. Towner, G. B. Colegrove and E. M. Cutting.

Canadian Hydroelectric Commission.

A meeting of representatives of the different cities and towns who have agreed to take power from the Hydroelectric Power Commission was held in Toronto last week, with Hon. Adam Beck, chairman of the commission, presiding. Mr. P. W. Sothman, chief engineer of the commission, reported that Preston, Hespeler, Galt and Berlin will receive power next March, by which time power will be also delivered to Toronto. There are four gangs at work on the main transmission line, which it is expected to be ready before the municipalities have their distribution stations completed.

An action of Walter D. Beardmore to restrain the city of Toronto from entering into a contract with the commission will come before the courts for decision very soon, the statement of claim having been filed last week. The plaintiff alleges that the

city corporation had no authority to enter into contract with the Hydroelectric Commission to take 10,000 hp, claiming that the contract does not conform to by-law No. 4834. The plaintiff also wants the Crown added as a third party, further claiming that the Government has no power to carry on such business and that the Acts of the Legislature bearing on the subject are unconstitutional.

An action brought by R. S. Morris to restrain the city of Hamilton from entering into a contract with the Hydroelectric Commission for electric power has been dismissed by Chief Justice Meredith. By this decision the corporation is now in a position to deal with the commission and at a recent special meeting of the power committee the city solicitor was instructed to prepare formal application to the commission at once for 1000 hp.

New York Public Service Commission News.

The Public Service Commission of the First District of New York has ordered an investigation of the proposed operation of cars by the New York & Queens County Railroad over the new Queensboro Bridge. Although the commission has not issued any permit for this operation, the Board of Estimate has authorized the bridge commissioner to issue a temporary permit. It is to establish its legal authority that the commission has taken action.

The Board of Estimate and Apportionment of New York City last week set aside $1,500,000 for the purpose of lengthening the platforms of the subway stations in order to accommodate six-car local and 10-car express trains. The Public Service Commission has already approved of this improvement and has prepared plans for the work. A requisition was made on the Board of Estimate for the money on June 2, 1909.

The Public Service Commission, Second District, will give hearings at Albany this week on the application of the Plattsburgh Gas & Electric Company for authority to issue a mortgage for $500,000 and to issue presently $340,000 in 5 per cent 30-year bonds, and the application of the Oswego River Power Transmission Company for authority to issue a first mortgage for $100,000 and to issue at present $65,000 of 5 per cent 20-year bonds.

On Friday, at Buffalo, the commission will hear the application of the Genesee Light & Power Company asking for permission to issue capital stock. The company is organized to take over the property and franchises of the Genesee County Electric Light, Power & Gas Company. Request is made for authorization to issue 1000 shares of preferred stock and 1500 shares of common stock at the par value of $100 per share, and also the complaint of the Cazenovia Business Men's Association, Dr. H. H. Glosser and others against the International Railway Company as to service on the Abbott-South Park Line in the city of Buffalo.

The commission has consented to the merging by the Nassau Light & Power Company of the Nassau Gas, Heat & Power Company, Floral Park Light & Power Company and the Oyster Bay Electric Light & Power Company.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission has placed on file a supplementary agreement between the Fitchburg Gas & Electric Light Company, under date of Oct. 1, in connection with the distribution contract of Aug. 30, 1909, abstracted in these columns last week. The supplementary agreement provides that when the distribution agreement has been in force 10 years from its date, and again when it has been in force 20 years, the Board of Gas and Electric Light Commissioners may, by its order, but only upon the petition of the Mayor and Aldermen of the city of Fitchburg, filed not later than Jan. 1, 1919, and Jan. 1, 1929, respectively, and after a hearing duly noticed, make such reasonable modifications of the terms of the agreement as the public interests require. Such orders are to be effective only if made before Aug. 30, 1919, and Aug. 30, 1929. If the modifications of the agreement are unsatisfactory to either of the parties, such party may elect to rescind the agreement by notifying the other party in writing within 30 days after the making of the board's order, and in that event the agreement becomes null and void, and the modifications not effective.

The Gas and Electric Light Commission approved the issue of new capital stock to the amount of $5,000 for the purchase of the plant and business of E. Leroy Gardner, of Chester, by the Chester Electric Light Company.

Hearings were resumed during the past week by the Massachusetts Railroad Commission and the Boston Transit Commission, sitting as a joint board, on various proposed additions and consolidation matters relating to the transportation system of the Boston Metropolitan district. On Oct. 5 an extended hearing was given on the proposed extension of the elevated structure of the Boston Elevated Railway Company from the present Sullivan Square terminal to Medford. The proposed route passes through the city of Somerville, and at the hearing much opposition to an elevated structure developed among officials and residents of that municipality. The construction of a subway or a surface line on Mystic Avenue was favored. Officials and citizens of Medford favored the construction of an elevated line, considering the cost of a subway prohibitive and a new surface line as an inadequate solution of the problem. Further protest against an elevated line will be heard on Oct. 13. The proposed Boston, Lowell and Lawrence electric interurban high-speed line is adversely considered by the opposition to an elevated structure in Somerville. The situation is somewhat complicated by the uncertainty existing in regard to a possible electrification of the suburban lines of the Boston & Maine Railroad by the controlling interests in the new Boston Railroad Holding Company—an organization chartered by the Legislature of 1909 practically to permit the control of the Boston & Maine system by the New York, New Haven & Hartford Railroad Company for the purpose of unifying steam transportation in New England. It is probable that a suitable electrification of the suburban lines would greatly modify the demand for new elevated lines in the Boston district.

The joint commission gave a hearing on Oct. 8 on the proposed consolidation of the West End Street Railway Company and the Boston Elevated Railway Company. Mr. Frederick E. Snow, counsel for the Boston Elevated Railway interests, urged the necessity for the consolidation and the willingness of the company to meet reasonable terms. The West End company was represented by Messrs. H. Heustis Newton, F. S. Mead and Charles Williams, who emphasized the strong financial position of the West End before its lease, about 12 years ago, to the Elevated. The West End company owns the surface lines in the Boston system, and its stockholders desire to be placed in an impregnable position in case the consolidation goes through. Counsel Mead stated that by the terms of the proposed consolidation, referred to the joint board by the Legislature of 1909, the stockholders of the West End are asked to give up their position as secured creditors and become partners in an organization which is relatively less prosperous than when the West End was in control. A chart was shown to the board to indicate that there has been no relatively large increase in business since the establishment of the lease. It is felt that the Boston Elevated property is somewhat handicapped by the increasing cost of operation and taxes, the unprecedented extension of transfer facilities and lengthening haul per passenger, and the heavy fixed charges which must be paid on the elevated, tunnel and subway construction, to which the company has been, and still is, committed.

The Railroad Commission has issued an order sustaining the Boston & Northern Street Railway Company in the petition of the Selectmen of Peabody for a reduction of the fare between Peabody Square and Salem Willows from 10 cents to 5 cents. The board states that the traffic on the line between Town House Square, Salem, to Salem Willows is considerable during the summer, but extremely light during the rest of

the year. After investigating the returns of the company, other fares on the system and the travel, with special care, the board concludes that the fare is neither unreasonable nor excessive and that the reduction asked would require the portion of the line between Town House Square and the Willows to render a free service to Peabody passengers. The petition is, therefore, dismissed.

The Railroad Commission has approved the consolidation of the Middlesex & Boston and the Newton & Boston Street Railway Companies, including the issue of $200,000 worth of stock by the former to effect the purchase.

An order has been issued by the Railroad Commission recommending the establishment of a free transfer point at the Boylston Street station of the Tremont Street subway, in Boston, for the use of passengers entering the subway at Park Street who desire to reach the South Terminal Station. The removal of elevated train service from this subway seriously interfered with transportation facilities between Park Street and the South Station. The present arrangement, as recommended, is not without its objections, in the opinion of the board, but it is to be tried experimentally until March 1, 1910. The board states that it is to be hoped that ultimately improved facilties may be established between these points. It is probable that legislative authority for the extension of the Cambridge subway from Park Street to the South Station will be granted in the near future.

Wisconsin Rate Commission News.

The application of the Cumberland municipal electric lighting plant for authority to increase its rates was granted by the Wisconsin Commission on Oct. 4. The testimony introduced at the hearing, as well as the investigations made by the commission, showed that the revenues received for electric lighting fall short of covering the operating expenses. In attempting to apportion the operating expenses in order to arrive at a satisfactory basis for rate making, considerable difficulty was experienced due to a lack of proper station data. From a study of conditions existing in other plants throughout the State it was found that 45 per cent of the operating expenses can be considered as fixed and 55 per cent as variable or output expenses.

The variable expenses to be met by the consumers must be apportioned over the kw-hour consumption for the year. No data was introduced covering the consumption of the various classes of consumers, nor was the output of the station by months given. No record was to be had of the connected load by classes or consumers. Consequently it was necessary to estimate the probable output.

From the annual reports submitted by a large number of electric plants in cities of from 1000 to 30,000 population, the average installation of various classes of consumers has been determined as shown in Table I. The connected load multiplied by the hours daily use of the same was used to obtain the daily and annual consumption in kw-hours for the different classes of consumers.

TABLE I.—AVERAGE INSTALLATION IN KILOWATTS.

Schools	3.06	Livery Stables	.57
Residences	.76	Factories	1.95
Saloons	.69	Hotels	2.70
Offices	.63	Restaurants	.76
Stores	1.02	Theaters	5.58
Laundries	.59	Churches	2.48
Depots	1.36	Lodge Halls	1.54

The plant, at the request of the commission, submitted a list of the metered consumers for the month of December, 1908. The number of unmetered consumers was known and their consumption was estimated as being the same proportionately as that of the metered consumers. There has been prepared in connection with this case a statement of the current output by months for a number of cities, with the per cent of yearly output worked out for each month. All cities with unusual load fluctuations have been eliminated.

From the above table the probable yearly and monthly outputs were determined and these with the estimated outputs determined by the other methods gave what was considered to be a satisfactory basis for rate making.

The commission recommended that 10 cents per kw-hour be charged for the first 30 hours' use per month of the active load, and 8 cents for all over 30 hours, with a minimum charge of 75 cents per month. The active load for residences and churches is to be considered as 50 per cent of the full connected load, and for all other classes of service, 100 per cent.

In the decision the question of fixed and variable expenses has been dealt with, as well as the subject of depreciation and the necessity for a depreciation reserve. These explanations have been made chiefly for the benefit of the municipal plants, where there seems to be a woeful lack of knowledge concerning such questions.

TABLE II.—MONTHLY OUTPUT IN PER CENT OF YEARLY OUTPUT.

July	5.91	Nov.	10.32	Mar.	8.20
August	6.18	Dec.	12.05	April	7.02
Sept.	7.67	Jan.	11.35	May	6.59
Oct.	9.26	Feb.	9.35	June	6.11

In 1908 the commission ordered the Douglass County Telephone Company to discontinue its free service, which, as a competing company, it had offered certain city officials of the city of Superior on condition that it be given connections with the city building, on the ground that such service was discriminatory. Although the company was willing, the city enjoined the company from taking out its telephones and sought to set aside the ruling of the commission. In a recent decision the Supreme Court has held that the contract is valid, and that the commission has no authority to set it aside. The court upholds an independent contract for free service if the contract was entered into before the passage of the public utilities law.

The hearing in the case of the Milwaukee petitioners against the Milwaukee Electric Light & Railway Company alleging inadequate service has been postponed until Oct. 20.

CURRENT NEWS AND NOTES.

ILLUMINATING ENGINEERING AND OPHTHALMOLOGY.—By invitation, Mr. L. B. Marks last week addressed the annual meeting in New York of the American Academy of Ophthalmology, the members of which include the leading oculists of the United States. In his address Mr. Marks made a plea for co-operation between the illuminating engineer and the oculist, and the Academy will probably take some action in the matter.

ATMOSPHERIC NITROGEN.—What is stated to be one of the largest orders ever placed for electrical apparatus in Europe is for generators for producing saltpeter from atmospheric nitrogen at Christiana, Norway. There will be five 17,000-kva, 11,000-volt, three-phase alternators designed for coupling to water turbines. These generators will be built by Brown, Boveri & Company, of Baden, Switzerland. The station of A. S. Rjukanfos, in which these alternators will be placed, is being designed for an ultimate equipment of 10 17,000-kva units.

GROUNDED SECONDARY IN COLORADO.—At the recent annual convention of the Colorado Electric Light, Power & Railway Association a committee was appointed to investigate the grounding of secondaries, and make a thorough trial by actual operation in as many cities as possible in the Rocky Mountain territory. Among the objections to grounding in this territory has been the prevalence of thunderstorms and difficulty in making good earths. The latter point will be made the subject of study. At the meeting of the association practically no opposition to grounding developed in the discussion of that subject.

UNITED WIRELESS STATIONS.—The United Wireless Telegraph Company has issued a list of stations, showing that it has now in commercial operation 97 land stations and 204 ship stations.

WIRELESS OVER 3500 MILES.—The army transport Bulford, which arrived at Manila on Oct. 6, reported that wireless messages were exchanged with the Pacific coast over a distance of 3500 miles.

AURORA BOREALIS AND CABLE SERVICE.—As previously noted, magnetic effects accompanying a display of aurora borealis seriously affected cable service on Sept. 25, and the same cause operated to block cable service for about an hour on the afternoon of Oct. 8.

ILLINOIS STATE ELECTRICAL ASSOCIATION CONVENTION.—The Illinois State Electrical Association will hold its annual convention this year at Alton, Ill., according to a notice recently sent out by Secretary H. E. Chubbuck, of Peoria. The dates are Oct. 26, 27 and 28. Exhibits by supply houses are invited.

PEA VINE DISABLES A TRANSMISSION SYSTEM.—A 24-hour shut-down of numerous manufacturing plants in Statesville, N. C., and also the suppression of all electric lights was produced recently by the contact of a matured pea vine with the transmission circuit of the Southern Power Company. During a storm the vine was carried on the wires from a stack of pea hay that had been piled close under the transmission line between two towers.

PITTSBURGH ELECTRIC TRACTION INQUIRY.—The Pittsburgh Civic Commission, which is said to be backed by Andrew Carnegie and H. C. Frick, has secured the services of Messrs. B. J. Arnold, J. R. Freeman, of Providence, and Frederick Laws Olmstead, of Boston, for the purpose of getting advice as to the improvement of the Pittsburgh street-car service, the river front and the park system. It is said that the experts will receive $800 a day for their services.

BALTIMORE ELECTRICAL SHOW.—A movement to hold a large electrical show in Baltimore within the next few months is gathering shape. An effort will be made to induce Mr. W. D'A. Ryan, illuminating engineer for the General Electric Company, to come to the city with his scintillator, which was one of the striking features of the Hudson-Fulton celebration. To insure the success of the exhibit it will be necessary to make arrangements for a large sum of money, as the exhibits are being planned on a very elaborate scale.

NEWS BY TELEPHONE.—A company has been incorporated having for its object the publication of news by telephone. Mr. Manley M. Gillam, president of the company, said that within a year subscribers in New York City will be furnished with telephone news of general interest, political happenings, baseball reports by innings, etc. He said that the plan of distributing news by telephone has met with success in London, Paris, Vienna and Budapest, and that the same general lines followed in these places will be pursued here when the telephone news service is established.

CHICAGO ELECTRICAL SHOW.—The Electrical Trades Exposition Company announces the dates for the 1910 Electrical Show, which will be held in the Coliseum, Chicago, Jan. 15 to 29, inclusive, 1910. This show will be under the same management as the four previous annual successes, and plans are under way for booths, decorations and lighting effects which will surpass the beautiful effects of previous shows. The benefits to manufacturers, contractors and dealers derived from this annual trade booster have been thoroughly demonstrated, and indications are that the 1910 show will be participated in by all of the leading firms in the electrical field. Offices have been opened at 115 Dearborn Street, Chicago, where all inquiries will be received and full information and details given regarding the show.

DENVER A. I. E. E. SECTION.—Secretary Ralph W. Pope, of the American Institute of Electrical Engineers, who has recently been making a tour of the far West to further the work of that body, stopped in Denver the week of the railway convention and was given a luncheon at the Brown Palace Hotel, Oct. 7. Prof. W. E. Goldsborough, now of Denver, presided. Several other out-of-town members of the Institute were also present. The speakers were Professor Goldsborough, Mr. Pope, Messrs. Chas. Hewitt, of Philadelphia; J. F. Dostal, of Denver; O. B. Coldwell, of Portland, Ore., and James H. McGraw, of New York. As the result of Mr. Pope's visit an A. I. E. E. Section will be organized by members in Denver and contiguous territory. A section is being organized in Salt Lake City, and several centers on the Pacific Slope have under consideration the establishment of sections.

WORCESTER POLYTECHNIC GRADUATES IN COLLEGE WORK.—Among recent appointments of graduates of the Worcester Polytechnic Institute to the electrical engineering staff of colleges are the following: A. B. Holcomb, 1908, instructor in electric engineering of Sibley College, Cornell; A. R. Powers, 1907, instructor in electrical engineering at the University of Pennsylvania; E. B. Paine, 1897, assistant professor of electrical engineering at the University of Illinois, has been appointed acting head of the electrical engineering department during the absence of Prof. Morgan Brooks on leave; R. H. Taber and C. E. Putnam, both 1909, graduate assistants in electrical engineering at the Worcester Polytechnic Institute; A. T. Childs, 1906, instructor in electrical engineering at the University of Maine; R. P. Clarkson, 1908, instructor in electrical engineering at the University of Vermont.

A CENTRAL-STATION SOLICITOR ABSCONDS.—The Topeka Edison Company reports that Norman Miner, who has been in its employ since February, 1908, as a solicitor, absconded from Topeka on Sept. 25, 1909, after cashing a number of worthless checks with Topeka merchants. Miner also abandoned his young wife, a Topeka girl whom he married in January, 1909, leaving her destitute. The man was employed for a short time as solicitor at Dubuque, Ia., and was also on the road for the Curtis Advertising Company, of Detroit. Previous to his employment by the latter he was for a time a solicitor with the Denver Gas & Electric Company. The Topeka merchants who were victimized will be glad to learn of this man's whereabouts. He also left a number of unpaid accounts and two merchants are endorsers on notes for a total of $650 which they will have to pay. Miner's parents are respectable people now residing in Brooklyn, N. Y. His name is Meinhold, the name Miner being one assumed by the young man for reasons best known to himself.

COLORADO SPRINGS ELECTRICAL ORDINANCE.—The city of Colorado Springs, Col., has under consideration the adoption of a comprehensive electrical ordinance along the lines of Denver's recent ordinance. The drafting of the ordinance is in the hands of the city attorney, who is consulting with the underwriters and various city departments. At present Colorado Springs calls for conduit feeds in all classes of buildings and cabinets for all cut-outs. The new ordinance will, it is understood, make the requirement for conduit complete in all installations within the fire district and for all warehouses, schools, churches or buildings of a public character, including apartment houses, throughout the city. Within a year or two it is contemplated making a requirement for conduit in all buildings in accordance with the present Denver ordinance. Sign circuits are already required to be in conduit and steel boxing throughout this city, which construction is probably unique for a city of the size of Colorado Springs, which has a population of less than 40,000.

Gas Engine Plant in Buenos Aires.

By J. P. Stone.

A NOTABLE instance of a complete steam-power plant being thrown out to be replaced by gas engines and producers is that of the power plant of the Buenos Aires (South America) slaughter houses. The whole of this equipment, comprising water-tube boilers, compound engines, generators and auxiliary machinery, is being dismantled and torn out to make room for gas engines, generators and producer plant. This steam station has been in operation nearly nine years, the original equipment being composed of two water-tube boilers, two horizontal-compound engines with their generators and two vertical-compound engines, another water-tube boiler being added later. All the generators were 120-volt belt-driven units. Power was principally used for lighting and pumping, but there were a few electric cranes. The plant gives a 24-hour service. Quite a novelty was introduced by employing two locomotive-type boilers as economizers, the gases after leaving the water-tube boilers passing through one or both of these boilers before reaching the chimney, which arrangement proved a very efficient water heater, as a steam pressure of 25 lb. could be generated by the heat from the waste gases.

The city engineers became interested in the use of gas engines some years ago, when two of the leading railway companies installed large gas-engine power plants to operate their workshops, the reliability of the gas engine as a prime mover being thereby firmly established. Prior to the installation of these two pioneer plants of large size, so little confidence was placed in the gas engine that no one would give it any consideration for important work, and such examples as these were necessary to assist in breaking down the prejudice and conservatism that existed.

When the general improvements in the slaughter houses were decided upon, which will greatly increase the consumption of electricity, it was decided to abandon the steam plant and put in gas. In February, 1908, the municipality called for tenders for the complete installation of two 250-hp and two 100-hp gas engines, each to be directly connected to their respective generators, together with the corresponding gas-producer plant of the pressure type, it being conditional that the contractors should remove the existing steam plant, install the new machinery, and

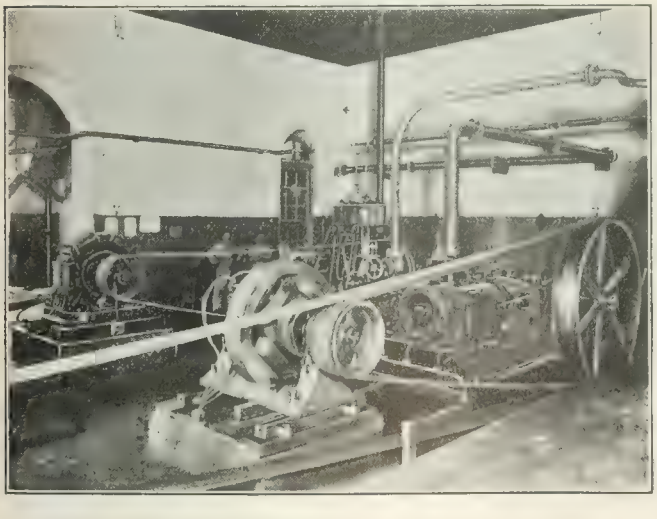


FIG. 1.—VIEW OF CORNER OF OLD ENGINE-ROOM.

put it in service without causing any interruption of the working of the plant. The specification also stated that the new machinery was to go into the existing buildings or, if that was not possible, the contractors had to provide the necessary enlargements.

The contract was awarded to Messrs. Agar, Cross & Co., Ltd., who are the agents for the Westinghouse Companies, and the Dowson Economic Gas & Power Company, their tender being the only one which fulfilled the conditions, which specified that the pressure type of producer was to be provided, all other competitors quoting for suction plants.

Before any work could be done it was necessary to remove the two boilers, two engines and generators, the principal exhaust main, and considerable steam piping, all of which was successfully accomplished without involving any interruption to the service.

A new temporary exhaust steam main had to be put in to take the exhaust out at the opposite side of the building, so as to leave the other side clear for the new work. The two 240-hp

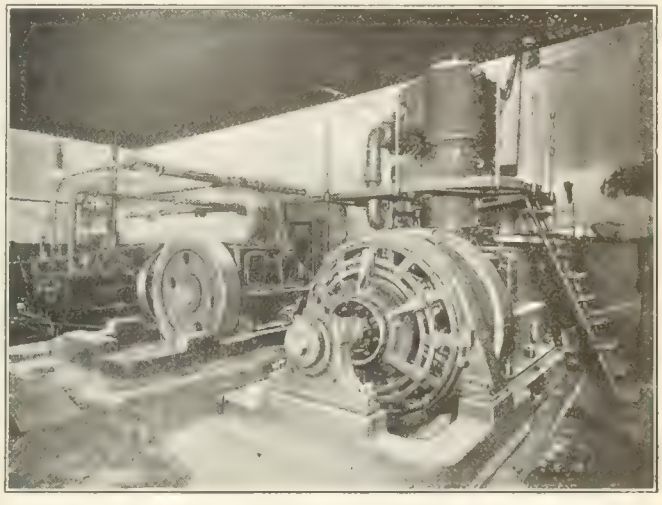


FIG. 2.—VIEW ALONG ONE SIDE OF GENERATING STATION, SHOWING GAS ENGINE PARTLY ERECTED.

gas engines are being erected in one half of the engine room. A view of the large gas engines partly erected is shown in Fig. 2, and the old steam engines can be seen in the background. As soon as the new engines are working the old steam engines now working in the other end will be removed and the 100-hp gas engines will be set up there.

The two 240-hp and the 100-hp gas producers have been set up in the boiler-room in the place formerly occupied by one of the water-tube boilers. It is expected that the gas engines will be operating under regular service conditions by the time this article appears.

Generators Designed for High Speed.

By A. G. Lang.

THE adoption of high-speed generators directly coupled to steam turbines has resulted in something like a revolution in the construction of electrical machinery, and marks an epoch in the evolution of the electrical industry.

In addition to being at least the equal of the reciprocating engine as a prime mover, so far as the cost of operation is concerned, the steam turbine possesses a number of advantages over its older rival—for example, smaller space requirements, less weight and absence of any reciprocating parts and crank mechanism.

It may be said that steam turbines can be used for the operation of generators only in the case of a direct coupling of the two machines. While the relatively high speed of rotation of steam turbines afforded a decided advantage to the electrical industry in reducing the required dimension of the generators as compared with their output, it nevertheless resulted in a number of new problems, a solution of which could be found only after prolonged experience. Owing to the enormous centrifugal force, only high-grade material could be used, while specially skilled labor was required to produce an efficient turbo-generator. Another problem connected with the construction of turbo-generators was to provide for adequate cooling to dissipate

the very considerable heat produced. The rotary part of the machine is of small diameter, resulting in a very compact design and small cooling surface. Artificial cooling was, therefore, found to be indispensable. For this reason turbo-generators are frequently entirely enclosed, with the exception of a few parts,



FIG. 1.—ROTOR OF 200-VOLT, 1020-KW, THREE-PHASE TURBO-GENERATOR.

such as the commutator and slip rings, while a part of the front surface of the rotor has been designed as a ventilator. Such turbo-generators are, therefore, also protected against the introduction of foreign objects, while any accidental contact of

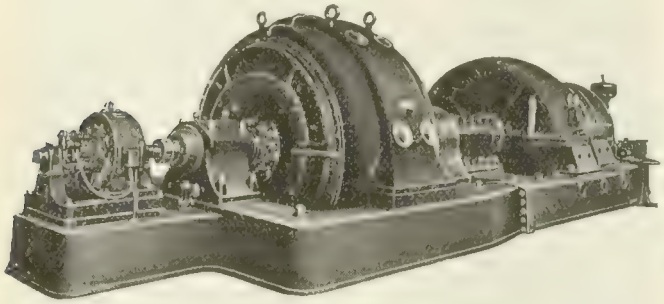


FIG. 2.—THREE-PHASE TURBO-GENERATOR, WITH DIRECTLY COUPLED EXCITER, DESIGNED FOR 6250 KVA.

current-carrying or rotating parts is effectively avoided. Moreover, the small diameter allows the centrifugal force to be kept within the proper limit.

In the case of single-phase or three-phase turbo-generators the rotor is the field structure which, in order to avoid any noise due to the high speed of rotation, is designed as a cylinder, as shown in Fig. 1. The field coils, which are embedded in slots, are secured against the effect of centrifugal force by metal wedges in the slots and by metal caps at the terminal surfaces. The exciting current is supplied to the rotor through carbon brushes. The armature coils, which are placed in micanite tubes, are anchored at the front surfaces by means of substantial blocks.

The continuous-current turbo-generator shown in Figs. 4 and



FIG. 3.—VENTILATED ARMATURE OF 500-VOLT, DIRECT-CURRENT GENERATOR.

5 is provided with commutating poles, and, if required, with compensating coils located in the faces of the main poles. The effectively ventilated armature, indicated in Fig. 4, carries a

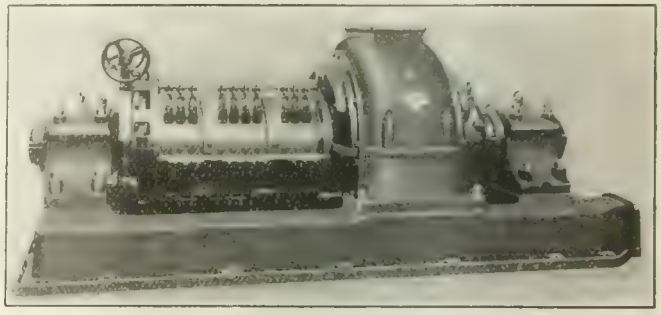


FIG. 4.—DIRECT-CURRENT TURBO-GENERATOR DESIGNED FOR 110 VOLTS, 1135 AMP AND 3000 R.P.M.

former made coil secured against the effects of centrifugal force by wedges and bronze caps.

Use is made of carbon brushes with a view to avoiding as far as possible any sparking while simplifying the operation. The commutators are ventilated by a strong air current, as well as by means of air channels arranged in the segments, or by special provision for heat radiation and conduction. The generators illustrated are of German design built by the Siemens-Schuckert Company, of Berlin.

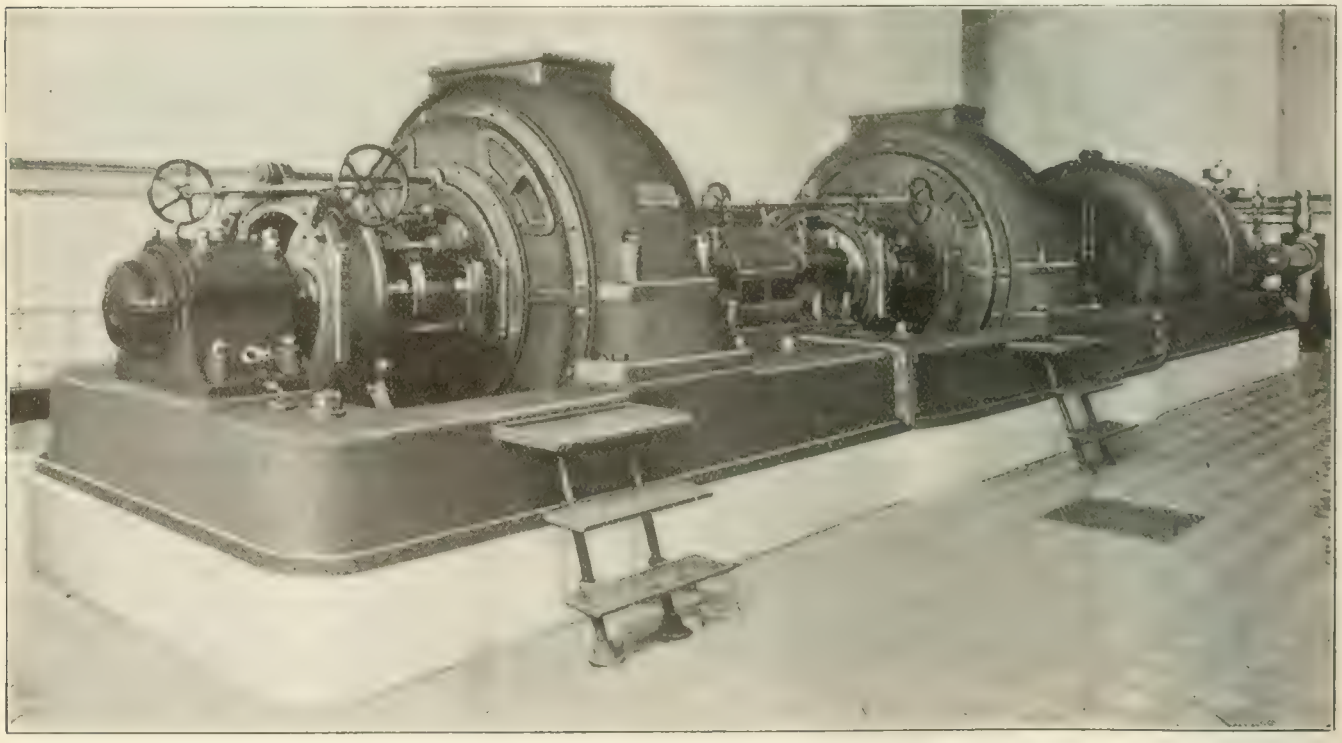


FIG. 5.—1950-HP STEAM TURBINE COUPLED TO TWO 500-VOLT, DIRECT-CURRENT GENERATORS.

The Grounded Secondary.

At the annual convention in Denver last week of the Colorado Electric Light, Power & Railway Association, Mr. W. J. Canada presented a paper entitled "Notes on Grounded Secondaries," of which an abstract follows.

The history of grounding was traced from 1885, when a proposition to ground the secondary met with strong resistance from the underwriters. As a compromise, a grounded shield between the primary and secondary transformer windings was adopted and used to some extent, but later abandoned, owing to trouble from its use. It also developed that a much more frequent trouble than transformer breakdowns was the falling of primaries on secondaries, or leaks between them through wet branches and the like. It became evident that both line and transformer troubles should be guarded against, and the ground on secondaries, still objected to by the underwriters, came to be generally accepted as the one real solution.

Injuries to persons, apparently and sometime undoubtedly, from higher voltages than are normal to inside wiring began to be more and more frequent. With the growth of a tendency to make operating companies responsible for such injuries these companies began to ground secondaries and to exert all possible influence with the underwriters to secure permission in the National Electrical Code for such connections. As the underwriters were the first objectors to grounding, whatever progress toward grounding has been made has meant a recession on their part from their original opposition. The 1901 edition of the "Code" contained permission for grounding and rules under which grounding should take place. This recognition of grounding applied only to the life hazard, the underwriters still maintaining that the grounding of one point on a secondary must necessarily increase the fire hazard. The number of service companies grounding the secondary grew rapidly from this time until to-day the great majority of companies throughout the country are operating in this manner.

The underwriters, originally tolerating ground connections only as safeguarding life, are now officially taking the neutral position of ignorance as to the relative fire hazard of grounded and ungrounded secondaries. Some few lighting companies still oppose it on the ground of needless initial expense, increased maintenance cost, and as probably increasing transformer troubles. Some companies even claim to consider, as the underwriters formerly did, that the fire hazard is increased by grounding. These obstacles to standardization of the practice of grounding are becoming daily less serious. The underwriters are finding fire losses from primary voltages on building wires more than balancing fire losses from local grounds inside buildings where low voltages only are concerned. Service companies are finding initial expense still an item, but not a prohibitive one, and all available records indicate that maintenance costs are rather reduced than increased, and that transformer troubles are much less. Opinion may be stated to be rapidly arriving at conviction that grounding is for our present form of alternating-current distribution a protection against life and fire hazards, and a necessary condition of reasonably safe operation.

To explain the attitude of the underwriters toward the grounding of secondaries when the matter was presented to them 20 years ago and their present hesitation to require grounding, the following letter from Mr. C. M. Goddard, secretary of the Underwriters' National Electrical Association, was, with Mr. Goddard's permission, quoted as representing his individual understanding of the matter and opinion.

"*First.*—When there is a ground on one side of any circuit only, it is, of course, conceded that no abnormal condition can result, but it requires two simultaneous grounds on opposite sides of the circuit. Therefore, there is, of course, a very much greater margin of safety when neither side is intentionally grounded, because to produce abnormal results an accidental ground must occur on each side of the circuit at the same time. With one side of the circuit permanently grounded the margin of safety is materially reduced, because in order to produce abnormal results a single accidental ground on the other side of the circuit at any time would be sufficient. This statement of the case will seem to be ample reason why, from a fire hazard standpoint, the ungrounded circuit is greatly preferable, and explains the objection of the underwriters to ground on the secondary.

"*Second.*—The improvement in transformer and circuit insulation, which has been secured as the use of electricity has increased, has, of course, materially reduced the probability of an accidental ground, and, therefore, has to the same extent modified the objections due to the increased fire hazard.

"*Third.*—The introduction of alternating-current systems with fairly high potentials on the primaries which have been so largely developed during the past few years has introduced, through the possibility of crosses between primary and secondary circuits and transformer breakdowns, what has been considered as a very serious life hazard, and the underwriters, who, in their electrical rules, have always taken the position that they must make no requirements against the fire hazard which would increase the life hazard, have modified their prohibition of grounds and have granted permission for grounding the secondaries under such restrictions as seemed necessary to keep the fire hazard at as low a point as possible.

"*Fourth.*—We think there is a considerable difference of opinion as to whether there is a greater fire hazard from the probability of primary current being communicated to secondary circuits than from the grounding of the secondaries. Personally, I am inclined to think that the two evils are pretty nearly balanced, although, as Code rules are more and more observed and installations of electric wiring improved, it is probable that the hazard from a grounded secondary may perhaps be less than an ungrounded secondary. However this may be, the life hazard which is guarded against by the grounded secondary should, I think, decide the question in favor of the grounded secondary."

The conditions usually stated as reasons for not grounding secondaries are, first, the difficulty in obtaining reliable grounds and the trouble and cost of maintaining them; and, second, the lessened factor of safety which exists in the transformer against breakdowns in electrical storms. Some companies claim this danger of breakdown extends to interior wiring installations, basing their claim, so far as known, upon incomplete theoretical deductions. Whatever the value of these objections they have been, barring the original veto of the underwriters, the one stumbling block in the way of absolutely standardizing the practice of grounding secondaries.

The validity of the foregoing objections to grounding may be tested by both theory and the experience of companies, and a few comparisons between grounded and ungrounded secondaries may illuminate the matter and clear away some common illusions.

As regards the proportion of lighting companies utilizing grounds, out of some 40 cities in this country fairly representing all parts of the country, 37 use grounded secondaries.

In the cities grounding no adverse criticism has been found. Of companies operating both systems, or which had formerly operated ungrounded, not one but preferred grounding from every standpoint, including a general reduction in maintenance and the quicker detection of minor troubles. Of those grounding not one reported greater trouble from transformer breakdowns. About half reported an improvement in service with the grounding of secondaries. On the subject of safety to life and property every company using grounds stated absolutely its confidence in grounding as a necessary practice for due protection to life and property.

As regards number of actual personal injuries and fires, while the total run high, it is almost impossible to give data with any completeness. In the case of accidents imputed to low voltages there is often possibility that primary and secondary have been in momentary contact, from swinging wires, static jumps in transformers, both frequent occurrences. We do know that 2300 is certain to be dangerous to persons if existing upon inside wiring. One hundred and ten volts or 220 volts

may be readily guarded against by the simplest precautions in employing ceiling lamps utilizing porcelain sockets and covering all live contacts generally in rooms with grounded surfaces.

There is no doubt that public sentiment is for the grounding, and that some of the damage suits based on this question have undoubtedly been decided on circumstantial and completely inadequate evidence. But, Mr. Canada states, there are numerous cases, many of which he has made notes of, where death certainly was due to 2300 volts on secondaries. Cases in point might be used in large number as illustration. And there is no case on record where suit has been brought for an injury to person occurring with grounded secondary, and such a suit would stand no chance at all.

With practice so strongly favoring the grounded secondary and with no positive reason for not grounding, it is interesting to examine in detail the defense offered for the ungrounded secondaries.

We may dispose, first, of the claim that there is greater fire hazard in building with grounded secondaries by the following considerations: Fire is caused in a building through electric wiring, by a short-circuit or by a ground where the building piping or material can come into circuit from any cause. The first cause, short-circuits, is not in any way affected by grounds, as the potential between wires in the secondary is in no way altered. The second cause, arcing grounds, is affected by the grounding of one point in the secondary circuit in one of two ways.

In the first place, if we ground one wire intentionally, an accidental ground at some portion of the interior wiring, and on the other side, is the only condition necessary for producing an arc at the point of the accidental ground. The circuit feeder and main fuse are in series with this ground to suppress it before it becomes of large proportions, but they do not prevent the arc, and the chance of arcing ground is much greater in this way than with both secondary wires ungrounded, as in this case an arcing ground can result only when two wires are accidentally grounded at one time, one of them within the building. This is the root of the past objection to grounded secondaries by the underwriters; but it is to be noted that the objection has been removed and that throughout the country the underwriters are *for* grounding. This arises from *other* causes of arcing ground within the buildings, which are becoming more and more of importance.

One of these other causes is the entrance of high voltage on ungrounded secondaries, to which an increasing number of fires are practically traced. This is so well recognized by service companies that two-thirds of those written on the subject assign the protection from fire hazard as a principal reason for grounding. It is almost certain that 2300 volts on ordinary interior wiring will cause damage, and ordinary 110-volt fuses are not reliable protection.

On the other hand, where grounded secondaries are used the accidental ground on an outer secondary, with the other side grounding, may be expected to blow the fuse in time to limit the arc and prevent fire. And it should be remembered, as three out of four of the above-mentioned service companies admit, that a large proportion of secondaries are in a permanent condition of accidental ground on one side or the neutral. This ground is ordinarily heavy enough to blow a circuit fuse, and it must, therefore, be admitted that this condition is equal in fire hazard to an intentionally grounded secondary.

When we add to this that two times out of three it is an outside wire of the ordinary 110-220-volt distribution which has this more or less permanent accidental ground, and the hazard is proportionately greater—at least four times, say—than with the middle point grounded, we can see plainly that it is not impossible that the fire hazard with ungrounded secondary might exceed that with them grounded. The average experience of the country indicates that this is really true and increasingly true; and underwriters, lighting companies and electrical engineers are all subscribing to this convention. We can, in brief, insulate with almost perfect safety from voltages of 110, or even 220, and our newer wiring installations do this. But we cannot insulate for 2200 volts in ordinary wiring, and we are not attempting to do so.

Other conditions constituting the defense for ungrounded secondaries are difficulties in obtaining thorough grounds and the prevalence of electrical storms.

The difficulty in obtaining good and permanent grounds is one of degree only; and in one method of grounding, and this the very best, all territories are alike in costs and thoroughness. This is the water-pipe ground, which should be made outside service switches of individual building services, or at foot of poles, or by continuous ground wire, tapped to secondary network and individual secondaries at frequent points and itself frequently grounded to water mains. This last method has in many cases proven the cheapest and most readily examined and repaired ground possible. It should be large enough to blow the primary fuse if necessary. This method may be as little as one-fourth or less the expense of individual building grounds. The individual building ground is now used exclusively by such companies as the Savannah, Toronto, Ottawa, Brooklyn, Providence and Boston service companies, among others. The Public Service Corporation of New Jersey makes this method of grounding standard in all the cities it serves. In a number of other cities this kind of ground is more or less frequently resorted to, but through no regular understanding with water companies or municipal water-works departments.

The grounding on water pipes is very rarely objected to by the water company where the nature of such a ground and its harmlessness to pipes is really explained. In most cities using other than water-pipe grounds the service company states that objection on the part of water companies is the only reason. This matter is now being brought before water-works engineers in a systematic manner so as to secure their active co-operation throughout the country.

As to the effect on water pipes of alternating current, Mr. E. E. Townsend, insurance engineer, of Chicago, writes: "Theoretically there is no danger whatever, and from my experience I have never known a pipe to be even slightly injured from such currents." Actual costs in grounding evidently have not proven in any manner prohibitive. Individual grounds are reckoned by one large service company to average about $10 to $12. Other companies approximate this same cost, and the grounding may usually be made at much less expense by selection of the services to be grounded. Three out of four companies find their costs in maintaining grounds more than offset by reduction in other troubles, such as fuse troubles in storms, meter registration accuracy, minor breakdowns on consumers' premises, and damage to buildings at fuse blocks or fixture canopies, etc.

In regard to lightning troubles, the damage to transformers is due to puncture of insulation between primary and secondary coils, or, as frequently, by breakdowns from primary to secondary cases and by the effecting dynamic current. The probable cause by which the transformer or line becomes the path is by its taking up the earth charge by slight leakage to a point nearer to the opposite atmospheric charge than is the earth itself. The discharge will be distributed through wires, trees or buildings, as they compare in area presented and amount of charge opposed to the atmospheric charge. This charge probably has nothing to do with the conductivity to earth, though the ease of the disposing of the charge is affected by this conductivity. Apparently the ultimate resistance from primary or secondary to ground through transformer is not the determining factor in the number of strokes. The secondary is close to ground potential and breakdowns occur in buildings when transformers are not grounded. The ground does usually save the building from fire damage, but does not invite the stroke. Of course, the better the ground the less the probability of building damage.

The well-grounded secondary may possibly assist in disposing of the discharge without any destructive effects, for it is a fact that of the number of companies reporting, those who have noticed any difference in their maintenance caused by ground-

ing claim that lightning troubles have been reduced by the grounding process. The protection to the building is considered by these companies to be very great, and the transformer to be in no way more subject to damage.

The frequent fires in buildings during electrical storms from unusual voltage on secondaries are also, so far as known, entirely in those cities where secondaries are ungrounded. In other words, experience has demonstrated the fact that the ungrounded secondary does not increase troubles due to lightning, but, rather, decreases them. An extension of this experience would be expected in a region of frequent electrical storms, surely not a reversal of the experience. And this experience covers companies operating with all sorts of grounds. The experience of companies seems to prove that grounding is in every respect practicable.

It may be stated both from theoretical considerations and from practical demonstrations in ordinary service, first, that the grounding of secondaries is thoroughly satisfactory as a means of preventing the entrance of abnormal voltages within buildings and the consequent fire and life hazard; and, second, that the grounding of secondaries is perfectly feasible from the standpoints of initial cost, cost of maintenance and the ease of obtaining thorough grounds, and, finally, it may be stated that lightning troubles are rather decreased than increased by grounding.

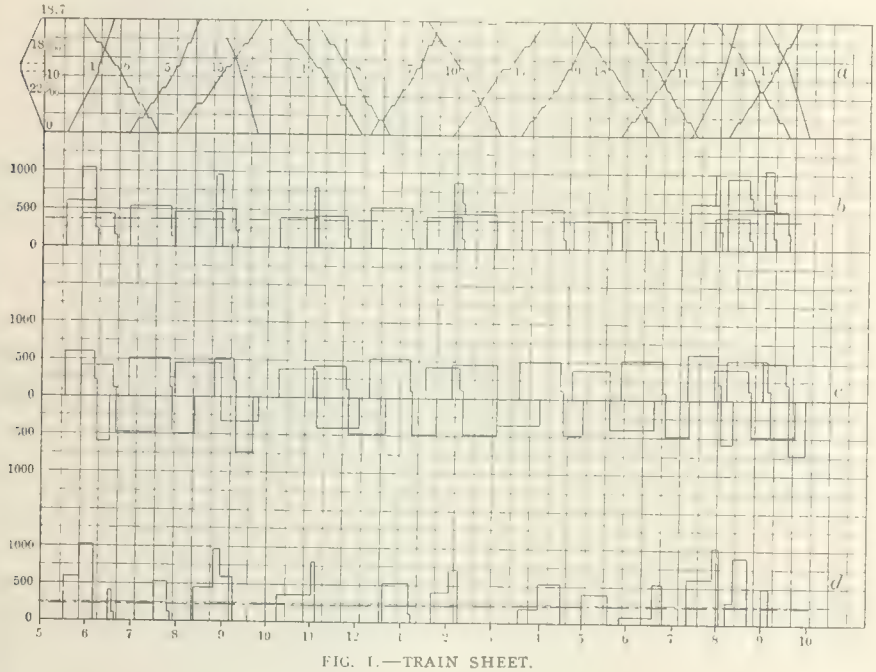


FIG. 1.—TRAIN SHEET.

Together with the above it may be stated that grounding rarely increases the fire hazard in any respect owing to the accidental grounds frequently existing on secondaries, and the constant voltage of 220 instead of 110 volts to ground within buildings thus caused. It may further be stated that in only one case does this grounding fail to any extent in its protection. This is the case where a broken primary falls on the ungrounded or outer secondary and, the transformer being cut out by the breaking of the primary, the secondary voltage is raised to a point approaching that with an ungrounded secondary. The low resistance and impedance secondary coil in transformer will even then ordinarily blow the next primary fuse, but under certain assumed conditions might not. This is the case of a single transformer and independent secondaries. Interconnecting obviates this possibility, and the case would be far worse at any rate with the secondary ungrounded. It is, however, noted as the one partial exception to perfect protection by the grounded secondary for interior wiring.

The final conclusion of the paper is that the grounding of secondaries is to be considered as a necessary practice for the adequate protection of life and property, a measure opposed by no engineering society, and conflicting with no vital interest.

Traction System Using Constant Direct Current.

By J. E. Dalemont.

ALTHOUGH the series system using direct current may not lend itself readily to the distribution of energy, yet it might be suitable for long-distance transmission from one point to another without intermediary distribution. Several applications of this system have been made in the past in Europe, and these have been described in different periodicals. However, the advantages of direct high tensions over alternating high tensions were not sufficient to insure the success of the series system in cases where it would seem to be quite suitable. One might mention, for instance, the transmission from Bellegarde to Paris (200,000 hp, 500 miles), which was studied recently by André Blondel for a three-phase current at 150,000 volts and 25 cycles. The attention of the engineering world to the advantages of the series system of traction for mountain or high-grade lines has been aroused by the discussion held before the committee appointed to consider the electrification of the whole railroad system in Switzerland.

In spite of the numerous advantages of the series motor with constant current, as a traction motor, such as high efficiency at any load, it seemed difficult to employ it, not only because all of the machines, generating or receiving, would have to be placed in series, but also on account of the great loss in the line, which remains constant at any load. However, this motor, more than any other, provides for a convenient recuperation of energy on down grades, and this relation improves the efficiency of the distribution and justifies the use of this system on graded lines.

In order, however, to apply this system it was necessary to make a study of special apparatuses for the sectioning of lines, so that all of the trains running simultaneously would be placed in series. Further on it will be seen that the devices suggested by Mr. Potterat, engineer, of Berne (Switzerland), are not more complicated than many others in general use to-day in central stations. Mr. Potterat also studied the application of this system to a 32-mile heavy traffic line in the south of France, over which 15 200-ton trains run daily in either direction, and he has shown that it compares very favorably in every way with the single-phase system.

In what follows there will be considered a line of 18.75 miles, with light traffic and two grades of 2.2 per cent and 1.8 per cent converging to a plane of 1.25 mile, as shown in Fig. 1. Table I

TABLE I.

Trains number	Sec. 1: 10 miles Grade: 2.2%		Sec. 2: 1.25 miles Grade: 0		Sec. 3: 7.5 miles Grade: 1.8%	
	Speed m. per h	Time min.	Speed m. per h.	Time min.	Speed m. per h.	Time min.
1 and 3.....	15	40	31	2.5	25	18
2 and 4.....	25	24	31	2.5	15	30
5, 7, 9, 11, 13....	12.5	48	21.5	3.5	18.5	25
6, 8, 10, 12, 14..	15	40	21.5	3.5	12.5	36
15 and 17.....	11.5	53	15	5	12.5	36
16 and 18	12.5	48	15	5	11.5	40

gives the speed in both directions, as well as the time of the different trains running on each section of the line. All of these trains are supposed to be composed of a 100-ton locomotive with tender, drawing cars aggregating in weight 200 tons.

The traction forces in pounds per ton for the locomotive f_1 and the cars f_c have been calculated by the following formulas:

$$f_1 = 3.970 + 2.840\,V\,(1.6\,V + 50)\,10^{-3}.$$

$$f_c = 3.530 + 1.630\,V\,(1.6\,V + 50)\,10^{-3}.$$

Where V is the speed in miles per hour.

These forces as well as the total force applied to each train are shown in Table II on page 908.

Tables III and IV give, respectively, the horse-power corresponding to these forces and the power in kilowatts calculated on the basis of a mechanical efficiency of 0.80.

TABLE II.

Trains. No.	Section 1 Speed	Section 1 Grade	Section 1 Traction forces in lb.	Section 2 Speed	Section 2 Grade	Section 2 Traction forces in lb.	Section 3 Speed	Section 3 Grade	Section 3 Traction forces in lb.
1 and 3..	15	+.022	10,300	31	..	3,000	25	—.018	9,450
2 and 4..	25	—.022	12,100	31	..	3,000	15	+.018	13,700
5, 7, 9, 11, 13..	12.5	+.022	16,800	21.5	.	2,200	18.5	—.018	9,900
6, 8, 10, 12, 14..	15	—.022	12,800	21.5	..	2,200	12.5	+.018	13,500
15 and 17	11.5	+.022	16,000	15	..	1,760	12.5	—.018	10,250
16 and 18	12.5	.022	12,900	15	..	1,760	11.5	+.018	16,000

In Fig. 1 curve *a* gives the course of all the trains in each direction; curve *b* is the total power consumed at every instant, assuming all the free energy in the grades to be consumed by friction brakes; curve *c* is the power consumed where recuperation in the grades is assumed; curve *d* is the actual quantity required in this case at the central station (not including line loss). In curves *b* and *d* the dotted lines show the average value of power for a given working time. It will be seen that these average quantities are, respectively, 480 kw without and 230 kw with recuperation.

Even if there be added in the latter case 60 per cent of the maximum quantity of power for line loss, the series system with recuperation will still offer a slight advantage.

LINE MATERIAL.

A short street-railway line supplied with constant direct current has been working for the past few years at Northfleet, near London, but the system adopted for feeding the car-motors in series was too expensive and not strong enough to be used. The line forms a closed loop, one branch of which is divided into short sections by switches, which the car opens automatically to introduce its motors in the circuit.

TABLE III.—POWER CONSUMED IN HORSE-POWER.

Trains, No.	Section 1	Section 2	Section 3
1 and 3.....	+658	+250	—635
2 and 4.....	—800	+250	+550
5, 7, 9, 11, 13.....	+565	+130	—500
6, 8, 10, 12, 14.....	—515	+130	+455
15 and 17.....	+500	+71	—344
16 and 18.....	—434	+71	+420

TABLE IV.—POWER CONSUMED IN KILOWATTS.

Trains, No.	Section 1	Section 2	Section 3
1 and 3.....	+605	+230	—582
2 and 4.....	—736	+230	+505
5, 7, 9, 11, 13.....	+520	+120	—458
6, 8, 10, 12, 14.....	—472	+120	+420
15 and 17.....	+460	+65	—316
16 and 18.....	—400	+65	+385

The ingenious contrivance of Mr. Potterat consists in placing alongside of the two trolley lines, divided in sections, a third continuous line, each section of which contains an automatic switch. This switch, which is shown in Fig. 2, is worked by a magnet fed by the current of the car passing over the section. Details of the automatic switch are shown in Fig. 3. It may be applied to a single track over which trains run in both directions. The two trolley lines *t*, *t'* are connected to the auxiliary conductor *c* by means of the commutator coils. The coils 1 and 3 draw the core upward, while the coils 2 and 4 have a downward movement.

When the first section is free no current exists in the commutator circuits, the contacts of which are in 1 and 4. If a locomotive runs to the left, its trolley passing on *t*, reaches the point of section x_2, and the current coming from *t'* through the motors, flows in coil 4, which attracts the cores downward, producing contacts in $n\,a'$ and $m\,b'$, while the current in coil 6 has the effect of opening the switch *i* in lifting its core. As soon as the second trolley reaches the point of section x_1 the current flows through the circuit $O_1\,n'\,a'\,c$ of the automatic switch in section x_1x_2, and the result is that the switch of the last section—that is to say, the section before x_1x_2—falls and renews the connection of the auxiliary line. When the second trolley of the locomotive leaves the section x_1x_2 the apparatus resumes its first position and is ready for work again.

When the locomotive comes into the section from left to right, the commutator works in the same way, but the cores are now attracted upward and the contacts are made in $m\,b$ and $n\,a$. In the case of a sidetrack, four trolley lines will be cut at the points of junction. A second commutator will be placed be

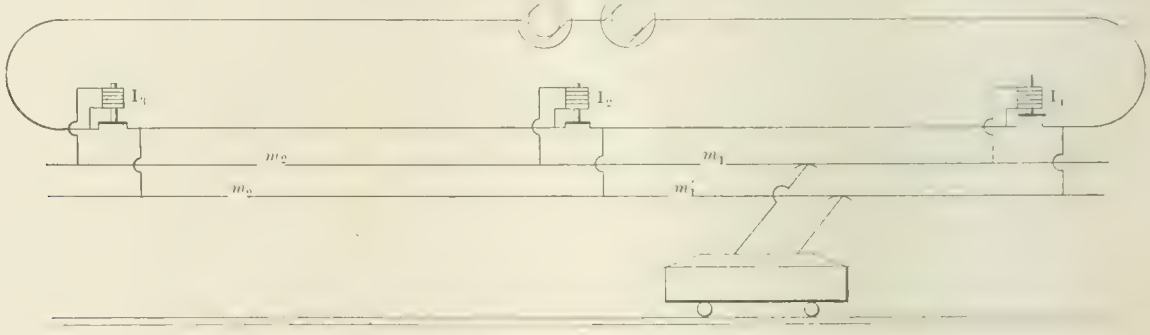


FIG. 2.—DISPOSITION OF TROLLEY LINES.

side the one on the first line, and the coils will be connected with the two trolley lines of the new track.

In these different workings the switches are opened when the current flowing through them has been sent in another road.

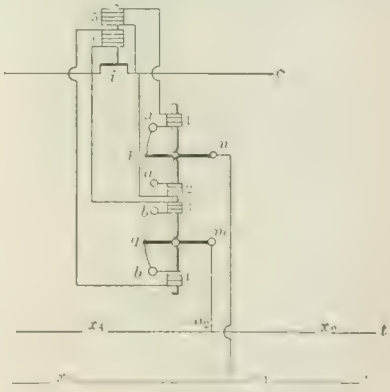


FIG. 3.—AUTOMATIC SWITCH.

The contacts, therefore, are not liable to deteriorate, and, if necessary, the commutator may be operated by hand.

The e.m.f. existing between the two trolley lines depends on the traffic, on the number of the locomotives running simultaneously and on the voltage adopted for each motor. Mr. Potterat, in the case of the Montrejoux-Tarbes line, adopted 10,000 volts between wires and placed the trolley lines outside of the tracks.

It is known that in the series system with constant intensity the regulation at the generating station is controlled by the e.m.f., which varies with the load. In the series system the trolley lines are under voltage during only the running time of a train, and the e.m.f. between the wires is not the same as that of the generating station. The result is that the setting up of the trolley lines in this system presents less difficulty than that of the three-phase system with constant e.m.f. It is not necessary here to go into the question of the suspension of lines

as it offers nothing of special interest. The system may be modified as required. It is well simply to call attention to the fact that the return of the current through the rails is cut off, and, consequently, the motor should be insulated from the truck. Mr. Potterat adopted for this purpose a motor with vertical axis set up in the box of the car and controlling the axle by the conical cog-system, shown in Fig. 4. The insulation of the framework of the motor from the axle is assured by an insulated elastic coupling enclosed in a box containing insulating oil. Although the e.m.f. of the motor may not be very high, the insulating e.m.f. between the wire and the ground is generally high and should be taken into consideration. As is well known, in order to set a motor running on a distribution in series it is only necessary to open a short-circuit switch. This is done without danger to the operator, without injuries to the apparatus, and without shock at the generating station. As the torque of the motor depends solely on the position of the brushes, the regulation of the torque and of the speed is obtained without rheostat by adjusting the brushes on the commutator. This greatly simplifies the arrangement of the locomotive circuits. Each motor requires one hand-operated short-circuiting switch, a crank for moving the brushes and an automatic short-circuiting switch, which

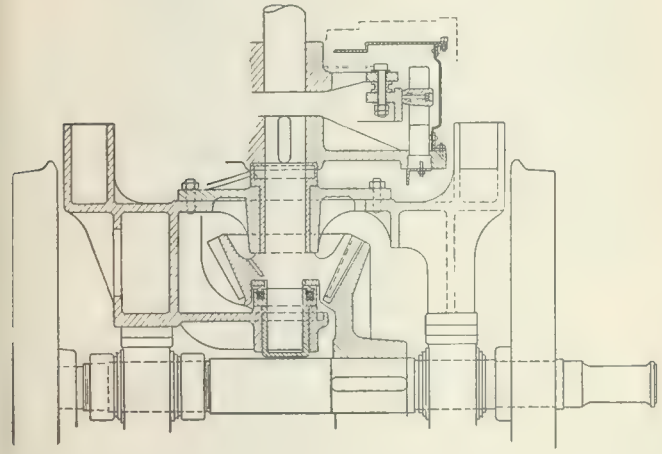


FIG. 4.—COUPLING.

acts when the brushes reach the nul point to cut off the current as the machine stops; an autotmatic switch for each high-tension circuit; an automatic speed-limiting switch.

The series distribution would be very inconvenient if all of the shunting had to be done in the station with the ordinary locomotives. But, as in the case of the steam engine, there is a tendency to use special small locomotives for this purpose, the same method may be resorted to in the case of electric traction, and this would do away with the distribution in stations, except for the principal tracks. In case of accident on the line, which must always be provided for, or, again, in the necessary shunting of big locomotives, Mr. Potterat suggests that each locomotive carry a 100-hp gasoline motor-generator, which could supply directly the necessary current to produce a reduced speed of the locomotive.

Finally, a very important advantage was pointed out in the case of trolley lines covered with a coating of ice or frost. The constant current would cause this coating to melt, and the chances of interruption in service are, therefore, reduced to a minimum. On the contrary, with the constant-potential system, the coating of ice may be sufficient to suppress the feeding of the motor and to stop the trains. As a matter of information, there may be added hereto the statements prepared by Mr. Bourdel in order to make a financial comparison between the single-phase and the series system.

	One-Wire Line.	Two-Wire Line.
Posts (53 per mile)	$1,030	$1,280
Trolley wire ½-in. in diameter (per mile)	724	1,450
Setting up (per mile)	320	640
Bonding of rails	320	.....
	$2,394	$3,370

If account be taken of the cost of setting up and the running expenses, one cannot but conclude that from the standpoint of economy, the series system might compare very favorably with the constant-voltage system. It now behooves traction engineers to study the advantages of this new system and the methods for its application.

Voltage Wave-Form of Delta-Connected Alternator.

By Shiro Sano.

It was shown by Prof. C. A. Adams recently before the A. I. E. E. that the voltage wave-form of an alternator depends on the style of winding of each phase and the way the phase windings are interconnected. It may be of interest to study in detail the case of a delta-connected armature with regard to the wave-form of the terminal voltage.

Let A, B and C represent the three separate phase windings of the delta connection. The induced e.m.f. in A may be represented by

$$E_1 \sin(\theta + \alpha_1) + E_3 \sin(3\theta + \alpha_3) + \ldots E_n \sin(n\theta + \alpha_n) \quad (1)$$

Where E_n stands for the maximum value of the induced voltage of the nth harmonic; θ the angle changing with time; α_n the phase difference the nth harmonic makes with the combined wave.

The induced e.m.f. in phase winding B will be

$$E_1 \sin\left(\theta + \alpha_1 + \tfrac{2}{3}\pi\right) + E_3 \sin\left\{3\left(\theta + \tfrac{2}{3}\pi\right) + \alpha_3\right\} + \ldots + E_n \sin\left\{n\left(\theta + \tfrac{2}{3}\pi\right) + \alpha_n\right\} \quad (2)$$

The induced e.m.f. in phase winding C will be

$$E_1 \sin\left(\theta + \alpha_1 + \tfrac{4}{3}\pi\right) + E_3 \sin\left\{3\left(\theta + \tfrac{4}{3}\pi\right) + \alpha_3\right\} + \ldots + E_n \sin\left\{n\left(\theta + \tfrac{4}{3}\pi\right) + \alpha_n\right\} \quad (3)$$

The combination of the above three e.m.fs. will give the resultant e.m.f. acting in the closed series delta circuit, including windings A, B and C, which is

$$E_1\left[\sin(\theta + \alpha_1) + \sin\left(\theta + \alpha_1 + \tfrac{2}{3}\pi\right) + \sin\left(\theta + \alpha_1 + \tfrac{4}{3}\pi\right)\right] + E_n\left[\sin(n\theta + \alpha_n) + \sin\left\{n\left(\theta + \tfrac{2}{3}\pi\right) + \alpha_n\right\} + \sin\left\{n\left(\theta + \tfrac{4}{3}\pi\right) + \alpha_n\right\}\right] \quad (4)$$

The fundamental e.m.f. will vanish, while the e.m.f of the nth harmonic may or may not vanish according to the value of n. The above expression may be transformed into the following form:

$$\Sigma_n E_n \sin(n\theta + \alpha_n)\left\{1 + \cos\tfrac{2}{3}n\pi + \cos\tfrac{4}{3}n\pi\right\} \quad (5)$$

Let

$$K_n = 1 + \cos\tfrac{2}{3}n\pi + \cos\tfrac{4}{3}n\pi$$

The values of K_n for various values of n are tabulated as follows:

n	1	3	5	7	9	11	13	15	17	19	21	23	25
K_n	0	3	0	0	3	0	0	3	0	0	3	0	0

This shows that there exist harmonic e.m.fs. of the third and the multiple thereof in the closed circuit, while all other harmonic e.m.fs. vanish.

Now, let the combined resistance of windings A, B and C be R, and the combined reactance corresponding to the fundamental frequency be X; then, since the e.m.f. in the closed circuit is

$$3E_n \sin(n\theta + \alpha_n),$$

the current circulating therein will be

$$\frac{3E_n}{\sqrt{R^2 + n^2X^2}} \sin\left(n\theta + \alpha_n - \tan^{-1}\frac{nX}{R}\right) \quad (6)$$

The resistance and the reactance of each phase may be taken as $R/3$ and $X/3$, respectively. The voltage drop in one phase due to this circulating current and accordingly the terminal

voltage of the machine will be for the nth harmonic of multiple of three:

$$\frac{3E_n}{\sqrt{R^2+n^2X^2}}\sqrt{\left(\frac{R}{3}\right)^2+n^2\left(\frac{X}{3}\right)^2}\sin\left(n\theta+\alpha_n-\tan^{-1}\frac{nX}{R}+\tan^{-1}\frac{nX}{R}\right)$$

$$=E_n\sin(n\theta+\alpha_n). \qquad (7)$$

Thus it is that the combined e.m.fs. are exactly the same as those in any one phase winding.

The copper loss due to the circulating current will be

$$\frac{1}{2}\sum_n\left(\frac{3E_n}{\sqrt{R^2+n^2X^2}}\right)^2R=\sum\frac{9}{2}\cdot\frac{E_n^2}{R^2+n^2X^2}R \qquad (8)$$

where n must be taken as 3, 9, 15, etc.

In conclusion, it may be said that when the e.m.f. wave is distorted the delta connection has no effect upon the wave-form of the e.m.f. and only causes an extra copper loss, which amounts to the value expressed in (8).

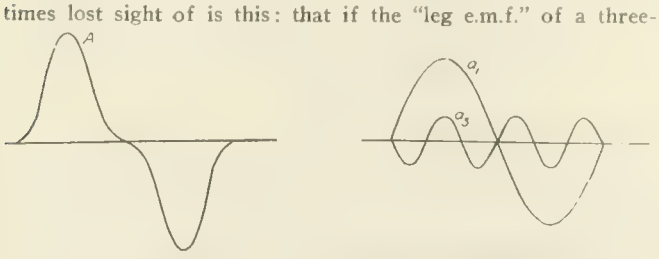
In star-connection the harmonics of the third and the multiple thereof disappear entirely without producing an extra copper loss.

Effects of a Third Harmonic in the E.M.F. Wave of a Three-Phase Generator.

By F. M. Denton.

IT is a matter of common knowledge that the wave of open-circuit potential difference between the lines of a three-phase generator contains no third harmonic. This is the case, no matter what may be the wave shape of e.m.f. of each leg of the armature winding. If, for instance, the wave of e.m.f. due to one leg of a star-connected armature, or the e.m.f. due to one isolated leg of a delta-connected armature, contain a pronounced third harmonic, nevertheless the open-circuit line voltage of the machine when its armature is connected for three-phase, either star or delta, will be free from harmonics of the third order or any order that is a multiple of three.

A fact of some importance, however, and one that is sometimes lost sight of is this: that if the "leg e.m.f." of a three-



FIGS. 1 AND 2.—E.M.F. WAVE AND ITS COMPONENTS

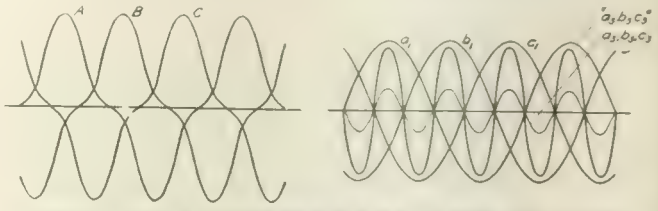
phase generator contain a pronounced third harmonic, the armature winding ought to be connected in star and not in delta; the delta connection will entail the setting up of a circulating current in the armature winding, with consequent waste of energy and overheating.

That this is the case may easily be shown thus:

Let Fig. 1 represent the wave of "leg e.m.f." of a three-phase generator, the wave when analyzed being found to consist of the fundamental and a third harmonic, as in Fig. 2. The wave shape of voltage inside the delta is found by combining three of these waves 120 deg. apart (Fig. 3). This is equivalent to combining three of the pairs of waves shown in Fig. 2, the fundamentals being placed 120 deg. apart (see Fig. 4). The result is to eliminate all the fundamentals and to add together all the third harmonics. The resultant triple amplitude third harmonic causes a triple frequency current to circulate around the delta.

To star-connect the armature of such a machine suffices, of course, to obviate the possibility of circulating currents. It at the same time eliminates the third harmonic from the wave of line voltage. For, let *OA*, *OB* and *OC*, in Fig. 5, represent the three legs of the star-connected armature. Then the wave-form of the e.m.f. generated in each arm is as in Fig. 1. The e.m.f. between *A* and *B* is the vector sum of the e.m.fs. in *OA* and in *OB*. The instantaneous values of the e.m.f. between *A* and *B* is found by combining two such waves as Fig. 1 placed 60 deg. apart, as in Fig. 6. This is equivalent to combining two of the pairs of waves shown in Fig. 2, 60 deg. apart (Fig. 7). The result is to eliminate the third harmonics and to produce as the line voltage a pure sine wave, having $\sqrt{3}$ times the amplitude of the fundamental of either leg voltage.

As regards wave shape of the line voltage, both star and



FIGS. 3 AND 4.—THREE-PHASE E.M.F. WAVES AND THEIR COMPONENTS.

delta connection produce the same result: they both eliminate the third harmonic. The wave shape of the line voltage of the delta-connected winding may be deduced as follows:

In each arm the e.m.f. generated is equivalent to the fundamental and a third harmonic.

The voltages due to the third harmonic in *AB*, *BC* and *CA*, Fig. 8, are in phase with each other and in series, therefore they spend themselves in sending a short-circuit current around the delta. Between *A* and *B* one must consider the effect of the third harmonic in *AB* in conjunction with the effect of the third harmonic in *BC* and *CA*.

Now the product of the short-circuit current around the wind-

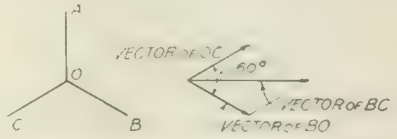
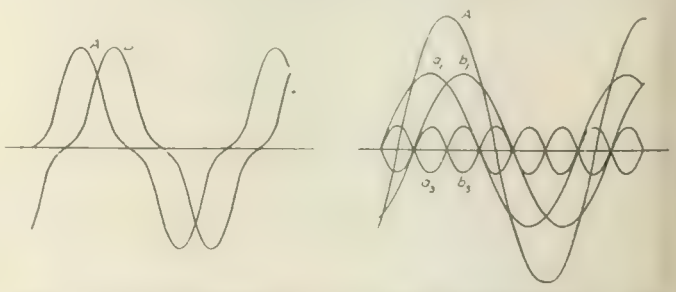


FIG. 5.—VOLTAGE IN STAR-CONNECTED ARMATURE.

ing, into the impedance of the whole winding is equal to the total e.m.f. due to this third harmonic. Similarly, for each leg, the product of the short-circuit current into the impedance of the leg is equal to the e.m.f. due to the leg. Hence, there exists between *A* and *B*—as between any other two points in the delta—no difference of potential. The e.m.f. in *AB* is exactly absorbed by the impedance drop in *AB*. Similarly the e.m.f. in *ACB* is exactly absorbed by the impedance drop in *ACB*, and again there is no potential difference between *A* and *B*.

The result is, therefore, that the third harmonic has no effect



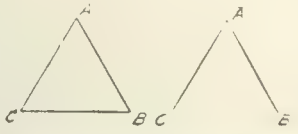
FIGS. 6 AND 7.—ELIMINATION OF THIRD HARMONIC BY 60 DEG. COMBINATION.

upon the voltage between *A* and *B*. The e.m.f. due to the fundamentals is, of course, sinusoidal; hence, the resultant line voltage is sinusoidal.

Thus it is that the wave shape of the line voltage is the same for the delta-connected as for the star-connected winding, third harmonics being in each case eliminated. (Some difference may be found, due to the reaction of the triple frequency short-circuit current upon the field flux, and, of course, if other harmonics besides the third are prominent considerable difference may be found.)

It is interesting to note that the so-called "open-delta" connection produces peculiar conditions of wave shape. The commercial use of the "open delta" connection is almost solely for transformers; in special cases, however, as, for instance, when one leg of the delta becomes damaged and has to be cut out, the open delta may be used for generators.

Let *CAB*, in Fig. 9, represent an open-delta connected winding—the leg *BC* being out of commission. It will be found that while, as would be expected, the voltages *AB* and *CA* are equal,



FIGS. 8 AND 9.—DELTA AND OPEN DELTA VOLTAGE VECTORS

that across *BC* will differ from them by perhaps several per cent. And the oscillograph will show that while both *AB* and *CA* give singly a wave form like Fig. 1, the open arm *BC* will give a shape such as Fig. 10. The reason for this is easily seen. The wave shape over *BC* is ascertained by combining two of the leg waves (Fig. 1) placed 120 deg. apart, as in Fig. 11 *A* and *B*. This is equivalent to two pairs of waves, such as in Fig. 2, placed 120 deg. apart, as in Fig. 12—a_1, a_3 and b_1, b_3. The fundamentals a_1 and b_1 combine to form a wave similar to themselves as at a_1b_1, in Fig. 12, and the thirds have their amplitudes added together forming a resultant third of double amplitude a_3b_3, Fig. 12. This resultant third combines with the resultant fundamental to form the wave of line voltage *A* in Fig. 12.

In illustration of these points the author has made observations upon a three-phase alternator whose wave of flux exhibited a prominent third harmonic. The machine was of the ordinary revolving-field type, rated at 60 kva, 250 volts between lines, and 60 cycles. It had eight poles and two slots per phase per pole. The short-circuit current around the armature winding when delta connected and giving a line voltage of 250 volts at 60 cycles was about 160 amp, a current just double the normal load current for which the winding was designed.

The waves were recorded photographically by means of a General Electric Company's oscillograph. The curves taken are shown in Fig. 14, *I, II, III, IV* and *V*. Curve *I* shows the wave shape of leg voltage of the machine; curve *II* the wave shape of the e.m.f. induced in each bar of the winding—this is similar to the wave of field flux; it was obtained by means of an auxiliary coil consisting of a few turns of thin wire wound close together over the middle of a slot in the armature, the winding being taken around over the housing.

Curve *III* is the wave shape of the third harmonic to which is due the triple-frequency short-circuit current around the delta. It was observed by joining one vibrator of the oscillograph across an open corner of the delta, as in Fig. 15. The

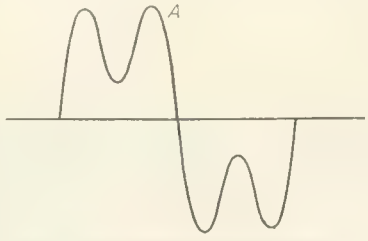


FIG. 10.—OPEN DELTA VOLTAGE

waves *I, II* and *III* were observed simultaneously by means of the three vibrators of the oscillograph.

Curve *IV* shows the wave shape of three-phase line voltage; it is much more nearly sinusoidal than the wave of bar voltage (*II*) or even of leg voltage (*I*), the third harmonic having been eliminated.

Curve *V* shows the wave of voltage over the open leg of the open-delta-connected armature.

The shapes of these curves agree with the explanation given above. Their analysis up to the eleventh harmonic is shown in the accompanying table. For this analysis use was made of Prof. S. P. Thompson's schedule. The method is a simple and speedy one; all the figures used in the calculations are shown in the table, and the analysis of the five waves occupied less than two hours.

The curves being to small scale and their outlines thick, it is, of course, impossible to make an absolutely accurate analysis. In measuring the ordinates of the waves a fine pencil line was made down the middle of the thick photographic outline. The

	I	II	III	IV	V
	Y_1 3.40	1.60	6 00	8.60	9.20
	S_1 6 80	3 20	12.0	17 2	18 4
0 262	S_1 1 78	0 84	3 15	4.50	4 81
0 500					
0 707	S_3 21.2	19.8	20 5	28 4	27.2
0 866					
0 966	S_5 5 15	40.6	29 2	55 7	28 8
1.000					
1st col.	7 45	6 1 2	52.9	88.6	60 8
2nd col.		7 4 6	58.1	53 6	87 6	59 1
SUM	14 9	11 9	10 7	17 6	12 0
DIFF.	-0.10	3 10	-0 70	1.00	1 70
$A_{1,3,5}$	100	100	100	100	100
11,9,7	-0.67	2.60	-0.66	0.57	1.42

	I	II	III	IV	V
S_1	6 80	3 20	12.0	17.2	18 4
+ S_3	3 0 0	2 8 0	2 9 0	4 0 2	3 8 4
	36.8	31.2	41.0	57 4	56.8
− S_5	5 3 2	4 2 0	30.2	57.6	29 8
= T_1	-16.4	-10 8	10.8	-0 20	27 0

	Y_2 9.10	5.00	12 3	15.3	15 0
	S_2 18 2	10 0	24 6	30 6	30 0
S_2	9 10	5 00	12 3	15.3	15 0
S_4	38 0	30.6	26.0	42 5	29.2
S_6	27 5	22.5	15 3	29 8	14 9
	7 4 6	58.1	53 6	87 6	59 1
	14 9	11 9	10 7	17 6	12 0
	-0.10	3 10	-0 70	1.00	1 70
	100	100	100	100	100
	-0.67	2.60	-0.66	0.57	1.42

	II	III	IV	V
S_2	18 2	10.0	24.6	30 6	30 0
$-S_6$	27 5	22.5	15 3	29 8	14 9
$= T_2$	-9 30	-12 50	9 30	0.80	15 1

	Y_3 15.0	14 0	14 5	20.1	19 2
	S_3 30.0	28.0	29 0	40.2	38.4
T_1	-11 6	-7 63	7 63	0.14	19.1
	-11 6	-7 63	7 63	0 14	19 1
	-20 9	-20.1	16 9	0 94	34.2
	-2 30	4 87	-1 67	-0 66	4.00
	-14.1	-16.9	15 8	0 54	28.5
	-1 55	4 10	-1 57	-0 38	3 34

	A_1	A_3	A_5	A_7
	100	-14.1	-1 41	0 47
	100	-16 9	-7 40	-2 18
	100	15 8	0 56	-2 44
	100	0 54	3 40	0 46
	100	28 5	-0.80	-2 00

	A_9	A_{11}	Y_1	Y_2	Y_3
	-1 55	-0 67	3 40	9 10	15.0
	4 10	2 60	1 60	5 00	14 0
	-1.57	-0 66	1 00	12 3	14.5
	-0 38	0 57	8 60	15 3	20 1
	3 34	1 42	9 20	15 0	19 2

	Y_4 21.9	17.7	15 0	24.6	16 8
	S_4 43 8	35 4	30 0	49.2	33.6
T_2	-9 30	-12 5	9 30	0.80	15 1
	-9 30	-12 5	9 30	0 80	15.1

	Y_5 26.6	21.0	15 1	28 8	14.9
	S_5 53 2	42 0	30.2	57 6	29 8
	S_5 13 9	11 0	7 90	15.2	7 8
	$-S_3$ -21.2	-19 8	-20 5	-28.4	-27.2
	S_1 6 58	3 08	11 6	16.8	17.8
	-0 70	-5.70	-1 00	3 4	-1 6
	-2.10	-8 80	0 60	6 00	-0.90
	0 70	-2.60	-2 60	0 80	-2 30
	-1.41	-7 40	0 56	3 40	-0 80
	0.47	-2 18	-2 44	0 46	-2 00

	Y_4	Y_5	Y_6
	21 9	26 6	27 5
	17 7	21 0	22 5
	15 0	15 1	15 3
	24 6	28 8	29 8
	16 8	14 9	14 9

	Y_6 27 5	22 5	15 3	29 8	14 9
	S_6 27 5	22 5	15 3	29 8	14 9
S_2	9 10	5 00	12 3	15 3	15 0
$-S_4$	-38 0	-30.6	-26 0	-42.5	-29 2
S_6	27 5	22 5	15 3	29.8	14 9
	-1 40	-3.10	1 60	2 60	0 70
	-2.10	-8 80	0 60	6 00	-0.90
	0 70	-2.60	-2 60	0 80	-2 30
	-1.41	-7 40	0 56	3 40	-0 80
	0.47	-2 18	-2 44	0 46	-2 00

ANALYSIS OF E.M.F. WAVES.

waves, and the amplitudes of their component sine waves, are as follows:

	A_1	A_3	A_5	A_7	A_9	A_{11}
Wave I—Leg voltage	100	— 14.1	— 1 41	0.47	- 1.55	— 0.67
Wave II—Bar voltage	100	— 16.9	— 7.40	— 2.18	4.10	2.60
Wave III—Third harmonic (to which is due the current circulating around the delta)	100	15.8	0.56	— 2.44	— 1.57	— 0.66
Wave IV—Line voltage of star-connected armature	100	0.54	3.40	0.46	— 0.38	0.57
Wave V—Voltage across open arm of open-delta	100	28.5	— 0.80	— 2.00	3.34	1.42

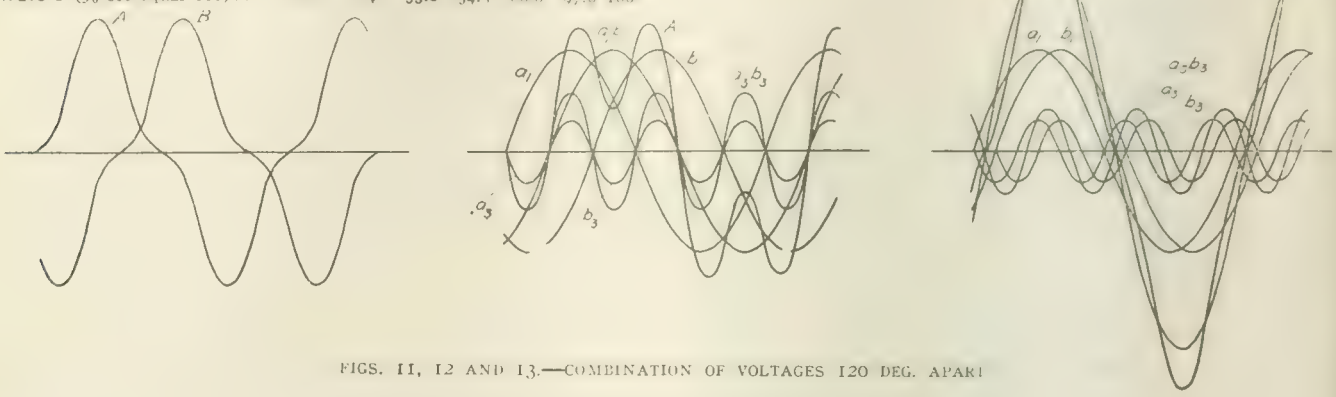
A_1, A_3, etc., are the amplitudes of the first, third, etc., harmonics, A_1 the amplitude of the first harmonic (fundamental)

having been reduced in each case to 100 for greater readiness of comparison.

The following points are brought out by the analysis: The wave of line voltage is nearly sinusoidal, all the harmonics being of negligible amplitude except the fifth, whose amplitude is about 3½ per cent of that of the fundamental.

Since there are two slots per phase per pole it should be possible to obtain Wave I by combining two of the waves of bar voltage (II) separated by the distance apart of two slots (30 deg.). This combination is carried out as follows:

	y_1	y_2	y_3	y_4	y_5	y_6	y_7
Wave II	1.60	5.00	14.0	17.7	21.0	22.5	21.0
Wave II, shifted 30 deg.	—1.60	0.00	1.60	5.00	14.0	17.7	21.
Resultant	0.00	5.00	15.6	22.7	35.0	40.2	42.
Resultant (y_6 set equal 100)	0.00	11.9	37.0	54.0	83.0	95.7	100
Wave I (y_6 set equal 100)	0.00	12.4	33.0	54.5	80.6	97.0	100



FIGS. 11, 12 AND 13.—COMBINATION OF VOLTAGES 120 DEG. APART

y_1, y_2, etc., are the ordinates of the waves, to an arbitrary scale, measured every 15 deg. over one quarter-wave length.

The analysis shows that the amplitude of the third harmonic in II is —16.9, while that in I is —14.1. Reference to Fig. 13 will explain this: a_1, a_3, b_1, b_3, are the first and third harmonics, respectively, of two bar voltages set 30 deg. apart. The combination of the fundamentals a_1 and b_1 gives a_1b_1, while the harmonics give a_3b_3. And the combination of a_1b_1 with a_3b_3 gives *A*, the resultant wave of line voltage. The ratio of the amplitudes of a_3 and a_1 (the components of the wave of bar voltage) is about one to three, that is, about 33 per cent, while the ratio of the amplitudes of a_3b_3 and a_1b_1 (the components of the resultant wave) is only about 25 per cent. Thus, the amplitude of the third harmonic has been reduced from 33 to 25, a reduction which roughly corresponds with the actual reduction found, namely, 16.9 to 14.1.

The combination of two such waves as I set 60 deg. apart should produce IV, in which the third harmonic is almost eliminated:

	y_1	y_2	y_3	y_4	y_5	y_6	y_7	y_8
Wave I	3.40	9.10	15.0	21.9	26.6	27.5	26.6	21.9
Wave I, shifted 60 deg.	—15.0	—9.10	—3.40	0.00	3.40	9.10	15.0	21.9
Resultant	—11.6	0.00	11.6	21.9	30.0	36.6	41.6	43.8
Resultant (y_4 set equal 100)	—26.6	0.00	26.6	50.0	68.7	84.0	95.2	100
Wave IV (y_4 set equal 100)	—29.0	0.00	29.0	51.4	67.5	83.0	97.0	100

Reference to Fig. 2 will make it evident that y_3 of III must be subtracted from y_3 of IV; y_6 of III from y_2 of IV; y_9 of III from y_3 of IV, and so on as shown. These figures show only a fair correspondence. The inaccuracy is due partly to the neglect of the fifth, seventh and eleventh harmonics, for III contains only those harmonics in the wave of leg voltage whose order is a multiple of three, and partly to the fact that the third harmonic is shown to so small a scale that its ordinates cannot be accurately measured.

The combination of three such waves as I, separated by 120 deg., should give III:

	y_0	y_1	y_2	y_3	y_4	y_5	y_6
Wave I	0.00	3.40	9.10	15.0	21.9	26.6	27.5
Wave I, shifted 120 deg.	21.9	15.0	9.10	3.40	0.00	—3.40	—9.10
Wave I, shifted 240 deg.	—21.9	—26.6	—27.5	—26.6	—21.9	—15.0	—9.10
Resultant	0.00	—8.20	—9.30	—8.20	0.00	8.20	9.30
Resultant (y_6 set equal 100)	0.00	—88.5	—100	—88.5	0.00	88.5	100
Wave III (y_6 set equal 100)	0.00	—93.0	—100	—93.0	0.00	93.0	100

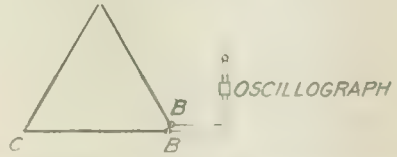


FIG. 15.—ARRANGEMENT OF OSCILLOGRAPH

The last three rows in this table represent every third ordinate (y_0, y_3, y_6) of Wave III.

Two such waves as I, separated by 120 deg., should give V:

	y_1	y_2	y_3	y_4	y_5	y_6	y_7	y_8	y_9
Wave I	3.40	9.10	15.0	21.9	26.6	27.5	26.6	21.9	15.0
Wave I, shifted 120 deg.	15.0	9.10	3.40	0.00	—3.40	—9.10	—15.0	—21.9	—26.6
Resultant	18.4	18.2	18.4	21.9	23.2	18.4	11.6	0.00	—11.6
Resultant (y_3 set equal 100)	101	100	101	120	127	101	64.0	0.00	—64.0
Wave V (y_3 set equal 100)	100	100	100	113	129	101	62.0	0.00	—62.0

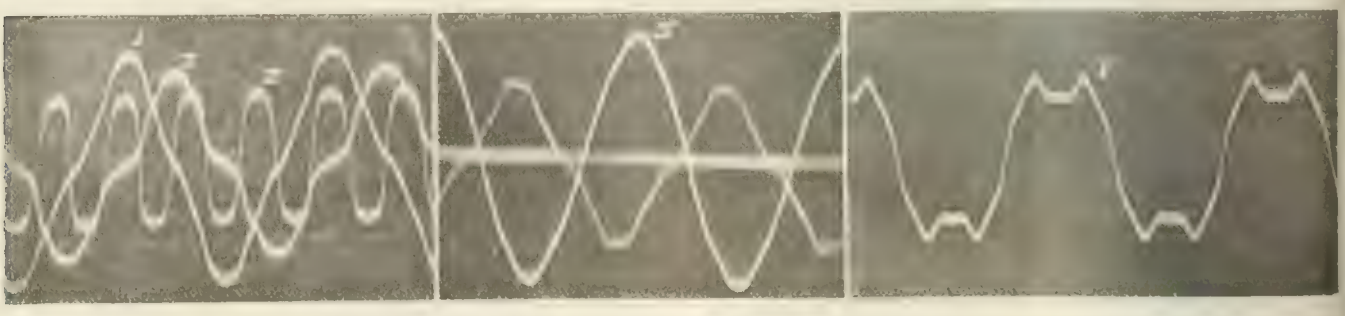


FIG. 14.—OSCILLOGRAM OF WAVES I, II, III, IV AND V.

The combination of IV with III should give I:

	y_1	y_2	y_3	y_4	y_5	y_6
Wave IV	29.0	51.4	67.5	83.0	97.0	100
Wave III, y_3 and y_6 (y_6 set equal 14.1)	—13.4	—14.1	—13.4	0.00	13.4	14.1
Resultant	15.6	37.3	54.1	83.0	110	114
Resultant (y_6 set equal 100)	13.7	32.7	47.5	73.0	96.8	100
Wave I (y_6 set equal 100)	12.4	33.0	54.5	80.6	97.0	100

Hudson-Fulton Celebration in New York State.

THE greatest public event ever held in the State of New York was brought to a close Saturday night with a carnival parade in the Borough of Brooklyn and with a spectacular pageant in the city of Troy. Connecting the 160 miles between both cities was a chain of great signal fires 30 ft. high burned from heights along the Hudson River. An illustrated account of the celebration in New York City appeared in the Sept. 30 issue, but the celebration was not confined to New York City and the lower Hudson, for great preparations had been made by the various cities along the upper Hudson during the week just ended. The occasion was also utilized as a sort of Old Home Week for all of the towns in the Hudson Valley north of Newburgh, and many of the floats used in the historical pageant in New York City were used in the parades along the river towns. The celebrations in the towns and cities south of Newburgh took place on Oct. 1 and 2. Monday, Oct. 4, was Dutchess County day, with celebrations at Poughkeepsie; Tuesday the city of Kingston was visited; Wednesday, Catskill, the county seat of Greene County, was the center of attraction, and on Thursday the fleet moved on to Hudson. On Friday, the flotilla advanced to the capital city of Albany, and on Saturday, Rensselaer County celebrated in the city of Troy. Thus the celebration, extending from Sept. 25 to Oct. 9, and commemorating the three hundredth anniversary of the discovery of the Hudson River by Henry Hudson and the one hundredth anniversary of the inauguration of steam navigation on the same river by Robert Fulton, was brought to a close. While on account of the nature of the events commemorated and the necessity for a certain amount of concentration in order to make the event effective, the celebration took place along the Hudson Valley, the whole nation took a lively interest in it, and the presence of foreign warships and diplomats gave to the event an international significance. Certainly no commemorative celebration had ever before been undertaken on anything like as large a scale. As in New York City, so also along the entire route electrical illuminations played a very important part in the celebrations, and a brief description of the spectacular lighting in the various cities along the Hudson is given herewith.

YONKERS.

The electrical illumination in the city of Yonkers was especially attractive. The public lighting consisted of the following: City Hall, 3000 lamps; high school, 1500 lamps; public



FIG. 1.—STREET ILLUMINATION, YONKERS.

library, 1500 lamps; Manor Hall, 1200 lamps; public dock, 1000 lamps; public parks, 3000 lamps; Broadway, 3000 lamps; Main Street, 2000 lamps; Getty Square, 1000 tungsten lamps; fire headquarters, 500 lamps; police department, 500 lamps.

Manor Hall was the principal attraction; not gaudy or incongruous, the historic manor was the acme of taste in both decoration and illumination. The delicate tinted colors of the country under which Henry Hudson sailed were interwoven with the national colors, and the lines of electric lamps which outlined the building were only eclipsed by the simple but cordial illuminated word "Welcome" constructed of 7-ft. letters along the roof of the building. The triumphal arch erected in Getty Square presented a bright picture. The device con-



FIG. 2.—GETTY SQUARE, YONKERS.

sisted of a great wooden frame covered with canvas painted a dark drab color. On each side at the piers were portraits of Hudson and Fulton, and beneath the figures were the names in laurel wreaths, and above the dates 1609 and 1807. On the face of the arch were colored pictures showing the *Half Moon* and the *Clermont*. Between the piers and the arch were shields bearing the date 1909, surmounted by American eagles. At the capstones were paintings of the Angel of Victory. Some distance north and south of the arch were large white Corinthian columns capped with golden globes, and connected with the arch by strings of electric lamps. Similar columns were placed at the end of the street festoons; the whole representing what was known as the Court of Honor. From the river front charming pictures were presented by the Nodine Hill and Lake Avenue water towers, and a temporary tower on the site of the Hendrick Hudson Hotel, on Park Hill. Surmounting the top of the Nodine Hill tower were four large signs bearing the dates 1609 and 1909. The body of the structure was covered with colored lamps, which flashed on and off, giving the tower the appearance of a gigantic Roman candle. On the Lake Avenue and Park Hill towers red and green fires were burned for two hours nightly. The municipal building, on Dock Street, though not offering the same possibilities for artistic effects as Manor Hall, was fitted up in a pleasing style, and at night when the lamps were lighted its appearance was very attractive. The police headquarters is such a large structure that to embellish it fully would require quite an outlay, but the decorative material employed was put to good use.

The illumination of the bank buildings facing Getty Square vied with the glittering triumphal arch that spanned South Broadway. On the First National Bank there were three large signs bearing the name of the institution and the date of its organization, the latter being surmounted by a magnificent electrical sunburst. Beneath the sign was an American shield with a bull's-eye on either side. Strings of white lamps were strung around and across the frontage of the Yonkers Savings Bank. Festoons were hung in exquisite designs on the face of the structure, and extended around the columns of the entrance. The illuminated sign of the institution put the finishing touches

to the whole design, surmounted by a blazing crimson star. Similar strings of lamps were displayed on the Westchester Trust Company Building, a structure which requires little to enhance its appearance. The People's Savings Bank was also well illuminated. Covering the entire front of the Guinzburg Building was the monogram "H-F" in red, white and blue. The Westchester Lighting Company's office showed illuminations distinct from all of the others. The Odd Fellows' illuminated sign, strung across North Broadway opposite the lighting company's premises, helped to make the corner of Wells Avenue a great blaze of light. The whole water front glittered with the reflected light from the numerous lamps of the Ben Franklin Transportation Company and the boat club. The wharves and buildings of the company were outlined with nearly 2000 lamps and three giant signs formed the initials B. F. T. Co. The prettiest picture of all was the recreation pier scintillating with thousands of miniature bulbs, the ample decorations at times blowing over them so that the kaleidoscopic effects from the river were beautiful. The great sign of the Chamber of Commerce announced to those who plied the river in ships that this was Yonkers, and that right here were 80,000 people. Many buildings upon Main Street were beautifully decorated. Riverdale Avenue for many blocks was bright with flags and bunting and aglow with electric lamps. On the Radford Building, in Getty Square, were two big electric pieces representing the American and Hudson-Fulton flags in colors. A large number of business houses and even private residences in the city were especially illuminated at night. The offices of the Yonkers Electric Light & Power Company were especially attractive.

Above Yonkers, Hastings, Dobbs Ferry, Irvington, Tarrytown, Peekskill and Ossining celebrated without any elaborate electrical displays. At Peekskill and Ossining electric signs with the name of the town in 10-ft. letters were erected on the hillsides above the villages. One of the most beautifully decorated places was the residence of Isaac Stern, at Irvington-on-the-Hudson. The whole turret of his home on Broadway was wound with electric lamps, and the flag pole was a streamer of red. Across the river in Nyack and Hastings many buildings



FIG. 3.—NEWBURGH DAILY NEWS OFFICE.

were outlined, and here and there festoons with special columns, towers, etc., were in evidence.

NEWBURGH.

Newburgh is on the western bank of the Hudson, and perched upon lofty crags, pinnacles and peaks, so that most of the illumination was visible from Fishkill Landing on the opposite bank of the river. Moreover, the contour of the city added greatly to the picturesqueness of the illumination, in which approximately 30,000 4-cp lamps and 1000 40-watt tungsten lamps were employed. A feature of the illumination was the flame effect at the foot of South Street. This was produced on a structure 100 ft. long and 60 ft. high, on which 2000 lamps were in circuit. The sign flashed up like flames of fire, and then the word "Welcome" in 8-ft. letters appeared in white. The letters forming the single word were made up of tungsten lamps, while the other part of the device was illuminated with



FIG. 4.—CITY HALL, NEWBURGH.

lamps tinted a yellowish red. Five of the church spires in town were illuminated nightly with three rows of lamps running from top to bottom, and the effect, particularly from a distance, was very fine. The City Hall shone out beautifully; in the center of the top were the words "City Hall" in letters of fire, while strands of lamps ran up and down the building to the flagstaff. A feature of the decorations on the City Hall was the kaleidoscope of varying colored lamps which, with every changing variety, fascinated the pedestrians in the immediate vicinity. The *News* office also came in for a large share of attention. The Court House was among the public



FIG. 5.—HUDSON RIVER TELEPHONE COMPANY, NEWBURGH.

buildings illuminated. There were arches and festoons of lamps over the front of the building, and the face of the official reviewing stand, erected in front of the Court House, was also brightly illuminated. All along Grand Street, at intervals of 100 ft. or so, there were festoons of electric lamps with stars strung across the roadway. The picture, particularly viewed from Broadway and from South Street, was fairy-like. At the corner of South and Grand streets were representations of two American flags placed close together and studded with electric lamps. At Washington's headquarters a waving Ameri-

can flag 30 ft. long, with changeable stars for the flagstaff, was erected. This equipment called for 1000 4-cp lamps. The flag was placed half way up the flagstaff at the northeast of the historic structure. By means of a flasher a shimmering or waving effect was obtained. Inasmuch as this illumination could be viewed from a distance of half a mile, it was particularly effective. Ferry Square was ablaze with light. At the corner of Second and Front streets there is a very tall telephone pole which was made the most of in the decoration of that corner. At the top of this pole there gleamed electric stars in red, white and blue colors. From the apex of the pole were eight strings of lamps stretched out and downward in various directions until they reached a lodgment at the Dell House, the United States House, Cameron's lumber yard and other places nearby. Other stars and strings of lamps added to the effect. Second Street, from Grand Street down to Front Street, was festooned with streamers, and at the center of the various streets the streamers were caught up with double stars. At the end of each street, and the terminal of the decorations, double electric flags were hung. On Bayview Terrace there were streamers of 500 tungsten lamps outlining the terrace and a 20-ft. *Half Moon*.



FIG. 6.—BROADWAY, NEWBURGH.
FIG. 7.—COURT HOUSE, NEWBURGH.

POUGHKEEPSIE.

It is estimated that over 15,000 lamps were used to decorate the city of Poughkeepsie during the Hudson-Fulton celebration. The general scheme of illumination was very similar to that used during the convention of the Volunteer Firemen's Association of the State of New York, an account of which appeared in the Sept. 9 number. As was pointed out in that issue, the Court of Honor was identical with that used in Washington in connection with the inauguration. Some changes were made, however, in the electric setting, diagonal overhead cross festoons as well as side festoons being employed. In the center set of columns was a large illuminated shell having on one side a picture of the *Half Moon* and on the other a picture of the *Clermont*, both outlined in electric lamps. Above each of the end squares formed by the pylons was an illuminated anchor at the center, and at the middle of each of the side festoons between each pair of columns was an illuminated disk bearing on one side the seal of the Hudson-Fulton Celebration and on the other that of the city of Poughkeepsie. Festoons of lamps were carried across Market Street from Cannon to the Soldiers' Fountain, being strung from tree to tree in a zigzag manner. At the fountain illuminated pond lilies in the basin and bands of colored lamps running from the centerpiece to the edge of the basin made a very pretty picture. On the way to the fountain the illumination of the Adriance Memorial Library Building by arc lamps and reflectors was particularly noticeable. The chaste marble structure stood out in marked contrast to the blackness of the night, the scheme being somewhat similar to that employed in the illumination of Grant's Tomb in New York City.

FIG. 8.—FERRY LANDING, NEWBURGH.
FIG. 9.—ARMORY, NEWBURGH.

The double strings of lamps along the curbs in front of the Post Office were taken down, and festoons running to the anchors and to the shell in a diagonal line across the street superseded them. Colored bulbs also formed a part of the changed decoration. On Main Street directly opposite Market Street, and facing the Court of Honor, was a large illuminated sign on which the words "Poughkeepsie Welcomes You" blazed forth. Running along the curb on either side of Main Street was a single strand of electric lamps, with festoons of lamps draped across the street so as to give the decorations a canopy effect. The wharves of the Day Line and Central Hudson Steamboat Company, as well as the ferry house and slip, were decorated and illuminated by means of flaming-arc

lamps. Lower Main Street below the New York Central Railroad station was lighted with flaming-arc lamps, and many of the public buildings, as well as business houses, were outlined in commemoration of the event.

KINGSTON.

Ulster County Day was celebrated at Kingston, the first capital of the State. The plan for illuminating this city was, briefly,



FIG. 10—MAIN STREET, POUGHKEEPSIE.

as follows: Four sections of the main thoroughfare, covering in all about 7600 ft., were lighted by streamers of lamps across the street every 100 ft.; there was a Court of Honor at the City Hall; large "Welcome" signs at the ferry depot, and also at the West Shore Railroad crossing of the main street, and an electrical waving-flag device at the corner of Fair and Main streets. The festoons were caught up by illuminated stars at the center, and approximately 10,000 4-cp lamps were utilized in the electrical decorations.

CATSKILL.

From Kingston the naval parade moved to Catskill, the county seat of Greene County, and the spot around which center many of the old Dutch traditions, notably the tale of Rip Van Winkle. At the ferry landing was a welcome sign and an anchor outlined with lamps, and the main thoroughfare leading from the landing to the center of the town was festooned with vari-



FIG. 11—COURT OF HONOR, POUGHKEEPSIE.

colored lamps. There was nothing remarkable about the illuminations in Catskill, since the appropriation for this purpose was very limited. The chief item of interest in connection with the celebration in Catskill was the trip planned by the Holland Society of New York in honor of the officers and men of the *Half Moon*. The party made its way to the mountain top, where the *Half Moon's* men had related to them in their native tongue the legend of Rip Van Winkle.

HUDSON.

Hudson, named after the explorer, and the county seat of Columbia County, held appropriate exercises on Oct. 7, and at night the city was illuminated. Warren Street from Public Square to Promenade Hill was a glare of light, and added to the electrical display of this street was the illumination of the Court House and Promenade Hill and the river front. On the flagstaff of Promenade Hill four flaming-arc lamps were burned, while at the steamboat dock were three more. Another flaming arc was used in Greene Street. About 40 festoons, containing approximately 1500 8-cp lamps, were fed from transformers on pole lines in Warren, Front, Ferry and Colum-

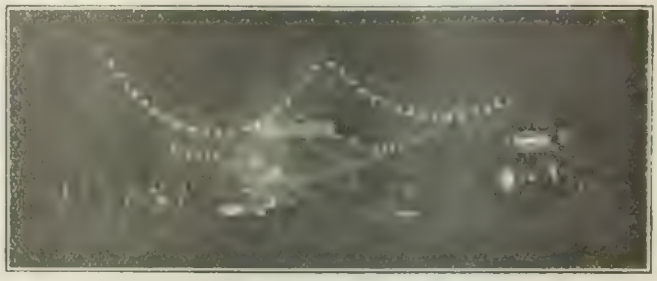


FIG. 12.—BROADWAY, KINGSTON.

bia streets, as well as in Park Place. A number of the bank buildings were also outlined in 16-cp lamps. The fire house of the C. H. Evans Hook and Ladder Company was covered with lamps, and the Elks' Club was also beautifully illuminated. The lamps on the street were festooned from pole to pole, and in order to keep the festoons across the center of the street away from the trolley wire they were elevated at the center by means of ropes fastened to the poles on the sidewalk.

Elaborate preparations were made in the cities of Albany and Troy, and as a result the illumination in both places was very surprising. The State, county and city buildings in Albany were dressed in appropriate colors, augmented by numerous incandescent lamps. The hill at State Street, from the river to the capitol, presented a very pretty sight, and this portion of the city was set aside as a Court of Honor. Festoons of varicolored lamps extended from pole to pole and at Pearl Street



FIG. 13.—COURT OF HONOR IN FRONT OF CITY HALL, KINGSTON.

four festoons of red lamps were caught in the center and held by the Hudson-Fulton initials spelled in light. The landing at Riverside Park was appropriately decorated and all the hotels, department stores, office buildings, theaters, etc., added to the gaiety of the scene by additional outline lighting.

Troy was even more elaborately decorated than the capital

city, and the illumination was not surpassed by that of any other city on the majestic river. There were many special decorations and illuminations of artistic design, American colors joining with those of the Hudson-Fulton festival, waving in an interchanging shade of light from lamps of various hues. In the public arches erected across the main thoroughfares 21,000 lamps were employed. The arch at Broadway and Third Street was studded with 3500 lamps whose rays fell upon a marvelously effective mingling of colors in the decorations. The official landing stage at the foot of Broadway was lighted by the rays of 500 lamps, and the approach to the city from the river was noticeably attractive. Congress Street Bridge was dressed in glorious colors from end to end and presented a splendid spectacle up and down the Hudson under the brilliance of 1000 lamps added to its regular service.

So general was the decoration that to cover it in detail would necessitate the publication of a list of business places in the heart of the Rensselaer County seat. The spirit of friendly rivalry in making the city beautiful was shown in all directions, and the public lighting at the intersection of the principal thoroughfares was very striking. Owing to the great pressure on our columns this week we are compelled to reserve that portion of the article treating of the illumination in Albany and Troy for the next issue.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Central-Station Power Load.

One of the most interesting papers presented at the recent meeting of the Pennsylvania Electric Association was a joint paper entitled "Power," which pointed out the value of a motor load to small central stations and indicated means by which such a load could be secured. Mr. T. E. Penrose, of Tyrone, was the editor of the paper, and in addition to contributing one section, added comments to the sections contributed by others. Mr. Penrose gave the results of tests at the Tyrone station of coal consumption in running a 500-kw turbine at different loads and for a different number of hours per day, the fires being banked for the remaining hours. Following are the results, the load factor applying to the period when the machine was in operation:

Load factor.	Hours run.	Coal per kw-hour.
1.00	2½	5.4 lb.
.90	7	4.4 "
.90	24	3.1 "

These figures, it was pointed out, clearly indicate how important a day load and high load-factor are to a central station.

Mr. J. W. Reeves said that the real cost of off-peak power business is so slight that for this business the charge per kw-hour can be much reduced, and yet the net profit increased. He said that his station at Johnstown had been making determined efforts to obtain off-peak load. A large isolated plant in a department store was superseded, adding to the station load 150 arc lamps, 1000 incandescents and 9 motors, with a total rating of 100 hp. Considerable of the lighting and all of the motors operate off the peak load. During the past two months the station has installed 27 motors, aggregating 222 hp, in a planing mill, replacing one 150-hp engine. Two small engines have also been replaced in a foundry with 10 motors, aggregating 100 hp, and one of the city laundries has been induced to install 16 motors, aggregating 28 hp, to replace a steam equipment. At present the company has on its circuits 504 motors with a capacity of 2611 hp. The Johnstown plant has a steam-heating auxiliary, and the increased load has caused a reduction in the amount of live steam required for this service. The amount of fuel consumed for both plants for an electrical output of 297,020 kw-hours was 3,222,640 lb., and when the electrical output was increased to 355,934 kw-hours the fuel consumed was only increased to 3,277,080 lb.

Mr. T. E. Spence gave figures showing the decrease of switchboard cost at the Plymouth, Pa., station due to taking on off-peak business. There was a total reduction in switchboard cost since March, 1907, of 0.195 cent per kw-hour, brought about by an increase of 734 hp in off-peak motor business. The load factor of this station has been increased from 20 per cent to 41 per cent in two years.

Mr. R. A. MacGregor, of the Easton, Pa., station, discussed methods for obtaining motor business. A motor solicitor, in presenting a case, should be well fortified with data from similar installations, and should become well versed in the details of the line of manufacture to which electric motors are to be applied. He should know what kind of motors to install and how to lay out an installation to the best advantage. Before presenting a case the solicitor should get up data as to the cost of operating by steam, of operating by electricity, of the cost of motor installation and the saving that may be effected, both direct and in increase of output. In commenting on Mr. MacGregor's paper, Mr. Penrose said that the motor solicitor can do more to reduce the kilowatt operating expense in 60 days than the whole operating force can in 10 years.

Mr. J. B. Kilmore, of Scranton, Pa., said the best examples of power business are city water-pumping plants running continuously and mine ventilating fans, which run at full load except when stopped for repairs. Closely approximating this class of business is that afforded in the silk industry. Although this business extends over the peak, yet the maximum demand is practically the average demand, the motors being started and stopped but once a week. Figures from a silk plant are given, showing that most of the motors, which vary from 2 hp to 50 hp, operate at practically full rated horse-power continuously, the load-factor ranging from 69 per cent to 100 per cent. In commenting upon Mr. Kilmore's paper, Mr. Penrose said that the high load factors there brought out should not influence one against low load-factor business. For example, a load made up of elevator motors, if there are enough of them, may give a very good average load owing to the diversity factor. Mr. Penrose said that blanks which he sent to lighting companies and to some of the manufacturers of electrical apparatus, asking for reports on motor installations, gave data which show that the cost of supplying a motor service is lower than is generally supposed.

Central-Station Commercial Development in Great Britain.

By Francis H. Davies.

While America is admittedly the birthplace of central-station publicity and commercial development as we know it to-day, and has well maintained the lead, the subject has by no means been neglected in England. The last three years have witnessed very remarkable progress. Many of the most staid of municipal bodies and the oldest of companies have awakened from their lethargy to institute new business departments, and the remainder are rapidly being forced into line by dwindling revenues occasioned by metal-filament lamps. The ways and means taken do not in the great majority of cases follow the American example closely, since conditions in Great Britain are very dissimilar and call for different treatment. Innate conservatism makes the task of pushing a new thing much harder, and if it is to go at all it must be pushed in the right way by steady, persistent effort rather than by aggressiveness as it is understood in America.

The British public is seldom to be hustled into anything; it is distrustful of all blatant advertisment, and looks upon electric light, gas and water undertakings as its natural enemies. It is, however, open to conviction, and does not mind being educated if the process be conducted in the right way, with all

due deference to its prejudices—which are, unfortunately, often very formidable obstacles. For these and kindred reasons it has been necessary for some time to feel the way very carefully and to determine how far it is expedient to follow the American precedent.

In the light of recent developments it appears curious that when the subject of publicity and systematic new-business work was first mooted in England many were found to condemn, root and branch, any but the old *laisser faire* policy of depending upon natural growth. Needless to say, such belonged mainly to the old school of professional engineer, the man who looks upon his calling more as a scientific pursuit than as a matter of business. In places, he still stems the tide of advancing commercialism, but on all sides there are indications of a new régime under which the man who extends the business, and by so doing makes it pay, will take the foremost position. Realization of this fact has doubtless been partly responsible for what progress has been made, but, of course, not entirely so. For many years past, in a considerable number of instances, commercial methods have been employed to increase business, but until recently they were anything but systematic. The germ, so to speak, has been lying dormant awaiting the impulse necessary to call it into life. That impulse came chiefly in the shape of a crusade in the technical press calling attention to the possibilities of a good commercial organization and quoting the American example, not necessarily for slavish imitation, but rather as an indication of what can be accomplished under one set of conditions. Several prominent English journals have each done yeoman service in the cause, and are continuing to further its interests in every possible direction.

So far as the writer is aware, the earliest really systematic effort was that of the Newcastle-Upon-Tyne Electric Supply Company, the management of which inaugurated an extensive new-business and publicity department in 1904. It is in active existence now and is the largest of its kind in the country. In comprehensiveness and organization the work of the Newcastle company compares well with that of the largest American new-business departments so far as one is able to judge from published accounts of the latter. For over three years the company issued its own monthly magazine entitled the *Tyneside Pioneer,* a publication noted for the quality of its matter and for its enterprise. A monthly bulletin is still issued, but it is now the product of the Electrical Press, Limited, and not the locally prepared article. All the usual publicity methods of circularizing, advertising, exhibitions, free trial of apparatus, etc., are employed, and at times the canvassing staff, which includes engineers capable of handling all branches of power and lighting work, has assumed very large proportions. On the whole, the Newcastle company's organization is very thorough and has proved eminently successful. The company's operations cover an area noted for its possibilities in the direction of energy supply.

The two municipal undertakings of West Ham and St. Marylebone probably afford the next best examples of systematic effort in business expansion. Their populations are, respectively, 308,000 and 133,000, and their annual outputs 11,299,783 kw-hours and 8,797,111 kw-hours, the former including 4,000,000 odd kw-hours sold for traction purposes. West Ham is an industrial area situated outside the jurisdiction of the London County Council. The undertaking has a large power load and great scope for increasing it, as the district is a popular one with manufacturers. Here, as at Newcastle, the organization is very complete and includes a showroom, a sales department and a large staff of canvassers. A quarterly publication, entitled the West Ham *Electrical Bulletin,* is circulated in the district with, it is stated, very good results. Printed on good paper, well illustrated and brightly written, it is certainly one of the best of its kind. It is quite impossible in a short review to detail in full the publicity and canvassing methods employed at West Ham. They, however, include newspaper advertisements, posters and enameled iron plates on signboards and public buildings, publicity circulars, pamphlets and postcards and many other recognized direct-appeal devices. Indirectly the work is forwarded by keeping in close touch with house and estate agents, builders and the local press.

On the subject of the St. Marylebone municipal undertaking, the writer—having until recently had charge of the publicity and canvassing department—can speak with more authority. The area is comparatively small, but it is very dense, consisting chiefly of the best class of private houses and large shops. Indeed, it is the complete antithesis of West Ham, and the lamp load far exceeds the motor load. The borough has been systematically developed for over three years, and all the usual new-business methods have been employed. A large showroom was inaugurated in the first instance and has always been a prominent and successful feature. As a seqquel to a course of circularizing, the principal part of the area has been canvassed street by street, and as a result the increase in new consumers and extensions connected has been very marked. A special feature was made of cooking demonstrations, the practice of the department being to instal the apparatus free of charge for a few weeks in any shop or restaurant suitable from the advertising point of view. This policy was found to arouse considerable interest in the subject and to assist materially in opening up new business in many directions by giving prominence to the supply generally. During the past three years a large number of pamphlets and circulars were published and regularly distributed. They were specially designed and compiled by the publicity staff, and a great deal of new business—particularly in heating—was directly traceable to their systematic use.

Of the 13 companies operating in London, the County of London Electric Supply Company and the Charing Cross & City Electric Supply Company are particularly noteworthy as having in active work properly systematized new-business organizations on a large scale. Practically all the remaining London companies are devoting attention to the work in varying degrees of thoroughness, and many of the municipal concerns have instituted, or are considering, publicity departments. In the provinces about an equal amount of progress may be recorded so far as important towns, such as Birmingham, Bradford, Bristol, Ipswich, Leeds and Sheffield, are concerned. These and a few others have for some time been developing their business upon commercial lines, but the majority of the smaller towns do not as yet evince a very progressive spirit. There are, of course, notable exceptions, but, on the whole, much remains to be done.

In Great Britain there is as yet little or no such co-operation as exists in America, a fact that is greatly to be regretted. There is decidedly room for some such organization as the Co-operative Electrical Development Association, and it is hoped in many quarters that the newly formed Electrical League—an association of men interested in electrical matters—may do something toward the desired end. In several directions there are indications of a desire for co-operative action, and some tangible steps were taken last year when the electric supply companies of London and a few of the local authorities jointly financed an electrical exhibit at the Franco-British Exhibition. The London supply companies have also combined in the production of a quarterly publication entitled the *Electrical Bulletin,* which has gained for itself a well-merited reputation and been closely imitated by the opposing Gas Light & Coke Company. A somewhat similar organization of London municipal engineers has issued several large posters of a striking nature. They are in evidence on signboards in many parts of London and have earned the distinction of being seriously objected to by the gas companies. Co-operative publicity does not extend beyond this, but its place is being to some extent filled by the Electrical Press, Limited, and one or two other concerns who are publishing a wide series of pamphlets, postcards and advertising matter generally, which is being distributed all over the country.

Cursory as the above details are, it will be seen that the last three years—more particularly in 1908—have been characterized by very considerable advancement. The stimulating effect of properly organized development work has commenced to make

itself felt in the case of the pioneers, and this is encouraging others to follow where they feared to lead. Much, indeed, remains to be done, but there is no doubt that the next year or two will witness remarkable developments in Great Britain which may be favorably compared with those of America, although perhaps along slightly different lines.

An English Central-Station Rate System.

By A. Hugh Seabrook.

I have been keenly interested in your issues giving accounts of tariffs recently adopted in several of your cities, and I enclose my recommendations for a revised tariff for the Borough of St. Marylebone, which have been adopted by the Borough Council.

After about 15 years' experience in electric supply I have come to the conclusion that flat rates of any kind are entirely wrong. Unless various classes of consumers are classified and a separate flat rate applied in each case, the flat-rate system is unfair; but a classification would be exceedingly cumbersome and likely to give rise to much dissatisfaction.

The greatest objection, however, in my opinion, is the fact that *no flat rate will induce long-hour uses of electricity.* It would not pay the proprietor of a store to illuminate his windows until midnight on a flat rate as low as 6 cents per kw-hour. The maximum-demand system, based on the "readiness-to-serve" charge plus a small charge per unit, is the only system which will induce consumers to be liberal in their use of electricity.

On the "telephone system" of charge, which, of course, is this "readiness-to-serve" system, a consumer, once having paid the annual charge, is induced to use electricity on account of the low price of 2 cents per kw-hour for lighting his windows until midnight, lighting up in dull weather, using electricity *only* instead of sometimes electricity and sometimes gas, because his annual charge once paid, the actual energy is practically given to him.

On one point I differ from the tariffs adopted in your country —namely, the running charge per unit. I stick to a level 2-cent rate for all purposes, but I notice that American central stations vary the running charge as well as the fixed charge. I would be glad to know what is considered to be the advantage of this variation, as at present it seems a departure from simplification, and one meter cannot be used for the whole of the premises for whatever purposes electricity is used, owing to this variation in the running charge per unit.

Our idea, with this tariff we are putting into force, is to induce a consumer to light completely his house with electricity and pay the extra $10 per annum for heating and other uses of electricity; because, when this total annual charge is paid, he can consider it fixed permanently (unless he rebuilds or extends his premises), and he can use electricity for any purpose he likes at 2 cents per kw-hour, which, I am convinced, will enormously lessen the difficulties of solicitors in introducing novelties and other apparatus for consuming energy.

The question will arise on reading the accompanying report that the kilowatt charge for heating and other uses of electricity is greatly lower than that for lighting. The lines we have gone along are that having obtained the lighting of the premises by electricity, we can afford to treat other uses of electricity as *additional output* and charge for that additional output in proportion to its cost, which is always considerably lower than the cost of the existing business.

In the particular case of this borough, we had to pay over $5,000,000 to the company to purchase the goodwill and right to supply, which is more than half our total capital expenditure; and whatever the increase in business we obtain in future, not a penny will be added to that $5,000,000. That is, of course, a somewhat extreme case; but it can be generally assumed that a system supplying, say, 10,000,000 kw-hours per annum can increase its output to 20,000,000 at a cost which is not at all in proportion to the cost of supplying the original 10,000,000.

Following is a reprint in part of the report submitted to the Borough of St. Marylebone (London) Electric Supply Committee by the writer, as general manager of the Marylebone municipal electrical supply system. After explaining the electrical terms used the report continues as follows:

Instance of a Typical Consumer.

A consumer who has in his house metal-filament lamps amounting to 1200 cp, consisting of, say, 40 30-cp osram lamps, will have a total power installed in his house of 1½ kw, or nearly 2 hp.

This consumer will not have his 1200 cp all going at one time, and his "average maximum demand" or "power required" will be about 750 cp, which is equal to 1 kw, or 1⅓ hp.

The Council Must Have Plant Ready to Supply the Consumer.

Now, for every such consumer requiring 1 kw connected to the mains (and consumers requiring other amounts of power—and all electrical apparatus require power—will be in proportion) the Council must have a kilowatt at their generating station in boilers, buildings, turbines, etc.—which plant costs a fixed sum to buy and to keep in order—ready to supply the consumer's kilowatt, or 1⅓ hp, at any time he wants it.

Cost to the Council of Being Ready to Supply a Consumer with a Kilowatt.

The cost of having the sum of these kilowatts ready at the station for the consumers is definite and ascertained, and the "kilowatt charge" or "annual charge" referred to in this report is based on that cost.

Cost to the Council of Supplying the Consumer with Kw-hours.

After this cost is covered there only remains the cost of supplying the units, or kw-hours, to the consumer, which is quite different from the "kilowatt" or "annual" cost, and is made up by coal, water, oil, repairs, wages, etc.; and the charge of 1 penny per unit, referred to in the report, is based on this cost, which is the only cost of supplying the actual units.

If a consumer only used his kilowatt for one hour in the year it would still cost the Council the "kilowatt charge" or "annual charge" to supply it, but one hour's use of the kilowatt would be one unit, and the charge for that would be 1 penny.

Comparison of Electric Supply with the Telephone Service.

The same thing exists precisely in the case of the telephone system. It costs the company a certain sum per annum per subscriber in capital, instruments, wires, cables, etc., to put the service into his house, for which the company charge an annual sum in advance, then the charge per call is 1d., which is operators' wages, management, accounts, repairs, etc. It costs the company this annual charge, whether the subscriber makes any calls or not, and the subscriber has to pay that charge whether he uses his telephone or not. If the subscriber makes a great many calls per annum, the average cost per call is a little over 1d. (1d. per call plus the proportion of the annual charge), because his load factor is high. If he only makes, say, one call per day, the average charge per call is high because his load factor is low.

Load Factor Apply Both in Electric Supply and Telephone Service.

In the same way, if an electricity consumer uses his kilowatt for many hours per year, his average cost per unit (proportion of annual charge plus 1d. per unit) is low, because his load factor is high. If he only uses his kilowatt for one hour per day his average cost per unit is high because his load factor is low.

The term "load factor" is, in the case of the telephone system, the percentage of the actual calls a consumer makes per annum to the maximum number he could possibly make. The maximum number he could make would be one every 10 minutes day and night throughout the year, equal to about 52,000 calls per annum. Suppose he actually made 20 calls a day throughout the year, he would make 7300 calls per annum, and his load factor would be 14 per cent made up by 7300 calls × 100 ÷ 52,000 = 14 per cent.

Likewise with an electricity supply, a consumer's load factor is the percentage of the actual hours per annum that he uses his kilowatt to the maximum he could possibly use it. The maxi-

mum possible number of hours would be 8760 per annum, and suppose he actually used it for two hours per day that would be 730 hours per annum and his load factor would be a little over 8¼ per cent calculated as follows: 730 hours × 100 ÷ 8760 = 8.3 per cent.

The term "load factor" is not peculiar to electricity supply; it can be applied to any business. For instance, a restaurant keeper only doing a luncheon trade has a low load factor, but a saloon keeper doing business for seven days a week and 15 hours per day has a high load factor.

Proposed Tariff.

The following will be of further assistance in explaining the proposed tariff: 750 cp in metal-filament lamps is equal to 1 kw of "maximum demand" or "power required" and consumes one unit per hour. This applies also to 250 cp in carbon-filament lamps; 1 ordinary four-lamp radiator; 2 ordinary size flame-arc lamps; 4 electric irons; 16 small fans. Seven hundred and fifty candle-power would be approximately the "maximum demand" or "power required" of a 1100-cp or 1200-cp lighting installation.

Modification of Tariff.

I am now in a position to put before the committee a complete scheme of optional tariff suitable for all consumers. For the purposes of this report I will include again the large consumers from 50 kw and upward. Between 50 kw and 20 kw I call "medium-sized consumers." Below 20 kw I call "small consumers."

Tariff—Large Consumers.

Power Required.	Per kw. £ s. d.	Minimum Fixed Annual Charge.
200 kw @	4 10 0	£900 0 0
175 kw @	4 17 6	853 2 6
150 kw @	5 5 0	787 10 0
125 kw @	5 12 6	703 2 6
100 kw @	6 0 0	600 0 0
75 kw @	6 10 0	487 10 0
50 kw @	7 0 0	350 0 0

Additional kilowatts, pro rata per kilowatt, or part thereof per annum; and 1d. per unit for all units consumed.

Terms.—Ten-year contract and exclusive use of electricity for lighting and power (motors). The "kilowatt charge" is payable annually in advance.

As an example of the above tariff, a consumer of 200 kw "power required" would pay £900 annually in advance and £4 10s. per annum for every kilowatt above 200 kw, plus 1d. per unit for all units consumed.

Tariff—Medium-size Consumers.

Power Required.	Per kw. £ s. d.	Minimum Fixed Annual Charge.
45 kw @	7 9 6	£336 5 0
40 kw @	7 10 0	300 0 0
35 kw @	7 15 0	271 5 0
30 kw @	8 0 0	240 0 0
25 kw @	8 7 6	209 7 6
20 kw @	9 0 0	180 0 0

Additional kilowatts, pro rata per kilowatt, or part thereof per annum; and 1d. per unit for all units consumed.

Terms.—Five-year contract and exclusive use of electricity for lighting and power (motors). The "kilowatt charge" is payable annually in advance.

Under this tariff a consumer having 30 kw of "power required" would pay £240 annually in advance for five years, plus 1d. per unit for all units consumed.

General—Large and Medium Consumers.

With regard to these two classes of consumers, my intention is that these shall be minimum terms under these conditions and I do not want it to be considered an inflexible tariff. For instance, if it is inconvenient for a consumer to pay annually in advance, or to enter into a long-period contract, the "kilowatt charge" will be accordingly increased, taking into consideration the directions in which the consumer cannot meet our conditions; and I recommend that the Council (per their general manager) may offer an increased price if the consumer is unable to meet any of the conditions stipulated. I recommend also that the Council may at their discretion (per their general manager) ignore the "annual or kilowatt charges" for uses of electricity other than lighting and motors, provided the premises are lighted exclusively by the Council.

In all these cases of contracts the charge per unit will be payable within 10 days of demand, either weekly, monthly or quarterly, as may be required by us.

Small Consumers—Lighting Only—Telephone System of Charge.

Power Required.	Per kw. £ s. d.	Minimum Fixed Annual Charge.
18 kw @	9 4 6	£166 10 0
15 kw @	10 0 0	159 0 0
12 kw @	10 10 0	126 0 0
10 kw @	11 0 0	110 0 0
8 kw @	11 11 0	92 8 0

Additional kilowatts, pro rata per kilowatt, or part thereof per annum; and 1d. per unit for all units used.

Power Required.	Per kw. £ s. d.	Maximum Fixed Annual Charge.
7 kw @	11 15 0	£82 5 0
6 kw @	12 0 0	72 0 0
5 kw @	12 10 0	62 10 0
4 kw @	12 15 0	51 0 0

Additional ¼ kilowatts, pro rata per kilowatt per annum; and 1d. per unit for all units consumed.

Power Required.	Per kw. £ s. d.	Minimum Fixed Annual Charge.
3½ kw @	12 17 6	£45 1 3
3 kw @	13 0 0	39 0 0
2½ kw @	13 2 6	32 16 3
2 kw @	13 5 0	26 10 0

Additional 1/10th kilowatts, pro rata per kilowatt per annum; and 1d. per unit for all units consumed.

Power Required.	Per. kw. £ s. d.	Minimum Fixed Annual Charge.
1¾ kw @	14 0 0	£24 10 0
1 kw		14 0 0
¾ kw		10 10 0
½ kw		7 0 0
¼ kw		3 10 0
1/10 kw		1 8 0

Additional 1/20th kilowatts, pro rata per kilowatt per annum; and 1d. per unit for all units consumed.

The charges for all units consumed to be paid weekly, monthly or quarterly as may be required by us.

A large proportion of our present and future consumers will be 1 kw and under.

I propose that this tariff be known as the *telephone system of charging*, which is self-explanatory, as most of our consumers are telephone users and understand the fixed payment annually in advance and 1d. per call. If the telephone company charged 8d. per call for a certain number of calls, and 1d. per call for all calls after a minimum number, it would be equivalent to our 8d. and 1d. charges for energy. The fixed "annual charge" plus 1d. is preferable both in the company's case and in ours, and covers in our case exactly the same cost as the company's, viz., fixed charges, including the capital, and the 1d. is the running cost. These terms would be minimum terms. Any consumer wishing to pay quarterly in advance instead of annually would pay a correspondingly higher rental.

No contract for a number of years is necessary with these small consumers, unless any consumer particularly desires it, in which case there would be no objection from our point of view, and each case would be considered on its merits.

The annual charge to be paid annually in advance and based on the consumer's "power required" for the previous year.

For example, a consumer, whose "power required" for the past 12 months has been ½ kw would have the option of paying £7 down, plus 1d. per unit for all units consumed. That "annual charge" holds good for 12 months. At the end of the 12 months the "annual charge" is again fixed for the ensuing 12 months. If the "power required" has gone up or down during any year the "annual charge" will be altered accordingly for the next year.

In the case of new consumers, whose "power required" is not ascertained, the "annual charge" for the first year to be assessed by the general manager, and after the first year the same procedure as with old consumers.

The general manager to have power during any year to reassess the annual charge for that year as circumstances may warrant.

Flats—Farming Out Electricity.

The practice of farming out electricity to flatholders by flat-owners will have to be carefully looked into, because it is to flatholders I am looking for extensive use of heating and cooking apparatus.

Small Consumers—Heating, Cooking and Other Uses of Electricity, Excluding Lighting and Motors—Tariff.

I do not suggest any alternative to the 2d. and 1d. maximum demand system for consumers using motors—*i.e.*, factories, etc., at present.

I recommend the following scale of charges for heating, cooking and other uses.

Power Required.	Fixed Annual Charge.
¼ kw	£0 5 0
½ kw	0 10 0
¾ kw	0 15 0
1 kw	1 0 0
2 kw	1 10 0
3 kw	1 15 0
4 kw	2 0 0
5 kw and upward	2 2 0

And 1 d. for all units consumed payable weekly, monthly or quarterly, as the Council may require.

Terms.—The "kilowatt charge" payable annually in advance.

The scale for heating and other uses of electricity only applies where the lighting of the premises is exclusively electricity from the Council's mains.

These terms again are minimum terms; any consumer who wishes to pay quarterly instead of annually will be charged a correspondingly higher rental.

For uses of electricity under this tariff we can generally assess the apparatus itself—*i.e.*, a four-lamp radiator would be £1 per annum, and five radiators (or their equivalent) would be £2 2s. 0d., and so on.

General Remarks—All Sizes of Consumers.

We have had to settle the tariff of the large consumers because, as the committee is aware, the matter was urgent When reporting on these I was not in a position to report upon the whole of the optional tariff down to the small consumers.

I have now been able to give the matter very serious consideration, and am satisfied that we shall do better with our existing consumers with a simplified tariff; that it will be easier to get additional lighting business, and that with the proposed rate for heating and cooking, etc., we can compete with gas.

Inspection.

Under this tariff the consumer must give all facilities for inspection of installations and apparatus by duly authorized officers of the Council periodically.

One advantage of this "annual charge" plus 1d. per unit tariff is that one meter only is required, the "power required" or "maximum demand" indicator remaining on all premises as at present, as the whole tariff depends upon the "power required" or "maximum demand."

Generally—As Regards Flat Rates.

I am of opinion that flat rates as a rule are incorrect methods of charge, and I would not recommend an extension of such rates for this district. The only fair method of charging on the flat-rate system is to group various classes of supply and give each class of supply a different flat rate according to load factor, which would result in no end of dissatisfaction among consumers.

Generally—As Regards "Maximum Demand" System.

The "maximum demand" or "power required" system of charging is the correct one, the difficulty having been to make it simple and understandable by consumers. This proposed tariff, I think, meets this difficulty. The variation in "annual charge" as between large and small consumers differentiates between wholesale and retail supplies. The "annual charge" plus 1d. per unit automatically gives a low average price per unit to the desirable long-hour consumer with high-load factor, and likewise a high average to the short-hour user with low-load factor, who is much more costly to supply. The annual payment in advance for large and medium consumers lessens the risk of bad debts to the Council, and further, in the case of small consumers, renders deposits unnecessary.

General—Saving in Duplicate Wiring.

A most important point to the consumer is that one set of wiring only is necessary in all premises, even where lighting, heating and cooking are mixed up. This is a considerable saving to the consumer, and one which the Council, in the past, has been endeavoring to effect by means of plug meters for heating, etc.

"Maximum Demand" or "Power Required" Indicators and Meters.

Under this proposed tariff, these indicators will only require to be read in the months of October, November, December, January and February. The fact that this tariff saves meters does not make much difference from our point of view, because meter rents are charged. Under the proposed tariff, meter rents, connection charges, inspection charges, etc., all remain as at present.

Definition of Power, Lighting and Other Uses of Electricity.

As to what may be termed "lighting," "power," "heating," "cooking" and other uses of electricity, the general manager's decision must be final.

Application of Tariff.

Any consumer wishing to avail himself of this optional lighting tariff must have the whole of his lighting on this system; but I recommend that any consumer, no matter the system he elects to be charged upon for lighting, can have the new "heating" and "cooking" and "other uses" rates, provided he puts in separate wiring for such uses, and uses exclusively the Council's electricity for lighting. The cost of separate wiring will, in any case, be an inducement to the consumer to take the "telephone system" of charging right through.

INTERIOR WIRING AND ILLUMINATION

New Decorative Lighting at the Alaska-Yukon Exposition.

On Sept. 18 the dome of the main government building at the Alaska-Yukon Exposition was lighted for the first time. The effect is very fine, as there are nearly 10,000 lamps on the dome and the intensity of illumination is such as to make it plainly visible from the many hills of Seattle even several miles distant. The dome lighting completes the decorative electrical effect of the main Court of Honor as originally planned, and



FIG. 1.—GENERAL VIEW OF COURT-OF-HONOR ILLUMINATION, ALASKA-YUKON EXPOSITION.

the completion of the work at this late date is due to the fact that the Government appropriation did not become available for this purpose till Sept. 6. The exposition management let the contract at once and within 10 working days had over 10,000 lamps in place, although some of the construction material had to be shipped from San Francisco. The lighting scheme is in accordance with plans of A. J. Quigley, assistant

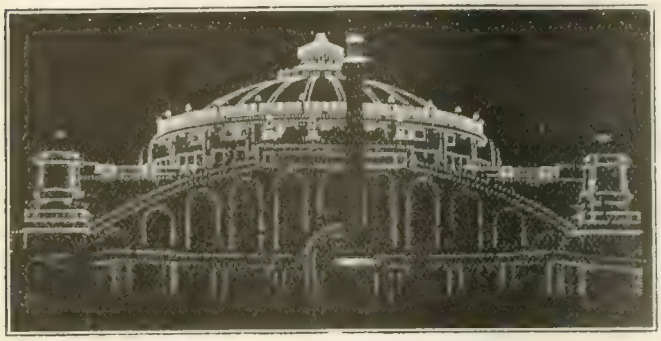


FIG. 2.—GOVERNMENT BUILDING ILLUMINATION.

electrical engineer of the exposition, and under his supervision the work was done by Agutter Griswold Company, electrical contractors of Seattle.

The pictures herewith show the marked change that has resulted because of this additional lighting. The architectural ornamentation of the dome was such as to lend itself well to electrical outlining. The ball of fire on top, the two crown like cappings below and the parapet wall at the base of the dome proper are all particularly beautiful at night. It is greatly to be regretted that the work could not have been done before the thousands of visitors from the East had come and gone

Illumination of Shop Yards by Means of Tungsten Lamps.

By Arthur Gillman.

Multiple tungsten lamps find an ideal application in the illumination of industrial-plant yards. It will be found that in many cases a 250-watt tungsten lamp can be substituted for an enclosed-arc lamp with very satisfactory results. One simple way of installing a unit out of doors is given in Fig. 1 Rubber-covered leads convey electricity from the main conductors to a porcelain or composition weather-proof socket which carries a brass shade holder and a tungsten lamp. An

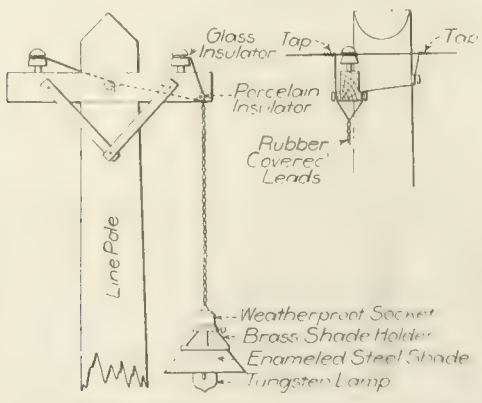


FIG. 1.—TUNGSTEN UNIT SUPPORTED ON POLE.

enameled steel shade or reflector, white inside and black or blue outside, held in the shade holder with binding screws, serves to protect the lamp and to deflect the light in a useful direction. There are several types of shade manufactured which satisfy the above general specification, and being of different forms provide different light distributions. Some makers are prepared to furnish curves showing the distributions rendered by their different reflectors, and from these the best type to meet any particular condition can be selected. In Fig. 1 the rubber-covered leads from the main conductors to the weatherproof socket are insulated from the cross-arm on which they hang by porcelain knobs held thereto with wood

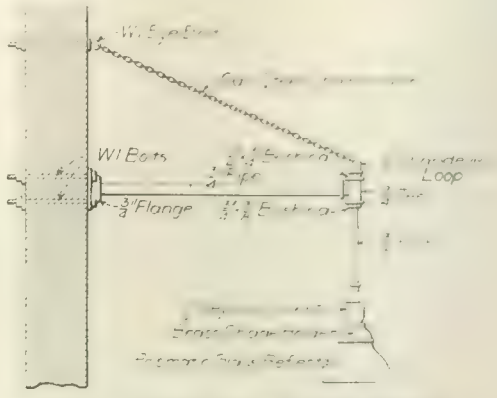


FIG. 2.—HOME-MADE OUTDOOR FIXTURE

screws. Little trouble is experienced in out-of-door work from filament-breaking vibrations, but in an installation such as that shown in Fig. 1 the lamp should hang far enough away from the pole to prevent its striking during a gale. Compare the arrangement in Fig. 1 with that involving an arc lamp for simplicity, reliability and economy.

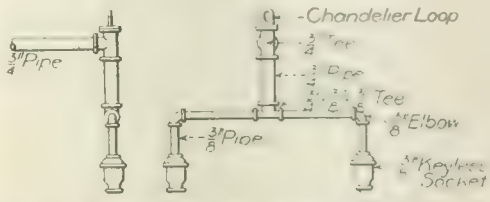


FIG. 3.—FIXTURE FOR 220 VOLT CIRCUITS.

A home-made out-rigger carrying a tungsten unit is illustrated in Fig. 2, as mounted on the outside wall of a building. All of the components in its construction are commercial and one can readily be assembled at low cost by a wireman. This being a side elevation only one steadying chain appears, but there are

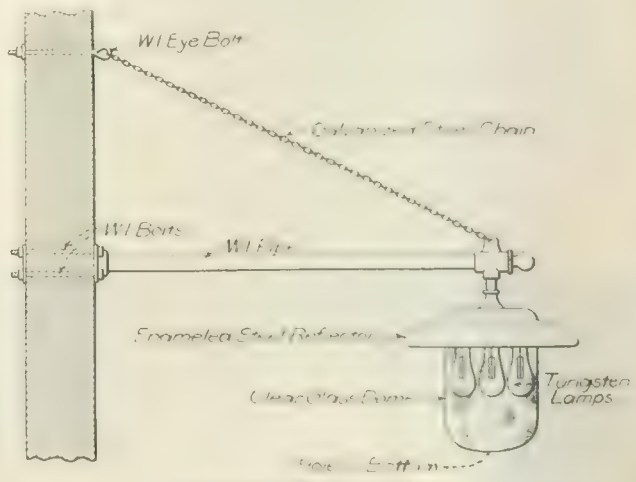


FIG. 4.—OUTDOOR CLUSTER.

two. The lower end of each engages in the chandelier loop and the upper ends are secured, each in its own eye-bolt, several feet apart, horizontally, on the wall. No provision is shown for damping vibrations, as such seldom exist in a location like that shown. Conductors to the lamp can be carried inside the 3/8-in. pipe up to the outrigger pipe and inside of it to the in-

terior of the building. A prismatic glass reflector is shown on the lamp. Glass reflectors particularly designed for street illumination are manufactured for use with series tungsten lamps, but they can be adapted to multiple installations and should give satisfactory results for industrial-plant yard lighting.

In plants where current at a tension of 220 volts only is available and it seems desirable to operate two 110-volt lamps in series across this, the fixture shown in Fig. 2 can be adopted for 220 volts, as detailed in Fig. 3, which shows only

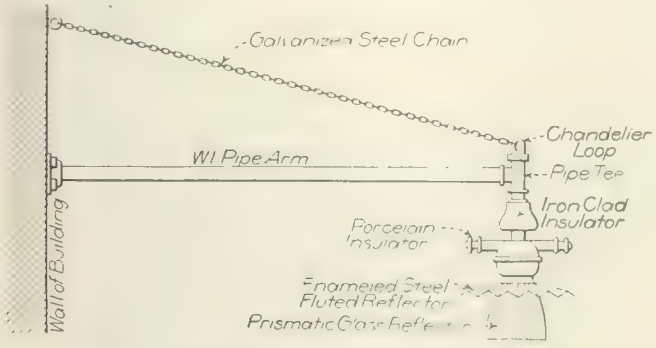


FIG. 5.—A SERIES INCANDESCENT ADAPTATION

the outer end of the fixture. If the wires conveying electricity are to be carried inside of the pipes composing the fixture it is desirable to substitute pipe crosses for the pipe tees. This will provide an open hole at each junction point through which access to the interior is given for pulling in the conductors. Keyless sockets with aluminum shells are commercially obtainable which are well adapted to out-of-door applications, such as those shown in Figs. 2 and 3.

A commercial out-of-door cluster is illustrated in Fig. 4 This type possesses the advantage of having a clear-glass dome which protects the lamps from dust. The dome is easily removed for cleaning without disturbing the tungsten lamps. The conductors feeding the cluster are carried inside of the wrought-iron pipe forming the arm. Two steadying chains are used, only one of which appears in the elevation shown. For 220-volt service the sockets can be wired in groups of two in series, permitting the use of 110-volt lamps.

Figs. 5 and 6 show adaptations of equipment, particularly designed for tungsten series street lighting to industrial-plant multiple conditions. Both equipments are commercial, but if desired for multiple service they should be so specified in the order. The outrigger unit (Fig. 5) can be furnished either

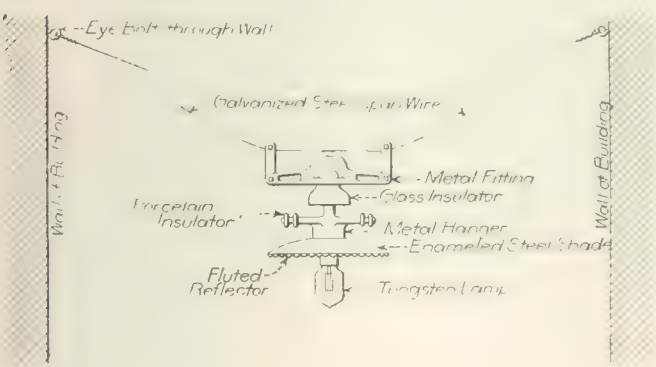


FIG. 6.—TUNGSTEN UNIT HUNG FROM SPAN WIRE.

with or without the fluted enameled steel reflector. Developments seem to indicate that the combination of fluted reflector and prismatic glass reflector gives best results for street and yard lighting conditions. For low-tension multiple work the massive iron-clad insulator between pipe-arm and fixture proper can be omitted. An arm, part of the fixture, has porcelain insulators mounted on each of its ends, on which wires supplying the lamp with energy can be terminated. A unit hung from a span wire strung between buildings is delineated in Fig. 6. The construction of this device is essentially like that just described (Fig. 5) except an arrangement is provided whereby the unit is clamped to the span wire. This combination should find many applications in industrial-plant practice for the lighting of areas between buildings and roadways. Obviously the span wire can be supported by a pole on either side of a roadway to meet the latter condition.

Multiple Tungsten Street Lighting for Grinnell, Iowa.

The City Council of Grinnell, Ia., recently voted to accept a proposition made by the Grinnell Electric & Heating Company to change the entire street-lighting system of the city from 6.6-amp alternating-current arc lamps to tungsten incandescent lamps. The city officials and citizens had been for some time dissatisfied with the system of street lighting in use. Mr. O. K. Cole, president and manager of the Grinnell Electric & Heating Company, instead of waiting for dissatisfaction with the system to gather strength, took steps in advance to offer the city as good a system of street lighting as the available appropriations would permit. Mr. J. R. Cravath was retained as consulting illuminating engineer to look over the existing situation, to decide upon the best system of street lighting available (bearing in mind the equipment which the company already had in place) and to formulate and present a proposition to the City Council on behalf of the company.

The present system of street lighting consists of a 6.6-amp alternating-current arc on every other corner, each arc being operated at constant potential from a small transformer located usually at the nearest alley. One side of the primary of each arc-lamp transformer is connected to the regular primary main, and the other side to a special street-lighting main which is controlled by a separate switch at the station. The multiple arc lamps are operated from standard-voltage transformers giving a secondary potential of 110 volts. The existence of this very peculiar system of street lighting had an important influence on the final decision as to the best scheme to adopt. The arc lamps were being operated on a moonlight 3 a. m. schedule at the rate of $65 per lamps per annum. There were also 11 incandescent lamps of 16 cp in use for street lighting.

At first some consideration was given to the possibility of retaining the existing arc lamps and filling in the dark spaces between with tungstens. It was soon evident, however, that this plan would call for a greater annual expenditure for street lighting than would be obtained from the city. The same objection held against another plan which was considered; that is, of moving all the arc lamps into the central part of town and spacing them one block apart instead of two blocks apart, as at present, placing tungstens in the outlying parts.

To replace the present arc lamps by some of the new luminous types recently placed on the market would have given a greater total amount of light, but would have involved a heavy investment cost in making the change, and would still leave the inherent defect of the present system, which is the difficulty of seeing a block away when facing an arc lamp when the surroundings are dark. Large lamps at such long intervals are blinding and extremely unsatisfactory.

It was finally decided that for all the residence portion of town the method of using an 80-cp tungsten lamp on each corner would give much better results than the present system, and at the same time would be within the reach of the city financially.

At first it was naturally assumed that the proper lamp to use would be the series tungsten lamp operated on a standard series street-lighting circuit with a constant-current transformer at the station. However, at the suggestion of Mr. Paul P. Meyers, superintendent of the company, estimates were also drawn up on a system using 110-volt multiple tungsten lamps operated from the small transformers at present used for the arc lamps. It was argued in favor of this system that it would

involve only a small initial investment to make the change to the new street-lighting system, and that the difficulties of maintaining lines would be much less than with a series system. The streets are lined with very heavy, rapidly growing shade trees, which flourish in the rich Iowa soil, and it is no small task to keep the street-lighting lines which run through these trees free from leaks and grounds. At present the 1100-volt primary lines are almost altogether in alleys which run north and south. The street-lighting transformers are located at the intersections of alleys with the east and west streets, so that there is only a half block of pole line in the street between the alley entrance and a street lamp. With this line from the alley to the street corner operated at 110 volts, much less trouble is experienced than with a high-tension line. Estimates were, therefore, made on both the series and the multiple tungsten system. It was found that the cost of changing to the multiple tungsten system would be about half that of changing to the series system. The reason for this difference was partly due to the fact that the transformers for the multiple system were already in use on the arc system, and the amount of new wire and poles was less with the multiple system because of the greater use which could be made of existing wires and poles.

Fig. 1 is a typical plan of two blocks showing the scheme to be employed for distribution on the multiple system. From

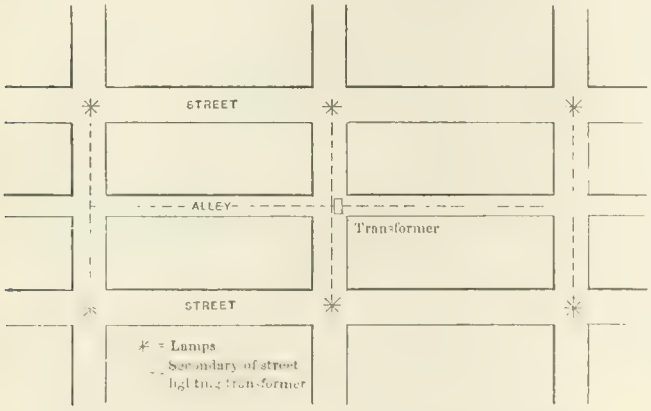


FIG. 1.—TYPICAL STREET-LIGHTING SECONDARY CIRCUIT.

this it is seen that one transformer of a sufficient rating to supply energy to one arc is adequate for six 100-watt tungsten lamps under the new system. This transformer is located centrally with regard to the six lamps which it supplies. One side of existing secondary circuits in alleys can be used as a return wire for the street-lamp circuit one block each way from each street-lighting transformer. This practically means that in two-thirds of the alleys there must be one additional secondary wire strung for street-lighting purposes. The third primary for the street-lighting transformers is already installed in most cases.

The tungsten multiple lamp is, of course, much more fragile than the series lamp, which point was given due consideration. However, since multiple tungsten lamps have been used in outdoor work where vibration and sudden shocks are more frequent than they would be in this case, it was thought that the other advantages of the multiple system would outweigh this possible disadvantage. The lamp sockets will be provided with a flexible support inside of the socket and reflector holder, so that shocks to the pole will be cushioned before they reach the lamp.

The present arc system supplemented with incandescents was costing the city $3,057 per annum. The rate offered by the company on a street-lighting contract providing for tungsten lamps was such as to provide an increase in gross revenue of $413 a year, at the same time providing street lighting for some outlying districts which have heretofore been practically without street lamps. In making this offer to the city it was necessary for the company to figure that most of the benefits to the company, as the result of this change, would be in the station equipment set free by the reduction in the maximum demand caused by street lighting. The financial returns to the comptany will, therefore, not be immediate, but will be spread out over a considerable period, whereas the advantages to the city will be immediate as soon as the improved and enlarged system is installed. While the rates per lamp are low considering the apparatus which must be thrown in the scrap heap, in deciding upon a price, the general principle was followed that it would be better to make it so low as to be beyond possible criticism than to attempt to make the new contract pay for the extra investment in a short period of time.

The proposition, as formulated and presented to the Council by the company's consulting engineer, was, in part, as follows:

"The present system of lighting is very inadequate, both in the central part of the town and in the outlying districts. In the central part of the town the long distance of two blocks between lamps makes a very dark space midway between lamps, which is made worse by shade trees and tree trunks. Large lamps at such long intervals are blinding, as all who have faced them at night know. In the outlying districts there are long intervals of several blocks in well settled territory in which there are no lamps.

"By virtue of some very important improvements in electric lamps which have come into practical use the past 18 months, it is possible for the company to offer you a system of street lighting which will not only cover a larger area than the present lighting, but will make an enormous improvement in lighting the entire city, for an amount but little greater than that now paid by the city for its street lighting.

"The system which is recommended consists of placing an 80 cp tungsten lamp on a bracket at each street intersection. In the central part of town around the business district and park several tungsten lamps of 48 cp each should be placed between street intersections as indicated on the map accompanying this report. The present arc lamp gives under actual service conditions about 200 cp at an angle which is effective for street lighting. The proposed system with an 80-cp tungsten lamp on each street intersection will give about 60 per cent more illumination midway between lamps than is now obtained with arc lamps on every other street intersection.

"It is recommended that these tungsten lamps be placed on brackets for several reasons: Brackets are neater in appearance than lamps suspended over the street. By using them it will be possible in some cases to place lamps in line with the tree trunks on one side of the street. This will result in less shading of the sidewalk by tree trunks on both sides of the street, a matter very serious with the present system. The use of the bracket also makes it possible to equip the lamp with a reflector which increases its useful candle-power for street lighting about 25 per cent. Such a large reflector as this cannot be used on a lamp suspended over the center of the street because of the effect of the wind on the reflector.

"The change to the new system will involve important changes in the company's entire street lighting system. The present arc lamps, which are only six years old, will have to be thrown out and at least half their value lost. However, on account of the greater economy of the tungsten lamp and the greater effectiveness of the smaller lamps placed on each corner as compared to the present arcs, the city can well afford to give the company a 10-year term of contract at a rate which will reimburse the company for throwing out the old apparatus.

"The following proposition is therefore submitted on behalf of the company:

"The Grinnell Electric & Heating Company will supply, light and maintain, for a period of 10 years, 122 tungsten lamps of 80 mean horizontal candle-power, each equipped with reflectors which will increase the candle-power at 5 degrees below horizontal to 100 candle-power, for the sum of $25 per lamp per annum.

"The Grinnel Electric & Heating Company will furnish, light and maintain, 21 tungsten lamps of 48 mean horizontal candle-power each, equipped with reflectors which will increase the candle-power 5 degrees below horizontal to 60 candle-power for the sum of $20 per lamp per year.

"These lamps will be lighted on what is commonly called "all night every night" schedule in which the lamps are to be lighted from dusk to dawn every night of the year.

"After a period of five years the cost is to be reduced to $20 a year for the 80-cp lamps and $15 a year for the 48-cp lamps.

"It is to be understood that the rated candle-power stated in this proposition is to be the candle-power of the lamps when

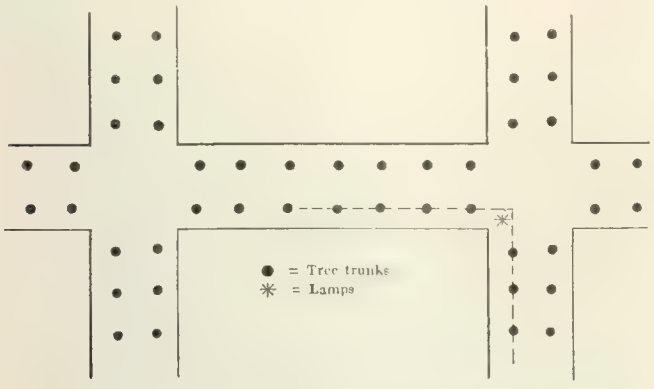


FIG. 2.—LOCATION OF LAMPS TO LESSEN TREE-TRUNK SHADING OF SIDEWALKS.

new and that 20 per cent depreciation from foregoing figures is to be allowed."

The plan suggested will cost the city per year for the first five years as follows:

122 lamps of 80 cp at $25 a year	$3,050.00
21 lamps of 48 cp at $20 a year	420.00
Total	$3,470.00

Fig. 2 illustrates the arrangement recommended in the proposition regarding the location of lamps to avoid the shading of sidewalks by large tree trunks. The trees are so large and numerous on many of the streets that arc lamps 900 ft. apart in the center of the street, as on some streets, throw very little light on the sidewalks. Soon after the presentation of the company's proposition to the City's Council, a sample installation of 100-watt tungsten lamps was put up and the advantages of the new system were apparent. The proposition was accepted.

New Telephone Patents.

NEW APPARATUS.

A new design of desk set has been invented by Mr. J. A. Birsfield, of Chicago, Ill., he having assigned his patent to Mr. Alfred Stromberg. One feature is the transmitter clamp. The head of the stand is a hollow sphere, cut at an angle into two parts which screw together. A plate with a central perforation crosses at the joint, and the movable part of the head swings about a lug which it carries and which projects into the hole in the plate. The body of the movable head is held with the inside of the hollow sphere, a leather friction washer being interposed.

The hook switch lever is also novel, being carried by a small cylinder which will drop into place in notches and be clamped by the head piece. The lever is thus readily removable. The springs are in the base of the stand, a push rod connecting the lever with them.

Mr. J. M. Haff, of Los Angeles, Cal., has patented an antiseptic device for transmitter mouthpieces. This is a funnel-shaped metal device carrying an antiseptic diaphragm. Its edge is turned back, forming a threaded flange upon which, from the rear, a clamp ring is screwed. This arrangement holds the device firmly in place.

An adjustable mounting for transmitters has been invented by Mr. A. G. Kaufman, of New York City, the American Callaphone Company having obtained the patent by assignment. The apparatus provides for a considerable vertical movement of the instrument and for cushioning it against jar.

Letter to the Editor.

Polyphase Magnetomotive Forces.

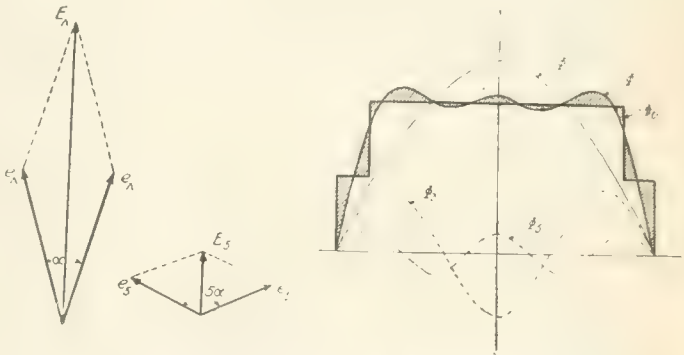
To the Editors of Electrical World:

Sirs:—In connection with the article by Mr. J. D. Nies en titled "Polyphase Magnetomotive Forces," which appeared in your issue for Aug. 26, the following remarks may not be out of order.

In the article referred to occurs the statement that in polyphase windings there are combined several m.m.fs., thereby developing a resultant m.m.f. which is in motion with respect to the coils that produce it. It would be more nearly correct to state that in polyphase windings there is produced a m.m.f. of approximately constant intensity, the direction of which revolves synchronously with approximately constant velocity.

In this article are also the statements that in the irregular step curve of m.m.f. in any polyphase apparatus there is a constant fundamental component rotating at constant synchronous speed and various harmonics, each of which is constant in value and rotates at a constant speed equal to 1/m th of the synchronous speed, and that in three-phase machines the third harmonic and all multiples vanish. Now it should be borne in mind that the harmonic components of any distorted wave are merely mathematical fictions and have no independent physical existence. The amplitudes of the fictitious components of a distorted flux wave are constant in value only in the case of an ideal motor, and in an actual motor the amplitudes vary somewhat from instant to instant.

Under the heading "Counter Electromotive Forces" is the statement that the counter e.m.fs. due to the harmonics are all



FIGS. 1 AND 2.—DIAGRAMS ILLUSTRATING METHOD OF CALCULATING E.M.F. FIG. 3.—DISTORTED FLUX WAVE

of the same sign and add directly to the counter e.m.f. due to the fundamental. A slight modification of this statement may not be out of place. The e.m.f. induced in the wires embedded in one slot by the pulsating or revolving flux of magnetism, the instantaneous values of which do not follow the sine law may be found as follows:

Denoting by e the instantaneous values of any distorted e.m.f. wave its effective value E is found from the equation:

$$E = \sqrt{\frac{1}{T}\int_0^T e^2 dt} \qquad (1)$$

Now $e = \Sigma E_x \sin x\,\omega t$, where E = amplitude of any harmonic component, x the order of the component under consideration. ω = angular velocity, t = time.

Transposing equation (1),

We obtain $E = \sqrt{\Sigma E_x^2}$ (2

Hence, if E_1, E_3, E_5, E_7 are the effective values of the harmonic components as calculated from their respective fluxes there is obtained for the effective value of the e.m.f. induced by the distorted flux wave:

$$E = \sqrt{E_1^2 + E_3^2 + E_5^2 + E_7^2}, \qquad (3)$$

since the wave of magnetism is symmetrical with respect to the 90-deg. ordinate.

When calculating the e.m.f. induced by a distorted flux wave

in the coils of a distributed winding, the following method must be resorted to, if accurate results are to be obtained:

Suppose the machine under consideration is a three-phase motor with two slots per pole per phase. Let the flux wave contain comparatively prominent fifth and seventh harmonics. Let e_1, e_5, e_7 denote the effective values of the fictitious components of e.m.f. induced in the wires of one coil. The total e.m.f. induced per pole per phase is now found as indicated below. With six slots per pole the angular displacement α between slots in electrical space-degrees equals $\alpha = \frac{180}{6} = 30$ deg.

First consider the fundamental (Fig. 1):

$$E_1 = 2\,e_1 \cos \frac{\alpha}{2} = 2\,e_1 \cos 15 \text{ deg.} = 1.9318 e_1$$

Considering that the electrical displacement for the fifth and seventh harmonic equals 5α and 7α, respectively, we obtain (Fig. 2):

$$E_5 = 2\,e_5 \cos 5\,\frac{\alpha}{2} = 2\,e_5 \cos 75 \text{ deg.} = 0.5176\,e_5.$$

$$E_7 = 2\,e_7 \cos 7\,\frac{\alpha}{2} = 2\,e_5 \cos 105 \text{ deg.} = -0.5176\,e_5.$$

Hence, the effective value of induced e.m.f. per pole per phase is found to be from equation (3):

$$E = \sqrt{(1.9318\,e_1)^2 + (0.5176\,e_5)^2 + (0.5175\,e_7)^2} \qquad (4)$$

If the individual distribution factors of the higher harmonics are not taken into account there is obtained:

$$E = 1.9318\,\sqrt{e_1^2 + e_5^2 + e_7^2} \qquad (5)$$

The difference between the values of E as obtained from equations (4) or (5) may be considerable.

Secondary Currents.

The fact that an induction motor may run against its own field as observed by Mr. O. S. More has been explained by Mr. Nies to be due to the presence of higher harmonics.

In the following an attempt is made to illustrate the effect of a distortion of wave shape upon the performance of an induction motor:

Assume that the distribution of the field in the air-gap of an induction motor does not follow the sine law, but contains a pronounced triple and a less prominent quintuple harmonic. Fig. 3 may represent such a curve.

As seen from the diagram Φ_1 Φ_3 Φ_5 represent the fictitious harmonic flux components of the first, third and fifth order respectively. The curve drawn in heavy full line marked Φ is the resultant of Φ_1 Φ_3 Φ_5, the equation of which may be written:

$$Y = \Phi_1 \sin \omega t + \Phi_3 \sin 3\omega t + \Phi_5 \sin 5\omega t$$

or, if there be assigned to the amplitudes of Φ_3 and Φ_5 the values 0.3 Φ_1 and 0.1 Φ_1 respectively, one may write:

$$Y = \Phi_1 (\sin \omega t + 0.3 \sin 3\omega t + 0.1 \sin 5\omega t)$$

The step curve Φ, such as may be obtained in a two-phase motor with two slots per pole per phase deviates somewhat from curve Φ_0. The shaded portions embraced by the curves Φ and Φ_0, which may be called "the remainder," are due to harmonics of order higher than five. The latter may well be ignored, as their influence upon the performance of the motor is negligible.

Imagine that the three fluxes Φ_1 Φ_3 Φ_5 are produced by three separate stator windings, w_1 w_3 w_5, which are arranged in such a manner along the circumference of the stator as to produce a sinusoidal distribution of the respective fields in the air-gap.

Let w_1 produce "p" poles, w_3 = "3 p," w_5 = "5 p" poles, the number of turns being so chosen as to result in the field densities assumed above.

If, now, the coils w_1 w_3 w_5 are in turn excited by three harmonic currents of "N" alternations per minute, the rotor will revolve with $\frac{N}{p}$, $\frac{N}{3p}$, $\frac{N}{5p}$ revolutions per minute, respectively.

Suppose the coils are connected in parallel and excited simultaneously by three harmonic e.m.f. of a three-phase system. One might then say that each of the three separate windings produces its own field, each of which fields induces an e.m.f. in the rotor. Going still a step further, one might say that the arrangement represents three (imaginary) motors, I, III, V, in one frame, each with separate stator and rotor windings.

The reader is now referred to Figs. 4 and 5, which represent the torque curves of an induction motor plotted as a function of the slip. The curves are intended to illustrate the effects of Φ_3 and Φ_5 upon the performance of the machine.

Assume first that the distribution of the field in the air-gap is sinusoidal, as shown by the curve Φ_1, Fig. 3; in other words,

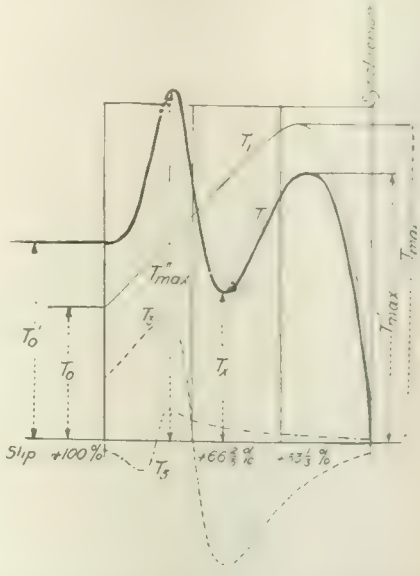


FIG. 4.—DIAGRAM OF TORQUE DEVELOPED BY HIGH-RESISTANCE ROTOR

only motor I is in circuit. The curves T_1, in Figs. 4 and 5, show the torque developed by motor I as a function of the slip; Fig. 4 for a high resistance, Fig. 5 for a low-resistance rotor. These curves are familiar to the electrical engineer and require no further explanation.

If, now, windings w_3 and w_5 are also excited, the torque is

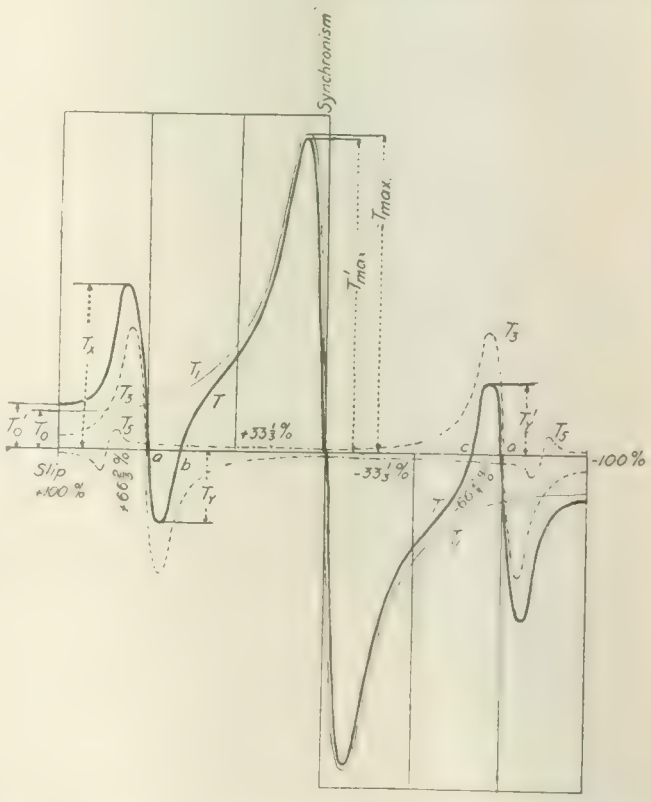


FIG. 5.—DIAGRAM OF TORQUE DEVELOPED BY LOW-RESISTANCE ROTOR.

no longer represented by the curve T_1. In addition to the latter there are to be considered the curves T_3 and T_5 representing the torques of fictitious motors III and V respectively.

Returning to the real motor, the distorted flux curve (step

curve) Φ_0 will give rise to the irregular torque curve T shown in heavy full lines in Figs. 4 and 5.

A brief study of the diagrams reveals the following facts:

In the absence of higher harmonics, the high-resistance motor will start with a torque T_0 and will attain its maximum torque T_{max} about 20 per cent below synchronism. Due to the field distortion there will result a torque curve which affects the performance of the motor in the following manner:

The starting torque is increased from T_0 to T_0'; the maximum torque T''_{max} is attained at a slip of about 70 per cent; and the torque T'_{max} developed at a slip corresponding to T_{max} reduces the pulling-out torque of the motor near synchronism considerably.

If at a slip of about 50 per cent the torque demanded by the load exceeds the value "T_x" the motor will fall out of step.

If, now, the high resistance rotor be replaced by one the resistance of which is low, the effect of the field distortion becomes much more marked.

An inspection of Fig. 5 shows that the increase in starting torque due to the higher harmonics is only slight; the effect of Φ_3 and Φ_5 upon the maximum torque near synchronism is negligible; at a slip of $+20$ per cent the torque has risen to a value T_x much in excess of the starting torque, due chiefly to the fictitious motor III, and at a slip of about $+65$ per cent the torque has become zero while at a slip of 60 per cent it reaches the negative value T_y.

Such a motor cannot accelerate to synchronism, even without load, because the torque between the points "*a*" and "*b*" is negative.

From the above facts can be explained the phenomena that a two-phase motor might run against its field. Suppose the motor of Fig. 5 is running at synchronous speed in a clockwise direction; and let the leads to one phase be reversed. The field will then revolve counter clockwise; the rotor speed will decrease and attempt to follow the field—that is, to reverse.

The rotor is now revolving with a negative slip, the torque being positive—that is, in the direction of the rovolving field.

As soon as the speed has dropped to a value indicated by point "*c*" at a slip of about -55 per cent, a further drop in speed will cause the motor to develop a negative torque—that is, a turning moment against the field which reaches a maximum in T_y' at a slip of about -60 per cent. At this value the motor speed remains, provided the torque demanded by the losses and load does not exceed the value T_y'. A slight further drop in speed causes the torque to go through zero at point "*d*" and the motor will reverse its direction of rotation.

It is seen, therefore, that primarily the effect of the third harmonic, as pointed out by Mr. Nies, is responsible for the phenomenon. However, it is not true that the third harmonic at a slip of 133 per cent becomes a "forward one." As seen from Fig. 5 the effect of Φ_3 at $S = -33$ is negligible.

Mr. Nies advocates the employment of fractional-pitch windings for the purpose of suppressing the higher harmonics in the flux wave of induction motors. As first pointed out by Professor Adams, a fractional-pitch winding, as compared with a full-pitch winding, embodies the advantageous features of reducing the reactance of the motor winding and decreasing the over-all length of the motor. On the other hand, with a fractional-pitch winding, the cross-connections are more complicated and the difficulty of insulation of slots and between coils (high-pressure machines) becomes more pronounced because certain slots contain conductors belonging to different phases.

Considering that in two-phase motors with a few slots per pole per phase the distribution of the field in the gap produced by a full-pitch winding deviates considerably from the sine form, the employment of fractional-pitch windings for such motors should prove advantageous. However, in the case of three-phase motors, where the amplitudes of the higher harmonics are only a few per cent of that of the fundamental wave, it would seem that the choice between full-pitch and fractional-pitch winding will vary according to the case under consideration.

Chicago, Ill. Henry Hermann

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Speed Control of Induction Motors.—H. C. Specht.—In a continuation of former articles on the speed control of induction motors, the author now discusses the use of frequency changers. The methods used are based on either of two general principles. By the first principle speed variation is obtained by changing the primary frequency applied to the driving motor and operating it as an ordinary induction motor. The second principle is that of connecting the primary winding of the driving motor to the constant-frequency supply circuit, speed control being obtained by impressing different frequencies upon the secondary winding of the driving motor. An example of the first principle is represented by the arrangement of induction motor and frequency changer set shown in Fig. 1, *A* being a

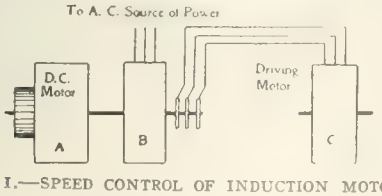


FIG. 1.—SPEED CONTROL OF INDUCTION MOTORS.

direct-current motor and *B* an induction motor. The primary of the induction motor *B* is connected to the alternating-current line and the speed of the set is controlled by the direct-current motor *A*. The secondary of this motor *B* furnishes the energy to the motor which is to be run at variable speeds. Another method of changing the frequency is by means of an arrangement similar to that just described except that the motor *B* is operated as an induction generator. For the foregoing methods of changing frequency (or speed), sufficient direct-current energy is required to make up for the change in frequency. As a rule, however, alternating current and direct current are not both available. As a third method of obtaining variable speed by change of frequency, the scheme shown diagrammatically in

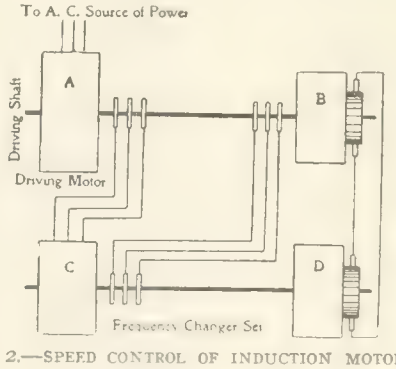


FIG. 2.—SPEED CONTROL OF INDUCTION MOTORS.

Fig. 2 may be more practicable. The primary of the induction motor *A* is connected to the alternating-current supply circuit and its secondary is connected to the primary of another induction motor *C*, the latter also being a wound-rotor type of machine, mounted on a separate shaft. The secondary of motor *C* is connected with the armature winding of a rotary conver-

ter *B* mounted on a common shaft with the driving motor *A*. The commutator of *B* is in circuit with the armature of another machine *D*, which is mounted on the same shaft as machine *C*. This latter machine acts as a frequency changer and its speed is governed by that of the direct-current machine *D*, which is given a certain excitation by a shunt-field circuit or by a compound shunt and series-field circuit, depending on the kind of speed regulation which is desired. The machines *D* and *B* may be self-excited or separately excited. For a certain speed of the set *C-D*, and with the connection between the commutators of *B* and *D* closed, the driving, or power, set *A-B* will have a definite speed. The regulation of speed is accomplished entirely by regulation of the field current of the machine *D*, a single adjustment being required for a given speed, without regard to the load. In an editorial by B. G. Lamme some general principles of changing the speed of induction motors are discussed, and a comparison is given between the alternating-current induction motor and the direct-current shunt motor as regards speed adjustment and regulation—*Electric Journal*, October.

Rectifier.—A description of a new rectifier made by a British manufacturer for converting alternating current to direct current, especially for small outputs, for charging storage batteries, etc. Its method of operation is based on the fact that if two secondaries of a transformer are alternately put into circuit at each half period, the induced current feeding the secondary circuit will be unidirectional. The apparatus consists of two parts: (1) A transformer wound with two secondaries in series or an auto-transformer with a middle point which acts as

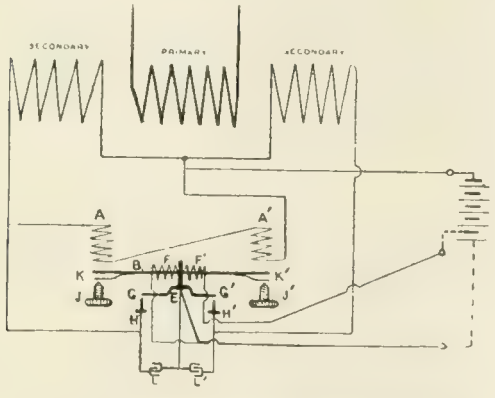


FIG. 3.—DIAGRAM OF RECTIFIER CIRCUITS.

a phase divider; and (2) the rectifier. In Fig. 3 *A*, *A'* are two small field magnets and *B* an oscillating armature pivoted at the center; the armature is wound with two coils *F*, *F'* and excited by direct current, taken from one of the cells to be charged; the current consumption of this is insignificant, being only 0.4 amp. If the apparatus is used for a purpose other than charging accumulators, a small cell is provided for this excitation. The two magnets *A*, *A'* are fed from one of the secondaries, and wound so as to have similar poles facing both ends of the armature. The latter carries a contact piece *E*, which, as the armature oscillates, makes contact alternately at *H*, *H'*. Two springs *K*, *K'*, bearing on two regulating screws *J*, *J'*, are provided for tuning up the apparatus. The two small condensers *L*, *L'* overcome any tendency to sparking at the contacts, although as the make-and-break takes place at zero current there is normally no tendency to spark. In operation, as the armature excitation is by no means of direct current, and fixed opposite polarities exist at either end, the armature receives an oscillating motion corresponding to the rapid change in polarity of the magnets *A*, *A'*, due to their alternating-current excitation; this oscillation alternately produces contact between *G*, *H* and *G'*, *H'*, cutting in and out first one transformer secondary and then the other, the induced currents feeding the outgoing circuit being always in the same direction. The field magnet excitation requires about 4 watts.—Lond. *Elec. Review*, Sept. 3.

Single Phase Commutator Motors.—J. Fischer-Hinnen.—A translation of his recent German paper on the calculation of single-phase motors from the practical standpoint.—Lond. *Electrician*, Sept. 24.

Operation of Alternators in Parallel.—K. Edgcumbe and A. H. Ellis criticise various points in the recent article of J. W. Anson, to which the latter replies.—Lond. *Electrician*, Sept. 17 and 24.

Lamps and Lighting.

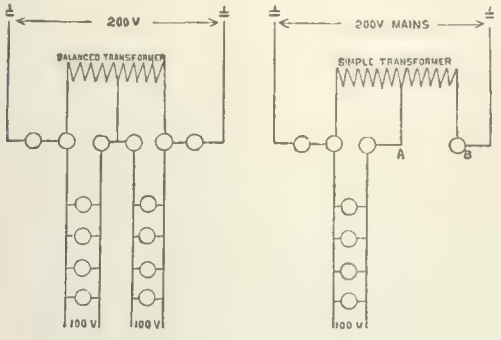
Tungsten Filament.—A. C. Jolley.—A communication on Steinmetz's recent article on the power characteristics of the tungsten filament. His experimental results are confirmed by the observations of the present writer, which are expressed by the equation $W = 0.0372\,V^{1.68}$. But, although as Steinmetz points out, it is possible to predict the 1.6th power of the voltage by assuming that the lamp is radiating according to the Stefan law, and that its resistance changes in direct proportion to the absolute temperature, it is, unfortunately, very probable that these two conditions do not hold for metallic-filament lamps, for most observers now agree that the radiation from these lamps is highly selective, and, therefore, does not follow the fourth-power law; moreover, owing to the accidental presence of impurity from the processes of manufacture, the tungsten filament seldom gives a temperature-resistance curve which would pass through the absolute zero. On the other hand, tantalum, which is produced in a high state of purity and mounted in the lamps as a wire, gives the required temperature-resistance curve. If the power consumption be plotted against voltage for such a lamp the relation $W = 0.0167\,V^{1.7}$ is obtained. It would, therefore, seem that the remarkable agreement between theory and experiment in the case of the tungsten filament must be regarded as a coincidence and is not of universal application.—Lond. *Electrician*, Sept. 24.

Tungsten Filament.—A note on a recent British patent of the Siemens & Halske Company (17,611, 1908; Sept. 16, 1909). Tungsten alloyed with from 8 per cent to 10 per cent of nickel is more ductile than pure tungsten, and can be drawn into filaments. According to this invention, the formation of the alloy is hastened by the addition of from 0.5 per cent to 1 per cent of iron, cobalt or copper.—Lond. *Elec. Eng'ing*, Sept. 23.

Cadmium Arc.—T. M. Lowry.—A paper read before the British association. In order to produce a cadmium spectrum of sufficient intensity for polarimetric work, advantage is taken of the favorable properties of the silver-cadmium alloys. On account of their isomorphism the two metals form an excellent series of alloys which are characterized by good mechanical properties and very high melting points. An alloy with 60 per cent Cd melts at a temperature as high as 700 deg. C. In striking contrast to the behavior of the pure metal, the alloy gives a steady arc which can be kept true to the center by rotating the electrodes in the opposite direction. The spectrum shows the silver as well as the cadmium lines, but these are so far separated that even with a low resolving power the slit of a spectroscope can be opened to its full width without any overlapping of the brilliant "blocks" of light which take the place of the usual "lines."—Lond. *Elec. Review*, Sept. 3.

Transformers for Metallic-Filament Lamps.—L. Crough.—The first part of an article on small transformers of from ¼ kw to 5 kw for metallic-filament lamps. Their manufacture has developed into a large industry during the past few years. The author describes and illustrates several types of construction. There are two vitally different arrangements of the secondary circuit; the difference is apparently slight (see Figs. 4 and 5), consisting in the omission of a second low-tension circuit across the points *AB* in Fig. 5. This difference, however, has a great effect on the rating of the transformer, since the utilization of the second low-tension circuit increases the total load that can be safely dealt with by the set by at least 600 per cent. The transformer is said to be of the "balanced" type if connected as in Fig. 4, and of the "simple" type if connected as in Fig. 5. For high efficiency and low cost of installation the "balanced" is far superior to the "simple" auto-transformer, since the maximum losses are only those due to the full load of the trans-

former when the total load supplied is six or seven times the latter. The cost of installation is also only that of a transformer capable of dealing with the out-of-balance current. The efficiency of a "balanced" auto-transformer may be kept well above 99 per cent, whereas that of a "simple" set rarely exceeds 98 per cent. It is difficult to obtain a high efficiency in simple transformers. Thus, the efficiency of a 200-watt eight-to-one transformer is not more than 93 per cent or 94 per cent. It



FIGS. 4 AND 5.—DIAGRAM OF SECONDARY CIRCUITS.

is usually advisable to secure maximum efficiency at about three-fourths full load, the efficiency at half and full load being less by about 0.5 per cent. The article is to be continued.—Lond. *Elec, Review,* Sept. 3. In the second part of his article the author discusses, with the aid of diagrams, the no-load losses and the cost of auto-transformers, and finally gives a numerical example of the economies attending the use of metallic-filament lamps and auto-transformers.—Lond. *Elec. Review,* Sept. 10.

Generation, Transmission and Distribution.

New Steam Turbines.—At Lot's Road generating station of the Underground Electric Railways Company, in London, eight old steam turbines, each rated at 6000 kw, which have been running since 1904, are being replaced by new turbines of the Parsons type. When the eight existing turbines are replaced by the six new ones, which will be more than sufficient for the load, the coal bill will be reduced by at least one-third, and it is estimated that a yearly saving of $150,000 will result, since at present some 500 tons are used daily. Moreover, it has previously always been found necessary to run the entire battery of eight boilers forming the complete unit for each turbine, which, therefore, was unable to develop its full power when one or more of the boilers was shut down for cleaning or repairs. With the lower steam consumption of the Parsons machines, only five boilers out of the eight are required for normal load, and it is hoped to keep them in better condition.—Lond. *Electrician,* Sept. 24.

Electric Power for Shipbuilding Plant.—An illustrated description of the uses of electric power in the works of Armstrong, Whitworth & Company, in Manchester.—Lond. *Elec. Review,* Sept. 10 and 17.

Steam Condensers.—F. Hodgkinson.—In a continuation of his illustrated serial on the choice of a steam condenser he discusses jet condensers and entrainers.—*Electrical Journal,* October.

Traction.

Electric Traction in Great Britain.—A. L. C. Fell.—His presidential address to the (British) Municipal Tramways Association. He first gives statistical data on electrical traction in Great Britain. There are 305 undertakings in the United Kingdom, 177 of which belong to municipalities and 128 to companies and private individuals. The tramways open consist of 1522 miles of double and 941 miles of single line, or a total of 2463 miles, compared with 2394 miles in the previous year. The total capital expended was $340,999,590, compared with $320,460,455 in the previous year. The total number of passengers carried was 2,625,532,895, compared with 2,454,807,487. The gross receipts were $62,198,125, compared with $59,245,875. The working expenses were $38,963,315, compared with $36,818,810 in the previous year. He then discusses the advisability of the revision of the British tramway act of 1870. He deals with "the best use of the thoroughfare," emphasizing that the installation of a tramway does not generally increase the congestion in a street. He refers to railless trolley systems, which may be of use in some special cases. He then emphasizes the necessity for standardization of plant, cars and equipment. He ridicules the use of the "car-mile" as a basis of comparison between different systems. The article is to be concluded.—Lond. *Electrician,* Sept. 24.

Energy Consumption on Tramways.—R. S. Pilcher.—A paper read before the (British) Municipal Tramways Association. The author believes that the remedy for preventing the increase in energy consumption per car-mile on tramways is improved methods of operation. He shows the effect at Aberdeen of explaining to the motormen the saving to be obtained by careful driving, following this up by the installation of meters on the cars. On the Aberdeen tramways he uses amp-hour meters, and these meters have already paid for themselves by the reduction in energy consumption. The author thinks that any system of electric tramways which has no method of checking energy consumption will use at least 5 per cent more energy per car-mile than a system which has a systematic check on the motormen. In Aberdeen, simultaneously with the introduction of systematic supervision of the motormen, he noticed a great improvement in the timekeeping of cars; also, which is very important, a great reduction in motor troubles, the number of armatures in for repairs being greatly decreased.—Lond. *Electrician,* Sept. 24.

Electric Tramways in the West.—Long detailed and profusely illustrated descriptions of the Denver street tramway system, interurban roads in Colorado, electric railways in Utah, electric railways in and about Spokane, in the Puget Sound district, in Oregon and Los Angeles. Also an account of historical interurban electric railways and a history of the past half-decade.—*Elec. Railway Journal,* Oct. 2. (Denver Convention Section.)

Installations, Systems and Appliances.

Earthing the Neutral of Three-Wire Systems.—A discussion illustrated by diagrams. The Board of Trade regulations in England are that the middle wire of every three-wire system shall be earthed at the generating station and efficiently insulated over the rest of its length. Either such earthing, or complete earthing, over the whole length of the main is necessary. If the earth at the generating station be through an appreciable resistance as is advisable for this earth connection to be the only one on the main, which should be carefully insulated at all other points. If, however, a very low-resistance earth connection be preferred, then the main should be earthed throughout its length, a number of local earth connections being undesirable. The author shows finally how to carry out calculations regarding neutral earth conductors.—Lond. *Elec. Review,* Sept. 10.

Controller for Elevators.—An illustrated description of an elevator control gear made by a British company. The controller itself is built up in skeleton form without the use of marble or slate panels, the whole of the apparatus being, in fact, carried on a metal framework, which is insulated where necessary with micanite. This type of construction, it is claimed, eliminates the possibility of the controller being crippled by the breakage of a panel, and at the same time allows the whole arrangement to be easily adjusted or cleaned. Various details of the construction are described and illustrated.—Lond. *Electrician,* Sept. 24.

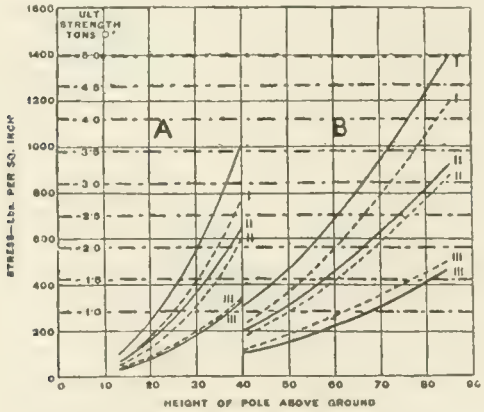
Repair Shop.—W. E. Ireland.—A paper read before the (British) Municipal Tramways Association. A description is given of the various shops comprising the repair depot of the London County Council Tramways. Details of the equipment of each shop, and the method of dealing with the repair and overhauling of cars, are given, together with interesting information with regard to the life of wheel tires, pinions, etc.—Lond. *Electrician,* Sept. 24.

Wires, Wiring and Conduits.

Pole Testing.—S. M. Powell.—The deflection of a simple cantilever, loaded either by a uniformly distributed or by one or more concentrated loads, theoretically varies in direct proportion to the total load, the equations applicable to the two cases being, respectively,

$$\delta = \frac{1}{8}\frac{Wl^3}{EI} \qquad \text{and} \qquad \delta = \frac{1}{3}\frac{Wl^3}{EI}$$

where δ = deflection, W = total load, l = length of cantilever or "arm" of load in the two cases, E = Youngs's modulus, I = moment of inertia of section of cantilever. The formulæ are very closely satisfied by ordinary single telegraph or telephone poles; the former is used in making calculations relevant to wind pressure, and the latter when estimating the effect of wind pressure on the lines, this being transmitted to the pole as a concentrated load by the cross-arms. Where A-shaped poles are used the deflection for a given load applied transversely to the length of the line is naturally much less than in the case of single poles (the ration varying from 1/30 to 1/60, and being usually about 1/50). Moreover, the deflection no longer varies directly with the load, but, roughly, in accordance with a law, $\delta = KL^n$, where δ = deflection, K = constant, L = load, and n = a numerical index constant for each particular case and usually lying between 1 and 2. The author then gives details of the construction of A-shaped poles, with notes on the liability to slip at the top joint. The stress on the poles at the ground level, and 5 ft. above the latter (these being standard points of reference in pole calculations), due to a wind pressure of 30 lb. per square foot (this being taken as the maximum force of the severest gale likely to be encountered on ordinary systems), are shown in Fig. 6. These results allow for the taper of the poles



A 10-in. poles. B 20-in. poles.
Full lines = stress due to B.M. at ground.
Dotted lines = stress due to B.M. 5 ft. above ground.
Case I = Parallel poles. Case II = Top dia. only half ground dia. Case III = Tapered to point.

FIG. 6.—POLE TESTS.

(about 1 in 120), and assume a cylindrical surface to have a coefficient of resistance equal to one-half of that of an equal plane surface. The curves refer to a considerable range of lengths and assume a uniform ground diameter of, say, 10 in., for poles up to 40 ft. long, and, say, 20 in., for poles 85 ft. long (these lengths being the projection above the ground; from 5 ft. to 9 ft. have to be buried according to the size of the pole). —Lond. *Elec. Review,* Sept. 3.

Calculation of Transmission Lines.—A. Blondel and C. LeRoy.—In the calculation of high-tension transmission lines it is necessary to take into consideration the capacity and leakage which are uniformly distributed along the line. In the past this problem has been solved mainly by means of graphical constructions, with the aid of hyperbolic functions. In the present article the authors begin to describe a simple method which is suitable for practical use and which does not necessitate the use of hyperbolic methods and complicated calculations. The article is to be continued.—*La Lumière Elec.,* Sept. 19.

Compound Conductors.—A note on a recent British patent of R. K. Gray (17,283, 1908; Sept. 9, 1909). In a conductor composed of a central solid or stranded core of one metal surrounded by a wire or tape sheath of another metal, the wires or tape of the sheath are given a coating of the same metal as that at the surface of the inner core. The object is to prevent corrosion due to moisture. If more convenient, both the core and the sheath wires may be given a surface coating of the same metal.—Lond. *Elec. Eng'ing,* Sept. 16.

Electrophysics and Magnetism.

Radio-Activity.—O. Hahn.—A British Association paper on the separation of new radio-active disintegration products. The author and L. Heitner have formerly proposed, as a working hypothesis, that single radio-active products emit only one type of radiation, either homogeneous alpha particles or homogeneous beta particles. This hypothesis has been found useful. An interesting deduction now made is that radium itself must be complex and consist of two different products, say, radium and radium x. "If further work should prove radium to be complex, there is little doubt that the few other radio-active transformation products which still emit complex rays are complex, and, therefore, to be separated. We might then be in a position to find some relation between the life period and other qualities of the products and the kind and velocity of the rays the particles emit."—Lond. *Electrician,* Sept. 17.

Luminous Discharges in Gases.—R. F. Earhart.—An abstract of a British Association paper on the effect of temperature variations on the luminous discharge in gases at low temperatures. The apparatus used in this investigation consisted of a small glass bulb in which two parallel electrodes were sealed. These electrodes were 5 mm apart. Suitable tubes permitted the bulb to be evacuated, the pressures being measured with a Macleod gage. The bulb was contained in an electric furnace, which could be used also as a container for carbon-dioxide snow, when measurements were taken of discharges occurring at low temperatures. Potentials required to produce a luminous discharge for pressure varying from 78 deg. C. to 325 deg. C. were observed. The gases operated upon were air, hydrogen and carbon dioxide. Potentials required to maintain the luminous discharge under similar conditions were also measured. Families of curves showing the effects of temperature and pressure for potentials both to produce and to maintain luminous discharge are given. They indicate that Paschen's law holds approximately for the discharge in air until temperatures in the neighborhood of 300 deg. C. are attained. Here Paschen's law does not hold even approximately. The effect of temperature variation on the potential required to maintain the discharge is much less than for the production of the initial discharge.—Lond. *Electrician,* Sept. 17.

Conductivity of Flames and Magnetism.—H. A. Wilson.—An illustrated paper read before the Royal Society in London on the effect of a magnetic field on the electric conductivity of a flame. The author gives an account of some measurements of the change in the conductivity of a Bunsen flame produced by a magnetic field, the direction of which is perpendicular to the current through the flame and to the motion of the flame gases The velocity of the negative ions in the flame is calculated from the results, and the value of the velocity obtained agrees approximately with that found by other methods.—Lond. *Electrician,* Sept. 24.

Determination of Resistances by Graphics.—F. W. Harris.—An article illustrated by diagrams showing a simple method by which the complex calculations required in determining resistances for motor control equipments to give certain conditions of acceleration are made with ease and clearness by graphic solution. The graphical determinations of both resistances in series and resistances in parallel are discussed.—*Electric Journal,* October.

Electrochemistry and Batteries.

Nitric Acid from Air.—F. Russ.—An illustrated description of the Innsbruck plant for obtaining nitric acid from air. Use

is made of the Pauling process, in which arcs are produced between two electrodes which are curved like the electrodes of a horn lightning arrester. The two horns are nearest together at the bottom, and the arc is lighted at that point. On account of the rising hot air the arc rises upward, becomes longer and is broken once for every half period of the alternating current. A new arc is then lighted at the bottom, and so on. At present 24 furnaces are in operation at the Innsbruck plant, with an aggregate rating of 15,000 hp. Sixty grams of HNO_3 are produced per kw-hour in the Paulding process.—*Electrochem. and Met. Industry,* October.

Electric Iron and Steel Industry in Sweden.—E. Haanel.—An account of his official report on his visit to Donnarfvet, in Sweden, where he investigated the Grönwall-Lindblad-Stalhane electric furnace for iron-ore reduction. He also describes a new electric steel furnace of the same inventors. It is operated by two-phase currents. The terminals of one pole of the two phases are electrically connected with one of the two adjustable electrodes of the furnace (suspended vertically through the top), while the terminals of the other poles of the two phases are electrically connected with the lining to the furnace. This lining is made of magnesite or dolomite. It is a "conductor of the second class" and is a non-conductor at ordinary temperatures. When the furnace is to be started, coke is placed on the lining and the lining is thus preheated and then becomes a conductor. The furnace is intended for continuous operation.—*Electrochem. and Met. Industry,* October.

Calcium Carbide.—C. A. Hansen.—A paper read before the International Congress of Applied Chemistry on an investigation in which the author studied the reaction $CaO + 3\,C = CO + CaC_2$, with particular reference to the equilibrium CO pressure at various comparatively low temperatures.—*Electrochem. and Met. Industry,* October.

Ferro-Vanadium.—J. Escard.—The first part of an article on properties and methods of manufacture of ferro-vanadium. In the present instalment electrolytic processes are described.—*La Lumière Elec.,* Sept. 18.

Laboratory.—E. G. Mahin.—An illustrated description of the elaborate laboratory for electro-analysis at Purdue University.—*Electrochem. and Met. Industry,* October.

Units, Measurements and Instruments.

A Source of Error with the Alternating-Current Bridge.—Behne.—If capacities or self-induction coefficients are compared by means of a Wheatstone bridge supplied with alternating current, the result is influenced by the fact that the different arms of the bridge may have a capacity against earth. The author mentions the following particular case in which two condensers, C_1 and C_2, of normally equal capacity were to be compared. (Fig. 7.) For certain reasons, a source of alternating current had to be used, but the voltage was too high for the bridge and some voltage has to be cut off by resistors in series. This was done by inserting at A a rheostat in the bridge arrangement; the bridge itself was shunted by an earthed resistance. The measurement showed that C_1 had twice the capacity of C_2. The condensers were then exchanged and now C_2 had twice the capacity of C_1. Correct results were obtained by connecting the rheostat to B instead of to A. The author calculates in detail what happened here as the result of the capacity of the bridge arms against earth.—*Elek. und Masch.* (Vienna), Sept. 19.

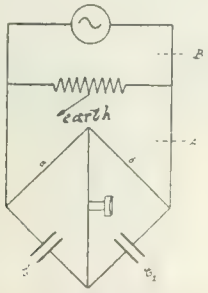


FIG. 7.—DIAGRAM OF ALTERNATING-CURRENT BRIDGE

Magnetic Testing of Iron.—A. Campbell.—A paper presented to the (British) Inst. of Elec. Eng. The introduction of high-resistivity iron alloys with low hysteresis loss has made it more than ever desirable that sheet material for use in transformers, or alternating-current machinery, should be tested for hysteresis and eddy-current loss by means of actual alternating current. The author has investigated the effect of widely different wave-forms and various materials on the accuracy of the formula given by Roessler for the iron loss of a transformer. For certain materials the author finds that the hysteresis loss increases considerably as the frequency is raised, due probably to magnetic viscosity. Experiments are recorded to show the effect of the thickness of the sheets on the eddy-current loss; the effect of the dimensions of the stampings on the hysteresis loss is also shown.—Lond. *Electrician,* Sept. 24.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—A note on a recent demonstration given at the wireless telegraph station at Cullercoats with Poulsen's high-speed system of transmission. In this system the receiving apparatus is exceedingly simple. A thermo-couple, or contact rectifier, is used as a detector; the unidirectional current thus obtained is passed through an Einthoven galvanometer, the vibrating wire of which is of platinum or gold, prepared by the Wollaston process, about 6 cm long, and having a resistance of 100 ohms if of gold and 400 ohms if of platinum. Its motion is made dead-beat by shunting it with a resistance of about 1500 ohms. A vertical image of this wire (the image being considerably improved by smearing the wire with a little lampblack) is projected by means of a microscope on to a horizontal slit behind which moves a strip of sensitive paper. This strip, passing the slit, is guided by pulleys through the troughs of two bird fountains, being developed in the first and partially fixed in the second. If a permanent record is required, the tape, on leaving the instrument, is run into a second fixing bath. The rectifier actually used in the experiments shown consisted of a small fragment of galena and one of metallic tellurium pressed together. The highest speed at which messages have been received at Cullercoats from Lyngby is 100 words per minute. At the actual demonstration the messages were received at the speed of 50 words per minute; with shorter distances, as between Lyngby and Copenhagen, a speed of 300 words per minute has been attained.—Lond. *Electrician,* Sept. 17.

Miscellaneous.

Iron Alloys.—C. F. Burgess and J. Aston.—An account of an investigation of some physical characteristics of iron alloys with special reference to forging, welding and machining. The authors started with pure electrolytic iron, and then tested alloys with aluminum, antimony, arsenic, bismuth, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silicon, tin, tungsten and vanadium. The results are given in the convenient form of a table.—*Electrochem. and Met Industry,* October.

Refractory Materials.—S. Wologdine and A. L. Queneau.—The conclusion of their long article on the conductivity, porosity and gas permeability of various refractory materials. The results are summed up in a large table.—*Electrochem. and Met Industry,* October.

Galvanized Metal.—W. H. Walker.—A paper read before the American Society for Testing Materials on the testing of galvanized and other zinc-coated metals. After describing the "Preece" test, he points out the desiderata of a new test, describes a test for detecting pinholes and cracks, and a test for determining the combined effect of imperfections.—*Electrochem. and Met. Industry,* October.

Liquefaction of Gases.—C. Lightfoot.—An illustrated article on the liquefaction of gases and the commercial production of oxygen. The author describes the Linde machine for making liquid air and the production of pure oxygen by the fractional evaporation of liquid air.—*Elec. Journal,* September.

BOOK REVIEWS.

Thermoelemente und Thermosäulen. By Prof. Dr. Franz Peters. Halle: Wilhelm Knapp. 184 pages, 192 ills. Price, 10 marks.

This book is a historically descriptive treastice of the development and applications of thermo-electric couples. It does not discuss the quantitative theory of thermo-electricity, but deals with the practical uses of thermo-electric batteries and with their construction. The value of the book is considerably enhanced by good indexes of subjects and of authorities. The work will be very useful as a reference book to students interested in thermo-electric cells.

Manual of Wireless Telegraph. For the Use of Naval Electricians. By Lieut.-Commander S. S. Robison, U. S. Navy. With revisions and additions by L. W. Austin, Ph.D. Annapolis: U. S. Naval Institute. 129 pages, 60 ills.

The title of this excellent elementary treatise on wireless telegraphy is somewhat misleading, as the amount of matter contained relating to wireless operation forms but a small percentage of the contents. Nevertheless, the practical information included probably represents about all yet available for systematic presentation. Chapters I and II deal with the fundamental principles of electricity, magnetism and hertzian waves, particular attention being paid to condenser and etheric wave phenomena. The presentation of the latter subjects is very satisfactorily accomplished without the use of mathematics or abstract conceptions, thus bringing their understanding within the capacity of one having little or no previous knowledge in the premises. Chapter III deals in a similar manner with damped and undamped oscillations, and Chapters IV and V are confined to sending and receiving circuits, respectively Without going into the details of specific types of apparatus, these latter chapters give a satisfactory idea of the principles upon which present apparatus are founded. Among the appendices is one on the installation and operation of navy wireless apparatus and another giving the code of naval wireless regulations. To one who wishes to obtain an intelligent working knowledge of the principles of wireless and their application, this book can be confidently recommended.

Elektrische Bahnen in Nordamerika. By Prof. Dr. Wyssling. Zürich: Meyer & Zellers. 302 pages, 123 ills.

This volume forms part of a report of a Swiss commission appointed for the study of electric railways in different countries. It covers all of the principal electrified steam roads and all of the interurban electric roads as well as the principal urban high-speed electric traction systems of the United States. All of the tabular and numerical subject matter has been recast into the metric system. Prices and costs have been translated into Swiss equivalents. The treatment is statistical and descriptive, rather than critical or deductive. In many respects the book furnishes a better comparative description of American electric railways than can readily be obtained by consulting American books on different railroads *seriatim*. The volume is not only of historical interest, but forms an excellent compendium of American electric railroads and systems in a very convenient form for comparison with similar systems in Europe.

NEW APPARATUS AND APPLIANCES

Curtis Turbine Used as Regulator.

By W. J. Davis, Jr.

An interesting example of the effectiveness of a Curtis steam turbine when used as a regulator on a large power system is found in the new Oakland power house of the Pacific Gas & Electric Company, of San Francisco. The installation consists of a 9000-kw vertical type Curtis turbo-generator, manufactured by the General Electric Company; eight 750-hp McNaull water tube boilers, and a Worthington condenser outfit having a cooling surface of 20,000 sq. ft.

The 60,000-volt transmission system of the Pacific Gas & Electric Company entering Oakland is delivering more than 100,000 kw during maximum demand. Of this amount 20,000 kw maximum are supplied to Oakland and immediate vicinity, the load factor being about 60 per cent. While the new plant is of great value in carrying the local peak load during hours of maximum demand, it is almost continuously kept connected to the transmission system on account of the steadying effect on the voltage and consequent improvement in the lighting service. When acting as a regulator the duty is especially severe, the turbine taking sudden momentary swings in load from 500 to 9000 kw. In a word, the action of this turbine on an alternating current system is equivalent to that of a large storage battery on a direct current system.

The ability of the Curtis turbine to successfully take these sudden fluctuations in load is due to the large flywheel effect (about 10 times that of a reciprocating engine of equal capacity), close speed regulation, large radial clearances between moving and stationary steam-using elements, and sturdy mechanical construction.

This use of a Curtis steam turbine is particularly interesting on account of the high economy obtained under varying load. Even when the turbine is operating as a regulator the overall economy of the plant is exceptionally good.

The Cooper Gas Engine.

The C. & G. Cooper Company, Mt. Vernon, Ohio, became convinced several years ago that in certain fields of work a thoroughly practical gas engine would prove advantageous, and



FIG. I.—ADMISSION VALVE.

began a careful investigation of the gas-engine situation in this country and in Europe. After examining existing designs, the company finally decided to design its own gas engine, and

unite, if possible, all the best engineering features which modern practice had proved to be sound and desirable.

Martin A. Thiel, the well-known gas engine expert and designer, was selected to supervise this important work. A German engineer of broad technical training, Mr. Thiel's many years of experience in designing and building the largest and most successful gas engines operating in this country especially fitted him to accomplish the desired result. Mr. Thiel's wide experience also in operating large gas-engine plants has proved valuable in solving with originality and skill many of the problems of gas engineering, such as ignition, timed lubrication, cooling and regulation.

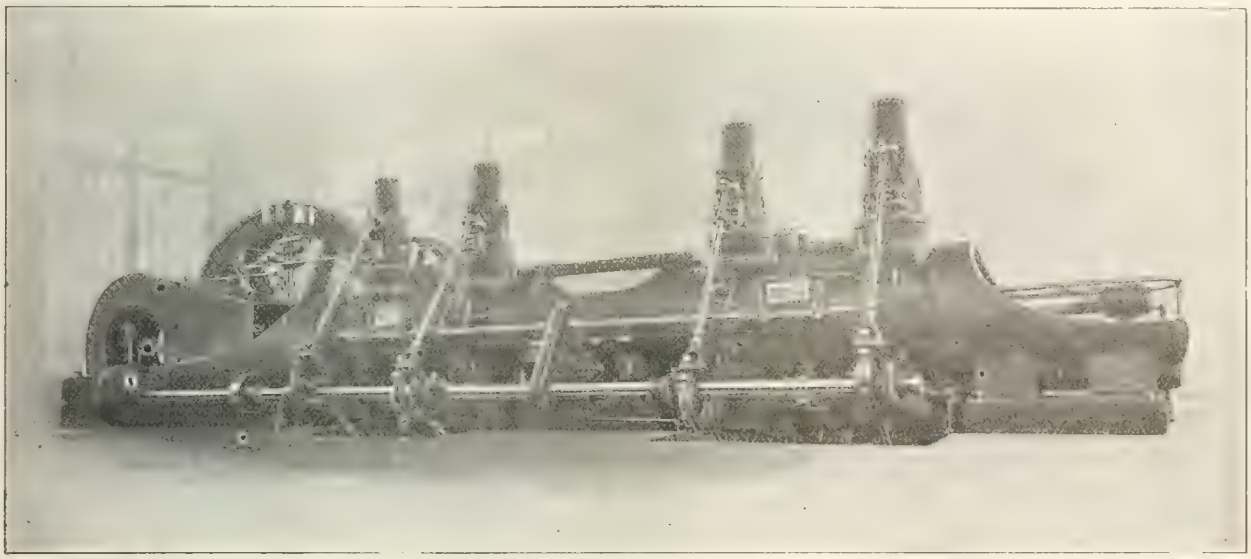


FIG. 2.—GENERAL VIEW OF GAS ENGINE.

Little publicity has been given the extensive gas-engine developments being carried on by the Cooper company, pending endurance tests in service of the new machines. These tests have thoroughly demonstrated the success of the design, which, it is believed, will be a valuable acquisition to the gas-engine field. Its regulation, running qualities and general reliability have been proved to be equal to that of a steam engine of the highest grade, while the thermal efficiency is, of course, far superior to that of any steam engine.

The new Cooper engine is a double-acting, four-stroke cycle machine, working on the constant mixture principle from the center of the engine so that they travel an equal distance and with equal resistance to the respective intake valves of the cylinders. The mixtures in the various cylinders, therefore, must be identical in volume and composition under all conditions of load. Upon a similar principle the cooling water is introduced into the piston rods from a central point and passes through each piston and piston rod, without reversing the flow, to the outlets at the forward and rear ends of the engine. The overhanging counter-balanced type of crank has been adopted.

The bed is of the heavy-duty rolling-mill type, having an open top, permitting access to the crosshead, and easy removal of the cylinder head and piston through the bed. The bed is rigidly bolted to the foundation, while the distance pieces and tail-rod supports, which are of cylindrical construction, rest on base plates in machined ways. The main bearing is of special design. The lower shell rests in a bored seat, and may be easily removed after relieving it of the weight of the shaft. This shell is babbitted and cored for water cooling. The side gibs are provided with wedge adjustment on either side and are lined with babbitt. The cap is babbitted at the ends only, and is used to clamp the quarter boxes and the bottom shell into place. In addition there is a transverse rib on either side of the cap extending the length of the bearing, which provides a retaining wall for the oil, and compels it to enter the bearing above the

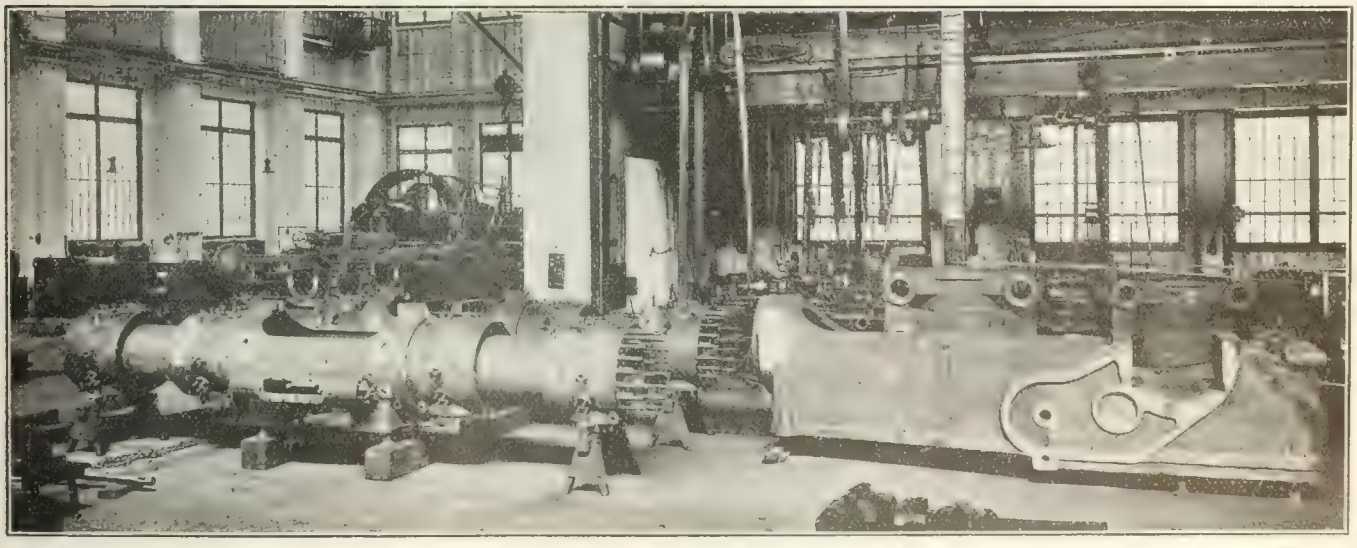


FIG. 3.—GAS ENGINE IN PROCESS OF ERECTION.

side gibs. The cross-head is fitted with an improved flat shoe, the top face of which is bored to allow the cross-head pin to align itself with the crank pin, should the latter be thrown out of the horizontal plane by shaft deflection.

All pistons and piston rods are similar, and are interchangeable. The pistons contain no ribs and float on hollow rods between the main, intermediate and supplementary crossheads. The rods are drilled for water circulation and forced into the pistons. The cylinder is a one-piece barrel, with inlet and exhaust chambers bolted to it so as to remove all cooling strains in the castings. The water jacket is closed at its center by a belt in three segments. The cylinders are supported only at the ends by the main bed and guide castings, and as the piston and rods are carried by their respective crossheads, the cylinder barrels are permitted to expand and contract with freedom. The exhaust piping is of flexible construction throughout, insuring free movement for expansion and contraction due to changes of temperature.

The ignition is of the "make and break" mechanically operated type, and two or more igniters are operated simultaneously at each end of each cylinder. This system is connected with a safety stop, which automatically breaks the electric circuit when the engine speed exceeds 10 per cent above normal, or the cooling water supply fails. The engine is regulated by varying the quantity of a constant mixture controlled by the governor through an automatic relay. The lay shaft is driven by spur and bevel gears, and is supported by bearings on the engine bed and base-plates, thus avoiding the common practice of supporting it on bearings from the cylinders, where these bearings are subjected to the changes due to expansion and contraction.

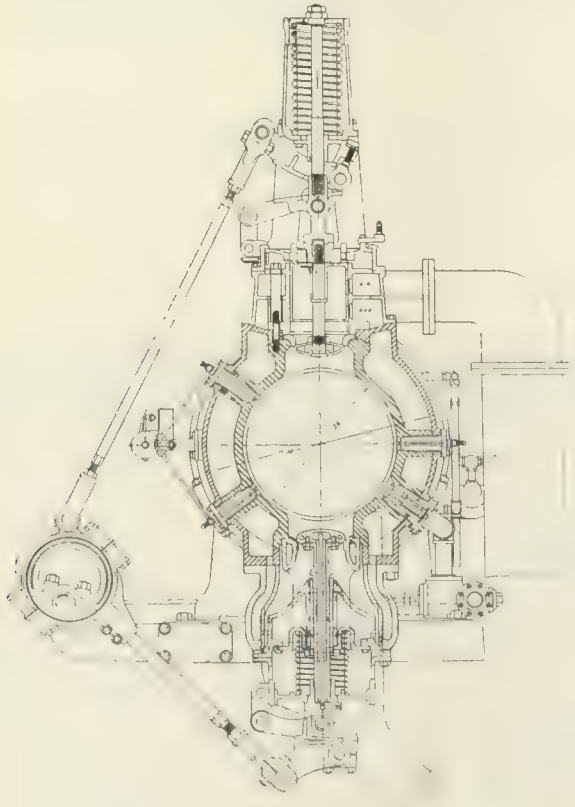


FIG. 4.—CROSS-SECTION OF GOVERNOR.

This plan has the additional advantage of permitting the removal of the cylinders without disturbing the lay shaft bearings. The inlet and exhaust valves at either end of each cylinder are actuated by a single eccentric on the lay shaft. The exhaust valve is of the separate cage, water-cooled type. The gas regulator is of a special oil-sealed, enclosed construction with balanced valve.

Aside from the remarkable combination in this engine of features essential to the best results in a gas engine, the construction details common to all reciprocating engines, such as bearings, connecting rods, etc., have been worked out with unusual painstaking and skill. The design and performance of the engine are stated to have been regarded as very remarkable by many prominent gas engineers who have inspected it. It will be built in single-tandem and double-tandem units of from 150-hp to 3000-hp capacity.

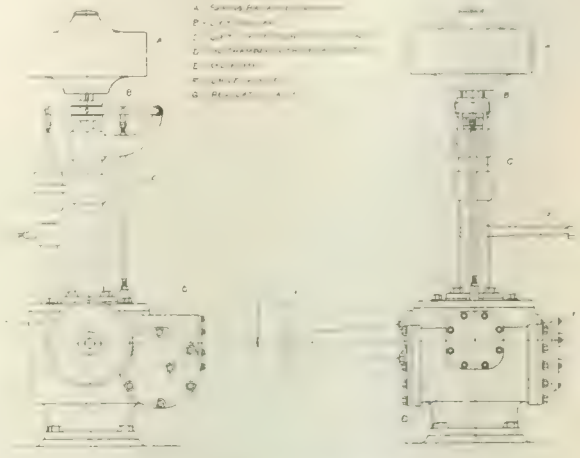
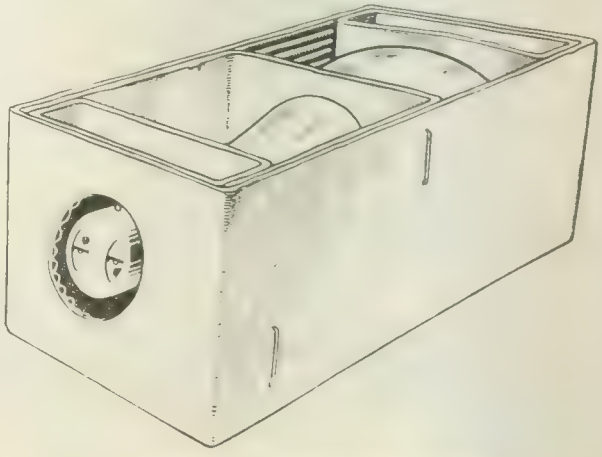


FIG. 5.—AUTOMATIC OIL-PRESSURE RELAY GOVERNOR.

Sealed Tungsten Lamp Cartons.

A sealed tungsten lamp carton of a type shown in the accompanying illustration is being adopted by many manufacturers abroad, in order to minimize claims made for lamps broken in transit. The lamp may be examined and tested, and even lighted while in the carton. It cannot be removed without breaking the seal, and, therefore, enables a hard and fast line to be laid down as between the seller and the buyer as to claims for breakage in transit.

In case a broken lamp is returned to the sender within a reasonable period with the seal of the carton unbroken, it is fair to assume that the breakage occurred in transit and a claim therefor allowed. The cartons, which are of square cross-section, and thus not likely to roll off the counter or shelf, have a label including brief instructions as to test and conditions of claims. Other advantages for the cartons are that they do not need any packing when cased; the breakage in transit is considerably reduced; improper claims for breakage are prevented, and arguments between the buyer and seller are minimized.



SEALED TUNGSTEN LAMP CARTON.

The Split-Pole Direct-Current Converter.

An interesting application of the split-pole scheme for varying the voltage ratio in dynamo-electric machinery is found in the C.M.B. direct-current "auto-converter" recently placed on the market by Crompton & Company,Limited, Salisbury House, London Wall, London, E. C., England. The principles upon which the converter operates were outlined on page 333 of our

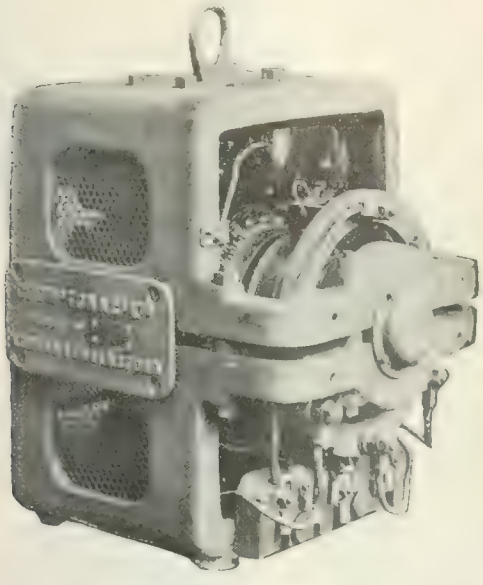
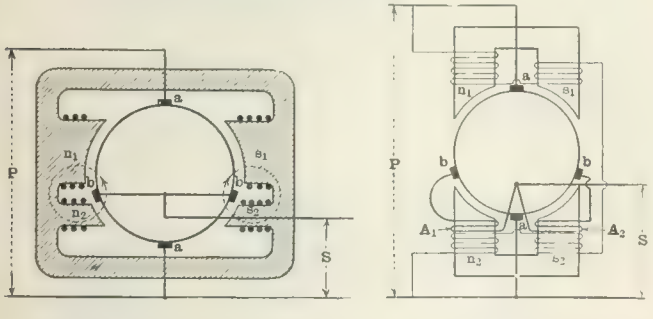


FIG. 1.—SPLIT-POLE DIRECT-CURRENT CONVERTER

issue for Aug. 5, 1909, while a view of the machine is given in Fig. 1 herewith.

The converter differs from the well-known bipolar type of direct-current machine in being provided with four brushes instead of two, the two extra brushes being placed at equi-potential points on the commutator so as to divide the e.m.f. between the main brushes into the proper ratio for the desired conversion. An idea of the scheme employed for obtaining the required voltage ratio may be gained from Fig. 2. The supply (primary) e.m.f. is impressed at *P* between the vertical brushes *aa*, while the delivered (secondary) e.m.f. is obtained at *S* between the lower *a* brush and the brushes *bb*. Slots in the two field poles serve for minimizing the spark-



FIGS. 2 AND 3.—MAGNETIC AND ELECTRIC CIRCUITS OF CONVERTER

ing at the brushes *bb*. The actual mechanical arrangement differs somewhat from the explanatory diagram of Fig. 2, being more nearly equivalent to that of Fig. 3. In comparing the latter diagram with the former, it will be noted that the reluctance of the path for any flux produced by armature m.m.f. is considerable. Moreover, the pole parts which regulate the secondary delivered e.m.f. are provided with series windings ,in addition to the ordinary shunt coils, as shown at A_1A_2. These coils serve to interconnect the auxiliary brushes and one of the secondary terminals of the machine. Under normal circumstances when there is no circulating current flowing through the armature across the short-circuited auxiliary brushes, each brush and each series-field coil will be carrying one-half of the secondary load current. If, however, a circulating current arises, it will flow in opposition to the load current in one coil, A_1, say, and in conjunction with the load current in the other coil, A_2; in effect, therefore, the current in coil A_1 will be less than in A_2, and if these coils are suitably coupled up will have the effect of correcting or preventing the short-circuit current from rising to any considerable value. In other words, as the current in the coil A_1 is less than the current in the coil A_2, the m.m.f. on the pole n_2 is less than the m.m.f. on the pole s_2, and this tends to cause a greater voltage to be generated under the pole s_2 than under the pole n_2, thus opposing the voltage which is creating the circulating current. The series coils can be arranged to give a compounding or a differential effect on the secondary circuit as desired.

The above-described machines can be used for obtaining a constant secondary e.m.f. for any value of the secondary current, or for giving a secondary current which is to remain approximately constant for a given range of secondary voltage, or they can be utilized as variable-ratio, split-pole synchronous converters by adding collector rings for the introduction of alternating current.

As a general rule the diagram shown in Fig. 3 is suitable for machines giving constant voltage. Such machines would be the direct current equivalent of an alternating-current auto-transformer, but would have the advantage that the secondary voltage could be easily altered at will, independently of the primary voltage or compounded for voltage drop. By so interconnecting the series coils that their m.m.fs. oppose the m.m.fs. of the

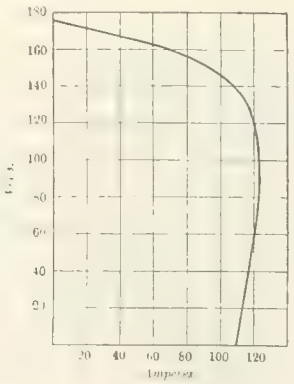


FIG. 4.—CHARACTERISTICS OF CONSTANT-CURRENT CONVERTER

shunt coils on pole-parts n_2 s_2 the machine may be caused to deliver automatically a practically constant secondary current.

Fig. 4 shows the relationship between the secondary amperes and voltage of a 220-volt machine made for the purpose of supplying energy to two 120-amp, 60-volt arc lamps in series. The efficiency of this machine, when supplying energy to the two lamps was over 92 per cent. The dimensions of the machine are 24 in. high by 22 in. by 24 in. long, and it weighs 900 lb. The weight of the set and the space taken up are remarkably small.

Condit Carbon-Break Circuit-Breaker.

Every carbon-break circuit-breaker has two functions, one of which is to carry its full rated current without undue heating, and the other to open the heaviest short-circuit which may be put upon it without burning the brush to such an extent that the breaker is rendered inoperative. In the ordinary form of carbon break, where the carbons are pivoted in a plane to the base, the pressure on the carbon and the amount of carbon in contact is greatest when the breaker is fully closed. When the secondary and the brush are leaving, which is the critical point, the resistance of the carbon path is comparatively high, as the pressure has been removed from the spring and the carbons have so slid as to present but a line contact.

In the breaker illustrated herewith, made by the Condit Elec-

trical Manufacturing Company, Boston, the desirable features of low secondary contact resistance at the critical point have been obtained by the use of sliding carbons which yield at right angles to the board. These carbons are so proportioned and

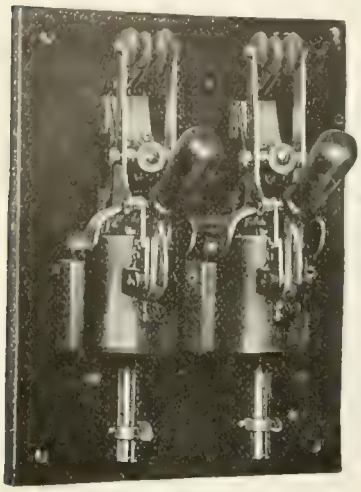


FIG. 1.—DOUBLE-POLE CIRCUIT BREAKER

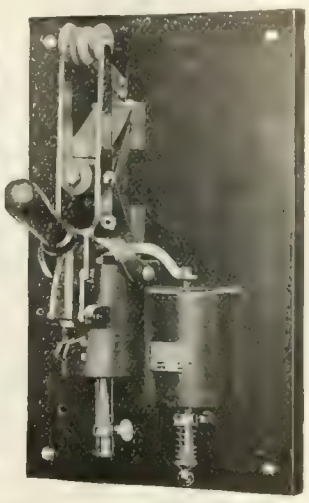


FIG. 2.—OVERLOAD-UNDER-LOAD CIRCUIT BREAKER.

arranged that a maximum surface contact and, consequently, minimum resistance, is obtained at the instant the secondary contact leaves the block. The spring being at right angles to the base and not in the plane of the movement gives equal pressure at all times. Among the other features of the breaker are a single coil to a pole, interlocking mechanism so that it is impos-



FIG. 3.—SINGLE-POLE CIRCUIT BREAKER.

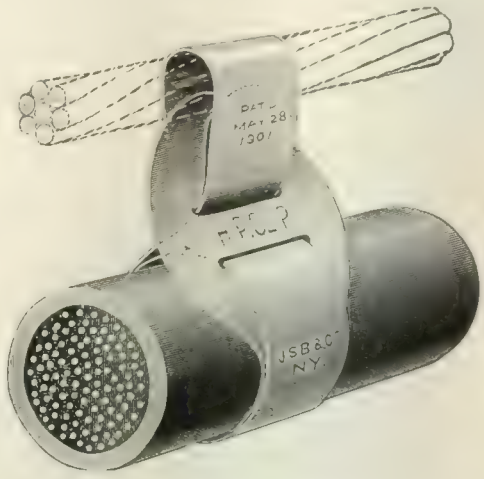


FIG. 4.—OVERLOAD NO-VOLTAGE CIRCUIT-BREAKER.

sible to open in any way one pole of the breaker without opening all of the poles, and heavy, massive parts. The cuts show a single-pole, a double-pole, an overload shunt-trip and no-voltage and overload-underload breakers. Besides these the breaker is also made for reverse-current attachment and in other special forms that may be required.

Cable-Hanger.

The cable hanger shown herewith, known as the "H. P. Rustless Cable Hanger," is stamped out of sheet zinc, and being complete in one piece has no parts to become detached or iron hooks to rust out, thereby allowing the cable to sag or fall. Being of zinc it is durable and affords a good metallic connection of the messenger wire with the lead sheath on the cable. This feature localizes the damage by lightning and high-tension crosses, thereby greatly reducing reconstruction costs. The hanger binds tightly on the cable, and being flat, does not interfere with the cable car riding readily over the messenger wire after it has been applied. It packs closely in small boxes, 500 in each, of convenient size for carrying under the arm. The hanger is attached as follows: Hold the circular end against the cable and wind the free end twice around and once over the



RUSTLESS CABLE HANGER

messenger wire as shown in the cut. The cable hanger described is made by H. P. Copeland, 127 Franklin Street, New York City.

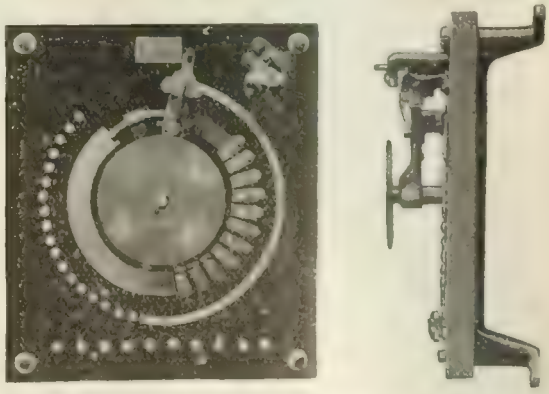
Machine-Tool Controllers.

The attached cuts show the newest type of Ward-Leonard machine tool controllers. The full reversing type, giving armature and field control in either direction, is arranged for either



FIG. 1.—FULL REVERSING-TYPE MACHINE-TOOL CONTROLLER.

hand or chain drive. The resistance is mounted directly on the face plate or at a distant point. The same is true of the non-reversing type. The cut shows the front and side view of the



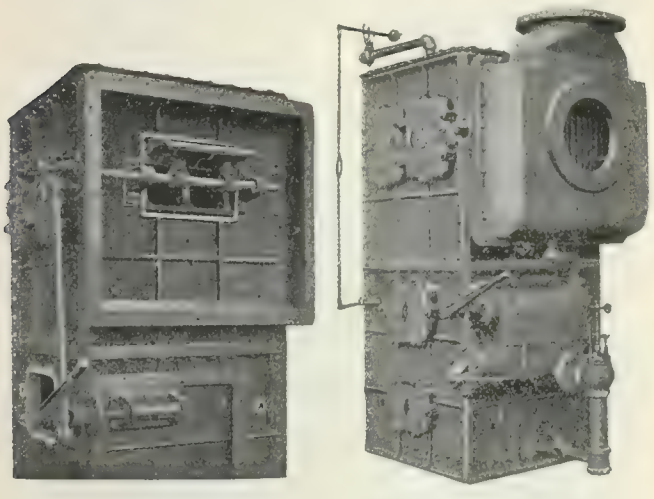
FIGS. 2 AND 3.—FRONT AND SIDE VIEWS OF NON-REVERSING TYPE.

non-reversing type. A plate is furnished to which the sprocket wheel is attached. The resistance in either case consists of standard Ward-Leonard enamelled resistance units

Combined Valve-Gear for Heaters and Receivers of the Steam Stack and Cut-Out Valve Type.

Some time ago the Harrison Safety Boiler Works, Philadelphia, Pa., put out a new type of combined heater and receiver for use in connection with exhaust-steam heating and drying systems. The peculiar feature about this heater was the extra large separator attached to and forming a part of it, and intended to purify all the exhaust steam delivered by the engine, including not only that entering the heater to heat the boiler feed-water, but also the surplus passing to the heating and drying system. In order to be able to cut the body of the heater out of circuit, as for cleaning and inspection while the heating system continues in operation, a manually controlled valve was provided to shut the separator off from the heater body and another to close the passage between the separator trap and the overflow of the heater, the latter being necessary in order that the trap might continue to drain the separator when the heater was cut out of circuit without allowing steam to enter the heater by way of the separator drain pipe and trap.

It is obviously necessary that both valves be closed when it is desired to cut the heater out; also, that if a man is to enter the heater body while the separator is receiving steam, some provision must be made against accidental opening of the valve.



FIGS. 1 AND 2.—COMBINED HEATER AND RECEIVER.

On small heaters it was found practicable to connect the spindles of the two valves together and to turn them by a single lever, the handle for operating the valves being attached to the spindle of the upper valve, while a connecting rod driven from a short crank on this spindle operates a second crank keyed to the spindle of the lower valve.

The steam valve between the separator and the heater is of the semi-cylindrical rotating type, and is held against its seat by springs, and also by the pressure of the steam. Where a pressure of 5 lb. per square inch, or more, is carried in the heating system, the total pressure over the valve of a large heater would render operation difficult, by forcing the valve tightly against the seat. In order to obviate this a special valve gear has been devised. The operating handle is attached to the spindle of the lower valve instead of to the upper, and the lower end of the connecting rod engaging the pin on the short crank of the lower spindle is slotted, so that the lower spindle has a certain excess of motion over that of the upper spindle. The amount of this excess motion is so adjusted that in closing the upper valve shuts off first, and then stands still while the lower valve rotates through the remaining arc of its motion, which it is enabled to do by reason of the lost motion in the connecting rod. In this way the upper valve is closed while there is still pressure in the heater to balance the pressure of steam on the outside of the valve. Subsequently, the lower valve closes, cutting off the heater, after which any steam contained therein will be condensed or escape from the vent pipe with which an open heater is always provided. Once both valves are closed, the operating handle is removed from its spindle before the cleaning doors of the heater are opened, making it impossible for the steam valve to be operated until the handle is replaced.

In opening the valves, the lower valve will swing through a sufficient arc to establish communication for steam through the separator drain pipe and trap into the heater, equalizing the pressure on the steam valve before the latter begins to move. Once the pressure is the same on both sides of the valve, the latter will slide easily, and the operation of opening can be completed. During this operation the valve in the vent pipe of the heater should be closed to permit pressure to build up in the heater when the lower valve is first opened.

Single-Phase Cars for New Haven Suburban Service.

At the East Pittsburgh shops of the Westinghouse Electric & Manufacturing Company there are now being installed the electrical equipments of a number of motor-cars for the suburban service of the New York, New Haven & Hartford Railroad. These cars are designed to operate on either the 11,000-volt alternating-current catenary trolley of the main New Haven electrification or the 600-volt direct-current third-rail section entering the New York terminal.

By reason of the fact that the New York, New Haven & Hartford equipments are required to operate on the New York



SINGLE-PHASE MOTOR CAR FOR 11,000-VOLT SERVICE.

Central direct-current third-rail the control equipment for effecting a change from alternating current to direct current is necessarily more extensive than would have been the case if the control had been arranged for straight alternating-current operation throughout, but, as seen in the accompanying illustration, this auxiliary apparatus has been so well distributed under the floor that there is ample room for everything in the space between the trucks.

The cars, which are intended to pull trailers, are equipped with four compensated series motors. These and the step-down auto-transformers are supplied with forced ventilation from the blower system. When the equipment is operated under forced ventilation the one-hour railway rating of each motor is 200 hp. Each car is guaranteed to haul two 50-ton trailers, and when so operated will accelerate normally at a rate of 0.7 miles per hour per second.

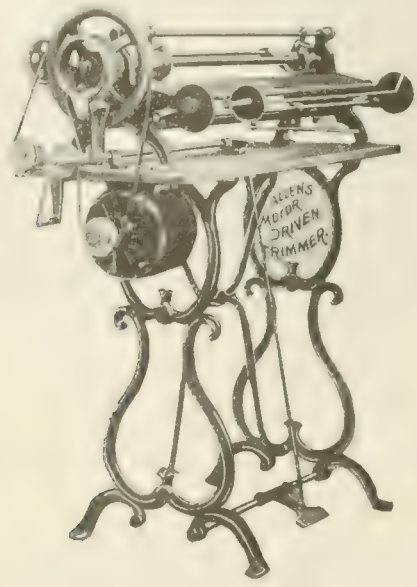
The arrangement of the motors differs from that of any other cars in use in this country, in having the motor geared to a quill surrounding the axle which is coupled to the wheels by means of springs of the same type as are used successfully on the New Haven locomotives.

Each car weighs 86 tons, is 70 ft. in length and has a seating arrangement for 72 persons. Cars and trucks, which were built by the Standard Steel Car Company, are of fireproof, steel construction throughout. They are handsomely finished and are said to be the most easy-riding cars ever built.

Electric Wall-Paper Trimmer.

The accompanying illustration shows an electrically driven wall-paper trimmer recently put on the market by A. Allen & Company. The construction is such that the operator has full control of the machine, being able to start and stop instantly, go slow or fast, the only effort required being a pressure of the foot.

It will readily be seen that this is a great advantage over the old way of turning the crank, as it gives the operator free use



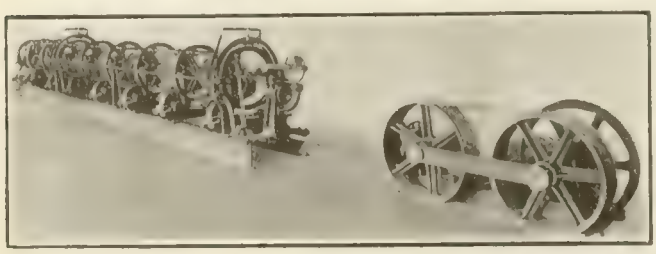
WALL-PAPER TRIMMER.

of both hands. While the user can turn out double the work in the same time with the greatest ease, the cost for energy is very small, as the Westinghouse motor used is but of ⅛ hp. This application is an exemplification of the fact that small motors are being utilized to drive all manner of machines formerly driven by hand or foot power, and in many instances are responsible for the developments of entirely new machines not possible without the motor. The outfit complete is sold by Messrs. A. Allen & Company, 2001-5 Carpenter Street, Philadelphia, Pa.

Reel Stranding Machine.

The accompanying illustration shows a new type of reel stranding machine made by the New England Butt Company, of Providence, R. I. In this type of machine the reels are carried in stationary cradles hanging at the center of the machine and the frame revolves about them. By this construction the machine is perfectly balanced and a very high speed becomes attainable.

In the size shown the reels are 16 in. diameter by 9½ in.



REEL STRANDING MACHINE.

traverse and hold approximately 250 lb. of wire. The whole machine is mounted on heavy 10-in. I-beams, and is entirely self-contained. It has tight and loose pulleys at the rear end of the revolving member, and a silent chain connection to a longitudinal shaft extending under the machine which drives the take-up. Adjustable rollers support the revolving member and are provided with bronze ring-oiling bearings. Suitable grooved sheaves are furnished at various positions for guiding the wires to lay the plate. Two powerful brakes are operated by a handle in a position convenient to the operator. The machine is equipped with a device which measures the product as it comes from the machine, and which can be swung out of the way when not in use.

The take-up is of the grooved double-drum type, which has proved to be much more satisfactory than the ordinary type of draw-off sheave. The drums are 30 in. in diameter and have eight grooves in each. A full set of change gears is furnished for producing lays from 1¼ in. to 5 in. The floor space occupied by the machine and take-up is 38 in. x 10 in. x 4 in. The machine fully loaded carries from 1700 lb. to 1800 lb. of wire, and is capable of being run at a speed of 400 r.p.m. The machine is made in various sizes from one taking reels 3 in. diameter, running at a speed of 1000 r.p.m., to a large machine with reels 32 in. in diameter.

News-Ad-o-Scope.

The Feature Advertising Company, with offices in the Metropolitan Tower, is giving the first public exhibition in New York of its "News-Ad-o-Scope"—the latest up-to-date advertising device. As the name implies, there is, in this machine, a newspaper (with bulletins direct from the football, baseball and racing fields), revolving advertisements (illuminated from behind) and stereoscopic projections in colors of advertisements



NEWS-AD-O-SCOPE.

and of views of special interest. The stereoscopic views are changed by an electric motor every six seconds, and the producer is thus enabled to show to the consumer every step in the manufacture of an article from the field to the table.

The "Window Ad-o-Scope" is a miniature form designed to show advertising cuts and stereoscopic views in the limited space of a show window. The intrinsic value of this machine lies in its economy of space, the projection of the size displayed (20 in. x 20 in.), requiring ordinarily a distance of from 15 ft. to 20 ft., but which it shows within a space of 18 in. This possibility has also been utilized in another design known as a "Theatrical Ad-o-Scope," in which the portraits of the different artists are reproduced in color on translucent glass (illuminated from behind), the stereoscopic projection giving the play complete, scene by scene, and act by act. The one exhibited at Madison Square Garden is a very artistic reproduction of Anna Held in "Miss Innocence," and created a sensation on Broadway when it was displayed for the first time week before last in front of the New York Theater

Car Lighting Exhibits.

The Association of Car Lighting Supply Manufacturers was very well represented by many members at the Chicago convention of the Association of Car Lighting Engineers, and the exhibits made a most creditable showing. The exhibits were placed in various rooms on the mezzanine and second floors of the Hotel LaSalle, where the convention was held, and excited a great deal of interest among the car lighting engineers. Nearly all of the exhibitors report very favorable results and expect to exhibit regularly. The following supply concerns were represented:

The Holophane Company was represented by Mr. V. R. Lansingh.

The Kerite Insulated Wire & Cable Company was represented by Mr. Watson, its Chicago representative.

The Tipless Lamp Company, New York, was represented by Mr. R. S. Carrick, whose lamps are used by many of the railroads.

The Franklin Electric Manufacturing Company, while not making an exhibit, had Mr. Peter S. Klees looking after its interests.

The Pyle National Headlight Company was represented by Mr. J. Will Johnston and showed one of its electric headlamps in operation.

The Oneida Steel Pulley Company was represented by Mr. H. P. Gale and showed several types of steel pulleys suited to axle-driven generators.

The Ward Equipment Company was well represented by Mr. G. B. Culver and showed some train-heating and heat-regulating devices and systems.

The Kuhlman Electric Company, of Elkhart, Ind., was represented by President Kuhlman, who was present in the interest of its transformers.

The Brilliant Electric Company was represented by Mr. H. H. Cudmore, the well-known orator, who is president and general manager of the company.

The Universal Storage Battery Company was represented by Mr. W. Bentley, and several of its well-known batteries and some of the new elements were exhibited.

The National Metal Molding Company, of Pittsburgh, had an exhibit in Parlor 221 in charge of Mr. I. A. Bennett, the Chicago manager, assisted by Mr. J. W. Hardy.

The Adams & Westlake Company was represented by Messrs. R. N. Newbold and Waters. A representative assortment of lighting fixtures for both electricity and acetylene gas was shown.

The Economy Engineering Company was represented by Messrs. T. A. Duffy and French. There was shown a very convenient hoisting device, suitable for elevating storage batteries and other articles.

The Sangamo Electric Company was well represented by Messrs. M. B. Southwick and R. C. Lanphier. Its exhibition of amp-hour meters attracted a large amount of interest and was very attractively arranged.

The New York Leather Belting Company was very ably represented by Messrs. W. H. Glatt and J. L. Abt. The exhibit consisted of several belts which are especially suited for driving car-lighting generators.

The Electric Storage Battery Company was represented by Mr. H. E. Hunt with the very able assistance of Messrs. Milton, Cressy and Baird. The exhibit, which included a very complete assortment of batteries and elements, attracted considerable attention.

The Gould Storage Battery Company was very creditably represented by Mr. G. R. Berger. The exhibit included an axle generator mounted as in service, batteries and plates, and controlling devices. Mr. Berger was assisted by Messrs. Milne, Shedd, Turbayne and C. W. Gould.

The Chas. L. Kiewert Company was represented by Mr. H. C. Olmstead and exhibited several flaming-arc lamps, showing both the alternating-current and direct-current patterns. There were shown one lamp with a single vertical electrode, and an assortment of Siemens electrodes, etc.

The National Electric Lamp Association was very ably represented by Messrs. C. W. Bender and R. I. Patterson, and exhibited a representative assortment of modern incandescent lamps. The Buckeye Electric Company and the Columbia Incandescent Lamp Company shared the exhibit with the N. E. L. A.

The General Electric Company was represented by Mr. J. Scribner, with the assistance of Messrs. Schroeder, Benson and Hawley. The exhibit, which was small but effective, consisted of a case of train-lighting lamps of all kinds, supplies, and a turbo-generator with the case removed to show the simplicity and relation of the parts.

The Western Electric Company's exhibit attracted considerable attention. A complete line of specialties of interest to car-lighting engineers was shown. A rather novel exhibit was one of its "Blue Bell" batteries standing over 6 ft. in height. Messrs. Geo. H. Porter and Geo. Lounsbery were untiring in their efforts to interest all visitors.

The Willard Storage Battery Company was represented by Mr. T. A. Willard, who was very ably assisted by Messrs. Norberg, Ballantine, Gassaway, Fijux and Sears. Several styles of storage batteries and plates were shown, among which were the plate with heavy tapering center web and a special plate with 80 ribs per inch. The latter was arranged to show the high quality of lead used in the plates, as the ribs are "plowed" from the web without tearing the lead.

The Central Electric Company was represented by Mr. J. M. Lorenz, assisted by Messrs. Cox and Pearl. Mr. H. W. Young also spent a large amount of time there. The exhibit was representative of its large line, and included many kinds of "Okonite" wire, train-lighting lamps, especially the 30-volt and 60-volt tungstens; "Opalux" shades and reflectors, 1910 Diehl fan motors, "P. M." remote-control switches and a rotary converter arranged to give energy at either 30, 60 or 110 volts at the generator end.

The Safety Car Heating & Lighting Company was represented by Mr. A. C. Moore, general manager, with the very effective assistance of Messrs. Van Winkle, Luckey, Wilham, Pinyard, Spinney, Lemmon and Bergstrom. The exhibit, which centered about a mounted generator, included batteries, controlling devices and a large assortment of car-lighting lamps. The special feature was a new berth-lighting fixture without a cover. Two push buttons were suitably mounted above the lamp.

The Westinghouse Interests, comprising the Westinghouse Lamp Company, the Westinghouse Electric & Manufacturing Company and the Westinghouse Storage Battery Company were well represented. Messrs. J. M. Schilling, Fisher and Schaulin represented the Lamp Company, Messrs. Jones, Dusenberre and Arlington represented the Battery Company, and Messrs. Davis and Talbott the Electric & Manufacturing Company. The exhibits included storage batteries, incandescent lamps, small generators, oil-break and air-break switches and controllers. The special feature of the exhibit was the "wire-type tungsten lamp," a product especially suited to car-lighting service.

The United States Light & Heating Company was represented by Mr. J. A. Smith, general manager, and Mr. W. M. Lalor, who had charge of the exhibit. They were assisted by Messrs. Bliss, Pomeroy, Hawley, Mead, Sherman, Bauer, Mau, B. Smith and Heister. Exhibits were made of four sizes of axle generators, 1.5 kw, 2.5 kw, 4 kw and 6 kw; National batteries, suspension devices for generators, controlling devices, lamp regulator of a new type, a 60-volt regulator, a "tapering" arrangement for battery-charge regulation, and the Bliss & Moskowitz axle-lighting systems. A special feature of the exhibit was a generator mounted on a part of a truck and controlled by a special device for varying the speed of the generator as in service.

Exhibits at the New York Electrical Show.

THE third annual electrical show, which began in Madison Square Garden, New York, on Oct. 11, and which will continue to Oct. 21, has for its object the creation of general public interest in things electrical. While it is impossible to display under one roof the myriad uses of this force, there is enough diversity of application on exhibition to make the show educational in character and to give the public some conception of the wide applicability of electricity. Certainly no one can visit the show and not be impressed with the immense amount of household work which can be performed through the agency of electrical appliances. The heavier branches of the industry are not neglected either; and the manufacturer can find much of interest and profit in the booths. Below is a brief synopsis of the exhibits, excepting those made by the four electric lighting companies, which will receive attention in a later issue. A brief glance of the array of apparatus scheduled shows the comprehensiveness of the exhibition as a whole.

The Electric Cleaner Company, Chicago, manufactures a complete line of portable electric vacuum cleaners known as the "Positive" and the "Reliable." Both of these machines are on exhibition and the demonstrators explain the various operating features. Mr. J. M. Rodger is in charge of the exhibit and he is assisted by Mr. A. B. Cousin.

The Baltimore Enamel & Novelty Company, New York, is exhibiting porcelain enameled iron reflectors for arc lamps, incandescent lamps, etc. The company also manufactures electric storage battery jars, messenger call-box shells, porcelain enameled iron advertising signs, agency signs, etc., all of which are on exhibition. Mr. C. A. Marsland is in charge of the company's interests.

Charles Biele, New York, is demonstrating his "Cafe Savoy" coffee on electric stoves with percolators. A miniature electric coffee roasting plant and an electric grinder are also shown in operation. Women demonstrators make an infusion of coffee on electric stoves and serve the same in dainty shell cups to all visitors. Mr. Biele is represented at the show by Mr. Charles H. Salzer.

Automatic Electric Washer Company, Newton, Ia., has on exhibition two electric washers. The device is said to comprise all that could be demanded of such a machine; a clean, substantial washing machine of ample capacity, with a powerful well-built electric motor and a ball-bearing reversible wringer combined in one complete equipment ready to attach to any electric lamp socket. The company is represented by Messrs. H. L. Ogg and R. Winger.

The Wonderful Pump Company, New York, is represented by Dr. J. Nelson Walter, Mr. G. B. Janson and Mr. J. T. Chesler. This company manufactures a screw pump, which is shown in operation direct-connected to a motor The device is said to possess very little internal friction and to be particularly applicable for gritty and sandy water. The size of the stream discharged is equal to the bore of the pump, and machines capable of delivering 40, 200 and 300 gal. of water per minute are shown in operation.

Dossert & Company, New York, are exhibiting a full line of solderless mechanical connectors, cable taps and terminals for electric cables and wires. Among the new devices exhibited is a cable tap for connecting aluminum and copper cables. This tap gives an aluminum contact at the point of connection with the aluminum cable and a copper contact at the point of connection with the copper cable. The method of making complete transformer connections with Dossert connectors is also shown. Messrs. C. A. Flynn, H. S. Shope and D. J. Fitch are in attendance.

Hurley Machine Company, Chicago, has on exhibition a line of "Thor" and "Chicago" electric washers and wringers. The company shows a universal rod in connection with its Thor electric washer running an ice-cream freezer, meat chopper, ironing machine and a number of other small articles used about the house. A feature of the exhibit is an ice machine said to be capable of freezing 20 lb. of ice in 20 minutes. This is operated by electricity. The following representatives of the company are present: Messrs. Neil C. Hurley, W. H. Haberle and E. J. Riedy.

Manhattan Electrical Supply Company, New York, exhibits a line of general supplies in its main booth. The list of goods manufactured by this company includes electric light specialties, medical apparatus and electrodes, telegraph and telephone apparatus, electric bells, massage vibrators, dry batteries, electric horns, jump spark coils, automobile switches, motors, dynamos, time switches, door openers, testing instruments, etc The company also has a special exhibit of wireless telegraph apparatus. This part of the exhibit is under the supervision of Mr. A. B. Cole, and two wireless outfits are in operation inside the Garden, so that messages can be sent and received at both stations. The general exhibit is in charge of Mr. J. C. Moulton, who has several assistants.

The Vacuum Engineering Company, New York, has on exhibition two rotrex vacuum cleaning plants, one showing a direct-connected, one-sweeper plant, and the other being a two-sweeper chain-driven plant. The above are both stationary, and are intended for installation in the basement of buildings, with pipe lines running to such points as are most convenient for hose connections. The pump differs from the ordinary pump used for this purpose in that it has no sliding blades, wearing strips or valves, and the plant has no separating tanks, the dirt being first taken into what is called a separating chamber, where it is dissolved, and then carried automatically and directly to the sewer in the form of dirty water. The exhibit is in charge of Messrs. W. H. Trump and Carroll A. Gibson.

The American Metal Hose Company, New York, has on exhibition a complete line of samples of its flexible metal hose in steel, copper and brass. The steel and copper hose are made for steam, compressed air and oil, while the brass hose is largely used in connection with automobiles. The company is also exhibiting a flexible metal conduit used for covering wires, etc., and a complete line of hose for gas use. In addition, there are some "Ametalhose" flexible arms for portable lamps and an electric heating apparatus in which the heating element is a flexible metal tube. The latter is the product of the Brockdorff-Witzenmann Works of Berlin. The same principle that is employed in this heater is also used in an apparatus to free oil in transformers from water, and a demonstration of this is made. Mr. Charles S. Hungerford represents the company.

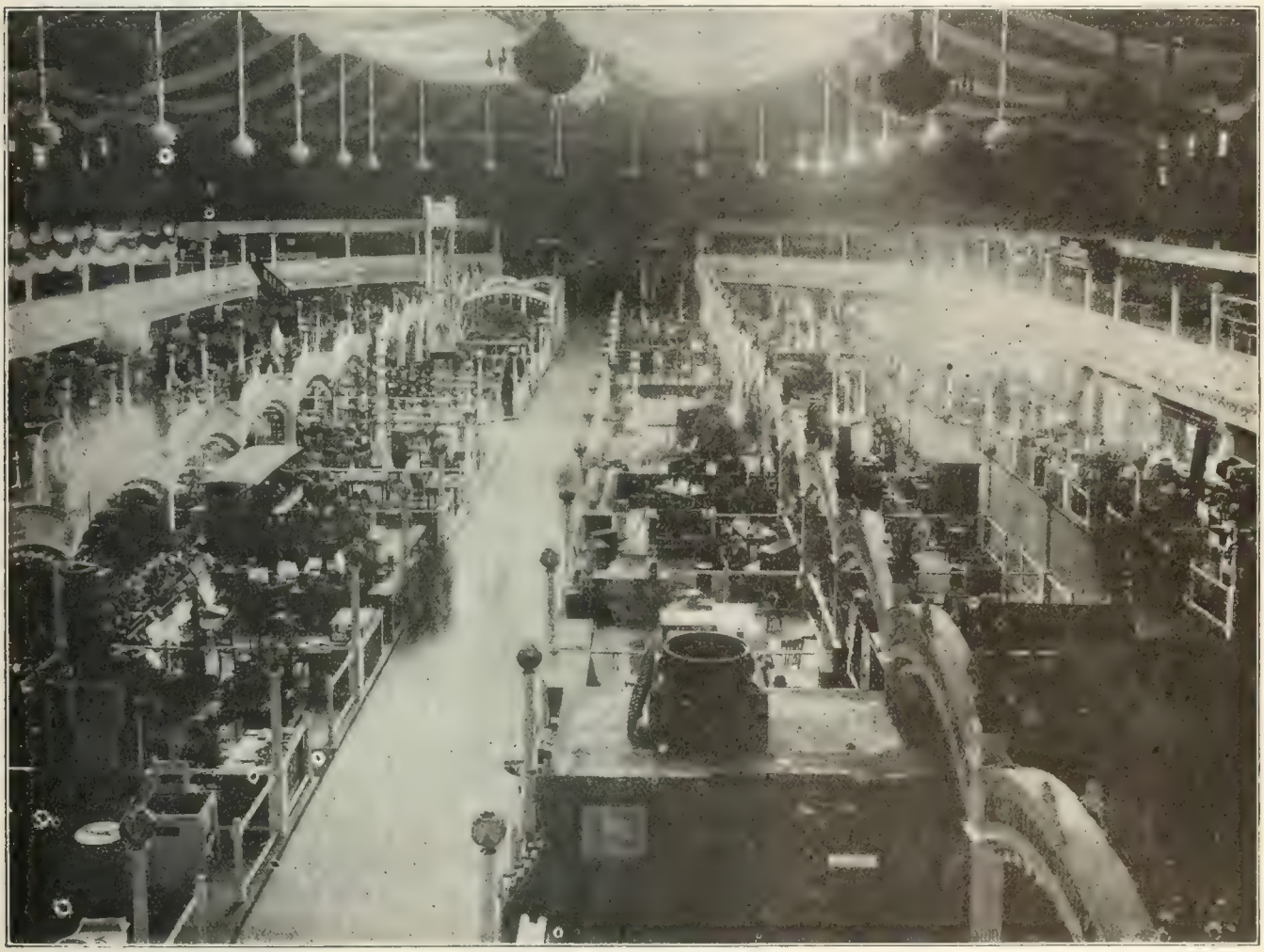
The Lansden Company, Newark, N. J., exhibits two of its machines, representing widely different lines of construction. The standard 1500-lb.. closed panel delivery wagon, such as is used for department stores or similar lines of work, has a speed of 11 miles an hour. The machine is said to carry 100 per cent overload, and its rated mileage with full load for the full distance is stated to be 40 miles. The weight of the vehicle is 3200 lb.; wheel base, 88 in.; the wheel gage, 50 in. and 3 in. by 32 in.; solid rubber tires are employed. The other machine on exhibition is an industrial truck, which has been developed for use in factories, mill yards, steamship piers, railroad terminals, etc. The vehicle is said to possess features which make it particularly applicable for such work. It is low and easily loaded, and on account of its peculiar construction can be maneuvered through narrow passageways. The machine is constructed in two forms, a three-wheel outfit and a four-wheel truck, which has an additional single steering wheel added to the opposite end. Those in attendance include Messrs. F. A. Whitten, A. J. Doty, J. R. Kinsey, L. H Van der Burgh and J. M. Lansden, Jr.

German-American Electric Company, New York, show a number of Grant flaming-arc lamps in operation and a complete line of Grant tungsten lamps, in addition to automatic hanging devices. The exhibit is in charge of Mr. Lambert Schmidt, who is assisted by Vice-President Whittlesey, and Messrs. R. Hanschke, Jr., F. E. Lande and E. J. Deuth.

Radio Reflector Company, New York, is demonstrating the merits of its reflector in the following manner: A number of carbon-filament lamps are shown without reflectors or shades in one cabinet. In another cabinet the same size and type of lamp is shown with Radio reflectors, thus demonstrating the increase in downward candle-power procured through the agency of the latter. A metal flash sign, containing 100 lamps, alternating with reflectors and without, is featured and the advantages of the reflector for lamps over machines of various kinds are pointed out. Mr. A. M. Hirshfield is in charge of the exhibit.

of "Ad-o-Scopes." The window ad-o-scope is 50 in. long, 41 in. wide and 15 in. high and weighs approximately 150 lb. By means of stereoscopic projections and colors a manufacturer may show to a consumer each step in the manufacture of an article, the purity of material, cleanliness in preparation and other points of interest. In addition it is possible to show 12 panoramic cards of the standard street-car style. The theater ad-o-scope is intended for showing living pictures of artists in colors illuminated from behind. The machine is 50 in. high, 42 in. wide and 18 in. deep, and by its use it is possible to show in panoramic photographs the portraits of the artists in the production and by the stereoscopic projections the complete play, scene by scene and act by act. The slides are turned by an electric motor and it is possible to insert new ones within a few minutes. Mr. W. Nephew King represents the company.

Moore Electrical Company, Newark, N. J., exhibits a yellow Moore light and a white Moore light. The former consists of



GENERAL VIEW OF EXHIBITS AT THE NEW YORK ELECTRICAL SHOW.

Empire Vacuum Company, New York, makes an exhibit of its "Imperial" vacuum cleaner. The general construction of the machine, with the various styles of cabinets containing the mechanism, are shown in connection with a full set of cleaning tools in different finishes, together with the styles of cord, hose and other appurtenances used with the equipment. Two handsomely finished cabinets are arranged for display purposes and practical demonstrations of alternating-current and direct-current machines are made. The company also exhibits a test motor and a pump showing the amount of vacuum obtained by this cleaner. This exhibit is intended primarily to demonstrate the efficiency of the suction and blowing device. Messrs. F. B. Cochrane and F. S. Bon represent the company.

Feature Advertising Company, New York, shows a number

a tube 162 ft. long, lighting the large main entrance corridor of the Garden. The exhibit of the white Moore light consists of an artificial daylight window about 2 ft. square. This is located in the booth of the United Electric Light & Power Company. The color from this window is claimed to be pure white and it is said to be the first light under which the quality of diamonds can be determined accurately. This form of Moore tube is especially novel because it is semi-portable. It operates on 220 volt, 60 cycle, alternating current, and is suitable for jewelry stores, silk and ribbon counters, dress goods departments of dry goods stores, and wherever true color values are of importance. The representatives of the company in attendance are Messrs. L. J. Auerbacher, James Bronis, W. P. Dickson, R. T. Trimble and C. D. Warner.

The Heany Lamp Company, New York, makes a display of Heany tungsten lamps, fireproof asbestos covered wire and tipless lamps, both of carbon and tungsten types, as manufactured by the Tipless Lamp Company. The Heany arc lamp manufactured by the Lord Electric Company is also accorded space in the company's booth. Mr. Arthur Starke is in charge of the company's interests at the show.

The Southern Exchange Company, New York, exhibits sections of its octagonal and square poles, cross-arms for telephone, electric light and transmission lines. The booth is tastefully decorated and enhanced by large pictures of the company's mills and yards in the south. The company makes a specialty of high-grade cross-arms, yellow pine octagonal and square poles and is the pioneer producer of the Southern wide cedar poles. Mr. E. G. Chamberlin is in charge of the exhibit.

Pelouze Electric Heater Company, Chicago, shows samples of its new 20-lb. tailor's goose. This iron is so constructed as to admit of three heats, adjustable while in operation. The low heat is arranged to keep the iron at proper working temperature while left standing. There is also on exhibition the "Universal" iron in three other sizes—4 lb., 6½ lb. and 9 lb. In this iron the temperature can be controlled by a simple movement of the hand while ironing. The iron has not only a hot point, but hot edges, and is so arranged as to give good distribution of heat on the bottom at all three contacts. Col. W. Pelouze and Mr. A. A. Guardia are representing the company.

Como Electrical Company, Spring Lake, New Jersey, manufacturer of the Hickley electrolytic alternating-current rectifier, has on exhibition a number of these devices. The largest type is intended for charging a 24-cell, vehicle battery, another type is intended for garage use in connection with six 6-volt batteries on a 110-volt, alternating-current line. Several smaller types suitable for charging batteries or for running small motors, such as are used in railroad signal work, are displayed. The company builds rectifiers to charge as many as 40 cells at 25 amp, also to operate searchlamps, x-ray apparatus, dental engines and lathes from alternating-current circuits. The rectifier, the manufacturer claims, will operate on any cycle from 10 to 133 and at any voltage up to 1000. The representatives at the Show include Mr. A. S. Hickley, Mr. Robert Boone and Mr. W. W. Rowan.

The Excello Arc-Lamp Company, New York, displays the various types of alternating-current and direct-current lamps manufactured by it, including alternating-current lamps for operation 4 in series on 220-volt circuits with enclosed compensating choke coil. A decorative brass-covered lamp with colored globe is on exhibition and a new quartz lamp is introduced as a novelty. The latter lamp is not being placed on the market by the Excello Company, but is exhibited merely to show recent developments in that style of lamp. In addition to the lamps shown in the company's booth the United Electric Light, Heat & Power Company has two alternating-current Excello flaming-arc lamps with reactive coils instead of resistances on exhibition, and there are eight Excello lamps used for the illumination of the Arcade at the Madison Avenue entrance of the Garden. Representatives of the company in attendance include Messrs. H. M. Hirshburg, R. F. Pierce, J. L. Dinsmoor and A. J. Thompson.

The Electric Home Supply Company, New York, specialist in selling electrical appliances for the home, is exhibiting goods made by the Vulcan Electric Heating Company, of Chicago, manufacturer of soldering and branding coppers, can-sealing device and the "electrocurl," which is an electrically heated curling-iron. The electric soldering coppers, as well as the electrocurl, are shown in operation. The company also exhibits the product of the Dielite Manufacturing Company, of Philadelphia, manufacturer of the "Dim-a-lite" regulating socket, Wirt regulating rheostats and dimmers, as well as the Dielite insulating joints. A full line of Pluto electric heating appliances is displayed. A feature of the exhibit is a 10-room, completely equipped and electrically lighted doll house and a case containing an electric cooking outfit intended for a child. The exhibit is supervised by Mr. Max Lowenthal, who is assisted by Mr. A H. Diamant, Mr. H. H. Russell, of the Vulcan Electric Heating Company; Mr. G. R. Hall, of the Dielite Manufacturing Company.

Sunray Electric Lamp Manufacturing Company, New York, has on exhibit a rack containing seven lamps, six of which show the progressive stages of the arc during the life of the electrode, demonstrating clearly the short arc travel and the small loss of light from deposit on the globe. An eighth lamp on the rack is said to have a life of 100 to 120 hours at a single trimming. The intention of the company is to trim this lamp at the opening of the exhibit and to permit it to burn 10 hours each day during the exhibition without retrimming. A table in the center of the booth is fitted with four lamps having various types of ornamental shades and fittings. On one side of the space is a small laboratory table with instruments for taking readings of the various lamps and a panel fitted with all the separate parts of the lamps is on exhibition. A high-voltage lamp for multiple connection on 220-240-volt circuits, which is built for 2 amp, 2½ amp and 3 amp, and is said to maintain a voltage of 150 at the arc, is also displayed. An attractive pamphlet, illustrating and describing the lamp and giving tests and useful information, is being distributed.

The General Electric Company's booth is located in the center part of the Garden to the left of the center aisle. Here is shown a complete line of heating apparatus, flaming arc lamps, intensified arc lamps and the company's multiple automatic cut-out and hanger for rope suspension. An interesting feature is a wire-braiding machine in operation, showing the method of making cord for heating devices. In the center of the booth are General Electric motors, operating Ingersoll-Rand drills and a Bridgeport Safety Wheel Company's grinder. A line of motors is also shown, not in operation, so as to admit of close inspection. In addition to the above there is displayed a complete line of fan motors, rheostats, circuit-breakers, meters, instruments, a multiple rectifier, a 10,000-volt lightning arrester and a complete line of automobile accessories. The General Electric Company also exhibits its complete line of tungsten and tantalum lamps, including the new 200-volt and 250-volt types. A circle of lamps surrounding the well-known G.E. monogram demonstrates the ability of the lamps to burn in any position. Included in the exhibit is a photometer, comparing a 32-cp, 110-watt carbon lamp with a 40-watt tungsten lamp, each lamp taking power through a testing wattmeter, thereby showing the different power consumptions for equal candle-power. Special attention is called to the comparison of quality of light illustrated by this apparatus The 4-cp, 5-watt tungsten sign lamps are shown in operation. and the striking white brilliancy is an attractive feature. A comparison board with a wattmeter shows that 10 tungsten sign lamps are equivalent to three carbon sign lamps in power consumption, but far superior in character and amount of illumination. Automobile lighting by tungsten lamps is given a prominent place in the exhibit, a model dashboard, with head-lamps. side-lamps and tail-lamps being shown. The tungsten head-lamp has a spiral filament of high intrinsic brilliancy, accurately located in the focus of a parabolic mirror, and gives an intense forward illumination fully equal to the ordinary acetylene head lamp. The outfit is operated by a 120-amp-hour storage battery and the convenient switching arrangement for controlling all the lamps independently from the dashboard is shown. The automobile lamps are made with sturdy filaments, to withstand the severest service. A very complete line of miniature and low-voltage tungstens is also exhibited. The company's tungsten street series lamps are shown on brackets, supported from the pillars of the booth. Numerous photographs of notable installations, using thousands of tungsten and tantalum lamps. give the public striking examples of the degree to which these lamps have superseded the carbon lamps. Among the representatives of the lamp works attending the show are Messrs. F. W. Willcox, G. C. Osborn, R. B. Parker, E. R. Sherwood, H. W. Jackson, C. M. Bunnell, W. C. Andrews and C. W. Bettcher.

New York Electrical School, New York, in its booth in the north gallery, makes a photographic display of the practical working conditions of its courses, samples of the work done by the students in electrical drafting, and a comprehensive description of the aims and purposes of the course given. The representatives who have charge of the exhibit are Messrs. John L. O'Conner, Geo. J. Cox and E. G. Grandstaff.

The Economical Electric Lamp Company, New York, manufacturer of turn-down lamps, has on exhibition the "Hylo" and "Economical" pull string, turn-bulb and long-distance lamps, and also the "Hylo-Economical" tungsten lamps. By means of automatic machines the large and small filaments of the lamps are switched in and out of circuit, so that the relative intensity of the light from each is shown. Messrs. L. and M. Lobenthal, assisted by several employees, are in attendance.

Collins Wireless Telephone Company, Newark, N. J., displays as leading features in its booth a variable tuning transformer, auto-transformer and rotating oscillation arc. These are the instruments which it is claimed were employed by Mr. Collins in talking from New York to Philadelphia without wires. The Collins transmitter is also on exhibition. This is a compact device made of brass, nickel and ebony. High-frequency and high-potential apparatus, induction coils and transformers for therapeutic, ignition and wireless work are shown. The booth is in charge of Mr. William White, assisted by Messrs. Sanchez and Copp.

Fox Bros. & Company, New York, are exhibiting their well-known "Polar" flaming-arc lamp, together with a complete line of miniature enclosed arc lamps and arc-lamp accessories. Included in the latter are Fox multiple and series contact couplings, positive safety winches, windlasses, etc. The company features what is said to be entirely new in the flaming-arc lamp field, a type of arc lamp known as the "Delta." These lamps burn with superposed electrodes, consisting of a thick core and a thick carbon surface, and electrodes are obtainable for white, yellow or golden light. A new type of "Radiante" lamp which is said to embody improvements in the miniature enclosed arc lamp line is on exhibition. The life on one trim of electrodes is claimed to be 100 hours and the lamp may be operated singly on 100 volts to 120 volts or in series on 200 volts to 240 volts, the power consumption being 440 watts. Messrs. H. L., H. C. and F. F. Fox, T. P. Gleeson, G. A. Nisbet, Mr. Batterman and Mr. Harris are in attendance.

General Vehicle Company, Long Island City, N. Y., shows one of its latest type 2000-lb. wagons complete. The truck is jacked up in such a manner as to permit the power plant to be operated. The wagon has ample floor loading space and is adapted to many lines of business. It is said to be capable of making 40 miles per charge of battery when loaded over half of its course so that it can meet the delivery requirements of almost all classes of business. The standard chasses are equipped with bodies of various shapes and designs to meet the requirements of purchasers. The battery comprises 44 9-plate cells arranged in four crates. An 85-volt General Electric motor is employed and Hess-Bright ball bearings are used to minimize friction. The countershaft is of the housed type on Timken roller bearings, and the first reduction of the transmission is by the Morse silent chain and the second reduction on roller side chains to each rear wheel. The exhibit is in charge of Mr. J. H. Vail, assisted by Mr. C. W. Squires, Jr.

F. L. Smidth & Company, New York, manufacturers of cement grinding machinery, show a "Lenix" drive which the company calls the paradox of an ordinary motor belt drive. Vertical superposed shafts are employed and the arc of contact between the belt and the large pulley is approximately 266 deg., and for the small pulley 200 deg. A brake is mounted on the driven shaft to show the action of the drive under load. At a glance the device looks like a belt tightener, but closer examination reveals the fact that it works on an entirely different principle. The Lenix roller has its bearings in a roller arm turning on the axis of a stand. The effect of the roller is two-fold; it not only increases the arc of contact between the belt and the pulleys, but also serves to regulate the tension in the belt. While the exhibit shows the pulley superposed, most of the installations made by the company have been for shafts placed in a horizontal plane or in an inclined plane, resulting in a considerable saving of floor space and the use of a large ratio of transmission without countershafts. The company is represented by the following: Messrs. Geo. M. Newcomer, H. W. L. Logan, E. Olsen, O. E. Morgensen and Thorkild Avnsoe.

The Westinghouse Electrical & Manufacturing Company's exhibit is representative of the complete line of small motors and electrical heating apparatus, intended for domestic use, manufactured by this company, omitting reference to its extensive and well-known products of electrical machinery for lighting, power and traction. Among the electrical heating devices are shown a toaster stove, steel-top hot plate, electric sad-irons, tailor irons and luminous and non-luminous radiators. A new automatic tailor iron is exhibited, which is arranged so that it heats only when it is placed on the stand, and, therefore, does away with the objection which the tailors have had—the trailing cord. The company has four demonstrators. One demonstrates the toaster stove and steel hot plate, toasting bread and cooking cereals, etc. Another demonstrates the family sewing-machine motor, one of which is connected with a sewing machine, where a regular seamstress is employed, making little garments, which, after the show, will be donated to one of the orphan asylums in New York. The family sad-irons are shown by a demonstrator who irons the garments which had been made by the seamstress. The tailor's iron is demonstrated by a tailor who brings in clothing from his shop and does the actual work of pressing the clothes at the exhibit. The booth is illuminated by festoons of low-voltage, 25-watt tungsten lamps with prismatic reflectors. Two large arches are lighted by tungsten lamps of different sizes from 25-watt to 250-watt, one arch showing the entire line for 110 volts, while the other arch shows the entire line of 220-volt lamps. The tungsten sign lamps, both the W type and the regular type, are displayed in large "W's," 18 in. high.

Roger Williams, New York, shows a very complete line of salable articles. The exhibit contains about 200 different devices and one of the latest on view is an electrical toaster which will toast four slices of bread in from 2½ to 3 minutes with a power consumption of 500 watts. This is claimed to be the most economical toaster on the market and is of the usual Simplex quality. There are also on exhibition a number of new devices, including a large nursery milk warmer, a hotel toaster, two styles of irons for heavy flat work, besides a complete line of household irons, laundry irons, tailor's irons, electric stoves, chafing dishes, water cups, curling-iron heaters, heating pads, percolators, dining-room outfits consisting of a chafing dish, coffee percolater and tea-kettle combination which is very popular with electrical companies, waffle irons, permitting waffles to be made on the dining-room table, and cooking utensils, such as blazers, double boilers, tea kettles and sauce pans, all arranged to clamp to the stoves, thereby making them more efficient and at the same time permitting them to be removed for cleansing. Among the other articles are electric ranges with a water heater, heating the water in the ordinary kitchen boiler. On these ranges no wires are exposed and no complications are involved. Glue pots, soldering coppers, regulator stands for the commercial irons and cord supports complete the exhibit. Mr. Roger Williams, the New York agent for the Simplex Electric Heating Company, is in charge of the exhibit, and he is assisted by Messrs. H. K. Stiles, C. O. Haggist, A. Hodgson and J. Ehler. From the Simplex Electric Heating Company there are present Messrs. J. I. Ayer, E. B. Stebbens and R. P. Ingalls. The company has loaned to the Dryer Manufacturing Company laundry irons with which to do ironing and electric heaters for the clothes dryers. In the New York Edison Company's exhibit the Simplex stoves for making candy and for baking shredded wheat, irons and numerous other articles are in evidence. The booth of the Edison Electric Company, Brooklyn, also has a complete line of samples, together with an oven made from plate glass so that biscuits and cake can be observed by the general public in the baking process.

National Electric Lamp Association has a booth facing the entrance to the Garden, where are displayed samples of the products of the various lamp companies in the association. The general scheme of decoration usually employed by the association at all exhibitions is followed out and sufficient room is allowed in the booth for entertaining visitors without encroaching on the exhibition space.

Duntley Manufacturing Company, Chicago, displays a number of pneumatic cleaners; a scrubbing machine for shampooing carpets and a small gasoline electric generator set capable of lighting eight lamps and giving the necessary electrical energy for operating the sweeping machines. Those in attendance include Messrs. G. R. Harms, P. G. Steigelman, N. Harms, L. E. Spurrell and M. Puessey.

J. Livingston & Company, New York, have on exhibition a "type B" portable suction sweeper. This machine embodies many improvements over the company's former type, and is made in three sizes, driven by ⅛-hp, ¼-hp and ½-hp motors respectively. The first two sizes can be operated by connecting them to any ordinary lamp socket, whereas the ½-hp size should have a special circuit. The work of the machine is said to be equal to that from a stationary plant, and its construction and design such that it is very easily handled. No tools are required for its ordinary use and much attention has been given to the design of the nozzles or the renovators. The exhibit is in charge of Mr. A. B. Cadley.

Murphy Electricity Rectifier Company, Rochester, N. Y., exhibits a rotary disk type of rectifier and also a stationary electrode type. The latter possesses an advantage over the former in being self-starting and in eliminating all moving parts with the exception of a small synchronous motor. It is, moreover, much smaller and simpler in construction. The principle under which the Murphy rectifier operates has already been described in our columns. The device is applicable to a large number of uses, including the charging of batteries for electric carriages, telephone, fire alarm systems and car lighting, also for moving picture machines, electroplating, x-ray work and other purposes where direct current is required and an alternating current source only available.

Electrical Testing Laboratories, New York, direct attention in their exhibit in the north gallery to three of the many and various classes of testing performed by them. The relative efficiencies and color values in modern electric illuminants are shown with the aid of specially constructed booths which conceal the lamps while displaying the characteristics of the light. The appearance of colored fabrics when illuminated by the lamps offers an interesting study of light quality. The relative brightness of screens illuminated by the lamps illustrates the strides which have recently been made in the efficiency of electric illuminants. An exhibit is made of a complete installation of a wire testing machine in operation, showing the Laboratories' method of making tensile, torsional and elasticity tests and the apparatus for testing the conductivity and insulation resistance. A few of the reference standards used by the Laboratories are also on view. Dr. Sharp and Mr. P. S. Millar are in attendance.

W. P. Pressinger Company, New York, general agent for the Keller Manufacturing Company of Philadelphia, exhibits in two adjoining sections a large number of "Santo" portable electric vacuum cleaners with full equipments; several special portable cleaners finished in different colors to show how the machine can be furnished when desired to meet architectural and personal wishes, and one transparent cleaner. In the latter machine the dust can be seen entering the bag and the full operation of the vacuum pump can be followed. There are also on exhibition truck type machines suitable for use in hotels, apartments, car-barns, railroad stations and places where a large and powerful machine is desired. In addition to its use as an exhibit the machine is employed by the show management for general cleaning throughout the exhibit. It is also at the service of the various exhibitors to be used by them for cleaning their exhibits. There are a number of attractive photographs showing portable and stationary machines in operation and various special tools intended for cleaning billiard tables and other apparatus. Representatives of the W. P. Pressinger Company distribute suitable circulars and pamphlets.

The Goulds Manufacturing Company, New York, features as its main exhibit a single acting triplex power plunger pump mounted on a bed plate with an adjustable belt idler and belt connected to a 220-volt, ¾-hp Crocker-Wheeler motor. The pump is fitted with a by-pass and relief valve arrangement so that in case a valve is shut or a stop occurs in the discharge line, the valve will open and allow the water from the pump to pass away without increasing the pressure. The pump is shown in operation, taking water from a tank beneath a table and discharging it into a glass aquarium. It is arranged to start and stop automatically by the rise and fall of water in the tank. The tank switch is mounted on a marble panel at the back of the outfit, and on this panel are mounted an ammeter, a pressure gage, knife switch and fuses. A valve on the discharge line permits the gage to record the pressure against which the pump is operating, while the ammeter shows the amount of current the pump is using. A number of pumps lying idle, together with framed photographs and sectional views of the pumps are on exhibition. Representing the company are Messrs. W. H. Hopper, W. E. Dickey, W. H. Valentine, E. E. Brereton and Jos. Burger.

Otis Elevator Company, New York, has a booth situated in the center of the Garden, where a working model of an Otis automatic push-button elevator is installed. In order to show the working and parts of this type of elevator a steel tower 30 ft. high is used. At the top of the four posts of this tower are large electric globes and underneath these enclosing the sheaves and governors are the words "Otis Elevator Company." The steel work and machine are painted in white with gold striping and the car is white enameled. Inside the car is placed the usual bank of buttons and connecting in series to this is a similar bank, because of the impossibility to see the working of the elevator when it is at the two upper floors. In order to show the operation of the car when called from any of the hall doors, the regular hall call buttons on the upper landings are connected with push buttons within convenient distance of the Garden floor. At the lower landing is a hall door and also a hall call button. The method of announcing at which floor the elevator car will stop is by means of an electric sign located at each of the three landings showing on all sides of the tower which reads "Car will automatically stop here." The safety device consists of an Otis roll safety switch placed at the top and bottom of the tower, limiting the travel of the car, and there is also the regular slack cable device. Besides the above safeties, use is made of a folding gate inside the car and also automatic of door locks. This is shown on the hall door at the bottom of the hatch and at the two upper floors. The motion of the car is visible because the doors are left out at the upper landings. By means of the last mentioned devices, the inability to operate the car until all the doors are closed is clearly shown. The elevator used is a regular Otis type "O" direct-current machine with full automatic controllers mounted on the bed plate to show the compactness of an elevator of this type in a private residence. Another feature of the exhibit is the official model of the Metropolitan Life Insurance Company Building, the model being 1/100 the actual size of the real structure. This building is the highest office structure in the world and contains in the tower six Otis traction elevators. A large electrically lighted colored photograph of the Singer Building, which is similarly equipped, is also on exhibition. In order to show the development of alternating-current apparatus the company has loaned to the United Electric Light and Power Company one of its latest worm-geared traction machines for basement installations. The apparatus consists of an Otis two-phase alternating-current slip-ring type of motor driving the traction sheaves through a worm and gear. An alternating current single-phase magnet controller and a magnetic brake also form parts of the exhibit.

Sibley & Pitman, New York, have an exhibition of portable electroliers and pendants with arc glass shades, the product of the Amboy Works. Messrs. O. M. Dickson and W. H. Schleicher were in attendance.

International Correspondence Schools, New York, show bound volumes of their various courses and specimens of students' work. The work of this institution is well known and needs no comment.

The Crane Company, New York, shows electrically-operated gates and valves, cast-steel valves and headers and an operating exhibit of the "Cranetilt" steam traps. The company is represented by Mr. F. C. Sabin, of Chicago, who is in charge and who is assisted by Mr. W. L. Oswald.

Electrical World has a booth on the main aisle, where current issues of the paper are being distributed and some of the standard McGraw publications are on exhibition. Representatives of the business, editorial and subscription departments are in constant attendance.

Hoover Suction Sweeper Company, New Berlin, Ohio, shows a number of sweepers in operation. Those in attendance include Messrs. W. W. Steele, A. W. Wassing, L. Carter, E. B. Schlitz, H. W. Hoover, A. Strahs, R. M. Thomas and E. E. Martin.

The General Compressed Air & Vacuum Machine Company, St. Louis, exhibits through Mr. A. C. Smucker, its New York agent, a number of Thurman portable electric vacuum cleaners. These are shown in operation by Mr. Smucker and a number of assistants.

The Storage Battery Supply Company, New York, is represented by Mr. T. D. Bunce. The feature of its exhibit is the Hudson-Fulton storage battery intended for Christmas tree outfits and similar uses. A hydrometer syringe, electrolyte tester and electric dome lamps complete the display.

Stanley & Patterson, New York, feature in their booth the wireless battery system and the Faraday electric bell. The battery system consists of devices for connecting dry cells in circuit without the intervention of wires. Floor boxes and stage pockets are also on view. Messrs. F. Eastman and C. F. Draper are in attendance.

The C. H. Wheeler Manufacturing Company, Philadelphia, is displaying a "rotrex" vacuum pump and centrifugal circulating pump, and a suction, valveless, double-acting, high-vacuum pump. These devices were recently described in our columns and are familiar to our readers. Mr. W. H. Trump represents the company.

H. Krantz Manufacturing Company, Brooklyn, N. Y., exhibits samples of panel boards, switches, connection strips, fool-proof push-button panels, standard post-office construction panel-boards, outlet boxes, marine fixtures, standard three-wire panels, etc. A complete set of the company's literature is distributed to interested parties by Messrs. H. Krantz, G. W. Eckerson and D. M. Anderson.

DeVeau Telephone Manufacturing Company, New York, features various lines of telephone apparatus, including intercommunicating telephone systems, apartment house telephones, branch exchanges, mine telephones, parts of telephone apparatus, a Woodruff carriage call system, annunciators, alarms, etc. Messrs. C. Auth, A. S. DeVeau, J. Humphrey and A. H. Teale explain the merits of the various devices.

Gudeman & Company, New York, electrical decorators, have a number of fruit trees, flowering plants, etc., on exhibition in which the fruit, flowers, etc., are represented by naturally shaped and colored lamps resembling the actual fruit or flowers, as the case may be. These are intended for dining-room and hotel use principally, forming attractive decorative features which add to the setting of tables, rooms, etc. Mr. Leo Gudeman is in charge.

American Electric Lamp Company, Philadelphia, displays a set of views showing the interior of its factory and the different parts at work. On each side of the space is a large case of lamps; one containing every type of tungsten and tantalum lamp and the other carbon metalized filament lamps. An exceptionally complete collection of miniature lamps all effectively displayed against a background of black velvet in illuminated cases is shown. The company is represented by Messrs. C. J. Purdy and LeRoy F. Johnston.

The Electric Storage Battery Company, Philadelphia, shows one element of type H-131 Exide battery, such as is installed at the Sixteenth Street station of the New York Edison Company; nine standard sets of vehicle batteries as built for electric vehicle companies, Exide sparking duplex and emergency sparking batteries, car-lighting batteries, a two-cell unit for this service, automobile electric head lamps operated by Exide sparking batteries, and a casting mold electrically operated for casting souvenirs consisting of lead disks bearing the imprint of the company.

The Shelton Electric Company, Chicago, shows a small hand hair-dryer which furnishes either hot or cold air by merely touching a button and which weighs 2¾ lb. Three kinds of vibratory massage machines designed for physicians, barbers and hairdressers and for home use are featured A new pedestal hair dryer which gives large volumes of hot or cold air, and takes all the weight from the hand, attracts no little attention. In the "Dragon" vibro-massage machine there is a piece to strap to the hand which transmits the vibration through the hand and also a regular massage handle for use in the regular way in barber shops. Those in attendance include Messrs. G. Shelton, J. Irwin, A. H. Wood and Mr. Crowley.

Charles L. Kiewert Company, New York, displays two "Aurola" lamps which give maximum distribution in a downward direction, two "Alba" vertical carbon lamps and one "Alba triplex," which is said to give about 4,000 cp with a difference of potential of 60 volts at the arc. At the back of the exhibition space is a show-window arranged to demonstrate the "Trucolor" lamp, particularly adapted to show-window use in connection with a prismatic hemispherical diffuser which equalizes and distributes the illumination in a most efficient manner. A line of Siemens carbons is shown. In addition to the display in the exhibit space there are eight Alba lamps on the tower of the Garden. Representing the company are Messrs. K. A. Albrecht, W. F. Hessel and S. Bernheim.

Tucker Electrical Construction Company, New York, features in its booth a 7-ft. model of the Manhattan Bridge across the East River as it appeared during the Hudson-Fulton celebration. The Tucker Company contracted for all the public work in the five boroughs and the bridge is illuminated by 350 11-volt, 2-cp lamps. On the back of the exhibition space are shown all the standard methods of wiring, including rigid conduit, flexible conduit, knob and tube, wooden moulding, metal moulding, fibrous conduit and combination systems, together with numerous devices used in household, tunnel, office, railway and marine work. The company is engaged in electrical contracting work only, and its booth has been arranged to feature this fact. Messrs. J. R. Strong, H. H. Sinclair and W. A. Cornell look after the interests of the concern.

The Watson-Stillman Company, New York, has on exhibition twin volute turbine pumps direct-connected to motors and pumping water for house-tank purposes against a pressure of from 25 to 50 lb. A shaft straightener for straightening 4-in. steel rods, a hydraulic punch, a hydraulic jack, hydraulic motor lift and a 60-lb. hydraulic broaching press operated by a motor are featured. Those in attendance include Mr. H. A. Prindle, E. A. Stillman, J. B. Ketcham and Mr. Baker.

Studebaker Bros. & Company, New York, have three electric vehicles on exhibition in charge of Mr. F. B. Cutter. Side by side are a five-ton stake truck, the largest built by the company, and an 850-lb. panel wagon, the smallest vehicle turned out by the Studebaker concern. The latest model of victoria-phaeton forms the third exhibit. Exide batteries are used in series in connection with Westinghouse motors. The large truck has a two-motor equipment which gives an individual drive for each rear wheel and eliminates the necessity of a differential or equalizing gear. The delivery wagon is fitted with 26 cells of 11 M V Exide battery, but where long distance is required 44 cells of Edison A 6 are installed.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The past week in commercial trade was but a repetition of the favorable reports from all branches. The wholesale business is thoroughly satisfactory and orders are being received liberally from all sections of the country. Even the South, where it was feared the shortage of the cotton crop would curtail business, seems to be optimistic and ready to buy. The high prices being received for cotton, together with the unprecedentedly early movement of the crop to market, has given plenty of ready money to the Southern planters and this condition is immediately reflected in the retail trade. The buying is, however, marked by the same conservatism that has prevailed since the hard times of two years ago. In spite of the widespread sentiment of encouragement and the abounding faith in the future, there is no disposition to overplay the game. The number of idle cars has steadily diminished and in many special lines there is considerable shortage of cars. It is in the industrial lines, however, that the great record is being made. The production of pig iron for September broke all previous records. It was 6.1 per cent above that of August and 2 per cent ahead of October, 1907, the previous high record. The manufacturing plants in the iron industries are all busy and orders are piling up for future delivery at such a rate that the capacity of the mills will be taxed far into next year. Rail orders have been received in good volume and more are known to be ready for placement. Prices are being advanced all along the line, but this does not seem to put any check upon the demand. Building operations continue to be active and a long way ahead of the same periods last year. Collections are much improved owing to the liberal movement of the crops and business troubles are not numerous. Failures for the week ended Oct. 7, as reported by Bradstreet's, were 203, as against 195 the previous week, 256 in the same week of 1908, 192 in 1907, 192 in 1906 and 183 in 1905.

THE COPPER MARKET.

After having been weak and dull all during the week the copper market was almost demoralized on Oct. 11, by the publication of the figures of the Copper Producers' Association for September. These showed a record production and an increase in American stocks of 15,840,207 lb. The production record for September was 3,934,104 lb. per day, as against 3,890,233 lb. for August, the previous high record. The total production for the 30 days of the month was 118,023,139 lb.; the deliveries were, for domestic consumption 52,105,155 lb., for export 50,077,777 lb., a total of 102,182,932 lb. The situation in a nutshell is that the rate of production in September was the greatest ever known and the deliveries were less than for any month since February. The tone of the market was not improved, either by the additional knowledge that stocks in Europe had been accumulating heavily in warehouses and that many consumers, both here and abroad, held supplies vastly in excess of their immediate needs. The total stock of copper in American producers' hands on Oct. 1 is given as 151,472,772 lb. It is estimated that speculators alone are carrying in Europe 210,000,000 lb. The result of the publication of these figures was the immediate lowering of asking prices abroad and decided weakness in the local market. Sales were light, however, and consumers are evidently willing to wait for further concessions. Exports for the month, including Oct. 11, have amounted to 7879 tons. The daily call on the Metal Exchange at 12:30 o'clock, Oct. 11, quoted standard copper as shown in the table above.

NEW YORK METAL EXCHANGE PRICES.

	Bid.	Asked.	Settling price.
Spot	12.25	12.50	.....
October	12.25	12.40	12.32½
November	12.25	12.45	12.35
December	12.35	12.50	12.42½

The London prices Oct. 11 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	[illegible]	57 2 6
Standard copper, futures	[illegible]	58 2 6
Market	Weak	Easy
Sales of spot		1,000 tons
Sales of futures		1,400 tons

Extreme fluctuations for this year

	Highest.	Lowest.
Standard	[illegible]	12.37½
Lake	[illegible]	12.55
Electrolytic	[illegible]	12.12½
Castings	[illegible]	12.00
London, spot	[illegible]	£54 12 6

SIERRA & SAN FRANCISCO POWER COMPANY.—All of the negotiations have been concluded between the Stanislaus Electric Power Company and the Tuolumne Water Power Company and the new holding company known as the Sierra & San Francisco Power Company. The latter company is the concern incorporated recently to take over the properties of the Stanislaus and Tuolumne companies, which were purchased at foreclosure sale by interests identified with the United Railroads Company, of San Francisco. It is the intention of the new company to improve the water plants to the utmost extent. Energy will be transmitted 140 miles from the Stanislaus plant to San Francisco. This transmission will be at 100,000 volts, and in a substation just outside of San Francisco the voltage will be stepped down to 11,000. The secondary current will be distributed to four substations, where the alternating current of 11,000 volts, 60 cycles, will be transformed through motor-generator sets to 600 volts direct current. This is the energy that will be delivered to the railroad company. G. W. Bacon, of Ford, Bacon & Davis, is president of the company. J. E. Woodbridge is the engineer in charge on the Pacific Coast for Ford, Bacon & Davis.

WESTERN ELECTRIC COMPANY'S BUSINESS.—The Western Electric Company's business for September was very close to that of August, which was better than for any month during the year. It was 50 per cent better than September, 1908. This month ends the ten-month period of the company's fiscal year, and indicates that the total business for the year will probably amount to $47,000,000, which is an increase of 42.5 per cent over the gross business of 1908. The business of the company continues to be largely in small apparatus and in telephone appliances, but the expansion in the latter direction has been so great within the past six months that the company has been kept very busy. At the present time it is said that there are 17,000 workmen on the company's payroll, and this compares with 13,000 one year ago. The greatest number which the company ever employed was 29,000, in 1906. The business of the company has been growing especially in the territory west of the Mississippi River, and this has necessitated the increase of the facilities at the company's plant in Omaha, so that this establishment now handles electric lighting and other supplies in addition to telephone appliances.

MONEY TO LENGTHEN SUBWAY PLATFORMS.—The Board of Estimate and Apportionment appropriated last week $1,500,000 to pay for lengthening the station platforms of the New York City subway so as to accommodate ten-car expresses and eight-car local trains. It has been claimed by the Comptroller that although the Public Service Commission approved this improvement last spring, the Interborough company had never, until the past week, expressed its readiness to go on with the work. It is the opinion of Theodore P. Shonts, the president of the Interborough, that this improvement will add 25 per cent to the carrying capacity of the subway. It will require at least six months to complete the work.

BROOKLYN RAPID TRANSIT TRAFFIC.—John F. Calderwood, vice-president and general manager of the Brooklyn Rapid Transit Company, has given out a statement in which he said that the company carried 13,285,000 passengers between Sept. 25 and Oct. 2, inclusive. This was an average of 1,660,000 per day, and was far in excess of any traffic record made by the Brooklyn Rapid Transit Company

MR. REISINGER ON GERMAN CONDITIONS.—Hugo Reisinger, the well-known importer of carbons, has returned from his annual trip to Germany. He says that general business conditions are improving in Germany, and, while they are much better than they were last year, he does not think that they are up to the mark of two years ago. While in Germany Mr. Reisinger spent a week at the carbon works of C. Conradty at Nuremberg, where the "Electra" carbons are manufactured. He fully discussed with the German manufacturers the new carbon situation created by the high rates of duty now imposed. Mr. Reisinger is of the opinion that the burden of the extra duty will have to be borne by the consumer, but that, nevertheless, he will be able to retain his full share of the business. He says that he will do this on account of the superior quality of the goods manufactured by his people, and on account of the additional fact that there are certain classes of goods which cannot be manufactured at all in this country, nor can they be manufactured in any other European country, their composition being an absolute secret possessed by the Conradty people. For the past year Mr. Reisinger has imported a carbon brush called "Bronskol," which was originally invented by a Swedish scientist, the patents of which for the world have been bought by Conradty. Mr. Reisinger claims that this "Bronskol" surpasses any carbon or metallic brush ever made, and that it has been adopted by all of the large electrical machinery manufacturers of the old world. While abroad Mr. Reisinger was honored by being received by the German Emperor and Empress of Germany, with whom he spent two hours.

BRITISH TUNGSTEN FILAMENTS FOR AMERICA.—F. Harrison, manager of the International Filament Company, Ltd., London, together with W. Stewart, financially interested in the enterprise, have been in this country for several weeks making contracts for the disposal of tungsten lamp filaments. These filaments are manufactured in England by a secret process controlled by Mr. Harrison, and are sold throughout Great Britain and on the continent by the Bryan Trading Syndicate of London. These gentlemen report that they have been quite successful in placing their filaments in this country, both with the independent manufacturers and with some members of the incandescent lamp combination. The same company also makes parts of lamps and has a patented sealed package for transporting tungsten lamps, so arranged that the lamp can be tested before the seal is broken, thus limiting claims to actual breakages in transit. Messrs. Harrison and Stewart have incorporated under the laws of New York a company, named the Electrical Manufacturers' Agency, for handling their goods in this country and which will have headquarters in New York. They also declare that if the market for their filaments turns out as satisfactory as it now promises, a factory will be established in this country in order to get the benefit of the 45 per cent tariff tax.

CENTRAL GEORGIA POWER COMPANY.—In a booklet recently issued, the first of a series, the Central Georgia Power Company advises the public of its plans which, in general, are to provide electrical energy in such a quantity and at such a cost as will make "Central Georgia one of the greatest industrial beehives on the American continent." The first hydroelectric plant will be on the upper waters of the Ocmulgee, near Jackson, Ga., where a dam 1700 ft. long is being constructed which will create a storage reservoir having an area of 6 square miles. In the power house, which will be integral with the dam, there will be six turbines direct connected to generators of 24,000 hp, with space for two additional units. When this and the other developments which the company's plan contemplates are completed, the company will have available a total of 150,000 hp.

ELECTRICAL BUSINESS EXPANDING.—The General Electric Company and the Westinghouse Electric & Manufacturing Company are now operating, according to a statement of an authority, at about 80 per cent of capacity. The present operation of these companies, it is said, is very close to what it was in 1907, but the manufacturing capacity has been greatly increased. The General Electric can now handle a gross business of $85,000,000 a year and the Westinghouse a business of $50,000,000. The relation between the two companies is said to be very much closer than it has ever been and it is intimated that there will not be a great amount of price cutting in the future.

TUNNELS UNDER THE EAST RIVER.—It is now given out with practically official authority that the tunnels under the East River from the Pennsylvania Railroad station in Manhattan to the railroad yards in Long Island City will be ready for operation by Jan. 1. This will probably also include the running of trains all the way to Jamaica. The north shore branch of this line will not be ready for operation before May. It is said that some time in the early fall of 1910 the entire electric zone of the Long Island Railroad Company will be in operation. The Pennsylvania Railroad Company does not expect to open its Hudson River tunnels until about the beginning of next summer.

DOMINION POWER & TRANSMISSION COMPANY.—It is announced that the Hamilton Cataract Power, Light & Traction Company is going to build a second transmission line to Brantford, a distance of 23 miles, the original line constructed in 1907 being already loaded up to its capacity. It is expected that the line will be built upon the right-of-way of the Brantford & Hamilton Railway, one of the allied concerns comprising the "Cataract" system now controlled by Dominion Power & Transmission Company. J. R. Moodie, president, and Wm. C. Hawkins, general manager, were in New York this week making the necessary financial arrangements.

NEW CORPORATION TAX LAW.—Haskins & Sells, certified public accountants, have issued a circular calling attention that the new corporation tax law, which became operative Aug. 5, prescribes methods of accounting for ascertaining net income which are at variance with the practices usually followed by industrial corporations and at variance with those prescribed for public service corporations by federal and State laws. The circular suggests that interpretations be secured as soon as possible from the Commissioner of Internal Revenue, so that accounting methods may be reconstructed before the end of the year and penalties avoided.

CLEVELAND STREET RAILWAY SITUATION.—Efforts have recently been made to arrange the final terms for the settlement of the Cleveland Street Railway difficulties. This situation has been an active fight for the past eight years. Under the new arrangement it is agreed that the city shall give to the Cleveland Railway Company, the owner of the lines, a 25-year franchise revokable at any time. The city of Cleveland is to reserve the right to purchase the lines at any time that municipal ownership is made lawful. The initial rate of fare is to be 3 cents on all lines, with a 1-cent extra charge for transfers.

ILLINOIS CENTRAL ELECTRIFICATION.—It is said that President Harahan, of the Illinois Central Railroad, will recommend at the company's annual meeting this month the immediate electrification of a two-track local suburban service from Randolph Street to Sixty-seventh Street. The company will buy the energy to operate this service and will probably use coke on other locomotives inside the city limits. The general electrification will be postponed for future consideration, but it is thought best to do something at once to appease public clamor.

GREAT NORTHERN DEVELOPMENT & LAND COMPANY.—All of the land on both sides of the Mississippi River from Anoka to Coon Creek Junction, in Minnesota, has been purchased by the Great Northern Development & Land Company, of Duluth. The company proposes to petition Congress for permission to erect a dam across Coon Creek which will cost $1,000,000. It is estimated that 50,000 hp can be developed, which will be transmitted upon high-tension lines to St. Paul and Minneapolis.

ROCKVILLE-WILLIMANTIC LIGHTING COMPANY.—The directors of the Rockville-Willimantic Lighting Company, of Willimantic, Conn., has adopted a new schedule of rates for energy. The new rates are on a sliding scale, and compared with present rates there will be a material reduction. It is stated that later on the company will adopt a new schedule for lighting. The company expects to connect the Willimantic system in the near future with South Windham and South Coventry.

GREAT WESTERN POWER COMPANY.—The Great Western Power Company, of California, has submitted a proposition to the City Council of San Francisco, offering to supply energy to operate the municipal electric light plant for ten years. This plan provides for the extension of the transmission line from Richmond to Alameda and would involve an expenditure of $10,000 by the city.

NORFOLK & WESTERN TELEPHONE SERVICE.—The Norfolk & Western Railroad has recently put into service two telephone circuits for handling its trains, one between Roanoke, Va., and Bluefield, W. Va., 102 miles, the other between Bluefield and Williamson, W. Va., 107 miles. There are 16 stations on the former circuit and 22 stations on the latter. Western Electric Company's telephone equipment and Gill selectors are used on both circuits. This equipment extends through some very mountainous country and affords a good test of telephone train dispatching under very severe conditions. It has been in service since Sept. 25, and W. C. Walstrum, superintendent of telegraph, reports that both circuits have been giving excellent service.

TO SEPARATE INTERESTS AT CHARLOTTE, N. C.—The Charlotte (N. C.) Consolidated Construction Company has applied to the Board of Aldermen of Charlotte for the right to separate its gas and lighting business from its traction business. It intends to form the Charlotte Gas & Electric Company, to take over these departments. The petition will probably be granted. The new company has been chartered for some months by E. D. Latta, president of the older company, and his associates. The company has numerous improvements in view. As to the separation of the traction interests from the electric light and gas interests, it is set forth by the company that such will greatly facilitate the issuance of bonds in the future.

LORD ELECTRIC COMPANY.—The Board of Water Supply of New York City has awarded to the Lord Electric Company the contract for furnishing two 12,500,000-gal. steam turbine pumps, two 225-hp tubular boilers and all accessories.

Financial Intelligence.

THE WEEK IN WALL STREET.

The past week in the Wall Street stock market has been one of heavy liquidation and declining prices. The main reason for this condition has been the rapid advance in rates for money. After a year and a half of extremely easy money conditions, where the bankers were practically begging for borrowers, and rates were so low that any dividend paying stock could be carried at a profit, there has been a sudden tightening up, both in this country and abroad, which has checked the upward movement of stocks. The Bank of England has advanced its minimum discount rate to 3 per cent, and the German Imperial Bank is charging 5 per cent. Call money in New York during the week was as high as 6 per cent. Hundreds of loans were called and the bankers were showing considerable anxiety about maintaining their reserves. This necessarily caused heavy liquidation; many accounts cannot be carried when loans are called. During the week there has been especially heavy selling of the Harriman issues and of Steel common. The reason for the weakness in the Harriman stocks is partly because the stocks have been pushed to very high levels, and partly because there is uneasiness lest the Harriman holdings may be thrown on the market in the settlement of his estate. Steel common had made a perpendicular rise of almost 50 points, and had reached the high record of 94⅞. It has for more than a year been the most popular medium of speculation, and when money became high and good profits were in sight, it was only natural that unloading should become general. The condition of the steel industry is just as satisfactory as ever, but carrying stocks is not as easy. As it has been pointed out, the market has been on too high a level for the condition of business, and at the present time there is an equalization being made. Money rates on Oct. 11 were: Call, 4 @ 5 per cent: 90 days, 4¾ @ 5 per cent. The quotations in the table are those of the close Oct. 11.

NEW YORK.

	Oct. 4.	Oct. 11.	Shares sold		Oct. 4.	Oct. 11.	Shares sold
All.-Ch.	15⅝*	14¾*	900	Int.-Met., pfd.	49	47¼	25,400
All.-Ch., pfd..	54⅜	52	4,200	Mackay Cos..	93½	91	3,825
Amal. Cop....	83¾	79⅜	159,223	MackayCos..p.	76½*	75½	615
Am. D. T....	20½*	20½*	———	Man. Elev...	142	142*	865
Am. Loc.	61	58	5,700	Met. St. Ry.	20*	20*	———
Am. Loc., pfd.	115¾	115	100	N.Y.&N.J.Tel.	139¼*	139½*	———
Am. Tel. & Cbl.	85*	85*	———	Steel, com...	93⅞	86¼	2,070,320
Am. T. & T..	143⅛	141⅞	52,782	Steel, pfd...	130¼	126⅜	58,360
B. R. T.....	80⅞	77¾	25,265	W. U. T.....	78½	76¼	4,075
Gen. Elec....	167	163	6,140	West'h. com..	87⅝	85⅜	5,200
Int.-Met.. com	16	15¼	16,310	West'h. pfd..	144	145*	700

PHILADELPHIA.

	Oct. 4.	Oct. 11.	Shares sold		Oct. 4.	Oct. 11.	Shares sold
Am. Rys.....	46	46*	———	Phila. Elec..	12½	12¾	———
Elec. Co. of A.	12¼	12¼*	———	Phila. R. T..	28¼	28	———
Elec. St. B'ty.	61	59½	———	Phila. Trac...	91	90	———
E. S. B'ty. pfd.	30*	30*	———	Union Trac..	53½	52½	———

CHICAGO.

	Oct. 4.	Oct. 11.	Shares sold		Oct. 4.	Oct. 11.	Shares sold
Chi. City Ry..	180*	180*	———	Chi. Tel. Co.	138*	137½*	———
Chi. Rys.,Ser.1.	109¼*	109¼*	———	Met. El., com.	17¾*	17¾*	———
Chi. Rys.,Ser.2.	36½*	36½*	———	Met. El., pfd.	51	50	———
Com. Edison..	120	121	———	Nat'l Carbon.	68½	90½	———
Chi. Sub'ws...	7⅞	5½	———	Nat'l C., pfd	120*	120*	———

BOSTON.

	Oct. 4.	Oct. 11.	Shares sold		Oct. 4.	Oct. 11.	Shares sold
Am. T. & T...	143¼	142	———	Mex. Tel....	2⅜*	2½*	———
Cum. Tel.....	140	142½	———	Mex. Tel.,pfd.	6½*	6*	———
Edison E. Ill..	252*	252	———	N. E. Tel...	137	136*	———
Gen. Elec.....	162½*	162½	———	W. T. & T..	11¾	10	———
Mass. E. Rv...	18½*	17½*	———	W. T. & T., p.	88	89	———
Mass. E. R..p.	80*	80	———				

*Last price quoted.
Shares sold are for week of Oct. 4 to Oct. 9.

ASSOCIATED GAS & ELECTRIC COMPANY.—A controlling interest in the Associated Gas & Electric Company has been acquired by W. S. Barstow & Company, 50 Cedar Street, New York, with offices also in Portland, Ore. At the present time the Associated Gas & Electric Company has authorized $5,000,000 of collateral bonds, with stocks and bonds as collateral, of which there are $1,725,000 issued; $1,500,000 of debenture bonds, of which there are $225,000 issued; 6 per cent cumulative preferred stock authorized $1,000,000, of which there is $500,000 issued; common stock authorized, $1,000,000, of which $600,000 is issued. The properties to be taken over by W. S. Barstow & Company are as follows: Ithaca Electric Light & Power Company, Homer & Cortlandt Gas Light Company, Ithaca Gas Light Company, Norwich Gas & Electric Company, Hornell Gas Light Company, Canisteo Gas Light Company, Bethlehelm (Pa.) Consolidated Gas Company, Van Wert (Ohio) Gas Light Company, Greenville (Ohio) Gas Light Company, Delaware County (Pa.) Electric Company. The total securities of these companies are $1,950,000 stocks, $1,717,000 bonds. The officers of the Associated Gas & Electric Company, which will continue in existence and control the properties above mentioned, are: W. S. Barstow, president: William T. Morris, vice-president; O. Clement Swenson, treasurer; Jos. B. Taylor, secretary; T. W. Summers, general manager. The office hereafter will be at 50 Pine Street, New York, which is the headquarters of W. S. Barstow & Company. The properties, which formerly belonged to the Associated Gas & Electric Company, and which were disposed of outside of the present transfer, are: Lyons (N. Y.) Gas Light Company, Newark (N. Y.) Gas Light & Fuel Company, Oswego Gas Light Company, Palmyra Gas & Electric Company, Penn Yan Gas Light Company. These properties were not included in the sale to Barstow & Company and have been taken over by W. T. Morris, formerly president of the Associated company, who will manage them personally. The Delaware County Electric Company, which is mentioned above, is a consolidation of properties operating in Delaware County west of Philadelphia. The Associated Gas & Electric Company will own a large majority of the bonds and stocks of its subsidiary companies. W. S. Barstow is authority for the statement that there is plenty of money in sight under the new plan of financing to care for all of the extensive developments which are now contemplated in the subsidiary properties.

CHICAGO SUBWAY DIFFICULTIES.—When the stock of the Chicago Subway Company sold the other day at 4⅞ on continued heavy liquidation the representatives of the prinpal stockholders met in conference to consider the future of the property. It is said that the trouble with the company is that it has expended much larger sums in extensions than the development of traffic has warranted. A large part of this money was borrowed from E. H. Harriman and J. Ogden Armour on notes which are now falling due. This debt, it is said, amounts to about $14,000,000 and will require skilful re financing.

LOS ANGELES GAS & ELECTRIC BONDS.—N. W. Harris & Company and E. H. Rollins & Sons report that the $1,000,000 5 per cent bonds of the Los Angeles Gas & Electric Corporation which they recently offered were all sold in one day and that a large number of bids were received which could not be filled. This is but one of many instances showing the growing popularity of the securities of public-service corporations.

AMERICAN POWER & LIGHT COMPANY.—There was incorporated last week under the laws of Delaware a new holding company to be known as the American Power & Light Company. The interests back of this concern are identical with those of the Electric Bond & Share Company, which, it is understood, belongs to the General Electric Company's interests. The new corporation will have a capital stock of $15,000,000, of which $5,000,000 is to be cumulative 6 per cent preferred. The immediate issue of stock will be $2,500,000 preferred and $5,500,000 common. The new company has already acquired the Home Light, Heat & Power Company, of Pittsburgh; the United Gas Company and the Edison Light & Power Company, of Wichita, Kan., and the Astoria Electric Company, of Astoria, Ore. In speaking of the organization of this new company, an official of the Electric Bond & Share Company said that the reason for it was that it was thought better to create a new company which could issue collateral bonds and new stock rather than to go through the necessary legal formulas for increasing the security issuing power of the Electric Bond & Share Company. All of the stock of the new company will belong to interests identical with the Electric Share & Bond Company.

CONTINENTAL TELEGRAPH & TELEPHONE COMPANY.—There was incorporated in New Jersey last week a company called the Continental Telegraph & Telephone Company, with an authorized capitalization of $50,000,000. The stock is equally divided between preferred and common. The purposes of the company, as announced, are to take over telephone lines in New York and New Jersey. The named incorporators are employes of the law firm of Philbin, Beekman & Menken, of New York, but at the office of that firm it was announced that at the present time no information concerning the new company could be given out. At the New York office of the American Telephone & Telegraph Company a positive denial was made that the new concern has anything to do with the Bell enterprises. It is understood that the company is to be a holding concern for numerous independent companies and it is intimated that it is allied with one of the big independents that has been endeavoring for some time to enter the field in New York City.

CONTEST FOR CONTROL OF WORCESTER COMPANY.—While the contest for control of the Worcester Electric Light Company is still being actively prosecuted there is no certainty as yet as to whether the Worcester interests or outside parties will win. This will not be determined until the result of the stockholders' meeting of Oct. 13 is made known. The protective committee, of which President Augustus B. R. Sprague is the chairman, announces in a circular which has just been issued to stockholders that it has secured control of enough stock to control the company. This committee has asked for deposits of stock in trust for 60 days and guarantees not to make any sale for less than $300 per share.

NORTHERN INDIANA GAS & ELECTRIC BONDS.—White & Company are offering $1,869,000 of 5 per cent bonds of the Northern Indiana Gas & Electric Company. These bonds are a portion of an authorized issue of $10,000,000. Of this authorized issue $1,756,500 are to be reserved to take up the bonds of the subsidiary companies and $6,434,500 is to be used for acquisitions and betterments at 85 per cent of cost. The company was formed last April by the consolidation of the South Shore & Electric Company, the Indian Harbor & East Chicago Electric Company and the Michigan City Gas & Electric Company. It is said that the company's earnings for the year will show a big advance over last year.

CONSOLIDATED GAS, ELECTRIC LIGHT & POWER COMPANY, BALTIMORE.—The annual report of the Consolidated Gas, Electric Light & Power Company, of Baltimore, shows a net income in excess of operating expenses and taxes of $2,202,744. This is an increase over the previous year of $332,659. After providing for all fixed charges there was a balance of $828,197. This left a balance applicable to dividends of $828,197, which after paying the regular preferred dividend left an amount equal to 6.4 per cent on the common stock. The business of the company has been gradually growing, and the officials declare that the prospects for the coming year are exceedingly bright.

KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY.—The directors of the Kings County Electric Light & Power Company have recommended to the stockholders that they authorize an issue of $5,000,000 of convertible debenture bonds bearing 6 per cent interest. This will undoubtedly be done, and the proposition will be passed up to the Public Service Commission for authority. It is understood that extensive improvements in connection with the Edison Illuminating Company of Brooklyn are contemplated, and new money is required for this purpose. Up to this time the application for the bonds has not been filed with the Public Service Commission.

GRAND RAPIDS-MUSKEGON POWER COMPANY.—Proceedings have been started in the Supreme Court at Lansing, Mich., against the Grand Rapids-Muskegon Power Company, organized under the laws of Maine, to prevent it from exercising a franchise for the construction and operation of three dams along the Muskegon River, near Mecosta, Mich. It is alleged that the corporation has failed to comply with the terms of its franchise. The company has applied to the State Railway Commission for permission to issue $75,000,000 of gold bonds, which it is proposed to use as the demands of the property need.

HORNELL (N. Y.) TRACTION COMPANY.—A new corporation has been formed in the State of New York, known as the Hornell Traction Company, which will operate in Steuben County. The new company will take control of the Hornellsville Electric Railway Company, the Hornellsville & Canisteo Railway Company and the Canisteo Valley Electric Railway Company. The combined capital stock of these three companies is $120,000; the total capitalization of the new company is for the same amount, $120,000. The directors of the new company include Charles Adsit, George T. Rehn and Milo Macker.

AMERICAN TELEPHONE & TELEGRAPH COMPANY.—Recent publications concerning the stock ownership in the American Telephone & Telegraph Company show that outside of the Mackay Companies, of New York, there is really not any very large stockholder. Out of an issue of $200,000,000 there are but 32 stockholders who own as much as 5,000 shares each, and a number of these are brokerage houses which are probably carrying the stock for customers. It is said that there are 35,000 stockholders in all in the telephone company, but only 254 of these own as much as 1,000 shares.

CONNECTICUT VALLEY STREET RAILWAY BONDS.—The Railroad Commissioners of Massachusetts have approved the application of the Connecticut Valley Street Railway Company for permission to issue $700,000 of first mortgage bonds. Of the proceeds of the issue $500,000 is to be applied to the payment and refunding the issues of several companies which have consolidated with the Connecticut Valley company and the balance is to be devoted to taking up floating indebtedness and to improvements.

MICHIGAN WATER RIGHTS SECURED.—The Eastern Michigan Edison Company, of Detroit, has secured water rights along the Huron River which have heretofore been held by Frank I. Cornwell and John L. Duffy, of Ann Arbor. These rights give the company practically the entire water power of the Huron River from Lake Erie to Zuke Lake. The deal includes the transfer of the properties known as Dover's Dam, Hudson and Scio Dam.

PUBLIC UTILITIES IN QUEBEC.—It is said that a project is on foot for the consolidation of public utilities in Quebec. This involves the merging of the Quebec Railway & Light Company and the other lighting and power companies of the city. The details of the combination have not been worked out as yet, but the negotiations have been sufficient to advance the stock of the railway company from 57 to 68 in the past week.

NEW COLORADO ELECTRICAL ENTERPRISE.—Pueblo & San Luis Valley Railroad & Power Company has been incorporated in Colorado with a capital of $8,000,000 to construct an electric railway from Pueblo across the Sangre de Christo Mountains into the San Luis Valley. It is planned to build an interurban system among the towns in the valley. All along the route spur tracks will be run to the mining camps.

MIDDLESEX & BOSTON RAILWAY CONSOLIDATION.—The Railroad Commissioners of Massachusetts have approved the consolidation of the Middlesex & Boston Street Railway Company and the Newton & Boston Street Railway Company. They have also authorized the issue by the former company of $200,000 additional capital stock for the purpose of furthering the consolidation.

ASHEVILLE & EAST TENNESSEE RAILWAY.—At least $500,000 in bonds will be asked by the promoters of the Asheville & East Tennessee Railway, $200,000 from Buncombe County, $100,000 from Asheville and $200,000 from Mitchell and Yancey counties toward the completion of this projected electric highway from Weaverville to connect with the Carolina, Clinchfield & Ohio. The various counties and Asheville will hold elections if the proper petitions are presented to the authorities asking for the same, and several have already promised to call such elections if necessary. The proposed line would handle both freight and passengers. The Weaver Power Company has begun work on a new power plant near Marshall on the French Broad River, where the river is bounded on either side by high mountains, making such a plant feasible. This company has an agreement with the Asheville & East Tennessee Company to supply energy at reasonable rates.

WHITNEY POWER COMPANY.—An announcement has been made that the Bankers' Trust Company of New York has taken an appeal from the decision of Judge J. C. Pritchard, in Federal court, in the case of the Whitney Power Company, in which is involved the question of the control of the $4,000,000 plant of the company on the Yadkin River. This appeal, it is said, will have the effect of stopping all work on the plant now nearing completion under the direction of the receiver, Col. W. S. Henderson.

CHATTAHOOCHEE POWER COMPANY.—Application has been filed for a charter for the Chattahoochee Power Company, of Columbus, Ga. The authorized capital stock is $2,000,000, and the incorporators are: B. H. Hardaway, George A. Pearce and P. J. Rankin, of Columbus. The company has acquired 7 miles of water front on the Chattahoochee River, in Harris County, and proposes to construct a dam 30 ft. high, where it is expected to develop 4000 hp. This will be transmitted to Columbus, a distance of 17 miles.

WESTINGHOUSE AIR BRAKE COMPANY.—The net earnings of the Westinghouse Air Brake Company for the fiscal year which ended July 31, 1909, show a gain of $14,517 over the previous year. While this gain is not large, and while the gross returns are a trifle less than for the year previous, the condition of the company is thought to be distinctly improved. The surplus for the year was within a few thousand dollars of that of the year previous.

SOUTHERN POWER COMPANY FRANCHISES.—Following in the wake of the action of the City Council of Columbia, S. C., in refusing the Southern Power Company certain franchises it is reported that at the next meeting of the South Carolina Legislature action may be taken to restrict the company's operations or to regulate it in accordance with the State's laws under the heading of so-called "anti-trust" legislation.

TELEPHONE ABSORPTION ENJOINED.—The Iowa courts have enjoined the Iowa Telephone Company, a Bell concern, from absorbing the Mutual Telephone Company of Des Moines. The latter company is an independent and the action was brought on a minority stockholders' petition. The Bell company recently secured the majority of the stock of the Mutual company.

NASSAU LIGHT & POWER COMPANY.—The Nassau Light & Power Company, of Mineola and Roslyn, Long Island, has been granted permission by the Public Service Commission of the Second District to absorb the Nassau Gas, Heat & Power Company, Floral Park Light & Power Company and the Oyster Bay Electric Light & Power Company.

DETROIT UNITED RAILWAY BONDS.—The Michigan Railway Commission has been asked by the Detroit United Railway Company for permission to issue $2,000,000 additional 5 per cent bonds. These bonds will be issued in January, 1910, and the proceeds will be used to take up a similar amount of collateral trust notes which will fall due Feb. 15, 1910.

DIVIDENDS

American Light & Traction Company, preferred, quarterly, 1½ per cent, payable Nov. 1; common, quarterly, 2 per cent, payable Nov. 1; extra on common, 2½ per cent, payable Nov. 15.

Brooklyn City Railroad Company, quarterly, 2½ per cent, payable Oct. 15.

Cape Breton Electric Company, preferred, semi-annual, 3 per cent, payable Nov. 1.

Colorado Telephone Company, quarterly, 1¾ per cent, payable Oct. 15.

Edison Electric Illuminating Company, Boston, quarterly, 2½ per cent, payable Nov. 1.

Electric Securities Corporation, preferred, 2½ per cent, payable Nov. 1.

Guanajuato Power & Electric Company, preferred, quarterly, payable Nov. 1.

Holyoke (Mass.) Water Power Company, quarterly, 3 per cent, extra, 20 per cent, payable Oct. 5.

International Steam Pump Company, quarterly, 1½ per cent, payable Nov. 1.

Mexican Telephone & Telegraph Company, preferred, semi-annual, 2½ per cent, payable Nov. 1.

Milwaukee Electric Railway & Light Company, preferred, quarterly, 1½ per cent, payable Nov. 1.

Montreal Street Railway Company, quarterly, 2½ per cent, payable Nov. 2.

National Carbon Company, quarterly, 1¼ per cent, payable Oct. 15.

Nebraska Telephone Company, quarterly, 1½ per cent, payable Oct. 10.

Ottumwa (Ia.) Railway & Light Company, preferred, quarterly, 1¾ per cent, payable Oct. 15.

Pioneer Telephone & Telegraph Company, of Oklahoma quarterly, 1¾ per cent, payable Sept. 30.

Twin City Electric Railway Company, quarterly, 1¼ per cent, payable Nov. 15.

J. G. White & Company, preferred, quarterly, 1½ per cent, payable Nov. 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses	Net earnings	Charges.	Surplus.
Blackstone Valley Gas & Electric Company					
August, 1909	$74,404	$40,070	$34,334	$24,102	$10,232
August, 1908	68,340	34,967	33,372	.....	.....
Commonwealth Power Company, Jackson, Mich.:					
Year ended August, 31, 1909	583,090	283,735	299,356	145,323	154,033
Year ended August 31, 1908	536,815	259,420	277,395	139,745	137,649
Dallas (Tex.) Electric Corporation:					
August, 1909	128,749	88,218	40,531	28,648	11,883
August, 1908	94,738	63,553	31,185	28,329	2,856
Duluth-Superior Traction Company:					
August, 1909	92,235	53,650	38,585	18,416	20,169
August, 1908	84,733	46,109	38,624	8,916	19,708
Galveston-Houston Electric Company:					
August, 1909	111,294	62,976	48,318	21,679	26,639
August, 1908	101,707	55,100	46,607	20,527	26,080
Granby Consolidated Mining, Smelting & Power Company:					
Year ended June 30, 1909	3,983,536	3,470,029	513,507	270,000	243,507
Year ended June 30, 1908	3,790,184	3,435,760	354,424	675,000	320,576
International Railway Company, Buffalo:					
Year ended June 30, 1909	4,093,912	2,409,933	1,805,593	962,645	842,948
Year ended June 30, 1908	4,522,924	2,698,778	2,008,675	996,573	1,012,102
Minneapolis General Electric Company:					
August, 1909	77,568	36,806	40,612	30,028	10,584
August, 1908	74,411	34,414	39,997	32,091	7,906
Portland (Me.) Electric Company:					
August, 1909	25,503	10,640	14,863	.....	.....
August, 1908	22,530	9,045	13,494	.....	.....
Seattle Electric Company:					
August, 1909	610,815	312,119	298,696	108,787	190,109
August, 1908	382,741	219,659	163,082	94,834	68,248
Twin City Rapid Transit Company:					
August, 1909	641,062	262,479	378,582	140,250	238,332
August, 1908	592,702	281,707	310,995	128,667	182,328
Westinghouse Air Brake Company:					
Year ended July 31, 1909	5,286,021	3,246,748	2,039,273	118,715	1,920,557
Year ended July 31, 1908	5,308,016	3,298,260	2,014,756	43,960	1,970,796

GENERAL NEWS

Construction News.

BESSEMER, ALA.—It is reported that the Bessemer Gas Company will soon apply to the City Council for a franchise to operate an electric light plant in Bessemer.

GLOBE, ARIZ.—It is reported that the Arizona & Michigan Mining Company is planning to install a new steam-driven electric unit in its plant.

GLOBE, ARIZ.—Preparations are being made by the Arizona & Eastern Consolidated Mining Company for the construction of a hydroelectric plant to furnish electricity for operating its properties.

PHOENIX, ARIZ.—The Pacific Gas & Electric Company is receiving electricity for operating its system in Phoenix, from the hydro-electric power plant at the Roosevelt Storage dam, 80 miles distant. The Pacific company is the first to receive service from the plant, but later electricity will be furnished to settlers removed from the ditches, who will irrigate the land by pumping plants, power being furnished in lieu of water for acreage interests in the reservoir.

MAMMOTH SPRING, ARK.—It is reported that Frank F. Hill, of Memphis, Tenn., and associates are interested in a project to construct a hydroelectric plant to transmit electricity to Mammoth Spring and Jonesboro, Ark.; West Plains, Mo., and other cities, at a cost of about $300,000.

ALAMEDA, CAL.—The Great Western Power Company, of San Francisco, Cal., has submitted a proposition to the City Council offering to supply electricity to operate the municipal electric light plant for a term of ten years. The plan provides for the extension of the transmission line of the company from Richmond to Alameda, which would involve an expenditure of $10,000, to be paid by the city. It is not expected that the offer will be accepted.

BEAUMONT, CAL.—The question of installing a street lighting system in Beaumont is under consideration.

CHICO, CAL.—Application has been made to the City Trustees by Guy R. Kennedy, representing the Sacramento Valley Power Company, for a franchise for the construction of a lighting, heating and power distributing plant in Chico. The company is reported to have plants located on Snow and Cow Creeks in Shasta County capable of developing 16,000 hp. It is proposed to erect an extension of its transmission line to Chico by the way of Anderson and Red Bluff.

LONG BEACH, CAL.—The City Council is considering the question of extending the street lighting system along Ocean Avenue for at least two miles and installing additional lamps to the pier and American Avenue.

LOS ANGELES, CAL.—The Board of Public Works is now in a position to appoint a consulting board of three engineers to have charge of plans for electrical power development along the line of the Los Angeles aqueduct.

LOS ANGELES, CAL.—The Sunnyslope Land Company has commenced work on the construction of an electric power plant, the cost of which is estimated at $50,000. George H. Ennis, of Los Angeles, Cal., is president of the company.

REDDING, CAL.—The Sacramento Valley Power Company will extend its transmission lines to Red Bluff and Chico, construction work now being under way. The company is a consolidation of the Northern Light & Power Company and the Shasta Power Company, each of which had an overhead distributing system covering the City of Redding. The Sacramento Valley Power Company is now taking down the Shasta Power Company's transmission system in Red Bluff. The Northern Light & Power Company's poles are allowed to remain because they carry the wires of the city fire alarm system. In those parts of Redding where the Sacramento Valley Power Company has only one line of poles they will be allowed to remain. The company has already applied for a franchise in Chico. The trustees of that city have taken favorable action, and bids for the sale of a franchise will be opened Nov. 2.

SACRAMENTO, CAL.—The Great Western Power Company has its transmission line almost completed from the Brighton plant to the city line at Sacramento, and connection with the city distributing point will be effected very soon. The Brighton substation has an output of 12,000 hp, which can be increased as required to 20,000.

SACRAMENTO, CAL.—After seven years of litigation over the control of the water of the American River at Folsom Prison, the State of California, through its prison board, and the Sacramento Electric, Gas & Railway Company, have reached a compromise. The power company is to have control of the waters as before they were restrained, but must stop or commence the flow upon written request of the prison board when it is shown desirable to State interests. The State won the suit, but found that in dry seasons by not damming the river there was not sufficient flow to give the prison even lights.

SAN BERNARDINO, CAL.—The County Board of Supervisors has passed a resolution directing an advertisement for the sale of a franchise for overhead transmission lines over various highways in the county applied for by the Southern California Edison Company, the new company into which the large companies of Southern California were recently merged. Bids for the sale of the franchise will be opened on Nov. 2. The resolution provides that the company is to pay the county 20 per cent. of the gross earnings after the first five years. The application was filed by Attorney Frank B. Daley.

SAN DIEGO, CAL.—G. W. Pursell, general manager of the San Diego, El Cajon & Escondido Electric Railway, has purchased the franchise sold by the City Council granting the company permission to enter San Diego for $5,100.

STOCKTON, CAL.—It is announced locally that the Santa Fé Railroad will at once equip all of its cabooses used in connection with freight trains with telephone instruments for the purpose of giving better protection from accidents. A portion of each caboose will be cut off and the necessary equipment for making connections with any of the offices along the line of the system will be installed.

YUBA CITY, CAL.—The Pacific Gas & Electric Company is securing rights of way for a transmission line from Yuba City to Sutter City and Meriden along the route of the survey for the proposed extension of the Northern Electric Railway from Yuba City to Colusa.

BRUSH, COL.—The Brush Electric Light & Power Company has just completed a power station to supply the Town of Brush, Col., with electricity for lamps and motors.

FLORENCE, COL.—The Arkansas River Power Company has filed maps and plans for the flume and ditch it proposes to construct between Salida and Florence. The ditch is to be 6 ft. deep, 36 ft. wide at the top, 24 ft. at the bottom and 45 miles long. The cost is estimated at $2,500,000. The company will supply power for all uses from four power houses, one at the mouth of Texas Creek, one at Howard, one at Coaldale and one at Parkvale. The incorporators are F. M. Tomlinson, Peter O'Brien and E. F. Hiatt.

MANCOS, COL.—The Mancos Electric Light & Power Company has just completed a new electric light plant in Mancos. The company will furnish lighting and power service.

PITKIN, COL.—A. E. Reynolds, manager of the Gold Links tunnel, mines and mill, it is reported, will install a hydroelectric plant.

WATERBURY, CONN.—It is reported that the Connecticut Company is planning to construct a new power house in Waterbury. The initial equipment will have a rating of 3000 hp, which it is planned to duplicate later. It is stated that Bigelow boilers will be installed.

WILLIMANTIC, CONN.—The directors of the Rockville-Willimantic Lighting Company have adopted a new schedule of rates for electricity for motors in Willimantic, Rockville, Stafford Springs and other places where the company furnishes electrical service. The new rates are on a sliding schedule and compared with the present rates there will be a material reduction. Later the company will adopt a new schedule of rates for electricity for lamps. The company expects to connect the Willimantic system with the new high-tension line within a month and is also planning to extend its electric lighting service to South Windham and South Coventry in the near future.

FORT DUPONT, DELAWARE CITY, DEL.—Sealed proposals will be received at the office of the constructing quartermaster, Fort Dupont, Delaware City, Del., until Nov. 9 for the construction of an electric lighting system (no machinery required) at Fort Dupont. Plans and specifications can be seen at the above office and also at the office of the chief quartermaster, Department of the East, Governor's Island, N. Y. A deposit of $5 will be required on each set of plans loaned, which will be returned on return of same.

WILMINGTON, DEL.—No proposals were submitted to the Street and Sewer Directors for lighting the streets of the city in response to their call for bids, which were to be opened Oct. 5. The contract for street lighting with the Wilmington City Electric Company expires April 1, 1910.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Oct. 19, to furnish at the navy yards and naval stations the following supplies: Portsmouth, N. H.; Boston, Mass.; Brooklyn, N. Y.; Philadelphia, Pa., and Mare Island, Cal. Schedule 1711—Water tight bells and buzzers. Portsmouth, N. H., and Philadelphia, Pa. Schedule 1711—Non-water tight bells and buzzers. Boston, Mass.; Norfolk, Va., and Mare Island, Cal. Schedule 1711—Testing generators. Portsmouth, N. H., and Brooklyn, N. Y. Schedule 1711—Dynamotors. Portsmouth, N. H.; Philadelphia, Pa., and Brooklyn, N. Y. Schedule 1711—Night signal set keyboards. Brooklyn, N. Y.; Norfolk, Va., and Mare Island, Cal. Schedule 1711—Reserve type dry cells and lighting fixtures. Portsmouth, N. H.; Boston, Mass.; Brooklyn, N. Y.; Philalelphia, Pa.; Norfolk, Va., and Mare Island, Cal. Schedule 1711—Fuses and fuse wire. Boston, Mass.; Brooklyn, N. Y.; Philadelphia, Pa.; Norfolk, Va., and Mare Island, Cal. Schedule 1711—Wiring appliances. Philadelphia, Pa. Schedule 1711—41 Cut-out switches. Mare Island, Cal., and Brooklyn, N. Y. Schedule 1711—Knife switches and switches. Brooklyn, N. Y.; Philadelphia, Pa.;

Norfolk, Va., and Mare Island, Cal. Schedule 1711—Water tight boxes and terminals tubes. Portsmouth, N. H.; Boston, Mass.; Philadelphia, Pa.; Norfolk, Va.; Mare Island, Cal., and Brooklyn, N. Y. Schedule 1711—Electric fittings. Boston, Mass.; Philadelphia, Pa.; Norfolk, Va.; Mare Island, Cal., and Brooklyn, N. Y. Schedule 1711—Connection boxes and interior fittings. Boston, Mass., and Philadelphia, Pa. Schedule 1711—Water tight attachment plugs. Pensacola, Fla. Schedule 1750—16,600 lb. sheathing copper, etc. Mare Island, Cal., or Brooklyn, N. Y. Schedule 1725—22,000 ft. copper wire, insulators, clamps, etc. Applications for proposals should designate the schedule desired by number.

AUGUSTA, GA.—The City Council has granted a franchise to the Georgia-Carolina Power Company to do business in this city. It is said that work will soon commence on construction of a dam, which, it is expected, will develop about 10,000 hp.

COLUMBUS, GA.—Application has been filed for a charter for the Chattahoochee Power Company with a minimum capital of $100,000 and a maximum capital stock of $2,000,000. The incorporators are: B. H. Hardaway, George A. Pearce, E. J. Rankin and others, of Columbus, Ga. The company has acquired seven miles of water front on the Chattahoochee River in Harris County and proposes to construct a dam 30 ft. high where 4,000 hp will be developed, which will be transmitted by electricity to Columbus, a distance of 17 miles. The cost of the dam, power house and transmission lines is estimated at $400,000.

MACON, GA.—The Macon Traction Company has been granted a 50-year franchise by the County Commissioners to construct an electric railway from East Macon to Recreation Club, a distance of five miles. Frederick Kauffmann is said to be interested in the company.

SAVANNAH, GA.—The Twin City Power Company, which is constructing a dam above Augusta, has applied to the City Council for a franchise to supply electricity in Savannah. The company, it is said, proposes to develop about 50,000 hp.

WAYCROSS, GA.—Burdette Loomis, of Hartford, Conn., it is said, has again applied to the City Council for a franchise to furnish electricity in Waycross.

AURORA, ILL.—Plans are being prepared for improvements to the municipal electric light plant which will include the installation of new machinery and a thorough overhauling of the transmission system.

CHAMPAIGN, ILL.—The Illinois Traction Company has been granted a 25-year franchise by the City Council to extend its electric railway system in Champaign, under the terms of which the company is to pay the city $10,000.

HARRISTOWN, ILL.—It is reported that the Illinois Traction System, of Champaign, Ill., is contemplating the erection of a substation in Harristown.

MOLINE, ILL.—The Tri-City Railway & Light Company is contemplating the construction of a new gas plant in Moline next spring at a cost of about $500,000. J. F. Porter is president..

MONMOUTH, ILL.—The Western Stoneware Company is reported to have under consideration a number of improvements to its various plants, which will include substituting electricity for steam power in plants 1 and 2 in Monmouth, Ill.

RICHMOND, ILL.—The capital stock of the Spring Grove Telephone Company has been increased from $10,000 to $20,000, and its name changed to McHenry County Independent Telephone Company.

BEDFORD, IND.—The City Council has granted a franchise to the Bedford Power Company, which is building a dam across White River, at Williams, to furnish electricity for lamps and motors in Bedford.

MARION, IND.—The Indiana Auto Parts Company, recently organized, is planning to equip a plant for the manufacture of motor car specialties. Motor-driven equipment is contemplated.

SULLIVAN, IND.—The Sullivan Independent Telephone Company has purchased and taken over the plant and holdings in this city and county owned by the Central Union Telephone Company. The consideration was $100,000.

COLO, IA.—The Colo Lighting Company, recently organized, has purchased the Carver lighting plant. It is said that the company will make improvements to the plant and light the village. J. E. Morrell is president of the company and John Niland secretary and treasurer.

GRAND JUNCTION, IA.—The local electric light plant, owned by Ole Sweden, has been purchased by Wellington Jackson, of Newton, Ia.

POCAHONTAS, IA.—The question of establishing an electric light plant in Pocahontas is under consideration.

WELLSBURG, IA.—The construction of an electric light plant in Wellsburg is under consideration.

NICKERSON, KAN.—The question of issuing $35,000 in bonds for the construction of an electric light and water works plant is under consideration, and which, it is said, will be submitted to a vote.

GLASGOW, KY.—The Burren County fiscal court has granted a franchise to Charles Van-Den-Bergh to construct an electric railway through Burren County to Hart County. The railway will extend from Glasgow to Horse Cave, a distance of 18 miles.

LOUISVILLE, KY.—Plans are being made by the Kentucky Electric Company for extensive improvements and additions to its plant, which will involve an expenditure of about $400,000. The work will include the construction of a tunnel under Water Street and wharf, between Second Street and Third Avenue to the river for condensing water, railroad switches, coal and ash handling systems, etc. The output of the station is to be increased to 14,000 kw. Contract has been awarded for additional turbo-generator sets and boilers. Bids will soon be received for construction of tunnels to the river.

CLINTON, LA.—At an election held recently the citizens are reported to have voted to issue $15,000 in bonds, the proceeds to be used to establish a municipal electric light plant.

WEST POWNAL, MAINE.—Bids will be received by the Board of Trustees, Main School for Feeble Minded, West Pownal, Me., until Oct. 28 for furnishing material and labor for the construction of a power station for the Maine School for Feeble Minded. Plans and specifications for the building may be seen at the office of Coombs & Gibbs, architects, Lewiston, Me. Plans for the boilers, pumps, engines, etc., may be seen at the office of Arthur B. Fels, engineer, Portland, Me.

BOSTON, MASS.—The State Board of Railroad Commissioners has approved of an issue of bonds by the Connecticut Valley Street Railway Company not to exceed $700,000, of the proceeds, $500,000 is to be used for payment and refunding of bonds of several street railways, which have consolidated with the Connecticut Valley Company, the balance to be used for payment of floating indebtedness and improvements to the railways.

SALEM, MASS.—Announcement has been made by the Salem Electric Light Company of a reduction in commercial rates for electricity from 15 cents to 13 cents per kw-hour for incandescent lamps.

ANN ARBOR, MICH.—A deal has been closed whereby the Eastern Michigan Edison Company, of Detroit, Mich., has secured water rights along the Huron River held by Frank I. Cornwell and John L. Duffy, of Ann Arbor, Mich., which gives the company practically the entire water power of the Huron River from Lake Erie to Zuke Lakes. The deal includes the transfer of the property known as Dovers dam, Hudson and Scio dams and all flowage rights in connection with the dams. The Edison company is now dredging out the tail race and raising the dam whereby it will double its present power.

DETROIT, MICH.—The Gould Storage Battery Company, of Depew, N. Y., has been awarded the contract for furnishing and installing the regulating battery equipment for the electrical operation of the Detroit River tunnel at Detroit by the Michigan Central Railroad Company. The plant to be installed will have a rating of 1500 kw hour, which later will be increased to 2500 kw hour.

FLINT, MICH.—The Hirsch-Wesson Manufacturing Company, recently organized, is contemplating erecting a plant in Flint, Mich., and will require power equipment and light tools.

GRAND RAPIDS, MICH.—The Grand Rapids-Muskegon Power Company has applied to the State Railway Commission for permission to issue $75,000,000 in bonds for the purpose of developing its property George L. Erwin is secretary of the company.

MUSKEGON, MICH.—It is reported that the Interurban Electric Light & Power Company has purchased the uncompleted dam site on the Pere Marquette River, owned by a syndicate of business men of Hart. The syndicate is said to have expended more than $7,000 in partial development of the water power. The price paid for the property by the Interurban Electric Light & Power Company is said to be $10,000. The present plans of the company provide for the construction of a concrete dam and the erection of a transmission line reaching all the Oceana County villages.

NEGAUNEE, MICH.—Plans have been prepared by the Cleveland Cliffs Iron Company for the construction of a new hydraulic plant, which will include the construction of dam and flume and the installation of water turbines, etc.

PONTIAC, MICH.—The Rapid Motor Vehicle Company is making arrangements for installing an electric generating plant aggregating 1500 hp with Corliss engine drive, with auxiliary equipment for complete power service.

DULUTH, MINN.—The Great Northern Development & Land Company, of Duluth, Minn., has purchased all the land on both sides of the Mississippi River from Anoka to Coon Creek Junction. The company proposes, it is said, to petition Congress for permission to erect a dam across Coon Creek to be utilized for power purposes. The cost of the dam will be about $1,000,000 and it is estimated that 50,000 hp can be developed, which will be transmitted by electricity to St. Paul, Minneapolis and surrounding country for lamps, heat and motors.

LE SUEUR, MINN.—The city has awarded the contract for a Corliss heavy duty engine, 16 in. x 36 in., to drive an alternating-current generator (bids for which were opened Oct. 1) to the Bates Machine Company, of Joliet, Ill., for $2,398. James A. Morgan is city clerk.

MANKATO, MINN.—It is reported that the proposition to establish a municipal electric light plant will be submitted to the voters.

OLIVIA, MINN.—Arrangements are being made by the local telephone company to install the common battery system. The company, which was incorporated as the Bird Island Telephone Company, will change its name to the Renville County Telephone Company. It is expected that the company will erect a number of rural lines.

ST. PAUL, MINN.—The St. Paul Gas Light Company is contemplating increasing the output of its electric generating plant and will install new machinery to cost about $50,000.

WHITE BEAR, MINN.—H. M. Byllesby & Company, of Chicago, Ill., are reported to have taken an option on the plant of the White Bear

Electric Company, which is owned by the Fulton estate and George Reif. It is said that the Byllesby company will exercise its option and will take possession of the plant Nov. 1. The new owners, it is understood, will make many improvements to the plant and will install hydroelectric power, which will be secured from the large power plant on Apple River, Wis.

ACKERMAN, MISS.—At an election held recently the citizens voted to issue bonds for the construction of an electric light plant.

KING CITY, MO.—The question of installing an electric lighting system in King City is under consideration.

MEXICO, MO.—The Mexico, Santa Fé & Perry Traction Company, of Mexico, Mo., has awarded general contract for construction of its interurban railway to Burns & Co., 705 Isabella Building, Chicago, Ill. The railway is to extend south from Mexico to Columbia and Fulton, and north to Santa Fé, Perry and Hannibal, a total distance of 113 miles. Work will be started in Mexico about Nov. 1 in both directions. Burns & Co. will purchase all material and let all sub-contracts.

ST. LOUIS, MO.—The Foresight Investment Company, which controls Forsyth Place, a residence section lying west of Washington University, has decided to operate its own lighting, heating and cold storage plants, plans for which have already been prepared. The plant will be run on the co-operative plan. A flat rate will be maintained, based on the number of rooms in each house. Every house owner will be given a share of stock. George J. Lewis is secretary of the company.

SIKESTON, MO.—Plans are being made by the Sikeston Ice, Light & Power Company for improvements and extensions to its plant, to be made between now and early spring, which will involve an expenditure of about $15,000. C. L. Clary is manager.

HELENA, MONT.—Bids will be received at the office of the city clerk until Oct. 18 for furnishing material for a municipal electric light system as follows: Five miles or more of No. 4 triple braided weatherproof wire, not to exceed 875 lb. to the mile in coils; 20 miles or more No. 6 triple braided weatherproof wire, not to exceed 600 lb. to the mile; 250 or more 35-ft. 7-in. top, white cedar, dry peeled poles; 100 or more 45-ft. 7-in. white cedar, dry peeled poles; two or more series arc transformers, 6.5 amp, 60 cycle, 50 or 75 lamps each; 15 transformers, 5 kw, 2200-110 volts; 100 or more series alternating-current street arc lamps, 6.5 amp, 60 cycle, 700 or more 40-watt series tungsten lamps; three regulators 16.5 kva series tungsten system; three or more transformers for series tungsten 5.5 amp. 60-cycle system; 50 or more lightning arresters for pole line; 500 or more street hoods complete with insulators, pole arms and sockets for series 40-watt tungsten lamps and accessories in accordance with specifications on file in the office of the city clerk, which will be mailed on application. J. A. Mattison is city clerk.

LIVINGSTON, MONT.—Work has commenced on the construction of the new power house of the Livingston Water Works & Electric Light Company. The plans for equipment provide for a motor-driven centrifugal pump of 1,500,000 gal. capacity.

STEVENSVILLE, MONT.—The Bitter Root Valley Irrigation Company has placed orders for complete equipment for an electric light plant to be installed at the model town of Three Mile. The machinery for the plant will cost about $3,000 and will furnish electricity for lamps and motors and for lighting the streets of the town.

TROY, MONT.—A co-operative telephone company has been organized to construct a telephone line to Bull Lake.

BEATRICE, NEB.—The Dempster Manufacturing Company is making extension to its foundry and implement factory and also increasing the equipment of its power plant, which will include the installation of a 150-hp Murray-Corliss engine and Allis-Chalmers electric generators and motors, which have already been purchased. The cost of the improvements is estimated at $40,000.

PAPILLION, NEB.—The State Railway Commission has authorized the Home Telephone Company, of Papillion, Neb., to issue capital stock to the amount of $10,000, increasing its capital to $37,450.

STERLING, NEB.—It is reported that a movement is on foot to organize a company to establish an electric lighting system in Sterling.

ORANGE, N. J.—The City Council has rejected the bids for construction of the municipal electric light plant and distributing system, which were received Sept. 20. Revised plans and specifications are being prepared by Runyon & Carey, of Newark, N. J.

RINCON, N. M.—William Palmer, Jr., has been granted a franchise to construct and operate an electric light plant in Rincon. Work has commenced on the erection of the plant.

SILVER CITY, N. M.—The Grant County Telephone Company will commence work at once on the extension of its Surro Mountain telephone line to the Azure Mining Company properties in Burro district.

BROOKLYN, N. Y.—The directors of the Kings County Electric Light & Power Company have voted to recommend to the stockholders an authorization of an issue of $5,000,000 in convertible debenture bonds, bearing interest at 6 per cent. Application will be made at once to the Public Service Commission for approval of the same. The proceeds of the debentures will be used to take care of development work of both the Kings County Electric Light & Power Company and the Edison Electric Illuminating Company.

CLINTON, N. Y.—The Village Trustees have awarded the contract for furnishing electricity for operating the municipal electric light system to Charles A. Borst, of the Clinton Hematite Ore Mines. The contract is for a term of five years, and the prices are as follows: Electricity for 27 arc lamps at $35 each per year; for 20 incandescent street lamps of 32 cp at $15 per lamp per year, and electrical energy for commercial and residential lighting at eight cents per kw-hour. The Franklin Springs Paint Company now furnishes the service for which the town pays $40 each per year for arc lamps; for 32-cp incandescent lamps $20 per lamp per year and 10 cents per kw-hour for electricity for other purposes. Mr. Borst will install a plant at once at his mines so as to be ready to furnish electrical energy when the present contract expires next February. The village owns the distributing system.

COPENHAGEN, N. Y.—The Deer River Power Company, which is constructing a large power plant near Copenhagen, has commenced to acquire land for a storage reservoir near Carthage. A large retaining dam will be erected and several acres of land will be flooded. It is said that the company will extend its transmission line to Carthage.

HORNELL, N. Y.—Papers have been filed with the Secretary of State certifying to the consolidation of the Hornellsville Electric Railway Company, the Hornellsville & Canisteo Railway Company and the Canisteo Railway Company under the name of the Hornell Traction Company. The company is capitalized at $120,000. The directors are: Charles Adsit, George T. Rehn and Milo M. Acker, all of Hornell, N. Y.

LOWVILLE, N. Y.—The Public Service Company has authorized the Wetmore Electric Company to begin the operation of an electric light plant in the Village of Castorland and the Town of Denmark, and also to extend its distributing system in the Towns of Croghan and New Bremen for the purpose of furnishing electricity to the Villages of Beaver Falls and Naumburg.

NEW YORK, N. Y.—The contract for furnishing and installing two 12,500,000-gal. steam turbine pumps, two 225-hp water tube boilers and all accessories was awarded by the Board of Water Supply to the Lord Electric Company, of New York, N. Y., for $34,884.

PAWLING, N. Y.—The Pawling Electric Light & Power Company is planning to erect a new power plant, and will soon be in the market for an engine or turbine, electric generator, exciter, etc.

ROSLYN, N. Y.—The Public Service Commission, Second District, has approved of the consolidation of the Nassau Light & Power Company, the Nassau Gas, Heat & Power Company, the Floral Park Light & Power Company, of Roslyn, N. Y., and the Oyster Bay Electric Light & Power Company, of Oyster Bay, N. Y.

ASHEVILLE, N. C.—It is reported that the promoters of the Asheville & East Tennessee Railroad Company will ask $200,000 in bonds from Buncombe County; $100,000 from Asheville and $200,000 from Mitchell and Yancey counties toward the completion of its projected electric railway from Weaverville to connect with the Carolina, Clinchfield & Ohio Railway to the east. Electricity for operating the railway will be furnished by the W. T. Weaver Power Company, of Asheville, N. C., which has commenced work on the construction of a new power plant near Marshall on the French Broad River. The proposed railway will be 40 miles in length and will extend to Galax, to connect with the Carolina, Clinchfield & Ohio Railroad, giving Asheville direct connection with the coal fields of Virginia and West Virginia. The railway will carry both passengers and freight.

CHARLOTTE, N. C.—The Charlotte Consolidated Construction Company has applied to the Board of Aldermen for permission to separate its gas and electric system from its traction system. The company proposes to organize a company under the name of the Charlotte Gas & Electric Company to take over the lighting departments. The new company was chartered some months ago by E. D. Latta, president of the Charlotte Consolidated Construction Company.

GRAHAM, N. C.—The River Falls Cotton Mills Company, recently incorporated with a capital stock of $200,000, is planning to develop a water-power on Haw River and erect a hydroelectric plant to furnish electricity to operate its proposed new cotton mill. J. W. Menefee is president and treasurer and R. N. Cook, secretary.

HICKORY, N. C.—The Thornton Light & Power Company will begin using electricity furnished by the Southern Power Company about Nov. 1, and will expend $5,000 in making the change. It is said the Thornton Company will dispose of its old steam plant and generators.

ROCKY MOUNT, N. C.—The local telephone system is being improved by the installation of cables under the superintendence of F. C. Topleman, who is interested in numerous systems in eastern North Carolina.

SALISBURY, N. C.—Announcement has been made that the Bankers' Trust Company, of New York, N. Y., has taken an appeal from the decision of Judge Pritchard, in Federal Court, in the case of the Whitney Power Company, in which is involved the question of the control of the $4,000,000 plant of the company on the Yadkin River. This appeal, it is said, will cause the suspension of all work on the plant now in course of construction under the direction of the receiver, Col. W. S. Henderson.

DAYTON, OHIO.—The City Council has approved the report submitted by City Engineer Cellarius for the installation of the boulevard lighting system in the district outlined by the Council, at a cost of $33,680.

MARIETTA, OHIO.—The Parkersburg, Marietta & Interurban Railway Company is planning to commence work at once of improving and remodeling its power station in Marietta.

YOUNGSTOWN, OHIO.—The court house building commission has awarded the contract for gas and electric light fixtures for the new court house to the Marreau Lighting Fixture Company, of Cleveland, Ohio, for $18,000.

ALTUS, OKLA.—Plans are being prepared for enlarging the municipal electric light plant and installing pumping machinery for an extensive water distributing system.

ELK CITY, OKLA. The City of Elk City is receiving bids for $35,000 municipal light plant bonds. R. J. Carlile is city clerk.

HENRYETTA, OKLA.—Edwin R. Knecht, of Shelbyville, Ill., has been granted a franchise to erect an electric light and power plant. Under the terms of the franchise work is to commence on construction of the plant within 60 days and is to be completed within eight months.

MULHALL, OKLA.—It is reported that an electric light plant will be installed in Mulhall in the near future.

MUSKOGEE, OKLA.—The Muskogee Electric Traction Company will soon commence work on the construction of 2½ miles of track, for which ties and rails have been purchased.

OKLAHOMA CITY, OKLA.—Bids will be received at the office of B. Parman, city clerk, until Oct. 18 for furnishing and installing pumping engine, high speed steam engine and electrical apparatus, in accordance with plans and specifications on file in the office of Vincent G. Shinkle, superintendent of water.

OKLAHOMA CITY, OKLA.—We are informed that the company which has been formed to construct an electric railway from Oklahoma City to Shawnee, has commenced construction work and is in the market for equipment. Two power stations will be erected, sites for which have not yet ben selected, in connection with the North Canadian River Water Power Company. Homer S. Hurst, of Holdenville, Okla., is president; Alfred Hare, of Oklahoma City, is secretary and general manager.

RYAN, OKLA.—F. H. Lancashire, engineer, Wilson Building, Dallas, Tex., has been engaged by the Town of Oklahoma to revise specifications and to do the engineering work in connection with the construction of municipal electric light plant, water works and sewers.

KALMATH FALLS, ORE.—The Reclamation Service contemplates establishing a plant along Link River to furnish power for operating the pumping stations in connection with the Klamath reclamation project.

OSWEGO, ORE.—The Oregon Iron & Steel Company, of Portland, Ore., is reported to have decided to construct a large hydroelectric plant at the outlet of Tulatin Lake to furnish power for its works in Oswego, and other industries. Plans for the plant and equipment have not yet been prepared.

PORTLAND, ORE.—Property owners along Sixth Street are considering the question of installing cluster lamps, ten lamps to the block, from Jefferson Street to the Union Depot.

PORTLAND, ORE.—The Coos Bay & Inland Electric Company, recently incorporated, is securing rights of way for an electric railway from Roseburg to Marshfield. The officers of the company are: Jacob Haas, president; Charles Ringler, secretary and treasurer.

PORTLAND, ORE.—Arrangements are being made for the installation of cluster lamps on Grand Avenue and East Morrison Street. Secretary Atchley, of the East Side Business Men's Association, and W. H. Newhall are interested in the project.

BERWICK, PA.—The American Car & Foundry Company is remodeling and extending the electrical equipment in its plant in Berwick, and will install additional motors.

BLOOMSBURG, PA.—Announcement has been made that work will soon be started on the extension of the Columbia & Montour railway from Berwick to Wilkes-Barre, a distance of 32 miles, and on the Danville & Bloomsburg Street Railway from Danville to Sunbury, 14 miles in length. It is expected that further extensions will be made to Shamokin and then throughout the West Branch. Both of the railways are controlled by the Columbia Power, Light & Railways Company, of Bloomsburg, Pa.

CANONSBURG, PA.—The Washington Electric Light & Power Company, which controls the Canonsburg Electric Light, Heat & Power Company, of Canonsburg, Pa., has commenced work on the construction of a substation in West End, Canonsburg, electricity for which will be supplied from the main power station at Washington, Pa. Improvements are being made to the plant of the company which will improve the service, and when completed a 24-hour service will be established. The local power station will be dismantled as soon as the transmission line from Washington is completed.

EBENSBURG, PA.—Work has commenced on the construction of an electric light plant in Ebensburg, which will provide electricity for lighting the streets of the town and for commercial and residential lighting. Conrad Brothers are interested in the project.

HOOVERSVILLE, PA.—The Somerset County Telephone Company is planning to make extensive improvements to its system and will install a new switchboard in its exchange. A new telephone line will be extended from Boswell to Somerset.

PHILADELPHIA, PA.—Plans have been completed for the illumination of the business section of the city embracing Market Street between the Delaware and Schuylkill rivers, and Walnut and Chestnut streets, between the Delaware River and Twenty-fourth Street. The plan provides for 150 sidewalk arc lamps on Market Street between the two rivers, where now there are but 50 lamps, and on Chestnut and Walnut streets combined, 456 arc lamps, where now there are but 97. The new lamps are to be supported in pairs on ornamental sidewalk poles, four to each block, and four posts, each with twin lamps, at street intersections. The total cost of the lamps and posts for the entire district is estimated at $24,865; the cost of the maintenance of the additional lamps is estimated at $66,000 per year. It is said that the plan has the approval of the Mayor, and it is expected that the Citiy Councils will make an appropriation for the improvement.

DILLON, S. C.—Dr. Wade Stackhouse, who recently purchased the municipal electric light plant, has engaged F. M. Laxton, of Charlotte, N. C., electrical engineer, to make investigations in connection with the proposed improvements to the plant.

LEAD, S. D.—Plans are being prepared by the Homestake Mining Company for the construction of a large hydroelectric power plant. The company, it is said, will install new ore-crushing equipment this fall.

WATERTOWN, S. D.—The Dakota Central Telephone Company is contemplating equipping its local exchange with the automatic system.

BEEVILLE, TEX.—The Beeville Light Company is reported to have been granted a 40-year franchise by the City Council.

SALT LAKE CITY, UTAH.—Plans are being prepared by the Portland Cement Company for the installation of a breaker plant, crushing rolls, tube and ball mills, rotary kilns, boiler, engine and electrical equipment, comprising a complete manufacturing unit.

MONTPELIER, VT.—The Corry-Deavitt-Frost Company has awarded a contract to D. W. Cooley, of Waterbury, Vt., for the construction of a concrete dam, gates to the penstock and for foundation for power house No. 2, which will be located about 2000 ft. above the present plant at Kinney's Mills. The dam will be 150 ft. long and 12½ ft. high and will have a fall of 30 ft. The power house will be located about 1500 ft. below the dam and will be connected by a steel penstock. The proposed plant will have an output of about 1000 hp. The company furnishes electricity for operating the electric railway and has just entered into a contract with the Wetmore & Morse Company, of Barre, Vt., for a term of five years to furnish electricty for its quarries. The cost of extension is estimated at from $30,000 to $35,000.

LEXINGTON, VA.—The plant and holdings of the Lexington Mutual Telephone Company has been purchased by R. D. Moses and D. T. Odineal, both of Lexington, Va. It is reported that the price paid for the property was $25,000 and includes the Lexington and Buena Vista exchanges. The officers of the new company are: R. B. Moses, president, and D. P. Odineal, secretary-treasurer and general manager.

RICHMOND, VA.—E. W. Trafford, consulting engineer for the municipal electric light plant, has submitted to the Council committee on water and lights his report on the cost of the distributing system, which provides for 960 arc lamps, based on overhead construction, including an overhead transmission line to the city hall, and nearby public buildings, with entire new equipment, which he estimates will cost $72,000. In addition to the above a separate statement was presented giving the cost of the erection of a transmission line from the electric light plant to the pumping station of the water works system, which is estimated at $9,737.

WINCHESTER, VA.—The Winchester & Washington City Railway Company is reported to be contemplating the construction of a large steam generating plant in Millville. The new plant will have an output of 1500 hp, which will be used as an auxiliary to the hydroelectric plant on the Shenandoah River. D. M. Swink is superintendent.

WOODSTOCK, VA.—Plans are being prepared for the construction of a hydroelectric plant on the Shenandoah River, about two miles from Woodstock, a site for which has already been purchased. The proposed plant will furnish electricity for lamps and motors in this city. H. B. Chapman and others are interested in the project.

BELLINGHAM, WASH.—A permit has been granted for the construction of a new power and heating plant for Saint Joseph's Hospital. The cost of the building is estimated at $2,500.

METALINE, WASH.—The Lehigh Valley Cement Company has awarded the contract for the construction of its power plant to the Sylvester Engineering Company. The new plant will be located at the confluence of Sullivan Creek and the Pend Orielle River, just above Metaline Falls. The cost of the plant is estimated at $350,000.

NORTH YAKIMA, WASH.—The Northwest Light & Power Company has offered to sell its electric light plant to the city for $30,000, which is a reduction of $21,000 from the original offer. It is said that the last offer meets the approval of the Mayor and that arrangements will be made for the formal transfer of the plant to the city.

OAKVILLE, WASH.—Application has been made to the Town Council for a franchise to install electric light and water systems in Oakville. Mr. Shoemaker agrees to have the electric plant in operation by the latter part of December and to start work on the water system within four months.

SEATTLE, WASH.—Architects Gould & Champney have completed details for a new building planned for the Seattle Electric Company to be erected on the south side of Olive street between Sixth and Seventh avenues, at a cost of $150,000. The Stone-Webster Enginering Company will erect the building.

CAMERON, W. VA.—T. B. Cox, of Sherrard, W. Va., is reported to be interested in a project to construct an electric railway between Cameron and Wheeling, a distance of 20 miles.

CLEAR CREEK, W. VA.—A telephone company has been organized in Clear Creek for the purpose of erecting a telephone line between Clear Creek and Lawson. The line will be ten miles in length and will extend through Artie and Colcord.

AMHERST, WIS.—Preparations are being made by B. E. Dwinnell & Company, of Amherst, Wis., for enlarging their hydroelectric plant, which will include the construction of a concrete flume and the installation of new turbines, electrical machinery, etc.

JANESVILLE, WIS.—The Janesville Electric Company has purchased the Indian Ford dam and power plant of Captain P. Norcross. The company now owns, in addition, the dam at Fulton and two plants in Janesville, aggregating 2000 hp. It is understood that transformers and a new switchboard will be installed and other improvements made to the Indian Ford plant.

OSHKOSH, WIS.—The Paine Lumber Company, of Oshkosh, Wis., is said to be contemplating increasing the output of its power plant by the installation of steam turbines and generators having a total rating of 2000 kw.

OSHKOSH, WIS.—Plans are being considered by the Board of Regents for the construction of a power and heating plant for the Oshkosh Normal School Building, for which an appropriation of $18,000 has been made. It has not yet been decided whether an electric generator will be installed to furnish electricity for lighting the building, but space will be provided for it in the building.

LETHBRIDGE, ALTA, CAN.—A local company is being formed to build an electric street railway system with lines to adjoining settlements and towns.

CRESTON, B. C., CAN.—The Creston Light, Power & Telephone Company is putting the finishing touches to its telephone system, which will be in operation before the end of October. Several long distance lines will be built in the immediate future.

NEW WESTMINSTER, B. C., CAN.—The British Columbia Electric Street Railway Company has closed the contract for the erection of five power stations between New Westminster and Chilliwac. The stations will furnish electrical power for railway purposes and also for the distribution of electricity to the settlers. R. H. Sperling, of Vancouver, is general manager.

PRINCE RUPERT, B. C., CAN.—The Grand Trunk Pacific Railroad Company is installing a modern telephone system. For further information address A. B. Smith, manager of telegraphs, Winnipeg, Man.

SYDNEY, N. S., CAN.—The Cape Breton Electric Company has been asked by the City Council to make a number of extensions to both its railway and lighting systems.

BARRIE, ONT., CAN.—John W. Moyse, of Toronto, Ont., has submitted a proposition to the City Council to build an electric street railway system in Barrie with radial lines to adjacent villages and settlements, and to connect the Canadian Northern and Canadian Pacific railways.

BRANTFORD, ONT., CAN.—The Brantford Street Railway Company is asking permission of the City Council to make certain extensions.

HAMILTON, ONT., CAN.—After several years of legal controversy the city is free to take electric power from the Ontario Hydro-Electric Commission. An injunction was taken out by R. S. Morris, a local ratepayer, but it has been thrown out by Chief Justice Sir William Meredith. An agreement is being drawn up for this city to take 1000 hp from the Ontario Hydro-Electric Commission.

NIAGARA FALLS, ONT., CAN.—The Ontario Power Company has commenced preliminary work on the construction of another pipe line in Victoria Park, which will extend from the gate house at the head of Dufferin Island to the power house in front of the Horseshoe Falls. The new line will cost about $1,000,000, and will be a duplicate of the first, a steel tube 20 ft. in diameter, enclosed in concrete. The new pipe line is being constructed so as to enable the Ontario Power Company to fulfill its contract with the Hydro-Electric Power Commission to supply the Ontario municipalities with electricity.

PORT ARTHUR, ONT., CAN.—H. S. Acres, engineer for the Hydro-Electric Commission, is here making arrangements for the substation for the distribution of power.

PORT ARTHUR, ONT., CAN.—The Ontario Hydro-Electric Commission has offered to supply Port Arthur with power for $17 per hp with an ultimate reduction in price to $13.

STURGEON POINT, ONT., CAN.—S. Anderson, who owns and operates 40 miles of electric railway in this vicinity, is reported to be considering the construction of an electric railway from Fenelon Falls to Bobcageon via Sturgeon Point.

TORONTO, ONT., CAN.—It is reported that the Standard Sanitary Manufacturing Company, of Pittsburgh, Pa., is planning to construct a Canadian branch manufacturing plant in Toronto, Ont., Can., at a cost of $500,000. It is said that $500,000 additional will be spent for equipment and securing electrical power from Niagara Falls. The plant will be fully equipped for electric motor drive. An auxiliary steam plant will also be provided.

WELLAND, ONT., CAN.—B. Corey has applied for a franchise to operate a street railway system in Welland. It is expected extensions will be built to Port Colbourne and Niagara Falls.

MONTREAL, QUE., CAN.—The city has received permission from the Quebec Legislature to borrow money to install a high-pressure fire-protection service, to purchase the property of the Montreal Water & Power Company and for conduit work.

VERDUN, QUE., CAN.—Bids have been asked for the construction of a building for the new municipal electric light plant. It is expected to have the plant in operation by next March.

CARNDUFF, SASK, CAN.—This town is installing a municipal electric light and power plant, which will be in operation before the end of the year. Electricity will also be supplied for domestic purposes.

GUADALAJARA, MEX.—Plans are being considered by the Guanajuato Power & Electric Company for the erection of a transmission line into the City of Aguascalientes to supply electricity to the general shops of the National Railways, the smelter of the American Smelting & Refining Company and other manufacturing plants. The company has recently issued $80,000. in bonds and will soon commence work on the construction of a third power plant on the Angulo River in Michoacan, which will give the company a total output of 22,000 hp.

New Industrial Companies.

F. ALEXANDER, INC., of New York, N. Y., has filed articles of incorporation with a capital stock of $10,000 to manufacture electric lamps and electric articles. The incorporators are: Focsaneanu Alexander and Louis Liebes, and John M. Raymond, of New York, N. Y.

THE AMBURSEN COMPANY, of South Berwick, Maine, has been incorporated by W. Thompson and F. A. Hobbs, both of South Berwick. The company is capitalized at $200,000, and proposes to do mechanical and electrical work.

THE BALLIN WATER TUBE BOILER COMPANY, of Portland, Ore., has been incorporated with a capital stock of $50,000 by Fred A. Ballin, Arthur Langguth and Edward G. Gordon.

THE BIXLER MANUFACTURING COMPANY, of Springfield, Ill., has been chartered with a capital stock of $2,500 to manufacture electrical and dental supplies by John W. Bixler, M. E. Bixler, James De Bixler and George M. Morgan.

THE CLEMORE MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated by Charles M. Carpenter, Simon La Grou, C. Doolittle and Duncan Moore. The company is capitalized at $15,000 and proposes to manufacture street railway equipment.

THE ELECTRIC THEATER SUPPLY COMPANY, of Philadelphia, Pa., has been chartered with a capital stock of $10,000 by Albert W. Sanderson, of Philadelphia, Pa., treasurer; Matthew Brady, Horace D. Sansom and Albert W. Sansom, all of Philadelphia, Pa.

THE HOUSTON MANUFACTURING COMPANY, of Rockford, Ill., has been incorporated with a capital stock of $10,000 to manufacture vacuum cleaning devices. The officers of the company are: C. S. Brantingham, president; E. P. Lathrop, vice-president, and F. K. Houston, secretary and treasurer.

THE HYDROELECTRIC CONSTRUCTION COMPANY, of Seattle, Wash., has been incorporated with a capital stock of $200,000 by W. A. Insinger, J. A. Bennett, Frank MacKean, Harry F. Reynolds and J. S. Perky.

THE McCANN BROTHERS' CONSTRUCTION COMPANY, of Murphysboro, Ill., has been incorporated with a capital stock of $40,000 for the purpose of doing general construction work. The incorporators are: P. S. McCann, J. McCann and C. McCann, of Murphysboro, Ill.

THE POTTSTOWN CONDUIT COMPANY, of Pottstown, Pa., has been incorporated with a capital stock of $5,000. The directors of the company are: Herbert G. Williams, treasurer; William L. Binder, Fred S. Roesch, all of Pottstown, Pa.

THE ROCHESTER TELEPHONE MUFFLER COMPANY, of Rochester, N. Y., has been incorporated with a capital stock of $10,000 by Mortimer E. De Witt, Frederick W. Zoller and Arthur G. Moore, all of Rochester, N. Y.

THE SIMPLEX GAS ENGINE STARTER COMPANY, of Chicago, Ill., has ben incorporated with a capital stock of $20,000 to manufacture automobile parts. The incorporators are: Edwin A. Gardner, Christopher Baldacci and Louis Funal.

THE WESTSIDE POWER COMPANY, of San Francisco, Cal., capitalized at $25,000, has been incorporated by George Pollock, E. A. Clausen and G. S. Borkley.

THE WEST SIDE CABLE COMPANY, of Seattle, Wash., has been incorporated with a capital stock of $2,000 by A. B. Coon and others.

THE WHELCHEL ELECTRIC COMPANY, of Anderson, Ind., has been formed with a capital stock of $25,000 to manufacture electrical supplies. The directors are: Bert Whelchel, I. W. Jones, A. S. McCall and John Rickes.

New Incorporations.

LAKEPORT, CAL.—The Highland Pacific Railroad Company has been chartered with a capital stock of $2,500,000 for the purpose of taking over the holdings of the Sonoma & Lake County Railroad Company, which proposes to construct an electric railway from Upper Lake to Lakeport, and a branch three miles in length frm Kelseyville to the nearest point

on the main line in Big Valley, in addition to the route previously mapped out, from Lakeport to Preston and on to Santa Rosa. The total length of the railway is estimated at 70 miles. Most of the right of way has been secured. The incorporators are: J. E. Fulton, R. M. Beattie, A. E. Dickinson and Henry Eickoff, of San Francisco, Cal.

LOS ANGELES, CAL.—The Tidewater Northern Railway Company has filed articles of incorporation with a capital stock of $800,000 for the purpose of constructing an electric railway along the coast from Santa Monica to Ventura. The incorporators are: R. N. Hart, R. H. Barr and J. S. Wallace.

PUEBLO, COL.—The Pueblo & San Luis Valley Railroad & Power Company has been incorporated with a capital stock of $8,000,000. The company proposes to construct a steam railroad from Pueblo to Fremont County and the West Mountain Valley, reaching Silver Cliff and other towns in the State. The steam road will terminate at Alamosa, Monte Vista or Del Norte, but will be continued by an electric railway, which will extend to Pasgosa Springs and Durango.

ROMEO, COL.—The Romeo Rural Telephone Company has been incorporated, with a capital stock of $500, by George H. Berry, W. H. Vassar and E. M. Crow.

DOVER, DEL.—The Sun Telegraph & Telephone Company has been chartered with a capital stock of $50,000 by Terry W. Allen, John F. Wisdon and W. G. Timperlake, all of Jackson, Tenn.

WILMINGTON, DEL.—The North Dakota Heat & Power Company has been incorporated, with a capital stock of $200,000, by F. M. Shive, S. E. Robertson and Harry W. Davis, all of Wilmington, Del.

ASHLEY, ILL.—The Ashley Telephone & Telegraph Company has been incorporated, with a capital stock of $5,000, by H. A. Walker, C. H. Walker and M. Kay.

DELPHI, IND.—The Delphi, Flora & Burlington Traction Company has been incorporated with a capital stock of $25,000 by E. W. Bowers, president; J. C. Smock, secretary, and others. The company proposes to construct a traction system from Delphi to Burlington, via Flora.

RICHMOND, IND.—The Liberty Light & Power Company has filed articles of incorporation with the Secretary of State, with a capital stock of $25,000. The company proposes to generate and distribute electricity to towns and cities for heating, lamps and motors. Robert S. Asher, John A. Perkins, Winfred Jessup and Gordon E. Varney are directors.

SEDAN, KAN.—The Pecan Creek Telephone Company has been incorporated, with a capital stock of $500, by P. E. Ross, Kelly Askew and J. H. Zimmerman.

AUGUSTA, MAINE.—Articles of incorporation have been filed for the Sonora Telephone Company, with a capital stock of $600,000. The officers are: M. E. Gould, president, and F. L. Dutton, treasurer and clerk.

MINNEAPOLIS, MINN.—Articles of incorporation have been filed for the Lake Minnetonka Public Service Company by Henry W. Benton, Leo M. Crafts and Joseph S. Wenster. The company is capitalized at $150,000, and proposes to supply villages along the shore with electricity for lamps.

HIGBEE, MO.—The Citizens' Electric Light Company has been incorporated, with a capital stock of $5,000, by S. H. Hirsch, H. C. Eubank, T. J. Cooper and others.

ST. JOSEPH, MO.—Articles of incorporation have been filed for the St. Joseph & Savannah Railway Company by J. H. Van Brunt, C. E. Foster, Jr., James N. Burnes, J. S. McDonald, Charles Pasche, John Donavan, G. G. Lacy, J. G. Schneider and R. A. Brown. The company is capitalized at $350,000, and proposes to construct an electric railway from St. Joseph to Savannah, a distance of 15 miles. This company is said to be a subsidiary of the St. Joseph Railway, Light, Heat & Power Company.

BUTLER, N. J.—The Butler Electric Light & Power Company has been incorporated with a capital stock of $50,000. The incorporators are: E. O. Jones, of Rutherford, N. J.; J. B. Lydecker, of Bloomingdale, N. J., and H. R. Schneider, of Westwood, N. J.

TRENTON, N. J.—Articles of incorporation have been filed for the Continental Telegraph & Telephone Company by William M. Clark, of Plainfield, N. J.; Powell Crichton and William E. Conley, both of New York, N. Y. The purpose of the company is the amalgamation of telephone and telegraph lines. The company is capitalized at $50,000,000.

BATAVIA, N. Y.—The Genesee Light & Power Company has been incorporated with a capital stock of $250,000. The company is a reorganization of the Genesee County Electric Light, Power & Gas Company, and will operate in the villages and towns in Genesee County. The directors are: Walter C. Lewis, of Boston, Mass.; George M. Kimball, of Concord, N. H.; Ferdinand W. Keller, of New York, N. Y., and John K. White, of Tonawanda, N. Y.

CARROLLTON, N. Y.—The Carrollton Electric Company has been chartered, with a capital stock of $25,000, to operate a light, heat and power plant.

ELIZABETHTOWN, N. Y.—Articles of incorporation have been filed for the Elizabethtown Terminal Railroad Company, with a capital stock of $80,000, to operate a railroad either by steam or other motive power. The proposed railway is to extend from the Delaware & Hudson station at Westport to Elizabethtown. The directors are Richard L. Hand, Francis L. Smith and George W. Jenkins, of Elizabethtown, N. Y.

HAMBURG, N. Y.—Artices of incorporation have been filed for the Howard A. Pierce Electric Light Company by H. A. Pierce, E. Pierce and L. S. Frank, of Hamburg, N. Y. The company is capitalized at $30,000, and proposes to furnish electricity for lamps, heat and motors.

PORT JERVIS, N. Y.—Articles of incorporation have been filed for the Port Jervis Traction Company by J. E. Daily, J. V. Torney, of New York, N. Y., and T. H. Milson, of Paterson, N. J. The company is capitalized at $43,000.

SNOW HILL, N. C.—The East Carolina Electric & Realty Company has been chartered, with a capital stock of $25,000, for the purpose of constructing telegraph or telephone lines, by S. L. Lynch, of Kinston, N. C., W. H. Wells, of Snow Hill, and others.

CLEVELAND, OHIO.—The Gillen Electric Company has been incorporated, with a capital stock of $10,000, by E. J. Gillen, S. A. Gillen, Vincent J. Rogers, Herman Dorsey and W. J. Wilson.

SPRINGFIELD, OHIO.—The Consumers' Light, Heat & Power Company has been incorporated by James B. Malone and others. The capital stock of the company is placed at $50,000.

XENIA, OHIO.—The Xenia, Lighting Company, with a capital stock of $20,000, has been incorporated by P. H. Flynn and others.

CHARLESTON, OKLA.—The Home Rural Telephone Company has been chartered, with a capital stock of $1,500, by F. Z. Winfell, A. L. Rodkey, J. A. Hickory and M. A. Treadway, of Charleston, Okla., and H. J. Jordon, of Protection, Kan.

JENNINGS, OKLA.—The Jennings Refrigerator, Electric Light & Power Company has been incorporated with a capital stock of $10,000 by Frank Adams, J. C. Murphy and C. W. Shoemaker.

SEDAN, OKLA.—The Pecan Creek Telephone Company has been incorporated with a capital stock of $500 by P. E. Doss, Kelley Askew and J. H. Zimmerman, all of Sedan.

GLENWOOD, ORE.—The Klickitat Valley Development Company has been organized for the purpose of developing the water power of the upper Klickitat River to be utilized to generate electricity and the irrigation of 45 square miles in the Camas Prairie. William R. King, of Portland, Ore., and W. N. Coler, Jr., of New York, N. Y., are interested in the project. The plant will be located near the town of Glenwood on Camas Prairie, where it is estimated that 40,000 hp can be developed.

PORTLAND, ORE.—The Odin Falls Irrigation & Power Company has filed articles of incorporation with a capital stock of $90,000. The incorporators are: Charles M. Lanning, Joseph G. Houston and George Broughton.

BEAVER FALLS, PA.—Application has been made for a charter for the New Castle & Beaver Valley Railways Company to construct an electric railway from New Castle to Beaver Falls by Stewart S. Neff, Gerald Holsman, Hiram G. Miller, Robert W. Cunningham, John M. Morris, Leonard N. Uber and Joseph V. Cunningham.

BENTLEYSVILLE, PA.—The Bentleysville Electric Light, Heat & Power Company has been chartered, with a capital stock of $15,000. The directors are: E. E. French, of Ellsworth, Pa., treasurer; J. G. McCormick, Nicholas Veeser, of Bentleysville, Pa.; Charles F. Fisher, of Pittsburgh, Pa., and George C. Schlehr, of Ellsworth, Pa.

BOILING SPRINGS, PA.—The M. E. Kraybill Light, Heat & Power Company has been incorporated with a capital stock of $25,000 by Martin E. Kraybill, of Boiling Springs, Pa., treasurer; C. J. Kraybill, of Boiling Springs, Pa.; Benjamin E. Kraybill, of Mechanicsburg, Pa.; Amos E. Kraybill, of Johnstown, Pa., and John A. Herman, of Harrisburg, Pa.

FENELTON, PA.—The Fenelton Independent Telephone Company has been chartered to construct a telephone line from Fenelton to Chicora and Carbon Center, via Rattigan. The officers of the company are: F. P. McBride, of Fenelton, Pa., president; S. I. Pontius, of Chicora, Pa., vice-president; W. I. Sipe, of Fenelton, secretary, and P. S. Fennel, of Fenelton, treasurer.

HANOVER, PA.—The Hanover & Warrior Run Street Railway Company has been incorporated with a capital stock of $100,000 to construct an electric railway from Hanover to Warrior Run via Wilkes-Barre, a distance of six miles. The incorporators are: J. R. Scouton, of Wilkes-Barre, president; L. F. Camp, H. H. Davenport, and M. T. Rees.

INTERCOURSE, PA.—The Intercourse Electric Light, Heat & Power Company has been incorporated with a capital stock of $6,000 and the following-named directors: Ezra Zimmerman, of Intercourse, Pa., treasurer; E. K. Denlinger, Willis L. Zimmerman, all of Inercourse, Pa.

ROYERSFORD, PA.—Articles of incorporation have been filed for the Royersford Interurban Traction Company by Joseph A. Buckwalter, R. S. Raiser, of Royersford; A. B. Eddowes, W. W. Levering and W. H. Houston, of Philadelphia, Pa. The company is capitalized at $25,000 and proposes to construct an electric railway in Royersford, about four miles in length.

SLIPPERY ROCK, PA.—The Slippery Rock & Grove City Street Railway Company has been incorporated with a capital stock of $55,000 to construct an electric railway from Slippery Rock to Grove City, 9 miles in length. The incorporators are: John P. Barr, of Grove City, presi-

dent; W. Henry Wilson, James A. Jolliffe, S. L. McClure, C. S. Shrubb, John Carruthers and W. M. Graham.

ROCK HILL, S. C.—The Rock Hill Water & Electric Company has been chartered, with a capital stock of $100,000, by R. T. Fewell and P. A. Willcox. The company proposes to generate and distribute electricity for lamps and motors, and also supply water for domestic and commercial use.

ANGUS, TEX.—The Angus Telephone Company has been chartered, with a capital stock of $1,230, by R. Knight, T. Ware and A. H. Birdwell.

CROSBYTON, TEX.—Articles of incorporation have been filed for the Crosbyton Telephone Company with a capital stock of $10,000 by Julian M. Bassett, J. C. Johnson, Taylor Gault, and others.

OLTON, TEX.—The Olton Independent Telephone Company has been chartered, with a capital stock of $1,000, by H. R. Miller, D. C. Young and W. D. Wicker.

WALNUT SPRINGS, TEX.—The Glen Rose & Walnut Springs Railway Company has ben chartered with a capital stock of $100,000 to construct an electric railway 15 miles in length extending from Glen Rose to Walnut Springs. The incorporators are: Judge Sadler, J. H. Farr and others.

WILLS POINT, TEX.—The Wills Point Telephone Company has been incorporated, with a capital stock of $16,500, by O. L. Fink, E. F. Fink and H. F. Goodnight.

KAMAS, UTAH.—The Kamas-Woodland Telephone Company has filed articles of incorporation, with a capital stock of $12,000. The officers of the company are: Charles B. Stewart, president; J. O. Park, vice-president, and John B. Hoyt, secretary and treasurer.

SEATTLE, WASH.—Articles of incorporation have been filed for the Oregon & Washington Long Distance Telephone Company, with a capital stock of $1,500,000, by Samuel Hill, W. G. Collins and Henry Lindley.

SEATTLE, WASH.—The Collins Pacific Coast Wireless Telephone & Telegraph Company has been chartered with a capital stock of $2,000,000 by B. F. Shoemaker, C. O. White, Sylvester Sullivan and C. L. Vaughn.

TACOMA, WASH.—The Skagit, Cascade & Chelan Railway Company has been incorporated, with a capital stock of $25,000,000, by W. W. Shenk and others. The company proposes to construct an electric railway from Rockport to Spokane, with branches to Silver Basin and to the British Columbia line. Electricity for operating the railway will be generated on Thunder Creek.

LONETREE, WYO.—The Lonetree & Linwood Telephone Company has been incorporated, with a capital stock of $3,000, to construct and operate a telephone system from Lonetree to Linwood. The directors are: T. A. Welch, Robert D. Swift, Clark Logan, Sterling Summers and John Fluhman.

WINGHAM, ONT., CAN.—The North Huron Telephone Company has been incorporated, with a capital stock of $10,000, for the purpose of erecting and operating telephone lines in the townships of Turnberry, Morris, East and West Wawanosh, Howich, Kinloss, Culross and Carrich. The company has erected lines to the villages of Bluevale, Belmore, Belgrave and Whitechurch. Work on the new telephone lines will begin as soon as possible. George Spotton is president; W. J. Greer, vice-president; William Mapwell, managing director; H. B. Elliott, secretary and K. Vanstone, treasurer.

Personal.

MR. F. T. BODINE, of the Philadelphia Electric Company, has been appointed president of the Syracuse Lighting Company.

MR. SAMUEL INSULL will address the Chicago Electric Club Oct. 20; the topic to be, "The Sale of Electrical Energy in Chicago."

MR. GEORGE L. KNIGHT will present a paper before the Brooklyn Engineers' Club on Oct. 14, entitled "The Generating and Distributing System of the Brooklyn Edison Company."

MR. J. J. CUMMINS has resigned as president of the Syracuse Lighting Company in order to become associated with the Dunfee Construction Company. Mr. Cummins will remain a director of the Lighting Company.

DR. ELIHU THOMSON.—At the ceremonies attending the induction of President Lowell, Prof. Elihu Thomson received from Harvard University the degree of Doctor of Science in recognition of original work in electrical research.

MR. EDGAR W. MIX, who made the record flight in the recent international balloon contest for the James Gordon Bennett prize, is a member of the American Institute of Electrical Engineers, having entered as an associate in 1889, and was transferred to full membership in 1895. Mr. Mix has resided in Paris for many years, where he practises as an electrical engineer.

MR. FRANK VAIL BURTON, Eastern sales manager of the Bryant Electric Company and the Perkins Electric Switch Manufacturing Company, of Bridgeport, Conn., and Miss Marion Andrew, daughter of Mr. and Mrs. Thomas Winter Andrew, of Swarthmore, Pa., were married in the Walnut Street Presbyterian Church, in Philadelphia, on Saturday afternoon, Oct. 9. Mr. and Mrs. Burton will make their home in Bridgeport.

Trade Publications.

INDICATING FUSES.—The Detroit Fuse & Manufacturing Company, Detroit, Mich., is distributing revised price lists of its line of "Arkless" indicating fuses, which call special attention to the absolute guarantee placed on every "Arkless" fuse, and to the special features embodied in this line.

TUNGSTEN LAMP.—A small folder issued by the General Electric Company contains data relative to the 40-watt tungsten lamp, which should be of general interest. It shows in dollars and cents the saving resulting from the use of the tungsten lamp in place of the ordinary carbon lamp.

HARVARD CATALOGUES.—The Harvard Electric Company, of Chicago and New York, has just issued bulletin No. 19 relating to brackets, sectional switch boxes, conduit boxes, telephone fuses, wire joints, etc. In this bulletin there is given a detailed description of the various Harvard specialties, dimensions, etc.

GIRL PICTURES.—The General Incandescent Lamp Company, of Cleveland, Ohio, has once more started the distribution of the G. I. series of girl pictures taken from life. They sent out a very attractive set of five last season at different intervals. If the first one for this year is any indication of what may be expected of the others that are to follow they surely will be appreciated by the recipients. This is a very attractive form of advertising and the pictures are so artistic that many will find their way to the picture framer and will be hung permanently on office walls.

INDICATORS.—The Trill Indicator Company, of Corry, Pa., has just issued an attractive 44-page booklet describing its various types of indicators. The "Faultless" reducing motion, Trill planimeter and indicators for high pressure and ammonia work are also described. Discussions are included on numerous cards and the causes of various unusual curves pointed out. A method is given for drawing adiabatic and saturation curves, and a section treats the indicating of gas engines with discussions of faulty diagrams. There is also a section on indicating compound engines and drawing combined cards.

Business Notes.

THE TREGONING ELECTRIC MANUFACTURING COMPANY, of Cleveland, O., owing to a largely increased business, has removed its plant from 224 High Street to 418 West Prospect Avenue. The new factory is equipped with much additional machinery and equipment for the manufacture of the Tregoning specialties.

PASS & SEYMOUR NEW YORK OFFICE.—Mr. W. Brewster Hall has been promoted to the position of assistant sales manager of Pass & Seymour, with headquarters at Solvay. The New York office will be in charge of Mr. F. S. Baldwin, late of the Syracuse Supply Company, who has been engaged in the electrical jobbing business for the past five years.

STEINER FAMILY MOTORS.—St. Louis last week enjoyed a centennial celebration, on one day of which there was a parade of floats. One of those which attracted most favorable attention was entered by the Steiner Manufacturing Company. This consisted of a flower-trimmed body on which Steiner family motors were shown in actual operation applied to various domestic uses.

HENRY F. FROSCH & COMPANY.—Henry F. Frosch & Company announce the removal of their office and warerooms from 656-658 Howard Street, to the Electric Building, 171-173 Second Street, San Francisco. The company represents the following firms on the Coast and carries a complete stock for immediate delivery: Federal Electric Company, Chicago, Ill.; General Incandescent Lamp Company, Cleveland, O.; Albert J. M. Anderson Manufacturing Company, Boston; Minerallac Electric Company, Chicago, Ill.; Crescent Company, Valpariso, Ind., and Excello Arc Lamp Company, New York City, N. Y.

TANTALUM LAMPS.—The General Electric Company reports very gratifying sales of tantalum lamps. The sales of this lamp are more than double what they were a year ago, and the lamp appears to be sharing in the demand for high-efficiency lamps created by the introduction of tungsten lamps. The tantalum lamp, as at present supplied, is giving excellent life service. Contrary to general belief, these lamps will give good commercial life on alternating current of 60 cycles or less. Their life on this frequency will average well above 600 hours. An interesting tantalum lamp order recently received called for 1900 lamps for the U. S. war vessels attending the Hudson-Fulton celebration in New York.

ANOTHER ACHESON EXTENSION.—Another substantial and commodious building is to be added to the Niagara Falls, Ont., branch works of the International Acheson Graphite Company. The structure is to be 50 ft. wide by 105 ft. long, and the contract has been awarded to W. S. Homan, of Niagara Falls, Ont. The facilities afforded by this addition will make the Canadian works of the graphite company quite complete in its ability to care for a rapidly growing trade due to Canada's industrial growth. The building will contain a new grinding plant, in which the lubricating, electrotype, and other grades of powdered graphite will be prepared for market. It will also contain a stock room for package goods, such as graphited greases, powders, etc., while a new shipping room will make it most convenient for promptly filling orders.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED OCT. 5, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector Street, N. Y. City.]

935,682. GEARING FOR LOCOMOTIVE RECORDING INSTRUMENTS; S. T. Park and J. E. Phillips, Danville, Ill. App. filed Dec. 21, 1908. Gearing for actuating the paper feeding device of a recorder on a locomotive which records the tractive force, the steam pressure, the air pressure, etc.

935,705. STRAIN RELIEVING MEANS FOR TERMINALS OF LAMP SOCKETS, etc.; F. A. Swan, Cliftondale, Mass. App. filed Apr. 15, 1908. Provides a flat terminal strip with a headed strain relief projection extending laterally from the flat side of the terminal strip about which the conductive wire may be wrapped.

935,721. WIRELESS TELEGRAPH SYSTEM; V. C. De Ybarrondo, Los Angeles, Cal. App. filed Jan. 2, 1909. A central switchboard with suitable wiring in position so as to be connectable with the aerial and sounding apparatus.

935,750. DEVICE FOR PRODUCING SOUND SIGNALS IN WATER; H. B. Gale, Boston, Mass. App. filed Mar. 5, 1906. Includes a water-tight case capable of vibration and of transmitting sound, together with a striker within the case which strikes a thickened portion of the internal wall of the case.

935,768. ELECTRIC BLOCK SIGNALING SYSTEM; W. F. Meschenmoser, Hoboken, and C. H. Kinsman, Plainfield, N. J. App. filed July 24, 1908. For single track roads in which two pairs of setting and restoring track magnets are used, a shunt track circuit for each magnet connected with insulated track sections at opposite ends of the block, and signals at opposite ends of the block controlled by the magnets.

935,792. TELEPHONE RINGER; N. P. Jensen, Waterloo, Iowa. App. filed Jan. 9, 1909. The cores of the electromagnet which operates the ringer are hollow and a compression spring is seated in the hollow of each core to move the armature in one direction.

935,796. PRODUCTION OF MAGNESIUM; F. Von Kugelgen, Holcombe's Rock, Va., and G. O. Seward, East Orange, N. J. App. filed July 8, 1907. Electrolizes a magnesium salt with a cathode of molten aluminum, producing a magnesium aluminum alloy and dissolves out the magnesium by using it as an anode in a molten electrolyte, depositing the magnesium at the cathode.

935,816. ELECTRIC HEATER; W. A. Rankin and W. M. Harwood, Hutchinson, Kan. App. filed Oct. 23, 1908. For sad irons and the like, in which the side opposite the acting face is provided with an integral raised portion and a multiplicity of slots and two layers of zigzag grids in the slots.

935,838. REVERSIBLE FUSED AND SOLID TERMINAL; R. H. Conway and H. E. Bisbing, Philadelphia, Pa. App. filed Nov. 20, 1908. A turning plug which in one position constitutes a fused circuit closer and in another a solid circuit closer.

935,852. TROLLEY WHEEL; A. M. Levering, Philadelphia, Pa. App. filed Oct. 1, 1908. Permits a pivotal movement of the rim of the wheel with relation to the body to permit it to follow curves. Comprises a central disc with aligned longitudinal openings therein, pins in the openings of greater length than the openings, and a rim on the disc with recesses to receive the pins.

935,881. SINGLE PHASE MOTOR; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Dec. 26, 1907. A single-phase motor of the commutator type with inducing and exciting windings on the stator and a reactive winding in stator slots, connected to the exciting winding and arranged non-inductively with respect to the other windings.

935,892. ELECTRIC SIGNAL FOR RAILWAYS; A. C. Carey, Boston, Mass. App. filed Nov. 21, 1907. A conductor is arranged alongside of the track and co-operates with mechanism in the cab of the locomotives, including an audible alarm and means for actuating the air brake, with a regulator for the current.

935,895. TROLLEY WIRE SUPPORT; R. O. Couch, Charleston, W. Va. App. filed Mar. 20, 1909. Hangers for trolley wires, including a base block, a clamp which grips it and supports the wire, the block having a water shed overhanging the clamp, and a second water shed overhanging the base block and members secured thereto.

935,896. ARC LAMP; J. T. H. Dempster, Schenectady, N. Y. App. filed May 1, 1905. Arc lamps with a feed for the electrodes. Includes a pair of main electrodes and an auxiliary electrode, the lower main electrode including an iron tube filled with a mixture of oxides of metals, and the auxiliary electrode being used to warm the arcing end of the main electrode.

935,897. MICROPHONE; C. E. Egner, Stockholm, and J. G. Holmstrom, Saltsjostorangen, Sweden. App. filed Mar. 27, 1908. Includes a sealed casing having one wall formed by the vibratory diaphragm, the casing being charged with hydrogen.

935,908. ARC LAMP; C. D. Haskins, Schenectady, N. Y. App. filed Feb. 18, 1907. In order to feed electrode, makes it of material in a plastic state which is fed progressively.

935,915. ELECTRIC SWITCH AND OUTLET BOX; A. H. Kling, Detroit, Mich. App. filed Apr. 16, 1908. Two similar units with ears extending inwardly and interchangeable end plates.

935,920. ARC LAMP; E. J. Murphy, Glasgow, Scotland. App. filed Oct. 26, 1905. An arc lamp frame having a hood, a platform, parallel channel bars, two coil forms bent laterally to form cups which are secured at one end to the hood and at the other end to the platform.

935,923. CONDENSER; F. J. Newton, Schenectady, N. Y. App. filed Nov. 8, 1906. A plurality of metal plates, some of which are channeled, lugs on the plates and parallel conducting tools passing through the lugs to make electrical connection with the plates.

935,934. MAIL BOX; F. H. Sieh and F. L. Lowe, Minneapolis, Minn. App. filed June 24, 1909. Has a spring controlled block in the path of the lever which controls an alarm.

935,935. ELECTRIC ANNUNCIATOR; A. J. Smith, Bath, Me. App. filed Oct. 29, 1908. A sliding gravity drop retained in position by a mechanically actuated catch. Details.

935,937. ELECTRIC FURNACE; W. A. Smith, Niagara Falls, N. Y. App. filed June 15, 1909. The walls of the furnace are perforated and permeable to the gaseous reaction products.

935,939. ELECTRICAL FURNACE TERMINAL; E. C. Speiden, Niagara Falls, N. Y. App. filed June 17, 1909. The terminal includes graphite members spaced in the direction of the current flow and an interposed filling of electrically conductive material of relatively low heat conductivity.

935,941. ALTERNATING CURRENT DYNAMO ELECTRIC MACHINE; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 13, 1908. The armature is wound with uniform coils of a pitch which prevents the induction in said coils of one harmonic of the induced e.m.f., and certain of the coils are offset with respect to other coils in series therewith to eliminate another harmonic.

935,942. PROCESS FOR MAKING SUGAR; C. P. Stewart, Los Angeles, Cal. App. filed Mar. 6, 1908. Effects a chemical reaction between mixed carbon monoxide and hydrogen obtained by passing superheated steam to the carbon; cools, compresses and passes an electric current through the mixed gases.

935,972. SAFETY SWITCH LOCK; A. Haddock and A. Schmitt, New York, N. Y. App. filed Nov. 13, 1908. A safety switch lock adapted to engage a switch point with a motor and spring for actuating it and an electromagnetic catch and motor for controlling it.

936,001. DRY-CELL TESTER; E. S. Lincoln, Brookline, Mass. App. filed Mar. 6, 1908. Contact members are located upon the exterior of the casing and a solenoid magnet within it. A drum is mounted upon the core of the magnet and bears a strength indicating scale upon its periphery. A spring tends to eject the core from the magnet.

936,009. TELEPHONE STAND; E. A. Metcalf, Forbes, Mo. App. filed Nov. 11, 1908. A telephone stand carrying a ring with arms projecting from opposite sides and a pair of seats on the ring, together with a receiver arm pivoted to the stand and normally resting upon one of the above seats.

936,039. ELECTROLYTIC APPARATUS; I. L. Roberts, New York, N. Y. App. filed Apr. 3, 1905. Making porous diaphragms for cells of woody material and then partially carbonizing the same.

936,055. TROLLEY GUARD; S. Stroup, Peru, Ind. App. filed Aug. 18, 1908. A trolley guard including retainers normally above the top of the wire which yield when they strike a hanger.

936,067. INCLOSED METER LOOP; E. C. Wigham, Boston, Mass. App. filed Apr. 19, 1909. A meter loop block having contacts accessible for connection to service and enclosed and insulated from one another.

936,071. MOTOR CONTROL; E. F. W. Alexander, Schenectady, N. Y. App. filed Dec. 17, 1907. For alternating current motors of the commutator type having a controlling switch arranged to short-circuit the motor armature and connect the stator windings in series with a reactive coil in shunt to the exciting winding at starting. The magnet circuit of the coil is saturated by the starting current.

936,100. TROLLEY WHEEL AND HARP; F. L. Eager, Waterbury, Conn. App. filed Oct. 3, 1906. A base for a trolley harp having ears projecting therefrom, a carrier, a trolley wheel on the carrier and contacts pressing against the wheel.

936,116. SAFETY APPLIANCES FOR ELECTRIC ELEVATORS; C. S. Gilbert, St. Joseph, Mo. App. filed Dec. 28, 1908. A brake operated electrically with means for preventing the starting and stopping mechanism of an elevator from being moved after the electric current has been cut off until the armature of the motor has ceased to revolve.

936,140. TELEGRAPH SYSTEM; W. Leivesley, Springsure, Queensland, Australia. App. filed Aug. 7, 1906. A telegraph system having a main circuit, a key and a principal relay therein, a repeater and a battery.

936,163. RECEIVING SYSTEM FOR ELECTRICAL OSCILLATIONS; E. Quack and F. v. d. Woulde, Berlin, Germany. App. filed Apr. 27, 1908. For receiving waves in the Pederson system. The detector is permanently included within the oscillating circuit, and the condenser in parallel to the detector is intermittently connected with the circuit by an interrupter device.

936,175. PUSH BUTTON SWITCH; F. E. Seeley, Bridgeport, Conn. App. filed Apr. 21, 1909. A push button switch having a hollow push button and a visible indicator within the same operated by the switch mechanism.

936,195. CLAMP; J. H. Umpleby, Friendly, W. Va. App. filed Nov. 3, 1908. For splicing together the ends of wires by means of a gutter-shaped sleeve and keys securing the wires to the sleeves.

936,207. TELEPHONE TRANSMITTER; C. D. Babcock, New York, N. Y. App. filed Apr. 17, 1909. For wireless telegraphy, the transmitter including oxide of a metal whose conductivity becomes extremely sensitive at a certain critical temperature with controllable means for heating the oxide.

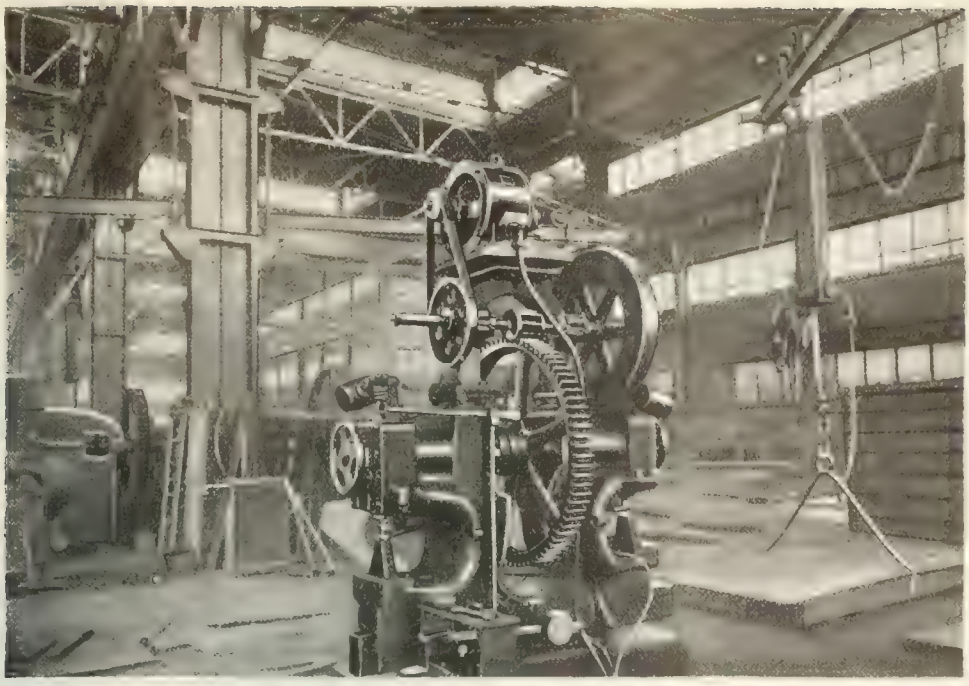
936,208. ELECTRIC BRUSH; M. E. Bacon and L. J. Meller, Deerfield, Kan. App. filed Oct. 19, 1908. For supplying electrical current to brushes used in massage. Details.

936,227. ELECTRICAL FUSE; A. Grant Fay, Highland Park, Ill. App. filed Oct. 26, 1908. Provides an outer shell and a filling, the ends of the outer shell being reduced for sharpening the effect of the detonation of the fuse.

936,252. METERING PANEL BOARD; A. C. McWilliams, Chicago, Ill. App. filed Oct. 23, 1907. The panel board includes an insulating board, two sets of conductors permanently mounted thereon and arranged in parallel planes.

936,255. AUTOMATIC SIGNAL SYSTEM; J. S. Payne, Mulvane, Kan. App. filed Mar. 2, 1909. Displays a danger signal at the proper time and provides a riding link struck by the locomotive to effect the operation of the signal.

936,258. RECEIVER FOR SPACE TELEGRAPHY; W. Schloemilch, Oberschoneweide, near Berlin, Germany. App. filed Jan. 3, 1906. An electrolyte, electrodes of different materials in contact therewith to form a primary battery and a local circuit, including an indicator influenced by variations of current in the circuit.



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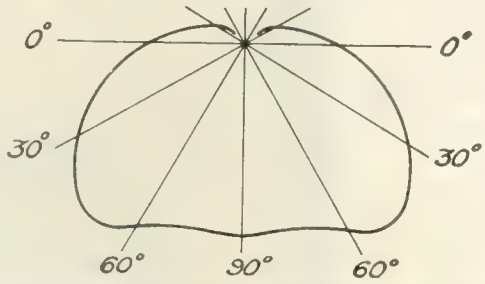
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Lighting Reforms in Budapest.

Until very recently Budapest, albeit one of the most important and progressive cities in Eastern Europe, has been almost unique, from the fact that electric lighting on the streets of this city was conspicuous by its absence. There are two active and successful electrical companies in Budapest doing a large commercial business, but until very recently the entire city has been lighted by gas in Welsbach burners. Such lighting is an anachronism, which produces a most curious effect on the stranger who is used to seeing well-lighted cities all over Europe; and it is only fair to say that for gas lighting the street illumination in Budapest is rather good. The absence of electric light is not entirely due to lack of enterprise, but to an old and sharp bargain driven between the municipality and the gas company. The latter, under the terms of its franchise, has, in lieu of taxes and franchise dues, to furnish the city free of charge nearly one-fourth of the total output of gas delivered by the company for lighting purposes, and has besides to maintain the lamps used for street lighting at what is really a nominal price. Having this arrangement, therefore, to take out in trade its claims against the gas company on most advantageous terms, the municipality has very naturally maintained its gas lamps, although when a new franchise is due, which will be presently, it is very possible that other arrangements will be made.

The direct-current central station of Budapest is in charge of M. Etienne de Fodor, a conspicuously able engineer and energetic administrator, and it is pleasant to record that he has broken through the municipal crust in Budapest far enough to be allowed to install as a demonstration what from Mr. Jehl's account is evidently one of the most complete and most modern street-lighting systems to be found anywhere. The white flaming arc of the Blondel type chosen for the work is already in use in a number of important European cities, and in point of beauty and efficiency stands unexcelled. It is peculiarly well adapted to the multiple distribution almost universally used in street lighting abroad, because it operates successfully on only 30 volts at the arc, thus allowing three flame lamps to be put in series on an ordinary 10-volt circuit. The life of the electrodes is sufficient to give all-night burning with a very modest length, so that the lamp itself is not of unwieldy length. The color of the light given by these arcs is a peculiarly beautiful pearly white, sometimes with a barely perceptible pinkish tinge; but on the whole the color is so close to that of a first-class open arc of large amperage that it is difficult to tell the two apart, although the flame arc is of very much higher efficiency as an illuminant. These Blondel type lamps throw the maximum of light considerably further out on the horizontal plane than do the flame lamps with converging carbons, which again fits them excellently for street lighting and, particularly, when the lamps are placed rather closely, giving exceptionally brilliant illumination.

The general arrangement of the lights on the demonstration circuit in Budapest seems to be most admirable, the height being 30 ft. and the lamps being placed about 164 ft. apart on each side of the street, the rows on the two sides being staggered. The type of poles used is almost universal on the Continent, the structures of steel and cast-iron carrying also in this case an ornamental basket for planting flowers during the summer season. The figures for efficiency given by Mr. Jehl are very interesting. Each lamp consuming 550 watts, including its steadying resistance, gives 1750 lower hemispherical hefners and working therefore at about ⅓ watt per candle even with an opal glass globe cutting off as much as 30 per cent of the total light. The vertical carbon-flame arc with yellow-flame carbons will do even somewhat better than this; but considering the very pleasing character of the light given by the white carbons a slight loss of efficiency can very well be forgiven. Altogether, Messrs. de Fodor and Jehl are to be congratulated not only on having gotten things moving in Budapest in spite of the difficulties of the situation, but on having installed what seems to be a model system for the conditions they have had to meet.

Making the Most of a Low Head.

The Middle West, in spite of its many streams, is not favored with frequent opportunities for easy hydraulic development. It is flat alluvial country for the most part, with streams which are steady, as compared to those in a mountainous country, but shallow and of low gradient, so that it is very hard to get a distinct operating head, and dams, although generally low, have to be of considerable length. The Tippecanoe River, on which the Monticello plant is situated, is an entirely typical stream of the region. It is a wide and rather shallow river, rambling through a flat country of rich farm lands, and is about as unpromising, from the standpoint of hydraulic engineering, of any stream with which we are acquainted. Yet in Monticello they have gone ahead on a modest scale and have utilized the old stream for a successful local hydroelectric development. The head is only 8 ft., and to secure this a dam more than 300 ft. long was necessary. It was cheaply and effectively put together by use of the timber crib construction and favoring conditions as to foundations. The flood gates are motor driven and controlled from the station, which enables the power-house attendant to work the gates without leaving the station. The wheel plant, under the exigencies of low head, has to assume a form unfamiliar on most streams. It consists of four 50-in. vertical shaft turbines, all driven by bevel gears and individual clutches on the same line shaft, which goes through into the dynamo room and drives two generators of 150 kw and 250 kw respectively. These are of the ordinary three-phase type for 2200 volts. A simple Corliss engine, which can be belted to a pulley on the main shaft, is available for emergency service, steam being supplied from two horizontal tubular boilers worked with a short stack under forced draft. The plant is, in spite of the necessary complications of the wheel system, of extreme simplicity, so that it can be and is handled by one man, and actually kept in operation 24 hours per day by two men working 12-hour shifts. Monticello is a place of little over 3000 inhabitants, and this extremely simple and workable plant is fully capable of supplying its regular needs. In the few cases when steam operation is necessary ,a temporary fireman comes in and assists the station operator; and in times of flood the wheel governor is cut out and the engine runs with the wheels as auxiliary doing the necessary regulation. The plant is a capital example of what can be done to meet the needs of a small and growing community by utilizing such water-power as is at hand. Many another community is similarly situated, although in few cases, we think, would the hydraulic conditions be harder to overcome than in this. Plants of this kind, built without strenuous efforts of promotion and for the purpose of doing paying business, as a rule manage to make good, and as time goes on the number of them is bound to be increased.

Loss of Power in Alternating-Current Measuring Instruments.

The use of permanent magnetic fields in direct-current electrical measuring instruments has served greatly to increase their sensitiveness and greatly to diminish the power they consume when at work. Reference is here made to measuring instruments of the d'Arsonval type. In alternating-current instruments, the permanent magnetic field has not been available for use, and when magnetically operating instruments are used, the alternating current is required to produce its own magnetic field. Consequently, alternating-current magnetic measuring instruments require more excitation and more wasted power than their direct-current prototypes. An interesting article on this subject by Herr J. von Studniarski, is referred to this week in our notices of current literature. Among other things, the article shows that standard alternating-current voltmeters operating at about 100 volts have about 16 ohms resistance per volt of full scale and consume about 6 watts, when of the dynamometer type; about 7 ohms per volt and 22 watts when of the hot-wire type; and about 10 ohms per volt and 10 watts when of the soft-iron type. The dynamometer instruments are thus the most sensitive and economical of power, although they are also, perhaps, the least rugged of the three types compared. Comparative tables of such instruments are given, covering a wide range of actual service in pressure and current, while the relative accuracies of different types of wattmeters are discussed at length.

Persistence of Vision.

The *Physical Review* for January, 1909, contains an article by Mr. Frank Allen on "Some Phenomena of the Persistence of Vision," giving the results of experimental observations on this interesting but complex phenomenon. In front of the slit of a spectrometer is placed a sectored disk, driven by an electric motor at a measured speed. When the flickering of the color viewed by the observer at the spectrometer just disappears, the speed of rotation determines the interval of persistence of vision for that particular color and intensity of light stimulus. It appears from the observations that the effect of complete rest for the eye increases the persistence of vision, at least up to five minutes. Thus, with a certain blue light the persistence of vision for the normal eye was observed to be 0.019 second, but after keeping the eye in darkness for 15 minutes the persistence rose to nearly 0.022 second. Under normal conditions, the persistence interval is distinctly less for yellow light than for red light or for blue light. That is, in the middle of the visible spectrum, the persistence of vision is only about one-half what it is near the limits of the spectrum.

By varying the color, and in particular by producing combinations of color, results were obtained which strongly support the view that there are three and only three, fundamental color sensations—namely, one at each end of the visible spectrum (red and violet), and one at or near the middle (green). Consequently, we see these particular colors of red, green and violet each with single sense organs in the retina. If we see red color, the green and violet organs of color vision are dormant, and similarly for the other two; but any other color or colors are combination sensations, in which either one pair or all three color vision organs unite in transmitting the stimulus. Color blindness usually consists in the absence, or inoperativeness, of one of the three sets of color vision organs. Since the responsiveness of these three different color detecting instruments in the visual mechanism of the normal eye is different in regard to the power of light stimulus, expressed in watts reaching the retina, and since the fatigue and persistence of the sensation are apparently different for the three sets of instruments, the complexity of the actions involved in color photometry can be readily imagined.

Units and Symbols.

As noted in our Digest columns this week, the German committee appointed to consider and recommend technical notation and symbols for use by engineers has recently published a report in the *Elektrotechnische Zeitschrift* on certain portions of its work. In general, this report will, we think, commend itself to all readers, and we subscribe to it heartily. In detail, there are certain objections that we find against it, and we offer our criticisms on these points in the hope that the committee may take these criticisms into consideration when it revises and collates this work. The interests to be considered in this matter are not merely national. They are international. That national system of notation and symbols is the best which best lends itself to international adoption. If any one country possessed a monopoly of all science, both pure and applied, then that system of notation which best suited the language, literature and habits of thought of that country would be the best to employ. But the sciences belong to every country as much as the international atmosphere, the international ocean, or the international ether; so that the best interests of scientific development are found in a symbology that lends itself to international adoption, with the minimum sacrifice of orderly arrangement and systematic construction. We believe that these propositions are acquiesced in by the German committee, because there are distinct evidences in its past work of an endeavor to shape its proposals in accordance with international usage and with a view to the needs of engineers in other nations.

The German committee recommends a main list of 35 symbols, only 10 of which are strictly electromagnetic, the remainder being important fundamental and subsidiary units of mechanics and physics. Only one of these 35 symbols is, in our judgment, open to serious criticism, and that is the symbol A, suggested for *work*, being the initial letter of the German word *Arbeit*. This letter A, or its lower-case prototype a, is not used to any appreciable extent, outside of German speaking countries, to designate *work*. In France, T and W are used for this purpose. In England E and W, in Italy L and W, in the United States W is used almost universally. Even in German technical literature the letter A, although very generally used for *work*, is not exclusively so used. Occasionally T and W are used for this purpose. Consequently, it seems undesirable to stamp officially the adoption of a symbol so little internationally employed for this term. An international vote would probably be in favor of W instead of A.

The German committee also recommends an auxiliary notation list in alternating-current engineering containing some 12 or 13 additional symbols. Here L appears for *power*, being the initial of the German word *Leistung*. In the electrotechnical literature of England, France, Italy and the United States it is usual to find power represented by P, with W to some extent, owing to its being the initial of *watts*. Even in German literature P is occasionally found for power, and W is frequently met with. Consequently, the choice of L for power is unfortunate from an international standpoint. Moreover, the use of the symbol L for power displaces this symbol from its ordinary use for designating self-inductance, and the German committee, therefore, recommends a modified form of L—a script form—to represent inductance. This in turn is unsystematic and is unfortunate, not only because it breaks up almost universal international usage, but also because it introduces a solitary script letter into a company of otherwise unbroken latin type. At present script letters are almost exclusively used for magnetic quantities. The use of L for self-inductance in the literature of all civilized countries is almost universal, and it would be deplorable to disrupt this already existing unanimity. From an international standpoint, the best thing to do is probably to leave L alone for inductance, as heretofore, and preferably to use P for *power*.

The committee also proposes J and i for *current-strength*. We believe that I and i would be more consistent and more generally acceptable; but since J and I are, in script, so closely alike, this criticism seems of lesser importance than the preceding. For the symbol of *resistance* the committee proposes R, for which we are very glad. There has always been a strong presentation of W in German literature, as the initial of *Widerstand*, although the concurrence of other literature toward R has been overwhelming. The new proposal is a great step gained toward international unity. The committee also proposes S for *impedance* and B for *reactance*. These proposals are somewhat novel and are not much supported by precedent. In this country and, to a very appreciable extent in other countries, Z and X are used for those terms respectively. The only objection to these latter seems to be their well-known abundant use as unknown quantities in algebra. This matter is debatable and does not seem to us to be of prime importance. Summing up, then, our principal criticism is against the use of L for *power*. If the German committee would consent to drop this proposal in favor of P, we think other nations might be ready to stretch a point, in favor of Germany, in some other direction; such as in *impedance* or *reactance* or even *work*. In general, however, we heartily endorse the German committee's effort to unify and standardize the symbols employed in ordinary engineering, provided that no attempt is made to extend the process to pure science. It is as important that pure science should move unfettered in symbolism as that engineering should move in uniform regimentals.

N. E. L. A. Administration Plans.

At the first session of the Colorado Electric Light, Power & Railway Association, at Denver, Oct. 7, Mr. Frank W. Frueauff, vice-president of the Denver Gas & Electric Company, and president of the National Electric Light Association, was called upon to make a few remarks on the N. E. L. A. work and gave an interesting account of the plans of the present administration of that body.

He said that the present officers took charge on July 1, and one of the first things taken up was the appointment of a permanent secretary. The work of the association needed a permanent secretary to devote his entire time to association work, as a secretary identified actively with one of the member companies must either neglect the association work or his regular work. The committee unanimously agreed upon Mr. T. C. Martin, for many years one of the editors of the *Electrical World*, as the man best fitted for this position, and who is well acquainted both with the men and the needs of the field through his long service as a journalist. He said that one of the first things to which Mr. Martin will give his attention will be the building up of company sections. Another matter to be taken up is a standard vocabulary of terms used in the electric light and power business. At the present time there is confusion because some of the terms used are not always employed to convey the same meaning. For example, the term flat rate is sometimes used as applying to a fixed monthly rate where no meter is employed and also as applying to a uniform meter rate which is not subject to discount.

A table of electrical values for use in text-books is to be compiled by Dr. A. E. Kennelly, of Harvard University, and Mr. W. D. Weaver, editor of the *Electrical World*. The public-policy committee this year is to give special attention to the corporation tax law and the question of proper allowances for depreciation.

Recently some questions have been raised as to the best method of resuscitation from electric shock. Methods used abroad differ from the older method used here, and to investigate this question and formulate standard instructions for emergency use on this important matter will be the work of one committee.

The Vermont Electrical Association has become recently affiliated with the N. E. L. A. and this movement of affiliation with State associations will be continued. In answer to questions asking for further information on the matter of affiliation with State associations, Mr. Frueauff explained that in case of such affiliation one-half of the dues of N. E. L. A. members in the State revert back to the State association. On motion of Mr. Geo. B. Tripp, of Colorado Springs, it was voted at the close of this address by Mr. Frueauff to appoint a committee on affiliation with the N. E. L. A.

Organization of Accounting Committee, National Electric Light Association.

At a meeting of the accounting committee of the National Electric Light Association, held in New York on Sept. 24, a comprehensive organization was effected. Three sub-committees were appointed which will take up the work outlined as follows:

1. Sub-committee on forms: E. J. Allegaert, general auditor electrical department, Public Service Corporation of New Jersey; R. H. Ballard, secretary and assistant general manager, Edison Electric Company, of Los Angeles; E. J. Bowers, Peninsular Electric Light Company, Detroit; A. S. Michener, Stone & Webster; J. L. Bailey, treasurer, Consolidated Gas, Electric Light & Power Company, Baltimore. This committee will collect all forms used by member companies and will submit to the association a complete set of forms which it will recommend as standard for the operating, commercial and accounting departments.

2. Sub-committee on uniformity of accounts and practices: J. L. Bailey, Consolidated Gas, Electric Light & Power Company, Baltimore; C. H. Jelliffe, secretary, American Light & Traction Company; E. J. Bowers, Peninsular Electric Light Company; A. S. Michener, Stone & Webster; J. J. O'Brien, auditor, H. M. Byllesby & Company, Chicago. This committee will urge the adoption of the classifications of operating and construction accounts by all member companies, will interpret the text and will endeavor to harmonize electrical accounting practices with those of other public utilities.

3. Sub-committee on public relations: H. M. Edwards, auditor, New York Edison Company; F. L. Dame, engineer, Electrical Securities Corporation; G. E. Claflin, United Electric Securities Company, Boston. This committee will co-operate with the various public service commissions and assist member companies and State organizations or other associations with advice on accounting problems.

Forms of Annual Reports for New York Public Service Corporations.

Mr. W. J. Meyers, statistician of the New York Public Service Commission, Second District, has issued a letter asking for criticisms of the forms of annual reports prescribed for public-service corporations. Mr. Meyers says in part:

"At the present time it is one of the duties of the Public Service Commissions of this State to keep themselves informed concerning the affairs of the various public-service corporations subject to the oversight of the commissions. Great latitude is allowed by the statute concerning the form which such annual reports shall take, the statutory provisions concerning them placing their form largely within the discretion of the commissions.

"In connection with the annual reports of the commissions to the Legislature, the statute requires the publication of 'abstracts of the reports to such commission of common carriers, railroad corporations and street railroad corporations, and gas and electrical corporations,' and requires such abstracts to be distributed to 'railroad, street railroad, gas and electrical corporations, and other persons interested therein.'

"Owing to the large number of corporations placed within the supervision of the Public Service Commission for the Second District, the critical examination of the annual reports of the said corporations and the compilation therefrom of matters of sufficient general interest to warrant publications is a work of considerable magnitude and a correspondingly great expense. In order that such expenses may not be an unwarranted burden upon the public funds, the information published should be such as satisfies some genuine public need, and this letter is sent to you in the hope that you may help to determine what are the public needs to be satisfied by such publication and what is the character of the matters to be compiled and published in order to meet such needs.

"The various persons interested in the operations of public service corporations may conveniently be grouped into (a) consumers, (b) managers, (c) investors, and (d) employees. Each of these classes is doubtless interested from a separate standpoint in the matters under consideration, and we are desirous of affording in our statistical publications such information as is necessary to meet the real wants of these various classes so far as it is significant and can be provided without unwarranted expense.

"In our endeavor to shape the requirements of our annual reports so as to yield truly significant information and to compile therefrom for publication matters of real public interest, it will be of material assistance for us if we may have from you in the course of the next 30 days a discussion of the general question of what information shall be gathered and published concerning the affairs, conditions and operations of public-service corporations, together with a statement of the standpoints from which you approach the question and the significance which in your opinion is to be attached to the various matters which you suggest as worthy of publication. The more specific and concrete your suggestions, the more valuable they will be."

Railroad Electrification Warfare in Chicago.

In the campaign under way in Chicago to compel the steam railroads to electrify their lines within the city limits, with particular reference to the Illinois Central, which is the most conspicuous offender, a contribution from the railroad side is found in the annual report of President J. T. Harahan, of the Illinois Central Railroad Company, dated Sept. 14, but made public on Oct. 12. Mr. Harahan considers the electrification of the Chicago terminal of his company briefly, and it will be of interest to quote what he has to say on the subject, which is expressed in the following terms:

"The subject of electrification of the Chicago terminals of this company has had and is having most earnest and thorough consideration. The problems presented are unique and complex.

"There are no great freight terminals operated by electricity, and it is questionable, even aside from the great expense involved, if it is practicable. There are over 310 miles of track in the terminals, and there is a very heavy exchange of cars between this road and other roads in Chicago. To effect this exchange it is necessary that the trains of this company shall go upon the tracks of other companies, and that their trains shall come upon our tracks. With this road alone electrified, this exchange of cars would not be practicable.

"Without precedents to guide, the estimates of cost are at best unreliable. From the best obtainable information it would appear that the cost of electrifying the terminals of this company would be more than $18,000,000—a great sum to expend upon what would be a doubtful success in operation.

"Earnest and painstaking investigation and consideration are being given to the subject, and, pending a solution of the problem that will be satisfactory to all the interests concerned, this company is devoting great attention to reducing to a minimum the noise and smoke of its locomotives.

"The board has authorized the purchase of, and the officers are negotiating for, cars propelled by gasoline motors and adapted for handling suburban passengers. Experiments in the use of coke as fuel for locomotives are being pursued."

It will be noticed that Mr. Harahan makes no definite pledge of any kind. It is this extreme wariness which has exasperated the people and city officials of Chicago, for the subject has been under discussion for the last 10 years. The local transportation committee of the Chicago City Council has under advisement Alderman Snow's proposed ordinance requiring the electrification of the terminals of all roads within eight miles of the center of the city before Jan. 1, 1912. It is thought that this proposal is too drastic, and the committee will probably modify the proposed ordinance in several essential particulars. It is likely that steam power will be prohibited, but that electricity will not be specifically required. Railroads will be given permission to electrify if they wish, but at any rate must abolish the nuisance due to the use of steam locomotives. It is probable that the eight-mile zone for electrification will be stricken out and that the boundaries will be defined in exact terms for the different roads, depending on the density of population and similar considerations. The arbitrary date of Jan. 1, 1912, for electrification will probably be changed in favor of various time limits which will be legal and practicable. The city and the railroad lawyers agree that the city cannot order the roads to use electricity, but it seems to be conceded that the use of steam locomotives can be prohibited if they produce noise, smoke, gases and cinders to such an extent as to be injurious to health and property.

On the part of the railroads it is contended that they do not make more than 10 per cent of the smoke which obscures the air in Chicago. The railroad people assert that the city might just as well prohibit all hotels or office buildings or manufacturing establishments to stop burning coal as to apply the same prohibition to the railroads. The lawyers for the city, however, are confident that this objection to a mandatory ordinance can be overcome

Japanese Commercial Commission at Schenectady.

Reference was made last week to the visit of the Japanese Commercial Commission to the works of the General Electric Company at Schenectady, the account covering the inspection of the shops and offices in the morning and afternoon. About 80 guests and officials of the company attended a banquet given in the evening. President Coffin presided, with Baron Shibusawa at the right and Baron Naibu Kanda, professor of the Peers' School, Tokyo, and a graduate of Amherst College, on his left. In his opening remarks at the conclusion of the dinner, President Coffin thanked the guests for their presence in the city and at the General Electric Works, and spoke at some length on the historical developments which have led up to the present international harmony between these two nations. In discussing the part Japan is now playing in the world's work, Mr. Coffin referred to the remarkable combination of industry and art which characterized present Japanese development.

Baron Shibusawa's response to Mr. Coffin's address in part was as follows: "I thank you sincerely for the cordial welcome which has been extended us to-day. I thank you for the hospitality and thank you, Mr. President, for the very sympathetic manner in which you referred to Japan and myself. We have long known of your great country and we may say that our knowledge of Schenectady is a delight. We knew that the General Electric Company was a big thing, but usually when expectations are great an actual view brings disappointment. The reality generally falls short; but in this case what we have seen far surpasses what we expected. I feel thankful that you have given me this opportunity of expressing my profound appreciation of the magnificent attitude which your company has always adopted toward us. A large number of my fellow countrymen have received most cordial treatment on the part of your officers and men in receiving instruction which we could not otherwise have realized. One of them, I am proud to say, was near and dear to me. His name was Shibusawa."

Baron Shibusawa's address was delivered in Japanese and translated into English by Mr. Motosado Zumoto, proprietor and editor of the *Japanese Times*.

Baron Kanda, the next speaker, spoke in part as follows: "Since arriving in this country I have been forcibly reminded that civilization prolongs life. We have covered in 40 days about 11,000 miles, and had it not been for the progress of civilization it would have taken us seven months. As I sit here by my venerable friend (pointing to Professor Morse), who was the friend of my father, I feel more at home than I have felt since leaving Japan. He introduced the study of natural sciences in Japan 30 years ago, and I often heard my father speak of him. You don't know how glad I was to clasp his hand here to-night. I heard of Schenectady years and years ago, and of Union College during my college years. In recent years we have heard much of the General Electric Company. I can say without hesitation that the General Electric Company is the greatest manufacturing plant that we have seen this side of the Pacific."

Prof. E. F. Morse, of Boston, was the last speaker of the evening. He told of his work in Japan during a period of years in which he was there, and testified to the high regard for truth and the honesty of the Japanese, and said we might well emulate them in many ways.

At the conclusion of the formal addresses several members of the Schenectady Jest and Song Club presented an entertainment in the form of a minstrel show. This club is made up principally of young men in the employ of the company. The notable feature of the entertainment was the part taken by Japanese employees of the company as "end men." The amusement of the entire party of Japanese knew no bounds when they heard the individual hits in their own language made by the Japanese minstrels.

The party broke up at a late hour, the visitors going direct to their train, which left Schenectady for New York at 1 o'clock the next morning.

Chicago Electrical Show.

As announced in last week's issue, the fifth annual electrical show of the Electrical Trades Exposition Company will be held in the Coliseum, Chicago, on Jan. 15 to 29, 1910, inclusive. Plans are under way for booths, decorations and lighting effects which will surpass, it is believed, the beautiful results achieved at previous exhibitions. D. H. Burnham & Company, the well-known architects, are planning new interior decorations to be combined with brilliant decorative lighting effects. As electrical manufacturers, contractors and dealers have benefited in a marked degree by exhibiting at previous shows, it is thought that the 1910 show will have a list of exhibitors embracing all the leading concerns in the electrical field. Mr. Homer E. Niesz will be the manager of the exposition as in former years, and the exposition company has opened an office at 115 Dearborn Street, Chicago, where Mr. Niesz will give further details regarding the forthcoming show.

At the recent annual meeting of the Electrical Trades Exposition Company, Mr. Samuel Insull was re-elected president, Mr. E. B. Overshiner vice-president and Mr. Stewart Spalding secretary-treasurer. Messrs. Overshiner and Spalding, with the addition of Mr. Louis A. Ferguson, constitute the executive committee. In addition to the gentlemen named, the directors of the company are: Messrs. G. H. Atkin, George B. Foster, T. P. Gaylord, H. V. Bennis and W. W. Low. This strong board is representative of the varied electrical interests of Chicago.

Mexican Electrical Development.

The syndicate of Montreal (Canada) men which has already invested many millions of dollars in electrical and railway enterprises in Mexico, particularly in the vicinity of Mexico City, has recently extended its operations to Northern Mexico, where it has just let the contract for the construction of a great dam across the Conchos River in the State of Chihuahua for the purpose of forming a reservoir of water to afford the initial power for its proposed hydroelectric plant to be installed there. A separate company has been organized to carry out the plans for this new project, called the Compania Agricola de Fuerza Electrica. The contract for building the dam was awarded to S. Pearson & Son, Ltd., the British firm which has done an enormous amount of harbor improvement work for the Mexican Government during the last several years. Some idea of the size of the proposed dam may be had when it is stated that its cost will be about $15,000,000 Mexican currency, which is equivalent to $7,500,000 gold. It is stated, however, that embraced in this contract is the building of a system of irrigation canals and ditches which will be operated in connection with the electrical enterprise. The dam will be the second largest dam on the American continent, it is said. It will form a reservoir which will have a capacity of 1,840,000,000 cu. m. of water, which will be 180,000,000 cu. m. more than the capacity of the great Tonto Basin dam in Arizona.

The site of the proposed hydroelectric plant has been graded and its construction will soon be started. It will have a capacity for generating 25,000 hp. It is stated that contracts have already been made for the utilization of practically all of this power, which will be transmitted over modernly constructed lines to the towns of Chihuahua, Parral, Jiminez, Santa Rosalia and a number of smaller places, and to several large mining camps situated within a radius of 200 miles of the generating plant.

The site of the proposed dam is where the Conchos River empties into a narrow canyon, about 17 miles southwest of Santa Rosalia. The dam will be more than 200 ft. high. The Conchos River is a tributary of the Rio Grande; it drains about one-half of the State of Chihuahua and has an estimated annual flow of water of more than 3,000,000,000 cu. m.

The company has also let the contract for the construction of a standard gage railroad about 20 miles long, which will run from the site of the proposed reservoir to a connection with the Mexican Central Railroad at Santa Rosalia. This road will be built immediately so as to afford a means of transporting the material and supplies to the building site.

The concession for this gigantic enterprise was originally obtained from the Mexican Government by Paul Ginther, of Santa Rosalia, and Joaquin Cortazar, of Chihuahua, and was transferred to the Canadian syndicate about two years ago. Mr. Frederick Adams, managing director of the construction department of the firm of S. Pearson & Son, Ltd., will have charge of the building of the dam.

Electrochemical Society Papers.

At the autumn meeting of the American Electrochemical Society, to be held in New York from Oct. 28 to 30, the following papers will be presented: "The Titanium Arc," by Mr. W. S. Weedon.—"The Element Boron," by Mr. E. Weintraub.—"A New Electrolytic Method for the Preparation of Explosive Antimony," by Mr. R. C. Palmer.—"Advances in Electrochemical Analysis," by Dr. Edgar F. Smith (an experimental lecture on invitation of the board of directors).—"The Preparation of Silundum," by Messrs. S. A. Tucker, H. F. Kudlich and E. M. Heumann.—"The Laws of Electrode Losses in Electric Furnaces," by Mr. Carl Hering.—"Furnace Electrode Losses," by Mr. C. A. Hansen.—"Electrode Losses and Furnace Efficiency," by Dr. E. F. Roeber.—"A New Method of Measuring Mean Thermal and Electrical Conductivities of Electrodes," by Mr. Carl Hering.—"The Practical Conductance of Electrolytes," by Dr. Jos. W. Richards and Mr. W. S. Landis.—"A New Theory of Corrosion," by Dr. Maximilian Toch.—"Evolution and Present Status of the Dry Cell," by Mr. J. W. Brown.—"Dry-Cell Tests," by Mr. F. H. Loveridge.—"Some Characteristics of Dry Cells," by Drs. C. F. Burgess and Carl Hambuechen.—"The Manufacture of Air-Saltpeter by the Process of the Badische Anilin and Soda Fabrik," by Dr. C. Schonherr.—"Power for Electrolytic Copper Refining at the Buffalo Smelting Works," by Mr. W. L. Spalding.—"A Process for Simultaneously Cleaning, Annealing and Zincing Wire by Electrochemical Cementation," by Mr. Alfred Sang.—"Notes on Zinc, Copper and Brass Dusts," by Mr. Alfred Sang.—"Alloys of Copper with Electrolytic Iron," by Dr. C. F. Burgess and Mr. James Aston.—"Electrolytic Preparation of Calcium," by Mr. Francis C. Frary.—"An Electric Furnace for Production of Pig Iron," by Mr. Edward R. Taylor.

The entertainment features and visits to industrial plants planned for the members and guests were outlined on page 890 of our issue for Oct. 14.

Electrical Lectures for Insurance Men.

Mr. B. E. Blanchard, chief electrical inspector of the Chicago Board of Underwriters, is delivering a series of six lectures on electrical subjects before the Fire Insurance Club, of Chicago This club is composed of men connected with the insurance interests in various capacities, and it holds meetings twice a month, with an average attendance of about 100. Mr. Thomas Cooper is president, and by the courtesy of the Chicago Board of Underwriters the assembly room of that organization, at 159 La Salle Street, is used for the meetings. Mr. Blanchard's lectures are based to a considerable extent on the rules and requirements of the National Electrical Code, which are explained in non-technical language for the benefit of insurance men. A great deal of interest is being taken in this course, which the lecturer's hearers find to be not only instructive but unusually attractive.

Four lectures have already been delivered, as follows: April 13, 1909, "Electricity"; May 11, "The Electrical Inspector"; June 8, "Outside Work—Systems and Voltages"; Oct. 12, "Inside Work," including interior wiring and the use of heating appliances. The latest lecture was accompanied by demonstrations, and Mr. Blanchard exhibited a number of electric heating and cooking appliances. In doing so he was assisted by Mr.

R. E. Flower, of the General Electric Company, and Mr. H. F. Holland, of the Pacific Electric Heating Company. Both of these gentlemen spoke briefly, at the invitation of Mr. Cooper, during the discussion the former devoting his attention more particularly to electric cooking and the latter to the use of electric flatirons.

Two lectures remain to be given, and they will complete the course. The first will be delivered on Nov. 9 and will be on "Low-Potential Systems," having to do more particularly with the Underwriters' rules relating to such system. On Nov. 23 the subject will be "High-Potential Systems," and it is probable that in that lecture some attention will be given to the electrical hazards of moving-picture shows.

Proposed New Engineering Association.

The British Society of Engineers has awarded a prize to Mr. G. A. Thomas for a paper recently presented before that body entitled "Status of the Engineering Profession," in which the organization of a new association of engineers is advocated. The author considered that although the science of engineering now enters so very largely into our modern civilization, yet the position of engineers at the present day is very far from being satisfactory, and is not likely to improve unless some definite steps are taken to secure for them the recognition which is accorded to members of other professions. This condition he believes to be due, among other things, to the misuse of the term engineer, the multiplication of engineering societies, personal advertisement of engineers and the practice by some manufacturing firms in giving free advice to clients. The title of engineer, he says, is to be seen tacked on to almost every imaginable industry, and can be freely adopted by anyone who cares to do so. He regrets that it is not possible to restrain people from misleading the public in this way, and suggests that it may be possible to devise a new name by which to distinguish professional engineers, or to provide means for preventing the misuse of the old title. The use of numerous society titles as a distinguishing mark results in cheapening the value of such distinctions, and causes confusion in the minds of the public.

As to advertising, the author considers that to allow managers of engineering businesses to use their position as members of the engineering profession for the purpose of personal advertising, while the purely consulting engineer is debarred by engineering ethics from so doing, is the height of injustice.

Many manufacturing firms at the present time, he says, make a practice of giving advice on engineering matters, prepare estimates, and even drawings, free of any charge if an order for a part of intended work is placed with them. Advice of this kind, he states, is entirely biased, and often results in an expensive plant being installed which is quite unsuited for the purpose in view; and such a state of affairs is manifestly unfair to the consulting engineer, as well as detrimental to the interests of the public. The profession, he states, would hold a higher position in the estimation of the public when once it is realized that the advice given is as independent as that given by any other body of consultants. It would then become an understood thing that a consulting engineer's opinion is not only desirable, but practically essential, and their recognition as members of the profession would be secured.

As a means whereby the obstacles to the advancement of the engineering profession may be removed, the author suggests the formation of a central engineering body whose duties shall be to deal with problems affecting the profession as they may arise. To this end he urges that the present Institutions of Civil Engineers, Mechanical Engineers and Electrical Engineers shall convene a joint meeting for the purpose of appointing a committee of their members to consider the better organization of the profession, the preliminary expedients to be adopted and the form which the permanent scheme should take. This committee would proceed to organize a central governing body, which should be equally representative of each of the three societies, the members being either nominated or elected by the respective councils. The body should then endeavor at the earliest possible moment to obtain recognition as a legalized corporation by act of Parliament. In all matters relating to the profession this body should have supreme jurisdiction, its duties being both organizing and judicial, although in practice it would probably be found advisable to give as free a hand as possible to the three component societies in matters especially relating to their respective branches. The body should then proceed to compile a register, containing the names and addresses of qualified members of the profession, their present occupation and an outline of their qualifications. No one should be allowed to have his name entered on this register unless he is a full member of one of the three societies, and at least an associate member of one of the others. Anyone not thus registered should be legally disqualified from receiving fees as a consulting engineer, and debarred from holding any public engineering appointment. Moreover, any infringement of the laws drawn up by the central body for the protection of the profession, or serious breach of professional etiquette, should make the offender liable to have his name struck off this register, so that he ceases to be a recognized member of the profession.

The paper also touches upon the subject of engineering education, and suggests future qualifications for admission to the Institutions of Civil, Mechanical and Electrical Engineers. The classes of student members in the three bodies should, the author believes, be eventually abolished, and no one should be admitted to any of the societies without passing examinations conducted by the councils of the separate societies, and all appointments should be approved by the central body.

In the discussion, Mr. C. Collingwood suggested that a conference of all engineering societies should be called in order to form a union, and that Parliament should be asked to make the registration of engineers compulsory. Mr. H. Howard Humphreys agreed with the author that what was needed was a general engineering council composed of members of the three societies. Mr. C. J. Yorath thought that the multiplication of societies is due to the fact that engineers who are not able to get on the councils of existing institutions form a body of their own. Mr. P. Griffith thought that the author had too much discounted the value of the smaller societies. Mr. H. Ross Hooper believed that the proper course to follow at the present time is to urge upon the councils of the institutions mentioned the importance of bringing before the public, and before the engineering profession, the influence which engineers ought to exert. Mr. J. W. Wilson believed that general engineering education should come first and specialization later on. He thought that names of responsible engineers should be mentioned in notices of any engineering achievement; that something should be done among themselves to see that they were not ignored, and that engineer's names should be given in any articles dealing with engineering work carried out. Mr. E. Benedict, of the Institution of Civil Engineers, did not think it probable that any of the large societies would be willing to sink its identity in such a scheme of a central body as proposed. He asked why a man who engineered some important work should not advertise himself as well as a man who read a paper, and whose name went all over the world as the author of the paper. Mr. R. Brown suggested that civil engineers as the leading body should take the lead in getting rid of the misuse of the word "engineer," and that the word should be kept for the sole use of members of the chartered institutions, of which there were at present only three. Mr. H. Conradi said that some years ago a similar attempt to the present one was made, but that it came to nothing.

Baltimore Electrical Ordinance.

The electrical clause of a natural gas ordinance now before the City Council of Baltimore continues to be the subject of much local interest. The committee which is considering the ordinance has consulted with various authorities on the subject, and has secured an opinion from President Frank W. Frueauff, of the National Electric Light Association. Twelve questions were asked, to which Mr. Frueauff replied as follows:

1. It seems to me altogether practical to regulate rates under the method proposed in the ordinance (according to the average of rates in the 10 largest cities in the United States, excluding Baltimore), as there should be no difficulty in securing the rates for like service in other cities and arriving at an average for comparison with the Baltimore rates.

2. The rates in any of the cities named may be obtained directly from the light company or from the proper city officials, so that there should be no difficulty in determining the schedule in existence in the various cities and from them securing the average of their rates.

3. It seems to me, under all the conditions, that this (the above-mentioned system) is the fairest method possible of regulating the rates in your city.

4. I cannot see that any difficulty would be experienced in determining any difference in the relative conditions of manufacture. (This in reply to the question, "Should there be any difficulty in determining any differences in the relative conditions of manufacture?" The section of the electrical clause to which it refers has been criticised as ambiguous.)

5. It would seem improbable that any one company would gain control of the companies in these 10 cities, but assuming that such was the case, my belief, based on the study of conditions where properties are grouped under one control, is that the rates would be lower than where companies are operating independently. So that if the condition of control by one syndicate should come about, it would not work a hardship as to the matter of rates to Baltimore consumers.

6. The method proposed in the ordinance would give the users of electricity in Baltimore the benefit of any improvement due to cheaper coal or water-power over the conditions in the cities compared, which would entitle them to a corresponding reduction below the average in the other cities.

7. I do not consider the clause "adjusted to like manufacturing conditions" a danger to the consumers in Baltimore, but rather a protection to their interests.

8. Viewed from the experience of past years, it is altogether fair to presume that the proposed methods of regulating rates will result in reductions from time to time as conditions of manufacture improve, and as development of business in new fields warrants rate reductions.

9. I cannot see how it would be possible to presume that this method would result in rates being maintained at the present figures for the ensuing 20 years. The rates in the past 10 years have been materially reduced all over the country, and it is fair to presume that even a greater reduction will be the logical outcome of the development of sales of electricity.

10. The plan proposed of dividing any excess in profits above a fixed amount with the users is extremely attractive to all parties concerned. This will act as a stimulus to the company to develop its business for the sake of added profits, which it will divide with the users, and, going to the users, will result in a lower average rate paid by them. In this respect the section somewhat resembles what is known as the "London Sliding Scale," which was adopted some years ago by the Boston Consolidated Gas Company and, I presume, has proved satisfactory to both company and consumer. Under that plan the company is permitted to increase its dividend rate as its rate per thousand is decreased, so that both parties are interested in the development of the business.

11. The table of rates submitted shows that the Baltimore rates are already slightly under the average in the other cities, and I feel that these rates are fair to all, in view of the responsibility on the company's part to maintain good and complete service.

12. Study of the tabulation of comparative rates indicates that the Baltimore rate for similar service conditions is as low or lower than the average in the 10 cities given, these tables fairly setting out the rates charged for various classes of service.

The ordinance has now been referred to the Board of Awards. The attitude of the majority of the city officials seems to be that of Comptroller Hooper, who said: "I am in favor of a public-utilities commission, and I will positively oppose any effort to exempt any corporation from the regulation of such a commission."

Worcester Electric Light Company Retains Present Management.

The annual meeting of the Worcester (Mass.) Electric Light Company was held at the company's office on Oct. 13, and the present administration was continued in power by a majority of the stock. During the past three weeks the efforts of several powerful public-utility syndicates to secure control of the Worcester company have aroused much interest in Massachusetts central-station circles, offers of $300 per share having been made for the stock by Stone & Webster, of Boston; Lee, Higginson & Company, Boston, and a pool of Worcester men outside the present controlling forces. To offset these attempts to acquire the company a protective committee was formed in the directorate and among influential stockholders, and a majority of stock was acquired, with voting and selling powers covering a period of 60 days beginning Oct. 1. This committee reported at the annual meeting that it is unanimously opposed to selling the stock of the company, and that it is in favor of the present administration remaining in control, the committee thus favoring keeping the management of the company in Worcester. President A. B. R. Sprague was in the chair at the meeting. The protective committee consisted of Gen. A. B. R. Sprague, Col. A. George Bullock, Matthew J. Whittall, Esq., F. H. Dewey, Esq., and John C. MacInnes, all of Worcester.

Four new members of the board of directors were elected to strengthen the company: Messrs. Matthew J. Whittall, Rockwood H. Bullock, John A. Denholm and Charles E. Hildreth. Directors A. B. R. Sprague, George T. Dewey, Frank L. Coes, John C. MacInnes and Edgar Reed were re-elected, and Directors Otis E. Putnam, William H. Coughlin, T. C. Bates and H. H. Fairbanks retired from the board. A meeting of the directors was held after the stockholders' meeting, and the present officers of the company were re-elected. These are: President, Gen. A. B. R. Sprague; treasurer, Mr. H. H. Fairbanks, and superintendent, Mr. William H. Coughlin. About 5700 shares were voted at the stockholders' meeting. It was stated by the protective committee that the company has plans for business expansion arranged for, and that the policy and growth of the company will be such as to entirely meet the requirements of the consumers and the expectations of the stockholders. Several new sites are under consideration with a view to possibly establishing a new station, and using the present plant as a distributing substation, in case an arrangement is made with the Connecticut River Transmission Company to handle power from the Vernon plant in Worcester. At present a decision is pending in the Board of Gas and Electric Light Commissioners upon the appeal of the Worcester company against the franchise granted the Connecticut River Transmission Company by the Worcester Board of Aldermen. Before any definite announcement can be made by the company this appeal will have to be settled and a basis arranged, if any, for handling the hydroelectric power in the city. The treasurer's report for the year ending June 30, 1909, showed earnings of $349,743.48; expenditures of $171,968.48; net earnings, $177,766; assets, $1,472,523.06; liabilities, $1,098,823.32, and balance, $373,600.74.

Street-Lighting Experiments in Liverpool.

By Glenn Marston.

A number of important street-lighting experiments are being conducted in Liverpool at the present time with flaming arcs and tungstens. Street-lighting conditions there are peculiar in that the street-lighting department, a separate bureau from the electricity supply department, purchases gas and electricity at meter rates. The street-lighting department does not install the lighting fixtures, but specifies their location and character, and

maintains them, the fixtures being placed either by the gas company or the electricity supply department.

Gas is very low in price, and very good in quality. The gas company is well and popularly managed, and competes keenly on all street-lighting proposals. In order that the municipal plant may secure even a reasonable share of the street lighting it must constantly and quickly meet the improvements which are introduced by the gas company. The gas company has a further advantage in being represented by one of its directors on the council's street-lighting committee.

These conditions—the progressiveness of the gas company and its representation on the street-lighting committee—have resulted in an unusual amount of gas lighting in Liverpool, and this lighting is on the increase. All street lighting is a fair and open fight between the gas company and the municipal electric plant, and the gas company appears to have the upper hand.

About five months ago the electricity supply department installed five flaming arcs along one of the principal thoroughfares. These lights are on posts in the middle of the street, about 20 ft. above the ground. They replace 450-watt carbon lamps similarly located, and an excellent opportunity is afforded for a comparison of illuminating values. According to Mr. Clough, the electricity department's resident engineer, the increase in candle-power is in excess of 50 per cent, although a casual observer would place it even higher. There is a certain amount of criticism, however, of the yellow light given by flaming arcs, and this is said to have considerable influence on the street-lighting department's attitute toward flaming arcs.

A still more interesting feature of these posts on which the flaming arcs have been placed is the addition of a collar about 10 ft. from the ground, from which are hung five 35-watt tungsten lamps. The flaming arcs are extinguished at midnight, and the tungstens provide light for the balance of the night. The drop in illumination is, of course, very noticeable at the time of the change, but the tungstens appear to provide lighting which is quite adequate to the needs of the city at that hour. The English are partial followers of Franklin—"Early to bed," though they are not particularly early to rise.

On Bold Street the old arc lights have been replaced by tungsten clusters. This is a narrow street, not over 35 ft. wide at any point, and the arc lights were suspended from wires fastened to the buildings on either side. The transmission line was supported by these wires, and ran down the middle of the street. This method of carrying wires is to all practical purposes as satisfactory as underground conduits, and is a great deal less costly. There is no street obstruction whatever by posts or poles, and the interference in fire fighting is reduced to a minimum.

The new lighting on Bold Street is similarly hung, each unit consisting of ten 35-watt tungstens hung in a cluster somewhat resembling the Federal style familiar in America.

The question most likely to arise regarding tungsten street lighting is in the life of the lamps. Mr. Clough states that the life of the Bold Street lamps is over 1000 hours. There are no trams on Bold Street and comparatively little heavy traffic.

The other lamps are, however, subject to the severest practical test which could well be conceived. They are in an exposed location on a wide street where the traffic is very heavy. They are on poles between tram tracks, the poles supporting the trolley wires, together with the flaming arcs, which must be trimmed aloft; yet Mr. Clough says these trying conditions have not reduced the average life below 900 hours.

As to cost, the energy consumption of both tungstens and flaming arcs is lower than that of the motor installations; just how much Mr. Clough did not say. The cost of maintenance in both cases is higher, and, in Mr. Clough's opinion, very nearly offsets the saving in cost of energy. In every case, however, the illumination produced was superior to the power lighting, and as far as candle-power cost is concerned, Mr. Clough feels that either form will compare with gas on a favorable basis, although no actual tests have yet been made. The real problem is one of cost of current and maintenance.

Meeting of Electric Vehicle and Central Station Association.

The first fall meeting of the Electric Vehicle and Central Station Association was held at the Edison Building, Boston, on the evening of Oct. 13. President Frank J. Stone was in the chair. Before the opening of the session an attractive exhibit of electric trucks was displayed in front of the building to give a more definite setting to the proceedings.

Before the paper of the evening was read President Stone presented a brief survey of the progress that has been made within the past 21 months in the electric vehicle field in Boston. There has been an increase of 119 per cent in the number of vehicles operated by electricity. One garage manager is using double the energy this year that he consumed in 1908. It is estimated that there has been an annual increase of 231,000 kw-hours for commercial vehicle service and 95,000 kw-hours for pleasure vehicle consumption; this energy at 4 cents for commercial revenue and 7 cents for pleasure service represents $15,876 per year additional revenue. In all New England it is estimated that there has been a yearly increase of $28,000 for vehicle charging. This is, of course, not a remarkable total, but it shows the growing interest of the public and the central stations in this phase of transportation. There are six electric garages in Boston, compared with two a year ago, and at present there are 88 charging points in Boston and vicinity.

Mr. Stone emphasized the necessity of the central station taking up this question in earnest, and in order to show how valuable the vehicle business is in relation to other forms of energy sale, he presented the following data, comparing the 550-watt arc burning four hours per day, the 50-watt incandescent burning one hour, and the 500-watt flatiron working 156 hours per year with five different types of vehicles: Pleasure vehicle, 100 charges per year, equivalent in energy consumption to 1.66 arcs, 73 incandescents and 14 flatirons; commercial-professional vehicle, equivalent to 5 arcs, 219 incandescents and 42 flatirons; light commercial vehicle, equivalent to 7.25 arcs, 320 incandescents and 61 flatirons; heavy commercial vehicle, equivalent to 13.6 arcs, 600 incandescents and 115 flatirons; another heavy commercial vehicle, equivalent to 18 arcs, 800 incandescents and 153 flatirons.

The charging business is doubly attractive on account of its coming upon the station during the valley of the load curve. The expenditures necessary to take up vehicle charging are very small. Each company should put a rheostat in its exciter circuit if it can do no more, and start with its own vehicle. Little headway can be made without the co-operation of the central station. In conclusion, President Stone stated that the organization is only seven months old, and yet it has attracted attention all over the country. A valuable business awaits exploitation.

A paper by Mr. H. T. Cameron, superintendent of the automobile station of the New York Edison Company, on "Electric Vehicle Service of the New York Edison Organization," was read in the author's absence by Mr. Robinson, of the New York company. This company began in 1901 with two electric vehicles, and it now has 65 machines in service. Each operator has a day card on which are inscribed details of the runs, stops and mileage. A number of different forms are used in order to enable the company to keep a close record of the vehicles. Tire mileage is kept by a brass tag, numbered, on each wheel, the tag being destroyed after its record has been taken. Each machine is given a thorough yearly overhauding, and all but one are constantly in shape for service. In general, the machines are equipped with from 40 to 44 Exide cells. The company has 10 surreys, two landaulets and one roadster for the use of the officials. These make 40 miles per day on one charge. The life of the positive plates is 368 days, and the service 9382 miles; the negative plates last 535 days, running 11,831 miles. There are 19 lamp wagons for incandescent and emergency service, running 30 miles per day on one charge. The life of the positive plates is about 364 days, with a record of 8188 miles.

and of the negatives 558 days, on 11,064 miles. Twenty-three general delivery wagons are owned by the company and these run 35 miles per day on one charge. The haulage capacity of each is 2000 lb. The positive plates have a life of 390 days and 8,635 miles, while the negatives last 670 days and run 11,814 miles.

There are also three trucks of from 2.5-ton to 3-ton haulage capacity each, used in hanging signs and arc lamps. These run from 20 to 25 miles per day on a charge, and the positive plates last 388 days, or 5612 miles, and the negatives, 445 days or 5919 miles. The equipment is completed by five 5-ton cable trucks, running 15 miles per day each on one charge. These have 48 cells each, and the positive plates show a life of 395 days on a service of 3733 miles, and the negative last 461 days on 9630 miles running.

In a short discussion which followed the presentation of the paper, Mr. Robinson stated that at least 25 per cent of the cost of the former horse-drawn service has been saved by the electric vehicles, and if all were modern in design the saving would probably be 50 per cent. An approximate tire life on the older vehicles is about 10,000 miles. These are 3.5-in. tires, 36 in. in diameter. The point was brought out that ton-mileage should not be considered in trucks which are largely occupied in such work as cable pulling, pole setting and other construction duties. The Edison company owns one gasoline machine, which is used in the Bronx. The automobile maintenance is handled by a superintendent, a foreman of drivers, a clerk, one mechanic, one electrician, one blacksmith, one carpenter, one painter, two washers, one battery-room foreman, one battery man, one night man and two helpers. The company assembles its own batteries, a hydraulic lift enabling them to be changed in 12 minutes.

Novel Electric Sign in Boston Y. M. C. A. Work.

In connection with a recently organized attempt to raise $500,000 for the erection of a building by the Boston Y. M. C. A. a novel electric sign has been placed in a prominent position on a vacated building front opposite the entrance to the Park Street subway station. The sign is constructed in the form of a large clock with an illuminated dial, and the marking is in proportion to various sums of money that are to be raised in securing the total $500,000. Three o'clock represents $125,000; 6 o'clock, $250,000, and so on. The minute-hand is moved toward the complete hour as fast as the money is raised, and it is fitted with incandescent lamps supplied with service by Edison current. Situated in one of the busiest parts of the city, this sign has already attracted wide attention and doubtless will play a prominent part in the raising of the fund which will bring the hand around to the full hour.

Colorado Association Convention.

The Colorado Electric Light, Power and Railway Association, which held its convention at Denver Oct. 7 to 9, elected officers at its closing session too late to be included in the brief report presented last week. The officers elected were as follows: President, Mr. W. T. Wallace, of the Colorado Electric Light & Power Company, Canon City and Cripple Creek; vice-president, Mr. H. L. Corbett, United Hydroelectric Company, Georgetown and Idaho Springs; secretary and treasurer, Mr. J. C. Lawler, Colorado Springs Electric Company. Executive committee: Messrs. George B. Tripp, of Colorado Springs; J. F. Dostal, of Denver, and the officers. Advisory committee: Messrs. W. J. Barker, of Denver Gas & Electric Company; J. F. Vail, of Pueblo & Suburban Traction & Lighting Company; L. M. Cargo, of the Westinghouse Denver office; John A. Clay, of the Animas Power & Water Company, Durango, and John A. Beeler, of the Denver City Tramway Company. Finance committee: Messrs. W. G. Matthews, of the Denver City Tramway Company; J. C. Davidson, of Hendrie & Bolthoff, Denver, and F. C. Carstarphen, Denver. Membership committee: Messrs. J. J. Cooper, of the Mountain Electric Company, Denver; George Wooley, of the General Electric Company, and C. K. Durbin, of the United States Light & Traction Company, of Denver.

At the request of several members a vote was taken which resulted in the appointment of a committee to make a report on standard methods of checking and calibrating watt-hour and curve-drawing instruments. This committee consists of Messrs. F. P. Cummings, of the Denver Gas & Electric Company; W. N. Clark, of the Pueblo & Suburban Traction & Lighting Company, and H. J. Buell, of the Northern Colorado Power Company, Boulder.

Mr. W. A. Carter, of Denver, said he thought that the discussion had centered too much about the fire risk with respect to grounded and ungrounded secondaries, and that too little consideration had been given to the reduction in life hazard which grounding brought about. It was voted to appoint a committee of three to investigate the matter of grounding.

Mr. Canada said that in the Rocky Mountain territory the fires due to the ungrounded condition of secondaries were enough to justify grounding to reduce fire hazard, to say nothing of the life hazard. As to the existence of differences of opinion on the part of authorities, he considered this doubtful, and pointed out that the National Electric Light Association and the American Institute of Electrical Engineers have recommended for years that incandescent lighting circuits be grounded, the only difference between these bodies being that the former has proposed 150 volts as the upper limit, while the latter favors 250 volts.

DISCUSSION ON GROUNDING SECONDARIES.

Below is given an abstract of the discussion on grounding the secondary, which followed the presentation by Mr. W. J. Canada of a paper on that subject, an abstract of which was printed last week.

Mr. J. C. Lawler, of Colorado Springs Electric Company, said that his company had tried grounding secondaries in some sections of the downtown district, but not in the outlying districts. He told of one case where a ground occurring on the underground side of a grounded secondary caused such an arc as to start a fire, but that this would not have occurred had proper circuit fuses been used. Mr. W. N. Clark, superintendent of the mountain division of the Pueblo & Suburban Traction & Light Company, at Victor, reported having some grounded secondaries on transformers supplied from 6600-volt primaries. This had been done after an accident which indicated the desirability of such a move.

Mr. J. F. Dostal spoke of Colorado conditions being peculiar, in that good grounds are in many places hard to secure on account of rock or dryness of the soil. Mr. Lawler said that the grounding done in Colorado Springs was by connection to water pipes when reconstructing the lines.

Mr. C. K. Durbin asked Mr. Canada whether he would favor grounding in the five towns in which his companies are operating, knowing the condition of the interior wiring in those towns. He also asked who should pay the expense of making defective wiring right, where repairs were made necessary by the grounding. Mr. Canada said he would ground in the towns mentioned and also said that grounding might well be required by city ordinance.

The discussion in general indicated that the members were fearful lest the condition of interior wiring in many places is so poor that a number of defects and fires might be an immediate result, and that there was an uncertainty in the minds of some members as to the desirability of grounding.

Mr. J. F. Dostal said that the Denver Gas & Electric Company had been considering the grounding of the secondaries on one feeder as an experiment. As it seemed to be agreed that a ground that cannot be depended upon is worse than none, and as the only certain method of grounding is to water pipes in a soil as dry as that in Denver, the company had applied to the water company for permission to connect to its mains. The

water company asked for the opinions of authorities as to the safety of such a procedure from the water company's standpoint. These opinions were promptly furnished. Then the water company came back with a contract holding the water company free from injury as a result of such connections. This contract had not at that time been finally ratified. It is the intention when this grounding is begun to test all consumer's services for grounds and to see that the series coils of the meters are all on the outer legs or ungrounded side of the circuit in order that grounds on the neutral will not cause part of the load to be shunted around the meter and fail to register.

A Yachtsman's Experiences with Electricity and Magnetism.

Mr. E. P. Warner, of the Western Electric Company, Chicago, is an experienced and enthusiastic yachtsman, with a record of 30 years' pursuit of the pastime, and advantage was taken of this fact to induce him to address the Electric Club of Chicago on Oct. 13 on "Electricity and Magnetism from a Yachtsman's Viewpoint." Mr. Warner told a number of amusing stories of fresh-water yachting experiences, but he also contrived to impart considerable interesting information which was new to most of his hearers.

The speaker devoted some attention to the electrical installations on board pleasure vessels, and said that a yachtsman is ready to try almost anything in lighting, but, as a rule, if the craft is of any size, he comes down to electric lighting at last. With acetylene and gasoline there is always some danger of explosion, due to the strains to pipes and fittings incident to the rolling and tossing of the vessel during rough weather. Both primary and storage batteries are used on yachts for lighting. The yachtsman's experience with dynamos has been rather unfortunate. Usually the generator is driven by a gasoline engine, and the engineer looks upon the electric lighting machinery as merely so much additional equipment to be looked after, and, therefore, he has a sort of standing grievance against it. Often this functionary does not feel hurt if the generator gets out of order, and sometimes for this reason electric lighting equipments are not satisfactory to the owners of the vessels.

Speaking of electrical installations and contrasting the improved apparatus of to-day with that in use only a few years ago, Mr. Warner recalled one plant placed in a steam yacht 12 or 14 years ago which consisted of an engine, generator and storage battery. The speaker gave a humorous account of the troubles with that battery as subjected to the rough treatment inevitable to shipboard operation, and said that the net result of its use was that it was serviceable just 4½ nights during the season. The battery man, who was called on to make repairs, was in such frequent requisition that he practically passed a very pleasant summer on board the yacht. The fact was simply that the conditions under which the battery was installed were such that it could not be made to work well with the equipment available at that time.

Mr. Warner also told the story of a yachtsman seeking a satisfactory battery for a motor boat. In conversation with an electrical dealer this inquirer was assured that the dealer's batteries were much more satisfactory for this particular purpose than any other make. Not only were the volts just as good, but the amperes were much thicker; in fact, the battery gave such a fat spark by itself that by using it no spark-coil would be needed in the operation of the motor-boat gasoline engine. The speaker also dwelt on the enthusiastic spirit of the true yachtsman. He said that nothing but absolute poverty will cure a deep-seated attack of the yachting "game." Further on, he declared that his own success in yachting has been due to his failures in electricity, which have taught him to be a philosopher.

Mr. Warner gave an interesting account of the occurrence of the phenomenon known as St. Elmos's fire in the northern end of Lake Michigan. The appearance was observed toward the end of an unusual electrical storm with almost continuous lightning flashes. The corposants, or streams of bluish light, were observed from all the points of the vessel's spars and rigging. They are really a brush discharge due to atmospheric electricity. Sailors say that when they see these corposants the storm is nearly over, and this, indeed, proved to be the case in this instance.

At another time, during a storm on Lake Michigan, a stay line or hempen rope fastened between the masts of a schooner to connect and strengthen them temporarily became a literal wave of flame during an electrical storm. One could almost see to read by the light playing about this rope and converting it into an apparent hawser of fire. At this time all the upper part of the yacht was so luminous that the vessel seemed to be a complete torch.

Much of the address was devoted to the peculiarities of the mariner's compass. This instrument, valuable as it is, causes many perplexities and ludicrous incidents. The compass should be studied to understand the various influences which affect it. Mr. Warner told one instance where in crossing Lake Michigan in his yacht, a distance of 70 miles or 80 miles, in thick weather, he was thrown out of his course by a compass error to such an extent that he arrived at his destination 12 hours later than he would have done if the compass indications had been true. In some spots on the Great Lakes the compass readings are absolutely true; in others there is a variation up to 11 deg. or 12 deg. In addition to this correction, local influences—that is, the influences of magnetic material on the vessel itself—must be taken into account, and these influences cause the yachtsman more trouble than the original compass deviation, which can be calculated and allowed for. Some little change in the position of a piece of iron on the boat may throw the navigator out of his course in sailing. Even a parasol or an umbrella in a lady's hand may affect the compass sufficiently to render it misleading.

At this point the speaker told the story of a joke played on a man referred to as John by a party of friends on a yacht bound for the entrance of Toronto Harbor after nightfall. John prided himself on his skill as a navigator, and was taking the vessel to her mooring in the harbor. One of the mischief-makers had provided himself with a bar magnet, and stationing himself near the compass, he could manipulate the latter to suit himself. By this means he managed to have the navigator head the vessel out into the open lake and they proceeded two or three miles in a direction directly contrary to the real destination. The yacht was proceeding under auxiliary gasoline power, and when it was thought about time to disclose the joke it was found that the gasoline was exhausted, so that the incident did not possess the complete degree of hilarity that had been originally planned by those in the secret. However, a passing fishing boat was hailed, and by making a liberal inducement to the skipper the party finally made port.

There are some discrepancies in the action of compasses which seem to be unaccountable. In compensating for local conditions by placing pieces of iron, etc., about the vessel, care must be taken not to make a "dead" compass. If, for instance, a compass were placed in an iron pot, it would become "dead" or useless. It is obvious that the compass must be free and lively to answer its purpose. Mr. Warner related how he had compensated for local conditions on one of his yachts by using a steel rudder stock. This piece of metal was so placed that it lay in a north-and-south direction when the boat was laid up for the winter, and it became itself magnetized, so that a shingle nail would be held up at one end of it. If the boat should be laid up for the winter in an east-and-west direction, other characteristics developed in the iron and steel placed about to counteract local magnetic attraction, and these tendencies must be taken into consideration. All of these considerations show the necessity of making careful study of the phenomena affecting the operation of the compass. It is well to take every occasion to correct the instrument by means of outside comparisons. However, the speaker remarked that when due care is taken in checking it up the compass is, of course, invaluable. There is one course on Lake Michigan of

210 miles straightaway, and by the aid of a corrected compass it should be made, and is made, without a variation exceeding one mile from the true course at the end of the voyage.

Mr. J. M. Wakeman, vice-president of the *Electrical World*, New York, added a few pleasant remarks at the conclusion of Mr. Warner's talk by the invitation of President F. P. Vose. Among other things, Mr. Wakeman commented on the stout "spirit" of the yachtsman which enabled him to view with equanimity blue lightning when his boat, if not himself, was all "lit up."

Rochester Industrial Exposition.

Spurred by the enthusiastic aggressiveness of its 210,000 inhabitants, the city of Rochester, N. Y., is holding a second industrial exposition in Convention Hall facing Washington Park, and in commemoration of the event the main thoroughfares of the city are brilliantly illuminated, thanks to the gener

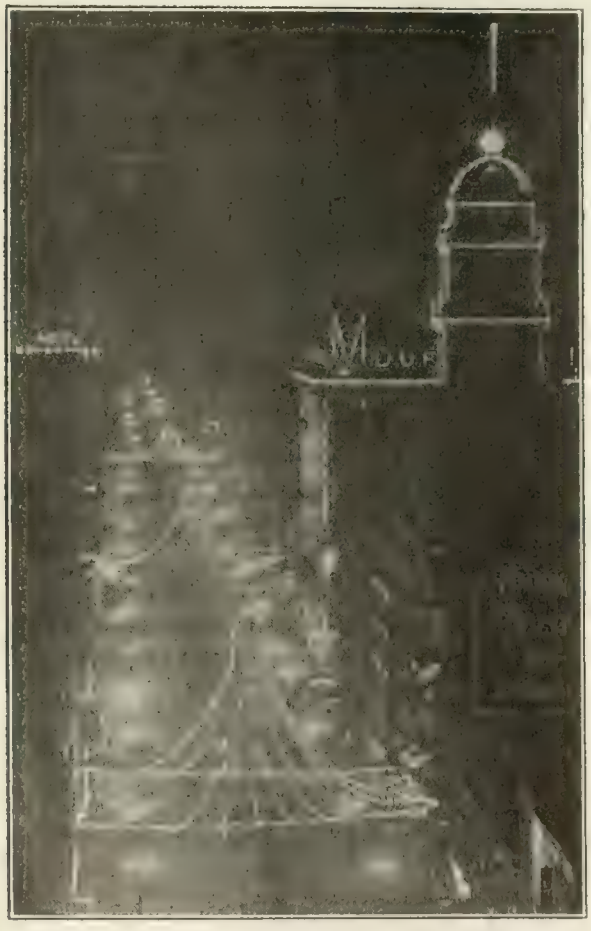


FIG. 1.—SPECIAL LIGHTING ON MAIN STREET DURING ROCHESTER INDUSTRIAL EXPOSITION.

osity of the Rochester Railway & Light Company. The exposition opened on Oct. 11 and will continue until Oct. 23. Its primary object is to give evidence not only of the municipal prosperity of the city but to inform the world in general that Rochester leads the world in the manufacture of a dozen essential products and that "Rochester made means quality." Anticipating a dearth of space, a generous City Council provided $100,000 with which to build an addition to the Exposition Hall and every square foot of space in the enlarged building is taken up. Fifty of the exhibits at least are of the working variety, giving the people a clear impression of how the goods of the industrial plants of Rochester are turned out. A shoe factory is in operation turning out hundreds of shoes daily. The button industry, which centers there, is represented by an exhibit in which buttons are made in sight of visitors. A miniature brewery is shown in operation, and although the plant has a capacity of one barrel of beer a day the company has to be content with "brewing" a barrel of water. The electric light company shows



FIG. 2.—FLORAL COLONNADE ON CLINTON STREET, ROCHESTER.

an electrically driven refrigerating plant in operation and an electric hoist for contractors, as well as motors, etc.

The feature of the special illumination arranged for the occasion is centered in seven immense canopies located at the intersections of the principal thoroughfares on Main and State streets. Each canopy contains 1050 lamps ranging in size from 16 cp to 4 cp. The tops of the canopies are 100, 80 and 60 ft. above the roadway depending on the height of the buildings from which the canopies are supported. A ball on top of each canopy is 28 in. in diameter and contains 24 16-cp ruby lamps. The bell shaped portion of the dome is in the 100 and 80-ft. canopies, 15 ft. high by 12 ft. in diameter and in the 60-ft. canopies, 8 ft. high by 12 ft. in diameter. There are 12 ribs to each bell and on these spaced 1 ft. apart are 4-cp incandescent lamps. From the bell to the square base of the canopy are 24 stringers of lamps containing 4-cp and 8-cp lamps in the upper and lower halves respectively, and the base of the canopy is lighted by 8-cp lamps spaced 1 ft. apart. The view of the canopies from the sidewalk is much more picturesque than the photographs taken from above them would indicate. Viewed from a distance Main Street looks like a shimmering mass of light, the twin arcs on the sidewalks presenting the appearance of a string of pearls.

Leading from Main Street to the Convention Hall is a floral colonnade, picturesque by day as well as by night. Festooned from pole to pole on either side of the street are 2000 4-cp

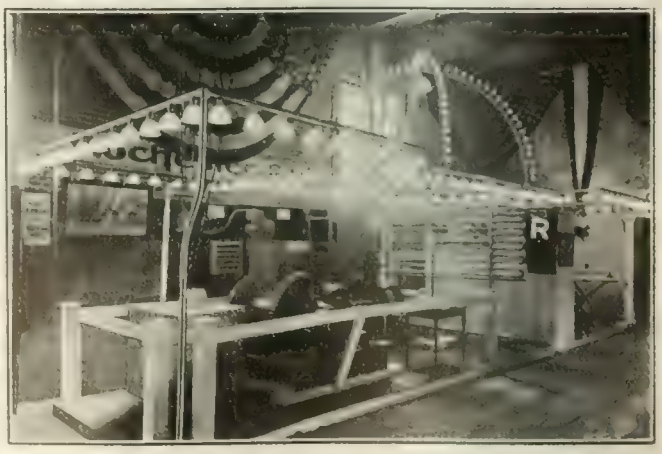


FIG. 3.—EXHIBIT OF THE ROCHESTER RAILWAY & LIGHT COMPANY

lamps spaced 1 ft. apart and in Washington Park fronting the hall there are 2400 4-cp lamps festooned from tree to tree and from the Soldiers' and Sailors' Monument in the center to each

corner. Rochester being also known as the "Flower City," laurel wreaths are festooned from pole to pole and down each pole to a latticed box. Hanging from each pole, which is painted white for the occasion, are also two baskets of shrubs and flowers kept green and blossoming by the florists of the city, gratis.

The canopies are held 25 ft. above the roadway and are supported from neighboring buildings by two ⅜-in., seven-strand, galvanized-steel cables. Two double sheave blocks and ¾-in. hemp rope are used to raise the canopies in place after which they are lashed in position with ⅜-in. wire and insulated from ground. The lamps are fed in most cases from diagonal corners from the 110-220-volt system and are controlled by six service switches. In addition there are service switches in the manholes which control the entire group. The streamers on Clinton Street are fed from six underground taps and service wires feed into the system at regular intervals. The trolley poles are used to support the lamp circuits. As indicative of the Rochester spirit, it might be mentioned that the $6,000 needed for the erection of the canopies was raised by popular subscription in four days.

The Rochester Railway & Light Company, following its usual broad policy in such matters, has furnished all of the lamps used in the street illumination as well as the energy, gratis. It has also loaned every motor used in the exhibition hall in connection with working exhibits and given the energy consumed free of charge. The same is true of the gas used in connection with the exhibits and this very broad attitude has increased the very friendly feeling already existing toward the corporation. The Rochester Railway & Light Company operates the street railway, the electric light stations and the gas works, and is looked upon as one of the most enterprising public service corporations in the country.

Canadian Hydroelectric Commission.

The scene of the battle between the Hydroelectric Power Commission on behalf of the Western Ontario municipalities which have combined to obtain electric power and the electrical interests opposed to the present policy of the Ontario Government has been shifted, for the time being, to Ottawa. At a recent meeting of a sub-committee of the Dominion cabinet council, composed of the Premier, Sir Wilfrid Laurier, and Hon. Dr. Pugsley, a number of eminent counsel presented their arguments respecting the alleged unconstitutionality of the electric power acts passed by the Ontario Legislature. The Premier promised consideration and stated that the whole subject would be referred to the Department of Justice for an opinion.

The corporation of the city of Hamilton has practically concluded a contract with the Hydroelectric Commission for 1000 hp of electrical energy. All details were finally settled at a meeting of the city representatives and the commission in Toronto on Friday last, and it is expected that the contract as finally prepared will be duly executed this week, thus closing a very interesting struggle which has been going on in Hamilton for the past three years.

The citizens of Hamilton, by large majorities in 1907 and 1908 each time, voted to authorize the City Council to enter into a contract with the Hydroelectric Commission for electric power sufficient for the corporation's own requirements, estimated at about 1000 hp. The Dominion Power & Transmission Company, which has had the street-lighting contract for years, however, did not propose to stand idly by and allow the city to install a competing plant and equipment. Strenuous efforts were put forth last year by the company, with the result that in July, 1908, the City Council, by a close vote, entered into a contract with the Hamilton Cataract Power, Light & Traction company (one of the Dominion subsidiary concerns) for a supply of power for both pumping at the water works and for the street lighting—not before the company, however, had practically cut its price down from $82.50 to $47.50 per arc lamp per annum. A ratepayer, one James Smith, then brought an action attacking the validity of the pumping contract. When the action came to trial the judge held that as the Council had failed to provide in the estimates a sum sufficient to pay for the power for pumping, the contract was null and void.

At the beginning of the year the civic election resulted in the return of a majority of the "Hydro" aldermen, being those who were in favor of the city corporation joining with the other municipalities and taking power from the commission. As the whole subject had been delayed so long, however, a plebiscite was again taken in June last among the citizens resulting in an overwhelming vote in favor of the city taking the Hydro power.

An action was promptly brought by a ratepayer, R. S. Morris, seeking to restrain the city from executing the contract on the ground that the vote was illegally taken and other charges, but this suit has been dismissed by Chief Justice Meredith, leaving the city again free to enter in contract with the Hydroelectric Commission, which it is proposed to complete at once.

The situation now stands that the city will take 1000 hp for civic purposes, including pumping; but the Cataract Company still has the contract for the street lighting for five years, and has recently finished the erection of about 400 additional arc lamps. Hamilton has now an arc lamp on practically every street corner, making it one of the best lighted cities in America

Massachusetts Commission News.

The Massachusetts Railroad Commission has resumed public hearings on the petition of the Boston, Lowell & Lawrence Electric Railroad Company for a certificate of public convenience and necessity, which will enable it to build its line between the above cities. The project is a renewal of a campaign of about two years ago by interests allied with the Ames family to build a high-speed electric interurban road on a private right-of-way between Boston and the Merrimac Valley. The enterprise was originally denied a certificate of exigency by the commission, largely on the score of insufficiently thorough and earnest preparation of plans and intentions. The promoters now before the board have made a complete study of the situation, and have retained Westinghouse, Church, Kerr & Company, of New York, as consulting engineers. Hearings began in the early summer on the renewed project, and prominent residents of the territory to be traversed testified in its favor.

The principal engineering testimony before the fall hearings began, about three weeks ago, was presented by Mr. Lester W. Tucker, of the Westinghouse, Church, Kerr organization, who gave extended particulars of the location of the line, the right-of-way, roadbed and track plans, power system and distribution. During the past three weeks the general testimony in favor of the road has been completed, and cross-examinations begun by counsel for the Boston & Maine Railroad and the Boston & Northern Street Railway Company. The chief witness was Mr. James C. Boyd, consulting engineer, with Westinghouse, Church, Kerr & Company, who was called to the stand for several days' review of the operating features of the proposed road. The petitioners were represented by Mr. J. W. Farley and former Chairman of the Railroad Commission James F. Jackson. The Boston & Northern Street Railway Company was represented by Mr. Bentley W. Warren, and the Boston & Maine Railroad by Mr. William H. Coolidge.

The company expects to carry passengers from Lowell to the Sullivan Square terminal of the Boston Elevated Railway Company in 35 minutes, a distance of about 25 miles. The line is to be without grade crossings, with only 11 or 12 local stops en route. Near the Shawsheen River the line is to branch, one part going to Lowell and the other to Lawrence. The power house will be located here at the branching point, and will contain an initial equipment of 3000 kw in turbo-alternators, transmitting power at 20,000 volts to four rotary converter substations, feeding energy to the third-rail at 600 volts.

The cars are to be of the multiple-unit type, with cross-seats, capable of making 55 miles per hour with two 200-hp motors each.

The estimated annual gross earnings of the road are about $1,000,000, or $4.50 per capita of the territory served, excluding the population of Boston. Extended comparisons were made with the Lackawanna & Wyoming Valley Railroad, as the line most closely resembling the proposed railway, and considerable emphasis was laid upon the desirability of terminating the Boston, Lowell & Lawrence road at the limits of the Boston Elevated rapid transit trunk lines, in order to avoid duplicating costly facilities in the business center of Boston and to afford the best possible distributing service throughout the metropolitan district.

The logical terminus of the road is at Sullivan Square, where a quick and facile transfer can be made to the Boston Elevated trains. The former congestion at Sullivan Square will be largely cut off by the enlargement of the present elevated stations in Boston to handle eight-car trains, by the operation of trains in the comparatively level and straight Washington Street tunnel instead of the crooked and hilly Tremont Street subway, by the extension of the elevated system to Malden and a further possible extension to Medford.

Under cross-examination, Mr. Boyd stated that electrification had doubled the traffic on the Rochester division of the Erie Railroad in the first year of its operation, and that the Long Island and other electrifications had been successful in meeting the expected requirements. He admitted that it would cost less to electrify the suburban service of the Boston & Maine between Boston and Lowell than to build a new electric road as proposed, but emphasized the radical differences between the Boston, Lowell and Lawrence and either the existing trolley lines or the competing steam system. The hearing was continued.

The Massachusetts Gas & Electric Light Commission has received a petition from the Edison Electric Illuminating Company of Boston asking for authority to issue 19,452 shares of stock. A hearing will be assigned. The board has sent an important communication to Mr. G. E. Brock, acting chairman of the Boston school committee, declining to request the Boston Edison Company to furnish electricity for school houses at lower than its regular rates. The essential particulars of this letter will be given in the next issue.

New York Public Service Commission News.

The Public Service Commission of the First District of New York has received during the past week a communication from the attorneys of the New York Parcel Despatch Company calling attention to the fact that that company possesses a franchise granted by the Legislature in 1868 which entitled it to construct a pneumatic tube service under the streets of New York for the transmission of letters, packages and merchandise, and under the East River to Brooklyn. The company also has a right to erect upon the sidewalk, and in other places, receptacles connecting with the pneumatic tubes for the deposit of letters and parcels. It is said that important banking interests have recently become affiliated with the company and are proposing to go on with a comprehensive scheme of construction under the old grant. It is also claimed that the original grant permits of tubes only of a mean diameter not exceeding 54 in., which, of course, precludes any idea of passenger transmission. It is argued by some interests that this old franchise is revived at this time in connection with the Wilgus plan for the construction of a freight and passenger subway and elevated system around the water front of Manhattan Island. This plan was submitted to the commission last November, but whether the old franchise may operate as a block to the Wilgus plans, or whether it might be made to operate in connection with it, is not as yet understood.

The Public Service Commission has raised the point in a hearing as to the right of the New York & Queens County Company (a Belmont enterprise) to operate its cars on the Queensborough Bridge. The company obtained a temporary permit from the bridge commissioner under instructions from the Board of Estimate, on Oct. 14, and a shuttle service has been maintained ever since. The commission explicitly disclaims any intention of interfering with the shuttle service, but is investigating the right of the company to operate merely as a method of establishing its authority. The temporary permit for the shuttle service was granted without any consultation whatever with the commission.

The Public Service Commission of the Second District will give hearings the present week at Albany on the application of the Great Bear Light & Power Company, which has asked permission to extend its electric light and power lines from East Worcester, Otsego County, to the unincorporated village of Worcester. The existing lighting plant in that village will oppose the application. The complaint of the Mayor of Little Falls against the Utica Gas & Electric Company as to gas and electric rates charged in that city will also be heard. Also the application of the municipality of Sylvan Beach, which asks for consent to construct and operate an electric light plant for other than municipal purposes.

CURRENT NEWS AND NOTES.

SAN FRANCISCO ELECTRICAL SHOW.—A movement is on foot for the holding of an electrical show in San Francisco early in December.

INTERNATIONAL TELEPHONE CONVENTION.—The annual convention of the International Independent Telephone Association will be held at the Auditorium Hotel, Chicago, on Dec. 7, 8 and 9. It is probable that simultaneous "practical-conference" and "business" sessions will be held.

EDISON EXTRA.—The Edison Employees' Club of the Boston Edison Company has issued the first number of a club newspaper and bulletin of company affairs which bears the provisional title *Edison Extra.* A prize has been offered for the best suggestion for a permanent title, the award to be made in time to enable the second issue to carry the new name.

ELECTRICAL ENGINEERING AT UNIVERSITY OF ILLINOIS.—The registration of students in the College of Engineering of the University of Illinois footed up to 1275 on Oct. 2, as compared with 1179 at the same date last year. The enrollment in electrical engineering is 311, in mechanical engineering 271 and 382 in civil engineering.

GERMAN ELECTRICAL INDUSTRY.—Sir Francis Oppenheimer, British Consul-General at Frankfort-on-Main, says in his report for 1908 that the German electrical industry has been but little affected by the economic depression. With regard to new inventions, the electrical industry holds the record for the greatest number of patents applied for during 1908, which was 2721, and also for the number which were granted; while from 1877 to 1903 the patents applied for amounted to 30,483, and those which were granted to 11,749. From statistics published in the report it appears that the horse-power of motors built by the Allgemeine Elektricitäts-Gesellschaft increased from 647,273 in 1904-1905 to 1,350,327 in 1907-1908, the corresponding figures relating for the Lahmeyer Company being 265,000 and 358,000. During 1904-1905 the Schuckert Works built motors of 964,150 total horse-power, and in 1906-1907 of 1,060,150 hp. Generating plant in power stations shows a growth from 191,646 kw in 1900 to 730,151 kw in 1907, since when the figures have further increased. The new capital invested in electrical companies during 1908, not including new power stations, was 78,330,000 marks ($19,842,500), as against 42,365,000 marks ($10,593,750) in 1907; and the average dividend of 45 electrical companies, controlling capital amounting to an aggregate of 573,245,000 marks ($143,311,250), is calculated at 8.1 per cent for 1906-1907, and at 8.3 per cent for 1907-1908.

CARNEGIE INSTITUTION PUBLICATIONS.—The publications of the Carnegie Institution of Washington now number 124 according to a list issued under date of Oct. 11. Another list just issued contains entries of 24 books in the fields of chemistry and physics, the titles of which are followed by excellent descriptive notes.

AIR-NITRATE FERTILIZERS.—The Bureau of Manufactures, United States Department of Agriculture, has issued a bulletin giving reports by the consular officers at Christiana, Norway, and Niagara Falls on the manufacture of fertilizers by the fixation of atmospheric nitrogen by electrical means.

ELECTRIC RAILWAY CROSS-TIES.—In 1908 the electric railways purchased 6,425,368 cross-ties, or 5.7 per cent of the total number purchased in that year. The average price paid by electric railways for sawed ties was 54 cents. The electric railways used 61,492 treated ties, or 9.6 of the total purchased by them, while the treated ties used by the steam railroads formed 21.8 of the total.

AUSTRIA TO SELL RADIUM.—According to a dispatch from Vienna the Austrian Government will put upon the market a portion of the 154 grains of radium chloride, the product of the St. Joachimathal (Bohemia) plant, for 18 months. The Vienna hospitals and scientific institutions are to be supplied first, free of cost, the remainder to be offered for sale at $75,000 a gram.

CHAMBERLAIN LIBRARY.—Part II of the library of the late J. Chester Chamberlain will be sold by the Andeson Auction Company, 12 East Forty-sixth Street, New York, Nov. 4 and 5. The first part of this great collection of first editions of American authors was sold in February, bringing over $30,000. The catalog includes 788 items, and many of the books, as in the case of those sold previously, retain the original covers under a special binding.

BALTIMORE "WHITE WAY."—The illumination on Baltimore Street, the main thoroughfare of Baltimore, is to be extended for several more miles. At present ornamental "goose-neck" poles with two arc lamps brilliantly light the lower section of the street, and in extending the illumination the same type of pole will be used, but with a single arc. There will be about four arc lamps to a block, instead of one as at present. The neat "goose-neck" poles are rapidly being substituted for the unpainted chestnut ones.

LIGHTING OF COLON AND CRISTOBAL.—The Isthmian Canal Commission has assumed control of the lighting of Colon and Cristobal, Isthmus of Panama. A value of $11,664.73 has been placed on the pole lines and fixtures taken over from the Panama Railroad. For the present electricity will be furnished from the plant operated in connection with the cold-storage warehouse, but as soon as frequency-changers are installed current will be furnished for lighting purposes from the power plant at Gatun Locks.

"THE ROAD OF ANTI-WHITE."—In the campaign to compel the Illinois Central Railroad to "electrify," and that speedily, its suburban service in Chicago the newspapers of that city bear a conspicuous part. One of them, parodying a popular advertising jingle, calls the line "The Road of Anti-White," alluding, of course, to the smoke nuisance. The same paper gives a list of phenomena that may be observed during the passage of Halley's comet. Mirages, earth tremors, plural shadows of opaque objects and other strange things are on the list, and at the end is the statement that "The Illinois Central will begin to electrify its tracks."

LARGE SPANISH TRANSMISSION PLANT.—Mr. H. F. Parshall has been engaged as engineer by a syndicate that will develop for electrical generation a number of water-powers on the Ebro River, Spain, the power to be transmitted to various towns and cities in Northeast Spain, including Barcelona and Tarragona. The longest transmission line will not be over 100 miles. The capital of the company is $17,500,000. The Ebro drains five-sixths of the southern Pyrenees, and the flow of water is well maintained even in summer. The water-power available for development is sufficient to deliver 134,000,000 kw-hours annually.

CHICAGO ELECTRIC CLUB.—At the meeting of the Electric Club of Chicago on Oct. 13 changes were made in the constitution and by-laws by which the annual dues were raised from $2 to $5, and providing that an initiation fee of $5 as well as the first year's dues must accompany application for membership. At this meeting every man present was asked to stand up and give his name and business connections, so that every other person could know who he was and "place" him in the industry. The speaker of the day was Mr. E. P. Warner, whose address on "Electricity and Magnetism from a Yachtsman's Viewpoint" is reported on another page.

INTERNATIONAL TECHNICAL ANNUALS.—A firm of publishers in Stuttgart, Germany, announces that it has undertaken the publication of three annual volumes setting forth yearly developments in certain branches of electrical engineering. One volume will cover dynamos, motors and transformers; another prime movers, and the third, power houses. The annuals will contain only illustrations with the most important data relating thereto, and the names of the technical journals from which the matter is taken. Herr George Dettmar, general secretary of the Association of German Electrical Engineers, 3 Monbijouplatz, Berlin, is editor of the annuals.

MUNICIPAL LIGHTING COST IN FORT WAYNE.—The old complaint that it is almost impossible to obtain exact information of the cost of electric street lighting from a municipal plant is repeated from Fort Wayne, Ind. The *Daily News,* of that city, under date of Oct. 11, says that a report of the first year's operation of the municipal light plant is now under compilation, adding this comment: "Nothing is mentioned, however, of the cost per lamp for street lighting, on which Controller Schmidt states that such utter ignorance prevails. The statement is made that the city operates lamps at a cost of $53 per year, but this figure is probably taken from the reason that such an amount is converted to the lighting fund. Whether it pays the real bill or not is more than 'Gus' Schmidt knows, according to his own statement. Mayor Hosey seems better informed, however, and states that the report will show that during its first year the plant has paid the interest on the investment by lowered cost of street and public lighting, and has netted a goodly revenue from the private lighting contracts."

TEST OF ELECTRIC LOCOMOTIVE HEADLIGHTS.—The Indiana Railroad Commission, assisted by several professors from Purdue University at Lafayette, made the first practical tests of the use of the powerful electric locomotive headlights and the ordinary oil headlights on the night of Oct. 13. The tests were made between 5 p. m. and 5 a. m. on a stretch of track on the Big Four Railroad, near Avon, west of Indianapolis. The commissioners, professors and officials of the road were seated in an observation car behind the electric light or oil lamp and approached the signal tower from a distance of 5000 ft. The results in distinguishing signal lights were individually noted, and the general result of all the tests was that at 5000 ft. the colors could not be distinguished under the electric light, and that all the colors could not be distinguished at less than about 2000 ft. The colors when the oil lights were used were easily distinguishable. The commission will make one other test before making up its finding on the question of whether or not electric or any other form of strong headlight shall be ordered substituted for the ordinary oil headlight.

PHYSICS AT PRINCETON.—During the present week, on Friday, Oct. 22, the Palmer Physical Laboratory, at Princeton University, will be formally opened with appropriate ceremonies.

INTERESTING SAW-MILL TURBO-GENERATOR EQUIPMENT.—The Hammond Lumber Company, Astoria, Ore., will install two turbo-generators in its plant, the electrical energy generated to be sold to the Astoria Electric Company. The turbines will be of the "mixed-pressure" type, which will be supplied with exhaust steam when the saw-mill is in operation, and with live steam at other hours.

A "BROOMSTICK" COVER.—Those who recall Oliver Wendell Holmes' whimsical verses on "The Broomstick Train," written on the occasion of the first appearance of trolley cars in Boston some 20 years ago, will appreciate the cover of the *Electric City Magazine* for October, in which the witch, with her trolley-pole "broomstick" and her black cat, are boldly set forth. *Electric City*, distributed free in drug stores, is a medium of the Commonwealth Edison Company in advertising central-station service and is skilfully edited by Mr. H. A. Seymour.

INDIANA WATER-POWER LEGISLATION.—The water-power companies in Indiana will contest any legislation which does not permit them to lease water-power in perpetuity. Proposed legislation requires that hydraulic power companies shall obtain water-power permits and pay a reasonable fee to the Government therefor. In Indiana water-power is principally used to generate electricity and already plants are being built or in operation on White, Tippecanoe and St. Joseph rivers. State Geologist Blatchley is busy locating power sites on these and other streams. The local Conservation Association is thought to be behind the demand for restrictive legislation.

PITTSBURGH A. I. E. E. SECTION.—At a regular monthly meeting, on Oct. 12, of the Pittsburgh A. I. E. E. section, Mr. C. B. Auel, manager of the railway and control department of the Westinghouse Electric & Manufacturing Company, presented a paper on arc and incandescent welding. Messrs. F. Theodore Nagle, of the Crucible Steel Company; Geo. H. Wood, of the Homestead Steel Works; Frank G. Galbraith, of the Mesta Machine Company; C. F. Scott, of the Westinghouse Electric & Manufacturing Company, and Julian Kennedy took part in the discussion which followed the reading of the paper.

HORTICULTURAL ELECTRIC LIGHT SHOW.—During the recent visit of President Taft to Chicago he passed at the head of a procession along Garfield Boulevard, which was appropriately decorated for the occasion. One of the especial features was a mound of greensward by the side of the boulevard bearing in flowers and foliage plants the words "Edison Light" in a semi-circle of large letters above a representation of the familiar lamp badge of the Edison companies. A low hedge separated the mound from the sidewalk and around about were bunting, flags and shields, the whole presenting an attractive and novel appearance. The mound was about 8 ft. high, and the letters and design were on the sloping surface. It has been suggested that similar flower-bed designs calling attention to the service of the Commonwealth Edison Company be placed permanently at appropriate locations about the city.

GERMAN ELECTRIC STEEL-MAKING PROCESS.—The *Bulletin* of the American Association of Commerce and Trade in Berlin states that German iron and steel manufacturers are not a little excited over what is considered to be a successful solution of the problem of making steel directly from iron ores by electricity. This has occurred at Dommeldingen in the Grand Duchy of Luxemburg, where an electric furnace has been producing steel for a short time. Although the ores used are low-grade and contain a considerable percentage of phosphorus, the furnace yielded a steel fully equal to the best grade made from Swedish ores. The success of this invention is expected to have very far-reaching results for the German steel industry, as it will hereafter be possible to make first-class steel out of the extensive phosphorized iron-ore deposits of Lorraine and Luxemburg, where geologists estimate that there are enough ores to last Germany for several centuries. The electric furnace used at Dommeldingen is the invention of two German engineers, Rüchling and Bodenhauser, and it is produced by one of the big electrical companies of Berlin, which has organized a special company for exploiting it.

NEW YORK SECTION I. E. S.—The meeting of the New York Section of the Illuminating Engineering Society, held on Oct. 14, was devoted to a discussion of papers presented at the recent annual convention of the society. In commenting upon the paper by Dr. H. E. Ives on allowable frequencies in incandescent lamps, Mr. P. S. Millar stated that the flicker from tungsten lamps ceases to be objectionable when the frequency is above 18 cycles per second for the 100-watt lamp, 27 cycles for the 40-watt lamp, and 28 cycles for the 25-watt lamp. To render the frequency imperceptible a frequency as high as 23 cycles is required for the 100-watt lamp. Mr. A. A. Wohlauer called attention to the fact that the choice of the lighting installation for factories depends upon the floor area per operator. When the area is large and the operators few, individual lamps should be used, but when there are many employees working in a limited area it is more economical to resort to general illumination of the so-called space-lighting type. At the next meeting of the section, which will be held on Thursday, Nov 11, the subject for discussion will be the qualifications of an illuminating engineer and the division of membership of the society.

BRITISH WELSBACH ELECTRICAL POLICY.—The English electrical journals naturally take a lively interest in the recent entry of the British Welsbach gas interests into the electrical field. The London *Electrical Times* prints an interview with the managing director of the Welsbach Company, who, however, displayed some reticence in replying to inquiries. He said, however, that the company desired to maintain good relations with electrical supply dealers and contractors, and that it did not intend to sell lamps direct to the public, but only through the trade. The supply of lamps would also naturally involve the sale of glassware and fittings, just as the company sold burners and shades in connection with gas mantles. House transformers would also be sold, but there was no intention to embark upon the business of supplying wiring requisites and accessories generally. A strong point would be made of the price of maintenance of lamps, and retailers would be required to sell at full list prices or have their supplies cut off No information was given concerning the nature of the patents behind the new incandescent lamp, nor about the character of the filament, nor where the lamp is being made in Germany It was stated, however, that the Welsbach Company intended to erect a lamp factory in Great Britain. Another electrical journal criticises the offer made by the Welsbach Company to replace the whole of the carbon lamps in any existing installation with Welsbach metallic filament lamps in return for a payment of the difference in the quarterly bill for energy. It says that while this is a very attractive offer to the consumer, it is one which central stations will not be pleased to see accepted, as the tendency will obviously be to replace carbon lamps, thereby reducing the station output. It adds that the only gleam of hope is that the consumer, being aware that he will have to pay to the Welsbach Company the difference between his quarterly bill with the two types of lamps, will use energy lavishly, so as to bring his new bill somewhere up near the level of his old one. It also criticises the plan of selling lamps through hardware and similar stores outside of the electrical trade, and predicts that the introduction of this aggressive form of competition with the electrical industry will very likely lead to further reductions in the selling price of metallic filament lamps.

Low-Head Hydroelectric Development on Tippecanoe River at Monticello, Ind.

MONTICELLO, the county seat of White County, Indiana, is a pleasant little city of something over 3000 population on the Tippecanoe River—the same Tippecanoe which was associated with "Tyler, too" in a widespread political rallying cry of 70 years ago. At this place there is a moderate-sized water-power development which is worthy of attention, because of the low head utilized—8 ft.—and the fact that the stream furnishing the power does not differ essentially from many others in the Middle West capable of a similar development. As time goes on it is probable that the number of small low-head water-power developments of this character will be greatly increased.

One favorable characteristic of the Tippecanoe River water-power which is often absent from other streams is its comparatively uniform flow. Ordinarily the variation between high and low water is not more than 4 ft. or 5 ft. The flow in past years has varied from a minimum of 400 second-ft. to 16,000 second-ft. in case of flood, but these are extreme variations and, as Western rivers go, the flow is fairly uniform the year round. The existing plant, which has been built recently, is the property of the Tippecanoe Electric & Power Company. It utilizes a head of 8 ft. and furnishes all the electrical energy required for light and power for the city of Monticello at the present time. This head could be doubled, if necessary, without overflowing a great deal of land.

Water-power has been developed on this site for many years and formerly it was utilized to drive a grist mill, a woolen mill and a saw mill. The grist mill, operated from an old 4-ft. dam, survived until a couple of years ago. In December, 1907, the Tippecanoe Electric & Power Company was organized to build a modern water-power plant and market the electrical energy resulting from it. This company leased the water rights for a long term of years, and proceeded to develop the power. Later it took over the Monticello Electric Light & Power Company, of which Mr. L. M. Barnes was principal owner. That company did commercial lighting, but had no day load.

At the point where the Monticello dam is placed the Tippecanoe River is 316 ft. wide and would have an average depth, if not obstructed, of about 3 ft. The stream is remarkably uniform in cross-section. In building the new plant it was hoped to utilize the old dam, but when opened it was found to be in such bad shape that this was impracticable. Therefore, a new dam was built on the site of the old one, utilizing the old rock filling. The bed of the river consists of gravel, rock and sand, and the water is unusually clear, a number of springs in the bottom of the river being encountered. The dam is of a timber-crib construction, the cribbing consisting of 12-in. x 12-in. timbers spiked together with ¾-in. drift pins 23 in. long. The plant is now practically completed and in operation, and a good general view of it is shown in Fig. 1. Fig. 3 is a drawing showing the general arrangement of the power house, wheel house, dam and flood gates. While the plant was under construction a temporary plant was erected and service was given from this by June 1, 1908, according to contract with the city, to which the company supplies street lighting. The new plant was put in service in January, 1909.

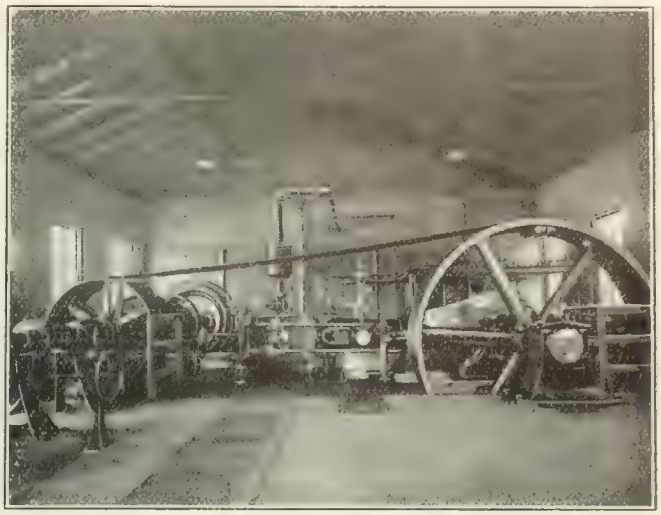


FIG. 2.—PARTIAL VIEW OF ENGINE-ROOM



FIG. 1.—GENERAL VIEW OF POWER HOUSE, WHEEL HOUSE, DAM AND FLOOD GATES, MONTICELLO, IND.

In building the dam it was necessary, of course, to bore a large number of holes in the timbers of the cribbing receiving the drift pins. It would have been a long and tedious job to do this work by hand, so an electric portable drill was employed with entire success. This tool consisted of a 1 1/3-hp, 110-volt,

direct-connected motor driving a bit which bored holes 11/16 in. in diameter. By the use of this device one man could easily drill all the holes necessary in the timbers that required 12 carpenters for framing and fitting. Electricity was supplied to the drill from a 2-hp motor driven as a dynamo by a traction engine installed to drive a centrifugal pump.

Instead of carrying the water to the wheels in a raceway, as is frequently done in water-power installations of this general nature, the wheel-house is carried over the river and in line with the dam, of which it is, indeed, a part. The general arrangement is well shown in Figs. 1 and 6. The power house is on the west bank of the river at the end of the dam. The wheel-house comes next to it, extending over the river on the dam, as shown. Next comes the dam proper. There is a fish ladder at the eastern end of it, and between the end of the dam and the eastern abutment are the flood gates, as indicated. A bend in the river upstream protects the wheel-house from the major force of the current, which sets over toward the eastern side of the river, being drawn in this direction furthermore by the flood gates placed at the eastern end of the dam. This has resulted in practically still water on the wheel-house side of the dam. The flood gates have been designed to have a capacity slightly larger than that required by the obstruction to the flow of the river due to the new dam.

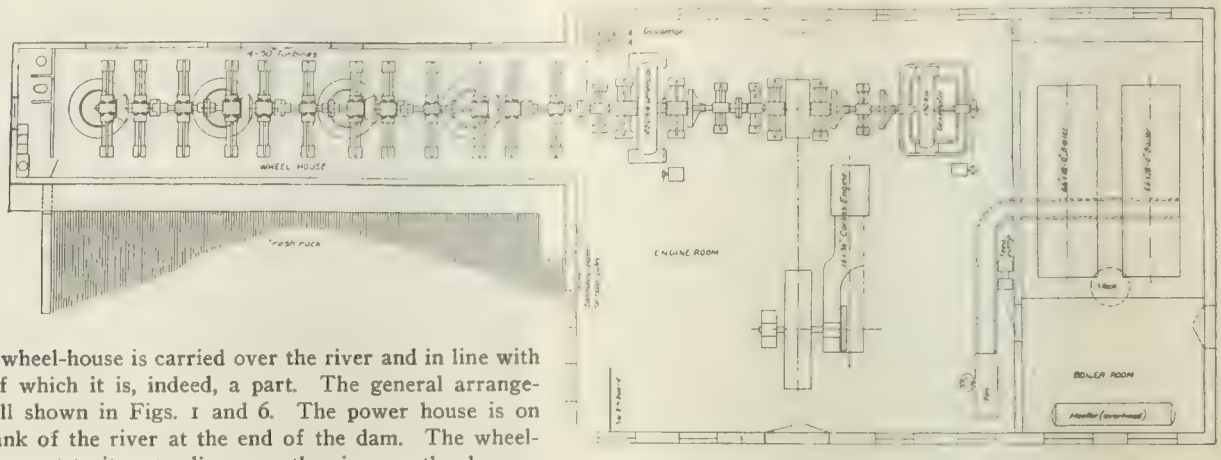


FIG. 3.—GENERAL PLAN OF POWER HOUSE.

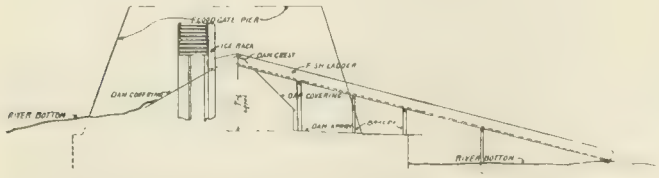


FIG. 4.—CROSS-SECTION OF DAM, SHOWING FISH LADDER.

Placing the flood gates at some distance from the power house in this manner, instead of near at hand, with access by a bridge, as is usually the case, necessitated some system for remote control to operate the gates. Otherwise it would require two men to operate the station—one to look after the gates, if hand operation was relied upon, while the other was attending to his duties in the power house. As it is, one man operates the plant very nicely. There are three of the flood gates, and each is equipped with a 2-hp electric motor of the induction type. These motors are operated from a power house by a nine-wire subaqueous cable. A controlling panel is placed near a window in the engine-room, and by standing there the station operator has a full view of the gates, which he raises or lowers by the use of double-throw switches on the controlling panel.

Each of the three gates is equipped with a separate motor having its own circuit leading to its individual switch on the controlling panel of the power house. The motor shaft is geared to a worm shaft, which in turn drives a gear on the winding shaft—a 4-in. shaft on which the hoisting chain is wound. This system of gearing reduces the motor speed of 1140 r.p.m. to 2 r.p.m. on the winding shaft, raising or lowering the gates at the rate of 3 ft. a minute. Fig. 5 is a drawing showing details of the motor drive of the flood gates, while Fig. 6 is a reproduction of a photograph showing the motors used for raising and lowering the gates. A form of Tainton gate is used, and a specially designed bearing (shown in detail in Fig. 5) is employed for each gate. This bearing has a radius of 9⅞ in. It consists of a cylinder of boiler iron having 19¾ in. inside diameter slipped over the end of two 15-in. I-beams. The entire space inside the cylinder and around the I-beams is filled with concrete. The "box" of the bearing consists of a ¾-in. x 6-in. strap. The bearing turns very slowly in this strap, and on account of its slow motion no lubrication is required.

A further detailed drawing, in Fig. 5, shows the ingenious method adopted of bracing the downstream side of the flood-gate piers. This construction is so arranged that the side pressure, due to water in one compartment when the gate is raised, is transmitted through a series of struts to the embankment on the shore.

The fish ladder placed between the eastern end of the dam proper and the flood gates, as indicated in Fig. 4, is constructed according to the provisions of the laws of Indiana. It is 30 ft. long and has an 8-ft. rise. The sluiceway is 4 ft. wide and 18 in. deep, and is constructed with baffles to retain the water in the manner common to all fish ladders, but complying particularly with the statute requirements of Indiana.

The flood gates, wheel-house and foundation for the power house are all of reinforced concrete. There is a natural gravel

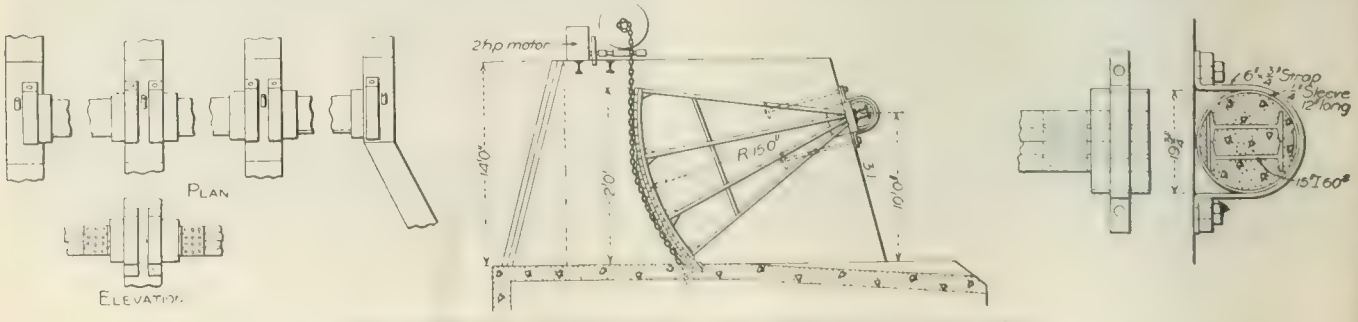


FIG. 5.—DETAILS OF CONSTRUCTION AND OPERATION OF FLOOD GATES.

pit half a mile above the power-house site, and the engineers developed a rather ingenious plan for utilizing this gravel during construction work. On examination the pit showed sharp sand and gravel in about the right proportions for making concrete, but it was also discovered that small quantities of clay were mixed with the gravel and sand. To remove this objectionable clay a submerged platform was built 12 in. below the surface of the water at the mouth of the old millrace. The flow of water from the millrace was blocked off in such a manner that all of the water from the race had to flow over the platform. Loads of sand and gravel from the pit were floated downstream on scows, each load consisting of 5 cu. yd. The contents of the scows were shoveled onto the submerged platform, and as the sand and water settled to the bottom in the rushing water the clay was washed out. From the submerged platform the materials were shoveled to a gravel platform in front of the concrete mixer. The gravel was effectually cleaned for use in making the concrete by this simple, but effective, method. One portion of cement was used to eight portions of mixed sand and gravel, as it came from the washing platform.

Fig. 3 is a general arrangement drawing showing the disposition of machinery and apparatus used in the wheel-house, engine-room and boiler-room, the last named being provided to furnish a steam reserve. Four 50-in. Leffel vertical turbine waterwheels have been installed in the wheel-house. Each wheel sets in an individual compartment with reinforced concrete on three sides and the gate for the admission of water on the fourth, so that any wheel can be shut down at any time without disturbing the others. The waterwheels are rated at 115 hp each, and the gates are hand-operated.

As a further protection against ice, in addition to the favorable configuration owing to the bend in the river mentioned before and the placing of the flood gates on the farther side of the river, thus forcing the strong current away from the wheel-house, a log boom has been provided in front of the wheel-house. A Woodward waterwheel governor is used, and it is placed in the engine-room.

The waterwheels all drive on one main shaft, each having an individual clutch. There is also a clutch by which the wheel-house and engine-room can be entirely disconnected. This is used when the generators are driven by the steam engine, ordinarily held in reserve. The main shaft extends through the wheel-house and engine-room, and in the latter it drives a 250-kw alternator and a 150-kw machine of the same type. Both of these generators are wound for 2200 volts and deliver three-phase, 60-cycle current. The smaller machine was made by the Western Electric Company. The shafting is so arranged with clutches and quills that any combination of engine, waterwheels and generators may be arranged. An interior view of a portion of the engine-room is shown in Fig. 2.



FIG. 6.—VIEW OF MOTORS OPERATING FLOOD GATES

A Murray heavy-duty simple Corliss engine, having cylinder dimensions of 16 in. x 36 in., is belted to a pulley on the main shaft and drives the generators when necessary. To supply steam to this engine there are two horizontal tubular boilers 66 in. in diameter and 18 ft. long. A short stack is provided, but forced draft is relied upon to operate the boilers. The fan for this purpose is located in one corner of the engine-room. This fan is steam driven. The feed-water heater used is of the closed type.

The switchboard is of marble and has four panels—one for each generator, one feeder panel and one for the arc-lamp circuits. The city of Monticello is divided into three parts for the

purpose of distribution, and there is one single-phase circuit leading from the power house to each of these districts to supply commercial lighting. There is also one three-phase power circuit and two arc-lighting circuits supplying electrical energy for alternating-current series 7½-amp arc lamps. The two arc circuits are connected across the three phases by two-phase three-phase transformers to keep the machine in balance.

The plant is operated 24 hours a day by two men relieving each other in 12-hour shifts. One man is able to assume the entire direction of the plant with ease, unless steam operation is required, when it is necessary, of course, to employ a fireman. This is certainly a minimum of labor for the operation of a 400-kw generating plant. So far, in the operation of the station, steam has only been needed in an occasional instance of ice trouble, or when it has been thought advisable to shut down the waterwheels for examination and possible repair of the hydraulic equipment. In times of flood water, when the head is diminished, it has been found practicable to cut out the waterwheel governor entirely and to drive with the steam engine on the same shaft, accomplishing regulation by means of the steam governor and letting the steam engine "float" on the system, as it were, furnishing its quota of power automatically as might be required.

In several ways the Monticello Electric & Power Company, which is capitalized at $100,000, shows that it is enterprising and up to date. A considerable motor load has been secured for loading the plant during the daytime. The industrial establishments supplied with electric power include a large printing plant having its headquarters in Indianapolis, a thread factory and a flour mill. There are also many users of electric power for miscellaneous purposes. The company has the street-lighting contract and has a large number of commercial lighting customers. It maintains a creditable display-room in a store on the principal street of the city. Here are shown all kinds of electric heating devices, fans, pumps, fixtures and the like. A number of electric flatirons have been sold to the housewives of Monticello, and they contribute their mite to the day load. All customers are supplied with energy through metered circuits, the base rates being 10 cents a kw-hour for electricity used for lighting and 5 cents a kw-hour for energy consumed in operation of motors and heating devices. Liberal discounts are allowed from these rates for the use of electricity in large quantities and also for payment within 10 days from the date of the bill. There is talk of extending the lines of the company to some of the nearby towns. Mr. A. S. Straus is the president and principal owner of the company, and the plant was designed, supervised and is still operated by Postal & Linn, consulting engineers, of Chicago, to which firm F. J. Postal & Company are successors.

Utilization of the Energy from Niagara Falls.

Grouped around Niagara Falls are seven hydroelectric generating stations, four of which are on the Canadian side and three on the so-called American side. Of those on the Canadian side, one is so small in comparison with the others that it is usually ignored; however, it is not devoid of interest, because it represented one of the earliest hydroelectric developments and the only one at Niagara not utilizing alternators. This plant is the generating station of the International Railway Company, from which energy is obtained for operating the cars of the belt line on the Canadian side, for which about 1200 hp is required. The station contains a 2000-hp, vertical-shaft, direct-current turbo-generator, and older horizontal shaft generators driven by belt and bevel gearing by means of low-head waterwheels.

Of the remaining three Canadian stations, one generates energy exclusively for the Canadian market, one is operated in connection with two stations on the New York side and delivers very little energy in Canada, while the third transmits energy over a considerable portion of New York and is arranging to transmit a large amount of energy in Canada.

The energy from the plant of the Electrical Development Company of Ontario is utilized in part by the Niagara, St Catherines & Toronto Railway Company, a part is transmitted to Toronto, while a part is sold to the Cataract Power & Conduit Company, of Buffalo. The load of the Niagara, St. Catherines & Toronto Railway Company reaches 1000 hp. The Toronto load is taken by the Toronto Electric Light Company which uses 10,000 hp, and the Toronto Railway Company, which uses 16,000 hp. The Cataract Power & Conduit Company takes a load of 8000 hp.

The plant of the Canadian Niagara Power Company is operated in parallel with the plants of the Niagara Falls Power Company, the load on which will be discussed below.

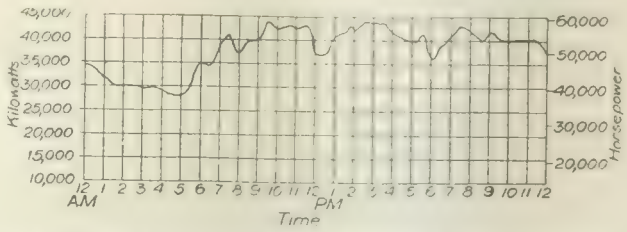


FIG. 1.—DAILY LOAD CURVE OF THE ONTARIO POWER COMPANY

The output of the plant of the Ontario Power Company is handled by three companies—namely, the Niagara, Lockport & Ontario Power Company, which sells energy exclusively in the United States; the Ontario Distributing Company, which delivers energy in the townships of Stamford and Niagara, Ontario, and the Falls Power Company, which transmits energy to the townships of Bertier, Willoughby, Pelham, Thorold, Humberstone, Crowland, Wainfleet and Grantham, in Ontario. The lines of the Niagara, Lockport & Ontario Power Company transmit energy to Lewiston, Lockport, Gardenville, Depew, Lancaster, West Seneca, Athol Springs, Hamburg, Oakfield Akron, Batavia, Caledonia, Avon, Mortimer, Rochester, Auburn, Syracuse, Baldwinsville, Phœnix and Fulton.

Of the output of the Ontario Power Company, which totals 58,700 hp, the electrochemical load represents 14,500 hp, railway 19,000 hp, lighting companies 11,200 hp, and industrial loads 14,000 hp. Of the same total 14,900 hp is used in Canada; 11,000 hp is transmitted to Lockport, N. Y.; 10,900 hp is distributed at Depew and West Seneca; 9600 hp is distributed in Rochester and Batavia, while 12,300 hp is sent to Auburn and Syracuse. All of the electrochemical load is either in Canada or within 20 miles of Niagara Falls on the New York side. The transmission distances are as follows: Lockport, 20 miles; West Seneca, 45 miles; Rochester, 80 miles, and Syracuse, 170 miles from Niagara Falls. The nature of the load on the system can be judged from an examination of Fig. 1, which is characteristic of every day except Sunday, when the load is somewhat reduced.

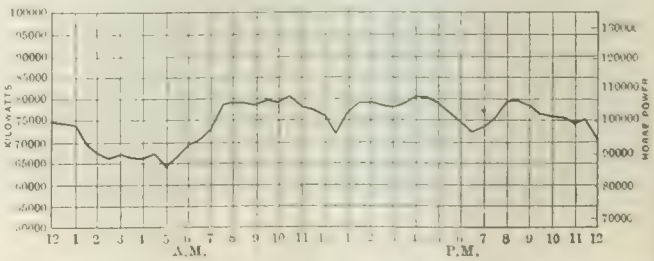


FIG. 2.—DIAGRAM OF COMBINED LOADS OF THE NIAGARA FALLS POWER COMPANY AND THE CANADIAN NIAGARA POWER COMPANY.

On the New York side the plant of the Niagara Falls Hydraulic Power & Manufacturing Company supplies energy exclusively for local distribution. Electrochemical industries use about 51,000 hp, pulp and flour mills about 2000 hp, the local lighting company about 1500 hp, while about 4500 hp is used for various minor industrial purposes, including the operation of the Niagara Gorge Railway. It is evident that the preponderance of electrochemical load causes the total load on the system

to be practically constant with very small daily and seasonal variations.

The local lighting company on the New York side is known as the Buffalo & Niagara Falls Electric Light & Power Company. In addition to the above amount, it obtains about 2000 hp from the Niagara Falls Power Company. The local lighting company uses about 600 hp for municipal 125-cycle arc lamps, 1800 hp for 125-cycle incandescent lamps, 800 hp for 25-cycle incandescent lighting, and 500 hp for 500-volt, direct-current motors.

The Niagara Falls Power Company operates two plants on the New York side, which are joined in parallel with the plant of the Canadian Niagara Power Company, as noted above. The energy from these three plants is used locally to a large extent and is transmitted over the lines of the Cataract Power & Conduit Company, of Buffalo, to North Tonawanda, Tonawanda and Buffalo. The combined loads at North Tonawanda and Tonawanda equal about 2240 hp, which represent 250 hp in municipal lighting, 450 hp in commercial and residential lighting and 1540 hp in industrial service. In addition thereto

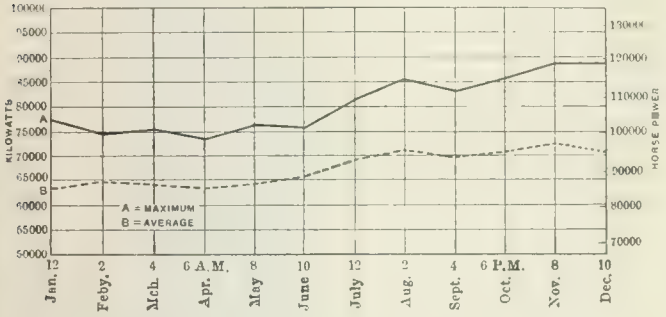


FIG. 3.—MAXIMUM AND AVERAGE LOADS THROUGHOUT THE YEAR

is a railway load of 2500 hp at Tonawanda. The total of the Buffalo loads is about 47,200 hp, of which 2400 hp is used for city pumping, 15,000 hp for railways, 16,800 hp for industrial service and about 13,000 hp for the Buffalo General Electric Company. Of the latter amount 2100 hp is used in city lighting, 9100 hp in commercial lighting and 1800 hp in industrial service. Due to the variation in the time-distribution of the several Buffalo loads, the actual total load transmitted over the circuits of the Cataract Power & Conduit Company seldom exceeds 40,000 hp, instead of reaching 47,200 hp. Moreover, although the total of the loads of the Buffalo & Niagara Falls Electric Light & Power Company is 3700 hp, the actual total load on its system is only about 3500 hp.

In addition to the local lighting load of 2000 hp at Niagara Falls, N. Y., which has already been referred to, the Niagara Falls Power Company delivers energy for a 61,000-hp electrochemical load, a 1500-hp railway load and other industrial loads totaling 5000 hp. At Niagara Falls, Ontario, its electrochemical load is 300 hp and its other industrial loads 500 hp.

In spite of the fluctuations in the lighting and railway loads, the load factor of the output from the stations of the Niagara Falls Power Company and the Canadian Niagara Power Company is remarkably high, as shown by Fig. 2, which shows the load curve for April 30, 1909. An indication of the normal yearly variation in both the load and the load-factor of the combined plants is given in Fig. 3, which shows the maximum monthly peak and average monthly load on the combined stations for the year 1907, which was more nearly a normal year than was 1908.

A review of the above values will show that the energy from Niagara Falls is used at the rate of 126,800 hp for electrochemical processes, 56,200 hp for railway service, 36,400 hp for lighting and 54,540 hp for various industrial services, the total being 273,940 hp. Since the water of Niagara Falls represents probably 5,000,000 hp, it would seem that only about 5.5 per cent of the available power is being utilized at the present.

It is interesting to determine the proportion of the energy from Niagara Falls used locally as compared with that transmitted elsewhere. The above figures show that 12,300 hp is transmitted over more than 100 miles; 33,500 hp is transmitted more than 75 miles and less than 100 miles; 3100 hp is transmitted 50 miles; 79,640 hp is transmitted more than 10 miles and less than 30 miles, while 145,400 hp is used locally on the Canadian and New York sides of the Falls. That is to say, more than 50 per cent of the energy actually utilized is employed locally; almost all of this is used in industries that have been attracted to Niagara Falls by reason of the generating stations located there, electrochemical processes forming 87 per cent of this amount and 46 per cent of the total amount utilized.

Lignite and Its Relation to Other Fuels of the Southwest.

By A. C. Scott.

THERE is probably no other single fuel field anywhere in the United States that covers so large an area as that included in the lignite belt of Texas, which extends in a strip from 50 miles to 100 miles in width from the Louisiana boundary to the Rio Grande River at a distance of from 75 miles to 150 miles from the Gulf Coast and nearly parallel with it. The depth of the deposit is from the surface in some places to something over 100 ft. in others. The most productive mines now in operation are at Rockdale, Bastrop, Calvert and Lytle.

Lignite is an intermediate fuel between peat, on the one hand, and soft coal, on the other, and occurs in decidedly lenticular deposits, some of which at points of the greatest depth of vein are 14 ft. or more in thickness. The lignite in the mine contains as an average about 28.5 per cent moisture, with a possible saturation value of from 31 per cent to 39 per cent. Table I shows the values obtained as test results of several samples

TABLE I.

Name.	Heat Units per lb.	Per Cent water.	Per Cent volatile	Per Cent fixed carbon	Per Cent ash.	Remarks.
Bastrop	8,830	28.0	....	.....	....	(wet)
"	8,830	23.6	.....	.....	....	(wet)
"	9,298	28.1	28.90	33 20	9.8	(wet)
"	10,980	....	.....	.....	....	(dry)
"	10,620	....	.....	.....	....	(dry)
"	10,515	....	.....	.....	....	(dry)
Calvert	10,223	29.7	.....	.....	....	.....
"	9,808	28.0	.....	.....	....	.....
"	9,767	26.9	29.30	31.80	12.9	.....
Rockdale	9,135	33.2	.....	.....	....	(14' vein)
"	9,100	33.3	25.05	34.2	8.3	7' "
"	9,767	26.1	25.90	34.9	12.8	
Melcher	10,380	....	.....	.....	....	(dried)
"	8,700	11.2	15.45	58.60	14.8	(samples)

from representative mines, the coal in most cases being heated for one hour at 104 deg. C.

By far the majority of lignite mines have veins from 4 ft. to 7 ft. or 8 ft. in thickness, and that of the Big Square Mine, at Rockdale, of 14 ft. is, therefore, remarkable. The lignite is dug out with pickaxes in the hands of Mexicans and negroes and hauled in mule cars to the shaft. It is usually perfectly clean coal in the veins, containing no shale or other foreign matter. It is undesirable to use powder in mining the lignite, partly because it is not solid enough to permit a blast to be thoroughly effective, and partly because in most mines a part of the overlying shale would come down with the coal and render it unsalable unless subsequently screened or separated by hand. Screening tends to break up the lumps and inasmuch as the evaporation of a considerable portion of the moisture in the coal usually occurs in transit, it is essential that the lumps be kept as large as possible when loaded for transportation, because the tendency to slack and fall to powder is much decreased. Various appliances have been tried for getting out the coal mechanically, but little success has thus far been attained. There is a wide difference in the expense attached to the mining of lignite, however, due to the fact that in some mines the rooms and entries are entirely self-supporting, while others must be timbered in part or completely. A mine recently in-

vestigated by the writer showed a vein from 3.5 ft. to 4 ft. in thickness, with the necessity of supporting the roof everywhere. The mine was comparatively dry, but the shale overlying the lignite formation would not support itself. At Bastrop and also at Rockdale, even in the 14-ft. vein, the overhead material is sufficiently rigid to render the use of timber unnecessary. It is considered by some to be more or less dangerous to work a 14-ft. vein, and it is difficult to pick out the lignite at such heights.

No evidence of explosive gas has ever been noticed in the lignite mines, and the miners use the same sort of lamps as are used in the anthracite coal mines. The mines are all ventilated by air shafts extending down to the bottom of the vein from various places at the surface, and fires are frequently kept burning in some of them, with very satisfactory ventilation as a result. The majority of mines inspected by the writer have not been uncomfortably warm, nor poorly ventilated, although the mines having 3-ft. or 4-ft. veins and timbered throughout are disagreeable to move about in. Of course, the main entries in a timbered mine are high enough for the mules to get along, and the untimbered ones have a space at the top only wide enough for a mule's head.

Practically all of the lignite mines are worked by the room-and-pillar method, and in many cases the final robbing of the pillars enables from 85 per cent to 90 per cent of the total amount of lignite to be taken out. The specific gravity of average lignite is about 1.25, making the weight of a cubic foot about 78 lb., whence it is readily seen that a vein averaging 6 ft. in thickness would yield something over 10,000 tons per acre. Since the formation is of lenticular character, however, it may readily average above or somewhat below that value. It frequently happens that the vein is only a foot or so thick at the beginning of the hillock of coal underneath the surface and increases in thickness, even reaching the 14-ft. value, and after passing the maximum gradually decreases in thickness to a narrow vein again. Continuing in the same direction, another vein is struck a short distance away in the direction of the general trend of the coal formation, and the hillock or lenticular formation is again encountered. Nearly all of the mines now in operation have a second, and in some cases a third, vein beneath the one which is being worked, and these veins are for the most part thinner, but more compact, than the upper ones. Thus far no one has, to the writer's knowledge, worked a second vein, and definite data concerning these veins are, therefore, not available.

The price of lignite at the mine tipple is from 85 cents to $1 per ton, and the freight rates make the use of lignite at distances far away from the mines more or less unprofitable in comparison with oil and soft coals. It may be said, however, that statistics recently collected show that about 20 per cent of all the electric lighting and power companies in the State are using lignite as a fuel, the total number of such companies in the State being about 200.

Table I shows some variation in moisture content and calorific value of the different mine samples recently tested, but on the whole there is no great variation. It will be noticed that the amount of volatile matter is relatively high and suggestive of lignite as a good producer-gas making fuel. It has already been found to be a very economical fuel in the producer, and it appears that the demand is increasing rapidly for that purpose. Lignite is in many places a successful competitor on the basis of cost per horse-power produced, with both semi-bituminous coal and oil, and it appears to have been thoroughly demonstrated that there is much better economy obtained in a producer than under the boiler. The chief difficulty encountered in burning lignite is due to its comparatively large moisture content, which varies from 28 per cent to 31 per cent or 32 per cent as taken from the mine. When exposed to the dry atmosphere the lignite slacks and crumbles into small pieces, and this is just what happens in the furnace when the lignite is used under the steam boiler. This peculiarity makes it necessary to use a special form of grate upon which the coal may be economically consumed.

The most successful grate appears to be of German make and is known as the step grate; it differs from the ordinary flat grate in its greater angle of inclination and in the form and position of the grate bars. In the ordinary grate the bars stand on edge, extend lengthwise of the firebox and the grate is horizontal as contrasted with the step grate, in which the bars lie on the side, extend across the firebox and the grate is inclined at an angle of from 30 deg. to 40 deg.; the inclination varies with the quality of fuel used, the finer the fuel the greater the angle of inclination. A form of flat grate in which the grate bars are made thin and placed close together is used with success in burning such coals as lignite; these bars are slightly thicker at the bottom than at the top, the dimensions being ¼ in. and 5/32 in, at bottom and top, respectively, and the space between the bars at the top about ⅛ in. These flat grates are much cheaper to install than the step grates, and the bars in the grate only have to be changed, to replace the ordinary grate, while in changing from the ordinary grate to the step grate the entire furnace must be changed.

Recent experiments on the briquetting of lignite appear to have been successful without the use of a binder. Whether, however, the expense of briquetting can be shown to be justifiable is an open question, when considered with respect to economy in power-plant consumption of the fuel. After a careful study for the past six years of the conditions pertaining to the mining of lignite and the utilization of fuel in Texas, the writer is strongly of the opinion that the greatest economy in the consumption of lignite will be found in producer work, and that there is little to be gained by briquetting beyond the satisfaction of having solved a very difficult problem.

Another class of fuels to be considered is the semi-bituminous variety which is mined in several localities in Texas, notably at Santo Thomas, San Pedro and Duff mines, in Webb County, near Laredo; at Mount Marion and Strawn, in Palo Pinto County, near Strawn; and the Thurber mine in Erath County, near Thurber. The coal from the Webb County district is not really a semi-bituminous coal, but rather a poor quality of cannel coal. It is hard and lustrous, the moisture content is small and the calorific value is much higher than that of lignite, but not as high as that from the other two fields above mentioned. The coal from the latter two fields is strictly semi-bituminous; it is hard and brittle, contains a comparatively small percentage of moisture and has a much higher calorific value than lignite or the other coals. The latest report relating to fields of this class, by the United States Geological Survey, 1900-1901, pertaining to the State of Texas shows:

Area of coal-bearing formations	11,300 square miles
Per cent of probable productivity	45
Rank of field and State, in area	11
Production in 1900	968,373 tons
Average price per ton	$1.63
Per cent of total production	.36

Table II shows recently determined data relative to this class of fuels:

TABLE II.

Name.	Heat Units per lb.	Per Cent water.	Per Cent volatile.	Per Cent fixed carbon.	Per Cent ash.
Santo Thomas	13,100	4.45	42.91	45.55	7.69
San Pedro	13,800	3.73	39.36	32.00	25.64
Duff	8,820	6.5	26.00	28.00	39.00
Strawn	14,190	3.2	.....	.....	.....
Mt. Marion	12,810	3.8	.....	.....	.....
Thurber	12,920	4.9	29.50	61.4	5.4

The third class of fuels for comparison is Texas petroleum or crude oil. The organic theory of the origin of crude oil considers that crude oil results from the fractional distillation of animal and vegetable matter, under heat and pressure. The current belief is that oils with a paraffine base result from the distillation of vegetable matter, while those with an asphalt base come from the distillation of animal matter; whether or not this be true it appears certain that the asphalt base is a polymerized paraffine, having the same percentage composition as paraffine, but a different molecular weight, and altogether different physical and chemical properties, as is well known. One of the chief distinguishing characteristics of pure asphalt is its con-

choidal fracture, when it is cold enough to be brittle. Oils having an asphalt base are entirely unsuited for the manufacture of high-grade cylinder oils unless changed by the introduction of paraffine to replace the asphalt. When, as sometimes occurs, intermediate oils contain a small fraction of the asphaltic constituent which is non-volatizable at a red heat, the successful and economical operation of low-compression oil engines of the Hornsby-Akroyd type becomes a serious matter. In the Diesel engine, where high compression is employed and under steam boilers, the asphalt-base oil appears to be quite as satisfactory as oil with a paraffine base.

Table III shows data on oils from various representative Texas fields as recently obtained in the engineering laboratories of the University of Texas. The specific gravity was taken in all cases with a Westphal balance, the flash point determined in open vessel, the heat units per pound obtained with a Parr calorimeter, and the carbon residue by heating a carefully weighed sample to a bright red heat and then weighing the cooled residue.

TABLE III.

Field.	Specific gravity.	Barometer "Hg.	Flash point Deg. Fahr.	Percentage fixed carbon.	Heat units per lb.
Corsicana	.6386	28.84	38	1.54	19,320
Corsicana	.9231	29.29	126	2.81	19,490
Beaumont	.9172	29.27	142	3.23	18,700
Sour Lake	.9231	29.28	85	1.64	18,790
Mission	.9826	28.84	300	4.73	*9,430

*Sample contained 25.4 per cent water.

The characteristics of crude oil vary greatly with different specimens. The odor may vary from pleasant to very disagreeable, and the color from almost transparent to black. It will be seen by the table that the range in specific gravity is also great.

RELATIVE HEATING VALUES OF THE THREE CLASSES OF FUELS.

The average calorific value of lignite, in the condition in which it usually reaches the furnace, may be taken as about 8000 lb.-Fahr. units per pound of coal, which is the calorific value of the partially dried coal as commonly used under boilers. The delivered price will vary, of course, with the location of the boiler plant with respect to the mine, but a fair price may be taken as $1.20 per ton, which would make the cost of fuel 7.5 cents per 1,000,000 lb.-Fahr. units.

The average calorific value of the semi-bituminous coal above considered, as used in the furnace, may be taken as 13,000 lb.-Fahr. units per pound of coal, and the delivered price as $2.60 per ton, which makes the cost per 1,000,000 lb.-Fahr. units 10 cents.

If the average calorific value of crude oil be 18,500 lb.-Fahr. units per pound, and the specific gravity 0.92, which will make a gallon weigh 7.67 lb., or a barrel of 42 gal., 322.1 lb., and if the price of the oil is $1.10 per barrel, then the cost of 1,000,000 lb.-Fahr. units will be 18.5 cents.

Of course, these values do not show conclusively which is the most economical fuel, because there are other factors which must be considered; the most important of these is the per cent of the heating power or energy of the fuel utilized in making steam and the cost of accessories and maintenance to produce steam continuously. A special form of grate is required which is designed to burn coal which slacks greatly, and even then it is a difficult matter to maintain maximum furnace economy. The efficiency of lignite as a steam-making fuel would probably be increased materially by the use of mechanical stokers in plants of moderate and large size. When stokers are used, the door to the firebox does not have to be opened frequently with the consequent inrush of cold air across the fire and resulting waste of heat units. When semi-bituminous coal is used the fire may be bedded much thicker than is possible with lignite, the furnace door opened less frequently and both loss of heat and labor of firing much reduced. One of the important prerequisites of successful lignite firing is a strong draft beyond that required for soft coals, and installations designed for successful lignite work must recognize the fact as well as the importance of larger grate surface, and, if possible, a different kind of grate, as above mentioned. The Dutch-oven type of furnace, which is so much used in Louisiana, where sawdust, bagasse and other refuse are burned as fuel, ought materially to improve results with lignite and ordinary hand firing.

So far as the ash is concerned the effect in the calorimeter is only to reduce the heat units per pound, but under the boiler, of course, besides reducing the calorific value, the presence of the ash makes it necessary to shake a considerable portion of unburned lignite through the grate in order to get out the ash, and, therefore, a considerable waste when handled by hand-firing methods. Using oil as a fuel, no grate is required, and the burner may be regarded as the equivalent of a combination grate and mechanical stoker. The doors to the firebox are not opened during the firing period; there is no ash to be handled, and the supply of oil and air or steam may be so regulated that very little soot will be deposited on the heating surfaces.

The following résumé of tests made upon a 100-hp boiler of the West Side Hygeia Ice Company, of New York, under which Beaumont oil was used, shows the relative efficiency of oil as a fuel:

Duration, hours	3.5	8	11	13
Horse-power	146.9	112.7	189.7	138.0
Steam pressure (gage) lb.	87	86	86	86
Feed-water temperature, deg. Fahr.	69	90	70	90
Temperature of flue gases, deg. Fahr.	374	360	398	370
Quality of steam	Dry	Dry	Dry	Dry
Oil per hour per square foot of heating surface, lb.	0.181	0.135	0.226	0.163
Dry steam per hour from and at 212° per square foot of heating surface, lb.	2.73	2.09	3.52	2.56
Heating surface per horse-power, sq. ft.	12.6	16.5	9.8	13.5
Total dry steam per pound of fuel as fired from and at 212°, lb.	15.29	15.53	15.55	15.71
Per cent of steam used by burner	3.6	3.1	4.8	3.5
Net pounds of steam per pound of fuel fired from and at 212°	14.74	15.05	14.80	15.16

After this test had been completed with oil, another test was made using coal as a fuel, and the comparative heat balances of the two tests are given below:

	Oil.		Coal.	
	Heat units.	Per cent.	Heat units.	Per cent.
1. Utilized in production of steam	14,963	78.5	8,636	71.4
2. Evaporation of moisture in fuel and due combustion of hydrogen	1,245	6.5	277	2.3
3. Wasted in superheating water products	113	0.6	23	0.2
4. Wasted in dry chimney gases	1,837	9.7	1,981	16.4
5. Wasted in unburned carbon in ashes	.....	....	788	6.3
6. Radiation and imperfect combustion	902	4.7	415	3.4
7. Heat per pound of fuel, by calorimeter	19,060	....	12,100	....

—From University of Texas Mineral Survey Bulletin No. 3.

In considering the heat balances above, one of the most noticeable differences is in the percentage of heat wasted in chimney gases and in the loss due to ash in coal, which would necessarily be increased with lignite. No data appear to be available on comparative tests, where lignite was one of the fuels used, which will readily allow of a comparison with soft coals and oil under precisely similar conditions of service.

It may be safely assumed that 60 per cent of the heat units in lignite can be utilized in the production of steam. If dry steam is wanted at 150 lb. gage pressure, then 1 lb. of this steam will contain 1193 heat units, and if the water is fed to the boilers as low as 75 deg. Fahr., for example, then 1150 of these heat units must be supplied by the combustion of the fuel in the furnace. One ton of lignite, having 8000 available heat units per pound, would produce 8350 lb. of steam at a fuel cost of $1.20, or 0.0144 cent per pound of steam produced. One ton of soft coal, having 13,000 lb.-Fahr. units per pound, would produce 16,140 lb. of steam at a fuel cost of $2.60 or 0.0161 cent per pound of steam produced. One barrel of oil, having 18,500 heat units per pound, would produce 4060 lb. of steam at a fuel cost of $1.10, or 0.0271 cent per pound of steam produced.

Kind of fuel.	Per cent of heating power utilized.	Fuel cost of production of one pound of steam.
Lignite	60	.0144 cent
Soft coal	71.4	.0161 "
Fuel oil	78.5	.0271 "

The above tabulated statement refers only to the cost of the fuel; other indeterminate factors which would affect the economy of using the different kinds of fuel are cost of firing and depreciation of boiler and furnace. The cost of firing will be

much greater with lignite than with soft coal or crude oil if the hand-firing method be employed. The depreciation of boiler and furnace would be about the same for both lignite and soft coal, but much greater for oil. Where oil is used the furnace must be relined with firebrick frequently, and the cost of building and maintaining storage tanks and accessories for use of oil must also be considered. A careful test alone can determine the exact relative economy of the different fuels, but it appears certain that lignite, if properly handled, at prices as above indicated, is the most economical fuel, with soft coal next and oil the least economical of the three. This conclusion is justified, moreover, by the fact that many of the plants which used oil when it could be purchased at a lower price than the present are now changing equipment for burning coal or lignite.

Hudson-Fulton Celebration in New York State.

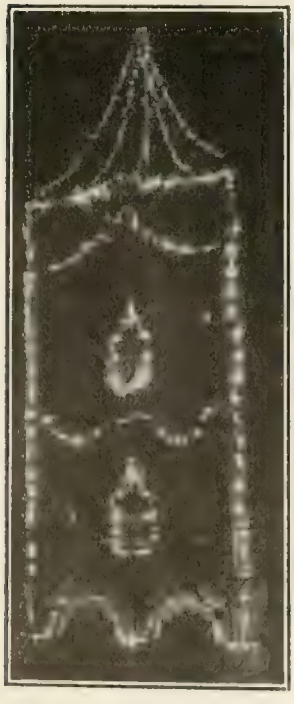
THE issue of *Electrical World* of Oct. 14 contained an illustrated description of the Hudson-Fulton illuminations in various cities along the Hudson River in commemoration of the three-hundredth anniversary of the discovery of the Hudson River by Henry Hudson and the one-hundredth anniversary of the inauguration of steam navigation on the same river by Robert Fulton, but owing to space limitations the portion referring to the Albany and Troy illuminations was held over. This is now given below.

ALBANY.

Historic Albany opened its two days of Hudson-Fulton celebration on Oct. 7, beginning in the morning with about 6000 school children forming a living flag on the steps of the Capitol, and in the evening with a parade confined exclusively to fraternal organizations. The decorations were the most elaborate ever seen, and the State, county and city buildings were dressed in appropriate colors, augmented by electric lamps. State Street leading to the Capitol was set aside as a Court of Honor, and a colonnade was formed from Capitol Park to the Post Office. Strings of 4-cp lamps were looped from pillar to pillar the width of the street, so that traffic passed under arches of light. At the intersection of State and Pearl streets four strands of looped red lamps were caught up from the four points of the compass and fastened with Hudson-Fulton initials spelled in light. The landing at Riverside Park was tastefully decorated with 1000 lamps located on the landing float, arch and in the park itself. Curtains of light draped many of the business houses. The Capitol was all alight within, so that the white marble walls and front stood out in high relief. The City Hall, diagonally opposite, had a continuous pyrotechnic display in the shape of a gigantic electric skyrocket at half-minute intervals. This shot up a great bar of light into the sky along the City Hall tower and broke out in a shower of colored stars. The Ten Eyck Hotel was a great skyscraper of brilliance, and the dome of the Albany Trust Building lifted its outlines against the sky emblazoned with electric lamps. Another great pool of light was Market Square. Lyons Block, facing the square, was outlined with electric lamps, together with bas-reliefs of Hudson and Indians framed in electricity. Two anchors of blue lamps and festoons of colored globes were placed on top of the building. Munson's, at the south of the square, was latticed with lines of light, its electrical illumination being one of the most talked-of features of the celebration Pearl Street, to the north, was festooned with lamps, and the Myers Department Store resembled a cloth of gold under the golden rays of numerous flaming-arc lamps. The Delaware & Hudson Building, on Pearl Street, with its Hudson-Fulton colors in electric lamps, was particularly attractive. To the south on Pearl Street Proctor's Theater was studded with tri-colored lamps, and north and south to Clinton Avenue on one side, and to the power house on the other, were vistas of illuminated arches. The little Dutch building of the Albany Day Line was the most characteristic and original in its decorations of anything along the streets. Broadway from the railroad station to State Street had cross streamers 40 ft. apart, and in addition to the cross streamers on State Street there were streamers parallel with the sidewalk. It is estimated that 5000



FIG. 4.—STATE STREET, ALBANY



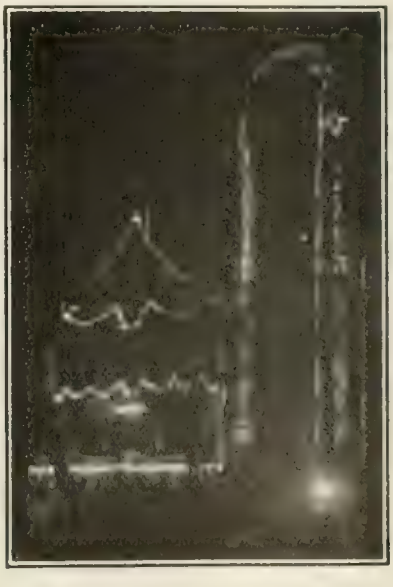




FIG. 1.—DELAWARE & HUDSON BUILDING, ALBANY. FIG. 2.—CITY HALL, ALBANY. FIG. 3.—PEARL STREET, ALBANY.

lamps were used on State Street and Broadway. These were fed from the main-service transformers, supplemented in many places by additional transformers to carry the load. A military tournament at Island Park was a feature of the week, and at night the grounds were lighted by 40 flaming-arc lamps with reflectors.

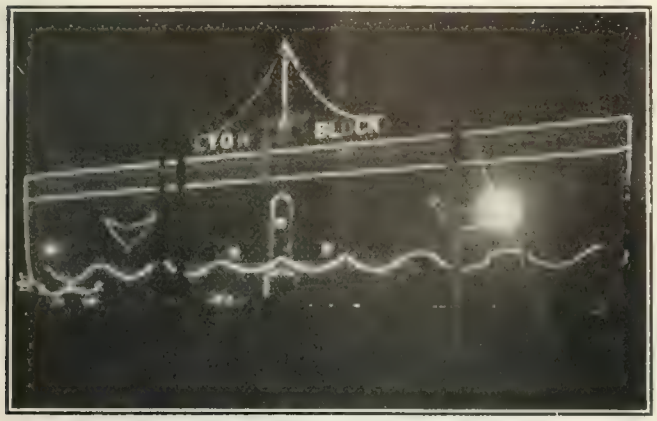


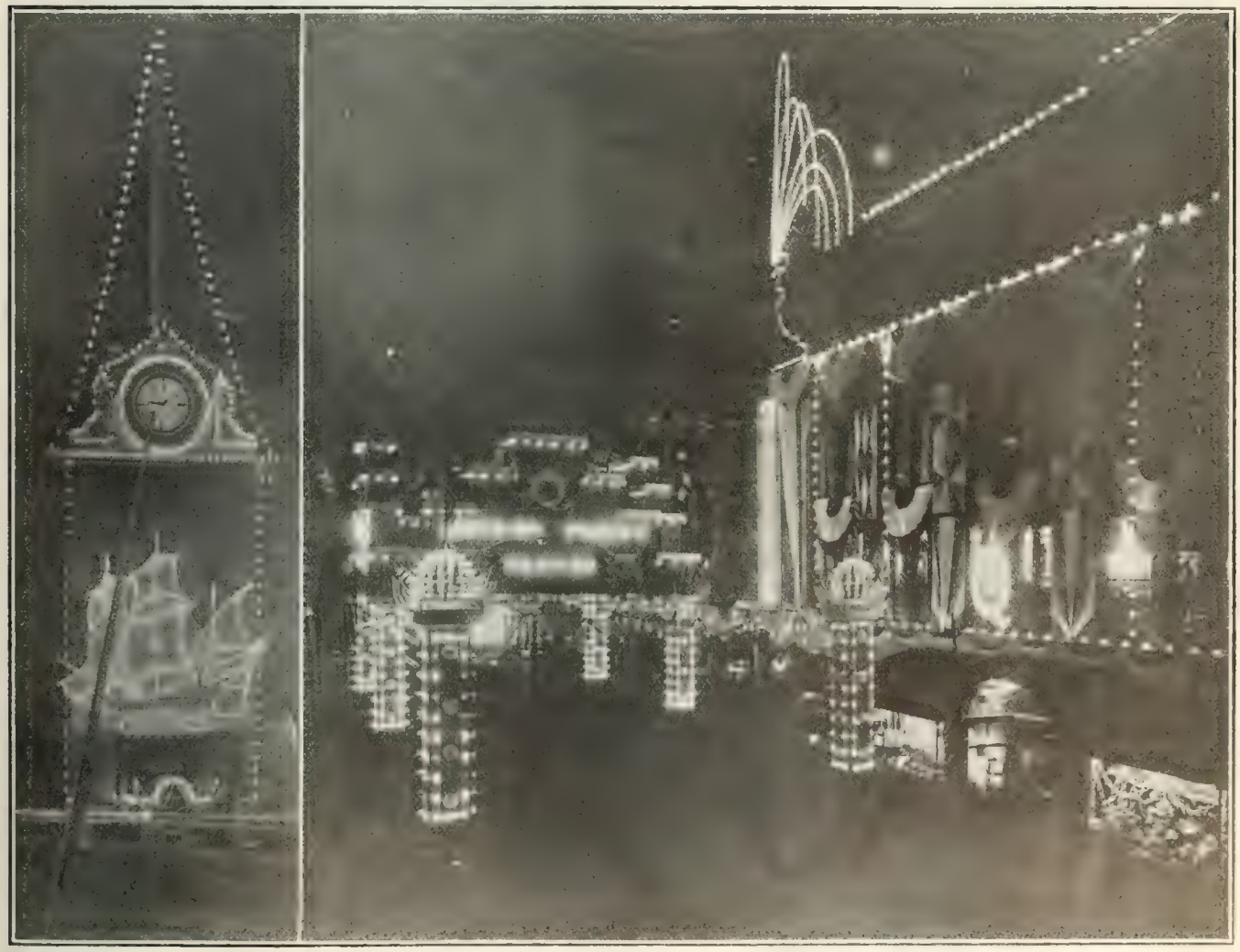
FIG. 5.—LYON BLOCK, MARKET SQUARE, ALBANY.



FIG. 6.—STATE STREET FROM BROADWAY, ALBANY.

TROY.

Troy surpassed all of the other cities in the upper Hudson Valley in spectacular illumination. In the public arches alone other arches shed radiance from 1084 lamps, while there were 2000 more on the bridge approach and 668 to illuminate the quaint old Dutch mill on Franklin Square. Approximately 500 lamps were arranged at the foot of Broadway, the official landing-place for the participants in the water pageant, and there were 575 in the arch at the Union Depot. At the junction of River, Third and Fulton streets there was a mingling of colors from an arch lighted by 2000 lamps, and a radiant effect flowed from arches at Congress and State streets, Grand and River



FIGS. 7 AND 8.—MANUFACTURERS' BANK AND ARCHWAY AT BROADWAY AND THIRD STREET.

erected across the main thoroughfares 21,700 lamps were employed. In the central arch at Broadway and Third Street there were 3500 lamps, and their rays fell upon a marvelously effective mingling of colors in the decorations. Each of the streets, Grand and Fourth streets, Fulton and Fourth streets, Fulton and Union streets, Broadway and Union Street, Broadway and Fourth Street, State and Third streets, Congress and Third streets, State and River streets, River and First streets.

and Broadway and River Street. There were many special decorations and illuminations of artistic design, American colors joining with those of the Hudson-Fulton festival waving in an interchanging shade of light from lamps of varied hues. The Soldiers and Sailors' Monument, on Monument Square, which was profusely decorated, was lighted at night by 800 lamps. The Manufacturers' Bank displayed on its ample front one of the unique and appropriate designs to be seen.

There was a reproduction of the *Half Moon*, the vessel being illuminated by 1000 lamps, reinforced by 1000 more lamps upon the bank building. The Congress Street Bridge, which was dressed in glorious colors from end to end, presented a splendid spectacle up and down the Hudson under a brilliance of

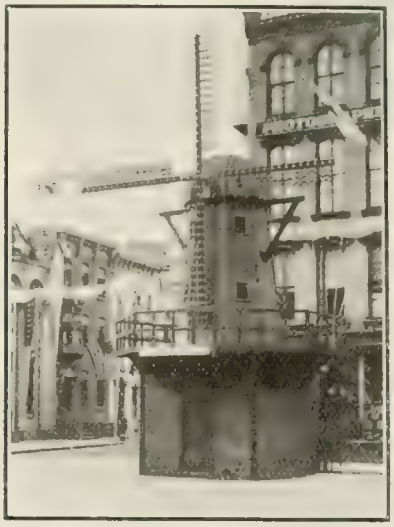


FIG. 9.—DUTCH WINDMILL AT TROY

1000 lamps added to its regular service. The City Hall, which was one of the best decorated buildings, had the great seal of the city and its motto in bold relief hung in the center arch studded with hundreds of lamps, and the Court House, dressed in American and festival colors, was lighted from top to bottom. The buildings of the Read Steamer Company and the fire headquarters, as well as those of other fire department buildings, were masses of electric decorative color. Rensselaer Hotel was



FIG. 10.—ILLUMINATION IN FRONT OF CITY HALL, TROY.

conspicuous by the elaborateness and richness of its exterior decorations, a feature being facsimiles of the *Half Moon* and *Clermont*, while coats of arms of colonial date added significance to the display. The Elks' clubhouse and Pafraets Dael were dressed in most brilliant colors, which were reflected in profuse illuminations; and the Windsor Hotel, Fifth Avenue Hotel, New Revere, Grand Union, Wolf's, Conway's, Mansion



FIGS. 11 AND 12.—SOLDIERS' MONUMENT AND ELKS' CLUB, TROY

House and Pursell's Hotel were likewise illuminated. Germania Hall, Commercial Travelers' Association, Chamber of Commerce quarters, Federation of Labor Hall, Rensselaer County Republican Clubhouse and Harmony Hall were also among those making a particularly attractive appearance. Music Hall, including the massive front of the Troy Savings Bank Building, showed a wealth of tasteful decorative effort. The Troy Public Library, Willard Seminary buildings, on Second Street, Young Women's Association and the Young Men's Christian Association buildings added to the general decorative result, the spirit of friendly rivalry in making the city beautiful having been shown in all directions. Every newspaper establishment in the city, banks, offices and stores were outlined. Indeed, so general was the decoration that to cover it in detail would necessitate the publication of a list of business places in the heart of Troy. The firm of G. V. S. Quackenbush & Company had an electric and decorative exhibit of its own. The building was covered with national and festival colors, and on the summit of the southwestern corner was an electrical fountain calling for 1000 lamps. The spray of the fountain was white, and the surrounding and base lamps were vari-colored. Besides the fountain the building's exterior was illuminated by approximately 1000 electric lamps, and over each of the entrances was a shield of red, white and blue lamps, with the monogram of the house in the center. One of the buildings in the center of the city which showed off to

good effect was that occupied by R. C. Reynolds, in Monument Square.

The structure was hidden beneath a profusion of colors, and flooded by light from lamps of various hues in a sign overhead with 1200 lamps and electric streamers on each side. A department store directly opposite the City Hall was ablaze with lamps from the sidewalk to the roof, there being 1600 lamps in the decorative scheme of the building, besides 439 in the sign in regular service. The lamps in the festoons forming the roof on Third and State streets were colored orange, green, red, blue and white, while the dome of the roof was a mass of stars.

The features of the Troy illumination were well advertised, so that visitors from far and near poured into the city to witness the pageant and the blaze of glory which marked the end of the Hudson-Fulton celebration.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Electric Lighting at Van Wert, Ohio.

An effective street-lighting method involving electric arches is being utilized by the Van Wert (Ohio) Public Service Company, as indicated in the accompanying illustrations. Considerable time was spent by the company in endeavoring to interest the merchants in the installation of the arches. The effort proving unsuccessful, the matter was presented to the Business Men's League, a few energetic members of which appreciated the advantages of having the main street of the town artistically illuminated. After putting their names down for a certain amount toward the cost of the arches, these men made a thorough canvass of the merchants, which resulted in the raising of enough money for the construction of 15 arches.

These arches are lighted from dusk until 10 p. m. every evening except Saturday, when they are lighted until 11 p. m. Each arch consists of 15 8-cp lamps. Small lamps were used, as it was found by experimenting that no great difference in the illumination was noticed between an arch consisting of 8-cp lamps and one consisting of 40-watt tungstens. The arch is constructed of 1-in. black pipe and malleable iron tees. In each tee is inserted a plug and the two leads of a weatherproof socket are brought through gimlet holes in the plug.

Fig. 2 shows the arch as it appears in the daytime. The scroll on top adds a great deal to the appearance. The privilege of using the iron poles on either side of the street, for support, was kindly donated by the trolley company. Fig. 3 shows an ordinary wagon which was converted into a tower wagon for raising the arches. The type of arches here shown cost approximately $35 each, complete.

As soon as the arches were put in service about 300 4-cp lamps were used in outlining the towers of the Court House.

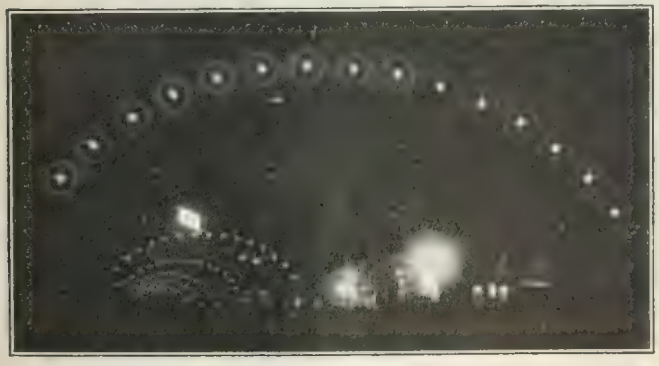


FIG. 1.—VIEW OF ARCH ILLUMINATION.

These lamps are on the circuit which controls the arches. A transformer was used to reduce the e.m.f. from 110 to 10 volts. The outline lighting on the Court House, together with the arches, makes a wonderful improvement in the appearance of the town during the evening. The streets are illuminated with 4-amp magnetite arc lamps. About 100 of these lamps are in service; they show a great improvement over the ordinary carbon-arc lamp, not only in the amount of light, but in efficiency.

About 1500 tungsten lamps are in use in the town, the popular sizes being the 60-watt and 100-watt lamps. Experience has indicated that the most successful way to get new business with the tungsten lamp is to make flat-rate contracts, always with the



FIG. 2.—VIEW SHOWING ARCH CONSTRUCTION.

provision that the consumer buys the lamps and pays for renewals. This arrangement puts a check on the consumer, almost as effectively as though a meter were used. This idea relating to tungsten lamps is applied only to business places.

No difficulty whatever has been experienced in getting stores to replace gas arcs with tungsten lamps on a flat-rate basis. Fair success has awarded the effort to obtain a motor load. During the past year one flour mill and a number of grain



FIG. 3.—TOWER WAGON FOR ARCH CONSTRUCTION.

elevators have installed motors. In addition there are a number of electric elevators in service.

A department store operating a 60-kw, gas-engine-driven, direct-current unit was induced to purchase energy from the central station notwithstanding the fact that the engine was operating on natural gas costing only 25 cents per 1000 cu. ft. A 15-kw motor-generator outfit was installed to furnish direct current for the two elevators and the cash-carrier motor. The lamps, consisting principally of tungstens, receive energy from

the alternating-current feeders. The service has been very satisfactory to the store people, not only as regards the saving in cost, but also on account of the fact that all shut-downs are eliminated.

During the past year the gross business of the company has been increased by fully 20 per cent. The electrical property is owned by Philadelphia people. The president and manager is Mr. E. E. Mandeville, Philadelphia, and the superintendent is Mr. A. J. Darrah, Van Wert, Ohio.

Street Lighting in Budapest.

By Francis Jehl.

Though the streets of nearly all cities of Europe, and even of the world, are now lighted with arcs, Budapest has retained its gas lamps. This situation prompted the general director of the Budapest direct-current system, Mr. Etienne de Fodor, to apply some time ago to the city authorities for permission to install an arc lamp trial circuit at the company's own expense, and thus show the advantages of arc lighting to a city as modern as Budapest is in other respects.

When finally, after some opposition from various sources, the necessary permission was received from the city for a trial installation in the Rákóczi ut, one of the principal streets of the city, the work was immediately taken up and a system was introduced which, according to Dr. Louis Bell, the well-known authority, is one of the most perfect systems of street lighting yet invented, and which he pronounced the coming system when he was in Budapest last year. In this connection it may be said that when the International Medical Congress held its sessions in Budapest a month ago, and after the system was installed, many of the foreign members inquired what kind of

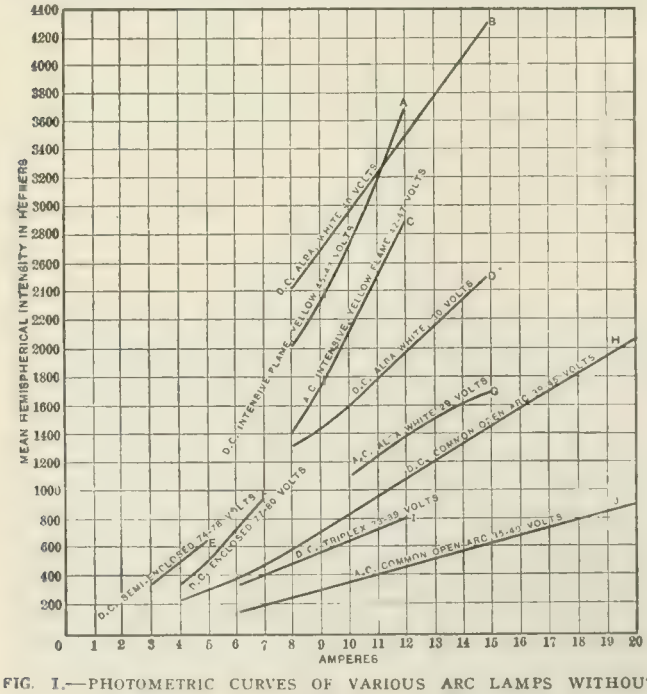


FIG. 1.—PHOTOMETRIC CURVES OF VARIOUS ARC LAMPS WITHOUT GLOBES.

arc lamps were used to light up Rákóczi Street, as the lighting was the finest that they had ever seen.

The arc lamps used are the latest type of the Blondel lamp, known as the "Alba," which gives a splendid white light and has many other good points. The positive as well as the negative carbon are cored for direct current; in fact, Alba carbons are practically all core, there being but a very thin covering of ordinary carbon material that serves merely as a case for the core.

The carbons are placed in the lamp one over the other as in a common arc lamp, with the difference that the positive is at the bottom. Among the great advantages of the Alba lamp are that it gives a well-distributed light, marked by the absence of shadows; the light has a pure white and soft color; the carbons are short in comparison to other kinds of flame carbons, a pair of Alba carbons having a length each of 325 mm (12.8 in.), lasting 16 to 17 hours; last but not least, the Alba lamp can be used three in series on a 110-volt, direct-current circuit, a lamp only requiring about 30 volts. This means also that the lamp is more economical and gives more light per watt than an ordinary lamp. The lamps can also be used two in series—that is, with 40 volts at the arc, at which it gives a proportionately greater quantity of light, but the beautiful pearl-white light becomes then tinged with a slight rose color.

Fig. 1 gives some interesting data concerning various arc lamps in general. In making comparisons with the 30-volt, direct-current Alba flame lamp it should be borne in mind that the latter are connected three in series, while the common flame or ordinary open arcs are connected two in series on a 110-volt circuit. The following notes apply to the various curves:

Curve A—Direct-current intensive flaming arc, yellow light, 45-47 volts at the arc.

Curve B—Direct-current Alba flaming arc, white light, about 40 volts at the arc.

Curve C—Alternating-current intensive flaming arc, yellow light, 42-46 volts at the arc.

Curve D—Direct-current Alba flaming arc, white light, about 30 volts at the arc.

Curve E—Direct-current semi-enclosed arc lamp, with only one clear glass globe, about 74-78 volts at the arc.

Curve F—Regular enclosed arc lamp, having inner and outer globes, about 77-80 volts at the arc (tested without outer globe).

Curve G—Alternating-current Alba flaming-arc lamp, white light, about 29 volts at the arc.

Curve H—Direct-current common open-arc, 39-45 volts at the arc.

Curve I—Direct-current triplex common open arc, 33-39 volts at the arc.

Curve J—Alternating-current common open arc, about 35-40 volts at the arc.

Fig. 2 shows the distribution of light from the Alba flaming-arc at various angles when taking 12 amp at 30 volts.

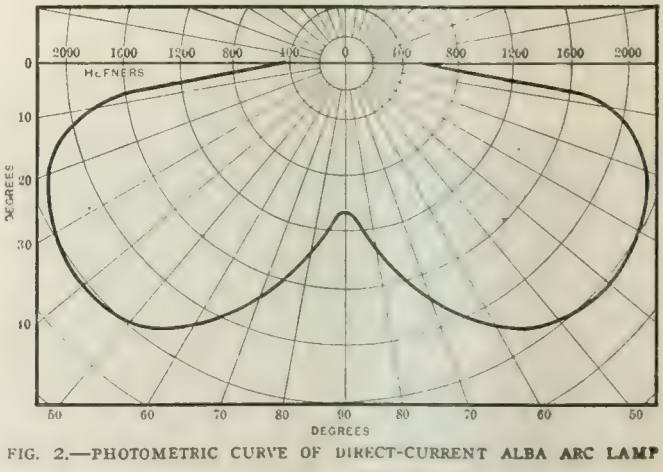


FIG. 2.—PHOTOMETRIC CURVE OF DIRECT-CURRENT ALBA ARC LAMP WITHOUT GLOBE.

The invention of the Alba carbon necessitated the design of a special arc lamp, as the vapors given off when the carbons burn demand good ventilation in order to prevent deposits from them on the enveloping glass globe. The fact that the Alba carbons give off large quantities of vapor makes this kind of lamp unsuitable for ordinary indoor service.

The Alba lamps used by the Budapest General Electric Company in lighting Rákóczi Street are manufactured by the Siemens-Schuckert Company, which also owns the patents for making Alba carbons. The lamp is constructed on the differential principle, and it may be stated that it has given satisfaction in

every respect; it holds its current steady and regulates perfectly, in striking contrast to many kinds of arc lamps that bob up and down and take varying currents. The fact that the Alba lamp sends out its light in a more horizontal direction than other kinds of lamps makes it especially adapted for street lighting, while at the same time it does not require the high masts usually employed with the common arc or flame lamp. Flame-arc lamps generally have their carbons at an angle to one another, and thus a great part of the light they give is thrown down directly under the lamp, in which area it is at a maximum and decreases rapidly with increase of distance from the lamp. The Alba lamp, on the contrary, gives less intense light in its immediate vicinity, while the total illumination is quite even in its distribution.

The contrast is the more marked for the reason that flame lamps having their carbons at an angle give such an intense light in a small space underneath as to cause the pupil of the eye to contract, so that when the person leaves this space he has the visional sensation of plunging into darkness. It is also this effect that creates with the uninitiated the illusion that lamps having their carbons at an angle and fitted with small globes are more powerful than other lamps.

In Rákóczi Street the arcs are about 9.5 m (30 ft.) from the level of the street, the masts being placed at a distance of about 50 m (164 ft.) from one another on one side of the street and about 35 m (115 ft.) in a diagonal direction from the lamp on the opposite side of the street. Of course, there is some variations in the distances given above on account of obstacles such as trees, lamp-posts, etc., encountered when the positions for the masts were being determined. The principal parts of the masts are made from Mannesmann tubes and wrought iron, the sockets being of cast iron. Fig. 3 gives a view of the masts, which are neat in appearance, rigid and well built. The masts include a basket in which flowers are placed in the summer time.

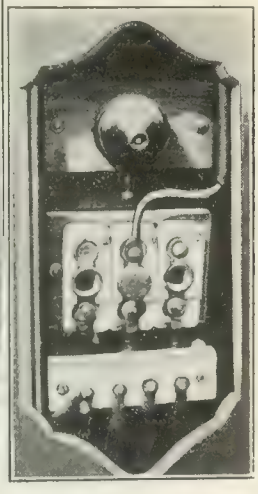
Each mast contains a reel, concealed in the base, by means of which the lamp is raised and lowered. Connected with the lamp is a safety clutch that not only makes contact when the lamp is raised to its position, but also relieves the wire rope of strain due to the weight of the lamp. The wires lead from this contact clutch to a small marble panel in the lower part of the base, shown in Fig. 4. This carries a switch and fuses and has seven cable terminals, three of which are for 2 × 110-volt connections from the street mains of the General Electric Company, the other two (four ends) leading to the adjacent masts on either sides. Fig. 5 will give an idea how the cables run into each mast. It may be mentioned that Mr. Etienne de Fodor desired to make this experimental installation so flexible that arc lamps of any description, whether single ones on a 110-volt or 220-volt circuit, or two, three or more in series, could be tried. In fact, lamps of all kinds can be thus tried and any manner of connection made. One cable can also be used in experimenting with switches actuated from a distance. The whole plant forms practically a street laboratory, where experiments can be made on the spot.

Kind of arc lamp.	Common arc lamps, 2 in series on a 110-volt circuit.	Alba arc lamps, 3 in series on a 110-volt circuit.
Amperes	15	15
Volts at the arc	42	30
Mean hemispherical Hefners. Without glass globe	1460	2500
Mean hemispherical Hefners. Clear glass globe 15% loss	1240	2100
Mean hemispherical Hefners. Opal glass globe 30% loss	1020	1750
Consumption in watts, including resistance	825	550

The arc lamps in Rákóczi Street are connected three in series on a 110-volt circuit and take 15 amp, which gives a consumption of 550 watts, including resistance. The above figures show the relation that exist between a 15-amp common arc and a 15-amp Alba arc, the former taking 42 and the latter 30 volts at the arc.

In conclusion we may congratulate the general director of the Budapest General Electric Company, Mr. E. de Fodor, for the manner in which he had the work carried out, and for his persistence in urging the city authorities to give permission to the company to demonstrate the merits of direct-current street lighting.





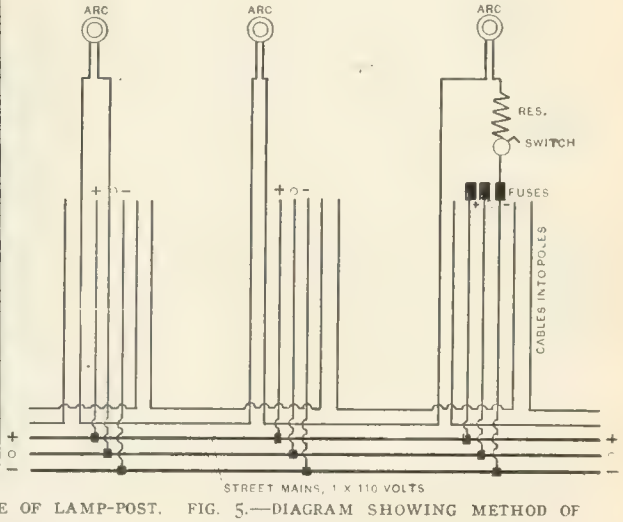


FIG. 3.—VIEW OF LAMP-POST, BUDAPEST. FIG. 4.—SWITCH PANEL IN BASE OF LAMP-POST. FIG. 5.—DIAGRAM SHOWING METHOD OF RUNNING CABLES IN POST.

Street-Lighting Earnings in Massachusetts Cities.

Central-station revenue derived from street-lighting service rarely forms a large proportion of a company's total earnings from operation, although considerable variation is often encountered in the results obtained in adjacent communities. As the volume of power business increases and as the efficiency of the tungsten lamp becomes more generally appreciated by the consuming public, the tendency is for commercial service to overshadow the municipal operations of the company. The purchasing power of the private individual or organization is much more elastic than the ability of the municipality to invest in a larger amount of illumination. This does not mean that street lighting will remain at a standstill, so far as its effect on central-station revenue is concerned, for in many communities the lighting of the thoroughfares is entirely inadequate when

judged by the easily realized possibilities of modern equipment. Revenues from power and commercial lighting service are likely to maintain their pre-eminence indefinitely, but the per capita street-lighting revenue is likely to grow considerably beyond the present lower limits before the communities spending small amounts per year for light per inhabitant can be said to be saturated, from the standpoint of illumination. The great majority of streets are under rather than over-lighted.

In the following paragraphs are given some broad street-lighting comparisons for the fiscal year ending June 30, 1908, drawn from the returns submitted by a number of representative urban companies to the Massachusetts Gas and Electric Light Commission. Figures for 1909 are not yet available, and in some cases the conditions have changed since the operations below were tabulated, but the data indicate the general condi-

TABLE I.

Company.	Population.	No. arc lamps.	No. incan. lamps.	Total revenue.
Boston	703,597	3,969	5,950	$4,229,239
Worcester	131,549	826	199	332,375
Lowell	110,786	549	784	328,033
Fall River	105,762	813	.....	237,055
Malden	101,129	458	2,943	260,237
Cambridge	97,434	654	494	297,239
Lawrence	89,972	572	808	221,554
Lynn	89,358	576	1,529	370,577
Springfield	86,486	1,078	425	465,682
New Bedford	79,777	258	21	151,238
Brockton	57,484	314	915	206,665
Haverhill	37,830	203	5	155,207
Salem	37,627	359	440	188,316
Fitchburg	33,021	324	94	130,608
Quincy	28,076	167	675	96,896

tions existing in a single recent period upon 15 systems serving upward of 2,000,000 people, and represent the latest proportions of revenue available for the group of cities and towns selected. The populations used are taken from the Massachusetts Census of 1905, in the absence of any more recent figures of equal accuracy. It shows the population served by each company in all the municipalities covered by its lines, the number of arc and incandescent lamps in street service on June 30, 1908, and the total income from the sale of electric light and power for the year.

The Boston figures cover 24 cities and towns besides Boston proper, all supplied with service by the Edison Electric Illuminating Company, and the Malden figures include the data obtained by the Malden Electric Company from the cities of Everett, Medford (town) and Melrose, which it serves. In the other instances the suburban communities served by the central-station organizations are mainly of small size. The table shows that the incandescent lamp is becoming a close rival of the arc light even in the city districts, while in suburban service its foothold is unquestioned. The total revenue of the companies is seen to vary widely for the same population. In none of the cities has the arc lamp been entirely displaced, but in all except Fall River, New Bedford, Worcester, Haverhill and Fitchburg, the incandescent lamp is strongly intrenched. The incandescents of the Worcester company are not located in that city, but in the outlying town of Leicester, at the end of the company's alternating service to the southward.

Table II shows the income of each company from street arcs and incandescents, as of June 30, 1908, the total street-lighting

TABLE II.

Company.	Arc income.	Incan. income.	Total st. ltg. income.	St. ltg. per cent of earnings.	Pop'ltn per st. lamp.
Boston	$435,611	$91,897	$527,508	12.5	71
Worcester	74,272	2,687	76,959	23.1	128
Lowell	54,095	15,701	69,796	21.3	83
Fall River	77,050	.....	77,050	32.9	130
Malden	39,193	48,787	87,980	33.8	30
Cambridge	55,634	13,327	68,961	23.2	85
Lawrence	47,131	14,777	61,908	28.	65
Lynn	49,034	24,152	73,186	19.7	43
Springfield	81,676	4,734	86,410	18.6	58
New Bedford	23,226	.....	25,911	17.2	286
Brockton	26,917	14,479	41,396	20.	47
Haverhill	20,469	52	20,521	13.2	182
Salem	32,998	9,536	42,534	22.6	47
Fitchburg	32,042	2,270	34,312	26.3	79
Quincy	11,662	10,766	22,428	23.2	33

income, the percentage of the total revenue derived from this class of service, and the population per street lamp for the fiscal year 1908.

It is noteworthy that in the Malden company the revenue from series incandescent lighting on the street exceeded that from arc lighting by about 25 per cent—there were about 6.5 times as many incandescent as arc lamps. In each of the other cases the revenue from arc service considerably exceeded that from the tungsten or carbon-filament street lamps, with the exception of Quincy, where the income was nearly equal from each class of service. At the prevailing rates there are four to six times as many incandescents as arcs before the incomes from each class can be equated. In general, the street-lighting income averaged from one-fifth to one-quarter of the company's total operating earnings. The column of population per electric street lamp installed shows wide differences among the companies in the installations. The Malden company had one street lamp installed for every 30 persons in its territory, with Quincy a close second, while the New Bedford company had one street lamp for every 286 inhabitants. These figures do not, of course, indicate the lighting facilities installed in the different cases, as the gas lamps in service often round out a considerable number of total illuminants. Thus, in the Boston territory of the local gas company there were over 10,000 gas lamps supplied for street service on June 30, 1908; Worcester had 562 gas lamps; Lowell, 1392; Fall River, 377; Cambridge, 418; Lawrence, 154; New Bedford, 983, and Haverhill, 368. It is noteworthy that the lighting of the minor thoroughfares of Malden, Salem, Lynn, Fitchburg, Brockton and Quincy is generally effected by series incandescents instead of gas lamps, judging from the returns of the gas companies occupying these cities.

Table III shows the average yearly income per arc lamp and per incandescent street lamp installed for each company, on June 30, 1908, with the total and street lighting income of each company per capita.

TABLE III.

Company.	Avg. income, arc lamp.	Avg. income, inc. lamp.	Total. income per capita.	St. ltg. income per capita.
Boston	$110.00	$15.40	$6.02	$0.75
Worcester	90.00	13.50	2.53	0.59
Lowell	100.00	20.00	2.97	0.63
Fall River	96.00	.....	2.24	0.74
Malden	85.50	16.50	2.58	0.87
Cambridge	85.00	27.00	3.05	0.71
Lawrence	82.50	18.30	2.46	0.69
Lynn	85.00	15.80	4.15	0.82
Springfield	76.00	11.10	5.39	1.00
New Bedford	90.00	.....	1.90	0.33
Brockton	85.50	15.80	3.60	0.72
Haverhill	101.00	10.40	4.10	0.54
Salem	92.00	21.60	5.00	1.13
Fitchburg	99.00	24.10	3.96	1.04
Quincy	70.00	15.90	3.46	0.80

In considering Table III, it should be borne in mind that the average income per lamp obtained by the companies for the year shown is not necessarily the contract price that was in force in the municipality during the period, since it does not take account of outages or the average number of lamps of each kind that were in service throughout the 12 months. The detailed contract prices in force for the year 1908 may be obtained from the last annual report of the commission; they have not been included here for the reason that the object of the data presented is to show in a large way what the various communities listed were paying per capita for electric street lighting, and the relation of this expenditure to the total revenues of the companies. There are wide variations among the central-station incomes per capita for all service and from street illumination. Boston, Springfield and Salem exceeded $5 per capita for 1908 in total income, and in addition, Lynn and Haverhill exceeded $4. The small cost of street lighting to the communities served is indicated by the fact that in practically all cases the average cost of such service per person in the community supplied varies between one and two cents per week.

Table IV gives the total kw-hours delivered at the switchboard for the year by companies, the energy delivered at the board for street illumination, and the per capita energy delivery for the latter service.

The figures below show that the proportion of energy devoted to street lighting service at the station bears a close relation to the income from this class of service compared with the total

TABLE IV.

Company.	Kw-hours delivered at switchboard.	Kw-hours st. ltg. at switchboard.	St. ltg. kw-hours per capita.
Boston	88,535,490	11,051,308	16.6
Worcester	5,400,192	1,278,173	9.7
Lowell	9,426,511	1,218,950	9.7
Fall River	4,061,284	1,589 448	15.
Malden	4,647,454	1,258,075	12.4
Cambridge	6,043,204	1,536,305	15.8
Lawrence	4,363 416	1,107,861	13.9
Lynn	8,776,166	1,390,215	15.6
Springfield	16,230,797	1,910,400	22.2
New Bedford	1,747,178	438,206	5.5
Brockton	3,803,885	841,650	14.7
Haverhill	4,408 965	553,038	14.6
Salem	4,462,550	732,388	19.4
Fitchburg	3,288,623	639,700	19.4
Quincy	1,470,066	345,973	12.3

operating revenues, and that the actual amount of energy required per capita to provide the electric illumination of these municipalities averages not far from 15 kw-hours per year, requiring an average generating capacity at the station of approximately 1 kw for every 266 persons, assuming a lighting service of 4,000 hours per year.

INTERIOR WIRING AND ILLUMINATION

A Kansas Street Sign.

The accompanying illustration shows a sign recently installed in Wichita, Kan., by the Edison Light & Power Company of that place. The sign remains the property of the company under the terms of a three-year contract with the city for its energy. It is 84 ft. long and 10 ft. high. The letters are each 3 ft. in height and the sign contains 217 lamps on each side. The sign was received on a Saturday morning and during the day was entirely put together on one of the side streets, within 100 ft. of the avenue on which it was erected; at about 1 o'clock



ILLUMINATION OF A WICHITA STREET

at night, after the trolley service has been discontinued to allow removal of the trolley wire, the sign was placed in position and connected so that it was alight on Sunday night. In other words, within 36 hours of the arrival of sign in the city the sign was hung and burning. It weighs 3½ tons and was constructed by the Federal Electric Company, of Chicago. It is operated by a flasher, one side being on for 10 seconds, then off for 10 seconds while the other side is on, and thus continues to flash alternately every 10 seconds.

The street decorations shown in this photograph were temporary for a carnival held in the city. The arc lamps at the side are permanent, and the sign will remain permanent, at least during the three-year period covered by the contract.

The Edison Company also operates another large sign reading "Eat Niagara Ham." The city can thus boast of two signs stretching across the street 83 ft. from curb to curb, which doubtless is a record distance.

Line Pole Statistics.

The United States Census Bureau has issued a circular giving data as to the purchase of line poles in 1908. The telegraph and telephone companies purchased in that year 2,562,239 poles, or 78.9 per cent of the total, the value being $3,425,621. The purchases of electric railway and electric light and power companies aggregated 531,497 poles, valued at 2,001,499, and forming 16.4 per cent of the total.

The average cost of poles varied from 59 cents for oak to $4.09 for Douglas fir. The average cost of poles was 33 cents greater in 1908 than in 1907. The highest average cost per pole for any class or species, $18.93, was reported for oak poles 60 ft or more in length, while the next highest, $18.12, was reported for redwood poles 40 ft. or more in length.

Less than 62,000 of the poles of all kinds purchased in 1908 had a length of 45 ft. or over, while nearly 2,860,000 poles, or 88 per cent of the total number, were under 35 ft. in length Over nine-tenths of the oak poles purchased were less than 25 ft in length. In contrast with this large proportion of small oak poles is the small proportion of chestnut poles of the same length. Not quite one-fifth of the total number of chestnut poles were less than 25 ft. in length, while over seven-tenths were between 25 ft. and 40 ft. in length. Of the "all other" kinds purchased, 87 per cent were under 25 ft. in length and were used largely by small rural telephone lines. "All other" kinds of wood include sassafras, mulberry, catalpa, hemlock, cottonwood, elm, walnut, butternut, willow, chinquapin, cherry, balsam, and several other woods which were used to a very small extent.

The report states that each year substantial progress is disclosed in the practice and methods of treating poles with chemicals to preserve them from decay, and the benefits derived from such treatment are being demonstrated under practical conditions.

To secure permanent results the wood should be thoroughly impregnated with the preservative, and not merely treated on the surface, although the superficial application of a high-grade preservative will afford some protection from decay if the wood is first thoroughly dried.

A recent inspection of some poles on a Georgia line showed that at the end of four years 67 per cent of the poles that had been treated with certain derivatives of wood and oil compounds were still sound, while the untreated poles were more or less decayed, in some cases to such an extent that their renewal was necessary.

The tendency to substitute the more plentiful and cheaper kinds of wood for more expensive material emphasizes the necessity of a thorough preservative treatment, especially if the poles are to be set in the Southern States, where the atmosphere is warm and humid. Pine poles properly treated with creosote have been known to give efficient service for over 20 years.

The returns for 1908 showed that 344,388 poles purchased during the year received some preservative treatment before being set in position. Of these poles, 101,998, or 29.6 per cent, were bought already treated, while 242,390, or 70.4 per cent, were treated after purchase.

The number of poles reported as having been given some preservative treatment in 1908 showed a slight falling off as compared with the corresponding number for the preceding year. This was probably due to the abnormal business conditions obtaining during the later year, which caused the purchasers of poles to practice every possible economy in expenditure. As treated poles cost materially more than untreated poles the use of a smaller number of them was the natural policy pursued by many companies. The number of treated

poles reported formed 10.6 per cent of the total number bought in 1908 as against 12.1 per cent of the total in 1907.

Telephone and telegraph companies reported 218,317 treated poles, or 63.4 per cent of the total of all treated poles, for 1908, and this number formed 8.5 per cent of the total number of poles bought by this class of companies in that year, while for 1907 10 per cent of their total pole purchases were treated.

Electric railway and electric light and power companies reported 78,083 treated poles, or 22.7 per cent of the total in 1908, and this number formed 14.7 per cent of the total purchases by this class of companies, while in the preceding year treated poles formed 12.4 per cent of their purchases.

While about seven-tenths of the treated poles were treated after purchase, the proportion was slightly less in 1908 than in 1907, for all companies, and for each class of companies, except in the case of steam railroads, where the percentage increased from 53.4 per cent in 1907 to 77.9 per cent in 1908

Street Lighting in Western Canada.

The interest which is being taken in effective street lighting in the rapidly growing country of Western Canada is well indicated by the recent improvement of street illumination in Edmonton, as shown by the accompanying illustrations. The city recently installed a new electric railway, using center-pole



FIG. 1.—LAMPS ON ELECTRIC RAILWAY POLES, EDMONTON

construction in which the metal poles for supporting the overhead were utilized also for supporting the arc lamps. Westinghouse series, 6.6-amp, alternating-current arc lamps are used throughout, being suspended with their cut-outs from loops mounted upon alternate poles, as shown in Fig. 1. The spacing



FIG. 2.—NIGHT VIEW OF JASPER AVENUE, EDMONTON.

of the lamps is 200 ft., resulting in a very even distribution of the light.

Figs. 2 and 3 are night views, showing the lights on Jasper Avenue, the principal thoroughfare of the city. The city has approximately two miles of these lights spaced 200 ft. apart, in addition to the usual number of arc lamps placed at each crossing in the residence district of the town. The very excellent lighting service which the city maintains as a municipal enterprise at once impresses the newcomer with the progressiveness of the city engineering staff, which is certainly far above what would be expected of cities in this very new Northwestern country



FIG. 3.—NIGHT VIEW OF JASPER AVENUE, EDMONTON.

New Telephone Patents.

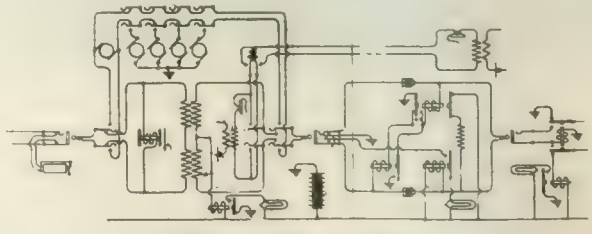
NEW CIRCUITS.

One of the greatest struggles in telephone operating has been with "recalls," it having been found extremely difficult to induce an operator to respond to keyboard signals with line signals "staring her in the face." Even pilot lamps associated with cord supervisory signals have failed to prove effectual.

Mr. W. S. Paca, of Oil City, Pa., has now introduced a new element in the shape of an audible signal. This is a clicking following the supervisory relay and introduced upon the operator's circuit through an induction coil. The battery supply to the supervisory lamps is carried through its primary and thus every variation in current caused by the operation of the relays of the positions results in a click. These clicks must not be sufficiently audible to affect disagreeably the operator's responses to subscribers, but practical provision can be made for this.

Mr. C. S. Winston, of Chicago, Ill., has endeavored to cut down the clicks of an operator's response to a call. He suggests that these are due to the rapid changes of current incident to false and temporary contacts during the insertion of a plug in the jack. To overcome the difficulty he uses relay contacts to keep the ring of the plug disconnected from the battery until after the plug has been completely pushed home. He has assigned his patent to the Kellogg Switchboard & Supply Company.

Another patent granted to the same inventor covers a trunk circuit for toll to local use, the toll operator doing the ringing.



WINSTON TRUNK CIRCUIT.

Three line wires are required and provision is made to clear the live side of the line during the ringing period. The circuit is shown above, the trunk circuit lying at the right. Ringing is done out of the tip side of the line. All ground legs from the tip side are open during this period, while the non-inductive leg is connected to ground from the return side.

Letters to the Editor.

Parallel Operation of Gas-Driven Alternators.

To the Editor of Electrical World:

Sir:—From Mr. Warren H. Miller's article on "Dampeners" in your issue of Sept. 30, one might believe that successful parallel operation of gas-engine-driven alternators was still unknown to the engineering art, while in reality the plant to which Mr. Miller refers is probably the only large plant in this country or abroad in which the generators are operated separately, as outlined by him in the above article. The subject of parallel operation has by proper investigation been reduced to a science, but if "wild visions and tortured cries of demented brains" enter into it, it is apt to become befogged.

The literary value of the above contribution is beyond discussion, but, treating the subject from a technical standpoint, the situation is as follows:

The hunting of gas-engine-driven alternators has been reduced to a minimum by using a stable rather than a "prompt" governor—i.e., by carefully avoiding the remedy suggested by Mr. Miller, and by choosing the characteristics of the units so that resonance between natural and forced frequencies does not occur, a method similar to changing the length of a pendulum receiving impulses at regular intervals to prevent excessive swings. What is left of hunting is controlled by dampers. That the type of valve gear adopted has nothing to do with the question under discussion is recognized by all the prominent gas-engine builders of the world, and is proved by the fact that engines using all possible methods of regulation are in successful parallel operation here and abroad.

Milwaukee, Wis. L. C. Marburg.

Errors in Testing Sources of Light.

To the Editor of Electrical World:

Sir:—The editorial on page 887 of your issue of Oct. 14, on "Some Errors in Testing Sources of Light," calls attention to "an evident ignorance of the application of mathematics to physical problems" and regrets that certain fundamental distinctions have been completely overlooked in some of the current literature on this subject.

I am pleased that you called attention to these points, as it bears out what I have said repeatedly in trying to bring order out of the chaos which exists concerning the comparisons of different sources of light. But in my opinion the suggested new classification, namely, a division of naked sources of light into the three general classes—"point, volume and surface sources"—complicates rather than simplifies, and is, moreover, of a hybrid nature and therefore unscientific, besides being incomplete.

It can readily be shown that to "apply mathematics to physical problems" in connection with all the different forms of the sources of light, the first general classifications must be into points, lines and surfaces (considered as mathematical conceptions), because the laws governing radiation phenomena are radically different in these three cases. This I discussed in detail, giving the formulas and laws, in a paper read at the convention of the Illuminating Engineering Society, in October, 1908, entitled "Calculating and Comparing Lights from Various Sources," and published in the *Transactions* of that society, November, 1908, p. 645.

The point emphasized in the editorial, that some sources are more or less translucent and must, therefore, be considered as having volume, is, however, in my opinion, a very important one, and was referred to by me in the above paper. I do not wish, therefore, to be understood to criticise this feature. I merely criticise the classification, which is based partly on an incomplete geometric distinction (line sources being omitted) and partly on the translucency of the source.

In my opinion it is more rational to divide the sources geometrically into the three classes I suggest, for the reasons above given, and then show how the laws or formulas for each of the three classes should be modified when the source is not a perfect point, line or surface, but has some appreciable volume and is more or less translucent.

Or, if it is found that they bend into each other, and become more nearly alike, then it might perhaps be best to extend the classification to points, lines, surfaces and volumes, thus putting into a fourth class all such sources which by reason of their depth or translucency deviate too much from points, lines or surfaces to follow the specific laws pertaining to these geometric conceptions. My criticism of the editorial, then, is mainly on the omission of lines in the proposed classification. While this may not be a serious omission in view of the fact that at present no such sources are used in practice (the present tube lights being all translucent), yet in making a classification it seems to me that it ought to be done as completely and as perfectly as possible, even though this may include some unimportant classes, as we never know what the future may bring forth.

Philadelphia, Pa. Carl Hering

Photometric Units.

To the Editor of Electrical World:

Sir:—In your issue of Sept. 23 I note on page 696 the suggestion that the "lux" be from now on used, in so far as possible, as the working unit of illumination.

I cannot see that it is really desirable to follow your suggestion. We have already had, and are still having, difficulty with the foot-candle as a unit, on account of the name failing to suggest its meaning, and why, therefore, should we introduce still another unit of which the name suggests its meaning even less? If the time is coming, as is to be hoped, when light sources will be rated by the total flux in lumens, and "lumen" becomes a familiar term, will not the conception of illumination be most easily grasped by expressing it in terms of lumens received per unit area? In such case "foot-candle" will become "lumens per square foot" and "lux" will become "lumens per square meter." These new terms will be easily understood and further, the relation between them will be at once apparent, while to ascertain the relation between "foot-candle" and "lux" the average man would find it necessary to refer to a textbook on illumination. I have on a previous occasion advocated expressing illumination in the above manner (see *Transactions* of Illuminating Engineering Society for April, 1909, page 311) and was glad to hear it advocated by Dr. Sharpe and Dr. McAllister at the recent convention of the above-mentioned society.

Generally speaking, is it not unnecessary and a mistake to give names to units when their meaning is thereby obscured? Have not the terms "watt" and "kilowatt," containing a time dimension, caused endless trouble owing to this time dimension being concealed in the name, contrary to the usual custom? We speak of "miles per hour," "gallons per minute," "cubic feet (of gas) per hour," but not correctly of "watts per hour." Is it not true, however, that laymen generally, as well as many in the electrical business, habitually speak of "watts per hour" when they mean "watts" and of "watts" when they mean "watt hours"?

Boston, Mass. J. S. Codman.

[The disinclination of laymen and others to spend the few moments necessary to learn the meaning of a new unit can scarcely be weighed against the scientific and other advantages usually incident to a proposal to establish a unit. The use of the term "lux" rather than "foot-candle" is preferable for the reasons, first, that it abolishes an expression which appears to be simply a product of two units when, in fact, it bears a complicated relation to the units; and second, that it is based on the metric unit of length. As a lesser evil and for the purpose of insuring the immediate abolishment of the term "foot-candle" (which recalls a candle a foot long rather than a physical unit), there might be provisionally employed as a direct substitute therefor the hybrid expression "lumen per square foot," the

significance of which is indicated in the expression itself, as pointed out by our correspondent. It is desirable, however, to employ the metric units of length and area, and hence, as a further step in the improvement of illuminating terminology, the light flux density should be expressed in "lumens per square meter." For this expression there should be employed finally the shorter name, "lux."—Ed.]

Machine Telegraphy.

To the Editor of Electrical World:

Sir:—Some of the newspaper comments upon the determination of the Postal Telegraph-Cable Company to discontinue the use of the Rowland printing telegraph indicates much misconception of the facts. The following brief statement shows the great carrying capacity of the printer and the reasons why this capacity is not conclusively advantageous under present traffic-handling methods.

The Rowland printers have been in operation for about two years upon six of our important circuits, three being operated in octoplex, two in quadruplex and one in duplex. The octoplex circuits show an ordinary carrying capacity of from 2000 to 2500 telegrams of 30 words each per day. The other circuits have the same relative carrying capacity. When there is more active traffic we have found the system generally to be capable of carrying approximately 50 per cent more than the above-mentioned traffic when the operators were called upon to make the effort.

One of the quadruplex Rowland installations has been in operation on the line from New York to Chicago (about 1057 miles) for nearly two years, and includes a Rowland repeater at Meadville, Pa., midway upon the circuit. This circuit has never hitherto been operated on quadruplex so satisfactorily as with the Rowland system.

One of the quadruplex circuits is operated between New York and Pittsburgh, Pa., and presents unusual conditions, because of the fact that the wires pass through the coal regions and are unavoidably coated with carbon to a considerable extent. The method of operating this circuit with the Rowland system has largely obviated any difficulties in that section resulting from these conditions, and our quadruplex operation of this circuit with the Rowland is more satisfactory than it has been with the Morse quadruplex.

Our operators are young women, inexperienced in Morse telegraphy, and, in general, they have proved able to sustain a rate of 300 messages per day, and some of them are able to increase this to 400 messages per day, and sometimes 500 messages per day.

We have found the method of "half working" when difficulties of balancing occur an important and useful improvement in the Rowland system. We have occasionally found it possible to operate the Rowland circuit in full octoplex when it was difficult, on account of weather conditions, to operate with Morse in any larger capacity than that of duplex. The standard-model Rowland apparatus is well constructed and durable.

By the employment of low-priced operators we have been able to effect economies in labor cost, and it is obvious that the use of the Rowland at times results in considerable wire saving.

On the other hand, we have not succeeded in maintaining Rowland operation at all times so steadily as not to conflict with a prompt service. Although the Rowland carries a large amount of traffic, it is subject to more or less frequent interruption. We cannot keep all the parts of the machine constantly operative and we do not keep reserve installations.

To secure successful operation the Rowland must be used upon wires with which the Rowland attendants are familiar. The Rowland cannot be promptly placed in operation upon a wire which has not previously been used in Rowland service, or one whose characteristics have not been approximately noted so as to avoid delay in getting started.

The recent determination to prevent every avoidable delay to telegrams has brought into prominence the somewhat numerous interruptions that take place in the operation of an intricate page printer. It has become necessary to increase greatly the amount of printer apparatus held in reserve, or to provide a reserve of Morse operators and equipment always ready to supplement the work of the printer. To prevent delay to traffic either of these reserves would have to be too expensive to permit economical operation of the printer, and for this reason we have decided to stop using the printer for the present.

Although the use of the Rowland system has extended over a period of several years, this use has always been experimental. Modifications of the Rowland apparatus have been suggested, and it is quite possible that further experiments will be made.

New York, N. Y. Charles P. Bruch,
Vice-president, Postal Telegraph-Cable Company.

[Until our telegraph systems are radically reorganized from top to bottom on the basis of machine telegraphy, and manual telegraphy is finally consigned to the tomb that has been yawning for it for the past 30 years or more, the telegraph industry will continue to lag far behind all other electrical development. Almost necessarily machine telegraphy cannot be "conclusively advantageous under present traffic-handling methods."—Ed.]

The Fuel Problem.

To the Editor of Electrical World:

Sir:—Referring to the editorial on "The Fuel Problem" in your issue of Oct. 7 setting forth the objects and aims of the International Railway Fuel Association, and with particular reference to that portion of your comments relating to the possibilities of increased use of water-powers and also in view of the fact that so much attention is now being directed to the conservation of our natural resources, it becomes interesting to make an approximate estimate of the amount and value of fuel which would have been required for the production of the combined output of four hydroelectric developments of which figures are available operating in Canada along the Canadian frontier under the Canadian Electricity and Fluid Exportation Act. Three of these developments are located at Niagara Falls, Ont., while the fourth is located on the boundary between New Brunswick and Maine. The annual report of the Gas and Electricity Branch of the Canadian Inland Revenue Department shows that during the last fiscal year the amount of electrical energy generated by the four power companies referred to for Canadian consumption and for exportation to the United States was as follows:

Amount generated for use in Canada = 135,075,680 kw-hours; amount generated for use in United States = 359,283,286 kw-hours; total amount generated = 494,358,966 kw-hours.

As the efficiency of the largest and most economical steam-driven electric plants in operation do not show a greater value than 10 per cent from the coal pile to the switchboard, and as a large proportion of the total load supplied by the four power companies in question would have an average thermal efficiency considerably below that above noted, if each of the plants consuming the above aggregate amount of power were to individually generate its energy from coal in steam-driven electric plants, the average thermal efficiency for these plants as a class may be liberally placed at 7 per cent.

If the average calorific value of fuel used in these plants be assumed to be 12,000 pound-Fahrenheit units, and remembering that a kw-hour represents 3412 heat units, 1 lb. of coal would produce 840 heat units at the switchboard; or reduced to the basis of kw-hours, it appears that 1 lb. of coal produces $\frac{840}{3412}$ kw-hour, or approximately ¼ kw-hour. This means that 4 lb. of coal would be required for the production of the average kw-hour at the switchboard of the various plants of the four power companies considered if operated by steam. Therefore, the total coal represented by the 494,358,966 kw-hours generated by these four power companies would be 1,977,435,864 lb., or 988,718 tons, of coal. If the average cost of a ton of coal be taken at $3 delivered to boilers, then 988,718 tons would represent an expenditure of $2,966,154.

This saving of approximately $3,000,000 worth of fuel is

quite formidable, and while representing the total of only four isolated cases, causes one to reflect upon the great good that these and other hydroelectric developments are doing toward the amelioration of fuel exhaustion and indicates the paramount importance of developing our available water-powers to their fullest extent.

Edgewood Park, Pa. Clarence P. Fowler.

Proposed Remedy for a Patent-Office Abuse.

To the Editor of Electrical World:

Sir:—In your issue of Sept. 23, 1909, quoting from the New York *Evening Post*, you discuss the Selden automobile patent as an illustration of the evil that may arise from permitting a patent application to remain pending in the Patent Office for an excessive length of time. In 1879 Selden applied for a patent on a hydrocarbon engine united to a horseless carriage by means of a clutch. The disclosure was crude and the alleged invention was elementary, but no particular harm would have been done if the patent had issued promptly, for in that case its 17-year term would have expired about 1896 or 1897, before the automobile industry had made much of a start. But by keeping his application pending till 1895 Selden secured a patent which enables him, at this late day, to levy tribute on the whole automobile industry. The enormous resultant evil has been pointed out in your article to which I refer.

To remedy this evil in future, I suggest the following amendment to be added to Section 4884 of the Revised Statutes, this section being the one which fixes the term of a United States patent at 17 years:

"Provided, that every patent for an invention, discovery or design granted on an application filed subsequently to (some date in immediate future) shall be so limited as to expire 20 years after the first occurrence of any of the following events, namely, (1) the issuance of a patent in any country for the same invention, discovery or design; (2) the description of the same invention, discovery or design in a printed publication in this or any foreign country; (3) a public use or sale in this country of any embodiment of the same invention, discovery or design. In no case shall a patent be in force more than 17 years."

As far as practicable, the phraseology is drawn from prior enactments, of which numerous adjudications would be available in order to interpret this proviso in relation to special cases that might arise. Patents granted prior to the year 1898 were "so limited as to expire" with the expiration of a foreign patent for the same invention; hence we have had experience with a statute cutting short the normal 17-year term of a patent. Patenting abroad, description in a printed publication, public use and sale, have all been defined and discussed in numerous court opinions in connection with Sections 4886 and 4887 of the Revised Statutes, which provide among other things that a patent must be applied for within two years of the first occurrence of any of these events. Hence the proposed amendment would be tolerably definite from the first.

The proposed amendment is conservative. No burden is imposed on the Patent Office, as would be the case if an effort were made to limit the time during which a patent application might remain pending in the Patent Office. Some years ago Commissioner Seymour tried the plan of cutting down to six months the time during which an application might await action by the applicant. Every patent attorney knows that he could keep an application pending many years even if he had to make replies to office actions within six months thereof.

Two objections present themselves, as follows:

(1) In case of an interference with a co-pending application, there might be a long delay which the applicant could scarcely avoid according to the present practice. Even granting that this could not be helped, it is a reasonable proposition that the rights of the public are of major importance and may require a sacrifice of some advantages otherwise accruing to an individual applicant. However, the interference practice ought in some way to be expedited and made less expensive; that is another problem. Under the statutes as they are now, the Commissioner of Patents would undoubtedly have authority to summarily hasten the prosecution of a particular interference in case it was necessary to avoid cutting short the term of the patent to be issued under the law, amended as proposed.

(2) Testimony in court relative to the application of the proposed law would relate back to matters occurring more than 20 years earlier, and hence there would be opportunity for fraud and perjury, or, on the other hand, it might be hard to establish the facts. The answer to this is that foreign patenting and printed publication are about as easy to prove at one time as another, for they are matters of record; as to public use or sale, if it was of so little extent as to be incapable of proof 20 years later, then it would not be unjust to permit the patent involved to live its natural term of 17 years. No doubt the courts would require definite and full proof on these matters, as they have done in the past.

The amendment would not work to the disadvantage of the inventor who is "ahead of his time," meaning the inventor who is ahead of other inventors. If this law had been in force at the time of Selden's first invention, and if he had believed himself a long time ahead of other inventors, then he might have kept his secret to himself and kept his patent application pending exactly as he did do. Not until there was a foreign patent issued on the same invention or until the device was described in print or put to public use or sale would the 20 years have begun to run against him. Thereafter he would have had three years more in which to bring to a close the prosecution of his application, and even then the natural 17-year term of his patent would not have been cut short by the 20-year rule. It is to be remembered that the Patent Office keeps pending patent applications secret from the public.

There are other evils in our patent system that need correction, but I believe the particular fault here mentioned would be effectively and justly remedied by the simple amendment which I propose.

Chicago, Ill. Carl A. Richmond.

[While the above suggestion would tend to remedy one abuse of our present patent system, it would accentuate another, namely, the use of "feeler" interferences whereby a meritorious invention can be kept from issue indefinitely. This is alluded to in objection (1), but the sacrifice entailed, while inflicted on the bona fide inventor, would not be in the interest of the public. Piecemeal patent legislation will probably only result in changing the incidence of abuses. Our present patent system was founded on industrial conditions that have little in common with those of to-day, and what appears necessary is a radical revision of the entire system to meet present conditions.—Ed.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Oscillating Motor.—P. Boucherot.—A paper presented to the Society of Electricians in Paris. He describes several designs of machines operated by single-phase alternating current so as to produce an oscillatory movement. The principle of one of them is shown in Fig. 1. B_1 and B_2 are two windings in series or in parallel supplied with single-phase alternating current. The arm C has a third winding supplied with direct current from a battery Q. R and R^1 are two springs connected to the two fixed points E and E^1. The arm C is movable around the axle D. When no alternating current is supplied to B_1 and B_2, the arm C is in the position shown in the illus-

tration, and the magnetic flux produced by the direct current in the arm C is divided into two halves passing through the two halves of the electromagnet core A. When an alternating current is supplied to B_1 and B_2, the arm C oscillates alternately between the sides in synchronism with the current. The author also shows how this oscillatory movement can be changed into a rotary movement. A motor based on this principle was shown

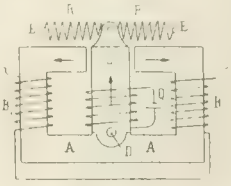


FIG. 1.—DIAGRAM SHOWING PRINCIPLE OF OSCILLATING MOTOR

at the exhibition of Marseilles. The author thinks that motors of this type can be used for single-phase traction. They can be directly operated by high-tension single-phase current. The speed can be regulated either by adjusting the impressed alternating e.m.f. or the strength of the exciting direct current. The power consumption is proportional to the speed for a given torque. The power factor can be made equal to unity for a given load if the excitation is held constant, and for a varying load if the excitation is varied accordingly. The angular speed is comparatively low so that direct connection to the wheels without any gearing is possible.—*L'Industrie Elec.*, Aug. 25.

Tips of Teeth on Armature Cores.—M. Walker.—An illustrated article in which the author deals with the main considerations controlling the design of tips of teeth and the effect of the shape on the magnetic leakage. Curves are given showing the relation between the dimensions of the tip and the permeance of the leakage path, so that the designer while modifying the shape, can see exactly what he is doing and can with a minimum amount of calculation decide on the shape which will best meet all conditions.—Lond. *Electrician*, Oct. 1.

Theory of Single-Phase Commutator Motors.—F. Schmidt.—An article illustrated by diagrams in which the author gives a theory of the different types of single-phase commutator motors based on the consideration of the rotary field, which is common to the stator and the rotor. The author investigated the e.m.fs. produced during a period by this rotary field. He deals with a series motor and the repulsion motors of Latour, Winter-Eichberg and Thompson.—*Elek. und Masch.* (Vienna), Sept. 26.

Thickness of Laminations.—F. Loppe.—An article giving formulas, tables and diagrams for determining the most advantageous thickness of the iron sheets to be employed in the construction of electric machines.—*L'Industrie Elec.*, Sept. 25

Lamps and Lighting.

Enclosed Flame-Arc Lamp.—An illustrated article on recent modifications of the Jandus enclosed flame-arc lamp. The design of the electrode has been altered considerably, the upper electrode now having six soft cores spaced symmetrically, about the center, so that it will burn to a point. The cores are composed of a mixture of carbon and a special chemical paste, giv-

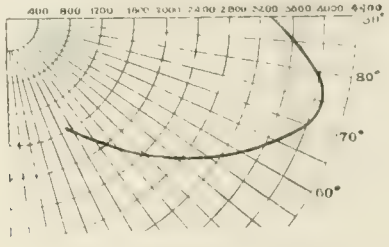


FIG. 2.—DISTRIBUTION CURVE.

ing a "fat arc." As in the original pattern, the lower electrode is star-shaped in section, the grooves being filled with a paste. The new electrodes give a mean hemispherical candle-power of 3000, and cost less than 0.2 cent per hour. Fig. 2 shows the polar candle-power curve of a lamp consuming 460 watts and giving a mean hemispherical candle-power of 3160 with a specific consumption of 0.166 watt per candle. The maximum candle-power is over 4000 at an angle of 15 deg. below the horizontal, which is most suitable for street lighting. The lamp can be burned either on direct-current or alternating-current circuits, and takes 8 amp, burning two in series on 110 volts or four in series on 220.—Lond. *Elec. Eng'ing*, Sept. 30.

Arc Lamp.—Bermbach.—A paper read before the German Association of Electrical Engineers on a new "universal" arc lamp (Conta lamp) with parallel (slightly inclined) electrodes side by side. The lamp has no regulating mechanism. Its special feature is that ordinary round electrodes can be used. The negative electrode rests on a piece of copper, which is made of large cross-section in order to facilitate quick conduction of heat away from the end. For this reason the carbon piece neither melts nor evaporates. The length of the arc varies only within small limits.—*Elek. Zeit.*, Sept. 2.

Safety Lamp in Mines.—J. G. Patterson.—A note on a new safety lamp recently exhibited before the British Institution of Mining Engineers. It consists of a metallic-filament lamp placed in front of a strong parabolic reflector and behind a glass lens, so that a beam of 20 cp, measured along the focus axis, is obtained. This is operated from a 4-volt cell contained at the base of the lamp. In conjunction with this, however, at the back of the lamp, is a small oil lamp protected both with a glass shield and a piece of gauze, which is intended for testing for gas in the usual way. A switch is arranged whereby the light from the electric lamp can be turned off, and simultaneously a current is passed through a platinum wire by means of which the oil lamp is ignited. In order to prevent both the oil lamp and electric lamp glowing simultaneously, when the latter is switched on, a snuffer over the oil lamp is brought into operation. Moreover, in a gassy mine, an arrrangement is provided on the lamp for shutting off the air supply to the oil lamp in order to extinguish the flame. The weight of the whole equipment, which is intended to burn from 14 to 20 hours continuously, is 5 lb.—Lond. *Elec. Eng'ing*, Sept. 23.

Regenerating Blackened Carbon-Filament Lamps.—A note on a recent British patent of E. A. Krüger (8283, 1909; Sept. 16, 1909). After the bulb has been opened, and the carbon deposit removed from its walls by heating, it is evacuated and a definite quantity of pure hydrocarbon is introduced. The filament is then brought to incandescence by the passage of a current which decomposes the hydrocarbon, and carbon is deposited on the filament.—Lond. *Elec. Eng'ing*, Sept. 23.

Prevention of Blackening of Lamps.—A note on a recent British patent of W. C. Arsen (18,054, 1908; Sept. 16, 1909). In the opinion of the inventor, the blackening of metal-filament lamps may be practically obviated by removing from the bulb the readily ionized mercury vapor which may have reached there. For this purpose the stem holding the filament cage is coated with silver or other mercury-absorbing material. The silver may be applied by painting the stem with silver oxide dissolved in ammonia and heating afterward. This liquid may contain silver in suspension. As an alternative, silver foil may be wrapped round the stem.—Lond. *Elec. Eng'ing*, Sept. 23.

High-Voltage 22-cp Osram Lamps.—The British company which sells the osram lamp announces that it is about to supply 32-watt osram lamps for working on 220-volt circuits. The rating will be 22.5 cp (25 hefner candle-power) and the lamp will burn at any angle.—Lond. *Elec. Eng'ing*, Sept. 30.

Generation, Transmission and Distribution.

Water-Powers in Europe.—T. Koehn.—The first part of an article on some large European water-power plants and their commercial importance. He first gives the following tables of the water-powers which could be developed in eight European countries on the basis of the quantities of water per second available during nine months. The first column gives the total water-power in horse-power which could be made available

at the axles of the turbines. The second column gives the number of horse-power per square kilometer of the country, and the third column gives the number of horse-power per thousand inhabitants.

	Total hp.	Hp per sq. km.	Hp per 1000 inhabitants.
Great Britain	963,000	3.06	23.1
Germany	1,425,900	2.6	24.5
Switzerland	1,500,000	36.6	454.5
Italy	5,500,000	19.0	169
France	5,857,000	10.9	150
Austria and Hungary	6,460,000	9.6	138
Sweden	6,750,000	15.0	1,290
Norway	7,500,000	20.0	3,409

Switzerland has the largest water-power available per square kilometer, but Norway has by far the largest total water-power per 1000 inhabitants. Norway has also the largest total number of horse-power which could be developed, 5.36 times the horse-power of Germany. On the other hand, the present commercial value of the water-powers of Germany is by no means in the same ratio to the water-powers of Norway, because Germany will be able to find use for all its available water-power in the near future, while Norway could utilize hardly more than 10 per cent at present. The author gives an interesting review of the developments of water-powers in Europe and discusses especially the water-powers of the Rhine. After a review of the water-power plant at Rheinfelden, he notices some new plants, projected or in course of erection along the Rhine, namely, Laufenburg (50,000 hp in 10 units), Wyhlen-Augst (two power houses with 10 2000-hp units), Rheinau (12 1600-hp turbines). The author discusses the commercial importance of the developments of these water-powers. The paper is to be concluded.—*Elec. Zeit.,* Sept. 23 and 30.

Vertical Motors for Pumping.—An article on some new designs of vertical motors made by a European company for vertical rotary pumps. Fig. 3 illustrates a ready mounted sinking pump used at the Gabriela Mine, Brandau, Bohemia. The water-tight motor is of the short-circuited rotor type, and develops an output of 42 hp at 500 volts and 2900 r.p.m. The connection between the pump and the motor is cushioned with rubber rings, as it frequently happens that the pump has to work entirely under water. The top bearing of the motor is constructed as a suspension bearing and supports the rotor, while the lower journal bearing simply serves to guide the shaft, the pump possessing its own bearings. The motor terminal box is also made water-tight and the leading-in cables are thoroughly bushed with rubber. Lubrication of the top suspension and guide bearing is effected automatically. Oil, contained in a reservoir, which totally encloses the lower journal bearing, travels along a transporting worm cut in the motor shaft through a special channel, also provided in the shaft, to the top bearing and returns to the reservoir through the pipe seen at the side of the motor.—Lond. *Elec. Eng'ing,* Sept. 30.



FIG. 3—ELECTRICALLY DRIVEN SINKING PUMP.

Reversing Rolling Mill.—C. A. Ablett.—A paper read before the Iron and Steel Institute on the determination of the economy of reversing rolling mills. The author first criticises the usual methods of determining the efficiency. The energy consumption of an electrically driven reversing rolling mill as expressed in kw-hours per ton rolled can be determined in the simplest possible manner by inserting in the supply system an ordinary watt-hour meter, which is an instrument that can always be left in circuit and requires no attention. If a reading of this instrument before the commencement of a shift and a second reading at the end of the shift are taken, the difference gives the total kw-hours used during the shift, and dividing this by the tonnage rolled the total kw-hours per ton is obtained. The following figures show some of the characteristic values for the kw-hours per ton rolled obtained from tests on reversing rolling mills:

	Kw-hours per ton.
4.5 in. x 4.5 in. billets from 2.5-ton ingots, output 53 tons per hour	22.5
6 in. x 6 in. blooms from 2.5-ton ingots, output 63 tons per hour	17.5
8 in. x 8 in. blooms from 2.5-ton ingots, output 80 tons per hour	13.0
12 in. x 9½ in. blooms from 7-ton ingots measuring 34.5 in. x 25 in., output 65 tons per hour	11.2
32 in. x 9 in. slabs from 6-ton ingots measuring 36 in. x 19½ in., output 40 tons per hour	4.3
32 in. x 5 in. slabs from 6-ton ingots measuring 36 in. x 19½ in., output 40 tons per hour	5.8
Flange rails, 100 lb. per yard, from 2-ton ingots, output 30 tons per hour	48.0
Beams, 120 lb. per yard, from 1.5-ton ingots	36.0
Channels, 92 lb. per yard, from 1.5-ton ingots	37.0

Twenty firms have now decided to adopt electrically driven reversing rolling mills, and 12 such plants are at work in different parts of the world, one at least being installed to replace an engine less than 10 years old which was in good condition. —Lond. *Electrician,* Oct. 1.

Electric Winding Plant in Mine.—H. Wille.—A fully illustrated account of tests of the electric main-shaft winding plant at the Ottilie mine, in Clausthal. A storage battery is used in connection with the Pirani booster for winding in the mine shaft. The curves and figures show that the storage battery keeps the strong load variations away from the central station. Efficiency tests were made and a consumption of from 1.78 kw-hours to 1.80 kw-hours per hp-hour in the shaft was found. For 100 per cent efficiency 1 kw-hour = 1.34 hp-hour.—*Elek. Zeit.,* Sept. 23.

Electric Power at a Harbor.—An illustrated article on electrically driven machinery at Fishguard Harbor, in southern Ireland. The power plant contains four direct-current sets. Three have a combined rating of 360 kw at 480 volts, while the fourth is a balancer consisting of two machines, each of 60 kw at 240 volts. Energy is used for lamps and motors, especially for the operation of the cranes in the harbor. Some details of the crane construction are described and illustrated.—Lond. *Electrician,* Sept. 24.

Traction.

Tramways.—A. R. Fearnley.—A paper read before the recent conference of the (British) Municipal Tramways Association, giving some comparisons of methods of operating tramways in Great Britain and in continental Europe. The author first considers the advantages of the double-deck car compared with the single-deck car and gives some interesting details of the cost of operation of the two types. He then discusses the use of trailer cars and the vestibule type of car, the latter being much in favor on the Continent. He expresses the opinion that the bow collector is better than the trolley boom, and finally refers to the railless electric trolley car, which he considers will play in the future an important part in tramway business.—Lond. *Electrician,* Sept. 24.

Railless Traction.—A. R. Fearnley.—Some data concerning the hub-motors used on the Vienna municipal trackless trolley system. Each motor of the trackless trolley vehicles gives about 20 hp with energy at 500 volts, and the motors can take 100 per cent overload for considerable periods without detrimental heating. They are designed so that the field-magnet spindle is mounted and fixed on the axle as an internal pole star. The armature is placed outside, and forms part of the wheel itself. For this purpose it is carried on two ball bearings, one each side of the field magnet. The field magnet is of steel, and has 10 poles riveted together under a special process. Each spool consists of a flat copper band of uniform section, but of variable width and depth. In this way the space between the spools is used to best advantage, although these spaces get narrower toward the center of the wheel on account of the radial disposition of the spools themselves. The armature is built in a similar way out of the best steel, and consists of a large number of spools, insulated by silk, which are built into the frame of the wheel, the latter being made of special gun-metal. The brush holder is arranged in a vertical plane, so that the vibration of the car cannot lift the brushes, which consist of special carbon and require only very weak springs. For

overhead line purposes use is made of only four brushes, which are fixed on one ring. It is sufficient to take off the cover plate to fix or tighten up any part. The motors are completely dustproof and waterproof, and the design of the axle makes it possible to take off at one operation the whole wheel motor, and at the same time the radius rod, which is designed as the fixing point of the brakes. The motors are placed in the back wheels for trackless trolley operation and in the front wheels for fire-brigade work. The efficiency of the electric motors on the brake is between 80 per cent and 90 per cent, and if one considers that the power is directly brought to the motors in the wheel itself, and, therefore, no gearing or change of power or transformation of any kind is employed, this represents the efficiency at the wheel for a given current in the overhead line, which result, it is claimed, cannot be surpassed by motors of any other type.—Lond. *Electrician,* Sept. 24.

London.—Statistical data on the equipment and financial returns during the past year of the six tube railroads in London and of the Metropolitan District Railway and the Metropolitan Railway. The "most creditable record" is that of the City & South London Railway (a tube railroad), which shows working expenses of only 5.7 cents per car-mile, the seating capacity of each car being 32 passengers.—Lond. *Electrician,* Oct. 1.

Industrial Electric Locomotives.—Henry.—Illustrated descriptions of various types and constructions.—*L'Industrie Elec.,* Sept. 25.

Installations, Systems and Appliances.

Central-Station Statistics of Germany.—G. Dettmar.—During the past 13 years the *Elek. Zeit.* has published each year complete statistical tables of the central stations of Germany. Beginning with the present year these tables, which have increased rapidly in size, are being published separately in book form, and only a summary of the data is given in *Elek. Zeit.* The figures of the present statistics refer to the central stations existing on April 1, 1909. The number of stations on that date was 1978. The editors had on hand also 107 other names concerning which no reliable data was available, while it is certain that a great many of them really existed. It may, therefore, be assumed that on the date mentioned there existed in Germany about 2050 central stations. The increase during the last two years has been 448 stations. This figure does not tell the whole story, because various old works have been absorbed by new works and are, therefore, no longer counted as independent stations. There were in course of erection on the date mentioned 64 stations. The total connections to all the central stations were 1,872,592 kw. These comprise 12,808,351 incandescent lamps (670,418 kw); 234,566 arc lamps (129,011 kw); 896,910 hp of stationary

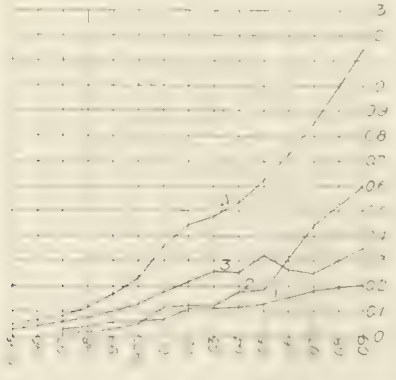


FIG. 4.—CURVES SHOWING INCREASE IN AGGREGATE RATING.

motors; 286,910 hp of tramway motors of traction systems supplied with energy from lighting stations, and 37,721 kw of cooking and heating apparatus. The increase of the aggregate rating of central stations during the last 14 years is shown in Fig. 4. Curve 1 gives the aggregate rating of single-phase and polyphase central stations; curve 3 the aggregate rating of direct-current stations; curve 2 the aggregate rating of stations with a mixed direct-current and alternating-current system, and curve 4 the total central-station rating in millions kw. The abscissas give the years from 1895 to 1909. Out of the cities which have electricity works, 1010 have no gas works and 351 have gas works, while no information is available in this respect of the remaining 617 cities. Fig. 5 gives curves for showing the motive power of the different stations from year

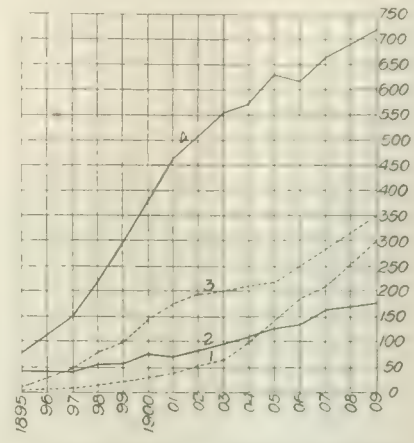


FIG. 5.—CURVES SHOWING INCREASE OF MOTIVE POWER.

to year since 1895. The ordinates are the number of stations and the abscissas give the years from 1895 to 1909. Curve 1 is the number of stations operated exclusively by internal-combustion engines; 2, water-power stations; 3, stations operated both by water-power and steam; 4, stations operated exclusively by steam. A list is given of the 93 stations which have a rating of more than 2000 kw each. The aggregate rating of these 93 stations is 785,000 kw. The largest station is the Berlin Electricity Works, covering the city and suburbs of Berlin, with a rating of 148,462 kw.—*Elek. Zeit.,* Sept. 30.

Balanced Transformer Protection System.—A note on a recent British patent of the Allgem. Elek. Ges. (4705, 1909; Sept. 23, 1909). In protective systems in which the secondaries of two transformers are balanced against one another in a closed circuit, the secondaries are shunted by overload relays, the contacts of which are in parallel in the tripping-coil circuits of the main-circuit breakers. As an alternative, the primaries of the transformers, which are in the circuit to be protected, are shunted by resistances which will maintain the balance at a momentary overload, but which upset the balance if the overload exists sufficiently long to heat them up.—Lond. *Elec. Eng'ing,* Sept. 30.

Wires, Wiring and Conduits.

Gutta Percha.—R. Apt.—An article on the production of gutta percha and its application, with special reference to the new rules for conductors of the German Association of Electrical Engineers.—*Elek. Zeit.,* Sept. 23.

Electrophysics and Magnetism.

E.M.Fs. of Solutions in Capillary Tubes.—A. T. Cameron and E. Ottinger.—An account of an experimental investigation of the e.m.fs. produced by acid and alkaline solutions streaming through glass capillary tubes. The experiments described lead to the conclusion that Helmholtz's and Dorn's value of 5 volts for the potential difference between glass and water is correct, and that when the liquid is made acid or alkaline, the change is of the order of half a volt to the negative side in the first and to the positive side in the second case, the sign always applying to the liquid. Some theoretical considerations are added.—*Phil. Mag.,* October.

Electric Discharges Through Gases.—L. Vegard.—An account of an experimental investigation on the electric discharge through the gases HCL, HBr and HI. The general character of the discharges is the same as for elementary gases. The "electric absorption" of a gas is found to be closely connected with the size of the cathode fall, which leads to the assumption that the absorption is caused chiefly by positive ions being shot into the cathode.—*Phil. Mag.,* October.

Striations in Electric Discharge.—J. J. THOMSON.—An account of experiments in which he investigated the distribution of the electric force in the neighborhood of a striation in an electric discharge through a gas. The chief result is that there is intense negative electrification at the bright head of a striation (by head is meant the side next to the cathode) and a weak positive electrification through the rest of the field. The author gives a theoretical explanation of the heaping up of the negative electricity at the head of the striations.—*Phil. Mag.*, October.

Radio-Activity.—A paper read by J. Jolly on the considerable amount of radio-activity found in certain lavas; a paper by T. S. Taylor on the retardation of alpha rays by metals and gases; a paper by F. Soddy and A. S. Russell on the gamma rays of uranium and radium; and a note by J. W. Waters on radio-active minerals in common rocks.—*Phil. Mag.*, October.

Electrochemistry and Batteries.

Capacity of Storage Batteries.—F. LOPPE.—For the discharge of a storage battery at constant current i in t hours the following empirical relation holds good: $i^n t = k$, where n is a constant which varies between 1.15 and 1.80 and depends on the type of the storage battery, and k a constant depending on the dimensions of the cell. This relation found by Peuckert is of sufficient accuracy for practical applications. If the same battery is discharged at constant current i_1 and the time of the discharge is t_1 hours, while i is the normal current and the normal duration of discharge is t hours, then the following relations hold good: $i_1^n t = {}^n t$ and

$$\frac{(i_1 t_1)^n}{t_1^{n-1}} = \frac{(i\,t)^n}{t^{n-1}} = \frac{C_1^n}{t_1^{n-1}} = \frac{C^n}{t^{n-1}}$$

C_1 and C are the useful capacities in amp-hours (*i*$_1$*t*$_1$ and *i t*) for the discharge rates in t_1 and t hours respectively. From this is obtained the relation

$$C_1/C = (t_1/t)^{\frac{n-1}{n}}$$

where C_1/C is the ratio of the two capacities. The author has calculated a table in which he gives this ratio for various ratios of t_1 to t and for different values of n. The same table also permits one to find directly the coefficient n when the capacities of a storage battery at two different discharge rates are known.—*L'Industrie Elec.*, Sept. 25.

Ferro-Vanadium.—J. ESCARD.—The conclusion of his article on the production of ferro-vanadium. In the present installment he describes electric-furnace methods and the alumino-thermic method for making ferro-vanadium.—*La Lumière Elec.*, Sept. 25.

Electric Iron Smelting.—E. J. LJUNGBERG.—An illustrated account of tests of an electric furnace for smelting iron ore used in a Swedish plant.—Lond. *Electrician*, Oct. 1.

Units, Measurements and Instruments.

Insulation Tests.—S. A. RUSSELL.—An article on Rousseau's method of measuring the insulation of a live three-wire system. The apparatus required consists of an electrostatic or high-resistance voltmeter, a resistor of known resistance, and one or more switches; and the test is made by first determining the

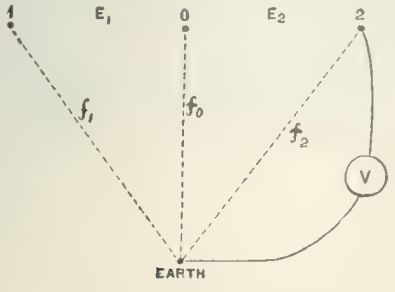


FIG. 6—INSULATION TESTS.

joint fault resistance of the system, which is done by connecting any one of the three wires to earth through the voltmeter and noting the reading V, and then connecting the same wire to earth through the resistance S and noting the reading V^2. The joint fault resistance is $F = S\frac{V - V^2}{V^2}$, provided an electrostatic voltmeter is used, or a voltmeter whose resistance is very high compared with the values of F and S. After obtaining the value of F, the voltage E_1 on one side is raised and the voltage E_2 on the other side of the system is lowered, so as to make the ratio $\frac{E_1}{E_2} = K$ as large as is conveniently possible, and the reading V of the voltmeter when connected between one wire and earth is noted. The voltage is then again changed so as to make the ratio $\frac{e_1}{e_2} = k$ as small as possible, and the reading v of the voltmeter is noted. Referring to Fig. 6, in which 1, 0 and 2 are the three wires, f_1, f_0 and f_2 the fault resistances, and V the voltmeter connecting the wire 2 to earth. One can then find f_1 from the equation

$$f_1 = \frac{FE_2e_1(K-k)}{e_2V - E_2v}$$

further f_0 from the equation

$$\frac{E_2}{f_0} = \frac{V}{F} - \frac{E_1 + E_2}{f_1}$$

and f_2 from the equation

$$\frac{1}{F} = \frac{1}{f_0} + \frac{1}{f_1} + \frac{1}{f_2}$$

—Lond. *Elec Review*, Sept. 17.

Units and Symbols.—A report of the committee on units and symbols of the German Association of Electrical Engineers proposing uniform symbols for temperature and alternating-current units. Impedance S is defined as the ratio of effective resistance to effective current, and is called "Scheinwiderstand" (apparent resistance). Effective resistance R is defined as the ratio of power to the square of effective current, and is called "Leistungswiderstand." Reactance B is defined by the equation $B = \sqrt{S^2 - R^2}$ and is called "Querwiderstand" (literally translated quadrature resistance). What we call effective current and effective voltage is called "Leistungsstrom" and "Leistungsspannung" respectively. What we call wattless current and reactance voltage is called "Querstrom" and "Querspannung" (quadrature current and quadrature voltage) respectively. Finally, the following general table is given of the symbols recommended by the committee:

Length	l
Mass	m
Time	t
Radius	r
Diameter	d
Wave length	λ
Volume	V
Angle, arc	α, β
Angle of phase difference	φ
Speed	v
Acceleration or gravity	g
Angular acceleration	ω
Number of revolutions per unit of time	n
Work (mechanical or electrical)	A
Efficiency	η
Pressure (force divided by surfaces)	p
Modulus of elasticity	E
Absolute temperature	T
Temperature from molten ice as zero point	t
Quantity of heat	Q
Specific heat	c
Specific heat at constant pressure	c_p
Specific heat at constant volume	c_v
Coefficient of heat expansion	α
Gas constant (per molecular weight)	R
Intensity of magnetism	T
Field intensity	H
Flux tensity (magnetic induction)	B
Magnetic permeability	μ

Magnetic susceptibility ..... *κ*
Electromotive force ..... *E*
Current ..... *J*
Coefficient of self-induction ..... *L*
Electric capacity ..... *C*
Electric quantity ..... *Q*

Critical notes are added by members of the committee giving its reasons for the recommendations that were made.—*Elek. Zeit.*, Sept. 9.

Energy Consumption of Alternating-Current Instruments.—J. von Studniarski.—The conclusion of his paper in which he gives a graphical method for determining the correction made necessary by the energy consumption of a watt-hour meter itself. The author gives tables of electric data of the most important types of alternating-current instruments of different manufacturers. He finally discusses the influence of the range of measurements and of the sensibility on the correction factors for wattmeters, voltmeters and ammeters, and gives a numerical example of calculating the corrections.—*Elek. Zeit.*, Sept. 9.

BOOK REVIEW.

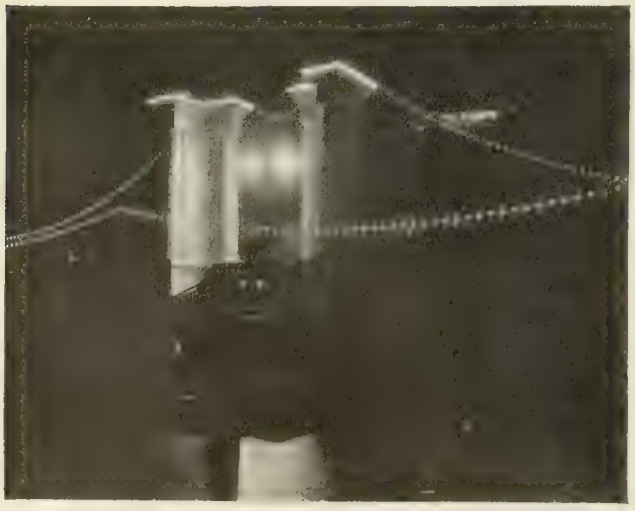
Hendricks' Commercial Register of the United States. New York: S. E. Hendricks Company. 1220 pages. Price, $10

The eighteenth annual edition of this useful manual, which has just been issued, comprises about 350,000 names and addresses of American manufacturers classified under 35,774 heads and representing every machine, material, apparatus or specialty required in the various industries in which it specializes. There are, for instance, over 2700 classifications of machinery alone. A convenient feature of the directory is the inclusion wherever possible of trade-mark names, which assist one in search of a certain brand to locate it. The comprehensiveness of the contents is indicated by the fact that for railroads everything is listed from a track bolt to a locomotive; for the electrical industry everything from a push-button to a generator. The book is particularly valuable in locating material mentioned in specifications, and a considerable use of the directory indicates that its compilation is remarkably accurate.

NEW APPARATUS AND APPLIANCES

Arc-Lamp Illumination During the Hudson-Fulton Celebration.

During the Hudson-Fulton celebration week business and commercial houses in and around New York City vied with each other to obtain the best illumination effects. The festooning of incandescent lights formed the bulk of the work done by electric illuminating engineers for the celebration. There were, however, a few instances in which arc lamps were used, and which seemed to show the utility of this method of illumination for celebration purposes. They gave a solidity and uniformity



WATER GATE.

of illumination in buildings and an interior decoration which were a distinct feature.

A noteworthy instance of the nature of this illumination was seen at the 13-story building of the Western Electric Company, which faces on West Street, directly overlooking the river from its front, north and south windows. The arc lamps in the rooms and offices of the building were the Hawthorn enclosed-carbon type, which are so extensively used at the present time for factory illumination. The distribution of these lamps was not especially arranged for a lighting display, but was that used for lighting the interior of the building under working conditions; at night the shades of approximately 200 windows facing directly west were simply lifted, and the effect, from a distance, unlike that of buildings which had their outlines illuminated with festoons of incandescent bulbs, was of an interior of considerable depth. On the roof of this building five immense flags floated from staffs, each under the rays of its own spotlight.

Another feature of arc-lamp lighting is shown herewith, which is a photograph of the "Water Gate" that was erected at the foot of West 110th Street. This was the central point for the landing of officers and men in the assembled cruisers and battleships, and the celebration commission was at work for some time previous to the opening of the fête planning this ornamental gateway. The intensity of the artificial light at this arch, which was produced by two Hawthorn flaming arcs, is readily seen from the distinct showing up of the design in the ornamentation on the column caps.

The flaming arcs were suspended, as shown, from the top of the arch and between the two great white supporting columns at the water gate, which are thrown into relief by the rays. Due to the lamps being suspended at a considerable height and to the soft yellow color of the rays, there was no blinding effect when standing at close range. The lamps, therefore, served a double purpose of decorative illumination and provided an intensity of light which was sufficient to light up the arch nearly as well as in daylight.

Improvement in Jet Condensers.

The accompanying illustrations show a new form of jet condenser recently installed in the power house of an electric railway company by the Wheeler Condenser & Engineering Company, of Carteret, N. J. This outfit is installed in the basement beneath a Westinghouse-Parsons 1000-kw steam turbine. The injection water is taken from a creek nearby, and the warm water is pumped from the condenser head by a centrifugal pump driven by a vertical engine. Air is withdrawn by a rotative dry-vacuum pump, while a horizontal relief valve provides outlet to atmosphere in case of stoppage of circulating water. All of the pumping apparatus is of Wheeler make.

The salient features of this condenser may be observed in the accompanying cross-sectional drawing, which, however, does not show the exact type of hot-well installed in the above plant. The condenser head, however, is identical. Referring to the drawing, the water is introduced at the upper right-hand corner into an extended trough or pan, from which it overflows through numerous short tubes, also at the edge on the extreme left, falling into a second and similar pan provided with similar overflow pipes and weir, and finally falling into the lower part of the shell, and overflowing thence to the barometric

column or to the centrifugal or other type of pump serving to overcome the atmospheric pressure.

The steam enters through the opening at the left, passes horizontally across through the shower of water, ascends to the second level, passes to the left through the upper shower, and finally all that is left of the steam vapor, together with the air and other gases, passes horizontally to the right and over the entering and coldest water at the top to the dry-vacuum pump suction opening in the uppermost part of the shell. It will be noted that the cross-section of the passage traversed by the steam continuously diminishes as the volume of steam is reduced by condensation and that, therefore, a uniform steady velocity is maintained throughout, leaving no dead pockets in which air might accumulate. Air is nearly twice as heavy as the same volume of steam at the same temperature, and unless swept forward positively will collect in the lowest part of the condenser shell. In surface condensers it is allowable to place the air-pump suction at a low point, but not in jet condensers, because of the possibility of water being carried over. In order to lessen the size and work of the pump it is also important that the air may, at the last moment, be in contact with the coldest water. From the drawing it will be seen that it is impossible for any of the steam to pass to the air-pump suction without having traversed all of the sprays. The water is finely divided by the small baffles hung below the tubes.

At the right of the drawing will be seen a float controlling a vacuum-breaking valve. In case the water level should rise abnormally in the shell, due possibly to stoppage of the circulating pump, this will break the vacuum, upon which the inflow of water will cease, since the circulating water is syphoned up to the condenser head from a lower level. The steam would thereupon escape through the relief valve.

Tests made on this condenser in actual service show that the

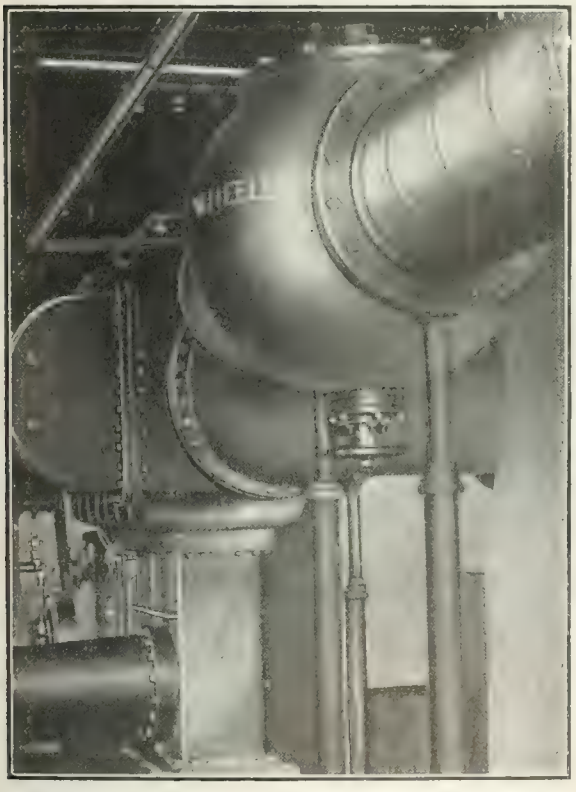


FIG. 1.—RAIN-TYPE CONDENSER INSTALLED BENEATH A TURBINE.

innovations introduced by the designers have worked to good advantage. On the day of the test the barometer stood at 29.9 in., while the street-railway load on the turbine varied from full load to 10 per cent overload. Temperature readings were taken by thermometers placed in the exhaust pipe and in the hot well, while the vacuum readings were taken from a mercury column connected to the condenser. The vacuum only varied between 28.55 in. and 28.75 in., the temperature of the injection varying between 43 deg. and 44 deg.

Although, due to the widely varying load on the turbine, it was necessary to set the injection valve to care for the maximum load likely to be carried, the temperature of the tail water was kept very close to the temperature of the exhaust steam; although, due to the coldness of the condensing water available,

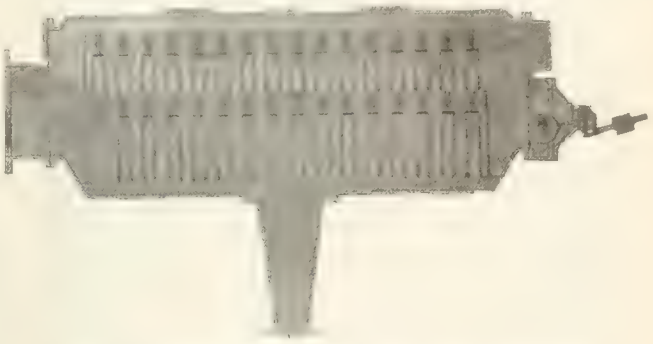


FIG. 2.—SECTIONAL VIEW OF RAIN-TYPE CONDENSER.

the rise in temperature of the injection water was quite large, and only a comparatively small amount of water was required, a condition unfavorable to close adjustment. Calculation showed that 24.3 lb. of circulating water were required to condense 1 lb. of steam. As a matter of fact, the amount would be less than this, since not all of the exhaust is steam when it arrives at the condenser, some of it having already condensed in the turbine and in the exhaust pipe, due to work performed and to radiation. Supposing that 10 per cent of the steam is water, the ratio of the circulating water to steam becomes 21.9.

Lighting Plant of Metropolitan Building, New York.

One thing that made possible the extraordinary exhibition of lighting in New York City during the Hudson-Fulton celebration was the fact that many modern office buildings supplied their own current from their own isolated plants. This was the case with one of the most remarkable light exhibits, namely, the Metropolitan Life Insurance tower on Madison Square. The photograph on page 1000, taken between daylight and dark,

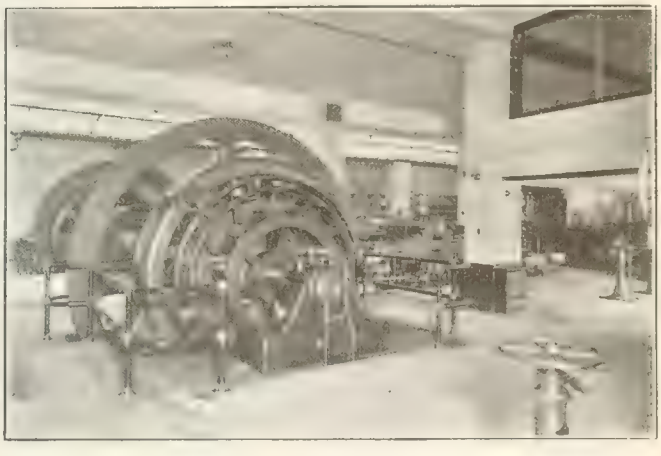


FIG. 1.—POWER PLANT.

gives but a faint impression of the effect secured by the great tower during the illumination. The current for the Metropolitan tower and building is supplied by the Metropolitan power plant in the southeast corner of the building. This plant is a model equipment in every sense of the word. The principle of publicity, which is so strongly emphasized in the prominent construction of the building, has been carried out thoroughly in

the location of the engine-room. The room used for the electric plant in many buildings seems to be chosen for that purpose mainly because it cannot conveniently be used for anything else. Here, on the other hand, a spacious section, 50 ft. wide and over 100 ft. long, is utilized. In the center of the



FIG. 2.—METROPOLITAN TOWER ILLUMINATED.

plant is situated a large glass-enclosed observation gallery, from which a visitor may view the entire equipment. The effect of this publicity on the appearance of the equipment has been unmistakeable. The unusual cleanliness of floors, walls and machinery has made the plant a show feature of the building. Another noticeable condition is the entire absence of hum and vibration. The plant contains four 120-volt, 100-r.p.m. Crocker-Wheeler direct-current generators with a combined capacity of 1100 kw. Its appearance is well brought out in the accompanying illustration.

Flexible Insulated Shaft Coupling.

The flexible insulated coupling illustrated herewith is designed for the transmission of power from one shaft to another where electrical insulation and a moderate degree of flexibility are desired.

The two outside flanges (Fig. 1) can be either key-seated or set-screwed to the ends of the shafts. The central disk is made of specially selected leather, and has lugs securely cemented and riveted to each side. The disk supplies the insulation and the lugs

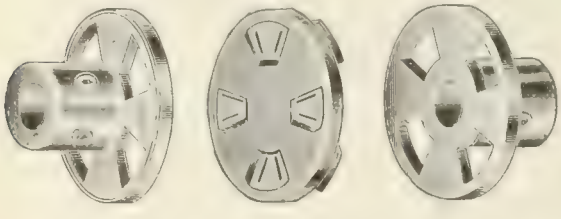


FIG. 1.—PARTS OF INSULATED SHAFT COUPLING.

transmit the power to the outside flanges. Fig. 2 shows the coupling complete.

The manufacturer, Charles Bond Company, 520 Arch Street, Philadelphia, Pa., claims that this coupling will transmit more power than any other flexible coupling of equal diameter and that it will sustain uneven strains. It is said to provide an ideal connection between dynamo and gas-engine cranks or similar machinery, and where it is not possible to secure perfect alignment of shafts the coupling will adjust itself to any such inequalities.

These couplings can be made in all sizes. They can run in

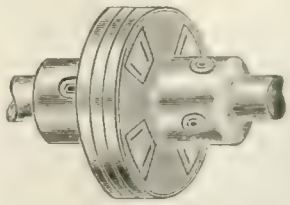


FIG. 2.—COUPLING COMPLETE.

either direction, and, it is said, are adapted for high-speed rotation.

Ozone Attachment to Ventilating Systems.

For some weeks past a test has been in progress in the Chicago Public Library building on the application of ozone generators to its ventilating system. Ten thousand cu. ft. of air per minute are required to be treated so that the ozone may be detected in the most remote part of each room having leaders from the main air duct. The foul air in the library main reading room has been the source of much adverse comment and discussion for years, perhaps no public building in the city having been subjected to so much condemnation on its ventilating system. Following are the results of the tests, as communicated by the makers of the ozonizing apparatus:

The complete deodorizing of the main reading room, freeing the air from the obnoxious personal odor which for years has permeated the papers, books, furnishings, etc., in the large room. The injecting of fresh sterilized air in the room at all times and the reduction of the humidity in the various rooms during hot and oppressive days of last summer. The disinfecting of all books, periodicals, etc., on shelves, racks and tables. Perfect comfort where formerly it was unendurable

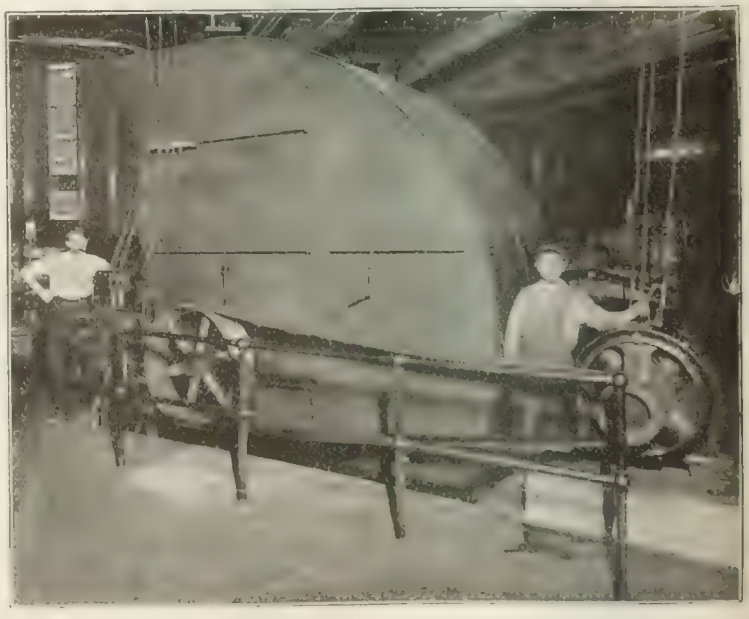


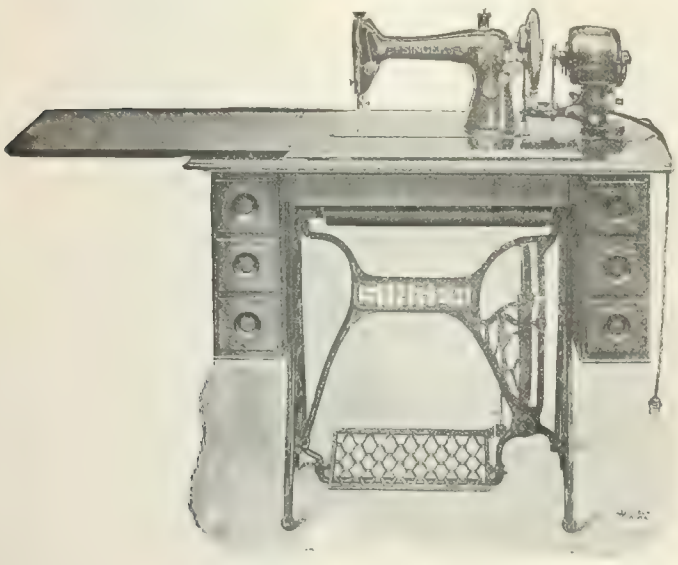
FIG. 1.—OZONE ATTACHMENT TO VENTILATING FAN.

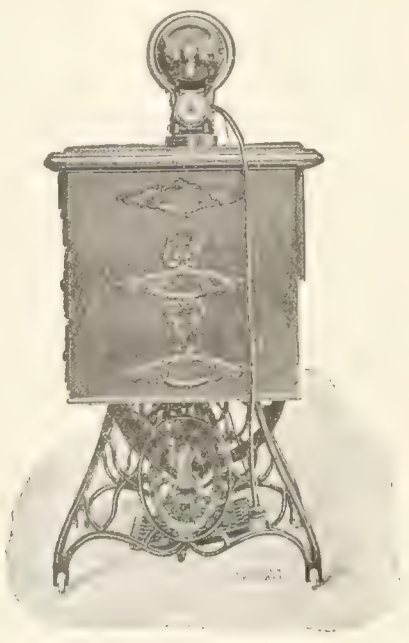
most of the time on account of lack of pure air and the presence of offensive odors.

The air ducts of the ventilating system being so complex in the library building, only the north portion of the building was available for demonstration. The ozone generator installed in this large air duct, measuring 6 ft. x 9 ft., consumes about 715

watts in treating 15,000 cu. ft. of air per hour. In dimension the generator is 6 ft. high, 11 in. thick and 1 ft. wide. It is neatly encased and inserted in the opening of the duct to permit the air for ventilators to pass through it, thereby becoming charged with ozone. By placing the ozone generator between the fan and spray of water used in washing the air, greater efficiency was obtained than placing it in front of the spray. A connection with the 110-volt service is made to a transformer which steps up to 7000 volts and supplies a series of electrodes in the form of ordinary hair brushes; a static electrical charge is thus maintained, which plays against a series of glass plates. Through this blue electrical discharge at 7000 volts air is forced, producing ozone. When the electrodes become dirty or clogged, they are easily rubbed together and cleaned as one would clean two hair brushes; placed back in position and they are then as good as new.

The system described is that of the National Air Filter Company, Chicago. The apparatus is made in five regular sizes, the consumption of electrical energy varying from 25 watts for 25 cu. ft. of air per hour to 660 watts for 10,000 cu. ft.





FIGS. 1 AND 2.—ELECTRICALLY DRIVEN SEWING MACHINE.

Sewing Machine Motors.

An interesting application of the General Electric small motors is to the driving of sewing machines. Figs. 1 and 2 show a motor of this type driving a sewing machine by means of the new General Electric sewing machine attachment. The design of this device is extremely simple and it can be attached to any machine of the usual construction in a few minutes. Either direct-current or alternating-current motors can be used.

The attachment comprises simply the operating switch, cable and socket, so anyone without special mechanical or electrical knowledge can install the motor. An advantage claimed for this particular device is that no part of the sewing machine is disturbed in order to equip it with the electric motor, not even the flywheel connecting rod. It is only necessary to remove the belt. The motor is so placed that its shaft and the shaft of the hand wheel are in the same straight line. Sewing is accomplished by turning the switch and depressing the pedal in the usual manner. This latter action removes the friction brake and increases the tension of the driving belt, the whole attachment rocking about the pivot, which can be seen directly below the motor. When the pressure of the foot on the pedal is removed, a coiled spring in the base of the attachment causes the tension on the driving belt to be relieved and the brake to be applied to the hand wheel, causing the machine to stop. This method of control is so positive and simple that it is not necessary for the operator to remove her hands from her work. In case the sewing machine is so constructed that the pulley is on the outside of the hand wheel, provision has been made for changing the small driving pulley of the apparatus.

When it is desired to lower the head or to place the cover on a stationary head machine, the driving apparatus can be turned to one side by withdrawing the indexing pin shown close to the table. If the machine is not to be used for a considerable period of time, the complete driving mechanism can be removed, leaving only the small plate, which is not objectionable in appearance. No special house wiring is necessary for this motor, connection being made from any lamp-socket by means of a flexible cord and attaching plug.

Adjustable-Speed, Single-Phase Motor.

The accompanying illustration shows an adjustable-speed, single-phase motor built by the Kimble Electric Company, of Chicago, Ill., for printing-press work. This type of motor is built in sizes of ¼ hp, ⅛ hp and ½ hp and is equipped with a spring base and friction pulley which is set up against the flywheel of the press, so that when the motor is started it will run free and to start the press it is only necessary to give the flywheel a start by hand. The motor requires no rheostat, but is controlled by a lever contained in the machine itself, to which is attached a foot pedal which enables the operator to control the motor by this means. The speed is not controlled by steps, but by shifting the brushes with which the motor is equipped. By means of the lever the machine may be started, stopped and its direction of rotation reversed, in addition to the added advantage of being able to adjust the speed. It is claimed that the range is from 300 r.p.m. to 3000 r.p.m.



ADJUSTABLE SPEED, SINGLE-PHASE MOTOR.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The continuous record of improvement in commercial and industrial conditions was as much in evidence during the past week as it has been for the past three months. Trade is better in practically every line and prosperous times are at hand. There is to be heard from all sections one continuous song of optimism. Wholesale and jobbing trade has been considerably improved by numerous reorders, which have been sent in to fill up stocks depleted by the active buying of consumers throughout the West and South. As has been noted many times heretofore, the retailers have been conservative in placing their orders for goods, and this has resulted in many instances in their having underestimated the demands of their customers. The only retarding feature in the upward march is the undeniably high level at which all commoditiees are now held. This is especially observable in the case of cotton goods, the prices for which are high with advancing tendencies. Such a level has, to some extent, checked the freedom of buyers and reduced the size of orders. There is little prospect, however, of any lower prices, in view of the upward tendency of raw cotton and the well known shortage of this year's crop. In industrial lines it is the same old story of full order books and active operation. Hours are growing longer, additional workmen are being employed and pay rolls are expanding. This is especially noted in the iron and steel industries, which now have their plants fully occupied for many months to come. The advance in the rate for money, which has done much to check speculation in securities, has had practically no effect upon commercial trade. In fact, the expansion of trade, bringing into employment idle money, is one of the causes of the advance in rates. With the liberal movement of the crops to market and the general improvement in retail business, collections have become notably better. At this time they are entirely satisfactory and business troubles are few. Failures for the week which ended Oct. 14, as reported by *Bradstreet*, were 220 against 203 the previous week; 244 in the same week of 1908; 194 in 1907; 170 in 1906, and 178 in 1905.

THE COPPER MARKET.

The main features of the copper market continue to be the unprecedented production and the limited consumption. During the past week the rate of production has continued at the high record made in September, the imports have been heavy, the purchases by domestic consumers have been light and the exports have been only moderate. During September the melters in this country, according to the figures of the Copper Producers' Association, took about 45,000,000 lb. and there is no reason to estimate that they will take more during the present month. The heavy stocks already carried in Europe together with the hardening tendency in the money market have had a discouraging effect upon speculative buying abroad. When money could be borrowed in London at 2 per cent, carrying copper for an anticipated rise was easy; when money costs 4 or 5 cent speculation is not so alluring. All of these facts point to a further accumulation of copper in the hands of producers and tend to make the price situation uncertain and discouraging. On the other hand, there is little likelihood of any serious demoralization. The copper situation is—as it has been for two years—in very strong hands. The powerful financial interests which control the production and sale of copper are thoroughly able to carry any sized burden in the face of adverse statistics. This explains the fact that in the face of heavy production and light buying price concessions are unimportant. The hard and fast rules of supply and demand do not operate to any considerable extent. If the consumers will not pay the holders' prices there is no sale. The seller and not the buyer controls the situation. The price of copper will never be permitted to go below the point where a reasonable profit is assured to the Amalgamated company and its affiliated interests. During the present month, including Oct. 18, exports have been 11,032 tons. The daily call on the Metal Exchange, at 12:30 o'clock, Oct. 18, quoted standard copper as follows:

	Bid	Asked	Settling price
Spot	12.45	12.50	.....
October	12.45	12.50	12.37½
November	12.45	12.50	12.37½
December	12.45	12.50	12.37½

The London prices Oct. 18 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	57 18 9	57 15 0
Standard copper, futures	58 18 9	58 15 0
Market	Firm	Easy
Sales of spot		780 tons
Sales of futures		1400 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.00	12.35
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

HUDSON & MANHATTAN RAILROAD COMPANY.—It is given out that the present passenger traffic of the Hudson & Manhattan Railroad Company is now running at the rate of 40,900,000 passengers per year. At this rate the company will not earn its fixed charges, but will earn approximately 1 per cent on its issue of $10,000,000, 5 per cent non-cumulative preferred stock. Since the opening of the downtown section of the Hudson tunnels the traffic of the company has increased from an average of 46,000 passengers per day to 115,000 passengers per day. During the week which began Sept. 25 the daily average was 141,000 passengers, and on the four parade days of the Hudson-Fulton celebration the company carried about 604,000 passengers, making a daily average of 151,000 passengers. President McAdoo expressed the belief that when the entire system is in operation it will carry 100,000,000 passengers per year.

COSMOPOLITAN ELECTRIC COMPANY'S PROGRESS IN CHICAGO.—Work is steadily progressing on the new generating plant and distribution system of the Cosmopolitan Electric Company, of Chicago, a central-station company to which reference has previously been made in these columns. During the last month 200,000 duct-feet of underground conduit has been laid and 10 miles of cable have been pulled in and connected for service. The new Grove Street power house is now inclosed, and the first of the generating units, a 3500-kw, 12,000-volt, three-cycle turbo-alternator, is being installed. H. E. Niesz, manager of the company, is busily engaged superintending the extensions and improvements now under way.

DAVENPORT (IA.) WATER POWER COMPANY.—It is announced by the Davenport (Ia.) Water Power Company that Eastern capitalists have been interested in the development of its power plant. It is expected that at least 16,000 hp will be developed in the Mississippi River at this point, and it is estimated that the project will not require more than $2,000,000. The company already possesses a Government franchise and expects to build an initial power plant next year, utilizing the water-power of the Davenport-Leclaire Rapids in the Mississippi River.

RUSSELLVILLE (ARK.) ELECTRIC PLANT.—It is stated that the power company which has constructed a dam across the Illinois Creek, near Russellville, Ark., and installed a hydroelectric plant to furnish electricity in central Arkansas, will be ready to begin business early in November. The company is also making preparations to build an electric railway connecting Dardanelle with Mt. Nebo, one of the summer resorts in western Arkansas. Electrical energy for operating the railway will be supplied from the power plant at Russellville.

VALENTINE, NEB., MUNICIPAL PLANT.—The Board of Trustees of Valentine, Neb., is advertising for proposals, to be opened Oct. 25, for the construction, machinery and apparatus for an electric light and power system for that city. The proposals include power house equipment and dam, as well as transmission lines.

J. B. TAYLOR & COMPANY, engineers and contractors, will within a short time establish a foreign branch in London and perhaps in St. Petersburg, the latter to keep in touch with the rapid expansion of Russian railroad building and industrial development. The Taylor company has recently received a contract for all of the engineering of the American Central Railroad of Texas, some 500 miles of line, and will start 10 corps of engineers to work at once, expecting to finish about Jan. 1, 1910. The company has leased a large suite of offices in the Hudson Terminal Buildings, 30 Church Street, New York, and aside from engineering work, will take large construction contracts and also assist in financing meritorious propositions, including electric railway and lighting plants, through banking connections in New York and London. Mr. Frank Weeks, of Chicago and New York, who has a large acquaintance throughout the railroad, banking and engineering world, is the manager, and Mr. W. E. McClintock, at the head of the engineering department, is an engineer of large ability. Mr. J. P. Hornaday, a New York banker, is president of the company.

TO SELL "WOLFRAM" LAMPS.—P. H. Klein, Jr., who for many years represented the Bergmann Company in America, and who has had to give up his American trade on account of the contract entered into between the General Electric Company and the Bergmann Company, will continue to sell the "Wolfram" tungsten lamp in those portions of America which are not covered by the General Electric contract. This will mean that Mr. Klein can handle this lamp in South America, in Cuba, in Canada and in Mexico. It is understood now that the General Electric contract only refers to the United States and its possessions. Mr. Klein expects to continue the importation of tungsten lamps, and at least for the time being his office will continue to be at 110 Liberty Street.

DR. F. S. PEARSON'S MEXICAN ENTERPRISES.—Among the new enterprises which have been fostered by Dr. F. S. Pearson is the Mexico North Western Railway Company. This concern comprises a consolidation of three small lines: The Rio Grande, Sierra Madre & Pacific; the Chihuahua & Pacific, and the Sierra Madre & Pacific. These three roads have been consolidated and will reach the Madera and Chihuahua lumber districts, which are controlled by interests affiliated with Dr. Pearson. It is contemplated that these roads will eventually be operated by electrical energy, which will probably be generated by water-power plants, but so far the details of these operations have not been worked out.

UTAH LIGHT & RAILWAY COMPANY.—Work has been commenced on the construction of the new power plant for the Utah Light & Railway Company on the Davis and Weber Counties Canal in Weber Canyon. The plant will involve an expenditure of about $400,000, and the equipment will include one 2500-kw generator direct-connected to a 5000-hp Pelton water wheel. There will be enough space left for the installation of a duplicate of this apparatus later on. The energy generated at this plant will be transmitted to the present transmission line between Ogden and Salt Lake City.

GEORGE WESTINGHOUSE OPTIMISTIC.—In an interview given out last week by George Westinghouse: "Business is good, and the outlook is excellent. The improvement in the electrical industry has perhaps been slow, but it is very satisfactory and there is nothing in sight to indicate that the improvement will not be maintained." Mr. Westinghouse said that the demonstrations of the Melville-MacAlpine reduction gearing for the use of turbines in ships were proving very satisfactory at the plant of the Westinghouse Machine Company in Pittsburgh.

UNITED ELECTRIC SERVICE COMPANY.—A resolution was introduced at the meeting of the Board of Estimate and Apportionment of New York City on Oct. 16 providing that unless the United Electric Service Company proceeds within 30 days with the construction of the electric messenger call and burglar alarm system, for which a franchise was granted it on June 16, the franchise will be rescinded. Action upon the resolution was postponed for two weeks in order to give the company an opportunity to be heard.

SEABOARD AIR LINE USING TELEPHONES.—The Seaboard Air Line Railway Company has now in operation telephones for train despatching between Raleigh and Monroe, N. C., 148 miles. Part of this road is single track and handles very heavy traffic, and the movement of trains is assisted by the block telephone system. The telephones that are in use on this line are those constructed by the Western Electric Company, and they are especially designed for train despatching on steam railroads.

ALLIS-CHALMERS TURBINE SHIPMENTS.—During the month of September the Allis-Chalmers Company shipped a total of 21 steam turbines, none of which was of less capacity than 300 kw. Although this figure is stated not to represent a record in shipments, it nevertheless serves to give a fair idea of the large number of Allis-Chalmers steam turbines being placed in operation at various points throughout the country.

HARVEY HUBBELL, INCORPORATED, EXPANDING.—Harvey Hubbell, Bridgeport, Conn., has arranged to take over the entire output of shades and reflectors manufactured by the Tea Tray Company, of Newark, N. J., and all sales will hereafter be made by Harvey Hubbell (Inc.). The line will be increased by the addition of many new designs.

MUNICIPAL PLANT AT ORANGE, N. J.—The Street Committee of the Common Council of Orange, N. J., has decided to receive two sets of bids for the construction of a municipal electric light plant. These bids will be opened Nov. 8. The plant will supply energy for 368 arc lamps and 95 tungsten lamps.

PROPOSALS FOR QUINCY (FLA.) MUNICIPAL PLANT.—The town of Quincy, Fla., writes that proposals for a 1500-kw, direct-current, electrical generating plant will be received until Nov. 4. George H. Palmer, city engineer, will supply full information upon request.

Financial Intelligence.

THE WEEK IN WALL STREET.

The stock market during the past week returned to its old position of confidence and strength. The advances were pronounced and the tone was decidedly strong. A good share of the losses which occurred during the previous fortnight's decline have been wiped out. There were a few spots of weakness, to be sure, but generally speaking the same buoyancy of sentiment controlled. There were indications that purchases had been renewed by important investment and semi-investment interests, and there was some evidence that the floating supply of stocks, of the best character, was growing very small. The bear party, which had been led to become hopeful during the days of reaction, was speedily driven to cover. It is improbable that many of its members secured substantial returns through the decline, and it is quite well known that a number incurred heavy losses. The decline was brought about un-

NEW YORK.

	Oct. 11.	Oct. 18.	Shares sold		Oct. 11.	Oct. 18.	Shares sold
All.-Ch.	14¼*	15¼	400	Int.-Met., pfd.	47¼	51½	24,100
All.-Ch., pfd.	52	53⅜	2,000	Mackay Cos.	91	93	2,900
Amal. Cop.	79⅜	84⅛	220,800	MackayCos., p.	75½	76¼	1,300
Am. D. T.	20½*	20½*	——	Man. Elev.	142*	142	——
Am. Loc.	58	60	4,430	Met. St. Ry.	20*	20*	——
Am. Loc., pfd.	115	115*	180	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & Cbl.	85*	85*	.....	Steel, com.	86¼	91¼	1,401,005
Am. T. & T.	141⅞	142	21,950	Steel, pfd.	120⅞	128⅜	32,755
B. R. T.	77¾	78¼	17,635	W. U. T.	76¼	77½	2,775
Gen Elec.	163	164⅜	4,400	West'h, com.	85⅜	86½	4,900
Int.-Met., com.	15¼	18⅞	20,165	West'h, pfd.	145*	140*	100

PHILADELPHIA.

	Oct. 11.	Oct. 18.	Shares sold		Oct. 11.	Oct. 18.	Shares sold
Am. Rys.	46*	45⅞*	——	Phila. Elec.	12¾	13¼	——
Elec. Co. of A.	13¼*	13¼	——	Phila. R. T.	28	27⅝	——
Elec. St. B'ty.	59½	60¼	——	Phila. Trac.	90	89*	——
E. S. B'ty, pfd.	30*	30*	——	Union Trac.	52½	53	——

CHICAGO.

	Oct. 11.	Oct. 18.	Shares sold		Oct. 11.	Oct. 18.	Shares sold
Chi. City Ry.	180*	180*	——	Chi. Tel. Co.	137½*	136½*	——
Chi. Rs., Ser. 1.	100¼*	100¼*	——	Met. El., com.	17¾*	17¾*	——
Chi. Rs., Ser. 2.	30½*	35½	——	Met. El., pfd.	52	53½	——
Com. Edison.	121	120½	——	Nat'l Carbon.	99¼	98½*	——
Chi. Sub'ws.	5⅛	8¼	——	Nat'l C., pfd.	120*	120*	——

BOSTON.

	Oct. 11.	Oct. 18.	Shares sold		Oct. 11.	Oct. 18.	Shares sold
Am. T. & T.	142	141⅞	——	Mex. Tel.	23¾*	23½	——
Cum. Tel.	114½	113¼	——	Mex. Tel., pfd.	6½*	6*	——
Edison E. Ill.	252	250*	——	N. E. Tel.	136¼*	136½	——
Gen. Elec.	162½	161¼	——	W. T. & T.	10	10*	——
Mass. E. Ry.	17½*	17¼	——	W. T. & T., p.	80	80*	——
Mass. E. R., p.	80	81	——				

*Last price quoted.
Shares sold are for week of Oct. 11 to Oct. 16

doubtedly by the hardening of money rates, both in this country and abroad, and the decline stopped of its own accord as soon as it became evident that there was going to be no serious scarcity of money for all legitimate purposes. Although the Imperial Bank of Germany and the Bank of England have both advanced their discount rates, the bankers of this country are still charging only reasonable terms, and are very liberal in their accommodations to responsible borrowers. As the decline was led by United States Steel common, so the recovery was led by the same stock. The extremely prosperous condition of the steel industry, the confident prediction that the record of the Steel corporation for the current quarter will show immense earnings have inspired so much confidence in these shares that it will require more than the tightening of the money market to permanently hold them down. While the industrial stocks are still apparently the favorites with investors, the improvement of railroad reports is bringing the carrying shares into notice. Booming industry and plenteous crops are bound, sooner or later, to make heavy traffic. The money market has remained in about the same condition it was about a week ago. The banks have reduced their loans, but are apparently still well supplied with cash. Rates for money Oct. 18 were: Call, 3¾ @ 4¾ per cent; 90 days, 4¾ per cent. The quotations in the table are those of the close Oct. 18.

OHIO HOME TELEPHONE COMPANY.—The Ohio Home Telephone Company, of Cleveland, has been incorporated, with a capital stock of $500,000, for the purpose of taking over the property of the United States Telephone Company of that city under a 99-year lease. In addition to taking over and operating the long-distance lines in that State, the new company will assemble and protect the independent local companies from the aggression of the Bell interests. Its influence will cover Ohio and perhaps some adjacent territory, as it is thought that the companies in Pittsburgh, Wheeling, Detroit and some other near-by towns will be taken in. The incorporation was effected through Otis & Hough, brokers, of Cleveland, and it is said that there is some English money back of it. The plan, as understood now, is to have the independent companies over Ohio and in adjacent territory hold the stock and in turn give them a long-distance service. Information as to who is actually in control of the new company has not been forthcoming as yet. The incorporators are F. L. Griffith, Harlan Reed, Howard Howells, W. C. Henderson and John H. Otto. E. G. Tillotson is the chairman of the board of the United States Telephone Company and has been active in its management. He is believed to be the promotor of the new company. A year ago a similar plan, steered by St. Louis men, failed because the terms were not satisfactory to the Cleveland people. The stock of the United States Telephone Company has been deposited with the Cleveland Trust Company under a voting trust agreement and negotiable receipts have been issued for it. Everything is in shape for executing the lease. The United States Telephone Company was organized in 1898 and has an authorized capital stock of $5,000,000. The lines of this company connect with 350,000 telephones in Ohio, with over 14,000 circuit miles of wire and 30,000 actual miles of copper wire. The local companies, which it controls, operate 20,000 telephones, serving a population of 300,000 people.

EDISON ELECTRIC ILLUMINATING COMPANY.—The Edison Electric Illuminating Company of Boston has petitioned the Massachusetts Gas Commission for authority to issue 19,452 shares of additional capital stock. The proceeds of this are to be used to take up notes issued for new properties acquired last month at a cost of $2,870,000, and also notes issued from time to time to take care of the normal growth of the business, amounting to about $1,000,000. At the annual meeting of the company, Oct. 12, the financial report for the year which ended June 30, 1909, was presented. It showed gross earnings of $4,111,342, and net earnings of $1,881,747; this compared with net earnings for the same period in 1908 of $2,006,336. After paying the regular dividends for the year, there was a deficit of $92,029. In discussing this report, Charles L. Edgar, president of the company, said the introduction of tungsten lamps, which has taken place very largely in the territory served by the company, was, in a measure, responsible for the slight decrease in earnings. He says: "The increasing introduction of this highly economical lamp, while temporarily checking the growth of the earnings of your company, is in reality popularizing the electric light, and putting it ahead of any of its competitors in price as it long has been in quality." Mr. Edgar says that the recent purchase of the properties at Newton and Chelsea, together with the contracts which have been made with electric railway companies, will eventually increase the earnings of the company about $600,000 a year, and will be the means of enabling a reduction to be made in the retail price for lighting of from 12 to 11 cents. This reduction will be made on Jan. 1.

ALLIS-CHALMERS COMPANY'S EARNINGS.—The annual report of the Allis-Chalmers Company for the year which ended June 30, 1909, shows total net earnings, after deducting expenses, taxes, fixed charges and dividends on the preferred stock of the Bullock Electric Manufacturing Company, of $1,809,009. At the end of the year the company had a surplus of $521,429 and the cash on hand amounted to $2,299,017. The report does not give the figure for gross earnings in 1908. In his report to the stockholders W. H. Whiteside, president of the company, said that while the company had suffered, along with other industrial enterprises, in 1908 that business now was in a very satisfactory condition. "New business booked," said he, "commenced to show substantial gains in January last, and for the last half of the year averaged per month nearly 65 per cent more than the monthly average for the first half. This increase with advancing prices has continued to the present time."

INDIANA GAS & ELECTRIC COMPANY.—W. E. Hutchinson, president of the Indiana Gas & Electric Company, says that it is the purpose of the concern to supply gas to 42 cities and towns in Indiana and that the product will be manufactured at one central station. He declined to give, at this time, the names of the cities to be supplied or the small companies that would be absorbed. The company was organized a year ago under the laws of New Jersey, with an authorized capital of $5,000,000 and an issue of $5,000,000 bonds. Mr. Hutchinson says that $3,000,000 of stock has been issued to take over the Indiana properties and that the balance will be issued as needed. According to the articles filed by the company with the State Department of Indiana it contemplates manufacturing and selling electrical energy as well as gas. It is said that quite a number of the properties to be taken over are central stations.

SALEM ELECTRIC COMPANY SALE.—Charles H. Tenny, of Boston, has purchased control of the Salem (Mass.) Electric Company at a price understood to be at about $300 per share. Practically all of the 2750 shares of the company were pooled last May, with the understanding that they would not be sold for less than $225 a share. Since that time various interests have been negotiating for control. The company has paid 18 per cent dividends during the current year. Mr. Tenny and his associates now control the following gas and electric properties: Concord (N. H.) Electric Company, Haverhill Electric Company, Malden Electric Company, Malden & Melrose Gas Light Company, Springfield Gas Light Company, Salem Electric Company, Suburban Gas & Electric Company, Fitchburg Gas & Electric Company, Peoples' Gas & Electric, Oswego, N. Y.

CHICAGO SUBWAY COMPANY.—No definite plan has as yet been announced for the reorganization of the Chicago Subway Company. It is stated that the decline in stock is not because the Harriman interests have been sold out, or because the interests represented by J. Ogden Armour have been sold, but merely because smaller holders have taken fright. A number of meetings have been held by the interests that are endeavoring to reorganize the property. It is understood that a committee has been appointed to analyze the present condition of the company and to report, but so far no such report has been made public.

CENTRAL COLORADO POWER COMPANY.—A new bond issue amounting to $1,350,000 has been authorized by the Central Colorado Power Company, for the purpose of redeeming the coupons on the outstanding $9,000,000 of first mortgage bonds as they fall due within the next three years. The new issue is for 20-year bonds bearing 5 per cent. Negotiations are now in progress between the company and the Denver City Tramway Company for the sale of energy, and a temporary contract has been made with the Denver Gas & Electric Company.

AMERICAN TELEPHONE & TELEGRAPH COMPANY.—The total receipts of the American Telephone & Telegraph Company for the nine months which ended Sept. 30 were $23,325,410, which was an increase over the same period in the previous year of $2,596,081. After allowing for fixed charges and dividends, the surplus for the period was $4,102,921.

WORCESTER ELECTRIC LIGHT COMPANY.—The old management of the Worcester (Mass.) Electric Light Company won a victory at the annual stockholders' meeting on Oct. 13 and retained the management of the property. For some weeks there has been a contest for control of the company and Stone & Webster, of Boston, had sent out circulars offering $300 per share for the stock. To offset these offers a protective committee was formed by the directorate, the shareholders were urged not to sell and proxies of 60 days' duration were asked for. These efforts on the part of the directors were successful and sufficient stock was secured to score a decisive victory at the meeting. Out of the 8000 shares 5700 were voted at the meeting. The new board of directors consisted of: A. B. R. Sprague, George T. Dewey, Frank L. Coes, John C. McInnes, Edgar Reed, Matthew J. Whittall, Rockwood H. Bullock, John A. Denholm and Charles E. Hildreth, the last four named being new members. Mr. Sprague was re-elected president of the company. The financial report for the year, which ended June 30, 1909, showed gross earnings of $349,743 and net earnings of $177,766. The management announced that several plans were under consideration for expanding the company's business, which probably involve the erection of a new generating station.

GENERAL ELECTRIC COMPANY IMPROVEMENTS.—Announcements have been made within the last few days that the General Electric Company is contemplating extensive improvements to its plants, both at Schenectady and at Lynn. It is said that contracts for two buildings have been made at Schenectady, and an announcement of the plans has been given out by the general manager of the works, G. E. Emmons. One of the buildings, it is stated, will be 80 ft. x 400 ft. and five stories high, to be built of reinforced concrete and steel. The other is in the form of a 200-ft. extension to building No. 50, which is a warehouse. The first of these buildings will be used for manufacturing purposes. In this connection it is also given out that the Lynn plant is to be extended by the erection of two mammoth new buildings at the river works. Building No. 74 will have an added length of from 300 to 500 ft., which will make the structure the largest single building for manufacturing purposes in New England. It is also understood that the employees of the Lynn plant will be increased from 9200 to 15,000. The business of the General Electric has so materially increased that it is necessary to extend its manufacturing facilities.

WESTERN UNION TELEGRAPH COMPANY.—At the annual meeting of the Western Union Telegraph Company it was shown that the net income for the year which ended June 30, 1909, was $7,347,107, as compared with $3,402,996 the previous year. After paying fixed charges there was left a net profit of $5,614,856. This return was considered by the stockholders to be very satisfactory. President Robert C. Clowry declared that the marked improvement in the company's business was continuing, and that all conditions were satisfactory for a prosperous year. He said that contracts covering 4073 miles of railroad were closed during the year, and that other lines of business were extended. Referring to the sale of the company's holding of the New York Telephone Company stock, Mr. Clowry said that, as the telephone company intended to raise a large sum of money to be used in connection with the absorption of other companies, the Western Union management thought this a favorable opportunity to dispose of its minority interest. He said that in connection with this sale arrangements had been made for the retirement on May 1, 1912, of the $10,000,000 4 per cent convertible bonds.

ANDERSON (S. C.) TRACTION COMPANY.—At the sale of the entire property of the Anderson Traction Company on Oct. 11 the property was bid in by Edwin W. Robertson, of Columbia, S. C. The price paid was $154,050. There is included in the sale 18 miles of track, rolling stock, power plant, equipment and franchise. The bankruptcy proceedings grew out of a claim held by the International Trust Company of Maryland, which instituted the proceedings some months ago to recover moneys due it. Mr. Robertson has been acting as receiver for the Anderson Traction Company, and held second mortgages on the property. There was a prior sale ordered under a ruling by Federal Judge J. C. Pritchard at an upset price of $175,000, but no bids were forthcoming. The second decree named no upset price, and also made provision for a large suit pending against the traction company. Mr. Robertson has announced that the company will be reorganized and the system operated in good shape.

CHICAGO UTILITIES COMBINE DENIED.—When Samuel Insull, president of the Commonwealth Edison Company, Chicago, was asked whether there was truth in the widespread rumor that a $300,000,000 combination of all the traction, electric-service and gas interests of Chicago was to be effected, he said that the newspaper story to that effect was pure imagination. "I have no objection," said Mr. Insull, "to be quoted as saying in the most positive way that this $300,000,000 combination story is without any foundation in fact. It must be a vagary of the disordered fancy of some daily newspaper writer. There is absolutely nothing in it, so far as I know, and it is natural to suppose that I would be cognizant of the plan if anything of the kind were on foot at the present time."

BIG TRANSFER OF TELEPHONE STOCK.—Following closely the incorporation of the Ohio Home Telephone Company by independent interests, came the announcement that the Everett-Moore holdings in the United States Telephone Company and the Cuyahoga Telephone Company had been sold to James S. Brailey, of Wauseon, Ohio, for a consideration of something like $2,000,000. The Everett-Moore holdings represent a large proportion of the stock of the two companies and their acquisition will give Mr. Brailey the controlling interest in both. Their representatives on the board of voting trustees are now in the majority. F. H. Goff, president of the Cleveland Trust Company, represented the Everett-Moore people in the negotiations, but he acted only in the capacity of agent.

NORTH SHORE ELECTRIC COMPANY.—A new issue of $400,000 of new stock of the North Shore Electric Company, Chicago, will be offered to the stockholders at par. Since the organization of this company in 1902 the capitalization has been increased from $1,000,000 to $4,000,000, the improvements and extensions being capitalized instead of being bonded. Samuel Insull is president of the company, and the ownership is identified with the interests that control the Commonwealth Edison Company. The increase in business for the past year was 20 per cent.

LONDON (OHIO) TELEPHONE COMPANY.—Arrangements are now being made for the reorganization of the London (Ohio) Telephone Company, which was recently purchased by the Columbus Citizens' Telephone Company. The London company will maintain its corporate existence, but new officers and new directors will be elected connected with the Columbus company. It is expected that the lines of the London company will be extended and that the exchanges and switchboards will be overhauled.

FAYETTEVILLE (N. C.) CONSOLIDATED POWER & STREET RAILWAY COMPANY.—The financial difficulties of the Fayetteville (N. C.) Consolidated Power & Street Railway Company have practically been adjusted. It is understood that bonds to the amount of $75,000 will be issued, and an application will be made at once to the court to dissolve the receivership. The funds to be raised by this bond issue, it is stated, will be sufficient to carry out the plans for improvements and extensions.

VERNON, ILL., ELECTRIC RAILWAY.—Plans are being perfected for the construction of an electric railway from Vernon, Ill., to a point on the Mississippi River near Chester. The road will pass by way of Winkle, Ill., and will be about 83 miles in length. It will be constructed especially for the transportation of heavy freight, although a passenger service will be provided. It is said that the road is being financed by a syndicate of St. Louis capitalists, who are represented by Albert J. Dows.

CONCORD & MONTREAL RAILROAD COMPANY.—The stockholders of the Concord & Montreal Railroad Company, Concord, N. H., have voted to issue new capital stock to the amount of $250,000. The proceeds of this issue are to be used for the purchase of the water-power rights on the Pemigewasset River in Franklin and surrounding towns. The energy developed will be used in the car shops at Concord and in operating the Concord & Manchester Electric Railway.

CONNECTICUT POWER PLANT SOLD.—Carl A. Ross, promoter of the power project at Fifteen-Mile Falls, on the Connecticut River, is reported to have sold his interests to Massachusetts capitalists, who are already making plans for the erection of three large power dams. It is estimated that these plants will develop about 5000 hp. Work on this new project will begin next spring.

McCALL FERRY POWER COMPANY.—Judge Lacombe, of the United States Circuit Court in New York, has affirmed a decree of foreclosure against the McCall Ferry Power Company in favor of the Knickerbocker Trust Company, of New York. The McCall Ferry Power Company owns large tracts of land in York and Lancaster Counties in Pennsylvania, and under the receiver is now constructing an immense dam on the Susquehanna River. The present decision directs that unless the principal and interest due on the bonds, which amount to $9,226,534, are paid to the Knickerbocker Trust Company within 10 days all of the property will be sold. This decision is really only a matter of form, and there is no doubt that the completion of the work will be permitted under the direction of the receiver, and that within a few months energy will be delivered in Baltimore and other neighboring cities.

PLATTSBURG GAS & ELECTRIC COMPANY.—The Public Service Commission of the Second District of New York has authorized the Plattsburg Gas & Electric Company to execute a mortgage to guarantee an issue of $500,000 in bonds. It is proposed to issue $340,000 of these bonds at this time, and the commission provides that they shall not be sold for less than 92. The proceeds will be used to take up an outstanding issue of bonds of the Plattsburg Light, Heat & Power Company, and to either take up or refund the bonds of the Lozier Light & Power Company, both of which properties are owned by the Plattsburg Gas & Electric Company.

JAMES J. HILL IN OREGON TRACTIONS.—It is reported that James J. Hill and others who are interested in the Oregon Trunk Line are the real buyers of the United Railways Company, of Portland, Ore. This involves three miles of Portland river front; more than 10 miles of modern standard gage railroad within the limits of Portland, and a right-of-way from Portland to Tillamook, Ore., on the Pacific Coast. This purchase is said to be a part of Mr. Hill's plans for covering Oregon with a network of branch traction lines, which will operate as feeders to his steam road.

POUGHKEEPSIE LIGHT, HEAT & POWER COMPANY.—The Poughkeepsie Light, Heat & Power Company has been granted permission by the Public Service Commission to issue the remainder of its first mortgage bonds, which amount to about $100,000. These bonds must be sold for not less than $95.

DIVIDENDS.

American District Telegraph Company, of New Jersey, quarterly, 1 per cent, payable Oct. 22.

Columbus (Ohio) Railway Company, quarterly, 1¼ per cent, payable Nov. 1.

Commonwealth-Edison Company, quarterly, 1½ per cent, payable Nov. 1.

East St. Louis & Suburban Railroad Company, preferred, quarterly, 1¼ per cent, payable Nov. 1.

Electric Bond & Share Company, preferred, quarterly, 1¼ per cent; common, 2 per cent, both payable Nov. 1.

Grand Rapids Railway Company, preferred, quarterly, 1¼ per cent, payable Nov. 1.

Havana Electric Railway Company, preferred, quarterly, 1½ per cent; common, 1 per cent, both payable Nov. 13.

Houghton County (Mich.) Electric Light Company, preferred, semi-annual, 3 per cent, payable Nov. 1.

Lowell (Mass.) Electric Light Corporation, quarterly, 2 per cent, payable Nov. 1.

Malden (Mass.) Electric Light & Power Company, quarterly, 2½ per cent, payable Oct. 15.

Mexican Tramways Company, quarterly, 1½ per cent, payable Nov. 1.

Minneapolis General Electric Company, quarterly, 1½ per cent, payable Nov. 1.

Oklahoma Gas & Electric Company, preferred, quarterly, 1¾ per cent, payable Oct. 15.

Pacific Telephone & Telegraph Company, preferred, quarterly, 1½ per cent, payable Oct. 15.

Railways Company General, quarterly, 1 per cent, payable Nov. 1.

Rio de Janeiro Tramway, Light & Power Company, quarterly, 1 per cent, payable Nov. 1.

San Diego Consolidated Gas & Electric Company, preferred, quarterly, 1¾ per cent, payable Oct. 15.

REPORTS OF EARNINGS.

	Gross earnings	Expenses.	Net earnings	Charges.	Surplus.
Allis-Chalmers Company:					
Year ended June 30, 1909	.....	.....	$1,809,009	$1,673,578	$135,431
Year ended June 30, 1908	.....	.....	2,573,961	1,958,147	615,814
American Telephone & Telegraph Company:					
September, 1909	$1,605,124	$203,033	1,402,091	498,658	903,433
September, 1908	1,273,904	172,659	1,101,245	614,215	487,030
Associated Bell Operating Companies:					
Eight months ended Aug. 31, 1909	88,822,114	36,422,457	51,919,657	32,397,203	19,552,454
Eight months ended Aug. 31, 1908	82,248,034	35,641,892	46,566,142	28,594,656	17,971,486
Cape Breton Electric Company, Ltd.:					
August, 1909	22,005	11,504	10,500	4,111	6,388
August, 1908	22,958	11,886	11,071	4,053	7,018
Columbus (Ga.) Electric Company:					
August, 1909	31,783	20,311	11,472	11,449	23
August, 1908	29,693	16,080	13,551	11,618	1,933
Chicago Railways Company:					
August, 1909	1,288,200	650,632	437,576	.....	.....
August, 1908	980,160	650,128	330,038	.....	.....
Edison Electric Illuminating Company, Boston:					
Year ended June 30, 1909	4,111,341	3,737,496	1,419,205	86,845	1,332,360
Year ended June 30, 1908	4,220,739	2,658,929	1,608,751	54,989	1,553,762
Edison Electric Illuminating Company, Brockton, Mass.:					
August, 1909	10,539	12,733	7,058	3,135	3,923
August, 1908	15,699	8,210	7,489	2,543	4,945
El Paso (Tex.) Electric Company:					
August, 1909	40,440	28,545	12,091	8,259	3,832
August, 1908	41,398	30,889	10,889	7,075	3,813
Jacksonville Electric Company:					
August, 1909	38,781	21,292	17,489	8,478	9,011
August, 1908	36,271	19,141	17,129	8,252	8,877
Lowell Electric Light Corporation:					
August, 1909	26,664	15,017	11,616	4,237	7,379
August, 1908	26,228	15,464	10,763	3,471	7,292
Mexican Telephone & Telegraph Company:					
August, 1909	39,836	18,232	21,604	.....	.....
August, 1908	31,180	16,357	14,823	.....	.....
Northern Texas Electric Company:					
August, 1909	69,441	57,892	11,548	17,189	31,359
August, 1908	92,593	53,530	38,924	17,434	21,538
Paducah (Ky.) Traction & Light Company:					
August, 1909	16,930	11,280	8,648	6,518	2,130
August, 1908	19,851	11,694	8,157	6,751	1,405
Pensacola (Fla.) Electric Company:					
August, 1909	22,205	12,514	9,691	4,371	5,319
August, 1908	19,585	13,141	6,420	4,487	1,933
Puget Sound Electric Railway Company:					
August, 1909	194,383	113,867	80,515	44,700	35,815
August, 1908	158,594	95,845	62,749	39,020	23,729
Savannah (Ga.) Electric Company:					
August, 1909	53,931	36,384	17,546	15,768	1,778
August, 1908	51,511	30,858	20,686	15,835	4,851
Tampa (Fla.) Electric Company:					
August, 1909	48,468	28,803	19,665	3,844	15,820
August, 1908	15,474	29,723	5,751	4,388	11,362
Western Union Telegraph Company:					
Year ended June 30, 1909	30,541,072	23,197,966	7,343,106	1,732,250	5,614,856
Year ended June 30, 1908	28,850,281	25,179,215	3,671,065	1,732,250	1,938,815

GENERAL NEWS

Construction News.

ANNISTON, ALA.—The City Council has granted the Coosa River Development Company a franchise to do business in Anniston.

DUNCAN, ARIZ.—Investigations are being made by the Consolidated Telephone & Telegraph Company, of Tucson, Ariz., for the purpose of erecting a telephone system in Duncan and surrounding territory. E. J. Lehman, of Clifton, Ariz., is local manager.

GOLDROAD, ARIZ.—Preparations are being made by the Gold Road M. & E. Company for operating its hoists, compressors and other machinery by electricity, which will be supplied from the plant of the Desert Power & Water Company at Kingman, Ariz. About 200 hp will be required. Power for operating its plant has heretofore cost the Gold Road Company from $26 to $43 per hp per month, while the present service will cost but $11.50 per hp per month.

PHOENIX, ARIZ.—The Overland Telephone Company is contemplating the erection of a long-distance telephone line between Wickenburg and Parker, work on which will begin soon.

WHIPPLE BARRACKS, ARIZ.—Proposals will be received at the office of the constructing quartermaster, Whipple Barracks, Ariz., until Nov. 10 for furnishing labor and material required for the construction of an electric lighting system at Whipple Barracks, Ariz. Blank forms of proposals and further information may be had upon application to the above office. Lieut. William A. Alfonte is constructing quartermaster.

HEBER, ARK.—Surveys and plans have been completed by the Heber Light & Power Company for the construction of its proposed electric railway in Heber, one and one-half miles in length. W. H. Horton is secretary.

LITTLE ROCK, ARK.—Plans and specifications are being prepared by the Garland Power & Development Company for the construction of five dams on the Ouachita River. Three of the dams will be constructed to create reservoirs to furnish water for the plants during the dry seasons and two dams will be utilized to furnish power for the power plant in Garland County to generate electricity to be distributed throughout Central Arkansas. The cost of the dams is estimated at $3,000,000. Henry Dalhoff is interested in the project.

RUSSELLVILLE, ARK.—It is reported that the power company which is constructing a dam across the Illinois River, near Russellville, and installing a hydroelectric plant to furnish electricity in Central Arkansas will be ready to furnish electricity early in November. The company is also making preparations to build an electric railway connecting Dardanelle with Mount Nebo, one of the summer resorts in Western Arkansas. Electrical power for operating the railway will be supplied from the power plant at Russellville. Jesse M. Martin is said to be interested in both projects.

GAZELLE, CAL.—The Board of Supervisors has granted a franchise to the Edson & Foulke Company, of Gazelle, to construct a private telephone line along the county road from Gazelle and the Granada Ranch, near Montague.

MAMMOTH, CAL.—It is reported that the Copper Creek Mining Company, of Copper Creek district, 14 miles east of Mammoth, is contemplating enlarging its electric plant in the near future.

OROVILLE, CAL.—Notice of appropriation of 5000 miners' in. of water of Butte Creek has been filed by Frederick F. Conger. The water will be utilized for power, mining, domestic and irrigation purposes.

PACIFIC GROVE, CAL.—The Monterey County Gas & Electric Company has petitioned the Board of Supervisors for a franchise to extend its proposed transmission line from Monterey to Salinas. The transmission line will be about 30 miles in length and will supply electricity in Castroville, and also to operate pumping plants in that locality. The line will parallel the Southern Pacific Railway to Castroville and from there will extend along the county road to Salinas and thence to Spreckles, where, it is said, the sugar company will utilize electricity taken from the Monterey system.

POMONA, CAL.—The construction of an electric railway from Pomona to Claremont, the seat of Pomona College, and on to Indian Hill, is said to be under consideration by the business men of Pomona. The proposed railway will be about 5 miles long.

PORTERVILLE, CAL.—Plans are being made to form a new company for the purpose of constructing a power plant, to be located about a mile below Springville, where a fall of from 100 to 120 ft. can be secured. It is said that A. M. Coburn has offered to the company use of the water which he now has the privilege of taking for his mill in exchange for power, which, it is understood, will be accepted. It is said that $70,000 has already been subscribed for stock in the company. S. E. Henley is interested in the project.

RED BLUFF, CAL.—The Sacramento Valley Power Company has been granted a franchise to erect its transmission lines in Red Bluff.

RED BLUFF, CAL.—The Board of Supervisors has granted the Sacramento Valley Power Company a franchise to construct transmission lines over certain highways in the county.

SAN DIEGO CAL.—Bids will be received by J. T. Butler, city clerk, until Nov. 15 for lighting the streets and parks of the city with electricity beginning June 1, 1910.

SAN DIEGO, CAL.—Plans are being made by the Home Telephone Company for extensive improvements to the local plant and extension to the service in and around San Diego, which will include the installation of both aerial and underground cable systems in the business district and improvements to the branch lines to City Heights, Chollas Valley, Point Loma.

TULARE, CAL.—The Whitney Power Company has purchased the electric lighting system of the Consolidated Heat, Light & Power Company in Tulare. The power company has supplied the Consolidated company electricity for operating its lighting system for the past ten years, and when the contract expired began the installation of a new plant in Tulare, which resulted in the Consolidated company selling its electric system to the Whitney company. It is said that the flat rates will be abolished as soon as meters can be installed.

VENTURA, CAL.—The Town Board is considering the question of replacing the present street lighting system with tungsten lamps.

AGUILAR, COL.—The Southern Colorado Power Company is extending its high-tension transmission line from Trinidad to take in several additional mining districts. It is said that the substation will probably be located on the site of the present lighting plant in Aguilar.

DENVER, COL.—The Denver, Colorado Springs & Pueblo Interurban Electric Railway Company has completed its permanent line survey for its proposed electric railway between Denver and Colorado Springs, 73 miles in length. Arrangements have also been made with the Denver City Tramway and the Colorado Springs & Interurban Railway companies for operating over the terminal tracks from the city limits of both Denver and Colorado. L. E. Briggs, of Denver, Col., is chief engineer.

DORCHESTER, COL.—The United Colorado Mines Company, of Dorchester, recently installed a hydroelectric power station two miles from its plant, which is now operated entirely from this source.

PITKIN, COL.—A franchise has been granted to the local Independent Mining Company for the installation of an electric lighting system. A. E. Reynolds is reported to be interested in the project.

RIFLE, COL.—The electric light and power station of the Rifle Light, Heat & Power Company at Rifle, Col., is now completed and in operation.

NORWICH, CONN.—The Falls Company has commenced work on the construction of an electric power plant at the dam near the Chelsea File Works, where it is proposed to generate 200 hp to be transmitted to its plant over high-tension transmission lines. The company manufactures textile fabrics.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Oct 26 to furnish at the navy yards and naval stations the following supplies: Washington, D. C. Schedule 1793—Cold water turbine meter. Brooklyn, N. Y. Schedule 1785—Six complete sets propelling machines. Schedule 1789—14 ammeters and 12 voltmeters. Boston, Mass. Schedule 1785—Six complete sets propelling machinery. Schedule 1795—8500 lb. seamless brass pipe and 2250 lb. seamless copper pipe, 5000 lb. seamless drawn brass tubing, etc. Bids will also be received until Nov. 2 as follows: Mare Island, Cal. Schedule 1757—Four 3-hp chain ammunition hoist motors with spare parts. Puget Sound, Wash., or Brooklyn, N. Y. Schedule 1775—Voltmeters, ammeters and millimeters. Applications for proposals should designate the schedule desired by number.

QUINCY, FLA.—Bids will be received by George H. Palmer, city engineer, Quincy, Fla., until Nov. 1 for construction of power house, reservoir, a 150-kw direct-connected generator, 200-hp engine, four-valve type, 1,500,000-gal. pump, air compressor, stand pipe, fire hydrants, 4 to 12 in., cast iron pipe, valves and boxes, poles, wire, arms and sewer pipe 8 to 18 in. For further information address the city engineer.

ST. PETERSBURG, FLA.—It is reported that the St. Petersburg Investment Company, which controls and operates the St. Petersburg Electric Light & Power Company, is planning to rebuild the electric light plant, including the installation of engines and generators.

ATLANTA, GA.—Plans to have a "Great White Way" on Peachtree Street and adjacent territory, by the installation of electric lamps, are being made and several thousand dollars have already been donated by property owners for the purpose. A committee has been appointed to solicit subscriptions and make the undertaking a success.

ATLANTA, GA.—Extensive improvements are being made by the Georgia Railway & Electric Company which will involve an expenditure of about $150,000. Car barns are being erected at a cost of about $50,000; a new substation is being erected on Walton and Fairlie streets, which will have an output of 1500-hp, at a cost of about $25,000; also

the installation of a new motor-generator set in the Davis Street power plant, the cost of which is estimated at $25,000, and $50,000 for new tracks from the Hapville line to the autodrome.

CANTON, GA.—It is reported that the Canton Cotton Mills will erect an addition to its mill and install 10,000 spindles, 300 looms, electric generator, etc.

GREENVILLE, GA.—This town has voted in favor of the proposition to issue bonds for the construction of electric light, water and sewerage systems.

HAWKINSVILLE, GA.—It is reported that the citizens have voted in favor of issuing bonds for the construction of a municipal electric-light plant.

MACON, GA.—Preparations are being made for the installation of a complete electric plant at Mercer University this fall to furnish electricity for lighting the college buildings and grounds. The power plant will be located across the campus from the buildings. The city has granted the college authorities permission to erect overhead wires across Elm Street.

SENOIA, GA.—We are informed that the election held Sept. 11, at which the citizens voted to issue $10,000 in bonds for the construction of an electric-light plant has been pronounced illegal, owing to its not having been properly advertised.

WHITESTONE, GA.—We are informed that work is not likely to commence on construction of the hydroelectric power plant in which Frank Eastman, of Chicago, Ill., is interested to furnish electricity for the marble works near Whitestone, Ga., before next spring. H. von Schon, of Detroit, Mich., is engineer in charge.

MURRAY, IDAHO.—The City Council is considering the question of installing an electric light plant, water works and sewers in Murray. An election will soon be called to submit the proposition to the people.

ATLANTA, ILL.—The Atlanta Electric Light, Heat & Power Company is erecting a high-tension transmission line from Atlanta to McLean, five and one-half miles distant. The company will also install an alternator to provide for the increased load.

CARPENTERVILLE, ILL.—The equipment of the new plant of the Star Manufacturing Company, of Carpenterville, will include two large dynamos and from 50 to 75 alternating-current motors, together with other machinery. The plant will be driven by a hydraulic turbine.

MOMENCE, ILL.—The Momence Electric Light Company, it is said, contemplates enlarging its power plant next spring. W. B. Harpole is manager.

OSWEGO, ILL.—The New York Telephone Company has been granted a franchise to construct a subway for its cables from East Fourth to West Second Street in Utica Street and beneath the new Utica Street Bridge.

PLANO, ILL.—The construction of an electric railway, which is to extend from Sandwich to Plano, and from Plano to Bristol on the north side of the river, thence to Oswego to Aurora on the west side, is under consideration. John B. Newhall, of Cincinnati, Ohio, is interested in the enterprise.

ROSICLARE, ILL.—The Rosiclare Lead & Fluorspar Company is contemplating the installation of one or two large motors to operate the machinery in its plant.

VERNON, ILL.—Plans are being considered for the construction of an electric railway from Vernon, Ill., to a point on the Mississippi River, above Chester by the way of Winkle. The railway will be about 83 miles in length and will be constructed especially for heavy freight. A passenger service will be provided. It is reported that the project has been financed by a syndicate represented in St. Louis, Mo., by Albert J. Davis.

WAUKEGAN, ILL.—It is reported that the Central Engineering & Construction Company, of Chicago, Ill., has decided to undertake the construction of the proposed electric railway of the Waukegan, Rockford & Elgin Traction Company. It is said that the railway will be built next year. Robert D. Wynn is president of the company.

INDIANAPOLIS, IND.—The Indiana Motor & Manufacturing Company will receive bids for boilers, motors and a full line of electrical equipment to be installed in a large factory building in Franklin, Ind. Charles B. Riley, 717 East Twenty-second Street, Indianapolis, Ind., is general manager.

INDIANAPOLIS, IND.—Application has been made to the Commissioners of Marion County by Louis McMains and associates for a franchise to construct and operate an electric railway from Beech Grove to Indianapolis, along the Churchman's pike, a distance of eight miles.

RENSSELAER, IND.—Surveys are now being made for locating the proposed electric railway to be built by the Northwestern & Indiana Traction Company between Rensselaer and Lafayette and a branch from Monticello to Logansport.

ROCKPORT, IND.—The Rockport Traction Company is reported to have awarded a contract to the Tennis Construction Company, of Pittsburgh, Pa., for the construction of an extension of its railway system to Troy, Tell City and Cannelton.

SOUTH BEND, IND.—The South Bend & Logansport Traction Company has placed a contract with the Indiana & Michigan Electric Company, of South Bend, Ind., for wiring and supplies. Other contracts will be awarded in a short time. The company proposes to construct an interurban railway connecting South Bend and Logansport. P. J. Haulihan is interested in the project.

CHARITON, IA.—The City Council has awarded the contract for the new engine for the municipal electric-light plant to the Kansas City Machine Works, of Kansas City, Mo.

DAVENPORT, IA.—The Davenport Water Power Company announces that it has interested Eastern capitalists in the project whereby it expects to develop 16,000 hp at a cost of $2,000,000. The company already has a government franchise and hopes to build its canal and power plant next year, utilizing the water power of the Davenport-LeClaire Rapids, in the Mississippi River. The company will ask for a franchise in Davenport.

GRINNELL, IA.—It is reported that the plant and holdings of the Grinnell Electric & Heating Company have been purchased by J. A. Radford, of Chicago, Ill.

IOWA FALLS, IA.—The Interstate Power Company has applied to the City Council for a 25-year franchise. If granted a franchise the company will expend about $500,000. The question will be submitted to a vote.

OXFORD JUNCTION, IA.—Plans are being made for the installation of an 18 x 30 in. Corliss engine in the power plant of the Oxford Junction Light, Power & Mill Company.

WELLSBURG, IA.—H. A. Schmitt, of Wellsburg, Ia., is contemplating the installation of an electric plant in this town.

LUCAS, KAN.—Bids will soon be asked for the construction of an electric light plant and water-works system in Lucas. J. S. Worley & Company, engineers, of Kansas City, Mo., have charge of the work.

NEWPORT, KY.—Bids will be received by John W. Davis, city clerk, Newport, Ky., until Oct. 28 for the telephone and telegraph franchise giving the right and privilege of entering in, through and under the streets, alleys and public highways of the city of Newport; to construct and maintain underground conduits and to place and maintain wires, cables, conductors and all necessary appurtenances thereto for the purpose of furnishing telephone and telegraph service for a term of 20 years. Conditions and all information pertaining to the above proposed franchise can be obtained at the office of the city clerk.

ALFRED, MAINE.—Preparations are being made to light the streets of the village by electric lamps. Many of the residences will be lighted by electricity. It is understood that the service will be furnished by the Alfred Embroidery Company.

OAKLAND, MD.—Surveys are being made for the construction of a hydroelectric power plant near Oakland, and rights of way are being secured for the erection of a transmission line. It is proposed to develop the water power of Swallow Falls and other falls, to be utilized to generate electricity for lamps and motors throughout Garrett County. Hiram R. Tasker is interested in the project.

POOLESVILLE, MD.—Owing to the United Telegraph & Telephone Company of Pennsylvania having withdrawn its telephone service from Poolesville and vicinity, the farmers and citizens in Poolesville and adjoining territory have decided to erect a telephone line from Poolesville to Boyds, and thence to Barnesville, taking in Dickerson and other districts in the county, and make connections with the Chesapeake and Potomac system. Several thousand dollars worth of stock have already been subscribed.

ABINGTON, MASS.—Owing to the street-lighting committee and officials of the Electric Light & Power Company, of Abington and Rockland, being unable to come to an agreement in regard to the new lighting contract the streets of the town will be in darkness for the present. The town last year paid at the rate of $70 each for arc lamps and $16 per lamp for incandescent lamps, aggregating a total of $4,325, for street lighting. At the March meeting the town instructed the committee to place 18 more lamps in various parts of the town and to make a new contract with the company at the same amount, but so far no agreement has been reached. The committee has decided to notify the company to discontinue the service until satisfactory terms are made.

BALDWINSVILLE, MASS.—The electrical service in the town of Templeton has been changed from the plant of the Gardiner Electric Light Company to the system of the Connecticut River Transmission Company, which furnishes electricity for operating the Gardiner Electric Light Company's system in Gardiner, from its hydroelectric plant in Vernon, Vt. Electricity from the plant of the Gardiner Electric Light Company was furnished at 133 cycles and that by the Connecticut Company is 60 cycles, which will necessitate changing all motors in this town, which will be done at the town's expense.

BLACKINTON, MASS.—The Blackinton Woolen Company has purchased six 20-hp motors, which will be used as auxiliary power for its new weave shed.

CHESTER, MASS.—The State Gas Commission has approved of an issue of $5,000 additional capital stock by the Chester Electric Light Company to purchase the plant and holdings owned by E. L. Gardiner, under the name of the Chester Electric Light Company.

NORTHAMPTON, MASS.—The City Council is considering the question of lighting Main St. with overhead arches carrying from 16 to 20 tungsten lamps of 60 cp. The cost of the installation is estimated at $800, of which the Northampton Electric Lighting Company has agreed to pay half. The mercantile committee of the Board of Trade has asked the Council for an appropriation of $400 to pay for the other half. The cost of maintaing the lamps this year, which is estimated at $1,600, is to be paid by the merchants on Main Street.

SOUTH BARRE, MASS.—Work has commenced on the new power house for the Barre Wool Combing Company, which will be equipped

with machinery to generate electricity to be operated in conjunction with its water privilege, which is already partly developed.

WORCESTER, MASS.—The Osgood Bradley & Sons Company has purchased property in Greendale, in the northern section of the city, for the purpose of erecting a plant on the site. The company is negotiating with the Connecticut River Power Company for furnishing electricity to operate its works. Arrangements will be made for the installation of steam engines and electric generators in the power house, in case they are required later.

WORCESTER, MASS.—The Worcester Electric Light Company is reported to have several new sites under consideration with a view of constructing a new steam-generating plant. At present the company subleases water rights from the American Steel & Wire Company, which controls water rights of Salisbury pond. It is said that the company may decide to purchase power from the Connecticut River Transmission Company, which has a hydroelectric power plant in Vernon, Vt., and is now furnishing electricity in Clinton and Fitchburg, Mass.

AUSABLE, MICH.—Preparations are being made by the Eastern Michigan Power Company for the development of the water power of Ausable River, to be utilized to generate electricity, which will be transmitted to the Saginaw Valley cities. The present plans include the construction of 13 dams along the river eventually. Work will soon commence on the initial development and definite location will soon be decided on for the dam, power house, etc. The cost of the work is estimated at $300,000. H. M. Loud's Sons Company, of Ausable, are interested in the new company. W. G. Fargo is engineer.

BADGER, MINN.—The independent telephone company organized by the farmers in the Pine Creek settlement is planning to extend its line to this village next spring. H. S. Halverson is secretary of the company.

WASBASHA, MINN.—The property of the Greenwood Telephone Company is reported to have been taken over by the Dwelle Company. The new company is planning to install the central battery system.

ACKERMAN, MISS.—Bids will be received until Nov. 2 for the construction of a municipal electric-light plant. The cost of the plant is estimated at $35,000. X. A. Kramer, of Magnolia, Miss., is engineer in charge.

HAVRE, MONT.—The Montana Independent Telephone Company has applied to the City Council for a franchise in Havre.

STEVENSVILLE, MONT.—The citizens on Oct. 4 voted to grant a franchise to the Missoula Light & Water Company, of Missoula, Mont., to install an electric system in Stevensville. Under the terms of the franchise the company is to have the plant established within ten months. Electricity for the system will be furnished from the company's plant in Missoula.

NELSON, NEB.—Bids will be received by the city clerk until Oct. 29 for furnishing material and machinery for water works system for the City of Nelson, as follows: 50-kw, alternating-current generator and engine direct-connected, two marble switchboards and instruments, one boiler and equipment, one feed-water heater, one centrifugal pump and motor, 35 fire hydrants, 20 valves and boxes and 100,000-gal. elevated tank. Plans and specifications are on file in the office of the city clerk.

ODELL, NEB.—Barry & McAllister have been granted a 20-year franchise to construct and operate an electric light system in Odell. It is understood that work will soon commence on construction of the plant.

VALLEY, NEB.—The contract for the construction of an electric-light plant and water-works system was awarded to the National Company, of South Bend, Ind.

VALENTINE, NEB.—Bids will be received at the office of the village clerk, Valentine, Neb., until Oct. 25, for the construction of the whole or parts of the water and lighting system for Valentine, including the furnishing and installation of all machinery and apparatus, in accordance with plans and specifications prepared by W. K. Palmer Company, of Kansas City, Mo., as follows: Section 1—Power house, power house equipment and dam. Section 2—Pole line from power house to wells. Section 3—Wells, pump pits, pumphouses and equipment. Section 4—Pipe line from wells to city and city water system. Section 5—Concrete tank and pipe line from tank to wells. Section 6—Pole line from wells to city and city lighting system. Plans and specifications are on file at the office of the city clerk, Valentine, and at the offices of the W. K. Palmer Company, engineers, Dwight Building, Kansas City, Mo. Plans may be secured from the engineers upon payment of five dollars to cover cost of preparing same.

TONOPAH, NEV.—The telephone line extending from Tonopah to Clifford has been purchased by Edward Clifford, Sr., who proposees to erect extensions to Ellendale and Stone Cabin.

WELLS, NEV.—The Pacific Reclamation Company, it is said, will construct a power plant on Bishop Creek. Electricity generated by the plant will be transmitted to Wells.

CONCORD, N. H.—The stockholders of the Concord & Montreal Railroad Company have voted to issue new capital stock to the amount of $250,000, the proceeds to be used for the purchase of water powers on the Pemigewasset River in Franklin and surrounding towns, recently acquired by the Boston & Maine Railroad Company. It is proposed to develop the water power to generate electricity to be utilized for motive power for the car shops in Concord and for operating the Concord & Manchester Electric branch and other purposes.

LITTLETON, N. H.—Carl A. Ross, promoter of the power project at Fifteen-Mile Falls, on the Connecticut River, is reported to have sold his interests to Massachusetts capitalists, who are already making plans for the development of three large power plants, by which it is estimated that about 5000 hp would be generated. It is understood that work will commence on the plant next spring. Carl A. Ross will have charge of the project.

MEREDITH, N. H.—A new electric light plant is being installed in Meredith.

PLAISTOW, N. H.—The Popularis Light & Service Company is contemplating the construction of an electric plant between Plaistow and Newton to furnish electricity for lighting the streets and residences of both villages. Frank W. Preble, John E. Hayford and Everett M. Bartlett, of Newton, N. H.; Thomas M. Everett, of Dorchester, Mass.; John H. Jennings, of Boston, Mass.; Joshua T. Nowell, of Melrose, Mass., and Boardman B. Merrill, of Boston, Mass., are interested in the company.

COLUMBIA, N. J.—The Eastern Pennsylvania Power Company is reported to have closed contracts for the purchase of turbines and generators for a large hydroelectric power development. It is said that additional equipment will be purchased later.

GRENLOCH, N. J.—The Bateman Manufacturing Company, of Grenloch, N. J., which manufactures agriculture implements, has recently placed contracts for the installation of a 160-hp Riverside engine and a gas producer manufactured by R. D. Wood & Company. The engine will be directly connected to a Crocker-Wheeler generator. The company, it is said, will be in the market for motors.

ORANGE, N. J.—The street committee of the Common Council has decided to receive two sets of bids for construction of the proposed municipal electric light plant, which will be received until Nov. 8. Proposals will be received from general contractors for construction of the entire plant, and separate bids will also be received for the generating plant and the distributing system. In the revised plans some important changes have been made, including the substitution of motor-driven Brush arc generators for rectifiers and transformers. The switchboard sections have been reduced from 13 to 8. The plant will supply energy for 368 arc lamps and 95 tungsten lamps. Runyon & Carey, of Newark, N. J., are engineers.

BROOKLYN, N. Y.—Sealed bids will be received by Bird S. Coler, borough president, Room 2, Borough Hall, Brooklyn. N. Y., until Oct. 27 for material and labor for construction of station building to be known as the power and gate houses and appurtenances complete for the Gowanus flushing tunnel, located at Douglass Street and the head of Gowanus Canal, in the Borough of Brooklyn. Blank forms and further information may be obtained at the office of Bureau of Sewers, 215 Montague Street. Borough of Brooklyn, N. Y.

BUFFALO, N. Y.—The Steel Storage & Elevator Construction Company of Buffalo, N. Y., has been awarded the contract for the construction of a 1,000,000-bushel grain elevator for the Spencer Kellogg Company, at Michigan and Ganson Streets, Buffalo, the cost of which, with equipment, is estimated at $275,000. The company is said to be in the market for a complete grain conveying outfit and elevating machinery and electrical power equipment.

DUNDEE, N. Y.—Plans are being prepared for the construction of an electric railway to connect Dundee with Starkey Station on the North Central Railroad of the Pennsylvania Railroad system, and also to Starkey Point on Seneca Lake, connecting there with boats for Geneva, Watkins Glen, etc. The road is to be promoted and owned by the owners of the Dundee electric light plant, together with an electric park at the lake. A. J. Pierce, of Dundee, N. Y., is engineer.

HANNIBAL, N. Y.—William Stock, of Hannibal, has been granted a franchise to furnish electricity for lamps in Hannibal, and has also secured a contract for lighting the streets of the village. The street lighting contract calls for 20 tungsten lamps. Mr. Stock has entered into a contract with the Oswego River Power Transmission Company to furnish electricity for the territory he proposes to serve in Hannibal, Red Creek and other districts.

PLATTSBURG, N. Y.—The Public Service Commission, Second District, has authorized the Plattsburg Gas & Electric Company to execute a first mortgage to secure an issue of $500,000 in bonds, and to issue $340,000 of the bonds, to be sold at not less than 92, the proceeds to be used for the discharge of an outstanding issue of bonds of the Plattsburg Light, Heat & Power Company to the amount of $125,000, the discharge or refund of $100,000 in bonds of the Lozier Light & Power Company, to discharge indebtedness of $65,734 incurred in additions and betterments and for further additions and improvements to its system, amounting to $ 8,342.

POUGHKEEPSIE, N. Y.—The Public Service Commission, Second District, has granted the Poughkeepsie Light, Heat & Power Company permission to issue under its first mortgage the remainder of unissued bonds aggregating $100,000 par value, the proceeds to be used for the payment of bills incurred for extensions and improvements of its plant and property amounting to $82,439 and the balance for further extensions and improvement to its plant and distributing system. The bonds are to be sold at not less than 95.

SYRACUSE, N. Y.—The Oswego River Power Transmission Company has applied to the Public Service Commission, Second District, for permission to extend its transmission line from Phoenix to Oswego; also to mortgage its property for $100,000 and to issue presently $6,000 in

bonds. The company has already erected a transmission line from Baldwinsville to Phoenix.

TOMKINS COVE, N. Y.—It is reported that the Tomkins Cove Stone Company is contemplating the installation of two compound engines and electrical machinery in its power plant this winter.

ALBEMARLE, N. C.—The City Council is reported to have engaged J. M. Bandy, of Greensboro, N. C., as consulting engineer in connection with proposed water works, electric lighting system and sewer system, for which the city recently voted to issue $67,000 in bonds.

CONCORD, N. C.—The Magnolia Mills Company, it is said, is contemplating building an addition to its plant and will install additional machinery. The mill is operated by electricity.

FAYETTEVILLE, N. C.—Arrangements have been made for adjustment of the financial difficulties of the Fayetteville Consolidated Power & Street Railway Company. Bonds to the amount of $75,000 will be issued and application will be made to the court for dissolving of the receivership, and preparations made for carrying out plans for improvements and extensions formerly made, as sufficient funds have been raised to liquidate all indebtedness. W. D. Neill, receiver, will be reinstated as president of the company.

HENDERSONVILLE, N. C.—The Hendersonville Light & Power Company will construct an electric street-car system through the main streets of the city and out to Parceola Lake, about 4½ miles in length. Improvements will be made to the power plant, including the installation of a 1300-kw turbine and 300-hp boilers. C. H. Broward is superintendent.

HICKORY, N. C.—Flaming-arc lamps will be substituted for the lamps now in use when the city begins to use electricity furnished by the Southern Power Company about Nov. 1, which will be distributed by the Thornton Light & Power Company.

REIDSVILLE, N. C.—The city is reported to have voted to issue bonds for the construction of an electric light plant.

STANLEY, N. D.—The Queen City Telephone Company, of Ryder, N. D., is considering plans for the construction of a telephone line to Stanley with an exchange at Ross.

COLUMBUS, OHIO.—The Casparis Stone Company, of Columbus, Ohio, which is reported to have purchased two large gyratory breakers will install two 1,000-hp steam turbo-generator sets in its eastern quarries.

DEFIANCE, OHIO.—The Board of Public Works, it is said, contemplates asking for bids for an electric light franchise in the near future. It is understood that if bids are not satisfactory a municipal electric light plant will be installed.

GENOA, OHIO.—The Village Council has awarded a contract to the Toledo, Port Clinton & Lakeside Railway Company, of Toledo, Ohio, to light the streets of the village. The street-lighting system will include about 20 arc lamps.

LONDON, OHIO.—Arrangements are being made to reorganize the London Telephone Company, which was recently purchased by the Columbus Citizens Telephone Company. The London company will maintain its corporate existence but new officers and directors will be elected connected with the Columbus company. Plans are being prepared for overhauling the exchange and lines of the local company.

MIAMI (P. O., CLEVES), OHIO.—Plans are being considered for the reorganization of the old Maumee Valley Electric Company, which controls the water-power plant at Miami. It is proposed to remodel the plant and develop 2500 hp to be utilized for manufacturing purposes in Toledo. It is proposed to ultimately increase the output to 10,000 hp. Contracts involving an expenditure of $100,000 have already been placed. It is expected to have the plant in operation by next February. It is said that the name of the company will probably be changed to the Maumee Rapids Power Company.

QUINCY, OHIO.—The City Council has granted the Pressed Steel Car Company a franchise to install an electric light plant and to furnish electricity for lighting the streets of the village.

SPRINGFIELD, OHIO.—The contract for the construction of a new plant for the Springfield Light, Heat & Power Company has been awarded to J. A. Ross, of Springfield, Ohio.

WESTERVILLE, OHIO.—The Village Council is considering a proposition submitted by S. S. Wyer, representing the Municipal Utilities Company, of Columbus, Ohio. The plan proposed contemplates the company taking over the municipal electric and water works system for a period of ten years, the village paying for the improvements made by the company and $3,000 per year for operating the plants. The company proposes to use electricity taken from the high-tension transmsission line of the Columbus, Delaware & Marion Railway Company at Flint, four and one-half miles distant. In place of the present water works system the company proposes the erection of a 100,000-gal. standpipe, which will be supplied with water from wells drawn by electrically driven pumps.

WALTER, OKLA.—The City Council has awarded the contract for construction of water, light and sewer systems to the O'Neal Construction Company. The cost of the water system is estimated at $57,000 and the light plant at $7,000.

WETUMKA, OKLA.—Bids will be received by the City of Wetumka, Okla., until Oct. 27 for material for water and light plant as follows: Two boilers, one feed-water heater, one boiler feed pump, one steam fire pump, one tank and tower, one alternating-currnt generator, one electric-driven pump and motor, three miles of pole line, arc lamps, etc.; 8-in. cast iron water pipe, 6-in. cast iron water pipe, 4-in. cast iron water pipe, 4 and 6-in. hydrants and 6 and 8-in. valves. Plans and specifications are on file at the office of the city clerk and at the office of the Federal Engineering & Contracting Company, Okmulgee, Okla.

ASTORIA, ORE.—We are informed that the Hammond Lumber Company contemplates the installation of two 800-kw, mixed-pressure turbines, direct connected to generators. The company proposes to use exhaust steam from its sawmill when in operation and direct steam when the mill is idle. The electrical energy will be delivered to the Astoria Electric Company, which operates the local lighting and power plant. A. B Hammond is president.

NEWBERG, ORE.—The Yamhill Electric Company has secured franchises from the cities of Dayton, Lafayette and Dundee, Ore., to furnish electricity for lamps and motors for a term of 20 years. Contracts have also been made with the towns for street lighting for a period of ten years. Electricity will be furnished from the plant of the company at Newberg, transmitted at 6600 volts, three-phase. The transmission line will be about 10 miles in length. The company has just installed two Babcock & Wilcox boilers. C. J. Edwards is president and manager.

PORTLAND, ORE.—Preparations are being made by the Gibson Manufacturing Company, it is said, for the construction of a power plant on the Clackamas River to generate power for manufacturing purposes.

BEDFORD, PA.—The Bedford Electric Light, Heat & Power Company is contemplating the installation of a new steam engine with a rating of from 250 or 300 hp. William Brice, Jr., is manager.

McKEESPORT, PA.—Preparations are being made by the McKeesport Tin Plate Company to install an engine and generator of from 400 to 500 hp to furnish electricity to operate its plant. The company will also equip its plant with direct-current motors.

PHILADELPHIA, PA.—Bids will be received by the Department of Public Works until Nov. 4 for pumps, boilers and mechanical and electrical equipment for the Queen Lane filter plant. The machinery to be installed includes two high-pressure, direct-acting pumping engines rated at 2,000,000 gal. each, and two 5,000,000-gal. centrifugal pumping engines to pump wash water for preliminary filters.

WATSONTOWN, PA.—L. R. Gross, of Watsontown, writes that proposals will be received by the borough of Watsontown, Pa., for furnishing one water-tube boiler and steel chimney. For specifications and further information apply to the borough secretary.

ANDERSON, S. C.—The plant and holdings of the Anderson Traction Company was sold on Oct. 11 in bankruptcy proceedings to Edwin W. Robertson, of Columbus, S. C., for $154,050. The property includes 18 miles of track, rolling stock, power plant and equipment.

LANCASTER, S. C.—The City Council has entered into a contract with Col. Leroy Springs and T. Y. Williams to furnish electricity for lighting the streets of the city. The contract calls for not less than 30 arc lamps, the system to be installed not later than Jan. 31.

IPSWICH, S. D.—Preparations are being made by the Ipswich Electric Light & Power Company for the construction of an electric-light plant, plans for which are being prepared by Oscar Claussen, consulting engineer, German-American Bank Building, St. Paul, Minn. The cost of the plant is estimated at $12,000. Captain Arnold is president of the company.

LEMMON, S. D.—The Dakota-Montana Telephone Company is planning to extend its telephone line to Mobridge.

PIERRE, S. D.—The City Council has awarded a contract for the installation of a 150-hp engine and generator in the municipal electric light plant and also a 250-hp engine and pump for the water works, at a cost of $20,500.

LIMESTONE, TENN.—John Gillespie, of Johnson City, Tenn., is reported to have secured an option on Chuckey River Falls with a view of building a hydroelectric plant.

COLEMAN, TEX.—The West Texas Telephone Company, it is reported, contemplates improvements to its local system, which will involve an expenditure of about $16,000.

GONZALES, TEX.—The Gonzales Cotton Mill Company contemplates installing 2000 spindles, 50 looms and hydroelectric equipment in its mills.

PORT LAVACA, TEX.—Preparations are being made by the Port Lavaca Telephone Company to extend its telephone line down the coast to the townsite of Port O'Connor, a distance of 25 miles.

PARK CITY, UTAH.—The Telluride Power Company, of Provo, Utah, has petitioned the City Council for a franchise to construct and operate an electric light plant in Park City for a term of 50 years. The company offers to furnish electricity to consumers from 25 to 50 per cent less than the rate now charged by the Park City Light, Heat & Power Company, and will have the plant in operation within nine months if the franchise is granted. Under the terms of the franchise the city has the privilege of purchasing the system at any time during the life of the franchise by paying the company the value of the same with a reasonable rate of interest on the investment.

SALT LAKE CITY, UTAH.—It is reported that work will commence this fall on equipping the railroad from Salt Lake City to Saltair, on Salt Lake, 18 miles in length, to be operated by electricity.

SALT LAKE CITY, UTAH.—Work has commenced on the construction of the new power plant of the Utah Light & Railway Company, located on the Davis and Weber counties canal in Weber Canyon. The

plant and equipment will involve an expenditure of about $400,000. The equipment will include one 2500-kw generator direct connected to a 5000-hp. Pelton water wheel. Sufficient space will be allowed for another generator, to be installed later. The plant will be equipped with traveling cranes and other apparatus. Electricity generated at this plant will be transmitted by means of a steel tower transmission line to the present transmission line from Ogden to Salt Lake City, a distance of about five miles.

SPANISH FORK, UTAH.—The contract entered into by the Reclamation Service and the city officials of Spanish Fork whereby the former agrees to furnish electricity to the City of Spanish Fork for lighting purposes in amounts not exceeding 65,000 per kw-hours per month at the rate of 0.8 cent per kw-hour has been approved by the Secretary of the Interior. The Reclamation Service is utilizing a drop in its main canal on the Strawberry Valley project to furnish power to generate electricity, a portion of which is transmitted to the mountains and utilized in the excavation of a tunnel, 4 miles in length. This tunnel will bring the waters of the Strawberry River through the Mountain Divide into Salt Lake Valley to irrigate 30,000 acres.

MARTINSVILLE, VA.—At an election held Oct. 2 the citizens voted in favor of the proposition to issue $35,000 in bonds, the proceeds to be used for enlarging the municipal electric-light plant. We are informed that contracts have already been placed for the work. J. R. Gregory is superintendent.

RICHMOND, VA.—We are informed that bids will be called for at once by the City of Richmond for piping, pumps, heaters and condensers in connection with the municipal electric light plant, contracts for which will be awarded Nov. 8. Contracts for line work, poles, wires, etc., will be awarded at an early date. E. W. Trafford is consulting engineer.

LACROSSE, WASH.—W. A. Gildersleeve, who is constructing an electric light and power plant in Washtucna, Wash., has been making investigations in Lacrosse with a view of extending the transmission line to this village to furnish electricity for lamps and motors.

ODESSA, WASH.—The Council has granted a franchise to the Washington Water Power Company to furnish electricity for lamps and motors in Odessa.

PASCO, WASH.—The Hanford Irrigation & Power Company, it is said, contemplates enlarging its pumping plant at Priest Rapids in order to operate pumps for its irrigation projects at White Bluffs, Pasco and other Columbia River points.

RENTON, WASH.—The Independent Telephone Company is planning to construct a new exchange and to make other improvements.

SPOKANE, WASH.—Plans are being made by the Spokane & Inland Railway Company to double-track its Greenacres line, to erect 40 miles of high-tension transmission lines and increase its power plant to 10,000 hp and also to purchase freight and passenger locomotives.

TEKOA, WASH.—The City Council has entered into a contract with the Idaho-Washington Light & Power Company for lighting the streets of the town for a period of five years. Tungsten series lamps of 80 cp will be used.

TWISP, WASH.—Arrangements are being made to form a telephone company under the name of the West Side Telephone Company for the purpose of erecting various telephone lines in this vicinity.

VANCOUVER, WASH.—Plans are being prepared by Berndt & Tegan, of Portland, Ore., architects, for a steam-driven electric-power plant and steam-heating plant for the new St. Joseph's Hospital, the Sisters' Academy and old hospital.

WALLA WALLA, WASH.—We are informed that the Portland Flouring Mills Company is not contemplating the construction of a new power plant in Walla Walla, Wash., as reported in the issue of Oct. 7.

TERRA ALTA, W. VA.—Plans are being prepared by J. A. Martin, owner of the local electric light plant, for the construction of a new plant.

STEVENS POINT, WIS.—The Bukolt Manufacturing Company is erecting a three-story extension to its factory. Additional power and operating machinery will be installed, together with a heating system utilizing motor-driven blowers.

SUPERIOR, WIS.—The United States Gypsum Company, it is said, is planning to remodel and equip its plant with modern machinery, which will be equipped as far as possible for individual motor drive.

CHEYENNE, WYO.—A. G. Langenbach, manager of the Cheyenne Light, Fuel & Power Company, writes that the company is now installing a 600-hp Franklin water tube boiler, one 500-hp Corliss engine, two 200-kw General Electric generators, and is also erecting an addition to the present power house 30 x 76 ft. The company is also making improvements to its gas plant.

EDMONTON, ALTA., CAN.—The Alberta Government telephone system now has connections with existing systems enabling residents here to talk with Spokane, Wash.

NANTON, ALTA., CAN.—The citizens on Oct. 1 voted to appropriate $16,000 for the construction of an electric light plant. A. S. Thurber, of Nanton, is engineer.

BRANDON, MAN., CAN.—The Canadian Pacific Railroad Company has put in operation a telephone line from Brandon eastward to Cartier, Ont., a distance of 1045 miles. For the time being this line will be used for emergency purposes only and not for the operation of trains.

WINNIPEG, MAN., CAN.—The Winnipeg Electric Company has promised to build a number of extensions to its existing car lines as early next year as possible.

AYLMER, ONT., CAN.—The power house of the municipal electric light and water plant was destroyed by a boiler explosion Oct. 12, causing a loss of about $50,000. At present the city is without light or water service.

COBALT, ONT., CAN.—The Cobalt Power Company has awarded a contract to the General Electric Manufacturing Company, of Sweden, for the supply of switchboards and 60 transformers in sizes of 160 kva, and less.

PORT ARTHUR, ONT., CAN.—The joint railway board has decided to order four additional street cars.

CHICOUTIMI, QUE., CAN.—The Chicoutimi Pulp Company has awarded contracts for the construction of an electric railway from its mills to the limits in the Riviere du Moulin district.

MONTREAL, QUE., CAN.—The Canadian General Electric Company, of Toronto, Ont., has been awarded the contract to furnish a 500-kw steam generator to the Saraguay Electric & Water Company.

MONTREAL, QUE., CAN.—The Saraguay Electric & Water Company is reported to have awarded the contract for a 500-kw steam turbo-generator set to the Canadian General Electric Company, of Toronto, Ont. Charles Brandeis, of Montreal, is consulting engineer.

VERDUN, QUE., CAN.—I. Collins, of Montreal, Que., has received the contract for the new municipal power house here.

WEYBURN, SASK., CAN.—The south line of the Weyburn Rural Telephone Company has been put in operation, and other lines will be built at once.

New Industrial Companies.

THE ANTICOR MANUFACTURING COMPANY OF MAINE, of Portland, Maine, has filed articles of incorporation with a capital stock of $1,000,000. The company proposes to manufacture and deal in machinery, tools and appliances. The incorporators are: C. E. Eaton, T. L. Croteau and J. E. Manter, all of Portland, Maine.

THE B. F. BROWN GAS ENGINE COMPANY, of Syracuse, N. Y., has been incorporated by B. F. Brown, of Syracuse, N. Y.; H. T. Gardenier, of Chicago, Ill., and C. A. Hull, Jr., of Morristown, N. J. The company is capitalized at $50,000 and proposes to manufacture engines, turbines, motor boats, etc.

THE CADY CONSTRUCTION COMPANY, of Chicago, Ill., has been chartered with a capital stock of $25,000 for the purpose of doing construction and contracting work. The incorporators are: Lewis V. Cady, E. J. Shackenberg, Edward D. Pray, Priggle, Morthrup & Terwillinger, all of Chicago, Ill.

THE DUNFEE CONSTRUCTION COMPANY, of Syracuse, N. Y., has been incorporated with a capital stock of $100,000 by Joseph Dunfee, Harry Harvey, William F. Canough, all of Syracuse, N. Y. The company proposes to do general contracting work.

THE ELECTRIC ECONOMY COMPANY, of Newark, N. J., has been chartered with a capital stock of $25,000 for the purpose of doing a mechanical and electrical engineering business; also as machinists. The incorporators are: L. Froelich, J. O. Sharp and A. S. Randolph.

THE ELECTRIC STERILIZING COMPANY, of Dover, Del., has been incorporated with a capital stock of $100,000 by Phillip I. Marvel, of Atlantic, N. J.; Franklin S. Smith and George W. Coles, of Philadelphia, Pa.

THE ELLETT ELECTRIC COMPANY, of Elmira, N. Y., has been chartered with a capital stock of $10,000 by John D., Henry D., and Frederick S. Ellett, all of Elmira, N. Y. The company proposes to do general electrical work and manufacture gas and electrical fixtures, etc.

THE GERVAIS ELECTRIC COMPANY, of New York, N. Y., has been chartered for the purpose of manufacturing electrical novelties and hardware. The company is capitalized at $110,000 and the incorporators are: H. Milbank, of New York, N. Y.; R. O. Bersick and H. Martens, of Brooklyn, N. Y.

The J. W. CODY SHOREING & CONTRACTING COMPANY, of New York, N. Y., has been chartered with a capital stock of $1,000 to do a general contracting business by Joseph W. Cody, James E. Smith and Edward J. Reynolds, all of New York, N. Y.

THE LA SALLE SUPPLY & CONSTRUCTION COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $5,000 to do general construction work by L. D. Carver, M. W. Hanley, W. F. Mulcahy and Eugene Purtelle, all of Chicago, Ill.

THE NATIONAL TELEGRAPHONE COMPANY, of El Paso, Tex., has been chartered with a capital stock of $5,000 by W. B. Glardon, H. W. Cutshall and George E. Milligan.

THE NORTH SHORE CONSTRUCTION COMPANY, of Chicago, Ill., has been chartered with a capital stock of $12,000 by Peter Bartzen, William J. Mueller and Louis A. Helle, all of Chicago, Ill. The company proposes to do general construction work.

THE RAMBLER AUTOMOBILE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000 by Thomas H. Beardsley, George Tiernan, Frank H. Purcells, all of New York, N. Y.

The company proposes to manufacture motors, engines, machines, wagons, etc.

THE ROBBINS-RIPLEY COMPANY, of New York, N. Y., has been incorporated by Allan A. Robbins, of New York, N. Y.; John W. Ripley, of Flushing, N. Y.; Arthur P. McKinstry and George P. Bard, both of New York, N. Y. The company is capitalized at $20,000 and proposes to do a contracting and engineering business.

THE SCHROEDER AERIAL NAVIGATION COMPANY, of New York, N. Y., has been incorporated by L. B. Newby, G. E. F. Fleming and W. H. Crow. The company is capitalized at $75,000 and proposes to manufacture machines for navigating the air.

THE S. J. STEWART COMPANY, of New Orleans, La., has been incorporated with a capital stock of $150,000 for the purpose of manufacturing electrical appliances, tools, etc. The incorporators are: Seymour J. Stewart, W. A. Dinkle, M. D. Theard and others.

THE VENN-SEVERIN MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated by Theodore H. Venn, Frank W. Severin, Henry L. Venn and Joseph H. Muhlke, all of Chicago, Ill. The company is capitalized at $25,000 and proposes to manufacture engines and machinery.

Company Elections.

WATERVILLE, MAINE.—At the annual meeting of the Waterville & Fairfield Railway & Light Company held recently, the following directors were elected: George K. Boutelle, Charles F. Johnson, Dr. F. C. Thayer, C. A. Leighton and Ralph Patterson. George K. Boutelle was elected president and H. D. Bates, treasurer.

SYRACUSE, N. Y.—At the annual meeting of the Syracuse Lighting Company, the following named directors were elected: S. T. Bodine, Walter Clark, G. W. Curnan, W. F. Douthist, Lewis Little, all of Philadelphia, Pa.; Stephen Peabody, Henry Seligman, of New York, N. Y.; John J. Cummings and J. C. LeLong, of Syracuse, N. Y.

BUCYRUS, OHIO.—At the annual meeting of the Bucyrus Light & Power Company the following named directors were elected: J. T. Lynn, F. C. Kingsbury, Edward Silliman, H. O. Dutter and P. J. Carroll. The directors have elected the following officers: J. T. Lynn, president; F. C. Kingsbury, vice-president, and Edward Silliman, secretary and treasurer.

New Incorporations.

MARMADUKE, ARK.—The Independent Rural Telephone Company has been granted a charter by the Secretary of State with a capital stock of $2,000. The officers of the company are: T. R. Corley, president; B. B. Stone, vice-president; G. C. Meredith, secretary, and C. H. Ross, treasurer.

MILLBRAE, CAL.—The Sierra & San Francisco Power Company has been incorporated with a capital stock of $20,000,000 for the purpose of acquiring by purchase or otherwise water rights for irrigation, domestic use, mining and other purposes, and to build and operate water works, etc. The directors are: J. S. Thornton, of Sonora, Cal.; Winfield Dorn, of Oakland, Cal.; H. F. Jackson, of Berkeley, S. H. Whipple, of San Francisco, and Warren Gregory, of Berkeley.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Home Long-Distance Telephone Company by Louis S. Beedy, of San Francisco, Cal.; James Lanergan, of San Francisco, Cal.; A. S. Keeler, of San Rafael, Cal.; H. G. Holabird, of Los Angeles, Cal., and Almeric Coxhead, of Berkeley, Cal. The company proposes to erect telephone lines from San Francisco to extend to the northern, southern and eastern boundaries of the State, covering a distance of more than 3000 miles.

DAVID CITY, NEB.—Articles of incorporation have been filed for the Butler Electric Company with a capital stock of $15,000 by John D. Sprague, S. C. Beede and others.

KINGSTON, N. C.—The East Carolina Electric & Realty Company has been chartered with a capital stock of $25,000 by S. L. Lynch, of Kingston; W. H. Wells and E. L. Lynch, of Snow Hill.

MARION, S. C.—The Marion Water & Electric Company has been incorporated with a capital stock of $50,000.

Personal.

MR. W. H. BARROW has resigned from the staff of the Boston Edison Company to accept a position on the faculty of the Cloyne House School, Newport, R. I.

MR. HARRY B. SPENCER has resigned as general superintendent of the Delhi (N. Y.) Electric Company, and opened an office as consulting engineer in the Parker Building, Schenectady.

M. L. NEWMAN & COMPANY, consulting and industrial engineers, have moved their offices from 25 Broad Street to the United States Express Building, 2 Rector Street, New York.

MR. J. W. BRAGDON, district agent of the Boston Edison Company, has been appointed first lieutenent and aide-de-camp to Brig.-Gen. W. A. Pew, Jr., of the Massachusetts National Guard.

MR. T. R. FREEMAN, chief engineer of the Greencastle, Ind., electric light and water-works plant, has resigned to accept a similar position in Kansas City. He is succeeded by Mr. P. K. Cunningham, of Chester, Pa.

DR. J. FRANKLIN MEYER, formerly head of the Department of Physics at the Pennsylvania State College, has accepted a position in the research department of the Westinghouse Lamp Company, at Bloomfield, N. J.

MR. A. J. QUIGLEY, who served as assistant electrical engineer of the Alaska-Yukon-Pacific Exposition, has become sales manager of the Agutler Griswold Company, of Seattle, which installed the lighting equipment on the Government buildings at the Exposition according to plans made by Mr. Quigley.

MR. L. G. KIBBE has resigned as treasurer of the Wheeler Condenser & Engineering Company, of Carteret, N. J., in order to take an active part in the management of the Warren Steam Pump Company, of Warren, Mass. Mr. Kibbe will be located at the head offices of the latter company at Warren.

DR. FRANK W. GUNSAULUS, president of Armour Institute of Technology, Chicago, has declined the presidency of a similar institution in New York City. It is said that a number of New York capitalists wished to see established in this city a school similar to the Armour Institute, and offered the presidency to Dr. Gunsaulus.

MR. S. E. BASTOW, of Messrs. Bruce Peebles & Co., Ltd., was entertained at dinner recently by a number of his friends in Edinburgh, preparatory to his leaving this country for a tour round the world on behalf of his firm. Mr. Bastow is now in Canada, and will proceed from there to Australia, New Zealand and South Africa. He expects to be away for at least six months.

MR. CHARLES T. RIPLEY, who was graduated last June from the course in railway electrical engineering at the University of Illinois, has been awarded the first prize in an electric railway car design contest recently held under the direction of The John G. Brill Company, of Philadelphia. The prize consists of the John G. Brill memorial medal and $250. The contest was open to all schools giving instruction in electrical engineering or railway electrical engineering, its purpose, as stated, being to "awaken the intelligent interest of technical students in a field which offers great opportunities for personal endeavor, scientific research, and a substantial reward."

MR. HENRY MANSON BYLLESBY, head of H. M. Byllesby & Company, Chicago, has been elected president of the Chicago Civic Federation. Mr. Byllesby, who has been identified with electrical enterprises for many years, was born in Pittsburgh 50 years ago and is a graduate of Lehigh University. He was one of the early associates with Edison, and has been the vice-president of the Westinghouse Electric & Manufacturing Company and managing director of the British Westinghouse interests. He is a member of the American Society of Civil Engineers, American Society of Mechanical Engineers, and associate member of the American Institute of Electrical Engineers. Connected with public-service enterprises in several States, as the nature of his business requires him to be, Mr. Byllesby takes an intelligent interest in all subjects relating to political economy and public policy, and it is not strange therefore that he should be honored with the presidency of the Chicago Civic Federation, which is a branch of the National Civic Federation, although with its own independent work and aims. It is interesting to note that Byllesby & Company are managers and operators of public-service properties in Mobile, Ala.; Fort Smith, Ark.; San Diego, Cal.; Sand Point, Idaho; Ottumwa, Iowa; Stillwater, Minn.; Enid, Muskogee and Oklahoma City, Okla.; Kalispell, Mont., and Tacoma, Wash.



H. M. BYLLESBY.

Obituary.

MR. W. I. BUCHANAN, well known as a diplomat and from his prominent connection with the Buffalo and other expositions, died suddenly in London, on Oct. 16. Mr. Buchanan had spent most of his time in recent years in Europe, although his permanent residence has been in Buffalo, N. Y., since 1901. He was born in Covington, Ohio, on Sept. 19, 1853. In 1894 President Cleveland appointed him Minister to Argentina, which post he held for six years. In 1901 he became Director General of the Pan-American Exposition at Buffalo. After the close of the exposition he was engaged as the diplomatic agent of the New York Life Insurance Company. In 1903 he became the first United States Minister to the Republic of Panama. His most prominent public service was the settlement of our long standing difficulties with Venezuela, which he accomplished during President Roosevelt's administration. For some time he represented the Westinghouse Companies in connection with important business transactions. Mr. Buchanan is survived by a widow, a son and a daughter.

Trade Publications.

TIME SWITCHES.—The Campbell Electric Company, Lynn, Mass., has issued an illustrated catalog giving descriptions and price lists of time switches.

X-RAY APPARATUS.—Electrotherapeutic devices for all medical purposes are described and illustrated in catalog No. 29 of the Campbell Electric Company, Lynn, Mass.

GAS ENGINES, for electric lighting, pumping and general industrial purposes are well illustrated and described in a neatly executed catalog issued by the Bruce-Macbeth Engine Company, Cleveland, Ohio.

THERMO-FLASHERS.—A leaflet of the Campbell Electric Company, Lynn., Mass., is devoted to a form of thermo-flasher arranged for use with 12 16-cp lamps on alternating current or three 16-cp lamps on direct current.

EXHAUST STEAM HEATING.—The financial effect of combining an exhaust steam-heating system with an electric plant supplying power to lamps and motors is discussed in a convincing manner in bulletin No. 115 of the American District Steam Company, Lockport, N. Y. In addition to giving cost data, the bulletin contains descriptions of the auxiliary devices used with exhaust steam-heating equipments.

LIFTING MAGNETS.—Much information concerning the constructive details and operating characteristics of lifting magnets is given in a neatly executed bulletin issued by the Electric Controller & Manufacturing Company, Cleveland, Ohio. That the lifting magnet has become a standard part of the equipment of foundries, machine shops and steel mills is indicated by a seven-page list of companies to which the magnets have been sold.

ELECTRICAL OPERATION OF PULP AND PAPER MILLS.—Bulletin No. 4665 of the General Electric Company, entitled "Electrical Operation of Pulp and Paper Mills," illustrates and describes the application of the electric motor to the paper industry. As an example of the application of electric drive in the manufacture of paper is given the plant of the United Box-board & Paper Company, Lockport, N. Y., with data relative to the number and size of the motors installed.

ELECTRIC VEHICLES.—The Waverly Company, Indianapolis, Ind., has just issued a handsomely designed and executed catalog of its electric carriages. The various styles of vehicles are illustrated very artistically and briefly described, general specifications of the different models being also given. The text and general features of the illustrations are printed in a light drab color against which the vehicles are printed in deep black, the combination producing a very pleasing and contrasting effect.

ELECTRIC PYROMETERS.—The Bristol Company, Waterbury, Conn., has issued two bulletins relating to electric pyrometers for use with processes for the heat treatment of steel. Bulletin No. 108 deals especially with the application of pyrometers for hardening and tempering furnaces, showing the type of instrument recommended and the method of applying the thermo-couples to the most generally used kind of hardening furnaces. Bulletin No. 115 relates to the applications of electric pyrometers to furnaces for annealing and case-hardening. In these long-continued processes it is more important to use the recording pyrometers than in the tempering furnaces. It is said that these pyrometers have been used very extensively in both the hardening and annealing processes.

Business Notes.

H. M. BYLLESBY & COMPANY, engineers, Chicago, have removed to 218 La Salle Street, their present quarters being in the old Continental National Bank building.

WALKER ELECTRIC COMPANY.—Mr. Henry F. Haviland, who has been connected with the New York office of the Walker Electric Company, has been transferred to Chicago, where he will open a branch office for the company.

THE KELMAN ELECTRIC & MANUFACTURING COMPANY of Los Angeles, Cal., and Pierson, Roeding & Company, of San Francisco, have completed arrangements whereby the latter firm acquires the Pacific coast agency for the Kelman high-voltage oil switches and circuit-breakers. This company has branch offices in Los Angeles and Seattle, the latter office especially covering a large territory, which includes Oregon and Washington, as well as British Columbia and Alaska, and is particularly well qualified to handle this line.

RADIO REFLECTOR.—The Radio Reflector Company, New York, is now making a "Radio" reflector 6-in. in diameter in addition to the 5-in. size described and illustrated in these columns Sept. 23. It is stated that this new reflector effects an increase in the downward candlepower as compared with the 5-in. size, as is being demonstrated at the Electrical Show at Madison Square Garden, New York. The 5-in. size will continue to be manufactured, and both sizes will have a heavy coating of green enamel on the back, which will not only add to the appearance of the reflector but will improve its wearing qualities.

KELMAN ELECTRIC & MANUFACTURING COMPANY ORDERS.—Orders have recently been received through the San Francisco office of Pierson, Roeding & Company, for 24 15,000-volt electrically-operated cell-type oil switches for equipping the Fruitvale Power House of the Southern Pacific Company, and 6 75,000-volt oil switches for the Northern California Power Co., at Redding, Cal.; from its Seattle office orders from the British Columbia Electric Railway Company, Ltd., for 20 45,000-volt electrically-operated automatic oil circuit-breakers. Orders recently completed included 6 out-door type oil switches complete with steel towers and disconnecting switches as follows: Two 40,000-volt equipments for the Mexican Light & Power Company, Ltd., Mexico City, Mexico; 2 50,000-volt for the Siskiyou Electric Light & Power Company, Yreka, Cal., and 2 33,000-volt for the Southern California Cement Company, Riverside, Cal. Also 7 indoor type as follows: Two 45,000-volt automatic circuit-breakers for the Gold Road Mining & Exploration Company, Gold Road, Ariz.; 1 70,000-volt automatic circuit-breaker for the Big Bend Light & Power Company, Spokane, Wash.; 1 40,000-volt automatic circuit-breaker for the Tom Reed Gold Mines Company, Oatman, Ariz.; 2 50,000-volt automatic circuit-breakers for the Nevada-California Power Company, Goldfield, Nev., and 1 45,000-volt switch for the Utah Light & Railway Company, Salt Lake City, Utah.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED OCT. 12, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

936,283. DWARF RAILWAY SEMAPHORE SIGNAL; H. M. Abernethy, Cleveland, O. App. filed Dec. 31, 1906. Locking mechanism holds the gravity-operated semaphore in either position, and electrically unlocks and moves the semaphore in one direction.

936,284. FRICTION CLUTCH ELECTRIC CONTROL; H. M. Abernethy, Cleveland, O. App. filed April 3, 1908. An electrically operated friction clutch; an electromagnet throws the cones into and out of engagement with each other.

936,292. INDUCTION MOTOR; S. R. Bergman, Lynn, Mass. App. filed March 22, 1909. An induction motor with a primary winding, a secondary winding of the squirrel-cage type, and a starting device having means for varying the reactance of the end ring of the secondary winding.

936,304. TRANSMISSION OF ELECTRICAL POWER; C. L. Chisholm, Marysville, N. B., Can. App. filed Jan. 9, 1908. Electro-harmonic printing telegraph with keyboard at sending end and a receiving typewriter or the like at the receiving end. Tuning forks control the generation of electrical currents.

936,305. ELECTRIC ARC LIGHT; F. P. Cobham, Jamestown, N. Y. App. filed Jan. 10, 1908. Enclosed arc light for headlights of cars. The movable carbon is contained in a tube which is connected to the feeding-clutch magnet whose core consists of finely divided magnetic metal.

936,329. ELECTRICALLY-OPERATED AUTOMATIC SWITCH; W. A. Lacke, Chicago, Ill. App. filed May 29, 1908. Solenoid-operated switch for moving a damper, the circuit being dead after the switch is operated.

936,340. TROLLEY CLIP; J. C. Michaelson, Charleston, W. Va. App. filed July 2, 1908. An adjustable trolley clip formed of pieces of sheet metal with grooves to receive the wire and a pin for giving a wedging clamping action to the pieces.

936,341. TROLLEY; G. G. Miller, Baltimore, Md. App. filed Nov. 3, 1908. Prevents wheel from leaving wire by spring pressed arms surrounding the wire and projecting above the wheel.

936,360. INDUCTION MOTOR; C. Robinson, Schenectady, N. Y. App. filed Feb. 14, 1906. The motor has a rotary casing containing mercury which short-circuits the squirrel-cage winding at speed by centrifugal force leaving in the high resistance on starting.

936,370. HANGER FOR WIRES; F. L. Sessions, Columbus, O. App. filed July 17, 1902. Particularly for roofs of mines. A single bolt constitutes the fastening device, formed by two parts which when fitted together constitute a pin which enters a hole drilled in the roof of the mine.

936,372. RAILWAY CROSSING SIGNAL; G. A. Silver, Huntsville, Ont., Can. App. filed March 18, 1909. Sounds an alarm by a trip device consisting of a hollow arm, which latter carries a spring-pressed head struck by the train.

936,373. SELECTIVE RINGING KEY; C. A. Simpson, Chicago, Ill. App. filed June 8, 1905. For telephone switchboards; avoids connecting the contacts in series by providing a normally closed shunt around the keys, which is opened when a ringing key is operated to call.

936,374. TELEPHONE TRUNKING SYSTEM; C. A. Simpson, Chicago, Ill. App. filed March 18, 1907. Two-way trunk in which a visual busy signal is used for each truck cord which is displayed at one end when the trunk is used at the other end.

936,381. SWITCH-OPERATING MECHANISM FOR RAILWAYS; C. W. Squires, Beverly, Mass. App. filed Aug. 15, 1908. The switch tongue is moved by a magnet and connections, including an angle lever and spring, which ensures a tension for the extreme portion of said angle lever.

936,403. PROCESS OF MAKING FILAMENTS FOR ELECTRIC INCANDESCENT LAMPS; Werner Von Bolton, Charlottenburg, Germany. App. filed Oct. 2, 1906. Inserts the refractory metal powder in a tube of metal, exhausts the air, seals the ends and works into filamentary form.

936,405. WIRELESS RAILWAY-SIGNAL SYSTEM; E. R. Brodton, Mobile, Ala. App. filed June 29 1908. Electric waves are sent out from one engine cab to the other. Controls the strength of the waves so as to keep them uniform by day and night.

936,432. TELEPHONE; H. Eccles, Laclede, Mo. App. filed March 21, 1907. Subscriber set in which the movement of the receiver arm automatically controls the talking and ringing circuits.

936,463. CLUSTER LAMP SOCKET; Herman J. S. Lewis, New York, N. Y. App. filed May 27, 1908. Threaded shells are secured to an insulating ring by loops which pass around and through the center of the ring. The center contacts are established by a band on the outside of the ring.

936,495. TELEPHONE SYSTEM; F. C. Unger, St. Louis, Mo. App. filed Oct. 22, 1908. The central has line drops and an alternating-current ringing machine, and the subscriber's receiver controls a circuit which causes a current to pass through the ringing machine and drop to notify central of the call.

936,503. MAGNETIC REGULATOR FOR AUDIPHONE RECEIVERS; C. E. Williams, Natick, Mass. App. filed Jan. 4, 1908. For adjusting sensitiveness of audiphone receiver by a screw which controls a magnetic shunt for the magnetic path of the lines of force, adjustable from the outside of the instrument.

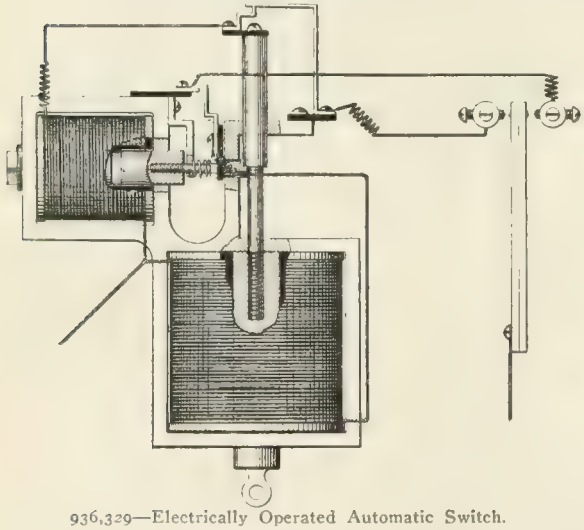
936,512. CLUSTER LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed April 14, 1904. Insulates the outer metal casing by means of an insulating lining and bushing of insulating material in the cord aperture.

936,525. PROCESS OF MAKING METALLIC FILMS OR FLAKES; Thomas A. Edison, Llewellyn Park, Orange, N. J. App. filed Jan. 18, 1907. For making flake cobalt for positive electrodes of storage batteries by electro-depositing of a film of copper, then of cobalt and finally dissolving the copper by a cyanid of an alkali.

936,538. CIRCUIT FOR PROPAGATING WAVE FORMS; D. C. Jackson, Madison, Wis. App. filed Sept. 23, 1901. Avoids the condenser effect on telegraph lines by providing inductance continuously throughout the cable by winding the conductor about a magnetic core, the core being in circuit.

936,556. ELECTRIC LAUNDRY IRON; H. C. Newman, Los Angeles, Cal. App. filed July 20. 1908. The heating element consists of a coiled wire with spacers of insulation removably inserted between coils of the wire.

936,557. ELECTRICAL CONTROLLING MEANS FOR PLANERS AND OTHER MACHINES; A. P. Steckel, New York, N. Y. App. filed Feb. 10, 1908. A shunt field motor running in one direction drives a part in opposite directions through one or two transmission devices. A tumbler, actuated by tappets, can be set to regulate the forward and back speeds of the bed of the planer.



936,329—Electrically Operated Automatic Switch.

936,578. ELECTRIC CIRCUIT INTERRUPTER; H. R. Stuart, Wilkinsburg, Pa. App. filed Jan. 24, 1906. High-voltage release including a buffing device having a stationary and movable core member with a hammer rod on the movable member with an enlargement at one end, a lever engaging the enlargement and a dial for the lever, the lever adjusting the air gap.

936,584. ELECTRIC CIRCUIT CONTROLLER AND INTERRUPTER; C. A. Tucker, Edgewood Park, Pa. App. filed Jan. 3, 1906. A double-throw switch controlled by high voltage having an operating handle and spring-connected dogs automatically returning the movable contact member to said positions.

936,594. ELECTRICAL CIRCUIT-BREAKER; C. Aalborg, Wilkinsburg, Pa. App. filed May 2, 196. Adjusts pressure between contacts by an adjustable bracket secured to the movable contact member.

936,597. ELECTRIC TOASTER; W. S. Andrews, Schenectady, N. Y. App. filed Nov. 21, 1908. A plurality of vertical heating units or sets of wires contained in a folding open-work cage.

936,601. SWITCH; C. Carson, Wilkinsburg, Pa. App. filed Dec. 27, 1906. Pendant switch containing a spring-pressed tube, sliding in a fixed tube, which operates a ratchet and contact fingers.

936,615. ALTERNATING-CURRENT MOTOR; F. Eichberg, Berlin, Germany. App. filed April 19, 1907. The stator has an inducing winding. Superposes on the shunt excitation produced by the constant impressed voltage, a series excitation which compensates for the drop.

936,622. COIL SUPPORT; I. L. Griffith, Pittsburgh, Pa. App. filed Jan. 10, 1908. For supporting coils of dynamos by an L-shaped bracket having a removable side and a clamping bolt.

936,639. MOLDING FOR ELECTRIC WIRING; W. H. G. Kirkpatrick, Philadelphia, Pa. App. filed Oct. 27, 1908. Has a wire-receiving groove, one of the walls of the groove having projecting portions at intervals for retaining the wire.

936,648. ROCKING SOLENOID SWITCH; A. T. Marshall, Hartford, Conn. App. filed Oct. 1, 1908. The solenoid is pivotally mounted and carries a sliding core, which slides toward the tilted end to control the circuit.

936,656. ELECTRICAL DISCHARGE APPARATUS; N. J. Neall, Pittsburgh, Pa. App. filed Jan. 24, 1906. Lightning arrester composed of bodies of refractory conducting material individually coated with insulation and bound together by the embedding insulating material.

936,666. SWITCHING DEVICE; O. Rennert, London, Eng. App. filed Jan. 12, 1903. Annunciator in which the drop is first operated and then the bell by switching the current from drop to bell.

936,669. ELECTRICAL COIL; M. C. Rypinski, Pittsburgh, Pa. App. filed Nov. 18, 1907. A cylindrical coil having two disks located at one end of the coil with vertical slits and projections to connect to terminals.

936,684. RECEIVING SYSTEM FOR HIGH-FREQUENCY ELECTRIC OSCILLATIONS; F. K. Vreeland, Montclair, N. J. App. filed Nov. 4, 1905. Two dissimilar coils in inductive relation and connected in parallel constitute a current multiplier.

936,692. COMMUTATOR BRUSH; V. G. Apple, Dayton, O. App. filed July 7, 1906. Two carbon blocks form opposite sides of brush and have interfitting projections and clamp between them a thin sheet of metal.

936,705. JUNCTION WALL FLOOR, OR OTHER BOX; D. Conlan, Jr. App. filed Oct. 3, 1907. The box has a valve lying between spring contacts operated by a plug carrying contacts.

936,724. ELECTROMAGNETIC SWITCH; J. D. Ihlder, New York, N. Y. App. filed Oct. 11, 1907. An electromagnet, switch arms, stationary contacts, a lock and pivot shaft for the switch arms and locking key for stationary contacts.

936,747. ELECTRIC LAMP; G. L. Van Wart, Waterville, Conn. App. filed Aug. 3, 1908. A dimmer for incandescent lamps throwing resistance into circuit by a lever with arc-shaped portion moving over contacts.

936,775. ELECTRIC SWITCH; H. D. Grinnell, New Bedford, Mass. App. filed March 23, 1909. For turning on and off gas supply of automobile lamps. Consists of a gear wheel having contact sections controlled by a pinion on a hand-operated shaft.

936,809. OUTLET OR JUNCTION BOX; C. T. Pratt, Frankfort, N. Y. App. filed Feb. 15, 1907. Made of sheet metal with beveled screw threaded openings and disk closers therefor.

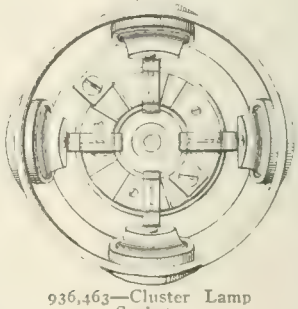
936,835. SIGNAL MECHANISM; W. W. Van Horn, Shelby, O. App. filed March 25, 1908. For operating a bell a predetermined number of times by means of a series of disks on a shaft, each disk carrying contacts.

936,840. ELECTRIC INSULATOR; J. A. Wells, Detroit, Mich. App. 12, 1909. An insulating joint or pipe coupling. Details.

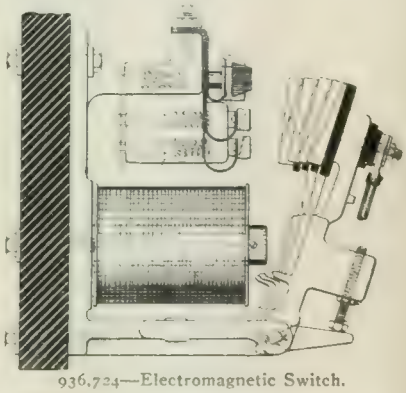
936,849.—PRINTING TELEGRAPH; J. C. Barclay, New York, N. Y. App. filed April 3, 1907. Printing telegraph having a mechanical selector controlled by sunflower and relays, which latter are controlled by impulses on the line.

936,869. ELECTRIC-LIGHT BRACKET; E. I. Drent, New Orleans, La. App. filed Feb. 20, 1909. The body has a bulb-carrying socket, clamping jaws removably securing the feed wires in place in the body and a ring removably engaging the jaws.

936,870. ELECTRIC DRILL; W. O. Duntley and H. J. Kimman, Chicago, Ill. App. filed May 3, 1905. Connection between motor and spindle disconnects on overload.



936,463—Cluster Lamp Socket.



936,724—Electromagnetic Switch.

936,871. METHOD OF PREPARING MOLDS FOR ELECTROTYPES; G. E. Dunton, New York, N. Y. App. filed March 3, 1909. Shaves and polishes the wax mold.

936,873. BED; S. Ellery, Albany, N. Y. App. filed Jan. 22, 1908. Magnetizes the spring bed mattress to cure the suffering patient.

936,874. BED; S. Ellery, Albany, N. Y. App. filed Feb. 29, 1908. See 936,873.

936,878. AUTOMATIC CONTROLLER; F. R. Fishback, Cleveland, O. App. filed Jan. 23, 1909. An elevator motor controlled by pointer and scale to stop at any landing desired.

936,914. ELECTRIC ALARM FOR INCUBATION; C. L. Kulp, Sunbury, Pa. App. filed March 3, 1909. The damper-operating lever controls a trip which controls an alarm circuit.

936,923. AUTOMATIC FIRE ALARM; C. D. Miller, St. Louis, Mo. App. filed Dec. 21, 1908. Automatic circuit-closer consisting of a spring arm whose free end is held above the circuit wires by a fusible link.

936,952. CONTROLLER FOR ELECTRIC MOTORS; O. F. Shepard, Jr. App. filed Jan. 15. 1906. The motor has a shunt field with a plurality of resistance sections adopted to be traversed by the current of the field circuit and a plurality of magnetic devices, each controlling the current in the field through a resistance section.

936,993. ELECTRIC WATER PURIFIER; M. R. Frei, Kansas City, Missouri. App. filed May 1, 1909. Constructive details of electrolytic filter.

937,018. SYSTEM FOR ELECTRICAL DISTRIBUTION; F. G. Beetem, Philadelphia, Pa. App. filed Feb. 12, 1908. Storage battery used to compensate. A carbon regulator of piles of blocks is controlled by a solenoid supplied by a generator.

937,032. PRINTING TELEGRAPH; J. C. Barclay, New York, N. Y. App. filed Sept. 21, 1908. Controls the various mechanism of the printer by one class of line signals. Improvements in the relay for the hammer magnets and in various features of the machine.

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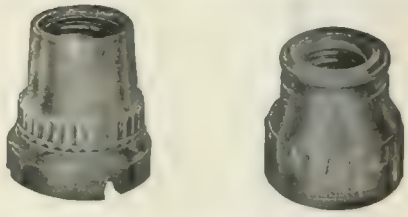
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The Old Guard in Energy Transmission.

Our readers will be interested in an account elsewhere in this issue of the present state of electrical energy transmission in Southern California. To the engineer the development is of particular interest on account of its completeness in covering the territory, the elaborateness of the network including both steam and electric stations, and finally, because it is the oldest development in the country in its inception and in its development. The very first high-voltage plant in the country, from the mountains back of Pomona and San Bernardino, was put into operation about 17 years ago. It was a little single-phase affair, but worked at the voltage, then unprecedented in America, of 10,000, obtained from a long line of twenty 500-volt transformers with their coils in series. In 1893 the first commercial three-phase transmission appeared in the same territory in the Mill Creek development No. 1. The hydraulic equipment of this plant has been somewhat changed by the use of a head higher than the original one, but it is interesting to note that some of the original 250-kw generators installed more than 16 years ago are still doing good service. This pioneer plant also, through its being the basis of early and important extensions, set the frequency of 50 cycles per second, which has been used throughout the whole great Southern California network. It is the only large system at this frequency in the United States, although this particular figure is the standard in European practice. A little later the Santa Ana Canyon plant, transmitting energy into Los Angeles, formed the basis of the immense network of the Southern California Edison Company, which has grown until it reaches from Redlands to the sea and now includes a great transmission system extending from the Kern River, far to the northward, into Los Angeles, 122 miles. This system covers the valley from Redlands to the Pacific very thoroughly. It includes seven hydraulic and four steam stations, at times all operated in parallel, although of late the Kern River plant with the Los Angeles steam plants have furnished most of the energy in that city. It is to be noted that when everything is in parallel the operation has been found to be particularly satisfactory, the long lines and transforming stations serving as buffers, so that plants of very varied character can be operated in multiple with entire success.

Second only to the system of the Southern California Edison Company is that of the Pacific Light & Power Company, which covers particularly the territory between Los Angeles and the sea. As in the other network, the principal station is on the Kern River, the distance between the power plant at Borel and the Los Angeles receiving station being 127 miles. This is a 66,000-volt installation. The Pacific Light & Power Company has four other hydraulic plants and three steam generating stations, of which the most interesting is the steam-driven station at Redondo, which contains three 5000-kw, 18,000-volt, 50-cycle, direct-coupled units. This plant, which is the main generating station for the Los Angeles Railway Company and the Pacific Electric Railway Company, uses crude oil

as fuel, as do the other steam stations in this territory. In this network, one again finds the utmost freedom in multiple operation, experience showing here as well as elsewhere that in working on a large scale over long lines there is not any material difficulty in such operation. In the early days of energy transmission there was some hesitancy in even operating water-driven machines in multiple, which was done commercially for the first time in the old Redlands plant.

A glance at the maps accompanying the article will show the thoroughness with which these two systems supply energy to the great central valley of Southern California for lamps and motors. Hardly any region in the country is so completely served, for the branch lines run to little towns and villages, to small industrial plants; every place, in fact, where a suitable market can be found. The lines of the Pacific Light & Power Company reach outward as far as Mentone, covering practically all the territory not already thoroughly supplied by the network. We have seen no accurate estimate of the areas served, but the combined systems must cover more than 2000 square miles, to say nothing of the long reach northward in the Kern River country. To obtain the necessary hydraulic power, the utilization of some of the existing irrigation plants has been necessary, so that a continuous flow of water has to be kept up somewhat irrespective of load. The ordinary wheel governing by deflecting nozzles takes care of this necessity, so that the water does double service. The industrial work done by these transmissions is of very important character and shows particularly on the load curve given in the paper. On the Edison system the 24-hour industrial load forms about one-third of the maximum load and the average load for the 24 hours is between 50 and 60 per cent of the peak, an unusually favorable condition.

Central-Station Power for Traction Service.

For some years there has been a marked tendency toward the wholesale manufacture of electrical energy in a central steam plant for distribution throughout a district formerly supplied by a number of local central-station plants, an idea doubtless rendered familiar by the development of hydroelectric transmission systems. There does not, in fact, appear to be any reason why in time electrical generation by steam plants should not, as in many cases of hydroelectric generation, become recognized as an entirely separate undertaking, having no connection as a business with the utilization of the energy developed, which would be supplied in wholesale quantities for any desired use, either at a standard voltage or in a converted form for lighting, traction and other purposes. Elsewhere are accounts of two recent interesting and important proposals having a bearing on this subject. These are the proposal of Mr. Samuel Insull to supply electrical energy from the central-station plant of his companies for the proposed electrified Chicago railroad terminals, and the similar offer of the New York Edison Company to relieve New York City of the expense of erecting generating plants for the operation of subways for which plans have been completed. While the subway electrical proposition may be considered in the light of an innovation by the New York public, the case is different in Chicago, where the central-station company already supplies electrical energy to one of the elevated roads and to both of the large urban street-railway systems. Undoubtedly among the factors that have influenced railroad men in their opposition to the electrification of terminals have been the large and uncertain investment for generating plant, distributing and transforming system, and the anticipation of perplexing technical detail connected therewith, both initially and under operation. The proposal of Mr. Insull puts an entirely different aspect on the question, and will doubtless clarify a situation which is now engaging lively attention in Chicago. The definiteness of both offers should also set the New York Central and electric traction interests generally in New York City to work thinking on the desirability of their going out of the electrical generation business and effecting an arrangement whereby the present central-station interest would take over their power houses and then supply them with traction power on a contract basis. Owing to the influence of diversity factors in such a combined system and the smaller expense of administration, etc., the economies possible should result in reduced cost of operation of the traction properties, and in lower cost of energy for light and stationary motors.

The N. E. L. A. Accounting Committee.

Under the form of organization which is open for the continuance of the work of the accounting section of the National Electric Light Association during the year, the committee on accounting has proceeded to take action that should make its efforts effective and contribute to permanent results in behalf of the member companies. As stated in our issue of last week, the committee has been organized into three active sub-committes to take up, respectively, the accounting problems indicated by the subjects of forms, public relations and uniformity of accounting practices. The work which lies before these sub-committees is indicated with sufficient clearness in their titles, and if they fulfill the objects of their creation, a long step forward will have been taken toward making the proceedings of the next annual meeting of this section so important that there will be no argument on the subject of adequate recognition for the accountants. One of the important matters which may be investigated with advantage under this form of organization is the extent to which uniformity in accounting methods prevails among the electrical corporations of the country. As the situation exists at present, no determined effort is made in many localities to follow accounting practices that are in accord with the latest recommendations of the association. Until within a few years, uniformity has not been prescribed by statute for many properties except in Massachusetts. However, the situation in this respect, notably in the States of New York and Wisconsin, has undergone a material change and assumed an importance that was not considered likely until the actual passage of acts conferring broad powers upon public-utility commissions. Eventually, more communities will prescribe a form of accounts for electrical corporations and it is highly desirable that methods that are as nearly uniform as possible should prevail among the companies. If an acceptable uniform system prevails, commissions that may be constituted hereafter with power to prescribe accounts will be more likely to adopt, or use as a basis, the uniform classification which they find in the district over which their jurisdiction extends. The accounting committee will have a difficult task before it in its endeavor to bring about the adoption of a uniform system, but the arguments which it can advance are so strong that it should receive support and co-operation from all companies whose operations are sufficiently large to render advisable the adoption of a system in the detail recommended.

Calculation of Transmission Lines.

We print an interesting article this week, by Mr. J. E. Dalemont, on the calculation of transmission lines, it being assumed that the lines are so short that their capacity may be safely omitted from consideration, and consequently that the effects of distributed capacity are still more negligible. Within these limits the method of computation described is swift and convenient. It is well worthy of study by transmission engineers in regard to its form. Of course, the substance of the method is necessarily presented in any method which engineers now use to predetermine the size of transmission line wires or to present the conditions of voltage at the two ends of a line already erected under varying conditions of load. Different engineers employ different methods of arriving at the required results. The relative merits of these different methods lie in their comparative simplicity, convenience and perspicuity. While calling attention to the advantages of the method presented in Mr. Dalemont's article, it is also fair to criticise a matter of detail in the terminology employed. We offer this criticism not in any captious attitude, nor merely as a matter of principle in terminology, but mainly because we think the reasoning is obscured by the use of the terms referred to. From our standpoint, the demonstration of the method would be simplified and clarified by the amendment here suggested, although we should be glad to see the matter discussed on both sides.

The gist of the method set forth in the article consists in treating the load at the delivery end of the line as an impedance per mile of distance. The impedance per mile presented by the line at the generating end is then the sum of the load impedance per mile and the line-wire impedance per mile. That is, the diagram in the article is essentially a linear impedance diagram, containing linear resistance for its horizontals, linear reactances for its verticals and linear impedances for its hypothenuses. Now, the linear properties of the transmission line r, x and z are described and shown as linear resistance, reactance and impedance respectively; whereas the corresponding quantities of the load, as presented at either end of the line, are described and shown as voltages, a use of language which is neither precise nor facilitating. A voltage divided by a line length and by a current is no longer a voltage, but becomes a linear impedance. Once the diagram is recognized as a pure-impedance diagram the advantages of the method in convenience and directness are immediately realized. If the diagram be regarded as multiplied by line current then all its lines become linear voltages. But it is illogical to consider part of the diagram as linear impedances and the remainder as linear voltages.

Counter Electromotive Force in the Electric Arc.

Considering the large number of arc lamps that are in nightly operation all over the world, the countless measurements of voltage and current that have been made on them, the number of years during which such observations have been accumulated, and the number of trained observers who have carefully studied arc phenomena, it is wonderful how much disagreement has existed upon certain properties of an arc that at first sight appear very simple. Reference may be made, in particular, to the questions of what are the resistance and the c. e.m.f. of an ordinary voltaic arc burning in air between a pair of opposed solid carbons? Various answers have been offered to this inquiry, at different times, by different skilled observers. A large part of the inconsistency between these answers is due to differences in the use of terms. Concerning the actual facts there is a greatly reduced margin of disagreement. An interesting article, by Prof. C. D. Child, on this subject has recently appeared in the *Physical Review*. The article shows that at least four different meanings have been employed, by different writers, for the term "resistance" of the arc, and that more than one meaning has likewise attached to the term "c. e.m.f." of the arc. The article should be read by all who desire to be familiar with the results of investigation in this branch of physics and engineering. It effectively sums up and enumerates the various researches on the subject. We can only touch one surface of the matter in this brief discussion.

If we send a direct current steadily through an electrolytic cell, we may observe the current strength with an ammeter, and the terminal voltage across the cell with a voltmeter. We might properly call the ratio of the volts to the amperes the apparent resistance in ohms of the cell. In general, however, we prefer to regard the terminal voltage as made up, in part, of a c. e.m.f. at the electrodes, and in remainder of a drop of potential in resistance within the electrolyte. This is particularly the case when dealing with storage cells. When charging a storage cell with 20 amp, at a terminal pressure of, say, 2.6 volts, we might speak of the cell as having an apparent resistance of 0.13 ohm, but it is usual to say that the cell offers a c. e.m.f. of 2.5 volts, and an internal resistance of 0.005 ohm. The reasons for preferring the latter, and seemingly more complex, mode of expressing the facts, is that if the charging current is shut off we still find a residual e.m.f. of 2.5 volts in the cell, and, moreover, if we vary the distance between the plates of the cell we find that the internal resistance of 0.005 ohm varies substantially in proportion to this distance.

In the case of a carbon arc burning in air we may have, say, 10 amp and 50 volts across the terminals. We may correctly state that the apparent resistance of the arc is then 5 ohms. But if the length of the arc be varied, at constant current, and the corresponding change in voltage be examined, we find that perhaps 28 volts are indicated across the very shortest arc that can be produced, and that the remaining 22 volts appears to be an IR drop varying substantially with the arc length. Some express these facts by saying that the arc has a c. e.m.f. of 28 volts, and a resistance of 2.2 ohms. But if the current is suddenly shut off the arc there is no such residual e.m.f. as 28 volts. There may be a small residual e.m.f. of less than 1 volt, but some observers have reported none at all, even when the current was very quickly shut off. It seems, then, improper to call the 28 volts that do not depend upon the arc length a c. e.m.f. A true c. e.m.f. should persist. It seems proper to regard this as an IR drop, localized in a very thin layer at the surfaces of the electrodes, the layers offering together a resistance of nearly 2.8 ohms. We conclude then that an ordinary arc offers a certain resistance in the column of hot vapor and also certain resistances at the anode and cathode surfaces. The arc only offers a small c. e.m.f. of about 0.6 volt, which is of thermoelectric origin, and which depends upon the temperatures of the carbons.

Offer of New York Edison Electric Power for New Subways.

The New York Edison Company has made a formal offer to the New York City Public Service Commission for the supply of electric power for the proposed new Broadway-Lexington Avenue subway and other subways and connecting lines to be constructed or already constructed, but for which no arrangements for operation have yet been made. The Edison company requests an opportunity at the proper time to present bids for the supply of electrical energy for the lighting of the subways and tunnels and also for the supply of electric power necessary for the operation of the cars and trains, and asks that where specifications provide for the construction of a power plant they be so drawn that they will also permit the contractor, who may assume the operation of the subways, to propose an alternative arrangement under which he may obtain the supply of power from a properly equipped electricity supply company. If it should appear to be to the advantage of the city and the operators of the subways or tunnels to purchase power for lighting and traction in preference to making the large investment necessary for the construction and operation of a special generating plant exclusively for that purpose, the contractor, it believes, should have the option of providing for the necessary energy by contract with a company in the business of supplying electricity for lighting and power.

The communication to the commission states that the generating plants of the Edison company are of large capacity, provided with adequate reserve in every part and equipped with the latest and most improved types of apparatus for the economical generation of electrical energy. The company is prepared to supply any lighting or power service, existing or prospective, for street railways, subways or other means or transportation, however extensive the service may be.

With the already large energy output from the existing plants, the opportunity of taking advantage of the diversity factor in the demands for the various industries to which power is now being supplied, the considerable margin of capacity always available, and the possibility of providing a reserve held in common instead of its unnecessary multiplication, should, it believes, place the company in a position to provide adequate power supply under most advantageous terms, reducing to a large extent the investment which would have to be made for a special generating plant. It considers, therefore, that it will be found alike to the advantage of the city of New York and the contractors for the construction and operation of the subways and tunnels to contract for their power service rather than to make the large investment that may be necessary to provide a special power plant.

Case Involving Definition of Annual Horse-Power.

An interesting action was tried at Toronto before Justice Britton on Monday, Oct. 18, which involved an issue as to whether maximum or average horse-power was implied in a contract. The Attorney-General of Ontario, on behalf of the Queen Victoria Niagara Falls Park Commission, brought suit against the Canadian Niagara Power Company, that being the name of the company operating the power house of the Niagara Falls Power Company, on the Canadian side. The amount sued for is $15,217.97, and the claim is for rentals and payments on electrical horse-power generated by the Canadian company in excess of 10,000 hp per annum, during the period between Nov. 1, 1905, and May 1, 1908. If the suit is decided in favor of the Park Commission, the commission will continue to collect future rentals on the basis of the claim advanced at the trial of the suit.

After all of the arguments of counsel had been submitted, the judge stated that "most of the difficulty appears to be in the fact that words of a technical character have not been used in their strictest sense. For instance, horse-power and power are not the same, and yet they are used practically interchangeably in the agreement. If this were a dispute between two private parties I would have no hesitation in deciding it now, but considering the importance of it, I shall reserve judgment."

The Park Commission claimed, under the agreement, that for any amount of power generated up to 10,000 hp $15,000 per annum was to be paid; for between 10,000 hp and 20,000 hp $1 per horse-power extra; for between 20,000 hp and 30,000 hp 75 cents per horse-power, and for over 30,000 hp 50 cents per horse-power was to be paid each year. The plaintiffs claim, under the agreement, to be entitled to collect $23,716.65.

The defendants, the Canadian Niagara Power Company, contended that the agreement states it should pay but $8,700.26, and this sum has been paid without prejudice. The attorney-general, for the commission, therefore sued for the remaining sum, with interest, which totals $15,217.97. The company's counsel argued that they were under agreement to pay rental for the amount of power used and sold, and not the amount generated. They had generated on some days much more power than they had on other days, and did not consider that they should be charged for the maximum generation all the year through.

New Orleans Electricians' Licensing Law Declared Unconstitutional.

The Supreme Court of the State of Louisiana, one judge dissenting, has pronounced unconstitutional, in a case appealed from the Criminal District Court for the Parish of Orleans, the act (known as the New Orleans Electricians' License Law) on the grounds that it is in violation of the Fourteenth Amendment of the Constitution of the United States. The decision practically declares that the exemption of railways and lighting companies, and the Department of Police and Public Buildings from the provisions of the act, constituted class legislation.

It is not anticipated that the Board of Electrical Examiners and Supervisors will ask for a rehearing from the Supreme Court, as the language of the decision is vigorous and unmistakable in its position. It is possible that another act may be brought before the Legislature next May, which, however, could hardly become operative before September following.

Massachusetts Commission Rules Against Reduced Electric Rates for Boston School Houses.

The Massachusetts Gas and Electric Light Commission has issued an important ruling in the form of a letter to Mr. George E. Brock, acting chairman of the Boston School Committee, relative to the rates for electrical energy supplied to the buildings of the city of Boston under the custody of the committee. During the summer this committee requested the board to consider the question of school-house rates, with the hope of securing a reduction for this service, which is furnished by the Edison Electric Illuminating Company of Boston. The committee urged that the city is entitled to a lower rate than is charged other customers of the company; that the price should be reduced in proportion to the cost of producing electricity; that the school committee is a large consumer of electricity and hence should enjoy a lower rate than ordinary customers of the company; that it costs less to supply electricity to the city than to ordinary customers of the company; and that as the demand upon the company does not come at the time of the peak load the city should enjoy a more favorable rate than the company's ordinary customers. Data were also submitted to show that other cities of the State and country obtain electricity for public buildings at considerably less than is charged other customers under like conditions.

The board states that the issue is of too far-reaching importance to be answered solely with respect to the interests represented by the committee, and says in part:

"It may be conceded that reductions in the cost of supplying electricity should be followed by reductions in price. But that is not the real issue presented—it is rather that the board shall now recommend that the company shall discriminate in favor of the city over all its other customers. The board believes that such discrimination cannot be seriously urged on the ground of any substantial difference in cost. The two items of advertising and collection mentioned form so trivial a part of the cost of supplying electricity (probably not over a small fraction of a cent per kw-hour sold) as to be negligible. The board also believes that a discrimination cannot be properly based on the school committee being 'a very desirable customer of the company because of the hours during which its buildings consume current.' Other customers are equally desirable for the same reason, and no discrimination can fairly be based on this ground, which does not apply to all customers in a similar situation as well as to the city.

"The board is unable to adopt the suggestion that the school committee as a large consumer is entitled to a discrimination. The board has had repeated occasion to say to companies that discriminations in prices based solely on the amount consumed by different customers are not justifiable. It is an open question whether the school committee is, according to the common acceptance of the term, a 'large consumer' of electricity. The aggregate consumed in all the buildings under the committtee's care is large, but the amount consumed per building is small, and, as a rule, the buildings are widely scattered, and are, and must of necessity be, independently supplied. It would hardly be claimed that a private owner of similarly located buildings is entitled to different treatment solely because the aggregate of all his bills is large.

"The board recognizes the weight commonly given to the argument that the company enjoys valuable privileges in the public streets granted to it by the city and that in consideration therefor the company should make concessions to the municipality as a customer. Municipal officers in making such grants are not acting as the agents of the city, but as public officers designated by the Legislature for that purpose. The streets are laid out to serve the general public convenience and this applies not only to travel over their surface, but to their use for the supply of water, light and sewers. The fact that the power to locate public ways is to a considerable extent vested in municipal officers and that their construction and maintenance have to a large extent been imposed upon municipalities, gives to the municipalities or their inhabitants no peculiar privileges in such ways. The right to erect poles and wires in or under public streets cannot be properly granted for the private advantage of the company, but solely to serve the public convenience. Any attempt to charge for the use of the streets, either directly by some form of tax, or indirectly by a concession in price made to the municipality, is virtually an attempt to shift a portion of the burden of taxation from the taxpayer as such to the consumer of electricity as such. This is the fundamental question involved in the position taken by your committee.

"The board believes that in the absence of express legislative sanction, it is not within its province to put into effect by indirection a policy which the Legislature has repeatedly declined to endorse. For the reasons thus outlined the board is unable to require the company to make a discriminatory rate in favor of the city's buildings under your care. In the views now stated the company's general schedule is not involved. If your committee or other consumers of electricity believe that the present prices are too high, the board has ample jurisdiction upon formal complaint in the manner provided by statute to order a reduction. But until the board is convinced that its present position is erroneous, reductions in price must be ordered for the benefit of all customers and not for the benefit of any one customer, although that customer is a municipality. Notwithstanding the practice by many companies of making special concessions to municipalities, the board is of the opinion that such practice should be supported by stronger reasons than have yet been presented in order to justify its continuance."

Brailey Telephone Properties.

For the past week there have been conflicting rumors as to the probable disposition of the United States Telephone Company and the Cuyahoga Telephone Company, both of Cleveland, Ohio, the controlling interest in the properties having passed into the hands of Mr. James S. Brailey, Jr., for years one of the most prominent independent telephone men in the United States. A telegram from Toledo reported that the Bell people had acquired control through an option, not only of the two companies named, but also of the Home Telephone Company, of Toledo, the Indianapolis Telephone Company, of Indianapolis, and the long-distance lines of Indianapolis. Mr. Brailey has issued a statement which declares that there is absolutely no truth in the rumors that the Bell company has acquired an interest in any of the properties with which he is associated. He states that after two years' work he has completed financial arrangements for an interest in his various telephone properties, and since then has been arranging to buy additional securities for his syndicate. He is personally interested in this syndicate and expects to remain permanently one of the largest holders of independent telephone securities. He further stated that the United States Telephone Company is going ahead with its development work and is about to put up a new No. 8 copper circuit between Columbus and Toledo and between Columbus and London, and that he wanted every independent company and interest in Ohio to know that the United States Telephone Company would do everything in its power to protect their interests in the future the same as in the past.

Mr. Brailey expressed regret that a report that he had turned over the control of the independent companies to the Bell interests should have been given such wide publicity. He said he could account for the origin of the story in no other way than that he had been picking up the stock of the two companies in Toledo, Indianapolis and other places for his syndicate, and some of the newspaper men got the idea that it was for the purpose of turning it over to the Bell company.

Nothing new can be ascertained regarding the course that will be pursued by the Ohio Home Telephone Company, recently incorporated for the purpose of leasing the independent long-distance lines in Ohio. At the office of the United States Telephone Company it was said that the company is in a state of "suspended animation" for the present, and it is not known what will come of it. The step taken by the Brailey syndicate in securing a controlling interest in the stock of the two companies put a stop, temporarily at least, to further progress in the execution of the plans that had been mapped out for the new company. Mr. Brailey has given no hint of his intention regarding the leasing proposition, but still insists that the independent local companies will be protected and that their long-distance business will be taken care of by the United States Telephone Company.

Denials have been made by officials of all the companies included in the report coming from Toledo to the effect that the Bell interests are in control. The denials further state that there is no intention of turning the business over to any other companies or syndicates, and that it will be pushed just the same as in the past.

The Boston Electrical Show.

Active preparations are now under way to establish an electrical show in Boston next month which will surpass all previous enterprises of this kind in New England and compare most favorably with the exhibitions held in the other large centers of the country. The show will be held in the Mechanics' Building, on Huntington Avenue, from Nov. 15 to 25 inclusive, and the floor space is now practically all sold for the entire period. Upward of 100 exhibitors have signed contracts with Manager Chester I. Campbell, and an unusual diversity of appliances will be displayed. The General Electric, Westinghouse, Allis-Chalmers, and many other manufacturing companies have reserved prominent locations, and the representa-

tive supply houses of New England are preparing to show full lines of the latest apparatus and materials. Motor-driven machinery will predominate, and electric heating devices will receive special attention at the show. The exhibition is being held on unique lines, with a mutual co-operation plan in effect for the first time, by means of which any exhibitor who joins the association will participate in any profits of the show.

The illumination will be of the most elaborate character, about 100,000 incandescents or their equivalent being used. The artistic side of the decorations is being designed and executed under the plans of Mr. E. W. Campbell, architect, of the Atlantic Decorating Company, of Boston. The Edison Electric Illuminating Company of Boston has taken active interest in the exhibition from the start, and a large staff of the company's employees will be on hand to welcome visitors. A prominent location in the central hall has been secured by the company, and it will install a handsome Italian garden with electric illumination, electric fountains and booths for the special use of suburban patrons. There will also be public exhibitions of high-tension experiments and a prize contest for boys interested in electrical matters.

Alternating-Current Traction Replaced by Direct-Current System.

The Washington, Baltimore & Annapolis Railway will soon finish the work of changing its system from single-phase alternating-current to direct-current traction. Treasurer Gladfelter has stated that the change will effect an annual saving of $100,000 or more. Among reasons given for the change are that the use of the single-phase system prevented the company from availing itself of favorable opportunities for extending its traffic in Washington, and introduced complications at Annapolis and Baltimore. The voltage of the main line will be 1200, but in Baltimore and the District of Columbia operation will be at 600 volts.

Proposed Municipal Electrical Monopoly in Jamestown, N. Y.

Jamestown, N. Y., which has a Mayor who appears to be an enthusiastic advocate of municipal ownership and operation, has a municipal electric lighting plant, and there is also a central-station company, the Jamestown Lighting & Power Company, which has always had the larger portion of the commercial electric light and power business. The commercial business of this company is said to be nearly three times as large as that of the municipal plant. It is now proposed, however, that the city of Jamestown purchase the franchise and property of the Jamestown Light & Power Company for the sum of $90,000, which the central-station company, through H. P. Sheldon, its president, has said that it will accept, provided the purchase is consummated by Dec. 1, 1909. The owner of the Jamestown central-station plant is the United Electric Securities, of Boston, which has signified its willingness to accept the terms proposed.

For some time the Board of Electric Light Commissioners, operating the municipal plant, has been convinced that the two electric lighting plants represented a useless duplication of effort. In a communication to the Common Council of Jamestown, dated Oct. 14, the commissioners, with Mayor Carlson at the head, say that there is no more necessity for two electric light plants than there is for two water plants. Therefore, numerous conferences have been held, with the idea of arriving at an agreement by which the central-station property might be purchased by the city. A complete inventory was made of the company's property, the company being represented, of course, and the city being represented by the superintendent of the municipal plant, while as an arbitrator Mr. W. S. Barstow, of New York, was called in as an expert electrical engineer. The net footing arrived at for the visible assets was about $89,500. This did not represent anything for good will or franchise, and only $500 is added to cover this feature. The electric light commissioners have recommended that the purchase be made at the figure given, $90,000. Should the Common Council and taxpayers confirm this recommendation, it will be necessary to consolidate the two plants, and the further sum of $30,000 is estimated as necessary for this purpose, making a total of $120,000 needed to execute the plan. The board therefore recommends that a special election be held at an early date to vote upon the proposition to bond the city of Jamestown for the sum of $120,000, this sum to be applied to the purchase of the franchise and property of the central-station company and also for the combination of the two plants with necessary extensions. It is the desire of the commission that the taxpayers vote on the proposition on the regular election day next month. It is said that the net earning capacity of the two plants after consolidation will, at present rates, be 14 per cent on the investment after allowance has been made for interest on bonds and for depreciation.

Illinois Central Refuses to "Electrify" in Chicago.

Issue seems to be joined between the city of Chicago and the steam-railroad companies, particularly the Illinois Central, on the question of terminal electrification, as the result of the annual meeting of the Illinois Central Railroad Company on Oct. 20. At this meeting the stockholders of the company, on the recommendation of the directors, adopted the following self-explanatory resolutions:

"Whereas, In the report submitted by the president to the board of directors mention is made of the complete and exhaustive investigation into the subject of electrifying the Chicago terminals, and special attention is called to the suggestion from the city authorities that the local suburban service be electrified with a view to demonstrating the advisability and practicability of a further extension of the system to the balance of the terminals, and

"Whereas, The report of the experts who have been engaged in the study of the entire problem for the last year or more develops that, in view of the complications brought about by the necessity of providing for suburban and through passenger traffic, through freight, transfer and switching movements, as well as interchange between railroads which deliver business to our line in the Randolph Street yard, and the necessity for delivering a large part of our business into other railroad yards, via Sixteenth Street and Forty-third Street, electrification at this time is impracticable; hence the necessity of the greatest possible study in order that intelligent prudence shall form the basis for an expenditure of a large sum of money. The study and investigation up to this time have developed a decidedly complex situation, distinctly different from that which pertains wherever electrification has been applied, and

"Whereas, The general public is more concerned in the elimination of the smoke nuisance than it is in a change of motive power, and the interests of the public, as well as that of your stockholders, will be conserved by extending the use of coke or other smokeless fuel to engines on the Chicago terminals as rapidly as possible, therefore, be it

"*Resolved*, That this board feels the necessity for deferring a determination as to the electrification until such time as a continued study of the subject can intelligently determine the proper line of procedure."

In his special report to the directors, discussing the electrification problem, President Harahan, of the Illinois Central Company, gave four cardinal reasons why the road should not attempt to make this improvement at the present time. In brief these reasons may be stated as follows:

1. The art of electric traction has not progressed beyond the experimental stage sufficiently to justify the large expenditure necessary for its application on the company's Chicago terminals. It would be impracticable to operate the interchange of

freight traffic and switching movements with electric traction as developed at the present time.

2. The large expenditure necessary would involve fixed charges in excess of economy effected from electric operation.

3. Smoke may be eliminated by other means.

4. It would be inadvisable for any one railroad in Chicago to undertake electrification before a comprehensive plan has been developed in which all of the railroads may participate.

Mr. Harahan made the following financial statement of the results, applying to the year ended June 30, 1909, if the suburban service alone were electrified compared with the present steam operation:

Gross earnings		$1,056,446
Operating expenses (82.9%)	$872,307	
Taxes (7%)	74,427	
		946,734
Net revenue		$ 109,712

ESTIMATED RESULT UNDER ELECTRIFICATION.

Gross earnings		$1,056,446
Operating expenses (66%)	$697,254	
Taxes (7%)	74,427	
		771,681
Net revenue—Electric operation		$ 284,765
Net revenue—Steam operation		109,712
Increase		$ 175,053
Estimated cost of electrification of suburban service		$8,000,000
Interest at 5% per annum		400,000
Depreciation at 5% per annum		400,000
Total fixed charges account electrification		$ 800,000
Saving in operation under electrification		175,053
Amount loss in operation under electrification		$ 624,947

Electrical men will note with surprise that Mr. Harahan's estimate does not make any allowance for probable increase in gross receipts after electrification, owing to the greater attractiveness of the electric service. He also places the operating expenses under electricity at the rather high figure of 66 per cent of gross earnings.

In relation to the smoke nuisance, Mr. Harahan says that the company is experimenting with coke to replace soft coal on locomotives, and also that it is negotiating with a view of securing self-contained motor-cars, evidently referring to cars operated by gasoline engines, for use on the suburban lines.

In answer to this attitude of the railway company, the local transportation committee of the City Council has under consideration the draft of a mandatory ordinance to compel every railroad company in Chicago to operate its cars within certain limits prescribed by the ordinance after Jan. 1, 1912, by some other power than that of steam. The proposed ordinance provides that all railroad companies in the city shall within six months after its passage submit to the Commissioner of Public Works plans and specifications for the operation of their cars within the territory named by some power other than steam. If these plans are approved, the company must proceed with all reasonable haste to make the change. No company is to be allowed to operate its cars within six months after the passage of the ordinance within the limits mentioned, unless it shall have submitted the plans and specifications referred to. The limits of the territory to be covered by the provisions of the ordinance have not been determined, but it is expected that, in the case of the Illinois Central, they will be fixed at least as far south as Sixty-seventh Street. It is provided that any railroad company which shall violate any of the provisions of the ordinance shall be fined in a sum not exceeding $200 a day.

This measure is subject to modification, of course, and it is believed that the city will have to rely upon the police powers of the municipality in order to enforce it.

The newspapers have been interviewing the directors of the Illinois Central Railroad on the subject of electrification, and what Mr. Cornelius Vanderbilt, of New York, has to say on the subject is of particular interest. Mr. Vanderbilt is reported to have declared that the fact that the New York Central is operating passenger trains successfully in its New York terminal has no bearing on the situation in Chicago. "It is one thing to handle passenger trains by electricity where the tracks are comparatively simple and the trains light," Mr. Vanderbilt is reported to have said, "but an entirely different problem is presented in Chicago. A large proportion of our business in Chicago is interchanged; three other roads use our terminal regularly, and it would be impossible for us to electrify our tracks unless the other roads did the same. In time, perhaps, a plan might be worked out whereby the roads could all use electricity, but it would require years to accomplish. As it stands now, we do not know enough about the operation of trains by electricity."

General resentment is expressed on the part of the public toward the obdurate attitude of the railroad company, and it seems reasonably certain that the campaign to obtain the advantages of railroad electrification in Chicago will be maintained with vigor.

New York Edison Company Entertains Electrical Contractors.

The New York Edison Company entertained over 1000 electrical contractors at a smoker given in connection with the New York Electrical Show in Madison Square Garden on Oct. 19. The entertainment began with a series of motion pictures in the Concert Hall, followed by a vaudeville performance given by artists appearing in various music halls in New York during the week. Cigars and cigarettes were distributed, and by the time the excellent program was exhausted it was midnight. The Electrical Show being cleared of visitors, the arena was again lighted and the guests given the freedom of the Garden to inspect the exhibits. Meanwhile the arena platform was cleared, and by an ingenious use of the counter around the balcony, a dining table two blocks long was provided on which a midnight supper was served.

Inspection of Moving-Picture Shows.

In accordance with the opinion of the corporation counsel of Chicago, the duty of inspecting moving-picture shows in compliance with the terms of an ordinance adopted Feb. 1, 1909, falls on the Department of Electricity. There are 450 "nickel theaters" of this class in Chicago, and between Sept. 30, when Mr. William Carroll, city electrician, notified his inspectors of the decision of the corporation counsel, and Oct. 19, 200 inspections had been made. This prompt work on the part of the Department of Electricity revealed the fact that in most cases the ordinance is not being complied with, but the violations are not of such a serious nature as to require drastic action. Mr. Carroll is now sending a copy of the rules and regulations of his department referring to moving-picture machines to all owners of theaters of this class. He is also sending out a circular letter saying that the apparatus used must be made to comply with the ordinance within 10 days after receipt of the letter. As soon as the theater owners are notified arrangements have been made to inspect the premises once a month thereafter or at as frequent intervals as shall be found necessary to see that the appliances installed are maintained and used in such a manner as to insure safety.

The ordinance provides that the arc lamp used as a part of moving-picture machines must be constructed as provided in that part of the rules and regulations of the department applying to portable arc-lamp equipments in theaters. Rheostats also must conform to the rheostat requirements for theater arcs. There must be an automatic take-up for the film, and the doors and openings of the casing for this take-up must be kept closed while the machine is in operation. The use of motors for the operation of moving-picture machines is prohibited, although the take-up reel can be operated by motor if desired. Moving-picture machines must be placed in a fireproof housing. No person but the operator in charge shall be allowed in the lamp-room during the time the picture machine is in use. Before every performance the operator must examine the machine carefully and see that it is in a safe condition to operate. Other precautions of a non-electrical nature are enjoined, such as the prohibition of smoking in the moving-

picture-machine inclosure. Policemen are instructed to cooperate with the electrical inspectors in enforcing the terms of the ordinance.

Chicago Municipal Inspection of Electric Meters.

The committee on gas, oil and electric light of the City Council of Chicago has under consideration an ordinance providing for the inspection of electric meters which will probably be adopted by the aldermen when presented. A similar inspection of gas meters is now provided by law, and it is proposed to afford the same privilege to users of electric meters, although, as a matter of fact, there is very little complaint of the accuracy of electric meters on the part of consumers of electricity. The inspection is to be made under the supervision of the city electrician. If a patron of the central-station company feels that his meter is not registering properly, he may have the instrument inspected by the Department of Electricity by making a deposit covering the cost of inspection. If the meter is found correct, the customer will forfeit his deposit, but if it is found to favor the company the deposit will be returned to him and the company will be asked to pay the cost of making the inspection. There will probably be in the ordinance also an arrangement for the return of overcharges if any should be found as the result of meter inaccuracy. In practice, however, it is probable that even after the ordinance is adopted the city electrician will not be called on to make a great many inspections, for he will first ask the complaining customer to take up the matter with the company, and, judging by the experience of the past, in 9 cases out of 10 a satisfactory adjustment will be made between the company and the customer treating directly with each other.

Wisconsin Water-Powers.

The special committee on water-powers, forestry and drainage appointed last spring by the Wisconsin State Legislature has just made an inspection trip in northern Wisconsin. The committee visited Eagle River, Star Lake, Arbor Vitae and Trout Lake to look over the forest reserve lands between Trout Lake and Boulder and Island Lakes. The trip through the Manitowish chain of lakes was made in a launch. This chain, which is composed of Rest Lakes, Manitowish, Ashland, Duluth and Cass Lake, Minnesota, compose the principal reservoirs of the proposed Chippewa River Valley reservoir system. The committee returned by way of Chippewa Falls, where a close examination of the water-power of the Chippewa River was made. The members of the special committee are as follows: Senators H. F. Bird, Paul O. Husting, Henry Krumrey; Assemblymen William M. Bray, George P. Hambrecht, secretary, F. W. Kubasta and James E. Thomas.

A movement has been put on foot at Dolgeville, Wis., to establish a system of reservoirs and dams on the creeks in that region. Considerable horse-power can be developed in this way, and the electricity would readily be used by the mining camps.

Telephone Situation in Jamestown, N. Y.

One of the public-utility problems engaging the attention of the citizens of Jamestown, N. Y., is the status of the Independent telephone plant of the Home Telephone Company. This company has reached a stage where it wants permission to raise its rates or else have the city buy the whole outfit or permit it to sell out to the Bell Company. The Common Council at a meeting held nearly a month ago voted down a resolution to submit to the vote of the people the question of buying the plant for $286,000. Then the Chamber of Commerce called a public mass meeting to discuss the whole subject. The Home Company has refused to make extensions and the situation was so complicated that it was thought that a public meeting might in its wisdom devise some solution of the problem.

This meeting was duly held on Oct. 4, and Mayor Carlson made a speech favoring municipal ownership, recommending that the question be decided by a referendum, the vote to be upon all of the propositions under consideration. He said that the subscribers pay the entire expense of the telephone service, whether it is privately owned or publicly owned, and that municipal ownership would enable this service to be given to the users without the inclusion of dividends or profits, which would go to the private owners. An auditor who had examined the books of the Home Company said that the company's gross income in 1908 was $46,890 on an estimated average of 2587 telephones, being an average of about $18 per telephone. Deducting expenses and bond interest, the net profit was $2,050, from which to make extensions and provide for depreciation. This gentleman expressed the opinion that it would be unwise for the city to buy the plant.

The president of the Common Council said that the majority of the aldermen favored a raise in rates and competition in the telephone business. He recalled that the appearance of the Home Company in Jamestown had resulted in a reduction of telephone tolls. There was considerable discussion, in which the fact was brought out that there had been internal dissensions in the management of the Home Company. The question was also raised whether the city had any right to buy the plant under the State constitution.

At the conclusion of the mass meeting the Common Council held a meeting, and a resolution to submit to the taxpayers a proposition to buy the plant or secure bids for the construction of a duplicate plant at a cost not to exceed $315,000 was voted down by a vote of 8 to 3. It was decided to ask the corporation counsel to give an opinion on the legality of buying the plant, and this opinion was presented a week later. It was to the effect that the Council did not have a legal right to purchase the plant on the ground that it would be taxing all for the benefit of a few; further, the bonding limit of the city would be exceeded if the sum of $286,000 was added to the present debt.

In view of the opinion of the corporation counsel, the Common Council, on Oct. 11, by a vote of 7 to 4 decided to give the Home Telephone Company the authority to make the desired increase in rates. The resolution authorizes the company to increase its rates to a maximum of $36 per year for a single-party business telephone. The new rates decrease to $16 a year for a four-party residence telephone. Mayor Carlson vetoed this resolution, but before doing so he called another telephone mass-meeting in which the subject was again threshed over at considerable length. The point was made that the rates would have to be increased whether the plant was operated by the city or by private owners, but a motion was carried that it was the sense of the meeting that the Mayor should veto the resolution granting the increase in rates. The Mayor accordingly did so, but at a meeting of the Common Council on Oct. 18 the resolution permitting the increase in rates was carried over the Mayor's veto by a vote of 8 to 2. At this meeting the Mayor enlivened matters by apparently charging the general manager of the Home Telephone Company with bribery. This gentleman was present and denied the charge, and he asked the Common Council to make an investigation.

Sons of Jove Annual Meeting.

The seventh annual meeting of the Order of Rejuvenated Sons of Jove was held on Oct. 14 and 15, 1909, at Cleveland, Ohio. Headquarters were at the Hollenden Hotel, and about 175 Jovians attended.

The work on the first day was confined to the meeting of committees, and in the evening the Cleveland Jovians gave a theater party at Keith's Hippodrome. Friday, the 15th, was Jupiter's Day. In the morning a business session was held at the Hollenden. In the afternoon special cars carried the Jovians to the Euclid Garden Theater, where a class of nearly 100 candidates was initiated, one of the largest classes in the history of the order. The work of the Rejuvenation was ex-

emplified in full form by the Buffalo degree team in seven tableaux, with appropriate scenic setting and accessories. The floor work was in charge of Mr. Harry C. Rice, No. 376, of Cleveland, assisted by an Imp team of six Cleveland Jovians.

In the evening the Joviation dinner was held at the Hollenden Hotel. The toastmaster called upon the following Jovians, who responded briefly: Seventh Jupiter J. Robert Crouse, No. 260, of Cleveland; Past Jupiter William E. Robertson, No. 424, of Buffalo; Mr. P. Yensen, general manager Cleveland Telephone Company; Mr. E. H. Haughton, No. 278, of Chicago; Mr. H. E. Hackenberg, treasurer of the National Carbon Company, Cleveland; Mr. E. E. Noble, of the Cleveland Electric Illuminating Company; Mr. C. A. Parker, secretary Curtis Advertising Company, of Detroit, and Mr. J. W. Worbs, secretary-treasurer of the Adams-Bagnall Electric Company, Cleveland.

Following the dinner the entertainment committee, Mr. H. H. Cudmore, chairman, put on a very clever line of vaudeville. Before the Joviation ended a silent toast was drunk to Past Jupiters C. W. Hobson, No. 1, and C. A. Newning, No. 2, according to the Jovian custom. The nominating committee offered two tickets for election, resulting in the choice of Mr. Oscar C. Turner, No. 333, Life 3, of Warren, Ohio, as the reigning eighth Jupiter.

An interesting feature of the convention was the election of Mr. Charles F. Brush, the well-known pioneer in the electric lighting field, as an honorary member of the order. The greatest enthusiasm was evoked by the announcement that Mr. Charles A. Coffin, president of the General Electric Company, had become a life member. Eight life members were elected, making a total membership in all classes of more than 2500 Jovians.

Von Bolton Tungsten-Lamp Filament.

A patent was issued Oct. 12 on a process for making tungsten filaments to Mr. Werner Von Bolton, of Charlottenburg, Germany, one of the inventors of the tantalum lamp. The invention consists in inserting a refractory metal powder (tungsten) in a tube of ductile metal, and subsequently working the tube and contents into a filamentary form. One of the claims covers exhausting the air from the tube of ductile metal, sealing its ends and subsequently working it and the enclosed metal into filamentary form; and a third claim provides for removing the tube after the metal has been drawn into filamentary form. It is stated that by this process it is easy to draw a body from an original length of a few centimeters and a diameter of some 5 mm or 10 mm into a fine wire only a fraction of a millimeter in diameter. The specification says that it is old to purify tungsten and draw it in filaments without the use of an outer shell. The present process, however, differs also from the old method in that the metal powder can be used without the previous formation of a homogeneous fused mass; and, furthermore, by the present process the difficulties which are encountered in the drawing of tungsten by the old method are avoided. The tube may be composed of a ductile metal, such as tantalum or iron, and finally removed by one of a number of chemical dissolving agents, since tungsten is very difficult to dissolve. If the shell consists of nickel, this metal can be removed by evaporation, as it evaporates considerably below the melting point of tungsten.

Barclay Stock-Ticker System.

A United States patent was issued Sept. 21 to Mr. J. C. Barclay, assistant general manager and electrical engineer of the Western Union Telegraph Company, on a printing-telegraph system of the stock-ticker class. The patent discloses several radical improvements over existing stock-ticker systems, and a wide range of application of the instrument. The present tickers print the characters on a paper tape, but the Barclay instrument prints them in lines on a message blank or a sheet of paper, as does an ordinary typewriter. The message blank lies flat, horizontally, in the machine, in direct view of the operator, the paper carriage being operated automatically. This feature renders the instrument available for commercial business. The printing characters are disposed on the face of a type wheel, which is rotated synchronously with the sunflower arm of the transmitter. A pause in the motion of the arm on any one of the segments of the sunflower causes the printing of the corresponding character on the typewheel. Only one class of signals is transmitted over the line, the various operations of the receiving apparatus being controlled by a "separator" relay. The relay is governed by a commutator which rotates with the typewheel, and the relay in turn controls sundry local circuits containing magnets which control the performance of such functions as shifting the typewheel, return of the paper carriage, feeding of the paper, etc., at the proper times.

An important feature of the system is that it can be operated over long lines, thus affording means of transmitting stock quotations direct from one city to another city over one wire.

Joint Institute and Western Society Meetings in Chicago.

A tentative program of papers to be presented at joint meetings of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers, at the rooms of the latter in the Monadnock Building, Chicago, has been prepared, although the exact dates are not definitely fixed. The November meeting (probably on the 19th) will be addressed by Dr. C. P. Steinmetz. Other papers to be presented at the monthly meetings have been arranged as follows:

December, Low-Tension Street-Railway Feeder Systems, by Mr. R. H. Rice.—January, Recent Developments in the Automatic Telephone, by Mr. Lee Campbell.—February, Special Motor Controls, by Mr. C. A. Dresser.—March, Electrical Features of the Reclamation Service, by Mr. O. H. Ensign.—April, Some Proposed Improvements in Underground Conduit Construction, by Mr. E. N. Lake.—May, Depreciation and Reserve Funds for Electrical Properties, by Mr. W. B. Jackson.—June, Induction-Motor Phenomena, by Prof. John D. Nies.

Mr. Insull on the Sale of Electric Energy in Chicago.

The most successful meeting in the history of the Electric Club of Chicago was held on Oct. 20, when about 200 representative electrical men of that city were present to listen to an address by Mr. Samuel Insull, president of the Commonwealth Edison Company, on "The Sale and Distribution of Electric Energy in Chicago." The address followed the weekly luncheon of the club, and Mr. F. P. Vose, the president of the organization, presided at the speakers' table, with Mr. Insull on his right and Mr. B. E. Sunny, president of the Chicago Telephone Company, on his left. There were several out-of-town electrical men present, including Messrs. James I. Ayer, of Boston; M. S. Hart, of New Orleans; H. R. Sargent, of Schenectady, and W. K. Archbold, of Syracuse. Mr. Vose introduced the speaker of the occasion, and he took occasion to declare that Mr. Insull and Mr. Sunny were elected members of the club "on sight."

Mr. Insull's address, although brief, was very instructive and interesting. The speaker gave most of his hearers, electrical men though they were, a new conception of the magnitude and importance of the business of supplying electricity in a city like Chicago. He declared that the business of supplying electric service should be a monopoly business in each community served, and that if his company were secured from competition, say, by a public-service commission, he would be entirely willing to agree to a periodical five-year adjustment of rates and to make public to the fullest extent an exact statement of the

profits, so that all might see the small margin on which the business is conducted. Mr. Insull pointed out how the rates for electricity has steadily decreased in Chicago, with the growing volume of the business, and he said that he hoped to see these rates go down to a still lower point, although, of course, no man could foretell how low the rates might be made in the future or at what time it would be found possible to reduce them with safety. To show the volume of the business, the speaker made the striking statement that if his company could reduce its operating cost one-thousandth of a cent per kw-hour it would mean a saving of $4,500 a year.

Beginning by saying that Chicago is the market place of the richest producing valley in the world, Mr. Insull remarked that to assure its continued success and prosperity, not only were men needed—men possessing the characteristics that have made Chicago great—but these men must have at their disposal material advantages which are essential to the industrial, commercial and social life of a great city. Among these advantages the possibility of procuring cheap electric energy is most important.

All electrical men, whether in the service of the electricity supply company or in the service of manufacturing corporations

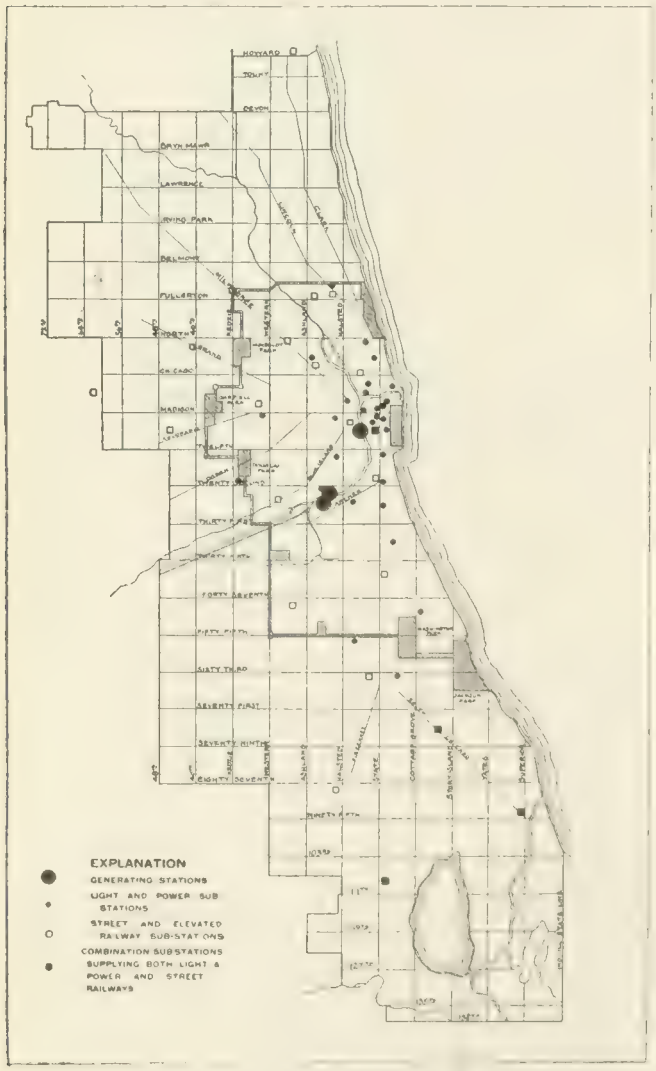


FIG. 1.—OUTLINE MAP OF CHICAGO SHOWING LOCATIONS OF GENERATING AND SUBSTATIONS.

or engineers advising their clients, are equally interested in the development of electric service—in the distribution and sale of cheap electricity in the community.

The figures bearing on this business are very interesting. There is about $60,000,000 invested at the present time in the generation and distribution of electric energy from central stations within the corporate limits of Chicago. One may gain a better idea of what this means when he reflects that to pay 6 per cent interest on the money invested takes about $400 an hour, 24 hours a day and 365 days in the year. To enjoy the right to earn that interest the company has to pay, and does pay with pleasure, to the city and State an amount in taxes and compensation that exceeds $100 an hour. The total amount paid this year in taxes and compensation is about $900,000. It

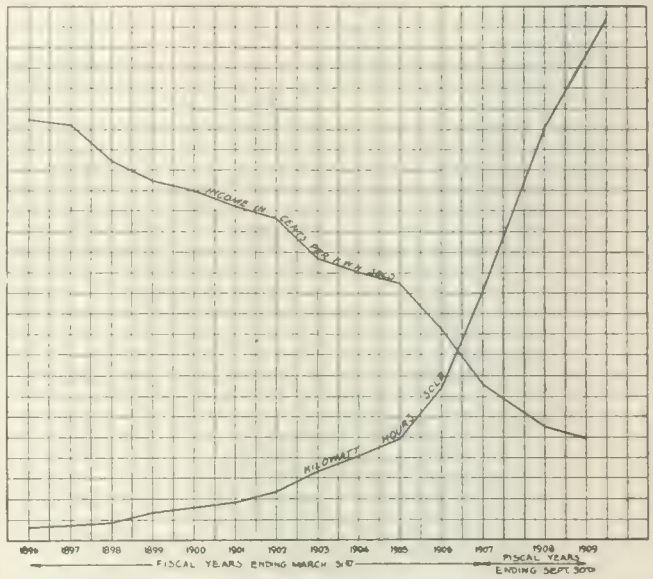


FIG. 2.—CURVES SHOWING DECREASE IN RATES AND INCREASE IN BUSINESS.

is a common thing for the newspapers in discussing public-service corporations to indulge in criticism relating to the alleged evasion of taxes on the part of these corporations. Mr. Insull asked his hearers to believe, in view of the statement he had just made, that such criticism did not apply to the company of which he has the honor to be the head.

It takes an average of more than 100 tons of coal an hour 8760 hours a year to produce the energy which the Commonwealth company sells. At certain times in the winter this coal must be burned at the rate of from 200 tons to 250 tons an hour. "Fancy," said Mr. Insull, "the engineering brainwork that must be centered in that one proposition—how to get through the grates 250 tons of coal in an hour. To take care of the business, to stand ready to deal with large and small consumers as they come along, we have at the present time a capacity of 240,000 hp, and during this coming winter the maximum load on our central stations will be upward of 200,000 hp. I do not know how much electricity is being generated by water-power plants at Niagara Falls, but I think the amount of electric energy we get from our steam plants here in Chicago will compare favorably with that produced by the great plants at the foot of Lake Erie."

Fifty-four stations and substations are needed to meet the various classes of business, from the smallest lighting installation to the operation of a railway system. These substations have a converting capacity of 275,000 hp, and the current that passes through them is conveyed by a total mileage of 1255 miles of cable, 400 miles of overhead wires and a conduit mileage of 2200. This development has taken place in less than 30 years, and in order to take care of the growth of the business the company is spending about $6,000,000 a year, or nearly $2,000 for every working day of the year. These figures give some idea of the investment side of the electric service business in Chicago.

Mr. Insull referred to the accompanying diagram to show that the kw-hours sold between 1896 and 1909 had multiplied 40 times, and here he remarked that the extent of the business was now such that the saving of one-thousandth of a cent in the unit of manufacture would amount to about $4,500 a year. Forming a striking comparison with the increase of the business is the decrease in average rates. This is shown by the

upper curve on the diagram. The company's income for the present year is only 25 per cent per unit sold of the income received in 1896. Of course, the gross income is much larger, but the curve shows the decrease of the average rate at which a kw-hour is sold. This marked decrease in rates has been accomplished by improved apparatus, concentration of production and some success in selling the greater volume of output.

The speaker referred to the sale of electricity as a monopoly business, and said that an isolated electric plant is as much of an anomaly as an isolated gas plant or an isolated water works would be. He contended that the day of the isolated plant has passed, and whether for supplying electricity to an office building or for the electrification of the terminal of a great railroad, there is no economical justification for the existence of such a plant.

"I wish to dwell upon this point," said Mr. Insull, "for the benefit of those of you who are not engaged in the manufacture of current. If you will bend your energies to the sale of current-consuming devices you can build up a business which has a permanency; if you bend your energies to competition with a power-generating company, I do not care in what city that company may be located, you are in the course of years doomed to failure. It is not among the possibilities in this day that electric current can be produced by small units in competition with the large production on a wholesale basis of the generating company."

Mr. Insull made the interesting statement that in looking over the field for his company in Chicago, as near as he could figure, the company is doing only about one-third of the possible business. This does not refer to the growth of the city, but simply to the possible electricity supply business in Chicago as it exists to-day. The speaker then called attention to a map of Chicago, also reproduced herewith, showing the generating and substations of the company, various symbols being used to distinguish the light and power substations from the railway substations and the combined light and power and railway substations. Beyond the city limits, too, electricity generated in Commonwealth stations is distributed as far north as Milwaukee on the north and Kankakee on the south, a distance of about 140 miles.

In closing, Mr. Insull emphasized the fact that the interests of all members of the Electric Club should be as one in extending the use of electricity. The producing company is engaged in an effort to produce the largest amount of electric energy at the lowest possible selling price. The claim is made for Chicago that it has the lowest selling price of any large electric supply company in the world. Taking the whole schedule of rates through, it is believed that electricity is sold cheaper in Chicago than anywhere else on either side of the Atlantic where energy is produced from steam-driven stations or even from water-power stations established as commercial propositions to make money. This fact should mean a great deal to those who represent manufacturing companies. If electricity is cheap there is, of course, a greater inducement to use current-consuming devices.

The cheap electricity available in Chicago should have an important bearing upon the agitation in relation to electrifying the terminals of the steam railroads. There are, of course, vast problems to be settled before this electrification can be accomplished, and it is well for all who are not steam-railroad men to treat these problems with respect. But so far as the current-producing side of the argument is concerned, it is a mistake to say that electrification is impossible because of the cost of electric energy. If this objection is based on a knowledge of the cost of electric energy used for the electrification of steam-railroad terminals around New York, it is based on false premises if it is contended that the same cost of electric energy must apply in Chicago. It is a fact that electric energy can be bought in Chicago considerably cheaper than it is now being produced by the two great traffic lines which are now engaged in electrifying their terminals in New York.

Mr. Insull said that he would be glad to answer any questions put to him, and when the applause following his address had subsided one visitor asked whether in case the railroad companies in Chicago should decide to electrify their terminals, using current purchased from the Edison company, it would be necessary for that company to build new generating stations to care for this demand. The answer of Mr. Insull was that his company could take care of any two railroad-terminal electrifications in Chicago, based on the present consumption of current by the roads running into the New York Central station in New York, with the present capacity of the Edison stations. With additional equipment, which has been ordered to go into service within a year, two additional terminals of like capacity could be served.

Mr. F. J. Holmes, of the Vulcan Electric Heating Company, asked how much of a factor in the growth of the business the placing of electric heating devices on the circuits of the company was proving to be. Mr. Insull responded that this was a difficult question to answer. He spoke, however, of the company's recent flatiron campaign, with which readers of these columns are familiar, but said that it would be difficult to trace exactly the amount of load due to electric heating appliances. He said that some years ago he tried to figure out the effect of fan motors on the business, but had to relinquish the idea of getting exact information, as anything like fan motors or electric heating appliances, that are more or less a matter of general daily use among the 70,000 or 80,000 customers of the company, are difficult to trace as a component part of the total load. The speaker added that he thought the reduction in the rates had had the effect of encouraging the use of heating devices.

Mr. J. W. Mabbs, superintendent of the Board of Trade Building, referring to the curve in the diagram showing the reduction in average rates, said that it would be interesting to have a curve of profits to compare with it. To this remark Mr. Insull made answer as noticed above, to the effect that if there were no danger from competition he would be glad to disclose in exact figures the profits of the company, showing the small margin remaining for this purpose.

Central-Station Economics.

The first meeting of the season of the Chicago Section of the American Institute of Electrical Engineers was a joint meeting with the Electrical Section of the Western Society of Engineers, and was held on Oct. 22. Mr. J. G. Wray, secretary of the local branch of the Institute, presided, and the speaker of the evening was Mr. W. L. Abbott, chief operating engineer of the Commonwealth Edison Company, whose subject was "Central-Station Economics." By a coincidence the date of the meeting fell on a day when there was an unusually heavy demand for central-station service, the maximum load rate in the afternoon being 130,000 kw. The subject was, therefore, particularly timely.

Mr. Abbott spoke of the reduction in the selling price of electricity in the last 15 years, and said that radical changes which had been made in central-station economics have made this possible. He sketched briefly the development of the art of generating and distributing electric energy from central stations, and said that the great increase of business has made necessary large and specialized organizations and elaborate analyses of costs. Roughly, the revenue received by the large central station may be distributed as follows: Fixed charges, 50 per cent; general expenses, 20 per cent, and operating expenses, 30 per cent. Thus, the fixed charges equal the other two items combined, and the capital charge is the severest burden on the business and has the most to do in determining the selling price of electricity. In time the relative importance of the fixed charges will be lessened, and herein will lie the possibility of making material reductions in the selling price of electrical energy in the future.

Competition in the central-station business means a duplication of capitalization, and is an economic error. Where there is such competition the inevitable tendency is toward consolidation, and when this is effected the resulting monopoly is

loaded with duplicate investments on which fixed charges must be paid, and these fixed charges are paid by the consumer. It is apparent, therefore, that the business in any given community should be a monopoly. But it should be a regulated monopoly, protected against competition; the electric service company should be willing to accept fair regulation in rates and service as provided by the city or State.

In considering the matter of investment it must be remembered that the amount of money so expended must always be considerably in advance of the current demand to provide for the growth of the business. Furthermore, it is often necessary to expend large sums in building transmission or distribution lines through thinly settled areas, in order to reach some place of demand farther out. People in selecting their homes and factory locations in a large city and its environs give no thought to the matter of economical distribution from the central station.

The number of power houses to be erected depends on the extent of territory to be served, the density of population, whether the distribution is overhead or underground, and the permissible voltage. The cost of transmission lines, particularly if underground, has a material influence on the location of power houses. Thus, to transmit 50,000 kw for five miles underground at 900 volts may cost $2,500,000, and this large investment must be taken into consideration when the location of the generating station is considered. In case an ideal site for the power house can be obtained near the center of the territory served, there are advantages and economies in building a few large power houses rather than a number of small ones, but when this problem of the cost of transmission is also considered, it will be seen that a point is reached beyond which the concentration of generating equipment in the large power house becomes too great to be economical. In selecting the site for a power house arrangement must be made to have an ample area, an abundance of water for condensation and a location on one or more railroads supplying coal, unless access to the coal fields can be had by water transportation. When the requirements of the great power house of a large city are attentively considered it will be found that few suitable properties are obtainable, and the real-estate buyer for the central-station company has his troubles as well as the engineer who locates the station.

Fuel, next to fixed charges, constitutes the largest single item entering into the expense of producing electricity. The fuel question is a serious one, as it is by no means impossible that in the years to come there will be a scarcity of coal in this country owing to the enormous and increasing demand. Coal lands are being rapidly secured by railroads or by large holding corporations, and it is imperative that the large central-station company should make intelligent provision for its supply of coal for a long period of years ahead. An electricity producing company, such as that in Chicago, consumes the output of two or three fair-sized coal mines, so far as the particular grade of coal burned is concerned. However, these coal mines produce other grades of coal too expensive for power-house consumption, so that it is not desirable for the central-station company to mine its own coal unless it is prepared to dispose of the standard grades of fuel which it does not itself consume. It may be possible to combine with some railroad running through cheap coal lands by which the whole supply of mines may be taken, the railroad hauling the standard grades and disposing of them to other consumers.

In power-house design the controlling feature is the planning of the station in such a manner that the enormous quantities of coal passing through the boiler-room may be handled and burned cheaply. This implies, of course, suitable arrangements for the removal of the ashes. The advent of the automatic chain grate was a great step in advance in power-house construction. The automatic grate not only saves labor, but permits the boilers to be more efficiently and evenly fired and results in practically smokeless consumption of the coal. It is almost impossible to avoid smoke with hand firing.

Boilers are now worked to a much higher degree than formerly. It is very common to operate the boiler at 50 per cent above rating, and not infrequently at 100 per cent. It is found that this forcing does not hurt the boiler at all, but rather seems to add to its efficiency. In the very best practice 86 per cent of the potential heat energy of the coal is wasted in power houses; ordinarily 88 per cent is wasted, in spite of the most exacting and constant precautions to prevent waste of heat. Mr. Abbott then exhibited the following table compiled to show the losses made in converting fuel energy into electrical energy:

ONE POUND OF COAL = 10,000 B.T.U.

Ash pit	300	
Stack	1,960	
Banking fires	560	
Radiation and unaccounted for	800	
Total boiler-room loss		3,620
Rejected to condenser	4,810	
Pipe radiation, etc.	370	
Total turbine-room loss		5,180
Delivered to busbars		1,200
		10,000

In discussing this table Mr. Abbott made the striking statement that one-fifth of the coal bill is paid just to produce a draft in the smokestack. Furthermore, 48 per cent of the heat of the coal is wasted in the condenser. This could be avoided if the condenser could be operated at something like minus 500 deg. Fahr., but, of course, this is impossible because in that case the station would be operating on ice and not on steam.

The speaker remarked that the fuel economy of gas engines is much greater than that of steam engines or even steam turbines, but, as a matter of fact, what is saved in fuel by the use of large sizes of gas engines is more than made up in the increased fixed charges, owing to the comparatively high price of these units. The steam turbine has enabled generators to be reduced in size and weight, while its efficiency is greater than that of the piston engine and its economy is practically constant over a wide range of load. Mr. Abbott gave the following interesting figures of comparison:

The steam engine of large size costs 10 cents a pound. A steam turbine of equal capacity costs 30 cents a pound. But the engine weighs 286 lb. per kilowatt, and the turbine weighs but 34 lb. per kilowatt; therefore, the turbine is much more economical. The generator of a turbine unit weighs 21 lb. per kilowatt, while the generator of a large engine unit weighs 80 lb. per kilowatt. The relative costs are approximately proportional to the weight. The foundations of an engine and generator set cost $3 a kilowatt, and the foundations of a turbogenerator cost 50 cents a kilowatt. In view of these facts, it is not at all strange, said the speaker, that turbines at once obtained complete mastery of the field in large power houses. Furthermore, turbines make possible the use of larger generators than ever before used. These machines are now made up to 14,000 kw, and within a few years there will probably be 25,000-kw units.

The difference in efficiency between engines and turbines is due to the fact that in large steam engines in ordinary practice the steam is expanded to about 25 times its original volume, whereas in the turbine it is possible to expand the steam to 700 times its original volume.

The economy of labor is also to be considered in comparing the turbine and engine. In the great modern power houses millions of dollars' worth of equipment are placed at the disposal of employees who often do their work at a distance of several miles from the administrative headquarters of the company. It is important that these men should be of high class and they should be generously rewarded for faithful work. The greatest of all extravagances of the central station is the loss due to shutdowns. Great diligence must be taken to guard against this possibility. A shutdown might be a veritable calamity, not only to the business of the company, but to the community which it serves. Money to insure against such a disaster is well expended; and this means not only that the help should be of high quality, but that there should be a merciless abandonment of inefficient apparatus.

Thirty per cent of the company's revenue goes for operating

expenses, and the speaker gave the following table to show how this money is spent:

DISTRIBUTION OF OPERATING COSTS.

	Per cent	
Generating Costs:		
Operating payroll	6.1	
Fuel	20.8	
Supplies and repairs	4.8	
		31.7
Distributing Costs:		
Battery and substation operation and maintenance	12.1	
Street system maintenance	12.2	
Reading and maintenance of meters	6.8	
Free lamp renewals	16.6	
Free maintenance of other current-consuming apparatus	12.9	
Free wiring and free repairs on customers' premises	7.6	
		68.3
Total		100.0

It is interesting to observe that the free-lamp renewals cost as much as the expense for labor in all departments of the company, and four-fifths as much as the cost of the coal.

In the discussion, Mr. R. F. Schuchardt, electrical engineer of the Commonwealth Edison Company, reverted to the fallacy of competition, or, as he expressed it, the inevitable logic of centralization. The secret of the logic of this situation lies in the diversity factor, and Mr. Schuchardt showed how various classes of public service, as railways, power and lighting, do not make their maximum demands on the station at the same time. Furthermore, the reserve can be common to all and in this way the central station is enabled to effect marked economies. For instance, the Commonwealth company, by supplying large blocks of electrical energy to the railway companies, is enabled to make lower rates to the householders of Chicago.

Mr. Staunton criticised the figures as given out by the Illinois Central Railroad as to the probable cost of terminal electrification, and said that he thought they not only were too high in the matter of electricity supplied, but also that the railroad people made no allowance for the value of steam locomotives replaced, which could either be used on other parts of the system or sold to other companies.

Mr. A. Bement gave some interesting reminiscences of early electric lighting in Chicago. He also pointed out that the per centage of loss by radiation in steam power houses is greater when the boiler is banked than when it is in full operation.

Mr. Robert A. Kuss, of the city smoke department, alluded to the electrification problem and said that possibly self-contained electric or partly electric motor-car or locomotive units might be the solution of the problem.

Mr. O. E. Olson, superintendent at the Fisk and Quarry Street stations of the Commonwealth company, said that not as much smoke was now produced in one of the great Fisk Street stacks as from the stack of a 50-arc lighting plant a few years ago.

Mr. George H. Jones, of the Commonwealth company, mentioned the fact that the company now supplies electricity to 160,000 hp in motors, exclusive of railway load.

Mr. D. W. Roper, of the same company, spoke of the heating load due to the electric heaters in railway cars, which are operated from the central station. He noted the difference between two days recently, on one of which the heaters in the railway cars were not in use, whereas on the other they were turned on. The difference in current demand was 12,000 kw.

Mr. F. H. Bernhard asked if it would not be possible to utilize the exhaust steam, say, from the Harrison Street station, for heating buildings in Chicago, but Mr. Abbott said that the complications in conducting the steam under the streets of Chicago at the present time would render this plan impracticable. Others taking part in the discussion were Messrs. E. N. Lake, B. E. Strom, J. H. Warder and E. F. Smith. In closing Mr. Abbott emphasized the fact that not alone to the operating engineers must the reduction in the price of electrical energy be looked for. Such reductions, when accomplished, will be due more to improved methods and apparatus, and above all to a more careful consideration on the part of the designing engineer in laying out systems to be permanent through a long series of years. He repeated that the period of competition had passed; the period of municipal regulation is here.

Indiana Commission News.

The Indiana Railroad Commission has taken up the question of high-tension wire hazard with respect to the contact at crossings between telephone and telegraph wires with the high-tension wires of electric lines. In a circular prepared by Commissioner Dowling and sent to all the electric roads and all the steam roads paralleled by electric lines, it is stated that a number of fatal accidents occasioned by electric shocks had been reported to the commission recently.

With a view to lessening the electric hazard the commission is asking the railroads to furnish a list of all such dangerous wires where they cross lines where the steam and electric lines run parallel to each other, the station nearest to which the objectionable and dangerous wire is located, the number of telegraph or telephone poles nearest the wire, the height of the wire above the rails, why the wire is dangerous and the name and address of the owner of such wire.

When the information is collected, the commission will proceed to recommend immediate action calculated to do away with the live-wire hazard. The recent death of Motorman Plummer on the Indiana Union Traction line, who was killed while attempting to use the telephone to secure orders from the train dispatcher, is cited along with other accidents as reasons for taking precautions to do away with the hazard.

The commission has also issued a bulletin to the steam roads of the State recommending that in switching across interurban tracks they observe the same rules of stopping as are required to be observed at all main-line crossings where block signal towers are not maintained.

The commissioners say that in a large number of places where steam roads are paralleled by traction lines, the latter are cut by switches from the steam roads to elevators and other industrial plants. The traction employees always stop their cars on approaching such a switch, but on the contrary no stop is made by the trainmen in charge of steam cars. The commission hopes to make this rule extend to the steam roads.

Massachusetts Commission News.

The Massachusetts Railroad and the Boston Transit Commissions, sitting as a joint board, gave an important hearing in Boston on Oct. 20 upon the plans of the proposed Boston & Eastern Electric Railroad Company, which provide for a high-speed, double-track line upon a private right-of-way between Post Office Square, Boston, and Lynn, Salem, Beverly and Danvers. The project has been held back by the necessity of legislation to enable the road to build a tunnel and subway under Boston Harbor. The Legislature of 1909 referred this question to the above joint board, in connection with other transportation problems now at the front in Boston, and the joint board is to report its conclusions to the Legislature of 1910 early next January.

The hearing last week was mainly devoted to a discussion of the relations of the proposed road to existing and future facilities, the general line of argument being that it will take care of a class of suburban traffic which neither the steam roads, whether electrified or not, nor the street railways in the territory can properly and profitably handle. The company was represented by its counsel, Moorfield Storey, Esq., of Boston, and by its chief engineer, Mr. John H. Bickford, of Boston. Present in opposition were Attorneys William H. Coolidge, Esq., for the Boston & Maine Railroad; Bentley W. Warren, Esq., for the Boston & Northern Street Railway Company; Woodward Hudson, Esq., for the New York Central Lines; and Thomas A. Babson, corporation counsel of the city of Boston. Frederic E. Snow, Esq., was present on behalf of the Boston Elevated Railway Company.

Mr. Storey opened the case for the Boston & Eastern and stated that the company stands ready to build the road immediately upon authorization. Its engineering plans and esti-

mates, with figures of proposed schedules and anticipated earnings, have been favorably passed upon by such authorities as Messrs. William Barclay Parsons and H. M. Brinckerhoff, of New York, and J. R. Worcester, of Boston. Chief Engineer Bickford was then called, and briefly reviewed the plans of the company.

The proposed new road is to be of the third-rail type, without grade crossings, and will carry passengers from the heart of Boston to Beverly, 19 miles distant, in 23 minutes by express trains and 30 minutes by local runs. The trains are to be run on the zone system, no train making more than eight stops en route. The existing facilities cannot handle traffic in this way nor give suburban patrons the benefits of real high-speed service. The Boston & Eastern plans to run trains from 7½ to 15 minutes apart, with an all-night service proportioned to the traffic demands. The road can handle 15,000 passengers per hour, and the right-of-way will be wide enough for four tracks when business requires them. The total cost of the road, including the tunnel under Boston Harbor, will be about $11,000,000, and the tributary population is figured at 230,000, exclusive of the Boston terminus, earnings being calculated on the basis of $7 per capita per annum. The territory is densely populated and demands additional facilities. It is growing 88 per cent faster than the city of Boston and 63 per cent faster than the State as a whole.

The subways and tunnels of the Boston Elevated system were, according to Mr. Bickford, little more than elongated terminals for the reception and facilitated handling of surface-car traffic originating in the five-cent fare zone. The street railways in the outer suburbs have attempted to carry the cast-off traffic of the steam roads with indifferent success. The new type of electric railroad is ready to step into this field and stimulate patronage of all the facilities in the territory through its created travel, while reserving to itself the longer suburban patronage so indifferently cared for by the existing facilities. The schedule speed of the combined surface and elevated lines, including the subway and tunnel lines in Boston, is about 11 miles per hour, and he claimed that this is not sufficiently fast to enable the outer zone of suburban travel to be handled to advantage.

Danger to the profits of the Boston Elevated Railway Company, said Mr. Bickford, will result if it extends its rapid transit or elevated lines to considerable distances into the suburbs, and that even if this were done, the necessary fast service could not be given without sacrificing the intermediate suburban facilities and handling the traffic with great loss and serious congestion.

The public can look for no substantial reduction in fares if the steam roads are electrified, and unless motor cars are provided on separate tracks, the problem will be only half solved.

The Boston & Eastern fares are arranged on a basis of 1.25 cents per mile. On the Boston rapid transit system the average fare per passenger-mile should not fall below 1.5 cents for profitable operation, giving a radius of 3⅛ miles as the average length of haul that the company can afford to render for a single fare. The surface lines are the salvation of the Boston system, according to the arguments of Mr. Bickford. The greatest care must be taken not to extend the costly rapid transit lines of the city system into the outlying districts.

In conclusion Mr. Bickford discussed the route of the Boston & Eastern through East Boston and urged that it would not interfere with the profits of the present East Boston tunnel, which is owned by the city of Boston. He recommended extending the East Boston tunnel through to Bellingham Square, Chelsea, by a slightly circuitous route, and contended that if this should be done, there would be no competition of any amount between the two systems. Regarding the proposal to bring the present Boston, Revere Beach & Lynn Railroad into Boston through the Boston & Eastern tunnel, Mr. Bickford said that the company was willing to have this done if the summer traffic of the former road continued to be handled by the ferry service. He stated that it would be unprofitable and disadvantageous to bring such traffic into a costly tunnel, and there is no reason why expensive, high-speed service should be given to mere pleasure seekers. Later it may be desirable to electrify the entire Revere Beach system, and in such event it could be handled in connection with a second Boston & Eastern tunnel.

Mr. Bickford's testimony was largely cumulative under cross-examination. He stated that the Aurora, Elgin & Chicago Electric Railway runs into the city over the existing elevated lines, in reply to a question by Counsel Snow. Mr. Snow stated that the Boston company will be well prepared to receive traffic from outside roads at Sullivan Square as soon as certain changes can be made in the station, and that the conditions applying when the Railroad Commission formerly forbade the Boston & Eastern to terminate at this point would no longer be in effect. At the conclusion of Mr. Bickford's testimony the hearing then adjourned.

Final cross-examination of Mr. James C. Boyd, consulting engineer of the Westinghouse, Church, Kerr organization, for the Boston, Lowell & Lawrence Electric Railroad Company, was held before the Railroad Commission on Oct. 12. As stated in the issue of Oct. 21, page 971, the company is seeking a certificate of exigency to build a high-speed interurban railway on a private right-of-way without grade crossings between the cities named in its title. Cross-examination was conducted in the hearing of the twelfth by City Solicitor Kaan, of Somerville, and Attorneys B. W. Warren for the Boston & Northern Street Railway Company, W. H. Coolidge for the Boston & Maine Railroad, and C. M. Hight for the Lexington & Boston Street Railway Company.

Mr. Boyd stated that the company expects to deliver an average of about 4000 passengers per day to the Boston Elevated Railway Company at the Sullivan Square elevated station in Charlestown, and improvements are in sight for this station. Mr. Boyd reviewed the estimates of earnings for the road and discussed the possibilities of operating the line for about 50 per cent of the gross receipts. He stated that the probable passenger earnings per capita of other roads were applied to the Boston, Lowell & Lawrence conditions in order to estimate what might be expected in Massachusetts. The financial success of the other roads was not a point at issue, so far as per capita statistics on the new line were considered. He further stated that every road upon which Westinghouse, Church, Kerr & Company had estimated passenger receipts per capita had equaled or exceeded the estimates when placed in operation.

Mr. Boyd contended that the Boston, Lowell & Lawrence could handle trains with its multiple unit equipment much more rapidly in and out of the terminal station than the Boston & Maine; that the latter could not maintain as short headways in and out of its present terminal, even if two new tracks were available; and that the cost of electrification in the suburban zone of the Boston & Maine would be enormous in comparison with the $7,000,000 needed by the proposed line. More fast trains could be run with the high-speed electric road than on even the electrified steam system.

Mr. Boyd admitted that if 12½ per cent of the traffic of the Lexington & Boston Street Railway Company is through business between Lowell and Arlington Heights, taking two hours for the trip, the new road would doubtless take away a good deal of this. The possibilities of operating economy in the high-speed electric line arise from the absence of grade crossings, absence of track maintenance in paved streets, absence of heavy peak loads on the power station, use of steam turbine equipment at favorable load factors, high speed and low platform costs per car-mile. In conclusion Mr. Boyd discussed the traffic possibilities of the territory, emphasizing the creation of new business by new facilities, and citing the case of the Detroit, Ypsilanti & Ann Arbor electric line, which multiplied the travel 25 times between certain points along a route parallel to the Michigan Central Railroad on account of new facilities of transportation.

Wisconsin Commission News.

Commissioner John H. Roemer, sitting for the Railroad Commission, heard testimony in Milwaukee on Oct. 18 as to why a certificate of necessity and convenience should be given to the Milwaukee Western Electric Railway Company. The company proposes, if granted a certificate, to build an electric line from Beaver Dam to Milwaukee, passing through Hustisford and other towns in Dodge County, and North Cape and other towns in Waukesha County. The petitioners and witnesses testified as to the pressing necessity for such a road. Considerable data regarding freight and population in the territory which the road is intended to serve were introduced, which will be carefully verified and considered by the commission in forming its decision. It was brought out in the testimony that the patrons to be served by this road now have to drive several miles in order to obtain railroad transportation. Protests against the granting of this petition were filed by the Chicago & Northwestern Railway Company and by the Milwaukee Electric Railway & Lighting Company, although the latter was withdrawn upon condition that the petitioning company change its route into the city of Milwaukee.

The commission authorized the DePere Electric Light & Power Company to issue $10,000 worth of stock, to consist of 100 shares of common stock of a par value of $100 each. The stock is to be sold to supply the company with funds for the purchase of new machinery and the construction of the necessary lines and cables for extending and enlarging the business of the company.

The Cazenovia & Sauk City Railway Company petitioned for a certificate authorizing it to issue and sell 160 shares of its capital stock, each of a par value of $25, and to issue and sell $45,000 of its first-mortagage, 30-year, 5-per-cent bonds, and to issue 1040 shares of its capital of the aggregate par value of $26,000 to certain municipalities along its right of way and to receive in payment therefore the 5-per-cent 20-year bonds of said municipalities, the proceeds of the sale of all of which are to be applied to the purchase, acquisition and construction equipment for operation of a section of its road between LaValle and Cazenovia.

New York Public Service Commission News.

The Public Service Commission of the First District of New York has approved the bond issue of the Coney Island & Brooklyn Railroad Company, amounting to $107,000, which will be used for improvements and extensions. The proceeds of this bond issue will only return to the company about $85,000 cash, as the bonds, bearing only 4 per cent, cannot be sold at par. The company applied for authority to issue $372,000 in bonds, but this request was cut down by the commission on the theory that mere replacements must not be made a part of the capitalization of a company. The amount allowed was the sum which the engineers figured would be necessary for actual betterments.

Counsel for the Public Service Commission of the First District of New York has been instructed to bring proceedings in the Supreme Court, either by mandamus or injunction, to compel the Staten Island & Midland Railway Company and the Richmond Light & Railroad Company to exchange transfers at three points in West New Brighton, as had heretofore been ordered by the commission. The commission last spring, after hearings, ordered the companies to exchange transfers, first, at the points where the tracks approach within 20 ft. of each other; second, where there is actual connection between the tracks, and third, where the tracks of the two lines meet. This order has never been obeyed. The suit is not for the collection of penalties, but is a mandamus proceeding to compel compliance with the commission's orders.

In accordance with a private arrangement between the Public Service Commission and the general manager of the Interborough Rapid Transit Company, it was promised last week that the service in the subway would be increased 14 per cent by the lengthening of the rush hours, and by the addition of extra trains. It was stated that the service of the subway was maintained at this standard during the Hudson-Fulton celebration, and, as there were many complaints charging inadequate service, the commission insisted that the regular service be maintained up to the standard that prevailed during the emergency service.

The Public Service Commission, Second District, during the present week, will hear the case of the Great Bear Light & Power Company, which operates in the unincorporated village of East Worcester, Otsego County, and in the village of West Richmondville and Richmondville, Schoharie County, and which now seeks authority to operate in the unincorporated village of Worcester. It has been ordered to produce its books and papers in relation to the stock and bond issue authorized by the commission in March of last year. One of the stockholders of the company has complained to the commission of the manner of disposing of the capitalization authorized by the commission.

The commission will also hear at Albany the petition of the Port Jervis Traction Company for a certificate of convenience and necessity and for permission to issue a mortgage for $50,000 and bonds to the same amount; also $28,812.50 in common capital stock in connection with the street railway system in the city of Port Jervis; also an order to show cause made against the Twin State Gas & Electric Company as to alleged unlawful exercise of rights and privileges in Hoosick Falls.

The application of the Great Bear Light & Power Company for permission to exercise franchises in the unincorporated village of Worcester will be heard at Worcester.

Canadian Hydroelectric Commission.

At a meeting last week of the North Toronto Conservative Association in Toronto, Mr. W. K. McNaught, M.P.P., one of the members of the Hydroelectric Commission, stated that the Government transmission line from Niagara Falls to Toronto would be ready to deliver power in Toronto inside of six months, and he hoped that the city would be ready to distribute the power to the citizens as soon as the transmission line was completed.

Speaking in reference to the statement of Mr. McNaught, the city's electrical engineer, Mr. K. L. Aitken, stated that he was confident the city would be in a position to distribute the power within the city by the end of the six months' period mentioned by Mr. McNaught. There would not be lines to all the residences that would want light, but it was expected that the city would be able to serve the down-town district where the factories are. It was the policy of the city to keep poles off the high-class streets. One of the substations would be at the St. Lawrence market down town, and others erected probably at the Bay Street fire hall and in the basement of the City Hall. When the contract with the Toronto Electric Light Company expired Mr. Aitken stated the city would be ready to do the street lighting.

The electrical department has completed the work of remodeling the East Toronto electric light plant to make it suitable for receiving and distributing the Niagara power.

CURRENT NEWS AND NOTES.

ELECTRICITY FOR IRRIGATION.—The San Joaquin Light & Power Company, of Fresno, Cal., is increasing its generating equipment by 17,000 hp in anticipation of a large increase in the number of motors driving irrigation pumps along the eastern foothills of the San Joaquin Valley.

NEW PHYSICS BUILDING AT UNIVERSITY OF ILLINOIS.—The new physics building of the University of Illinois, at Urbana, Ill., is to be dedicated on Nov. 26, and the exercises incident to that occasion will extend over into the 27th. Prof. W. F. M. Goss, dean of the College of Engineering, is in charge of the arrangements.

N. E. L. A. COMPANY SECTIONS.—Steps are being taken for the formation of N. E. L. A. company sections by the employees of the Buffalo General Electric Company and the Toronto Electric Company.

CONTRACTORS' LICENSE CASE IN BALTIMORE.—The Maryland State Board of Electrical Examiners has revoked the license of a prominent Baltimore contractor for a period of 90 days for doing alleged unsatisfactory work. The board claims that this action was one of its perogatives—is within its powers—but the authority will be tested in the courts.

PUBLIC BENEFITS FROM HYDROELECTRIC DEVELOPMENTS.—A writer in a recent issue of the San Francisco *Chronicle* discusses in a convincing manner the benefits derived by California from the hydroelectric developments within the State. Not only have new industries been established on account of the electric power rendered available, but old industries have received lasting benefits. The storage of water during the flood period for use during the dry season has greatly increased the effectiveness of the natural-grade irrigation ditches, while electric pumps have caused land above the ditches to become equally as productive as that below.

ATTENDANCE AT THE NEW YORK ELECTRICAL SHOW.—The New York Electrical Show, at Madison Square Garden, which came to a close on Oct. 21, was visited by approximately 175,000 persons, according to the management. On the two last nights the crowds were so great that the police had to be called as a matter of precaution and very many persons were unable to gain admission. The exhibition was the most successful ever conducted, the attendance being over 30,000 more than last year. Contracts have been made with the owners of the Garden for next year's show, which will take place during the middle of October.

N. E. L. A. MEMBERSHIP.—In a talk before the Denver N. E. L. A. Section, President Frueauff referred to the recent increase in the membership of the National Electric Light Association from 1300 to 3400, which he believed clearly demonstrated the limitless possibilities ahead. The American Institute of Electrical Engineers has almost 7000 members, and as the possibilities of extending the membership of the N. E. L. A. are practically as 9 to 1, that body should have a membership nearer 34,000 than 3400 to equal what other organizations are doing. He said that during the present year an active campaign will be carried on to enlarge the membership.

CHICAGO PRESS CLUB INSPECTS GENERATING STATIONS.—Mr. Samuel Insull, president of the Commonwealth Edison Company, of Chicago, was the guest of the Press Club of Chicago at a luncheon at the home of the club on Oct. 22. Mr. Insull made a brief address reviewing the progress of the art and setting forth his belief that electric service should be a monopoly in every community. After the luncheon about 100 of the members of the club were taken on special trolley cars to the Fisk Street and Quarry Street generating plants, where the operation of these great stations was explained to the visitors.

CONFERENCE ON GROUNDING THE SECONDARY.—A conference was held in the rooms of the National Electric Light Association, Oct. 15, on the subject of grounding secondary circuits, at which representatives were present from that association, from the American Institute of Electrical Engineers, the Association of Edison Illuminating Companies and the National Electrical Inspectors' Association. While all admitted that grounding is in general desirable, there was a difference of opinion as to the advisability of grounding from 150 to 300 volts, and after several hours of discussion no decision could be arrived at that would permit the drafting of a rule on the subject.

ELECTRIC MEASURING INSTRUMENTS.—Circular No. 20, issued by the Bureau of Standards, entitled the "Testing of Electrical Measuring Instruments," not only gives a list of fees for testing instruments, but contains an excellent outline of the characteristics of the various types of instruments now in commercial service. The descriptive matter covers ammeters, voltmeters, wattmeters, watt-hour meters, ampere-hour meters, recording meters and instrument transformers. Sources of errors, reliability of electrical instruments and apparatus for checking instruments are fully discussed. A copy of the circular will be sent to anyone upon request addressed to the Bureau of Standards, Washington, D. C.

LONG-DISTANCE WIRELESS.—It was announced last week that the Great Northern steamship *Minnesota,* plying between Seattle and Japan, was in communication with the Seattle and Japanese wireless stations every night during her trip. It is stated that she exchanged messages with the Seattle station until she was 3628 miles away. The ship is equipped with ordinary aerials, and with a generating apparatus of only 5 kw. The navy is soon to conduct experiments in long-distance wireless. Messages will be sent from Brant Rock, Mass., beginning probably in December, to the scout cruisers *Salem* and *Birmingham* at sea. Efforts will be made to communicate with these ships when they are 3000 miles away from the sending station.

WATER-POWER HEAD RIGHTS.—An injunction suit is being tried in the Superior Court at South Bend, Ind., involving the respective riparian rights of hydraulic power owners. The Mishawaka Hydraulic Company, which owns and maintains a power dam in the St. Joseph River, seeks to enjoin the South Bend Manufacturing Company, which owns and maintains a similar power dam a few miles lower down in the river, from forcing back water against its dam. The Mishawaka Company alleges that the South Bend Company has raised its dam to a height sufficient to back the water up to and destroy the power derived from turbine wheels. The trial will last more than three weeks and is attracting wide interest.

N. E. L. A. AND ELECTRIC AUTOMOBILES.—In an address before the Denver N. E. L. A. Section, President Frueauff said that the National Electric Light Association is this year giving considerable attention to electric automobiles. He did not consider that central-station men have been as alive to the possibilities along this line as they should be, that automobiles present a great opportunity for the improvement of the load factor, and as city streets are getting better the possibilities throughout the country are greatly improving. He believes that the larger cities will eventually legislate against the gasoline machine on the grounds that in crowded thoroughfares the stench from them is often a serious nuisance and particularly when it is known that the electric automobile will do the same work at a less cost.

DANGER IN ELECTRIC FIRE EXTINGUISHERS.—Considerable attention has been directed to what is known as the "dry shampoo case" in the London courts in which the manager and female assistant of a massage parlor are held for manslaughter because of the death of a woman after a dry shampoo. It appears that tetrachloride of carbon is the chief ingredient of the dry shampoo lotions, and Dr. Chaldicott, anesthetist of St. Mary's Hospital, testified that the fumes, according to the strength of the lotion, may cause fainting, giddiness and even death. Tetrachloride of carbon is inflammable and is a non-conductor of electricity. It is very volatile and heavier than air. Some of the best electric fire extinguishers are composed chiefly of tetrachloride of carbon, so that in applying the liquid the operator should be above the point of application or, being mindful of the poisonous quality of the fumes, should guard himself against them.

ST. PETERSBURG TRAMWAY ELECTRIFICATION.—The municipality of St. Petersburg, Russia, has elaborated a measure to electrify the remaining horse-car lines of that city, at a cost of $11,000,000, as against a cost of $9,400,000 for the lines previously electrified.

DR. STEINMETZ TO LECTURE IN CHICAGO.—At a joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers, to be held at the rooms of the latter in Chicago, probably on Nov. 19, there will be an address by Dr. C. P. Steinmetz, of Schenectady, on a subject which has not yet been announced.

VALUES OF PUBLIC-UTILITY CORPORATIONS IN VIRGINIA.—The corporation commission report of values of public utilities up to June 30, 1909, for taxation for the current year, shows that telephone and telegraph companies occupy fifth place in the list, being valued at $2,617,000, while electric railways hold fourth place, with a total valuation of $8,643,000. The State tax on these items will amount to over $100,000.

INVENTORS' LEAGUE.—The Inventors' League, recently organized, held a meeting in Washington, D. C., Oct. 21, and decided to establish a monthly paper to be known as the *Inventors' Guide*. At the meeting the following officers were elected: First vice-president, Mr. George W. Bartlett, of Seattle, Wash.; second vice-president, Mr. O. H. Delmarton, Tampa, Fla.; treasurer, Mr. J. R. Kelley, Washington; financial secretary, Mr. C. C. Phillips, Washington.

ELECTRICAL EQUIPMENT OF THE NEW CORT THEATER, CHICAGO.—The new Cort Theater, at 76-82 Dearborn Street, Chicago, a rather small but attractive playhouse, was opened with its first attraction on Oct. 25. The electrical equipment of this cozy theatrical "bandbox" consists of 1500 16-cp lights, with the addition of 150 16-cp equivalents in electric signs. There are also four flaming arcs and 30 hp in motors, besides 24 50-amp charging plugs. The Commonwealth Edison Company supplies the electricity.

EXAMINATION FOR GEOLOGICAL SURVEY ELECTRICAL ENGINEER.—The United States Civil Service Commission will hold an examination Nov. 23-24 to secure eligibles from which to make certification to fill a vacancy in the position of junior electrical engineer in the technologic branch of the Geological Survey at a salary ranging from $960 to $1,200 per year, and vacancies as they may occur requiring similar qualifications. A list of the places at which examinations will be held may be obtained from the Washington office of the commission.

HIGH CONCRETE DAM.—The concrete dam, 178 ft. in height and 750 ft. long, which the Central Colorado Power Company is building on Middle Boulder Creek, is being erected at the rate of 600 cu. yd. daily, and will serve for storing the flood waters next spring. The concrete gravity pipe which leads from the dam to the forebay, where the water drops 1860 ft. to the power house, has been completed and most of it is in place. The power house near Boulder has been inclosed and most of the heavy equipment is in place. It is expected that it will be in operation during next summer.

TELEPHONE TRAIN DISPATCHING ON THE ROCK ISLAND.—As revealed by the recent annual report of the Chicago, Rock Island & Pacific Railway Company, the telephone system of train dispatching has been installed on 419.5 miles of the lines of that company on June 30, 1909. This installation of telephones for transmitting train orders has cost the company $33,214. Authority has been given for the equipment of 181 miles additional, and work is in progress for this extension of equipment, for which material has been purchased.

ELECTRICAL DEVELOPMENT IN URUGUAY.—Consul F. W. Goding, of Montevideo, reports that a French syndicate has made an offer to establish electric power houses to supply light and power to the inland towns of Uruguay. It binds itself to furnish apparatus, light and energy to the State as well as to the citizens at a price at least equal to the lowest price now paid in any of the towns. The concession is asked for 25 years, after which time the power houses, kept in perfect condition, will become the property of the State. The sum to be employed in the first installation, in the 18 towns not now provided with plants, will be $517,000, and the work will be completed within 18 months after the concession has been granted.

ILLINOIS STATE CONVENTION.—As this issue goes to press, the annual convention of the Illinois State Electric Association is being held at the Illini Hotel in Alton, Ill., the dates being Oct. 26, 27 and 28. A good program was prepared for this convention, including papers with the following titles: "Lighting Rates in Small Towns," Mr. W. J. Whetzel, Eureka; "Lighting Rates in Larger Towns," Mr. M. J. Linn, Bloomington; "The Relation of the Electric Vehicle to the Central Station," Mr. H. W. Dickerman, Rockford; "Gasoline Lighting," Mr. David Davis, Litchfield; "Power," Mr. F. H. Golding, Rockford; "Advantages of the Tungsten Lamp,' 'Mr. John G. Learned, Chicago. In addition there are various entertainment features and inspection trips.

TELEPHONES HERE AND ABROAD.—A correspondent of *The London Times,* in a comparison between the use of telephones in Europe and the United States, points out that in Europe, with a population of 400,000,000, only 2,300,000 instruments were in service on Jan. 1, this year, whereas in this country, where the population is not far from 85,000,000, nearly 7,000,000 telephones were employed on that date. England has a somewhat smaller number than three American cities combined—New York (334,186), Chicago (184,922) and Boston (more than 100,000). France makes a far less favorable showing (194,159), and Austria is credited with only 80,975. Italy, Belgium and Hungary are each said to have fewer telephones than St. Louis, Pittsburgh or San Francisco.

ANNUAL BANQUET OF CHICAGO BRANCH, N. E. L. A.—The annual banquet of the Commonwealth Edison Branch of the National Electric Light Association will be held at the Lexington Hotel, Michigan Avenue and Twenty-second Street, Chicago, on Thursday evening, Oct. 28. It is expected that about 300 members and guests will be present, and Mr Frank W. Frueauff, of New York, president of the association, and Mr. Samuel Insull, former president, are to be the principal speakers. Mr. George H. Jones, president of the local branch, will preside at the dinner, and will turn the direction of affairs over to Mr. Louis A. Ferguson, another former president of the association, who will act as toastmaster. Mr John W. Ferguson is chairman of the entertainment committee

STREET-RAILWAY REHABILITATION IN CHICAGO.—For the first 9½ months of 1909, up to Oct. 15, the Chicago Railways Company reports that it has laid 99 miles of single track railway on the streets of Chicago, making a total of 170 miles completed since the work of rehabilitation was begun. All the rails used in the new construction weigh 129 lb. to the yard, and there has been much special work, including curves and crossings. The new track does not constitute all the work that has been done, for several new buildings have been erected, including car houses, machine shops and offices. Mr. John M. Roach, president of the company, predicts that by the end of the year the construction operations of the company needed to comply with the ordinance will be finished. The company has had between 2500 and 3000 men at work on this new construction during the year

IOWA COURT ON TELEPHONE MERGERS.—Judge McHenry on Oct. 20 denied at Des Moines, Iowa, an injunction asked by minority stockholders in the Mutual Telephone Company, stopping the Iowa Telephone Company, the Bell concern, from absorbing the mutual or independent line. The courts held that such a merger is not against public policy.

WATER-POWER INVESTIGATION IN JAPAN.—The next national budget of Japan, while containing measures for the reduction of taxes and greater economy in administration, nevertheless includes provision for several commercial projects of magnitude. One of these is the creation of a fund to be used in the investigation of water-powers in Japan which may be electrically utilized for industrial purposes.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS.—A regular monthly meeting of the Society of Wireless Telegraph Engineers was held in Boston on Monday evening, Oct. 11, at which Mr. John Stone Stone read a paper on "The Singing Arc and Its Application to Wireless Telephony." The paper consisted in part of an historical résumé of the development of the "singing arc" along lines which adapted it for use in wireless telephony. An explanation of the theory of the arc, illustrated by numerous diagrams and oscillograph curves, concluded the paper.

OZONE FOR NEW YORK SUBWAY AIR.—In a letter to the New York *Times,* Mr. John T. Morrow advocates the use of ozone generators on the cars of the New York subway in order to render the underground atmosphere more endurable. He suggests that several ozone generators of a small type that is now available be placed in each car of subway trains and connected to the electric lighting circuit. By this means not only would a large portion of germ life be destroyed by the ozone, but owing to the large amount of oxygen which the air would then carry a person would leave the subway with a feeling of exhilaration rather than depression.

INDEPENDENT TELEPHONE RATES INCREASED IN ROCHESTER.—The Rochester (N. Y.) Telephone Company (Independent) has been given authority to increase its rates by the Common Council of that city. Hereafter the authorized rate for unlimited business service will be $60 a year instead of $48. By the new schedule a rate of $48 a year is fixed for two-party service, and probably many small merchants will choose this rate instead of paying the higher price for unlimited service. Rochester has always been remarkably "Independent" in telephone matters, and during the numerous public hearings before the Aldermen, when the rates were under discussion, there appeared to be a strong public sentiment in favor of continued competition in the telephone business.

RADIO-TELEGRAPHY AND TYPE-SETTING.—A Norwegian naval officer, Captain Hovland, has invented a system of secret type-printing for radio-telegraphy, and lately gave a demonstration of it in Melsomvik, Norway, to the local authorities and pressmen. "Wireless" telegrams were exchanged between a station erected by the inventor and a station at Tjömö, belonging to the Norwegian navy, over a distance of 20 km. The characters are transmitted by means of a keyboard similar to that used on an ordinary type-writing machine. On reaching the receiving station the telegram may be received at will in secret or in ordinary type. Captain Hovland has had considerable aid from the naval authorities of Norway, at whose disposition he has placed the results of his work.

SMOKING CARS ON CHICAGO ELEVATED RAILWAYS.—In Chicago every train operated on each of the four elevated railways has one smoking car, but Mr. Clarence A. Knight, president of the Chicago & Oak Park Elevated Railroad Company, has announced that smoking cars will be abolished on that road. This decision is partly due to the fact that it is proposed to adopt a multiple-unit system of train operation which, owing to local conditions, will make it inconvenient to have smoking cars on all trains. Nevertheless, Mr. Knight thinks that after the plan is tried it will please the patrons of the road, although perhaps there will be some slight loss of patronage at first. Other elevated-railway presidents in Chicago are skeptical as to the success of the plan, or else are perfectly willing to wait and see it tried out on the Oak Park line first. There are no smoking cars on the surface lines, but smoking is allowed on the front platforms of cars. One reason why smoking cars are favored is that it gives a place for workingmen in their rough and soiled garments to ride with the consciousness that they are not giving offense to women passengers.

THIRTY-FIVE-YEAR-OLD EDISON PATENT CASE ADJUDICATED.—A decision was rendered in the United States District Court a few days ago in an Edison patent case which dates back to 1874, and which in its earliest days was a *cause célèbre.* The patent was on the quadruplex telegraph, and a remarkable complication arose through the claim of two parties that each had purchased the patent from Edison, one representing the Western Union Telegraph Company, and the other representing the Atlantic & Pacific Telegraph Company, then controlled by Jay Gould. One Harrington claimed an interest in the rights transferred to Gould, who turned the patent over to the Atlantic & Pacific Telegraph Company. The pooling arrangement between the latter company and the Western Union, giving Jay Gould control of the Western Union, followed the transfer of the patent, which in December, 1874, was said to be worth $4,000,000. After long proceedings a special master appointed in the case found it worth only $1,622,760 at the same period. The present action was brought against the Atlantic & Pacific Telegraph Company and the executors of the late Jay Gould by Harrington and others for a reargument of the motion to confirm the special master's report. In denying the application Judge Hough stated that the complainants had failed to show any damages or profits to the company by the use of the patent, and that a rise in stock values, which was one of the showings made in the bill, could not be said to show an increased value of the patent.

FUN WITH WELSBACH ELECTRIC LAMPS.—Our London contemporary, ***Electrical Industries,*** refers to the entertainment incidentally afforded by the British Welsbach Company's offer to replace carbon-filament lamps with Welsbach tungsten-filament lamps, and take its return on the difference in quarterly bills. "The story goes that a Scotchman of the name of Mosenstein, or something similar, read the Welsbach Company's offer in his copy of the ***Sunday Companion.*** He closed one eye and opened it again, having in the interval come to a decision. He then rang up the manager of his vast warehouse in the city, and asked him what lamps were being used in it. The answer was that the lamps were metal-filament lamps, but not of the tungsten breed. MacMosenstein gave orders that the original carbon lamps were to be replaced at once. When that was done, he sent for the Welsbach Company, and said 'Hoot awa',' or words to that effect. Other reports come along which lift the lid off frightful conspiracies between contractors and their clients. When a consumer rings up his contractor and asks whether this offer should be accepted, the contractor, feeling that he need not consider the feelings of an ironmonger dealing in Welsbach lamps, or an ironmonger's friend, pays a special visit to his client, and advises him to accept the offer at once. He goes on to point out that the essence of the contract, from the consumer's point of view, is to leave the lamps on all night. If this is done on a sufficiently lavish scale, the subsequent bills will be larger than the old carbon lamp bills, and the Welsbach Company will have to be paid a negative sum of money."

Hydroelectric Development of the Uncas Power Company at Scotland, Conn.

THE Uncas Power Company, which transmits electrical energy to Norwich, Willimantic and Stafford Springs, Conn., has a rather interesting hydroelectric development on the Shetucket River at Scotland, Conn., a hamlet seven miles south of Willimantic. The station erected at this point is capable of developing about 1200 kw, the greater part of which is transmitted to Norwich, 11 miles away, at a tension of 22,000 volts. Here a substation is operated in conjunction with the municipal electric light plant and the energy is distributed at 2200 volts, two-phase, to the city circuits. The existing municipal steam station at Norwich is used as an auxiliary to the hydroelectric station at Scotland, the Uncas Power Company selling energy to the city of Norwich at the rate of 1.1 cent per kw-hour. The Willimantic Gas & Electric Company, which will maintain its own line and transformer station, will receive energy at the rate of 1 cent per kw-hour on a basic consumption of 1,000,000 kw-hours per annum; the energy being metered on the high-tension side of the transformers.

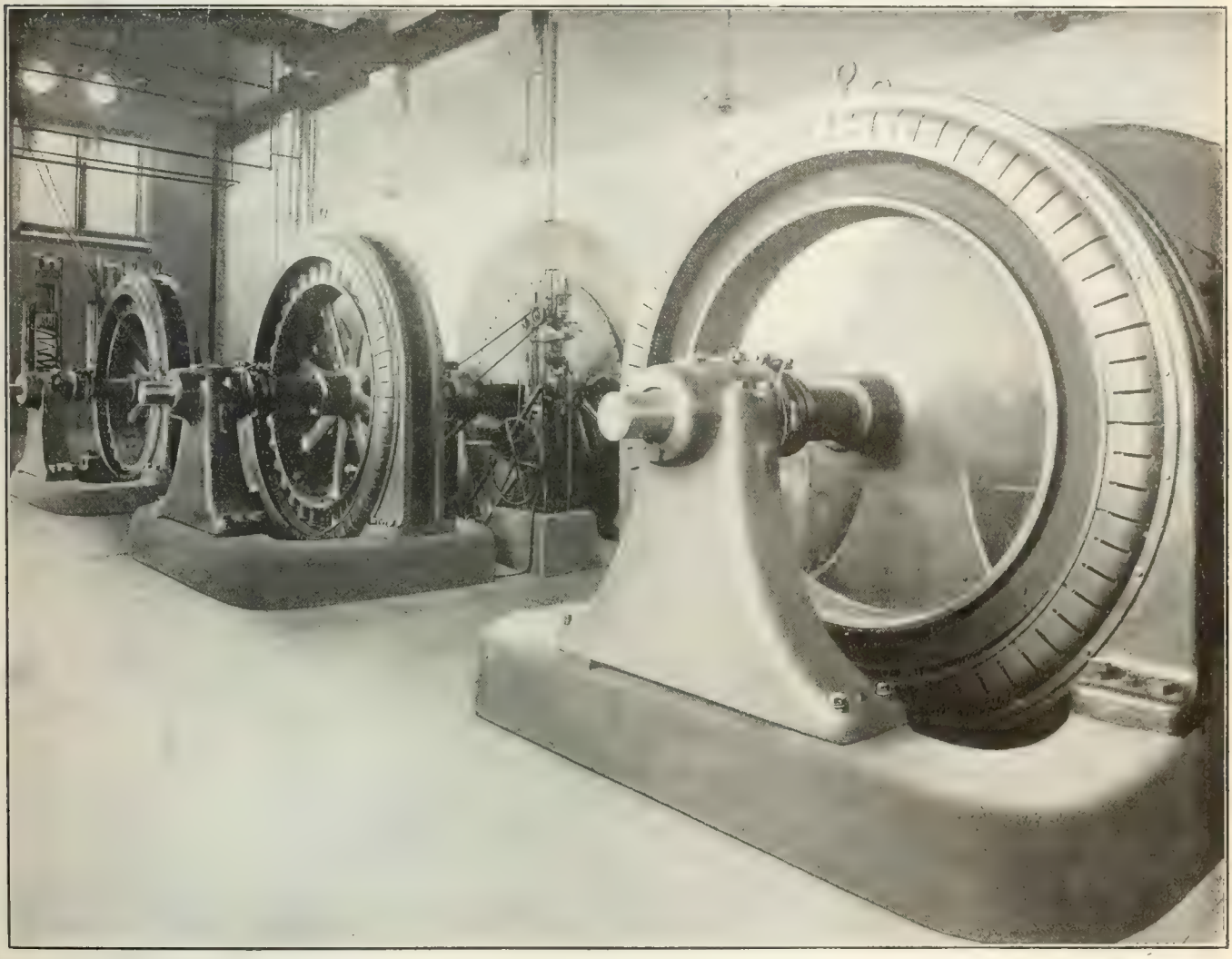


FIG. 1.—GENERAL VIEW OF HYDROELECTRIC STATION OF UNCAS POWER COMPANY.

An operating head of 25 ft. is obtained at the generating station by means of a concrete dam located at a narrow point in the river valley. The total length of this structure and the power house which adjoins it on the east is 470 ft. Its height above foundations is 36 ft. and about 27 ft. above the bed of the stream. The dam is made up of a number of different sections. The spillway section next the power house is of solid concrete; adjoining this is a hollow reinforced concrete dam, followed by a section containing five Tainter gates, and beyond this is an earth embankment with a reinforced concrete core wall. The original plans called for a solid concrete structure across the river; but a bottom of large gravel and small boulders was encountered after the first section was built on solid ledge, and the method of construction had to be modified radically in order to meet the changed conditions. The spillway adopted was of hollow reinforced concrete with a 60-ft. base, licensed under the Amburson Hydraulic Construction Company's patents. Tainter gates, quite common in the West but not so in the East, were also added to the design, and an earth embankment with a reinforced concrete core wall substituted instead of a concrete dam on the west bank. The length of the various sections, not counting in the widths of the piers between them, is as follows: Earth embankment, with reinforced concrete core wall, 170 ft.; Tainter gate section, 116 ft.; hollow reinforced concrete rollway, 80 ft.; solid concrete rollway, 20 ft.; power house, 70 ft.

A cut-off wall of sheet piling was driven beneath all the structures across the stream, with the exception of the power house and solid concrete spillway, which rested on the rock ledge on the east bank. For the core wall of the earth embankment on the west, 6-in. x 8-in. splined-timber sheeting was used. For the remainder of the distance across the stream, Wemlinger corrugated sheet steel piling was employed. Both the latter and the timber sheeting had a minimum length of 18 ft. below the bottom of the foundation at the point where driven. Two thicknesses of steel piling were used, according to the difficulty of the ground, ¼-in. material being used wherever the 3/16-in. sheeting was not strong enough to withstand the drive from a steam-hammer. A single row of timber

sheeting was used under the core wall of the earth embankment, and two lines under the Tainter gate and hollow reinforced concrete rollway sections, one line being placed under the upstream and the other under the downstream.

The core wall of the earth embankment is 12 in. thick for its entire length, and ⅜-in. twisted-steel bars were placed vertically on 15-in. centers, and horizontally on 4-ft. centers, with alternate horizontal bars in the upstream and downstream faces for reinforcement. Sand, gravel and loam taken from the foundation excavation and from pits on the west bank were used in making the earth embankment. Outward from the earth embankment, and separated from it by a retaining wall with wing walls, is a section 116 ft. across in the clear, containing five Tainter gates, which are utilized for getting rid of the flood flow of the river quickly. Each of the gates is 20 ft. wide and 13 ft. high; the face of the gate being on the circumference of a circle with a 14-ft. radius. The face is made of ¼-in. steel plates lap-riveted together, supported by radial arms and struts trussed to provide the requisite strength, and carried by steel pins at the center of the 14-ft. circle; the pins being bedded in the concrete piers. The latter are 4-ft. thick between adjacent gates, and are carried down from the walkway above the gates to the foundations, and backward to the downstream edge of the section; each gate being placed in a compartment by itself. In discharging water from the pond above the dam, the gates are raised from their seats, permitting the water to flow into a tumble bay. Two traveling crabs are employed in raising the gates. These travel on 15-in. 42 lb. I-beams spaced 2 ft. 5½ in. apart, and may be operated manually or by means of 3-hp motors fed from the exciter circuits. Two ¾-in. chains are attached near the lower edge of the gates 5 ft. each side of the center, and these pass over grooved-chain drums geared for manual or motor drive on the crab carriages. In the manipulation of the Tainter gates the operators are instructed to make certain that the track is clear, and that the hoists are ready to be moved from one gate to another. In winter, especially, ice must be kept from forming on the upstream side of the gate, a long rod being used to break the ice forming next to the steel shell. If water has been spilling over the top of the gate the ice between the concrete pier and the steel arms of the gate must be broken up, if any exists. The gate must always be raised slightly by hand before the motor is connected into circuit, so that there can be no doubt as to its freedom to move; a single lever being used for this purpose. When it is necessary to operate the gates manually, a hand wheel is employed, rather than the single lever, and in cold weather heated oil is applied to the worm occasionally when operating the hoist, so as to insure smoothness of action and to reduce friction. When not in use the handwheels are protected from the weather, but must be ready at all times to be slipped on the operating shaft of the hoist so that manual operation can be employed if necessary. After the lifting motor has been started the dogs are disengaged from the chains, and when the gates are raised to the point desired the dogs are slipped into the chains and the gate lowered until the entire strain is taken from the hoist of the motor and carried by the dogs. This releases the traveling crab so that it may be moved to a new position on short notice.

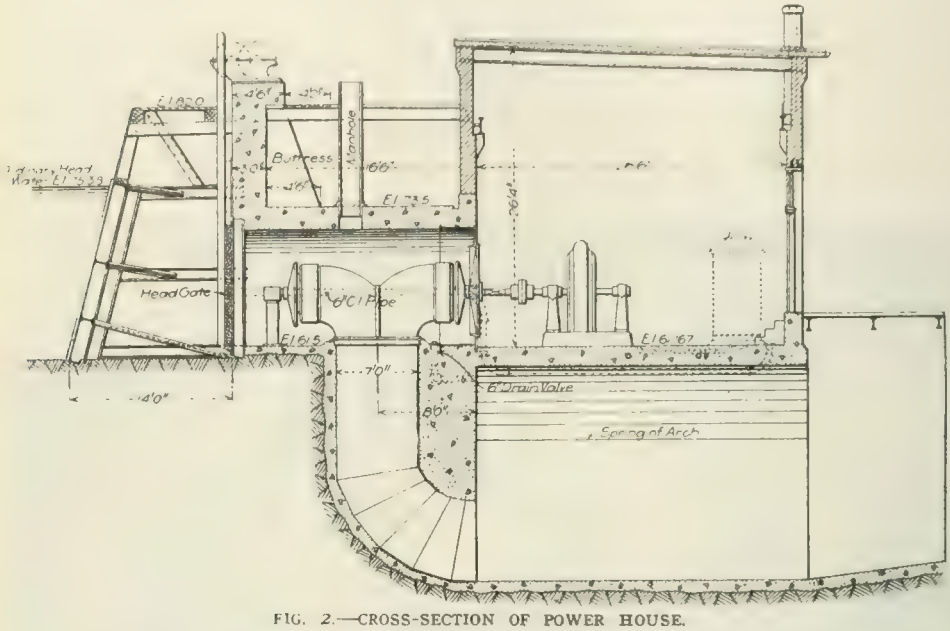


FIG. 2.—CROSS-SECTION OF POWER HOUSE.

The gates are made watertight by bolting 4-in. x 9-in. timber on the lower edge, which seats on a 2-in. x 8-in. timber bolted into a 9-in. channel imbedded in the concrete, with the legs upward. The sides between the steel gate and the piers are made watertight by means of flat-rubber strips fastened to the gates, and in order that these may not be worn out quickly and as a preventive against being caught in the rough concrete work, sheet metal was placed in the forms along the arc traced by the gate in opening and closing.

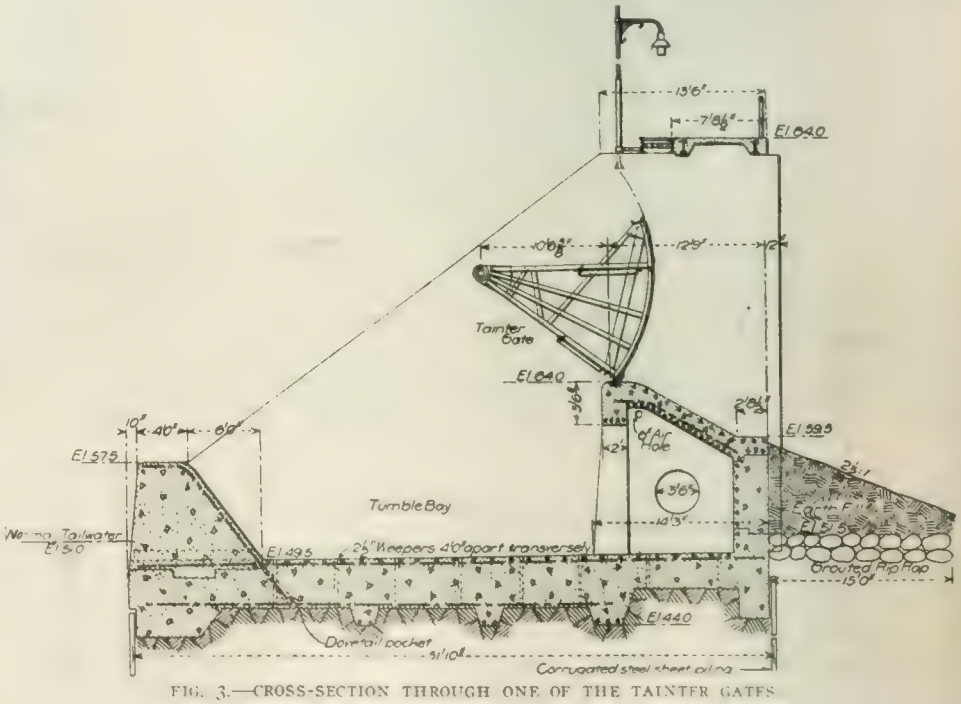


FIG. 3.—CROSS-SECTION THROUGH ONE OF THE TAINTER GATES.

In order to relieve any pressure of ground water beneath the section, 2½-in. tile weepers are placed vertically and extend through the concrete of the tumble bay floor. Any water coming up through the weepers must, of necessity, seep at least 18 ft. below the bottom point of the concrete foundation around the lower ends of the sheet piling. The seepage is discharged

from the tumble bay of each gate through five 10-in. circular weepers cast into the weir at the lower end of the tumble bay. The length of the foundation of the Tainter-gate section parallel to the flow of the stream is 51 ft., and cut-off walls of concrete are placed at the upstream and downstream edges, and at three intermediate points running transversely to the direction of the flow of the stream. Beneath the weepers at the lower end of the tumble bays is a reinforced concrete apron, and below this is a protection of reinforced concrete "book slabs" extending 70 ft. farther. Below the book slabs is the final protection against downstream erosion, consisting of riprap 3 ft. thick, extending for a distance of 30 ft.

A bridge on the Tainter-gate section is supported by 12-in. 13½-lb. I-beams covered by concrete with a reinforced expanded metal floor. Wrought-iron pipe railing runs along the upstream edge of the wall, while posts along the crab tracks are used as standards for lamps for night operation of the gates and for carrying the two conductors to which the leads of the hoist motors may be hooked.

The hollow reinforced concrete spillway section has a base 61½ ft. long. Its length is 80 ft. and its crest rises about 36 ft. above the lower point of the concrete cut-off wall in the foundation. The foundation on which this portion of the dam rests is of very compact gravel, and the floor is provided with concrete cut-off walls at the upstream and downstream edges and at four intermediate points. The concrete cut-off walls are cast around the tops of the rows of sheet-steel piling. The buttresses on the interior of the dam are spaced on 10-ft. centers, and are reinforced at suitable intervals with concrete struts. The buttress walls vary in thickness from 18 in. at the bottom to 12 in. at the top, and the struts are 12 in. x 15 in. The sloped upstream deck is 1 ft. 8 in. thick at the lower edge and 1 ft. 6 in. thick at the top. The sloped downstream apron is 1 ft. 8 in. thick. Ground-water pressure from below is prevented by tile weeper holes similar to those placed in the floor of the tumble bays, and any water coming through them is drained from the interior of the dam by 10-in. weeper holes between each two buttresses. Just below the crest of the dam a 3-in. vent hole is left in each panel so as to prevent a vacuum beneath the falling water. A walkway is provided through this



FIG. 4.—VIEW OF DOWNSTREAM SIDE OF DAM AND SPILLWAY.

section of the dam 5 ft. wide. Downstream from the reinforced concrete hollow dam is a concrete apron extending for a distance of 24 ft., and then riprap 3½ ft. thick as far as the riprap on the Tainter-gate section. The solid rollway section has a base of 35 ft., and rises 22 ft. above the rock ledge in the river bed.

The forebay was blasted out of solid rock, and is protected from floating logs and ice by a boom attached to the nose of the pier between the hollow dam and the solid concrete portion, so that all floating material will be discharged over the hollow concrete dam. A similar log boom is placed on the other bank, and terminates at the end of the hollow dam, thus affording protection to the earth embankment and to the Tainter-gate section.

The Tainter gates may be employed to hold the water



FIG. 5.—SIDE VIEW OF DAM SHOWING MOTOR HOISTS FOR GATES

in the pond at a steady height, and in winter they may be manipulated to allow the water to pass out and to keep the ice back of the dam should there be any tendency of the ice to pack in the river below, and for this reason to back up water in the tailrace and thus reduce the available head. Provision has been made for a footway across the river, there being bridges over the Tainter gate and the solid concrete dam sections, and a walkway through the hollow reinforced concrete section. The latter is reached through manholes built into the piers between the hollow section and the Tainter gates on one side, and the hollow section and the dam on the other side.

The power house is 70 ft. long and 29 ft. 2 in. wide over all, and is built adjoining the solid concrete rollway section. The racks and penstocks are outside of the walls of the building, the racks being placed on a line with the upstream edge of the dam. These are made of 3-in. x ¼-in. bars placed 1¼ in. on centers, and supported by very heavy I-beam struts and knee braces. The latter have been designed to withstand the worst possible conditions—that is, when the rack bars are completely closed with ice, and bear a full head of water. The trash is removed from the racks from above, where a walkway is provided. The penstocks are of concrete 12 ft. wide, with vertical walls rising 8 ft., topped by an arch with a 2-ft. rise. The penstock for the exciter units is 5 ft. wide and 5 ft. high. These penstocks are built horizontally, and the waterwheels set inside of them and directly above the draft tubes. The latter are 7 ft. in diameter, and flare to an elliptical shape into the tailrace. The floor of the penstock is a few feet

above the level of the power-house floor, the penstock being separated from the power house by a cast-iron diaphragm, which also carries the main bearing between the generator and the waterwheels. Each penstock can be cut off from the forebay by means of heavy timber gates operated by hand from a bridge at the power-house roof level. When the penstock has been cut off by dropping the gate, it can be drained through a duct closed with a plug valve. Each penstock can be entered from the bridge above through a manhole made of boiler plate. The downstream arches, into which the draft tubes discharge, support the power house, and for the main units are 15 ft. wide and 18½ ft. high, and for the exciter unit 5 ft. wide and 14½ ft. high.

The three main units are 33-in. wicket gate waterwheels mounted two on one shaft, and manufactured by the S. Morgan Smith Company, of York, Pa. Each set is rated at 650 hp and direct-connected to a 400-kw, 2300-volt, 60-cycle alternator, manufactured by the General Electric Company. The exciter unit consists of one pair of 12-in. wicket gate wheels, direct-connected to a 40-kw, 125-volt generator. An additional exciter unit of the same rating is driven by a 60-hp induction

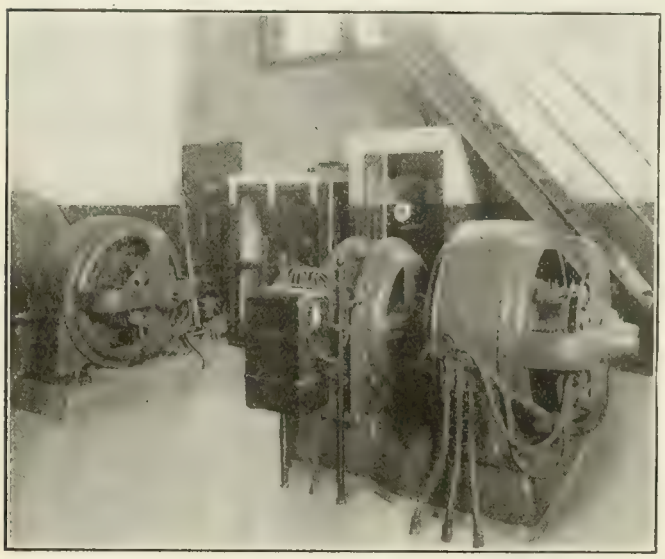


FIG. 6.—TURBINE- AND MOTOR-DRIVEN EXCITER SETS.

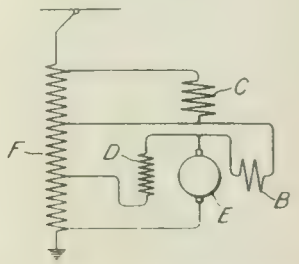
motor, equipped with a starting compensator. Lombard waterwheel governors are used on the main units, and a Woodward governor on the exciter unit. The governor of the main wheels may be controlled from the switchboard. A 5-ton hand-operated traveling crane extends over the entire operating room.

The output from the generators is transmitted through three 400-kw, 60-cycle, oil-insulated, water-cooled General Electric transformers, at a tension of 22,000 volts, to Norwich. The cooling water for the transformers is taken from the forebay, but in case of an emergency may be supplied by a Morris centrifugal pump belted to a 2-hp motor, which also drives a compressor for furnishing compressed air for cleaning purposes. A General Electric spark-gap, lightning arrester equipment is installed on the outgoing lines, and a similar equipment is installed in the substation at Norwich. The generator and transmission circuits are controlled from a six-panel switchboard. The generator panels have hand-operated oil switches, and electric push-button controllers for the motors on the waterwheel governors. A Tirrill regulator forms part of the switchboard equipment, which in other respects follows standard practice.

A single three-phase, 22,000-volt line, consisting of No. 4 hard-drawn copper wire on porcelain insulators, is carried on 40-ft. wooden poles. The line follows the Shetucket River to a point above Baltic, and then crosses the hills and open country to Norwich. Except for a small portion of the line on the highways, the circuits are carried over private right-of-way. At Norwich the tension is stepped-down from 22,000 volts to 2300 volts, and the current changed from three-phase to two-phase by means of two banks of transformers. The switchboard at the station comprises four panels, two for controlling incoming lines and two for outgoing lines. The municipal plant, in one corner of which the substation is erected, contains 1000 kw of 2300-volt, two-phase, alternating-current machinery, and a 100-kw rotary converter set, giving 550-volt, direct current for operating motors in the various city buildings. The hydraulic engineering features of the Uncas Power Company's plant were designed by Mr. William G. Fargo, Jackson, Mich., and the contractors were Messrs. Tucker & Vinton, of New York City. The work was originally started in March, 1907, and resumed again in April, 1908, the plant beginning operations a few months ago. The officers of the company are: President, Mr. C. W. Comstock; secretary, Mr. J. D. Hall; treasurer, Mr. Z. R. Robins; and Mr. M. S. Caldwell is the superintendent of the station.

Single-Phase Commutator Motor.

A patent issued on Oct. 5 to Mr. E. F. W. Alexanderson relates to constructive features of the "series-repulsion" motor with which this inventor's name has been associated. The machine starts from rest as a repulsion motor with its armature short-circuited; but for high-speed operation the exciting winding on the stator is connected in the armature circuit and a shunt voltage is impressed on the armature and exciting winding in series, and a second shunt voltage is impressed on the exciting winding alone through a reactance. The arrangement is shown in the accompanying diagram. The purpose of impressing the shunt voltage on the armature circuit *E* is to reduce the strength of the inducing field, which field is beneficial at low speeds as regards commutation, but has an excessive and injurious effect on commutation at high speeds. The object of including the exciting winding *B* in the armature circuit is to shift the armature current somewhat out of time-phase with the current in the inducing winding *C*, so as to produce a leakage field which, when cut by the armature coils short-circuited by the brushes in commutation, induces in those coils e.m.fs. neutralizing the e.m.f. of commutation reactance. The object of impressing the second shunt voltage on the field winding is to compensate for the drop in power factor produced by connecting the exciting winding in the armature circuit, instead of in circuit with the inducing winding, and the purpose of the reactive winding *D* in series with the second shunt voltage is to prevent this second shunt voltage from definitely fixing the amount and time-phase of the field flux and thereby making the motor essentially a shunt motor, as would be the case were the reactive coil omitted.



SINGLE-PHASE COMMUTATOR MOTOR.

The claims of the patent cover the scheme of placing the reactive winding *D* upon the stator core in such a position, and so connected, that it is non-inductively related to all other windings on the motor. It is placed in slots which would otherwise be occupied by the inducing winding *C*, alternate coils being reversed in connection so that there is a non-inductive relation between these two windings. The interconnections are such that the winding *D* produces twice as many magnetic poles as there are armature poles, and hence there is a non-inductive relation between the armature winding and winding *D*.

The Transmission of Electrical Energy in Southern California.

IN the distribution of electrical energy in Los Angeles three companies are interested, namely, the Los Angeles Gas & Electric Company, the Pacific Light & Power Company and the Southern California Edison Company. The first-named company obtains its energy exclusively from steam, while the other two depend largely on water for their source of supply. Thus the transmission of electrical energy to Los Angeles, and also throughout a large part of southern California, is controlled by the Pacific Light & Power Company and the Southern California Edison Company. The present article gives an outline of the generating apparatus and transmission systems of these two companies.

THE PACIFIC LIGHT & POWER COMPANY.

The Pacific Light & Power Company owns and controls five hydroelectric and three steam generating stations. The principal hydroelectric station is located at Borel, Kern County,

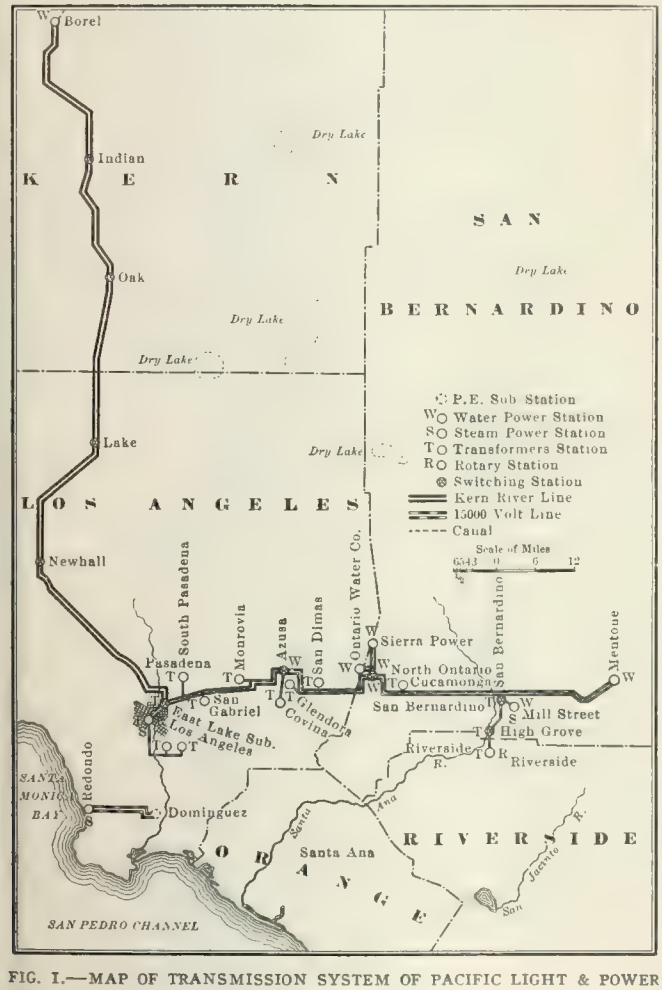


FIG. 1.—MAP OF TRANSMISSION SYSTEM OF PACIFIC LIGHT & POWER COMPANY.

Cal., its energy being derived from the Kern River. The station equipment consists of five 2000-kw, three-phase, 2200-volt, revolving-field generators directly connected to turbines operated under an effective head of 246 ft. The generators are operated on the unit system, the e.m.f. of each being raised to 66,000 volts through a bank of three 750-kw, General Electric, oil-insulated, water-cooled transformers. The energy generated at this station is transmitted to Los Angeles over two independent pole lines each equipped with three No. 3-0 copper wires. The distance between the generating station and the receiving station is 127 miles. As indicated on the map, shown in Fig. 1, four switching stations are installed on the line at Indian, Oak, Lake and Newhall, situated, respectively, 25, 44, 71 and 96 miles from the generating station. An idea of the arrangement of the switches and the change-overs that can be made by means of them will be gained from Fig. 2. The receiving station in Los Angeles is equipped with four transformer banks, each of which consists of three 750-kw, oil-insulated, water-cooled General Electric units designed to decrease the e.m.f. from 66,000 volts to 15,000 volts to feed into the company's high-voltage distributing circuits.

A single-unit hydroelectric plant operating at constant load is located at Mentone, Cal., on the Santa Ana River, about 65 miles east of Los Angeles. This plant contains one 1500-kw, 2200-volt, two-phase, 50-cycle Westinghouse generator directly connected to a Doble waterwheel operating under an effective head of 352 ft. The water is conveyed to the plant through a 36-in. wood-stave pipe line 3.5 miles in length. The load is kept constant on the machine, use being made of a deflecting nozzle in order not to disturb the flow of water, which is used for irrigation. The e.m.f. is raised to 17,500 volts by two water-cooled Stanley transformers T-connected to deliver three-phase energy.

A second station, deriving its energy from the Santa Ana River, is located at Riverside, about 55 miles from Los Angeles. It is equipped with two 300-kw General Electric, 11,000-volt, three-phase, 50-cycle generators directly connected to Stillwell-Bierce turbines operating under an effective head of 85 ft. The e.m.f. is raised to 17,500 volts by means of three 200-kw Stanley oil-insulated, water-cooled transformers.

The smallest hydroelectric station of the company is one equipped with two 300-kw Westinghouse, 50-cycle, 500-volt, two-phase generators directly connected to Pelton impulse waterwheels operating under a head of 590 ft. Two banks of Westinghouse oil-filled, water-cooled transformers serve for increasing the e.m.f. to 17,500 volts, three-phase.

A station at Azusa contains five 500-volt, two-phase, 50-

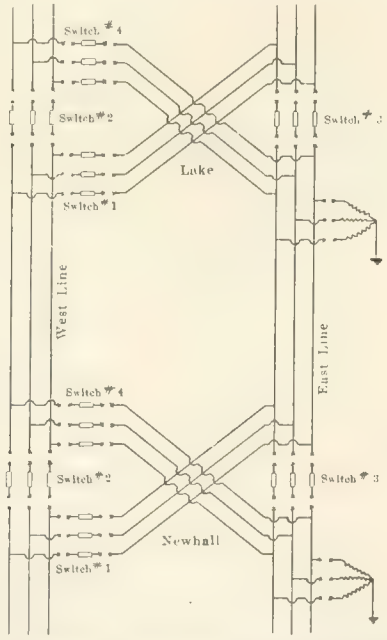


FIG. 2.—WIRING DIAGRAM OF SWITCH STATIONS.

cycle Westinghouse generators directly connected to Doble waterwheels operating under an effective head of 396 ft. Five banks of Westinghouse transformers increase the e.m.f. to 17,500 volts, three-phase.

In the Third Street steam station there are one 300-kw Westinghouse, 2400-volt, two-phase, 60-cycle generator belted to a Hamilton-Corliss non-condensing engine; one 750-kw, 2400-volt Westinghouse, two-phase generator directly connected to a cross-compound McIntosh & Seymour condensing engine, and one 1500-Bullock generator of the same type directly connected to a similar engine. These generators supply energy to the high-tension distributing system through three banks of Westinghouse transformers, each consisting of two 625-kw units

arranged for converting to 15,000 volts, three-phase. This station is used for relay purposes, the above-mentioned transformers acting as step-down units whenever the steam-generating station is not operating. This station also contains two 225-kw, one 250-kw and two 400-kw rotary converters.

A steam station at Sixth Street and Central Avenue, Los Angeles, is equipped with three Bullock and two Stanley 1500-kw, 50-cycle, 2300-volt generators, four of which are directly connected to McIntosh & Seymour cross-compound condensing engines, the fifth being directly connected to a Nordburg cross-compound condensing engine. The station also contains one 1050-kw Westinghouse, 550-volt, direct-current generator directly connected to a McIntosh & Seymour cross-compound condensing engine.

The largest and most unique steam station is the one at Redondo, which contains three General Electric 5000-kw, 18,000-volt, 50-cycle, three-phase generators directly connected to McIntosh & Seymour vertical, cross-compound, condensing engines. The energy from this station is fed directly to the high-tension distributing system of the Los Angeles Railway Company and the Pacific Electric Railway Company. In these stations use is made of crude oil as fuel. A fully illustrated description of the Redondo station appeared in our issue for Sept. 12, 1908.

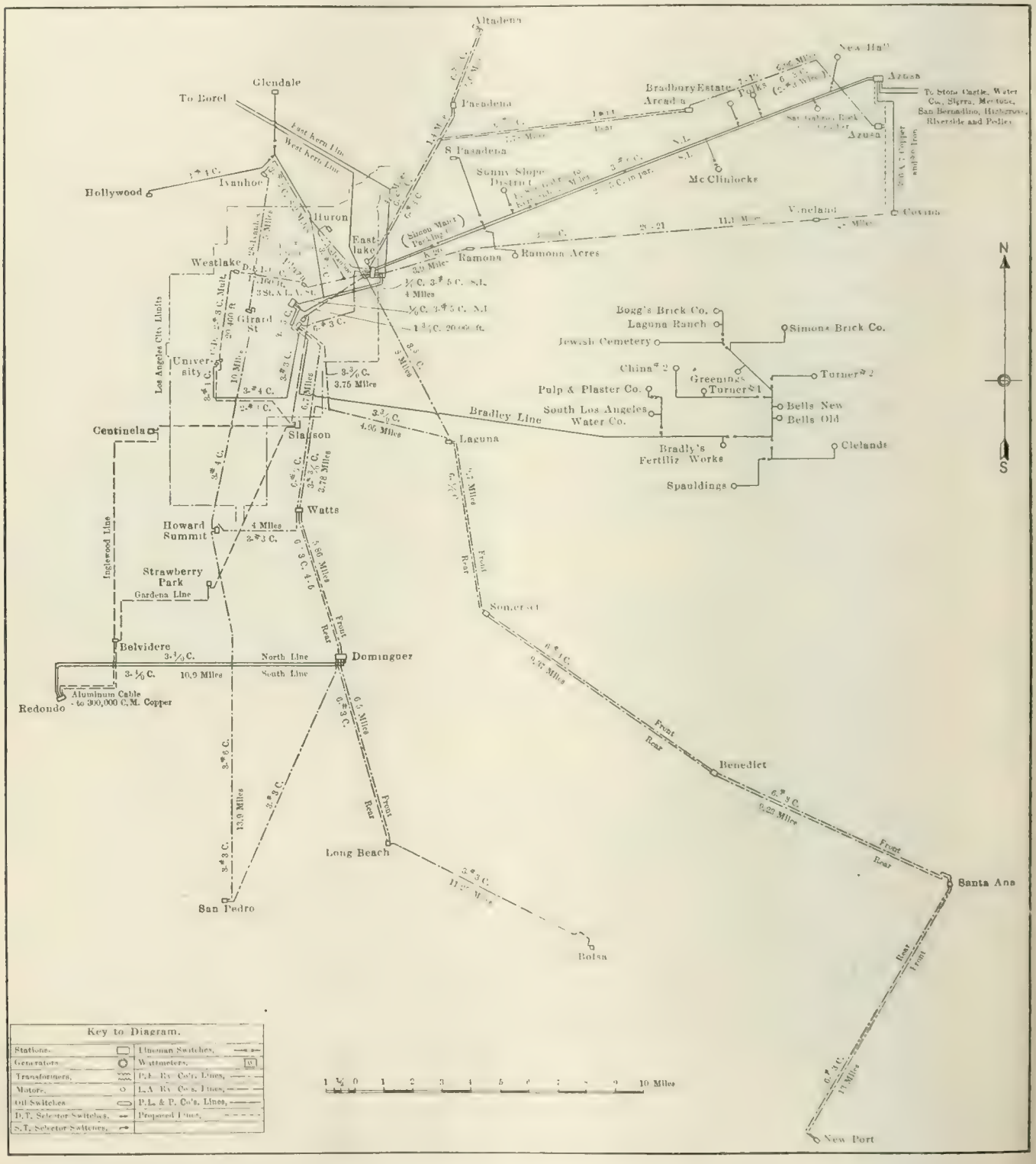


FIG. 3.—DIAGRAM OF 15,000-VOLT CONNECTIONS.

A diagram showing the 15,000-volt distributing circuits of the Pacific Light & Power Company is given in Fig. 3, which gives some indication of the nature of the load on the system. In addition to its very large railway load, the company supplies energy to a large number of industrial establishments and to many pumps for irrigation. Moreover, its commercial department furnishes electricity for lamps and motors in the towns of Riverside, San Bernardino, South Pasadena, Azusa, Alhambra, Covina, San Gabriel, Huntington Park, Glendora, Dolgeville, Corona, Hollywood, Arcadia and Los Angeles.

The president of the Pacific Light & Power Company is Mr. W. G. Kirchhoff, the general manager Mr. A. C. Balch, and the electrical engineer Mr. E. R. Davis.

SOUTHERN CALIFORNIA EDISON COMPANY

A transmission system of more than ordinary interest, on account of the large number of widely separated generating stations that are operated in parallel and by reason of the limitations imposed upon the hydraulic units and the unusual character of the load, is that of the Southern California Edison Company. This company owns seven hydraulic and four steam stations, the prime movers in which have a total rating of 55,500 hp. Although the distance between two of these stations reaches a value of almost 200 miles, all of the 11 stations are normally operated in parallel. An idea of the character of the load, which will be discussed more fully below, may be obtained from the statement that the distributing circuits extend from the summer mountain resorts to the winter resorts in the lowlands, and cover a territory where artificial irrigation has reached its highest development.

Fig. 4 is a map of the transmission and distributing systems, giving the size and voltage of the various circuits and showing the locations of the generating stations and substations. Beginning at the eastern side of the map, the Santa Ana River station No. 1 contains three Pelton and one Doble waterwheel operating under a head of 760 ft., each of which drives a 750-kw, three-phase, 50-cycle, General Electric generator wound for 750 volts. Four banks of transformers, three of which are of the air-blast type and one oil-cooled, serve for raising the e.m.f. to 33,000 volts. In the Santa Ana River plant No. 2 there are two Doble waterwheels, designed for a 305-ft. head, driving two 600-kw, General Electric, 750-volt, three-phase generators. Six 175-kw transformers of the air-blast type are used for increasing the e.m.f. to 33,000 volts. These two plants are situated along a stream all of the water of which is used for irrigation. It is necessary, therefore, so to operate the plants as not to interfere even momentarily with the flow of water. In order to obtain this result the waterwheels are provided with deflecting nozzles. However, the plants are operated continuously at such loads as will use all of the water to the best advantage. That is to say, the wheels are run without the governors, which come into play only in case of an excessive decrease in load on the system.

There are three separate hydroelectric developments on Mill Creek, although there are only two generating stations. Development No. 1 utilizes three Pelton wheels under a head of 510 ft. for driving 250-kw General Electric, three-phase alternators designed for 2500 volts. Two banks of Westinghouse water-cooled transformers raise the e.m.f. to the transmission value of 33,000 volts. The generating apparatus for developments Nos. 2 and 3 is placed in a common station building, although two different hydraulic heads are used. Three Doble wheels and one Pelton wheel utilize a fall of 1960 ft. Each of these wheels drives a 750-kw, 750-volt, three-phase alternator, while a fifth Pelton wheel operating at 630 ft. drives a 250-kw generator. The water in Mill Creek is used for irrigation, so that the same restrictions apply to this stream as to Santa Ana River. However, conditions are frequently such that certain of the wheels operate with governors for varying the load without altering the flow of the water.

As intimated above, and as will be noted from Fig. 4, the energy from the Santa Ana and the Mill Creek plants is transmitted at 33,000 volts. What may be called a secondary transmission e.m.f. or a primary distributing e.m.f. of 10,000 volts is

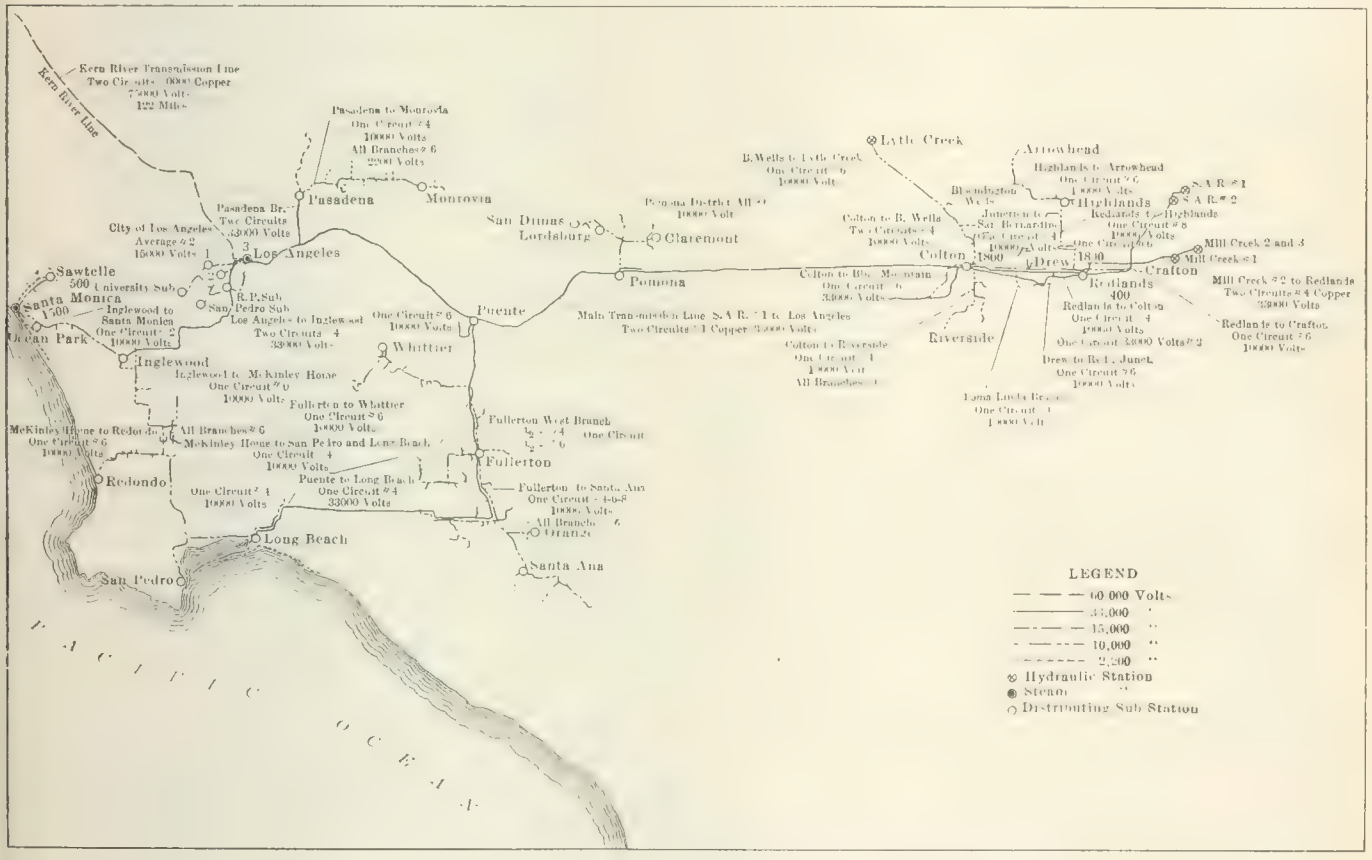


FIG. 4.—MAP OF TRANSMISSION SYSTEM OF THE SOUTHERN CALIFORNIA EDISON COMPANY.

used for conveying the energy from the various transformer substations located along the route of the 33,000-volt circuits. One of these substations, which is at Redlands, contains an 1890-kw transformer equipment for the local load and for supplying energy to resorts along the San Bernardino Mountain. A second transformer station is at Colton for supplying energy to the Riverside and San Bernardino neighborhood; it is equipped with 1800 kw in transformers. In the 10,000-volt circuits from the Colton transformer station energy is fed directly from two 250-kw, 10,000-volt generators driven by Pelton wheels receiving the water of Lytle Creek under a head of 483 ft. These machines are usually run at constant load. The Kern River plant was started successfully on Sept. 1.

Although at the present time the plant on the Kern River is out of service, on account of certain repairs and changes that are being made in the hydraulic tunnels, so that energy is now being transmitted toward rather than from Kern River, yet mention should be made of the normal conditions under which this plant operates. The plant consists of four pairs of Allis-Chalmers impulse waterwheels utilizing a head of 874 ft., each of which drives a 5000-kw, 50-cycle, three-phase alternator wound for 2300 volts. There are four banks of transformers for raising the e.m.f. to either 56,000 volts, 66,000 volts or 75,000 volts for transmitting energy 122 miles over a steel-tower line to Los Angeles. Under ordinary service conditions the wheels in the Kern River plant operate under complete control of the governors to carry the fluctuating portion of the load on the whole system.

For supplementing the hydroelectric generating equipment outlined above, as may be noted, and for use in emergencies, the company maintains four steam generating stations favorably located along its distributing circuits. The most important steam stations are at Los Angeles and Redlands, while smaller stations are in Santa Monica and Santa Barbara. The Los Angeles station contains two 2000-kw, 2300-volt, Curtis-General Electric steam-turbo units and one 6000-kw, 15,000-volt generator of the Westinghouse-Parsons type. Energy is transmitted from this station at 15,000 volts to five substations in the Los Angeles neighborhood, the substations being known as Los Angeles No. 1, Los Angeles No. 2, San Pedro, University and River Power, which are equipped for 1275 kw, 4250 kw, 525 kw, 1200 kw and 750 kw, respectively. The Los Angeles station contains not only the above-mentioned generating apparatus, but it is equipped with transformers for receiving energy at 56,000 volts, 66,000 volts or 75,000 volts from the Kern River plant and 33,000 volts from the Santa Ana, Mill Creek and Lytle Creek plants. Thus its transformer equipment acts as the connecting link between steam and hydroelectric stations rated at 10,000 kw and 29,610 kw, respectively. However, only a part of the power from the generating stations passes through the transformers, which have a total combined rating of only 26,700 kw in 21 units.

A single 450-kw, 2300-volt alternator comprises the generating equipment of the Redlands steam station. However, the station contains a transformer installation rated at 1890 kw for delivering or receiving energy at 10,000 volts and 33,000 volts. The Santa Monica steam-generating equipment is rated at 200 kw, but the transformer banks, of which there are two, have a combined rating of 1000 kw. The Santa Barbara station contains two 500-kw, 2200-volt alternators and two 500-volt generators, having a total rating of 500 kw.

In addition to the substations mentioned above, there are substations at the following places for receiving energy at 33,000 volts: Pomona, 750 kw; Puente, 450 kw; Fullerton, 2400 kw; Long Beach, 3000 kw; Pasadena, 2550 kw; Inglewood, 2400 kw.

An inspection of the above substation ratings and a study of Fig. 1 will show the geographical distribution of the load on the whole system. It will be noted that not far distant from the Santa Ana and Mill Creek and Lytle Creek stations, with their 9610 kw of generating equipment, there are substations at Redlands and Colton with transformer equipment of 3690 kw for distribution, while along the line to Los Angeles and its branches there are substations at Pomona, Puente, Fullerton, Long Beach and Pasadena, having 9100 kw in transformers. It would seem, therefore, that energy from the two plants along the Santa Ana River, the three plants along Mill Creek and the Lytle Creek plant is seldom transmitted to Los Angeles, but is used for various purposes along the route before reaching that city. Either the Kern River plant or the Los Angeles steam station is capable of supplying all of the power required at the substations in the Los Angeles district. However, when the plants are connected normally in parallel, the operation of the system as a whole is much more satisfactory and reliable than when the separate plants supply energy exclusively to consumers in their immediate neighborhood.

In addition to its lighting loads at the various places mentioned above, and shown on the map in Fig. 4, the company supplies energy to street cars at Redlands, Colton and Riverside and there are connected to its circuits various motors for driving cement mills, rolling mills, ice machines, irrigation pumps, etc. It will be noted that the industrial load is of a very advantageous nature, as viewed by the supply company, on account of both the daily and seasonal load factor. An ideal of the daily load factor can be gained from Fig. 5. The high "valley" load is attributable to the 24-hour industrial load which forms about one-third of the maximum load and one-half of the average load. The smallness of the seasonal variation in the load will be appreciated at once from the nature of the industrial load. However, it is worthy of note that the railway portion of the load, and even the lighting load, maintains a high seasonal load factor on account of the fact that both winter and summer resorts obtain their supply of electricity from this company's system.

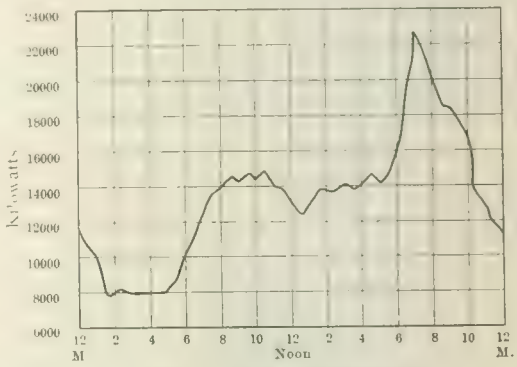


FIG. 5.—DAY LOAD CHART.

Complete technical descriptions of the Mill Creek, Santa Ana River, Lytle Creek and the steam plants of the company appeared in our issues for Feb. 25, March 4, 11 and 25, and April 8, 1905, while the Kern River installation and transmission system were illustrated and described in our issues for Aug. 10, 17, 24 and 31, 1907.

The president and general manager of the Southern California Edison Company is Mr. John B. Miller. The superintendent is Mr. B. F. Pearson, and the electrical engineer is Mr. J. A. Lighthipe.

Training of Electrical Engineers.

In a lecture on the subject of "Electrical Inventions and the Training of Electrical Engineers," recently delivered at the University of London, Prof. J. A. Fleming laid stress upon the necessity for diligent work in the laboratories of the universities and technical colleges, and suggested the desirability of carrying out scientific and commercial testing work. Students were also advised to visit various works and power stations whenever a chance presented itself, and if possible to go to America and the Continent, where large hydroelectric power stations may be seen, and other things of educational value not to be found in England. He expressed the opinion that a good constitution was the most essential thing that a young man should possess to enable him to become a successful engineer, because the engineering profession is exceptionally arduous.

Calculation of the Voltage Regulation of Transmission Lines.

By J. E. Dalemont.

PRACTICAL methods for calculating transmission lines with reactance have been given by different authors, such as Mr. Ralph D. Mershon and Prof. L. A. Herdt in America, while in France the same question has been treated by Blondel, Pionchon, Barris, etc.*

The very simple chart published by Prof. L. A. Herdt in the *Electrical World* of Jan. 2, 1909, is sufficiently accurate for practical purposes, although, as the author himself points out, it will not give exact results for calculating the voltage regulation, when the power factor of the receiver is unity. With equal facility one may calculate by means of the two following very simple formulas the size of the conductors and the voltage regulation of any transmission line with reactance and with any power factor:

Let v_0 be the voltage at the generator end per mile per ampere.

v, the voltage at the receiving end per mile per ampere.

$\frac{v_0 - v}{v}$, is the regulation.

z, the e.m.f. drop *of the line* per mile per ampere (= impedance per mile).

x, the self-inductive e.m.f. *of the line*, per mile per ampere (= reactance per mile).

r, the resistance drop *of the line* per mile per ampere (= resistance per mile).

$\cos\Theta$, the power factor of the receiving circuit.

The triangle of the tensions is shown in the accompanying

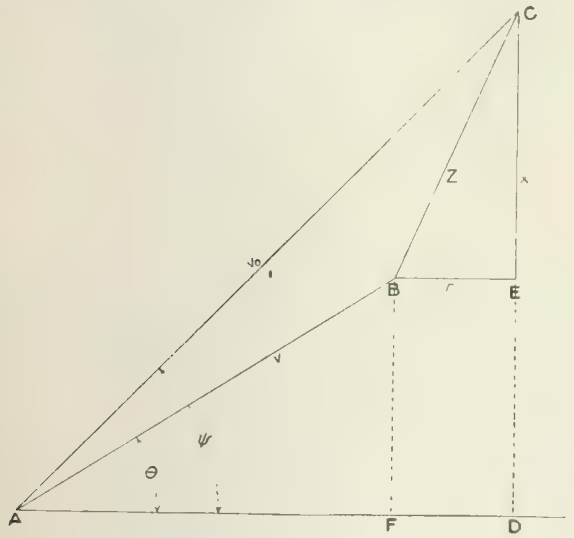


DIAGRAM SHOWING VOLTAGE RELATIONS.

illustration. It will be noticed that with a given frequency and distance between the wires, the value of x remains almost constant, and in any case varies so little, that the variation relatively to the value of v may be neglected.

From the illustration we may deduce:

$$C\,D = v_0 \sin\Psi$$
$$C\,D = v\sin\Theta + x$$
$$\sin\Psi = \frac{v}{v_0}\sin\Theta + \frac{x}{v_0} \qquad (1)$$

On the other hand:

$$B\,E = r = A\,D - A\,F$$
$$r = v_0\cos\Psi - v\cos\Theta \qquad (2)$$

The values of x for single-phase lines may be found in columns 4 and 8 of the table, while those for three-phase lines appear in columns 5 and 9, and are equal to one-half of those for the single phase lines.

Distance between wires. Inches. | Values of x per mile of wire (B. & S. gage). 60 cycles | | | | 25 cycles | | | |

(1)	(2)	(3)	(4) Average Value of x	(5)	(6)	(7)	(8) Average value of x	(9)
	No. 2. B. & S.	No.0000 B.&S.	single-phase.	three-phase.	No. 2 B. & S.	No.0000 B.&S.	single-phase.	three-phase.
72	....	....	....	....	0.67	0.61	0.64	0.32
60	1.56	1.41	1.49	0.74	0.64	0.58	0.61	0.30
36	1.43	1.28	1.35	0.67	0.59	0.54	0.56	0.28
30	1.38	1.24	1.31	0.65	0.57	0.52	0.55	0.27
24	1.33	1.19	1.26	0.63	0.55	0.50	0.52	0.26
18	1.27	1.12	1.19	0.59	0.52	0.47	0.50	0.25
12	1.16	1.02	1.09	0.55	0.48	0.43	0.45	0.23

Values of x per mile of wire (B. & S. gage).

	No. 0000.	No. 000.	No. 00.	No. 0.	No. 1.	No. 2.
Single-phase line	0.52	0.66	0.72	1.04	1.31	1.65
Three-phase line	0.26	0.33	0.36	0.52	0.65	0.82

Examples of the calculation of different transmission lines, where the voltage drop per cent is known and the size of the wire is sought, are given further on.

Suppose, now, that the e.m.f. at the receiving end and the size of the wire are given, and that we wish to determine the e.m.f. at the generator end. This e.m.f. will be the hypothenuse of a right triangle, the sides of which are:

$$v\cos\Theta + r$$
$$v\sin\Theta + x$$

and, consequently, as x and r are given, it is easy to draw or to calculate the value of v_0 and the voltage regulation.

The most interesting cases, however, and the most numerous, are those where the size of the wire is sought, and, for this reason, the treatment below will be confined to such examples.

EXAMPLE I.—SINGLE-PHASE LINE.

Transmitted power, kw	250
E.m.f at the receiving end, volts	2,000
Distance of transmission, miles	19
Power factor	0.80
Frequency, cycle per second	60
Distance between wires, inches	18
E.m.f. drop	0.23

To find the size of the wire calculate, first, the current $\frac{250{,}000}{2000 \times 0.80} = 156.25$ amp; the e.m.f. v at the receiving end per mile per ampere $= \frac{2000}{19 \times 156} = 6.75$ volts; the e.m.f. v_0 at the generator end per mile per ampere $= 1.23 \times 6.75 = 8.32$.

From column 4 of the table we obtain the average value of x for wires at a distance of 18 in. as 1.19 ohms. This gives

$$\sin\Psi = 0.812 \times 0.6 + 0.143 = 0.63$$
$$\cos\Psi = 0.775$$

r (per mile of line) $= 8.32 \times 0.775 - 6.75 \times 0.8 = 1.04$.

Use should, therefore, be made of No. 0 B. & S. wire.

Example II.—Single-phase line with $\cos\Theta = 1$ and a frequency of 25 cycles. By using Professor Herdt's chart, the line current at 2000 volts is found to be $\frac{250{,}000}{2000} = 125$ amp; line drop 23 per cent of 2000 volts = 460 volts; line drop per mile per ampere $\frac{460}{19 \times 125} = 1.935$ volts, and, consequently, one should use No. 3 B. & S. wire. If the size of the wire be calculated with the help of the above formula, the e.m.f. v at the receiving end per mile per ampere is $\frac{2000}{19 \times 125} = 8.43$ volts.

The voltage v_0 at the generator end per mile per ampere is $1.23 \times 8.43 = 10.35$ volts.

Since x taken from the above table is 0.5 ohms,

$$\sin\Psi = \frac{0.50}{10.35} = 0.0483$$
$$\cos\Psi = 1.00$$

r (per mile of line) $= 1.92$ ohms.

THREE-PHASE LINES.

In the calculation of three-phase lines, the line is generally

*One must distinguish clearly between the charts intended for the calculation of lines, where the reactance alone is considered and the capacity neglected, and the method indicated by different authors for calculating lines with reactance and capacity. The former cannot be used for long distance lines with very high tension. Dr. Pender recently pointed out in the *Electrical World* a method for such calculation, the principle of which method was laid down in 1906 by Blondel in *La Lumière Electrique*.

created as being replaced by a single-phase line which transmits half the power at the same e.m.f. The three-phase line may also be considered as replaced by three single-phase lines, transmitting the same power; one conductor of each is similar to each of the conductors of the three-phase line, while the other has zero resistance.

It is easy to see that the e.m.f. drop is the same in the two cases.

Let V_1 be the voltage between wires of the three-phase line.

I_1 the amperes in each wire.

$\cos \Theta_1$ the power factor of the transmitted power.

Half of the power transmitted by the single phase will be:

$$\frac{\sqrt{3}}{2} V_1 I_1 \cos \Theta_1$$

With the e.m.f. V_1 between wires, the current will be,

$$\frac{\sqrt{3}}{2} I_1$$

and the voltage drop

$$[V'] = [I_1' z'] = \left[\frac{\sqrt{3}}{2} I_1 z'\right]$$

In the case of a single-phase line with an assumed return circuit of zero resistance, the e.m.f., here called "star tension," is $V_1'' = \frac{V_1}{\sqrt{3}}$, while the current in the wire is I_1.

The e.m.f. drop is $[V''] = I_1 z''] = [\frac{1}{2} I_1 z']$; the same, therefore, for the *same e.m.f.* as in the preceding case.

For three-phase lines, replaced by a single-phase line transmitting *the same power,* one-half of the values of r and x corresponding to single-phase lines would be taken; the values of x are given in columns 5 and 9 of the preceding table.

Example III.—Assume a three-phase line with the following data:

Transmitted power, kw	4,300
E.m.f. at the receiver, volts	30,000
Distance of transmission, miles	27
Power factor of the receiver	0.70
Frequency, cycle per second	25
Distance between wires, inches	24
Voltage drop	0.16

The "star e.m.f." is $\frac{30{,}000}{\sqrt{3}} = 17{,}300$ volts; the "star current" is $\frac{4{,}300{,}000}{\sqrt{3} \times 30{,}000 \times 0.7} = 118.5$ amp; the "star e.m.f." at receiver per mile per ampere $= \frac{17{,}300}{27 \times 118.5} = 5.42$ volts; the "star e.m.f." at the generating end per mile per amp $= 1.16 \times 5.42 = 6.29$ volts.

Since

$$\sin \Psi = \frac{5.42}{6.29} \times 0.712 = \frac{0.26}{0.24} = 0.654$$

$$\cos \Psi = 0.755$$

r (per mile of wire) $= 6.29 \times 0.755 - 5.42 \times 0.7 = 0.95$,

and consequently No. 2 B. & S. wire will be used.

It is seen, therefore, that with the help of the above table and formula (1) and (2) one may calculate accurately the size of wires for all lines with induction reactance (ignoring capacity) as well as for all power factors.

The Recent Magnetic Storm.

During the magnetic storm of Sept. 25 which seriously affected the telegraph service in America and Europe, the recording instruments at Kew Observatory were violently agitated. During the disturbance there was an almost uninterrupted succession of large oscillatory movements in the magnetic curves, especially those of declination and horizontal force. When the storm was at its height the oscillations exceeded the width of the photographic paper on which they were recorded and the maximum intensity, therefore, could not be measured. Underground cables and wireless telegraphy did not suffer, according to *Engineering,* of London. It is a noteworthy fact that wireless operators on steamers at sea were not aware of any unusual magnetic conditions.

Determination of the Constants of Instrument Transformers.

By P. G. Agnew and T. T. Fitch.

THE determination of the ratio and phase angle of instrument transformers is an important problem, and one in which considerable precision is required for technical work. The principle of the method here described is the same for both series and shunt transformers, being an application of the potentiometer method. The present article is based on a paper on this subject presented at the Washington meeting of the American Physical Society.

SHUNT TRANSFORMERS.

If a non-inductive circuit of high resistance be connected in parallel with the primary of the transformer, the secondary voltage may then be applied to it potentiometer fashion, as shown in Fig. 1, by connecting one terminal in a reversed

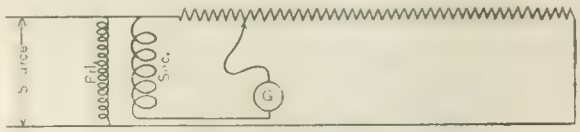


FIG. 1.—POTENTIOMETER SLIDE FOR TESTING SHUNT TRANSFORMER.

sense to one end of the resistor and applying the other terminal, through a detector G, to the resistor. If there were no phase difference between the primary and secondary voltages, a point could be found at which no current would flow through the detector. But, in general, there is a phase difference, so that the e.m.f. at the terminals of G can only be reduced to a minimum value Q, Fig. 2, which is in time-quadrature with the primary e.m.f. If, then, use were made of an idiostatic voltmeter that would read to 0.001 volt with an accuracy of 1 per cent or 2



FIG. 2.—VECTOR DIAGRAM FOR TERMINAL E.M.FS.

per cent, it could be adjusted for a minimum only and then the value of Q could be read. The ratio of the total resistance of the shunted circuit to the part tapped off would then give the voltage ratio of the transformer, the ratio of Q to E_s, giving sin Θ. However, as such an instrument does not seem to be available, some more indirect method has to be used. The method first tried by the authors was to balance the small quadrature component Q, using as a source of e.m.f. a second phase from a two-phase machine, and making use of a tele-

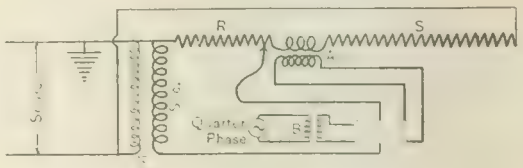


FIG. 3.—DIAGRAM OF CONNECTIONS FOR POTENTIAL TRANSFORMERS.

phone as a detector. The low frequencies and the capacity effects of the various parts of the circuit reduced the accuracy on account of the greater sensitiveness of the telephone to the harmonics present. Either a thermo-galvanometer or a vibration galvanometer gave greater accuracy, but neither was satisfactory as regards ease of manipulation. A method considerably more accurate is to use a vibration galvanometer and only a single source of e.m.f., placing variable inductances in the two parts of the high-resistance circuit and alternately adjusting the resistances and inductances for zero deflection and then calculating the difference in the phase angles by which the e.m.f. leads the current in the two parts of the high-resistance circuit.

The method finally adopted as most satisfactory was to use as detectors two electrodynamometers A and B (Fig. 3). The field coil of one was placed in series with the high resistance, while the field of the second was energized by a quadrature current from a two-phase machine. The operation is to throw the switch to the right and adjust R for no deflection. The

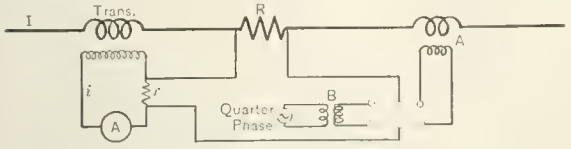


FIG. 4.—DIAGRAM OF CONNECTIONS FOR CURRENT TRANSFORMERS.

current in the moving coil is then not necessarily zero, but is in time-quadrature with that in S. Then throw the switch left and read the deflection which measures the quadrature component Q. The first setting gives the ratio

$$\frac{E_p}{E_s} = \frac{R+S}{R}$$

while the deflection of the second dynamometer gives the sine of the time-phase angle

$$\sin\ \Theta = \frac{Q}{E_s}$$

With the instruments used in obtaining the ratio and phase-angle curves shown below, about 0.05 amp was drawn through

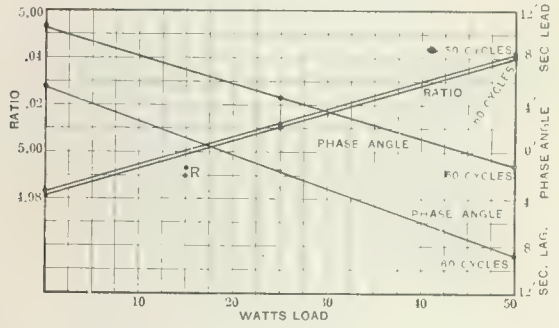


FIG. 5.—POTENTIAL TRANSFORMER M_1.

$R+S$, and a constant current of 0.5 amp maintained in the field of the quarter-phase dynamometer. For the safety of the operator the point of connection of the two transformer windings was connected to earth, and the portion S put out of reach.

The chief objection to this method is that the instrument draws a very small current from the network of conductors, and hence for the phase-angle measurement must be calibrated as a voltmeter under the conditions of use. This is easily accomplished by keeping a circuit of known resistance in series with the field coils of the quarter-phase dynamometer, with a

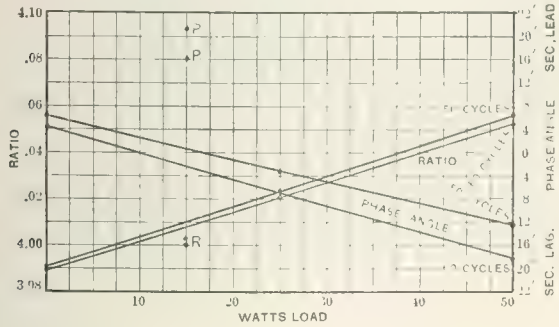


FIG. 6.—POTENTIAL TRANFORMER M_2.

switch so that the e.m.f. at its terminals may be impressed upon the potential circuit, while the transformer is disconnected from the source. At first sight it would seem that the multiplier should be R only (Fig. 3). But analysis shows, as seems evident from a close study of the figure, that R and S are in parallel, so that for calibration they are so connected.

This two-dynamometer method has the advantage of giving a uniform scale, practically independent adjustments for the two settings, a high sensibility, and the ratio can be determined at zero load on the secondary. The correction factor for any slight departure from exact time-quadrature of the field in the second dynamometer is inappreciable except for the most pre-

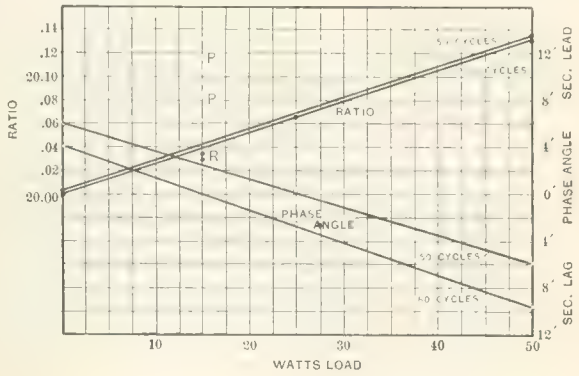


FIG. 7.—POTENTIAL TRANSFORMER N.

cise measurements, in which case the adjustment may either be made or easily corrected for.

Analysis also shows that if the time-constants of R and S differ sensibly, due to the inductance of the dynamometer and the residual reactances of the resistors, a small correction equal to the phase difference between the e.m.fs. at the terminals of R and of $R+S$, must be applied. With high-grade resistors the time-phase angle will usually not exceed one minute.

With the instruments used, the maximum sensibility was one part in 20,000 in ratio and about 0.1 minute in phase angle, but the absolute accuracy is, of course, less, being limited by the accuracy of the resistors of high resistance in the ratio determination and by the residual reactances in the multipliers in the determination of the phase angles.

The method has been compared with three others, and the results agree within the accuracy attainable by the other methods.

In Figs. 5, 6, 7 and 8 are shown load curves of typical shunt transformers designed especially for use with measuring instruments, from different makers. The full-line curves are for non-inductive load, while the isolated points shown in some instances are for the highly inductive load of the potential coil of a watt-hour meter, being plotted in volt-amperes for comparison.

DIFFERENTIAL TEST.

The same method may be used to determine differences in ratio and in phase angle between the transformer under test and a second one used as a standard, by putting their primaries in parallel on the same source and measuring the ratio of their secondary voltages and the phase angle between them. This method avoids the necessity of working on the high-voltage

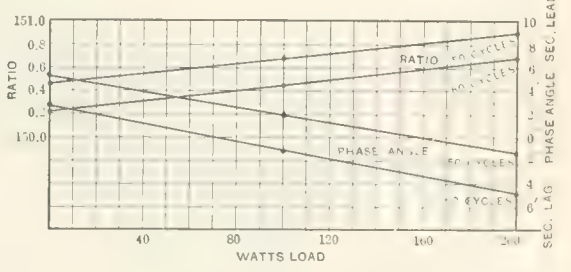


FIG. 8.—POTENTIAL TRANSFORMER O.

side. The sensibility goes up enormously because the resistance S is here reduced to a few ohms, thus lowering the resistance in series with the moving coil of the dynamometer. With the same instruments the sensibility, when used differentially, was a part in a million in ratio, and 0.05 minute in time-phase angle, though, of course, the *absolute* accuracy is not at all increased.

In fact, by using the pivoted movements of portable dynamometer voltmeters an accuracy greater than is needed in any technical work may be obtained. Hence the use of standard transformers whose ratios and phase angles are to be determined once for all is proposed.

SERIES TRANSFORMERS.

The problem of the series transformer has been a more difficult one, for the resistance and inductance of a sensitive instru-

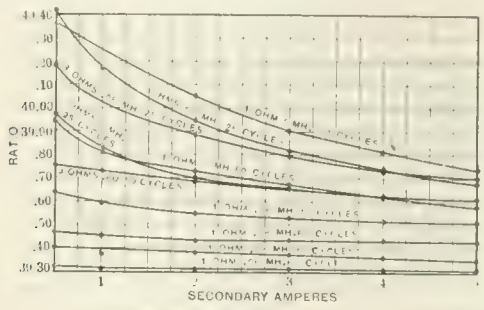


FIG. 9.—CURRENT TRANSFORMER A. RATIO CURVES.

ment placed in the secondary circuit will change both the ratio and the time-phase angle very appreciably, so that results thus obtained do not correspond to the conditions of use. However, the same potentiometer principle used in the case of the potential transformer may be applied. An electrodynamometer and a non-inductive circuit of low resistance R (Fig. 4) are placed in series with the primary of the transformer, and a second non-inductive circuit r of resistance of such a value that r/R is approximately the ratio of transformation, is placed in the secondary circuit. The potential terminals of these resistors are joined so as to oppose the e.m.fs. impressed upon them,

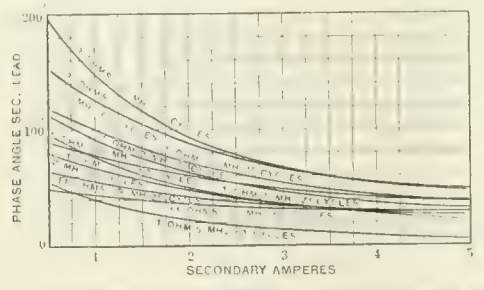


FIG. 10.—CURRENT TRANSFORMER A. PHASE-ANGLE CURVE.

the leads being brought to a double-throw switch so that the resultant e.m.f. may be applied to the moving coil of either the series or of the quarter-phase instrument. The switch is thrown to the right and r is adjusted (by shunting) to give no deflection. This arrangement gives the ratio of the currents. The switch is then thrown to the left and the component of e.m.f. in time-quadrature Q is measured by deflection. This reading gives the time-phase angle, since

$$\tan \Theta = \frac{Q}{IR}$$

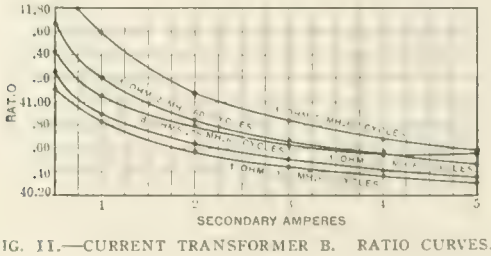


FIG. 11.—CURRENT TRANSFORMER B. RATIO CURVES.

When the time-phase angle is large it must be taken account of in calculating the ratio. By analogy from Fig. 2,

$$\frac{I}{i} = \frac{r}{R} \cos \Theta.$$

However, for most work the correction due to the cosine factor may be neglected as it amounts to less than 1 part in 6000 for a time-phase angle of 1 deg. and is only 1 part in 1000 at 2.5 deg. Theoretically, the same correction should apply to the shunt transformer measurements, but with good transformers it is entirely insignificant.

For the most accurate work the moving coil of the series dynamometer should be set at the point of zero mutual inductance, and that of the quarter-phase dynamometer worked as near the point of zero mutual inductance as practicable. Moreover, considerable care must be taken to keep the leads twisted together to avoid induction from stray magnetic fields.

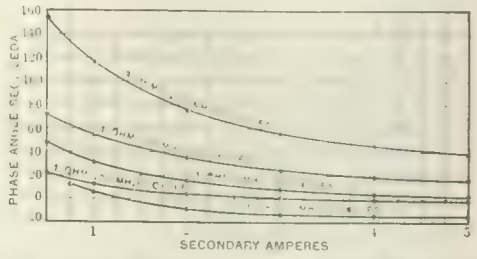


FIG. 12.—CURRENT TRANSFORMER B. PHASE-ANGLE CURVES.

With the dynamometers used at maximum sensibility, in the case of good transformers at full-load current, of about 1 part in 20,000 in ratio and 0.1 minute in time-phase angle was obtained by using from 0.1 volt to 0.4 volt drop in the shunts; of course, the final accuracy is less. This arrangement requires only a few hundredths of an ohm to be placed in the 5-amp secondary of the transformer, which value is comparable to the resistance of connecting leads as ordinarily used. The energy necessary to operate the instruments is taken chiefly from the primary instead of from the secondary.

As the sensibility in making the ratio settings varies inversely as the square of the current, dynamometers having two

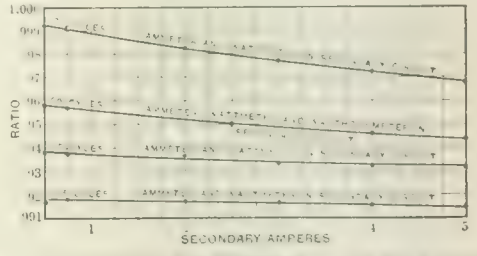


FIG. 13.—CURRENT TRANSFORMER C. RATIO CURVES.

current ranges were ordinarily used by the authors in order to keep up the sensibility at low loads. The sensibility of the measurement of the time-phase angle varies inversely with the load.

The multiplier of the quarter-phase instrument was usually adjusted to give a deflection of 1 cm per millivolt.

A correction must be applied to the time-phase angle measurement, due to the inductances of the shunts. The quarter-phase instrument can readily be used to compare the inductances of two shunts and if one of them is of a form such that its inductance can be calculated it may be used as a standard

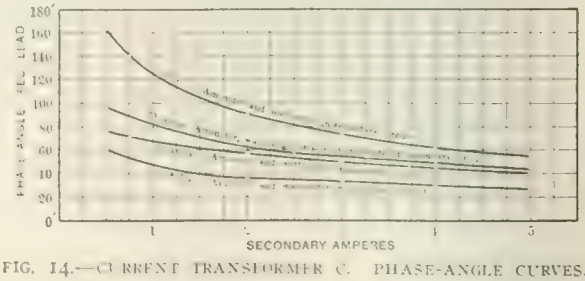


FIG. 14.—CURRENT TRANSFORMER C. PHASE-ANGLE CURVES.

and others determined in terms of it. The resistance in the secondary circuit r may be made sensibly non-inductive, but the inductances of the heavier shunts R, together with the very low resistances, give measurable values of lag—from 1 minute to 10 minutes at 60 cycles.

In Figs. 9 to 14 are shown ratio and time-phase angle curves for different characters of secondary load.

EFFECT OF MAGNETIC HISTORY.

It does not seem to have been before noted that both the ratio and the time-phase angle of a series transformer may be changed by the past magnetic treatment the core has received.

If a direct current of full-load value be passed through either winding, the flux rises to an abnormally high value, and when the circuit is broken the iron does not return to a neutral state, but is left in a state in which its differential permeability is less. Hence, when it is again used to measure an alternating current, it draws a higher magnetizing current than before, and both its ratio (primary to secondary current) and its time-phase angle are increased. The effect is precisely the same when the secondary is accidentally open-circuited while alternating current is passing through the primary, although the amount by which the calibration curves will be shifted depends upon the point in the cycle at which the circuit happens to be

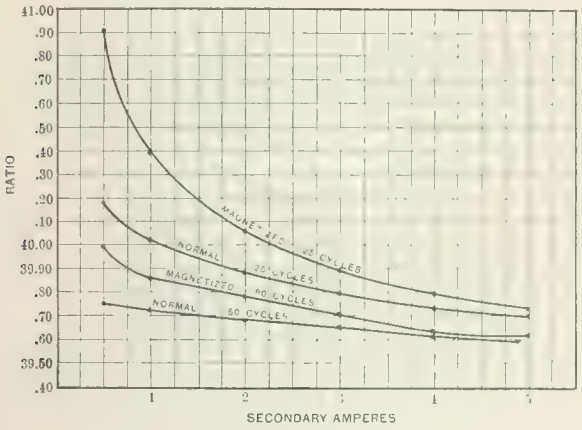


FIG. 15.—EFFECT OF MAGNETIC HISTORY ON PHASE ANGLE OF SERIES TRANSFORMER A.

closed. Figs. 15 and 16 show the effect of such treatment in raising the entire curves, both of ratio and of time-phase angle.

This effect has been found to be very appreciable in every transformer investigated, and is also present with every condition of secondary load. As indicated by theory, it is greater the greater the impedance in the secondary circuit, and, as theory also indicates, it decreases as the load increases. The change

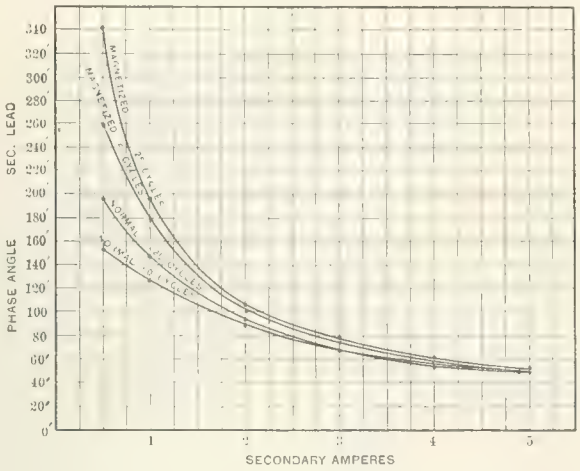


FIG. 16.—EFFECT OF MAGNETIC HISTORY ON PHASE ANGLE OF SERIES TRANSFORMER A.

in ratio at full load is nearly always about 0.1 per cent, but at one-tenth load it may be anywhere from ½ per cent to 5 per cent or 10 per cent, depending upon the quality of the transformer core and the amount of resistance and inductance in the secondary.

This is, no doubt, a frequent source of serious error in measurements requiring the use of series transformers. It is clear that the secondary of a series transformer should never be open-circuited while current is passing through the primary, and that the direct current used in calibrating standards, sometimes employed with them, should not be allowed to pass through the transformer, as is sometimes done.

Fortunately the effect may be entirely removed, in case the secondary has been accidentally open-circuited, by demagnetizing the core. This may be conveniently done by opening the secondary, passing full load, or an overload alternating current through the primary and continuously reducing it to zero.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Electric-Power Booklets.

The Central Georgia Power Company, as noted previously, is issuing a series of "booklet" talks to users of electrical energy, written by Mr. J. J. Cagney, manager. The second one of the series, just issued, is entitled "The Trend of the Times," and presents the advantages of electric power to workshops, mills and factories. The booklets are tasteful in design, and in very readable form set forth the arguments in favor of the use of electricity as a motive power.

Holland (Mich.) Municipal Plant.

The annual report of the board of public works of the city of Holland, Mich., on the operation of the municipal central station plant of that city, is a model for the class of plants considered. More than a dozen tables give very complete information on the financial and operating conduct of the plant, together with comparative statements of receipts, disbursements, equipment and cost of production from the commencement in 1894 to the present year. Among the expenditures are entered $1,000 for estimated loss of taxation and $8,547 for depreciation. The total investment in the plant to date is $166,273, against which a total of $57,270 has been charged off for depreciation. The outstanding bonded indebtedness is $74,000. The rate of depreciation applied is 5 per cent for buildings, 6 per cent for station equipment and meters, and 10 per cent for distribution system. The average annual load factor of the plant is 34.8 per cent. The average loss in transmission between generators and customers' meters is 15 per cent for both lighting and power, the figures separately being 23 and 11.9 per cent, respectively. The average coal consumption is 6.51 lb. per kw-hour of output. The rated capacity of the plant is 925 kw; the maximum load at present is 600 kw, and the total connected load is 2232 kw. The cost of production in detail is given under 25 heads.

Electricity at Halloween.

A suggestion for Halloween parties is the use of the electric cornpopper. By the use of this device corn may be popped in a parlor, if desired, by connecting the popper to an incandescent lamp circuit and rolling it back and forth on a table. This should constitute something of a novelty in a party of young people. Festoons of colored miniature incandescent lamps can be used for decorations, and even the grinning jack-o'-lantern may be illuminated by an electric lamp. These suggestions are made by the Commonwealth Edison Company, of Chicago, and may be of general interest.

Meter Rate Obligatory in Pasadena, Cal.

The City Council of Pasadena, Cal., has passed unanimously an ordinance forbidding flat-rate charges for central-station energy, and requiring the central-station company to install meters for all customers. The ordinance also establishes maximum rates as follows: Up to 100 kw-hours per month, 11 cents; 100 to 500 kw-hours, 10 cents; 500 to 1000 kw-hours, 9 cents; 1000 to 2000 kw-hours, 8½ cents; over 2000 kw-hours, 8 cents.

An Echo of the Street Railway Convention.

Denver has a famous street-car line which is all down hill one way. The horse which pulls the car up hill rides on one platform on the down trip. During the recent street-railway convention at Denver members of the new-business department of the Denver Gas & Electric Company saw an opportunity for a timely bit of local advertising and at the same time contribu-



AN ANCIENT STREET CAR AT THE DENVER CONVENTION.

ting something to the entertainment and amusement of the visiting street-railway men. They temporarily chartered this car, put it on a flat car of the Denver City Tramway Company and had it hauled around the downtown streets by a motor car. The appearance of this odd-looking outfit is shown in the accompanying engraving. Secretary C. N. Stannard, of the Denver Gas & Electric Company, is acting as conductor on the rear platform. Members of the new-business department dressed as various characters and a negro quartet to keep things lively form the supporting army. It is needless to say that this strange outfit attracted plenty of attention. The picture tells the rest of the story.

Selling Electricity.

At the convention of the Colorado Electric Light, Power and Railway Association at Denver, Oct. 7, Mr. H. McConnell, of the Colorado Springs Electric Company, presented a paper on selling electricity in which the following suggestions were offered for cities of from 10,000 to 50,000 population:

In the author's opinion much business can be obtained for a central station through newspaper advertising. He does not mean by this that a central station should tie itself up with a newspaper to take a specified amount of space each month, but when the company has any special appliances or a demonstration to advertise, the company should go to the paper, instead of having the advertising manager of the paper appear at the company's office every morning with that stale question: "Have you to-day's ad ready?" with the consequent feeling which often comes: "Well, we have contracted for it, so I suppose we have to take it." With this system one advertises because he thinks he must and not because he thinks it is going to do him any good.

Of the salesmen the one whose task is the hardest is the "power" salesman. One important characteristic should be part of his make-up, and that is, enthusiasm. He should possess so much of this that almost his every thought should be connected with his work. When he goes into a factory operated with other than central-station energy, he must have clearly in mind the exact way to connect the motor with the peculiar kind of mechanism used in that factory. He must be ready to adapt his company's services to the peculiar needs of the factory, always keeping in view the main idea of economy for the company as well as for the customer. While looking over the plant he must carefully make notations of the actual time the machinery is running at its maximum and its minimum capacity and then carefully weigh in his mind what load factor will apply. Then he should go to the shop foreman and obtain from him some idea of the average number of hours the plant is operated and, generally, by this time, he will be surprised at the small amount of energy used. Next he should get his selling points together in order to show why this factory should become a central-station customer so that, when he leaves the factory for the office, he can let his imagination drift to such an extent that he can already hear the hum of the motors in the factory. When, however, he enters the prospective customer's office he must be careful to appreciate the customer's position in the matter. He must remember that the man with whom he is dealing has a big investment in an isolated plant and that he is trying to operate as economically as possible. The factory owner probably has heard people complain about their bills, and he may think, as do many, that the electric companies are grinding corporations. Is not this the opportune moment for central stations to install motors on a six-months' trial? The companies would certainly get their investment back in future earnings.

The increased number of electrical appliances on the market to-day is making the power salesman's path a smoother one than ever before, but few of them, in the endeavor to close down steam or isolated plants, realize what opportunities are being stumbled over. It is safe to say that in the average business block there is scarcely a business house which cannot be induced to install a motor of some kind. The druggist can use an electric drug chopper; the tailor an electric clothes cutter, and the baker an electric dough mixer; the butcher a meat chopper, and so on.

Many methods have been tried to increase sign loads, and those stations having the most success are the ones giving a flat-rate charge per month. This price, in some cases, includes the rental of the signs, lamp renewals and patrolman's service. Other stations install signs on long-time payments, and some have gone so far as to give free signs. This class of business is desirable as it enables the central station to hold a customer on a contract to burn his sign certain hours every night in the month for a term of from one to three years. It also enables the customer, by giving him a flat rate, to figure this class of business as advertising. Many companies do window lighting on this same basis.

In securing house-wiring contracts many companies have found it advantageous to allow two years' time for the final payment on wiring, the payments being on the monthly plan. In putting appliances out on trial one company met with much success by sending with every meter an electric iron on 30 days' trial, thus educating the public to an increased consumption at the start instead of waiting until the customer had paid several bills. A central-station commercial manager should not be satisfied until he has the public educated to the fact that his company is no longer the electric lighting company, but the electric company, so that when a customer applies for electricity he realizes that he is applying for something by which he is able to sew, wash, iron, clean, cook and heat as well as light his home. Many central stations overlook the fact that if the proper methods were carried out additional lighting could be taken on their city lighting contract. To get this business a middle-Western company went to the expense of donating some artistic park lighting effects for one of the small parks and it proved to be such a wonderful improvement over the old type of lighting that the city gave the company a contract to place this same effect in all of the parks and public squares, thus beautifying the city and also increasing the sale of electricity.

In the discussion on this paper Mr. Taylor, of Denver, expressed the opinion that motors placed on trial represent money well spent. Mr. H. J. Buell, of the Northern Colorado Power Company, said that the work of the new-business department should be directed so as to increase the load factor of the plant. He drew a typical load diagram on the board and showed the effect of irrigation pumping load, such as he is securing in the agricultural districts through which the lines of the Northern Colorado Power Company run. This business is taken under a contract by which the user turns off the circuit from 7 to 10.30 p. m. This is a summer load, and by such a contract it does not come on the summer peak.

Mr. George B. Tripp, of Colorado Springs, complained of the difficulty in getting automobile garages to refrain from charging during peak hours. Mr. Taylor, of Denver, said that the practice there was to issue to garages a card showing the non-peak hours and schedule of hours. The readiness-to-serve rate is $7.50 for charging at all hours and $5 for charging only during non-peak hours. The hours at which a consumer charges are followed up by inspection. Mr. C. F. Oehlmann, of Denver, said that the idea of having the meter men deliver irons to consumers had an advantage in that it took less labor than sending another man around on this errand. Some companies have been loaning irons free on six months' trial, and he questioned whether renting would not be better.

Lighting Companies' Exhibits at the New York Electrical Show.

The third annual New York Electrical Show, in Madison Square Garden, was brought to a close Oct. 21, the exhibition having been the most successful artistically and commercially ever given in New York. Inasmuch as the show was fostered by the lighting interests of the greater city, it was natural that the New York Edison Company, the United Electric Light & Power Company and the Edison Electric Illuminating Company of Brooklyn should be the largest exhibitors.



FIG. 1.—EXHIBIT OF THE UNITED ELECTRIC LIGHT & POWER COMPANY.

The exhibit of the United Electric Light & Power Company occupied the entire south side of the main floor of the Garden. The space was divided into 10 separate booths, in each of which the principal idea was to exhibit by actual display the advance which has been made in the application of alternating current within the past year. In the first booth were shown various advertising and spectacular effects with the use of alternating current, induced electrical effects, the use of transformers and other alternating-current apparatus. The second booth contained a complete outfit of alternating-current dental, X-ray and medical apparatus. Next to the medical and dental apparatus was a booth containing motion-picture apparatus, together with alternating-current types of lamps used in photographic work, blue printing and other commercial applications. In the household booth were shown practical applications of electricity used throughout the household. Included in the apparatus were electric irons, toaster sets, heaters, fans and many new devices for the convenience and comfort of the home. Carbon, tantalum, tungsten and metalized-filament incandescent lamps, arc lamps, vacuum lamps, sign lamps and the application of tungsten lamps to sign lighting were shown in a booth next to the side exit. A large ball made up of 25-watt, frosted-tip tungsten lamps, fitted with reflectors, and set on a very handsome brass pedestal, created considerable interest. Immediately below the lamp booth was the office and reception room of the company, where its customers were received and entertained. Adjoining the reception booth were shown recent developments in the commercial application of electricity for store purposes, including coffee mills, meat choppers, beer pumps, buffing machines, ice-cream freezers, exhaust fans and other applications of interest to the merchant. Among the industrial applications shown in the next booth were various electrical apparatus for use in shops, factories and commercial houses of all kinds, including cloth cutters, machine drills, jig saws, lathes, printing presses and applications of electric welding, etc. In what was termed a "construction booth" was a display of apparatus used in the construction of buildings operated from alternating current, such as electric hoists, electric drills, concrete mixers, pumps and riveters. The last booth of the company was utilized to show the advance which has been made in alternating-current elevator apparatus, a complete high-speed



FIG. 2.—ELECTRIC REFRIGERATOR AND WASHING MACHINE, BROOKLYN EDISON EXHIBIT.

alternating-current elevator motor being shown in operation.

One of the prettiest exhibits of the show was that of the Edison Electric Illuminating Company of Brooklyn, which was located at the east end of the Garden. In one corner of the



FIG. 3.—KITCHEN CORNER, BROOKLYN EDISON EXHIBIT.

space was an electric organ, and the effects which were obtained from electric flowers scattered throughout the booths added to the attractiveness of the exhibit. The aim of the Brooklyn company was to set forth all the advantages of electric housekeeping, and, although the various rooms were not shown as heretofore, all of the apparatus was on exhibition. In the kitchen and laundry were a clothes washing machine, drying machine, electric iron, electric water heater, electric range with utensils, including broiler, griddle and stoves, ice-making and refrigerating machine, electric plate warmer, electric coffee grinder, polishing machines, disk stoves, percolators and water pots.

Among the apparatus suitable for the dining-room shown in actual operation were an electric coffee percolator, a tea kettle, chafing dish, food warmer, waffle iron and toaster. For the parlor there were on exhibition an electric pianorchestra, a combination of all the different instruments used in a full symphony orchestra assembled in a single case and arranged to play in solo or concert work; an electric floral display and an electric fountain. The apparatus suitable for the bedroom, nursery and bath included electric heating pads, curling-iron heaters, baby milk warmers, hair dryers, radiators, foot warmers, massage outfits and sterilizers.



FIG. 5.—ELECTRIC FLOWERS, BROOKLYN EDISON EXHIBIT.

Among the other household appliances which were placed on exhibition were electric sewing machines, vacuum cleaners and portable lamps. Anticipating the numerous questions that might be asked regarding the various pieces of apparatus the company prepared a small pamphlet giving a description of the appliances, together with their initial cost and the cost of operating from the Edison system.

The New York Edison Company featured the application of the electric motor to industrial machinery. The company occupied the 10 booths on the north side of the Garden. The first of these was devoted to the electric signs of the Metropolitan Engineering Company. Immediately adjoining this booth was one of popular interest, in which the Cyphers Incubator Company maintained an exhibit, consisting of its electrically operated incubators hatching chickens during the show, brooders, electric hens, etc. A portion of the next booth was used by Causchois, the coffee man, who demonstrated electrically operated coffee urns to be used in restaurants. Two and one-half booths were occupied by a printing exhibit, consisting of a Whitlock cylinder press printing a sheet 36 in. x 48 in., a Dexter folder, Dexter cutter, Monitor stitcher and monotype machine. The printing press was operated during the show, turning out Edison pamphlets, the other machinery being employed in finishing them. In the booth alongside the side exit was an electric laundry equipment, with a washing machine, dryer, mangle and ironing table, all of which were used during the exhibition on flat work supplied from a neighboring hotel. Adjoining the laundry was a candy kitchen with a number of electrically operated machines used in the manufacture of various sweets. Philip Morris & Company occupied a booth where they showed a cigarette-making machine in operation, and



FIG. 4.—GENERAL VIEW OF EXHIBIT OF BROOKLYN EDISON COMPANY.

also a cork-tipping machine. Not the least interesting of the exhibits in the Edison space was that of the Natural Food



FIG. 6.—PRINTING-PRESS EXHIBIT OF NEW YORK EDISON COMPANY.

Company, which demonstrated its process of steaming, shredding and baking Triscuit. The whole wheat was first soaked



FIG. 7.—CORNER OF PRINTING BOOTH, NEW YORK EDISON PLANT.

and placed in a large bowl in the machine, then shredded by great combs. It was then baked in electrically heated forms,

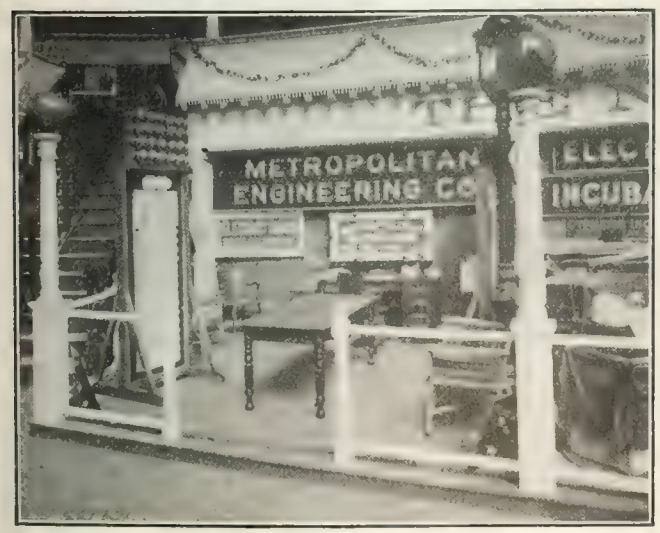


FIG. 8.—ELECTRIC SIGN BOOTH IN NEW YORK EDISON SPACE.

thus completing a remarkably simple operation. The remaining booth was occupied by Frank Brothers, embroidery manufacturers, who showed a sewing machine in operation, and also the use of electric irons for pressing the work. In the balcony the

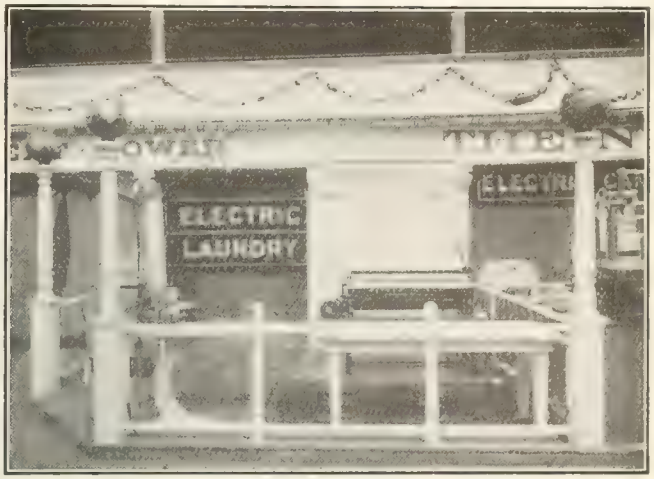


FIG. 9.—ELECTRIC LAUNDRY IN NEW YORK EDISON SPACE.

New York Edison Company had a Japanese tearoom where electric heated pots were used in brewing tea. All of the toast and cakes served were baked in electric ovens.

INTERIOR WIRING AND ILLUMINATION

Denver's New "White Way."

Seventeenth Street is the third of Denver's principal downtown streets to have special lighting. This street was equipped just in time for the recent street-railway convention. The same general plan has been used on Seventeenth Street as on the other streets. Arc lamps are suspended by ornamental brackets from each electric railway pole. Both bracket and pole are of special design approved by the Municipal Art League. The railway company changed the pole for this purpose and the bracket was paid for by the property owners along the street. The operation and maintenance of the lamps are paid for by the city. There are four of these lamps per block on each side of the street. The accompanying engraving is from a



SEVENTEENTH STREET, DENVER'S NEW "WHITE WAY."

photograph taken from one end of the street looking toward the Union Depot. The street so equipped is about a mile long.

In addition to the arc lamps temporary special festoons of colored incandescent lamps were hung on the span wires in honor of the street-railway convention. The arcs are the common carbon, enclosed type, with clear inner and opal outer globes. They are operated off a constant-potential alternating-current circuit and supplied by the Denver Gas & Electric Company.

A Large Temporary Lighting Installation.

The space required for the exhibits at the recent convention of the American Street and Interurban Railway Association at Denver was such that it was necessary to extend the Auditorium, where the convention was held, by building a large temporary annex. This annex occupied adjoining streets, which were temporarily vacated for the purpose. The lighting arrangements of this temporary building are shown in the accompanying engraving, which is from photographs taken from one corner, showing the two parts of the annex which occupied Fourteenth and Champa streets, respectively. The lighting was planned by Mr. George Williamson, one of the illuminating engineers of the Denver Gas & Electric Company. The square feet floor area aggregated 41,300, and there were 432 old-style 50-cp, 200-watt lamps equipped with extensive-type Holophane reflectors. The watts per square foot were 2.1.



TEMPORARY LIGHTING FOR DENVER STREET RAILWAY EXHIBITS.

Tungsten lamps were not used because of the danger of breakage in putting up and taking down for such a temporary installation.

Recent Progress in Illuminating Engineering.

Mr. J. R. Cravath, before the Colorado Electric Light, Power and Railway Association, Denver, Oct. 7, 1909, gave a talk on the above subject illustrated with blackboard sketches.

Three years ago the speaker gave a paper before the association on the lighting of small stores to get the best results and with the special object of meeting competition. Since that time the principles then advocated as to the use of incandescent lamps with reflectors of proper design have come into common use along with the introduction of the tungsten lamp. The speaker's object in the present talk would, he announced, be the explanation of some of the sources of loss and inefficiency, which are better understood now than a few years ago, and some of the short cuts in calculation which the increasing knowledge of illumination makes possible.

In most rooms the greatest opportunity for loss of light is by absorption by the walls. Usually the illumination of a plane about 30 in. from the floor is that taken into consideration. The light given off from a lamp in downward directions from a lamp strikes this plane directly without loss. The light which goes up toward the center of the ceiling is reflected from the ceiling to the working plane with one reflection and with small loss if the ceiling is light in color. The light which is given off horizontally from the lamp strikes the walls at such an angle that it must be reflected back and forth a large number of times between the walls before it reaches the working plane. Every reflection involves loss. A large percentage of the total light given out by an ordinary tungsten lamp is within a zone 30 deg. from the horizontal. If, therefore, this light is used inefficiently by directing too much to dark walls to be absorbed by multiple reflections the total efficiency will be low.

The bearing of this fact on practical work is to prohibit the use in most places of a flat type of reflector for incandescent lamps. This includes the flat reflectors used on clusters and the old distributing type of reflector first introduced with Gem lamps. These flat reflectors are not only wasteful because of the light which is absorbed by the walls of a room, but also because the lamp is so exposed that it blinds the eye and renders inadequate the illumination in many places where it would be sufficient were not so much glare present.

It has been found possible to design reflectors which will direct a large percentage of the light of a lamp downward at such angles that it strikes the working plane without the loss by reflection from one or more walls. Such reflectors as now made cover the lamp so as to intercept the horizontal rays and also to protect the eye of the user of the room from the glare of the unshaded filament. In the use of such reflectors the principal danger to be avoided is the use of a reflector giving a broad or extensive type of distribution in high narrow rooms where a large amount of light will be directed to dark walls where it will be lost. Concentrating reflectors should be used in such rooms when the outlets are close to the walls.

Another thing that has been learned from theory and experience the past few years is the fact that in lighting a large interior with a large number of lamps equipped with reflectors, the height at which the lamps are placed has very little influence on the efficiency as measured in foot-candles. On the other hand, it is desirable to hang lamps as high as possible to get them out of the range of vision so that they will interfere least with seeing clearly.

Indirect lighting in its latest improved form is coming into use where comfortable illumination is desired. Most of the indirect lighting installations of years past have been by placing the lamps in a cove around the sides of the room. Most of these were inefficient because the light from the lamps struck the ceiling at such an angle that instead of being directly reflected to the working plane it had to be reflected first from the ceiling to a wall, then back to another wall and so on, finally

reaching the working plane after many reflections with much loss at each reflection.

Indirect lighting as applied recently by inverted reflectors placed on chandeliers in the center of the room directs much of the light from the lamp to the ceiling at such an angle that it is reflected down to the working plane directly from the ceiling and hence with minimum loss. One of the greatest advances in the past three years, however, has been in the increasing amount of definite knowledge that is now available as the result of tests on actual installations. The speaker gave the accompanying table for use in calculating illumination. He stated it to be compiled from such tests as are now available on actual installations. The figures are approximately correct for a large number of every-day cases, but there are many things which will influence the results.

Size Room.	Height.	Color— Ceiling.	Walls.	Lighting with	Watts per Lumen*
50′ x 50′	10′ to 20′	Light	Light	Clear prismatic reflectors	0.20
50′ x 50′	10′ to 20′	"	Dark	" " "	0.25
15′ x 15′	8′ to 12′	"	Light	" " "	0.23
15′ x 15′	8′ to 12′	"	Dark	" " "	0.30
15′ x 15′	8′ to 12′	"	Light	Indirect; mirror reflectors	0.35
15′ x 15′	8′ to 12′	"	Dark	" " "	0.45

*The foot candles desired should be multiplied by this figure to get the watts per sq. ft. required.

The figures apply to installations which are clean and fairly new. A loss of from 5 to 35 per cent for dirt and depreciation should be allowed and the dirt floating in the air and the frequency of cleaning should be taken into account.

Working on Live High-Tension Lines in the Black Hills.

The linemen of the electrical transmission companies operating in the Black Hills in the mining district of South Dakota are accustomed to work on high-tension lines in a way that would fill an Eastern operator with astonishment. The climate is dry, so that the poles become good insulators. It is hardly necessary to say that live lines are not worked upon unless the weather is dry and has been so for some time.

The Black Hills Traction Company, for some time under the management of Mr. F. P. Wood, has 24,000-volt lines which are used for transmitting energy from a hydroelectric plant and distributing it over the mining district. It is the custom of linemen to renew insulators and do other work on the live 24,000-volt lines without the use of any insulating devices whatever. Figs. 1 and 2 show a lineman working on such live lines. As seen from the position of the wires in Fig. 1, the pole is on a steep mountain slope. Fig. 2 shows a lightning-arrester station being equipped with horn-gap arresters. The separation of the wires on this line is 5 ft. The men work without gloves and keep a constant hold on the wire with one hand to keep the static charge drained off. Sometimes after working all day at renewing insulators and making repairs on a live line a man will have a little soreness in his ankles next to the climbers, due perhaps to the static charge passing into the climbers. Probably 500 insulators have been changed in this manner.



FIG. 1.—WORKING ON A LIVE 24,000-VOLT LINE.

At first it was the custom to form a low-resistance path around a man's body by the well-known expedient of fastening a chain or a wire part way down the pole and connecting the upper end to the line wire to be worked upon. This chain drains off the static charge and precludes the possibility of dangerous current leaking through the man's body and down the pole. However, the workmen on these lines became tired of using the jumpers because they did not seem to be necessary, and work is now done without them.



FIG. 2.—ARRANGING HORN ARRESTERS ON A 24,000-VOLT LINE.

On the 11,000-volt lines of the Consolidated Power & Light Company, operating in the same district, insulators are renewed on live lines, but additional precautions are taken. Linemen wear rubber boots and rubber gloves and do not touch the wire, but use pliers insulated with linen varnished tape. The tape is much better than rubber in the climate of South Dakota as it does not dry out.

A Structural Steel Transmission Bent.

By H. V. Hodgman.

Coincidental with the rearrangement of feeder circuits radiating from an industrial-plant generating station it became necessary to carry a group of wires and a telephone cable across a river which intersected the property of the company. The installation of a terminal tower on each side of the stream was first considered, but this method was abandoned as some of the conductors were quite large and it was considered that the installation and repair of these would prove difficult. Furthermore, the cost of the two towers, which of necessity would be quite high and of sturdy construction, was excessive. It was finally decided to convey the conductors across on steel bents to be riveted to the struts of a steel bridge which crossed the river at a convenient point.

The bridge is shown diagrammatically in Fig. 1. There were actually more panels in the bridge than indicated, but the diagram makes clear the arrangement of bents and the method of attachment. A complete bent is detailed in Fig. 2. It is built up entirely of structural steel sections and plates held together with rivets and was designed for riveting to a vertical post or strut of the bridge. The posts (shown in a dotted line in Fig. 2) were each made up of two 6-in. x 8-in. channels arranged back to back and bound together with strap steel lattic-

ing; the rivet holes for the lattice bars being 8¼ in. apart horizontally. In laying out the bent, the holes in the 3-in. x 5-in. angles, forming the left-hand vertical of the bent, were made to correspond to this spacing and to the corresponding vertical spacing. The 5/16-in. plate taking the thrust of the

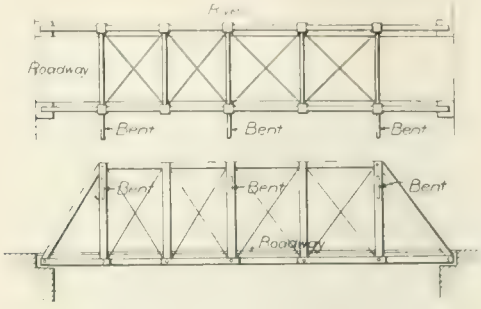


FIG. 1.—DIAGRAM OF BRIDGE.

diagonal brace was also drilled to coincide with the lattice-bar rivet holes. In attaching the bent to the post it was merely necessary to remove the lattice bars and rivet the bent to the strut members, using the old rivet holes.

All gusset plates were ½ in thick, this thickness being chosen so that the slots between members, determined thereby, would accommodate the 7/16-in. bolts used for securing the telephone cable support (Fig. 3) and the steel insulator pins (Fig. 4). The two lower gusset plates on the outer end of each bent were allowed to project ½ in. to form a shoulder to take the vertical thrust of the telephone cable support. In the lower plate two 11/16-in. holes were punched for the future accommodation of ⅝-in. tie rods, terminating at their inner ends on the bridge structure, in case the installation of such was ever deemed necessary to prevent swaying of the bents.

Fig. 3 is a detail of the telephone cable support which was formed from ½-in. x 2-in. wrought-iron bar. Half-round grooves were forged in the clamping plate and in a correspond-

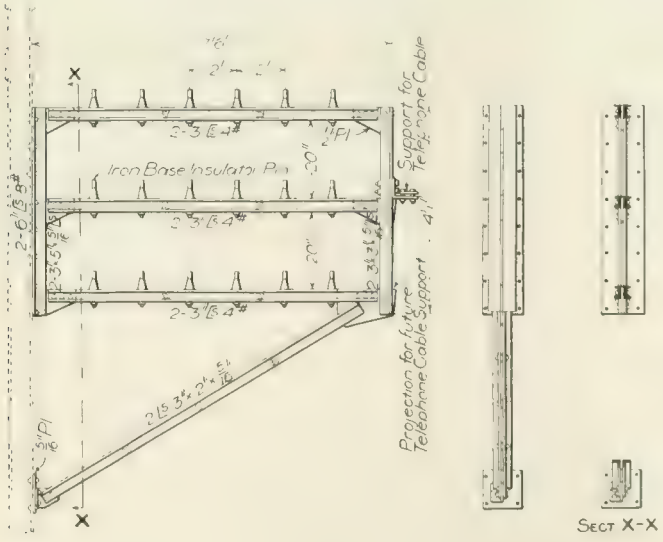


FIG. 2.—DETAILS OF BENT.

ing location in the L-shaped supporting member. A ½-in. stranded steel messenger wire, to which the telephone cable was supported with marline hangers, was clamped in these grooves, between the two members, with ½-in. bolts. Two 7/16-in. bolts, passing between the two 3-in. x 3-in. x 3/16-in. ells forming the outer vertical, held the support to the structure.

Fig. 4 shows the constructional features of the metallic insulator pin selected. This is a standard appliance purchaseable from any large dealer in electrical supplies. The top is a frustrum of wood, impregnated with a preserving compound, with a standard insulator thread turned on it. This wooden top fits into a base of galvanized malleable iron. A 7/16-in. galvanized wrought-iron bolt supplied with a punched washer

serves for a stem for attaching the pin to the cross-arms of the bent. It should be noted that, as a rule, any bolt smaller than ⅝-in. diameter should be avoided in general construction as an able-bodied lineman, with a 12-in. monkey-wrench, is capable of twisting smaller bolts asunder. In the construction de-

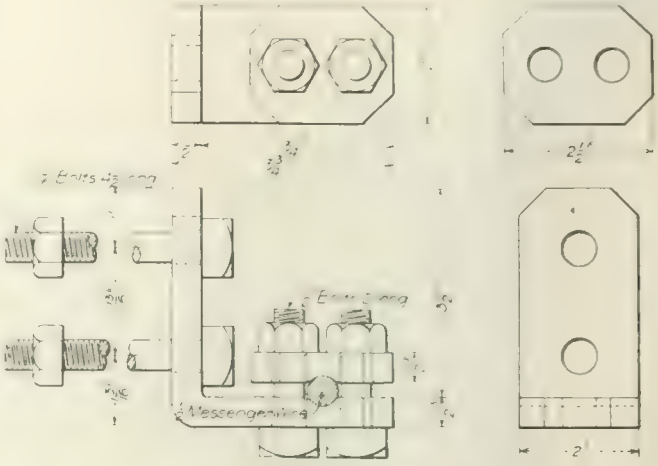


FIG. 3.—DETAILS OF TELEPHONE CABLE SUPPORT.

scribed the use of 7/16-in. bolts for both the telephone cable supports and the insulator pins was desirable to avoid excessive thickness of gusset plates and cross-arm spacing washers. These determine the width of the slots through which pin and supporting bolts must pass.

Only half of the pins were occupied at the time the bents were installed, and although pins may be easily removed from and inserted in the cross-arms, each bent was initially fitted with its full quota in order to avoid delays due to slow delivery on pins when new lines are to be strung. Inasmuch as the thread in almost all types of insulators is standard, any type that is likely to be used can be screwed on the pins.

The bents were spaced on every other bridge post (see Fig. 1), making very short sections. This was done to avoid

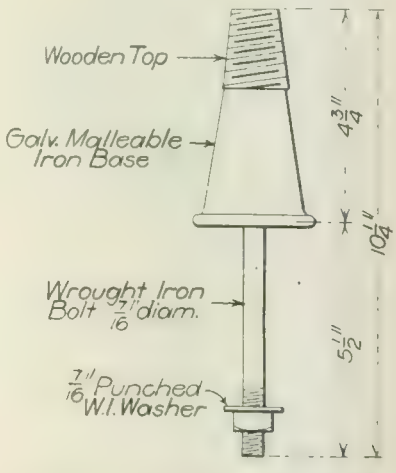


FIG. 4.—DIAGRAM OF METALLIC INSULATOR PIN.

the excessive loading of a few of the bridge posts. Each bent was thoroughly painted after erection.

Telephone Patents.

NEW ACCESSORIES.

A combined closure and antiseptic device for transmitters forms the subject of a patent granted to Mr. J. B. Burkholder, of Minneapolis, Minn. A perforated metal cap clamps over the mouthpiece, carrying a second piece with holes to register with the first and secured with a central loose rivet. It may thus be rotated to close or open the passage. An antiseptic pad behind the cap serves to disinfect the enclosure.

Messrs. K. M. Turner and H. W. Haff have patented a packet-battery casing and transmitter holder for audiphone sets. The battery casing has a pronged holder for taking the transmitter, from which, however, it may be readily removed. The circuits are made through flexible cord, all slack cord being stowed in the battery-box cover. The General Acoustic Company has been assigned this patent.

Letters to the Editor.

Effects of Third Harmonic.

To the Editor of Electrical World:

Sir:—Referring to the article by Mr. F. M. Denton in your issue of Oct. 14, entitled "Effects of a Third Harmonic in the E.M.F. Wave of a Three-phase Generator," and referring to the editorial on the same subject, I beg to offer the following comment:

Mr. Denton explains clearly in the article the effect of the third harmonic upon the e.m.f. wave form of a three-phase generator when the same is connected in star or in delta, and shows the effect by means of oscillograms in the case of a 60-cycle generator with two slots per pole per phase. In the editorial commenting upon the article it is stated that: "Designers take care to reduce the triple-harmonic frequency e.m.f. in the bars of the delta-wound armatures," etc. This is a point which might be more clearly brought out, since, although it may not be so intended by the article, it nevertheless gives the impression that the delta winding should be avoided.

The reason for the disappearance of the third harmonic from the terminal voltage in case of the star connection is that the windings of the two legs are distributed over two-thirds of the pole-pitch, or over 120 electrical degrees. In the same way can the third harmonic be eliminated in each one of the three legs, simply by "chording" the windings two-thirds of the pitch. In so doing, the winding of each leg is distributed over 120 electrical degrees instead of over 60 deg., as in case of a fractional-pitch winding, and the third harmonic will completely disappear from the voltage of each leg. In cases of new designs, and especially if for any reason delta connection is required, the winding can always be so arranged as to eliminate the triple harmonic.

In order to obtain the same e.m.f. for the winding, it is of course, necessary to increase the total number of armature conductors. This factor fixing this increase of conductors is the sine of 120/2 or 60°—namely, 0.866. That this increase in number of conductors required by the chord does not mean a sacrifice in copper or iron is a point that most designers are well aware of.

This point of eliminating the third harmonic may also be of value in connection with three-phase star-connected generators operating in parallel with grounded neutrals on account of the triple-frequency currents which may flow in the neutral connection. Similarly, it is a point worth consideration in cases of all armature windings, whatever phase or connection.

Edgewood Park, Pa. Jens Bache-Wiig.

The Lux as the Unit of Illumination.

To the Editor of Electrical World:

Sir:—In your issue for Sept. 23 there appeared an editorial comment on the standard of light in which it is stated that "rather recently some German writers have fallen into the quite inexcusable custom of adopting the term *lux* for the meter-hefner." Allow me to state that the use in Germany of the term "lux" as a unit of illumination identical with the meter-hefner is neither of recent date nor does it represent a quite inexcusable custom.

The fact is that the term "lux" has been used in Germany since 1897, following its adoption by the Verband Deutscher Elektrotechniker and by the Deutscher Vereine von Gas und Wasserfachleuten. The action of these, the two largest German illuminating engineering societies, was the result of action taken at the Geneva International Electrical Congress of 1896, at which Professor Blondel proposed his excellent photometric system. This congress passed a resolution stating that for the purpose of facilitating the standardization of the units, and as a provisional measure, the bougie-décimale should be considered as equivalent to the hefner; and Blondel stated in a report to the 1896 Photometric Congress that the hefner differed inappreciably from the Violle unit.

It will be seen, therefore, that in the year 1897 the German illuminating engineering societies defined the lux as the meter-hefner, while another nation defined it as the meter-bougie, the two values being practically identical at that time.

It is worthy of note that the values of light from the two different candles have varied from time to time, somewhat as have stocks and bonds. In the year 1896 the hefner was equal to 1.02 bougies-décimale, a difference of 2 per cent. Subsequently Laport showed that the ratio of the hefner to the bougie-décimale was 1:0.885, a difference of 11.5 per cent; the International Photometric Commission in June, 1903, verified this value. From this moment there were two different "luxes"—the German, with the hefner as the unit of light, the other with the bougie-décimale as the light unit. The ratio of the two "luxes" to each other as established by the International Photometric Commission at Zurich in 1907 was 1 hefner = 0.895 bougie-décimale, but in the year 1909, when the international candle was created, 1 pentane candle = 1 American candle = 1 modern bougie-décimale = 1.11 hefner, thereby again changing the ratio of the two "luxes."

From the above it will be seen that since 1896 the bougie-décimale lux has had four different values, while the hefner lux has remained constant. It is noteworthy, too, that seldom has a term been so rapidly adopted as has the "lux" by the German engineers. An examination of the recent contributions to lighting literature will show that German authors have used the word "lux" almost exclusively. There have been few original communications dealing with the measurement of light in the French literature since 1896. In the numerous American and English writings I have not found the term "lux" as an expression for the light flux density, but instead thereof the term "candle-foot" or "foot-candle." It would seem, therefore, that the home of the word "lux" has been in the German literature. Now that the importance of a unit of light flux density is becoming appreciated, and the "lux," which has not been used outside of Germany, is looked upon as a suitable term for the unit, it is hardly proper to reproach German engineers for continuing to apply this term to a unit that has remained constant and not varied by 11 per cent.

In the year 1907 I published a proposal that there be established an international uniform unit of illumination; that each individual country be free to employ its own existing unit of illumination to be expressed in terms of the international unit by means of a measured or determined ratio of transformation. The word "lux" was suggested as an appropriate term for the international unit.

There is reproduced herewith a table, brought up to date by including the recently adopted international candle, which was originally published by me in 1907 for showing the ratios of the various units of illumination.

RATIOS OF ILLUMINATION UNITS—CONVERSION FACTORS.

Illumination units.	Meter-hefner	Meter-candle (German lux)	Foot-hefner Foot-candle (International)	Meter-candle (International lux) Meter-bougie)	Meter-carcel
Meter-hefner (German lux)		0.9929	0.0837	0.9009	0.093
Foot-hefner	10.76		0.909	9.71	1.031
Foot-candle (International)	1.08	1.11		10.70	1.034
Meter-candle (International lux) (Meter-bougie)	1.11	0.103	0.920		0.104
Meter-carcel	10.75	0.9986	0.966	9.61	

Augsburg, Germany. Berthold Monasch.

[Even if one assumes with our correspondent that all of the variations in the ratio of the hefner to the bougie-décimale

have been caused by changes in the latter, while the former remained impeccable, yet the fact remains that the *lux* was defined originally as the *meter-bougie,* and thus its value should have followed the changes in this unit rather than remained fixed by the meter-hefner, to which it happened once to be equal. Accordingly, the "lux" should now be considered solely as the equivalent of the international meter-candle differing by 11 per cent from the German meter-hefner.—Ed.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Rectifier.—A. Soulier.—A description of a rectifier for changing alternating current to direct current. In a former apparatus of this kind devised by the author only one-half of the alternating wave was utilized. In the present device he utilizes both half waves. The arrangement is shown in Fig. 1.

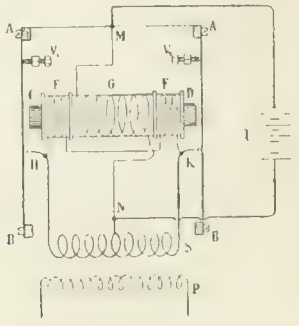


FIG. 1.—DIAGRAM OF RECTIFIER CIRCUITS.

Two vibrating telephone diagrams *AB* and *A'B'* suspended at their two ends have in their centers contact pieces which will make contact with the points *H* and *K* when the diaphragms vibrate. The soft-iron core *CD* has a coil *G* through which is passed a direct current, which may be taken from the rectified current obtained from the apparatus, as shown in the illustration. The two coils *E* and *F* at the two ends of the iron core are supplied with alternating current from the network. In the illustration *P* is the primary coil of a transformer connected with the alternating-current network. *S* is the secondary coil. All other connections are self-explanatory. From the points *M* and *N* a direct current can be taken off. This may be used to charge a storage battery, indicated by *U* in the diagram. The chief feature of the telephone diaphragms is that they will vibrate synchronously with any alternating current of usual frequency, say, between 25 cycles and 100 cycles per second. If the ratio of self-inductance to resistance of the circuits is properly chosen, it can be easily accomplished that the movement of the diaphragm is in time-phase with the alternating current, so that at the moment when the circuit is opened, the current is exactly zero. This can be easily obtained with the currents of from 10 amp to 30 amp at from 100 volts to 150 volts. Under these conditions there will be no sparks and the contacts will last a long while.—*L'Industrie Elec.,* Sept. 25.

Magnetic Properties of Iron-Manganese Alloys.—C. F. Burgess and J. Aston.—An account of an experimental investigation of the magnetic properties of iron-manganese alloys. Magnetization curves of such alloys, prepared with different heat treatment, are given. The deductions to be drawn from these tests have an important bearing upon certain problems in the manufacture of steel for electrical purposes, particularly steel castings. It is well known that there is a decided lack of uniformity in this material, and experience shows that numerous concerns have difficulty in making castings of this class, although for other purposes their product is of high grade. The results of the authors indicate a falling off in the magnetic quality of the alloys with an increase of manganese. For a percentage of 0.50 the permeability is only slightly less than that of the standard electrolytic sample. At 1 per cent Mn the quality has become appreciably less, and on further increase to 2 per cent the alloy is of comparatively low grade. It might be advisable not to use manganese in steel for electrical purposes at all. Of still greater importance, however, is the proper heat treatment.—*Electrochem. and Met. Industry,* November.

Movement of Energy in Generators.—F. Emde.—On the basis of Maxwell's electromagnetic theory, Poynting proposed 25 years ago a hypothesis on the movement of the energy in and around a wire carrying current. The present author applies the same theory to the movement of energy in generators. From the prime mover the energy is transmitted mechanically to the axle of the generator. The flow of energy in the generator is in a radial direction from the axle to the circumference. At the armature surface the energy is deflected from the radial direction and flows off in the form of electromagnetic energy through the air to the air space between the conductors on the transmission line. There the energy follows the laws of Poynting.—*Elek. und Masch.* (Vienna), Oct. 2.

Theory of Commutation.—J. Sumec.—The first part of a theoretical paper on the present status of the theory of commutation. The author discusses especially the two following problems: First, the self-induction and the strength of the commutating field, and, secondly, the question of the infinite current density at the moment when a brush leaves a segment.—*Elek. Zeit.,* Oct. 7.

Slip-Ring Motors.—F. Niethammer.—An article on devices for short-circuiting the slip-rings and removing the brushes when an induction motor has accelerated to full speed. The author describes and illustrates, first, the usual arrangement and then a second arrangement in which the slip-rings are placed, not side by side, but concentrically one in the other. The brushes slide laterally and the sliding surfaces are not cylinders, but planes perpendicular to the axle.—*Elek. und Masch.* (Vienna), Sept. 26.

Exciting Current.—E. Stadelmann.—An article discussing the principles of different methods of regulating the exciting current for separately excited single-phase or polyphase generators.—*Elek. Anz.,* Sept. 30.

Lamps and Lighting.

Increasing the Popularity of Electric Lighting.—E. Wikander.—As was noticed in the Digest, recently there has been in the columns of the *Elektrotechnische Zeitschrift* an extended discussion of ways and means for making electric lighting more popular, especially with small consumers. The present author, who started this discussion, is now summing up the results. He does not think that the present price of electrical energy is the main factor which prevents small consumers from using electric lighting. If this were true, the introduction of metallic-filament lamps should have brought far more connections than has been the case. He thinks that the main point must be to facilitate the wiring of houses and residences. Various central stations have already gone ahead in this direction, especially privately owned stations in contradistinction to municipal stations. The results seemed to show that such a policy has resulted in better financial returns. The author first mentions three chief methods. The first is that used by the Berlin Electricity Works to carry out the wiring free of charge, and then charge continually a high price for the energy. The second method is to carry out the wiring at the expense of the central station and to cover the cost by the stipulation that the consumer has to guarantee a certain minimum amount of payments during the first years, to cover both the cost of the

wiring installation and the cost of energy. This method has brought good results in Strassburg. The third method is to let the consumer pay for the installation and to supply him with energy for a certain time, for instance, for a year, either free of any charge or at greatly reduced prices. Other recommendations which have been made by various correspondents are to let the consumer pay for the cost of wiring on the instalment plan; the sale of suitable and inexpensive fittings by the central station; the reduction of the meter rent; sale of lamps, arc-lamp electrodes, etc., at cost to the central station; simplification of the wiring rules; putting before the public by advertisements and personal canvass from house to house the advantages and cost of electric lighting, etc. As to the question whether a flat rate is suitable it appears that just one-half of the correspondents were in favor of it and the other half against it. It appears that the chief reason advanced against a flat-rate charge is to be found in the fact that very often the flat rate has been placed at too low a figure. The remedy is evidently to make the yearly rate per kilowatt so high that with the long hours of lighting to be expected, the central station will earn at least as much per kw-hour as from the average of the consumers who pay a rate according to a meter. Fraud can be easily prevented by means of devices which limit the consumption. Such devices are much cheaper than meters. In fact, the use of such devices changes the whole character of the simple flat rate. The author recommends allowing the consumer to choose between the rate based on metering the energy and on the flat rate with limiting devices. He urges that more central stations should try such a system.—*Elek. Zeit.,* Oct. 7.

Flame-Arc Lamps.—A description of a new flame-arc lamp of the Siemens-Schuckert Company with "TB" electrodes for direct-current and alternating-current circuits. With the usual

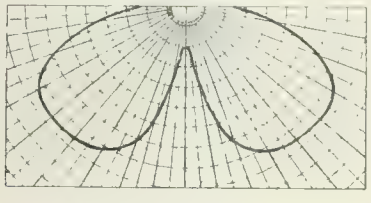


FIG. 2.—DISTRIBUTION CURVE.

flame-arc lamps quietness of the arc can be obtained only when the diameter of the electrodes is small. To get a sufficiently long life of the electrodes they must, therefore, be long and must be arranged side by side. Such lamps generally send most of the light vertically downward. With "TB" electrodes it is possible to use larger diameters and to get the same quietness of arc. Almost the whole cross-section of these electrodes is impregnated and only the thin surrounding cylinder which holds the impregnated electrode in shape is of pure carbon. Such thick electrodes can be made relatively short and arranged one above the other in the lamp. This gives the same favorable distribution of light as is obtained with arc lamps with pure-carbon electrodes. The distribution of candle-power is indicated in Fig. 2, which shows that the maximum of candle-power is at an angle of about 50 deg. from the vertical. For this reason the maximum of illumination of the

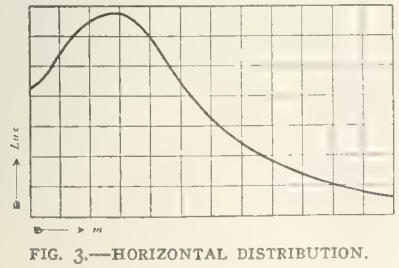


FIG. 3.—HORIZONTAL DISTRIBUTION.

ground is at some distance from the lamp. Fig. 3 shows the illumination of the ground by an alternating-current arc lamp with "TB" electrodes. The ordinates give the illumination in lux and the abscissas the distance of the point illuminated from the point below the lamp in meters. If arc lamps of this kind are arranged properly a very uniform illumination of the ground can be obtained. A special arrangement, which is not described, is used to prevent any deposition of salts from the evaporation of electrodes on the globe. It is claimed that after 16 hours of burning the globe is as clear as at the start. The light from these arc lamps is purely white. They are built either for 30 volts or 40 volts. The 30-volt lamps are used three in series at 110 volts. The 40-volt lamps are used two in series.—Supplement to *Elek. Zeit.,* Oct. 7.

Sale of Metallic-Filament Lamps by London Gas Company.—A letter and some notes on the sale of metallic-filament lamps (which are not the Osram lamp) by the Welsbach Incandescent Gas Lamp Company of London. No attempt is being made to cut the retail price of the lamps, which is the same as that of those with which the company is competing. The Welsbach company does not limit its business to its existing agents, but will be prepared to supply lamps to any firm of lamp dealers or wiring contractors on a trade basis. The offer to replace consumers' carbon lamps with metallic-filament lamps, and to accept in payment a sum equivalent to the reduction in the consumers' electric lighting bill, is also made to any lamp dealer or contractor. Consumers who write to the company to say that they are desirous of profiting by the offer advertised are asked to give the name of their lamp dealer, and, if the company is satisfied that the firm is a reputable one, the order is passed on to him and he carries out the work and makes the necessary arrangements for the collection of payment on the basis advertised. At any rate, up to the present no particular form of agreement with the consumer has been drawn up by the company, and the agent who supplies the lamps is left a free hand in this respect. Moreover, the company is prepared to indemnify the consumer and agent against patent proceedings. The Welsbach company's offer extends only to the replacing of carbon lamps by metallic-filament lamps, and does not include making any change in the consumer's wiring or any other alterations or additions to the consumer's installation.—Lond. *Elec. Eng'ing,* Oct. 7.

Counter-E.M.F. of an Arc.—C. D. Child.—A review of the literature on the subject of counter-e.m.f. of the electric arc shows that this expression has been used with several different meanings, and the most recent meaning is not the same as that given to the expression when applied to a cell or an electric motor. A review of the literature on the residual e.m.f. of the arc shows that the majority of experimenters have found such an e.m.f. whose value was somewhat less than 1 volt. This e.m.f. has been explained as being due to the difference in temperature of the electrodes. This was tested by cooling the anode by three different methods and the results were in harmony with such an explanation.—*Physical Review,* September.

Universal Arc Lamp.—A long letter by O. Arendt discussing Bermbach's recent paper on the Conta arc lamp, with special reference to the question whether patents of the Beck arc lamp have been infringed. Also reply of Bermbach.—*Elek. Zeit.,* Oct. 7.

Mercury Arc.—I. Ladoff.—An illustrated article on the evolution of the mercury-arc lamp from the earliest forms to the recent quartz lamp.—*La Lumière Elec.,* Oct. 2 and 9.

Generation, Transmission and Distribution.

Electricity in Building Operations.—The first part of an article in which a description is given of the application of the electric drive to the machinery employed by builders and contractors, typical installations of mortar mills, concrete mixers, etc., being illustrated. The opinions of a few building contractors as to the advantages to be obtained by the use of electric motors are then put forward, and finally the position of the electric supply authorities in various British towns is outlined, as indicated by the prices charged for electrical energy and the provisions made for hiring out electric motors.—Lond. *Electrician,* Oct. 1.

Motors in Mines.—Henke.—A paper read before the Electrical Society of Hanover on the use of electric motors in potassium salt mines for mining, hoisting, grinding the salt, etc., with special reference to the installation of the potassium salt works of Friedrichshall, A. G., Sehnde.—*Elek. Zeit.*, Oct. 7.

Traction.

Railless Omnibus.—Trial runs are being made with a trolley omnibus on an experimental road at Hendon, in England. The car has two 25-hp motors driving countershafts through bevel gears. A two-wire overhead construction is used, and contrary to practice in Continental Europe the frame of the car is electrically connected to the earthed negative trolley wire. A device to warn the driver if the car becomes connected with the positive wire is provided. As an alternative a three-wire line may be employed. The two sets of trolley wheels are mounted on the same head at the end of a double pole, and means are provided to counteract the side pressure when the car deviates from the center of the road.—Lond. *Elec. Eng'ing*, Sept. 30.

Installations, Systems and Appliances.

Control of Voltage.—W. Kallmann.—A paper read before the Berlin Electrical Society on the voltage control in central stations with the aid of variators—that is, iron resistors in a hydrogen atmosphere, such as are used in "ballast" in connection with the Nernst lamp. Fig. 4 shows the principle of the

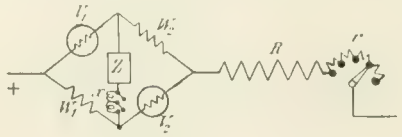


FIG. 4.—DIAGRAM OF CIRCUITS.

arrangement. V_1 and V_2 are two such variators, W_1 and W_2 are two resistors of constant resistance. Z is an amp-hour meter or other meter which may be connected in series with the resistor x to reduce the sensitiveness. For alternating current an induction meter is suitably used. R is a resistor of constant resistance, the value of which is chosen according to the voltage to be controlled. It is connected in series with the resistor of adjustable resistance r. The variators V_1 and V_2 may be enclosed in oil to increase their sensitiveness and the speed of the variations. The use of a meter Z instead of a voltmeter has distinct advantages as it enables one to get a much higher sensitiveness than with most voltmeters or relays, and, moreover, the rotating motion permits a very simple indication for optical devices. If account be taken of the fact that the voltage drop in the main current coil of ordinary electricity meters or in the main-current resistances of direct-

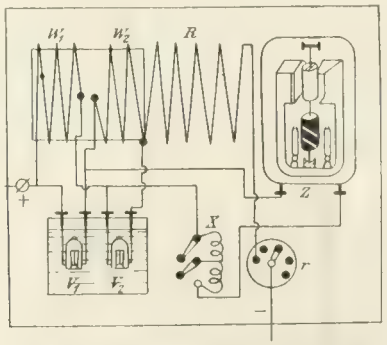


FIG. 5.—ARRANGEMENT OF CIRCUITS.

current amp-hour meters is hardly more than 1 volt at maximum load, it is evident that even a small voltage acting on the main-current coils will produce quite a strong rotation of the meter. The meters begin to run at 1 per cent of maximum load, so that an e.m.f. of 0.01 volt is sufficient to start the meter. A practical arrangement of this method is shown in Fig. 5. If the voltage rises or falls the meter will begin to rotate either in the one or the other direction.—*Elek. Zeit.*, Oct. 7.

Electricity in Agriculture.—Lewin.—An account of various electric installations made by the Allgem. Elek. Ges. for agricultural purposes in Germany. An account is given of three agricultural central stations. The Vangerom-Lottin station has a 300-hp water-power plant and an 180-hp steam plant as a reserve. This station supplies energy to 61 agricultural undertakings and five townships, together with 41,200 acres of arable land. The network of connecting wires is 137 km in length, supplying energy over an area of 270 sq. km. There are 102 consumers with 150 motors, equal to 1115 hp, and about 5000 incandescent lamps. During last year about 440,000 kw-hours were supplied at an average price of 3 cents for motors and 6.85 cents for lamps. The second station, Bartin-Beswitz, which commenced operations last year, started with a transmission line of 180 km, but 40 km have been added, and this station now supplies energy over 170,000 acres, of which 80,000 are plowed land. There are 180 motors and about 5000 incandescent lamps, representing a total of approximately 1300 kw. The price of energy for lamps is 6.25 cents; for motors there is a sliding scale of from 2.75 cents to 3.75 cents. Each member of the syndicate has to guarantee a minimum consumption of 5 kw-hours per year per acre of arable land. An estate of 2000 acres of plowed land must, accordingly, consume 10,000 kw-hours per year. The Birnbaum-Meseritz-Schwerin station has also begun operations, and already supplies energy to 10 estates and 14 villages. Transformers convert the high voltage to a lower pressure, such as is required for use on estates and in villages. The transformers are generally housed in small buildings; for field work, however, where the energy is required in various places, portable transformers are used. By means of a flexible connection the primary of the transformer can be joined to the overhead wires at any desired point, while the secondary is connected to the motor. Thus the agriculturalist is in a position to make use of the energy in any portion of his land. Electric locomotives are also used for agricultural purposes, and two plants in which electric energy is used for drainage purposes is noted. —Lond. *Elec. Review*, Oct. 1.

Calculating the Probable Financial Returns of a Central Station.—J. Mathieu.—The author thinks that on the basis of statistical data it is possible to get sufficiently accurate empirical constants by means of which to derive a formula which will indicate under which conditions a central station of given size will be financially successful. The author gives formulas and curves for the solution of this problem. One of the problems which can be solved in this way is the finding of the minimum number of kw-hours per year which a central station of a given kw-rating must produce in order to earn money. Different curves are derived according to the proportions of energy employed for lamps and for motors, respectively. Numerical examples are added.—*La Lumière Elec.*, Oct. 9.

Municipal Tax on Electricity.—F. Niethammer.—Some notes on and criticisms of the new tax on electricity which is to be levied by the city of Brünn, in Austria. It will be valid for the next three years, and after that the State itself seems to intend to levy a tax on electricity. The tax amounts of 0.4 cent for each cubic meter of gas consumed for lighting and to 2 cents for each kw-hour of electrical energy used in lighting. Since the price of the kw-hour in Brünn for lighting has always been high, namely, 14 cents per kw-hour, it will now be 16 cents.—*Elek. und Masch.* (Vienna), Oct. 10.

Wires, Wiring and Conduits.

Magnetic Blow-Outs for Circuit-Breakers.—A note on a recent British patent of T. Von Zweigberck (25,954, 1908; Sept. 30, 1909). In circuit-breakers for direct-current lines operating at e.m.f. of from 3000 volts to 4000 volts, the current density in the blow-out coils has, it is stated, to be of the nature of 20,000 amp to 28,000 amp per square inch in order to bring the size and cost of the coils within practical limits. Auxiliary contacts are sometimes used to charge the blow-out coil just before the switch is opened, but these are not always

satisfactory. According to the present invention, the current in the blow-out coil depends on the position of the arc to be blown out. In addition to the two main contacts a third is provided, and the blow-out coil is connected between this, and, say, the positive main. Normally, no current passes through the coil, but directly an arc is formed, it is transferred from the main positive contact to the auxiliary contact, so that the whole current passes through the blow-out coil. A description is given of special arrangement by which the blow-out coil is normally in series with a high resistance, the two being shunted across a low series resistance in the main circuit. When the arc jumps to the auxiliary contact, the two resistances are in series and are shunted across the coil, which then carries the main current.—Lond. *Elec. Eng'ing*, Oct. 7.

Electrophysics and Magnetism.

Source of Light Radiation.—T. P. Irving.—An account of an experimental investigation of the electrical character of the source of light radiation. The author has studied simultaneously the electrical and spectroscopic characters of the divided Bunsen flame, both in its simple state and when colored by metals or salts. One of the most important results of this investigation is the demonstration of the presence of principal series lines in sources whose electrical character presents qualitative differences. This fact is brought out most clearly in the case of lithium. The Li outer cone is electrically neutral and principal series lines are obtained from it; the Li flame above the inner cone is always positive and principal series lines are obtained from it also. Therefore, the principal series lines of Li arise from a positive or neutral source.—*Physical Review*, September.

Radiation.—S. J. Allen.—An account of an experimental investigation of the secondary radiation produced from solids, solutions and pure liquids by the beta rays of radium. Although in a great many cases the secondary radiation does seem to be a function of the atomic weight, yet there are many exceptions which are undoubtedly in some way closely associated with the way in which the atoms are combined with one another chemically. It is still too early to put forward any hypothesis to account for the experimental results.—*Physical Review*, September.

Photoelectric Effect.—J. Kunz.—A theoretical paper on the photoelectric effect of sodium-potassium alloy and its bearing on the theory of the structure of the ether.—*Physical Review*, September.

Discharges in Gases.—R. F. Earhart.—An account of the experimental investigation of the effect of temperature variations on the luminous discharge in gases at low pressures.—*Physical Review*, September.

Electrochemistry and Batteries.

Electric Zinc Smelting.—E. Fleurville.—An illustrated article in which the author first considers the possibility of electric zinc furnaces compared with the present retort furnaces. He then gives a review of experiments made with the Côte-Pierron process, which is now in use on a commercial scale in southern France. In order to facilitate the condensation of the zinc vapor use is not made of carbon as a reducing agent, but iron, and by the direct reaction between zinc blende and iron in the electric furnace they obtain iron sulphide and zinc vapor. The latter is not diluted with inert gases like carbon monoxide, so that the condensation will be more easily accomplished. For the present they have, however, only produced zinc white, and for this purpose they use the reaction between zinc blende and lime and carbon. The process seems to be a commercial success.—*Electrochem. and Met. Industry*, November.

Electric Furnace Efficiency.—C. Hering.—An article on the electrode efficiency of furnaces, supplementing the author's former article on furnace electrode losses. For any given electrode material there exists a minimum drop in voltage between the hot and cold ends of the electrode. It depends on the temperature difference between the two ends, and on the ratio of the electric and thermic conductivities of the material. For graphite it is 0.0231 volt per degree Centigrade.—*Electrochem. and Met. Industry*, November.

Pinch Effect.—J. Harden.—An account of various observations of the "pinch effect" in electric furnaces of the induction type, with additional notes on the peculiar movements of the charge in an induction furnace.—*Electrochem. and Met. Industry*, November.

Tungsten Valve Electrode.—L. H. Walter.—The metal tungsten, like aluminum and tantalum, behaves as a valve electrode in a large number of electrolytes, those which have been tried being for the most part of high conductivity and less adapted to the securing merely of high critical voltages. The critical voltages in the strong acids are, as a rule, higher with tungsten than with aluminum, but not so high as with tantalum. The maximum pressure obtainable being 90 volts, it was found that this voltage could be withstood by the tungsten anode in sulphuric acid of 1:15 concentration (15), in potassium iodide (0.2), acetic acid (0.1), potassium bichromate (1.8), sodium potassium tartrate (0.1), and borax (1.0) solutions, none very dilute. The sensitiveness of the tungsten valve to heating is not at all pronounced, while the valve seems to be very sensitive to the cutting off of the current. For practical uses the high concentration of the acid must be taken into account.—Lond. *Electrician*, Oct. 1.

Units, Measurements and Instruments.

Magnetic Measurements.—V. Bjerknes.—A highly theoretical paper on the absolute measurement of electromagnetic quantities.—*Physical Review*, September,

Telegraphy, Telephony and Signals.

Telephone Transmitter.—Successful experiments made with a new telephone transmitter of C. E. Egner and J. G. Hölmstrom over a 4.5-mm line between Stockholm and Paris, about 2500 miles in length, have been noticed before in the Digest. The construction of this transmitter is the subject of a recent British patent (12,918, 1909). The principle upon which the instrument is based is that the diaphragm is so clamped that there can be no doubt that the point of the greatest vibration is exactly at the center, and the front disk of the microphone (which in this instrument is not formed by the diaphragm itself) is so fixed that its entire surface moves with this maximum amplitude. This arrangement is indicated in Fig. 6.

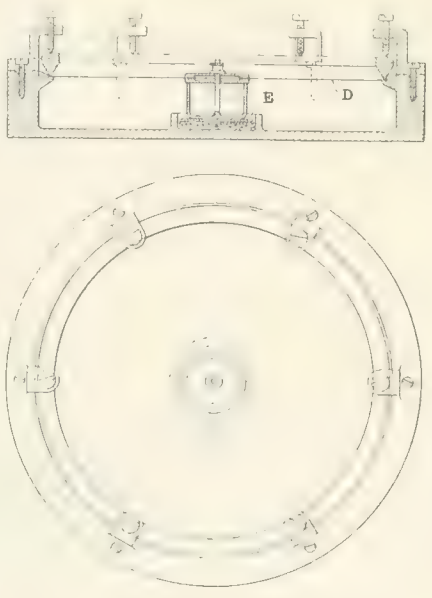


FIG. 6.—TELEPHONE TRANSMITTER.

The method of clamping the diaphragm *D* with an additional clamping ring is shown, as is also the attachment of the front disk *E* of the microphone, which, it is seen, is devised in such a manner that the movement of the ends of the disk is the same as that of the center. As an alternative form, there is described a multiple transmitter in which use is made of a number of microphone cells fixed at several points around a

disk F, as shown in Fig. 7—in which, however, one only of the microphone cells is shown so as not to confuse the sketch. There will thus be absolute synchronism between all the cells. The thin cylinder connecting the disk F to the diaphragm is of steel, and is perforated to save weight and also to assist cooling. The cups containing the carbon granules are supported in such a way that by rotating the ring G the height of them all can be adjusted simultaneously, while the screw H affords a means of adjusting each cell separately. In a previous patent (6587 of 1908, the only other patent taken out by these inventors during the past few years), a description is given of a microphone in which is hermetically sealed the chamber containing the granules and holding hydrogen or a hydrocarbon gas instead of air.—Lond. *Elec. Eng'ing*, Oct. 7.

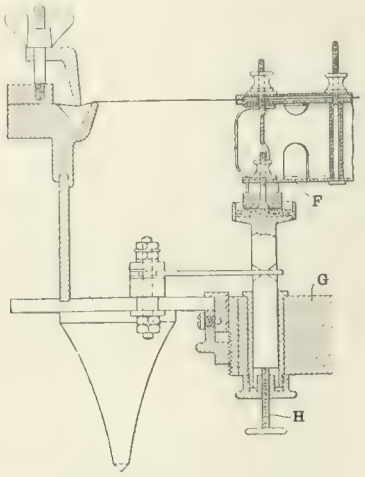


FIG. 7.—TELEPHONE TRANSMITTER.

Multiplex Telephony.—A. Maior.—The author purposes a system of multiplex telephony in which the microphone currents are superposed on an alternating current and use is made of resonance phenomena. The principle is shown in Fig. 8, where the two stations are shown at the left and right. E is a high-frequency alternator. In the left-hand station M_1 and M_1' are two microphones and T_1 and T_1' two telephones. Z_1 and Z_1' electric rectifying valves; for instance, electrolytic aluminum rectifiers. They are so arranged that one rectifier permits one-half of the alternating current to pass while the other rectifier permits the other half to pass. In the right-hand station the electrolytic valves are so arranged that Z_2 permits the passage of only the half of the wave which comes from Z_1, while Z_2' permits the passage of only the half of the wave coming from Z_1'. The microphone currents superposed in the circuit a upon the high-frequency current can be heard in the circuit A by the telephone T_2 and the microphone currents superposed in the circuit b can be heard in B by the telephone T_2'. On the basis of this principle it is possible to transmit four conversations simultaneously with the aid of two alternating currents. The difference of the frequencies of the two alternating currents must be found experimentally. The connections are shown in Fig. 9. E_1 and E_2 are two alternators with different frequencies. L_1, L_2, L_1' and L_2' are inductance coils, while C_1 and C_2 are capacities, so that the system A is brought into resonance with E_1 and system B in resonance with E_2. The electrolytic valves are so arranged that the microphone currents from a are passing only through a_1, from b only through b_1, from c only to c_1, and from d only to d_1. The microphones and the telephones are not shown in this diagram. The same principle may be used for multiplex telephony.—*Elek. Zeit.*, Sept. 23.

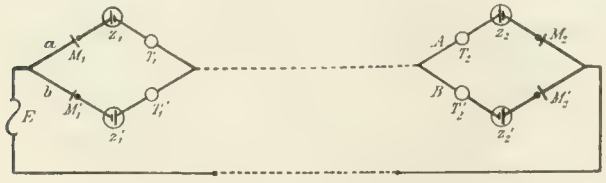


FIG. 8.—PRINCIPLE OF MULTIPLEX TELEPHONY.

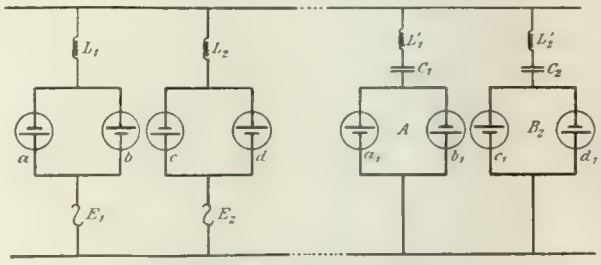


FIG. 9.—DIAGRAM OF CONNECTIONS.

Wireless Telegraphy.—J. Bethenod.—A mathematical paper on the calculation of the damping constant in an antenna with indirect shunt excitation.—*La Lumière Elec.*, Oct. 2.

Miscellaneous.

Engineering Profession.—G. A. Thomas.—A paper read before the (British) Society of Engineers. The author deals at length with a number of ways in which the present position of the engineer, both internally and relative to other professions, might be improved. Overcrowding, misuse of the word "engineer," and multiplication of societies and other evils requiring mitigation are gone into, and schemes for education and registration suggested. The disabilities of consulting engineers are also considered.—Lond. *Electrician*, Oct. 8.

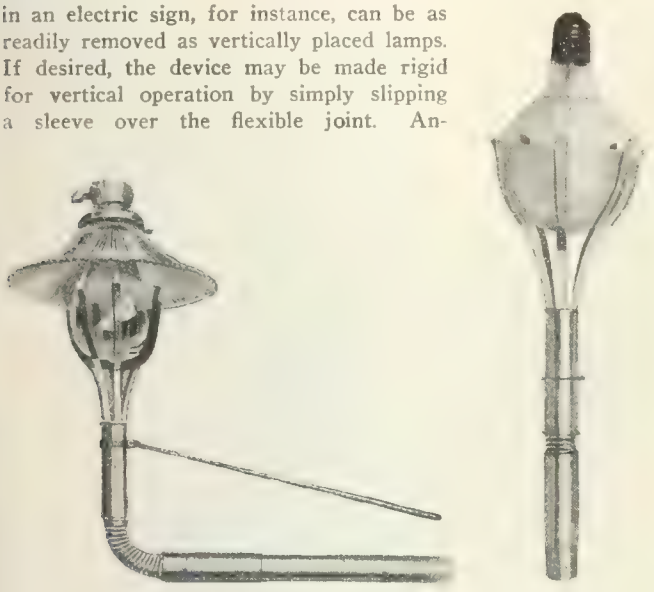
NEW APPARATUS AND APPLIANCES

National Electric Lamp Association at New York Electrical Show.

The exhibit of the engineering department of the National Electric Lamp Association at the New York Electrical Show occupied the same position that it did in previous years, at the right of the main entrance. All types of the regular multiple tungsten lamps in prismatic reflectors, hanging pendant from arches which conformed to the general style used in the show, surrounded the booth. Upon special exhibition racks were exhibited all of the latest improvements in tungsten high-voltage sign and multiple 110-volt types, as well as the tantalum series-burning lamp for street-railway service and the high-voltage tantalum. This portion of the exhibit showed the most recent developments in the lamp industry. Street series-tungsten lamps held a prominent position, being equipped with regular street-series prismatic reflectors and suspended from brackets on the corner posts. The tungsten sign lamp for low-voltage circuits, which is coming into very general use, was given special attention. The exhibition of the original carbon-filament incandescent lamp made by Goebel long before the cellulose carbon-filament lamp was invented created a great deal of interest. In the center of the booth was exhibited a large glass case which contained a complete line of tungsten, tantalum and Gem lamps, both regular and miniature styles, hanging pendant from brass fixtures. The entire furnishings of the booth were in conformity to a special finish of oak, which was uniform for the cases, racks, tables, chairs, etc. The exhibition of the Engineering Department was in charge of Mr. P. F. Bauder, assisted by Messrs. P. S. Dodd, C. O. Brandall and N. H. Boynten.

Adaptable Lamp-Changer.

A simple, but ingenious, lamp-changer intended to facilitate the placing and removing of incandescent lamps in places that would be otherwise inaccessible except by the use of a ladder is illustrated herewith. The device is adjustable to any type or size of lamp, and is provided with a flexible spiral joint so that lamps installed in a horizontal position, as in an electric sign, for instance, can be as readily removed as vertically placed lamps. If desired, the device may be made rigid for vertical operation by simply slipping a sleeve over the flexible joint. Another sleeve is provided by which the opening on the jaws adapted to receive the lamp may be regulated. Thus, the device can be used for a large meridian lamp, as shown in one of the illustrations, or it can be made small enough to remove the base of an ordinary incandescent lamp in case the bulb should be broken off. The tool is compact and well made, and weighs only 4 oz. without the pole or handle. Poles are furnished separately, and can be either of nickel, steel, aluminum or wood. The jaws of this lamp-changer are protected by rubber so that no damage to the lamp will result in screwing it into the socket or taking it out. The device is made by the Illinois Appliance Company, 646 First National Bank Building, Chicago.



FIGS. 1 AND 2.—LAMP-CHANGER.

Pocket Meters.

Those engaged in electrical pursuits have become so accustomed to the large power installations of the present time that they are apt to lose sight of the fact that an immense number of units of energy in the aggregate are being used in the shape of dry cells and small storage batteries, and that the daily production of batteries in this country, measured by their kw-hour capacity would, if known, be astonishing.



POCKET METER.

The widespread use of batteries has led to a demand for small pocket meters with which to test them, and the Hoyt Electrical Instrument Works, early recognizing the importance of this field, have devoted a great deal of attention to it. Their latest addition to their line of small meters consists of ammeters and voltmeters approximately the size of a No. 16 watch. A novel feature of these instruments is a silver-plated metal scale which combines accuracy, durability and tastiness in design. Realizing that the first requisite is careful standardization, the makers claim to have designed every part so carefully that exhaustive tests have failed to show any material error in any part of the scale.

These meters are of the permanent-magnet type, and in designing them the purpose of their use has been constantly kept in mind. The relation of the moving system to the poles of the permanent magnet is such as to insure a practically dead-beat movement, with extreme sensitiveness to current changes. Every detail has been carefully looked after, even to the construction of the case, which is substantially made in one piece to insure rigidity and mechanical accuracy.

A novel design of lettering has been adopted for the dial, and it is the purpose of the makers to carry out the same idea in all instruments of this type in order to distinguish them readily from other meters of somewhat similar general appearance.

Screwless Monkey-Wrench.

The Wright Wrench Manufacturing Company, Canton, Ohio, has brought out a monkey wrench which differs radically from the familiar type on the market. It is made without a screw, and is adjusted to fit the nut by means of a slight pressure upon the jaw with the thumb of the hand holding the wrench. The device is made of drop-forged steel, carbonized, mottled and hardened, and consists of the following parts: The bar, which forms the handle and head; the jaw; the pawl set into the jaw; the rack, which when the wrench is put together is set into the bar and held in place by a set screw, and the spring. When the wrench is put together the jaw slides up and down on the bar, after being released by a slight pressure of the thumb. When the jaw is adjusted to fit the nut the pressure is taken off the spring, and immediately the pawl engages the rack holding the jaw firmly in position. The pawl and the rack have a set of ratchet-like teeth, which fit into each other and prevent the jaw from having any play after it is once set. The jaw is instantly released from the nut, however, by a slight pressure upon the spring. The standard wrenches are made in 6 in., 8 in., 10 in., 12 in., 15 in. and 18 in. sizes.

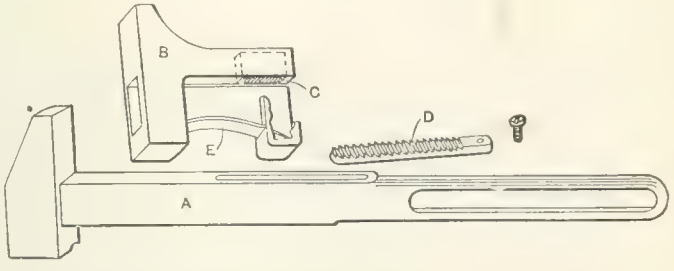


FIG. 1.—DETAIL PARTS OF SCREWLESS MONKEY WRENCH.



FIG. 2.—SCREWLESS MONKEY-WRENCH.

Meeting of Technical Publicity Association.

The first of the Technical Publicity Association's monthly meetings for 1909-10 was held Thursday evening, Oct. 14, in its headquarters, 14 Gramercy Park, New York. The president of the association, Mr. Charles S. Redfield, advertising manager of the Yale & Towne Manufacturing Company, was toastmaster. The only extended address was that of Mr. George French, editor of *Advertising and Selling*.

Mr. Howard M. Post, advertising manager of the Western Electric Company, told of plans for a systematic, analytical study of effectually tracing results from trade-paper advertising. The keying method, he said, has proved inadequate, and there should be some way of determining the effect of such advertising. At the conclusion of a discussion of this subject Mr. Post was made chairman of a committee to outline this study work for the association.

The remarks of Mr. French were an interesting presentation of the psychological and artistic aspect of advertising. His hearers were taken into the field of optics, and shown the effect advertisements have upon the eye of the reader.

Mr. French took as his text the postulate of Hugh Chalmers in a recent address at Louisville, namely, that every sale by anyone anywhere is made in a man's mind—the mind of the one to become the purchaser. "Advertising is profitable," he said, "only when we consider this one thing. The individual advertisers are the men who create, who place, who look at this. If I am to do anything, if I am to be effective, I have got to get the mind of the man to whom I am to sell goods. We all realize this, and all work toward it. If we want to arrive at any point, even if that point be the North Pole, we want to locate that place first—to fix it on the map. I will assume that in order to sell goods there must be a salesmanship message in the mind of the customer. The question is how to place that message; what kind of place is the mind; how does it comport itself; what that message is to be, and how is it to be sent."

This led to the statement of the subject, psychology. He made his chief point in the phenomenon of suggestion. "It is well to assume," continued Mr. French, "without any discussion that every human mind is favorably inclined to receive a suggestion. This is a psychological fact, established and indisputable. There are many fallacious ideas in circulation about suggestion. There is nothing occult about it. It is not even mental, but purely a physical quality of the mind. It is guided by definite, well-known, or rather, well-ascertained laws. Memories and forgotten knowledge are in the mind, and help to make its decision." The illustration Mr. French gave was that of a fork in a road. "A man must decide," he said, "which way to turn, whether to the right or left. Once he has made his decision to go to the right, all thoughts and ideas having any connection with the left road are banished from his consciousness." Mr. French added that it adds greatly to one's power and his clearness of expression and lucidity to look up psychology and the matter of suggestion. Reference was made in passing to Prof. Hugo Münsterberg's "Psychotherapy."

Mr. French then came to the second part of his subject, which he declared to be more or less allied with psychology. "The principles and fundamentals of art are a great help also to advertisers," he said. "This is largely mechanical, largely psychological. In advertising it is of the first importance. You must think of your advertisement as a picture. The eye has to have something to attract it, or a person can't be impressed. The impression is dulled unless there is a distinctive something to attract the eye, like a picture. Certain elements or qualities go to make an advertisement attractive. These are the same that lie behind every piece of art; that is, true art. Some of these are form, proportion, balance, harmony, tone, symmetry, perspective, color. They are easy to get if in planning you have in mind their usefulness. The most common form in advertising is the oblong rectangle. This is a rule of proportion. It can't be varied without bad results. Three to five, broadly, are the proportions. This is about the shape of a magazine text page. It is also the proportions of a properly constructed cross. Radiating from the point of intersection of the cross one may work out symmetry, harmony and tone. A harmonious tone is almost impossible with the use of half-tone illustrations. Personally, I am very glad to see the renaissance of the line engraving, or the pen-and-ink sketch, in the work of advertising. It doesn't 'hog' all the attention given to the advertisement.

"This is a profitable line of study. Advertising may be made especially attractive, and one may trace the cause back to these principles. Some advertisers, I do not recall now just which ones, use lower-case type in the display line to produce a harmonious effect. These principles of art have never been gathered together anywhere especially for advertisers. We have to read through a good many books, and perhaps only a few pages in each have direct bearing.

"One other line of study is well worth reading up a little, and that is optics. The power of the eye is extremely limited. It seeks to reject the printed matter we seek to impress upon it. It acts in a seemingly erratic manner in reading. It doesn't travel steadily, but in jerks and jumps. These are known as fixation points. The eye wants to stop; it goes on haltingly, painfully. The normal reading line is not over 3½ in. wide. This the eye can take in with five, six or seven fixations. It should be divided up so that the eye can read it easily. Catchlines should be of such a nature that the eye can pick them up without conscious impulse—without any effort of the will. There should be no obstacles. This is of the utmost importance to the advertiser."

In response to a query as to the size of the type, Mr. French said that "Type below 9-point is apt to be less agreeable than 9, 10 or 11. We must also consider the design. Only two or three designs of type face endure. All publishers have noticed how many series of type have dropped out of use. Almost all that have lasted are of the pure Roman style, because it is more agreeable to the eye. Caslon type, now more than a century old, is just as popular to-day as when first put forth."

Mr. French re-stated his thesis in the words that "It is from science and pseudo-science, from art and physiological-psychological questions, such as optics, the groundwork of advertising, that we can gather a great fund of strength and knowledge. Not only that, but it is a delightful field to grub around and study in."

After disposing of business matters the association adjourned to meet again in the same place on Nov. 11.

Semi-Enclosed Arc Lamp.

The Stillwell-Van Demark Company, of New York, has placed on the market, under the trade name "Stilvan," a type of semi-enclosed arc lamp said to possess a number of desirable features in construction. Rigidity is imparted to the structure by two parallel rods which run the length of the lamp and to which the various parts are secured. The upper electrode holder guide is of the parallel rod construction, insuring free movement of the holder. The circuit connection to the positive electrode is made through a flexible wire and screw contact on the holder. In this lamp small diameter carbons held in coaxial relation to each other are used and burned at a high-current density. This causes the carbon points to heat to a white-hot incandescent stage and after the lamp is burning for a short time the gases collecting in the globe, due to the combustion of the carbons, are claimed to become highly luminous. By using this principle the manufacturer says a large volume of steady, well-distributed, white light is obtained. The specific consumption is stated to be approximately 1 watt per mean lower hemispherical candle-power in one of the smaller types of lamp. The intense heat from the arc with ordinary construction would destroy the working mechanism through failure of the insulation of the electromagnet. The manufacturer employs an electromagnet, wound under a patented process, which is stated to be indestructible under operating conditions. Uniform burning hours of carbons are obtained by a method of globe protection and support which gives a tight-fitting globe. The latter is held in position by a wire ball which supports it

from the bottom. With this method small variations in globe dimensions do not affect the holding of the globe in its proper position. This support and the economizer ring which fits over the open end of the globe reduce the possibility of shipping and globe breakage to a minimum. The parts are all accessible and the entire construction is said to be the acme of simplicity. The lamps are built to operate in multiple on both direct-current



SEMI-ENCLOSED ARC LAMP.

and alternating-current circuits. To meet the various conditions required in practice, a number of different types of lamp having various designs and dimensions, power consumption, carbon burning hours and giving different volumes of light have been developed. The company's standard 4-amp direct-current lamp is made in two types, one burning approximately 30 hours and the other 70 hours. Both are adjusted for 4 amp and 76 volts at the arc when operated in multiple on 118-volt circuits and may be adjusted for 110-volt to 120-volt circuits as well. The alternating-current lamps are adjusted for a current consumption of 6 amp with a difference of potential of 72 volts across the arc on 110-volt circuits of frequencies of from 60 cycles to 133 cycles. The lamps may be adjusted for circuits having potentials of from 104 volts to 120 volts. Under ordinary conditions the carbon life in the alternating-current lamp is 30 hours. The lamps are adapted for interior lighting of stores, silk mills, etc., where a daylight quality of light is required.

Softening Boiler Make-Up Water.

The apparatus shown in the accompanying illustration, made by the Harrison Safety Boiler Works, Philadelphia, has been especially designed for use in connection with exhaust-steam heating and drying plants where the make-up water requires softening. It is so arranged that the reagent is fed continuously in proportion to the inflow of the make-up water, and suitable provision is made for the removal of the resulting precipitate from the water by sedimentation and filtration. A special feature is a by-pass which comes into play automatically in case the filter should be neglected and allowed to clog, thus insuring a supply of hot softened water to the boiler-feed pumps at all times.

The apparatus shown also has attached to it a new surplus-exhaust separator which the above concern has recently devised for use on heaters and receivers installed in connection with exhaust-steam heating and drying systems. This separator differs from the Cochrane oil separator heretofore used on heaters made by this concern in being extra large and in having an outlet at the top for passing the purified exhaust steam to the heating system directly without need of an independent oil separator. Convenient valves are also provided for cutting off connection between the separator and the heater, and between the trap which drains the separator and the heater, so that the heater body can be cut out of circuit and opened for cleaning and inspection while the heating system continues in operation. This does away with the independent oil separator and trap, and with the valves, tees and elbows required for its installation, cutting down the first cost of the plant and the space required, while increasing convenience of operation.

The makers guarantee for this apparatus that where it is operated in accordance with their instructions, hard scale will not form in the boilers, which can be washed out by means of water from a hose, and that the boilers will be entirely protected from corrosion. They also guarantee that water heated by exhaust steam that has been passed through the oil separator attached to the apparatus, or water condensed from the steam itself, will be entirely suitable for boiler feeding and other purposes.

In the apparatus shown, the return and treated water are mingled together in the sedimentation chamber and the whole volume is passed through the filter; but where the percentage of returns is large it may be advisable to give over the entire sedimentation and filtering capacity to the make-up water alone and to pass the pure condensed returns, after reheating, directly to the pump-supply chamber. This gives better results than if the two water supplies are mingled before treatment.

This apparatus is equally applicable in the case of surface condensing steam-power plants where the condensed water is utilized as boiler feed, in which case there is the large volume of condensation to be heated and a comparatively small vol-



APPARATUS FOR SOFTENING BOILER MAKE-UP WATER.

ume of supplementary make-up water to be heated and softened. The apparatus can then be so arranged that the exhaust steam will first come in contact with the make-up water, insuring full temperature for the chemical reaction, before heating the vacuum-pump discharge. This apparatus thus saves a large part of the cost of separate feed-water heater and water-purifying systems, and makes it possible to purify

the small amount of raw water at a merely nominal cost. The driving off of air and gases from the feed water reduces to a certain extent the amount of gases to be dealt with by the vacuum pump, while the elimination of scale-forming matter from the water should obviate the gathering of scale upon and erosion of turbine blades.

Intercommunicating Telephone System Used in Connection with Dispatching Trains.

At the Erie Railroad terminal station, Jersey City, N. J., an intercommunicating telephone system is used in connection with the dispatching of the suburban trains and for directing commuters to their trains. It is also the connecting link between these suburban trains and the Hudson & Manhattan Railroad Company's tunnel trains, running from the station to New York City.

The tunnel trains do not enter the Erie depot, but stop at a point 900 ft. west of the ends of the train sheds opposite to the station. At the ends of the sheds nearest the tunnel is a well-lighted and ventilated underground concourse, which is connected to the tunnel train platform by a subway. Five stairways, one for each pair of suburban tracks, lead from the concourse floor to the tracks at ground level. The stairways are seen at the left of the accompanying photograph, Fig. 1.

The dispatching tower at the Erie station, which is located at the end of the train sheds and overlooking them, is shown in the partial interior view of Fig. 2. At the right, the intercommunicating desk set for the gate-control system is mounted on an equipoise arm. The ringer and key box connected with this set are to be seen behind one of the levers on the desk. On the gate-control system are the tower set and five wall-type intercommunicating sets, shown in Fig. 1—one at each stairway leading from the concourse floor to the train sheds. All the apparatus installed is according to the latest designs of the Western Electric Company. The sets have an ultimate capacity of 11 connections. The conductors connecting each set with all of the others are carried throughout in lead-covered cables, and are insulated with double-cotton and silk, differently colored for identification.

The operation of this part of the system is as follows: Suppose the commuters live in Bloomfield and Montclair. They enter the concourse from the Hudson tunnels, by way of the subway, but the closed stairway gates prevent their going to the train sheds. The dispatcher presses the button on his key box marked 7 and 8. This act automatically connects his set with the one at the gate to tracks 7 and 8 and rings that bell. When the guard answers he is told to put up signs that the Bloomfield, Montclair, etc., train will leave track 8.

When the train is ready the dispatcher rings a gong over the gate. The guard then presses the properly numbered one of the two buttons under his telephone and opens the gate. Should the button pressed show the dispatcher that the guard is opening the wrong gate, or if there is any other misunderstanding, the guard can be easily reached by one of the intercommunicating telephones. When to close the gate and other instructions are given by telephone.

The gongs referred to are controlled by means of the long box in front of the tower window (Fig. 2). The buttons at the bottom ring the gongs for the 10 suburban and four other tracks. When a guard presses the bell button under his telephone, the bell on top of the control box rings and a corresponding numbered drop appears in the row at the top of the box. The control is of special design and was built by the Western Electric Company.



FIG. 2.—INTERIOR OF DISPATCHING TOWER.

In the dispatcher's office is a second and similar intercommunicating set. On this system are sets for the trainmaster, stationmaster, terminal tower, engine yard and passenger yard. These have proved sufficient for keeping the dispatcher in touch with train make-ups and special work. In the center of the view of the tower is a desk set connected to a three-plug magneto party line system. This old system is kept in place for emergency uses.

The desk equipment of the chief attendant in the concourse is shown in Fig. 3. The set to the left is on the gate-control system and is for tracks 1 and 2. The wall-type magneto set, in the center, is connected to a similar set on the tunnel train platforms and is used to announce arrivals of the tunnel trains. The use of this set enables the dispatcher to know the schedule of the tunnel trains and regulate his make-up accordingly. The third set, farthest to the right, is on another system maintained by the Hudson tunnels.



FIG. 1.—VIEW OF STAIRWAY FROM CONCOURSE.



FIG. 3.—TELEPHONE EQUIPMENT IN CONCOURSE.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The continued cool weather has added to the already buoyant condition of trade. In practically every line of business conditions are entirely satisfactory. Hardware, groceries, lumber and building materials are especially active. Wholesalers and jobbers are receiving many reorders to fill out stocks which have been depleted by the active retail trade. Merchants all over the country are already preparing for the holiday trade, and the prospects are that this trade will be the best that has ever been known. There is still considerable evidence of conservatism in buying, which is due almost entirely to the high range of prices for all commodities which now prevails. This is especially noticeable in the cotton goods trade, where prices have been advanced and where manufacturers are holding rigidly to the high schedule. In spite of the abolition of the duty on hide, the shoe and leather business is being transacted on a higher scale than ever before. Prices have not been reduced, and on many classes of goods have been advanced. In quite a number of industrial localities there is complaint over the scarcity of skilled labor. In the iron and steel mills this is especially true. There is at this time some talk of car shortage, but thus far this has not interfered in any way with the free movement of the crops. Both corn and cotton have been sent to market with remarkable freedom, resulting, of course, in liberal additions to the spending money of the producers. This is one of the reasons that retail trade has shown such commendable growth. It is also due to this fact that collections have visibly improved. Business failures for the week which ended Oct. 21 were 244 as against 220 the previous week; 231 in the same week of 1908; 220 in 1907; 184 in 1906, and 178 in 1905.

THE COPPER MARKET.

There has been little doing in the copper market during the past week and prices have been lower. The stringency of the money market and the advance of rates abroad caused considerable liquidation and the first effect was a drop of 17s 6d. in London. The carrying charges for standard copper abroad have been advanced, causing anxiety among the speculators and practically putting an end to new commitments. Such conditions might have resulted in demoralization in this market had it been less firmly in the grasp of the strong interests which have so long been in control. As it is, while the market has been weaker and lifeless there has been no pressure to sell and price concessions have been fractional. Domestic consumers have taken little interest and purchases have been moderate. The statistical position remains unchanged practically. Production goes on at record quantities, domestic and foreign are only fair and there is evidence that stocks are being increased from 30,000,000 to 40,000,000 lb. every month. During the week there was a long conference of the leading copper men of the country at the offices of the Amalgamated company which revived rumors of a giant merger and also of a curtailment agreement. All of these rumors met prompt denial. Imports continue to be heavy and exports for the month, including Oct. 25, have amounted to 18,235 tons. The daily call on the Metal Exchange at 12:30 o'clock Oct. 25, quoted standard copper as follows:

	Bid.	Asked.	Settling price
Spot	12.00	12.25	.....
October	12.00	12.25	12.12½
November	12.00	12.25	12.25½
December	12.00	12.25	12.12½

The London prices Oct. 25 were as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	56 12 6	56 8 9
Standard copper, futures	57 15 0	57 11 3
Market	Easy	Easy
Sales of spot		1,500 tons
Sales of futures		1,800 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13 00	12.12½
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

KELLOGG-DEAN ELECTRIC COMPANY.—The arrangements for the combination of the Kellogg Switchboard & Supply Company, of Chicago, and the Dean Electric Company, of Elyria, Ohio, previously announced in these columns, have progressed so far that it may be stated that a new company will be formed to absorb the two old ones. This company will be known as the Kellogg-Dean Electric Company, and its headquarters will be in Chicago. Both the factories at Chicago and at Elyria will be retained. The capital stock will be $7,000,000, of which $3,500,000 will be 7 per cent stock, preferred both as to dividends and assets, and $3,500,000 will be in common stock. The new company has not been organized, but it will have a board of directors containing some of the most prominent men in the independent telephone industry in the United States. The arrangements are being made under the legal advice of Mr. Charles H. Aldrich, of Chicago, former solicitor-general, who has taken a leading part in telephone affairs for a number of years.

LAMP MEN'S CLUB.—The National Electric Lamp Association last week opened a clubhouse at 1910 East Fifty-fifth Street, Cleveland, to be known as the National Club. Only members of the association can belong to the club. It is for the younger men, who coming from college, join the engineering staff of the association, that they can live at the club, a dining-room, gymnasium and bed-rooms being provided for them. The clubhouse is made over from two former dwelling houses, and a third house adjoining them, at present occupied by part of the engineering staff, will shortly be added to the present club accommodations. Judging from the enthusiasm shown at the opening and from the number of applications for membership, the National Club will prove a very popular institution.

OHIO ELECTRIC CAR COMPANY.—The organization of the Ohio Electric Car Company at Toledo has practically been perfected. This concern is a reorganization of the old Pope Company and will manufacture electric vehicles. The capital stock was immediately subscribed by Toledo capitalists, a large number taking part as the limit of the company was $5,000 to any individual. The interest in the new company was largely stimulated by a trial run of a car from Toledo to Cleveland, 184½ miles, on one charge of the battery. The office and works of the company are located at the Milburn Wagon Company's plant, which, it is said, is admirably adapted for this purpose. The company is preparing to make a large output of cars for 1910.

BUSINESS IN THE FAR WEST.—F. H. Gale, advertising manager of the General Electric Company, has just returned from an extended trip through the West. He attended the meetings of the Northwest Electric Light & Power Association at Seattle, the Colorado State Electric Light & Power Association and the American Street & Interurban Railway Association at Denver. He also attended quite a number of Institute meetings during his trip. Mr. Gale said that he found business everywhere in the West in splendid condition and on the Pacific Coast especially was the progress noteworthy. In that section there was marked growth in every branch of the electrical industry.

DUTY ON REFLECTORS REDUCED.—The Board of United States General Appraisers has decided that reflectors for electric lights are dutiable at 45 per cent, either as manufactures of glass or of metal. Until recently collectors had been assessing this class of goods at 60 per cent, on the theory that the glass was silvered for the purpose of ornamentation. The Appraisers' Court holds that the silvering process is for utility and that the reflectors should not pay the rate demanded on ornamental glass. George Borgfelt & Company were the importers which raised the issue.

NEW ELECTROLYTIC METAL REFINING PLANT.—The United States Metals Refining Company, with extensive works for refining copper by electrolytic methods located at Carteret, N. J., has recently purchased 12 acres adjoining its plant upon which will be erected a large establishment for refining lead.

MICHIGAN CENTRAL TRAIN DISPATCHING.—The Michigan Central Railway has just completed a telephone train-dispatching circuit between Niles, Mich., and Kensington, Ill., a distance of 76 miles. There are 18 regular train-order stations and two emergency stations. The emergency stations are for the use of train crews and are so arranged that a crew may at any time stop at these sidings and call up the dispatcher to obtain assistance if necessary, or get instructions to go ahead if the track is clear. This installation is on the main line of the Michigan Central Railway, between Chicago and Detroit, and is the fourth circuit of this kind installed by this road. When the circuit now being installed between Jackson, Mich., and Niles, Mich., is completed, all trains run between Chicago and Detroit, Detroit and Toledo, and Detroit and Saginaw on the Michigan Central Railway will be dispatched and receive all running orders by telephone. This equipment of about 500 miles, one-fourth of the entire Michigan Central mileage, was furnished by the Western Electric Company. It is reported that extensions will be made as expeditiously as possible until every train on this road receives its orders by telephone. The Lake Shore & Michigan Southern Railway Company has ordered telephone equipment and is making provision to equip for telephone train dispatching the Youngstown Division of its road, and is making the new Clearfield Branch a part of its telephone system. This is the second circuit on this road to be equipped with Western Electric telephones for train dispatching. The first circuit, between Buffalo and Erie, has been in service more than a year. It is being clearly recognized now by the majority of the larger roads that the telephone has passed the experimental stage for this class of service.

IMPEDIMENTS TO AMERICAN EXPORT BUSINESS.—A correspondent in Buenos Aires, connected with the electrical industry there, in commenting on the small part played by this country in the import trade of Argentina, points out a number of reasons for the disparity. One of these arises from the metric system being employed in that country and the dislike of engineers and others to consider offers based upon the English system owing to the annoyance of translation into the metric system. Another reason is that, unlike European manufacturers, American manufacturers will not consider the specific needs and the tastes of South American customers and present material that will appeal to them, but expect that they shall change their ways and adapt themselves to the industrial conditions of the United States as relates to machinery and supplies; and, unlike the Europeans, they do not send commercial representatives versed in the Spanish language and acquainted with Latin customs. A cause of no inconsiderable prejudice is that the greater part of correspondence from the United States is insufficiently postpaid, thereby subjecting the receiver to an expense of 20 cents per letter. Another great impediment to business with this country relates to credits. Many American manufacturers refuse orders unless prepaid, though the goods many not be actually delivered for six months, or make a condition of a very short credit; European houses, on the other hand, do not require payment until from one to six months after actual delivery.

HENRION CARBONS IN AMERICAN MARKET.—The Edward E. Cary Company, 61 Park Place, New York, importer of electrical specialties, is the agent in this country for the lighting carbons manufactured by Fabius Henrion, France, who is known throughout the world as one of the leaders in the French electrical industry. Mr. Cary claims that, owing to the fact that this plant can manufacture enclosed arc-lamp carbons in 12-in. lengths by the use of automatic machinery, it is able to place them on the American market at a much cheaper rate than those that have heretofore prevailed. Before the passage of the new tariff law it was the habit of importers to order carbons in 24-in. lengths, thus securing a material reduction in the rate of duty. Carbons of this size all required hand labor, and they were, therefore, Mr. Cary states, much more expensive than the shorter carbons made by machinery. He claims that the Henrion factory is the only one in the world that has thus far succeeded in eliminating hand labor. It was testified before the Ways and Means Committee last year that carbons 12 in. long for enclosed arc carbons cost to make in this country about $16 to $18 per thousand at the factory. Mr. Cary claims that he can pay the present duty and yet be able to meet the American prices.

WOULD SUPPLY ENERGY FOR SUBWAYS.—The New York Edison Company has written a letter to the Public Service Commission of the First District, requesting an opportunity to present bids at the proper time for the supply of electric energy for operating and lighting any new subway tunnels that may be constructed. The company suggests that when the specifications for new subways are drawn up, in addition to providing for the construction of power plants, they be so drawn as to permit the operating contractor to provide an alternative arrangement under which he may obtain the necessary energy from a generating company already equipped. The Edison Company in this letter says that its generating plants are of large capacity and provided with adequate reserve in every part, and with the latest and most improved types of apparatus for the economical generation of energy. It is suggested that the company would be able to supply power cheaper than an independent operating company could generate it in its own plant. The letter was written simply that the Public Service Commission might not overlook this sort of an arrangement in its provisions for new subways.

ELECTRIC HEATING OF AN APARTMENT HOUSE.—Neville & Bagge, architects, have prepared plans for a 12-story apartment house on Riverside Drive, near 122d Street, New York, which, it is promised, will contain many electrical novelties. The building is being erected by Clinton W. Kinsella, a contractor who has built many handsome apartments in the metropolis. It is said that, in addition to the operation of the passenger elevators and the dumbwaiters by electric power, every apartment will be supplied with an electric vacuum cleaning device, and that the entire heating will be done electrically. Inquiry at the office of Neville & Bagge developed the fact that the plans for the electric heating had not yet been entirely worked out. It is promised, however, to heat each room separately, and as there will be in the building 40 apartments, many of them containing as much as 14 rooms, it will be understood that the undertaking is not a small one.

ELECTRIC ORE UNLOADERS AND MAGNETIC LIFTS.—Extensive improvements, involving nearly half a million dollars, are about to be made by the Maryland Steel Company at Sparrows Point, Md., for the handling of its ore, which arrives in vessels from Cuba and foreign countries, will include two large electrically operated unloaders, each machine having a capacity of 500 tons per hour, or a combined capacity of 1000 tons an hour. The contract for the unloaders has been awarded to the Brown Hoisting Machine Company, of Cleveland, Ohio. Another improvement will be the installation of a lifting magnet of sufficient power to handle eight rails 30 ft. long, weighing 3000 lb., at one time and place them in the car in which they are to be shipped.

PERU (IND.) ELECTRIC MANUFACTURING COMPANY SOLD.—The plant of the Peru (Ind.) Electric Manufacturing Company has been sold to Charles H. Brownell, the heaviest creditor. The plant was sold at a receiver's sale and Brownell secured the plant for $25,000. The plant is said to be worth $40,000. It is understood that new machinery and equipment will be installed in the plant and that the industry will be started up again. The company manufactured porcelains and brass parts and specialties.

IN FAVOR OF TUNGSTEN STREET LAMPS.—The committee recently appointed by the city government of Plainville, Conn., to investigate the relative merits of tungsten lamps and Welsbach gas lamps for street lighting reported last week in favor of the tungstens. The Connecticut Railway & Lighting Company has submitted a proposition to the city to furnish 90 100-watt tungsten lamps for an annual charge of $1,800, and to furnish 10 similar lamps free in place of the 10 16-cp lamps its charter now requires.

AMERICAN DIESEL ENGINE COMPANY.—The American Diesel Engine Company has been purchased by Adolphus Busch, of St. Louis, and the company has been reorganized with J. R. Harris as the manager. W. R. Haynie, who is connected with the company, reports that it has recently obtained orders for two engines each from the Samson Cordage Works, of Boston; from the Gillett Safety Razor Company, of Newark, and the Prairie Pebble Phosphate Company, of Mulberry, Fla., each engine being of 225 hp.

NEW SCHENECTADY SHOP BUILDING.—The General Electric Company has engaged the Stone & Webster Engineering Corporation to construct a reinforced concrete shop building, to be a part of the Schenectady works. The plans are not yet completed but the general dimensions are 80 ft. x 400 ft.

ELECTRIC POWER FOR SOUTHERN COTTON MILLS.—It is reported that the Southern Power Company, of Charlotte, N. C., offers inducements to large cotton mill and other manufacturing plants to build factories at or near the several hydroelectric plants of the company along the Catawba River, in North and South Carolina, where electricity can be supplied without loss in transmission at a very reasonable rate. The first plant thus organized is a $600,000-cotton mill, which will be built near Great Falls, 40 miles southwest of Charlotte, and in which Messrs. Hal Mebane, Robert S. Mebane and others are interested. It is likewise understood that J. B. Duke, largely interested in the Southern Power Company, will be a stockholder in the new mill. This policy gives promise of numerous extensive developments along the Catawba River.

NEW BALTIMORE CONTRACTING FIRMS.—The Howard Jefferson Electric Company has been formed in Baltimore to do electrical contracting in that city. Howard Jefferson was formerly a partner in the electrical firm of J. Frank Kline, of Baltimore. The Rosenfeld Electric Company, which has opened a large store on South Howard Street, Baltimore, is composed of William Rosenfeld and Isidor Bernstein, both of whom were formerly in the employ of Eugene Rosenfeld. Mr. Bernstein was the foreman of Eugene Rosenfeld, while his partner and former employer are brothers.

ADDITIONS TO BELLINGHAM AND NOOKSACK FALLS STATION.—Extensive alterations in the steam and water power plants of the Whatcom County Railway & Light Company, Bellingham, Wash., are to be made by the Stone & Webster Engineering Corporation. In the Nooksack Falls water-power plant an impulse wheel will be substituted for the present 3300-hp Francis turbine. The steam plant, known as the York Street station, will be enlarged to accommodate a new 1500-kw turbo-generator with boilers, condensers and other steam and electrical auxiliaries.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in our present issue are announcements of proposed new plants or considerable extensions of present plants at Greenfield, Mass.; Frankfort, Ky.; Philadelphia, Pa.; Elkhorn, Wis.; Durham, N. C.; Dalhart, Tex.; Bentendorf, Ia.; South Platte, Col.; Sikeston, Mo.; Ansonville, N. C.; Bracebridge, Ont., Can.; Bedford, Ind.; Verdun, Que., Can., and Grand Junction, Col.

Financial Intelligence.

THE WEEK IN WALL STREET.

The past week in the Wall Street market has been one of uncertainty and irregularity. Trading has been only moderate, and there has been an absence of that enthusiasm which has marked the earlier weeks of the fall. After several days of decline and liquidation, prices on Oct. 23 reached, for many stocks, the lowest figures recorded since midsummer. The close on that date was weak, and the situation discouraging. On Monday, Oct. 25, there was a sharp recovery, renewed activity in trading and advances that amounted in most cases to several points. The secret of this erratic behavior is that the market has been entirely dominated by the money market. When the banks of Germany and England put up their discount rates and quotations on call, money in New York advanced to 5 per cent, there was much enforced liquidation and widespread anxiety as to what the future held in store. Traders became careful about long commitments, bankers became conservative and indicated a strong disposition to curtail loans. This was the condition at the lowest point and then came the sudden improvement. When the market opened on Oct. 25, it was found that the conditions of the foreign banks was so much improved that further advances were unlikely, local money rates became easier, with bankers in more liberal disposition. The immediate recovery that followed but emphasized the fact that the only check to the long upward march had been the money market. Relieved of this restraining influence the market again displayed its buoyant tendencies. And why not? Commercial and industrial business continued to improve and the promise that 1910 will be a banner year is still alluring. Stocks may have been for many months too high for the level of business, but it is hardly reasonable to calculate that as business improves stocks will recede. With a tight money market liquidation and reactions are necessary, but there will be no permanent demoralization during a business boom. Money on Oct. 25 was quoted: Call, 3½ @ 4½ per cent; 90 days, 4⅞ @ 5 per cent. The quotations in the table are those of the close Oct. 25:

NEW YORK.

	Oct. 18.	Oct. 25.	Shares sold		Oct. 18.	Oct. 25.	Shares sold
All Ch	17¼	14½	1,345	Int.-Met., pfd	50½	49¼	65,100
All. Ch., pfd..	83	80½*	4,700	Mackay Cos..	93	90½*	1,300
Amal. Cop....	84	81¼	262,860	MackayCos.,p.	76¼	70*	580
Am D. T....	40½*	20½*	—	Man Elev....	142	142*	600
Am. Loc. ...	60	58½	1,100	Met St Ry.	20*	20*	—
Am. Loc., pfd.	115*	116*	550	N Y &N J Tel.	139½*	139¼	—
Am. Tel. & Cbl.	85*	85*	—	Steel, com...	91¼	89⅞	1,518,140
Am. T. & T..	142	140¼	17,500	Steel, pfd....	128⅜	126¾	28,590
B. R. T.....	78¼	76¾	18,300	W. U. T.....	77½	76½	1,700
Gen. Elec.....	164¾	160¼	500	West'h, com .	86½	84½	3,100
Int.-Met., com.	18⅞	17½	153,682	West'h, pfd..	140*	140*	100

PHILADELPHIA.

	Oct. 18.	Oct. 25.	Shares sold		Oct. 18.	Oct. 25.	Shares sold
Am. Rys.....	15¾*	15¾	—	Phila. Elec ..	13¼	13	—
Elec. Co. of A.	12¼	12½	—	Phila. R. T..	27⅞	28½	—
Elec. St. B'ty.	60¼	59	—	Phila. Trac...	89*	89½	—
E. S. B'ty, pfd.	30*	30*	—	Union Trac..	5*	5*	—

CHICAGO.

	Oct. 18.	Oct. 25.	Shares sold		Oct. 18.	Oct. 25.	Shares sold
Chi. City Ry..	180*	180*	—	Chi. Tel. Co.	136½*	136½	—
Chi. Rs.,Ser.1.	109¼*	108*	—	Met Ey., com.	17¾*	17¾*	—
Chi. Rs.,Ser.2.	35½	35½*	—	Met. El., pfd	50½	51*	—
Com. Edison..	120½	119½	—	Nat'l Carbon.	68½*	68*	—
Chi. Sub'ws...	8¼	7⅞	—	Nat'l C., pfd	120*	120*	—

BOSTON.

	Oct. 18.	Oct. 25.	Shares sold		Oct. 18.	Oct. 25.	Shares sold
Am. T. & T...	141⅞	140¼	—	Mex. Tel....	2¼	3	—
Cum. Tel	143¼	145*	—	Mex. Tel.,pfd.	6*	6	—
Edison E. Ill..	250*	252	—	N. E. Tel....	136½	134½	—
Gen. Elec.....	164¼	160	—	W. T. & T..	10*	10*	—
Mass. E. Ry..	17¾	17	—	W. T. & T., p.	89*	88*	—
Mass. E. R.,p.	81	80*	—				

*Last price quoted.
Shares sold are for week of Oct. 18 to Oct. 23.

ROCKINGHAM (N. C.) POWER COMPANY.—In the decision of the North Carolina Supreme Court in the case of Worth vs. Knickerbocker Trust Company, of New York, an important step in the fight for control of the extensive holdings and interests of the Rockingham Power Company is achieved. In the complaint, Mr. Worth alleged that he had taken stock in the Rockingham company, and also bonds of the company, and that the Knickerbocker Trust Company had secured control of a majority of the stock of the power company and "had formed a voting trust" to control the business management, etc., of the power company. The plaintiff further alleges that the defendant company entered into improvident contracts with other companies and had rendered the Rockingham Power Company insolvent, so the allegation sets forth. The Knickerbocker Trust Company asked that the action be dismissed and that an attachment on their property be discharged. In the lower court this request was granted to the extent of reducing the attachment to $50,000. The trust company appealed to the State Supreme Court asking that the lower court be reversed and the action dismissed. The higher court now upholds the lower court, and holds that the attachment was properly made, and that there was good cause for action. This decision throws the case back into the State court in New Hanover County for a jury to decide to what amount of damages, if any, Mr. Worth is entitled.

CHICAGO & MILWAUKEE ELECTRIC RAILWAY.—An order granting the receivers of the Chicago & Milwaukee Electric Railroad Company the power to buy 17 new cars at a cost of $135,000 and to sell 19 old cars for $29,000 was made on Oct. 19 in the United States Circuit Court in Chicago. Counsel for the receivers argued that the company's business had increased 63 per cent during the last year, compared with the year before, making the purchase of additional equipment necessary. The total receipts for April, May, June and July, 1909, were $299,024.08, as compared against $183,298.95 for the corresponding months of 1908. Expenses for these two periods were, respectively, $180,343.66 and $133,610.33. Thus the receipts are shown to be increasing at a considerably faster rate than the expenses.

AURORA, ELGIN & CHICAGO RAILWAY.—At the annual meeting of the Aurora, Elgin & Chicago Railroad Company on Oct. 19 the old directors were re-elected. The financial report shows a reduction in the ratio of operating expenses. Gross receipts were $1,411,722, an increase of $50,536, while operating cost was $706,270, a gain of only $8,001 compared with the previous year. The net income was $329,617, an increase of $42,694, which equals 5.63 per cent on the common stock. During the year the company paid 5 per cent on $3,100,000 preferred and 3 per cent on a like amount of common stock outstanding.

INDEPENDENT TELEPHONE INTERESTS NOT SOLD OUT.—In our last issue we gave the details of the organization of the Ohio Home Telephone Company, of Cleveland, which was incorporated as a holding company for the Independent telephone interests in the Middle West. It was stated that this company would take over the property of the United States Telephone Company, of Cleveland, under a 99-year lease. Details were also given of the purchase by James S. Brailey, Jr., of the controlling interests in the Ohio, United States and the Cuyahoga telephone companies, all large Independent concerns. Within the last week the publication was made at Toledo, and sent over the entire country, that through Mr. Brailey the Independent telephone interests of the Middle West had been sold out to the Bell people. It was stated that the Bell interests through options had secured entire control of the Independent companies in that section of the country. On Oct. 23 Mr. Brailey issued a signed statement in which he said: "There is absolutely no truth in the statement that the Bell company had acquired an interest in any of the properties with which I am associated." He further said that he had been working on the plans for the new Independent syndicate for two years, and that he had completed its financial arrangements and was ready to unify the Independent interests. He said that the United States Telephone Company was going ahead with its development work, and would put in a new No. 8 copper circuit between Columbus and Toledo and between Columbus and London. He said that everything would be done in his power to protect the Independents from absorption by the Bell interests.

TELEPHONE MERGER HALTED.—Vice-Chancellor Howell at Trenton, N. J., last week granted an order restraining the transfer of any of the property or securities of the Interstate Telephone Company to the American Telephone & Telegraph Company, or to any of the subsidiary corporations comprising the Bell system, and restraining the American company or its subsidiaries from taking any steps to acquire control of the Interstate company. The Interstate Telephone Company is an independent, which has been operating in New Jersey, and has heretofore had no connection with the Bell interests. It has been operated directly in connection with the Consolidated Telephone Company and the Keystone Telephone Company, of Philadelphia. It is stated that about 78 per cent of the stock of the company had been deposited under a pooling agreement, and that it was this interest that the American company had prepared to take over. Inquiry at the office of the American company in New York brought out the fact that this restraining order in no way affected the consolidation of interests that has recently been going on among the large Bell companies. The New York Telephone Company and the New York & New Jersey Telephone Company are in no way affected by this restraining order, which applies only to the independent.

DES MOINES CITY RAILWAY COMPANY.—The property of the Des Moines (Ia.) City Railway Company, and of the subsidiary railways which operate under this company's control, was sold Oct. 22 to W. B. McKinley, of Champaign, Ill., for $6,500,000. It is stated that in this enterprise Mr. McKinley is backed by Canadian capital. He already is the president and principal owner of the Illinois Traction System, which operates 530 miles of electric lines in the northern portion of Illinois, and has six power plants and 600 cars. As soon as Mr. McKinley took charge of the Des Moines property he made application to the City Council for a 25-year franchise, under an agreement to expend $1,500,000 in improvements within the next five years.

PHILADELPHIA RAPID TRANSIT CONTRACT.—An effort is being made in Philadelphia to annul the contract which was made some months ago between the city and the Rapid Transit Company. Both branches of the City Council have adopted resolutions looking toward the annulment of this contract. It is said that a petition bearing the signatures of 58,178 voters has been presented to the Council insisting upon an immediate restoration of the strip tickets, or six-for-a-quarter rate. The matter is being made a political issue, and the Rapid Transit company is being drawn into politics in spite of itself.

INTERNATIONAL STEAM PUMP BONDS.—William Salomon & Company are offering an issue of $8,500,000 of International Steam Pump Company bonds. These bonds are being offered in London at the same time. The subscription price is 96½ and interest, at which the yield will be about 5.30 per cent. The purpose of these bonds is to furnish funds for plant extension and to add to the working capital of the company. After some other indebtedness is retired on Oct. 28 these bonds will constitute the only funded debt of the International Steam Pump Company.

GENERAL MOTORS COMPANY.—At the annual stockholders' meeting of the General Motors Company in Jersey City, H. G. Hamilton was elected a director to succeed F. L Smith and J. T. Smith was elected to take the place of H. Russell. Otherwise there were no changes in the board.

SPRING GROVE TELEPHONE COMPANY.—The capital stock of the Spring Grove Telephone Company, of Richmond, Ill., has been increased from $10,000 to $20,000, and the name has been changed to the McHenry County Independent Telephone Company.

DIVIDENDS

Amalgamated Copper Company, quarterly, ½ per cent, payable Nov. 29.

American Gas & Electric Company, preferred, quarterly, 1½ per cent, payable Nov. 1.

The J. G. Brill Company, preferred, quarterly, 1¾ per cent, payable Nov. 1.

Edison Electric Illuminating Company, Brockton, Mass., semi-annual, 3½ per cent, payable Nov. 1.

Helena (Mont.) Light & Railway Company, quarterly, preferred, 1¼ per cent, payable Nov. 15; common, 1 per cent, payable Nov. 1.

Michigan State Telephone Company, quarterly, preferred, 1½ per cent, payable Feb. 1; common, 1½ per cent, payable Dec. 1.

Montreal Light, Heat & Power Company, quarterly, 1¾ per cent, payable Oct. 31.

United States Electric Securities Company, preferred, semi-annual, 3½ per cent, payable Nov. 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Changes.	Surplus.
Aurora, Elgin & Chicago Railroad Company					
Year ended June 30, 1909	$1,441,727	$796,270	$615,482	$341,327	$329,617
Year ended June 30, 1908	1,361,186	788,268	572,918	333,700	286,922
Brockton & Plymouth (Mass.) Street Railway Company:					
August, 1909	17,911	11,194	6,716	1,661	5,055
August, 1908	16,515	9,275	7,239	2,212	5,027
Electric Light & Power Company, of Abington & Rockland, Mass.:					
August, 1909	6,410	3,829	2,581	477	2,103
August, 1908	4,396	2,802	1,593	354	1,239
Fairmount & Clarksburg Traction Company:					
July, 1909	39,899	13,356	26,543	1,892	28,340
July, 1908	35,402	12,315	23,146	1,069	24,393
Houghton County (Mich.) Electric Light Company					
August, 1909	18,439	9,615	8,824	3,640	4,702
August, 1908	16,637	9,273	7,364	3,309	3,681
Keystone Telephone Company, Philadelphia:					
September, 1909	91,908	45,070	46,838	33,015	13,823
September, 1908	87,656	42,873	44,783	34,445	10,338
Lexington (Ky.) & Interurban Railways Company:					
July, 1909	54,238	34,720	19,517	—	—
July, 1908	58,706	37,495	21,210	—	—
Norfolk & Portsmouth Traction Company:					
July, 1909	181,277	101,163	79,994	—	—
July, 1908	181,803	98,326	83,478	—	—
United Railways of St. Louis:					
September, 1909	920,329	589,357	330,972	232,132	107,840
September, 1908	887,344	554,164	333,180	234,380	98,800
Whatcom County (Wash.) Railway & Light Company:					
August, 1909	30,841	19,174	17,666	8,063	9,602
August, 1908	29,417	17,267	12,149	7,976	4,172

GENERAL NEWS

Construction News.

BESSEMER, ALA.—Plans have been prepared by D. O. Whilldin, Title Guarantee Building, Birmingham, Ala., for the construction of a building 140 x 30 ft., for the Birmingham Light & Power Company, of Birmingham, Ala.

BRENT, ALA.—Plans are being considered by the Thompson Lumber Company for construction of a mill to replace the one recently destroyed by fire. It is said that a Corliss engine or steam turbine will be installed and probably electrical apparatus will be required.

CARBON HILL, ALA.—It is reported that an election to be held Oct. 30 the citizens will vote on the proposition to issue $25,000 in bonds for the construction of an electric light plant and water works system.

BISBEE, ARIZ.—Plans are being made by the Bisbee Improvement Company for the reconstruction of the local telephone system. The central battery system will be installed.

ARKANSAS CITY, ARK.—A contract has been awarded by the Land & Power Company, which owns and controls the Arkansas City Gas & Electric Company, amounting to $21.000 to the Allis-Chalmers Company, of Milwaukee, Wis. The contract calls for a new steam turbine and generator, also a separate generator, and two boilers and condenser. It is understood that the Southwestern Interurban Railway Company is contemplating making extensions to its system next spring. The power company furnishes electricity for operating the railway system.

MAMMOTH SPRINGS, ARK.—The Montgomery telephone system in Fulton County has been purchased by Lehman Kay, of Salem, and H. A. Northcutt. The new owners propose to extend the system from Mammoth Springs to various points in the county.

ALAMEDA, CAL.—The contract for finishing the power house of the Southern Pacific Company, which is being erected on the north side of the tidal canal between Park Street and Fruitvale Avenue drawbridge, has been awarded to F. P. Fisher, of Alameda, for $127,000. The station will furnish electricity for operating the passenger traffic of the Southern Pacific Railroad in the east bay cities, which will be changed from steam to electric power.

AUBURN, CAL.—O. T. Crites, local manager of the Pacific Telephone & Telegraph Company, states that his company will, within the next few months, put in a complete new telephone system in Auburn, which will entail an expenditure of about $35,000. All the overhead wires will be replaced with cables. The telephone exchange will be equipped with the central-battery system.

AUBURN, CAL.—The Board of Supervisors has granted Dr. Robert Peers, of Colfax, Cal., medical director of the Colfax School for tuberculosis, permission to erect and maintain a transmission line for the distribution of electricity for lamps and motors along the county road between Colfax and Auburn. Permission was also granted by the board for the erection of a telephone line between Colfax and the school.

BAKERSFIELD, CAL.—J. F. Stratton, vice-president and general manager of the Westside Electric Company, states that the company expects to have its plant in operation by Nov. 1. Westinghouse 2300-volt generators will be installed and the company is now making contracts to supply electricity to operate oil leases. The main office of the company will be located at Maricopa.

CORNING, CAL.—The County Commissioners have granted the Sacramento Power Company a franchise to operate its system in Tehama County.

FRESNO, CAL.—The Fresno Traction Company has applied to the Board of Supervisors for a franchise to construct an electric railway on First Street, from Tulare Avenue to Kern Avenue, bids for which will be opened on Nov. 11.

FRESNO, CAL.—Notice of appropriation of water of the middle fork of the Kings River in the Sierra forest reserve to the extent of 100,000 cu. in., to be utilized to generate electricity for commercial purposes, has been filed by Charles McBride.

FRESNO, CAL.—A. S. Wisbon, manager of the San Joaquin Light & Power Company, states that this corporation will next year furnish electricity for irrigation to all the foothills along the eastern portion of this section. An order will be placed soon for equipment for a 17,000-hp plant to be installed in Crane Valley by next May.

LOS ANGELES, CAL.—M. A. King has filed a petition asking the City Council to offer for sale to the highest bidder a 21-year franchise to construct and maintain a conduit system for carrying cables and wires on certain streets in the city of Los Angeles.

LOS ANGELES, CAL.—The City Council has adopted the recommendation of Mayor Alexander and has instructed the city attorney to prepare an ordinance calling for an election to be held Jan. 26 to vote on the proposition to issue $3,500,000 for the development of the Owens River project and $3,000,000 for harbor work.

OAKLAND, CAL.—The application of the Great Western Power Company for permission to erect a transmission line along Fifth Avenue has been refused by the Board of Public Works. The request was denied owing to the objection of erecting overhead wires in that section of the city. The board instructed the company to decide upon another route. Mayor Mott is in favor of the city installing its own conduit system and leasing space to the power, telephone and telegraph companies.

OROVILLE, CAL.—It is reported that surveys will soon commence on the large power development of the Feather River Power & Development Company on the middle fork of the Feather River. The plan includes a chain of three plants, by which it is estimated that 86,000 hp can be developed at low water. The first diversion of the water will be made at Nelson Point, in Plumas County, where 15,000 cu. in. of water will be carried 11 miles in a ditch to the mouth of Onion Creek where a fall of 1,000 ft. will be secured for the first plant. From this pond the water will be carried by a ditch, now increased to 20,000 cu. in., a distance of 14 miles, to a point near the mouth of South Branch, where a fall of 1,250 ft. will be had for the second power plant. From the second plant the water will be increased to 25,000 cu. in. and will be carried in a ditch six miles to Fall River, where a fall of 720 ft. will be secured for the third plant. H. O. Lague is manager and engineer.

OROVILLE, CAL.—General Manager H. H. Sinclair, of the Great Western Power Company, recently visited Oroville in company with Assistant General Manager George R. Field, H. W. Buck, J. R. Freeman, of Providence, R. I.; W. O. Crosby, of Boston, Mass., and A. P. Davis, of Washington, D. C., for the purpose of making preliminary arrangements for the construction of the permanent dam which the company is to erect at the intake, work on which, it is said, will be started next year after the heavy rainfall of the season is over. That the company has made any working agreement with the Pacific Gas & Electric Company, the Oro Water, Light & Power Company, or any other competing company, is denied absolutely by Mr. Sinclair.

PLACERVILLE, CAL.—It is reported that the Southern Pacific Company is making preparations for the construction of a large dam and power house in the upper region of the Rubicon River, in Placer County. the water-power to be utilized to generate electricity.

SACRAMENTO, CAL.—The Postal Telegraph Company has been granted permission by the city trustees to place its wires underground on certain streets in the city.

SACRAMENTO, CAL.—The city is negotiating with the Great Western Power Company to furnish electricity to operate its sewer pumping and water works plants. The main transformer station at Brighton is practically completed, but as yet nothing has been done towards the construction of the distributing station to be located at Eighth and R Streets.

SAN BERNARDINO, CAL.—Estimates are now being received by Seth Marshall for the Arrowhead Hotel Company for the installation of an electric light plant to furnish electricity for the hotel and grounds. The plant is to be installed immediately.

SAN FRANCISCO, CAL.—A certificate acknowledging the $12,000,000 increase of bonded indebtedness of the Sunset Telegraph & Telephone Company, voted at the directors' meeting held at Martinez July 7, has been filed with the county clerk, of which $6,500,000 will be used for new equipment, the balance in retiring outstanding debts.

SAN FRANCISCO, CAL.—The contract for construction of the substation of the Sierra & San Francisco Power Company, in Visitacion Valley, south of San Francisco, has been awarded to Duncanson & Haroldson. The United Railroads of this city will receive electricity through this station from the Stanislaus Power Company's plant.

WILBUR SPRINGS, CAL.—We are informed that plans are being considered for the installation of a lighting plant at the Wilbur Hot Sulphur Springs. Electric, gasoline and acetylene plants are under consideration, with a preference for electricity, if it can be installed advantageously. For further information address J. W. Cuthbert, Wilbur Springs, Cal.

YREKA, CAL.—The Siskiyou Electric Power & Light Company's transmission line from the power plant on Fall Creek to Dunsmuir is practically completed. The line is 65 miles in length and will furnish electricity for lamps in the towns of Dunsmuir, Sisson, Weed and intermediate stations. The company now has about 200 miles of transmission line, serving, in addition to the towns named, Yreka, Ashland, Montague, Hornbrook, Fort Jones, Greenview and Etna. The company supplies electrical power for several mines and dredgers as well.

ASPEN, COL.—Electrical pumps are being installed in the free silver shaft of the Smuggler mine.

BUENA VISTA, COL.—Preliminary plans have been filed with the county clerk by the Arkansas Flue & Ditch Company for a large power project, which will involve an expenditure of about $2,500,000. The plans call for the construction of a canal 42 miles in length, extending from the mouth of the Arkansas River, a mile east of Salida to Parkdale, and will carry 600 cu. in. of water per second. Four power stations will be erected along the canal, and each will have a head of 275 ft. of

water. It is said that the company also proposes to furnish water to the towns through which the canal passes. A. P. Hiatt, E. W. Tomlinson and Peter O'Brian, of Canon City, Col., are interested in the company.

DENVER, COL.—Plans are being considered by the Colorado & Southern Railway Company to broaden the gage and equip its railroad to be operated by electricity from Denver to Morrison, a distance of 16 miles.

DENVER, COL.—Preparations are being made by the Northern Colorado Power Company for doubling the output of its plant at Lafayette, plans for which are being prepared by the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa.

GRAND JUNCTION, COL.—The Grand Junction Gas & Electric Company is reported to have awarded contracts for new machinery which will involve an expenditure of $60,000 and which will double the present output of its plant. It is said that the company is preparing to supply electricity to operate the proposed interurban electric railway when completed.

SOUTH PLATTE, COL.—Plans and specifications have been prepared by the South Platte Power Company for the construction of a large power plant at Mill Gulch, located about 20 miles from Denver, Col. The cost of the plant is estimated at from $1,500,000 to $2,000,000, contracts for construction of which, it is said, will probably be let in the near future. The plans include the construction of transmission lines to Castle Rock, Littleton, Platte Canyon summer resorts and all surrounding territory, including a line to the city limits of Denver. The South Platte Power Company is reported to have been negotiating with the officials of the Colorado & Southern Railroad Company regarding the furnishing of electricity to operate the South Park division, if it is decided to equip the railway to be operated by electricity. Godfrey Schirmer, of the German-American Trust Company, Adolph Zang, Albert Jahl and others are interested in the project.

PLAINVILLE, CONN.—The committee recently appointed to investigate the relative value of the tungsten electric lamp and the Welsbach gas lamp for street lighting purposes has reported in favor of the tungsten lamp. The Connecticut Company has submitted a proposition to the town offering to furnish ninety 100-watt tungsten lamps for the annual appropriation of $1,800, and to furnish ten lamps on Whiting Street, free of charge, where it is now supposed to furnish 16-cp lamps under the agreement of its charter. The company has been endeavoring to secure the contract for street lighting for several years, and it is probable that the gas street lamps will be replaced with tungsten lamps.

WILMINGTON, DEL.—The contracts for electrical wiring and installation and for motor-generator set at the new filter plant were awarded to the Garret-Miller Company, of Wilmington, Del., for $5,605.

WASHINGTON, D. C.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Nov. 20, for one 75-kw engine driven generator set. Plans and specification can be obtained on application to the above named bureau. R. C. Hollyday is chief of the bureau.

CUTHBERT, GA.—The citizens have voted to issue $20,000 in bonds, the proceeds to be used for improvements to the electric light plant and water works system.

ELBERTON, GA.—The State Railroad Commission has authorized the Interstate Power Company, of Elberton, Ga., to issue $6,000,000 in capital stock and an equal amount in bonds, the proceeds to be used for a water-power development in Savannah River, near Elberton, Ga.

WAYCROSS, GA.—At an election held recently the city is reported to have voted against the proposition to issue $45,000 in bonds for an electric light plant.

CHICAGO, ILL.—The City Council is preparing an ordinance under which the railway companies will be compelled to change their motive power within the city limits from steam to electricity.

CHICAGO. ILL.—The North Chicago Railway Company, which has applied to the Secretary of State for a charter, will, it is said, take steps immediately to obtain a franchise from the City Council. The company proposes to take over the property of the Consolidated Traction Company on terms to be decided upon by the reorganization committee with the security holders.

CLINTON, ILL.—The construction of an electric light plant and water works system in Clinton is reported to be under consideration. L. W. Lemon is city engineer.

NAPERVILLE, ILL.—Plans are being considered for making improvements to the municipal electric light plant. Frank Strubler is chairman of light committee.

PEORIA, ILL.—The Farmers' Mutual Telephone Company has decided to increase its capital stock from $20,000 to $40,000.

ROCK ISLAND, ILL.—The Union Electric Telephone Company has petitioned the City Council for permission to install conduits in the down-town district for the purpose of placing its wires underground.

STREATOR, ILL.—The 90-day time limit granted by the City Council to the Central Light, Heat & Power Company in which to accept the franchise granted three months ago has expired and has been pronounced null and void by Mayor Lucey. Representatives of the company have filed petitions with the city clerk asking that the time be extended 90 days, but it is not expected that it will be granted.

AURORA, IND.—Work has been commenced by the Engineering & Equipment Company, of Aurora, Ind., on the construction of the proposed interurban electric railway connecting Aurora and Rising Sun. It is understood that power-house equipment, including oil engines, generators, etc., and also roadway material will be purchased.

BEDFORD, IND.—We are informed that bids will probably be asked in about 30 days by the Bedford Power Company for construction of its proposed power plant in White River, at a cost of about $350,000. The Mansfield Engineering Company, Board of Trade Building, Indianapolis, Ind., has charge of the work.

COLUMBUS, IND.—Preparations are being made by the Indianapolis, Columbus & Southern Traction Company to replace about 40 miles of 2-0 wire round trolley with 4-0 grooved wire, between Indianapolis and Columbus, Ind., work on which will begin in a short time. The company will also reconstruct its high-tension transmission line extending from Greenwod to Reddington, a distance of about 45 miles. C. O. Anderson [illegible] manager.

INDIANAPOLIS, IND.—The Capital Circuit Traction Company has secured practically all of the right of way, and surveys have been completed for its proposed electric railway connecting Greensfield, Fortville, Sheridan, Lebanon, Fountaintown and intervening towns. It is said that the company expects to place contracts as soon as the road is financed. J. N. Crabb, 1019 Law Building, Indianapolis, Ind., is president of the company.

MONROE, IND.—The question of establishing an electric lighting service in Monroe is under consideration.

WARSAW, IND.—Announcement has been made that work will be commenced at once by the Wabash & Northern Indiana Traction Company on its proposed electric railway from Wabash to Warsaw. Subsidies amounting to $57,500 have been voted in the townships of Wabash and Kosciusko for the railway company. J. A. Barry is said to be interested in the project.

ALBIA, IA.—The Albia Interurban Railway Company is planning to build a nine-mile extension to its railway next year. W. E. Gant is manager.

BETTENDORF (D. O. DAVENPORT), LA.—At a special election held Oct. 15 the citizens voted to grant the Bettendorf Improvement Company a franchise to construct and operate an electric light plant and water works system. The company, it is said, will commence work on construction of the plants at once.

COUNCIL BLUFFS, IA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 26 for installing a lighting and conduit system in the United States post office and court house and extension in Council Bluffs, Ia., in accordance with drawings and specifications, copies of which can be had at the above office, or at the office of the superintendent of construction, Council Bluffs, Ia. James Knox Taylor is supervising achitect.

DECATUR, IA.—The Leon Electric Light Company, of Leon, Ia., has submitted a proposition to the Town Council offering to extend its transmission lines from Leon to Decatur to furnish electricity for lamps and motors in this town, provided a franchise is granted to the company. A special election will be held Nov. 13 to vote on the question of granting the franchise.

DES MOINES, IA.—The Des Moines & Sioux City Railroad Company is reported to have awarded the contract for the construction of its proposed electric railway from Des Moines to Sioux City, a distance of 196 miles, to the American National Corporation, of Indianapolis, Ind. John P. O'Malley, of Perry, Ind., is president of the company.

DES MOINES, IA.—The property of the Des Moines City Railway Company and subsidiary railways was sold Oct. 22 by W. B. McKinley, of Champaign, Ill., representing insurance interests in Canada, for $6,500,000. Application was made to the City Council by the new owners for a 25-year franchise under an agreement to expend $1,500,000 in improvements within the next five years.

FRONTENAC, KAN.—The question of installing water works, pumping plant and electric lighting plant in Frontenac is under consideration. Mayor Beitsinger is said to be in favor of the proposition.

ST. JOHN, KAN.—Marshall Brothers, of Las Animas, Col., have secured the contract for the construction of the municipal electric light plant and water works system, for $12,025. Contracts for machinery and equipment have also been awarded.

FRANKFORT, KY.—Bids will be received by the Board of Regents of Kentucky Normal and Industrial Institute, care of Anderson & Frankel, engineers, Lexington, Ky., until Nov. 17, as follows: (1) Heating plant, including boiler-room equipment and heating pipes and radiation, etc. (2) Engine, generator, switchboard and electric wiring and fixtures, etc., and lighting the campus. (3) Gasoline engine. The above plant is to heat and light the Trades Building and Auditorium Building located on the campus of the Kentucky Normal and Industrial Institute, located near Frankfort, Ky. Plans and specifications may be seen at the office of the State Superintendent of Public Instruction, Frankfort, Ky., and at the office of Anderson & Frankel, engineers, Frankfort, Ky. J. G. Crabble is chairman.

PARIS, KY.—The Paris Electric Light Company has applied to the City Council for a 20-year franchise to furnish a day service for lamps, heat and motors. The company, it is said, proposes to install a new plant. The Council has passed an ordinance directing the sale of the franchise to the highest bidder.

NEW IBERIA, LA.—The City Council has authorized an election to be held Nov. 16, at which the people are to vote on the proposition of leasing the municipal electric light plant and water works system to private parties for a term of years or to appropriate funds for rebuilding the present plants. The vote will also include a proposition to amend the city charter so as to give the city authority to sell the plant and grant franchises to private parties. The cost of rebuilding the plants is estimated at $60,000.

PORTLAND, MAINE.—Bids will be received by the Commissioners of Cumberland County, until Nov. 1 for special electric fixtures for the new county building, plans and specifications for which may be seen at the office of George Burnham, architect, 120 Exchange Street, Portland, Maine. All bids must be made out on blanks furnished by the commissioners. James H. McDonald, Edward H. Trickey and James Carroll Mead are commissioners.

WASHBURN, MAINE—The Washburn Electric Company has been granted permission to erect transmission lines in Washburn. E. M. Hines is president and manager of the company.

WATERVILLE, MAINE.—The committee on public buildings has awarded a contract to the Waterville & Fairfield Railway & Lighting Company to furnish electricity for lighting the city hall and armory.

BOSTON, MASS.—Owing to the refusal of the Edison Electric Illuminating Company of Boston to grant a lower rate for furnishing electricity for lighting the school buildings the school committee is contemplating installing electric generating plants in various parts of the city to furnish electricity for private use as well as for the city buildings. The board claims that many of the school buildings could be equipped with generating plants with but little additional expense. Application will be made to the State Legislature for permission to extend wires across the streets to connect groups of school buildings. The school board has asked the Merchants' Association to investigate the cost of electricity for school buildings.

GREENFIELD, MASS.—Extensive improvements are to be made to the power plant of the Greenfield Electric Light & Power Company, which will include the construction of a new boiler house of sufficient size to accommodate five boilers. A new steam turbo-generator set with a rating of from 750 to 1000 kw is to be installed. It is said that the old generators will be replaced with new machines as fast as possible.

MARBLEHEAD, MASS.—It is reported that the municipal committee has recommended to the Council that an appropriation of $28,000 be made for improvements to the municipal electric light plant, of which $13,000 would be used for new equipment.

ROWLEY, MASS.—The question of establishing an electric lighting system in Rowley is under consideration.

MANISTEE, MICH.—The Manistee County Electric Company has been granted a franchise by the Board of Supervisors of Manistee County to erect seven dams on the Manistee River and its tributaries. It is expected that work will commence on the construction of the first of these dams immediately.

DULUTH, MINN.—The Council is reported to have approved the lighting scheme for East Superior Street.

MARSHALL, MINN.—The Northwestern Telephone Exchange Company is contemplating rebuilding and improving its system.

McKINLEY, MINN.—It is reported that the citizens have voted to issue $5,000 in bonds, the proceeds to be used for the construction of an electric light plant.

NASHWAUK, MINN.—The City Council has awarded to the Richardson Electric Company for $1,970 the contract for the installation of a Lycoming simple automatic engine, direct-connected to a Burke, three-wire, 110-220-volt, direct-current generator.

VIRGINIA, MINN.—Plans have been prepared by W. A. Wilkinson, architect and engineer, Security Bank Building, Minneapolis, Minn., for the construction of a power house and planing mill for the Edward Hines Lumber Company.

GLASGOW, MO.—At an election held recently the proposition to issue $30,000 in bonds, the proceeds to be used to purchase the local electric light plant and for improvements to the water works system, was carried.

SAVANNAH, MO.—At an election held recently the citizens are reported to have voted in favor of issuing $7,500 for the construction of an electric light plant.

SIKESTON, MO.—The Sikeston Ice, Light & Power Company is considering the installation of a 150-kw, two-phase, 60-cycle alternator direct-connected to a cross-compound, medium speed, condensing engine, together with a condenser; also an additional boiler, 66x18, high pressure type, and stoker equipment for three boilers. C. L. Clary is general manager.

BUTTE, MONT.—Plans are being considered by the Montana Independent Telephone Company for the erection of a telephone line from Whitehall and Twin Bridges to Virginia City.

HAMILTON, MONT.—The City Council is considering extending the electric lighting system to the Riverview addition.

HELENA, MONT.—A temporary injunction has been issued by Judge J. Miller Smith restraining the city of Helena from proceeding with its plan to establish a municipal electric light plant. Bids for installing the plant have already been received.

AINSWORTH, NEB.—A stock company is reported to have been formed for the purpose of building a dam at Plum Creek, 15 miles northeast of Ainsworth, the water power to be utilized to generate electricity which will be transmitted to Ainsworth. F. W. Sellars is president of the company, and Walter Williams, secretary.

BEATRICE, NEB.—The New Home Telephone Company is reported to have purchased the controlling interest in the Filley Telephone Company. It is said that many improvements are proposed to the system.

BOELUS, NEB.—The capital stock of the Howard County Telephone Company has been increased from $24,000 to $34,000, the proceeds to be used for extension of telephone lines and discharging outstanding indebtedness.

BROKEN BOW, NEB.—O. P. Sells, of Sterling, Col., is reported to have applied to the City Council for a franchise to construct and operate an electric light plant in Broken Bow.

LOUISVILLE, NEB.—Preparations are being made by the Plattsmouth Independent Telephone Company to erect a new exchange building.

STROMSBURG, NEB.—The State Railway Commission has authorized the Polk County Telephone Company to increase its capital stock from $66,875 to $74,875, for the purpose of extending its lines and payment of outstanding obligations.

BRIDGETON, N. J.—Bids will be received by Frank L. Hewitt, city clerk, until Nov. 2, for lighting the city for a term of five years, beginning December, 1909.

CALDWELL, N. J.—The Borough Council has voted to accept the new light contract submitted by the Public Service Commission for street lighting for a term of three years, dating from March, 1909. Under the terms of the contract the borough is to pay $16 per lamp the first year for 32-cp incandescent lamps, $18 for the second year and $20 for the third year. Under the new contract no free lamps will be furnished.

CAMDEN, N. J.—The Delaware Tunnel Railroad Company has been granted a franchise by the City Council to enter Camden with its rapid transit railway. The proposed railway will extend from Philadelphia, Pa., to Camden under the Delaware River. William A. Stern, of Philadelphia, Pa., is president of the company.

KEYPORT, N. J.—The Jersey Central Traction Company has awarded a contract for its proposed extension through South Amboy to Perth Amboy, 2½ miles in length, to the General Contracting & Engineering Company, of New York, N. Y.

PLAINFIELD, N. J.—Bids will be received by F. A. Waldron, engineer, 37 Wall St., New York, N. Y., on the following equipment: One direct-current, 40-kw, 220-volt generator, equipped with special shaft with flexible coupling on one end and pulley on the other, direct-connected to one vertical cross-compound non-condensing engine with the necessary governor, which shall regulate within two per cent from no load to full load; one rheostat for the above; one voltmeter; one ammeter and one single throw switch with approved fuse blocks; all to be mounted on polished slate panel. The above to be guaranteed against defects in workmanship and materials for one year, price to be f.o.b. Plainfield, N. J. An alternate proposal on one 50-kw outfit is also requested. Further information will be furnished on application to the engineer.

CIMARRON, N. M.—The application of Charles Springer, of Cimarron, N. M., for 95 cu. ft.-second of water of the Rio Honde River in Taos County has been approved by the territorial engineer. The water will be utilized to develop 5000 hp. The development will involve an expenditure of about $200,000.

DEMING, N. M.—Word has just been received from B. P. Shull, who has been in Wichita, Kan., negotiating with the Western Construction Company for the installation of a large central power plant in Deming, stating that the deal for the power plant has been closed.

PORTALES, N. M.—The citizens have voted to issue bonds for the installation of lighting and sewer systems.

RATON, N. M.—The Van Houton Coal & Land Company is said to have placed contracts for the installation of an electric plant at Raton, which will furnish electricity for lamps and motors at the mines of the company located near the Gate City. The cost of the work is estimated at $35,000.

BROOKLYN, N. Y.—The Public Service Commission, First District, has approved the issue of $107,000 in bonds by the Coney Island & Brooklyn Railroad Company. The bonds are to be sold at not less than 80, the proceeds to be applied only to pay for betterments and improvements in carrying out reconstruction work in Franklin and DeKalb Avenues and relaying of its present rails in Smith Street, and paving of all three streets.

FORT H. G. WRIGHT, (P. O. NEW LONDON, CONN.) N. Y.—Bids will be received by the constructing quartermaster, U. S. A., New London, Conn., until Nov. 8, for furnishing and installing electric light fixtures and wattmeters in 10 buildings at Fort H. G. Wright.

HOOSICK FALLS, N. Y.—The Public Service Public Corporation has served an order on the Twin State Gas & Electric Company, a foreign corporation, with principal offices in Hartford, Conn., to show cause before the commission why it should do business in Hoosick Falls without permission of the commission. The company in August, 1908, acquired the plant and franchises of the Hoosick Falls Illuminating Company without asking the consent of the commission. An application of the

Twin State Company for permission to acquire the stock of the Hoosick Falls Company was previously denied by the commission on the ground that the new company was a foreign corporation.

JAMESTOWN, N. Y.—The municipal lighting commission has adopted a resolution recommending the purchase of the system of the Jamestown Lighting & Power Company for $90,000 and the appropriation of $30,000 for consolidating it under one roof with the municipal electric plant. The United Electric Securities Company, of Boston, Mass., owners of the plant, is said to have accepted the proposition. The commissioners will ask the City Council to call an election to vote on the proposition. The commissioners estimate that the consolidated plants will pay for themselves and realize a profit of $26,000 annually.

NEW YORK, N. Y.—The Fifth Avenue Association is having plans prepared for improving the illumination of Fifth Avenue, which will require the installation of additional lamps. W. M. Kendall, a member of the firm of Meade, Kendall & White, New York, N. Y., is preparing plans.

ONEONTA, N. Y.—The Otsego & Herkimer Railroad Company, successor to the Oneonta & Mohawk Valley Railroad Company, has applied to the Public Service Commission for permission to issue $1,500,000 in common capital stock; also to issue first, second and third mortgages and for authority to issue $500,000 in first mortgage bonds, $300,000 in second mortgage bonds and $700,000 in third mortgage bonds, the proceeds to be used to take over the property and franchises of the railroad acquired and to take up outstanding obligations. The railway connects Oneonta, Cooperstown, Richfield Springs, Mohawk, Herkimer and Utica.

TONAWANDA, N. Y.—Preparations are being made by the McKinnon Chain Company, of Buffalo, N. Y., recently incorporated to manufacture an electrically welded chain by a new process, for the construction of factory building 304 ft. x 80 ft. and a power house 30 ft. x 40 ft., both of steel and concrete construction, in Tonawanda. It is said that a large amount of special machinery will be required. Lachan E. McKinnon, president of the McKinnon Dash Company, of Buffalo, N. Y., who is inventor of the process, is president of the company.

WORCESTER, N. Y.—The Great Bear Light & Power Company has applied to the Public Service Commission, Second District, for permission to extend its transmission lines from East Worcester to Worcester for the purpose of furnishing electrical service in the last named place. There is at present an electric plant at Worcester operated by Henry Shafer, which is furnishing electricity in this village, but the service is not at all satisfactory.

ANSONVILLE, N. C.—Preparations are being made by A. H. Richardson for the construction of a hydroelectric power plant, which will include the construction of a steel reinforced concrete hollow dam 500 ft. long in main part and extreme length of 880 ft., 50 or 60 ft. in height; the power house will be located in hollow dam. The plans call for the development of from 6000 to 8000 hp for transmission. The cost of the entire plant is estimated at $750,000. Mr. Richardson also contemplates establishing cotton mills and other industries to utilize electricity for lighting and power. A. F. Lyman, of Lilesville, N. C., is engineer in charge.

ASHEVILLE, N. C.—An order has been made in Federal Court here by Judge J. C. Pritchard, confirming the sale of the property of the Rock Hill Water, Light & Power Company, of Rock Hill, S. C., by the receiver, P. A. Wilcox, of Florence, S. C., to Martin Maloney, at $80,000, and also the sale of the plant and holdings of the Carolina Water, Light & Power Company, of Darlington, S. C., by P. A. Wilcox, receiver, to Martin Maloney for $51,000, and the property of the Marion Light & Power Company, of Marion, S. C., by Mr. Wilcox to Mr. Maloney for $50,000, who was the highest bidder for the three properties.

CHAPEL HILL, N. C.—Extensive improvements are being made to the University power plant at Chapel Hill, N. C. The system has been changed from direct to alternating-current, 60 cycles. The old steam pumps in the city water works system are being replaced with motor-driven rotary pumps, and the central heating system is being enlarged. J. E. Latta, superintendent, designed the plant and has charge of the installation of the new apparatus.

CHARLOTTE, N. C.—The Cole Manufacturing Company has awarded a contract for the construction of a foundry and five other buildings, which will be equipped for the manufacture of farm implements. The plant, it is said, will be equipped for electric motor drive.

DURHAM, N. C.—The Durham Traction Company is contemplating increasing the output of its power plant and expects to place orders within a few weeks for a 500-hp Corliss cross-compound, condensing engine direct connected to a three-phase, 60-cycle, 2300-volt generator, or a 500-kw turbo-generator set. R. L. Lindsey is general manager.

MURPHY, N. C.—J. L. Smathers, of Murphy, N. C., is reported to be in the market for an electric light plant for a $50,000 hotel.

SALISBURY, N. C.—The Board of Aldermen has granted a franchise to parties interested in building an interurban electric line into the town from Concord, 23 miles south, the Salisbury franchise to become operative when ten miles of the interurban tracks towards Concord have been completed.

WARRENTON, N. C.—Preparations are being made by the Peck Manufacturing Company for the construction of its mill building 132 x 195 ft. The equipment will include 5000 spindles, boilers, turbines, electrical motors, etc., for manufacturing yarns. It is said that contracts have been made for all but the textile machinery. J. E. Sirrine, of Greenville, S. C., is the architect in charge and Thomas D. Peck, president.

CINCINNATI, OHIO.—Sealed bids will be received by the Director of Public Safety, Cincinnati, Ohio, until Oct. 29 for furnishing underground cable for the signal and telephone circuits for the Fire Department of the City of Cincinnati, according to the specifications on file in the office of the Director of Public Safety.

CUYAHOGA FALLS, OHIO.—The City Council has rescinded its former action in regard to the franchises of the Walsh Electric Light & Power Company and the Falls River Falls & Machine Company and has given both companies an extension of two years to commence work on their plants. Both companies were granted franchises two years ago to operate heat, light and power plants in Cayahoga Falls, work to begin within two years, but owing to litigation work was not commenced within the time. The Council has at former meetings refused to extend the franchises.

FREMONT, OHIO.—The capital stock of the Fremont Power & Light Company has been increased from $350,000 to $750,000.

LANCASTER, OHIO.—Application has been made to the City Council by the Lancaster Traction & Power Company for a franchise to construct a street railway on certain streets in Lancaster. Bids will be received for the franchise until Nov. 8.

YOUNGSTOWN, OHIO.—The Mahoning & Shenango Railway & Light Company has placed contracts for two 500-hp Heine boilers with the Heine Boiler Company, of St. Louis, Mo. M. E. McCaskey is general manager.

RYAN, OKLA.—The contract for the construction of water works system, electric light plant and sewer system in Ryan was awarded to N. S. Sherman & Company, of Oklahoma City, Okla.

BEAVER FALLS, PA.—The New Castle & Beaver Falls Valley Street Railway Company has petitioned the City Council for a franchise to construct and operate an electric railway in Beaver Falls. The company also contemplates the erection of a power plant in this city. The proposed railway will extend from Beaver Falls to New Castle. Robert W. Cunningham and Stewart S. Neff are interested in the project.

EASTON, PA.—The Stroudsburg & Water Gap Street Railway Company has petitioned the Town Council for a franchise to extend its railway to the borough limits. The company is planning to extend its railway from Easton to Portland.

HUNTINGTON, PA.—The Huntingdon, Lewiston & Juniata Valley Traction Company has filed record of a mortgage in the court house in Huntingdon for $1,500,000 in favor of the Empire Trust Company, of New York, N. Y. It is said that the company will commence construction work within 60 days.

McKEESPORT, PA.—The Pittsburgh, McKeesport & Westmoreland Railway Company has secured a franchise to construct and operate an electric railway between McKeesport and Westmoreland, a distance of 19 miles.

PHILADELPHIA, PA.—The Philadelphia & Reading Railway Company has awarded the contract for the construction of a power house in connection with the elevation of its Ninth Street tracks at Percy and Wallace Streets to Fred A. Havens & Company. The plant will furnish electricity for heat, lamps and motors to the adjacent yard and engine houses.

EASLEY, S. C.—It is reported that plans are being considered for establishing an electric light and ice plant in Easley, S. C. W. C. Cleveland, of Spartanburg, S. C., and others, are interested in the project.

GREENVILLE, S. C.—The Southern Power Company is erecting a substation near the city, through which electricity from Great Falls will be supplied to the Monoghan mills and the Woodside cotton mills and other mills about Greenville.

BELMONT, S. D.—The City Council is reported to be considering the question of establishing a municipal electric light plant.

GALLATIN, TENN.—Preliminary surveys have been made for the proposed electric railway from Gallatin to Beckwith, a distance of 12 miles. C. H. Fidler, of Gallatin, is said to be interested in the enterprise.

LIMESTONE, TENN.—Plans are being considered by Williams Brothers for the construction of a hydroelectric power plant in Limestone in the near future.

BRYAN, TEX.—It is reported that a bonus of $10,000 has been subscribed for the construction of an electric railway between Bryan and the State College, five miles in length. J. T. Maloney, Mayor, and others are interested in the project.

DALHART, TEX.—Preparations are being made by the Dalhart Ice & Electric Company to double the output of its plant, which will include the installation of a 250-hp generator and other equipment. The cost of the work is estimated at $10,000. S. E. Kellen is manager.

FORT WORTH, TEX.—It is reported that the citizens have voted to issue $[illegible] in bonds, the proceeds to be used to extend the street lighting system.

FORT WORTH, TEX.—It is reported that the Fort Worth Mineral Wells & Western Railroad Company will submit a proposition to the Fort Worth Board of Trade asking for a bonus of $125,000, terminal site and right of way in Fort Worth. The citizens of Mineral Wells have accepted the proposition of the company to build its railway into Mineral

Wells for a bonus of $60,000, terminal site and right of way. L. C. Cole, of Fort Worth, Tex., is said to be interested in the project.

KINGSVILLE, TEX.—The Kingsville Ice Company, it is said, is contemplating the installation of an electric light plant. H. Delno is manager.

SALT LAKE CITY, UTAH.—The Utah & Nevada Telephone Company is extending its telephone line from Salt Lake City to Skull Valley, a distance of 75 miles.

MORRISVILLE, VT.—The citizens have voted to authorize the Water and Light Commissioners to enter into a contract with the Mount Mansfield Electric Railroad Company, of Stowe, Vt., to furnish energy to operate its railway, and to supply electricity to the village of Stowe for lamps at the rate of $30 per hp per year, with a minimum of $2,500 per year.

RICHMOND, VA.—It is reported that capitalists from Philadelphia contemplate building a double-tract electric line, at least 22 miles in length, to connect Colonial Beach with the Richmond, Fredericksburg & Potomac Railroad. It is said that Quantico, being the nearest railway station to Colonial Beach, will likely be the terminus of the electric line. The estimated cost of the work is about $250,000. The power plant will probably be located at Classic Shore. A further report has it that the Widener-Elkins street railway syndicate is behind this movement and that it is ultimately purposed to connect Richmond and Washington, D. C., by an electric line, several hundred miles in length. J. R. Benton, representing the parties interested, has already filed his petition for a franchise with the Town Council of Colonial Beach.

STANLEYTON, VA.—The contract for construction of an electric light plant has been awarded to P. H. Trout, of the Shenandoah Electric Company, of Staunton, Va.

PASCO, WASH.—The Walla Walla Valley Traction Company has filed a petition with the Superior Court asking for a franchise to construct its railway in the Riverside addition and on Ainsworth Avenue, and other sections outside the city limits. The company proposes to build an extension from Walla Walla to Pasco, surveys for which are being made.

SPOKANE, WASH.—The Crab Creek Telephone Company has applied to the County Commissioners for a franchise to erect a telephone line connecting Chattaroy, Milan and Deer Park and intervening farms.

SPOKANE, WASH.—Bids will be received until Nov. 5 by the Board of Public Works, Spokane, Wash., for the following equipment: Three 7,500,000-gal. multi-stage centrifugal pumps, three induction motors, switchboard and connections. Plans and specifications are on file in the office of Board of Public Works. George W. Armstrong is secretary of the board.

TRIADELPHIA, W. VA.—The Manufacturers' Heat & Light Company, of Pittsburgh, Pa., is reported to be contemplating the erection of a telephone line from Triadelphia to Majorsville, and is also considering building a line from Triadelphia across country to Fairmont, thence to Clarksburg and Lost Creek, W. Va. W. A. Jackson is superintendent.

ELKHORN, WIS.—Plans are being considered to enlarge the municipal electric light and water plant, which will include an addition to the power house, 24 x 40 ft., contracts for construction of which will soon be awarded.

MANITOWOC, WIS.—Contracts have been awarded by the Aluminum Foundry Company for the construction of a foundry and power house. The latter, it is said, will be equipped with gas engines, pumps and compressor.

MILWAUKEE, WIS.—Application has been made to the City Council by the Milwaukee Electric Railway & Light Company for a franchise to extend its railway over certain streets in Milwaukee.

PORTAGE, WIS.—The Chicago & Wisconsin Valley Railroad Company is said to be contemplating the construction of a steam turbine power plant, with rotary converter and transformer substations next spring. According to the present plans the generating units will be located at Portage. E. G. Frost, of Stevens Point, Wis., is president of the company.

RACINE, WIS.—The Belle City Malleable Iron Company has commenced work on the construction of a new building for its works and installation of a power plant, the equipment of which will include an engine-driven 200-kw generator and motors for operating machines; new blowers for furnaces will also be required;.

ST. JOSEPH, WIS.—The Moulton Rural Telephone Company has increased its capital stock from $3,600 to $6,000.

SUPERIOR, WIS.—The Great Northern Railway Company is reported to have awarded a contract to Schmidt Brothers & Hill for rebuilding one of its docks at Superior, which provides for all machinery to be operated by electricity.

VANCOUVER, B. C., CAN.—The British Columbia Electric Railway Company expects to place contracts within a few weeks for the construction of a 2½-mile extension in North Vancouver, and a 7-mile suburban system extending east from Vancouver through Burnsby Municipality.

AYLMER, ONT., CAN.—We are informed that the municipal electric light plant, recently destroyed by an explosion, will be rebuilt. The cost of the work is estimated at $15,000. John L. Millard is engineer of the plant.

BRACEBRIDGE, ONT., CAN.—Bids will be received until Nov. 1, by Alex. Salmon, Town Clerk, for the construction of a hydroelectric plant as follows: (a) For construction of general works of the hydroelectric development of Wilson's Falls, Muskoka River, including dams, coffer dams, rock excavation, concrete walls, foundations, etc.; (b) Hydraulic machinery, including 1100-hp turbine, 35-hp turbine, governor, penstock, etc.; (c) Electrical machinery, including generator, exciter, switchboard, etc. C. H. & P. H. Mitchell, Traders' Bank Building, Toronto, Ont., are engineers.

CHIPPAWA, ONT., CAN.—Work has commenced on the construction of the first building of the Electrical Furnace Company in Chippawa. The building will be 180 ft. x 135 ft., and will cost about $80,000. The initial power unit will be 1,000 hp.

OWEN SOUND, ONT. CAN.—The City Council is reported to be considering a proposition submitted by the Georgian Bay Power Company to furnish electricity to operate the municipal electric lighting system. The company offers to supply 1500 hp at $20 per hp at the power plant at Eugenia Falls, or $24 per hp delivered in Owen Sound.

TORONTO, ONT., CAN.—Final contracts have been awarded by the Hydroelectric Commission in connection with the transmission lines, transformer stations and all mechanical equipment as follows: To Royce, Ltd., of Manchester, Eng., for electric cranes for the transformer stations at Niagara Falls and Dundas; for electric cranes for the transformer stations at Toronto, London, Guelph, Preston, Berlin, Stratford, St. Mary's Woodstock and St. Thomas, to Mussens, Ltd., of Montreal and Walkerville. The total amount of the tenders amounted to $17,094.

AYLMER, QUE., CAN.—The Hull Electric Company has placed a contract for a steel bulkhead at the power house at Deschenes.

POINTE AUX TREMBLES, QUE., CAN.—The Parish of Pointe aux Trembles has awarded an exclusive franchise to the Saraguay Electric & Water Company to furnish electricity for lamps and motors. The territory extends from Boute de Isle to Longue Pointe, covering about 35 miles on the Island of Montreal.

VERDUN, QUE., CAN.—Contracts have been awarded by the municipality for equipment in the municipal electric light plant as follows: For two engines to Laurie & Lamb, of Montreal, Que., agents for Beliss & Morcom, Birmingham, Eng., at $9,000; two 235-kva, three-phase, engine-type generators with direct-connected exciters and switchboards complete to the Canadian Westinghouse Company, for $7,532 Charles Brandeis, of Montreal, Que., is consulting engineer.

New Incorporations.

DE QUEEN, ARK.—Articles of incorporation have been filed for the De Queen Light & Ice Company with a capital stock of $50,000. The officers are: C. W. Dawley, president; P. G. Whaley, vice-president; Paul Coleman, secretary and treasurer.

COLUMBUS, GA.—The Chattahoochee River Power Company has been incorporated with a capital stock of $100,000 with the privilege of increasing it to $2,000,000. The company proposes to construct a large dam and power plant on the Chattahoochee River between Columbus and West Point. The dam will be 1000 ft. long and 30 ft. high; horizontal wheels direct-connected to electric generators will be installed. The cost of the initial plant including transmission lines, dam, etc., will be $400,000 J. E. Sirrine, of Greenville, S. C., is engineer in charge.

KITTERY, MAINE.—The Kittery Water & Electric Light Company has been incorporated with a capital stock of $100,000 and the following officers: J. S. Whittaker, of Portsmouth, N. H., president; S. W. Emery, of Boston, Mass., treasurer.

BUFFALO, MO.—The Big Naungua Power Company has been chartered with a capital stock of $490,000 by W. C. Clayton, Irvin Phillips, A. W. Martin, and others.

LAS CRUCES, N. M.—The Texas, New Mexico & Pacific Railway Company has filed articles of incorporation for the purpose of constructing a street railway from Mesilla to Sunny Slope, via Las Cruces, three miles in length. The company is capitalized at $50,000, and the incorporators are: James T. Smith, Edward Ehle, Charles K. Atkinson, Allen J. Papen and Frank A. Jones, all of Las Cruces.

COLUMBUS, OHIO.—The Columbus & Cincinnati Air Line Traction Company has been chartered to construct an electric railway from Columbus and Cincinnati, via Washington, C. H., and Wilmington. The incorporators are: Frank E. Ruth, E. B. Tompkins, Randolph W. Walton, W. L. McVey and M. B. Recob. The company is capitalized at $10,000.

BEDFORD, PA.—Articles of incorporation have been filed for the Bedford, Fulton & Franklin Street Railway Company to construct an electric railway through Bedford, Fulton and Franklin counties, connecting Bedford and Chambersburg, 50 miles in length. The capital stock is placed at $300,000. The incorporators are: M. J. Murphy, of Pittsburgh, president; H. D. Tate, George W. Rook, John B. Fay, M. H. Sheats and J. Y. Daly.

BELLEFONTE, PA.—The Center County Traction Company has been incorporated with a capital stock of $100,000 to construct an electric railway from Bellefonte to State College, a distance of 15 miles. The incorporators are: W. C. Hagan, of Pittsburgh, president; William H. Furey and L. T. Munson.

JONESBORO, TENN.—The Markwood Power Developing Company has filed articles of incorporation with a capital stock of $20,000. The incorporators are: A. T. Markwood, C. E. Burchfield, W. H. Martin, and others.

BAY CITY, TEX.—The Gravity Irrigation & Power Company has been incorporated with a capital stock of $500,000 by Clinton S. Woolfolk and Henry S. Judson.

DALLAS, TEX.—Articles of incorporation have been filed for General Electric Company with a capital stock of $50,000 by B. E. Sunny, H. L. Monroe and Keames W. Johnson, all of Chicago, Ill., and James F. Strickland.

MANSFIELD, WASH.—Articles of incorporation have been filed for the Mansfield Water & Light Company with a capital stock of $5,000 by J. W. Wright and others.

SPOKANE, WASH.—The Idaho Central Railway, of Spokane, has been incorporated with a capital stock of $25,000 by A. Morgan and J. A. Rea.

SPOKANE, WASH.—Articles of incorporation have been filed for the Kettle River Water Power Company by E. L. Tate, R. L. Thompson, Reese Voorhees, Charles Grant and W. W. McCreary. The company is capitalized at $25,000.

MADISON, WIS.—Articles of incorporation have been filed for the Chicago & Wisconsin Valley Railroad Company for the purpose of constructing an electric railway from Janesville to Merrill, via Stoughton, Madison and other towns. The company is capitalized at $40,000, which will be increased later to build and equip the road. The officers of the company are: D. E. Frost, of Stevens Point, president; J. W. Purvis, of Friendship, vice-president; A. J. Behymer, of Indianapolis, Ind., secretary; A. J. Baskerville, of Madison, assistant treasurer, and Allen T. Russell, of Baltimore, Md., general and chief engineer. The contract to construct and equip the railway, it is said, will be let to the Western Indian Construction Company, which will open an office at Madison or Portage.

NELSON, B. C., CAN.—The Nelson Street Railway Company has been chartered with a capital stock of $50,000 for the purpose of acquiring from the city the present tramway and appliances. It is said that the company will make extensions to same.

Personal.

MR. L. B. MARKS has been appointed a member of the committee on gas and electricity of the Merchants' Association of New York.

MR. T. C. RYAN, of the Cincinnati office of the Ft. Wayne Electric Co., addressed the Electro-Technic Club of Ft. Wayne on Oct. 19, the subject being "Salesmanship."

MR. WALTER D'ARCY RYAN, of the General Electric Company, was married Oct. 23 to Miss Katharine Flora Haskins at the home of the bride at North Adams, Mass.

PROF. H. H. NORRIS, head of the department of electrical engineering at Cornell University, has been elected secretary of the Society for the Promotion of Engineering Education.

MR. N. J. NEALL will present a paper on "High Voltage Transmission and Lightning Protection" at a meeting of the Worcester Polytechnic Institute A. I. E. Branch on Nov. 19.

MR. GUY H. GIBBS, who has been with the Westinghouse Electric & Manufacturing Company for the past eight years, four of which have been with that company's Cincinnati office, now represents the Western Electric Company at Cincinnati.

MR. H. J. PLAGGE has been appointed instructor in the department of physics and illumination, of the Iowa State College. Mr. Plagge has the degree of B S. from Northwestern University, and has passed two years in graduate work and as instructor in physics at the University of Wisconsin.

MR. W. A. BEVAN has received the appointment as instructor in the department of physics and engineering of Iowa State University, his alma mater. Mr. Bevan has taken a graduate course at Chicago University and resigned as principal of the Cavite, P. I., Trade School to accept the present position.

MR. MATHEW C. BRUSH has resigned as general manager of the Boston Suburban Electric Company to assume the same position with the Buffalo & Lake Erie Traction Company, and Jamestown, Chataqua & Lake Erie Railway. These lines control 200 miles of electric railway, 50 miles of steam road and a fleet of steamboats.

MR. M. C. TURPIN, formerly superintendent of the Auburn (N. Y.) Light, Heat & Power Company, and more recently electrical engineer on the engineering staff of the Public Service Commission of the First District, New York City, has severed his connection with the commission and has accepted a position with the Westinghouse Company at East Pittsburgh.

MR. R. F. HAYWARD, formerly manager of the Mexican Light & Power Company, and before that chief engineer of the Utah Light & Power Company, has resigned his position to take a similar one with the Vancouver Light & Power Company. Mr. Hayward takes with him Fred D. Nims, who has been chief engineer in Mexico, and who will now be associated with the Vancouver company.

MR. EDWARD L. BAILEY, of the Dundee (N. Y.) Electric Lighting Plant, is planning to spend the winter with his family in Florida. He heretofore spent his winters in New York and Philadelphia doing engineering work for some of the large electrical construction companies. Prior to his connection with the Dundee plant Mr. Bailey was purchasing agent for the American Gas & Electric Company, of Philadelphia.

MR. C. A. FELKER, has been appointed superintendent of the New Sigourney Electric Light & Power Company, which recently purchased the central station property at Sigourney, Iowa. The old power house and station will be abandoned and a new alternating-current plant built. Mr. Felker has been connected with the electrical industry the past 20 years, at one time having been superintendent of construction and motive power with the Freeport (Ill.) Light & Railway Company, and later sales manager of the Central Electric Company, Chicago.

MR. GEORGE McKINLEY MATTIS, of Champaign, Ill., vice-president and treasurer of the Illinois Traction System, was married to Miss Elsie Evans Curtis, daughter of Mr. and Mrs. William E. Curtis, of Washington, D. C., in the latter city on Oct. 16. Mr. Mattis is a nephew of Hon. William D. McKinley, representative in Congress from Illinois, and president of the Illinois Traction System. Mr. Mattis comes from an old American family. His great-grandfather, the Rev. Robert Finley, was the founder of the American Colonization Society, under whose auspices the republic of Liberia was organized.

MR. ARBA B. MARVIN has opened an office in the Commercial National Bank Building, Chicago, for the practice of patent law. Mr. Marvin, who is an electrical engineering graduate of the University of Wisconsin, has served in the testing department of the General Electric Company, Schenectady, for a time was instructor in electrochemistry at the University of Wisconsin, and has made a specialty of electrochemistry and electrometallurgy. He studied law at the Columbian University, Washington, while an examiner in the U. S. Patent Office, and for the past five years has been an assistant attorney in the General Electric patent department.

MR. R. M. SEARLE, of the Rochester Railway & Light Company, was the chairman of the committee to whom much of the success of the recent industrial exposition in Rochester is due. In booming Rochester, Mr. Searle feels that he is adding to the income of his company which owns the railway, gas and electric light plants; for prosperity cannot come to Rochester without his company reaping a share of it. Mr. Searle was formerly connected with the Westchester Lighting Company and also with the Georgia Railway & Electric Company. Last January he was promoted from general manager to third vice-president of the Rochester company in recognition of meritorious service.

MR. C. W. HOUGH has been appointed general manager of the Consolidated Power & Light Company of Deadwood and Lead, South Dakota. Mr. Hough has for three years past been manager of the Consolidated Light, Power & Ice Company of Joplin, Mo., where his experience in building up a load among the lead and zinc mines of that district fits him especially for his new work. The company of which he has just assumed the management, supplies electric power to the gold mines of the Deadwood district and also lights the various towns. The company has a modern steam turbine plant and excellent opportunities for development. The president of the company is Mr. N. E. Franklin, a prominent citizen and capitalist of Deadwood, and eastern capital is also largely interested. Previous to his Joplin experience Mr. Hough was for seven years with the General Electric Company in various engineering and business capacities. His analysis of the Doherty "Readiness to Serve" rate, presented at the last Missouri convention and printed in these pages, attracted much attention among central-station men.

Obituary.

MRS. GARDINER GREEN HUBBARD, widow of the first president of the American Bell Telephone Company, and mother of the wife of Alexander Graham Bell, was thrown fram her automobile in Washington on Oct. 20 as the result of a collision with a trolley car, and died not long afterward. Mrs. Hubbard was 84 years old. She was a wealthy woman, and for many years was a leader in philanthrophic work in Washington.

Trade Publications.

DESK LAMPS, of neat and attractive appearance, are listed, described and illustrated in a leaflet issued by H. G. McFaddin & Company, 38 Warren Street, New York.

ENGINES.—Vertical-cylinder steam engines designed with particular reference to silent operation are treated in a mailing folder issued by the American Blower Company, Detroit, Mich.

LIGHTING SPECIALTIES, including snaplock sockets, fixture wrenches, and grips for incandescent lamps, are treated in leaflets issued by the Yost Electric Manufacturing Company, Toledo, Ohio.

ELECTROLYTIC RECTIFIERS, for 110-volt circuits and for currents ranging from 2 amp to 30 amp are fully described and illustrated in a catalog of the Como Electrical Company, Spring Lake, N. J.

DRILLS.—The Cleveland Twist Drill Company, Cleveland, Ohio, has issued a folder devoted to drills with flat taper shanks. These drills are twisted from a flat bar instead of being milled from round stock.

ACID-PROOF VALVES.—The Cleveland Bronze & Brass Works, Cleveland, Ohio, has issued a neatly executed catalogue describing valves designed for withstanding the influence of sulphuric acid and other corrosive liquids.

GAS ENGINES of the single-cylinder type, rated at from 20 to 100-hp, and of the tandem type, rated at from 50 to 500-hp, are illustrated and briefly described in a folder issued by the Bogart Gas Power Engineering Company, Buffalo, N. Y.

VACUUM CLEANERS.—A motor-driven 3-hp vacuum cleaning outfit is described in detail in a pamphlet issued by the Spencer Turbine Cleaner Company, Hartford, Conn. A separate publication gives an imposing list of cleaner installations now in service.

GAS PRODUCERS.—Bulletin No. 4 of the Hill-Hupfel Engineering Company, 30 Church Street, New York, gives much specific information relating to producer gas plants designed to use anthracite fuel. Brief mention is made also of plants for using bituminous coal, lignite or peat.

COPPER-CLAD STEEL WIRE.—The Duplex Metals Company, 149 Broadway, New York, has issued a well-prepared catalog dealing with its copper-clad steel wire. This wire is 60 per cent as strong as steel and has a conductivity of 40 per cent of that of a copper wire of the same size. Many railroads use this wire for signal circuits.

SUCTION CONVEYORS.—The Darley Engineering Company, Singer Building, New York, has issued bulletin No. 4. devoted to suction conveyors for coal and ashes. The bulletin contains a list of suction conveyor plants in operation or being constructed. A special leaflet issued by the company contains a large number of letters of endorsement from satisfied customers.

SPEED REGULATORS, for use with electric motors operating blowers of mechanical stokers, boiler feed pumps, gas pressure blowers, etc., are well treated in a pamphlet issued by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. The regulators are of the pressure-controlled type and can be employed with direct-current, single-phase repulsion or polyphase induction motors.

BOILER-TUBE CLEANERS.—The Lagonda Manufacturing Company, Springfield, Ohio, has issued a 48-page booklet describing Weinland boiler-tube cleaners. Full descriptions are given of the various types of cleaners manufactured by this company and of the scale conditions for which each is best suited is pointed out. Among the new types developed are the air-driven and steam-driven turbine, and also a line of cleaners for use in condenser and economizer tubes.

EXIDE SPARKING BATTERY.—The Electric Storage Battery Company, of Philadelphia, has recently issued an attractive publication on the "Exide Sparking Battery," which contains a very complete description of its well-known ignition cell and a rather unusual double-page illustration showing its entire construction at a glance. In addition to this description of the battery, three timely articles have been specially written for this publication by the editors of *Motor, Cycle and Auto Trade Journal* and *Automobile,* which touch upon such subjects as spark plugs, care of the automobile, etc.

Business Notes.

GENERAL ELECTRIC A.-Y.-P. GRAND PRIZE. The Alaska-Yukon-Pacific Exposition has awarded to the General Electric Company a grand prize on its general exhibit of electrical apparatus and completely furnished model apartment.

ICE MAKING AND REFRIGERATING MACHINERY.—A list of recent sales of ice making and refrigerating machinery of the York Manufacturing Company, York, Pa., includes more than two score plants from almost half that number of States.

ROEBLING A.-Y.-P. PRIZES.—The John A. Roebling's Sons Company has received 10 grand prizes, the highest awards, for its exhibit at the Alaska-Yukon-Pacific Exposition. A grand prize was awarded the company for its general exhibit and similar prizes were bestowed for different articles shown. Among the Roebling products thus recognized were iron telephone and telegraph wire, steel, brass and copper wire, and insulated wires and cables.

FRINK REFLECTORS.—The tower of the Metropolitan Life Insurance Building in New York City, which is the highest building in the world, is lighted by special reflectors placed there by the firm of I. P. Frink, 551 Pearl Street, New York. By their means the clock dials are rendered distinct and impressive, and the lantern at the extreme top, which is over 7 ft. in diameter, has the appearance of one mass of fire. It indicates the hours by flashes of white light. while red flashes indicate the quarter hours—one for one-quarter past the hour, two for one-half past the hour, three for three-quarters past the hour. I. P. Frink has just been awarded the grand prize for reflectors by the Alaska-Yukon-Pacific Exposition.

HALLER SIGNS.—The Haller Signs Works, Chicago, report the following recent installations of electric roof signs with spectacular display features: Krug Brewing Company, Omaha, Neb. (beerglass with overflowing foam effect); Brandeis & Sons (clothiers), large man with elaborate moving and whirling scroll border; Boston Drug Company, Kansas City, Mo., figure of man with lightning stroke effects; Gayety Theater, Minneapolis, Minn., dancing girl; Upmann & Wilcox, Cleveland, Ohio, and Columbus, Ohio, two lamp letter sign with large cigars and rising smoke effect; new Cort Theater, Chicago, house sign and attraction board with moving scroll border and kaleidoscopic top piece; new Cort Theater, Chicago, imitation fireworks display for finale of first act of "The Kissing Girl;"" The Ritter Company, Spokane, Wash., large sign with double whirling border effect.

THE IDEAL ELECTRICAL & MANUFACTURING COMPANY, Mansfield, Ohio, reports that it has taken contracts within the past thirty days for motors aggregating several thousand horse-power. It has also received orders for two 250-kw belted alternators for the Buckeye Mining & Smelting Company, Big Pine, Cal.; one 75-kw alternator for Clay Center, Neb.; one 75-kw alternator for the Turnbull Manufacturing Company, Toronto, Can.; nine 15-hp slip-ring alternating-current motors for elevators in the E. M. F. automobile factory at Detroit, Mich.; fifteen squirrel-cage motors for the M. C. Peters Mill Company, Omaha, Neb., sizes 3 to 60-hp; individual motor drive in a new mill of the Mansfield Elastic Web Company, consisting of seventy motors for individual drive on elastic web looms; three 400-amp, alternating-current motor driven low-voltage generators for electro-plating service; one 2500-amp plating dynamo, and two 1500-amp. plating dynamos. The factory is being run fifteen hours per day at the present time.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED OCT., 19, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector Street., N. Y. City.]

937,050. TELEPHONE SYSTEM; H. P. Clausen, Chicago, Ill. App. filed June 4, 1908. Central energy system with test circuits with a supervisory relay in the cord circuit with an induction coil having a tertiary winding with means for establishing a busy test through said relay and winding.

937,052. TERMINAL CONNECTOR CONSTRUCTION; C. Cuno, Meriden, Conn. App. filed Feb. 10, 1909. Connector for spark plugs having a clip and handle with a screw passing through a bored passage for the wire end.

937,062. THERMAL PROTECTOR; S. B. Fowler, La Fayette, Ind. App. filed May 23, 1907. For telephone systems to avoid resoldering consisting of a metallic flanged cylinder and a pair of insulating disks secured to the head of the cylinder.

937,074. ELECTRICAL HEATING METHOD; W. McA. Johnson, Iola, Kan. App. filed Jan. 11, 1904. A furnace in which a granular material of high resistance is fed between the charge and the wall of the furnace to avoid heat losses.

937,075. COUPLING FOR TROLLEY WIRES; J. W. Kline, Terre Haute, Ind. App. filed Dec. 26, 1908. A narrow plate having two passages at an angle to the length of the plate for receiving the ends of the wire sections with set screws for holding them.

937,098. MERCURY CONTACT RELAY; C. F. A. Schuldt and F. H. Nicholson, St. Paul, Minn. App. filed Oct. 12, 1908. For railway signals. A glass container surrounds magnetically operated contacts and a magnet outside of the glass operates them.

937,107. OVERHEAD ELECTRIC CONTACT; T. W. Small, Cleveland, Ohio. App. filed June 26, 1908. For trolleys. To operate a street indicator in the car. A block in the line of travel of the trolley wheel carries metal bristles with which the wheel contacts.

937,119. PROCESS OF PRODUCING SILICON CARBID; F. J. Tone, Niagara Falls, N. Y. App. filed Apr. 1, 1908. For smoking silicon carbide in an arc furnace, the arc zone being moved into the direction of the unreduced mixture.

937,120. METHOD OF REDUCING METALLIC COMPOUNDS; F. J. Tone, Niagara Falls, N. Y. App. filed June 24, 1908. Supports the charge with a reducing agent on a hearth which is pervious to the reaction products but impervious to the charge.

937,128. METHOD OF OXIDIZING METALS DISSOLVED IN MERCURY; J. Whiting, Boston, Mass., and C. F. Burgess, Madison, Wis. App. filed Dec. 16, 1908. Electrolyses alkali metals by providing carbon surfaces exposed to an oxidizing electrolyte and a moving body of amalgam, the circuit being made through a quiet body of mercury.

937,130. GROUND PIPE CAP; P. F. Williams, Chicago, Ill. App. filed Apr. 15, 1908. For ground pipes for overhead wire poles. The ground wire is clamped between the pipe and cap.

937,134. ADJUSTING MECHANISM; A. H. Wouters, Norwood, Ohio. App. filed Dec. 31, 1906. For forming wedge shaped coils by a rotary frame with means for intermittently moving the supports of the coils.

937,140. NON-DETACHABLE INSULATOR; H. Bartlet and A. P. MacCallum, Albuquerque, New Mex. App. filed May 12, 1908. For connecting the insulator to its supporting pin by an interlock.

937,189. TELEPHONE REPEATING SYSTEM; H. E. Shreeve, Wyoming, N. J. App. filed Aug. 21, 1908. Utilizes an induction coil with a plurality of cores and with line and repeater windings, one winding common to a plurality of cores.

937,201. CURRENT CONTROLLER; F. Andrew, Cincinnati, Ohio. App. filed Apr. 27, 1908. Positive stoppage of the controller arm occurs at each contact between the movements.

937,210. PROCESS OF PREPARING POTABLE WATERS; J. T. Harris, New York, N. Y. App. filed Nov. 20, 1906. Electrolyses water in contact with anodes of iron and aluminum with an electrode of copper thus producing chemicals which precipitate the impurities.

937,229. PUFF IRON; J. W. Cook, Omaha, Neb. App. filed Feb 16, 1909. Flat iron for shoulder puffs of irregular contour mounted on a supporting standard with an egg shaped head.

937,242. AUTOMATIC CIRCUIT-BREAKER; N. H. Holland, Brookline, Mass. App. filed Oct. 22, 1904. A sliding member is released by expansion to control the circuit.

937,277. BLOW PIPE FOR CALCINING INCANDESCENT FILAMENTS; G. Auger, Paris, France. App. filed May 2, 1908. A press with an annular burner through the center of which the filament passes.

937,281. SPACE TELEGRAPHY; S. Cabot, Brookline, Mass. App. filed Dec. 31, 1906. A multiple series spark gap with a rotating member.

937,282. SPACE TELEGRAPHY; S. Cabot, Brookline, Mass. App. filed Dec. 31, 1906. A multiple series spark gap and means for including any desired number of the electrodes in circuit.

937,291. RESILIENT DRIVING CONNECTION; G. M. Eaton, Wilkinsburg, Pa. App. filed Jan. 11, 1909. A floating ring and springs connected therewith.

937,324. ELECTRIC BATTERY; M. Nicolas, Paris, France. App. filed Feb. 21, 1907. A cylinder of carbon, a series of zinc washers around it and a series of felt washers.

937,326. FUSE MOUNTING FOR ELECTRIC CUT-OUTS; W. J. Patnode, Providence, R. I. App. filed Nov. 20, 1908. Contained in a case with clip ends so as to be readily detachable when the fuse is to be replaced.

937,328. COIL FORMING MACHINE; W. D. Pomeroy, Norwood, Ohio. App. filed Dec. 31, 1906. For making wedge shaped coils. A rotatable frame with means for varying the distance between the coil supports automatically as the frame rotates.

937,332. THERMIC CONTROLLER; E. H. Richardson, Ontario, Cal. App. filed May 14, 1908. For flat irons, etc., in which a moving element is anchored in a material when the latter is hard, but moves when the material softens under heat.

937,342. ELECTRIC CEILING FIXTURE; A. G. Walin, Seattle, Wash. App. filed Mar. 8, 1909. A hollow wall plate for electric lamps. Details.

937,377. APPARATUS FOR PREVENTING COLLISIONS ON RAILWAYS; T. C. Mason, Los Angeles, Cal. App. filed Feb. 24, 1908. Current producer on the train closes the throttle valve of both locomotives when they approach too near.

937,386. ARC LAMP; R. H. Pyle, Indianapolis, Ind. App. filed Oct. 9, 1907. An arc lamp with clutch ring and ball. Details.

937,387. PROCESS OF RECOVERING PRECIOUS METALS; J. H. Reid, Newark, N. J. App. filed Feb. 3, 1909. Ore is ground, mixed with a flux and then treated to several electric arcs, the volatilized portion being withdrawn by gas suction.

937,393. ELECTRIC FLUID PRESSURE BRAKE; W. V. Turner, Wilkinsburg, Pa. and R. H. Blackall, Edgewood Park, Pa. App. filed Feb. 24, 1904. Additional electrically operated valve devices to control the brake so that the brake is operated either electrically, pneumatically or vented automatically.

937,396. SMALL ARM; W. Venier, Klosterneuburg-Weidling, Austria-Hungary. App. filed Jan. 11, 1907. Hammerless gun with several barrels discharged electrically.

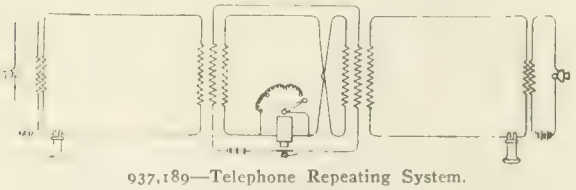
937,399. FOUR PARTY TELEPHONE LINE; K. Weman, Buffalo, N. Y. App. filed Jan. 23, 1906. Each subscriber's station includes a signal, condenser and retardation coil so arranged as to balance the line.

937,407. STEM FOR CHANDELIERS; G. M. Beardslee, Chicago, Ill. App. filed July 30, 1908. A hollow shell in two separable parts formed externally like a chain.

937,427. ROSETTE; F. C. De Reamer, Schenectady, N. Y. App. filed July 3, 1909. A base, body and cap with flat terminal and contact plates.

937,429. MEANS FOR COOLING DYNAMO ELECTRIC MACHINES; W. L. R. Emmet, Schenectady, N. Y. App. filed Aug. 19, 1905. For vertical generators. Uses a fan rotating with the armature inside of a hood.

937,435. FLEXIBLE CABLE FOR LAMPS; E. J. Guay, Lynn, Mass. App. filed Sept. 12, 1908. Beads of porcelain strung in the cable, insulate it.



937,189—Telephone Repeating System.

937,438. DEVICE FOR THE PREVENTION OF RAILWAY ACCIDENTS; R. Hauser, Oberstein-on-the-Nahe, Germany. App. filed Mar. 5, 1909. Stops the train when a signal is overlooked by actuating the air brake.

937,439. BLOCK SIGNAL SYSTEM; L. A. Hawkins, Schenectady, N. Y. App. filed Mar. 18, 1909. Alternating-current system in which a single track circuit controls a plurality of different signal operations. Uses a track relay operated through the rails and a second track relay in shunt to a short length of track. The two relays are in different control circuits.

937,440. BLOCK SIGNAL SYSTEM; L. A. Hawkins, Schenectady, N. Y. App. filed Apr. 23, 1909. Alternating current signal system with continuous rail paving A.C. sources across the rails, track relays and a resistance coil

937,442. CIRCUIT CONTROLLING DEVICE; E. Johnson, Schenectady, N. Y. App. filed Apr. 13, 1906. A switch, circuit breaker and stationary abutment with actuating toggle for the switch and one for the circuit breaker and a handle rigidly connected to the first toggle and through a lost motion, with the breaker toggle.

937,447. INSULATOR; M. T. A. Kubierschky and P. F. Herkner, Berlin, Germany. App. filed Oct. 19, 1904. Suspension insulator having a metal screw threaded shell, an insulated bolt and an independent insulator surrounding the bolt.

937,451. MOTOR CONTROL APPARATUS; W. O. Lum, Schenectady, N. Y. App. filed July 26, 1906. A plurality of electrically controlled switches, two circuits for actuating alternate switches and a two position relay for automatically causing temporary energizing of said circuits alternately.

937,462. DYNAMO ELECTRIC MACHINE; J. E. Noeggerath, Schenectady, N. Y. App. filed June 1, 1908. Collector ring for low voltage unipolor dynamo, a plurality of rings forming a set formed of a single casting. Also uses a magnetic ring surrounding armature to balance end thrust.

937,464. MEANS FOR ATTACHING INSULATING LININGS; C. D. Platt, Bridgeport, Conn. App. filed Sept. 26, 1908. Removable insulating lining for lamp sockets.

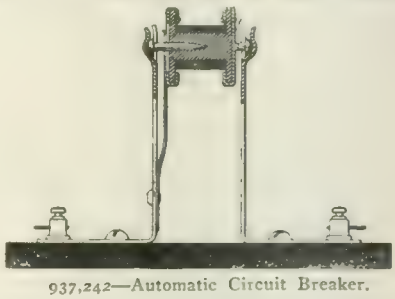
937,469. SYSTEM OF VOLTAGE REGULATION; P. Rose, Berlin, Germany. App. filed May 27, 1909. For automatically distributing the load of separately excited generators running in parallel, whose excitation is controlled by automatic potential regulator.

937,486. PROCESS OF PRODUCING STEEL FREE FROM PROTOXIDS; Otto Thallner, Bismarkhutte, Germany. App. filed April 26, 1909. Blows the steel and passes it to a basic electric furnace and adds silicon.

937,495. TROLLEY GUARD; S. G. Wilcox, North Adams, Mass. App. filed Nov. 18, 1908. A spring pressed sliding plate normally extending above the wheel and over the wire which passes the hangers and may be withdrawn by the operator when pulling down the pole.

937,515. INSULATOR PIN; C. J. Dorff, Chicago, Ill. App. filed Feb 3, 1909. A hollow screw with slots to make it compressible.

937,581. TELPHERAGE SYSTEM; O. J. Davy and C. W. Dauber, Washington, D. C. App. filed Dec. 28, 1906. Independent motors



937,242—Automatic Circuit Breaker.

in the carriages which run on a cable that also conducts the current. Avoids separation of the trolley from the cable.

937,586. STORAGE BATTERY; L. H. Flanders, Wilkinsburg, Pa. App. filed Aug. 6, 1904. A connecting plate for the electrodes of like polarity having a flexible terminal log with a highly conducting core.

937,590. ELECTROMAGNETIC MEANS FOR OPERATING AIR AND OTHER WHISTLES; H. H. Freeman, St. Paul, Minn. App filed Aug. 24, 1908. A double chambered valve casing separated by a diaphragm which operates a valve and is operated by an electro magnet.

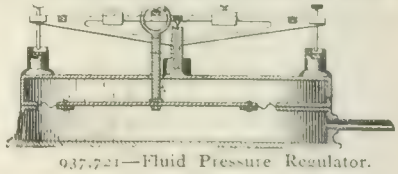
937,594. ELECTRIC BELL; E. A. Graham, Brockley, England. App filed Feb. 2, 1909. For protecting against moisture having a hollow electromagnetic winding with a vertical axis enclosed in water tight casing and a non-corrodible striker.

937,617. ALTERNATING CURRENT CONTROLLING MEANS; D L. Lindquist, Yonkers, N. Y. App. filed June 21, 1905. For changing the line voltage and for starting an induction motor by single phase current. Uses a parallelogram bridge of inductances and resistances with a transformer and motor.

937,634. ALTERNATING CURRENT ELECTROMAGNETIC VALVE APPARATUS; F. W. Newell, Philadelphia, Pa. App. filed Apr 2, 1907. For an alternating current elevator system using a main valve, a pilot valve connected between them and a multi-phase magnet for actuating the connections.

937,675. INDUCTOR DYNAMO; G. A. Colman, Seattle, Wash. App. filed Dec. 31, 1908. A high-speed rotor consisting of a smooth disk of solid metal and heterogeneous as to magnetism.

937,691. STATIC INDUCTION GENERATOR; B. E. Baker, Hartford, Conn. App. filed Nov. 6, 1905. A plate for static machines consisting of an insulating disk of layers of mica and a binding



937,721—Fluid Pressure Regulator.

material covered with fibrous material impregnated with an oxidizing oil.

937,709. SWITCH; H. N. Motsinger, Pendleton, Ind. App. filed Mar 28, 1908. For connecting a generator, a storage battery and a service line so that the latter may be served from the generator or battery or the battery charged from the generator. Includes a block with three pockets containing terminals and a switch pin.

937,721. FLUID PRESSURE REGULATOR; E. Schulte, Hamm, Westphalia, Germany. App. filed Nov. 29, 1907. For controlling blowers by means of a diaphragm in a closed chamber and three cups full of a conducting liquid with a balancing beam operated by change in gas pressure to control the circuits.

937,730. BATTERY ELECTRODE; G. A. Wedekind and H. P. I. Poerscke, Hamburg, Germany. App. filed June 19, 1905. A rigid plate with projecting lugs and a layer of electrolytic, spongy copper held on the face by the lugs coated with copper oxid.

937,736. INSULATOR; P. S. Dumbolton and F. Franz, Burke, Idaho. App. filed Nov. 21, 1908. Has a conical socket with a spiral groove which engages a spiral spring around the pin which carries the insulator.

937,737. BLOCK SIGNAL SYSTEM; L. A. Hawkins, Schenectady, N. Y. App. filed Mar. 11, 1909. Both rails are continuous and control a block signal system by a.c. current sources connected at intervals therewith, the currents from adjacent sources differing in character and operating relays.

837,738. BLOCK SIGNAL SYSTEM; L. A. Hawkins, Schenectady, N. Y. App. filed June 10, 1907. Both rails are continuous with a.c. current connected thereto at intervals, the adjacent currents differing in character, and controlling relays.

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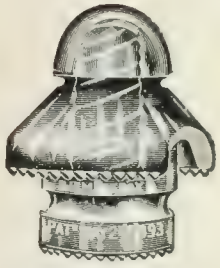
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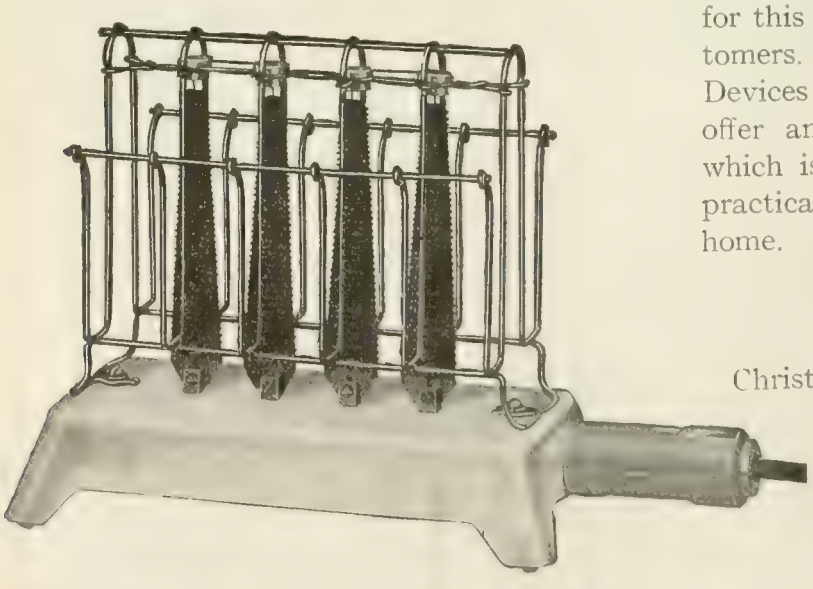
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Millions of Electric Flat Irons are in use today in American households, but the great majority of people have never considered the use of electricity for cooking. Here is a promising field for Central Stations. Electric Cooking Devices offer an unusual opportunity to increase the sale of current at a time of day when additions to the load curve result in profit without additional plant investment.

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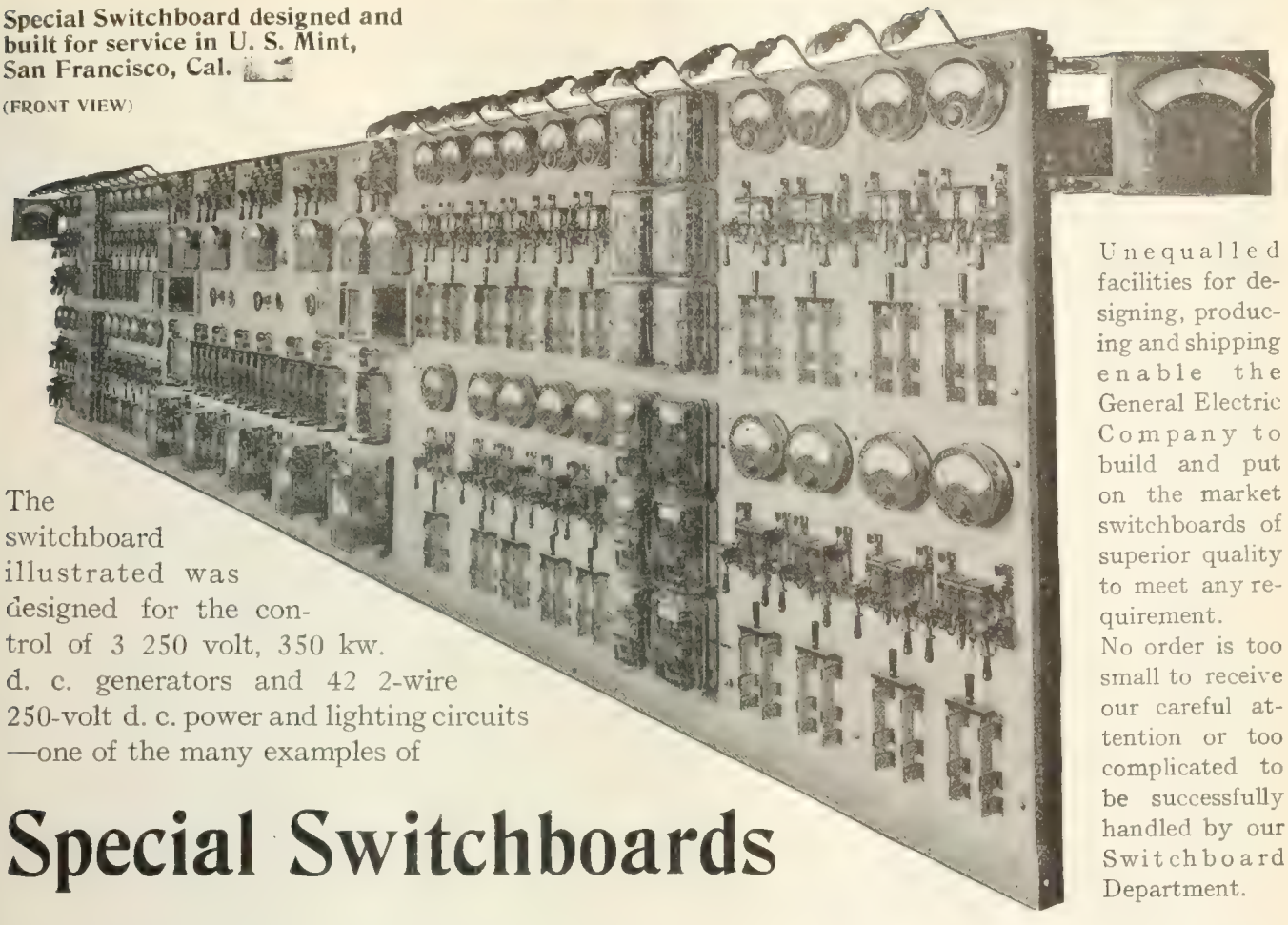
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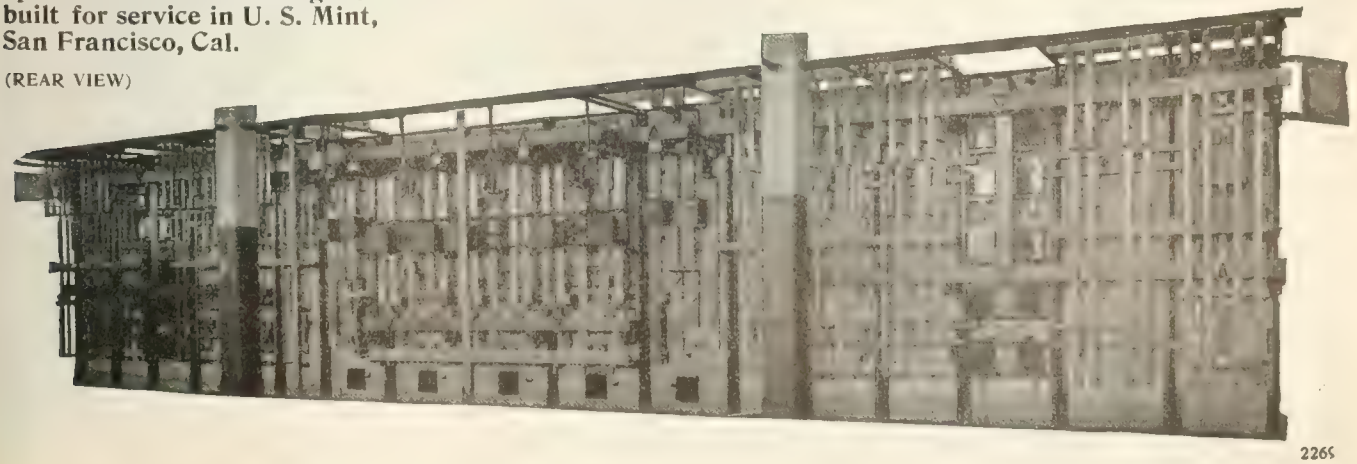
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Fire and Life Electrical Hazard.

One of the subjects discussed at the recent convention of the Western Association of Electrical Inspectors, noted elsewhere in this issue, was the relation of fire prevention to public safety in general. Little argument appears necessary to establish that every life hazard increases the possibility of fire, and renders the extinguishment of a fire already started to that extent more difficult. In the report of the Association Committee on Public Safety, it is stated that during the past three or four years hundreds of fires have been traced to primary voltage on secondaries, thus showing definitely the close relation of fire to life hazard, and indicating the necessity for considering both in any treatment of the subject of minimizing danger to property or to person. This report is very strongly in favor of grounding the secondary, and adds that personal injuries from electrical contact can be absolutely avoided by the abolishment of any fittings or wires that bear current-carrying metal parts, and the grounding of any exposed metal parts which may under any conditions form a part of electric circuits, which considerations underwriters will be more and more inclined to recognize in the code as wiring construction is developed and improved. The suggested type of construction will probably at first be merely recommended for certain specified locations, and its application subsequently extended, until finally it will be recommended for general use and in the end required for all service.

The Illinois Convention.

The Illinois State Electric Association attracted over 100 central-station operating men to its convention at Alton last week, a record of which the officers of that association may well be proud in view of the past history of the body. One gratifying feature of the discussions at this convention was the unanimity of opinion expressed on the subject of rates. The authors of papers and discussions practically all agreed that a proper system of rates for electric service should recognize the two elements, namely, fixed charges and variable running expenses, and that whatever the exact figures adopted by a company, these two elements should enter in making the kw-hour rate. It is not by any means to be taken from this that there is unanimity of practice among Illinois central stations in this respect, but it shows that an increasing number of central-station men have given the question intelligent analysis. It is to be regretted that such great diversity in systems of rates exists in practice. Nevertheless, if central-station owners are becoming unanimous as to the proper course to pursue, this lack of uniformity is likely to disappear gradually. The appointment of a committee to recommend uniform methods to the next convention will not by any means effect immediate reform of inconsistent rates, but its report will at least serve as a guide in the right direction for the small companies which

for the past 15 years have passed over the volumes of discussion on the rate question that has appeared in the technical press and in the proceedings of central-station bodies. It is indeed difficult for those who have studied this matter for years to realize the ignorance of the first fundamental principles of rate making among some of the smaller companies.

The discussion on gasoline lighting, which took up considerable time, was not quite so profitable. It would seem, in view of the widespread displacement of gasoline plants with tungsten lamps in cities where the central-station companies and contractors have properly pushed the matter, that it would be more profitable for a convention to listen to a recital of the experiences and methods of companies which have waged such a campaign successfully than to the experiences of those which still have a large number of gasoline plants in their territory. The discussion on electric motors was valuable for the very reason that it was an account of experience as to what had been actually done by various companies in the way of getting electric motors properly introduced. It was apparent that the excellent practice of installing motors on trial where the advantages of their use seem certain to the central-station company, is meeting with great success. Trials of this kind are more convincing than much argument; and the success reported with this method is such as to force it into the consideration of every company that wishes rapidly to build up motor business in localities where steam and gasoline engines are numerous.

The American Electrochemical Society.

Four years ago it was thought by many members of the American Electrochemical Society that two annual meetings are one too many, and it was then suggested to hold one large annual meeting each spring, at different places from year to year, and another meeting each autumn in New York City. This plan has worked so far very well, but the original intention of making the New York meeting secondary in importance has gradually been lost sight of. This year, with a New Yorker, Dr. L. H. Baekeland, as president, it was only natural that New York should make a special effort in behalf of its meeting, and as a result the sessions just closed proved to be of exceptional interest, both professionally and socially. The program of papers emphasized again the remarkable range of interest covered by the society. Dr. E. F. Smith's experimental lecture on new methods of electro-analysis was the summary of a succesful and active life's work and, besides its intrinsic scientific value, was a most enjoyable human document. The 21 other papers presented covered a wide range of subjects, including a paper of much metallurgical interest by Professor Burgess on carbon-free alloys of iron and copper; on the latest method of the Badische Company for making nitric acid from air; three papers on electrode losses in electric furnaces, and a paper by Dr. Richards on the role which a stray field of current plays in electric conductance in metals and electrolytes.

Of the papers which were of special interest to electrical engineers, that of Dr. Weedon on the titanium carbide arc is the result of a long extended research involving many different materials. An equally prominent example of the successful work now carried on in the research laboratories of our large manufacturing companies was contributed in Dr. Weintraub's paper on the preparation and properties of pure-fused boron, the investigation of which has opened many possibilities where resistors with certain temperature-resistance coefficients are desired. Mr. Spalding's paper on power for copper refining deserves the careful attention of central-station engineers. Mention should not be omitted of the two papers presented by Mr. Loveridge and Professor Burgess on dry cells. The importance of the dry-cell industry is probably little appreciated, though according to a reliable estimate made two years ago the number of dry cells used in this country was then more than 30,000,000 a year. As a result of the presentation of this subject at the meeting, we understand that a Committee on Standardization will be appointed to outline specifications and tests for dry cells. On the whole, the meeting has shown that the American Electrochemical Society is as wide-awake and progressive as ever. By deciding to hold its next meeting at Pittsburgh, the society enters what is no longer the enemy's country, but, on the contrary, a field where electrometallurgy will undoubtedly find in the near future a wonderful development.

Lighting Load and Population.

An interesting statistical study by Mr. Alton D. Adams elsewhere in our columns contains some interesting material in the way of a study of the relation between population and electric service in an important urban and suburban district of which our readers will probably surmise the location without the aid of a Sherlock Holmes. The situation is, however, thoroughly typical of what may be found in many other districts of the country. Considered graphically, the results show that there is no ascertainable relation between population, number of consumers and connected load, even in the same general territory where the electrical supply is substantially at the same rates throughout. The one point in the statistics which strikes one most forcibly at first sight is the small number of consumers per 100 of population, even in a prosperous district where the electric rates are on the whole low. The highest percentage of consumers to population reached anywhere in the territory concerned was 6.9 per cent, while the great urban district itself showed only 3.2 per cent, although in the latter case the number of lamps per consumer was considerably greater than in the former.

The figures show upon their face how very far electric light is from being generally treated as a necessity. The same territory here considered has more than three times as many telephones as it has customers for electric light, which shows how far the telephone has come to be regarded as a necessity. Mere smallness of population does not seem in any way to hinder a good market for electric light, since in the eight districts considered by Mr. Adams, the one with the smallest population has relatively the greatest number of consumers and has the greatest number of lamps installed with respect to the population, this number being 244 16-cp equivalents per 100 of population. The smallest proportion of consumers happens to be in a district of just about the same size as that mentioned. This place of extraordinary low load happens to be peculiarly a manufacturing community, consequently with a large number of relatively poorly-paid wage earners. On the other hand, the small district which shows a remarkably large number of electric lamps is an important residence district, a relatively wealthy community, which goes again to show the point of popular conception, that electric light is rather of a luxury than a necessity.

The great urban district under consideration has, of course, like most American cities, a large population of the poorer classes and also cheap gas supply, which it also should be said covers a great deal of territory not yet touched by a house-to-house electric service. This fact is probably the most significant one in determining the number of consumers. But looking at the matter from any one place it shows that there is a tremendous market in almost any urban and suburban territory which ought to be made profitable by the electric supply stations. To do so, it is of course necessary to cover the territory pretty thoroughly, especially the urban territory, since where electric service is not easily obtainable or where it is difficult to secure electric connections, the natural result is a small sale of energy. The competition from gas seems to cut very little figure in the game, since in one territory which furnishes an excellent electric load, gas is everywhere obtainable and decidedly cheap, much cheaper than usual in similar territory. Most of all, however, the small number of consumers is due in this case, as in many others, to the fact that the small consumer is seldom honestly cultivated by electrical supply companies, and while the rates to large consumers may be extremely low the rates to the small consumers are always and everywhere practically the maximum.

To put the fact baldly, the residence consumer is very nearly punished out of existence by having to pay substantially the maximum rate, not only in such territory as Mr. Adams is discussing, but quite generally. The maximum meter rate quoted is 12 cents per kw-hour, and it would have been very interesting if Mr. Adams had also been able to give us the number of consumers in each of the districts considered who actually paid this maximum rate. Had he done so we are inclined to think that the apparent mystery of the smaller number of consumers would have been made evident at a glance. It is the rare exception when a residence consumer gets the benefit of discounts which amount to anything, although, of course, he may not be entitled to them on the particular theory of charging adopted by the given central station. But the fact is that electric rates in this country have gradually been tending to a greater and greater discrepancy in the price charged the small consumer and the price charged the large consumer, a tendency, the effect of which has been painfully manifest in some sections through drastic rate regulation. The small consumer individually is without much influence, but collectively he is forced to be dealt with, and experience is beginning to show that he will not stand for any great inequality of rates. Consequently, it behooves the central station to deal with him more gently than has been the case and to realize that the public service corporation is most truly prosperous when it has many friends rather than a few enthusiastic friends who are the fortunate recipients of low rates owing to their large consumption of energy. The long and short of the matter is that the time has come when, if central stations are to keep on increasing their business and consequently increasing their revenues, it behooves them to start a vigorous campaign among relatively small consumers, and if necessary to revise their system of charging so that the small consumer will not of necessity turn to gas. Some central stations which we could mention have adopted the policy of booming electric lighting and electricity generally and have made a distinct success in spite of gloomy predictions of failure made by some of their contemporaries.

Report of French Committee of the International Electrotechnical Commission.

A report recently printed by the French committee of the International Electrotechnical Commission is a precise and business-like document, which does credit alike to that committee and to the representatives of electrical engineering in France. The report, embracing 28 printed pages, contains the statutes of the international electrotechnical commission (I. E. C.), as adopted in London last year; the statutes of the French Committee, as adopted at Paris in 1907; a list of the French Committee-members, and of the various French technical societies that they represent; a list of the varous national committees outside of France; and a résumé of the proceedings of the last meeting of the commission council at London in 1908. It will be recalled that this country was not officially represented at that meeting, though contributing to the support of the commission. The French committee is composed of representatives of French electrotechnical societies, on the stated basis of 1 per cent of the membership of such societies. In the case of societies not exclusively connected with electricity, a reduced representation is allotted. The most prominent French electrotechnical society is the Société Internationale des Electriciens, with 15 representatives. Nine other societies add 21 more names to the list. The local statutes, or by-laws, of this body contain 21 articles, and give a complete local working organization. Two working sub-committees are scheduled, one on nomenclature and symbols, the other on machinery and apparatus. The main body is required to meet at least three times a year. The official representatives of the French committee at conventions, either of the I. E. C. or of its council, are scheduled and printed. The plan of having all important national electrical bodies represented on such a committee appears to be an excellent one, and might with great benefit be adopted in this country.

The countries now possessing national committees of the I. E. C. are listed in the following order: Germany, Belgium, Brazil, Canada, Denmark, Spain, United States, Great Britain, Hungary, Italy, Mexico and Sweden. The British body has, like that of France, issued printed reports of its work. Each of these national committees has at least a president and a secretary, the American body in addition having two vice-presidents. Each such committee enrolls on the average 15 members, and in a few cases the organization is so far complete that sub-committees on different subjects are scheduled. The total number of names on all the national committees, including France, appears to be 219—a powerful aggregation of picked men.

It was at first supposed, from the attitude of her representatives at the preliminary conference, that France would be one of the least active large countries in the movement towards international electrotechnical standardization; but judging from the prompt and efficient manner in which the French committee handled the proposal for an international candle, which has since become universally adopted or admitted, as well as from

this recently published fine report, we may look for earnest and active co-operation from our French confrères in the future.

It is now high time that our own Institute of Electrical Engineers should bestir itself in the same good cause. The original suggestion for the formation of the commission started here, and it was first formally expressed at the St. Louis Congress; but up to the present time, the Institute has taken only a diminutive part in the international proceedings, its activities apparently having been confined to distributing the honors of membership in the national commission organized to co-operate in the work of the international body. It is to be hoped that from this time the American Institute may pull a more powerful oar in the international boat. Hitherto, by having a committee on standards separate from the National Committee of the I. E. C., the tendency has been to waste time and effort in their mutual activities. If, however, the Institute were to consolidate these two committees, the work should be greatly facilitated, and the efficiency increased. A strong committee engaged both on international and on local standardization questions can work much better than two committees working in the separate fields and hesitating to take action without mutual consultation.

The Regulation of Wireless.

We have several times taken up the necessity of proper Governmental regulation of the scores or hundreds of amateur, and, for that matter, commercial and Government wireless stations that daily afflict the overburdened ether with their sputtering. As spring brings a sort of recrudescence of general human foolishness, it starts into renewed activity all the schoolboys, would-be inventors and hungry promoters with their various apparatus, so that legitimate wireless business is interfered with in a somewhat serious manner. Fortunately, most of the over-curious experimenters have not the funds for putting up elaborate antennæ and are rather short of power, so that their chief occupation is merely interference with the proper reception of long-distance messages; but an increasing number means added chance of trouble and it is high time to call a halt, not upon experimenting, but upon the misuse of it and upon merely inquisitive meddlers. It has now been well established that the most important function of wireless telegraphy is marine communication, and it is self-evident that the value of the system for this purpose depends on freedom from interference. Most ships fitted with wireless are not provided with long antennæ or very powerful sending apparatus, as compared with the big land stations, and hence their business messages or calls for help are easily interfered with by small plants in seaboard cities. Receiving stations adjusted to pick up messages from ships are continually bothered by unknown meddlers, sometimes merely thoughtless or stupid, sometimes malicious.

If accurate syntonism were practicable over a wide range, which it does not seem to be at present, the trouble would be less acute. As things now stand, however, while a receiving station can tune out interference from certain sending stations, it cannot remain in touch with ships' equipments over any considerable distance without being bothered by multitudinous amateurs sending at all sorts of frequencies. The situation grows more serious as more and more ships are fitted with wireless and come to depend more and more upon it. They may often interfere with one another, but in the use of equipment that may make the difference between life and death, they have sufficient sense of responsibility to keep out of mischief. It is high time to undertake friendly but extremely thorough regulations, for amateur seaboard stations are much in the position of amateur lighthouse plants, interfering with the legitimate safety precautions with respect to navigation, which are peculiarly the business of the Government. It may be contended that private persons have the right to experiment even with lighthouse lenses, but, granting this, they should be compelled, and can be legally compelled, to desist from so experimenting as to interfere with navigation. Congress has ample powers under the Constitution to pass Federal statutes forbidding any and all acts inimical to public safety, and Federal authority is fully competent to enforce them. With the present tendency to make the installation of wireless apparatus compulsory on ocean-going passenger vessels, close regulation becomes imperative.

Just how this can best be accomplished with the least inconvenience it will take some experience to determine. The first and most obvious step is to require a Federal license for every wireless installation of every kind, the application for it being accompanied by proper certification of the applicant as a responsible and trustworthy person, who should appear in person before the proper local authority and take oath to obey the regulations under which license may be granted. A full specification of the apparatus to be installed should be given, together with the purpose for which it is installed and the stations with which it is proposed to communicate. With these data it would be feasible to specify the power and range of sending permissible, and to classify the station so that it should produce the minimum interference with its neighbors. As syntonism advances, this classification should become simpler and more effective. When a license is granted the licensee should receive assignment of an official call and an official year book with the specifications and calls of all licensed stations. Government and private stations authorized to do maritime work should have absolute precedence over all others, and other licensed stations should be kept to specifications that will insure freedom from interference. The chief thing is to prevent private and experimental stations from such sending as may interfere with the proper reception of messages from ships or between Government stations. Provision should be made for absolute cessation of sending, except from authorized maritime stations, in case of distress signals being received, the hearer to communicate at once by telephone or wire with the nearest such station. The exact details of regulation would have to be worked out by experience, but the task is not a difficult one if taken in hand at once. The chief trouble is likely to be that which may come from delay. The aim in view should be to discourage the merely curious, to extend to the bona-fide investigator all the assistance practicable, and to insure a chain of co-operating stations, public and private, all along the coast able to keep up a complete chain of communication with each other and with ships. In addition, the United States should take a hand in forming a group of powerful stations able to cover the whole

Atlantic, so that no properly equipped ship should be out of touch with land signals from one shore of the ocean even to the other.

Color Photometry.

Mr. P. S. Millar's paper on this subject at the recent convention of the Illuminating Engineering Society did good service in calling attention to the need of doing something definite about the comparison of lights of various colors. At the present time, when the light from commercial illuminants displays so wide a color range, it is certainly most important to come at least to a definite conclusion as to the precautions taken and methods to be employed in the commercial comparison of various illuminants. As Mr. Millar shows in his paper, even lamps differing so little as do ordinary carbon filament incandescents on the one hand, and tungsten lamps on the other, still present sufficient color difference to provoke very noticeable if not serious photometric errors. He mentions one instance in which two observers using the Lummer-Brodhun screens obtained differences as great as 3 per cent in making this sort of comparison.

Although after some months of such work there was no longer any constant color difference between the readings of the two observers, the case directs attention to the psychological errors involved in such comparisons. Different observers vary in their conception of what constitutes a balance between two differently colored lights. Although in the case just mentioned the two observers ultimately settled down to the same conception of balance, it is altogether uncertain whether one observer was right from the start and was ultimately joined by the other observer, whether the one ultimately wandered from the truth and merely made the same error as the other, or whether both were originally wrong and unconsciously compromised on some value between their original conceptions, which may or may not have been a correct value. As the color difference increases so does this psychological difficulty, until in comparing lights differing as much as an incandescent lamp and a mercury arc, the possible errors rise to a very considerable percentage. In another place Mr. Millar gives a report of the comparison of carbon lamps and a mercury-vapor lamp with different intensities of illumination upon the screen corresponding to the different distances of the lamp from the photometer, and even in this case, taking the means of determinations of two observers a maximum difference of 37 per cent, due to color differences, was found in changing the illumination from the screen with one of the photometers employed. With very strong illumination the determination was easier and more accurate, but it would still be interesting to know what the actual readings of the two observers showed in the way of variation. Difficulties of a similar kind, but of less degree, are quite certain to be encountered frequently in commercial photometry, and Mr. Millar's recommendation that the Illuminating Engineering Society should take the initiative in endeavoring to aid the work of standardizing, or at least conventionalizing commercial photometry, is a very important one.

The use of the flicker photometer in such work is a much-mooted question. It has been alternately lauded and condemned as an instrument of abolishing the difficulties of color difference. It certainly can be depended upon to give constant readings under conditions where the ordinary photometers vary widely, but whether the consistency means accuracy is quite another matter. Claims have been made, for instance, that with the flicker photometer a color-blind person would make the same readings as one with normal vision. If this were correct then certainly the photometer must mislead, because the luminosity values for lights of different colors to a color-blind person are absolutely not the same as they are to the normal eye, and should not give the same photometer readings. On the other hand, some experiments with color-blind persons seem to show that their settings of flicker photometer are not the same as those made by observers with normal vision. In the latter case one may assume that the flicker photometer actually did give correct values in spite of the color difference, or that it led to a new kind of error. Nothing save a very thorough investigation of the subject by numerous observers working independently can clear up facts that seem so irreconcilable. Again, it has been proposed to work on the basis of threshold acuity in comparing lights of two radically different colors. There seems little doubt that observers trained to make such comparisons according to a definite routine can obtain consistant results, but observers working independently and not according to a fixed routine are absolutely certain to get diverging results from mere differences of adaptation which rise at times to very large amounts, and no one can say whether the agreement obtained by specially trained photometric observers is indicative of precision or not.

A more useful modification of the acuity idea is the acuity wedge of which the two sides are covered with suitable characters to be read, and the wedge is slid along the photometer board until a balance of ease in reading is struck. We do not remember that this form of apparatus has yet received a suitable amount of attention, but it would seem to have value in that it compares at least one thing which is important in judging the relative luminous value of colored lights—that is, the ease with which one can see to read by them. Still another proposition is to use absorbing screens properly standardized by the co-operation of many observers or to fall back on what is virtually spectrophotrometry in a simplified form—that is, a comparison of two lights merely in terms of their regions of greatest luminosity, following the general method laid down by Crova. All these diverse suggestions must be carefully considered and threshed over before heterochromatic photometry can be satisfactorily dealt with, and it is high time to begin work on the subject, since the amount of labor involved in the investigation is obviously great. One has only to read over the discordant opinions expressed by various investigators in various papers dealing with the matter to realize the immense difficulties of the situation. The chief practical requirement is to settle upon some reasonable simple method of working with general illuminants in such a way as to avoid as far as may be the psychological and physiological difficulties. Such method when found may prove to be somewhat empirical and perhaps lacking in fine experimental precision, but the errors just mentioned are so much larger than any ordinary instrumental errors, or errors of reading, that the first step toward success is to get them out of the way in so far as is practicable. One can get along very comfortably with a photometric method of only moderate ultimate precision if using it will escape errors of concept and errors of adaptation of a much more serious order of magnitude.

Decision on Water-Power Development on a Normally Navigable Stream.

The Economy Light & Power Company, of Joliet, Ill., of which Mr. Samuel Insull is president, has been victorious in the litigation growing out of the contention of the State of Illinois that the Desplaines River is a navigable stream and that, therefore, the company's development at Dresden Heights, Ill., should be abandoned. The company has maintained a water-power plant at Joliet for a number of years, and about three years ago it purchased land for a distance of about 4.5 miles on each side of the Desplaines River at Dresden Heights, which is where the Desplaines and Kankakee rivers join to form the Illinois River. All the land that would be overflowed by reason of the building of a dam was purchased. The company started to build the dam, but in December, 1907, the State authorities, at the instance of the Governor, brought suit to enjoin the construction of the dam. This injunction was sought on three grounds:

First, it was contended that the river is a navigable stream in which the public has an easement for navigation and which, therefore, may not be obstructed by private works. Second, it was asserted that the State actually owned the land in the bed of the stream at the location of the dam. Third, certain contracts and deeds obtained from the commissioners of the old Illinois and Michigan Canal, which parallels the Desplaines River, relating to small pieces of property owned by the State in the vicinity of the dam, were said to be void.

The suit came on for hearing before Judge Mack sitting as a circuit judge of Grundy County in April, 1908. The answers of the water-power company to the contentions of the State were as follows:

First, the stream is not "navigable" in the legal sense, because in its original state (before the water of the Drainage Canal was turned into it) it did not have the capacity to carry any useful commerce by reason of insufficient water, steep declivity, tortuous windings and other obstacles to navigation.

Second, the State, represented by canal trustees who then had charge of the lands of the Illinois and Michigan Canal, lawfully conveyed the land in the bed of the river in 1859, and the company acquired the title of the transferee.

Third, the contracts referred to in the third contention of the State were within the power of the canal commissioners to make; and it was also pointed out that work done under them would not injure in any way the Illinois and Michigan Canal.

Twelve weeks were consumed in the arguments before Judge Mack and later the court gave its decision in favor of the Economy Light & Power Company on all the points in suit and dismissed the bill for an injunction. The State appealed to the Supreme Court, and the appeal was argued at Springfield at the April term, 1909. The Supreme Court's decision has just been received, and it sustains the previous decision of Judge Mack at every point and, therefore, the contentions of the water-power company. The law firm of Isham, Lincoln & Beale and also the firm of Scott, Bancroft & Stevens, of Chicago, appeared for the company, and Messrs. Merritt Starr and Walter Reeves (deceased) were the attorneys especially appointed to represent the State.

The case has attracted a great deal of public attention owing to the proposal to use the Desplaines River as a part of the deep waterway between Chicago and the Mississippi River. It will, no doubt, be feasible to construct the deep waterway and at the same time utilize the power of the Desplaines River at this point, but in that case the State administration could not develop the power itself, as is believed to be its desire, unless condemnation proceedings were instituted under an act which might be passed by the Legislature declaring it to be the policy of the State to utilize the Desplaines River as a part of the deep waterway.

The opinion of the court accompanying the recent decision of the Supreme Court of Illinois was written by Judge Vickers and was handed down on Oct. 26. On the question of the navigability of the Desplaines River as affected by the deep-waterway project there is one passage in the opinion which is of special interest. It is as follows: "What the future will see accomplished along these lines no one can know. It may be that when that future is unfolded it will bring a realization of the hopes of the most optimistic, and that the appearance of sea-going vessels plowing through the prairies of Illinois, laden with the people and products from the uttermost parts of the earth, will be as common as the now almost forgotten 'prairie schooners' of 1849 were in those days. But if this transition is to occur —if the powerful hands of the Government are to lay hold of this gigantic enterprise—they must do so with due regard to the sacred right of every citizen, however humble and insignificant those rights may seem in contrast with the great public consummation."

British Bremer Lamp Patent Declared Invalid.

On Oct. 18 judgment was delivered by Justice Joyce, of Manchester, England, declaring invalid a patent granted in 1902 to Hugo Bremer for improvements in electric arc lamps. The Court considered that the plaintiff's patent, even if otherwise valid, had been anticipated by an American patent in the name of Graham; but the ground upon which he decided the case was that in the so-called invention as claimed there is no real invention or special matter to support a patent. He held that there could not under the circumstances be a patent merely for the use in any new or special kind of arc lamps, of that which was already known and commonly adopted in ordinary arc lamps for practically the same purpose.

Edison Entertains Japanese.

After visiting the lamp factory of the General Electric Company and other manufacturing establishments in Newark, N. J., last Wednesday, the Japanese commercial commission, which is making a tour of this country for the study of our various industries and commercial methods, paid a visit to Mr. Edison at his laboratory in West Orange. As they had expressed an earnest desire of meeting him personally and of examining the great industrial plant established by him in the vicinity of the



JAPANESE COMMERCIAL COMMISSION AT EDISON LABORATORY.

laboratory, the inventor had previously extended a cordial invitation.

There were about 50 in number, including six ladies, and they were accompanied by several prominent citizens of Newark, as well as by members of various trade and mercantile bodies from other sections of the country. Five of the six ladies were wives of the members of the commission, while the sixth was a companion of Baroness Shibusawa, whose husband was the head of the commission.

The party arrived at the laboratory in automobiles, and were conducted into the library where they were received and

entertained by Mr. Edison in his characteristic genial manner, and who was kept exceedingly busy answering the numerous questions propounded by the eager and interested visitors, most of whom speak good English.

The official heads of the various Edison industries located in the neighborhood of the laboratory were present with a force of about 20 of their subordinates to take the visitors in groups through the shops, and everything was done to facilitate the object for which they had made the trip.

In accordance with the previously expressed wish of the commission the group was photographed, with Mr. Edison in the center. The elderly gentleman immediately at his right in the accompanying reproduction of this photograph is said to be the John D. Rockefeller of Japan. Mrs. Edison sits immediately to the left of her husband.

The visitors' registry at the laboratory is enriched in picturesqueness by the autographs of the visitors.

Electrical Trades Association of Chicago.

Closing a fiscal year of successful accomplishment, the fourteenth annual meeting and dinner of the Electrical Trades Association of Chicago will be held at the University Club, Chicago, on the evening of Nov. 12. Mr. Charles E. Brown, of the Central Electric Company, will act as toastmaster, and the list of speakers includes Mr. Samuel Insull, president of the Commonwealth Edison Company; Mr. H. E. Hackenberg, treasurer of the National Carbon Company; Mr. James Wolff, president of the National Electrical Trades Association; Hon. William F. McSurely, judge of the Superior Court of Chicago, and Mr. Charles E. Kremer, who is spoken of as the wit of the Chicago bar. The entertainment committee in charge of the affair consists of Messrs. William P. Crockett, A. O. Kuehmsted, J. F. Gilchrist, H. L. Holland and W. P. Johnson. There is also a nominating committee consisting of Messrs. W. D. Rumsey, Henry Schwab, G. A. Roth, H. B. Davis and W. H. Gross. These two committees together constitute the reception committee.

The membership of the Chicago association is said to embrace all of the representative electrical manufacturers and jobbers in the territory from Cleveland to Denver, extending as far south as New Orleans. These members, 210 in number, cooperate with similar associations having headquarters in Boston, New York, Philadelphia and San Francisco. The members exchange information relating to the credit of customers, and the association also extends its help in the collection of accounts. But the main objects of the association are to protect the mutual interests of members, to work for uniformity and improvement in the customs and usages of the electrical trade and to settle differences among members. Since the organization of the association in 1896, Mr. Frederic P. Vose has been the secretary, and his office in the Marquette Building has been long recognized among electrical manufacturers and jobbers as the credit center of the industry in Chicago. The association is powerful, but it has never used its power tyrannically and has a record of helpfulness directed to the general good of the trade.

Worcester (Mass.) Electric Light Company to Build New Plant.

Following the decision of the stockholders to retain the present management of the Worcester Electric Light Company, it has been decided by the directors to build a new and thoroughly modern generating station in the southern part of the city and to use the present generating plant as a distributing station. Eight acres of land have been purchased from the Curtis Manufacturing Company, with water rights in Curtis Pond and Ram's Horn Brook, and the new station will be erected beside the pond on Webster Street, with special provision for the economical delivery of coal by rail via the New York Central Lines. The area of Curtis Pond is sufficient to provide ample water for condensing purposes and also boiler feeding. Mr. George T. Dewey, counsel for the company, stated at the time of the purchase that the site is regarded as one of the best in the country for a modern station, and that the money to be expended in the new plant, equipment, and on the property will approximate $350,000. It is expected that power can be produced on the location at reduced cost, the manufacturing expense per kw-hour at the Faraday Street station being about 1.25 cents. The old station, which has been described in these columns in connection with a gradual transition from a line shaft and belted plant to a modern direct-connected installation, is handicapped by the absence of railroad facilities and limitations in regard to water supply. The center of distribution is about ¾ mile south of the old station, while the new plant will be about 2½ miles south of the distribution center itself. In case arrangements are later made with the Connecticut River Transmission Company for a certain amount of power to be utilized on the company's system, the location of the old station will be favorable to convenient connection with the Transmission Company's system. Plans for the new power house will be prepared at an early date and new machinery purchased. Active efforts are also under way to extend the company's power service and connected load.

Proposed Baltimore Municipal Lighting Plant.

In view of the expiration in September, 1910, of the contract for city lighting, Mayor Mahool is gathering data on the subject of a municipal electric lighting plant. An investigation of the availability of the old garbage reduction plant at Port Covington was made by Mr. Robert J. McCuen, city electrician, and the report which he has just submitted to the Mayor is favorable to the establishing of a municipal plant on this site. Mr. McCuen's report states that such a plant can be erected at Port Covington at a very small cost in comparison to the outlay that a site on the city's water front would require. Steam could be used as the power of the plant on the Covington site and the cost would be greatly reduced. Mr. Preston, the building inspector, has been instructed to visit the present plant and determine whether any difficulty is to be anticipated with respect to foundations.

Hamilton (Ont.) Street-Lighting Arbitration.

The hearing of evidence in the arbitration of the street-lighting contract made by the city of Hamilton, Ontario, with the Cataract Power Company in June, 1899, was resumed last week. It will be recalled that the judge, on the former hearing, gave his award allowing the city a rebate of $15.50 per lamp per year on something over 400 lamps, aggregating about $6,000 per year for the last five years of the term of the contract, from 1904 till the end of 1908.

The Cataract company thereupon appealed from the award, and the Court of Appeal gave its decision referring the whole question back to the original court, with the suggestion that the company's books and plant should have been open for investigation. In deference to the Appeal Court's decision, an order was recently made by Judge Snider permitting experts appointed by the city to inspect the books and plant of the company, and it was for the purpose of hearing the evidence of these experts that the arbitration was resumed.

The city was represented by Mr. Hugh E. Rose, K. C., of Toronto, and City Solicitor F. R. Waddell, while the side of the company was presented by Messrs. George S. Lynch-Staunton, K. C., and W. W. Osborne. The evidence given by the experts for the city was not very satisfactory, the accountant testifying that he was unable to ascertain from the company's books anything that would show the cost of producing power for street lighting in either 1899, the year in which the contract under arbitration was made with the company, or 1904, from which

period the city claimed the reduction in price. The electrical expert who had been over the company's plant submitted certain details of cost of plant and equipment, which were similar in most respects to those given by the city's expert in the original hearing.

The company, however, presented a new witness, Mr. Percy H. Knight, who was formerly engineer in charge of construction at Provo, Utah, for the Telluride Power Company in 1899. Mr. Knight testified that since he had been in Utah nothing new had been discovered in the electric art that would lessen the cost of energy to the city. By regulating the use of water and the voltage in different proportions, the cost could be slightly lessened, but eliminating the water question, he thought there was no other way to reduce the cost from what it was in the year 1899. This testimony has an important bearing on the arbitration, since the judge has to base his award upon the terms of a clause in the original contract which reads that should "improvements and advances be discovered in the electrical art" the city shall be entitled to a reduction in price for the last five years of the contract. The hearing was adjourned till Nov. 5.

The special power committee met on Thursday last and passed a recommendation to the Hamilton City Council to sign a contract with the Hydroelectric Power Commission for 1000 hp under the terms offered last June by the commission, with the option of entering fully into the project by Dec. 31, 1910.

If the Council adopts this course it will put an end to a question which has been foremost in municipal circles for the last three years. Though the power committee passed the recommendation in favor of the hydroelectric power, the members were not unanimous, the Mayor and two Aldermen reserving their right to deal with the question at a following Council meeting, which would indicate that the struggle is not yet over, though it is well known that a majority of the Aldermen are in favor of taking power from the Hydroelectric Commission.

Boston School Committee May Appeal from Commission Rate Ruling.

There is a prospect that the Boston School Committee may appeal to the courts as a result of the recent ruling of the Massachusetts Gas and Electric Light Commission that the school houses are not entitled to lower rates for electricity than other consumers of the Boston Edison Company. The board ruled that such a practice would be discriminatory, as reviewed in these columns at the time, and held that it could not properly ask the Edison Company to make a reduction. Had a reduction been made the city figures that it would have reduced the cost of lighting and power for school service by about $20,000 per year. The Edison Company admitted that the city is a large user, but that the scattered nature of the load rendered it out of the question to give special rates, and the commission sustained the company's position. The School Board has under consideration the possibility of establishing plants of its own, but it is questionable if the inauguration of such a municipal service would not cost the city far more in the long run than the present supply from the Edison Company. The situation is one of much interest to central stations in the State.

Distributing Freight by Electricity.

In an illustrated lecture before the New York Electrical Society, on Oct. 28, Mr. G. Herbert Condit described the antiquated methods employed in America for handling freight in less than car-load lots at railway terminal and steamship docks. Statistics show that the cost of transferring package freight by trucks from a boat to the distributing points ranges from 20 to 50 cents per ton. When this value is compared with 0.1 cent as the cost of removing coal from barges, elevating it and conveying it to bunkers by means of electric motors, the advantages to be gained by substituting electricity for hand power will be appreciated. In European cities, especially in Germany and France, electric cranes, travelers and telphers are extensively employed at steamship docks, but such labor-saving devices have been introduced to only a limited extent in this country. Freight-handling devices have been highly developed for certain services, and combinations of these devices, as now obtainable from a large number of companies, are immediately available for solving the problem of handling and distributing freight at railroad terminals and steamship docks.

Mr. T. C. Martin gave estimates of the money expended in New York for transferring freight and claimed that electricity will revolutionize the methods employed in handling package freight by reducing the cost to probably one-seventh of the present amount. He outlined the pioneer electric telpherage experiments conducted by Mr. H. M. Harding on Madison Square Garden roof in New York.

Mr. E. B. Katte remarked that the steam railroads have made considerable use of mechanical labor-saving devices for handling package freight. A disadvantage of the telepherage and similar transferring systems is found in the fact that the apparatus cannot be moved from place to place as freely as can the laborers who handle the freight on trucks.

Mr. H. M. Harding called attention to the fact that the cost of loading and unloading a barge is greater than that of towing the barge several hundred miles along a canal. An appreciable reduction in the cost of handling the freight means, therefore, a large decrease in the cost of transporting the material.

Telephone to Prevent Spreading of Forest Fires.

The State Forestry Department of Massachusetts is considering a plan for the establishment of observation stations at mountainous elevations to facilitate the discovery of fires and the protection of timber land and woodland growths. The State has been tentatively divided into five sections for this purpose, and each station will probably be equipped with a topographical map, range finder, telephone and other apparatus. Arrangements may be made at some places to use telephones already installed for private or semi-public parties, while in situations where no telephone service exists, the State is considering an appropriation for the installation of the necessary instruments. It is anticipated that by the use of the telephone from a station constantly manned during the dangerous season from March to October, incipient fires can be quickly extinguished and much more destruction prevented than where forest patrols are established and maintained in the lower levels of the country.

Revised Exterior Circuit Regulations for New York City.

Commissioner O'Brien, of the New York City Department of Water Supply, Gas and Electricity, which includes the electrical inspection service of the city, has announced the withdrawal of a rule relating to pole lines, which appears on page 21 of the printed electrical rules of the department, and reads as follows:

"25.—Conductors must not be placed upon fixtures erected or maintained for supporting wires of another class, except at crossings, when approved by said department."

For the above rule the following has been substituted:

"*25a.*—Electric light and power wires must not be placed on the same cross-arm with telegraph, telephone or similar wires, and when placed on the same pole with such wires the distance between the two inside pins of each cross-arm must not be less than 26 in.

"*25b.*—Electric light and power wires must not be placed on the same pole with telegraph, telephone or similar wires unless the former are placed above the latter and separated therefrom by a vertical distance of at least 4 ft., and where the voltage does not exceed the following operating values: Constant-

potential circuits, 5000 volts; alternating-current series circuits, 5000 volts; direct-current series circuits, 7500 volts; direct-current railway circuits, 700 volts.

"*25c.*—In the event of electric light or power wires passing down a pole carrying signal wires, the former must be enclosed in a grounded metallic covering and be suitably protected against mechanical injury, from the lowest electric light cross-arm to the ground or to a point 3 ft. from the center of the pole, measured horizontally.

"*25d.*—Mast arms and other conducting fixtures or rigging located below the lowest electric light and power cross-arm must be grounded. Transformer cases must be grounded unless the secondary circuits are grounded.

"*25e.*—Mast arms, etc., transformers with ungrounded secondaries, and shields for conductors running down the pole must be grounded at the pole to which they are attached, and messenger cables for electric light and power must be grounded at least every 500 ft., either by independent ground wires or by bonding to ground wires already in place.

"*25f.*—Transformers must not extend below, and cable boxes must not extend above, their respective cross-arms, unless the distance between the two groups of cross-arms be suitably increased."

Engineers Lacombe, Sever and Wynkoop, who have given the subject much attention in Brooklyn during the past four or five years and in Manhattan and the Bronx since the reorganization of a year ago, submitted the following report in connection with the recommendation for a change in the rule, which the commissioner has accepted:

"The old rule, the abandonment of which we are recommending, has been inherited from the Board of Electric Control and was undoubtedly appropriate to the wire conditions and to the state of the art at the time of its adoption. With the infinitely better construction which finds favor to-day, and with the gradual reducion of wire congestion on our principal highways, it is believed to be good policy to restrict the number of poles by requiring that all overhead conductors erected on any street be carried, so far as practicable, on one line of poles. It is believed also to be sound engineering to support upon one series of poles conductors for signaling and those for electric light and power, provided, first, that the signal wires, which are the less substantial, be placed underneath so that they may fall away from rather than upon the electric light and power wires; and, second, that the voltage of the electric light and power circuits be limited to the value which the consensus of electrical opinion throughout the country endorses for this situation.

"The policy of requiring grounded metallic coverings for wires carrying dangerous potentials when brought down within reach of the public or even within reach of the signal lineman, has met with some objections, either technical or financial, from the various electric companies in this city, but these alleged obstacles are not insurmountable, and, therefore, we believe should carry no weight where human life lies in the other side of the balance."

Brailey Telephone Properties.

More than 100 independent telephone men of Ohio met at the Chittenden Hotel, Columbus, on October 29 to discuss the recent change in the control of the United States Telephone Company and the Cuyahoga Telephone Company, and to take such steps as they believe will afford them protection in case the actual purchasers of these interests should be allied with the Bell Company in any way. While not contesting that James S. Brailey, Jr., head of the syndicate which purchased the Everett-Moore stock, is sincere in what he asserts, yet the lack of information in detail as to his associates is a matter which has disturbed them. Even with the situation as he states it, the control of the companies is with a new faction and the situation has changed materially through this step. To meet any conditions that may arise from that feature they have taken advantage of the opportunity to forestall any arrangement that will weaken them as a body against their competitors.

Mr. Brailey was in Columbus and attended some of the sessions. He reitereated his statements that neither he nor his associates were connected in any way with the Bell interests, and further asserted that the companies will remain independent, as there is no thought of allowing the control to go into other hands. He refused, however, to name his associates in the syndicate or give any details regarding the purchase of the stock. Mr. Brailey further said that he was not prepared at that time to make a statement as to the completion of negitiations for leasing the United States property to the Ohio Home Telephone Company, which was incorporated for that purpose just a few days previous to the announcement that he had secured control of the companies mentioned, as well as those at Indianapolis.

President Frank L. Beam, of the Ohio Independent Telephone Association, appointed a committee of 15 members to have charge of matters pertaining to the situation and from this number five were chosen to investigate the deal recently made. They are as follows: Messrs. Louis Brucker, Mansfield, chairman; H. M. Daugherty, Columbus; D. J. Cable, Lima; H. D. Critchfield, Chicago, and W. Guy Jones, Delaware. It is said that this committee has been authorized to bring proceedings under the anti-trust law if it develops that the Bell people have any interest in the control of the companies.

Mr. Herman C. Stifel, member of the board of directors of the United States Telephone Company and of the voting trustees of the Toledo Home Telephone Company, brought suit against the latter on Oct. 29 to require it to set a date upon which he may examine the books. He states that he is a stockholder and that, upon proper demand made the day previous, the company refused to allow him to see the books. He asks that the court enjoin the company from removing the books from its jurisdiction. On the same day Mr. Stifel brought suit in the courts of Marion County, Ind., praying for a writ of mandamus compelling the New Long Distance Telephone Company, of Indianapolis, to permit an inspection of its books.

President James S. Brailey, Jr., of the Toledo Home Telephone Company, stated that Mr. Stifel has had the company's monthly statements and could have had any further information he desires. He says he knows nothing further for the reason of the suit. Mr. Stifel is a broker of St. Louis and is prominent in the independent telephone movement. His attorneys would give no information regarding the matter.

Officials of the United States Telephone Company and the Cuyahoga Telephone Company, at Cleveland, state that they are not acquainted with any of the details of Mr. Brailey's plans. They say that he has told them that there will be no change in the policy of the companies and that they have every reason to believe all he says.

The organization of the Ohio Home Telephone has been completed by the election of a board of directors as follows: Messrs. Will Christy, Akron; S. W. Harper, Wheeling, W. Va.; W. F. Laubach, Akron; Harry M. Daugherty, Columbus, and B. G. Hubbell, Buffalo, N. Y. The directors organized by selecting the following officers: President, Mr. Will Christy, Akron; vice-president, Mr. S. W. Harper, Wheeling, W. Va.; secretary and treasurer, Mr. H. A. Hauxhurst, Cleveland.

The Inventors' League.

BY JOSEPH J. O'BRIEN,
General Secretary of Inventors' League.

It has been well said that the birth of the patent system marked one of the most important events in the history of mankind. That the patent system was conceived, in the rough, by the founders of the Republic, as a necessary measure to the development of native industries and national prosperity, is both a tribute to the foresight of these illustrious thinkers and an acknowledgment of the fundamental relation of security in property created by invention to national advancement. For years Congress proceeded in its work of forming and shaping laws of one kind or another before it finally

founded the present system of rights which rests on the issuance of patents for inventions. It was not till confusion had developed in the operation of the earlier patent laws that the essential features of the present system were incorporated into law.

While the theory of the present system of patent rights is admirable, the design of the system and the operation of patent laws are in constant and dangerous conflict with the interests which these laws were originally intended to protect. While industry has made wonderful progress because of the advances rendered possible through the patent system and the diffusion of knowledge, the patent system has not kept pace with the needs of the inventors, of the industries and of the nation. As a consequence there now exists a wide-spread unrest among the inventors and throughout the industrial fields respecting the present scope and operation of the patent laws, and there is a general agreement that inventors should unite in favor of the improvement of existing laws and methods.

In a world organized by invention the inventors are now the most isolated and disorganized class. Their grievances are in large part the indirect result of their helplessness, due to their present isolation. For years individuals have contended for improvement in the laws and methods of the patent system but with little or not result, and it is safe to assert that individuals may continue to contend as individuals for years to come and will achieve little of value. Organization is absolutely essential to a correct itemization of existing evils and needs; a correct definition of negative and positive causes; and the elaboration and successful promotion of an adequate program of revision and reformation. To provide the basis for an organization of inventors which would be at once free and properly limited to the vital needs of the inventors as a class, the Inventors' League has been organized.

The Inventors' League is the result of the earnest effort of inventors residing in the national capital to provide an organization which would be broad enough to include those inventors who were in favor of improving and protecting their interests, and narrow enough to exclude all who possessed interests conflicting with the interests of the inventors. Its membership is limited to three classes, as follows: Class A includes those who have secured patents in this country; the control of the League is in the hands of this class. Class B includes those who have filed applications in the Patent Office for patents, which class do not have the right to vote, but have a vote in the affairs of the League. Class C consists of inventors who have not filed applications, and are merely corresponding members. Practising patent attorneys, regular attorneys in practice, professional patent promoters, and employees of the Patent Office are not eligible to membership.

The constitution of the Inventors' League has been drawn with the object in view of providing an instrument whereby it would be impossible for the officers to "handle" the organization, but it would be possible for the organization to "handle" the officers. To this end a three-check system has been devised for the control of funds; the initiative and referendum have been included to provide for frequent general voting on all important questions and to provide adequate opportunity for the expression by the membership of organization and inventive needs, and for the improvement of the lines of organization; the recall has been included to prevent the abuse by the officers or servants of the organization of their positions; and the affairs and interests of the League have been distributed in such a way to bring out the best that can be secured and to afford adequate discussion and free and responsive action. When the League is not in session the Executive Council, of five members, acts for it. Five general committees are provided for, namely: Committee on legislation, consisting of ten or more members; Committee on the Patent Office, consisting of ten or more members; committee on foreign patent laws, consisting of five or more members; committee on assistance to inventors, consisting of ten or more members; committee of education and publicity, consisting of seven or more members.

These committees have not yet been named and will not be for some time yet, as it is the desire of the League to have its membership fully representative before the committees are filled. As the League is a national organization these committees will be selected from many States.

The objects of the Inventors' League are defined in the Constitution as follows:

"The intellectual and material advancement of inventors and the development of collective means for the protection of their rights.

"To secure a higher, more just and more practical realization of the constitutional foundation of the Patent System as set forth in the Constitution of the United States, as follows: 'The Congress shall have the power * * * to probate the progress of science and the useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries.'

"To secure closer co-operation between inventors for their mutual protection, without loss of their independence.

"To secure adequate provision for the just and effective consideration of new inventions and the safe keeping of the priceless records of invention.

"To facilitate the development, advancement and utilization of inventions by the extension of existing opportunities and by the diffusion of facts among the inventors and the people, concerning the vital importance of the rights of inventors, and by the encouragement of awards and similar measures for new inventions.

"To discover and define opportunities for the application of inventions and to bring inventors into closer and freer relations with such opportunities.

"To collect and preserve the history of inventive achievements and the literature of invention."

From the foregoing it will be seen that the Inventors' League is committed to a program designed to render property in inventions more secure and to improve and protect the interests of inventors.

The League has opened a headquarters in the Munsey Building, Washington, D. C., and is now at work completing plans for the publication of a monthly journal to be devoted to its work and the interests of inventors. In order to keep the League out of purely commercial work, and thereby consistently true to its mission, the constitution prevents it entering into any commercial pursuits or endorsing any one engaged in such pursuits.

The initiation fee has been placed at $1 and the dues at $4 a year, or $1 a quarter. The journal to be soon published by the League will be furnished free to all members. Its policy will be consistent with the interests of the inventors as a class. It will be of all things a paper advocating their interests and serving them along such lines as do not conflict with the foregoing objects.

Following are the present officers of the Inventors' League: Mr. William P. Armstrong, president; Mr. George W. Bartlett, first vice-president; Mr. O. H. de Lamorton, second vice-president; Mr. Joseph J. O'Brien, general secretary; Mr. C. E. Phillips, financial secretary; Mr. J. R. Kelly, treasurer.

The Inventors' League is the first organization conceived by inventors; shaped for the advancement of inventors by inventors, and controlled by inventors in the interest of inventors as a class. The earnest co-operation of all inventors is asked that the work of improvement can be carried on with the best and surest success.

Locomotive for Pennsylvania Tunnel.

Beginning on Oct. 29 the Pennsylvania Railroad Company has been testing on the Long Island Division the first of the electric locomotives to be used in the New York tunnel extension. This locomotive is one of 24 to be assembled at the Altoona shops, where the mechanical details were built; the electrical apparatus was constructed at the East Pittsburgh

shops of the Westinghouse Electric & Manufacturing Company.

As seen from the accompanying illustrations, the locomotive is built in two sections, there being two cabs and two running gears, jointed at the middle. Each section has eight wheels, four of which are 68-in. drivers, the other four being 36-in. truck wheels. The sections are permanently coupled back to back by friction draft gear and levers, so that the leading section pilots the rear one. All of the manipulating levers are



FIG. 1.—LOCOMOTIVE FOR PENNSYLVANIA NEW YORK TUNNELS.

duplicated in each section and hence the locomotive need not be turned at the end of a run.

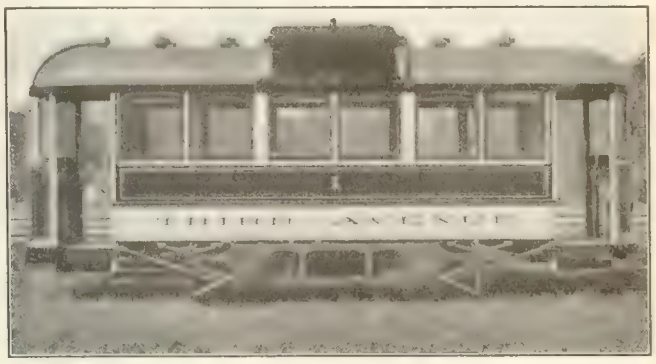
Each motor is provided with two cranks, one on either end of its shaft, placed 90 deg. apart. By means of coupling rods the motor delivers all of its power to a crank-shaft in line with the driver axles to which it is coupled. The arrangement is such that the torque on the drivers is constant throughout each revolution. It is said that the height of the center of gravity closely approximates that in the best high-speed steam locomotives. All of the gearing mechanism is spring supported from the driver and truck wheels.

Each motor weighs, without gearing, 45,000 lb., and is rated at 2000 hp. The total weight of the locomotive is 166 tons, the electrical parts weighing 62 tons. The maximum draw-bar pull for the two motors is 60,000 lb.; a speed of 70 miles per hour can be reached under load on level track. The total length of the locomotive is 65 ft.

A large part of each cab is filled by the motor. In a bulkhead sort of an arrangement centrally located in the cab is the main control apparatus, while at one end is located the electrically driven air-compressor for operating the brakes. The switching operations are performed by electro-pneumatic devices, the movements of which are governed by a miniature master controller. The locomotive is equipped with third-rail collector shoes for normal service, but is provided with an overhead contact mechanism for use where a third-rail cannot be installed.

Gasoline-Electric Car for New York Service.

A single-truck car, similar in external appearance to the ordinary electric car, but containing its own generating station, has been built by the General Electric Company for the Third Avenue Railroad Company of New York. The propelling equipment consists of two motors mounted on the axles in the



GASOLINE ELECTRIC CAR FOR NEW YORK.

usual manner. These motors receive energy from a generator directly connected to, and totally enclosed with, a gasoline engine of the four-cylinder, four-stroke-cycle type. Controllers at each end of the car allow it to be operated in either direction as desired. The controllers connect the motors progressively in series and in parallel, and regulate the voltage supplied to the generators, as required by the speed of the car. In this way all mechanical connections between the gas engine and the driving axle are eliminated. The gas engine, provided with automatic centrifugal-throttle governor, runs at constant speed regardless of the speed of the car, and thus operates at all times at high efficiency.

A Bosch low-tension magneto supplies energy for the ignition system, which is of the "make-and-break" magnet plug type. A directly-connected exciter supplies energy, not only for the field circuit of the main generator, but also for the car lighting.

The car has no monitor, its roof being dome-shaped with suction ventilators. Water-cooling radiators are placed on the roof over the center of the car and are connected to the water jackets of the cylinders by pipes enclosed within the center posts of the car. The circulation is semi-siphon.

The over-all length of the car is 28 ft. It is provided with seats for 26 persons and weighs 12 tons when completely equipped. The truck is of special light construction of riveted plate frame, equipped with Hess-Bright ball-bearing journal boxes. The truck frame is supported on coil springs and is steadied at the ends by half-elliptic springs.

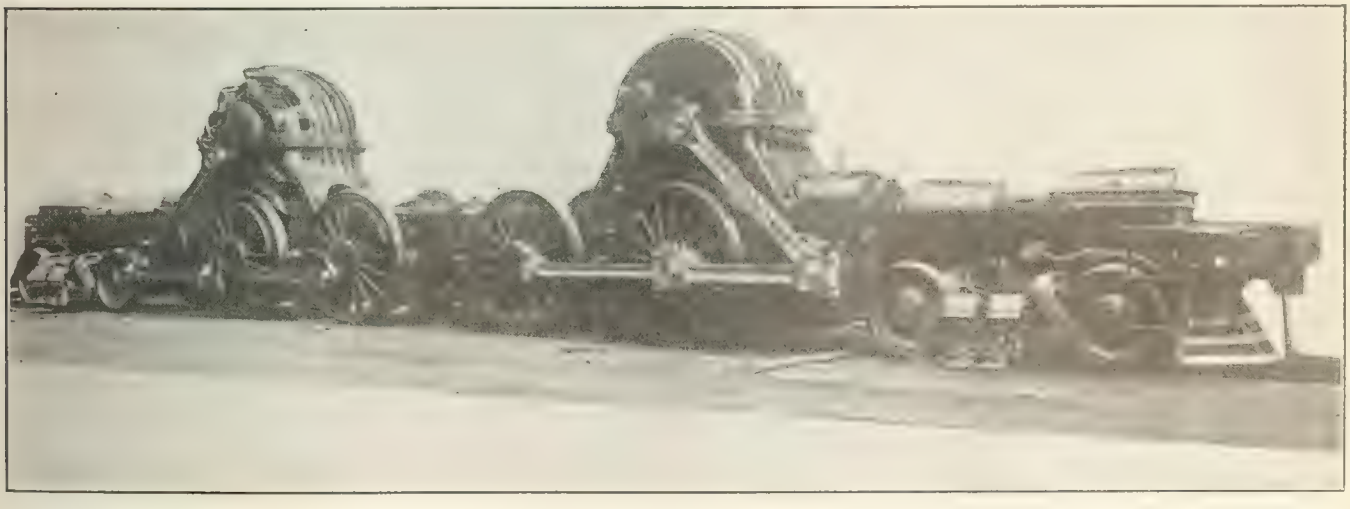


FIG. 2.—CHASSIS OF PENNSYLVANIA RAILROAD LOCOMOTIVE.

Western Association of Electrical Inspectors.

The Western Association of Electrical Inspectors held its fifth annual meeting in Detroit, Mich., on Oct. 26, 27 and 28. The report of the secretary showed that there are now 187 members, of whom 15 were added during the past year. The registration at the meeting was 35.

A committee, of which Mr. Frank R. Daniel was chairman, submitted a report on the grounding of conductors for safety which produced considerable discussion. The main point at issue was the advisability of grounding the exterior casing of all fire and police telegraph alarm boxes. The objections urged were based on the facts that some of the boxes were not designed to permit grounding without injury to the service and that many burnouts in these boxes were directly traceable to the ground connection. A committee was appointed to investigate the problem and determine the best method of handling it. The association decided that ground rods driven into the earth as usually installed do not form reliable ground connections and should be condemned or improved by the addition of more surface area and greater length of pipe to insure the penetration of the permanent moisture level.

The proposition to provide a surface ground, as well as a permanent ground by means of one plate embedded in coke below the permanent moisture level connected with one embedded in coke 8 in. below the surface of the earth, started a general discussion. It was decided that this question could not be disposed of and was referred back to the committee for further investigation.

Tours of inspection were made, including visits to a theater wiring installation, the storage battery auxiliary supplying energy for emergency purposes and the sprinkler supervisory system of the Still Alarm Company. Later visits were made to the factories of the Detroit Fuse and Manufacturing Company, where the manufacture of fuses was exhibited; the Detroit Insulated Wire Company, where was witnessed the process of insulating wire with rubber, and the American Electric Heater Company, where the manufacture of electric heating apparatus was exhibited.

PUBLIC SAFETY.

In a report on public safety in relation to fire prevention, submitted by a committee of which Mr. W. J. Canada was chairman, it was stated that hundreds of fires within the past four years have been traced to primary voltage reaching secondary circuits, and that, therefore, there is a close relation between fire and life hazards and there exists a necessity for recognizing both in any treatment of the subject. The suggestion of the committee to abolish brass-shell sockets and flexible cords in rooms having stoves, bath-tubs, sinks, damp floors and the like, was adopted as a recommendation, but not to be treated as mandatory. It was recommended also that knob and tube construction be replaced wherever possible with conduit.

Following an informal dinner at the Log Cabin Inn, Mr. James E. Cole delivered an illustrated lecture covering the history of the wiring troubles in Boston and describing the methods employed for eliminating them. Mr. Alexander Henderson discussed the effect of inspection on the manufacture of electrical appliances. He advocated rigid inspection, uniform rules and co-operation with manufacturers who are trying to produce safe appliances. In an address on the technical press and its relation to electrical inspection work, Mr. J. B. McCarthy entered a plea for the gathering of data relating to fires of electrical origin for publication in the technical press. Mr. H. C. Harris asked for patience on the part of inspectors toward the developments in installations made in connection with the improved lighting equipments. A discussion of metal molding brought out the fact that this type of molding has proved satisfactory and will in time supersede wood molding. The desired fittings are gradually being developed for all classes of work.

The report of a committee on architects' specifications gave specifications covering installations for residences and bank buildings and work condemned by the Underwriters. This report was not adopted on account of the prevailing belief that form specifications are unwise.

"Instructions to the Public Concerning the Safe Operation and Maintenance of Electric Wiring and Apparatus" was the subject of a report of a committee of which Mr. T. D. McColl was chairman. The committee recommended that every effort be made by inspectors to create in the minds of the public a proper recognition of the fact that electrical construction requires skilled work and cannot be done by the "jack-at-all-trades." The instructions offered covered electric lamps, motors and smoothing-irons.

Mr. Charles W. Arrick, as chairman, submitted the report of the committee on installation and operation of induction motors, which asked for the discussion of various points. In the discussion it was held that the resistance type of starter is not so good as the impedance type. The use of an outside oil switch on high-potential installations was advocated. No mandatory action was attempted on this report, and the committee was instructed to pursue further investigation.

The committee on construction and installation of electric signs, of which Mr. Emil Anderson was chairman, submitted certain questions for answers by the members. The answers indicated that low-voltage lamps give good service. It was suggested that copper shells be required on sockets and receptacles exposed to the weather, and that signs be so suspended as not to come into contact with wires used for other services; the method of suspension being governed by published rules.

Illumination by means of reflected light was stated to be the standard for show windows in a report of the committee on show-window and display lighting, of which Mr. Fergus P. McGough was chairman. For such installations conduits and metal moldings are preferable to wooden moldings and are not materially more expensive.

Discussion of difficulties arising in electrical inspection work brought out several good points. Much time was devoted to packing-house, brewery and malt-house wiring, and several types of construction were described. The use of inverted troughing in excessively damp places with glass insulators was recommended, but where vapors or injurious solutions of any sort are present the rubber insulation should be protected by a lead covering supported on porcelain cleats. The lead covering should be broken at intervals to clear any grounding contacts. At these breaks the wire and lead covering should be heavily taped and carefully painted. Conduit work was recommended for wiring in the ordinary damp place.

The following officers were elected for one year: President, Mr. Fred G. Dustin, Minneapolis, Minn.; first vice-president, Mr. W. J. Gilsdorf, Lexington, Ky.; second vice-president, Mr. H. G. Young, Streator, Ill.; secretary and treasurer, Mr. William S. Boyd, Chicago, Ill.

The next meeting will be held in Omaha, Neb., in October, 1910.

Electrical Securities as Investments.

An instructive talk was given before the Electric Club of Chicago at the weekly luncheon of Oct. 27, by Mr. George B. Caldwell, manager of the bond department of the American Trust and Savings Bank, whose subject was "Electrical Securities as Investments." Mr. Caldwell mentioned four elements as essential features of a marketable bond on an electrical plant. First, the property must not be overbonded; second, it must have good management; third, it must have a depreciation reserve or sinking fund, and fourth, there must be honest accounting. It is important to remember that the investor seeks security first, income second and convertibility third. This is the case with the securities of all corporations.

In the case of electrical properties the feeling exists that electricity has not yet been fully developed and that the methods employed for its production and distribution are rapidly changing. It is sometimes objected that electrical apparatus has not

become standardized as yet, and that therefore there is additional risk—a sort of double depreciation. But Mr. Caldwell's own observation is that standard apparatus is now to be had for electric light and power and that it furnishes a safe business risk for a 15-year or 20-year bond. But it is important that tests of the durability and productive power of modern electrical plants should be clearly and conservatively determined, and the facts freely published, if securities are to be sold to the public.

Referring to a proper depreciation charge, the speaker noted that this item has been very large, but he remarked that it will grow to be less of a hazard, especially with standard machinery. It is contended nowadays that where a property is kept up to a high state of efficiency a depreciation charge of perhaps 5 per cent, or at most 7 per cent, will keep the security good. If this is true, electrical securities are as good as those of any other industrial enterprises and compare favorably with the depreciation account on city real estate. An electrical property costing $250,000 must earn $25,000 a year above operating expenses to care for a 5-per-cent depreciation and pay 5 per cent on the money invested. Such an earning power does not, however, justify a bond issue for more than one-half of the investment, and then only where the franchise situation and management are of the best and the public is a ready consumer.

Considering the marketability of electrical securities, the speaker noted the large number of small central stations and said that it is obvious that one must have very specialized information to be a judge of the character of these thousands of different issues of bonds and stocks. Bond issues on these properties bear 5 or 6 per cent. Even though conservative, they lack in convertibility, which is another word for marketability. It is probable that within a few years there will be consolidations of many small properties, correcting operating evils and broadening the market. At present the market for securities of plants in cities of 10,000 to 20,000 population is slow and doubtful, even though the margin of security is ample. If sold at all, the discount is heavy and money secured in this manner frequently costs from 8 to 10 per cent. The remedy for this situation seems to lie in the operating company with capital sufficient to handle many small "situations" economically.

But the speaker was willing to concede that the business of manufacturing and selling electricity has been almost uniformly profitable. He regards a bond issue on a modern electric-light plant in cities of 50,000 and over as only an ordinary business hazard. For such a hazard 5 per cent on a bond issue for not over one-half the cost, with sinking-fund provision, makes a safe investment provided the net earning power averages twice the interest. With the questions of management and marketability worked out, as they surely will be—the first by honest engineering and the latter by honest financing—the investing public will have less cause for apprehension. Markets will broaden and prices improve.

Competition in electric service is not desirable. Fair treatment to the public should be obtained by regulation of rates and service in the hands of fair-minded public-service commissions. It is good business policy to give the customers good service at reasonable cost. Given intelligent technical management, conservative accounting and a liberal interpretation of consumers' rights, Mr. Caldwell sees no reason why funds will not be found that will absorb all the electrical securities which it may be found necessary to create.

The speaker, in answer to a question from Mr. F. P. Vose, gave an interesting account of the procedure followed when an electrical operating man comes to a banker or bond house to secure funds. The first inquiry is whether the proposition offered is genuine or a fantasy. The physical characteristics of the plant or plants under consideration are considered; also the franchise and management. The banker gets all the facts available and then asks the applicant what he wants so much money for. The latter usually explains that he wants to make large extensions and improvements for the future. Perhaps his ideas are visionary; he may be over-enthusiastic by reason of local pride. It may be necessary to cut out certain things. The applicant is asked: "What have you got as a basis for credit? What is the earning power of the property? What will be its future earning power?" Often the visitor can make only vague answers to these inquiries.

If the conversation goes so far, the terms of the mortgage are next taken up, and what is offered to the applicant may be unsatisfactory to him. Perhaps he will go away and make the round of the bond houses, coming back after a while to resume the negotiation. If the proposition is at all interesting, the banker or dealer in bonds will demand reports on the situation and property from an engineer and an accountant to be nominated by the banker, but to be paid by the applicant for the money. Having received these reports, the banker makes his final decision. If he goes ahead with the bond issue the question of a market comes up. All the banker's deposits could be put out in unmarketable securities, but a due regard for the depositors' money makes this impossible; the securities must be marketable; they must be an element of strength and not of danger. If satisfied on this point the bank will be willing to develop the enterprise for the commissions and profits which it receives from the transaction.

The great question is, Can the bonds be sold? When the question of rehabilitating a small run-down property in a small city comes up it may be better for the men in charge to go to a large operating company and interest that company in the re-equipment of the property rather than offer bonds on the individual property to a bond house. The question of earnings is only a part of the problem. More important is the situation and management of the property. Troubles and losses in small stations come usually from poor management. Thus the security may be intrinsically good, but the management may change hands; poor management may ruin a good property. This question of management is vital. The management should be intelligent and tactful. The bank is very sensitive about the character of the investments on which it sells bonds, for its customers must have a complete sense of security in bonds purchased. The bank recommends the securities and must watch the management of the property closely. The question of marketability of electrical securities is going to right itself, but the matter of the security involved must always rest on good judgment.

The basis of financing electrical properties of small size must be that the local people have a substantial stock interest. Nobody should borrow all the money he does business on. Real estate loans, for instance, are made on a basis of 40 or 50 per cent of the value of the property. It is inconsistent with conservative finance for a man to attempt to sell an electrical property to the public and still own it himself. Stake your own money with that of the bank. The applicant will receive careful attention if the security offered and the management of the property are right; the bank will take care of the marketability.

In the discussion Mr. George Cutter, of South Bend, Ind., alluded to the conspicuous improvement in industrial business. Certain classes of machine tools, for instance, have increased 20 per cent in price within the last few months and deliveries are not to be had in less than a year's time.

Mr. F. J. Postel questioned Mr. Caldwell in relation to the responsibility of trustees for bond issues so far as protection to the bondholders is concerned. The answer was that the greatest protection of buyers of bonds is the character of the house dealing in them. However, according to the usual practice, if there is a default in interest the holders of 25 per cent of the bonds may combine and petition for a receiver or other relief.

Mr. George H. Lukes asked why a greater number of bonds of less than $1,000 denomination were not issued. He pointed out that local people of small means might buy bonds if they were not required to invest as much as $1,000. Mr. Caldwell said that this was a good point. The principal objection to small bonds on the part of banks and dealers is simply one of physical quantity; the greater number becomes cumbersome and are burdensome on vault space. There appears to be no other

objection to small size from the bank's point of view. In cases where bonds of $1,000, $500 and $100 have been issued, it has been almost invariably the case that the $100 bonds sold first. The farther you get away from the commercial centers, the smaller are the investors, and the securities should be suitable to the locality in which they are sold. This matter can be handled as the borrower wishes.

Illinois State Electric Association Convention.

The Illinois State Electric Association held its annual convention at Alton, Ill., Oct. 26, 27 and 28, 1909. This was by far the most successful convention ever held by the association as regards attendance, the registration showing 104 central-station operating men in attendance. The first session was scheduled for the afternoon of the 26th, but owing to the delay in the arrival of a special car over the Illinois Traction System, which brought a large number of delegates, no session was held until the morning of the 27th. About 3:30 p. m. a visit was made to the large plant of the Illinois Glass works. In the evening a smoker was given at the Elks Club by the supply men. The entertainments provided by the supply companies were managed by Mr. W. R. Pinckard, of the Westinghouse Chicago office.

The first session was called to order in the council chamber of the city hall Oct. 27, with President F. M. Sinsabaugh, of Carrollton, in the chair. The report of Mr. David Davis, of Litchfield, chairman of the committee on membership, showed 11 central stations as recently joining the association. The president appointed as a committee on resolutions Messrs. Frank J. Baker, of Chicago; R. H. Abbott, of Petersburg, and H. A. Foster, of Fairbury.

"Lighting Rates in Small Towns" was the subject of a paper by Mr. W. J. Whetzel, of the Eureka Electric Service Company, Eureka, Ill. A paper on "Lighting Rates in Towns of over 15,000 Population" was read by Mr. M. G. Linn, of the Bloomington & Normal Railway & Light Company, Bloomington, Ill. These drew out a long discussion, as is usual when rate questions are brought up at conventions of this kind. After some discussion of this subject it was voted to appoint a committee of five to make a report and recommendations to the next convention as to proper methods of arriving at rates and systems of charging for electricity. The object of appointing this committee is not to have it recommend specific figures or rates, because these rates necessarily should vary according to the cost of production in different towns, but rather to recommend certain standard methods of arriving at rates, so that the smaller companies seeking for light on this subject may have something to guide them. This committee on rates, which was appointed by the president at the morning session the next day, consists of Messrs. R. S. Wallace, superintendent of the Peoria Gas & Electric Company; G. W. Burton, of Danville, attorney for the Illinois Traction System; S. B. Cushing, of the North Shore Electric Company, Evanston; J. J. Frey, secretary and manager of the Hillsboro Electric Light & Power Company, and E. L. Brown, owner of the Elmwood electric light plant.

From the question of rates the convention drifted into the subject of requiring a deposit from new consumers or requiring the signature of some property owner to an application for service. The opinions of members seemed to be divided on this subject, but several from the larger companies expressed disapproval of requiring such deposits except in a few cases where credit was known to be bad. This disapproval was based on the bad effect on the new customer and on the public in general of acting as if every new consumer were a suspicious character.

Wednesday afternoon the session was opened in the lodge room of the Elks Club. Mr. H. W. Dickerman, of Rockford, Ill., presented a paper on "The Relation of the Electric Vehicle to the Central Station." Following this several members gave their experience with electric automobiles. Outside of Rockford and Chicago no great amount of progress with electric vehicles was evident, but many managers expressed interest in the electric vehicle and the intention to cultivate this business.

A talk on "Gasoline Lighting" was given by Mr. David Davis, of the Litchfield Gas & Electric Company. The discussion which followed indicated that a few companies were having considerable trouble with gasoline competition, and with others this has ceased to be a very live issue because of the advent of the tungsten lamp and proper systems of charging for electricity.

Mr. C. A. Howe, of the Holophane Company, gave a brief talk on "The Doing and Undoing of the Watt." He described briefly and plainly the simple method of estimating the watts per square foot required to produce a given illumination with fair approximation, from tables compiled by Cravath and Lansingh. In general, he did not approve of what he called the "anti-wattage" engineer, whose only object is to reduce the wattage required to light a given area. He believed rather in an increase of the general standards of illumination. The tungsten lamp is a help rather than a detriment to the central station, and the companies which were most afraid of introducing tungsten lamps are now the ones having the most trouble with gasoline plants.

The president appointed a nominating committee, consisting of Messrs. J. G. Learned, North Shore Electric Company, Chicago; R. L. Bivans, of the Jerseyville Illuminating Company, and W. H. Brown, of the Peoria Gas & Electric Company.

Wednesday evening the association members were guests of the supply men at the Temple Theater, where a concert was given by the Walter Damrosch Orchestra. After the concert the Sons of Jove held a rejuvenation at the Elks Club.

Thursday morning resolutions of regret were presented on the death of Mr. A. V. Schroeder, formerly superintendent of the Springfield Light, Heat & Power Company, and at one time active in the association. Resolutions of thanks were passed to the Alton Railway, Gas & Electric Company, and especially to the manager, Mr. O. C. Macy, and to the supply men, for the entertainment provided; also to the Elks Club for the use of its clubhouse for the meetings and smoker, and to the Illinois Glass Company, whose works were visited.

A paper on "Power," by F. H. Golding, manager of the Rockford Electric Company, was presented. The discussion on this centered about the question of rates and methods of determining the consumer's maximum demand, and also the subject of installing motors on trial as a quiet way of answering all arguments and getting the motors introduced.

Mr. John G. Learned, of the North Shore Electric Company, Chicago, presented a paper on "The Advantages of the Tungsten Lamp," which was discussed briefly, no dissenters being found from the sentiment that the tungsten lamp has been found a great boon to the electric lighting industry.

The convention went into executive session and passed an amendment to the by-laws whereby the annual dues are graded according to the population of the town in which the member company is doing business.

Officers elected for the ensuing year upon recommendation of the nominating committee are as follows: President, Mr. E. W. Smith, manager of the Kewanee Light & Power Company; first vice-president, Mr. W. G. Austin, secretary and manager of the Effingham Electric Light & Power Company; second vice-president, Mr. H. A. Foster, secretary and manager of the Fairbury Electric Light, Heat & Power Company; third vice-president, Mr. A. R. Manley, superintendent of the Mount Carmel Gas & Electric Company; fourth vice-president, Mr. F. H. Golding, manager of the Rockford Electric Company; treasurer, Mr. E. McDonald; secretary, Mr. H. E. Chubbuck, general manager, Illinois Traction System, Peoria, Ill.; assistant secretary, Mr. C. A. Willoughby, Illinois Traction System, Peoria; executive committee: Messrs. W. B. McKinley, president of the Illinois Traction System; F. J. Baker, general manager of the North Shore Electric Company; E. G. Schmidt, manager of the electric lighting companies of Spring-

field and Peoria; F. M. Sinsabaugh, of Carrollton, and David Davis, manager of the Litchfield Gas & Electric Company.

Thursday afternoon the convention was taken by two special cars to the power house of the East St. Louis & Suburban Company, which supplies the companies operating railway and lighting service over a large territory in the vicinity of East St. Louis. This power house is interesting as having one of the largest installations of cooling towers for condensing water in the country. The plant contains both high and low-pressure steam turbines and engines, the low-pressure turbines being operated between the exhausts of the engines and the condensers. The cooling towers are of the steel-encased stack type, with forced circulation and ventilation.

Mr. E. W. Smith, president-elect of the association, is manager of the Kewanee Light & Power Company and of the Kewanee Gas Light & Coke Company, which position he has held for two and one-half years. Mr. Smith is 37 years of age, and has lived at Kewanee 18 years. He gathered his electrical experience with the old electric lighting company at Kewanee. For a time he was in the employ of the large steel tube works at that place, later returning to the electric lighting property, where he was general superintendent for several years. This is one of the properties controlled by the American Gas Company, of Philadelphia.

Abstracts of the papers and discussions will appear in later issues.

Annual Dinner of Commonwealth Edison N. E. L. A. Branch.

The second annual dinner of the Commonwealth Edison branch in Chicago of the National Electric Light Association was held at the Lexington Hotel on the evening of Oct. 28. It was a carefully arranged, well-appointed dinner, with speeches of exceptional value, and was a highly satisfactory affair in every way to the 235 gentlemen who were present. The chairman of the branch, Mr. George Harvey Jones, presided, and the toastmaster was Mr. Louis A. Ferguson, vice-president of the Commonwealth Edison Company and a past-president of the National Electric Light Association. There were two other speakers, Mr. Frank W. Frueauff, New York, president of the National Electric Light Association, and Mr. Samuel Insull, president of the Commonwealth Edison Company and a past-president of the National Electric Light Association. There was some excellent singing by the Weber Quartette.

At the conclusion of the dinner all present were given an opportunity to shake hands with Mr. Frueauff, who came from New York simply to attend this dinner. Mr. Jones opened the speechmaking by reviewing the history of the branch during the year. As it was the last meeting of his administration he also announced the appointment of a nominating committee, consisting of Messrs. E. W. Lloyd, W. L. Abbott and J. H. Goehst. He then surrendered the direction of affairs into the hands of Mr. Ferguson, who introduced Mr. Frueauff by referring, among other things, to the remarkably successful career of that gentleman.

After alluding pleasantly to the work of a Commonwealth Edison man in saving the day for the West at the memorable baseball game at the Atlantic City convention last June, Mr. Frueauff spoke of the work which the National Electric Light Association has under way. He referred particularly to the new features, as the appointment of an executive secretary, the preparation of a table of electrical values for use in school books and the standardization of the vocabulary of electrical terms.

In his introduction of Mr. Insull, Mr. Ferguson gave some figures showing the work accomplished by that gentleman in the electrical field in Chicago and vicinity which were of much interest. He said for one thing that when Mr. Insull took hold of the company in 1892 its income was $350,000 a year, while now it is about $10,000,000 a year.

Mr. Insull was in a particularly happy vein and he spoke to his associates and assistants for three-quarters of an hour in a most earnest and helpful spirit. His address made a deep impression. He told of his early association with Edison and the great man's abiding faith in the future of the electrical industry. He said that there is more of a chance for the young electrical man to-day than there was even at the beginning of the art of electrical illumination a quarter of a century ago. The way for the young man to get on is to keep his eyes open and to know why things are done. The speaker dwelt on the great field for electrical service in Chicago and also emphasized the necessity of treating customers with unfailing courtesy and tact.

Mr. Ferguson, Mr. Frueauff and Mr. Insull were enthusiastically applauded and their remarks were listened to with careful attention. Those present departed with the feeling that the dinner had been indeed a noteworthy affair.

Meeting of Electrical Section of Canadian Society of Civil Engineers.

The Electrical Section of the Canadian Society of Civil Engineers held its first meeting for the year on Thursday evening, Oct. 28, in the auditorium of the Society at Montreal, Canada. Prof. L. A. Herdt, chairman of the section, made a brief address setting forth the necessity of all the members interesting themselves in the work of the society. Mr. E. I. Wenger then read a paper on the "Determination of Train Resistance." This paper was very instructive and contained an excellent outline on the work done by different commissions, companies and universities on this determination. The paper was fully discussed by a number of engineers present, the attendance at the meeting being exceptionally good, about 100 members being present.

Hearing on Franchise of Economic Company.

The hearing on the application of the Economic Power & Construction Company for approval of its franchises and construction at Geneva, N. Y., was resumed by the New York Public Service Commission, Second District, at Geneva, on Sept. 23. Chairman Stevens presided. An account of the previous hearing was published in the issue of Sept. 16, 1909, page 645.

Mr. J. A. Bendure, general manager of the Economic company, was recalled for direct examination by Mr. Herbert P. Bissell, counsel for the company. Mr. Bendure testified that the electrical service in Geneva before the Economic company purchased the property of the Geneva Steam Heating Company was poor and that he believed a good opportunity existed for another company to do electric lighting business in Geneva. There would be advantages in combining steam-heating service with electric light. Mr. Bendure had had experience with combination plants in various cities and testified that the current was generally furnished for less and the steam heating was furnished for less. The witness testified that 76 or 78 merchants were supplied for commercial purposes. The company did not enter the residence districts.

Various residents of Geneva who were using the service of the Economic company were called as witnesses in its behalf.

Mr. W. Marvin Rogers, city clerk of Geneva, testified that he had not found, in the original record book of the city or the village which preceded it, any record of any grant or franchise to the Geneva-Seneca company or its predecessor corporation, to use public streets. The first mention he had found was of a regular meeting of the board of trustees in the village of Geneva on Feb. 19, 1884, when a resolution was passed giving the Brush-Swan Electric Light Company the power to install poles for the purpose of carrying wires to furnish electric light. Mr. L. E. Carr suggested that a petition had been presented to

the board on Feb. 2, 1884, and this was confirmed and read by Mr. Rogers, who also referred to the various other entries relating to agreements between the company and the village or city subsequent to that time.

Mr. Bissell said that these entries were made to show that the Geneva-Seneca Electric Company had no right to be in the streets and that under the charter provisions of earlier years the right could not be granted for an indefinite period. There was a gap of seven years for which Mr. Rogers had no books on file in his office. He had no information as to the whereabouts of the village records during that period.

Mr. L. E. Carr stated that the contention of the Geneva-Seneca company was that the petition presented in 1884 and the resolution passed at that time were sufficient permission for the company to secure use of the streets, install poles and string wires and that the action of the company in this matter had been recognized by the municipal authorities for the ensuing 25 years.

Mayor Arthur P. Rose, of Geneva, was introduced as a witness on behalf of the Economic company, and was cross-examined by the attorneys. Chairman Stevens inquired whether the witness had had any experience as to how long competition would continue between two rival companies and whether he had known of any instance where such competition had existed. Mayor Rose had had no experiences of this nature. Chairman Stevens asked whether there was any requirement of the charter or any agreement by which competition must be maintained between the two companies. There was none to Mayor Rose's knowledge. In response to another question, the witness stated that he did not know whether the gross revenues of the companies were sufficient to make any return upon the capital invested in the two plants. Chairman Stevens asked what would happen if there was not sufficient business in Geneva to pay any dividends upon the capital investment in the plants. The Mayor supposed that receivership would follow and that unquestionably in that case one company would operate the entire property eventually.

Mr. Bissell introduced in evidence a general release to the Economic Power & Construction Company from the mortgage of the New York Power & Securities Company covering this plant. That release had been recorded. The chairman had called attention at the last hearing in Albany to the fact that the commission desired to protect the public by having a value in the plant, which had already been encumbered by an issue of bonds and was then encumbered by a further mortgage to the New York Power & Securities Company. The latter mortgage, which had been upon the real, personal and franchises and property of every name and nature, had therefore been released, leaving the plant encumbered only by the mortgages securing $30,000 of bonds, and by a $4,000 underlying mortgage on the lot where the plant was built. The $30,000 of bonds were issued by the Geneva Steam Heating Company under two mortgages, first and second; one of $20,000 and the other of $10,000. Mr. Bissell said that it was intended to release the property entirely from all indebtedness to the New York Power & Securities Company so as to leave it free and clear in order to answer the requirements of the commission.

Mr. L. E. Carr made public a statement signed by 78 of the customers of the Geneva-Seneca company stating that the service of the company was entirely satisfactory. Chairman Stevens thought that no statement which covered a period of time as to which evidence had been given of improper or insufficient service ought to be received. The witnesses ought to be heard on that subject. So far as the present service was concerned, he saw no objection to receiving the statement in view of the evidence.

Mr. Bissell objected to the introduction of any paper of that character. Chairman Stevens said that no evidence had come to his attention where any witness had sworn that the service of the Geneva-Seneca company in 1909 was in any way unsatisfactory. If there was any, he had overlooked it. The evidence that had been given of unsatisfactory service covered a period up to the time when the Economic company entered.

Mr. L. E. Carr wanted to be sure that he was not mistaken on that point because in the decision of the commission in the Niagara Falls case, where it was a fact that the existing company was affording reasonably good service, that was held to be an answer to the petition of a new company seeking to enter in order that it might compete. It seemed to him that the Geneva-Seneca company had met the public needs.

Chairman Stevens said that the situation was radically different from what it was in Niagara Falls. In Niagara Falls an entirely new company which was not in service was involved. In Geneva the company was actually doing business. It alleged that the service was not what it should be and the rates not what they should be and that under the spur of competition the services had been improved and brought to a point where no evidence was offered that the old company was not performing its duty now. The Economic company said it entered because it believed it had a legal right to do so based upon the judgment of the Supreme Court. It was a fair proposition, but it turned out by virtue of a decision of the Court of Appeals that the company had no legal right in Geneva at the present time.

Patrons of the Geneva-Seneca Electric Company testified on Sept. 24 regarding its service.

Mr. F. N. Lawton, manager of the Geneva-Seneca Electric Company, was called as a witness. He said that about 50 consumers of the Geneva-Seneca company went over to the Economic company. The Geneva-Seneca company had added 72 customers since the beginning of 1909.

Mr. F. L. Dame, electrical engineer, testified that he had been managing or supervising the management of electric light plants since 1891, but that he did not know of any city in the United States of the size of Geneva where there were two competing companies at the present time. He had known of a number of small cities where two companies had operated for a time, and a consolidation of the properties had followed invariably. But competition of this nature had resulted in ruinous rates for each company, in the destruction of business, a loss for each company and an unnecessary duplication of investment. He did not know of any situation where competition had been eliminated by combination where the rates formerly in force had been continued, unless possibly in the instance of Lockport, N. Y., where the commission prescribed the retention of the existing rates.

The Geneva-Seneca company had ample station capacity in Geneva to-day to handle the entire lighting of Geneva, Waterloo and Seneca Falls, and the lines in Geneva had been extended as fast as the necessity existed for the service. The conditions in Geneva respecting the extension of the facilities were about what existed normally in the development of electric light properties. There was absolutely no necessity for the existence of a competitive company. The character of service during the last three or four years had been as good as was usually found in places of the size of Geneva. The plant in a city of that size was not likely to have the most modern direct-connected units, particularly where there had been an electric lighting plant in the earlier days. The company had not felt that the business justified further expenditures than it was making and the business was never sufficiently prosperous to justify dividends. The new station had the most modern type of machinery that could be installed. The old station, which was used in the day for service and for reserve, had practically the same class of machinery as the Economic company was operating, but of greater capacity.

Mr. Dame testified that the statement made in relation to the supposed economy from combination of the electric lighting and the steam-heating business was true when the loads balanced in the two systems, but it may cost more to produce electric light in connection with the heating system in an unbalanced system than if the same machinery should be operated independently of the heating system, for the reason that the heating system required a pressure of circulating steam, and his experience in the smaller communities had been that the pressure was generally rather high. After cross-examination by Mr. Bissell, it

was testified by Mr. Dame that the Geneva-Seneca Electric Company was owned by the General Electric Company. The greater part of his time was taken up in making examinations of properties throughout the country in connection with the purchase of securities; he had examined a number of combination plants and had had full access to the figures showing results of operation.

Chairman Stevens asked Mr. Dame whether he had said that as good results could not be produced with belted machinery so far as the consumer was concerned as with direct-connected units. Mr. Dame said that as steady a light could not be given with the belted machinery from a high-speed engine as with the other. High speed, he explained, would be an engine that ran 175 r.p.m. to 200 r.p.m. or over.

Chairman Stevens told Mr. L. E. Carr that he had not connected the present company with the Brush-Swan company. Mr. Carr said that he could file a copy of each lighting contract which had been made to show how the business had followed during the 25 years.

Chairman Stevens also called attention to the fact that the Geneva-Seneca company was receiving $75 per arc lamp for lighting the streets and that the Economic company had offered at this hearing to fix the price at $65. Mr. J. O. Carr, of counsel for the Geneva-Seneca company stated that the lamp which the Economic company had offered at $65 consumed substantially only one-half as much current as the present lamp furnished by the Geneva-Seneca company at $75. The company was entirely willing to have the commission fix a rate which would be reasonable.

Chairman Stevens then announced that while the Economic company was operating without any authority at the present time, there would be no criticism on the part of the commission as to its continuance during the pendency of this case. Since it was proved by the applicant that it was actually engaged in business without authority of the commission and without the consent of the law, the commission should say either that it would not, at the present time, take any cognizance of that fact, inasmuch as the company was seeking permission of the commission, or that it would, and it therefore made the announcement that it would not take such cognizance.

Adjournment was taken with the understanding that further information might be requested by the commission or submitted on behalf of either company.

Proposed Baltimore Public Utilities Commission.

The controversy over the "electric clause" of the natural gas ordinance has led to a movement in Baltimore for securing a public utilities commission. The idea took some tangible form last week when former City Solicitor William Cabell Bruce endeavored to persuade the Charter Commission, of which he is a member, to recommend to the Legislature the extension of the powers of the Board of Estimates to include those of a public utilities commission. Mr. Bruce contended that the necessity for a public utilities commission exists right in Baltimore, where the operations of public service corporations in Maryland are largely confined, and for that reason he prefers a municipal rather than a State commission. In his opinion, the Board of Estimates could easily be clothed with the powers of a public utilities commission.

The suggestion has met with some opposition on the grounds, first, that the jurisdiction of a municipal utilities commission might be disputed where complaints are made against public service corporations whose lines extend beyond the city; and in view of the fact that the lines of the electric company, united railways, telephone companies and almost every other public service enterprise extend into the counties, such a commission might prove ineffective. The second objection is directed against constituting the Board of Estimates as a public utilities commission on the ground that the board, with the present heavy duties which it has to perform, could not give all of the attention required to supervising public service corporations.

Massachusetts Commission News.

The final hearing upon the relation of the proposed Boston & Eastern Electric Railroad to the existing and probable future transportation facilities in the Boston district was held by the Massachusetts Railroad Commission and the Boston Transit Commission, sitting as a joint board, on Oct. 26.

Mr. Frederick C. Dumaine, for the Boston Railroad Holding Company, stated that this organization now controls the Boston & Maine Railroad in accordance with recent legislation, and it is opposed to the building of the Boston & Eastern in its territory. The desire of the holding interests is to provide every point served by it with suitable facilities. Mr. Woodward Hudson, for the New York Central Lines, opposed the road on the ground of interference with developments planned in East Boston by the Boston & Albany division in connection with docks and terminals for transatlantic freight shipments. He also objected to the building of a tunnel under Boston Harbor by private interests.

For the Boston & Maine Railroad, Mr. William H. Coolidge pointed out the ability of that company to handle the business offered, and deprecated the entrance of any rival road into the present field. He stated that under the general railroad laws of the State, improvements can be ordered by the Railroad Commission if the board deems them necessary, and he contended that the advent of a new road would tend to prevent investment in established and future projects in the Commonwealth.

Mr. Bentley W. Warren, counsel for the Boston & Northern Street Railway Company, pointed out the improvements in suburban traffic conditions which would result from the electrification of the steam railroads around Boston, as indicated in the report of the Metropolitan Improvement Commission of 1909. He believed that the extension of the Boston Elevated system will improve conditions of travel in the nearer suburbs, and quoted the Improvement Commission to the effect that the present trackage facilities are adequate, with the possible exception of certain missing links which may be necessary after electrification in order to supply circuit movements. In his opinion, any new line should utilize the existing terminals of the Boston system and not attempt a separation of traffic. Mr. Warren also stated that if the road is to be built, it will injure existing facilities, but in any event should not be started until the money for the construction of the tunnel is placed in the hands of the Boston Transit Commission, which should investigate the desired route and design and build the tunnel under the harbor and the subway under the streets to Post Office Square, or whatever terminus is selected.

Mr. Frederic E. Snow, of the Boston Elevated Railway Company, reiterated the fitness of the company's present plans for terminal improvements to afford a satisfactory transfer point between the new road and the elevated system.

Mr. Moorfield Storey, counsel for the Boston & Eastern, closed the case by stating that his company offers a plan to serve the public in a new and profitable way, as favored by the Legislature of 1906 when it established the electric interurban railroad on a private right-of-way as a new and necessary addition to the transportation agencies of the State. The Railroad Commission has already declared that public convenience and necessity require the building of the road, and the issue now is: How can it be accomplished with the best results in connection with existing and future facilities? The present roads are, in his opinion, unequal to the task. The objections of the New York Central in East Boston can be overcome by suitable engineering skill. The Railroad Commission has already declared against terminating the road at Sullivan Square, on the Boston Elevated system. He urged that the Boston & Maine and the New Haven systems are both committed to such costly expenditures for betterment in the next few years that there is little chance of their carrying out the improvements needed in the line of electrification and high-speed suburban service. The road will bring traffic to other lines and will not injure the East Boston tunnel.

Following the Boston & Eastern hearing, the joint board

listened to arguments of Mr. Daniel J. Cronin for petitioners asking that the elevated structure in Washington Street, Boston, be removed between Oak and Dudley streets, and a subway substituted. Mr. F. E. Snow, for the Boston Elevated, contended that the elevated structure is owned by the company in perpetuity, and that the board has no authority to order its removal. Chairman Hall suggested that counsel submit briefs and the hearing was continued until Nov. 4.

New York Public Service Commission News.

The Public Service Commission of the First District of New York has notified the contractors who have been awarded the work of constructing the Fourth Avenue Subway in Brooklyn, to prepare to execute their contracts at once. The action of the Board of Estimate and Apportionment in voting the necessary $15,000,000 to build the line, from the Manhattan Bridge to Forty-third Street, which was taken last week opens the way for the actual work to begin as soon as the consents of the property owners can be obtained. The contractors have already deposited certified checks, but will, of course, be required to give heavy bonds before the work is commenced.

The commission has adopted a resolution modifying the Broadway-Lexington Avenue Subway plans so as to include a branch up to the White Plains Road from its juncture with Westchester Avenue to the West Farms Road. This addition will give the proposed route three branches and will add five miles to the line. It is estimated that the addition will cost about $4,000,000 and the total construction, including the Canal Street line, about $70,000,000.

The commission has been overruled by the Court of Appeals in the case of the South Shore Traction Company, the court holding that the company must be given its franchise. The South Shore Traction Company was given a franchise by the Board of Estimate and Apportionment permitting it to build a line across the Queensboro Bridge. The commission disapproved of some of the terms of the franchise and refused to give its approval. The Court of Appeals has now upheld the contention of the Board of Estimate that it possesses the sole power of fixing the terms upon which franchises may be granted for extensions to existing surface lines, and in providing for transportation across the bridges. The only point for the commission to decide is that there is a demand for the line by "public convenience and necessity."

The application of the Bronx Gas & Electric Company for permission to issue $1,500,000 of bonds has been granted. The company had asked to be allowed to issue $740,000 at once, but the amount of the immediate issue was scaled down to $624,636.

The Kings County Electric Light & Power Company has applied for authority to issue $5,000,000 of 6 per cent convertible debenture bonds, payable in 12 years. The proceeds of the bonds are to be used for extensions and improvements. The date for the hearing has not been fixed as yet.

Another hearing was held last week on the 10-cent-Coney-Island fare question, but no conclusion was reached. The Coney Island & Brooklyn Railroad contends that a reduction of the fare would be an injustice to the security holders, who would thereby be deprived of any chance to get returns on their investments.

The commission has adopted an order requiring the New York & Queens County Railway Company to double track its line between Flushing and College Point and also in Flushing. Between Flushing and Jamaica the company is required to lengthen the turnouts and switches and to maintain a headway of five minutes during the rush hours.

The Public Service Commission, Second District, has granted authority to the area and territory known as Sylvan Beach, in the town of Vienna, Oneida County, to build, maintain and operate for other than municipal purposes, an electric plant and distributing system for the generating and supplying of electricity.

The commission has received an application from the Elizabethtown Terminal Railroad Company for a certificate of convenience and necessity. The proposed railroad will extend from Westport, where it connects with the Delaware & Hudson to Elizabethtown, a distance of eight miles, and will be of service to the towns of Lewis, four miles north of Elizabethtown and Keene, 12 miles west, all in the county of Essex. Freight and other business from these points are now hauled from Keene via Elizabethtown. The only way of reaching Elizabethtown is by way of the Elizabethtown-Westport Turnpike Company, which operates a toll road. The motive power to be used for the operation of the rolling stock of the proposed road will consist of combination passenger motor cars operated by gasoline. The common capital stock will be $80,000. The directors of the corporation are Richard L. Hand, Francis A. Smith, George W. Jenkins, Livingston Woodruff, Merritt O. Stanton, Victor W. Prime, Robert B. Dudley, Benjamin F. Stetson, Elton A. Foote, and Harry H. Nichols, all of Elizabethtown. The commission will hear the application at Albany on Tuesday, Nov. 16.

The commission has authorized the Hilton Electric Light, Power & Heat Company to issue its capital stock to the amount of $5,000, and has authorized this company to construct a plant and exercise franchises in the village of Hilton, Monroe County, also to issue $5,000 capital stock for the expense of the construction of its plant.

Charles Austin Borst, of the village of Clinton, Oneida County, has been authorized to exercise rights and privileges under a franchise granted him by the Superintendent of Highways of the town of Kirkland, Oneida County, and to construct and maintain poles, wires and electrical apparatus on Utica street, in the village of Clinton, for the purpose of conducting electrical current from his power house to the corporation limits of the village of Clinton, to be sold and used by the village for municipal and other purposes. The Vestal Lighting Company has been authorized to issue its capital stock in the amount of $1,000, the proceeds to be used for the construction and equipment of pole lines in the town of Vestal, Broome County. The A. L. Swett Electric Light & Power Company has been authorized to execute and deliver certain coupon sheets and to assume mortgage indebtedness amounting to $74,500 on the property of the Albion Power Company. The petitioner on Sept. 10 acquired from foreclosure sale certain property, contracts, rights and effects formerly owned by the Albion Power Company.

Wisconsin Rate Commission News.

On Oct. 26 the Wisconsin Rate Commission granted the petition of the Bloomer Telephone Company for a readjustment of its rates. Practically all residences heretofore have been on single lines and the petitioners testified that the increasing number of subscribers is overloading the residence leads besides taxing the capacity of the present switchboard. As any further increase would necessitate the use of cable, and wishing to obviate the immediate large expenditure for cable construction, the company desired to put the residence subscribers on the two-party basis and to charge them the same rates as they had previously enjoyed on the single-line basis. The single-party rate was increased to $1 and the two-party rate left at 75 cents per month.

The Grand Rapids Street Railway Company was authorized to issue 1250 shares of common stock at a par value of $100 per share, the funds derived from the sale of stock to be used in the construction and equipment of a line of street and interurban railway running from Grand Rapids to Nekoosa, Wis.

Authority has been granted the Antigo Electric Company to issue 500 shares of common stock of the par value of $100 for the purpose of supplying the said company with funds for making additions and improvements to the electric plant in the city of Antigo and to pay the outstanding indebtedness of the said plant.

A peculiar condition has arisen in the petition of the Fond du Lac Business Men's Association vs. the Wisconsin Telephone Company. The directory published by the company contains the advertisements of outside firms and this has been made the subject of an appeal to the commission by the business men of the city. The commission has not as yet taken any action on the case.

CURRENT NEWS AND NOTES.

RADIUM $2,500,000 AN OUNCE.—In a recent address Sir William Ramsey said that while it once was possible to buy radium at $2 a milligram, the market price is now $90 a milligram, equivalent to $2,500,000 per ounce.

LECTURES AT COOPER UNION.—Among the courses of lectures to be offered at Cooper Union, New York, is one on "The Relation of Magnetism to Electric Currents," by Prof. John S. McKay, of Parker College Institute, which will be delivered on Saturday evenings throughout the session.

N. E. L. A. COMMITTEE ON ELECTRICAL NOMENCLATURE.—The National Electric Light Association has appointed the following as members of its recently authorized Committee on Terminology. Mr. W. H. Gardiner, chairman; Dr. C. P. Steinmetz and Messrs. Ralph D. Mershon, R. S. Hale and A. S. Loizeaux.

LONG-DISTANCE WIRELESS.—It is stated that the Great Northern steamship *Minnesota,* on her recent voyage from Seattle to Japan, a distance of 4500 miles, was in constant communication with both of the shore stations throughout the whole trip. The Pacific Mail liner *Korea* is reported to have transmitted a message 3300 miles to San Francisco on Oct. 29. The ship at that time was 2680 miles from Japan.

GAS-PRODUCER TESTS.—A recent bulletin of the U. S. Geological Survey has for its subject "Incidental Problems in Gas-Producer Tests," the authors being Messrs. R. H. Fernald, C. D. Smith, J. K. Clement and R. A. Grine. A greater part of the bulletin is taken up with a discussion as to the proper length of gas-producer tests. Information is also given as to details of such tests.

N. E. L. A. MEMBERSHIP CAMPAIGN.—An active campaign for increasing the membership of the National Electric Light Association is being instituted by Mr. H. H. Scott, chairman of the membership committee. This will not be confined merely to direct solicitation of membership, but present members will be asked to give direct aid in working up "prospects" in their territory.

PENNSYLVANIA TUNNELS.—The tunnels built by the Pennsylvania Railroad Company for the operation of its trains electrically under New York City will be described at two meetings of the American Society of Civil Engineers. On Dec. 1 Messrs. J. H. Brace and Francis Mason will present a paper dealing with the cross-town tunnels, while on Dec. 15 the same authors will present a paper devoted to the East River tunnels.

UNITED STATES WATER-POWERS.—The United States Geological Survey has just issued a pamphlet (paper 234) which deals with the conservation of water resources and the water-powers of the country. It is stated that out of 37,000,000 hp available in water-power at the minimum flow of streams, but little more than 5,000,000 hp has been developed, or about one-seventh of the minimum available power. The State of New York has the largest development with 885,862 hp, California standing next with 466,774 hp. The publication presents statistical tables of water-powers covering all sections and States.

STEAM TURBINE-ELECTRIC LOCOMOTIVE.—President Hugh Reid, of the Glasgow University Engineering Society, has announced as under construction a new locomotive, which appears to be based electrically on the Ward Leonard system, but employing a steam turbine to generate electric power for application to the driving motors. The new locomotive, which is now being built by the North British Locomotive Company, will have a boiler of the ordinary locomotive type, which will supply steam to a turbine running at a speed of 3,000 r.p.m., and direct-connected to a direct-current, variable-voltage generator, which will supply electrical energy to four series of motors having armatures built on the four main driving axles of the locomotive.

TRAFFIC INTERCHANGE BETWEEN STEAM AND ELECTRIC ROADS.—The Interstate Commission will soon take up the matter of a complaint of the Columbus Traction Company, of Columbus, Ohio, against the Baltimore & Ohio South Western, Norfolk & Western and other steam roads for refusing to permit physical connection to be made between the tracks of the electric line and the steam roads, and also for refusing to make through routes and joint rates for either freight or passengers. While the law does not explicitly require connection between the two systems of railroads, it is stated to have been the policy of the commission to require such connections where the conditions appeared to demand or even to warrant them, and that through routes and joint rates for freight and passengers naturally follow.

RAILWAY SIGNALING DISCUSSED.—At a special meeting of the Armour Institute of Technology branch of the American Institute of Electrical Engineers, held in the engineering rooms of the Armour Institute, Chicago, on Oct. 28, Mr. C. C. Bailey presented a paper on "Railway Block Signaling." Mr. Bailey, who is a senior in college, described the development of electric signaling on railroads, beginning with the telegraph block system. The controlled manual system was explained, with the use of diagrams, and statistics were given showing the economy resulting from the adoption of this method of train operation. The disk and semaphore systems were compared and different types of semaphore mechanisms were explained. The alternating-current single-rail plan of signaling was then taken up, and this was followed by a short résumé of the principles involved in electro-pneumatic signals. The meeting closed with a discussion of the features of operation of the various systems of signaling in use on both steam and electric railways.

UNITED STATES WATER-POWER CONCESSIONS.—In a recent letter, which takes the form of a public statement, Forester Gifford Pinchot points out that the renewal of a water-power permit at the end of 50 years is at the option of the Government, is revokable by the Secretary of the Interior, but unless revoked continues 50 years, when it terminates without any special action, and may then be renewed at the option of and under conditions fixed by the Government. He says that the increased radius of practicable electrical transmission, and the recent financial history of the country as to consolidations of other kinds of business, seem to justify the belief that there is a strong tendency toward concentrating control of hydroelectric development of the United States. The nation, he says, should understand these tendencies, realize their import and take effective steps now while there is yet time to retain and exercise public control of national water powers. This he says may be done by giving concessions limited in time, requiring a fair rental and imposing conditions to prevent evils which experience has taught are to be expected from unregulated monopoly.

NEW ENGLAND Y. M. C. A. ELECTRICAL COURSES.—The Taunton (Mass.) Y. M. C. A. has commenced an electrical course which will extend over the fall and winter. It will be in charge of Messrs. James Craig and W. B. Clayton, of the Lynn works of the General Electric Company. Similar courses will be given at Lynn, Salem and Gloucester to Y. M. C. A. classes.

ILLUMINATED GARDEN.—Mr. James O. Dobson, of Portland, Me., has provided for illumination of the ornamental garden in front of his residence, using for this purpose 230 2-cp lamps. The lamps are placed in an effective way among shrubs, trees and plants, allowing the light to shine through the leaves. A Lombard poplar has 85 lights extending to the top, giving it the appearance of a Christmas tree. The various lamps are in groups controlled by four switches.

"EDISON LIFE."—The monthly publication of the Edison Employees' Club and the Boston Edison Company has adopted for its name *Edison Life*. As previously noted, the first issue was entitled *Edison Extra*, and a prize offered for the best suggestion of a permanent name, which has been awarded to Mr. Harry B. Knight. Sixty-three persons offered a total of 173 names, and that suggested by Mr. Knight received the unanimous approval of the committee which awarded the prize.

AUTOMATIC BLOCK SIGNALS ON ROCK ISLAND RAILROAD.—On June 30, 1909, 346 miles of main line on the Chicago, Rock Island & Pacific Railroad were protected by automatic block signals which have cost $456,359. The work of installing automatic block signals between Davenport and Muscatine, Ia.; between Davenport and Iowa City, Ia., and between Topeka and Herington, Kan., was completed during the fiscal year ended June 30 last. Signals for 232 miles of main line in the State of Iowa are being installed.

ELECTRICAL WORK ON THE ISTHMUS.—The first of the three turbo-generators in the Miraflores power station on the Canal Zone, Isthmus of Panama, has been completed. Wires have been strung on the transmission line leading from this station to the Pedro Miguel locks, and work will soon be begun on the new substation at that point, which is to be equipped with two 500-kw rotary converters. It is interesting to note that a little over one-half of the total excavation to be made for the Panama Canal has now been completed.

LARGE AUSTRIAN HYDROELECTRIC PLANT.—A company called the Società Adriatica d'Elettricitcità has been formed in Fiume, Austria, for the purpose of erecting a central generating station equipped with an installation capable of developing 45,000 hp to 50,000 hp, which may, if necessary, be increased to 80,000 hp. The capital of the company will be about $5,000,000. The motive force will be obtained from waterfalls of the River Gaska, near Otociac on the Croatian frontier. The energy generated will be utilized for lighting and industrial purposes.

MULTIPLEX WIRELESS TELEGRAPHY.—An invention has been patented in Berlin by F. van der Wonde which adapts wireless telegraphy to multiplex working. The antenna is joined to a spiral device carrying a number of contact arms, which, when revolved, makes the following connections: (1) Transmitter joined up; (2) antenna earthed; (3) transmitter cut out; (4) receiver joined up; (5) earth disconnected; (6) receiver cut out. The speed of action is such that several revolutions take place during the time necessary for the sending of a Morse dot.

AN AVERAGE OF 299 ELECTRIC SUPPLY CONTRACTS A DAY.—The business of extending the central-station electric service in Chicago is being prosecuted at present in various directions with remarkable success. It is reported that during the month of September the contract department of the Commonwealth Edison Company closed an average of 299 contracts for new business for every working day in the month. Since then the campaign has been and is being carried on with equal vigor. Clerks are employed at night to keep pace with the business taken in during the day.

LOYOLA UNIVERSITY.—As an outgrowth of St. Ignatius College, which has been conducted by the Jesuits in Chicago for a number of years, an institution of higher learning and wider scope has been developed and it bears the name of Loyola University. The name St. Ignatius will be retained for the school of arts and sciences, but it is the intention to have a university complete in all departments. With this view, 17 acres of land have been purchased at Devon Avenue and Sheridan Road, Chicago. One feature will be an engineering school which will be opened next September, according to present plans. This school will emphasize training in broad scientific fundamentals, with the thoroughness for which the Jesuits are noted. The Rev. Alexander J. Burrowes, S. J., is the head of the new university.

PENNSYLVANIA RAILROAD NOT QUITE CONSISTENT.—While strenuously denying the feasibility of electrifying its terminal in Chicago, the Pennsylvania Railroad "points with pride" to the advantages of electrical operation in its New York tunnel extension. The publicity department of the railroad sent to the Chicago daily newspapers on Oct. 29 a long account of the new "Pennsylvania type" electric locomotives to be used in New York. These locomotives are to be used in tunnels, and in that respect the New York situation differs from that in Chicago. Nevertheless, the simple Chicago people think it strange that electrical operation for New York should be set forth with such acclaim while the mention of similar train service in Chicago should be received with emphatic disapproval on the part of the railroad company.

SPECIAL STREET ILLUMINATION IN CHICAGO.—Continued interest is manifested in Chicago in the formation of a business men's lighting association to establish special street illumination in various localities to attract business. Several of these projects were described and illustrated in an article published in our first issue of September. Since that time merchants of other localities have entered into a contract to supply special illumination of this nature. One is on West Twenty-sixth Street, near Kedzie Avenue, where there are 55 lighting units, each consisting of four 60-watt tungsten lamps supported on an attractive post. The second locality to avail itself of this up-to-date form of street advertising is Milwaukee Avenue, near Armitage Avenue. For some time there has been a special illumination of this character on Milwaukee Avenue near Chicago Avenue, but the newer equipment is distinct from this. The Commonwealth Edison Company supplies electricity for all of these street-lighting equipments.

FIRE AND POLICE ALARMS IN LOS ANGELES.—As the result of advertisements for bids for supplying the University District of Los Angeles with fire-alarm and police-alarm signaling systems, four systems were recently demonstrated in that city. These were the signalphone, made in Milwaukee; a system developed by Siemens & Halske, of Berlin; the well-known Gamewell equipment (fire-alarm boxes only), and the system of A. L. Cregier, of Chicago. A committee, consisting of Mr. Manahan, city electrician; Mr. Frankhauser, city telephone and telegraph superintendent, and Mr. Alfred L. Sohn, will report on the competing apparatus. It is desired, if practicable, to connect the new installation with the Gamewell system which is used in other portions of the city. The German system, demonstrated by Dr. Karl Georg Frank, the American representative of the company, attracted attention by its thoroughness and excellent workmanship. The American systems revealed the ingenuity which has been so highly developed in this country in these classes of electrical signaling.

Electrical Equipment of the Luzerne County Court House.

THE Luzerne County Court House at Wilkes-Barre, Pa., is a monumental structure, cruciform in shape, the length of each axis being 200 ft. Erected in one of the richest counties of the State, the building vies with other architectural structures of note in the country and possesses a benefiting position on the banks of the Susquehanna River. The center of the structure is given up to a rotunda 53 ft. x 53 ft. capped with a dome whose base is 100 ft. above the floor. The various court rooms and offices are reached from the corridors and galleries encircling the rotunda. Marble is used throughout in the finish of the latter, as well as in the arches of the penetrations under the dome. Supporting the dome are four piers of buff-colored marble. The rusticated walls around the first floor are of Botticino stone; while the cornices, columns, balustrades and corridor wainscoting base are finished in Alps green. In the marble cornice of the second story and in the marble balustrades of the second-story gallery and main stairway, statuary-finish bronze has been used to advantage. The elevator enclosures, electroliers and office screens are of cast bronze, and Tennessee marble is used for the floors.

The interior of the dome is executed in plaster and colored the prevailing tints of the stone, embellished with portraits and emblems painted as cameos. The pendatives are painted with figures on mosaic backgrounds. Mosaics are also employed in the vaulted ceilings of the rotunda corridor and entrance corridors, the pendentives holding portraits of persons of prominence connected with the early history of Luzerne County. The lunettes along the corridor walls have paintings depicting the early settlement of Wyoming Valley, the heart of the anthracite coal district of Pennsylvania, in which Wilkes-Barre is located.

There are five court rooms in the building, four on the third floor and one on the second floor. The court rooms on the upper floor are similar in design, the finish in two being mahogany and in the other two Circassian walnut. The chambers of the judges adjoin the court rooms and are similarly finished. The treatment throughout is rich and somber and the electroliers used are of brass, gold plated. The court room on the second floor has a wainscot of paneled white marble and the law library, stack room and bar association room in the south wing of this floor are finished in dark oak; the base and fireplace face in the law library being Numidian marble.

There are 3600 incandescent lamps used in the illumination of the building, consisting of 16-cp, carbon-filament lamps and 25-watt tungsten lamps, the tendency being to replace all of the former by the latter. In addition there are 437 hp in motors, so that the electrical installation is the largest of its kind in northeastern Pennsylvania. Although the county commissioners had instructed Messrs. McCormick & French, the architects, to design a complete power plant for the building, the latter found, after an extended examination of the different plants throughout the State, cost of running a plant of the proportions required, etc., that the cost of operating such a plant would be greatly in excess of the rate offered by the Wilkes-Barre Gas & Electric Company, and that the proposition offered would save the county considerable expense in the consumption of energy, maintenance of plant, interest, depreciation, etc. The matter was placed before the commissioners and they decided to install the necessary motors, transformers,



FIG. 2.—SERVICE TRANSFORMERS AND SWITCHBOARD.

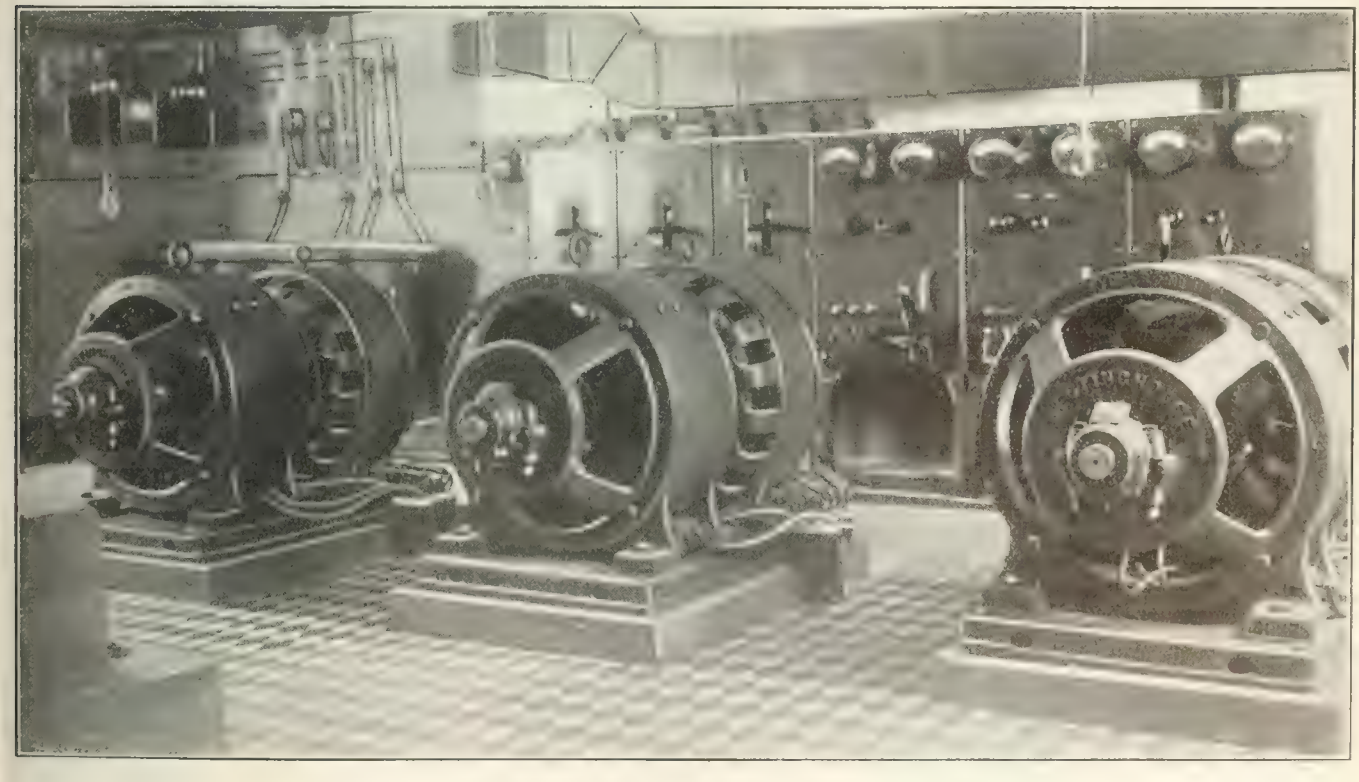


FIG. 1.—MOTOR-GENERATOR SETS IN LUZERNE COUNTY COURT HOUSE.

etc., and secure the electricity from the local electric light company at a rate of 3 cents per kw-hour, the meters being on the primary side of the transformers.

The feeders from the Wilkes-Barre Gas & Electric Company's two-phase, 2200-volt, 60-cycle machines running at 840 r.p.m. Each generator has an independent switchboard panel equipped with circuit-breaker, switch, ammeter, voltmeter, field rheostat and ground detector plug. All conduit, sheath of cables, frames of motor-generator sets, etc., are grounded.



FIG. 3.—ONE OF THE FOUR COURT ROOMS ON THIRD FLOOR.

The steam for heating the building is obtained from the jail not far from the court house. There are six motor-driven fans used in the heating and ventilating system. Each of the motors is a 220-volt, direct-current machine fitted with interpoles so as to obtain wide speed variations without sparking. Four of the motor-driven fans are used in connection with the hot-air system and two are used for exhausting the air from the rooms. A spraying device is used in connection with the heating system to impart the necessary humidity to the atmosphere, and the four pumps used are driven by 3-hp motors. All the motors throughout the building are automatically controlled, and owing to the necessity of running the motors at different speeds, direct current was specified as giving the best control. Interpole motors are also used to drive the pumps employed in connection with the hydraulic elevators, with which the building is equipped. Two 30-hp motors are used for this purpose, and a 5-hp motor drives an air compressor used to supply air to the hydraulic tanks. Two small air pumps are also used in connection with thermostats in the various rooms to furnish compressed air for opening and closing the hot and cold-air dampers in the heating system. Each of these motors is rated at ½ hp.

circuits enter the building underground on what is known as the transformer room. Lead-covered cable in iron conduit is used for this service connection. The service tension is 2200 volts, and this is stepped down for lamp circuits in two 75-kw transformers. The primary wires are No. 4 duplex, lead-covered, and are provided with suitable pot-heads at all terminals. The secondary cables are of rubber-covered stranded copper with a cross-section of 1,500,000 circ. mils, run in iron conduit. At the point where the service wires enter, oil circuit-breakers are installed on the wall, each having a current carrying capacity of 200 amp at 2200 volts. The circuit-breakers are arranged to release automatically on overload. From the circuit-breakers the lines run to the transformers and thence to the main distributing board. The transformers shown in Fig. 2 have since been housed in a fireproof vault built around them. From the same circuit-breakers in the transformer room, the primary mains are extended to a starting panel board controlling three 50 kw motor-generator sets. On each starting panel are three, double-throw, oil-immersed circuit-breakers provided with adjustable tripping devices which are independent of the operating handle and are arranged to release automatically. On the rear of the board are mounted the starters for the motors, which are rated at 75 hp and are



FIG. 4. [illegible] ROOM, LUZERNE COUNTY COURT HOUSE.

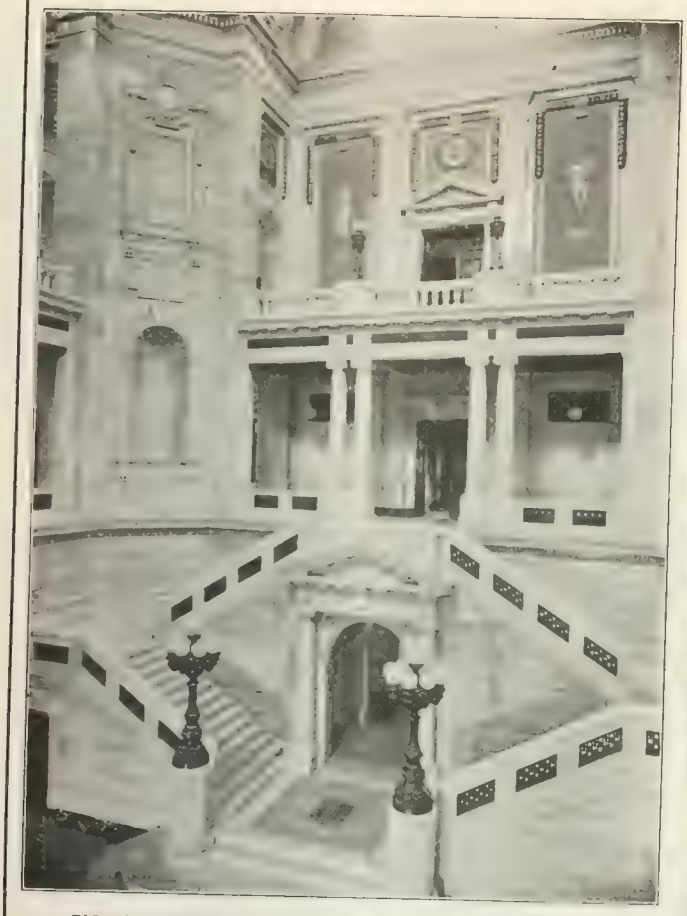


FIG. 5.—ROTUNDA OF LUZERNE COUNTY COURT HOUSE.



FIG. 7.—SECOND-FLOOR GALLERY.



FIG. 6.—THIRD-FLOOR GALLERY.



FIG. 8.—FIRST FLOOR CORRIDOR AROUND ROTUNDA.

ELECTRICAL EQUIPMENT OF THE LUZERNE COUNTY COURT HOUSE.

The illumination of the building is particularly pleasing. A feature which appealed to the general public which viewed the structure when it was thrown open to the public for the first time since its acceptance on Oct. 28, was the lighting of the dome. This satisfactory piece of illumination is obtained by means of 640 lamps placed in aluminum parabolic reflectors on top of the marble cornice around the rotunda and by 320 lamps similarly equipped in the base of the dome. The reflectors are arranged so that the light from each lamp strikes the opposite side of the dome and the art-glass cap of the dome is illuminated by fixtures above it. Viewed at night the effect is very pleasing; not a lamp is in sight nor a reflection on the white marble to indicate the presence of lamps. Every painting and piece of decoration stands out in bold relief, and the absence of shadows and the general uniformity of illumination have been the subject of much favorable comment. The wiring throughout the building is in rigid conduit, with short stretches of flexible conduit here and there to meet certain conditions.



FIG. 9.—LAW LIBRARY, LUZERNE COUNTY COURT HOUSE.

Magnificent bronze chandeliers and fixtures have been installed in the court-rooms, offices and corridors which add materially to the artistic surroundings. At the two entrances there are four bronze bracket lanterns in each of which there are 10 25-watt tungsten lamps. Hanging within the porch are three lanterns, each holding six incandescent lamps, and in the lobby to the main entrance are eight ceiling outlets feeding 48 lamps.

In the corridors around the rotunda are three lanterns hung from the vaulted ceiling on each of the four sides with a five-lamp fixture at each corner, the latter differing in design from the former, which are merely suspended spheres, as shown in Fig. 8. On either side of the grand stairway, resting on the newels, are two standards, each holding 15 25-watt tungsten lamps in outer opalescent globes and the eight standards arranged around the balustrade of the third floor have three lamps in each globe. The corridors on the second floor are lighted on the same general scheme as those on the first floor.

Passing from the corridors, the lighting of the individual rooms calls for some mention. The four courtrooms are used very rarely at night or when much artificial light would be necessary. The general tone of the furnishings and decorations being dark, much light is, of course, absorbed. Sufficient general illumination is obtained, however, from two magnificent chandeliers. Each of these has eight arms arranged to support three lamps within an outer globe. In addition there are a number of portable lamps for the tables fed from Krantz floor boxes and fitted with amber-colored glass shades. The Orphans' Court, on the second floor, is fitted with 12 ceiling fixtures of the type shown in Fig. 4, each of which holds three lamps. Numerous portable desk standards are also employed.

A very warm and cozy effect is obtained in the illumination of the law library. The general color scheme is subdued, and this is enhanced at night by the light from a center orange-amber colored fixture in which 15 lamps are placed. On the walls near the ceiling are also 10 bracket lamps each holding three lamps enclosed in ivory-tinted shade. On the desk are six portable lamps fitted with amber-glass shades. The book cases are lighted by means of 25-watt lamps placed in half-round aluminum reflectors and burn in a horizontal position. The filing cases, stackrooms, etc., are similarly lighted with lamps attached to the cases. Adjoining the law library is the room of the bar association. This is lighted by two six-lamp chandeliers and portable desk standards.

The architects of the building under whose supervision the installation was made are Messrs. McCormick & French, of Wilkes-Barre. Mr. E. F. Roth, of the same city, was the electrical contractor, and the motors and other electrical equipment were built by the Westinghouse Electric & Manufacturing Company. All the wire used was of local manufacture, being made in the mills of the Hazard Manufacturing Company. The Enos Company, of New York, supplied the electrical fixtures.

Village Electric Light Plant.

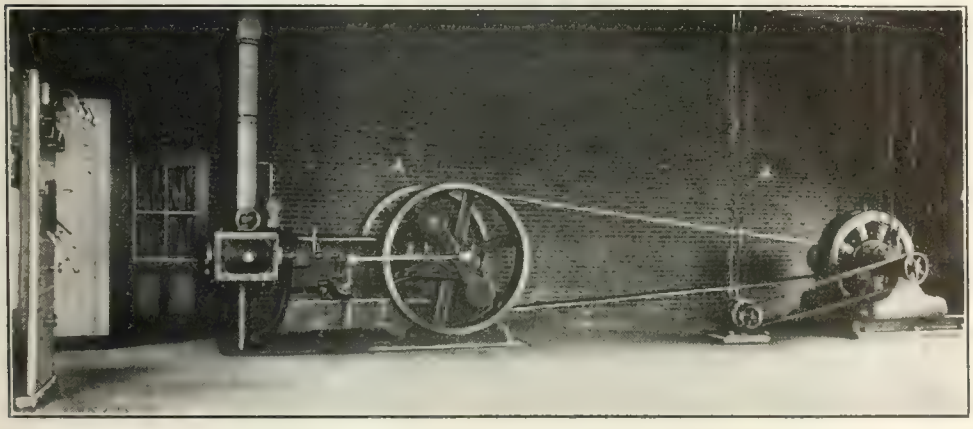
Nestling among the hills of Yates County, in Western New York, is the village of Dundee. It is situated in the heart of the lake region of New York and has a population of 1300 people. The country surrounding it is devoted to the culture of small fruits and grapes. There are several thousand acres of apple orchards and small fruits, and the hillsides are covered with vineyards. All the residence streets are bordered with magnificent elm and maple trees, forming an archway over the road. Every street and avenue in the village has its concrete sidewalks complete, and the prominent thoroughfares are parked.

Serving this delightful community is the Dundee Electric Lighting Plant, managed and owned by Mr. Edward L. Bailey. The station is adjacent to the railroad depot of the Pennsylvania division of the New York Central Railroad, and contains a 60-kw General Electric single-phase, 60-cycle, 1100-volt alternator belted to an Imperial high-speed, automatic engine, and another unit of similar characteristics rated at 90 kw. The boiler-room contains two 100-hp return-tubular boilers, burning soft coal costing $2.15 per ton. Water is taken from the railroad tanks near by under a head of 35 ft., in return for which the depot and freight house are lighted free of charge. A day-and-night service is maintained, and in anticipation of increased load the management is planning to

install a 150-hp boiler and a 20-kw unit to carry the load after midnight.

The circuits are all overhead, needless to say, but the poles for the most part are placed within the front yards along the streets, so that not one-third of the poles are on the public thoroughfares. In this way the tax on poles on public highways levied by the State is kept at a minimum. Sawed octagonal poles are employed, and these are painted a dark olive green so as to make them inconspicuous. Being within 3 ft. of the fence lines, troubles from shade trees, with which the village abounds, are minimized. The day load at present consists of 37 hp in motors; three rated at 10 hp, one at 5 hp and one at 2 hp. Two more 10-hp motors will be installed shortly and also a number of small motors. The management expects to do all the pumping for the railroad, and also to supply energy to a four-mile single-phase railway to be built next spring. The railway will connect Dundee with Starkey Station on the Northern Central Railroad of the Pennsylvania System, and will continue on to Seneca Lake, making connection there with steamers plying between Geneva, Watkins Glen, etc. Lakemont and Himrod will also be supplied with electricity next year from the Dundee station.

The accompanying illustration gives a view of the first unit installed in the station in January, 1898. This unit has been run constantly without shut down or interruption for nearly 12 years, and for the past six months on a 24-hour service. The brushes on the machine were renewed but once and the entire outfit appears as good now as when installed. The exciter is now on the base of the frame.



ELECTRIC LIGHT PLANT, DUNDEE, N. Y.

Steam heat is supplied from the station to a brass foundry directly across the road from the station. The night load on the station is about 500 amp on 1100 volts. A contract has been made with the village to light the streets with 63 100-watt tungsten lamps in place of the 25-cp carbon-filament lamps at present in use for $1,800 per annum. The company at present receives $1,500 per annum for this service.

All customers have been gradually changed over from a flat rate to a meter basis, and the rate for energy varies with the load. The maximum rate is 20 cents per kw-hour on a consumption of $3 and less per month. Persons using $18 worth of electricity are given a rate of 15 cents per kw-hour and the minimum rate is 10 cents on a yearly consumption of $36 and over. No discount is allowed for cash, and interest at the rate of 6 per cent is added on all bills not paid on the tenth of the month. All bills are payable at the Dundee National Bank. On the first of each month a list of the customers, together with the amount each owes, is sent to the bank, and, although kept behind the desk away from public scrutiny, its effect is such that no bills remain unpaid, consumers feeling that their credit in the village will be impaired if their electric light bills remain unsettled.

The company has 150 customers and the system is run by four men. The station is operated by three men in three shifts. Each man does his own firing, carting of coal from a spur track, cleaning, etc. The chief engineer does wiring with a helper, and looks after the customers' wants and the general condition of the circuits. He devotes his afternoons to this work. A line of supplies is carried at the station and also in the office on the main street. The circuits have been singularly free from mishaps; the primary is protected by arresters at various points and when the transformers are oiled in the spring, an inspection is made of the lines, etc., at the same time. The secondary circuits are not grounded, and the house-wiring work is chiefly concealed knob and tube, installed according to the Code requirements. The gross income of the plant is approximately $8,500.

Electrical and Mechanical Equipment of the Blackstone Hotel, Chicago.

Now that the exterior of the Blackstone Hotel at Michigan Avenue and Hubbard Place, Chicago, is practically finished, all beholders agree that it is a beautiful architectural addition to the city. The building is 20 stories high, and the top of the mansard roof is 287 ft. above the sidewalk. A picture of it was given in the *Electrical World*, May 20, when a brief outline of the proposed uses of electricity was given. The interior finishing and furnishing of the hotel will be in keeping with the beautiful exterior, and at the present time a more detailed account can be given of the electrical and mechanical features than was possible at the earlier date.

There will be a power plant in the basement on a level 28 ft. below the street. The general arrangement is shown by the accompanying drawing. The plant will contain four 250-hp Stirling water-tube boilers with McKenzie chain grates. Coal will be brought in through a sub-basement connection with the freight-tunnel system of the Illinois Tunnel Company, and a complete system of coal and ash conveyors of the Stephens-Adamson type will be installed. Ashes may be removed either through the tunnel or brought to the surface of the street. A traveling weight-hopper, driven by an electric motor, will deliver coal from the bunkers to the furnace magazines. The chimney extends 328 ft. above the grate bars. It is of steel with an elliptical section 6 ft. x 7 ft. in diameter. The breaching and stack are lined with Johns-Manville vitrobestos. One Wainwright feed-water heater will be installed, and all pumps will be of the American Steam Pump Company's single-cylinder type. All steam mains of 3 in. and above will have welded flanges and Nelson valves.

In the engine-room there will be three generating units, consisting of four-valve engines made by the Ball Engine Company, of Erie, Pa., direct-connected to Western Electric direct-current generators. One of these units will be rated at 300 kw and two at 200 kw. The generators are wound for 250 volts and connected on the three-wire system. A switchboard of pink Tennessee marble has 14 panels, three for the generators, one totalizing panel for the station, six for lighting circuits and four for motor circuits. The busbars are so arranged that the lamp and motor circuits can be operated separately or together, the lighting at 125 volts and the motors at 250 volts, and any machine can be connected either to the lighting circuits or to the motor circuits.

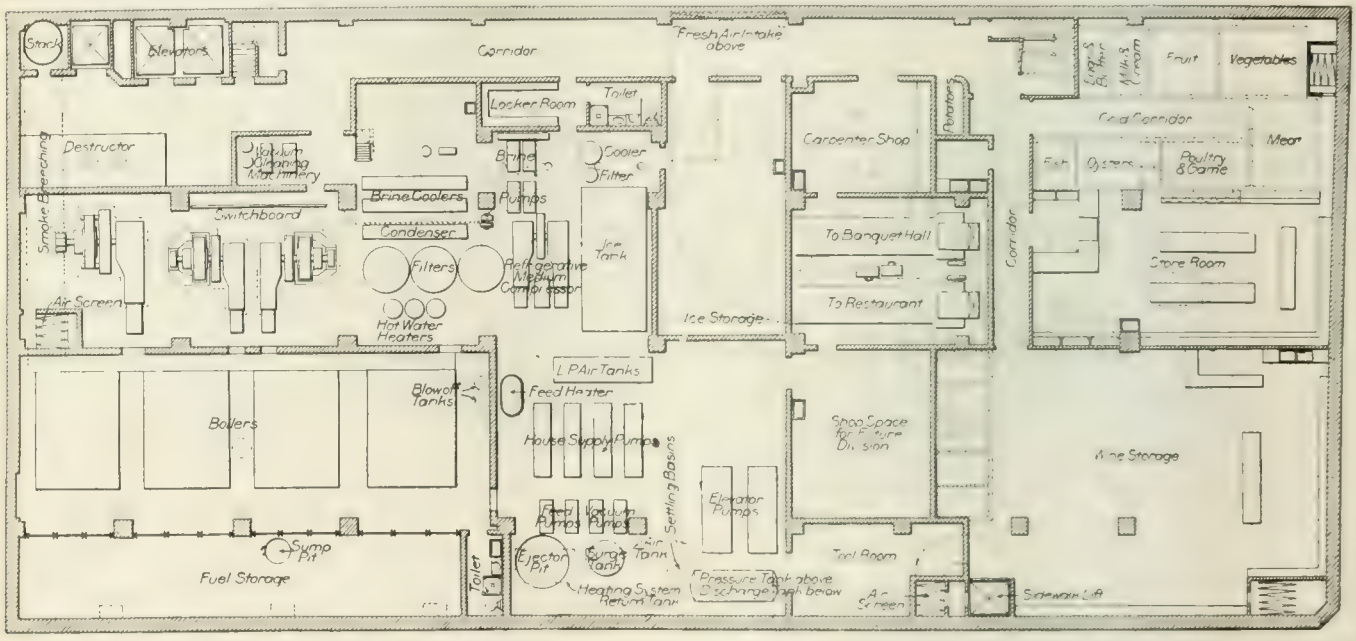
A feature of the engine-room is the refrigerating machinery. This consists of two carbonic-acid compressors driven by Murray rolling-mill engines. One of these machines, of 50 tons capacity, is used for ice making and refrigerating purposes for the house. The other, of 120 tons, provides the air-cooling for cafés, restaurants and banquet halls in summer.

Four house-service pumps are installed. The building is so high that it was thought wise to divide the water-supply system into two sections. The upper floors have a high-pressure system and the lower floors a low-pressure system. The upper floors are fed by gravity from large enamel-lined tanks on the roof, and the lower floors are supplied by direct upward pressure. All water used in the hotel is filtered. The high-pressure system is available throughout the whole building in case of fire.

Heating is accomplished by the exhaust steam from the engines. The vacuum system is used and by its means all water of condensation is returned to the power plant. The Illinois Engineering Company installed the vacuum system of heating. Heating is accomplished by both direct and indirect methods. By the latter system the air is heated in the power plant and is forced through large ducts to the compartments heated, which consist of all cafés, restaurants and public reception rooms. An elaborate ventilating system has been installed in the hotel.

The kitchen and all service pantries have a separate ventilating system with a separate stack extending to the roof. The hotel service. The rise of these elevators is 250 ft. and four of them are of the Otis traction gearless type and two of the traction worm-gear type. The elevator mechanism is placed overhead, a 50-hp motor, turning at 60 r.p.m., being provided for each outfit. A telephone is placed in each elevator car, and there are electric lamp signals. Three hydraulic elevators are also installed, one running to the ballroom, which extends through the second and third floors; one for service to the kitchen on the second floor and the third a sidewalk elevator for supplies. The hydraulic pumps for these elevators are placed in the basement.

Two Burdett-Rowntree dumb-waiters extend from the first floor to the eighteenth. Each is operated by a 7½-hp motor placed above its shaft. The operation of these dumb-waiters is under the control of a dispatcher in the kitchen and is automatic and ingeniously worked out. If an attendant in one of the service pantries wants an elevator he pushes a button which lights a lamp at the dispatcher's station in the kitchen. Lamp signals also indicate the position of each elevator to the dispatcher, who operates the cars by push-button control. On receiving the signal from the service pantry, the dispatcher



BASEMENT PLAN OF BLACKSTONE HOTEL, CHICAGO.

restaurants, cafés and all public service rooms are amply provided with a forced circulation of fresh air heated in winter or cooled in summer. The foul air is exhausted from the rooms through a separate system. All exhaust fans for the ventilating system are located on the upper stories and driven by electric motors. The forced-draft fans for the indirect heating and for ventilation are placed in the basement. The air is cooled in summer by the direct expansion of carbonic acid in coils in the fan chambers.

In designing the power plant an effort has been made to secure a certain degree of uniformity and to provide for interchange of electric motors in case of necessity. The contract for furnishing the motors has been awarded to the Allis-Chalmers Company. The Ward Leonard Electric Company, of Bronxville, N. Y., will supply the controlling apparatus for the motors and the J. Lang Electric Company, of Chicago, will furnish the switchboard. An interesting feature of the power plant is a completely equipped machine shop in the basement, with lathes, drills, grinders and other machine tools, all electrically driven. There is also a garbage destructor, 8 ft. x 22 ft. in floor space, in which all the refuse from the hotel is quickly burned.

Electric elevators are the chief reliance of the Blackstone for transportation within the building. There are six elevators driven by electric motors, four for passengers and two for presses a numbered push-button which sends the car to the floor desired. As in the case of automatic residence electric elevators, the car cannot be operated unless the doors in all shaft openings are closed.

An elaborate telautograph system forms part of the electrical equipment. There are 26 of these instruments located in the various offices of the hotel and in each service pantry on the upper floors. There is also a complete telephone equipment with an instrument in each guest-room. About 450 telephones are installed in the building, and there is a three-position switchboard on the fifth floor. All clocks are controlled pneumatically by a master clock system installed by the Hahl Automatic Clock Company. This system is entirely pneumatic in operation.

There is also one Western Union Clock in the engineer's office to check the pneumatic time system. A pneumatic tube system will also be a feature of the hotel service. Three-inch tubes are installed to carry small packages between the various departments of the hotel, in a manner similar to the familiar pneumatic delivery in department stores.

By using the telephone, telautograph and pneumatic tubes in conjunction very prompt service will be secured. Thus, if a man in a room on the sixteenth floor, say, wishes some cigars or a newspaper he calls up "Central" and gives his order. The girl at the telephone switchboard receives the call and puts

her telautograph in connection with the similar instrument at the cigar stand and also with the service pantry serving the floor on which the call originates. The cigar clerk receives a written order for the cigars, and he dispatches them through the pneumatic tube to the nearest service pantry to the room from which the order comes. The man in charge of this service pantry, having been notified in writing by his telautograph of the order, is waiting, and the cigars are at once taken by a bellboy to the guest's room. The whole operation will consume but a few seconds and by means of the telautograph there is a written record for the use of all the hotel attendants concerned in the transaction. In the same way an order for ice water may be transmitted to the service pantry, although as yet no effort has been made to deliver this indispensable hotel beverage through the pneumatic tubes. However, thermos bottles will be used in the rooms, which will keep water cold for a number of hours, so that the calls for ice water will probably be greatly diminished, to the grief, no doubt, of the ubiquitous "bellhop."

In the whole building the output of the electric motors, ranging in size from 1½ to 40 hp, will aggregate 450 hp. In addition to the motor applications already mentioned there will be motors used to operate two revolving doors at street entrances, which will be turning continuously. The centrifugal pumps for circulating brine and water on the refrigerating system are driven by electric motors, and there is also a 15-hp motor used for operating the ice-handling machinery, which is situated in the basement.

This machinery includes an ice breaker, ice-cutting machine, ice-shaving machine, ice-cubing machine and an ice-cream freezer, all driven from one shaft, to which the motor is attached. In the kitchen a wide use is made of a number of small electric motors, and these drive silver-polishing machines, a dish hoist (which requires a 5-hp motor), an electric dishwasher, dough-mixer and vegetable parer and other appurtenances of a large and modern culinary department.

The laundry is placed on the twentieth floor of the building, where it is well removed from the rest of the hotel. In every respect this will be a model plant for the handling of all classes of laundry work. An extensive use will be made of electric heat, while electric drive will be relied upon throughout. The washing machines will be driven in two groups, one consisting of three large washers and the other of three washers of medium size.

A desirable feature of this arrangement is that either or both of these groups can be operated according to the demand. One group will be driven by a 7½-hp motor and the other by a 5-hp motor. The driers, which are of the conveyor and sectional types, will be driven by a 1-hp motor. The extractors or wringers will have individual vertical motors directly connected. There are four of these machines, each having a 2-hp motor. The large flat-work ironer will be driven by 2½-hp variable-speed motor giving a difference in the travel of the machine depending on the time and quality of the goods being ironed.

Motors varying in size from ⅛ hp to 1 hp will drive individually and by direct connection the following machines: Collar-and-cuff starcher, shirt starcher, band starcher, handkerchief and underwear ironer, collar-and-cuff dampener, shirt ironer, band ironer, sleeve ironers, two body ironers and a collar-and-cuff ironer. There are a number of other machines requiring no mechanical power to operate them. Each of the ironing machines will be heated by electricity except one steam collar-and-cuff ironer and a cuff press, which are heated by steam. The small collar shapers, edgers and finishers will also be heated by electricity. All hand-ironing will be done with electric flatirons. For this large and extremely modern laundry equipment the total consumption of electricity for power will be 86 amp, while 48 amp will be required for heat. The Troy Laundry Machinery Company, of Chicago, will install the entire equipment.

A very complete vacuum cleaning plant will be installed by the Connersville Blower Company, but it will be entirely mechanical in its operation. A cycloidal blower in the basement, driven by a 7-in. x 7-in. vertical steam engine, will be connected to the piping system consisting of four risers going up through the entire building in four different locations. There are connections on each floor, of course, with each of the risers, so that all parts of the building may be easily reached for vacuum cleaning of rugs, curtains, draperies, etc.

While very careful attention will be paid to the electric lighting of this handsome hotel, the plans at the present time are not worked out so far that an adequate detailed description can be given.

There will be about 9000 incandescent lamps used, of which some will be tungsten, some tantalum and some ordinary carbon. It is quite possible that the lighting of the corridors will be on the indirect system, with fixtures throwing the light to the ceiling, from which it will be reflected for general illumination. A feature of the building will be a row of 31 standards along the roof line. Each of these standards will support a cluster of four 40-watt tungsten lamps and from their lofty position on the top of the mansard roof they will form a conspicuous feature of the building at night. Running around the building at the third-floor level there is a further line of 36 similar clusters, which will form a lower line of light. There will be four or more flaming-arc lamps placed on the street level.

The porte cochere on the Hubbard Place side of the building will be lighted by 12-lamp clusters with some ornamental lighting, which is yet to be finally determined. Throughout the various public reception rooms there will be many beautiful fixtures, and perhaps here, too, there will be indirect lighting. An illuminated display fountain will be a feature of the art-hall floor. Electric lamps in colors will present an attractive effect by shining through the water of this fountain.

In each guest's room there will be a tasteful central ceiling chandelier for general lighting and in addition a portable reading lamp placed on a table. Each dresser will be provided with two lamps fastened to the article of furniture itself and connected by flexible cable to baseboard outlets. By this means the dresser with its lamps can be moved about as desired. A feature of the guest-room lighting will be an automatic door switch supplied by the Hart Manufacturing Company. This switch is so arranged that when the occupant of the room goes out and locks his door on the outside the lamps are extinguished automatically, but the door can be locked from the inside or it can be closed without being locked from the outside without extinguishing the lamps. This is not only a great convenience to guests, but will result in a considerable saving in electricity, which is an item of some importance in a large hotel.

At the Hubbard Place entrance there will be two electric carriage calls, one placed at each end of the porte cochere. This signaling system consists of three boxes or frames containing electric lamps and covered by a glass face plate. These lamps are connected to a keyboard placed inside the entrance to the hotel and having three banks of keys. Each bank of keys contains the numerals from 0 to 9, and by pressing any one of them the corresponding figure flashes up in the box controlled by this bank of keys. Thus, to signal the number 346 the "3" key is pressed in the lower bank and successively "4" and "6" in the middle and upper banks of keys. By so doing the number 346 is outlined in electric lamps at each end of the porte cochere and is visible to all the waiting coachmen. This does away with the necessity of calling out the numbers of carriages and automobiles at a reception. The Chase Electric Company is installing this device.

The Blackstone is owned and will be operated by the Drake Hotel Company, of which Messrs. Tracy C. Drake and John B. Drake are the president and vice-president, respectively. Messrs. Marshall & Fox are the architects for the building, and their consulting mechanical and electrical engineers are Messrs. L. L. Summers & Company. Mr. F. K. Boomhower is the chief engineer of the Blackstone. It is expected that the hotel will be ready for guests Jan. 15, 1910.

Population, Consumers and Lamps.

By Alton D. Adams.

A certain single electrical supply system serves a metropolis and more than a score of the surrounding cities and towns at uniform meter rates for commercial and residence lighting. The maximum meter rate during the past year has been 12 cents per kw-hour, subject to various discounts according to the conditions of service. Records of this system show the number of lighting consumers and the equivalent number of the connected lamps, on a basis of 16-cp units, in each of the eight service districts into which its territory is arbitrarily divided. One of these districts is confined to the metropolitan city, and each of the other districts comprises two or more of the adjacent cities and towns. In the list of municipalities are some especially devoted to manufactures, some are mainly residential, and some are mainly farming districts.

Under the circumstances just detailed an exceptional opportunity is presented for the analysis of electric lighting service in a number of places that differ widely in population and in the occupations of their inhabitants. Comparisons of the numbers of lighting consumers and of connected lamps in different cities and towns are usually hampered by differences in the rates and the quality of the service, but in this instance the rates are understood to be uniform to all that are supplied with energy under like conditions. It may fairly be assumed, also, that the efforts to secure lighting business, and the quality of the service, tend to approach equality in the several places.

Figures of the 1905 census have been taken for the populations and in the metropolis certain deductions have been made for minor parts that were lighted by electric systems other than the one considered here. In the eight service districts the populations vary from 522,415 in the metropolitan city down to only 11,756 in two small towns, and the district next to the metropolis in point of numbers contained 78,940 persons. The table herewith presents the eight districts in the order of their populations, giving the number of inhabitants, the number of consumers, the equivalent number of connected 16-cp lamps, the number of lamps per consumer and per 100 of the population, and the number of consumers per 100 of the population in each.

In the totals for the eight districts are 703,597 inhabitants, 23,588 consumers and the equivalent of 1,040,713 connected lamps of 16 cp each.

To make more clear the relations of population, number of consumers and number of connected lamps, a diagram is presented for showing the population, the number of consumers per 100 of the population and the number of connected lamps per 100 of the population in each district. In the diagram each small circle represents a district, and each circle is located according to the number of its connected lamps per 100 population measured on the horizontal lines, and according to the number of consumers per 100 of the population measured on the vertical lines. Populations are indicated at the top.

POPULATION, CONSUMERS AND LAMPS IN ELECTRICAL SUPPLY DISTRICTS.

Population of District.	Number of Consumers	Equivalent Number of 16 cp Lamps.	Lamps Per Consumer.	Lamps Per 100 Population.	Consumers Per 100 Population.
522,415	16,840	838,723	50	160	3.2
78,940	1,986	46,677	23	59	2.5
28,976	1,300	38,487	28	133	4.8
19,772	797	22,036	27	111	4.0
16,070	601	14,056	23	88	3.8
13,830	836	30,567	36	221	6.0
11,829	321	21,572	67	182	2.7
11,756	868	28,595	35	244	6.9
703,597	23,588	1,040,713	44		

As shown in the table, the average number of lamps per consumer is down to 23 in each of two districts, and up to 67 in one. It is to be noted that the district of the metropolis does not stand highest, having 50 lamps per consumer, while the next largest district with 78,940 inhabitants has only 23 lamps per consumer. The maximum number of lamps per consumer is in a district of only 11,829 inhabitants, but the largest city with 50 lamps leads all the other districts.

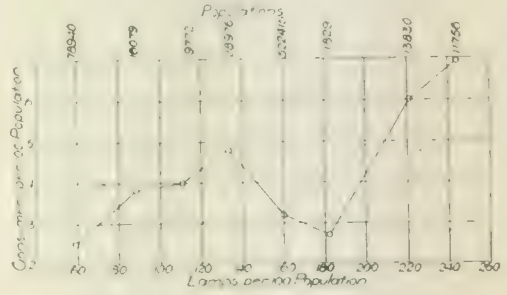
In number of lamps connected per 100 of the population the smallest district leads with 244, and two other small districts are ahead of the metropolis, which latter has 160 lamps. The least number of only 59 lamps per 100 people is found in the district with 78,940 people.

As to number of consumers per 100 persons the smallest district again leads with 6.9, and four of the other districts have more consumers per 100 than the metropolis with its 3.2. The second largest district stands lowest with only 2.5 consumers per 100 people.

With uniform rates for electric lighting in all of the above districts, it seems that the widely different ratios of consumers and connected lamps to the numbers of inhabitants must be due in large part to the local conditions, such as the character of the population, the extent of commercial and manufacturing interests, and the presence and price of gas supply.

In the metropolis of 522,415 people the commercial and manufacturing interests are very important and tend to increase the number of lamps per consumer, as well as the lamps per 100 of the population. On the other hand, a large percentage of the population is of foreign birth or very poor, and this reduces the percentage of consumers to the entire number of people. Another factor in this great city that keeps down the number of consumers is the supply of gas of about "18 cp" at the rate of 80 cents per 1000 cu. ft.

The district with a population of 78,940 includes one city and one town, neither of which is prominent in manufacturing industries. Both of these places are close to the metropolis, so that their commercial and retail business is relatively small, and they are occupied mainly as places of residence



RELATION OF LAMPS TO POPULATION.

Add to these facts the supply of illuminating gas at 90 cents per 1000 cu. ft. in the city part of the district, and at a somewhat higher rate in the town, and there is an explanation for the fact that the district has only 2.5 consumers and 5.9 lamps per one hundred of the population, and only 23 lamps per consumer.

In the district with 28,976 people there is a city containing about one-half of this number, and the remainder are in two towns. The city has a fair number of manufactures, but they are mainly tanneries that do not require much light, and the towns are largely places of residence for people employed in the cities. Gas is distributed in the city at $1.40 per 1000 cu. ft. and in one of the towns at $1.80. This district has 4.8 consumers and 133 lamps per 100 people, but the number of lamps per consumer is at the moderate figure of 28.

Five towns go to make up the district that has the population of 19,772, and these towns have about 60 manufacturing plants, which produce machinery, paper articles and food preparations among other things. As these five towns lay 20 to 25 miles from the metropolis their population is to a large extent employed at home. Gas is distributed in only one of the towns, which contains a little more than one-half of the population of the district, and is sold at the rate of from $1.50 to $2 per 1000 cu. ft. Under these conditions 4 per cent of the population use electric light, there are 111 connected lamps per 100 of the population and each consumer has 27 lamps as an average. It should be added that there is a large farming element in the population of this district.

A district comprising seven towns has the population of

16,079, and this population is less in comparison with the included area than any other here considered. The towns lay 20 to 30 miles from the great city, where the generating plant is located, and agriculture is an important occupation of their inhabitants. There are, however, some 46 manufacturing establishments in the district that produce metallic goods, chemicals, rubber articles, food preparations and books. Gas is not supplied in either of the seven towns. This district contains 3.8 consumers and 88 connected lamps per 100 of its population, and the number of lamps per consumer averages 23.

There are 6 consumers and 221 connected lamps that average 36 per consumer in the district that contains 13,830 people in four towns. Knit goods, food preparations and books are prominent articles of manufacture in this district and it contains not less than 26 manufacturing plants. One of the four towns contains about one-half of their combined population. Gas is supplied in this largest town at the rate of from $1.20 to 90 cents per 1000 cu. ft., but there is no gas in the other three towns.

In the district with 11,829 people there are 182 connected lamps per 100 of the population, and the large number of 67 lamps per consumer, but there are only 2.7 consumers per 100 inhabitants. These unusual results exist along with the following conditions: Two-thirds of the population of this district are located in one town and this town has 47 manufacturing plants that produced goods to the value of $3,453,094 in a recent year and paid $643,613 in wages. By far the most important of these manufacturing industries is that of boots and shoes, which represented $2,896,110 of the value of products and $489,920 of the wages paid in the year mentioned. The manufacture of shoes was carried on by 13 establishments. Gas is sold in this town at from $1.50 to $1.70 per 1000 cu. ft.

The smallest of the eight service districts in point of population contains 11,756 people in two towns, but the number of consumers is 6.9 and the number of lamps 244 per 100 inhabitants, the largest relative numbers of lamps and consumers in any district. At the same time there was only the medium number of 35 lamps per consumer. One of these two towns adjoins the metropolis and is important as a suburban residence, and the district contains 31 manufacturing plants. Gas is distributed at 80 cents per 1000 cu. ft. in one of the towns, but there is no gas sold in the other.

The above results appear to support to some extent the following conclusions:

Cheap gas reduces the number of electric light consumers, but attracts only the smallest.

A large city does not surpass small places in either the number of consumers or of connected lamps per 100 inhabitants, but usually leads in lamps per consumer.

Towns show the greatest percentage of electric light consumers and the greatest number of connected lamps in relation to population, and where there are numerous manufacturing plants of moderate size a town may also lead in the average number of lamps per consumer.

Experiences of an Erecting Engineer.

By C. T. Phillips.

TECHNICAL papers from time to time give descriptions of electrical and mechanical installations and the results of test and the way in which engineering problems are solved. To the layman who reads these articles it might seem that the life of an engineer is one continuous round of pleasant work, with no troubles or friction. In writing articles for the technical press, I presume the author thinks that his troubles would not interest the readers or else he does not wish to give the impression that an engineer ever has troubles. Perhaps some of them are so fortunate, if they have absolute authority, but where they are being continually advised by, or are doing work for, parties who think they know how it should be done, the engineer's troubles begin.

In the last 10 years I have handled quite a number of light, power and industrial installations in different parts of the country as consulting and erecting engineer. The majority of these installations were under 1000 hp, and as long as I had absolute control I had no trouble in producing satisfactory results. In a number of cases, however, I had anything but a pleasant time and labored under a handicap which frequently caused ill feeling and poor results, including loss of time and money.

On one occasion I was engaged to engineer the installation of a street-railway system in a small city, the maximum capacity of the power house being about 700 kw. As I was installing a commercial lighting system in another town at the time, I informed the railway people that I would not be able to be with them for about three weeks, but would get out my preliminary plans at once and put my ideas into shape, so when I did arrive no time would be lost.

In due time I arrived in the city and going to the president's office, received the startling information that to save time he (the president) had bought the power-house machinery, the car trucks, the motors and controllers. I was then shown a set of drawings of a boiler which, the president informed me, I was to build and use in the power house. On looking over the drawings I found that the boiler was very poorly designed, and I informed him of the fact. He stated that he had bought the rights to make the boiler and had named it after himself, that this type had been installed in the State Capitol, and what was good enough for the State Capitol was good enough for him.

The machinery order consisted of three simple engines, a piece of countershaft with clutch and tight pulleys, and three dynamos. I advised against the shafting, but he insisted upon using it. The countershaft had clutch pulleys which were of the wrong size to drive the dynamos, and plain pulleys for the engines. I asked him the reason and he stated that the salesman who sold him the shafting had said that in case they wished to cut out a dynamo to make repairs, or, on account of light load, they could use the clutch pulleys. I asked him what would happen if something went wrong with one of the engines, and he stated he never thought of that.

It took about two hours to explain to him that there were 50 chances of trouble on the engines to one on the dynamos; that, besides, no repairs could be made on the engine while running, nor would it be advisable to cut the steam off and let the engine run.

The usual source of trouble on a dynamo is the brushes and they could be repaired while running with the main and field switch open. In case of a burn-out the dynamo could be run dead until after shutting-down time and then the belt taken off.

The shafting was shipped back to the factory, and I turned my attention to other troubles, of which there were many, the principal one being the manufacture of the boilers and setting them into a power house that had been built with no idea of what was going into it—the boilers, consequently, had to be set at right angles to the engines, which necessitated much more piping and greater losses than if they had been set parallel to them.

The shafting was so long that the end bearings had to be set into the wall. The motors I found were larger than necessary and would not fit the trucks, so they were shipped back for others.

The power house was finally started and the cars assembled and wired, and the day arrived to take the first car out of the barn. I mounted the front platform and threw the controller on the first notch. There was a flash, and the motors bucked. I tried again with the same results. I tried the other controller and the circuit-breaker in the power house went out. I carefully examined the wiring, disconnecting it, made tests on the motors for grounds and shorts, and then carefully reconnected the controllers and found I still had the same trouble. After many tests and examinations I came to the conclusion that the trouble lay in the controllers, although the president stated that they were new. He afterward admitted, however, that he had bought them second-hand, the parties stating that they had never been used. A close examination revealed that they had been used and had been overhauled, re-

painted and rewired, and the wiring had been installed regardless of proper connections, no two being wired alike. They were all taken out and rewired, and at last the system was running. The efficiency was an unknown quantity.

I figured up roughly the last day I was there and gave the results to the president. There had been over 20 days' delay and an additional expense of about $3,500, not counting excessive fuel consumption or high maintenance.

In another case a railway company bought a new direct-connected unit for $18,000 from the manufacturer, the original cost of which was $23,000. The parties for whom it had been made refused to take it, and I found out later that it had not come up to the specifications, the steam consumption being excessive. When the railway company was offered the outfit at a reduced price (the manufacturing company stated that it would not let the parties for whom it had been made have it on account of their financial condition) the directors of the railway company bought it without consulting even their steam engineer, though knowing nothing about efficiency, steam consumption, maintenance or any other point which an engineer would go into thoroughly. Coal, in this section, cost about $4.75 per ton delivered into the power-house bunkers; consequently, quite a saving could have been made by installing an efficient generating unit.

The switchboard panel that came with the unit could not be used as it was intended for an isolated plant and had no provisions for connection to the busbars or equalizer. The board was rebuilt and the voltmeter discarded, as it was not necessary, there being one on a swinging bracket on the end of the old board.

I did not use a condenser on this unit as I found it would not pay, so used the exhaust steam for heating the feed water in an open heater. I made a detail report on the installation showing the saving that could have been made by a different installation. The report was read at a directors' meeting, but failed to meet with the enthusiasm which I anticipated.

On one occasion a commercial lighting plant in a small town was not paying, and I was employed to see what I could do with it. I found that the company was owned by an estate which was managed by a woman. The power house was in a very poor condition, the machinery being antiquated and only about half loaded. The service was very poor.

After getting the plant into shape so that the service was much better, I solicited enough consumers to load the plant up to its capacity and still had not canvassed the entire town. We decided that the plant should be enlarged and the woman who was manager came to borrow some electrical books that she might familiarize herself with the subject sufficiently so that she could buy the new machinery and superintend its installation. She expected to accomplish in a few weeks what it takes the average man, who devotes his entire time to it, five or six years. I lent her the books. A few days later she returned them stating that she did not understand them, and after that I heard no more about her engineering the new plant and I was able to follow out my own ideas without interference.

A manufacturer who by diligence had built up an immense business was going on a trip to buy machinery for a new plant. He intended to use individual electric drive, buying current from the power company. He asked me what I would charge to buy the motors for him and draw up a set of wiring specifications, and what would be the approximate cost of the motors. I gave him a figure of $150 for my fee, and told him that the motors would cost him $2,900 and the wiring $950.

After he had been away a few days I received a letter from him stating he had bought his motors and for me to let the whole matter drop. Sometime after that I saw him on the street and he invited me to look at his motors, on which he had saved $500 over the price I had quoted him. I took a look at the motors and found he had bought them from some small concern in a distant town and they were for direct current. I had figured on alternating-current motors for various reasons, one being that the power company had only alternating current in that vicinity. I mentioned that, and he said: "That is all right; I have a dynamo." I asked him what he was going to use to run his dynamo, and he stated he did not know that he had to have anything with which to run it. The next day he asked me to straighten the matter out for him. I informed him that as there was considerably more work, I would have to charge him more, and as I could not get rid of the motors he bought I would have to use them and buy a motor to run the dynamo. This motor would cost about $900, besides about $400 additional on the wiring and nearly $200 for a switchboard; then there were belts and other details I had not figured upon.

I had figured on an efficiency of 85 per cent in my proposed installation and the installation that finally went in had an efficiency of about 60 per cent. This man, to save $150 engineer's fee, spent about $1,300 in excess, besides causing an increase of over 20 per cent in current consumption and a much higher rate for maintenance and depreciation, and also increasing the fire hazard.

While acting as erecting engineer on a steam-electric central station of 20,000 hp we experienced a great deal of trouble owing to the fact that there were no plans or specifications to show in detail the wiring or the piping; consequently, it was one continuous fight between the pipe fitters and the electricians. The space was limited, and if the pipes were installed before the wires the wires suffered, and vice versa. After the plant had been running about a year, the wiring and small piping gave so much trouble that both had to be torn out and installed in accordance with a set of plans which had been prepared in the meantime to cover the details.

I must say that in the majority of cases I never had any trouble, and it is only where the engineer is not given complete charge that there is any occasion for complications like those just recited.

The Present Status of Ozone.

By G. M. Dyott.

OZONE has long been recognized as a most powerful and effective sterilizing agent, but being a very unstable gas and difficult to manufacture economically its commercial exploitation has been less rapid than what one would naturally suppose; in fact, there are few processes which, promising so much, have yielded so little considering the time they have been before the public. During the past 12 years there have been formed many companies advocating the use of ozone for some purpose or another, and it is unfortunate to relate that almost without exception failure has resulted, although in a few isolated cases a small measure of success has been obtained.

In view of the present knowledge of the art it seems that failure has been due to one or all of the following causes: Highly inefficient apparatus, ignorance of the laws governing the gas in question and the production of nitrous oxides along with the ozone which were in themselves more deleterious than the ozone was beneficial. Further, it might be mentioned that doubtful methods of financing, coupled with poor management at the hands of inexperienced men, have played not an unimportant part in hindering its successful exploitation along legitimate lines. Fortunately, to-day the tendency to look upon an ozone company as a stock gambling concern is not as great as it was, and the subject, which is one of world-wide interest, is now receiving attention at the hands of reputable engineers all over the country.

Progress in Europe has, as usual, been slow but sure, and in the purification of water the Siemens & Halske Company has done much; its apparatus can be found in all shapes and forms, from the portable military sets up to the larger units designed for municipal water works. For ventilating purpose a great deal of credit is due to the Ozonair Company, Limited, of London, which with exceptional vigor has covered this particular field in every direction with great success.

The theory and chemistry of ozone are too well known to be discussed here, but a brief summary of what has already been done with it commercially and what may be expected of it in

the future will not be out of place. The principal systems on the market to-day for producing it on a large scale are the Siemens & Halske, Otto, Vosmaer, Schneller, de Frise, Gerard, Armstrong and the Joseph. Of these the underlying principle of all is the same: a high potential discharge takes place over metallic surfaces separated by a dielectric. One differs from the other only in the materials used, the method of mounting them and the mechanical cooling devices employed. These and other minor features may seem trifling, but it is just such points which make an appreciable difference in the working results.

Up to the present time ozone has been considered chiefly in connection with the purification of water, since it has been shown that when water is thus treated it can be made absolutely sterile at a cost so small as to be incredible. In Europe a large number of communities suffering from impure water supply have availed themselves of the process with excellent results, and of the several plants installed in America one deserves particular mention since from the standpoint of efficiency and high concentration it exceeds anything else heretofore attained, either at home or abroad. The plant in question, which is located at the Homeopathic Hospital in Pittsburgh, was described in the *Electrical World* Aug. 29, 1908. The water, as received from the city mains, is particularly bad, and yet at a cost of electrical energy not exceeding 50 cents 100,000 gal. can be treated every 10 hours and rendered free of all pathogenic germs.

The production of ozone at this plant varies from 80 grams to 100 grams per kw-hour and every 100 gal. of water treated require about 1 gram of ozone. Under these conditions the concentration ranges from 6 grams to 14 grams per cubic meter of air. This is a remarkable achievement considering that it represents average working conditions on a commercial scale. The peculiar success of the Gerard apparatus can, no doubt, be attributed to the efficient method of cooling and the ingenious system of distributing the potential strains along the ozonizing tubes, thus reducing the possibility of breakage.

The next largest field of usefulness in which ozone has been introduced with success is that of ventilation. The ease with which the ozonized air can be generated and distributed, either in a single room or all over a large building, places it within reach of anyone. At the same time the initial cost is so small and the purifying of the air so effective that the day is not far distant when ozonizing sets will be as frequently seen as fan motors in summer.

As previously mentioned, the Ozonair Company has shown quite remarkable energy in developing this line of business. It has installed apparatus in some of the leading hotels and restaurants, etc., in London, and has sold an extraordinary number of small portable outfits, for which there is an increasing market.

The progressive central-station man will find here an avenue for disposing of electrical energy under very favorable conditions. Small portable sets consume from 50 watts to 100 watts according to the type and size, whereas a room measuring some 35 ft. x 80 ft. x 12 ft. would call for an expenditure of electrical power of about 300 watts. In a hotel visited by the writer in London 2 kw was more than sufficient for killing all disagreeable odors originating in the kitchen, for supplying fresh air over the entire building and for driving the fan motor. This plant was run about six hours every day, during meal times, and when once started required no attention whatever. Once a week the entire apparatus was inspected, new filter cloths inserted and fresh lime put in the dryer.

There is very little doubt that portable ozone generating sets, when properly designed, are of great value in homes or offices where the ventilation is poor. For this class of work a high concentration of ozone is not desirable; in fact, 1 gram or 2 grams per cubic meter is more than ample. The ideal ozonizer should be so designed that it always remains cold, the time taken by the air to pass through it should be as brief as possible, and a potential of over 10,000 volts is recommended. In most cases also the air should be thoroughly dried before being ozonized so as to prevent a formation of nitrous oxides. It seems that in the very interesting portable set devised by Mr. Armstrong this latter precaution is not so important, as the time of contact is exceedingly small. Moreover, this theory works out in practice for the system produces a pure and sweet ozone which is in marked contrast to the action of some of the so-called ozone machines.

To the refrigerating engineer ozone presents features of special interest. In laying out an ice plant, for instance, high economy engines could be used and a great deal of the bulky apparatus now essential for treating the water could be replaced by a simple ozone purification plant at a cost of about one-third. Moreover, the ice produced would be absolutely sterile and of much better quality. Bad odors in storage rooms could easily be destroyed by ozone, thus increasing their storage capacity considerably, and in some cases, with fruits, etc., ozonized air alone would prevent decay without the necessity of low temperatures being maintained.

The members of the medical profession, more than of any other, are slow to adopt anything new, and they cling to their old-established methods with remarkable tenacity, but it can be said with certainty that when they throw off their cloak of prejudice they will find in ozone an instrument unequaled both for the prevention and cure of certain diseases. Pulmonary troubles and diseases of the skin yield very readily to its action in quite a remarkable manner, and the writer firmly believes that time will prove it to be a cure for consumption, when administered with care, even in advanced stages.

Some time ago the writer had occasion to examine a high-frequency medical outfit used for curing skin diseases. It consisted of a large glass globe in which a high-potential discharge was taking place. The bulb upon being rubbed over the parts affected was claimed to perform wonderful cures. Upon examining the apparatus in action it was at once apparent that ozone was produced locally and it is not improbable that the real curative effect was due to a local production of ozone rather than the high-frequency current as claimed. Experiments conducted by Dr. Woolridge at the Homeopathic Hospital in Pittsburgh indicate that ozone is destined to become a great factor in the medical world.

On considering the subject one naturally wonders whether there is any limit to its field of usefulness. As a matter of fact, there is a decided line of demarcation. Ozone, in virtue of its chemical proportions, possesses certain remarkable qualities which when properly utilized are most effective. That these are capable of so many diversified applications is fortunate as well as interesting, but in appreciating this one must not forget that like everything else it has its limitations and cannot be looked upon as a panacea for all the unsolved problems of commercial endeavor.

Economical Methods of Meeting the Maximum and Minimum Demands for Steam.

By K. Williams.

In the power house or isolated plant there are times of great demand for steam. The engineer can prepare to meet the overload by having auxiliary boilers ready to cut in on the main steam line at the proper time. The boilers should be under steam and with banked fires, and some firemen prefer to carry the banked fires at the bridge-wall so that the moment the boilers are needed the ashes may be hauled out, the fires spread and coaled and allowed to burn quickly to generate steam of the required pressure. This is not the best method, however. There is more economy in banking the emergency fires at or near the furnace doors shortly before the overload appears; the bared portion of the grate bars behind the banked fires being covered with "green" coal, and when the time arrives for cutting in the boilers the bank is spread and coaled. The hot gases from fires banked at the furnace door have a greater amount of heating surface to traverse, whereas with fires banked at the bridge-wall there is a large amount of heating surface not subjected to the action of the heated gases given off by the banked fires.

The height of the feed water in the boilers is an important

factor to take into consideration in meeting an overload or sudden demand for steam successfully. It will be found expedient to have the boilers filled up to the safe limit with water before the overload arrives. The greater the amount of feed water at this moment, the longer the boilers will maintain steam without receiving a fresh supply of feed water.

If the maximum load demands a certain number of boilers, then as the load falls off the number of boilers generating steam should be decreased and the manner of firing the boilers to be cut out should change. Instead of firing over the entire surface of the grate, the fireman should coal only the back of each fire to be banked. Then by the time the lowest peak of the load arrives there will be sufficient fuel at the back of each fire to insure a "safe bank" and at the same time the full benefit of the burned fuel is obtained. There will also be less ashes to haul out of the furnace and less heat for the firemen to contend with. In managing the fires in this way a considerable amount of fuel can be saved. It is not uncommon to see firemen hauling out good steaming fire composed of half-burned coal and play water on it to "kill the heat" so as to enable him to work. This kind of firing is unnecessary.

Boiler Room Economy.

By William Kavanagh.

In order to realize the highest efficiency and economy in the boiler-room the consumption of fuel and conditions under which the boilers operate are two important factors for the consideration of the boiler-room engineer. If the boilers are too small for the work, there is always more or less trouble encountered in holding satisfactory steam pressure, and if the boilers are dirty, the coal of a poor quality and the fireman not over expert, trouble will be multiplied. For these reasons the following requirements are necessary to produce economical generation of steam: Every boiler plant should, if possible, be equipped with one or more auxiliary boilers so as to permit of cleaning and inspecting one of the regular boilers at stated times. When the boiler plant is thus equipped a number of boilers can be set aside to receive a thorough cleaning and inspection, and when these operations are completed, the boilers can be put in regular service again, when another set of boilers may be shut down for an equal amount of attention. In this way sets of boilers can be alternated, insuring economy because the boilers will be free from scale and the heating surfaces clean.

The facility with which heat can traverse along and through the heating surfaces is an important item in fuel economy. A

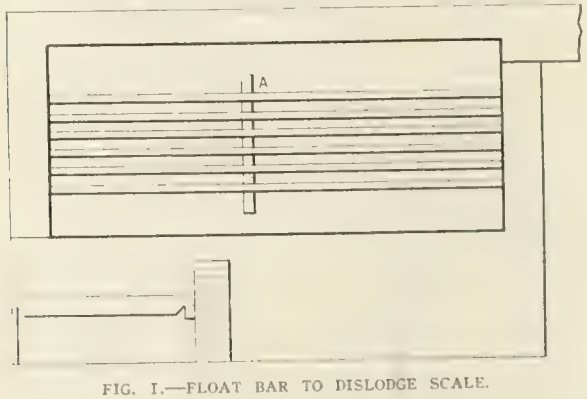


FIG. 1.—FLOAT BAR TO DISLODGE SCALE.

thin coating of scale on the inside of the boiler and a like coating of soot on the outside will retard to a large degree the transfer of heat to the water, and this means a loss of fuel. If the water contains scale-making properties, then a chemical analysis would show the best scale resolvent to pump in with the feed water to neutralize the scale and deposit it in such a manner as to make its removal easy.

The best time to blow-down boilers is after a period of rest, because the water is then quiescent and all material held in suspension falls on the crown sheet or inside the mud-drum whence a portion of it at least will run off through the blow-off valve. It is poor policy to blow-off and feed water through the same pipe, especially where a water-softening plant is not in use. When a boiler is fed and blown off through the same valve or pipe, in almost every case scale and mud will be found at the opposite end of the boiler to that in which the feed pipe is connected; hence the blow-off connection should be in the quietest and lowest region of the boiler. If the boiler is

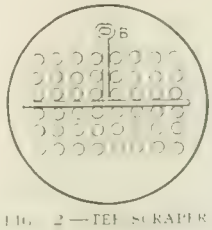


FIG. 2.—TEE SCRAPER.

of the horizontal-tubular type a manhole connection should be provided above and below the tubes. On cleaning the tubes of this type of boiler large quantities of scale will be found between the tubes in both the longitudinal and lateral directions of the boiler. A flat bar can be used to dislodge the scale between the tubes lengthwise of the boilers, as shown in Fig. 1 at *A*, and a tee scraper or cleaner can be used to clean between the tubes crosswise of the boiler (see *B* in Fig. 2).

Another important connection to receive attention during the cleaning process is the water column, shown at *A*, Fig. 3. The plug at *A* should be removed and a rod or drill run through the pipe and a gate valve should be installed at *B* to permit this During the cleaning process the grate bars should be leveled, and broken or warped bars thrown out and replaced with good ones. The furnace lining should be looked after, the back connection cleaned out, and if the boiler is fitted with an upper flue, this should also be cleaned.

If the boiler is of the water-tube type the deflecting arches should be inspected and all broken or cracked bricks removed and good bricks inserted in their places. It is important to have the heat travel around these arches and if holes or cracks are present the heated gases from the furnace will take a "short cut" to the stack and a great deal of heat will be lost in this way. Doors are usually fitted in the side walls of the boiler setting for the purpose of blowing off the ashes and dust from the tubes. The furnace, grate bars, and flues should receive the same attention as those of the horizontal-tubular boiler.

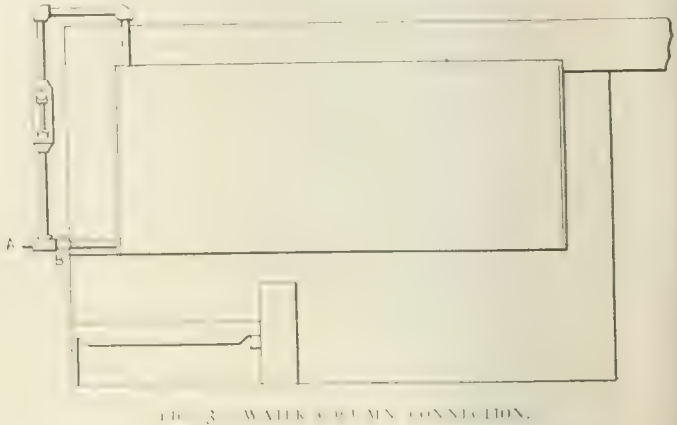


FIG. 3.—WATER COLUMN CONNECTION.

Some water-tube boilers are not fitted with side doors, connections being made for blowing soot and ashes from the tubes in the tube sheet. It is clear, however, from the foregoing that economy does not altogether hinge directly on the amount of fuel consumed, nor the ability with which coal is fired, for if the condition of the boiler is poor, then the most skilful firing cannot produce satisfactory results. Ease of access to the coal supply and facility for handling the ashes are also important considerations.

The Prevention and Removal of Boiler Scale—VI.

By W. H. WAKEMAN

Fig. 1 illustrates a very simple device for collecting certain kinds of impurities that would otherwise form into scale and prove both annoying and expensive. Feed water enters the upper part of the shell or is delivered through the front head



FIG. 1.—DEVICE FOR COLLECTING SCALE-FORMING IMPURITIES.

in accordance with good practice, and falls into the small tank 2. It then passes down through the narrow, flat conductor pipe 3 into the comparatively large, round pipe 4, which rests on cast-iron supports that prevent it from resting on the bottom of the shell. A narrow slit is cut in the top of this pipe, through which the feed water flows out into the body of water already there, thus preventing it from spreading until it is thoroughly heated and even then keeping it away from direct contact with the shell. The result is that nearly all impurities are retained in the lower pipe, which is called a "mud catcher." Experiments must be made to determine the length of time required nearly to fill this with sediment, in each case separately, and after this point is settled the manhole cover must be taken out and all foreign matter removed from the mud catcher within the specified time as otherwise it will become inoperative. It will be noted that this device does not remove impurities from the boiler nor change their nature and thus prevent them from forming scale.

Fig. 2 illustrates a very efficient mechanical cleaner attached to a horizontal tubular boiler. A funnel 2 is placed where the lower part of it corresponds to the low-water level of the boiler, which is generally about 3 in. above the tubes, therefore, under working conditions, the water level is at or near the widest part of the funnel, consequently a portion of the impurities which float at or near the surface enter this funnel as the body of water flows backward, and the natural momentum carries them

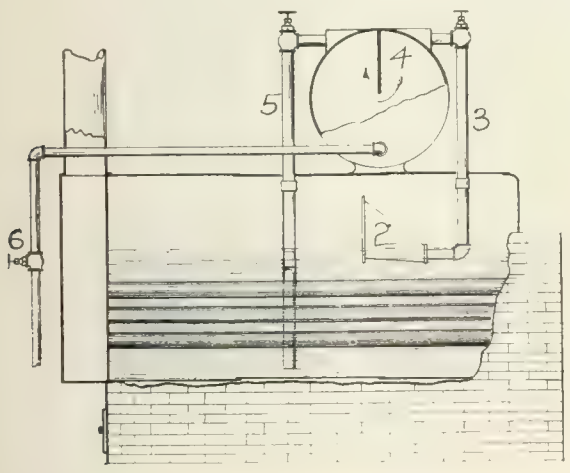


FIG. 2.—MECHANICAL CLEANER.

upward through pipe 3 into the reservoir 4, where, on account of the materially increased size of the passage and the deflector shown, they settle to the bottom while the partially purified water goes out through pipe 5 and is discharged into the lower part of the boiler. At suitable intervals, depending on the amount of foreign matter in the water, the drip valve 6 is opened for a few seconds, and sediment is thus removed from the reservoir 4. While the illustration shows this mechanical boiler cleaner attached to a tubular boiler, it is equally efficient when used on a plain cylinder, a flue or a locomotive boiler.

Fig. 3 illustrates another mechanical boiler cleaner in which impurities floating on or near the surface are caught in the skimmer 2 and are forced by the momentum of the rapidly circulating water out through the pipe 3 and into the precipitator 4, in which some of them settle to the bottom and are blown out through the valve 5. The upper part of the precipitator 4 is filled with coke, and, as this is an excellent filtering material, more of

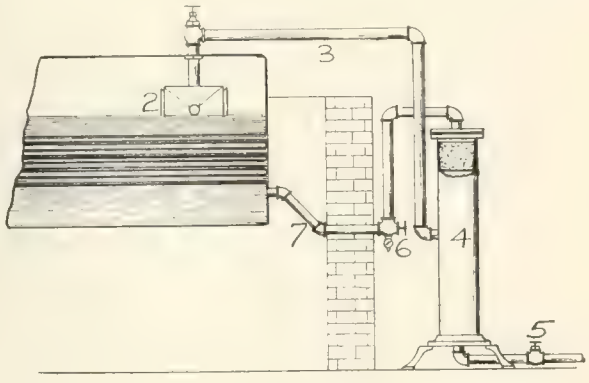


FIG. 3.—MECHANICAL CLEANER.

the scale-making impurities are intercepted by it and prevented from returning to the boiler through the cross-valve 6, which is used to regulate the flow, if any regulation is required.

Considerable care should be taken to make it impossible for a careless or ignorant attendant to close valve 6, because that would prevent circulation of water through pipe 7, and as this pipe is located in the direct path of hot gases from the furnace to the chimney, it would soon be burned off. Ashes and soot are also forced out into the room and the boiler must be cut out and shut down until repairs are completed, causing a delay that is usually annoying and expensive. The valve 6 ought to be provided with a chain and padlock, the key of which is retained by the chief engineer of the plant, enabling him to know when it is opened and closed, as it should be always open except when it is necessary to renew the coke in chamber 4. The pipe 7 ought to be protected from the intense heat by asbestos rope wound tightly around it.

Fig. 4 illustrates a somewhat similar device. The pump or

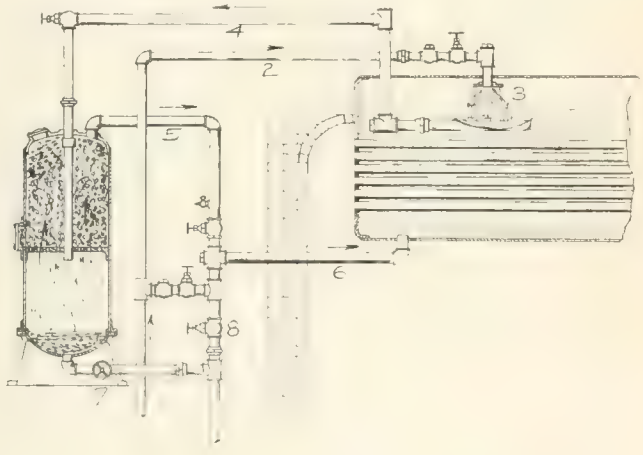


FIG. 4.—ARRANGEMENT OF PRECIPITATOR.

injector forces water in through pipe 2 into the steam space in the form of spray at 3. It is thus heated at once to a high temperature and falling into the feed pan shown is forced by momentum through the pipe 4 into the lower part of the precipitator, the upper part of which is filled with coke or other suitable filtering material. The water passes through pipe 5 and continues through pipe 6 into the boiler again. The blow-off pipe 7 is used to eject sediment out of the settling chamber and pipe 8 is the regular blow-off for the boiler.

LETTERS ON PRACTICAL SUBJECTS

A METHOD OF WIRE SUSPENSION OVER A WIDE RIVER.

It may be that what is new to the writer is also new to at least some readers, and acting upon this presumption the following description of the method used in suspending electric wires across the St. Joseph River at South Bend, Ind., is presented. Several of these suspensions are in use in that city and vicinity. The width of the river at the points of crossing is such that about 600 ft. intervenes between the suspension posts shown by Fig. 1. The sketch is made from the east

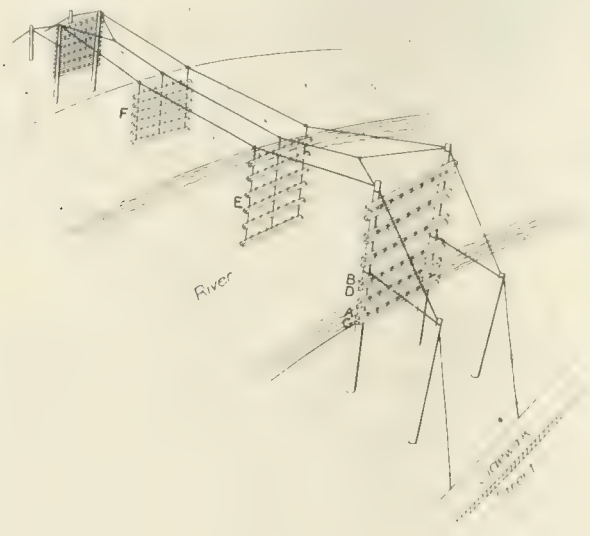


FIG. 1.—SPAN ACROSS RIVER.

bank of the river, and the east bank is from 20 ft. to 30 ft. lower than the west bank, which is rather a steep bluff. One of these suspension anchorages is so located between the river and a street and a wide canal that the anchorage space is very narrow. Another "landing" of one of the suspensions is in a public park. Another comes close to a public street and a railroad; therefore it was necessary in each instance to take as little room as possible for the guy wires, hence the intermediate shorter poles shown by the engraving in question.

For the sake of clearness, the wires have been omitted in the engravings. It will be noted that the cross-arms on the poles

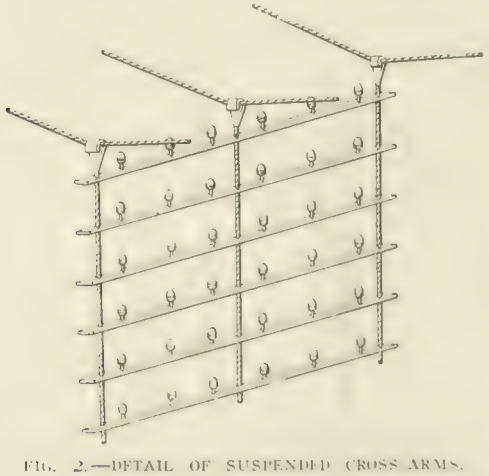


FIG. 2.—DETAIL OF SUSPENDED CROSS ARMS.

are double; the insulators being attached to the lower arm of each pair, while the upper arms *A* and *B*, Fig. 1, serve as secure footings for the linemen, at the same time protecting the insulators on arms *C D*, and also preventing wires from falling into and becoming entangled in the insulators of any section should any of the wires break in any other section. This is a very good point, and it could be followed with advantage on many an ordinary pole where wires must be worked over and under.

It will be noted that each pair of main poles is double guyed to the short poles. It will also be noted that there is a third cable attached by means of a Y on each side of the river, to the pair of main poles. When a 24-wire suspension is arranged the middle cable is omitted, together with the pair of Y connections. In this case the middle post of rack *B* would be omitted, and the same is true of rack *E* as well. In these suspensions the cables, which are ½ in. in diameter, are simply wrapped around each post and made permanently fast thereto. It would seem an improvement—to the writer at least—were a turnbuckle added, close to each pole, for the more convenient adjustment of the cables. It must have been quite a task to tighten the cables to exactly the right tension and then hold them there while made fast, and not have either of the racks hang out of plumb when the "come-along" tackle was removed from the suspension cables. Some turnbuckles, either in the main cables or in the "deadman" cables, would seem advisable. The turnbuckles could be placed close to the ground and still control the vertical line-up of racks *E* and *F* with ease and with certainty.

When a 24-wire suspension is required, the middle cable is omitted as stated, also the center post of each rack, and the two lower crossarms are also omitted from each rack. Fig. 2 represents the manner of construction employed in the racks. The upper end of each post is made from flat bar steel and is simply bent over upon itself, leaving just room enough that it may be hung upon a cable. Just below the hooks the flat steel is cut off and a threaded rod welded on. The holes in the rack cross-bars—these are also plain flat bar iron—are threaded, and the posts are simply screwed into threaded holes in the cross-arms.

A little care is necessary to enter each cross-arm at the exact distance required from the arm immediately above it. But once entered at the required distance from the preceding cross-arm, no further attention whatever is required in assembling the rack, as it is then impossible to get the arms out of place after the posts have once been entered in their respective holes.

The insulators are also attached to the bars by means of plugs which are screwed into the arms as shown. After the rack is in position upon the cables, the flat upper ends of the posts may be closed down upon each other with the certainty that the cable can never slip out even if it breaks in two between racks or posts. As the insulators are directly attached to a well-grounded metal arrangement, it would seem that extra good insulators should be employed, and those of the "high-tension" type would be in order to make an extra good job.

South Bend, Ind. James F. Hobart.

BOILER SCALE AND THE REMEDY.

To the engineer or station manager who has hard feed water to contend with, the effect and prevention of scale in boilers are matters of interest and importance, as the presence of scale resulting from use of such water may be a source of much loss and worry. It might be stated in the beginning that all available sources of boiler feed supply should be looked into when a plant is first installed, and that supply most suitable selected. However, at times all water available may be hard, containing lime and magnesium salts, in which event scale formation in the boilers is a foregone conclusion unless some step is taken toward its prevention. Presence of scale is not only a menace to the safety of the boiler itself, but the efficiency of the boiler is thereby impaired to an extent varying directly with thickness of scale present. It is estimated that a thickness of 1/16-in. scale is equivalent to a loss of from 15 per cent to 20 per cent of fuel; a thickness of ¼ in. to a loss of 60 per cent. It can therefore be seen that scale prevention is a matter of dollars and cents to the station manager. Aside from

the foregoing, a scaly boiler is liable to be burned at any time with the resulting formation of a bulge or sag in the plates. The scale being a non-conducting covering allows the portion of boiler exposed to the fire to be overheated, no water coming in contact with metal to cool it. A bulge results which at best means a patch on boiler. Scale also causes a great deal of trouble by stopping up pipe connections, gages, etc., and in some instances boiler explosions have been attributed to its presence, indirectly. Turning to scale formation one finds that solid matter may be contained in feed water either in suspension or solution. That contained in suspension is not, generally speaking, of much concern to the engineer, as it may be disposed of by filtering water prior to its entrance to boiler, or, if this should be impracticable, by frequent blowing off. The matter entering the boiler in solution is that of prime importance, as it is from this that the most objectionable scale is formed. Carbonates of lime and magnesia and sulphate of lime are soluble in water, and it is these salts that are most often found in feed waters. The carbonates are precipitated on boiling and have little cementing tendency, so if they alone are present little trouble is experienced. But the sulphate of lime is usually present also, and the carbonates seem to crystallize along with the sulphate, both adhering closely to boiler shell or tubes. Scale thus formed is usually of a white or grayish color, is very hard and dense, and is hard to remove. Such scale may be removed from the water by chemical reactions prior to its entrance to boiler, or may be taken care of in boiler itself. Where there is a condensing plant the same water may be used over and over again by proper use of surface-condensing apparatus, but where the installation is non-condensing the best procedure is to install open feed-water heaters or lime catchers, of which good types are on the market. Such a heater will dispose of nearly all the carbonates in solution as these are precipitated near the boiling point of water. The scale forming in the heater is readily removed. The heater will not take care of the lime sulphate in solution and in order to remove this or to change it into a harmless form, some reagent must be used on the water. It is sometimes found that the use of mechanical reagents like sand, malt grains, saw-dust, etc., in boilers, prevalent in some sections, prevent the formation of scale on boiler shell by offering their own surface for deposit. The use of kerosene is also very common throughout the country. The action of the oil is entirely mechanical, scale being loosened by its penetrative qualities. While the remedy is cheap and to some extent an effective one, the writer believes from experience that the use of kerosene causes about as much annoyance as scale itself. It will cause leaky joints and a general pitting throughout the entire steam system. It will dilute cylinder oil and at best is only a partial remedy as much scale will be left behind. Possibly the best remedy for the sulphate scale is to see first that the water enters the boiler at its coolest point, which is probably two-thirds distance from front to back of boiler, and a few inches below water line, in a return tubular boiler. Scale deposited at this point will be less harmful than elsewhere. A safe boiler compound should then be adopted that will act chemically on the precipitate, changing its solidifying character. The compound should be introduced, if possible, into an open feed-water heater and taken thence to the boiler. If the compound is effective both heater and boiler will be benefited. One should make use of soda ash as a boiler compound with great caution. The effect is the same as that of concentrated lye on packings, gaskets, and brass connections. Good results can be secured by use of some of the vegetable feed-water compounds. Such a compound should free the boiler from scale and keep it clean, in no way damaging the metal. A handy arrangement for feeding compound to the heater may be had by locating a barrel at somewhat higher level than the top of the heater and in a readily accessible position; a hole should then be tapped near the bottom of the barrel and also near the top of the heater and the two connected by a small pipe through a globe valve and check valve. The necessary amount of compound for a day's run may be mixed in the barrel and the feed to the heater regulated by a globe valve.

Washington, N. C. P. A. Tillery.

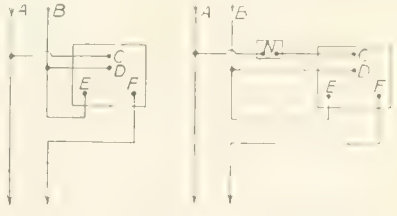
METER CONNECTION ON ALTERNATING-CURRENT SYSTEMS.

The measurement of power on an alternating-current system requires the use of a wattmeter, since the curent does not bear a fixed relation to the load as in a direct-current circuit, unless the power factor is unity. In nearly every system the power factor varies as the character of the load changes, and a wattmeter gives the true power regardless of any change in the power factor. On alternating-current systems there are two types of meters in general use, namely, the wattmeter and the watt-hour meter. The wattmeter gives the load at any time, but keeps no record of it. It is used for generator or feeder circuits and sometimes on main busbars or, in any case, where it is desired to note the load at different intervals of time. The watt-hour meter gives the load during the time and is constructed on the principle of an induction motor, the speed of which varies with the load passing through the main circuit. A worm on the shaft operates a train of gears, and a reading is obtained from pointers moving over dials; hence a reading may be taken at any time; the difference between any two readings gives the energy that has passed through the circuit during the time between the readings. The speed of the pointers is arranged so as to give a reading directly in watt-hours, or, multiplying the reading by a "dial constant," the result will be watt-hours or kilowatt-hours. This type of meter is sometimes used on generators, and it should always be used on the main busbars to give the total output of the station, and also on the service line of all customers. There is also a curve-drawing wattmeter made, but it is not in general use. Connections for all types are practically the same, and all types are made either for single or polyphase circuits.

For a single-phase system one single-phase meter is required. For a two-phase, a monocyclic or a three-phase system, two single-phase meters are necessary. A polyphase meter is simply two meters combined into one instrument. The two revolving disks are attached to one shaft, and the connections are exactly the same as for two single-phase instruments.

For circuits of 100 amp or less and a low voltage, the current coils of the meter can be made to connect directly in series with the circuit. However, with higher voltages it is undesirable to bring the circuit to the instrument, hence series and shunt transformers are used. Instruments to be used with series transformers usually have the current coils wound for 5 amp at full load. For tensions over 400 volts shunt transformers are used, and therefore meters may be used on circuits of any current-carrying capacity or voltage.

As the dial constant of a meter takes into account the ratio of the transformers, the meter should always be used with its own transformers, or if others of a different ratio are used, a new dial constant must be calculated. Fig. 1 shows the connections for a meter on a single-phase system, without transformers. *C* and *D* are the terminal studs of the potential coils, and *E* and *F* of the current coils. In this case the entire current



FIGS. 1 AND 2.—CONNECTIONS OF SINGLE-PHASE METERS.

of the circuit passes through the meter, and the potential coils are connected directly across the circuit. The voltage for which they are wound must be the same as that of the circuit. The resistance of the potential coils is high to limit the current flowing through them to a very small figure. Usually

it is necessary to connect a high resistance in series with the potential coils, and this resistance is sometimes placed inside the meter, or it is put in a separate case. When the resistance is external the connections are as shown in Fig. 2, *N* being the high resistance which must be connected in series with the potential coils. Fig. 3 shows the connections when series and shunt transformers are used, and an external high resistance, the primary of the shunt transformer being directly across the circuit. For a two-phase, four-wire system the connections are precisely the same, using a single-phase meter on each phase. The connections of two single-phase instruments on a two-phase, three-wire, a monocyclic or a three-phase, three-wire system may be represented in one diagram, if the proper arrangement of wires is observed. In the case of a three-wire, two-phase system the wire common to both phases should be the middle wire. In the monocyclic the middle wire must be the teaser, and in the three-wire, three-phase system it makes no difference which wire is considered the middle one. Fig. 4 shows the proper connections; *C-D* are the terminals of the potential coils and *E-F* of the current coils of one meter, or one element of a polyphase meter, and *G-H* and *I-J* of the other.

It is important to have the potential coil connected across the phase *A-B* for the meter or element that has its current coil connected to the series transformer in line *A;* likewise the meter or element connected to the series transformer in line *C* must have its potential coil connected across phase *B-C,* as mentioned before in a two-phase system. *B* must be the common return; that is, the line common to both phases. In a monocyclic system *B* must be the teaser; but in a three-wire, three-phase it is immaterial which wire it is. *N* and *O,* Fig. 4, are the high resistances to be connected in series with the potential coils of the meters. Eight wires between transformers and meters can be used if necessary; that is, separate wires to stubs *D, H, F* and *J.*

If ammeters are to be connected in to ascertain the current flowing in one or all of the lines, they can be cut in at *K, L* or *M.* That at *K* will indicate current in line *A;* that at *L* the current in line *C,* and that at *M* the current in line *B.* For ammeter at *M* to give the correct value of the current flowing in *B,* the series transformers must be connected up exactly as shown; two similar terminals must be connected to the common wire.

Voltmeters can also be connected across *R-S, S-T* or *R-T.* The voltmeter connections can, of course, be tapped on at any point of the circuit, except one wire must be on the side of the high resistance toward the transformer. For instance, one wire can be tapped on at any point of the wire *S-D,* but the other must be between *R* and *N.* The primary taps of the shunt transformers should be connected to the main circuit on the side toward the generator from the series transformer, so the current consumed by them does not pass through the series transformers. Overload relays for opening the circuit in case of trouble should have separate series transformers, except where indicating wattmeters or ammeters are used and a slight error in the reading is of no consequence. But for watt-hour meters, where accurate readings are of importance, relays should always have their own series transformers.

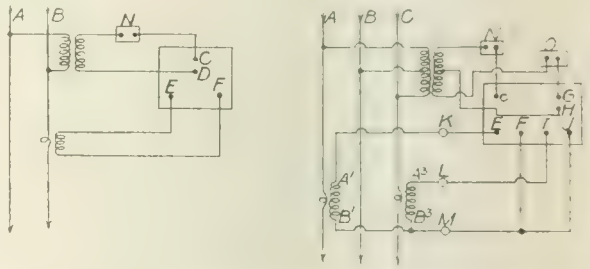
Owing to the construction of the series transformer, it operates normally with its secondary on a closed circuit of low resistance, or practically short-circuited. When the transformer is carrying load, its secondary circuit must not be opened, or the transformer will heat up to such an extent as to destroy the insulation on its coils. There will also be a high voltage impressed on the secondary circuit if the main circuit is carrying full load, and this voltage may be high enough to break down the insulation. It is also possible to receive a severe jolt if one should accidentally touch the secondary circuit when it is open. In testing the meters after they are in operation and it is necessary to disconnect the current wires, this circuit should first be short-circuited before removing the wires from the studs.

Usually, there is an arrow on the front of the meter case, which indicates in which direction the disk should rotate. If there is not, the proper direction of rotation may be ascertained by removing the case and turning the disk by hand, noting if the pointer on the dial starts moving in the right direction. After the meter is connected up, if the disk does not revolve in the proper direction it can be corrected by transposing the wires to the potential studs. If it is not convenient to transpose these, the ones to the current studs can be changed, and that will produce the desired result; but if both pairs are transposed the meter will not reverse.

In making this test on a polyphase meter, one element should be disconnected while the other element is being tested. Each element will then tend to revolve the disks in the proper direction. For this test the power factor must be higher than 0.50, as at this value the one meter or one element of a polyphase meter will stop, and at less than 0.50 it will reverse and run backward.

The foregoing also applies as well to single or polyphase indicating meters; the pointer should move over the scale, and if it tends to go backward against the pin at the zero mark, one pair of wires must be transposed.

For new work the switchboard panels come already drilled



FIGS. 3 AND 4.—METERS ON SINGLE AND POLYPHASE CIRCUITS.

for the instruments, but in mounting new instruments on old switchboard panels, holes must be drilled for the studs. The instruments should be located in the best position so as to improve the appearance of the panel. Usually a paper template accompanies the meter showing the exact location and size of the holes. This paper template can be pasted on the marble or slate in the exact position to be occupied by the instrument. The holes should be drilled as true as possible and can be a little larger than the studs, at least 1/16 in. Great care is necessary in starting the drill; generally it will save time to drill through first with a small drill, say, ⅛ in. The larger drill will then cut much faster and will not be so liable to run off center. When this occurs it must be corrected before the body of the drill enters the marble or slate. In laying out the position of the holes when a template is not used the centers should be marked with a prick punch and a line showing the edge of the hole scribed around the punch mark. If the drill runs off center it can be drawn back by cutting out with a fine chisel a little of the marble on the side of the hole toward which it is desired to draw the drill. Marble will drill faster by grinding the drill with more clearance behind the cutting edge than is used for metal. It is also best to dip the drill in water frequently; the dust will then form a paste and can be wiped off the drill. Thus the fine dust will not get over other instruments.

For satisfactory service a watt-hour meter must be set level. There is generally a planed surface on the top of the frame to lay a small level on. It is also possible to level a meter very accurately by placing a small piece of solder or lead on the disk near the edge; when level the disk will stay in any position, but if not level it will turn and come to rest with the weight at the lowest side. If the holes are not true it may be impossible to shift the meter to a level position; then the holes should be enlarged with a rat-tail file until the meter is level.

A wiring diagram should be made of the shunt and series transformers; also of the meter terminals, properly connected, marking each terminal with a number or letter. The number

of wires necessary should be measured off and cut, and each wire should be togged at each end so that any individual wire can be easily picked out. To make a neat job the wires can be pulled into a piece of loom or flexible conduit, or they may be taped into a cable and supported in position. The connections at each end can now be easily and quickly made with practically no risk of error. Tags can be made of a small piece of tin or thin sheet metal about ½ in. square with a hole punched in one corner and tied to the wire. The tags can be stamped with a letter or number, or a definite number of punch marks made on each pair.

PHILADELPHIA, PA. F. E. CONRAD.

LOSSES BY CARELESS FIRING, IRREGULAR WATER AND DIRTY BOILERS.

When the load on boilers is constant, the consumption of coal will be constant and regularity in firing and care of fires becomes a necessity. Irregular firing in such a case would mean loss of fuel and large fluctuation in steam pressure. Coaling over the entire surface of the fire is a loss; not only does a large portion of the gases escape unconsumed, but the boiler and furnace are cooled and remain so until the fresh bed of coal becomes incandescent, when the furnace and boiler will again become hot and steam will be generated. A loss also occurs from coaling one side of the furnace heavily and permitting the other side to burn down low, the uncovered or weakened side of the fire not being capable of igniting the fresh layer of coal until large quantities of gas have escaped. Hence no heat will be imparted to the boiler from the weakened side for a considerable time, thus causing the pressure to fall so that more heat will be required to raise the pressure to the original point. In such a case as this the loss is augmented by reason of the damper being kept wide open in order to have the weakened side burn its coal. Losses from dirty heating surfaces are just as great as the losses incurred by careless firing. When the tubes and shell of the boiler are allowed to get dirty or become covered with soot and ashes, the quantity of coal necessary to do the work under ordinary clean boilers can with dirty boilers readily increase from 50 per cent to 75 per cent. When the height of water in the boilers is allowed to fluctuate, losses also occur. It is a mistake to think that the carrying of low water will be an aid to economy in the generation of steam. In fact, the reverse is quite true; the higher the water is carried in the boilers the greater will be the amount of stored heat and, therefore, the boilers will be more capable of furnishing the required volume of steam for a greater length of time, thus enabling one to meet and more safely overcome the peak of the load throughout its duration. The heat of the average feed water is not above 208 deg. Fahr., and if the pressure carried is, say, 100 lb., then each pound weight of water pumped in the boiler or boilers must absorb considerable heat before it can form steam at that pressure; hence maintaining the level of the feed water at or about a fixed point in the gage glass is conducive to economy. Losses occur from leaky walls, flues and uptakes, dirty ash pits, leaking, safety and other valves. Leaks in the walls of the boiler setting can easily be located by taking a torch and passing the flame along each suspected hole or crack. If a leak is present the flame will be sucked in toward the boiler. It is almost needless to add that all cracks and holes should be promptly filled with fire clay or cement, and if fire clay and cement are not at hand asbestos cement will do the work nicely.

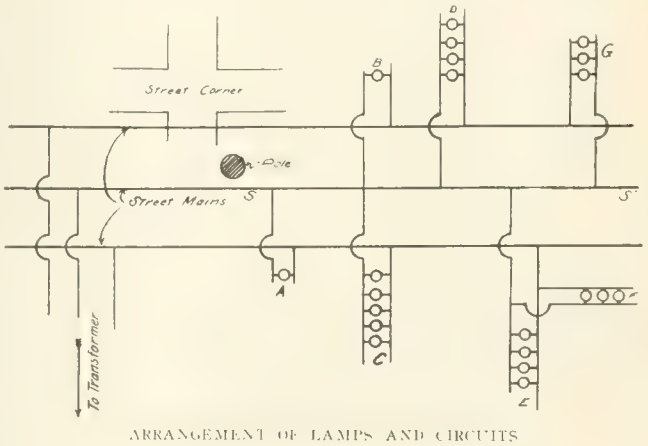
SAN FRANCISCO, CAL. JOHN HAINES.

AN OBSCURE FAULT IN A LIGHTING CIRCUIT.

Failure on the part of the lineman to make some very simple connection properly in an electric circuit may cause considerable trouble, by reason of the difficulty sometimes experienced in locating the source of the disorder.

The writer recently installed an alternating-current lighting system in a town where up to that time direct current had been used. The old system supplied 110-volt service near the power house, the load here being connected between the middle and either of the outside wires of three-wire mains; further away the middle wire of the street mains was left off and 220-volt lamps were used. When the new plant was put in it was desired to establish 110-volt service over the entire town. Hence three leads were run from the low-voltage side of the transformers to the old street mains and a middle wire was installed wherever these mains had previously consisted of only two wires. What happened on a part of this circuit may be best understood by reference to the accompanying diagram.

In the old direct-current line there were three wires as far as the pole shown at the street corner in the diagram. A middle wire was put in at *SS'*, the lamps being connected as indicated. A lineman, who was sent to put 110-volt in place of the 220-volt lamps on this circuit and to connect the middle wire at the corner pole shown, found the building at *F* locked, and hence the high-voltage lamps were not taken out at this place. That night the incandescent street lamps at *A* and *B* burned properly, as did also the lamps in the residences at *D*, *G* and *E*. As was to be expected, the 220-volt lamps at *F* were barely red. At *C*, however, one lamp at a time could be burned, but when all were turned on the lamps barely glowed at all. The wiring of this house was gone over carefully and found to be in good shape. The next day the line was ex-



ARRANGEMENT OF LAMPS AND CIRCUITS

amined and it appeared to be all right. The following night the lamps on this circuit, except those at *C*, which were reported as refusing to burn at all, were quite unsteady. Those at *B*, *D* and *G* fluctuated slowly all the time from a dull red to excessive brightness. On the next night the lamps at *E* went gradually out and all those on the other side of the street mains burned out. When on the morning following the current was turned on for the purpose of testing out the trouble the voltage at *E* was found to be zero and that at *G* approximately 220. Opening the entrance switches on the buildings at *C*, *E* and *F* took the voltage off entirely at *G*, and hence it became apparent that there must be a break somewhere in wire *SS'*, a result that had been carefully considered two days previous. A second examination of the circuit disclosed the fact that in tying the middle wire of the old street mains to the insulator where it was dead-ended at the street corner a very long tie wire had been used. The lineman had connected the wire *SS'*.

A puzzling thing about this case is that some of the lamps on the circuit under consideration burned in the normal way for awhile. Probably there was at first a conducting contact between the tie wire and the end of the old main; and the swaying of the wires in the wind may have caused the lamps to burn with the fluctuating brilliancy observed on the second night they were used, since such swaying would make the resistance of a loose contact variable. When this contact was destroyed the middle wire was connected to the outside wire on side *A* of the mains through lamps at *C*, *E* and *F*, thus putting the voltage of the outside wires on the other side of the circuit and burning out the lamps on that side. However, just why the lamps at *E* burned when those at *C* would not is not apparent.

CHAPEL HILL, N. C. J. E. LATTA.

QUESTIONS AND ANSWERS

Can two individual wattmeters be connected to show accurately the power being expended in an unbalanced three-phase, four-wire circuit?
E. A. T.

That two wattmeters may not register correctly the power used in an unbalanced three-phase, four-wire circuit will be evident when it is recalled that the current coils of the wattmeters may be connected in two of the outer wires, while all of the load may be between the third outer wire and the neutral. Under the conditions assumed herewith, the wattmeters would register zero, although, of course, a considerable amount of power might be expended in the single-phase circuit. In order to measure correctly the power in the four-wire, three-phase system, it is best to use three wattmeters, the current coil of each meter being connected in one of the outer wires, and the potential coils of the meters being joined between the neutral point and the three outer wires in which the individual current coils are connected.

What is the Pauling process of electrothermal oxidation of nitrogen?
H. H.

In the Pauling process air is directly burned in the arc produced between two electrodes of the horn type, well known in lightning arresters and often used for effecting the combustion of nitrogen. The arc travels up the two electrodes from the narrowest part of the gap until it breaks off, to be renewed the next moment. Air is blown into the gap from below and spreads the arc out. As arcs of several hundred kilowatts and 1 m in height have to be started at a high potential, which sinks abruptly when the arc is re-established, a special starting device is needed. This consists simply of two blades, which pass through the narrowest portion of the gap, at the point where the electrodes are slotted and bent. These blades approach one another in the vertical plane, when the milled heads at their insulated ends are turned. The ends of the blades are cut off at 45 deg., so that two sharp points face one another in the gap. The electrodes are made of iron; the horns are said to last 200 hours, and the blades somewhat less. Each furnace comprises two arcs burning in adjacent compartments, which are oval in vertical section. A furnace absorbs 400 kw at 4000 volts, and is fed with 600 cu. m of air per hour. The arcs, broad irregular flame sheets, are said to burn very steadily. The air is withdrawn above, cooled and reintroduced laterally into the upper portion of the flame.

How can slate switchboards which have been burned be cleaned?
W. H. B.

The damaged portion should first be rubbed down with sandpaper. This should be followed by a coat of good filler which must also be a non-conductor of electricity. When dry, all uneven surfaces may be evened up by the application of a good, hard-drying putty. The surface should then be rubbed down with rock pumice stone, cleaned and painted with two coats of color, followed by two coats of japan varnish which when dry may be polished in the usual way. Butter of antimony and raw oil make a good polishing medium.

It is desired to find the proper size of conductor for a three-wire underground cable allowing 3 per cent drop. The total distance from the transformer to the end of the circuit is 1000 ft., and 110-volt, 100-watt tungsten lamps are to be spaced approximately equal distances apart. Would the following formula apply: Circ. mils. = (10.8 × twice the distance × I × 100) ÷ (per cent × E). I understand that where wires in cables are carrying near their capacity, it is necessary to figure the reactance and impedance on alternating-current systems.
G. J. N.

When lamps are uniformly distributed along the circuit the voltage drop at the end of the circuit is just one-half as great as would be the case if all of the lamps were concentrated at the end of the circuit. This fact allows one to determine the size of circuits for uniformly distributed lamps with a considerable degree of simplicity. In the case mentioned a 3 per cent drop from an electromotive force of 220 volts would be 6.6 volts. With a current of 10 amp concentrated at the end of a circuit, the total resistance of the circuit could be 6.6 ohms. However, when the lamps are uniformly distributed the total resistance can be 13.2 ohms. The circuit having a total length of 2000 ft., the resistance per 1000 ft. should be 6.6 ohms, or a No. 8 B. & S. wire should be selected for the outside conductors. In almost no case is it necessary to calculate the reactance and impedance when cables are used for wires transmitting electricity to lamps.

We have a number of four-pole, 550-volt motors which occasionally give us much trouble owing to flash-overs. What would cause this and how may it be remedied?
O. S.

The usual causes for flash-overs are weak fields due to insulation rotting from the wires, or other defects which cause a shortening of the field circuit; and brush holders not spaced to cover the exact number of bars or placed to one side. The brushes should point exactly to the center of the armature shaft so that as the commutator wears they will not be thrown out of line and cover the wrong bars. Proper care should be taken in winding armatures to get the commutator bars perfectly lined with the slot in the armature core and to connect the proper lead from the coil to the proper bar in the commutator. With the coil lead one bar either way the same effect is produced as though the brushes were a little to one side, causing the brush holders to flash over.

Would a storage battery operating in conjunction with a power house having moderately fluctuating loads offer any advantages or show marked economy?
J. S. G.

In a small plant with few units, a battery is oftentimes useful for carrying peak and light loads and for a standby in case of accident to the generating equipment. In large stations, batteries are used to take momentary fluctuations, peaks and sudden demands. Very often they are installed as a guarantee against interruption to service, and this of itself outweighs all question of cost and economy.

What effect has the specific gravity of the solution on the e.m.f. of a storage battery?
C. A. O.

The e.m.f. of a lead, sulphuric acid cell varies with the specific gravity of the acid of a charged cell; but averages about 2 volts per cell. For a variation in e.m.f. from 1.9 to 2.1 volts the specific gravity variation is from 1.05 to 1.3 and between these limits the variation of voltage is gradual; but outside the limits the voltage varies much more rapidly than the specific gravity.

Why is it that the generators attached to turbines have larger air gaps than those driven by reciprocating engines?
L. A. J.

The number of poles on a generator for a given frequency varies inversely as the speed; consequently there are not so many poles in turbine-driven generators as in reciprocating engine-driven machines. Therefore, the former machines have a very large number of armature ampere turns per pole and this gives rise to a large armature reaction. In order to lessen the effect of this reaction, a large air-gap is necessary.

At various times I have experienced disagreeable odors in the neighborhood of mercury-vapor lamps. Is this imaginary, or if not, to what may it be attributed?
T. W.

The odor has hitherto been attributed to the ozonization of the air around the lamp by ultra-violet rays. Experiments, however, have recently been made which do not bear out this impression. The cause of the smell has been found to be due to the excitement of the olfactory nerves due to the electric charges of the ionized air round the lamp. This was proved experimentally by passing the air removed from the neighborhood of the lamp through an earthed metal tube in which the ions were discharged. The gas issuing from the tube was odorless; but when a glass tube was substituted for the metal one, the odor persisted.

Does the glass cover of an electric instrument ever exert an influence which might render it erroneous?
D. B.

Instruments like galvanometers, having a long pointer near the glass and a feeble directive force, may be influenced considerably in dry weather by simply rubbing the glass. Oftentimes delicate instruments in a dry, warm room are caused to indicate erroneously when touched by the dry hand. The trouble is due to the static charge on the glass and while the deflections so produced are not lasting they may be obviated by simply breathing on the glass before using the instrument.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Flat Rate for Porch Lights.

The Los Angeles Gas & Electric Company has inaugurated a new system which is meeting with considerable favor among its clients. This is to charge 70 cents per month for an 8-cp light burning all night on the porches of private residences. This light is a protection against burglars, and has been very popular with the residents of Los Angeles. The charge is so reasonable that hundreds of consumers have taken advantage of it, and it is entirely outside of the ordinary lighting bill.

The Grounding of Widely Extended Distributing Systems.

By J. A. Seager.

In small central-station systems covering a comparatively restricted area it is a quite simple matter to arrange that all non-potential portions of the system shall be sufficiently grounded. This is done by placing an adequately large earth plate at the generating station in damp ground or a coke pit, placed in the soil, and connecting up the framework of the switchboard to the earth plate. The lead covering of all cables brought to the board is then connected to the framework and thus an efficient earth is provided for every portion of the system.

Where, however, the distribution system extends perhaps over several square miles the potential difference between various portions of the earth itself becomes of increasing importance, and much more attention has to be paid to the matter. In a system of this sort in Great Britain containing a considerable number of substations at which the high pressure obtained from the generating station was transformed down to a suitable pressure, the covers of all the cables entering the substations were earthed at their respective substations in the manner indicated above. It was found, however, by the jointers employed upon the system that this manner of earthing was not sufficient, inasmuch as it was occasionally possible to get considerable shocks from the lead cover of the cable to earth. The matter was given attention and upon voltmeter testing it was found that there was a considerable difference of potential between a cable cover earthed at one station and that earthed at another substation. Numerous cases were found in which the continuity of the earth covering was broken at a street box. The trouble from this cause was so severe and the possibility of corrosion due to electrolysis was so dangerous that it was found the only way to effect a permanent cure was to link up all the substation earth plates with a special ring main of cable, thus equalizing the potentials between them and practically forming one big earth plate in place of about 15 separate earths.

Watt-Hour Meters.

In a paper read at the recent convention of the Colorado Electric Light, Power & Railway Association, Mr. F. P. Cummins, of the Denver Gas & Electric Company, gave much information concerning the practical operation of watt-hour meters.

The author stated that the modern types of meters were preferable to the older types by reason of improvements introduced to render the meters permanently accurate. The friction of the bearings supporting the moving element and the aging of the permanent magnets are the greatest factors that effect the accuracy after an extended period of use. The several other factors, such as frequency, voltage and temperature variation, cause only slight errors in the later type of meters. In a certain make of meter, within the past few years, there has been an increase of 300 per cent in the driving torque without an increase in the weight of the moving element and with only a slight increase in the shunt-circuit loss. After running for 5,000,000 revolutions the bearings on the modern type of meter show no appreciable wear.

As an indication of the monetary value of the loss in the shunt circuit it is to be noted that the actual cost of keeping a meter excited with energy at 1.5 cents per kw-hour at meter is about 2.25 cents per single-phase meter per month, or about $22.50 per thousand meters installed per month. The series coil loss is very small and varies with the load. A 10-amp meter may have a drop across the coils of 0.1 volt at full load on the meter.

The Denver Gas & Electric Company makes nearly all tests on meters in the shop. Series of tests are made from one-tenth to full load, after which an experienced meter man can tell where the trouble is if error is found. When the part supposed defective is repaired the meter is set and tested for light-load adjustment and for full load. No regular tests are made on the power-factor adjustment. Three-wire meters are tested on one side at a time, thereby giving the conditions of maximum unbalancing of load. Three-phase meters, which are simply two meters operating on one shaft, are tested with both potential coils and one current coil excited at a time. A fact worth noting in regard to this type of meter is the care that should be taken to keep each unit of a three-phase meter accurate rather than the sum of the two. If this point is not observed, the error on loads of any power factor other than unity will be governed by the element moving the faster.

Some months ago a test was made on the effect of change in power factor upon some of the older type of meters in comparison with one of latest design. The old-type meter was provided with a device for power-factor correction, but it was found that by closing the short-circuited turns the potential field became unbalanced to such an extent that creeping followed. The new meter was found to be without appreciable error from unity to 35 per cent power factor at one-fourth load, while the older type ran 30 per cent slow on 40 per cent power factor, 20 per cent slow on 60 per cent power factor, 12 per cent slow on 80 per cent power factor; at unity power factor, however, it was correct.

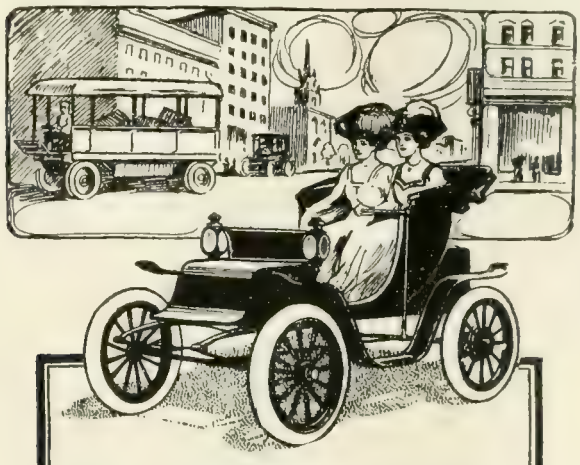
To give some idea of the loss in revenue occasioned by the use of the older meter on single-phase motors, the two-meter, three-phase combination for three-phase power measurement, or any induction load, consider the case of a 16-in. fan running on a 10-amp meter, taking about 1.25 amp at 110 volts, at 65 per cent power factor for 150 days of eight hours each, or 1000 hours. The actual consumption would be about 90 kw-hours, which at 8 cents would amount to $7.20. The meter would show a registration of only about 74 kw-hours, which would amount to $5.92, or a net loss to the company of $1.28 per fan. An arc lamp would even show a greater loss. An investigation of this nature made it evident that care should be exercised in placing only the newer type meters on fan service, the older ones being reserved for the incandescent lighting load.

A special test was also made on pivot-bearing jewels with the idea of replacing the present sapphire bearings with diamond jewels. Out of a lot of seven new sapphire jewels an average life of 900,000 revolutions was attained before any pitts or scratches appeared on the surface. With three diamonds, operating under the same conditions, an average life of 9,000,000 revolutions was attained. If the life of the jewel be based upon the record made by the diamond jewel and there be taken values the results of tests made upon 22 sapphire jewels removed from meters that had been in service for a greater or

less length of time, computing energy at 5 cents per kw-hour and diamond jewels at an extra cost of $1.40 each, the diamond would show a net advantage over the sapphire of from $26.80 for 700 meters operating at 5 per cent average load to $1 for the same meter at 40 per cent of full load. The author said that too much care cannot be taken in the selection of meters, in buying new ones and in properly selecting the older ones that may now be in possession of the company for service where they will give satisfactory results.

Electric Vehicles Advertised by a Central-Station Company.

The active interest that central stations are now taking in calling to the attention of the public the merits of the electric vehicle is shown by the advertisement of the Commonwealth Edison Company in a Chicago daily newspaper of Oct. 19. In several ways the demand for electricity for charging electric automobiles forms a desirable load on the central station, and it follows that far-seeing managers of electric service properties are desirous of encouraging the business. The principal demand for electricity used for this purpose comes during the summer months, when the lighting load drops off and when there is a somewhat decreased need for electricity for factory motors and heating appliances. The load factor of this business is also fairly good, and taken altogether the extension of the electric-vehicle business, relating both to pleasure and commercial vehicles, is worthy of attention.



The Efficiency of the "Electric"

is beyond question. For pleasure purposes it is ideal. It costs less than any other type of Automobile and its expense for upkeep is remarkably low. It is so simply operated—so easily controlled that a beginner can successfully run it. And considering safety, cleanliness and comfort—nothing compares with it for pleasure driving.

Its Wide Range of Usefulness

For trucking—or delivery—the Electric Vehicle is without a superior. In this field it represents maximum economy in barn space—low cost for maintenance and operating expense.

Charging Stations for Electric Vehicles are conveniently located all over the city. Arrangements may easily be made for wiring your stable or garage—for charging—by means of which you may operate your car at the utmost economy. For particulars call Randolph 1280.

Commonwealth Edison Company
139 Adams Street

ELECTRIC VEHICLE ADVERTISEMENT.

In the accompanying advertisement the Commonwealth Company calls attention first to the advantages of the electric car, both for pleasure purposes and for trucks or delivery wagons, and then points out how easy it is to arrange for charging the batteries in these automobiles either from public garages or from plants installed on the premises of the owners of the vehicles.

British Central-Station Rates.

The inaugural address of Mr. W. M. Mordey, president of the British Institution of Electrical Engineers during the past year, is now some months old, but far from being out of date in its matter. It is particularly rich in valuable data, and in effect is a spirited and effective defense of the British central-station industry against the popular imputation of lack of vigor. Mr. Mordey takes up the specific question as to whether electrical supply in England is backward and ineffective as compared with other countries, and brings to the support of the negative a formidable battalion of statistics. Of course, it must be admitted at the start that British electrical industry is somewhat handicapped by legislative restrictions of a character that make the initiation of large enterprises a matter of grave difficulty, and in particular make large power transmission work almost impossible. How far would Americans have advanced if every charter had to be fought through the United States Senate in its usual dilatory frame of mind? That British industry has made the progress that is evident from Mr. Mordey's presentation is a subject for profound congratulations. They are perhaps slow to move, but once under way they push doggedly ahead alike in industry and empire building and the results come in due season. The race is not always to the swift in the developing of industries, and in this case Mr. Mordey clearly shows that British persistence has in fact achieved considerably more than is popularly believed. Even a casual inquiry in England brings out the fact that electrical supply is quite widespread and relatively cheap, and the further one goes in the investigation the more striking the results.

Mr. Mordey marshals his data in a very telling manner. He gathers the complete data for six typical cities of three classes: First, those over 350,000 inhabitants; second, 100,000 to 200,000, and third, 10,000 to 20,000. Beside these stands London, unique, colossal, unapproachable. Now, taking up these groups, he finds for the large cities an average actual price of 6.44 cents per kw-hour, for the moderate sized cities 6.60 cents, and for the small cities 8 cents. These figures apply to lighting alone. It is evident at a glance that the average Briton gets electricity at a very moderate figure. London, even in spite of its heterogeneous supply, furnishes lighting at 6.55 cents per unit. The low prices set one to thinking, for their reason is not quite self-evident. That they are lower on the whole than here is clear, and Chicago, the only American city studied by Mr. Mordey, confirms this judgment by showing an average of 7.04 cents per unit. Now, in the first place there is an element of some uncertainty introduced by the fact that the supply in 16 of Mr. Mordey's 18 typical cities is from a municipal plant. And experience shows that in such plants there are very often unconsidered matters that result in a cost apparently lower than it really is and hence tempting to a lower price. This fact, whatever it may be worth, certainly has some bearing in comparison with American plants. In the case of German plants, which are largely municipal, this element of doubt may perhaps be set aside.

Another thing to be borne in mind is that in England competition with gas is a rather serious matter, gas being in general very cheap notwithstanding the high cost of coal. Here the gas man is on the defensive, there he is rampantly aggressive. Hence, there is a strong tendency toward forcing downward

the price of electricity. Finally, as compared with American the labor costs in England are low. In Germany, on the other hand, labor costs are not far from the same as in England. To continue his comparison, Mr. Mordey takes the corresponding groups of German cities, setting Berlin apart in a class by itself, and making his classification on the same basis as with English cities. For the large city the average price of energy for lighting turns out to be 11.34, for the medium-sized cities 9.34, and for the small cities 10.54 cents per kw-hour. More than this, every one of the six large German cities charged a price higher than the highest English city of the same class. Surely the British consumer is not getting the short end of the bargain when it comes to the cost of energy. And it is evident that the British consumer appreciates his advantages, since in the large cities he used for lighting 12.7 units per inhabitant, in the medium cities 9.2, and in the small cities 12.6. The corresponding German figures are 7.68, 7.30 and 12. London runs up to 28 units for lighting per inhabitant, while Berlin stands at 15.8. For comparison consider Chicago with 36.7 units. In units for motors, however, Berlin stands at 20.7 units per capita against London's 9.3, and Chicago comes cheerfully in with 24.3 units. Broadly speaking, all the figures show the stimulating effect of low prices on demand. It is a pity that Mr. Mordey could not obtain data from more American cities, but Chicago is an excellent type of the larger ones. His data for Paris were unfortunately incomplete, but showed a very much smaller use of energy than in London or Berlin, as might be expected from the enormous Parisian prices—higher probably than in any other city having any claim to consideration.. It is interesting, by the way, to note that Chicago shows greater use of lighting energy per capita than any other city in Mr. Mordey's list and in total use per capita is excelled by but one, Geneva, with 60.6 units per capita for motors. All in all, Mr. Mordey has clearly shown that his countrymen have been holding up their end excellently so far as relates to the commercial side of electricity.

Electric Service at Saratoga, N. Y.

BY WILLIAM H. STUART.

Saratoga, N. Y., has a winter population of 13,000, and in the height of the summer season 50,000. The main source of wealth to the citizens are the summer visitors, and the principal industry is the manufacture of silk gloves. In 1887 the Saratoga Gas Company started an electric light plant, the first in the town, as a side issue. This plant was located on the gas company's property on Spring Avenue and was housed in one of the gas-works buildings. The equipment at that time consisted of a 50-light Fort Wayne and Jenny arc machine. This was driven by a 65-hp Armington & Sims engine. The boiler was rated at 50 hp. In 1889 the American Illuminating Company started a plant in opposition to the gas company, at the corner of Ash and South Franklin streets. The equipment of this plant consisted of a 100-hp boiler, one 50-hp and one 75-hp Armington & Sims engine and two American-Wood arc-light machines. In the next year a consolidation took place, the title of this combination being the Saratoga Gas & Electric Light Company. The plant of the American Illuminating Company was dismantled and the equipment was moved to the gas works on Spring Avenue. To this equipment was added a Westinghouse alternating-current incandescent machine. In this same year, 1890, another company known as the People's Gas & Electric Company was organized. This company's plant was erected at a place called Geysers, and its equipment comprised two 50-light Westinghouse arc dynamos and one 750-light incandescent machine. After operating nine months the company failed. In 1893 the Saratoga Gas & Electric Light Company was reorganized and took up the business of the defunct People's Gas & Electric Company. The name of the company was changed to the Saratoga Gas, Electric Light & Power Company, which name is still retained.

On July 3, 1903, the plant of the company was shut down and dismantled and energy purchased from the Hudson River Electric Company. The amount purchased at first was about 125 hp, but the load has steadily increased until to-day it is about 3500 hp. The energy is received at a tension of 23,000 volts and is transformed to 2300 volts and again stepped down to 127 volts, single-phase, for lighting circuits and 220 volts, three-phase, for motor circuits. The company simply owns the outlets from the Hudson River Electric Company's converter station at the Geysers, and thus has nothing to do with the generating or transforming apparatus. The main water-power station of the supply company is located at Spier Falls, this being supported by another water-power plant at Mechanicsville. Here also is a steam emergency plant which is kept in readiness for operation in case of trouble.

Street lighting is done under a four-year contract dating from October, 1908. The number of lamps in nightly operation is 159 enclosed-arc lamps and 167 20-cp series incandescent lamps. The former are furnished at a cost of $87.50 per lamp per year, the latter costing $20 per lamp per year.

The meter department of the company is located at the office, 491 Broadway. Each meter is tested when received from the maker and retains the maker's number, by which it is known upon the records of the company. The meters, both gas and electric, are looked after entirely by the meter men. There are four men who operate this department and their duties call for testing, repairing and reading the meters every month. They also deliver bills and attend to inside trouble.

In 1903 the company started a new-business campaign along organized lines. Two men were delegated to act as solicitors, spending all their time during the spring and summer months securing new business and in the fall and winter months devoting their time to other work. A card system was introduced which noted every house in the town and its lighting equipment. These cards are kept up and used over and over again. Each call of the solicitor is noted under the proper date. From time to time special campaigns have been made to introduce the flatiron and other heating and cooking appliances and also the electric fan. The increase from 100 hp to 3500 hp is traced directly to three things: soliciting, introduction of a 24-hour service, and a reduction in rates from 20 cents to 4½ cents per kw-hour to large consumers. All of these improvements were started in 1903. In 1905 and 1906 the company did considerable advertising, but in 1907 and 1908 the advertising was suspended on account of the financial depression. Advertisements are carried in the two daily papers, the reading matter being changed once every week. Occasionally the company places pasters on the monthly bills advertising some feature like the flatiron or the electric fan. Manufacturers' advertising matter of electric appliances is always sent out with the bills and placed for distribution in the office.

Size of motor in horse-power.	Minimum charge.	Approximate full load consumption monthly in kw-hours; 10 hours per day, 26 days per month.	Average price per kw-hour when motor is run at full load.	Constant price per kw-hour after minimum charge has been deducted from gross charge.	Price per horse-power per month when motor is run at full load.
1	$1.00	200	$0.05	$0.045	$10.00
2	2.00	400	.04	.035	8.00
3	3.00	600	.04	.035	8.00
5	5.00	1,000	.035	.030	7.00
7.5	7.50	1,500	.035	.030	7.00
10	10.00	2,000	.03	.025	6.00
15	15.00	3,000	.027	.0225	5.50
25	20.00	4,000	.025	.020	5.00
30	30.00	6,000	.025	.02	5.00
40	40.00	8,000	.0225	.0175	4.50
50	50.00	10,000	.02	.0150	4.00

The rate for incandescent lighting varies from 11 cents to 5 cents per kw-hour. The minimum charge is $1.10 for 10 kw-hours or less consumed in any one month. A discount of 10 per cent is allowed for prompt payment. The sign rate is 5 cents per kw-hour. Panel signs are furnished free of charge and maintained. The minimum charge upon this class of signs is $1.90 per month on one of 24 4-cp lamps. All special signs

are sold at cost to the consumer and erected free. The signs are maintained for the consumers free of charge.

The rates for motor circuits are given in the table on the preceding page.

Thus, according to this scale, in computing the bill of a consumer who has a 10-hp motor with a consumption of 100 kw-hours, the charge would be $12.50. This would be 100 kw-hours at $0.025 plus a minimum charge of $10, making the total bill $12.50. It is readily seen that the rate is a favorable one for the consumers. There are no special rates granted. The company adheres strictly to its schedules.

During the last few years the company extended its service to Balston Springs. Here the consumers were all on the flat rate per equipment and without regard to the installation. After awhile it was thought advisable to install meters in this territory. That this could not be done without loss of some of the consumers and considerable dissatisfaction was apparent. It was found that consumers were getting energy for almost nothing. One of the largest consumers in Balston was approached first and a meter placed on his service. It was found that he was getting energy on the old flat rate for about $125 per month cheaper than by meter. On investigation it was found that there were many lamps that were never turned off. In the coal bins and storeroom, out-houses and halls large lamps were used where smaller ones would have answered. When the matter was called to the attention of the consumer, he readily made a change in the equipments with the result that light sufficient for all needs is obtained at a cost a little above what was paid on the flat rate. One large consumer would not listen to the meter proposition and installed an acetylene plant. This he operated but three months when he again used the company's service.

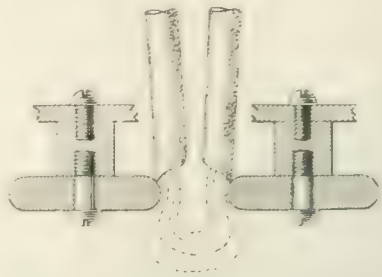
When a consumer has used a motor for a time and finds that he needs a larger machine, the company makes arrangements whereby the old motors will be sold by it to a firm which will give a much better price for the old machines than the consumer could possibly obtain were he to try to sell the motors himself. This policy has been the cause of consumers making the necessary changes in their equipment just as soon as they felt the need of additional power.

Mr. P. F. Roohan, the general manager, speaks of the work of the company in Saratoga as one that had been growing fast for some time and will still continue. Saratoga is wholly a high-class summer resort, and, of course, the heaviest business is done at that season. The balance of the year the business drops off considerably. The work of securing all the business possible must be done really during a few months of the year and it requires the energy of the entire force. The advertising is directed to uncover the business, but the company acquires it by hard and quick soliciting. The motor load is increasing and while the town is in no way a business one, yet there is considerable manufacturing done, and there is bound to be more. The company is seeking to secure all the business. Within a short time it will again resume an active campaign for new business, which was discontinued on account of the recent financial depression. The officials of the company are: President, Mr. E. Ashley; vice-president, Mr. C. E. Parsons; secretary and treasurer, Mr. E. West; manager and superintendent, Mr. P. F. Roohan.

INTERIOR WIRING AND ILLUMINATION

Support for Flaming-Arc Electrode.

The material forming the stops for the arc-lamp electrodes shown herewith is the subject of a patent issued on July 27 to Mr. Ralph Scott. Use is made of an alloy having equal parts of zinc and aluminum. The oxides of these metals are non-conducting, so that the stops will not allow an arc to form on their surfaces. The stops are non-magnetic and do not attract the arc, and they are heat-conductive and hence remain comparatively cool even where exposed to the arc zone. It is

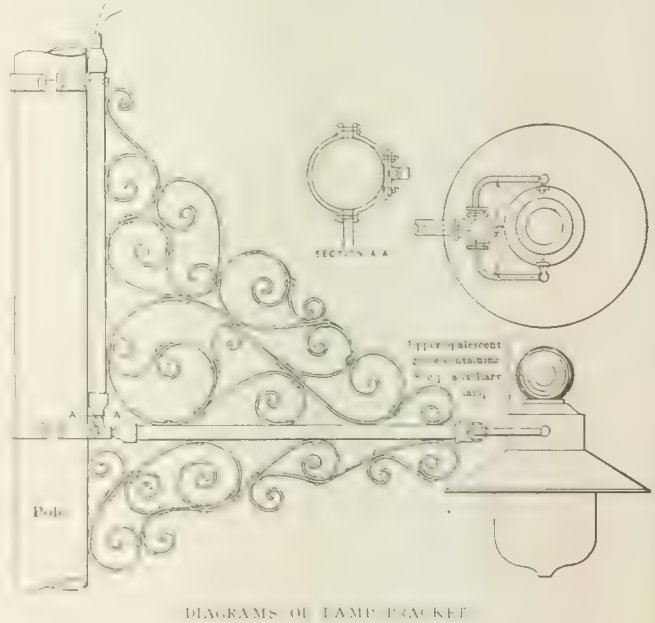


SUPPORT FOR FLAMING-ARC ELECTRODE.

claimed that the fusing point of the zinc-aluminum alloy is so high that it is out of the range of possible fusion by the arc.

Utilizing Electric-Railway Poles for Lighting in Kansas City.

Visitors to Kansas City are impressed with the clever and artistic way in which the side-suspension poles of the street-railway company are utilized also for street lighting. The accompanying drawing shows how the poles of the Metropolitan Street Railway Company have been made to serve this purpose by the engineers of the Kansas City Electric Light Company. It may be explained that both the street-railway and electric



DIAGRAMS OF LAMP BRACKET

light companies are owned by the Kansas City Railway & Light Company.

A handsome bracket fixture is attached to the electric railway pole at the side of the street. The framework of this fixture is of ornamental iron work, and the dimensions are such that the lamps, suspended by a trunnion, extend 40 in. over the street. The fixture is clamped to the iron pole in the manner clearly indicated in the accompanying drawing. While the fixture itself is made of iron work, the hood of the lamp is of copper. As originally designed, it was intended to place one 250-watt tungsten lamp, enclosed in a clear globe, in this fixture, but it was found, owing to the vibration and the delicate filament, that the life of the lamp was very short and also that the lamp threw a shadow on the street which was undesirable.

To overcome these defects the single 250-watt lamp was replaced with three 100-watt tungsten lamps. This ar-

rangement has been found to be very efficient from an illuminating point of view, while the life of the lamps has been increased materially, as the filament in the 100-watt lamp is much shorter than in the 250-watt size and is therefore better able to withstand vibration.

Above the lamp hood is a small opalescent globe about 5 in. in diameter. In this globe is placed an ordinary 8-cp carbon lamp. This finishing touch is considered essential, as it not only rounds out the fixture and makes it much more artistic and satisfactory, but it also prevents the formation of any deep shadow above the principal light-giving source. The whole combination is pleasing in appearance, and the fixtures are not only useful at night, but attractive in the daytime as well. The addition of the little lamp above the hood of the main lamps used for lighting is something of a novelty, but the result shows that the idea is conducive of an illuminating advantage that is generally commended.

Industrial Show at Buffalo.

The chief feature of the Buffalo Industrial Show, which was held from Oct. 6 to 16, was the electrical display, both inside the large arsenal and on the streets. The outside illumination consisted mainly of two large arches, one at Lafayette Square and Main Street, which is shown in the accompanying photograph, and the other at the entrance to the Broadway Arsenal, where the exposition was held. This second one spanned the street, Broadway, and was as high as the building. Besides these, decorative lamps spanned Broadway at intervals and showed the way from Main Street to the exposition building. The International Railway Company decorated and illuminated with about 250 lamps a large flat car on which stood a huge white buffalo, about 15 ft. high, with two incandescent lamps for eyes. This float was run over the principal car lines of the city between 5 and 9 o'clock each day.

The general interior illumination was furnished by 5000 16-cp carbon-filament lamps placed in 10 girder arches and five large electroliers. The roof truss work was concealed by fireproofed yellow bunting. For special lighting of booths tungstens, linolites, carbon-filament and Cooper Hewitt lamps were used. Although the building is very large (60,000 sq. ft.), no arc lamps of any kind were used anywhere.

In an industrial show there are always a large number of mechanical devices and machines that require power for demonstration, as does also the exhibitor who manufactures some of his products to show the different operations. There were 18 motors equivalent to 90 hp connected to furnish power.

For all lighting circuits, 25-cycle, single-phase current was used, distributed by three-wire system at 205 volts. In a small adjoining portion of the arsenal were placed the main transformers, four of 25 kw and three of 50 kw rating, connected to the 2200-volt outside overhead system. The distributing circuits were run from a large switchboard placed inside the main building.

For the five booths of the Buffalo General Electric Company two transformers were mounted on the exterior west wall of the arsenal. In a transformer house in the exhibit of the Cataract Power & Conduit Company there were three 20-kw oil-cooled transformers connected in delta, reducing the e.m.f. to 440 volts from 2200. One 5-kw transformer, connected to one phase, reduced the e.m.f. to 104 volts for the lighting circuit. This working example of transformer-house equipment was completed by an oil switch and circuit-breaker panel.

The exposition had an auspicious opening, the Japanese Commercial Commissioners being the honored guests on the opening night, Wednesday, Oct. 6. Baron Shibusawa threw in the main switch and formally opened the show.

The exhibit of the Buffalo General Electric Company covered five sections of floor space, and apparently was the most interesting to the majority of people. The "House Electric," as the exhibit was called, contained four rooms completely furnished in all respects, the kitchen, dining-room, bedroom and drawing-room. The fifth section contained a line of the General Electric Company's latest electric household devices and utensils. The wiring was very good, separate circuits taking care of the heating devices and the lamps, and a large number of base plugs were installed in each of the five booths so that demonstrations of all apparatus by well-informed demonstrators were possible.

In the drawing-room, besides an artistic ceiling fixture and portable table lamp, there was an electric luminous radiator kept in operation; in the dining-room, ceiling and wall fixtures and coffee percolator, chafing dish, toaster and tea kettle ready for use on the table. The bedroom was comfortably lighted and was provided with several base plugs also. This room was fitted up with a luminous radiator, water heater, curling iron, shaving mug and vacuum cleaner. Last, but probably most popular, was the kitchen, where were displayed a cooking table, oven, frying pan, tea kettle, coffee pot, griddle, double boiler and numerous other devices manufactured by the General Electric Company and the Westinghouse Electric & Manufacturing Company. A Thor electric washing machine proved very interesting to the women, as, in fact, did all of the household devices. The lamps used in these booths were 25-watt tungstens.



DECORATIVE LIGHTING OF ARSENAL FOR INDUSTRIAL EXPOSITION.

The Cataract Power & Conduit Company's exhibit attracted unusual attention considering that the nature of the work or exhibit of a transmission company is more technical and is more difficult to show than is electric lighting and heatng apparatus. The transformer house, which was part of the exhibit, has already been described. A 40-kw, 250-volt, direct-current generator driven by a 60-hp, 440-volt, three-phase induction motor, with switchboard, was also shown, and four aluminum 25,000-volt lightning arresters with horn-gaps were connected up, while a fifth was shown in sections.

The Robertson-Cataract Electric Construction Company exhibited, among other electrical devices, fuse cabinets, panels and an induction motor dis-assembled. Two Cooper Hewitt lamps were used to augment the general illumination. The Buffalo Forge Company showed some electric forges and blowers; Schneible Brewery Machine Company, motor-driven beer pumps, etc.; United States Headlight Company, different types of headlamps as used on electric and steam railways all over the country; Wegner Machine Company, motor-driven refrigerating plant in operation; and the Automatic Transportation Company, motor-driven carriers. Both the Bell and Federal Telephone companies had booths.

The exposition in all respects was better and more popular than previous ones and will continue to be an annual affair. That the electrical illumination and decoration was largely responsible for its success is certain from the main remarks which were heard—it was really an electrical show.

An Automatic Starting Compensator.

By George S. Wall.

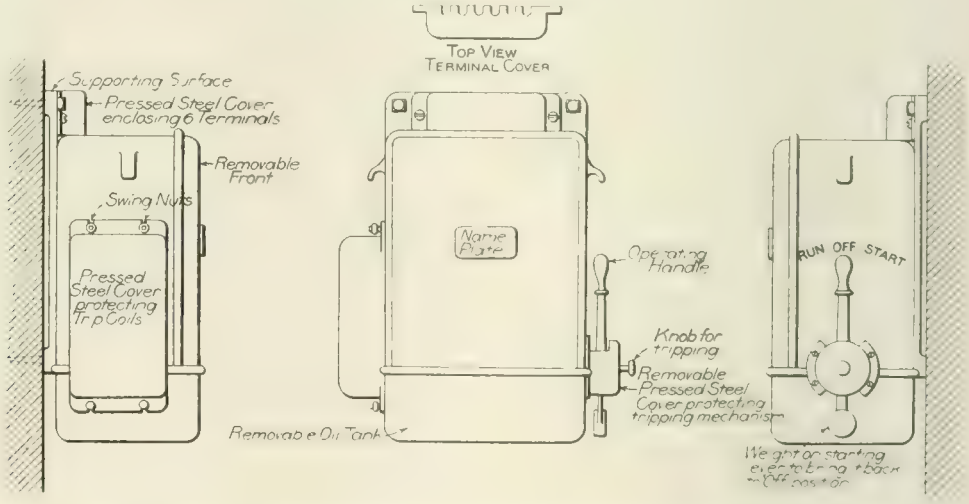
The subject of safety service boxes for induction motors must have been frequently considered by industrial plant engineers. A recent writer proposes enclosing the fuses protecting induction motors in a service box which should also be arranged so that it can be made to perform the functions of a switch. This appears to be excellent as far as it goes, but there is a well-defined movement on foot toward the elimination of fuses for the protection of motors and the substitution therefor of automatic cut-outs. The first cost of automatic protecting equipment is very much higher than that of fuses and holders, but for many applications the annual cost, taking into consideration the value of fuse renewals and of time and labor lost while a blown fuse is being replaced, is less with automatic protection. Certain industrial corporations specify double-pole circuit-breakers on all direct-current motor-starting panels, and much of the motor-starting equipment for the United States Navy is provided with this kind of protection. The same manufacturing concerns referred to above protect polyphase motors with circuit-breakers having the breakers so arranged that protection against overload is provided with the starting compensator switch in either the running or the starting position. A no-voltage release device for the circuit-breaker is usually specified. These equipments serve their uses well, but usually bare metal current-carrying parts are exposed, which is undesirable for electrical, commercial and humanitarian reasons. Furthermore, it does not seem reasonable to cut a circuit-breaker into a circuit which already contains an oil switch which can readily be made automatic.

The writer has often wondered why some one of the induction-motor manufacturers did not develop, for use with polyphase motors, what might be termed an "automatic starting compensator." This would be a standard compensator with which would be incorporated overload and no-voltage trip coils so arranged as to cause the oil switch, which now forms a part of each compensator (probably somewhat modified) to assume an open position under overload or no-voltage conditions. Such a device might be arranged somewhat as indicated in Figs. 1, 2 and 3, which show, respectively, left side, front and right side views of a commercial starting compensator arranged for automatic protection.

On the left-hand side of the cast-iron case, enclosing the compensator coils, is mounted a pressed-steel cover, easily removable by unscrewing swing nuts, containing the no-voltage and overload release trip coils. Motion from these is transmitted to the tripping mechanism, concealed in a cover at the right-hand side of the case, by means of a slender rod extending through the switch shaft, which is hollow. A knob extends to the right from the tripping-mechanism case for manually tripping the switch.

The switch operates in oil contained in the removable oil tank and is restrained by a spring which tends to hold it always in an open position. The operating handle lever is not rigidly attached to the hollow switch shaft and only operates the shaft when the tripping mechanism is in normal engagement. Upon either no-voltage or overload, one of the trip coils, located within the pressed-steel cover at the left of the case, acts and disengages the handle lever from the switch shaft and by virtue of the spring referred to above, the switch assumes an open position.

The following six requirements should be satisfied in the construction of an automatic starting compensator designed to fulfill the requirements and withstand the abuse of industrial-plant operation at the hands of ignorant and often vicious operators: (1) All bare current-carrying parts should be totally enclosed, as should trip coils and tripping mechanism. Swing nuts should be provided for attachment of covers which it is necessary to remove at times of inspection. (2) Handle and switch should be so restrained that they must first be thrown to "starting" position before being thrown to "running" position. (3) Handle and switch should be so arranged that they cannot remain in "starting" position unless manually held there. If the hand is removed from the handle they should return automatically to "off" position. (4) Handle should be so arranged that a quick throw is required to bring it and switch from "starting" to "running" position. (5) When brought into "running" position handle and switch shall be automatically held there until released, by either the no-voltage or overload release or the hand tripping knob, when they shall automatically return to "off" position. (6) A no-voltage and an overload release shall be provided which will, on no-voltage or overload: (a) permit switch and handle to return automatically to "off" position from the normal "running" position described under 5, or (b) permit switch to return automatically to "off" position even though the handle be manually held in either "starting," "running" or intermediate positions. When the hand is removed from the handle it also should automatically return to "off" position.



FIGS. 1, 2 AND 3.—DIAGRAMMATIC VIEWS OF AUTOMATIC STARTING COMPENSATOR.

The necessity of the requirements outlined under item 1 is obvious. It is really deplorable to observe the makeshiftts which electrical superintendents in some mills have to resort to in order to enclose "live" parts of controlling apparatus located in exposed positions. Enclosures of simple, rugged design should be provided by the manufacturers of equipment. Swing nuts should be used where possible instead of ordinary machine screws because they are not easily lost.

Referring to item 2: If a compensator is not arranged as therein specified the unskilled attendant is as likely to throw

the starting handle to the "running" position first as to the "starting" position. Most commercial starting compensators are now so designed that this regulation is complied with. If the suggestion of item 3 is not followed, frequently motors will be allowed to operate for long periods on the "starting" voltage, and as in such cases they are usually over-protected, trouble ensues from overheated stator windings. Some modern compensator starters are arranged in accordance with this requirement and some are not.

The provision of item 4 is necessary to prevent the appreciable slowing down of the connected motor while the compensator switch is being thrown from "starting" to "running" positions. Some commercial starters already have this feature and some have not. Features to meet the requirements of items 5 and 6 are not, to the writer's knowledge, incorporated with the starting compensators furnished by any induction-motor manufacturer, and it is by their incorporation that the use of fuses at the compensator could be eliminated.

The wiring diagram in Fig. 4 is a suggestion for a scheme of connections for an automatic starting compensator, such as this article advocates. At the point where the branch wires to the starter are tapped from the mains, fuses are provided. These are for the protection of the branch conductors only and are not for the protection of the motor. They should be of large current-carrying capacity so as readily to pass the starting current to the motor. A no-voltage trip coil is bridged, between two of the conductors, within the starter. Overload trip coils are inserted in series with two of the lines. The taps from these to carry the starting current are taken from such a turn in the windings as to cause the coils to trip on excessive starting current. The running current, which is always considerably less than the starting current, traverses the entire length of the trip-coil winding to provide sufficient amp-turns to give an equivalent tripping effect.

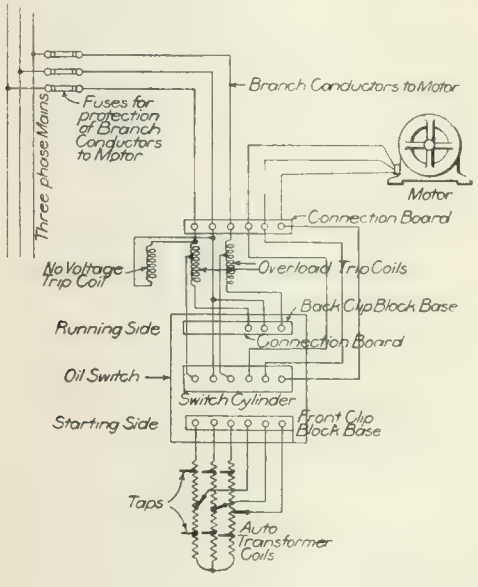


FIG. 4.—WIRING DIAGRAM.

It is further suggested that it is more logical to cast the legends "Run," "Start" and "Off" on the upper portion of the compensator case, as indicated in Fig. 3, where they are conspicuous and easily read instead of in the usual obscure location at the bottom of the starter on the side of the oil-tank casing. With the legends located as in present practice, on the oil-tank casting, when the tank is removed, to admit of inspection of the switch, there is nothing to indicate to a "green" electrician which is "starting" or which the "running" position, and in these days, when every second has its value, it should not be necessary to refer to a casting, which may have been carried away for new oil or for cleaning to get the information.

LETTER TO THE EDITOR.

Exhaust Steam Heating.

To the Editor of Electrical World:

SIR:—The several articles on steam heating by central stations which appeared in your first issue for October bring to mind the statement frequently heard that less coal is required when the exhaust steam is used for heating than when it is allowed to go to waste. Among the conditions that have caused this statement to be put forward in good faith, mention should be made of the increase of the electric lighting load when exhaust steam heating is undertaken. It is well known that the amount of coal required per kw-hour decreases considerably when the output from the station apparatus increases, all other conditions remaining unchanged. When exhaust steam heating is added to the load on the boilers, it is usually the case that the electrical load has increased also, so that the coal which would be required per kw-hour under the larger electrical load, without steam heating, would be considerably less than was actually needed before the heating load was added. Hence, when one compares the total coal used per kw-hour at the larger load directly with that required for the smaller load, he ignores an important change in the conditions. It is not surprising, therefore, to learn that in many cases the small increase in coal required for the heating load when divided by the increase in kw-hours of the electric load is even less than the coal per kw-hour required for the smaller initial electrical load.

The report in the issue referred to, from the Johnstown, Pa., plant, shows an increase in electrical output of 11 per cent when the exhaust steam heating load was added, and doubtless this increase would account in part for a decrease in the coal required per kw-hour. The reported decrease in actual coal consumed of 11 per cent is to be attributed to many causes in addition to the use of the exhaust steam, such as improved methods of firing, better grade of coal, less loss by radiation, etc. Whatever may be the causes for the results, the fact remains that the increase in coal required when the exhaust steam is used for heating is so small that the practical operating man is unable to detect it in many cases. It would seem that the advantages to be derived by central stations from adding an exhaust steam heating load would justify a thorough investigation by every manager in the Northern States.

NEW YORK. A. M. STRATTON.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Commutation.—J. SUMEC.—The conclusion of his theoretical paper on the present status of the commutation theory. The author discusses the current density when the brush leaves a segment and then applies his theory to the calculation of commutating poles.—*Elek. Zeit.*, Oct. 14.

Regulation of Low-Voltage Transformers.—E. F. GEHRKENS.—An illustrated description of a new method of voltage control for a 1600-kw, 25-cycle, single-phase transformer. It is wound for 2200 volts primary and from 40 volts to 200 volts secondary, the range being obtained by means of taps in the primary and a series or parallel connection of the secondary. It is designed to deliver 1600 kw at any voltage within the range given—that is, it has a range in current of from 8000 amp at 200 volts

to 40,000 amp at 40 volts. The regulation is made gradually and not in steps by means of a combination of switches so arranged that, by the use of a compensator and a number of small resistances, a simple and smooth regulation is obtained. Detailed drawings are given of the arrangement.—*Gen. Elec. Review,* October.

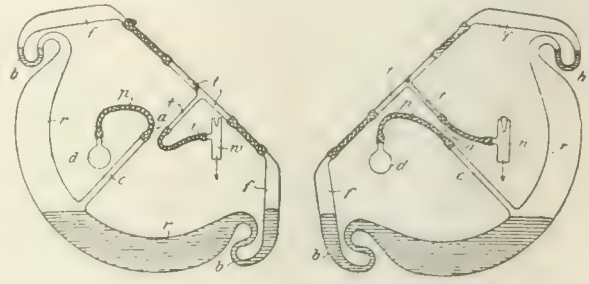
Lamps and Lighting.

Metallic-Filament Lamps for Street Lighting in England.—An article on the progress made during the last 12 months in a large number of English cities in the use of metallic-filament lamps for street lighting. The chief advance has been made in side streets. The use of flame-arc lamps in such positions is rather uneconomical, while the use of either Nernst or ordinary carbon lamps in fairly large units is inefficient from the electrical point of view. The metallic-filament lamp has just filled the breach, for it is now possible to obtain a high-efficiency lighting unit giving sufficient illumination for the purpose at a low cost. At Marylebone 1964 street lamps have now been converted from gas to electricity, costing nearly $7,500 less than was paid for the gas; nevertheless, a profit is being made on the electric lighting by the municipal station. At Croyden 265 side-street lamps have been installed. The lamp contains a single 200-volt, 88-watt Osram unit, giving approximately 70 cp. Further, it is proposed to scrap all the enclosed arc lamps (direct and alternating) and to replace them by high-candle-power metallic-filament lamps. Although it is not definitely decided whether a specially designed lantern containing three 110-watt, 200-volt lamps shall be used, a number of these are being erected and are giving very satisfactory results. Although the specific lighting output in candles per watt is not so high as with the magazine flame lamp, the initial cost is about one-sixth of that of the arc lamp, and beyond the cost of lamp renewals and energy there is very little further expenditure. A life of 2000 hours can be safely reckoned on for both the 88-watt and 110-watt lamps. At Croyden almost the whole of arc lighting will be replaced by high-candle-power metallic-filament lamps with the possible exception of the main street. Similar notes are given about 17 other English cities.—Lond. *Electrician,* Oct. 15.

Metallic-Filament Lamps.—An illustrated review of the metallic-filament lamps made at present commercially by British companies. Compared with last year great progress has been made, especially since the high-voltage lamp has materialized and metallic-filament lamps can now be used in all positions. One of the companies gives specific consumption of the low-voltage tungsten lamps at 1.1 watts per hefner candle-power and that of the high-voltage lamps at 1.2 watts. The lowest possible candle-power obtainable at present with metallic-filament lamps is a 5-cp tungsten lamp for 25 volts. The great suitability of prismatic glass globes, etc., for metallic-filament lamps is emphasized.—Lond. *Electrician,* Oct. 15.

Titanium Arc.—Wm. S. Weedon.—The titanium arc is formed between a titanium carbide cathode and a copper anode, the latter being above the former. The titanium arc is a flame arc and the efficiency increases with increase in current density and with increase in arc length. At 3 amp, 103 volts, and 1-in. arc length, the specific consumption is 0.228 watt per horizontal candle-power. At 2.87 amp and 95 volts the consumption is 0.51 watt per mean spherical candle-power and 0.37 watt per mean hemispherical candle-power. Titanium carbide arcs are most satisfactorily operated on a constant-current circuit rather than on a low-voltage multiple circuit. Some notes are given on the preparation of titanium carbide electrodes and on the use of titanium suboxide instead of the carbide. The suboxide gives even a somewhat better efficiency than does the carbide. —*Gen. Elec. Review,* November.

Mercury Air-Pump.—An illustrated description of a new mercury air-pump which is mechanically driven and which enables an extremely high vacuum to be attained. It consists essentially of a bent tube *r,* half-filled with mercury (Figs. 1 and 2) ending in two S-shaped extensions *b,* and connected at its center point by the straight tube *c,* and a flexible tube *p,* to the vessel to be exhausted *d.* The S-shaped ends expand into the tubes *f* to an ordinary air-pump *w.* In order to save time, the pressure in *d* is first reduced to from 10 mm to 20 mm of mercury by means of a pump *w* setting the tube in the position shown in Fig. 1. The apparatus is then set rocking about the axis *a,* from the position of Fig. 1 to that of Fig. 2. The mercury retained in the S-shaped extensions acts as a valve, preventing the return of air from the tubes *f* into the main tube *r,* while at the same time the air drawn from the vessel *d* through *c* is forced through the S-tubes into the tubes *f* and is removed



FIGS. 1 AND 2.—DIAGRAMS OF MERCURY AIR PUMP.

from these by the air-pump *w.* The pump is driven by means of a small turbine. It is stated that a vacuum of 0.00001 mm of mercury can be obtained with the pump. The parts can be very easily taken apart and cleaned. The pressure is measured by means of a special kind of Macleod gage, arranged in the form of a spiral tube, in which a portion of the exhausted space can be cut off by a mercury seal and the gases compressed to 1/1000 of their original volume, with a corresponding increase in the pressure, which is thus rendered measurable.—Lond. *Elec. Review,* Oct. 8.

Daylight Efficiency of Artificial Illuminants.—H. E. Ives.—An illustrated discussion of two methods for obtaining a measure of the approach of colored light to daylight. The "white light efficiency" is obtained by considering the white light available by the use of absorbing screens. It is the ratio of the intensity of non-selective white light available to the intensity of the source. The "white sensation efficiency" is obtained by considering the amount of white which, with a spectrum color, would match the light. It is the ratio of intensity of white sensation to intensity of source. The latter method is preferable from a scientific standpoint, while the first method gives important information on the practical merits of a source for illuminating colored objects. The author shows how by graphical means it is possible to combine the results of both methods.—*The Illumin. Eng.,* October.

Portable Photometer.—G. C. Shaad.—An illustrated description of a portable photometer for measuring the intensity of street-lighting sources. The construction is simple, if a standard photometer screen of the Bunsen or Lummer-Brodhun type is available.—*The Illumin. Eng.,* October.

Electric Lighting.—L. Gaster.—The first of a series of illustrated Cantor lectures on modern methods of artificial illumination. The author gives a review of the various new incandescent lamps developed in recent years.—Lond. *Electrician,* Oct. 15.

Generation, Transmission and Distribution.

Electromagnetic Clutch.—An illustrated description of a clutch (Fig. 3) which consists of a stationary magnetic body containing a coil, and provided with feet for fixing to a suitable support. The armature is divided into two parts; the driver is fitted with a renewable cone of phosphor bronze or hard fiber (according to the nature of the drive) and the driven part is supplied to the energizing coil, which draws the two parts of the armature together, driving being effected partly by the friction of the cones and partly by magnetism. Between all other faces of the clutch an air-gap is maintained so that sticking from residual magnetism is impossible. The principal advantage of the clutch is that it has no slip-rings or brushes, the cable being connected to terminals fixed on the side of the stationary magnetic body. Some large clutches have been suc-

cessfully applied to rolling mills using 1200 hp at 350 r.p.m., and 800 hp at 215 r.p.m., and they have been running for some time on wire-rod mills, enabling the mill to be stopped instantly from any number of desired points, and providing an auto-

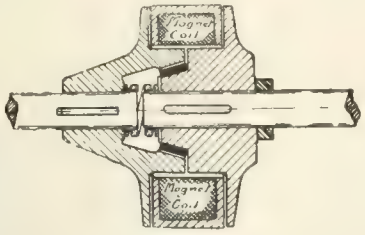


FIG. 3.—SECTION OF CLUTCH.

matic safety device against overload. Reversing clutches have been fitted to large planing machines, doing away with shifting belts, striking gear, etc.; they are said to be better than reversing motors, because the same speed of cut and return can be maintained for any length of stroke.—Lond. *Elec. Review,* Oct. 8.

Water-Powers in Europe.—T. KOEHN.—The conclusion of his long illustrated article on some important European water-powers and their commercial importance. In the present instalment the author deals with some water-powers in Bavaria, Italy, France and Norway.—*Elec. Zeit.,* Oct. 14.

Steam Pipes.—W. L. CATHCART.—An article on the loss of heat from uncovered steam pipes. The author discusses coefficients of heat conduction, the steam pipe as a cooling body, Dulong and Petit's and Peclet's experiments and formulas, test apparatus for saturated steam, heat losses of bare pipes conveying saturated steam, and the correction which must be applied to the computation of the latter losses from Peclet's formulas.—*Cassier's Mag.,* November.

Flour Mills.—J. LISTON AND L. O. GORDON.—An illustrated article on applications of the electric drive in grain elevators and flour mills.—*Gen. Elec. Review,* November.

Traction.

Single-Phase Traction in Hamburg.—W. WECHMANN.—The first part of a detailed illustrated description of the single-phase system used on the Blankenese-Ohlsdorf Road of the Prussian Railways. This is the first large single-phase road in the Prussian State railway system. The road is operated at 25 cycles and with 6000 volts on the trolley wire. The trains are built up of a number of train units, each train unit consisting of two motor cars coupled together. Motor cars have been supplied both by the Allgem. Elek. Ges. and by the Siemens-Schuckert Company. Each of the motor cars of the A. E. G. has two trucks, one having two motors and the other one motor (Winter-Eichberg type). Each motor is able to produce 115 hp for one hour at a speed of 27 km per hour. The weight of this train unit (double car) without passengers is 71,000 kg. Since there are 128 seats, the weight per seat is 570 kg. The weight per square meter is 975 kg. The weight of the electric equipment alone is 17 tons. Each of the Siemens-Schuckert cars has only two motors (series motors), each rated at 175 hp. The weight without passengers is 69,000 kg, or 566 kg per passenger and 948 kg per square meter of area. The electric equipment alone weighs 15.5 tons.—*Elek. Zeit.* Oct. 14.

London Tramways.—J. H. RIDER.—His long reply to the extended discussion of his recent paper on the electric system of the London County Council tramways.—Lond. *Electrician,* Oct. 15.

Installations, Systems and Appliances.

Small Central Station.—C. D. HASKINS.—An estimate on the equipment of a central station for a town of 1200 inhabitants, with notes on the management of the commercial lighting and the street-lighting systems.—*Gen. Elec. Review,* November.

Heating of Water by Electricity.—The thermal-storage type of electric water heater described in the Digest in the issue of Sept. 30, when consuming 200 watts heats 25 gal. of water per day instead of 25 qt. as stated in the issue just mentioned.

Wires, Wiring and Conduits.

Electrolytic Time-Limit Relay.—An illustrated description of a new time-limit relay devised by W. B. Thorpe, which in its construction has some points in common with his electrolytic watt-hour meter (see description below). The construction is shown in Fig. 4. On the occurrence of an overload, the series coil *W* closes the cell circuit at *Y*. Directly electrolysis commences the float *O* is lifted so that a circuit is completed. If the overload continues, electrolysis continues until the float *U* comes in contact with the adjustable contact *T*. This contact comples the circuit of the tripping coil *X* through *Z*, and the main switch is opened. The time which elapses before this occurs is determined by the position of *T*, and is denoted on the scale in seconds, so that the relay can readily be set to any desired value of the time. Should the overload cease before the predetermined time has elapsed, however, the cell circuit is opened at *Y*, but remains closed through the contact at *P*, so that the electrolysis continues until the float *U* touches *T* as before. In both cases the evolved gases are fired almost immediately after this by the breaking of the circuit at the level of the electrolyte, as in the case of the meter, but in the latter case contact between *U* and *T* does not complete the tripping-

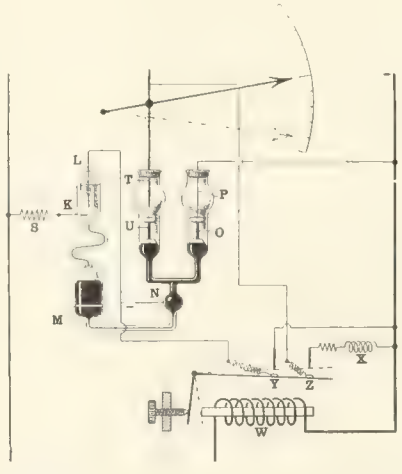


FIG. 4.—DIAGRAM OF ELECTROLYTIC TIME-LIMIT RELAY.

coil circuit, as it is broken at *Z* owing to the overload magnet having weakened. After even a momentary overload, however, the complete cycle of electrolysis and recombination takes place, so that a definite and constant time element is ensured. Although the right-hand bulbs of the cell are open to the atmosphere, the platinum mercury joint at *M* prevents the escape of the gases or electrolyte, and the cell therefore never requires refilling. This relay can be applied by substituting a shunt tripping coil for the usual series coil.—Lond. *Elec. Eng'ing,* Oct. 14.

Electrophysics and Magnetism.

Diffraction of Electrical Waves.—H. M. MACDONALD.—An abstract of a British Association paper. Imagining a source of Hertzian waves outside a sphere which might be transparent or opaque to the waves, the author calculates diffraction phenomena due to indirect and reflected waves at various distances from the sphere for different wave-lengths. For wave-lengths ⅛ mile the amplitude of the oscillations is reduced from unit value to 0.46, 0.43 and 0.40 at distances of 70, 93 and 116 miles; for greater wave-lengths the diminution is smaller.—Lond. *Engineering,* Sept. 24.

Magneto-Striction.—H. G. DORSEY.—An abstract of a Brit. Association paper on experiments on magneto-striction made with eight steels. The carbon percentages of the specimens ranged from 0.058 to 1.37, the phosphorus from a trace to 0.073, the silicon from 0.008 to 0.09, the manganese from 0.07 to 0.17, and the sulphur from 0.012 to 0.014. The rod under test was soldered on to a brass bar, while the free end bore with a needle system against a magnifier comprising a mirror; the usual magnification was 3000, but the apparatus admitted of going very much higher. The rod was placed within the magnetizing coil, which gave a very uniform magnetization over a

large portion of the rod. Instead of attempting to keep the temperature constant, which would have been difficult with his strong currents, he had heated the frame by a branch current to the temperature of the rod. The results of the many experiments are interesting, though the changes in length are far too small to become of practical importance. The maximum elongation is a function of the carbon contents, and there is a relation between the maximum elongation and the maximum susceptibility. The correction to be applied for the changes in length is of the same nature as the correction for the demagnetization of the ends of the rods. In strong fields the changes in length are dependent more upon the intensity of magnetization than upon the field.—Lond. *Engineering*, Sept. 24.

Electrochemistry and Batteries.

Concentration Cells.—F. J. Mellencamp.—An account of an experimental investigation in which simple concentration cells, made up of various solutions for which the heats of dilution have been determined, were investigated with reference to the application of the Gibbs-Helmholtz equation. The total heat of reaction becomes the heat of dilution and answers for the first term of the equation. The four following cells were investigated: (1) Zinc amalgam electrodes with zinc sulphate of different concentration as electrolytes. (2) Cadmium amalgam electrodes with cadmium sulphate of different concentration. (3) Zinc amalgam electrodes with zinc chloride of different concentration. (4) Lead amalgam electrodes with lead nitrate of different concentration. The first cell has a large positive temperature coefficient with a relatively small heat of dilution; the second, a small temperature coefficient with a relatively large heat of dilution; the third, a negative temperature coefficient with a large positive heat of dilution; the fourth, a positive temperature coefficient with a relatively large negative heat dilution. The Gibbs-Helmholtz equation applies rigorously in all cases, the difference being less than the probable experimental error.—*Phys. Review*, October.

Electrically Heated Oil-Tempering Baths.—H. Fulwider.—An illustrated description of oil-tempering baths heated by electric resistors. The advantages are absence of fire risk and ease of regulation of the temperature by means of a rheostat.—*Gen. Elec. Review*, November.

Units, Measurements and Instruments.

Electrolytic Watt-Hour Meter.—An illustrated description of a new electrolytic watt-hour meter of W. B. Thorpe. The meter is worked on the principle of the continuous electrolysis and recombination of water containing a small percentage of caustic soda in an hermetically sealed tube. Recombination of the evolved gases is effected automatically after a definite amount has been produced, and each recombination, corresponding to one or more units of electrical energy passed by the meter, is registered on a dial by an electromagnetic device. *E*, in Fig. 5, is the "registering" cell which is placed across the

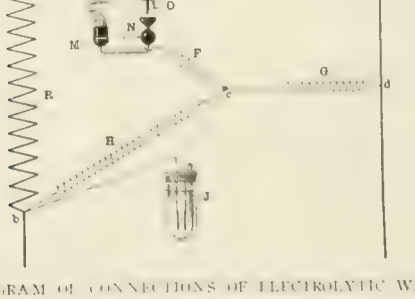
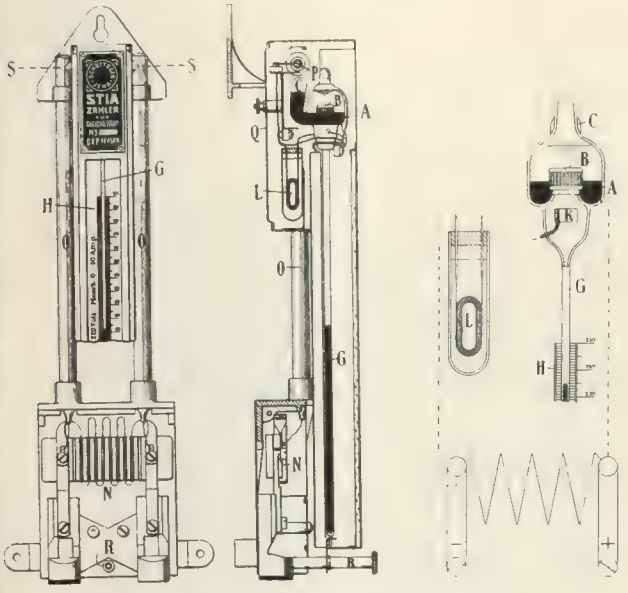


FIG. 5.—DIAGRAM OF CONNECTIONS OF ELECTROLYTIC WATTMETER

mains in series with a resistor of high resistance *G* and another of high resistance *F*, the resistances being so proportioned that the pressure across *a c* is about equal to the back e.m.f. of the cell, while that across *a d* is the full line pressure of 100 volts or 200 volts. The other end *b* of the main shunt *R* is connected to the point *c* through a resistor *H*; therefore, neglecting the drop across *R*, the pressure across *H* is also about equal to the back e.m.f. of the cell. First, with regard to the effect of variations in pressure, a rise in the main voltage would cause a larger current to flow through *H* and *E* than normally and this would result in a rise of pressure across *b c* and *a c*. So it was necessary to devise a third parallel path to *E* and *H* which would take the extra current consequent upon the increase in the line pressure without increasing the drop across *a c* and *b c*. An electrolytic cell *J*, called the "absorption cell," is employed for this purpose. It comprises a test tube in which are two plates of nickel, 160 mm square, immersed in a 20-per-cent solution of caustic soda. If these nickel plates were infinitely larger, the cell would take any curent without any rise in the pressure across *b c*, which would remain at the critical voltage of the cell. Actually, however, they are of such dimensions that the pressure across *b c* (and therefore across *a c*) rises in proportion to the increase in the supply pressure to such a degree that the cell registers an increased amount, making the meter in effect a watt-hour meter. Practically no gas is generated in the "absorption cell." When the load circuit is open the various pressures are so balanced that the voltage across the registering cell *E* is very slightly more than the back e.m.f. of the cell. This balance is obtained in setting the cell in the first instance by adjusting the resistance of *H*, this being the only adjustment necessary to set or correct the meter. A very minute quantity of gas is evolved under these conditions, but this is occluded by the nickel electrodes, and does not influence the reading of the meter. Directly the load circuit is closed, however, current flows through *R*, and a difference of potential is produced between the points *a* and *b*. This difference of potential is immediately effective in driving a current through the cell *E*, as it raises the pressure across *a c*. This increase in the pressure being proportional to the drop across *R*, the water is electrolyzed in proportion to the current taken, and, further, any variation of the supply pressure is accompanied by a corresponding variation in the amount electrolyzed, so that the rate of electrolysis at any instant is proportional to the watts then being consumed by the load. At full load the cell takes a current of about 0.003 amp. The cell *E* is hermetically sealed, and therefore the electrolyte never requires replacing. Recombination is effected as follows: Starting with the left-hand bulb entirely filled with the electrolyte, a quantity of oxygen and hydrogen is evolved by the passage of current until, after one, or, in the large meters, two, units have been passed, the level has fallen to that indicated in the illustration. At this point the mercury in the bend of the arm has been displaced so that the wooden float *O* (which has platinum contacts at each end connected together) comes into contact with *P* and completes the circuit through the registering cell, the platinum contact *N* sealed into the mercury bulb, and the series resistor *S*. Immediately a much more rapid decomposition of the electrolyte commences, and continues for a second or so until the level sinks below the tip of the electrode *L*. A spark occurs when the circuit is broken here, and the gases are recombined so that the electrolyte again fills the bulb. The cycle of operations is then repeated. In series with the resistor *S* is an electromagnet *X*, which operates a registering dial of the ordinary pattern, causing it to record a further one or two units every time the circuit is completed. It should be mentioned that the presence of this inductive winding ensures a strong spark when the circuit is broken at the level of the electrolyte, thereby making recombination certain.—Lond. *Elec. Eng'ing*, Oct. 14

Electrolytic Meter.—A description by the *Reichsanstalt* of an electrolytic meter made by Schott & Company which is thereby officially admitted for calibration. The meter is shown in Fig. 6. The electrolytic cell in series with the resistor *L* is in parallel with the manganin or constant in resistor *N* through which the main current passes. The current enters into the solution through the mercury surface *A* and leaves it through the iridium sheet *K* (Fig. 7). The mercury is dissolved by the current at *A* and is deposited at *K*; from there it falls in little drops into a tube *G* below *K*. The quantity of mercury deposited is proportional to the amp-hours. The electrolytic cell

consists of a glass globe, the lower part of which is turned inside and upward and a glass funnel is fused to this lower part. *B* is a grid of fine glass tubes, so arranged that the mercury cannot pass through, while the heavy salt solution above the mercury can flow off and can replace the dilute solution formed at the iridium sheet *K*. At certain intervals the meter



FIGS. 6 AND 7. DIAGRAMS OF ELECTROLYTIC METER.

is tilted and the mercury is brought back into the container *C*. —*Elec. Zeit.*, Oct. 14.

Residual of Inductance and Capacity in Resistance Coils.—S. L. BROWN.—An account of an investigation tending toward the construction of a resistance coil for alternating-current measurements, in which the error due to inductance and capacity is avoided. Instead of seeking to make the inductance and capacity both small, the author proposes to offset one against the other, making the residual smaller than can be measured. If measurements of residuals less than a few hundred micromicrofarads are required, the latter plan offers noticeable advantages. The author first shows theoretically under which conditions with two parallel wires the inductance and distributed capacity will balance. He shows that the relation between the resistance, capacity and inductance is approximately the same when either interrupted direct current or alternating current of moderate frequency is applied to a coil of small inductance, With such a parallel-wire standard the outstanding difference between inductance and capacity in resistance coils can be measured. The author finds that a standard coil, made by twisting the wires together and separating consecutive turns, is not completely compensated for inductance and capacity when capacities of a few hundred micromicrofarads are to be measured.—*Phys. Review*, October.

Magnetic and Electric Tests of Steel.—A. GRÜNHUT AND J. WAHN.—A paper read before the International Association for Testing Materials on the proposition that the changes which the curves of magnetization and permeability, hysteresis, remanent magnetism, coercitive force, and electric conductivity undergo when the materials are mechanically stressed should afford suitable criteria for judging the mechanical properties of such materials. The author has made experiments with a view to investigating the influence of elastic stress (tension, compression and torsion) on the magnetizing curves of iron and steel, the test-rod or wire being submitted to external forces during magnetization. However, the influence of the stresses upon the magnetization of iron could not definitely be expressed. Weak magnetism was increased by tensile stress; strong magnetism was diminished; the curves depend upon the past history of the material; whether or not the iron has been put under stress before magnetization makes a difference. Compression has in general the opposite effect to tension. The slow loading and releasing of the specimen during the magnetizing process is not immaterial to the result. Both the temporary and the remanent magnetism left in the iron after the completion of the magnetizing process are influenced by the tensile stress; the relation, however, is not simple, and depends upon the intensity of the previous magnetization. Effects similar to those produced by tension and compression are observed when the specimen is subjected to cyclic torsion while under magnetization. Magnetic metals exposed to shear or torsion show different magnetic permeability in the direction of the different axes. A large number of measurements were made for ascertaining whether, and in what way, the elastic constants of iron and steel were influenced by magnetic forces. The only fairly established fact is that with increasing magnetization the moduli of elasticity, both for tension and shear, increase rapidly at first and more slowly afterward, somewhat after the manner of the changes in permeability; the variations in the moduli, however, are not large. In general, temporary magnetism increases with temperature—rapidly at first, then more slowly up to a maximum, to decrease rapidly again when this temperature is exceeded. On cooling, magnetism reappears, reattains its maximum, and decreases to the original value on continued cooling. There is, therefore, for every magnetizing force a critical temperature at which magnetism reaches its maximum, and, conversely, for every temperature there is a critical magnetizing force. Remanent magnetism diminishes by heating, and is altogether lost by heating to a high temperature. In this connection, first heating should be distinguished from repeated heating. When the material is kept at a strong glow, it loses its magnetism permanently after repeated cycles. Repeated annealing, therefore, affords an excellent means for producing demagnetization. The most favorable hardening temperatures for permanent magnetization are between 750 deg. C. and 850 deg. C. (1382 deg. Fahr. and 1562 deg. Fahr.). The authors have arrived at the conclusion that the interrelation between the various phenomena are not sufficiently uniform, so far as actual experience goes, to make it possible to determine the physical properties of a material from magnetic tests.—Lond. *Engineering*, Sept. 24.

Standard Cells.—H. L. BRONSON AND A. N. SHAW.—An account of researches partly conducted at the Bureau of Standards, Washington. Fifteen Clark cells were made according to the specifications of Wolff and Waters. Weston cells were also made, and some were brought over from Washington, and six more from the National Physical Laboratory. The agreement between the different Weston cells was, on the whole, better than that between the Clark cells. More cells were then constructed with the object of determining the influence of various modifications, especially in the preparation of the mercurous sulphate; a comparison was also made between cells of the (British) Board of Trade specifications and the Wolff and Waters cells. The ratio of the electromotive force of the Weston cell (adopted by the conference of the Normal Weston cell) to that of the Clark cell was ascertained to be 0.716953, against 0.716958 founded by Wolff and Waters.—Lond. *Engineering*, Sept. 24.

Cable Fault Localization.—E. RAYMOND-PARKER.—The first two parts of an illustrated serial on the practical working during last year of his method for cable fault localization by means of graphs. The article is to be continued.—Lond. *Elec. Review*, Oct. 8 and 15.

Measurement of Phase-Difference.—M. MIET.—A mathematical article on the application of the two-wattmeter method for the direct measurement of the phase-difference in a balanced or unbalanced three-phase system.—*L'Industrie Elec.*, Oct. 10.

Testing Machines.—E. F. COLLINS.—The first part of an illustrated serial on commercial electric testing of machines. After general introductory remarks the author discusses saturation tests and describes three methods, designed as generator saturation, motor saturation and ballistic saturation.—*Gen. Elec. Review*, November.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—W. H. Eccles.—The first part of an illustrated review of recent patents in wireless telegraphy. Several proposals for duplex working in wireless telegraphy have appeared. One method employs, at each of two corresponding stations, mechanical devices for switching the aerial rapidly to and fro between the sending and receiving circuits; another method leaves sending and receiving apparatus permanently connected to the air-wires and balances the effect of the sender on the local receiver by means of compensating circuits. Several examples of these methods are described and illustrated. The author also describes some recent improvements in sending apparatus and methods.—Lond. *Electrician*, Oct. 15.

NEW APPARATUS AND APPLIANCES

The Effect of Rotary Condensers on Power-Factor.

By John Liston.

While the relation of power factor to the size and efficiency of prime movers, generators and conductors has long been understood by the engineering fraternity, the practical application of the synchronous motor as a rotary condenser, to raise the power factor of systems having induction motor and transformer loads, has lagged far behind other improvements in the generation and transmission of energy.

The Cleveland Electric Illuminating Company was one of the first central stations to give a practical demonstration on an extended scale of the value of rotary condensers in raising the power factor of systems carrying a heavy inductive load. Their installations exemplify the use of unloaded synchronous motors simply "floated" on the system to supply leading current to the line and of partially loaded synchronous motors for the same purpose.

Before describing the installation of rotary condensers on this system, and the very satisfactory results which have been thereby obtained, it might be well to outline briefly the theory on which these installations are based.

Induction motors and other inductive apparatus take a component of current which lags behind the line pressure, and thereby lowers the power factor of the system, while a non-inductive load, such as incandescent lamps, takes only current in phase with the voltage and operates at 100 per cent power factor.

As transformers require magnetizing current, they may seriously affect the power factor when unloaded or partially loaded, but when operating at full load their effect is practically negligible.

In order to maintain high power factor, induction motors should be run at their full rated load. Due to the complex industrial requirements of the average installation, most central stations have on their lines a group of induction motors operating at light loads, thereby lowering the power factor of the entire system. This feature of central station practice is sometimes rendered still more serious by the desire of a customer to have ample power for future extension or to take care of heavy temporary loads, so that motors of larger rating than that actually required for normal operation are frequently installed.

The magnetizing current of an induction motor is nearly constant at all loads and is wattless, lagging 90 deg. behind the impressed e.m.f., or at right angles to the current which is utilized for power. It is evident that if the load is reduced, the power component is reduced while the wattless is practically constant, and hence the power factor is reduced. This fact explains the low power factor of induction motors on fractional loads and indicates that since the magnetizing current is practically constant in value, the induction motor can never operate at unity power factor. At no load the power component is just sufficient to supply the friction and windage and the power factor is reduced to 10 or 15 per cent and the motor takes from the line about 30 per cent of full-load current. It therefore follows that a group of lightly loaded induction motors can take from the system a large current at exceedingly low power factor.

The synchronous motor when used as a rotary condenser has the property of altering the phase relation between e.m.f. and current, the direction and extent of the displacement being dependent on the field excitation of the condenser. It can be run at unity power factor and minimum current input, or it can be over-excited and thereby deliver leading current which compensates for the inductive load on other parts of the system. The rotary condenser, therefore, can supply magnetizing current to the load on a system while the power component is supplied by the generators.

In order to gain a comprehensive idea of the results obtained by the Cleveland Electric Illuminating Company, a brief description of the generating and transmission system is necessary.

Situated in the city of Cleveland, Ohio, which has an estimated population of 515,000, and extends, with its suburbs, along Lake Erie for about 17 miles, the generating station, with its substations, serves a territory of approximately 50 square miles.

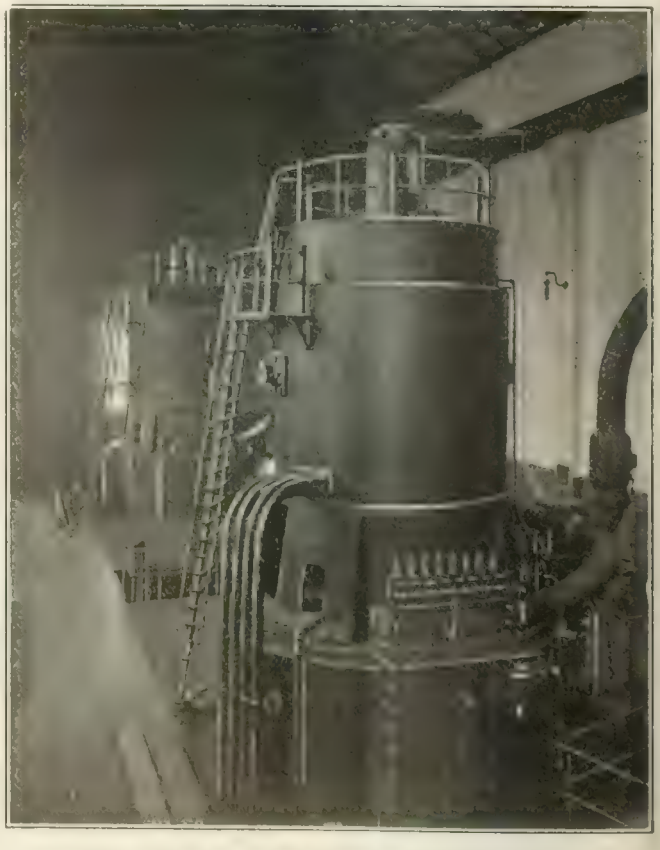


FIG. 1.—TWO 9000-KW CURTIS TURBO-GENERATORS.

The steam-driven generating station is located on Canal Street, near the business center of the city. The generating units now in service consist of two 9000-kw and one 1500-kw Curtis turbo-generator sets of General Electric manufacture, delivering energy at 11,000 volts, three-phase, 60 cycles. There are, in addition, some reciprocating engine-driven generators, delivering energy at 2300 volts, three-phase, 60-cycles. Transformers step-up the e.m.f. to 11,000 volts for the substations.

In addition to the alternating-current equipment there are three 1500-kw motor-generator sets and direct-current reciprocating engine sets and a storage battery. The energy for that part of the city immediately surrounding the generating station is distributed on a direct-current, three-wire Edison system. The balance is practically all alternating current, and is distributed to the substations at 11,000 volts, and redistributed at 2300 volts, three-phase, 60 cycles.

There are six substations, five of them being straight transformer stations, and the sixth being provided with a motor-generator set and battery in addition to the transformer equipment; the total distance between the two end substations is about 15 miles. All of the 11,000-volt circuits are under ground, being placed in vitrified clay or fiber conduits, the latter form having been adopted as a standard for all new work. The distribution circuits from the substations at 2300 volts for motors and lamps are underground cables for a short distance from the stations, where they join to pole lines. The secondary lighting circuits are three-wire, single-phase, 115 volts to 230 volts, and motors up to 5-hp rating are operated from the lighting circuits. The general inductive distribution is at three-phase, 2300 volts, the e.m.f. being stepped down to 460 volts and 230 volts at the customer's premises.

The motors are nearly all three-phase, but some two-phase motors are run from three-phase transformers by means of a T-connection. The ratio of alternating-current to direct-current load is about 2.5 to 1. The arc lighting load is nearly all carried by Brush arc generator sets.

It will be seen from the above that the operating conditions confronting the Cleveland Electric Illuminating Company are those which are ordinarily encountered by any central station located in a manufacturing city. The fact that more than 40 per cent of the connected load consisted of induction motors, which were frequently loaded far below their rated output, had a very noticeable effect on the power factor of the system, this effect being augmented by the numerous transformers located in the substations and on the customer's premises. So serious was this that the power factor of the entire system before the rotary condensers were installed varied between 65 and 70 per cent during the day, and at night, when the motor load was practically discontinued and the lighting load substituted, it rose to between 85 and 90 per cent.

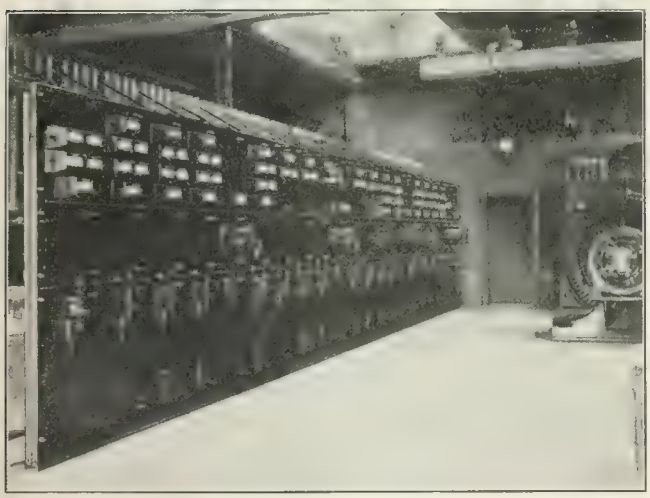


FIG. 2.—750-KVA ROTARY CONDENSER IN A SUBSTATION, CLEVELAND.

Realizing that these conditions affected both the permissible output and regulation of the entire system, it was determined to bring the power factor as close to unity as was economically possible by the installation of rotary condensers in those substations feeding induction motor installations, and also in the factories of large motor users.

Two 2300-volt rotary condensers of 750-kva rating and provided with directly connected exciters were, therefore, installed in one substation, and a third unit of the same rating was provided for a second substation. In addition to these, four 200-kva General Electric rotary condensers with directly connected exciters were connected to the low-tension side of the transformers on the customer's premises; the largest motor users on the various distribution lines being selected for the installation of these units. As auxiliaries to the rotary condensers, a number of synchronous motors partially loaded were installed, the kilowatt load delivered to the shaft varying from 50 to 75 per cent of the kva rating of the motor. These motors are used to drive alternating-current or direct-current generators for special purposes, and are the property of the customer, while the 200-kva rotary condensers referred to above and installed on the customer's premises belong to the illuminating company.

The General Electric 200-kva condenser has been adopted as standard for future installations in customers' plants, but will not be provided except where the power taken is in excess of 400 hp. While this is not theoretically the best method, it was considered advisable to have a single standard condenser placed in service where conditions warranted its use, instead of working out in detail a large number of various condenser ratings. The condensers thus installed are carefully inspected at frequent intervals by representatives of the illuminating company, but are normally operated by the customers, who are glad to provide the necessary room in their plants, as they benefit from the improved regulation.

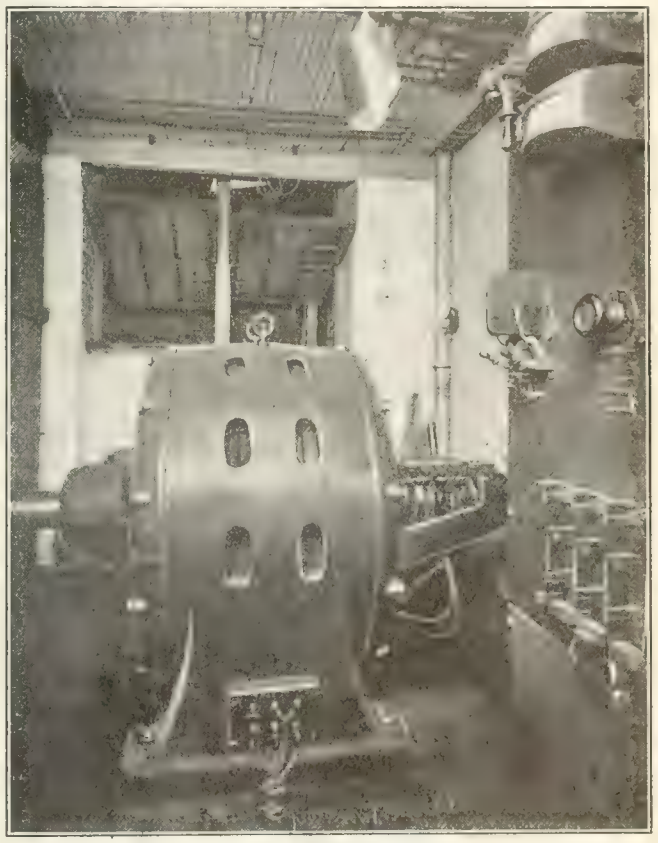


FIG. 3.—200-KVA ROTARY CONDENSER IN A CLEVELAND FACTORY.

A typical installation of this nature is that in the plant of the National Acme Manufacturing Company, makers of milled screws and "Acme" screw machines (Fig. 3). The motors in this plant are 440-volt, two-phase and have an aggregate rating of 1200 hp. The average demand on the substation is approximately 300 kw, and prior to the installation of the 200-kva condenser the power factor was about 75 per cent on this line; at the present time it is 90 per cent.

It will be noted that no rotary condenser has been located in the power house itself, the reason being that when a condenser is connected to the terminals of a generator it raises the power factor of the generator by supplying part, or all, of the wattless current of the load, but this wattless current has to be carried throughout the circuit external to the generator, and the

condenser therefore will benefit only the generating equipment.

When the condenser is installed at the end of a line carrying an induction-motor load and provided with step-up and step-down transformers, the condenser can supply magnetizing current to the induction motors located near it, and, as a result, the generators, transformers and conductors can be of reduced size, as they do not carry the wattless current.

In order to obtain most economically the required condenser effect with synchronous motors installed in industrial plants these motors should be partially loaded so that a percentage of their operating cost can be charged to useful output. It has been found that a synchronous motor used in this way and rated at, say, 100 kw, will give the best results when delivering 71 kw actual power and 71 wattless kva.

An example of a partially loaded synchronous motor is found in the plant of the National Electric Lamp Association, which is equipped with a 100-kw, 2300-volt to 430-volt alternating-current directly connected motor-generator set. (Fig. 4.)

At the works of the Ohio Ceramic Engineering Company a 100-kva General Electric synchronous motor has been installed, belted to a generator which loads it to about 60 per cent of its kva rating, the balance being utilized for condenser effect; this motor operates directly from the 2300-volt, 60-cycle feeder. (Fig. 5.)

The prompt recognition of the Cleveland Electric Illuminating Company of the serious effect of its inductive load on the power factor of its system and the improved general efficiency which has been obtained by the use of rotary condensers should appeal to every practical central-station manager.

A graphic illustration of the value of rotary condensers was given recently when one of the feeder circuits on the Cleveland Electric Illuminating Company's system was put out of commission during a storm, due to a tree falling across the line. This feeder was equipped with one of the 200-kva condensers already referred to, and while repairs were being made a feeder

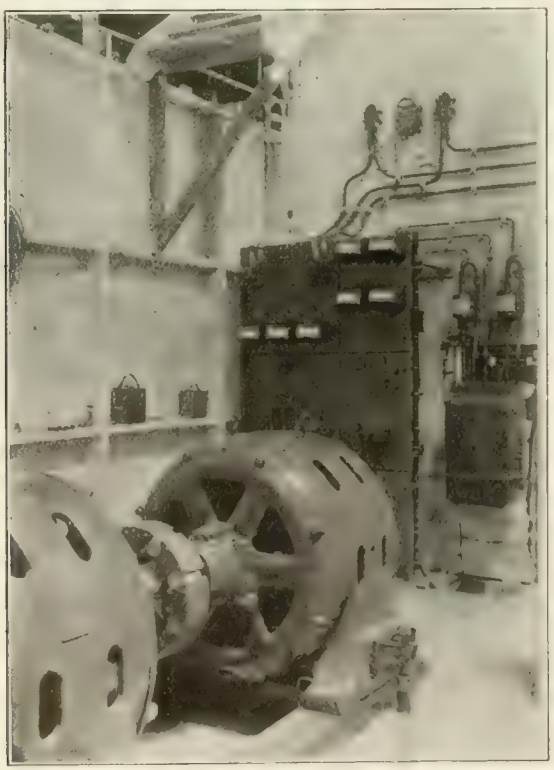


FIG. 4.—100 KVA SYNCHRONOUS MOTOR-GENERATOR SET IN LAMP PLANT, CLEVELAND.

from a different substation which was at the time carrying a heavy load at low-power factor, was joined to take on, temporarily, the additional load. It was found that the ammeter readings with this combined load were actually lower than they had been with a single load on the circuit not provided with a condenser. The kilowatt readings showed an increase of about 75 per cent, while the ampere readings dropped about 25 per cent.

The relative cost of condensers as compared with the investment losses in generators, conductors, etc., caused by low power factor, of course, depends on the percentage of the inductive load on a system; but the conditions which have to be met by the

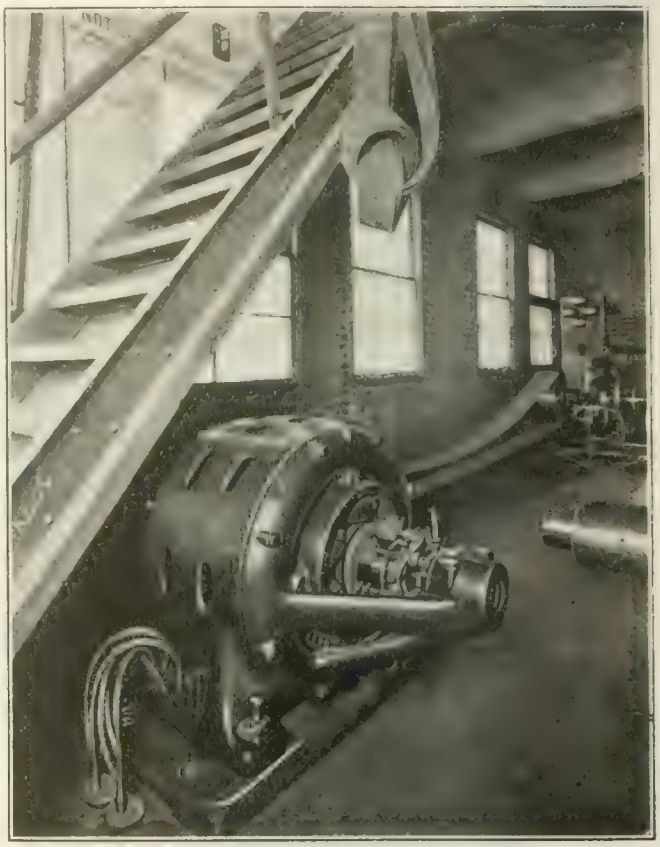


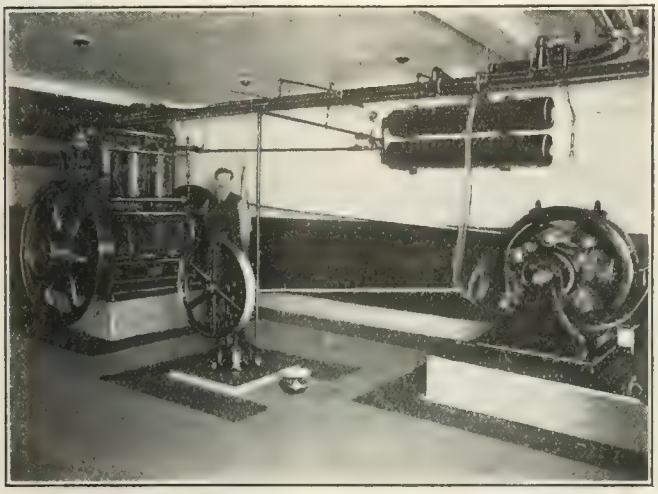
FIG. 5.—100 KVA SYNCHRONOUS MOTOR BELTED TO DIRECT-CURRENT GENERATOR, CLEVELAND.

average central-station distribution system indicate that the heat losses diminish effective output in generators and conductors, as well as the impaired regulation inherent in low power factor can be most economically overcome by the installation of rotary condensers.

Gas-Engine Plant for Charging Telephone Storage Batteries.

About a year ago the Colorado Telephone Company, of Denver, Col., found that its rapidly increasing business necessitated the installation of additional machinery for the purpose of charging the storage batteries. After some investigation, the company placed an order with the Hampson-Fielding Engineering Company, of Denver, for a 50-hp Nash gas engine, built by the National Meter Company, of New York. This engine was installed in the basement of the Main Exchange, on Champa Street, near Fourteenth Street, and at the time the installation was made much doubt was expressed as to the effect of the noise and odor attending the use of such a unit. The engine, which is a standard three-cylinder machine, uses illuminating gas from the mains of the Denver Gas & Electric Company through a 2-in. supply pipe. The gas has a thermal rating of 480 heat units, and, while it rarely falls below this rating, it possesses as high as 600 heat units. The foundation for the engine is built of concrete, and is separated from the floor of the building by a space of 1½ in. on all sides, the foundation extending to a depth of 4 ft. This arrangement was found to obviate all vibration. The engine is connected by a belt to a Western Electric 800-amp, 30-volt generator, and the equipment, which has been running for almost a year,

has developed its full rated horse-power on 21.6 cu. ft. of gas per brake hp-hour. The exhaust pipe of the engine is carried under the floor of the engine-room, through the wall and into an alley, the exhaust being discharged at the top of a nine-story building. The cooling water is provided from the city water mains, and the starting is effected by means of compressed air stored in a tank at a pressure of from 100 lb. to 120 lb. The noise and vibration, concerning which there were some misgivings at the time the contract was let, are unnoticeable, and the power cost of the plant is said to compare very favorably with that of a compound, non-condensing engine using coal costing $5 per ton. The accompanying illustration shows a view of the engine-room.



GAS-ENGINE PLANT FOR CHARGING STORAGE BATTERIES.

Electric Welding for Bonding Electric Railways.

A requisite of electric railway bonding is that the bonds shall not deteriorate from moisture, but hold indefinitely. There are two methods adopted to obtain the perfect weld implied, each of which requires a satisfactory flexible bond. These methods are electric welding and, so-called, copper welding.

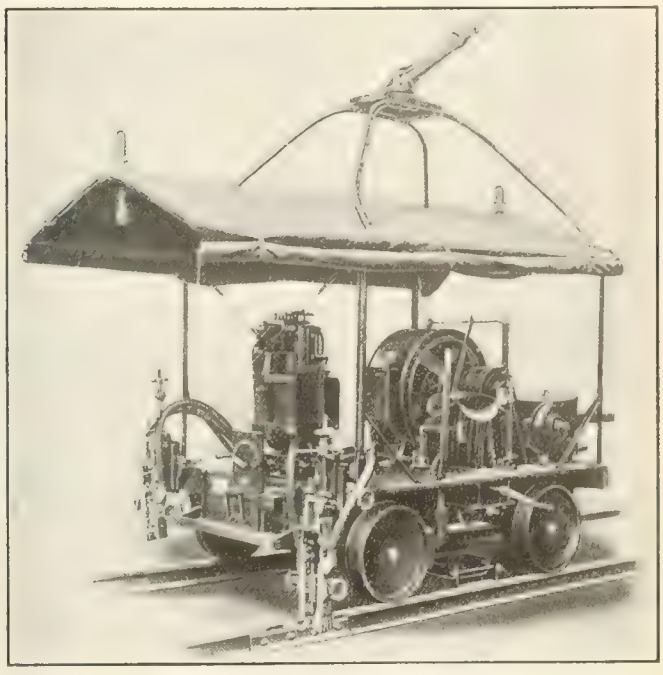
In the first method a heavy current is passed through the bond and the rail at the point of the weld, heating both to a sufficiently high temperature to weld them together. This requires a current of approximately 2000 amp at 5 volts. This may be obtained from the trolley line by means of a rotary converter and a special transformer, which lowers the voltage to the required amount.

The secondary terminals of the transformer are one of copper and one of carbon, so arranged as to clamp the bond and rail at the point of the weld. The flow of current heats the carbon terminal to incandescence and brings the rail and the copper bond to the welding point in from 45 to 60 seconds.

When the bonding is to be done by copper welding, molten copper is poured into a suitable mold and first heats the bond and the rail, and then forms the weld. The mold is of such shape that a large reservoir of metal is formed before the bond itself is covered. This insures thorough heating of the parts and is not wasteful of copper, as the reservoir is readily chiseled off after hardening and but a small neck connects it to the weld itself. This welding is particularly adapted to heavy bonds, return-feeder cable and around special work.

The illustration shows the outfit as supplied by the Electric Railway Improvement Company, of Cleveland, Ohio, which includes a standard Westinghouse 18-kw rotary converter and Westinghouse transformer. It will be noticed that the rotary converter may be used as a motor to propel the car. As high a speed as 30 miles per hour may be attained.

In order to remove the car from the rails to prevent interruption to traffic, a jack-screw is fixed under the center of the car. The weight of the equipment on the car is distributed to balance about the center, so that it is an easy matter to turn the car and roll it to one side and allow a regular car to pass. Economical bonding may be done on lines maintaining a five-minute service. For grinding the rail before welding, a small electric grinder, with leads and starting box complete, is provided.



APPARATUS FOR BONDING RAILS.

For rebonding lines in city streets this apparatus requires the removal of the paving blocks from a space of but a few inches wide and as long as the bond itself, which makes it economical for either new or old work.

Tungsten Lamp Shock Absorber.

This shock absorber, shown herewith, made by the Benjamin Electric Manufacturing Company, consists primarily of a strap-iron stirrup, a loose bushing centrally located, supported by a coil spring and tapped to receive the fixture stem. The compression spring forms a resilient connection between the supporting element (iron stirrup) and the fixture. The stirrup has two feet provided with screw holes for attaching to the supporting surface, and when so attached takes the place of an ordinary crowfoot. An additional strap, centrally threaded to fit a ⅜-in. insulating joint, is attached to the stirrup by means of two screws. This strap may be omitted for attaching to a wooden ceiling or block. In one case the device thus becomes a shock absorbing hicky; in the other, a shock absorbing crowfoot.



TUNGSTEN LAMP SHOCK ABSORBER.

Where it is desired to use brass casing and a canopy, a canopy

support consisting of ⅛ in. brass tubing with the upper end flanged outwardly passes through the opening in the bottom of the stirrup and surrounds the bushing. This permits the canopy to be attached by means of a ⅞-in. slip ring to the supporting element, thus leaving the fixture freely suspended, and effectually overcoming the difficulty of providing a means for preventing the transmission of shocks from the support to the fixture through the canopy and stem. There is also enough play between the movable parts to allow the fixture to hang plumb even though the support be uneven.

On either side of the stirrup are located machine screws, the purpose of which is to keep the bushing from being displaced. These screws, however, can be removed and the absorber taken apart for the purpose of changing the springs, or for removing or inserting the canopy support, which should be finished to correspond with the fixture. The device is furnished with one of these springs varying in stiffness to correspond to the weight of the fixture with which the absorber is to be used. The light spring will take a fixture from 1 lb. to 4 lb.; the medium, from 4 lb. to 10 lb., and the heavier, from 10 lb. to 16 lb.

In addition to other features, this shock absorber incorporates an essential for successful devices of this character, in that provision is made for locating it at the ceiling or the point of fixture support rather than above the individual lamp sockets. The initial shock of a sharp or sudden jar from the ceiling or point of support is intercepted before it reaches the fixture proper, while any subsequent vibration which might be transmitted is dissipated by the weight and consequent inertia of the fixture before it reaches the lamps themselves.

Inauguration of the Triumph Electric & Ice-Machine Company's New Plant.

On Saturday, Oct. 23, an informal reception was given to the employees of the Triumph company, their families and friends to celebrate the opening of the new plant at Oakley, Cincinnati.

An inspection of the plant, which is of the most modern construction, was energetically carried out by the entire party. An excellent band, located on the third gallery, discoursed music and younger members took advantage of the opportunities afforded for dancing. Refreshments were also served to the visitors. During the intermission several excellent speeches were made. The Deputy Mayor of Oakley welcomed the Triumph company in their midst and said that Oakley was proud to harbor such a progressive and up-to-date concern, and felt sure that the community at large would benefit thereby. It was a matter of gratification that Oakley would now be known all over the American continent; in fact, wherever modern machinery was in use.

A delegate of the Triumph employees spoke feelingly of the good fellowship and good-will that existed between the management and staff, and expressed a wish that such a feeling would long continue. Mr. J. C. Hobart, the manager, in reply referred to the value of "team work." He said that it was "team work" that had built up the Triumph company and had made the present buildings possible. It was "team work" that would eventually enlarge the plant to double or treble the present proportions, and he felt sure that if they continued to "pull together" as they had done in the past that the planned extensions would only be a matter of a few years.

An energetic call for the president of the company brought Mr. W. N. Hobart quickly to his feet. He said that it afforded him considerable pleasure to see the employees, their wives and children all gathered together and he welcomed the opportunity to say a few words to them collectively. He pointed out in a very convincing manner that the interests of the company and employees were identical. The advancement of the company meant better conditions and advancement for the men, and reflected naturally to their wives and families. He fully believed that each and every man had the interest of the company at heart, and cited as a proof of this the remarkable celerity with which the old factory had been dismantled and the new plant fitted up. He hardly believed that such a feat was possible, and it spoke volumes for the zest and energy of the men that it had been accomplished in such a short time.

The new factory is 300 ft. long, three stories high and 140 ft. wide, and provides some 125,000 sq. ft. of floor space. The building represents a capital outlay of approximately a quarter of a million dollars, in addition to which over $50,000 worth of new equipment has been purchased. The increased facilities so obtained will enable the Triumph company to turn out even better and more rapid work than heretofore.

Printing-Press Motor Controller.

In no application of individual electric drive to industrial purposes is the desirability of a properly designed controller better exemplified than in printing. The requisites of a wide speed variation and an ability to bring the driving motor to rest quickly have necessitated a special design of controller for this industry. A controller developed by the General Electric Company for this purpose is shown in Fig. 1 and Fig. 2 is a view with the enclosing cover removed. As will be observed, the control is obtained by means of a single handle which projects through a slot in the front of the case. All external wiring passes through a slot at the bottom.

A range in motor speed of 3-to-1 is obtained by variation in



FIGS. 1 AND 2.—PRINTING PRESS MOTOR CONTROLLER.

the armature and field circuit resistances. The operating handle will remain on any resistance point for forward running, but will automatically spring back to the "off" position from the reverse point.

A valuable feature of this controller is the use of a contactor for making and breaking all main circuits. The movement of the handle energizes the contactor and closes the motor circuit. An overload device protects the motor from too rapid acceleration or an overload at any time. Should the contactor drop out, either by reason of an overload or failure of voltage, the operating lever must be returned to the "off" position before the contactor can again be energized.

A quick-acting braking effect is provided by means of a dynamic brake resistance circuit acting automatically when the motor circuit is broken.

A feature of especial value to the printing trade is the remote push-button control. A single push-button may be used to either start the motor or bring it to rest quickly from any running position. This arrangement gives the operator perfect control when "setting up." Push buttons may be installed at any number of convenient points.

The resistors for the armature and brake circuits are contained in separate boxes arranged for mounting on the wall or any other convenient place. The resistors are made up of single resistance units, which may be easily replaced. Ample ventilation is provided for insuring a low-operating temperature.

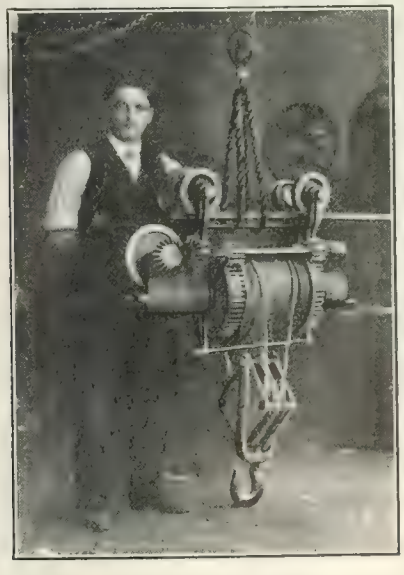
Gas-Electric Motor Cars for Southern Railway.

The General Electric Company has sold to the Southern Railway Company two of its latest type of gas-electric motor cars. These cars will be equipped with standard commutating pole railway motors of 100 hp. Two of these motors are located on the forward truck, giving a motor capacity of 200 hp to each car.

The current is supplied from a 600-volt generator, which is direct coupled to an eight-cylinder gas engine in the forward compartment. A controller similar to that used on an ordinary trolley car is located convenient to the operator, and through this the current passes from the generator to the motors. Combined straight and automatic air brakes will be provided, with the usual valves and accessories. The car bodies will be of steel, about 55 ft. long, with a seating capacity of 52 passengers. Both rear and center entrances are provided, thus furnishing a convenient means of dividing the two classes of passengers, as required in the South. The car bodies will be illuminated by electric light throughout. The order for these cars was placed only after a thorough test on the Southern Railway of this type of car between Manassas and Strasburg last summer.

Electric Hoist.

The accompanying illustration shows an electric hoist built by Gustav Rasmus, 514 West Fifty-seventh Street, New York, which embodies some rather novel features. In order to make the hoist as small as possible, without forfeiting strength or durability, the field of the motor is made the drum of the hoist. A standard type of motor is dismantled, the pole pieces being placed in the drum of the hoist, and the brushes and armature inside the drum between the two drum gears which form the front and rear casing of the motor. By the reduction of these parts, and by placing the armature within the drum, a number of casings and braces necessary to hold the motor in alignment with gears and drum are done away with. In order



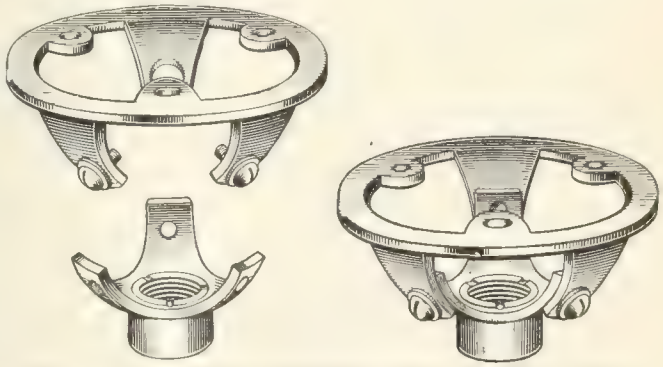
ELECTRIC HOIST.

to limit the friction to a minimum, the armature and the drum are designed to rotate in the same direction, the hubs of the drum gears being the bearings of the armature shaft. A feature of the design is a worm keyed to the armature shaft, thus eliminating the necessity of a load brake and a speed brake.

The motor is electrically controlled for speed, and when at a standstill the gears are locked in position by the worm. The hoist is supported by four flanged wheels mounted on slightly inclined studs in the suspending yokes. The hubs of the drum gears are journaled in the hoist frame, and through their hollow trunnions extends the armature shaft of the motor. The commutator and controlling apparatus are located at one end, and on the opposite end, on the extended armature shaft, is a worm engaging a worm wheel, which through beveled gears drives a shaft parallel to and above the armature shaft. This shaft carries pinions meshing the drum gears. The motor is of the bipolar type, and a limit switch is provided to break the circuit when the hook reaches the top of its travel. A five-ton electric hoist is said to require only 35¾-in. head room and to weigh 500 lb.

Separable and Adjustable Tripod for Electric Fixtures.

The Emery separable and adjustable tripod, or crowfoot, made by the Fairmount Electric & Manufacturing Company, of Philadelphia, Pa., comprises a top and lower portion, as shown herewith. The top portion is first screwed firmly to the wall or ceiling and the lower part screwed to the fixture. The lat-



FIGS. 1 AND 2.—PARTS OF SEPARABLE AND ADJUSTABLE TRIPOD.

ter is then hung on the top portion and the screws inserted in the fixture.

The advantage of this construction is that the workman is not compelled to bear the weight of the fixture while screwing up the tripod as in the old method, so that he is free to secure the tripod more firmly and more easily which is not the case if he must hold the fixture at the same time. The tripod also permits of adjustment where the ceiling is irregular or the thread is not true, so that it is not necessary to resort to blocks of

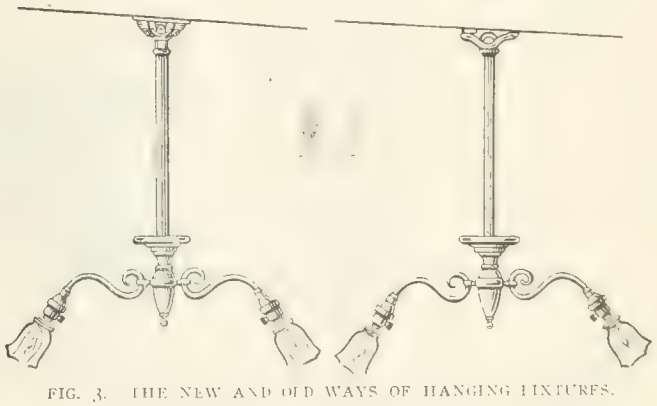


FIG. 3. THE NEW AND OLD WAYS OF HANGING FIXTURES.

wood to bring the fixture plumb. Moreover, the method of using a block of wood under the older type of tripod has much to condemn it, as in time the block becomes loose due to vibration and jars to which all fixtures are subject. The dropping of the block takes away from the rigidity of the fixture, which cannot be made secure again except at some expense. Fig. 3 herewith clearly illustrates the old and the new way of hanging fixtures and also shows the advantages of the adjustable tripod.

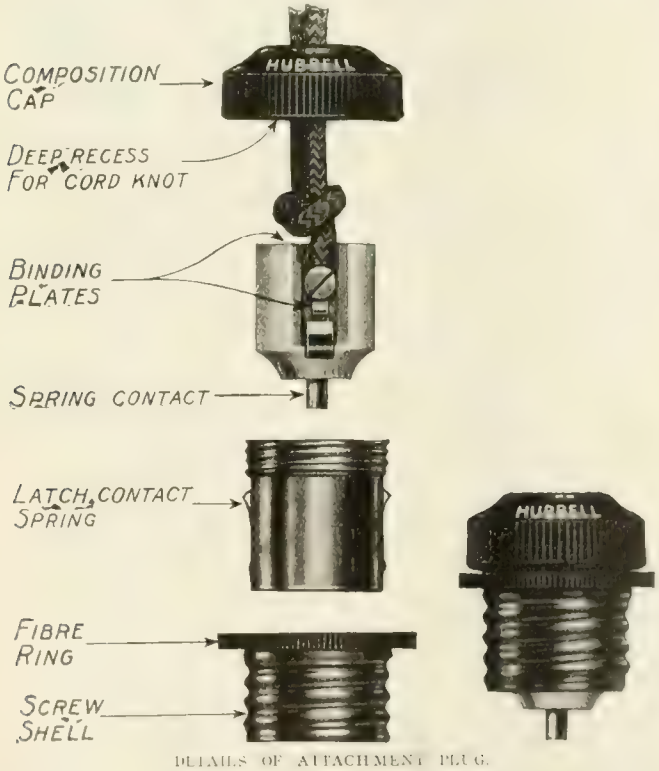
Train Dispatching by Telephone.

A telephone train-dispatching circuit between Raleigh and Monroe, N. C., a distance of 148 miles, has been used with excellent results during the past two months by the Seaboard Air Line Railway. The dispatcher's office is located at Hamlet, 53 miles from Monroe and 95 miles from Raleigh. There are 29 selector stations placed along the route.

The dispatcher's telephone equipment consists of three sets of head receivers and breast transmitters, with cord and plug attached. The sending cabinet is equipped with individual-call keys, one for each way station. The selectors at the way stations are of the main-line bridging type wound for 4500 ohms. By means of graduated resistance inserted in series with the individual selectors each selector receives about 8 milliamperes of current independent of its distance from the dispatcher's office. Between Monroe and Hamlet there is in service a special composite block telephone system, while between Hamlet and Norlina, a distance of 154 miles, there is a magneto-telephone block system. The telephones and terminal devices were furnished by the Western Electric Company.

Small Attachment Plug.

In making attachment plugs for use with ornamental lamps and the great number of electric household devices, the manufacturers have striven to get a smaller plug; because if smallness and sturdiness could be combined such a plug would be preferable to the large, and oftentimes unsightly, plugs heretofore used on household circuits. Harvey Hubbell, Inc., of Bridgeport, Conn., claims several features of merit for the



DETAILS OF ATTACHMENT PLUG.

attachment plug shown herewith and known as "5601." This is a separable attachment device with a push-in cap which, when given a slight pressure, snaps into a metal base. When the cap is inserted two stiff contact springs grip a groove in the base and the cap is held securely against vibration and undue strain on the cord. The push-in cap prevents twisting of the cord, while its action is smooth, quick and definite. The poles are in plain sight and there are no small parts or screws to handle, consequently the actual wiring of the plug is very simple. The total length of the plug is 1¾ in., and when in use the only visible parts are the cap and the thin fiber ring, both of which project ½ in. from the socket shell.

Theatrical Ad-o-Scope.

The little machine, illustrated herewith, is the latest application of electrical effect for theatrical purposes, and was exhibited by the Feature Advertising Company, Metropolitan Tower, New York, during the recent Electrical Show in Madison Square Garden. It is at present used by the New York, Gaiety and Herald Square theaters, where it may be seen every afternoon and evening flashing pictures of the artists and scenes in the play. This device, as its name implies, is a miniature "News Ad-o-Scope," which was described in our columns a short time ago, and seems to have solved a problem that has vexed managers for years, namely, how to reproduce,



THEATRICAL AD-O-SCOPE.

in the limited space of a theater lobby, pictures of artists in colors, illuminated from behind. Other stereoscopic projections usually require a distance of from 15 ft. to 20 ft., while the dimensions of this machine are 50 in. in height, 42 in. in width and 18 in. in depth.

By means of the "Ad-O-Scope" it is possible to show, not only the portraits of the artists, but to reproduce by stereoscopic projections a complete play, scene by scene and act by act. The photo-slides, 30 in number, are turned by an electric motor, and may be changed and new ones inserted within a few minutes

Novel Low-Pressure Turbine Installation in Akron, Ohio.

The Allis-Chalmers Company has recently received an order from the Diamond Rubber Company, of Akron, Ohio, for a rather novel installation. This will be a low-pressure turbo-generator set receiving its steam supply from the exhaust of the vulcanizers and other apparatus. The set has a capacity of 1000 kw when running at 1500 r.p.m. and will furnish 25-cycle, two-phase, 240-volt currents. The turbine will have a continuous overload capacity of 1250 kw. The initial steam pressure will be about 16 lb. absolute and the vacuum from 26 in. to 28 in., depending on the temperature of the condensing water at various seasons of the year. In connection with this turbine the Allis-Chalmers Company is furnishing a special condenser outfit.

The conductor head will be connected to the expansion joint of the exhaust line where it leaves the turbine. The mixture of steam, water and air coming from the head will be removed by a centrifugal pump driven by a small impulse steam turbine. The dry-air pump will be driven by a small reciprocating engine. Both these auxiliaries will run on high-pressure steam and the exhaust from them, which will be at atmospheric pressure, will be used in the large low-pressure turbine, which makes a most economical arrangement.

Crude-Oil Engine Internal Combustion.

An interesting type of internal combustion engine has recently been brought out in England, the manufacturers being Blackstone & Company, Rutland Works, Stamford, Eng. Crude oil, such as those of Texas and Russia, and also, it is stated, petroleum residue, may be used in the engine efficiently without the aid of abnormally high compression. Ordinary refined petroleum may also be used. One of the main features of the type is that the compression of the charge is comparatively low, namely, 150 lb. per square inch. The fuel is injected into the cylinder at or near the end of the compression stroke with a pressure of about 400 lb. per square inch. To ignite crude oils with a compression of only 150 lb. some additional means had to be provided. This consists in the employment of a dual spraying device, consisting of a main jet adapted to deliver a charge into the combustion chamber, and an auxiliary one delivering a similar charge into a bulb-shaped ignition chamber, heated at starting by a lamp, and afterward kept incandescent by the combustion of the fuel. This ignition chamber communicates with the combustion chamber by a port so arranged that the flame produced in the chamber impinges upon and ignites the main fuel spray in the combustion chamber. This oil is delivered from a tank to the spraying device by a governor-controlled pump, and first reaches the auxiliary or igniter spray, all oil in excess of the quantity required for this purpose overflowing into the main spray. This method insures a charge of oil being injected into the igniter at every cycle, thus keeping it hot irrespective of the engine running light or loaded.

A principal object kept in view in the design of the engine was to prolong the initial pressure of the explosion in the cylinder, which, it is claimed, has been done so successfully that the indicator card is parallel to the atmospheric line for a considerable distance along the working stroke, thus resembling the cards obtained from a steam engine working with a good cut-off. It was found by experiment that this object could not be obtained by injecting the whole of the fluid charge at the end of the compression stroke, so means were provided by which the injection of the charge is sufficiently prolonged to keep the pressure in the cylinder at its maximum during the first portion of the working stroke. To effect this purpose an oil reservoir is provided in conjunction with the main spraying valve into which the surplus oil from the igniter flows. This chamber is so formed that it is not immediately emptied when the spraying valve is opened, but a further supply of fuel is forced into the combustion chamber as the working stroke proceeds, thus maintaining the combustion and the pressure for a considerable portion of the stroke. A governor of the centrifugal type controls the speed of the engine by regulating the stroke of the oil pump, which is done by inserting or withdrawing a wedge-shaped packing piece between the end of a slot formed in the pump plunger and the end of the bell crank lever which actuates the pump.

New Appliances at Illinois State Electric Convention.

At the Illinois State Electric Association convention, held at Alton, Oct. 26 to 28, exhibit space was offered free to exhibitors in the basement of the Illinois Hotel. These facilities were taken advantage of by a number of supply companies. Many of the exhibits were of well-known appliances, but a few of the new things exhibited should have special mention.

The Pacific Electric Heating Company, maker of "Hot Point" irons, exhibited for the first time the "Utility Hot Point" iron. This is a small iron intended for the use of travelers and is put up in convenient shape for traveling. The iron alone weighs a little more than 2 lb. Besides being an iron, the appliances with it make it possible to use it as an electric stove and an electric curling tong heater. There is a stand by which the iron can be placed bottom up and used as a stove. A pan the shape of the iron is supplied with the outfit and can be used for heating water or other reasons. This pan serves as a receptacle for the iron when it is packed up. A receptacle in the iron takes a curling tongs. The whole outfit is placed in a neat leather bag for carrying. It weighs about 3¼ lb. The Pacific Electric Heating Company is getting this set out for holiday trade, and it should prove very popular. It is, of course, not to be recommended for heavy ironing, but is a very useful article to have around the house, even if it is not used when traveling.

The Holophane Company showed for the first time its new line of extensive and focusing D'Olier reflectors for use with pendant lamps. These extensive reflectors, when hung low over a workbench, give a wide distribution of light under the lamp, and at the same time completely cover the lamp.

The Central Electric Company has a new pothead for high-tension cables up to 12,000 volts. This pothead has high-tension insulators, through the center of which the high-tension cables are brought out. The external form of the insulators is similar to other high-tension insulators.

The American Washer Company, of St. Louis, had the Jewell electric washer in operation with motor drive. This washer is similar to those used in large laundries, being of the revolving barrel type.

The new P-M meter testing system shown by the Central Electric Company attracted much attention. This consists of a pressed sheet-steel box containing the consumer's meter and a main line cut-out equipped with certain receptacles into which plugs from a test meter can be placed. The consumer's meter can be short-circuited by means of these plugs so as not to interrupt service to the consumer while the test is going on. The meter can then be tested by the connection of an artificial load. The main object of this arrangement is to save the large amount of time taken by meter tests in connecting up and getting ready to test consumers' meters. This is a considerable percentage of the total time required in testing. The enclosing box also protects the service and meter terminals from tampering and theft of electricity.

The Jandus long-burning flaming-arc lamp of the regenerative type was shown. This burns 70 hours with one trim of carbons. The mechanism is simple and the lamp is easily cleaned and trimmed. The distribution of candle-power about the lamp is such as to make it well suited for lighting large areas. The maximum candle-power is about 50 deg. from the vertical instead of directly underneath the lamp as in most other types of flaming-arc lamps.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The condition of trade during the past week continued to improve. This is an old story. Every week shows additional expansion over the week previous, and the entire sentiment of the business world is one of buoyancy. Altogether the situation is considered so satisfactory, and the promises for the remaining months of 1909 are so bright, that many business men are predicting that the year will be close to the top record for general prosperity. Industry is leading in the upward movement; manufacturers are book-full with orders; overtime is the rule in many sections, and there are beginning to be complaints of the insufficiency of skilled labor. The mild weather has stimulated retail trade in all sections, and many fall festivals have done much to increase business. The jobbing trade has kept pace with the retail trade, and the distribution of goods, especially dry goods and clothing, has been very liberal. Buying for the holiday trade has also been active, and orders for spring delivery are coming in. During the past week the New York Central Railroad placed contracts for 325 locomotives, 197 passenger cars and 17,850 freight cars. Contracts are already arranged for the purchase of 165,000 tons of new steel rails to be delivered in 1910. It is said that the total expenditure of this road for new equipment will be close to $25,000,000. It is announced that the great Pennsylvania Railroad shops at Altoona are working either overtime or full time; that 12,000 men are employed and that the rush to put equipment into good condition is greater than ever before known. As a reflection of the increase in business, it is worth noting that the interest and dividend disbursements for November will show an increase of almost $8,000,000 over the same month of last year. This indicates the better condition of both railroads and industries, and does not include in the calculation of earnings the financial institutions. The one gloomy report from the industrial world comes from the cotton mills, where there is a movement on foot to curtail the output. This is due to the low prices now prevailing for cotton goods, and the high price that is demanded for raw material. Many of the mills, especially those in the South, claim that the output must be reduced until prices adjust themselves. Collections are practically normal, and there is no complaint heard from wholesalers and jobbers. Business failures for the week which ended Oct. 28, as reported by *Bradstreet*, were 217 against 244 the previous week; 241 in the same week in 1908; 233 in 1907; 163 in 1906, and 160 in 1905.

THE COPPER MARKET.

During the past week the copper market has been more or less excited, and fluctuations have been rather violent. The net result of the week's trading, however, amounted to only slight advances over the close of the previous week. There is much evidence that the copper market is being manipulated in the interest of Wall Street, and that there is more attention paid to speculation in copper securities than there is to the actual copper industry. A revival of the speculative interest in London caused a considerable advance in the price of standard warrants in that market. Before this movement began there was quite active buying of electrolytic copper by foreign consumers, and it is stated that the prices at which this copper was sold were more favorable to the melters than any that could be obtained by domestic consumers. The result of this is that domestic buying has been light. Another feature which has tended to excite the local market is the persistent rumor that a large copper combination is pending, which will include the leading interests of both America and Europe, and will practically dominate the copper industry of the world. John D. Ryan, president of the Amalgamated Copper Company, declares that there is nothing whatever in these reports, but the fact that numerous lengthy meetings have occurred at the Amalgamated offices keeps Wall Street talking of combinations. One report has it that J. P. Morgan & Company are to do the financing, and that W. E. Corey, of the Steel Corporation, will take active management. Whether this is nothing more than the gossip of the "customers' room," or whether huge plans are being matured, makes little difference in Wall Street. The prices of copper stocks have advanced sharply, and Amalgamated shows a gain of 7⅛ points on the week. For the month of October it seems probable that there will be an accumulation of copper of about 30,000,000 lb. Exports for the month are estimated at about 23,000 tons. On the Metal Exchange Oct. 30 standard copper was quoted as follows:

	Bid.	Asked.	Settling price.
Spot	....	12.50	....
[illegible]	....	[illegible]	[illegible]
[illegible]	....	[illegible]	[illegible]
[illegible]	....	[illegible]	[illegible]
[illegible]	....	12.50	12.25

The London prices Oct. 29 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	[illegible]	57 12 6
Standard copper, futures	58 17 6	58 15 0
Market	Strong	Easy
Sales of spot		1200 tons
Sales of futures		2800 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	[illegible]	12 12¼
London, spot	£64 [illegible] 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	65 15 0	59 0 0

RUTLAND (VT.) RAILWAY, LIGHT & POWER COMPANY.—It is stated that the Rutland Railway, Light & Power Company will extend its line from Poultney, Vt., to Granville, N. Y. Arrangements have been made to finance the construction of this railway from a point on the main line near Castleton, through the slate quarries to Poultney. The road will only be built provided a free right-of-way is granted, and that there is no trouble in securing the proper franchises. The company will supply energy for light and power along the route.

EAGLE PASS, TEX., INDUSTRIAL PLANT.—Plans are now under way and being matured by the Eagle Pass (Tex.) Industrial League, for the organization of a company to construct a hydroelectric power plant. The plans include the purchase of the local electric light, water and ice plants, all of these properties to be operated by electricity. It is also contemplated that sufficient energy will be developed to furnish power for industrial plants in Eagle Pass, Tex., and in Porfirio Diaz, across the Rio Grande River in Mexico.

OTTER TAIL POWER COMPANY.—A proposition has been submitted to the city of Fergus Falls, Minn., by the Otter Tail Power Company to furnish energy to operate a lighting plant for a term of 10 years at 2½ cents per kw-hour for the first 200,000 kw and 2¼ cents for the second 200,000 kw. This proposition covers energy which is delivered at the city switchboard, and the contract is made on the condition that the city will not furnish electricity for power purposes within the next 10 years.

ALLIS-CHALMERS SALES.—Among recent sales of the Allis-Chalmers Company are the following: Twenty-five direct-current motors to the Buffalo plant of the Lackawanna Bridge Company, which follows an order given in August for a 200-kw generator and 21 motors. To T. F. Fullerton, Sapulpa, Okla., a 360-hp, 60-cycle, three-phase, 2300-volt gas engine generating unit and exciter. To the U. S. Navy Department for the Philadelphia Navy Yard, three 100-kw motor-generator sets, two 25-kw exciter sets and a 27-panel switchboard. To the McKeesport, Pa., Tinplate Company, for its Port Vue plant, two 300-kw direct-current type generators and 19 direct-current motors. To the City of Greenville, Tex., two 300-kw, 60-cycle, three-phase alternators directly connected to cross-compound engines, an induction motor-driven exciter and switchboard. To the Cleveland Worsted Mills, a duplicate order for its Ravenna factory, consisting of a 1500-kw, 60-cycle,- three-phase alternator direct-connected to a cross-compound Corliss engine. To the Starr Manufacturing Company, Carpentersville, Ill., a 300-kw, direct-connected hydro-electric unit, 300-kw belted alternator, exciters for the above, fifty-two 440-volt induction motors, and switchboard. Orders for transformers varying in size from

200 kw to 1500 kw have been received from the Great Western Power Company and Pacific Gas & Electric Company, San Francisco; Bear Lake Power Company, Montpelier, Idaho; Portland Railway, Light & Power Company, Portland, Ore.; Sacramento Valley Power Company and Los Angeles Gas & Electric Company.

BUILDING A MONORAIL LINE.—With some ceremonies, at which the president of the Board of Aldermen turned the first spadeful of dirt, construction was begun, Oct. 28, upon the monorail railway line which will be built from Bartow station, on the New York, New Haven & Hartford Railroad, to City Island, N. Y. The line will be three miles long, and the greater portion of it will run through Pelham Bay Park. The line is being constructed by the Monoroad Construction Company, of which Bion L. Burrows is the president. Some time ago a syndicate, represented by Mr. Burrows, purchased the capital stock of the Pelham Park Railroad Company and the City Island Railroad Company, two short connecting horse lines. The Monoroad Company was then organized, and issued $100,000 worth of bonds, the stock of the two railroad companies being put up as collateral. Mr. Burrows says that this furnishes ample money for the construction of the road. The Interborough Rapid Transit Company is back of the enterprise. The Monoroad Company owns the rights, by purchase from the American Monorail Company, for that system of construction in the metropolitan district around New York. It is proposed to construct a small power house on City Island, where a waterfront site has been secured, to furnish the energy for the operation of the line. The rails will be laid on concrete ties, and the pedestals of the steel pillars which support the upper trolley will also be made of concrete. Three cars will be constructed, built of steel and aluminum. They will weigh only 15 tons, and Mr. Burrows is confident that a speed of 100 miles an hour will easily be obtained. The road expects to be ready for operation next summer.

NEW SUBWAYS VOTED.—The Board of Estimate and Apportionment of New York City last week authorized the issuing of $15,886,381 of bonds for the construction of what is known as the Fourth Avenue Subway in Brooklyn. This amount represents the contracts already let by the Public Service Commission, and there is now no reason why the work of construction should not proceed as soon as the consents of the property holders have been obtained. The subway will be four track for express and local trains, much the same as the existing subway in Manhattan, except that it is proposed to build separate tubes for each track for purposes of ventilation. So far the line contemplated only extends to Forty-third Street in Brooklyn, but plans are drawn for the extension to Ft. Hamilton, and from there to Coney Island. The Public Service Commission has already let contracts for this work as follows: For the first section, from the Brooklyn approach of the Manhattan Bridge to Willoughby Street, James F. Graham; for the second and third sections, from Willoughby Street to Ashland Place and from Ashland Place to Sackett Street, William Bradley; for the fourth and sixth sections, from Sackett Street to Tenth Street, and from Twenty-seventh Street to Forty-third Street, the F. S. Smith Contracting Company, of Philadelphia, and for the fifth section, from Tenth Street to Twenty-seventh Street, the Tidewater Building Company and Thomas L. Bryson. The contractors have been notified to execute their bonds at once.

REPRESENTATIVES OF LAMP COMPANIES ON WESTERN TRIP.—Messrs. F. S. Terry and B. G. Tremaine, of the National Lamp Company; Walter Carey, of the Westinghouse Lamp Company; A. D. Page, of the Edison Lamp Company, and C. I. Hills, of the Franklin Electric Lamp Company, are making a joint trip in the West in the interests of their respective companies. In an interview in a Denver newspaper, F. S. Terry said that every two or three years the four large manufacturers of incandescent lamps sent out representatives to visit the jobbers in the various cities of the country, and these traveled together in order to be able to meet the jobbers of the different cities at once, thereby saving time and holding a sort of convention in each city visited. The present trip extends from Chicago to the Pacific Coast, touching Portland, Seattle and important intermediate points. A visit to the South will be made upon the completion of the present trip.

TRADE IN INSULATED WIRE.—Reports of companies that manufacture insulated wire state that trade is rapidly improving, and that the demand for wire is better than at any time since before the panic. This business has been a trifle slow in coming, because the wiring contracts are usually the last that are made in connection with new buildings and because telephone extension is just beginning. The state of the trade is not altogether satisfactory, however, owing to the existence of some demoralization in prices. An official of one of the older companies declares that the market has been flooded with cheap wire, manufactured with poor insulation made up mostly of resinous materials, which goes to pieces within a few months. On account of this condition, an effort is on foot among the engineers of several of the principal manufacturing concerns to have a meeting with the Board of Underwriters and prepare stricter specifications for wire insulation. This movement is as yet only in an embryonic state.

ST. LAWRENCE RIVER POWER COMPANY.—The Cornwall (Ont.) Board of Trade has petitioned the Dominion Government to grant a franchise to the St. Lawrence Power Company for utilizing the channels of the river for a hydroelectric plant. This concern, associated with an American company, has already spent $1,000,000 in purchasing sites, etc. The first dam, which will cost $4,000,000, is to be built at the foot of the South Sault Channel, where it is expected from 65,000 hp to 70,000 hp will be devoloped. Later, another dam is to be constructed at the foot of Sheeks Island on the Canadian side, and finally, when needed, a dam will be built at the foot of Barnhart's Island, across the main channel of the St. Lawrence. At the first dam a lock is to be erected by which vessels will be able to take the whole 40-ft. drop at one lift, whereas six are now required in the Cornwall Canal. The company proposes to supply all demands for power in that section.

ATLANTIC COAST LINE INSTALLS TELEPHONES.—The Atlantic Coast Line has in process of construction, and will shortly put into service, a telephone train-dispatching circuit from Richmond, Va., to South Rocky Mount, N. C., a distance of 121 miles. The dispatcher for this circuit will be located at Richmond. There will be 32 selector way stations and two local telephone stations in the chief dispatcher's office and the superintendent's office at Richmond. These stations will be called by means of a buzzer. The transmission line is constructed of No. 9 B. & S. copper, 210 lb. per mile. Western Electric telephone apparatus and Gill selectors are used throughout. The Western Electric Company reports that within the past six weeks three other railroads have placed orders for telephone train-dispatching circuits leading out of Richmond. These are the Chesapeake & Ohio, Richmond, Fredericksburg & Potomac and the Seaboard Air Line.

CENTRAL COLORADO POWER COMPANY.—Negotiations have been closed between the Northern Colorado Power Company and the Central Colorado Power Company whereby the former company will secure energy from the hydroelectric plant of the latter company located in Boulder Canyon. The Northern Colorado Power Company has a large steam plant at Lafayette, but the customers of the company have increased so rapidly that the demand is now greater than this plant can satisfy.

MEXICO STEEL & CHEMICAL COMPANY.—The new organization of the Mexico Steel & Chemical Company, which was noted in our issue of Sept. 16, is rapidly being brought into condition for service. The company is financed by Dr. F. S. Pearson, of New York, the head of the Mexican Light & Power Company. It is stated that the company will use the Héroult type of electric furnace for the manufacture of tool and drill steel, shoes and dies, forgings and steel castings. It will also make light steel rails from 14 lb. to 20 lb. to the foot. The rail plant will have a capacity of 20,000 tons per year to begin with, which will be increased as the demand requires. The capacity of the electrical steel furnaces will be from 16 tons to 20 tons of steel ingots per day. In connection with the steel plant there will be a large factory making calcium carbide. It is expected that this plant will have a capacity of from 3000 tons to 5000 tons per year. The electrical energy for the entire establishment will be furnished by the Mexican Light & Power Company and will be delivered at 20,000 volts.

CANADIAN GENERAL ELECTRIC WORKS.—The Mayor, Controllers, Aldermen and civic officials of Toronto, upon the invitation of the Canadian General Electric Com-

pany, recently paid a visit to that company's works at Peterboro. The party was welcomed by Mayor Rush and Hon. J. R. Stratton. After a visit to the $600,000 lift lock built by the Dominion Government, followed by dinner at the Oriental Hotel, the party to the number of 40 went to the electrical works, which occupy 75 acres, and comprise a dozen large buildings, each devoted to a separate branch of the industry. After inspecting the works, the party assembled at the Peterboro Club, where the visitors expressed their hearty thanks to the company for the pleasant and entertaining outing.

KITTERY WATER & LIGHT COMPANY.—Preparations are being made by the Kittery Water & Light Company, of Kittery, Maine, to furnish the city with energy for light and power. Current for the operation of the system will be secured from the plant of the Rockingham County Light & Power Company, at Portsmouth, N. H.; the latter company proposes to extend a cable across the river for this purpose. John S. Whittaker, general manager of the Rockingham company, is president of the Kittery company.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in our present issue are announcements of proposed new plants or considerable extensions to present plants at Augusta, Kan.; Mammoth Springs, Ark.; Canadian, Tex.; Grand Rapids, Mich.; Manchester, N. Y.; Crescent, Cal.; West Boylston, Mass.; Pitkin, Col.; Great Capacon, W. Va.; Fort Spring, W. Va.; Kittery, Maine; Fort Lupton, Col., and Reidsville, N. C.

EDISON ELECTRIC ILLUMINATING COMPANY OF BOSTON.—A proposition has been submitted to the Board of Control of Chelsea, Mass., by the Edison Illuminating Company, of Boston, to furnish energy for 418 incandescent lamps of 60 cp, to be operated 3828 hours per year, at $23.48 per lamp; the terms for three years are $22.77 and for five years are $22.31. The proposition has not yet been acted upon.

WEST VIRGINIA HYDROELECTRIC PLANT.—Plans are being developed by the Hydroelectric Development Company for the construction of a hydroelectric power plant at Edes Ford, West Va., on the Great Capacon River. A dam will be constructed which will furnish 100-ft. head. The equipment will include four vertical turbines direct connected to vertical generators.

LACLEDE GAS LIGHT COMPANY.—It is stated that the Laclede Gas Light Company, of St. Louis, is maturing plans for the erection of an electric plant to furnish energy to office buildings and industrial plants within a limited area. The company now purchases its electrical power from the Union Electric Light & Power Company.

NAVAL PROPOSALS.—The United States Navy Department, Washington, invites bids, to be opened Nov. 16, for various kinds of insulated wire and cables, and 2000 globes, type F.

Financial Intelligence.

THE WEEK IN WALL STREET.

During the past week the stock market has continued to recover from the forced selling made necessary by the advance in the rates for money. The discount rates of both the Bank of England and the Imperial Bank of Germany have not been increased during the week, and the reports of these institutions indicate that their cash reserves are increasing. The condition of the local banks is distinctly better, and consequently the alarm that was felt by traders is in a large measure removed. While the volume of trading has been restricted, when compared with that of a month ago, this has been mainly due to the fact that most of the small speculators have been placed in the conservative list by higher money. There is still a large demand for all good stocks for investment purposes, and there is still plenty of buying by holders who will be able to command money even when the rate goes up. The result of the week's trading has been substantial advances in almost every active issue. Amalgamated copper especially has been strong, owing to the rumors of a copper agreement and the hardening of copper prices.

During the week there has been very active trading in Interborough Metropolitan stock, and both common and preferred have shown some advances. This has given rise to many rumors to the effect that a new reorganization plan for the Metropolitan Street Railway interests has been prepared. It is also stated that the action of the Court of Appeals in overruling the Public Service Commissions' opposition upon the South Shore traction franchise has given hope to many interests connected with the surface properties in the city. The improved condition of the industrials and of the railroads is so marked, together with the record-breaking contracts for steel

NEW YORK.

	Oct. 25.	Oct. 30.	Shares sold.		Oct. 25.	Oct. 30.	Shares sold.
[illegible]	[illegible]	[illegible]	[illegible]	Int. Met. pfd	49¼	50⅜	69,870
[illegible]	[illegible]	[illegible]	[illegible]	Manhattan	90⅝*	91¼	1,590
[illegible]	[illegible]	[illegible]	[illegible]	Mexican	75*	75½	600
[illegible]	[illegible]	[illegible]	[illegible]	Mo. Pac.	142*	142	1,125
[illegible]	[illegible]	[illegible]	[illegible]	Nat. R. of M. 1st pfd	24*	24*	200
[illegible]	[illegible]	[illegible]	[illegible]	N. Y. & N. E.	139¼*	—	—
Am. Tel. & C.	85*	85*	——	Steel, com.	89⅛	90⅛	1,328,850
[illegible]	[illegible]	[illegible]	[illegible]	Stor. Pur.	128	128	14,490
B. R. T.	76¾	76	29,479	W. U. T.	76½	77	2,585
[illegible]	[illegible]	[illegible]	[illegible]	West. El.	84	87	3,600
Int. Met., com.	17⅞	19¼	223,700	West'h. pfd	140*	140*	— —

PHILADELPHIA.

	Oct. 25.	Oct. 30.	Shares sold.		Oct. 25.	Oct. 30.	Shares sold.
Am. Rys.	45*	45*	——	Phila. Co.	13	13	——
Elec. Co. of A.	12½	12½*	——	Phila. R. T.	58¼	58¼	——
Elec. St. B'ty.	59	58*	——	Phila. Trac.	89½	86*	——
E. S. B'ty, pfd.	30*	30*	——	Union Trac.	52	51¾	——

CHICAGO.

	Oct. 25.	Oct. 30.	Shares sold.		Oct. 25.	Oct. 30.	Shares sold.
[illegible]	[illegible]	[illegible]	—	Chi. Tel. Co.	145*	130	——
[illegible]	[illegible]	[illegible]	—	Met. El. com.	17¾*	16*	——
[illegible]	[illegible]	[illegible]	——	Met. El. pfd.	51*	51¾	——
[illegible]	[illegible]	[illegible]	—	North Chicago	95*	97	— —
[illegible]	[illegible]	[illegible]	——	North C. pfd.	125*	125*	——

BOSTON.

	Oct. 25.	Oct. 30.	Shares sold.		Oct. 25.	Oct. 30.	Shares sold.
Am. T. & T.	141	141	—	Mex. Tel.	3	3⅛*	——
[illegible]	[illegible]	[illegible]	[illegible]	Mex. Tel. pfd.	6	6*	——
[illegible]	[illegible]	[illegible]	——	N. E. T. & T.	134*	135	— —
[illegible]	[illegible]	[illegible]	[illegible]	W. T. & T.	10*	10*	— —
Mass. El. Rys.	[illegible]	[illegible]	——	W. T. & T., pfd.	88*	89*	— —
Mass. El. Rys. pfd.	82*	82	——				

*Last price quoted.
Shares sold are for week of Oct. 25 to Oct 30.

products, that it would be hard to bring about anything more than a temporary reaction. Money on Oct. 30 was quoted at call, 4 per cent; 90 days, 5 @ 5½ per cent. The quotations in the table are those of the close, Oct. 30.

WASHINGTON, BALTIMORE & ANNAPOLIS.—The United States Court at Baltimore has appointed George T. Bishop, of Cleveland, and George Weems Williams, of Baltimore, receivers of the Washington, Baltimore & Annapolis Electric Railroad, running from Baltimore to Washington with a branch to Annapolis. Mr. Bishop has been president of the road and Mr. Williams counsel. The proceedings were brought by a stockholder and were not opposed by the company. Default on the bonds was made some time ago. Mr. Bishop issued a statement in which he said: "The receivership of the company was deemed necessary for the protection of the security-holders, when it became apparent that all of the reconstruction changes, made necessary by the adoption of the direct-current power system and the acquirement of new cars suitable for use in the streets of Washington, would not be completed, so as to enable the company to operate its cars in Washington by Nov. 15, as had been expected and relied upon by the company in making plans to care for its obligations. These changes cannot be completed before Feb. 15, 1910, owing to delays which the contractors were unable to foresee. A large portion of the cost of these changes has necessarily been paid by the company from its current earnings, necessitating a delay in the payment of pressing accounts, which would otherwise have been made from the earnings. We believe that the decreased operating expenses and increased earnings which will result from the improvements would have furnished sufficient funds to provide for the company's urgent and unusual requirements. Under the receivership, which will not be of long duration, all the reconstruction work can be continued, and the cost, which has not already been paid, can be provided for. A plan for the funding of the accrued and accruing interest and other indebtedness will be soon submitted to the security-holders, but it is the belief of the officers of the company that no drastic action will be necessary."

NEW YORK, NEW HAVEN & HARTFORD RAILROAD.—At the special meeting of the New York, New Haven & Hartford Railroad, Oct. 27, a new issue of $50,000,000 of capital stock was authorized, making the total capitalization of the company $171,000,000. This new stock will be sold to the present shareholders at $125 per share, payable in four installments at intervals of six months. It was explained at the meeting that the greater portion of this new money was to be

expended upon the complete electrification of the line from New York to Boston, and immediate work will be done on the branch between Stamford and New Haven. The road expects to operate both its passenger and freight service by electricity. There are also some plans being considered which will give the company an independent entrance into Manhattan, and bring it into connection with the Pennsylvania tunnel at Thirty-third Street. In explaining an item of loss in the report amounting to $453,000, President Mellen said that when the company was forced by the laws of Massachusetts to dispose of the Worcester & Webster Trolley Company and the Webster & Dudley line, these properties at forced sale brought that much less money than they originally cost the New Haven Company.

WATERTOWN (S. D.) LIGHT & POWER COMPANY.—The Watertown Light & Power Company, controlled by the Ferris Brothers System, has purchased the property of the Kirlin-Gray Electric Company, of Watertown. It is the intention of the company to build an entirely new station, and install 60-cycle, three-phase equipment. The Ferris Brothers now control and operate the Eldora (Ia.) Electric Light Company, Osage (Ia.) Electric Light, Heat & Power Company, Yankton (S. D.) Light, Heat & Power Company, Union City (Ind.) Lighting Company, Franklin (Ind.) Water, Light & Power Company, and Watertown (S. D.) Light & Power Company.

KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY.—A petition has been filed with the Public Service Commission by the Kings County Electric Light & Power Company, asking approval of a $5,000,000 bond issue. These are to be convertible 6 per cent debenture bonds, payable in 12 years, and convertible into stock at par at any time after three years. The purpose of the issue is to pay for construction and extension of plant and distributing system, and for the acquisition of other properties. The Edison Electric Illuminating Company, of Brooklyn, the entire stock of which is held by the Kings County Company, joins in the petition.

CONTINENTAL TELEPHONE & TELEGRAPH COMPANY.—It is now made known that the $50,000,000 Continental Telephone & Telegraph Company, which was organized recently under the laws of New Jersey and are referred to in our issue of Oct. 14, contemplates the absorption and merging of all of the principal long-distance Independent telephone interests between the Atlantic Ocean and the Rocky Mountains. The company, according to the statements given out by its organizers, will be the successor of the National Long Distance Telephone Syndicate, which for a year or more has been operating under the management of John A. Howard, of Wheeling, West Va., and Max Koehler and Herman C. Stifel, of St. Louis. The company has already taken over the property of the Independent Union Telephone & Telegraph Company. It is said that it is backed by both European and domestic capital. The organization is committed to an expenditure of about $20,000,000 in the next two years for the construction of a comprehensive system of lines reaching from the middle West and as far as the Rocky Mountains. The Independent Union, the first property acquired, operates from Newburgh, N. Y., to Erie, Pa., and takes in Albany, Troy, Schenectady and many other up-State towns. It is stated that the Continental Company has already started building east and west out of Buffalo with heavy copper lines for through business, and that contracts have been let for many other extensions. It is promised that when the system is completed it will connect 2,986,515 independent telephones with a national long distance service.

TOLEDO RAILWAYS & LIGHT COMPANY.—The earnings of the Toledo Railways & Light Company continue to run along with a slight increase over previous years, but it has become evident that any definite increase in the company's business is dependent upon an increase in mileage rather than upon the development of the city. The gross earnings for August were larger than for the same month in any previous year, but the surplus after charges for the month was but $32,614, as compared with $26,704 for the last year. The protective committee, which now has the property in charge, has petitioned that no receiver is necessary, and that the difficulties of the company will be finally cleared away and a permanent scheme of refinancing agreed upon. The entire matter is dependent largely upon the execution of a new franchise. Uncertainty with regard to this has been the main cause for the difficulty of refinancing.

GENERAL MOTORS COMPANY.—The holders of the common stock of the General Motors Company, of which there is now $5,500,000 outstanding, will receive on Nov. 15 additional common shares at the rate of 1½ for every one now held. This is a stock dividend of 150 per cent, and it will be paid out of the increase of $34,500,000 recently made in the common stock. The preferred shares have received 7 per cent ever since the company's organization a few years ago, but the common has as yet received no cash dividends, the company's policy having been to put all of its excess earnings back into the business. The General Motors Company owns or controls 13 of the largest manufacturing concerns of automobiles and motor cars. At the annual meeting held Oct. 29, W. A. Eaton was re-elected president, and W. C. Durant, chairman of the executive committee.

ELWELL PARKER ELECTRIC COMPANY.—The Anderson Carriage Company, of Detroit, has purchased the Elwell Parker Electric Company, of Cleveland, which has made a specialty of the manufacture of electric automobile motors. The company was capitalized for $400,000, and employed several hundred men. The works will continue to be operated in Cleveland. With this acquisition the Anderson Carriage Company will be manufacturing practically every part of its electric vehicles except the wheels and tires. The company recently increased its capital stock to $1,000,000.

ANDROSCOGGIN RESERVOIR COMPANY.—The Androscoggin Reservoir Company, of which A. N. Burbank, of the International Paper Company, is president, is rushing work on what will be one of the largest artificial lakes in the world, located at Aziscoos Falls, Me. The reservoir will be 12 miles long, and will contain 8,000,000 cu. ft. of water. The present available water-power of the Androscoggin River has been practically exhausted, and the creation of this new lake is designed to furnish additional power for the varied industries located along the river. Over $300,000 of the cost of developing this new reservoir has been contributed by the corporations interested in the use of power along the river.

OLD COLONY STREET RAILWAY.—The Railway Commissioners of Massachusetts are considering an application of the Old Colony Street Railway Company for an issue of 12,000 shares of additional capital stock, to be issued to shareholders at 195 per share. The proceeds of this issue are to be applied to the payment of $1,912,000 5 per cent bonds of the Clinton, Fitchburg & New Bedford Railway, which will mature Jan. 1, 1910. Any of these new shares which are not subscribed for by present stockholders will be sold at public auction, subject to the order of the commissioners. There is practically no opposition to this request.

WESTERN UNITED GAS & ELECTRIC COMPANY.—The Western United Gas & Electric Company, which was formed in 1905 as a consolidation of the Fox River Light, Heat & Power Company, of Aurora, Ill., the Joliet Gas Light Company, the La Grange Gas Company and the Elgin American Gas Company, has enjoyed a remarkable financial growth and is rapidly increasing its business. For the year which ended July 31, 1909, the gross earnings of the company were $823,755, an increase of 40.4 per cent over the earnings for the same period in 1906.

CONSOLIDATED GAS COMPANY.—An abstract of the report of the Consolidated Gas Company, and its subsidiary gas companies, for the year ended Dec. 31, 1908, has been given out by the Public Service Commission. The gross revenues from the company's business were $12,000,689, and from rentals and dividends on stocks owned, $5,939,404. After paying expenses, taxes and dividends, there was a surplus left of $3,045,174. The total assets of the company, according to the balance sheet, were $149,544,169.

KENTUCKY TELEPHONE DEAL.—The Louisville Home Telephone Company has negotiated to take over the bonds of the Independent Long Distance Telephone. These bonds were purchased from a bondholders' committee, which took charge of the company when it recently got into financial difficulties. There were in the hands of this committee between $450,000 and $470,000 of bonds, and the cash which figures in the present transaction will probably amount to $250,000.

CUTHERT (GA.) ELECTRIC LIGHT & WATER PLANT.—The City of Cuthert, Ga., has voted $20,000 of new bonds, the proceeds of which will be used for improvements upon the municipal electric light and water works. The work will be started as soon as the bonds are sold.

NORTHWESTERN ELEVATED'S ANNUAL REPORT.—In his annual report, made public Oct. 25, President M. B. Starring, of the Northwestern Elevated Railroad Company, of Chicago, reported net earnings for the year ended June 30 equal to a trifle over 7 per cent on the $5,000,000 preferred stock. The payment of dividends at the rate of 4 per cent was begun. The daily average passenger traffic for the year was 112,207, an increase of 9.75 per cent. The traffic of the road has shown a constant increase since 1901, when the daily average was 51,918. The gross earnings for the year were $2,540,083, an increase of 3.15 per cent over the preceding year. The net earnings were $1,545,064. The ratio of operating expenses to earnings (excluding the net earnings of the Union Loop) was 68.24 in 1909 and 66.44 in 1908. An interesting reference was made by Mr. Starring in respect to the rehabilitation of the surface lines on the Northwestern Elevated. He said: "The rehabilitation of the lines of the surface railways and the improvements in their rolling stock and schedules somewhat affected this company's gross earnings, not only upon its own lines, but by reason of the effect upon the revenue of the other Loop lessees, correspondingly affecting the revenue from the Loop. The most serious effects have now been felt, and the business of the elevated railways in its entirety is improving."

CENTRAL & SOUTH AMERICAN TELEGRAPH COMPANY.—It is said that the Central & South American Telegraph Company will shortly issue to its stockholders a 20 per cent stock dividend. This distribution represents the expenditure which the company made several years ago in the construction of a cable from New York to Colon via Cuba. This work was done in connection with the Mexican Telegraph Company.

ST. JOSEPH LONG-DISTANCE TELEPHONE COMPANY.—A new incorporation has been made in Missouri, known as the St. Joseph Long-Distance Telephone Company, with a capital stock of $1,250,000, of which $125,000 is common and has the voting power. The company proposes to absorb a large number of Independent telephone systems in northern Missouri and combine them into one system. The incorporators are men who have been identified with the Independent telephone business in that section for a number of years.

THIRD AVENUE RAILROAD EARNINGS.—The report of the Third Avenue Railroad Company, made to the Public Service Commission for the year ended June 30, 1909, showed a surplus on the entire stock, after the payment of operating expenses, taxes and of the $769,157 interest charges still in force, of $1,265,132. These figures do not account for the rental on the Third Avenue stock or the interest on the $37,560,000 of general mortgage bonds which are in default.

BITTER ROOT (MONT.) TELEPHONE COMPANY.—The plant and holdings of the Bitter Root (Mont.) Telephone Company have been purchased by the Montana Independent Telephone Company. The line of the Bitter Root company was 26 miles long, extending from Corvallis to Darby. It is stated that this line will be extended north through Victor to Florence, where it will connect with the main line running from Missoula.

YONKERS RAILROAD COMPANY.—The report of the operations for the year ended June 30, 1909, of the Yonkers Railroad Company shows a gross revenue of $487,552, and operating expenses of $489,241; adding in the taxes and the fixed charges the net deficit is $79,668. The total deficit on the company's books on the date mentioned was $440,764.

QUEBEC UTILITIES MERGER.—It is said that all the details for the managing of the street railway, electric light and power companies of Quebec have been concluded after negotiations which have lasted for several weeks. The capital of the united company will be $12,000,000 common stock, and $10,000,000 bonds.

BRASE ELECTRIC COMPANY, BALTIMORE.—An application has been made to the Circuit Court in Baltimore for the appointment of a receiver for the Brase Electric Company. The bill was filed by Claude E. Brasefield, the largest stockholder, who declares that the company owes him for salary and is insolvent.

DIVIDENDS.

Connecticut Railway & Lighting Company, quarterly, preferred, 1 per cent; common 1 per cent, both payable Nov. 15.

Electric Properties Company, preferred, quarterly, 1½ per cent, payable Nov. 10.

Ohio Traction Company, preferred, quarterly, 1¼ per cent; common, initial, 1 per cent, payable Nov. 1.

Pacific Gas & Electric Company, preferred, 1½ per cent, payable Nov. 15.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings	Changes.	Surplus.
American Cities Railway & Light Company—Operating Companies:					
September, 1909	$[illegible]	$287,470	$[illegible]	$106,724	$94,601
September, 1908	458,218	276,210	182,007	105,456	76,551
Binghamton (N. Y.) Railway Company:					
Quarter ended June 30, 1909	84,837	55,898	28,939	23,040	5,899
Quarter ended June 30, 1908	80,255	46,944	33,311	23,396	9,914
Birmingham (Ala.) Railway, Light & Power Company:					
[illegible]	[illegible]	105,753	82,611	.....	.....
September, 1908	[illegible]	107,566	69,822	.....	.....
Detroit United Railroad Company:					
September, 1909	[illegible]	477,850	273,968	158,124	127,606
September, 1908	668,489	423,136	245,353	135,049	115,332
Fairmont & Clarksburg Traction Company:					
September, 1909	43,674	15,094	28,580	10,416	19,947
September, 1908	39,741	12,469	27,272	10,416	17,121
Jamestown (N. Y.) Street Railway Company:					
Quarter ended June 30, 1909	52,194	28,503	23,690	15,056	6,280
Quarter ended June 30, 1908	45,589	28,939	16,650	14,729	517
Lake Shore Electric Railway Company:					
September, 1909	108,206	49,842	58,364	34,804	23,560
September, 1908	104,072	49,648	54,[illegible]	34,012	20,412
Manufacturers' Light & Heat Company, Pittsburgh:					
Nine months ended Sept. 30, 1909	3,864,290	1,523,179	[illegible]	783,654	1,557,456
Nine months ended Sept. 30, 1908	3,382,783	1,414,746	1,968,037	679,760	1,288,277
Massachusetts Electric Companies:					
Quarter ended Sept. 30, 1909	2,626,388	1,289,727	1,336,661	432,058	904,603
Quarter ended Sept. 30, 1908	2,483,710	1,341,817	1,141,893	417,493	724,400
Northwestern Elevated Railroad Company, Chicago:					
Year ended June 30, 1909	[illegible]	995,818	1,545,064	1,189,288	355,776
Year ended June 30, 1908	2,463,188	965,118	1,498,070	1,147,183	350,889
Pacific Telephone & Telegraph Company:					
Nine months ended Sept. 30, 1909	9,002,289	[illegible]	2,709,136	946,920	1,762,216
Nine months ended Sept. 30, 1908	7,738,528	5,727,001	[illegible]	747,742	1,250,785
Syracuse & Suburban Railroad Company:					
Quarter ended June 30, 1909	30,599	24,062	[illegible]	7,235	*614
Quarter ended June 30, 1908	30,209	14,964	15,244	7,309	8,341
Toledo Railways & Light Company:					
September, 1909	[illegible]	121,779	[illegible]	75,483	20,833
September, 1908	[illegible]	[illegible]	110,992	71,976	39,077
Toronto Railway Company:					
September, 1909	[illegible]	[illegible]	199,146	.....	.....
September, 1908	354,095	[illegible]	[illegible]	.....	.....
Tri-City Railway & Light Company:					
Quarter ended Sept. 30, 1909	506,987	279,364	227,623	[illegible]	97,432
Quarter ended Sept. 30, 1908	450,172	244,722	205,450	122,789	82,661
Twin City Rapid Transit Company:					
September, 1909	[illegible]	270,035	[illegible]	140,250	234,912
September, 1908	[illegible]	276,588	307,288	138,666	168,622
United Railways, San Francisco:					
August, 1909	[illegible]	363,952	278,168	.....	.....
August, 1908	[illegible]	356,028	[illegible]	.....	.....

*Deficit.

GENERAL NEWS

Construction News.

KINGMAN, ARIZ.—Preparations are being made by the Frisno Mines Power Company, operating near Kingman, to install an electric power plant on its property.

BONO, ARK.—The Farmers' Mutual Telephone Company is planning to extend its telephone line from Cash to Jonesboro, and to connect with the Lorado system at the county line between Craighead and Greene counties.

HARRISBURG, ARK.—The Going Telephone Company, of Harrisburg, Ark., has purchased the Sarle exchange, for $22,500. The company is operating in Harrisburg, Vanndale, Wynne, Earle, Crawfordsville and Marion.

JONESBORO, ARK.—Application has been made to the City Council by Preston Hatches, of the Home Telephone Company, representing a number of capitalists, for a franchise to construct a street railway in Jonesboro with interurban connection to Nettleton, three miles distant.

LITTLE ROCK, ARK.—Acting Mayor Tuohey, in a message to the City Council, has recommended that the city erect buildings for the municipal electric light plant, and to serve as an engine house and stable for horses belonging to the street and police departments on property owned by the city near the city hall. He also recommended that the proposed electric light plant should provide for 1000 lamps so as to meet demands for the future. There are now in service 370 lamps. The lease on the buildings now occupied by the above departments will expire February, 1910. The cost of the proposed buildings is estimated at $45,000.

MAMMOTH SPRINGS, ARK.—Work has commenced on the construction of the dam across Spring River in connection with the new electric power plant to be erected by Napoleon Hill, of Memphis, Tenn., at a cost of about $300,000. The proposed plant will furnish electricity to all towns on the 'Frisco railroad as far west as West Plains, Mo., and Jonesboro, Ark. The company also contemplates building electric railways to connect many inland towns.

PINE BLUFF, ARK.—The Moscow & Youngstown Telephone Company, recently organized, proposes to erect a telephone line to connect Moscow, Garretson and Youngstown; long distance connection will also be provided for. P. C. Galloway is president of the company and E. Young treasurer and manager.

BURBANK, CAL.—L. C. Brand has submitted a proposition to the citizens of Burbank offering to construct an electric railway from Burbank to Glendale, provided a bonus of $40,000 and the right of way along the route is given.

CRESCENT, CAL.—The Smith River Electric Company is contemplating the construction of a large hydroelectric power plant on Smith River about ten miles from Crescent City, work on which will probably commence within 90 days. It is estimated that 3250 hp can be developed. The present plans of the company include, beside the construction of the above plant, two other plants located at points along the north fork and middle forks of the river, and the erection of transmission lines which will extend through Del Norte and Humboldt counties, and a portion of Josephine County, Ore. It is also planned to duplicate the system and furnish a 24-hour service.

FRESNO, CAL.—Contracts have been awarded by the San Joaquin Light & Power Company for equipment for its power plant as follows: To the General Electric Company, Schnectady, N. Y., for generators with a total rating of 8000 kw; also 8000 kw in transformers with necessary switchboards and exciters; about 4000 ft. pressure pipe line to the Pelton Water Wheel Company, of San Francisco, Cal., and to the Abner Doble Company, of San Francisco, Cal., for water wheels. J. G. White & Company, of New York, N. Y., are designing and supervising engineers. A. G. Wishton is general manager.

MARYSVILLE, CAL.—Preparations are being made by the Northern Electric Company for extension of its valley lines during the coming year. The first extension will run from Marysville to Colusa.

NAPA, CAL.—Preparations are being made by the Napa Valley Electric Company to erect a transmission system to furnish electricity for lamps and motors in Napa County. The company has purchased franchises and contracts of the Snow Mountain Power Company in Napa, St. Helena and Calistoga. It is expected to have the system completed within 30 days. It is said the Napa company will distribute electricity generated by the Snow Mountain company. Henry Brown, of Napa, is one of the directors of the Napa Valley Electric Company.

DENVER, COL.—Negotiations have been closed between the Central Colorado Power Company and the Northern Colorado Power Company, whereby the last named company will secure electricity from the large hydroelectric power plant now being constructed by the Central Colorado Power Company in Boulder Canon. The Northern Colorado Power Company has a large steam plant at Lafayette, which furnishes electrical service throughout the northern part of the State. The demands for electricity already have reached the output of the plant, and plans are under way to double the size of the plant.

FORT LUPTON, COL.—The Lupton Utility Company is making preparations to begin work on the installation of an electric light plant and water works system in Fort Lupton. Contract has been awarded for the construction of the power house.

PITKIN, COL.—Preparations are being made by A. E. Reynolds, of Pitkin, Col., for the construction of an electric power plant to furnish electricity to operate the mining properties in this vicinity in which he is interested. A hydraulic turbine and generator will be purchased soon.

BRIDGEPORT, CONN.—The United Illuminating Company has submitted a proposition to reduce the price on arc lighting in the city by $5.47 per lamp, pending an investigation. This reduction would mean a saving of over $3,500 a year to the city. Under the terms offered the rate per arc lamp per year is reduced to $73, but no concessions are offered to private consumers.

NORWICH, CONN.—The Board of Electric and Gas Commissioners has announced a reduction in the price of electricity for lamps and motors as follows: For 1 to 450 kw, 10 cents per kw-hour; over 450 kw, 10 cents for the first 450 kw and 5 cents for each additional kw-hour. For motors from 1 to 500 kw, 5 cents per kw-hour; over 500 kw, 5 cents for the first 500 kw and 2 cents for each kw-hour additional. The city purchases electricity for operating the municipal electric plant from the Uncas Power Company for 1 cent per kw-hour. A profit was made in the electrical department in 1908 of $15,367, the total amount of sales being $82,819.

HASTINGS, FLA.—The Tennessee Cooperage Company is reported to be interested in the establishment of an electric light plant.

CUTHBERT, GA.—L. L. Martin, city clerk, writes that the city will make improvements to the electric light and water plants, which will involve an expenditure of about $20,000, as soon as the city sells the bonds which were authorized at an election held recently.

HAWKINSVILLE, GA.—Contracts have been awarded by the city for equipment for the municipal electric light plant as follows: To J. S. Schofield Sons Company, of Macon, Ga., for a 150-hp high pressure boiler at $970; for Corliss engine with generator direct connected to the Wisconsin Engine Company, of Corliss, Wis., at $2,865, and the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for generator, switchboard, arc and tungsten lamp-system, for $5,112. The total cost of the plant is estimated at $15,500.

SANDPOINT, IDAHO.—Preparations are being made by the Northern Idaho & Montana Power Company for the construction of a large power plant, work on which will commence within 30 days. The new plant will have an output of 1500 hp and will cost about $100,000. The company has awarded the contract for the construction of its substation in Newport, Wash., to Samuel Anderson, of Spokane, Wash. The cost of building and equipment is estimated at $15,000. J. G. Jones is manager.

PEORIA, ILL.—The Peoria Railway Terminal Company contemplates placing contracts for two generators, two turbines and other equipment within the next three months.

WAUKEGAN, ILL.—An addition is being erected to the plant of Wilder Brothers' Tanning Company in Waukegan, which will be equipped with a blower system and from 10 to 15 electric motors and freight elevator will be installed.

ANDERSON, IND.—It is reported that the American Steel & Wire Company contemplates enlarging its mills in Anderson. The plant, it is said, will be equipped for electric motor drive.

ELWOOD, IND.—Arrangements are being made by the Elwood Electric Light Company to extend its transmission lines to Frankton, Ind., four miles distant, to furnish electricity in that town.

ELKHART, IND.—The Brunswick-Balke-Collender Company, of Chicago, Ill., has purchased the Kimbark factory building in Elkhart, Ind., and will equip the factory for electric motor drive throughout. When completed the business will be moved from Chicago to Elkhart.

FORT WAYNE, IND.—The Board of Public Works has awarded the contract for the installation of two new switchboards, an oil filter and other electrical equipment for the municipal electric light plant to the Fort Wayne Electric Works for $1,225. The city is also considering the purchase of an additional boiler for the plant.

FT. WAYNE, IND.—The Board of Public Work has notified the Ft. Wayne & Wabash Valley Traction Company that the new cement poles erected by the company in the city for tests purposes have been found satisfactory. The traction company, it is said, will now proceed with the manufacture of cement poles to replace the present poles in Fort Wayne and ultimately on other portions of the railway.

GARFIELD (P. O. DARLINGTON), IND.—The Garfield telephone exchange has been purchased by the Home Telephone Company, which proposes to erect two new toll lines to Garfield, one of which will be extended to Darlington.

KENDALLVILLE, IND.—The Flint & Walling Manufacturing Company is constructing a new plant, the equipment of which will include an Allis Chalmers cross compound Corliss engine direct connected to generator, a 250-hp Babcock & Wilcox boiler, water purifying plant, heater and other equipment.

LAFAYETTE, IND.—The Indiana Electric Transmission Company has filed a notice with the Secretary of State announcing that the company has changed its headquarters from Lafayette to Terre Haute, Ind. The company is said to be considering a bond issue to finance its undertaking. H. S. Hyatt is secretary.

MONTICELLO, IND.—The Town Board has granted the Northwestern Indiana Traction Company a 75-year franchise to construct an electric railway the entire length of Main and Marion streets. The company claims to have secured the entire right of way for its proposed railway from Hammond to Dyer.

NEW ALBANY, IND.—It is reported that the Robison & Norton Company is contemplating rebuilding its factory recently destroyed by fire. The original plant was operated by electricity and the new plant will be equipped for electric motor drive throughout.

SEYMOUR, IND.—The contract for street lights will expire in a few days, and unless the city and the receiver for the Seymour Electric Light Company can get together on a new contract that the court will approve, the streets of the cilty will be in darkness. The city granted a franchise last March to the Indiana Public Utilities Company, represented by W. B. Holton, of Indianapolis, to construct and operate a light plant in the city. Although the plant was to have been completed by Oct. 1, nothing has yet been done. The City Council voted to extend the time until next July, and in the meantime the city will be without light unless the old company furnishes it.

SOUTH BEND, IND.—The City Council has passed an ordinance requiring the Bell Telephone Company and allied companies to place their wires underground.

WATERLOO, IND.—The Home Telephone Company, which has been instructed by the City Council to remove all its poles and wires from the business section of the city, announces that it will erect new wires and poles to be set in alleys; other improvements will also be made to its system.

ATLANTIC, IA.—The Atlantic Northern & Southern Railway Company, of Atlantic, Ia., is making preparations for the construction of its proposed electric railway, 58 miles in length, and is in the market for material for the same. Rattenborg, Ross & Judd, of Atlantic, Ia., engineers, will purchase the material.

DES MOINES, IA.—Plans are being considered by the Mississippi Telephone Company for improvements to its system in Southeastern Iowa, which will involve an expenditure of $10,000.

GRINNELL, IA.—The Grinnell Electric & Heating Company is contemplating the installation of 150 100-watt tungsten lamps.

LAURENS, IA.—The question of establishing an electric light plant in Laurens, is under consideration.

MARSHALLTOWN, IA.—The business men of Marshalltown are interested in a project to build an interurban railway from Marshalltown to Grundy Center, and eventually to New Hartford, Clarksville, Greene and Charles City. It is estimated that the railway could be built for $360,000.

ASHLAND, KAN.—The citizens are reported to have voted to issue $30,000 in bonds, of which the proceeds of $20,000 will be used to erect a water works system and $10,000 for an electric light plant.

AUGUSTA, KAN.—The City Council is considering a proposition submited by S. J. Stafford for the construction of an electric light plant in Augusta, under the terms of which the city is to grant a 50-year franchise and assist in the construction of a dam across the Walnut River. The city will soon take steps to secure estimates of the cost of construction of the dam.

IOLA, KAN.—The Iola Engineering Company is reported to be preparing plans for an electric light plant in Iola.

PINEVILLE, LA.—The Town Council has authorized Mayor Watkins to appoint a committee to investigate the question of lighting the town by electricity.

BANGOR, MAINE.—Work has commenced on the construction of a large reservoir to be located at Aziscoos Falls, Maine, by the Androscoggin Reservoir Company. The new lake will be about 12 miles long and will furnish additional power to the industries located along the river. A. N. Burbank, president of the International Paper Company, is president of the Androscoggin Power Company.

KITTERY, MAINE.—The Kittery Water & Light Company, recently incorporated, is making preparations to furnish the city with electricity for street lighting and interior service before the winter is over. Electrical energy for operating the system will be secured from the plant of the Rockingham County Light & Power Company, of Portsmouth, N. H. The last-named company proposes to extend a cable across the river to carry the transmission line from its plant in Portsmouth to Kittery. John S. Whittaker, general manager of the Rockingham County Light & Power Company, is president of the Kittery Water & Light Company.

SANFORD, MAINE.—Surveys have been completed for the transmission line of the Sanford Electric & Power Company from Sanford to West Buxton. The company will furnish electricity for operating the Goodall mills. The contract calls for the completion of the line within 90 days.

ATHOL, MASS.—The State Board of Gas and Electric Light Commissioners has granted the Athol Gas & Electric Company permission to issue 1718 shares of capital stock at $100 per share.

CHELSEA, MASS.—The Edison Electric Illuminating Company has submitted a bid to the Board of Control for lighting the streets of the city as follows: For furnishing electricity for 418 incandescent lamps of 60 cp to be operated 3828 hours per year—one year, $23.48 per lamp; three years, $22.77; five years, $22.31, and for ten years, $21.13 per lamp per year.

COHASSET, MASS.—Preparations are being made for the erection of a high-tension transmission line from the central power plant in East Bridgewater to the substation in Cohasset to supply electricity in this town. The property of the Cohasset Electric Light & Power Company, of Cohasset, was recently purchased by the Stone & Webster, of Boston, Mass. The contract for the erection of the poles has already been awarded.

LEOMINSTER, MASS.—Cluett, Peabody & Company, of Leominster, Mass., have decided to install a power plant to furnish electricity for operating their factory. The company has been negotiating with the Connecticut River Power Company to furnish electrical energy, but decided it could generate its power cheaper than it can be purchased. The company will also change its lighting system, installing tungsten lamps in place of the incandescent lamps now in use.

UXBRIDGE, MASS.—The Uxbridge Worsted Company has recently installed a 100-kw generator in its mill to furnish electricity to operate the machinery. The company has until recently purchased electricity from the Uxbridge & Northbridge Company to operate its plant.

WESTFIELD, MASS.—The municipal electric light department has decided to furnish electricity for heating residences and offices in Westfield.

WEST BOYLSTON, MASS.—At a special town meeting held Oct. 18 the citizens voted to establish a municipal electric lighting and power plant to furnish electricity for lighting the streets and residences of the town. Electricity for operating the system will be obtained from the transmission line of the Connecticut River Transmission Company. The cost of the proposed plant is estimated at $15,000.

WORCESTER, MASS.—The Worcester Electric Light Company has purchased the property of the Curtis Manufacturing Company, on Webster Street, with Curtis pond rights. The company proposes to erect a new plant on the site. George T. Dewey, counsel for the company, states that the new plant with equipment, etc., will involve an expenditure of from $300,000 to $400,000.

DETROIT, MICH.—The Reinforced Concrete Pipe Company, of Jackson, Mich., is reported to be erecting a new plant in Detroit for the manufacture of forms, molds and machinery to make reinforced concrete pipe. The building will be equipped throughout for electric motor drive; an electric traveling crane and considerable wood-working machinery will be installed.

GRAND RAPIDS, MICH.—Bids will be received at the office of the Board of Public Works, Grand Rapids, Mich., until Nov. 18 for furnishing and erecting two water tube boilers, or two internally fired boilers with Morrison corrugated furnaces having a rating of from 350 to 375 hp each, to be installed at the combination pumping and lighting station in the city of Grand Rapids, Mich., in accordance with plans and specifications on file at the office of the board. All proposals must be made upon blanks that will be furnished upon application to the board. William M. Gormley is president of the board.

MENOMINEE, MICH.—The Menominee & Marinette Light & Traction Company has commenced work on the construction of a substation for its new power plant, which will be located in the rear of its present station on Parmenter Street. Electricity will be transmitted from the power plant at Grand Rapids, to the substation for distribution in Menominee and Marinette. The plant at Grand Rapids will have an output of 7500 hp.

SAGINAW, MICH.—The Chippewa River Power Company has applied to the City Council for a franchise to furnish electricity in Saginaw. The company proposes to develop the water power of Chippewa River in Isabella and Midland counties to generate electricity for transmission to the Saginaw Valley to be utilized for heat, lamps and motors.

STURGIS, MICH.—The citizens have voted to issue $175,000 in bonds, the proceeds to be used to acquire and develop the Leland water power on St. Joseph River, 18 miles from Sturgis, to supply electricity for the municipal electric light and water plants and 1000 hp for manufacturing purposes.

CHISHOLM, MINN.—The Range Power Company is constructing a new power plant which will be completed early in December. When completed a 24-hour service will be established. The new plant will have an output of 550 hp. A new 50-arc lamp rectifier will be installed.

FERGUS FALLS, MINN.—The Otter Tail Power Company is reported to have submitted a proposition to the city offering to supply electricity to operate the electric light plant for a term of ten years at 2½ cents per kw-hour for the first 200,000 kw, and 2¼ cents for the second 200,000 kw, delivered at the city switchboard, on the condition the city will not furnish electricity for power purposes for ten years.

LINDSTROM, MINN.—It is reported that an electric light plant will soon be installed in Lindstrom.

McKINLEY, MINN. Fairbanks, Morse & Company have been awarded the contract for generator for the municipal electric light plant, for $1,297. Howard W. Irwin, superintendent of the Eveleth Electric Company, will have charge of the construction of the system.

SAUK CENTER, MINN.—It is reported that the Keller Manufacturing Company, of Sauk Center, is planning to rebuild its plant, which was recently destroyed by fire. The company will soon be in the market for equipment for the plant including boilers, engine, generator and other apparatus.

SEBEKA, MINN.—The construction of an electric lighting system in Sebeka is under consideration. John Konkler is interested in the project.

VIRGINIA, MINN.—V. M. Prindle, of Duluth, Minn., and W. D. Chapman, of Chicago, Ill., have applied to the City Council for a franchise to operate an electric street railway within the city limits. The promoters propose to construct a railway to connect with a line from Virginia to Eveleth, thence to Gilbert and from there to Virginia, which later will be extended to Hibbing and other range points.

MISSOULA, MONT.—The plant and holdings of the Bitter Root Telephone Company have been purchased by the Montana Independent Telephone Company. The telephone line of the Bitter Root Company is 26 miles long and extends from Corvallis to Darby, which will be extended north through Victor to Florence, where it will connect with the main line running from Missoula to Darby. T. S. Lane is manager of the Montana Independent Telephone Company.

AURORA, MO.—The City Council has granted the Springfield Gas & Electric Company, of Springfield, Mo., a franchise to establish a gas and electric plant in Aurora.

CHILLICOTHE, MO.—At a recent election the citizens defeated the proposition to issue $150,000 in bonds to establish a municipal electric light plant and water works system.

ST. LOUIS, MO.—The Laclede Gas Light Company is reported to be contemplating the erection of an electric plant to furnish electricity to office buildings and industrial plants for lamps and motors. The company now purchases electrical power from the Union Electric Light & Power Company, of St. Louis, Mo.

TRENTON, MO.—Preparations are being made by the Trenton Telephone Company for the erection of a metallic telephone line from Grundy to Princeton. Claud J. Bain is manager.

AURORA, NEB.—The Aurora Electric Light Company has petitioned the State Railway Commission for permission to issue $28,000 in bonds. The company contemplates the construction of a central heating plant.

HARVARD, NEB.—The Harvard Electric Company has applied to the State Railway Commission for permission to issue $12,000 in bonds, the proceeds to be used to construct an electric light plant in Harvard. The city at present has no electric system, but has made all necessary contracts for construction of the plant.

HOLDREDGE, NEB.—The City Council is contemplating extending the street lighting service in the residential section of the city.

LINCOLN, NEB.—The City Council has appointed a committee to investigate the municipal electric light plant in regard to increasing the efficiency of the plant, and the cost of the same, and report to the Council.

OMAHA, NEB.—Plans are being prepared by the Omaha & Council Bluffs Street Railway Company for the construction of a new power plant, which, with equipment, will cost about $1,000,000. It is estimated that it will require about three years to build the plant, but part of the plant will be ready for use within 12 months after work is started. When the plant is completed the company will equip its railway with large double-truck cars; the company also contemplates making extension to its railway lines. The new plant will be located at the foot of Jones Street directly across from the present power house. G. W. Wattles, of Omaha, Neb., is president of the company.

RENO, NEV.—Work has commenced on the construction of an electric line into the southeast end of the city, which will run on South Virginia and Moran Streets and Wheeler Avenue. Charles Burke and S. H. Wheeler are interested in the project.

HOBOKEN, N. J.—The Common Council has decided to reject all bids heretofore submitted for lighting the streets and public places in the City of Hoboken, and has authorized the city clerk to readvertise for bids for lighting the streets, roads and public places, in accordance with specifications now on file with the city clerk.

NEWARK, N. J.—Arrangements are being made by the Atha Steel Casting Company, of Newark, N. J., for the construction of an addition to its plant on Chapel Street and Lister Avenue, which will be equipped with electric hoists and traveling cranes.

AZTEC, N. M.—The Aztec Light & Power Company, it is said, will purchase equipment for a power plant and electrical transmission during the coming winter.

LAS CRUCES, N. M.—Plans are being made by the Texas, New Mexico & Pacific Railroad Company for the construction of its railway from Las Cruces to Sunny Slope, three miles in length, work on which will begin in about two months. The power station and repair shops will be located in Sunny Slope. James T. Smith is president and treasurer.

ALBION, N. Y.—The Public Service Commission has authorized the A. L. Swett Electric Light & Power Company to execute a mortgage on the property of the Albion Power Company to secure an issue in bonds amounting to $74,500. The Swett company recently acquired the property of the Albion company at a foreclosure sale.

BAY SHORE, N. Y.—The Board of Trade has adopted a resolution favoring the installation of a municipal electric light plant and water works system.

BINGHAMTON, N. Y.—The Binghamton Railway Company has commenced work on the extension of its State Street power plant to make room for additional equipment and the construction of a new smokestack, which will involve an expenditure of about $40,000.

BROOKLYN, N. Y.—The Public Service Commission, First District, has notified the contractors who have been awarded contracts for the construction of the Fourth Avenue subway in Brooklyn to prepare to execute their contracts at once. The Board of Estimate and Apportionment has voted to appropriate $15,000,000 to build the subway from the Manhattan Bridge to Forty-third Street.

CLINTON, N. Y.—Charles Austin Borst, of Clinton, N. Y., has been authorized by the Public Service Commission to exercise rights and privileges under a franchise granted him by the superintendent of highways of the town of Kirkland, N. Y., to erect and maintain transmission lines on Utica Street in Clinton for the purpose of transmitting electricity from his power house to the corporation limits of the village for the distribution of electricity for lamps and motors in Clinton for municipal and commercial purposes.

DUNDEE, N. Y.—The Yates County Electric Railway, which is constructing an electric railway connecting Dundee, Starkey and Starkey Point on Seneca Lake, will soon purchase overhead material for its road, including hard drawn wire, feeder cable and bonds. The railway is owned by Edward L. Bailey, who also owns and operates the Dundee electric light plant, which will furnish electricity for operating the railway.

HILTON, N. Y.—The Public Service Commission, Second District, has granted the Hilton Electric Light, Heat & Power Company permission to issue $5,000 in capital stock and to construct an electric plant and to exercise its franchises in the village of Hilton, and also to issue bonds to the amount of $5,000, the proceeds to be utilized to construct the plant.

MANCHESTER, N. Y.—The Ontario Light & Traction Company, of Canandaigua, N. Y., has purchased the property of the Manchester Flour & Feed Mills, including the water rights and privileges owned by the Manchester Power Company. The purchasing company proposes to utilize the water power to generate electricity. Work has commenced on the installation of two large generators. Later, it is said, the company will increase the water power by the erection of a new concrete dam 500 ft. long and 8 ft. higher than the present structure.

NEW YORK, N. Y.—Work has commenced on the construction of the monorail system, which will extend from Marshall's Corners in the Bronx to City Island. The road will take the place of the present Pelham Park Railroad Company and the City Island Railroad Company, which operate a horse railway system.

NEW YORK, N. Y.—The Public Service Commission has approved an issue of $624,636 in bonds by the Bronx Gas & Electric Company, the proceeds to be applied for refunding $500,000 in bonds and premiums thereon amounting to $65,000 and for outstanding obligations amounting to $59,636. The company asked for permission to issue $1,500,000 to be secured by a first mortgage, of which $747,000 was to be issued for the purpose of retiring $500,000 and other obligations.

NIAGARA FALLS, N. Y.—The Niagara Falls Hydraulic Power & Manufacturing Company has awarded the contract for the construction of a conduit from the Shoellkopf power plant on the Shoellkopf power canal to the proposed new water works plant on the Buffalo Road east of Echota.

NIAGARA FALLS, N. Y.—Work will begin within a year by the Niagara, St. Catherines & Toronto Railway Company on the extension of its railway from Port Colborne to Fort Erie. The company is now building an extension from Welland to Port Colborne, eight miles in length. Contracts have been awarded to the General Electric Company for electrical apparatus, amounting to $20,000, which will be installed at Welland.

SYLVAN BEACH, N. Y.—The Public Service Commission has authorized the construction and operation of an electric light plant in the territory known as Sylvan Beach, in the town of Vienna, to furnish electricity for municipal and other purposes.

SYRACUSE, N. Y.—The Syracuse, Lake Shore & Northern Railroad Company contemplates awarding contracts for construction of the proposed extension between Fulton and Syracuse in the near future.

VESTAL, N. Y.—The Vestal Lighting Company has been granted permission by the Public Service Commission to issue $1,000 in capital stock, the proceeds to be used for the erection of transmission lines in the town of Vestal.

WEST POINT, N. Y.—Bids will be received at the office of the quartermaster at West Point, N. Y., until Nov. 15 for furnishing and installing electric and combination gas and electric light fixtures in Battalion guard house and chaplain quarters, as per drawings and specifications on file in the above office. Forms for proposals will be furnished upon application to the quartermaster.

REIDSVILLE, N. C.—The Town Commissioners have decided to rebuild the municipal electric light plant in Reidsville. The electric and

water plants are located about a mile southwest of the town, and it is now proposed to have the electric plant located in the town. It is said that all of the electrical equipment and part of the steam plant has been purchased. Work on construction of the plant will commence at once.

BARTON, N. D.—The County Commissioners have granted the Barton Farmers Telephone Company permission to erect a telephone line along the county roads.

MANDAN, N. D.—The Mandan Electric Company contemplates the construction of a new building at a cost of $30,000.

STANLEY, N. D.—Plans are being made by the city to install a complete street lighting system.

TOWNER, N. D.—Plans and estimates are being prepared by E. D. Jackson, of St. Paul, Minn., for the installation of an electric light plant in Towner, N. D.

ALLIANCE, OHIO.—Preparations are being made for the construction of an electric railway between Alliance and Ravenna, a distance of 20 miles. The railway, it is said, will be built by a new company, of which C. R. Morley, president of the Stark Electric Company; Henry M. Everett, of the Northern Ohio Traction Company, and others are stockholders.

AMHERST, OHIO.—Plans are being made to increase the output of the municipal electric light plant, which will include the installation of an engine and 1000-kw generator.

SHELBY, OHIO.—Plans for the construction of an electric railway from Shelby to Bucyrus, a distance of 24 miles, and from Shelby to Mansfield, 11 miles in length, are under consideration. The plan includes the construction of a large power plant in Shelby, which would not only furnish electricity for the proposed new lines, but for the existing railway to Norwalk. The cost of the plant and equipment is estimated at $120,000. Preliminary surveys have been made. G. A. Bartholomew, Sherman Culp, of Norwalk, Ohio, and J. A. Shaidnagle, of Massillon, Ohio, are interested in the project.

LAWTON, OKLA.—We are informed that the Lawton & Fort Sill Electric Railway Company, recently incorporated, will commence work on the construction of its proposed electric railway within 60 days. The railway will be 15 miles in length and will connect Lawton, Medicine Park and Fort Sill. The power plant will be located at Medicine Park and will be operated by water power. Simon Smith is president.

LA GRANDE, ORE.—The Eastern Oregon Light & Power Company has filed a mortgage at the office of the county recorder in favor of the Fidelity Trust Company of Wisconsin, to secure an issue of $2,750,000, the proceeds to be used for payment of the property of the Grande Ronde Electric Company and for extensions and improvements to its several plants and distributing systems. The property covered by the mortgage includes the plant and holdings of the Elkhorn Light & Power Company, of Baker County; the Fremont Power Company, of Grant and Baker Counties, including mines; and all the property owned by the Grande Ronde Electric Company, including franchises in La Grande, Cove, Union, Haines, and other towns. Ray Nye is president of the Eastern Oregon Light & Power Company and F. A. Harmon, secretary.

ONTARIO, ORE.—Application has been made to the City Council by D. G. Sutherland, of Ontario, for a franchise to construct an electric or steam railway in Ontario. The proposed railway is to extend throughout the Snake Valley section.

SALEM, ORE.—Plans are being prepared by the Portland, Eugene & Eastern Railway Company for large extensions to its system in Salem and lines operating out of the city, which include the construction of a branch line to Mehama and on into the Santiam country by the way of the State Reform School, Turner, Marion, Peoria, Monroe, Junction City and Eugene, the cost of which is estimated at $150,000. The company is also preparing plans for the construction of a large power plant at Martins Rapids on the McKenzie River, which will involve an expenditure of $1,000,000. The company proposes to extend its system throughout the Willamette Valley.

CHESTER, PA.—Extensions are being made by the Seaboard Steel Casting Company to its foundry and machine shop, which will greatly increase the output of the plant. The company is said to be in the market for an electric crane, a shaper, planer and other machinery.

INTERCOURSE, PA.—Plans are being prepared by the Intercourse Electric Light, Heat & Power Company for extending its transmission lines to Leaman Place, Paradise and Gordonville, a distance of about three miles, to furnish electricity for lamps and motors. George W. Woods, proprietor of the Woods Lane Duck Farm, will utilize electricity on his farm, the service to be supplied by the Intercourse Light, Heat & Power Company. Enos L. Zimmerman is secretary and treasurer.

MERZTOWN, PA.—Preparations are being made by the Mountaintown Telephone Company to extend its telephone lines to Topton, Lyons, Bowers and Kutztown. The exchange for the new line will be located at Merztown. The contract for poles has been awarded to E. DeLong, and for electrical supplies to the Western Electric Company.

SHAMOKIN, PA.—It is reported that the Mineral Railroad & Mining Company, which has recently installed an electric light plant at its Luke Fidler Colliery, in Shamokin, is planning to light all of its collieries by electricity furnished from the Shamokin plant. It is proposed to erect arc lamps about the outside workings of all the collieries and to light the offices. The company has its own telephone system and the electric transmission line will be strung on the telephone poles.

GREAT FALLS, S. C.—Plans are being made to organize the Republic Cotton Mills to erect a plant to be equipped with 25,000 spindles, 640 looms, etc. The company is capitalized at $600,000. The mills are to be operated by electricity. Robert S. Mebane, of Graham, N. C., is president.

HURON, S. D.—Arrangements have been completed by the Central Dakota Telephone Company for establishing an automatic telephone system in Huron.

VIENNA, S. D.—Negotiations have been closed by the Town Board for the purchase of the local electric light plant. The price paid for the plant was a little less than $5,000.

WATERTOWN, S. D.—Plans are being made by the Watertown Light & Power Company for the construction of a new power station, which will be equipped with 60-cycle, three-phase equipment. The company would like to receive catalogues and information from manufacturers of electrical machinery and apparatus. For further information address James W. Ferris, secretary and manager.

CHATTANOOGA, TENN.—The City Council has granted D. J. Duncan and associates a franchise to construct an electric railway in Chattanooga, Tenn.

CHATTANOOGA, TENN.—The Chattanooga Railway & Light Company is reported to have issued bonds to the amount of $15,000,000; the proceeds of $10,000,000 will be used for general improvements and extensions to its electric plant, transmission lines, railways, etc.

CANADIAN, TEX.—Plans are being prepared for the construction of an electric light plant in Canadian. C. W. Conrad, of Topeka, Kan., civil engineer, has charge of construction of the plant.

EAGLE PASS, TEX.—Plans are being considered by the Eagle Pass Industrial League for the organization of a company to construct a hydroelectric power plant. The plan includes the purchase of the local electric light plant, water works system and ice factory, all to be operated by electricity transmitted from the proposed plant. It is also proposed to furnish electrical energy for industrial plants in Eagle Pass and Porfirio Diaz, across the Rio Grande River in Mexico.

ELGIN, TEX.—W. H. Kennedy, Mayor, writes that the town is planning to install a municipal electric light plant, but would give a franchise to any responsible company to install a plant.

GREENVILLE, TEX.—The city is contemplating issuing $50,000 in electric light bonds.

TERRELL, TEX.—At an election to be held Nov. 23 the citizens will vote on the proposition to issue $10,000 in bonds for improvements to the municipal electric light plant and water works system.

FAIRVIEW, UTAH.—The citizens are reported to be considering the question of purchasing the electric plant of the Fairview Electric Light Company to be owned and operated by the municipality.

FARMINGTON, UTAH.—Work has commenced on the construction of the power station of the Salt Lake & Ogden Railway Company at Ogden, Utah, which will involve an expenditure of $150,000. The initial equipment will include motor-generator sets with total rating of 1200 hp., the output to be increased as requirements demand. Substations will be erected at Stockdale, Lagoon, Clearfield and Ogden, at a cost of $25,000 each. The Falkenau Electrical Construction Company, of Chicago, Ill., has charge of the construction of the plant.

FORT DOUGLAS, UTAH.—Bids will be received at the office of the constructing quartermaster, Fort Douglas, Utah, until Nov. 20 for the construction of one double set company officers' quarters, with plumbing, heating, electric wiring and fixtures; one quartermaster store, with electric wiring and fixtures, at Fort Douglas, Utah. Plans and specifications, blank proposals, etc., may be seen in the above office. Lieut. Kenneth P. Williams is constructing quartermaster.

SALT LAKE CITY, UTAH.—The State Board of Examiners and Trustees of the Agriculture College are considering the question of installing an electric power plant at the Agriculture College, for which funds have been appropriated by the State Legislature.

SALT LAKE CITY, UTAH.—Application has been made to the State engineer by A. W. Gallacher, of the Utah Light & Railway Company, for the privilege of diverting 6000 cu. ft. of water from the flow of the Middle Canyon Creek in Tooele County, to be utilized to generate electricity.

SALT LAKE CITY, UTAH.—The San Francisco, Idaho & Montana Railway Company, which was organized to construct an electric railway from Caldwell, Idaho, to Jordan Valley, Ore., thence via Duncan, to Winnemucca, Nev., is reported to have been acquired by the Oregon Short Line Railroad Company. Grading has been finished to the Snake River, a distance of 20 miles, and track laying will probably be finished this fall, where connection will probably be made with the Oregon Short Line. It is expected that the new owners will extend the railway as far as Jordan Valley section at an early date, a distance of 56 miles. A contract has been awarded to D. M. Grogan, of Vail, Ore., for construction of the proposed Willow Creek branch of the Malheur Valley from the present terminus in Vail to Brogan, about 25 miles distant.

BENNINGTON, VT.—The Bennington Light & Power Company is making improvements and extensions to its power plant including the installation of a large engine.

PITTSFORD, VT.—Preparations are being made for lighting the Village of Pittsford by electricity. The town has made an appropriation for street lighting, and sufficient number of customers to warrant

the extension of the line have been secured. It is said that the Rutland Railway & Light Company will soon commence work on the extension of its transmission line from the Mendon station to the substation to be erected about one and one-half miles south of the Pittsford Mills, from which electricity will be furnished in the town.

RUTLAND, VT.—Announcement has been made by the Rutland Railway, Light & Power Company that it will extend its railway to Poultney and ultimately to Granville, N. Y. Arrangements have been made to finance the construction of the railway from the main line near Castleton through the slate quarries to Poultney, provided a free right of way is granted and the town of Poultney grant the company franchises on favorable terms. The company will supply electricity for lamps and motors along the route of the railway.

LURAY, VA.—The Town Council has granted the Mutual Telephone Company a franchise to erect a telephone system in Luray.

IONE, WASH.—The County Commissioners are reported to have granted a 25-year franchise to the Ione Water & Light Company.

MABTON, WASH.—Application has been made to the City Council by J. A. Humphrey and associates for a franchise to construct and operate a street railway in the town. It is said that the Yakima Valley Power Company is back of the project.

SPOKANE, WASH.—T. S. Lane, of Butte, Mont., president of the syndicate recently organized to purchase the control of the Spokane Company, states that the Home Telephone Company, of Spokane, Wash., will have its plant in Spokane in operation within six months and that $400,000 will be expended for equipment.

ZILLAH, WASH.—The Northwest Light & Power Company, of North Yakima, Wash., which is erecting a high-tension transmission line through the Yakima Valley from Naches to Kennewick, has agreed to build a loop from the main line through Zillah, provided the residents agree to take 50 hp. The company will furnish electricity for pumping water for irrigation from the Sunnyside Canal at that point to lands above the large ditch. George Arrowsmith is manager of the company.

BROOKLIN, W. VA.—Application has been made to the town officials by the New Martinsville Electric Light, Heat & Power Company, of New Martinsville, W. Va., for a franchise to establish an electric light plant in Brooklin.

FORT SPRING, W. VA.—Preparations are being made by B. F. Mann for the construction of a hydroelectric power plant to develop 1000 hp for transmission by electricity. The plans call for the construction of a dam 47 ft. high, 150 ft. at the base and 250 ft. at top. Surveys will be made at once and construction work will begin next spring.

GREAT CAPACON, W. VA.—Plans are being considered by the Hydro-Electric Developing Company for the construction of a hydroelectric power plant at Edes Fort, on the Great Capacon River, which will include the construction of a dam with a 100-ft. head, where it is estimated that 3000 hp can be developed for transmission by electricity. The equipment will include four 4000-hp vertical turbines direct-connected to vertical type generators. Samuel R. Boyer, of Steelton, Pa., secretary, will have charge of the work until an engineer is appointed.

MANNINGTON, W. VA.—The City Council has granted a franchise to the Fairmont & Mannington Traction Company to connect with the Morgantown & Dunkard Valley Electric Railway, which has also been granted a franchise and will construct an electric railway from Mannington to Blacksville, W. Va.

CRANDON, WIS.—Preparations are being made for the installation of an electric power plant and pumping station in Crandon in the near future, bonds for which have already been issued.

JANESVILLE, WIS.—The Lewis Knitting Company is erecting three 4-story buildings, all of which will be equipped for electric motor drive.

LA CROSSE, WIS.—Preparations are being made by the La Crosse Water Power Company for the construction of an interurban railway to extend from Winona to La Crosse and thence to Sparta, the cost of which is estimated at $3,000,000. The company will soon apply to the City Council of La Crosse for a franchise to enter the city and similar franchises will be asked of the Councils at Winona and Sparta. The railway will furnish both freight and passenger service.

MADISON, WIS.—The Badger State Shoe Company, it is reported, will install a producer gas engine and electric generator in its new factory.

MILWAUKEE, WIS.—The City Council is considering the question of purchasing a site near the city hall and erecting a building to install the power plant which is now located in the basement of the city hall. The cost of $22,000 per year for operating the plant is not considered economical and it is proposed to get a greater return from the plant by furnishing electricity to a section of the Seventh Ward.

NORTHFIELD, WIS.—The Northfield Farmers' Telephone Company is contemplating the erection of a telephone line to Merrillan. H. L. Hanson is secretary.

OSHKOSH, WIS.—Electrical equipment is being purchased by the Hydes Electric Power Company for its power plant located in Ellis Junction, Wis.

OSHKOSH, WIS.—The Morgan Company, it is reported, contemplates erecting an addition to its plant and installation of additional machinery, including wood-working machinery, motors, exhaust fan and possibly an electric generating unit.

NANTON, ALTA, B. C.—A municipal electric light plant is being installed in Nanton, the equipment of which will include a 75-kw, three-phase, 2300-volt General Electric generator. The plant will furnish electricity for both street and domestic lighting. Series arc lamps will be used for street lighting. An appropriation of $16,000 was recently made for constructing the plant. A. S. Thurber, of Nanton, is consulting engineer.

OSHAWA, ONT., CAN.—Arrangements are being made by local capitalists for the construction of an electric railway from Cobourg to Toronto. Application will be made to the Dominion Parliament for a charter for the road. The railway will be operated under the name of the Toronto & Eeastern Railway and will connect Oshawa, Whitby and Bowmanville.

New Industrial Companies.

THE ANIMATED SIGNS COMPANY, of Kittery, Maine, has been chartered with a capital stock of $100,000 for the purpose of manufacturing signs of all kinds. The officers of the company are: A. H. Peavey, president, and E. J. Burnham, of Kittery, Maine.

THE AUTOMATIC JACK COMPANY, of Bloomfield, Ind., has been chartered with a capital stock of $30,000 by P. J. Horrah, Charles E. Benefield and Charles E. Henderson. The company proposes to manufacture a lifting jack and wire stretcher.

THE BERGEN-FRANKLIN AUTO COMPANY, of Brooklyn, N. Y., has filed articles of incorporation with a capital stock of $10,000 for the purpose of manufacturing motors, engines, machines, etc.; also automobiles, cars, carriages, etc. The incorporators are: Frederick Albert, Frank Schmitter and A. Schmitter, all of Brooklyn, N. Y.

THE CARBON REMOVER COMPANY, of Staatsburgh, N. Y., has been incorporated with a capital stock of $10,000 to manufacture compounds used to remove carbon deposits from engines. The incorporators are: George Brock, of New York, N. Y.; C. W. H. Arnold and Harry B. Vosburgh, both of Poughkeepsie, N. Y.

CHARLES E. CHAPIN COMPANY, of New York, N. Y., has been incorporated by Franklin G. Chapin, of Greenwich, Conn.; Frederick W. Jabelman, of Brooklyn, N. Y., and Alexander H. Babcock, of New York, N. Y. The company is capitalized at $10,000 and proposes to manufacture electrical brushes and supplies.

THE CHARTER ELECTRIC COMPANY, of Chicago, Ill., has been chartered with a capital stock of $250,000 for the purpose of manufacturing, selling and installing electrical appliances. The incorporators are: G. C. Cummings, J. A. Kick and A. Wray.

THE COWLES-MCDOWELL ENGINEERING COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $25,000 by Irving Cowles, Ernest H. McDowell, Ewald J. Pfeiffer, William C. Moody, all of Chicago, Ill. The company proposes to do a general engineering and contracting business.

THE ELECTRIC MANUFACTURING AGENCY COMPANY, of New York, N. Y., has been chartered with a capital stock of $1,000 by William Stuart, Francis Harrison, both of London, Eng., and John S. C. Bailey, 63 Wall Street, New York, N. Y. The company proposes to deal in electric and other apparatus.

THE FEVAL ENAMEL INSULATED WIRE COMPANY, of Chicago, Ill., has filed articles of incorporation with a capital stock of $12,500 by C. L. Backus, A. M. Higgley, F. L. Silvertson, H. P. Simonton, all of Chicago, Ill. The company proposes to manufacture electrical supplies.

THE FLORENCE NOVELTY COMPANY, of New York, N. Y., has been chartered with a capital stock of $15,000 by George F. McGiry, of Brooklyn, N. Y.; George N. McKane and M. E. McKane, both of Sheepshead Bay, N. Y. The company proposes to manufacture ornamental electric lamps.

THE GLOBE POWER COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $30,000 for the purpose of dealing in and selling all kinds of machinery, using all kinds of motive power, establishing garages and dealing in supplies, etc. The incorporators are: C. C. McArthur, A. Shelden and E. J. Stanley.

THE IDEAL ELECTRIC COMPANY, of Chicago, Ill., has been chartered with a capital stock of $15,000 for the purpose of manufacturing automobiles, by J. A. Ryerson, S. H. Peterson and M. Mathison, all of Chicago, Ill.

THE INTERSTATE CONTRACTING COMPANY, of Ligonier, Ind., has been incorporated, with a capital of $50,000. The company proposes to construct and equip electric railroads. The directors are: D. T. Mohabb, Nicholas Knol and William T. Abbott.

THE INTERNATIONAL PNEUMATIC SERVICE COMPANY, of Boston, Mass., has been incorporated for the purpose of dealing in pneumatic and vacuum transmission service. The company is capitalized at $150,000 and the officers are: R. F. Miller, Boston, Mass., president, and W. E. Cooper, of Cambridge, Mass., treasurer.

THE LEWELL MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $30,000 by G. E. Chamberlain, C. E. Gilman and A. J. Ehrenberger. The company proposes to manufacture and sell machinery.

MEISSNER-FANGEMANN, INC., of Brooklyn, N. Y., has filed articles of incorporation with a capital stock of $10,000 for the purpose

of manufacturing motors, engines, and machines, cars, carriages, etc. The incorporators are: Charles F. Meissner, John G. Fangemann and M. Meissner, all of Brooklyn, N. Y.

THE MURRAY ENGINEERING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $1,000 for the purpose of carrying on a business as architects and engineers. The incorporators are: William V. Murray, Marle R. Murray and John T. Nichelson, all of New York, N. Y.

THE NATIONAL ELECTRICAL ADVERTISING COMPANY, of Evansville, Ind., has been incorporated to manufacture an electrical advertising device. The capital stock is $50,000. J. A. McCoy is president, and C. P. Schule, secretary.

THE PETERSON ENGINEERING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $25,000 by J. W. Peterson, of East Orange, N. J.; G. A. Conover, of Bayonne, N. J., and D. E. Deuel, of New York, N. Y. The company proposes to do a general engineering and construction business.

THE PRE-HEATING APPLIANCE COMPANY has filed articles of incorporation with the Secretary of State. The company is capitalized at $500,000 and proposes to manufacture electrical devices, etc. The incorporators are: W. S. Potter, B. L. Beck, of New York, N. Y.; W. B. Hutchinson, of Newark, N. J., and H. W. Davis, of Wilmington, Del.

THE TWENTIETH CENTURY ELECTRICAL CONSTRUCTION COMPANY, of Plymouth, Mass., has been incorporated by Burton Dinsmore, of Plymouth, Mass., and Winfield W. Rogers, of Swampscott, Mass. The company is capitalized at $12,000 and proposes to deal in electrical machinery.

THE UNITED ELECTRIC SMELTERS, of Newark, N. J., has been incorporated with a capital stock of $150,000 by James H. Reid, of Newark, N. J.; Edward A. Filkins and Frank E. Gollier, of New York, N. Y.

THE WESTERN COIL COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $1,000 by Charles O. Olson, Martin E. Olson and G. E. Little, all of Chicago, Ill. The company proposes to deal in x-ray coils.

New Incorporations.

VALDEZ, ALASKA.—The Valdez-Fairbanks Long Distance Telephone Company has been formed for the purpose of erecting a telephone line into the interior, which will ultimately be extended to Fairbanks.

SAN DIEGO, CAL.—The San Diego-El Cajon-Escondido Company has been incorporated with a capital stock of $2,500,000 by G. W. Pursell, H. G. Crowe, A. C. Riordan, of San Diego, Cal.; W. L. Ramey, C. O. Kelly, of Escondido, and others.

CHAMPAIGN, ILL.—The Illinois Consumers' Light Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $2,500, and the incorporators are: George M. Mattis, W. H. Carnahan and Charles Zilly, all of Chicago.

CHICAGO, ILL.—The Iowa Light & Traction Company, a South Dakota corporation, has filed articles of incorporation with the Secretary of State for the purpose of maintaining an Illinois office. The company is capitalized at $500,000. Joseph W. Gillis, 153 La Salle Street, Chicago, Ill., is one of the incorporators.

SPRINGFIELD, ILL.—Articles of incorporation have been filed with the Secretary of State by the Illinois Traction Company for the Decatur Belt Railway Company and the Edwardsville Belt Railway Company. George M. Mattis, W. H. Carnahan, Charles Zilly, B. E. Bramble and C. E. Cox, of Champaign, Ill., are incorporators and members of the board of directors of both companies.

TENNYSON, IND.—The Tennyson Mutual Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is placed at $2,000. The company proposes to build a telephone exchange and system in Tennyson and extend the lines throughout Warrick County. E. O. Simpson, W. O. Hendrickson, Adam Barchell and others are directors.

EAST TAWAS, MICH.—Articles of association of the following companies have been filed in the office of the county clerk of Isoco County: The Cook County Hydro-Electric Generating Company, the Thompson Hydro-Electric Generating Company, the Loud Hydro-Electric Generating Company, and the Five Channels Hydro-Electric Generating Company, which have all been organized with the same stockholders as follows: Edward F. Loud, H. Kimball Loud and L. A. Wood.

HARLOWTON, MONT.—The Meagher-Fergus Telephone Company has been incorporated with a capital stock of $40,000 by Lewis Penwell, of Helena, Mont.; M. N. Stevens, of Harlowton, and others.

NEBRASKA CITY, NEB.—Articles of incorporation have been filed for the Nebraska City Light & Power Company with a capital stock of $100,000. The incorporators are: E. K. Bradley, H. H. Hanks, J. F. Johnson, W. M. McNamara, Fred E. Johnson, A. G. Hastie and G. E. Hanks. The plant is located at the works of the King Alfalfa Milling Company.

GLOVERSVILLE, N. Y.—The Garoga Water Power & Transmission Company has been chartered by Mortimer Eversett, of Gloversville, N. Y.; William C. Dunlop, of New York, N. Y., and H. M. Brinckerhoff, of Briarcliff, N. Y. The company is capitalized at $50,000, and proposes to supply electricity for lamps, heat and motors, and water power in Ephratah, Johnstown, Gloversville, Fonda and Fultonville.

MINEVILLE, N. Y.—The Mineville Light, Heat & Power Company has been granted a charter with a capital stock of $10,000. The company proposes to supply electricity for lamps, heat and motors in the towns of Moriah, North Hudson, Elizabethtown and Westport. The incorporators are: Sheldon Norton, Solomon LeFevre, Samuel Dongan, all of Mineville, N. Y.

TRUXTON, N. Y.—The Truxton & Chening Telephone Company has been incorporated with a capital stock of $2,000 by A. Risley Muller, William Bell and W. R. Bennett, all of Truxton, N. Y.

COLUMBUS, OHIO.—The Ohio Home Telephone Company has been incorporated with a capital stock of $500,000 by F. L. Griffith, Harlan Reed, Howard Howells, W. C. Henderson and John H. Otto. The company was formed for the purpose of taking over the property of the United States Telephone Company, bringing to a close negotiations which have been in progress for over a year for a consolidation of all independent telephone interests in the State of Ohio.

NEW CARLISLE, OHIO.—The New Carlisle Light Company has been chartered with a capital stock of $10,000 by Harry G. Fisher and others.

CHECOTAH, OKLA.—The Checotah-Texanna Telephone Company has been chartered, with a capital stock of $4,000, by E. K. Cross, J. E. Wise and M. M. Cross.

HARMON, OKLA.—The Harmon Telephone Company has been chartered with a capital stock of $2,500 by S. C. Husted, C. H. Ernest, M. L. Husted, E. R. Mohoar and J. L. Butts, of Gould, Okla.

LAWTON, OKLA.—Articles of incorporation have been filed with the Secretary of State for the Lawton & Fort Sill Electric Railway Company, with a capital stock of $200,000, to operate an electric railway in Lawton with extension to Fort Sill, Medicine Park and other points in Comanche County, about 20 miles in length. The directors are: Simon Swift, of Oklahoma City, Okla.; W. H. Pattie, D. L. Sleeper and J. H. Miller, of Tulsa, and J. B. Sleeper, of Lawton.

NOWATA, OKLA.—The Coffeyville-Nowata Railway & Power Company has been incorporated with a capital stock of $200,000 for the purpose of constructing an electric railway from Coffeyville, Kan., to Nowata, Okla., 23 miles in length. The directors are: J. C. Denton, W. V. Thraves and J. A. Tillotson, of Nowata, Okla.; John B. Pollard, of Kansas City, Mo., and W. P. Brown, of Coffeyville, Kan.

SAPULPA, OKLA.—Articles of incorporation have been filed for the Sapulpa Electric Light Company with a capital stock of $150,000 by Willis H. M. Adams, J. E. Kimball and Joseph Kergegan, all of Guthrie, Okla., and Charles F. Lane, of Philadelphia, Pa.

MARSHFIELD, ORE.—The Coos Bay Electric Railway Company has been chartered with a capital stock of $1,500,000 by James H. Flannagan and others.

ALTOONA, PA.—The Altoona, Hollidaysburg & Bedford Springs Electric Railway Company has been chartered to construct an electric railway from Altoona to Bedford Springs, a distance of 50 miles, surveys for which are now being made. John G. Burns, of Pittsburg, Pa., is president, and F. W. Patterson, of Altoona, Pa., engineer.

WAYNESBURG, PA.—Articles of incorporation have been filed for the Waynesburg & Blacksville Street Railway Company by Samuel Eakin, of Wadestown, W. Va., president; L. L. Thomas, R. E. Lent, M. B. Patterson and Charles H. King. The company is capitalized at $40,000 and proposes to construct an electric railway from the Pennsylvania and West Virginia State line at Robert's Run along the Roberts and Smiths creeks to Waynesburg, a distance of 14 miles.

DURANGO (P. O. LOTT), TEX.—The Durango Telephone Company has been incorporated with a capital stock of $700 by J. H. Cox, G. L. Farmer and T. C. Farmer.

LEAGUE CITY, TEX.—The League City Telephone Company has filed articles of incorporation with a capital stock of $2,500. The incorporators are: George W. Butler, J. E. Walker, J. P. Atinson, O. V. King and R. H. Scholes.

KAMAS, UTAH.—The Kamas-Woodland Telephone Company has been incorporated with a capital stock of $12,000 and the following named officers: Charles B. Stewart, president; J. O. Park, vice president, and John B. Hoyt, secretary and treasurer.

SEATTLE, WASH.—The Columbia Irrigation & Power Company, capitalized at $100,000, has been incorporated by M. A. Robinson and H. A. Hyland.

SPOKANE, WASH.—The Kettle River Water Power Company, of Spokane, has been incorporated with a capital stock of $500,000 by E. L. Tate, R. L. Thomson, W. W. McCreary, Chas. Grant and R. H. Vorhees.

Personal.

MR. F. J. McGUIRE, who had been ill for some months, has recovered his health and resumed the active direction of his various enterprises.

MR. J. L. BAILEY presented a paper at the meeting last week of the Baltimore branch of the National Electric Light Association on the subject of "The Purposes and Applications of Accounts."

MR. CHAS. E. CANADA has resigned his position with the Hendrie & Bolthoff Manufacturing & Supply Co., of Denver, to identify himself with the sales department of the American Steel & Wire Company of Denver.

MR. J. W. McCROSKY, manager of construction for J. G. White & Co., Ltd., of London, arrived in New York Nov. 3 for a short visit, during which his address will be care J. G. White & Co., 43 Exchange Place, New York City.

MR. E. C. SORNBORGER has become identified with Allis-Chalmers Company in the capacity of a sales engineer in its pumping engine and hydraulic turbine department. Mr. Sornborger received his early training and practical engineering experience in the United States Navy and later entered the merchant service as assistant engineer. Subsequently he was connected with the Buffalo Steam Pump Company, Gordon Steam Pump Company and the Snow Steam Pump Works. Lieutenant Sornborger still retains his interest in naval affairs, being the commanding officer of a division of the naval militia of Buffalo.

MR. MYRON E. TERBUSH, for several years connected with the estimating division of the contract department of the Commonwealth Edison Company, of Chicago, has resigned to become manager of the new business department of the Topeka Edison Company, of Topeka, Kansas. Mr. Terbush is a Harvard alumnus of the class of 1900, and after graduation was for two years employed by the Boston Elevated Railway Company. Since that time he has been connected with the Commonwealth Edison Company.

MR. FRANK W. FRUEAUFF, of New York, president of the National Electric Light Association, was in Chicago on Oct. 28 to attend the annual dinner of the Commonwealth Edison branch of that association. He was entertained at luncheon at the University Club on that day by a party of central-station men consisting of Messrs. L. A. Ferguson, J. F. Gilchrist, W. A. Fox, P. Junkersfeld, E. W. Lloyd, George H. Lukes, S. M. Bushnell and George H. Jones. In the afternoon Mr. Frueauff was taken for an automobile ride around the city.

MR. RALPH W. POPE, secretary of the American Institute of Electrical Engineers, has returned to New York after an extensive official tour of the Far West and the Pacific slope. Judging from clippings in our newspaper service, Mr. Pope not only had a very enjoyable time, but greatly strengthened the Institute by his trip. Everywhere there was evidence of the warm personal esteem in which he is held by the membership, together with recognition of the rare ability that has been such a great factor in the upbuilding of the body.

MR. JOHN A. RADFORD, of Chicago, has acquired control of the Grinnell Electric & Heating Company of Grinnell, Iowa, where he will make his residence in Grinnell, and take the active management of the company of which he is president, but will continue in part his consulting practice. Mr. Radford has recently completed the engineering of several large power plants, but is perhaps best known in engineering circles as the chief engineer of the Commonwealth Edison Company's Fisk Street station in Chicago during the first two momentous years of its operation.

Obituary.

MR. CHARLES F. SPALDING.—Mr. Charles F. Spalding, prominent in the business life of Chicago, although comparatively a young man, died on Oct. 24, after an illness of short duration. Mr. Spalding was a director in several banks and connected with a number of industrial enterprises. He was a director of the North Shore Electric Company and was well known to many electrical men. He was a son of the late Jesse Spalding, who was at one time a director of the Chicago Edison Company. Mr. Spalding was buried on Oct. 27, and the list of honorary pallbearers included some of the most prominent men in the city.

MR. JOHN R. VAN WORMER.—Mr. John R. Van Wormer, general manager of the Lincoln Safe Deposit & Warehouse Company, New York, died Oct. 27 from the effects of a stroke of paralysis received Sept. 28. Mr. Van Wormer was born in Adams, N. Y., March 14, 1849, and was educated in the military academy in his native town. Colgate University conferred upon him the honorary degree of Master of Arts several years ago. He began his business life as a telegraph operator and was afterward engaged in newspaper work. He occupied several political positions of prominence at Albany and Washington and was closely associated with Postmaster General Thomas L. James during the period of the "Star Route" frauds investigation. Mr. Van Wormer was prominently identified with club life in New York. He never married.

Trade Publications.

RURAL TELEPHONY.—Much information concerning rural telephone equipments is given in a 48-page booklet issued by the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.

ELECTRIC HOISTS AND WINCHES.—The Sprague Electric Company is sending out an attractive pamphlet, No. 233, which calls attention to its line of electric hoists, shovels, winches, etc.

TELEPHONE CABLE TERMINALS.—Bulletin No. 3 of the Sterling Electric Company, Lafayette, Ind., is a well-illustrated 24-page publication devoted to cable terminals and protectors for all classes of telephone service.

GAS PRODUCERS for bituminous fuels are fully described in circular W. M. No. 503 of the Westinghouse Machine Company, East Pittsburgh, Pa. Much data relating to thermal efficiencies are given from actual operating tests.

GAS ENGINES, of the single-cylinder throttling type, designed for use with natural, illuminating and producer gas and gasoline, are discussed in an instructive manner in a well-executed bulletin designated as K-21 of the Du Bois Iron Works, Du Bois, Pa.

BOILER WATER TREATMENT.—An artistic catalog of the Dearborn Drug & Chemical Works, 1029 West Thirty-fifth Street, Chicago, contains a complete description of the processes involved in the purification of boiler feed water.

MOTOR-DRIVEN ALARM.—The Klaxon sound producer, which consists of a battery type motor driving a toothed wheel for vibrating a diaphragm of a megaphone, is well illustrated and described in a catalog issued by the Lovell-McConnell Manufacturing Company, Newark, N. J.

CARE OF BATTERIES.—The Willard Storage Battery Company, Cleveland, Ohio, has issued a revised edition of its instruction book for the care and maintenance of train-lighting batteries. All of the details of the batteries, and remedies for troubles that may arise are fully discussed.

VEHICLE BATTERIES.—Instruction for the operation and care of vehicle batteries are given in detail in bulletin No. 116 of the Electric Storage Battery Company, Philadelphia. The bulletin contains a reprint of a paper read by H. M. Beck at the convention of the Society of Automobile Engineers.

IMPREGNATING APPARATUS.—The J. P. Devine Company, Buffalo, N. Y., has issued mailing cards calling attention to the Passburg vacuum drying and impregnating apparatus. It is claimed that this apparatus saves one-third of the time and money expended when other devices are employed in the impregnating process.

FAN MOTORS FOR TELEPHONE BOOTHS.—In Booklet No. 3839 of the General Electric Company is illustrated and described a line of 8-in. four-blade fans designed for use in residences, small offices and telephone booths. It also describes a 12-in. six-blade fan for office use. This line includes fans for both alternating and direct current.

OPALUX GLASSWARE.—The Central Electric Company, Chicago, is distributing a new folder descriptive of Opalux glassware. This folder is of particular interest in that it announces the new method of packing and gives considerable information on the cost of maintenance, etc. Efficiency curves are given to show the light distribution with 100-watt lamps.

RECORDING THERMOMETERS.—Compensated recording thermometers for low and atmospheric ranges of temperature are illustrated, listed and briefly described in bulletin No. 112 of the Bristol Company, Waterbury, Conn. These thermometers are well adapted for recording the temperatures of condenser water, feed water, superheated steam, flue gas, and of generators and transformers.

RAILWAY MOTORS.—Two publications illustrating and describing in more or less detail the latest construction in connection with 500-volt, 40-hp and 600-volt, 65-hp railway motors, have been issued by the General Electric Company under numbers 4693 and 4692, respectively. These publications describe the GE-88 and GE-210 motors, and include tables of schedule speeds and various characteristic curves and motor dimensions.

SWITCHES FOR SPINNING FRAMES.—The extensive adoption of fire-proof devices in cotton-mills, flour-mills, saw-mills and other establishments operating under similar conditions has made necessary a compact, fire and dust-proof, oil-break switch of moderate cost. A switch of this character is described in Bulletin No. 4682, recently issued by the General Electric Company. This publication contains, also, dimensions and prices.

THE DYNATAK.—The Electric Speedometer & Dynamometer Company has issued a handsome catalog descriptive of the Hopkins "Dynatak" and electric speedometer. The former utilizes the thermo-couple to indicate the condition of internal operation of automobile and motorboat gasoline engines, and the latter is an efficient magneto-electric device for indicating in terms of speed the revolutions of the driving shaft of automobiles, motor boats, etc.

LUMINOUS ARC HEAD-LAMPS.—The luminous arc which has made possible the economical operation of a highly efficient street-lamp is found to be ideal for use in street railway head-lamps. The need of such a head-lamp is the natural result of the rapid growth of street and interurban traffic, and increase in the size and speed of the cars employed. The General Electric Company has placed on the market luminous arc head-lamps for both street service and use on mining locomotives. The principal advantage of these head-lamps is high efficiency; other advantages are enumerated in Bulletin No. 4698, recently issued by the company.

WISCONSIN ENGINES.—The first of a series of bulletins to be issued from time to time by the Wisconsin Engine Company, Corliss, Wis., is a handsome specimen of the printing and engraving arts. An interesting feature is that the cover of this first issue, while having the appearance of the usual catalog cover, will accommodate future bulletins through the use of an ingenious binding device. Another feature is that

white spaces are provided for the filing marks of the user of the catalog. In addition to a well-written description of the type of Corliss engine which forms the subject of the present bulletin, accompanied by numerous illustrations, several pages of useful information for engineers are included.

UTILIZATION OF EXHAUST STEAM.—"How to Utilize Exhaust Steam" is the sub-title of a catalog of the Cochrane Open Feed Water Heaters which has just been issued by the Harrison Safety Boiler Works, Philadelphia, Pa. The title is justified by the fact that fully two-thirds of the book is occupied by discussions and illustrations of the different ways of employing exhaust steam, as for heating, drying, evaporating, heating water for boiler feeding and for use in dye works, tanneries, bleacheries and paper mills, etc. In a chapter entitled "The Possibilities of a Pound of Steam" it is pointed out that at the best only 10 or 12 per cent of the total heat energy in steam can be converted into mechanical work, and that the remainder still present in the exhaust of an engine or turbine is as good for most of the purposes for which steam is employed as is the same weight of live steam. In a chapter on "Condensing Plants," the advantages of steam-driven auxiliaries are discussed. The section on "Corrosion" gives the latest results, showing that air in solution in the water is a necessary condition to corrosion and pointing out that a large part of this can be driven off from the water by spraying the latter through a steam bath, as in the Cochrane Open Heater. The book contains 104 pages, 6 x 9 in.

Business Notes.

McGOVERN, ARCHER & COMPANY SALES.—Among the recent sales made by McGovern, Archer & Company are two 300-hp. Heine water-tube boilers to the Hummelstown (Pa.) Consolidated Water Company, and two of the same type to the Lebanon Water Company. Quite a lot of small electrical apparatus has also been sold, and the firm reports that business is quite brisk.

THE COMMERCIAL SWITCHBOARD MANUFACTURING COMPANY, recently incorporated in Denver, Col., is becoming a very desirable factor in the mountain territory in the manufacture of steel cut-out cabinets. The excessive freight rates from Eastern factories and the convenience jobbers find in having orders filled quickly and special changes made as needed, have combined to increase the company's output.

THE AGUTTER-GRISWOLD COMPANY, Seattle, Wash., which recently suffered heavy fire loss in the manufacturing department, is again fully equipped for business at the old location, 411 Occidental Avenue. As the result of the fire considerably more floor space was secured, which allowed of a complete re-arrangement of machinery so that now the various departments are segregated. The firm will continue to manufacture the complete line of switches, steel cabinets, panel-boxes, panelboards and switchboards, as well as its more recently developed universal metering panels and meter boxes.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Lloyd Lyon, Mobile, Ala. Next meeting, Birmingham, Nov. 15 and 16, 1909.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, St. Louis, Mo., Nov. 15-18, 1909.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, 158 West 76th St., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, John W. Corning, Boston Elevated Railway Company, Boston, Mass.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting, Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, 509 Perry-Payne Building, Cleveland, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Los Angeles, Cal., May, 1910.

Association of Car Lighting Engineers. Secretary, C. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next semi-annual meeting, Buffalo, N. Y., June 7 and 8, 1910. Next annual meeting, Chicago, Oct. 4, 5, 6 and 7, 1910.

Association of Edison Illuminating Companies. Secretary, D. L. Huntington, Spokane, Wash.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Boston Electrical Show. Secretary, Chester I. Campbell, 5 Park Square, Boston. Mechanics' Building, Nov. 15-25, 1909.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary A. L. Neereamer, Indianapolis, Ind.

Chicago Electrical Show, Jan. 15 to 29 (inclusive), 1910. Manager, Homer E. Niesz, 115 Dearborn St., Chicago.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Colo.

Eastern States Independent Telephone Association of Pennsylvania, New Jersey, Maryland and Delaware. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

Electric Vehicle and Central Station Association. Secretary, H. T. Sands, 139 Pleasant St., Malden, Mass.

Electric Club, Chicago. Secretary, W. S. Taussig, 448 Commercial National Bank Building, Chicago. Meets every Wednesday noon at Chicago Automobile Club.

Electric Contractors' Association of New York State. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

Electric Trades Association of Philadelphia. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Contractors' Association of State of Missouri. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, Nov. 4, 1909.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 29 West 39th St., New York. Next meeting, New York City, Nov. [illegible]

Florida Electric Light and Power Association. Secretary, G. F. Doig, Gainesville, Fla. Next meeting, Tampa, Fla., April 21, 1910.

Illinois State Electric Association. Secretary, H. E. Chabbuck, Peoria, Ill.

Illuminating Engineering Society. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

Indiana Electric Light Association. Secretary, Fred. Leslie, Muncie, Ind.

Internal Combustion Engine Association. Secretary, Walter J. Sittig, 61 Ward St., Chicago.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y.

International Electrotechnical Commission (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

International Independent Telephone Association. Secretary, A. C. Davis. Next meeting, Chicago, Dec. 7, 8 and 9, 1909.

Iowa Electric Association. Secretary, W. N. Keiser, Des Moines, Ia.

Iowa Independent Telephone Association. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting, second Wednesday in March each year.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Sioux City, April, 1910.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, 1910.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

Maine Electrical Association. Secretary, Fred D. Gordon, Auburn, Maine.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. P. Biggs, Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, B. W. Cowperthwait, Faribault, Minn. Next meeting, St. Paul, third week in March, 1910.

MISSISSIPPI ELECTRIC ASSOCIATION. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, Jefferson City, Mo., April 14, 15 and 16, 1910

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, W. A. Wolls, Columbus, Ohio. Next meeting, Columbus, Ohio, Nov. 11 and 12, 1909.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive Secretary, T. C. Martin, 33 West 39th St., New York.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Atlantic City, N. J., July 20, 1910.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRICAL TRADES' ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, San Francisco, Cal., June, 1910.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, David Gaehr, Schofield Building, Cleveland, Ohio. Next meeting, Lima, Ohio, Nov. 19 and 20, 1909.

OKLAHOMA PUBLIC UTILITIES ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla. Next meeting, Sapulpa, Okla., 1910.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, F. J. Scherrer, 195 Broadway, New York.

PACIFIC COAST ELECTRIC AUTOMOBILE ASSOCIATION. Secretary, J. T. Halloran, 604 Mission St., San Francisco, Cal. Next meeting, Oakland, Cal., February, 1910.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. L. Smith, Towanda, Pa.

PENNSYLVANIA STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PHILADELPHIA ELECTRICAL SHOW. First Regiment Armory, Broad and Callowhill Sts., Feb. 15-27, 1910.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. D. Forbes, 96 Franklin St., South Framingham, Mass. Monthly meeting, first Monday of each month. Next annual meeting, Feb. 28, 1910.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D. Next meeting, Jan. 11 and 12, 1910.

SOUTHWESTERN ELECTRIC & GAS ASSOCIATION. Secretary, E. T. Moore, Dallas, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, G. H. Pardee, care of J. G. White & Co., New York.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester, Vt.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Omaha, Neb., 1910.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WIRELESS INSTITUTE. Secretary, Sidney L. Williams, 42 Broadway, New York.

WISCONSIN ELECTRICAL ASSOCIATION. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis. Next meeting, Milwaukee, January, 1910.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED OCTOBER 26, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., New York City.]

937,758. SWITCH STAND; S. K. Blair, Fort Wayne, Ind., and C. B. Hoyt, Bellevue, Ohio. App. filed April 28, 1909. A signal shaft which is independent of the switch operating shaft and in its safety position when the operating shaft is locked in its switch closing position.

937,759. PROCESS OF AN APPARATUS FOR THE PRODUCTION OF IONS; L. I. Blake, Denver, Col. App. filed May 16, 1908. Electrically charges by an external source of electro-motive force an incandescing body such as a conducting gas supply pipe.

937,761. TROLLEY; O. W. Brenizer, Philadelphia, Pa. App. filed April 21, 1905. Spring pressed arms rise on opposite sides of the wheel above the wire to keep the wheel from leaving the wire.

937,776. APPARATUS FOR HEATING WATER; A. C. Dunham, Hartford, Conn. App. filed Jan. 28, 1909. A cold water chamber having a portion heated by a resistance coil, the heated water being transferred to a hot water tank.

937,777. APPARATUS FOR HEATING WATER; A. C. Dunham, Hartford, Conn. App. filed Jan. 28, 1909. Automatically heats a portion of the water in a cold water chamber by a resistance coil and controls the amount of heat supplied, then transfers it to a hot water tank.

937,832. TELEPHONE EXCHANGE SYSTEM AND APPARATUS; R. H. Manson, Elyria, Ohio. App. filed Nov. 15, 1904. Common battery system in which a single relay combines the functions of the line and cut-off relays.

937,837. SIGNAL SYSTEM; W. Mears, Cleveland, Ohio. App. filed Nov. 27, 1907. For trolley roads in which an auxiliary conductor is strung parallel to the wire and the trolley wheel brings the trolley wire into contact with the conductor, thus closing a signal circuit.

937,839. AIR BRAKE; L. E. Morel, St. Hyacinthe, Quebec, Canada. App. filed July 14, 1909. An air brake in which the exhaust valve is electrically controlled.

937,855. PROCESS OF PRODUCING AND REFINING STEEL; F. C. Perkins, Buffalo, N. Y. App. filed May 11, 1908. Electrically treats the molten iron from a glass furnace with the heat produced by an arc or arcs formed between the slag of a bath and electrodes consisting of cored carbons.

937,857. PENDANT SWITCH; J. G. Peterson, Hartford, Conn. App. filed Jan. 5, 1909. Oscillating snap push button switch, in which a spiral spring is so arranged as to throw the yoke and brushes after compression.

937,858. COMBINED LAMP SOCKET AND AUTOMATIC SWITCH; J. W. Phelps, Detroit, Mich. App. filed Dec. 31, 1908. An insulator block having a socket portion and a latter extension with a thermo-dynamic switch mounted in a recess in the block.

937,859. MOTOR VEHICLE; H. Pieper, Liege, Belgium. App. filed Jan. 25, 1907.* A gas engine drives the vehicle and a dynamo motor is connected to another driving wheel to drive the vehicle supplied by a storage battery.

937,867. STRAIN INSULATOR FOR ELECTRIC LINES; E. E. Rose, Swissvale, Pa. App. filed Jan. 10, 1908. The parts are formed of metallic and insulating materials carrying the strains and an outer casing is yieldingly secured to the parts and not subject to strain.

937,877. TRANSFORMER; F. M. Slough, Elyria, Ohio. App. filed Sept. 11, 1907. A telephone ringing system for harmonic signaling in which the secondary winding of the transformer is separated from the primary to permit magnetic leakage which smooths out the wave form.

937,896. STRAIN INSULATOR; T. Varney, Pittsburg, and E. E. Rose, Swissvale, Pa. App. filed Jan. 10, 1908. Consists of two duplicate members whose inner ends are provided with external screw threads and a coupling sleeve into which said ends are screwed.

937,897. STRAIN INSULATOR; T. Varney, Pittsburg, Pa. App. filed Jan. 10, 1908. A strain insulator comprising parts formed of metallic and insulating materials carrying the strain and a segmental casing having sealed joints and enclosing the parts but relieved from the strain.

937,901. TELEPHONE REPEATER APPARATUS; N. G. Warth, Gallipolis, Ohio. App. filed Dec. 20, 1907. A relay whose windings can be changed to meet the particular or respective use, according to the requirements of the inventions shown in certain prior patents, for example 845,282.

937,909. METHOD OF WIRING TELEPHONE SWITCHBOARDS; C. S. Winston, Chicago, Ill. App. filed Dec. 27, 1904. Provides a plurality of terminals in a group which by means of short connecting wires will change the system from either the magneto lamp plan to a common battery system.

937,918. ELECTROLYTIC APPARATUS; A. Brichaux, Brussels, Belgium. App. filed Oct. 4, 1898. Two communicating vessels with a dense electrolyte in one and less dense in the other above the former, with electrodes arranged in contact with the electrolyte layers.

937,919. ELECTRIC ALARM; R. C. Bronson, Chicago, Ill. App. filed Oct. 12, 1908. By turning a cylinder, the striking mechanism in any desired number of rooms is operated.

937,935. TROLLEY POLE; J. Harsen, New York, N. Y. App. filed Aug. 25, 1908. An adjustable pole for rounding curves which is divided into sections pivoted together so that the portion carrying the reel may turn transversely to the line of travel.

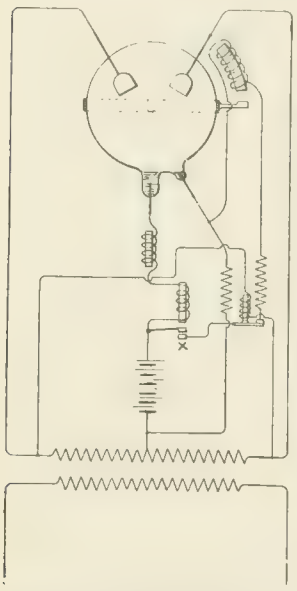
937,941. ELECTRIC PROTECTION SYSTEM; O. Jacobson, Hamilton, Ohio. App. filed Nov. 23, 1908. For protecting a safe whereby the safe door cannot be opened before moving the combination lock without ringing an alarm.

937,957. ELECTRIC SWITCH MECHANISM; J. G. Peterson, Hartford, Conn. App. filed Dec. 10, 1908. A rotary snap switch with an improved commutator. The commutator has four integral arms projecting from the surface of the plate and carrying pole pieces.

937,971. STARTING DEVICE FOR VAPOR CONVERTERS; P. H. Thomas, Montclair, N. J. App. filed May 11, 1905. Avoids reversing the polarity of storage batteries used in starting a vapor converter. Provides a flow of current which is opposite to the normal direction and utilizes the cathode activity thus produced to overcome the starting resistance of the normal cathode.

937,984. INSULATOR BRACKET; E. V. Brown, New Albany, Ind. App. filed Feb. 27, 1909. Has a vertical body portion with projecting arms and a rearwardly extending flange with a wedge movable over it to engage the joints.

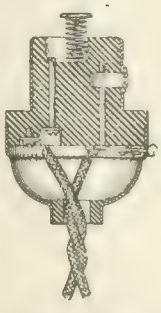
938,026. LOCKING AND SIGNALING SYSTEM FOR TELEPHONE REGISTERS; A. S. Spiegel, Chicago, Ill. App. filed June 10, 1907.



937,971—Starting Device for Vapor Converters.



938,127—Electric Heater.



938,238—Electric Attachment Plug.

Central station meter for measuring telephone service in which the meter is incapable of operation a second time during the period of a single insertion of the answering plug.

938,033. MEANS FOR HOLDING IN PLACE LAMINATIONS OF ALTERNATING CURRENT DYNAMOS AND MOTORS; C. E. Willey, Louisville, Ky. App. filed Dec. 12, 1908. A frame with a split ring to hold the laminations in place.

938,038. INCANDESCENT LAMP SOCKET; H. A. Bretz, Chicago, Ill. App. filed March 4, 1907. The lamp carries an electromagnet which when the current is on supports the lamps in position on a metal surface without using a hanger.

938,039. APPARATUS AND SYSTEM FOR MEASURING TELEPHONE SERVICE; S. H. Browne, Pittsburg, Pa. App. filed Jan. 17, 1905. Mechanism for measuring telephone service wtih means for counting and recording the total number of successful connections resulting from calls originating upon any one telephone line having an automatic switch.

938,060. APPLIANCE FOR USE WITH TELEPHONE TRANSMITTERS; C. J. Kintner, New York, N. Y. App. filed June 1, 1909. A secret appliance to prevent other persons in the room overhearing a conversation by means of a shield and ring attached to the mouth piece.

938,092. STRAIN INSULATOR; T. Varney, Pittsburg, Pa. App. filed June 8, 1907. Comprises a metal tube having paper ends with metal bushings therein and metal plugs insulated from the bushings.

938,127. ELECTRIC HEATER; H. W. DENHARD, San Francisco, Cal. App. filed June 25, 1908. Contains a fluid chamber, some of the fluid surrounding the electrodes so as to be heated by the passage of the current.

938,137. LIGHTNING ROD; J. F. Goetz, Hartford, Wis. App. filed April 6, 1908. The lightning rod is made of tubular sections and can move up and down slightly in winter or in summer to compensate for changes in temperature.

938,154. TELEPHONE SYSTEM; O. M. Leich, Genoa, Ill. App. filed June 19, 1908. An improved system for railway service for transmitting messages having a metallic line circuit, a return circuit, a plurality of substations, a telephone set at each station and electromagnetic means for connecting adjoining circuits in tandem.

938,155. SIGNALING SYSTEM; O. M. Leich, Genoa, Ill. App. filed Feb. 15, 1909. A metallic telephone circuit on which are arranged a plurality of non-interfering telephone circuits in combination with selective signaling means for calling the telephones, and signaling means for substation tandem telephones arranged on the local tandem circuits.

938,160. SYSTEM OF ELECTRIC MOTOR CONTROL; J. N. Mahoney, Wilkinsburg, Pa. App. filed Jan. 10, 1908. For controlling mining locomotives carrying a trolley and a gathering reel with independent switches for connecting the trolley and the reel to the controller and means for automatically preventing closing the two switches simultaneously.

938,175. ELECTRICALLY OPERATED RELEASE FOR DOORS; W. H. Snyder, Ashbourne, Pa. App. filed April 6, 1909. For stall doors of fire houses in which a bolt is held by a retaining device controlled by an electric circuit and controlling an alarm circuit.

938,190. AUTOMATIC HEAT REGULATING INCUBATOR; W. W. Wetherla, Chicago, Ill. App. filed Dec. 19, 1909. Incubator for infants with automatic electric heating appliance.

938,191. CIRCULATING DEVICE FOR MERCURY; J. Whiting, Boston, Mass. App. filed Dec. 16, 1908. For pumping or circulating liquid metal in an electrolytic cell such as used for decomposing alkali chlorides by means of a wheel having pockets.

938,212. ELECTRIC LAMP SOCKET FASTENING; H. Christensen, Seattle, Wash. App. filed Dec. 3, 1908. An annual clamping member whose interior is cone shaped, one side being formed into a cammed surface.

938,213. ELECTRIC LAMP SOCKET RETAINER; H. Christensen, Seattle, Wash. App. filed March 29, 1909. An insulator body having a shoulder arranged in a spiral and a retainer on the body with an end portion extending in a spiral path engaging the shoulder.

938,216. MESSENGER HANGER; C. E. Cook, Chicago, Ill. App. filed July 31, 1908. A clamp having a channel shaped jaw co-operating with a trough for clamping a rope therein.

938,237. ELECTRICALLY OPERATED WATER HEATER; J. A. Hunnewell, Lowell, Mass. App. filed April 4, 1908. A heating coil is arranged in a U-shaped tube through which the water flows.

938,238. ELECTRIC ATTACHMENT PLUG; S. W. Ito, San Francisco, Cal. App. filed March 18, 1909. Avoids twisting the conducting cords. A crank arm is moved to engage spring tips and the plug is inserted into the socket without twisting.

938,312. BATTERY; W. Gardiner, Chicago, Ill. App. filed Feb. 17, 1908. The annode contains molybdenum and the cathode likewise.

938,313. STRAIN RELIEF FOR ELECTRICAL DEVICES; G. W. Goodridge, Bridgeport, Conn. App. filed June 30, 1908. A rosette having a clamping device and binding screws to grip the insulated portions of the wires.

938,316. PROCESS AND APPARATUS FOR THE PRODUCTION OF COMPOUNDS OF OXYGEN AND NITROGEN; F. Haber and A. Koenig, Karlsruhe, Germany. App. filed July 15, 1908. A cylindrical vessel having electrodes situated in and parallel to the axis of the vessel, entry and exit openings to the gases and means for maintaining the gases in the vessel under reduced pressure.

938,324. AUTOMATIC CIRCUIT BREAKER; J. N. Kelman, Los Angeles, Cal. App. filed April 22, 1907. An oil circuit breaker for high voltages. Details.

938,331. BLOCK SIGNAL SYSTEM; J. D. Nix, Ferriday, La. App. filed Sept. 11, 1908. The apparatus is arranged on the engine and automatically operated by electric current from a generator carried on another engine when in the same block, thus shutting off the steam and applying the brake.

938,337. TELEGRAPHY; J. F. Richardson, Montreal, Canada. App. filed Jan. 11, 1907. For utilizing alternating currents in telegraphy. The relays include arc shaped solenoids with arc shaped cores.

938,345. ELECTRICAL SIGNALING SYSTEM; F. M. Slough, Elyria, Ohio. App. filed June 19, 1906. A harmonic signaling system utilizing a battery providing two electromotive forces of equal amounts but opposite sign, and suitable transformers.

938,351. ELECTRIC SMELTING FURNACE; E. R. Taylor, Penn Yan, N. Y. App. filed June 12, 1908. For smelting iron ores by a continuous process, by means of a furnace with horizontal electrodes and a body of stack form containing a working chamber into which the electrodes extend and provided with a central flue shaped feed passage.

938,352. ART OF ELECTRIC SMELTING; E. R. Taylor, Penn Yan, N. Y. App. filed March 3, 1909. See 938,351.

938,368. ELECTRIC CIGAR LIGHTER; S. A. Campbell, Newton, Mass. App. filed Aug. 14, 1908. The lighting flame is produced from a wick lighted by an electric spark, which is snuffed by a cover worked by the handle.

938,373. PROTECTING BOX FOR ELECTRIC WIRING; H. W. Eden, Detroit, Mich. App. filed Dec. 16, 1908. A box body with slots and notches and a fillet having projections engaging the notches.

938,394. CIRCUIT CLOSING AND BREAKING DEVICE FOR ELECTRICALLY OPERATED ANNUNCIATORS AND THE LIKE; A. May, New Orleans, La. App. filed March 25, 1909. The conductor is provided with pivotally mounted weighted arms electrically connected thereto and a device on the car has an insulated contact which engages the arms in the travel of the car.

938,399. ELECTRICAL EXERCISING APPARATUS; W. C. Schaufler, Amsterdam, N. Y. App. filed July 9, 1908. Currents are sent through the body of the operator when pulling the elastic cords of the exerciser.

938,409. STRAIN INSULATOR; C. F. Boldman, Canton, N. C. App. filed April 22, 1908. Includes a strain rod passing through the sleeve and having a head with a strain member clamped around the sleeve.

938,414. CONFECTIONER'S MELTING TABLE; G. F. Dickson, Chicago, Ill. App. filed Oct. 19, 1908. For manufacturing chocolates in [illegible] heated electrically.

938,429. MECHANISM FOR DANGER SIGNALS FOR RAILROADS; R. E. Murphy, Colorado Springs, Col. App. filed Sept. 16, 1907. Supplies torpedoes as a train passes by electro-mechanical means.

938,445. GLASS STORAGE BATTERY CASE; F. L. O. Wadsworth, Sewickley, Pa. App. filed July 27, 1907. Separate sheets of glass are arranged on opposite sides and have parallel ribs pressed therein.

938,451. PROCESS OF MAKING ACTIVE MATERIAL FOR STORAGE BATTERY ELECTRODES; J. W. Aylsworth, East Orange, N. J. App. filed Feb. 6, 1908. Electrolytically forms the active material out of a cyanid solution.

13,027. (Reissue.) ELECTRIC FURNACE; A. C. Higgins, Worcester, Mass. App. filed Oct. 12, 1908. Has water cooled walls and a removable water cooled casing projecting into the charge between the electrodes.

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Revival in Export Trade.

The figures issued by the Bureau of Statistics in the Department of Commerce and Labor bear out the view expressed frequently in these columns that the shrinkage in American manufactured exports was but one demonstration of universal trade shrinkage after the boom period up to 1907; and that returning good times would begin to see an approach to the old levels. The Bureau has just published an interesting analysis which shows "that the United States contributed in 1908, in fact, a larger percentage of the imports of the principal foreign countries of the world than in the earlier years when our export trade was at its maximum." This is, to say the least, an interesting and encouraging fact.

Turning to the specific figures just published for the month of September, it would appear that in certain branches of electrical export trade there is distinct improvement; while others are slow in emerging from depression. The export of electrical instruments and apparatus this September reached the respectable total of $686,049 as compared with $430,785 a year ago. This is really a notable gain, and if the rate is maintained 1906-7 will soon be left behind. The revival is not so marked in electrical machinery, but even there the sales abroad were $480,835 as compared with $568,525, indicative of growing taste and absorption for heavy apparatus in foreign countries that had nearly stopped buying at all. The total for this September is therefore $1,166,884 as compared with $999,310 in 1908, an increase of $167,574, a gain of nearly 15 per cent. Such data justify optimism, not only as to American electrical conditions, but as to those of the world at large.

Some foreign countries are taking a large proportion of the increase, British North America raising its purchases of instruments from $99,857 to $200,336, Brazil from $83,026 to $151,166, and Mexico from $34,427 to $90,471. There are no notable gains in heavy machinery, but British Australasia was virtually an exception in this respect by increasing from $11,977 to $68,065. There are also slight gains in both departments for the United Kingdom, an aspect of affairs all must view with pleasure in the hope that behind it lies a marked revival of British industry and foreign trade.

The Light of the Fire Fly.

The communication from Dr. Coblentz elsewhere in our columns is a most interesting contribution to the question of the fire fly's secret, apropos of Dr. Ives' paper before the recent Illuminating Engineering Society's convention. It is particularly instructive as impressing upon the reader the extreme difficulty of making radiometric measurements of the invisible radiation of the fire fly. From what Dr. Coblentz says, not only is the repetition of Langley's work, which we believe to be very instructive, highly desirable, but it seems somewhat doubtful whether the negative evidence obtained by Langley could really have been very conclusive. Dr. Coblentz suggests that the important thing is a hunt for radiation in the nearer part

of the infra-red rather than in the longer waves chiefly considered by Langley. As a preliminary step it would be very desirable to follow up Dr. Ives' experiments by work with photographic plates peculiarly sensitive to the extreme red and the nearer infra-red—such plates, for example, as were used by Abney in his infra-red researches. For, while Dr. Ives' experiments, already published, seem to make it perfectly clear that the spectrum of the fire fly's light is not merely not one of low intensity, it is still a little uncertain whether the radiation might not be materially further extended by the use of different plates from those he employed. At all events, the matter should be settled one way or the other.

A very interesting suggestion of Mr. Coblentz, and one which deserves close investigation, is the kinship of the radiation apparently given by the fire fly with some of the fluorescent spectra. The suggestion of a step-down process of radiation is certainly novel, but in matters involving physiological chemistry nothing is so extraordinary as to be improbable, and the possibility of such indirect type of radiation is at least worth considering. Certainly the fire fly should not be allowed to glow uninvestigated, for it is of considerable practical moment to find out whether the type of radiation it emits is really as efficient as its character suggests, or upon the whole perhaps inefficient, as Dr. Ives seems to think possible. If it should be shown that even by thoroughly indirect means it is possible by processes of physiological chemistry to obtain highly efficient radiation, then a new field of possible application is open; while if, on the other hand, investigation of the operation should show intrinsic inefficiency, progress along this particular line would seem to be far less likely. Fluorescent phenomena as such appear to be somewhat unpromising, since the very short radiations which are most effective in exciting fluorescence are not the ones the transformation of which is to be desired in producing light, since the energy waste of our present methods is in the existence of long rays and not the abnormal production of short ones. It will be interesting to know, however, at what efficiency the transformation downward by fluorescence takes place. Whether the fire fly is an example of such transformation is another matter, but assuredly the little being in all his varieties is well worth continued investigation.

The Design, Cost and Efficiency of Modern Electrical Machinery.

In this country, dynamo-electric machinery tends to become standardized in dimensions, cost and behavior by reason of its manufacture being largely confined to a very few large corporations; but even in Europe, where the manufacture is divided among a large number of firms, the tendency is toward a standard average of dimensions, cost and performance, owing to the influences of competition. An article on this subject by Mr. L. Grouch, in the London *Electrical Review*, abstracted in the Digest, presents a large number of facts concerning British dynamo-electric machinery in a readily assimilable graphical form. Naturally, the actual purchasing costs of British machinery cannot be directly compared with our own, but direct comparisons may advantageously be made between British and American machine designs and performances. It appears, from the diagrams illustrating the article, that motors of between 20 hp and 140 hp average in weight about 50 lb. per horse-power (21 kg. per horse-power), or give a rated power of 15 watts per pound of weight (33 watts per kilogram). Alternating-current generators come heavier, having to maintain a considerable reserve of structural strength and of voltage regulation. Up to 300 kw, they are indicated as weighing about 110 lb. per kilowatt (50 kg. per kilowatt); or as delivery, at rated load, about 9 watts per pound (20 watts per kilogram). Of course, a 300-kw generator is at the present time only a diminutive machine, by comparison with central-station generators in which the specific power delivery is greater.

In regard to speeds, direct-current motors are indicated as having distinctly lower speeds than alternating-current motors up to 120 hp. Above that output, the latter motors appear to run the more slowly. The alternating-current motors are also more expensive than the direct-current type, except in small sizes, perhaps on account of the finer machine work demanded in good polyphase construction. Attention is called in the article to the rapid reduction in purchase cost per horse-power in motors above the small sizes. This condition necessarily applies in all countries, and makes it desirable to use one large motor, instead of many small ones, where the duty is capable of being assumed by a single unit. A noteworthy feature of motor construction in Great Britain is ball bearings in motors up to 40-hp output. This is a standard construction that with us is not the most usual. It has the effect of reducing friction losses in small machines and thus of raising the efficiency. In regard to efficiency, power factor and slip, the conditions appear to resemble fairly well those that pertain here. Efficiency is not wholly a matter of purchasing cost. By improving the efficiency, and reducing internal losses to a reasonable extent, the manufacturer can increase to some extent the output and value of his machine, so that, apart from competitive influence, machine efficiencies tend to parallel themselves in different factories. The article concludes by pointing out that the high efficiency and moderate cost of modern electrical machinery have given the latter a unique position in modern engineering and factory practice.

Italian Report on 1908 Conference on Electrical Units.

The Italian report to the Minister of Agriculture, Industry and Commerce of Italy has now been printed on the conference of Government delegates, which met in London last October to discuss international electrical units. The burden of the report appears to be the explanation and justification of the "two zeros." The conference of October, 1908, has been called the "Two-Zeros Conference," because it defined the mercurial length of the international ohm as 106.300 cm and the electrochemical equivalent of the ampere, in silver, as 1.11800 milligrammes per second. Such a numerical procedure is always suspicious from a physicist's point of view, because two such final zeros are supposed to cover sins of omission; and no one believes that the international precision of measurement is really so great at present as these numbers would indicate. It seems that the principal reason for adding the two zeros in each case was to indicate that, whatever the last two digits might actually be, they were probably not very far numerically from two zeros, and that it would be better for the sake of international uniformity to keep to two zeros, even if measurements in the near future should indicate that other final digits were more probable. If this is a correct statement of the situation, the condi-

tions might have been better defined in language than by offending the numerical sense. That is, it might have been better to lop off the superfluous zeros in the specifications, and to state that for the present no higher degree of numerical precision was expedient to be formulated. However, so long as the reason for the existence of the two zeros is clearly discernible, they will make their own apologies to the wondering physicist.

Report of the British Association Committee on Electrical Standards.

The report of the British Association committee on practical standards for electrical measurements, presented at the Winnipeg convention, has recently been published, in abstract, by the London *Electrician*. The abstract contains some interesting tables of comparative measurements at the national physical laboratories of England, Germany and the United States of a set of eight standard resistance coils belonging to the Bureau of Standards. These coils were passed from one laboratory to another, so that the comparative measurements were all made within a few months. As might be expected, the measurements are in close agreement. There are 44 measurements recorded in all, and the largest discrepancy is 0.0029 per cent. The average discrepancy is about 0.002 per cent. According to the report, then, this is about the degree of precision which is attainable in the measurement of resistance standards, at the present time, as between different national laboratories. The precision of measurement in one and the same laboratory, by the same observer, would, of course, be greater. The discrepancies between the measurements of a resistance coil at different laboratories include more than mere discrepancies in resistance. They include discrepancies in local resistance standards and discrepancies in temperature observation. It is noted that one coil after being measured in England and shipped to Germany returned to England with an increase of 0.001 per cent. This means that a change of 0.001 per cent was looked upon as unexplainable by errors of observation. In some careful industrial measurements of resistance, a precision of 0.01 per cent is aimed at, and frequently secured, so far as concerns errors of observation, so that the national laboratories are one order of magnitude in precision. This is satisfactory, but by no means too good. At least one order of magnitude should be preserved, if possible, in our *lares* and *penates* at national laboratories over those preserved in industrial practice at our factories.

The Field for the Turbo-Generator.

The 5000-kw exhaust steam turbo-generator recently installed in the subway power house of the Interborough Rapid Transit Company is a capital example of putting the steam turbine to its very best use. There is still some doubt as to the apparatus best adapted to obtain the maximum efficiency of utilization from steam; but there is none whatever when it comes to working below atmospheric pressure. The relatively very high speed of the turbine is a blessing when it comes to low pressures, for it enables good output to be obtained in a machine of moderate cost and size subject to the minimum radiation losses. More than this, its friction is also very low, while that of a very low-pressure reciprocating engine is inconveniently high compared with the output obtained. On the other hand, at high pressure and superheat, the reciprocating engine is as yet unbeaten. While some of the big multi-stage, turbo-generators have done very remarkably well in the matter of economy, the record performances are not yet theirs, and perhaps never will be. Unless American builders take a brace, however, in the use of superheaters, the turbine may yet occupy the whole field to the exclusion of the older engine in all important plants.

Anyone who has built power plants fully realizes the dead level to which a stolid complacency in standardization has reduced most builders of reciprocating engines. With very few exceptions they have thus far refused to make use of modern improvements and have contented themselves with 100 deg. or so of superheating, steadfastly refusing to accommodate their designs to anything better. The result is that the turbine makers, more progressive from the very novelty of their work, are rapidly pushing ahead and beating out plants that they could not compete with save through the lack of enterprise of their rivals. While five-stage turbines are common, triple-expansion engines are scarce in power plants. An ordinary compound engine is not in competition with a multi-stage turbine, and engineers unmindful of the uniform loads to be had in a great modern power station have been unduly cautious in going to triple expansion. Perhaps one should not be ungrateful for this on the ground that by this negligence the turbine has been enabled to make more rapid progress, so that on the whole the art may have advanced. Certain it is, that the turbine is making wonderful progress all along the line, especially in marine work.

The turbine's best hold, however, just now seems to be in the utilization of exhaust steam as in the Interborough plant we are considering. The very fact that many very important reciprocating engine plants are inefficiently organized as respects high expansion gives the turbine a magnificent opportunity. What would be the ultimate economy of a plant like this one plus its low-pressure turbine as compared with a first-class pure turbine plant or a modern reciprocating engine plant at high superheat, does not for the moment matter. One has to deal with things as they are, and the fact is that a good compound condensing plant can be made much better by what amounts to triple compounding by means of a low-pressure turbine. The linking is not quite so direct as in ordinary triple-expansion practice; but perhaps the very flexibility of the connection is a material advantage once the governing problem is satisfactorily dealt with. The gain in space, too, is highly advantageous especially in a plant well crowded with machinery, so that really there is everything to gain and nothing to lose in adding the turbine. As to the absolute economy of the combination, few reliable data are at hand, particularly on a large scale, but that the results will be good there is no reason to doubt. It is not at all unlikely that we shall see large new composite plants built presently, although there is enough work on the older ones to keep the turbine builders busy for a long time to come. In the course of the next year, we shall hope to have full reports from the performance of this Interborough plant, reports detailed enough to form a complete basis for future practice. Meanwhile, its engineers are to be congratulated on their enterprise in installing an exhaust plant in such a thorough manner and on so large a scale as to give a proper criterion of its value.

Patent Office Permitted to Investigate Irregularities.

Justice Shepard, of the District of Columbia Court of Appeals, has decided that courts are invested with no power to interfere with or to supervise the conduct of investigation in the Patent Office. The decision reversed a decree of the lower court in an injunction granted John A. Heany, of the Heany Lamp Company, prohibiting Commissioner Moore, of the Patent Office, from prosecuting an investigation into alleged irregularities in applications for Heany's patents. The case grew from the criminal prosecution in connection with tungsten-lamp patents, which resulted in penitentiary sentences for Attorney Henry E. Everding, of Philadelphia, and Patent Examiner Ned W. Barton. From the facts brought out at the trial, Commissioner Moore decided to investigate the applications for the Heany patents on the use of tungsten as a filament. Heany thereupon obtained the injunction which has just been reversed.

A Comprehensive Report from Chicago Traction Engineers.

The first annual report of the Board of Supervising Engineers, Chicago Traction, has made its appearance. It covers the year from Feb. 1, 1907, to Jan. 31, 1908, its publication having been delayed for various reasons. The report makes a volume of 462 pages, and is carefully prepared, detailed and comprehensive—a worthy installment of the complete report of the great undertaking of rehabilitating the street-railway systems in Chicago. In eight chapters the history of street-railway service is given, followed by an account of the organization and work of the Board of Supervising Engineers, which consists of Mr. Bion J. Arnold, chairman; Mr. George Weston, representing the city of Chicago; Mr. Harvey B. Fleming, representing the Chicago City Railway Company, and Mr. John Z. Murphy, representing the Chicago Railways Company. The work described is that of rebuilding a modern and complete system of street railways at an expenditure, when completed at the end of the three-year rehabilitation periods, of approximately $43,000,000, divided into $17,000,000 for the Chicago City Railway Company and $26,000,000 for the Chicago Railways Company. The three-year period will expire April 15, 1910, in the case of the Chicago City Railway Company and Jan. 28, 1911, for the Chicago Railways Company. Much of the information contained in the book has already appeared in the technical press, but the volume contains a wealth of detail and statistical information which, with its successors, will make it valuable. It is said that the second volume of the report will soon be published.

Brailey Independent Telephone Situation.

Legal actions of various kinds are following the recent change in the independent telephone situation in Ohio. By some it is thought that these moves are the preliminary steps to force the new owners of the Cuyahoga Telephone Company and the United States Telephone Company to come to the front. Others state that they do not understand the motives of those who are instrumental in bringing legal proceedings.

Following the institution of a suit against the Toledo Home Telephone Company, by Herman C. Stifel, of St. Louis, to compel the company to permit an inspection of its books, he has been served with papers in a suit instituted by the company to collect on a promissory note for $7,000 which, it is claimed, was given on Nov. 12, 1908, for stock. The note was signed by Max Koehler and Mr. Stifel and was to run for six months. It is alleged that no payments have been made on the note and an attachment on the stock and other securities which Mr. Stifel left in possession of the company.

Daugherty, Todd & Rarey, of Columbus, Ohio; McGraw, Hauxhurst & Saeger, of Cleveland, and C. A. Seiders, of Toledo, are the legal firms employed by Mr. Stifel to conduct his suit at Toledo. Harry M. Daugherty, who has been active in independent telephone matters for a number of years, seems to be directing the proceedings. It is said that some of Mr. Brailey's friends admit that Mr. Stifel has a right, as a director and stockholder of the company, to inspect the books, but that he will not be allowed to do so just yet. They believe that Mr. Stifel has an idea that some of the securities of the company were put up to secure money for the purchase of stock in the Cuyahoga and United States Telephone companies, but they say this is not true. Further, it is said that he sold some of his holdings, but that he had a perfect right to do that, as any other stockholder may do the same thing.

The National Telephone Company, of Wheeling, W. Va., on Nov. 6, filed suit in the United States Circuit Court, at Cleveland, against the United States Telephone Company, asking that a contract for the sale of the Youngstown Telephone Company, the Columbiana County Telephone Company and some other systems and lines be enforced. An injunction is also asked to prevent the disposal of the properties and the appointment of a receiver to take charge of the long-distance lines pending a decision. The National Telephone Company alleges that on June 18 last it entered into a contract with the United States Telephone Company to purchase $200,000 of the common stock and $69,000 par value of the preferred stock of the Youngstown Telephone Company; all but five shares of the outstanding stock of the Columbiana County Telephone Company, which amounts to $300,000 par value; a half interest in the United States Telephone line between Youngstown and Sharon, Pa.; all lines from and into Youngstown to Sharon; the Youngstown-Pittsburgh line from Youngstown to the Ohio State line; the line from Sharon to Wellsville and the line between Wellsville and Steubenville. In return the National Telephone Company was to deliver 2700 shares of its stock to the United States Telephone Company on July 1 and was to reconstruct the Youngstown exchange and the Columbiana County system and do certain other things mentioned in the contract. It is claimed that the stock was tendered to the United States Telephone Company on Oct. 30, but that it was refused and the company refused also to turn over the properties claimed or to recognize the alleged contract.

Mr. E. G. Tillotson, chairman of the board of the United States Telephone Company, and Mr. W. L. Carey, secretary, state that negotiations were under way for a time and that the National Telephone Company failed to comply with the terms offered, so the matter was dropped. They say there is nothing in the suit and that the company can gain nothing by this action.

There are indications that this is part of the Stifel proceedings, but this is only a surmise, as nothing definite is known of it beyond the fact that McGraw, Hauxhurst & Saeger acted as attorneys for the National Telephone Company in this suit and that John A. Howard, head of the National, is associated with Mr. Stifel in the syndicate which is promoting the Continental Telephone & Telegraph Company.

Court Definition of Annual Horse-Power.

The interesting case at Niagara Falls recently noted in these columns, covering the point whether the Canadian Niagara Power Company should pay rental for water used in the generation of power at the maximum demand or simply upon the average amount used throughout the year, was decided on Nov. 1 in favor of the company, the court dismissing the action brought by the Attorney-General on behalf of the Queen Victoria Niagara Falls Commission, which made the lease to the company. The judgment covered 74 pages, and the effect of the decision is that the power company must pay, not at the rate of the maximum amount taken on any day, but for the actual power taken during the whole term. The amount of excess power rental sued for was $15,217.97.

Annual Report of the Commonwealth Edison Company.

At a special meeting of the stockholders of the Commonwealth Edison Company, Chicago, held Nov. 8, the company's capital stock was increased from $30,000,000 to $40,000,000, as recommended by the directors some time ago. The special meeting was preceded by the regular annual meeting of the company, at which President Samuel Insull presented his annual report for the fiscal year ended Sept. 30, 1909. This report shows that the business of the company is in a highly prosperous condition, the net earnings available for dividends, after paying interest on bonds and debentures and setting aside a depreciation reserve, being $2,386,996, or 7.95 per cent on the capital stock of the company. The net earnings reported a year ago were $1,857,704. The dividends paid during the year were at the rate of 6 per cent, leaving a balance carried to surplus of $586,996.

The following is a condensed statement of the earnings and expenses for the fiscal year, as well as assets and liabilities:

Business Summary		
Gross income from electric current and merchandise sales		$10,639,446.50
Operating, repairs and renewals, depreciation, taxes and general expense		6,642,693.67
Net income from all sources		$3,996,752.83
CHARGES AGAINST INCOME.		
Interest on bonds and debentures	$1,182,506.63	
Depreciation reserve under the terms of the mortgages made by the Chicago Edison Company and the Commonwealth Electric Company	427,250.00	
Dividends paid	1,800,000.00	
		$3,409,756.63
Balance		$586,996.20
Assets.		
Plants, real estate, etc.		$57,105,744.41
Unfinished plant investment		99,377.92
Open accounts		180,183.71
Material in store-rooms		793,777.05
Coal in storage		92,107.50
Accounts and bills receivable		1,287,464.02
Cash		1,026,329.76
		$60,584,984.37
Liabilities.		
Capital stock		$30,000,000.00
Bonds		24,662,000.00
Real estate mortgages		130,000.00
Depreciation reserve		2,221,750.00
Accounts payable		783,519.47
Municipal compensation		122,468.19
Bond interest accrued		224,042.46
Taxes accrued		411,387.55
Surplus account		2,029,816.70
		$60,584,984.37

During the fiscal year the directors of the company issued and sold $11,250,000 of the company's 5 per cent bonds, and paid off obligations amounting to $7,921,000. The obligations retired were: $500,000 of Commonwealth Electric Company 5 per cent debentures; $588,000 Chicago Edison Company 5 per cent first-mortgage gold bonds; $1,483,000 Chicago Edison Company 6 per cent debenture bonds; $5,000,000 Chicago Edison Company 5 per cent three-year gold debentures; $200,000 Chicago Sectional Electric Underground Company first-mortgage bonds, and $90,000 in real-estate mortgages.

The report shows that the company has four generating stations and 35 substations. This does not include the substations of railway companies to which electrical energy is supplied by the Commonwealth Edison Company "in bulk" at wholesale rates. The company's connected business (exclusive of electrical energy supplied to other public-service corporations) amounted to the equivalent of 4,920,800 standard 16-cp lamps Sept. 30, 1909. On Sept. 30, 1908, this figure was 4,137,650, a gain of 783,150 16-cp equivalents during the year.

The stockholders have authorized the directors to issue the $10,000,000 of new stock from time to time as the directors may deem advisable. It is probable that $3,000,000 of this new stock will be offered to the stockholders at par in February next. The board of directors consists of Messrs. Henry A. Blair, Edward L. Brewster, Benjamin Carpenter, Joseph Leiter, Robert T. Lincoln, John J. Mitchell, Erskine M. Phelps, A. A. Sprague and Samuel Insull. The executive committee consists of Messrs. Brewster, Sprague, Lincoln, Mitchell and Insull.

Statistics of Chicago Central Stations.

The first meeting of the season of the Lewis Institute Branch (Chicago) of the American Institute of Electrical Engineers, on Nov. 3, was attended by nearly 400 students. The speaker of the evening, Mr. Alex. D. Bailey, of the Commonwealth Edison Company, gave an interesting talk on central-station operation in Chicago. The Fisk Street and Quarry Street stations were cited as examples of the most modern central-station practice. The boiler-rooms of these two adjacent stations contain 104 boilers, with a total heating surface of nearly 14 acres, capable of evaporating over 2,500,000 lb. of water an hour and converting it into steam at 200 lb. pressure and 150 deg. superheat. This requires nearly 50 carloads of coal a day. The turbine-rooms contain 13 turbo-generators of a total rating of 162,000 kw. The current is generated at 9000 volts. The operation of the switches is carried on from operating galleries in the turbine-rooms with the remote-control system. Therefore, no pressure exists on the operating board over 110 volts.

Cleveland Electrical League.

The Electrical League of Cleveland held its first lunch at the Gillsy Hotel, Saturday, Oct. 30. About 95 members were present, and the occasion was one of much enthusiasm and interest. Mr. W. R. Warner, president of the Warner & Swasey Company, gave an interesting talk on methods of determining latitude in the polar regions. This club is the outcome of a "Harmony" luncheon given two weeks ago as a preliminary step toward bringing the electrical men in Cleveland into closer touch and promoting harmony and co-operation. For the present the organization will be simply a lunch club, but later on it is hoped that a closer organization will be perfected.

Peat as Fuel.

The use of peat as a factor in the production of electricity has again been brought to attention as a result of certain experiments recently made by the Dominion Government. The Department of Mines has been engaged upon a series of tests under the direction of the superintendent, Dr. Haanel, in the expectation that the results hoped to be achieved would warrant the use of peat in gas-producer plants as a means of generating electric current, which could then be transmitted in the same manner as electricity is now transmitted from water-power and steam-generating plants.

After extensive investigations into the methods pursued in other countries, the department procured a bog of about 300 acres, at Alfred, some distance east of Ottawa on the Canadian Pacific Railroad. The peat here is of good quality nd 8 ft. or 9 ft. thick. Extensive works have been installed, and the manufacture of peat fuel by the air-dried process has been successfully established.

Among the favorable points to be noted with regard to this method are the cheapness and economy of the plant. There is a minimum of apparatus, and as the peat is used the plant follows it. By next year the sale of peat will begin. It is hoped that the plant will be able to sell the fuel at $2.25 a ton. As 1 8/10 of peat fuel are equivalent to one ton of the best coal, the saving is quite apparent.

The fuel is expected to be of great value for domestic purposes, for which it is understood to be well suited, particularly if it can take the place of the imported anthracite, which sells locally at $7.50 per ton. Favorable results are also expected from the fuel if it can be extensively used in gas-producer plants, which will have the effect of causing large generating stations to be erected in the vicinity of the numerous peat bogs all over the country and make the peat field rivals of the water-powers as an efficient and economical means of generating electrical energy.

Electric Fire Protection on Governor's Island, New York.

Governor's Island, New York, the headquarters of the Atlantic Division of the United States Army and the Department of the East, has a population of about 400, exclusive of the military prisoners confined in Castle William. Until three or four years ago, strange as it may seem, this community, within a stone's throw of the metropolis of the Western Hemisphere, possessed no modern system of illumination, and was lighted exclusively by kerosene oil. About the time mentioned the Government laid a cable from Brooklyn to Governor's Island, and contracted with the Brooklyn Edison Company to supply electrical energy to the reservation. High-tension current is supplied to the cable on the Brooklyn side, and this is transformed and distributed from a rotary station on the island. Every building is wired, and the entire island, including the streets, is now lighted exclusively by electricity.

The means hitherto used for fire protection have been humorously primitive. In cases of conflagration water had to be supplied by the engine of the little ferryboat which plies between the island and the ferry landing in Manhattan. If a fire broke out while this boat was on its way to Manhattan, there was nothing to do but wait for its return to the island. Early in October a fire occurred while the boat was away from its island mooring, and considerable damage resulted before the flames could be extinguished. It was, therefore, proposed by the authorities at Washington to install a modern high-pressure pumping plant, and work on the installation is now under way. This plant consists of an electric motor connected to a 6-in., three-stage turbine pump, capable of throwing a 4-in. stream.

Electricity at the Boston 1915 Exhibition.

A somewhat unusual commercial-sociological exhibition is being held this month at the old Museum of Fine Arts Building, in Copley Square, Boston, with the object of stimulating public interest in the general welfare of the community and setting in motion reform movements which shall have reached a large fruition by 1915. The exhibition is conspicuous by the absence of commodities displayed for sale, and noteworthy on account of the space given to extended plans of urban improvement, philanthropic organizations, transportation, communication, industrial welfare work, religious and scientific activities. A number of the exhibits are dependent upon electricity for their operation or success, including the work of the local street railways, models of workingmen's homes, exhibition of new signal equipment, display of laboratory methods of work in connection with public water supplies, and the influence of the telephone upon the welfare of the community.

The Boston Elevated Railway Company is exhibiting numerous photographs of its system and the historic points reached by its lines, views of recent construction in Middlesex Fells, plans of the new Cambridge subway, maps of the territory tributary to the different subway and elevated lines and models in cardboard of the station to be built in Harvard Square and the existing tunnel station at Essex Street, Boston. The company is also showing a map of Boston in 1775, and wash drawings of Washington Street tunnel stations, entrances, exits and interiors. A number of views of the new construction of the company over the Charles River dam are also shown.

The Boston & Northern and Old Colony Street Railway companies are showing extensive photographs of attractive historic and woodland resorts on their lines, seaside points of interest and recent types of car construction in use by the lines north and south of Boston. The management is also using a reflectoscope in connection with the display of 300 views of the system, which cover over 900 miles of track in Massachusetts, New Hampshire and Rhode Island. Maps and folders are being distributed on a large scale.

The New England Telephone & Telegraph Company has installed a modern central-office exchange switchboard for minute examination by visitors, with several types of private branch equipment in addition. Illuminated signs for electrically advertising telephonic facilities are shown and a small cabinet of moving views of the company's exchanges, with an excellent wall exhibit of telephone fittings old and new, including all the more common forms of transmitters and receivers now in standard service, sections of switchboard cable, complete wiring for a private branch exchange, cable racks, splices, protectors, bells and equipment used in 1878 and in other early years of the art.

The Boston & Albany lines of the New York Central system have an elaborate exhibit of improvements made within the past two or three years, the latest of electrical interest being a new type of signal which is to be installed immediately on the main line. The signal is a product of the Hall Signal Company's shops, and differs from the same make of signals as previously installed on the road in the arrangement of its working parts, all these being carried in a head near the top of the post. The signal is of the semaphore type, and it is motor-operated, with all the parts accessible for replacement with minimum interference with other portions of the mechanism. In the new type, the wiring is carried farther away from the moving parts than in the old form, and greater freedom from interruption is thus assured.

The Edison Electric Illuminating Company of Boston is keeping open house at the exhibition, and has rented a large space where its friends may rest. Complimentary telephone service has been installed, and the company is showing views of its latest power and substation construction, and a map showing the entire system from South Boston to Hopkinton, 43 miles distant.

The Pennsylvania Railroad Company has an elaborate pictorial and model exhibit of its terminal improvements at New York, including a large number of photographs of recent steam and electric locomotives, etc., and a model of the New York and Long Island tunnel, 33 ft. long and 6 ft. deep. The latter model shows a train consisting of an electric locomotive and three cars, and the minute details of the tunnel down to the conduits for power, signaling and lighting cables. There are also photographs of the Washington terminal station, a model of the West Philadelphia freight yard, views of the proposed Hell Gate bridge, the New York City terminal, and many modern types of rolling stock.

The Boston Wire Department is showing numerous photographs of the streets of the city before and after removal of overhead lines, with maps of underground structures and statistical data. During the past 11 years the department has made 244,292 inspections of interior wiring, covering the installations of 6,032,688 lamps; and in the past 15 years 10,821 miles of overhead wire, 5000 roof structures, and 2350 poles have been removed. Three hundred miles of underground conduit have been built. There are now 15,000 poles standing in Boston. Two street miles of conduits are installed yearly at present.

The Massachusetts Institute of Technology has an extensive exhibit of its work in the water supply and sewerage fields, and shows laboratory apparatus for the study of the effects of electrolytic corrosion, electric illumination of chemical color reactions, electric pyrometer measuring to 1000 deg. C., and motor-driven machinery.

The Boston Transit Commission shows a model of the complex station of the Washington Street tunnel at State Street, maps, cross-sections and photographs of the subway and tunnel lines which it has built in the past 10 years.

Edwin C. Lewis exhibited electric lighting, interior wiring and switchboard equipment.

Numerous minor applications of electric lighting are in evidence at the exhibition, including electric flash lamps to attract attenton to charities, miniature lamps showing lighting of suburban farms, on models, signal lamps as used in tuberculosis sanatoria, the talking arc lamp, moving-picture equipment, map of the church distribution of Boston, using different colored

incandescents for the several denominations, and the general illumination of certain exhibit spaces by tungsten lamps.

The Mount Hope Citizens' Association shows drawings of the Forest Hills extension of the Boston Elevated Railway Company, indicating a saving of nine minutes in the time of transit between West Roxbury and the center of Boston by the use of the new elevated line.

The Boston City Hospital has an interesting exhibit of X-ray photographs and views of the treatment of superficial cancer by radium.

Illinois Electrical Exhibitors Association.

At the convention of the Illinois State Electrical Association at Alton, Oct. 26 to 28, an association of supply companies which exhibit at Illinois conventions was formed for the purpose of taking organized action as to entertainment and exhibit features at any future Illinois conventions to which the supply men may be invited. Mr. W. R. Pinckard, of the Westinghouse Electric & Manufacturing Company, who was active in the entertainment of this convention and is a man widely known in the Illinois central-station field for many years, was elected president of the new association, and Mr. W. S. Taussig, of Chicago, was made secretary. The organization is rather informal and the membership will be vested in the men who represent the various supply houses and manufacturing companies.

The organization was publicly announced at the banquet which wound up the convention. At that time the exhibitors presented Assistant Secretary C. A. Willoughby, of the Illinois State Electric Association, with a handsome Elk's pin in recognition of his efforts in getting together by far the largest and most successful convention of the association ever brought together. President Pinckard, of the Exhibitors' Association, made the presentation speech, and incidentally gave the salesmen present some good advice as to future conventions. He told of his special interest in the Illinois association because of his acquaintance with its members for so many years. He stated that the association had not at any previous convention made a formal invitation to make exhibits and provided a place to show them as at this. A continuance of this arrangement would depend on the conduct of the supply contingent.

Boston Electrical Show Nearing Completion.

The Boston Electrical Show, which opens on Monday evening, Nov. 15, for a 10-day run in the Mechanics' Building, is rapidly approaching completion, and bids fair to be one of the most successful exhibitions of its kind ever held in the East. About 100 exhibitors are putting their booths in shape to welcome the public next week and over 50,000 sq. ft. of space will be utilized. The Edison Electric Illuminating Company of Boston will have the largest space in the show, including the large stage in the hall and a considerable amount of space immediately in front. This will be arranged as an Italian garden with a fountain at the main entrance and another in the center of the stage. The passageway leading to the stage will be flanked on either side by palms and plants, water gardens and ornamental flower beds. A grand stairway will be built in Italian style, with colonnade and pergola. In the pergola spaces will be reserved for each of the 33 cities and towns in the Edison territory, which covers 509 square miles at the present time. More than 1,000,000 people occupy this territory, and the company plans to give all a distinctive representation. Personal representatives familiar with each district will be in the pergola spaces or reception parlors, dressed in Italian costume to harmonize with the scheme of the show. When the people call and register, tea will be served. The entire sales department will be present on every night of the show, in evening dress, and will act as escorts for all who visit the show. The company has sent an engraved invitation equivalent to an admission to the show to each of its 35,000 customers. Arrangements have been made for special city and town days, and electric cars will be run from all the suburban towns through to the Mechanics' Building without change. The show will be specially advertised by illuminated floats, which will be run over the Boston trolley lines and the tracks of suburban companies, starting at sundown and running in different directions until midnight on every night for a week preceding the show and on every day of the show. In addition 1,000,000 stickers have been distributed for use on letters and for attachment to parcels and boxes. The suburban sales offices have carried large signs in their windows announcing each day the number of days left before the opening of the show.

Among the novelties which will be exhibited are a model electric home and farm, including a Whiting dairy, where four cows will be milked by electric power at suitable times. A garden space will be set aside for electrically hatched chickens and ducks. An electrically operated laundry and kitchen will also be in service, and the rooms of the residence will be equipped with numerous labor-saving and comfort-insuring devices. Arrangements have been made for high-frequency demonstrations by Mr. Earl L. Ovington, a former pupil of Thomas A. Edison, and for talks on the "Commercial Electric Vehicle" by Mr. Day Baker, addresses by Mr. L. D. Gibbs, of the Boston Edison Company, and by Mr. Leon Bishop, of Boston, the latter on "Wireless Telegraphy." The officers of the exposition are: President, Mr. C. W. Holtzer; vice-president, Mr. A. B. Tenney; secretary, treasurer and general manager, Mr. Chester I. Campbell. Executive committee: Messrs. C. W. Holtzer, A. B. Tenney, C. I. Campbell, W. H. Atkins, G. M. Stuart, Frank J. Stone and Herbert S. Potter.

Water-Power Development on Peshtigo River.

A Chicago financial syndicate has underwritten $1,000,000 of first-mortgage 6 per cent bonds of the Northern Hydroelectric Company, of Green Bay, Wis. This company is developing water-powers on Peshtigo River at High Falls and Johnson Falls, about 54 miles northwest of Green Bay. These falls are about 4½ miles apart, and a 6000-kw plant at High Falls is now more than half completed. It is expected that electrical energy will be transmitted to Green Bay in April of next year. The plant at Johnson Falls will give an output as large as that at High Falls. The dam at the latter site is 40 ft. high and, with its dikes, 4500 ft. long. It will store about 800,000,000 cu. ft. of water. The head at this plant is 85 ft. The generating station contains five 1000-kw units now, and electricity will be transmitted to Green Bay, Marinette and Appleton, where it will be used for local electric light and street-railway service. In addition, the interurban electric railway between Appleton and Kaukauna will be operated by electricity from the Peshtigo River plants. Several large paper mills will also be operated by electricity supplied by the Northern Hydroelectric Company. Mr. Daniel W. Mead, of Madison, Wis., is the consulting engineer for this company.

Mexican Electric Power Projects.

The way in which the Guanajuato mining district has come to the front during the last few years under the influence of cheap electric power is serving as an incentive for a wonderful amount of electric power development in the mineral regions of other parts of Mexico. The latest of these projects has for its field of operations the mining districts situated adjacent to the city of Oaxaca. Large amounts of American capital have been invested in that section during the last four or five years, and in the development of different mining properties the necessity for cheaper power is seen. In order to provide this cheap power, F. Zorrilla, of the city of Oaxaca, and associates will install a hydroelectric plant in the mountains near Etla. The same parties who propose to install this

now plant already own the plant which is supplying Oaxaca with light and power. The present plant is operated by gas engines and is run in conjunction with the hydraulic plant near Etla. The capacity of the Etla plant is 1000 hp, power being obtained from a waterfall which has a head of more than 400 ft. It is planned to erect the new plant higher up in the mountains where an abundant water-power is available, the waterfall being about 900 ft. The hydroelectric plant will have a capacity of 10,000 hp at the start, but this capacity can be enlarged from time to time as the demand for power may require. Transmission lines will be built to Oaxaca, Etla Taviche, Ocotlan and a number of other mining camps and towns of that section. The longest of these proposed transmission lines will be about 60 miles.

The Mexican Light & Power Company expects to have its transmission line completed into the Pachuca mining district and city by July 1, 1910. The line will run direct from the great hydroelectric plants of the company at Necaxa. It is stated that the mining companies operating in the Pachuca district, as well as many other industrial concerns there, have agreed to take electric power and that a big business is assured for the Mexican Light & Power Company. This company is already supplying El Oro mining camp with electric power. It is stated that the amount required in the Pachuca district is more than 25,000 hp.

The Pacific Government & Concession Corporation, Ltd., a Canadian concern, with headquarters at Victoria, British Columbia, is preparing to develop on a large scale several big tracts of virgin land, situated near the port of Zihuatanejo, State of Guerrero, which it recently purchased. In connection with the proposed improvements will be the erection of a large hydroelectric plant. It will place about 50,000 acres of land under irrigation by means of a system of storage reservoirs and canals which it will construct. The first of these storage dams will be located on the Petatlan River near El Paso Chino, and will have a capacity of 70,000,000 cu. ft. of water; the second dam will be located on the San Geronimito River and will have a capacity of 60,000,000 cu. ft. of water, and the third dam will be located on the Arroyo Arenoso, near El Salto, and will form a reservoir with a capacity of 50,000 cu. m of water. The Federal Government of Mexico has granted a liberal subsidy in aid of this enterprise, the amount to be paid when the 50,000 acres of land are brought under irrigation being $1,200,000 Mexican currency. The hydroelectric plant will supply power for the company's industries and for the towns in that section. Mr. John Lee Stark, who recently completed the installation of a water-works system at Zacatecas, has been given the contract for the building of the dams. Mr. William C. Bond is manager of the company.

The Chapala Hydroelectric & Irrigation Company, of Guadalajara, will build a branch transmission line from its distributing station in the Hostotipaquillo mining district to the canyons in the Sierra Madre range southwest of that place in order to furnish power for boring the great tunnels which the Southern Pacific Railroad must use on the line which it is building through the mountains. The main transmission line, which is being built into the Hostotipaquillo district, will be finished in about two months.

Mr. T. H. Swenton is preparing to install a hydroelectric plant in the Sierra Madre mountains north of Culiacan, State of Sinaloa, with a view to supplying a wide scope of territory with power for operating machinery of mines and other industries. It is stated that about 10,000 hp will be developed, which output of power can be increased as the demands may justify. The recent building of the Southern Pacific Railroad through that territory has caused a big awakening in the mining industry and all lines of business. A Government concession will be requested for the proposed electrical enterprise.

The project of building an electric railway from Ciudad Porfirio Diaz to San Carlos, State of Coahuila, a distance of about 50 miles, is in a fair way to be accomplished. It is stated that General Lorenzo Trevino, who owns an enormous tract of irrigated land through which the road will pass, and several other men of wealth, are back of the enterprise. The Chamber of Commerce of Ciudad Porfirio Diaz and the Industrial League of Eagle Pass, Tex., which is situated immediately opposite on the other side of the Rio Grande, are giving the project assistance. In connection with this proposed electric railway it is planned to install a large electric power plant in the heart of the coal fields, situated just south of Ciudad Porfirio Diaz. The refuse matter from the coal mines will be used for fuel and the power thus generated will be transmitted to several towns of that section and also used to operate the electric railway. The headquarters of General Trevino are at San Carlos.

The Government of the State of Jalisco has granted a concession to Mr. J. H. McCreery, of Pittsburgh, Pa., and Mr. Richard Ivey, of Guadalajara, Mexico, to build and operate an electric railway in the Hostotipaquillo mining district. The proposed line will run from the station of Magdalena, on the Southern Pacific Railroad of Mexico, to the town of Hostotipaquillo and to the principal mines of the district. The power will be supplied from a hydroelectric plant which will be erected on the Santiago River.

Dr. J. F. de la Garza, of Nuevo Laredo, State of Tamaulipas, is at the head of a syndicate of Mexican capitalists who will build an electric street railway in that city. It is announced that the capital for the proposed line has already been subscribed. It will connect with the electric railway of Laredo, Tex., on the international bridge across the Rio Grande.

Proposed New St. Lawrence Dam.

On behalf of certain American and Canadian capitalists who have for two years been seeking permission from the Dominion Government to construct a big power plant at the Long Sault Rapids on the St. Lawrence River, near Cornwall, plans have been filed with the Canadian Canals department looking to the removing of certain objections which have been raised by the shipping concerns as to interference with navigation on the river. The present project contemplates the erection of an enormous dam at the foot of the rapids, where there is a minimum head of 40 ft. and where it is possible to develop several hundred thousand horse-power. It is proposed to create a new channel on the American side of the river near Cornwall having sufficient depth for all boats on the river, and also to build a new lock there. The proposal is to be examined by the engineers of the various Dominion Government departments interested.

The new company is an amalgamation of the St. Lawrence Power Company, which has authority to develop power on the Canadian side, and the Long Sault Development Company holding a similar charter granted by the New York State Legislature for the American side of the river. Among those interested are Messrs. F. H. McGuigan, formerly of the Grand Trunk and Great Northern Railways, and Henry Holgate, civil engineer, of Montreal.

Hon. Geo. P. Graham, Minister of Railways and Canals, in speaking of the works contemplated by the amended plans, stated that the rapids at the foot of the Long Sault would be turned into a big lake by means of a dam constructed at that point, and a portion of the water thus conserved would be diverted into the Little Sault on the American side where a new channel would thus be provided capable of accommodating the largest vessels now navigating the river. The canal on the Canadian side at Cornwall would not be interfered with in any way, and what would be lost in the descent of the rapids would be made up by the gain made by the erection of the new improved channel. It was claimed that by adopting the new plans it would be possible to develop 150,000 hp as against 30,000 hp developed on the Canadian side of the river. The whole question was now under consideration by the Government awaiting the report of the engineers who would be appointed to go over the whole situation.

As a result of the amalgamation of interests, the parties con-

cerned in the power development have applied for incorporation by the Dominion Parliament as "The St. Lawrence Power Transmission Company," with a capital of $500,000, and headquarters at Montreal. The company asks for authority to import power from the United States and to export it across the boundary; also to amalgamate with any other company of a similar character.

New Colorado Hydroelectric Plants.

Plans have been filed with the State Engineer of Colorado for the Custer reservoir in San Miguel and Dolores Counties. Work was begun on this project Oct. 11 and it is anticipated that it will cost about $200,000. The dam is to be 110 ft. high and will impound 756,800 cu. ft. of water. The sources of supply are Disappointment Creek and Spring Creek. The water will be used for both irrigation and development of power. Mr. M. J. Bailey, of Cedar, Colo., is promoting the project.

The Orchard Mesa irrigation project, extending from Grand Junction to Palisade, in the richest fruit district in Colorado, will be completed well before the contract time, April, 1910. The bond issue per acre required has been very large owing to the equipment necessary for providing water to this territory. The tract varies from one-half to two miles in width and lies at an elevation of from 80 ft. to 200 ft. above the Grand River. There is a dam 350 ft. wide in the Grand River at point of intake and a canal extends west 10 miles to a point directly south of Palisade. At the end of the power canal are two centrifugal pumps which raise the water for irrigation purposes 40 ft. and 125 ft. respectively, delivered into two main canals, which have a combined length of about 30 miles, and which distribute the water to nearly all portions of the tract.

The canals are of concrete, and the power for driving the centrifugal pumps is generated by the dropping of 300 second-feet of water through turbine wheels direct-connected with the pumps. The head on the wheels varies from 72 ft. to 80 ft., depending on the stage of the river at the power plant.

Twelve miles of 36-in. pipe have been completed by the Central Colorado Power Company from Nederland to the Kosler reservoir from which the water drops 1860 ft. to the power house on Middle Boulder Creek. The steel pressure pipe is now being put in and at the lower end will sustain a pressure of 800 lb. to the square inch. The power house has been completed and most of the machinery installed. The dam is now 100 ft. above creek bed and the storage of flood waters will commence next spring. Excepting the dam, the power project will be practically completed Jan. 1. The initial installation will be 10,000 kw, supplementing the Shoshone plant of the Central Colorado Company, now supplying several thousand kilowatts to the Denver Gas & Electric Company.

Interference of Railway Circuits with Telephone and Telegraph Transmission.

The first fall meeting of the Boston Section of the American Institute of Electrical Engineers was held at the Edison Building, Boston, with Chairman Dugald C. Jackson presiding. Mr. J. B. Taylor, of the General Electric Company, Schenectady, N. Y., read his paper on "Telephone and Telegraph Systems as Affected by Alternating-Current Lines," as recently presented at the New York meeting of the Institute.

Chairman Jackson introduced the discussion by emphasizing the necessity for co-operation between the various interests concerned in line troubles and called upon Prof. Albert S. Richey, of the Worcester Polytechnic Institute, to give his experience with telephone lines paralleling high-tension circuits. Professor Richey stated that his experience had been from the standpoint of the direct-current railway operator in the Central States. The railway lines he had in charge were supplied with direct-current power, the telephone wires being on one side of the track and the feeders on the other. These telephone lines were transposed about every half mile and jack boxes were installed every quarter mile for the use of the car-service men. These were simple wooden boxes, with the bottom and part of the front entirely open to the air. The connections for the telephone leads were on the back of the box, with two brass binding posts for the terminals. This construction in itself made a fair ground on the telephone service every quarter mile, but as the ground was the same on each wire, the circuit was well balanced and the results were good. When high-tension work began the line potential was 16,000 volts, paralleling almost 100 miles of the telephone service. The transmission wires were carried on the tops of 40-ft. poles, with the telephone lines on the opposite side of the track. The service remained good, and later in building another 125 miles of transmission line for 30,000-volt service the telephones lines were installed in two sets on arms 10 ft. below the power wires. The telephone line was transposed every 16 poles for convenience in further subdivision of the transposition if necessary. Little trouble was experienced. The transpositions were regular, the lines well balanced and the telephone wires were near the ground electrically by their location close to the direct-current feeders. Trouble occurred whenever there were bad connections in the line wires, which unbalanced the lines. Great care was taken to have the linemen make good connections in the telephone circuits and the company substituted for the old-fashioned transposition with two transposition glasses and from four to six joints in the line wire, a transposition with a single glass, which introduced no additional joints in the line wire. This was a decided help. If the transmission service was in trouble, the telephone lines felt it. Professor Richey closed with the statement that in the case cited the telephone and the railway companies have common interests and are equally concerned with establishing and maintaining good service.

Mr. W. H. Murray, electrical engineer of the New York, New Haven & Hartford Railroad, then submitted a statement regarding telephone troubles, which was read by Mr. N. J. Neill. This was used at the New York meeting and reported in these columns.

Mr. Sewall Cabot, of the Stone Telephone & Telegraph Company, Boston, referred to the system of metallic-circuit telephone lines mentioned by the author in which the first three lines are on a series basis and the remaining three on a multiple basis. He pointed out that in order to work such lines as this in connection with a railway system, going outward from a large city, it would be necessary to use repeater stations at both ends of the lines in order to connect them with other telegraph lines, and this would interfere with telegraph work because it is impossible to attach a grounded line to a metallic line without a repeater. In the multiple system the tendency would be for the action of the relays to be sluggish. He understood that there are two ways of remedying interference with the ordinary grounder telephone service. One is by means of the neutralizing wire with the compensating transformer for both current and potential, and the other by making what amounts to a three-wire trolley system. If a three-wire, single-phase system with the out-track of one polarity and the in-track of the other polarity were installed, and then those trolleys exchanged between track and track, this might be a virtual means of transposing the power system so that it would not cause disturbance with the telegraph and possibly not with telephone lines.

Mr. C. D. Jarvis, of the New England Telephone & Telegraph Company, stated that there is more difficulty in maintaining telephonic balances with the cables and apparatus than with the open wiring. Cables are made as well as they can be to obtain a very close balance, but even with the twisted pairs there is sometimes considerable difficulty in balancing for telephonic currents, especially where the so-called phantom circuits is provided, and which is operated over two telephone circuits. On a telephone circuit for ordinary commercial use it is not possible to impose upon it differential potentials higher than those common to telephone work, if good results are to be obtained. There is a great difference between local and toll practice in this respect. On the company's long toll lines, in order to meet the conditions of the public and increase the range of transmis-

sion, it is necessary, not only to employ open wires, but also to minimize the effect of capacity on this open construction by loading. These open wires are exposed to the field surrounding railway and power circuits, and there is no way of escaping them; but in the local distribution the company can use large numbers of conductors covered with a common lead sheath, which screens the conductors at least from any ordinary power circuit. In case of single-phase railway operation, the company is having trouble with the cables. The sheath is not effective as a screen in that case. On some of the New York lines a neutralizing transformer has been adopted. One of the open wires exposed to the New Haven electrification is damaged so much that the company has lost the open-wire efficiency entirely and might as well have cable to replace the open wires. Experience in telephone long-distance work in New England indicates that it will be necessary for the company to keep entirely away from electric light circuits. It is a question whether the company will be able to operate telephone lines on the same highway with power circuits. It is at present operating toll circuits in some cases for 10 miles parallel to power lines. Disturbances have not been entirely eliminated, although the telephone company is on the opposite side of the road. It has suffered repeatedly when there have been defects on the power system, the whole system often being at a standstill for several hours. In one case, where the two services parallel for five miles, the telephone lines have in the past year been thrown out of operation for three or four hours at a time. In this case the power circuit had a potential of 33,000 volts with a grounded neutral, and the induced current in the telephone lines was large enough to operate the arresters. It is not unlikely that the presence of power and lighting wires will ultimately drive the telephone company off the highways.

Mr. Taylor closed the discussion by stating that a comparison of notes and a discussion of the conditions by the different interests will often permit the settlement of troubles at small cost. A direct-current trolley wire may give some trouble as a result of commutated current at the motors and generators. A submarine cable carried overland down toward Coney Island gave troubles which were hard to account for, and the difficulty was finally tracked down to a point where the overhead wire ran close to the overhead trolley, the latter having a defective ear, which sparked badly with each passing car. Unbalancing of joints is as important as anything else. If a transposition is used in a form which causes joints, there may be more trouble than one would have without the transposition. A form of transposition where the wires do not have to be cut is desirable. He agreed with Mr. Cabot's criticisms. The multiple telegraph has not had a fair and commercial trial over a line of any length, and if attempted, the relays will have to be different or more carefully adjusted than the present types. The three-wire trolley plan is at present merely a paper scheme.

Radio-Telephony.

At a meeting of the Wireless Institute, held in the Engineering Societies Building, New York, on Nov. 3, an illustrated lecture on radio-telephony was delivered by Mr. Alfred N. Goldsmith. The speaker outlined the characteristic features of all wireless telephone installations which embody means for producing sustained oscillations having a frequency above the audible range and devices for varying the amplitude of the vibrations in accordance with the sounds to be transmitted. The high frequency oscillations can be produced directly by an alternating-current generator, as has been done by Fessenden, or by a resonating circuit shunted around a direct-current arc, as was done by Duddell when he devised the "singing arc." Upon the inductance and capacity in the resonating circuit depends the frequency of the oscillations, while the resistance in circuit determines whether the current in the arc will be oscillatory or unidirectional; in order for it to be oscillatory the total resistance in circuit must be of such a nature that an increase in current results in a decrease in voltage at the arc. Better results are obtained when the arc is formed in some gas other than oxygen or air; hydrogen and alcohol have been used successfully for this purpose. In order to permit a high voltage to be impressed across the arc, use is made of a magnetic field surrounding the arc.

For the transmitter proper use is made of carbon microphones, sometimes with as many as eight in series on an e.m.f. of 440 volts. Condenser types of transmitters are also employed. Between the high-frequency transmitter circuit and the aerial the coupling is always inductive and very loose, the object being to minimize all damping influences. The receivers are of the telephonic type familiar in wireless telegraph work, such as the DeForest "audion."

In comparison with wire telephony, wireless telephony possesses the decided advantage of transmitting speech without distortion quite independent of the distance. The author expressed the opinion that wireless telephony will prove useful for long-distance trunk-line communications as well as for communications between ships.

The next meeting of the Wireless Institute will be held on Dec. 1, at which time a paper will be presented by Mr. W. E. Smith, entitled "Conversion of Electric Oscillations Into Continuous Current by Means of the Vacuum Valve."

Boiler and Engine Questions at the Colorado Convention.

At the convention of the Colorado Electric Light, Power & Railway Association at Denver in October, a Question Box occupied parts of the program and the questions relating to boilers and engines which were discussed are given here with notes on some of the answers.

1. What is being done to prevent smoke nuisance? Have you received any complaints? Do you burn lignite or bituminous coal, and which gives the less amount of smoke?—Mr. J. F. Vail, of Pueblo, said his company had stokers which afforded smokeless combustion except when working the furnaces at less than full load of the boilers and in starting and shutting down. Smokeless combustion being partly a matter of furnace temperature, whenever the furnace falls below a certain temperature, as it does on light loads, the furnace will smoke.

2. Are any stations in the State using superheated steam, and do they advise it?—Mr. J. F. Dostal, of the Denver Gas & Electric Company, reported in the affirmative on both questions for turbines.

3. Are any stations in the State using automatic "runaway stops" for engines?—The Denver City Tramway has them, and believes in them.

4. Is the vacuum system of handling ashes a success?—Mr. Vail, of Pueblo, said that the installation at his plant is a success, but that there was some trouble at first because no account was taken of the lower vacuum obtainable at the altitude of Pueblo as compared with Eastern cities. Use is made of a 30-hp motor.

6. Are there any low-pressure turbines in operation in this vicinity?—The Colorado Springs Electric Company has some low-pressure turbines taking the exhaust of compound low-speed engines which were formerly run non-condensing. A cooling tower is used to supply condensing water.

7. It is necessary to connect a low-pressure steam turbine unit so as to operate in parallel with the high-pressure unit or can they supply energy to separate feeders?—It was agreed that they would have to be connected in parallel unless a steam-heat accumulator or regenerator is connected between the engine and the low-pressure turbine. Such regenerators are used in steel mills where the load is greatly fluctuating.

8. What type of cooling tower is most efficient? What percentage of water must be added?—Mr. Dostal said that the Denver Gas & Electric Company has two towers of the stack type. The water required is less than that required for boiler feeding.

9. Are there any gas producer plants successfully operating

electric light plants in the Rocky Mountain territory?—Mr. W. A. Carter, of Denver, said that the Western Chemical Company, of Denver, has a Westinghouse producer working on lignite coal and supplying gas to an engine and also to furnaces. It is operated continuously. Mr. J. R. Cravath, of Chicago, said that he had investigated a number of central stations using producers farther east. His conclusions were that any company installing a producer and gas engine should allow plenty of time for the training in of operators before depending on the engine for regular service. Given a proper chance to train operators, the producer and gas engine combination is an excellent one for a large number of central stations, of small size, both as regards economy and reliability.

10. Has anyone in this territory tried driving an induction motor above normal speed in parallel with generators?—Mr. John A. Clay, of the Animas Power & Water Company, said that this is being successfully done on mine tramways. It has been recently proposed and advocated for large stations to install some generators of the induction type in order to reduce the current which will be produced when there is a short circuit.

11. Is there a surge of current between high-speed and low-speed alternating-current generators when operating in parallel?—Mr. F. P. Cummings, of Denver, reported that when the water-turbine plant of the Central Colorado Power Company is operating in parallel with the steam engine and turbine-driven plant of the Denver Gas & Electric Company, at very light load there is some surging. The surging does not occur at heavy load. The surging may not be due to the difference in rated speeds of the turbines, however. Mr. H. L. Corbett, of Georgetown, reported that the United Hydroelectric Company is operating without trouble alternators driven by all kinds of prime movers in parallel—namely, waterwheels, steam turbines and Corliss engines. Mr. Lawler reported the same combination at Colorado Springs. The most surging is experienced on light load and low power factor.

Milwaukee Boiler Explosion Demonstrates One Advantage of Electric Drive.

As the result of a steam explosion in the large new power plant of the Pabst Brewery in Milwaukee (described in *Electrical World* of Feb. 4, 1909), at 4:40 a. m., on Oct. 25, the boiler plant was completely wrecked and much damage was done to surrounding buildings, the whole loss due to the explosion being estimated at $250,000. One man, a fireman, is missing, and it is supposed that he was killed, while another fireman was seriously injured. There were eight 400-hp water-tube boilers in the plant, and four of these exploded. The cause of the accident is not known, although low water and other conjectures have been advanced. The boilers were set singly without brickwork, but encased in a steel shell lined with tile and asbestos. The plant was designed for a normal steam pressure of 160 lb. and was carefully tested before acceptance. The quality of the metal used in the boilers was demonstrated by the fact that pieces of 9/16-in. steel were found folded together as the result of the accident as easily as a piece of leather or cloth would be folded, and without a crack.

The force of the explosion was very great. One large section of a boiler, weighing apparently several tons, was hurled high in the air, clear across Tenth Street, and embedded so firmly in the roof of an adjacent building 50 ft. or 60 ft. above the street that it was removed with great difficulty. Tenth Street from Chestnut Street to Cold Spring Avenue was buried under a great mass of broken machinery, twisted iron and steel and piles of brick. Panes of glass in stores and houses within a radius of two blocks were broken, and many people in the vicinity thought that an earthquake had taken place.

The brewery is electrically operated to an unusual extent, as related in the descriptive article in *Electrical World* to which allusion has been made. This condition proved very fortunate at the time of the disaster, for it enabled a temporary connection to be made with the central-station company so that the work in the great establishment in nearly all departments could be resumed speedily, and this saved thousands of bushels of grain in progress through the brewery from spoiling. There is a 13,200-volt, 25-cycle power circuit of the Milwaukee Electric Railway & Light Company in Chestnut Street. Soon after 6 o'clock on the morning of Oct. 25 Superintendent O. M. Rau, of that company, was communicated with, and preparations were begun at once to make an emergency connection to operate the brewery. Three large transformers were installed in the engine-room of the power plant (which is some distance from the boiler-room and was not injured). These are air-cooled transformers, and a motor-operated fan was also installed to cool them. By means of these transformers the 13,200-volt, three-phase energy was transformed down to 440 volts and fed into the busbars of the brewery power station switchboard. This work was done within 18 hours, and the day after the accident all departments of the establishment were in operation except the pasteurizing and brewing departments. The celerity with which this temporary supply could be arranged was a striking tribute to the advantage of electric drive in an emergency like this.

In clearing away the débris the oxhydric process of the Falk Manufacturing Company was used for cutting the iron and



EFFECT OF BOILER EXPLOSION.

steel beams. This process is based on the principle of the oxy-hydrogen blow-pipe. Mr. Lulli, an Italian, who is spoken of as the inventor of the oxhydric process of cutting metals, met with an accident in the process of clearing away the great mass of wreckage. He fell with a section of the débris and was picked up in an unconscious condition, but it is not believed that his injuries are serious.

Rather curiously, the brick chimney, 225 ft. high, which was a part of the power plant, escaped apparently without injury. Supported by this chimney are the aerial wires of the United Wireless Telegraph Company, and a wireless operator was able to give service as usual on the day of the accident. A section of the large malt elevator adjoining the boiler plant on the south and partly filled with grain was moved 3 ft. from its foundations and pushed to one side until it extended over an alley.

Co-operation of School and Factory in Industrial Education.

"The New Apprentice System as Developed in Combination with Educational Institutions" was the subject of Dean P. B. Woodworth, professor of electrical engineering at Lewis Institute, Chicago, at the meeting of the Electric Club of that city on Nov. 3. The speaker, who was followed with great

attention, described the new work at Lewis Institute by which boys are enabled to give half of their time to regular work in factory or workshop and the other half to a specially prepared practical course of instruction in the school, thus dovetailing instruction in practice and theory.

Professor Woodworth began by giving his version of an old saying, "Be sure you are right and then go ahead—and you won't go at all." To make progress one must be willing to take the risk of making mistakes. That has been the feeling in introducing the new course at Lewis Institute by which the boys go to school one week and then work another week, so alternating school and work a week at a time. Each boy has a mate, so that while one boy is in school the other is in the factory, and vice versa. This is substantially the scheme of the University of Cincinnati, which has attracted much attention, with the exception that in Cincinnati the students are required to be high-school graduates, while this stipulation is not made at Lewis Institute.

Manufacturing companies are asked to nominate two boys or more to take the course, there being no limit to the number at present, except that it must be a multiple of two. A number of concerns, principally in the metal trades, have responded to this invitation, among them the Aeromotor Company, the Allis-Chalmers Company, the Link-Belt Company and the Woods Motor Vehicle Company. Forty-seven boys have been in the course since it was established on Jan. 1. Of these 23 have dropped out for various reasons, and there are to-day 24 boys in the course, which makes a continuous class of 12, half working in their respective places of employment each alternate week, as explained.

The boys come to school at 8:30 a. m. and study physics for two hours. From 10.30 to 11.30 they have mathematics, and from 11:30 to 12:30 are given instruction in English. In physics the boys seem to shine particularly in the laboratory work. The training of their hands by practical work fits them for the demonstrations at the bench in the physics classroom. The instructor in mathematics follows up the work in physics, and in the hour devoted to English the students talk over the earlier work of the day or perhaps write an account of what they have done. Thus the three subjects are very closely related and are mutually helpful. The results are excellent, and the instructors are enthusiastic over the good work done by their pupils. In the afternoon there is instruction in mechanical drawing, pattern making, shop or foundry work. The school day is supposed to close at 5 p. m. in this course, but often the boys are so interested that they linger longer.

An ordinary school year is of about 1000 hours' duration. The new plan provides only for alternate weeks in school, but it runs right through the year, for the school is always open, although in summer more attention is paid to laboratory work. The school hours under the alternating scheme total 900, so that the difference between the amount of instruction given in this way and by the ordinary arrangement is not great. The students, who are termed co-operative students, seem to get along more rapidly than the regular day-school pupils. One reason for this is that they are themselves eager for the work.

Classifying the 23 who dropped out of the course, Professor Woodworth said that eight were dissatisfied with the shop where they were employed; eight were asked to leave because they did not evince sufficient interest; one dropped out owing to lack of ability; one was removed by parents; one left because he felt that he should be earning more than $10 a month, which he received for his half time. The others dropped out for reasons that are not ascertained. The age limit of students is from 16 to 20 years. Analyzing the ages of the boys now taking the co-operative course, it is found that two are 19 years old, ten are 18, nine 17 and three 16. Of the 24 students, 10 have put in one or more years in high school. The others did not get farther than the grade schools.

The employers seem to expect that the boys will get hold of the fundamentals of mechanics and that some time these boys will become shop foremen; but the speaker remarked that if you give the boy a chance you can't stop him, and it is the intention of the school to give the working boy a chance. The superintendents of the employing companies and the instructors at Lewis Institute hold occasional conferences which are mutually helpful. It is too early to speak with confidence of the results of this course, but the outlook is most promising. The idea of alternating outside work and school instruction is not new at Lewis Institute. Of a recent class of 14 graduates in mechanical engineering, the average student had earned $3,000 up to the time of graduation, according to a statement made by Director Carman.

More co-operative students can be taken at the school. There are now two classes of 12 students each, and these classes should consist of 25 or 30 boys each. The plan is for a two-year period. The work is of a generally elementary nature, and it is not expected that the boys will be carried far enough so that the instruction need be differentiated in relation to mechanical, electrical or chemical engineering. The boys are paid usually $1 a day for their work by their employer, although there is nothing to prevent a boy getting more if he makes an arrangement to that effect. Of the $14 paid to the school by the manufacturer for the boy, $10 a month goes to the boy himself and $4 to the school. It is the aim of Lewis Institute to duplicate from its own resources the amount of money paid in by pupils of any class for their instruction.

Employers are not limited as to the number of boys they may send to the school, but the largest number from any one shop now is six. The course extends over 50 weeks in a year—26 weeks in the shop and 24 in the school, the first two weeks in September being a vacation from school for students of this class. On Saturday both the boys in the team of two meet in the school.

Mr. F. P. Vose, in the discussion, spoke of the false idea that a gentleman was one with educated head and not educated hands.

Mr. Frank L. Perry, recounting some of his own experiences, spoke of the great advantage of the Lewis Institute plan over the night school. After working hard all day boys are half asleep in night school, and their intellectual faculties are not at their best; the plan of going one week to school and one week to work is much better. Manufacturers should be glad to enter their human machines in the schools to be polished and made more effective to do work for their employers.

Mr. C. H. Roth spoke highly of the co-operative plan, and referred particularly to the work at the University of Cincinnati.

Mr. Thelin, a graduate of Lewis Institute, spoke as one who had tried the plan in practice and found it good. He worked for the Commonwealth Edison Company and was permitted to go to school at Lewis Institute for half of each day. He found the combination of practical work and technical instruction very effective and was pleased at the opportunity to give his testimony to the value of the idea which Professor Woodworth had set forth.

New York Meeting of the American Electrochemical Society.

The sixteenth general meeting of the American Electrochemical Society was held in New York City on Oct. 28, 29 and 30. With respect to the attendance, the importance of the papers presented and the enjoyment of the social features, the meeting was one of the most successful held by the society. The number of those who registered was above 350.

Sessions for the reading and discussion of papers were held on Thursday afternoon at the Chemists' Club, and on Saturday morning and Saturday afternoon at Earl Hall, Columbia University. Abstracts of all the papers will be found below.

The whole of Friday was devoted to an excursion to the chemical and metallurgical industries of Bayonne, N. J. The plants of the Standard Oil Company, National Sulphur Company, Pacific Coast Borax Company, and the Gröndaly briquetting plant at the works of the General Chemical Company were

visited in the morning. At the lunch at noon, the Mayor of Bayonne, Hon. Pierre P. Garvin, spoke of Bayonne as an industrial center, emphasizing its vast possibilities with respect to available waterfront and railroad connections. In the afternoon the works of the Babcock & Wilcox Company, the Electro-Dynamic Company, the Electric Launch Company and the Industrial Oxygen Company were visited.

In the evening of Friday a very enjoyable subscription dinner was held at the Hotel Cumberland. Dr. Doremus acted as toastmaster, and speeches were made by President Dr. Baekeland, Prof. Armstrong, of London; Dr. Nichols, Dr. Loeb, Mr. Toch, Dr. Richards and Dr. Wiley. In the evening of Saturday the society was the guest of the Chemists' Club at a smoker in the clubhouse.

Special arrangements had been made for the entertainment of ladies, including a reception and tea by invitation of Mrs. W. H. Nichols at the Waldorf-Astoria, on Thursday afternoon; an automobile ride and tea at the Claremont on Friday afternoon, and a theater party on Saturday. A large number of ladies also participated in the dinner on Friday night.

Much of the success of the convention is due to the indefatigable work of the president, Dr. Leo Baekeland; the secretary, Dr. J. D. Richards, and the secretary of the New York section, Mr. A. von Isakovics.

TITANIUM ARC.

The first paper of the Thursday session was presented by Dr. W. S. Weedon. In a long extended research carried out by the General Electric Company a large number of elements, compounds and mixtures were investigated as to their suitability for arc-lamp construction. It was found that titanium carbide was most promising with a view of getting a high efficiency. The titanium-carbide electrode is the cathode and placed below an anode of copper, the latter being inactive and not wasting appreciably. The light is almost pure white, only the faintest tinge of yellow being noticed when observed from a distance. The titanium arc is a flame arc and its efficiency increases with increasing current density and with increasing arc length.

At 3 amp, 103 volts and 1-in. arc length, it consumes only 0.228 watt per horizontal candle-power. The mean spherical candle-power at 2.87 amp, 95 volts (273 watts) is 535, and the mean hemispherical candle-power 737.6. On this basis the specific power consumption is 0.51 watt per mean spherical candle-power, and 0.37 watt per mean hemispherical candle-power; this value corresponds to a yield of 1.96 mean spherical candle-power, or 2.70 mean hemispherical candle-power per watt. The electrical measurements given were made at the arc terminals and the photometric measurements were made through a clear glass globe of the usual thickness.

A study of the efficiency curves shows that titanium-carbide arcs are most satisfactorily operated on a constant-current circuit rather than on a low-voltage multiple circuit, with the necessarily short arc length. Some notes were given on the preparation of titanium carbide electrodes and also on the use of titanium sub-oxide for a direct-current arc lamp. The titanium sub-oxide is prepared by the reduction of rutile. The character of its arc is almost identical with that of the carbide, but the light is much steadier and the efficiency is even better. However, there are certain objections to the use of this electrode and it cannot well be operated with alternating current.

In the discussion which followed reference was made to the use of zirconium carbide, and it was stated by Dr. Weedon that the efficiency of the zirconium-carbide arc is less than that of the titanium-carbide arc.

BORON.

The second paper was presented by Dr. E. Weintraub, giving a most interesting review of several years' work in the research laboratory of the General Electric Company with the element boron. The author has gone far beyond Moissan and has prepared pure fused boron with the aid of an arc discharge similar to that producing nitric acid from air. The chemical reaction is the change from boron chloride and hydrogen into hydrochloric acid and fused foron. Fused boron is a very hard material. It is very much like black diamond, although not quite as hard as the diamond, yet harder than any other material. Boron seems to have important technical applications on account of its electrical properties. At ordinary temperatures it has a very high specific resistance, but this drops at a most unusual rate when the temperature increases. There is also a possibility of making alloys having any desired negative coefficient. Several of his preparations were exhibited.

SILUNDUM.

A paper by Prof. S. A. Tucker, H. F. Kudlich and E. M. Heumann on the preparation of silundum was presented by Prof. Tucker. Silundum is a name given to carbon articles which have been partially converted into carborundum in the electric furnace. Its most valuable property and probable use is its ability to withstand a high temperature in the air without sensibly undergoing oxidation, and, as it is a conductor of electricity, its use as a resistor material. It is a satisfactory material for temperatures up to 1500 deg. C.

ELECTRO-ANALYSIS.

On the invitation of the board of directors, Prof. E. F. Smith, of the University of Pennsylvania, presented a most interesting experimental lecture on recent developments in electro-analysis. Dr. Smith has been the leader in these developments for many years and his lecture was a very suggestive human document. He traced the gradual evolution of the different methods which have made electro-analysis such a simple and convenient procedure, speaking first of the use of rotating anodes, then of the use of mercury as cathode, and finally of the use of a double-compartment cell with mercury as connecting bipolar electrode. The lecture was illustrated by many experiments which showed the convenience and quickness of electrolytic analysis.

Two papers were presented at the beginning of the Saturday morning session, in the absence of the authors, in abstract by the secretary, Dr. Richards. The first was a paper by Dr. R. C. Palmer on the production of explosive antimony by electrolysis of non-aqueous solutions. The second paper dealt with the electrolytic production of perchloric acid, the author being Mr. F. C. Mathers; he proposes to use perchlorate baths for electroplating.

ELECTRODE LOSSES IN ELECTRIC FURNACES.

Four papers were then presented on electrode losses in electric furnaces. This loss is of importance because with improper design the electrode of an electric furnace may form the weak point in the heat insulation of the furnace and may tend to chill the furnace.

The first paper was presented by Mr. Carl Hering, who outlined the laws of the electric losses. They are as follows:

The combined loss through the cold end of an electrode is equivalent to the sum of the loss by heat conduction alone (when there is no current) and half the I^2R (Joulean heat) loss.

This combined loss will be at least when the loss by heat conduction alone is made equal to half the I^2R loss; the total loss will then be equal to the I^2R loss, and no heat will be conducted from the interior of the furnace.

This minimum loss is dependent only on the material, current and temperature, but not on the absolute dimensions; it merely fixes the relation of the cross-section to the length, but leaves a choice of either; this best ratio of cross-section to length is $S \div L = 0.3456\, I \sqrt{\frac{r}{kT}}$, where S is the cross-section in square inches, L the length in inches, I the current in amperes, r the "mean" electrical conductivity in ohms, cubic-inch units, k the heat conductivity in gram calories per second per cubic inch, and T the temperature difference between the hot and cold ends.

For each material there is a definite minimum loss of electrode voltage which depends only on the temperature and is

independent of the dimensions or the normal current for which the furnace is designed; hence,

The best possible electrode efficiency for any material may be determined from the total voltage of the furnace and this minimum voltage due to the material and to the temperature, and is independent of the dimensions.

The heat gradient of the combined flow is equal to the sum of the heat gradients of the individual flows.

A numerical application of his conclusions for carbon and graphite was also given by Mr. Hering.

In a second paper of Mr. Hering it was shown how to determine experimentally the mean heat conductivity and mean electric resistivity of an electrode material. The method, which is quite simple experimentally, is based on the laws of electrode losses as described above.

A paper by Mr. C. A. Hansen, of the General Electric Company, discussed the same subject with special reference to some difficulties in applying the theoretical formulas in practice. One of the difficulties is the selection of the length of an electrode in using the theoretical formulas. His results show the "effective length" to be the entire length of electrode from center of waterjacket to extreme hot end.

Mr. Hansen also showed how the contact resistance can be taken care of in the formulas. He also gave the results of an application of the theory to a special ferro-titanium furnace with a temperature of 3200 deg. C. at the hot end in the furnace and 200 deg. C. at the cold end outside the furnace. Under these conditions he found the following mean values for the electric resistivity of graphite and carbon and the heat conductivity of the same materials:

The mean resistivity of graphite under conditions applicable to a temperature difference of 3000 deg. C. is 0.00032 ohm per inch-cube = 0.000812 ohm per cm-cube. The mean resistivity of carbon under same conditions may be taken as 0.00072 ohm per inch-cube or 0.00183 ohm per cm-cube.

Ratio of carbon resistance to graphite resistance under these conditions is 2.25. The mean heat conductivity of graphite from 3200 deg. C. to 200 deg. C. = 1.3 watt-seconds per second per degree Centigrade for 1 in. length and 1 sq. in. section = 0.127 c.g.s. units. The mean heat conductivity of carbon under the same conditions is 0.13 watt-seconds per second per degree Centigrade for 1 in. length and 1 sq. in. section = 0.0127 c.g.s. units. Mr. Hensen also emphasized that the current density is of importance, as he found by experience that when exceeding a current density of 150 amp per square inch for graphite, and 50 amp per square inch for carbon electrodes, the end walls of the furnace became badly corroded. From these data and from the ratio of cross-section by length, it is always possible to calculate the best length which an electrode should have.

A fourth paper on electrode losses was presented by Dr. E. F. Roeber. The author stated that there are two ways of attacking this problem. The first is to consider an infinitely small particle in the same way as in the classical mathematical theory of heat, to see what happens there, and then to integrate over the whole electrode. This method leads to great mathematical difficulties in the integration, due to the change of heat and electric conductivities with the temperature. There is, however, a second method in which the electrode is considered from the start as a whole. It is possible to arrive at the fundamental equations of the theory by elementary considerations without any assumption as to the changes of heat and electric conductivities with the temperature. The resulting formulas contain mean values of the conductivities. These mean values are not mathematically defined, but can easily be measured by some such method as proposed in Mr. Hering's second paper. Then there can be no objection to the exactness of the theory.

There was quite an extended discussion on the subject of electric losses, participated in by Dr. Richards, Mr. Grower, Mr. Hering and Mr. Hansen, and a communicated discussion by Dr. Kennelly.

PRACTICAL CONDUCTANCE OF ELECTROLYTES.

A paper by Prof. J. W. Richards and Prof. W. S. Landis was then read by Prof. Richards. The authors discussed the actual conductance of the electrolyte in electrolytic refining tanks as the same are ordinarily set up and operated. In almost all refining tanks the edges of the anode and cathode plates, they being usually of the same size, are at some distance from the sides and bottom of the tanks. The free space, that not directly included between the plates, is a field through which stray current flows, the current lines being usually curved; it adds considerably to the conductance of the electrolyte. The authors have made an extended series of measurements of the conductance of electrolytic baths with more or less free space below the electrodes, and have plotted their results in the form of curves, by the use of which it is easy to determine in any case what will be the practical conductance. A maximum conductance is reached when the free space below the electrodes has reached a certain depth, so that it is useless to increase the depth of the electrolyte underneath or at the sides of the electrodes past a certain point, as any such increase in the dimensions adds nothing to the conductance.

The uselessness of increasing the depth (width) of an electrical metallic conductor conducting between points of contact at the two ends on the same side, beyond a certain depth which is approximately the ratio of depth to length of 1/5, is quite as important for the electrical engineer, in the design of equalizing bars and heavy busbars of short lengths, and shows the great importance of making contact over the whole end or face of the conductor in order to get the full utilization of the metal comprising it. Connection should never be made along an edge or at the corners.

The paper was discussed at some length by Messrs. Wolcott, Loeb, Sperry, Hering and Baekeland.

CORROSION OF IRON.

The last paper of the Saturday morning session was presented by Mr. Maxmilian Toch, who referred to an observation made by Mr. Sperry, namely, that the treatment of a piece of iron as cathode in a sodium carbonate solution of certain strength at a low voltage and at a high amperage makes the iron immune against corrosion. The paper was only of a preliminary nature, but Mr. Toch exhibited some interesting iron articles which showed more or less corrosion according to their treatment. The paper was discussed by Mr. Sadtler, Mr. Sperry, and Mr. Gaines. The latter emphasized that bacterial activity may be an important feature in corrosion.

DRY CELLS.

The first paper of the afternoon session was presented by Mr. F. H. Loveridge, giving a summary of typical dry cell tests of constant resistance. The results were given in a series of curves which show how to judge the quality of a dry cell. In the discussion which followed it was emphasized that standardization rules should be formulated on dry-cell tests, and a committee to take up this matter will be appointed by the president, Dr. Backeland. This subject was discussed at more length. Dr. Whitney suggested that perhaps two kinds of tests might be formulated, one for the interrupted service and the other for continuous service. Prof. Burges thought that constant current tests would be preferable, while Dr. Sharp thought that while constant-current tests are more convenient for testing a great number of cells in series at the same time, yet a test at constant resistance comes nearer to the use of the cell in actual practice.

The effects of chemical impurities upon the electrical characteristics of dry cells were discussed in a paper by Messrs. C. F. Burgess and Carl Hambuechen. The authors stated that about 80 per cent of the dry cells in use are of the cylindrical form, the zinc container being 6 in. high and 2.5 in. in diameter, a carbon rod serving as the cathode. A representative filling mixture consists of 10 parts of manganese dioxide, 10 parts of powdered carbon, 2 parts of ammonium chloride and 1 part of zinc chloride, sufficient water being added to give the proper amount of electrolyte to the cell. Mercury is occasionally added to effect amalgamations and prolong the life of the zinc. Upon the amount and availability of the manganese dioxide depend the qualities designated as "minimum prolongation" and "maximum recuperative power." Granulated carbon or graphite is employed

to give conductivity to the mixture. The ammonium chloride acts upon the zinc chloride formed as a result of the corrosion of the zinc to produce various single and double chlorides, the latter being less soluble than the former. The insoluble double chlorides crowd out the electrolyte and increase the resistance of the cell. Dry-cell construction can be improved by reducing the accumulation of insoluble non-conductive materials.

The authors called attention to the need for a logical method of rating dry cells, and suggest the use of a rating based on the energy output. On this basis the cell described above would be rated at about 30 watt-hours.

AN ELECTRIC FURNACE FOR IRON ORE REDUCTION.

Mr. Edward R. Taylor then read a paper on a special design of an electric furnace for the reduction of iron ore. Its features show quite some similarity with his well-known carbon by-sulphide furnace with respect to the arrangement of the electrodes and the method of pushing the charge forward by means of screws. The ore and the carbon are charged separately into the furnace in order to convert as much as possible of the carbon into CO_2, instead of CO_1, and thus increase the efficiency of the furnace.

MANUFACTURE OF AIR-SALTPETER.

The process used by the Badische Anilin & Soda-Fabrik for manufacturing air-saltpeter was fully described in a paper by Dr. Schönherr. In this process use is made of a tube in the axis of which the arc burns, a current of air being passed along the length of the arc in spiral form. The tube consists of an ordinary iron pipe, the upper part of which is provided with a special cooler which joins the upper electrode. The lower electrode is an iron bar centrally placed within the tube and insulated therefrom. There are no moving parts and no electromagnets. The author stated that the process furnishes the nitric oxide in a far higher concentration than most other processes.

An experimental plant at Christianssand, Norway, which has been in service for two years, utilizes 1800 hp in three 600-hp furnaces, each of which operates at 4200 volts single phase; the arc is about 16 ft. long. Arrangements are being made for installing ten 14,000-hp turbines for using the water of the Rjukan in the interior of Telemarken for manufacturing nitrate in a factory to be placed in operation in 1910. Moreover, concessions have been obtained for water-power amounting to 300,000 kw to be used in this new industry in Norway.

ENERGY FOR ELECTROLYTIC REFINERIES.

Mr. W. L. Spalding, who is connected with a large copper refinery in Buffalo, discussed in an interesting paper the importance of cheap energy for electrolytic refineries. The energy cost in electrolytic refineries is 40 per cent of the cost of converting anode to cathode copper, or 20 per cent of the cost including furnace treatment.

He reviewed briefly the use of steam power, gas power, and water-power, and the buying of electric energy.

In Buffalo the cost of the Niagara Falls energy in lots of 500 hp or over is $27.50 per horse-power year; converted to direct current at 87 per cent efficiency the cost equals $31.60, which is surprisingly large for a region situated near a source of vast water-power. The refiner who wishes to use both waste heat from his furnaces and electric power for electrolysis is confronted by the interesting problem of combining the two so as to secure minimum cost per ton of output. The most satisfactory way seems to supply a tank house circuit with two generators in parallel, one driven by a motor running on a constant amount of the purchased power, the other driven by a steam engine whose load varies with the steam.

This arrangement permits the load to be divided in any ratio between the two generators by hand or automatic regulation of the shunt field rheostats, or the engine to be shut down on Sundays and during the dipping of the furnace charges when the supply of steam is not more than sufficient for driving air compressors, pumps, etc., and heating or evaporating the electrolyte. At large ratios of the two loads the equilibrium is delicate, but not disturbed. The author finally emphasized that an electrolytic copper refinery is an ideal customer for a distributing company.

IRON-COPPER ALLOYS.

Messrs. C. F. Burgess and James Aston discussed the physical properties of iron-copper alloys in a paper giving much data relating to alloys of iron with from 0.1 per cent to 7.0 per cent copper. Under tensile tests unannealed alloys showed a yielding point varying from 52,580 lb. per sq. in. for 0.1 per cent copper to 122,900 for 7 per cent copper. The elongation in a 2-in. length varied from 28.5 per cent to 4.0, respectively, under the same condition. When annealed the 0.1 per cent copper alloy showed a yield point at 35,570 lb. per sq. in., and an elongation of 31.5 per cent; the 70 per cent alloy showed a yield point at 56,950 with an elongation of 17 per cent.

The authors remarked that their results and comparisons would indicate that the copper-iron alloys are worthy of consideration and might be comparable to the nickel steels in use, even if the strength should not reach such high values as those of the nickel. A 1.5 per cent copper alloy is of promise, since the smaller percentage required and the lessened cost per pound of copper as compared with nickel would result in a lessened cost of construction, even if there is some increase in tonnage required because of the slight decreased strength for equal weight.

ELECTRO-CEMENTIZING.

A paper by Mr. Alfred Sang described a process for simultaneously annealing, cleaning and coating a steel wire with zinc, the result being similar to that obtained with the sherardizing process. Use is made of electricity in the wire itself for raising its temperature, while in the sherardizing process heat is passed to the wire through a non-conducting mass of zinc dust. The wire is passed over brass contact sheaves through a mixture of crushed coal and oxide of zinc. By means of current the wire is quickly brought to a cherry red, at which temperature all grease is volatilized, scale or rust is reduced by the carbon and occluded gases are driven out; at the same time, the zinc oxide in immediate contact is reduced, and, as a vapor, enters the pores of the steel and condenses on the surface when the temperature is lowered as the wire enters the upper part of the furnace. The author claimed that the reduction yields a coating of pure distilled zinc which is thoroughly alloyed to the metal underneath.

The following two papers were presented in abstract in the absence of the authors.

A paper by Dr. M. DeKay Thompson on calcium carbide dealt with the equilibrium pressure of carbon monoxide in the monovariant system, consisting of this gas, lime, carbon and calcium carbide. The paper was discussed by Mr. Hansen.

A paper by Mr. F. C. Frary and W. L. Badger discussed a method of preparation of calcium in the laboratory, and some peculiar effects observed in it.

Mr. Taylor presented two resolutions which were adopted recommending the work of the National Conservation Commission and the Inland Waterways Commission, and of the work of the New York Water Supply Commission and referred to the importance of cheap water-power rendered available by the conservation policy for electrochemical and metallurgical industries. Mr. Hering proposed a vote of thanks to all who had made the meeting successful. The meeting then adjourned. The next meeting will be held in the spring of 1910 at Pittsburgh.

State Regulation of Public Utilities in Wisconsin.

An address was delivered before the Wisconsin State Bar Association at Milwaukee on Sept. 1 by Mr. John H. Roemer, member of the Railroad Commission of Wisconsin, on the subject, "Some Features of State Regulation of Public Utilities." Mr. Roemer said that the scheme of State supervision of pub-

lic utilities embraced in the public-utilities law of Wisconsin was the most comprehensive in all its economic aspects and the most effective of any law of the kind in existence. While intelligent judgment could not be passed at this time upon the final results of the operation of the law, or prediction made with any degree of confidence whether the law would meet fully the purposes of its enactment, the benefits which had resulted to the public and the utilities so far had been great and important, but the full benefits designed by the law, if attainable under it, could only be enjoyed in time to come.

Under the circumstances, the public, the utilities and the commission could well afford to labor together patiently and harmoniously, and, disregarding the clatter of the blatherskite and demagogue, to take each step cautiously, knowing that the achievement intended would redound to the material and moral welfare of society and, if successful, as it probably would be if confidence and patience were indulged, would be a credit to the State and a blessing to posterity.

Discussing the features of the law which he recognized as revolutionary in character, Mr. Roemer said that the duty of valuation imposed upon the commission was the gravest and most important of all its functions. There could be no escape from the conclusion that the value of every security of a public-service corporation in the State would be determined, and perhaps irrevocably fixed, by the appraisal made by the commission of the property of such corporation upon the credit of which such security was issued. While in time the conditions existing in some of the New England States, notably Massachusetts, where bonds of public-service corporations compete in a measure with public securities, may prevail in Wisconsin, Mr. Roemer thought that before such was likely to be the case, many, if not most, of the public utilities would have to undergo a financial regeneration.

The uniform system of accounting for public utilities had already demonstrated, Mr. Roemer declared, the wisdom of its adoption. While certain modifications might result, the principles upon which the system had been constructed, being in accord with the best thought and practice on the subject, would not be changed. Under the plan of accounting provided by the law and with the exercise of reasonable patience on the part of those charged with its execution, Mr. Roemer saw no reason why municipal plants might not be administered as efficiently and economically as those controlled by private capital.

Mr. Roemer described the work of the engineering staff under three heads: (1) valuation work; (2) service inspectional work, and (3) studies of operating conditions. The staff had just submitted to the commission an elaborate review of all available data touching upon the gas and electric service of the State with conclusions and recommendations drafted in the light of two years' experience under the public-utilities law. The studies of operating conditions promised far-reaching results when more fully developed. The commission had carefully guarded against assigning its staff to those lines of service which should properly be undertaken by the engineer in private practice.

In discussing the indeterminate permit for which provision is made in the Wisconsin law, Mr. Roemer said that the controlling reasons for the general failure of public-service corporations to surrender their municipal franchises and accept State permits seem to have been: (1) a doubt as to the legal right of the directors and stockholders to make the surrender without the consent of the bondholders whose mortgage security covers and includes the franchises of the corporation; (2) the practical impossibility of ascertaining all the bondholders and acquiring their consent, and (3) the erroneous, though perhaps not ill-founded, conception of the value of such franchises.

Mr. Roemer believes that the unbiased mind must necessarily come to the conclusion that the system of State regulation and aid provided by the public-utilities law of Wisconsin is capable of producing eventually more permanent and satisfactory results than any system of local control that can be conceived.

Amortization Rule of the New York Public Service Commission of the Second District.

Mr. George O. Bridgman, superintendent of the Board of Light Commissioners, of Boonville, N. Y., has filed a sworn statement with the New York Public Service Commission, Second District, concerning the treatment of the account "General Amortization—Electric." This statement says that the rule for the amortization of capital shall be to compute on the amount at which each subdivision of tangible capital was carried on the books as of Jan. 1, 1909, the percentages shown in the following:

PERCENTAGES.

	Per cent per annum.		Per cent per annum.
Land devoted to electric operations	0	Transmission system	1
Dam and flume	3	Distribution system	1
Power-plant buildings	2	Electric services	1
Turbines and water wheels	5	Electric meters	3
Electric generators	5	Municipal street lighting system	1
Accessory electric equipment	2	Line transformers	3
Substation buildings	2	Commercial arc lamps	5
Substation equipment	3	Electric tools and implements	5
Poles and fixtures	5	Laboratory equipment	10
		Other tangible capital	10

Mr. Bridgman says in his sworn statement, explaining the foregoing figures, that he has been superintendent of the Boonville plant since the commencement of operation on Jan. 1, 1904, and that he is familiar with the plant, its condition and the cost of maintenance and repair in each year of operation. Basing his opinion on such knowledge he prepared the rule for amortization upon the following basis:

"Land devoted to electrical operation," held in fee simple, is subject to no depreciation.

"Dam and flume" are of frame-timber construction, easily accessible for repair; estimated life, 35 years.

"Power-plant buildings" are on concrete foundation, the latter on rock; wood superstructures; slight repairs only required; estimated life, 50 years.

"Turbines and water-wheels" are McCormick longitudinal cylinder gate, controlled by No. 0 Lombard governor; estimated life, 20 years.

"Electric generators" are type A, G and B, 60-cycle General Electric Company alternating current running at 250 r.p.m. The alternator seems to be indestructible, the only repairs needed being on the exciter, belt-connected to the alternator; estimated life, 20 years.

"Accessory electric equipment" seems to be indestructible, except for nominal repairs; estimated life, 50 years.

"Substation buildings" condition the same as power-plant buildings.

"Substation equipment" needs but nominal repairs; estimated life, 35 years.

"Poles and fixtures." Poles are selected northern cedar, thoroughly set in heavy soil. Similar poles set in similar soil under observation after 20 years' service are still in good condition; estimated life, 20 years.

"Transmission system," "distribution system," "services" and "municipal street-lighting system" are all in similar condition. When wire requires replacement the salvage should be 80 per cent of original cost.

"Electric meters" require but slight repairs; estimated life, 35 years.

"Line transformers." Condition similar to meters; estimated life, 35 years.

"Commercial arc lamps" and "electric tools and implements"; estimated life, 20 years.

"Laboratory equipment" and "other tangible capital"; estimated life, 10 years.

In conclusion Mr. Bridgman says: "Computing the amortization as shown upon the various amounts of the above divisions of 'tangible capital' (exclusive of 'land devoted to electrical operation') amounts to a total sum of $1,468. The amortization averages approximately 2¾ per cent on the total amount. There is no 'intangible capital.'"

New York Public Service Commission News.

The Public Service Commission of the First District announces that all arrangements are practically made to begin work within a very short time on the Fourth Avenue subway in Brooklyn. All of the contractors who were awarded the work of construction have signified their intention to carry out their contracts, and William Bradley, who secured two of the most important sections, and Thomas E. Bryson, contractor for section five, have already perfected their contracts and offered their bonds. The other contractors will do this within a few days. It is believed by the commission that there will be practically no delay on account of securing the consents of property owners, and that work can begin at once.

Henry B. Seaman, chief engineer of the Public Service Commission of the First District, has filed a report recommending the proposed plans for a moving platform under Broadway. The proposition for the construction of this method of transit was made to the commission last February by the Continuous Transit Securities Company. Under the plans which have been submitted, it is proposed to build under Broadway, from Fourteenth Street north to Forty-second Street. The plan is to have a series of short units, forming an endless chain, which are kept in continuous motion. The platform is provided with seats and will travel at a speed of 12 miles an hour. To assure safety in getting on and off the 12-mile platform, there will be three loading platforms which will move at three, six and nine miles an hour respectively. Mr. Seaman is of the opinion that this mode of transit would be very serviceable for short trips.

There was some opposition developed in the Board of Estimate and Apportionment to the construction of an additional elevated line in the Bronx, as proposed by the resolutions sent to the board last week by the Public Service Commission. The matter was set for a hearing on Nov. 12.

The Public Service Commission, Second District, will give a hearing this week, at Port Jefferson, on the application of the North Shore Electric Light & Power Company asking permission to construct and operate an electric lighting plant at Port Jefferson, Suffolk County. At the present time there is an existing company furnishing light at Port Jefferson.

Canadian Hydroelectric Commission News.

The struggle between the opposing forces in Hamilton, Ont., for and against the city making a contract for electric power with the commission, mention of which has been made in these columns, was renewed at a meeting of the City Council on Monday, Nov. 1, and after a long debate, lasting over three hours, the Aldermen were evenly divided and it took the casting vote of the Mayor to carry an amendment putting over the proposed contract for 1000 hp in order to obtain further concessions from the commission. The special committee reported that "the question of entering into a contract at the present time with the Hydroelectric Commission for a supply of power having been approved by vote of the ratepayers, the committee recommends that the city apply to the commission for a supply of 1000 hp on the terms and conditions set forth in the said contract, upon the understanding that the $8,523 mentioned in the schedule of the contract includes sinking fund and interest, as well as line loss and other operating expenses."

An amendment was moved to the effect that the city should apply for the 1000 hp and, while not being bound to take power exclusively from the commission as other municipalities are, that the city should have all the rights enjoyed by the other municipalities.

The amendment carried with the casting vote of the Mayor.

On Nov. 4, the ratepayers of Port Arthur, Ontario, by a vote in the proportion of almost three to one, endorsed the acceptance of an agreement made by the city with the Hydroelectric Commission for a supply of electric power for the town. The agreement calls for delivery of 24-hour power at a sliding scale, beginning with $22.10, per annual horse-power, for a block of 1000 hp and running down to $17.65 for 5000 hp, this price not including interest on capital invested nor sinking fund. Strong opposition was suddenly developed against the proposition by James Conmee, acting for the Ontario & Michigan Power Company, who submitted three alternative proposals. After the result of the voting became known, notice of application for an injunction was served on the city seeking to prevent the signing of the agreement with the commission.

Hon. Adam Beck, chairman of the commission, who was in the city on the night of the voting, stated that the commission would forthwith let the contracts for the local transformer station building and its equipment at an estimated cost of $60,000. The commission had concluded a contract with the Kaministiquia Power Company on a principle similar to the contract with the Ontario Power Company in the Niagara district, under which power will be supplied at a sliding scale of $17 per annual horse-power in blocks of 1000 and running to $14 ultimately for the largest block. Mr. Beck also showed that Fort William, sister city to Port Arthur, would similarly benefit to the extent of about $30,000 per year, as that city has a contract which provides for a similar reduction in price in the event of lower rates being granted to other consumers of the Power Company.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission has issued a decision permitting the Connecticut River Transmission Company to enter the power field in the city of Worcester on the same principal limitations of demand and consumption as were laid down by the board in the recent appeal of the Fitchburg Gas & Electric Light Company against the Transmission Company. The Worcester Electric Light Company appealed to the board against a franchise granted the Transmission Company last May for locations and the right to sell electricity in Worcester to consumers of 15-hp rating and upward, with a minimum annual consumption of 22,500 hp-hours. A hearing was held by the board at the Worcester City Hall and arguments heard along substantially the same lines that were followed in the Fitchburg case.

The Worcester company offered practically no objection to the entrance of the Transmission company if the Fitchburg limitations should apply, and the latter confessed itself willing to abide by these limits. The municipal authorities of Worcester, however, desired a lower limit than was established in the Fitchburg case, and the hearing was carried forward on the basis of making clear to the city the reasons why the small power business should remain in the hands of the local company. In its decision the board repeats the Fitchburg limitations, which are that the Transmission company may sell power to consumers having a total connected load of not less than 300 hp, and an annual consumption of not less than 450,000 hp-hours. The board says in part:

"It is extremely doubtful whether the Transmission company can undertake to give the same advantages to both small and large users of power, and, on the other hand, it is equally doubtful if the Worcester company is likely to be in a position to profitably undertake to supply large power users. For this reason, and in the interest of the small user, the Transmission company should be willing to sell to the Worcester company, which in turn should be willing to buy all the power which the former may have available for the purpose and be willing to sell at a less price than the latter company can make it. To avoid the disadvantages necessarily incident to duplicate systems of distribution both companies may reasonably be required upon such terms and conditions as are equitable, to combine their lines, and while operating independently otherwise, to serve respectively the large and the small users of power.

"It is doubtful if any fixed rule can be laid down or exact lines drawn for the division between large and small users of power. Changes in local conditions may impose changes in the business of the company and the community. The limits and conditions under which power should in the public interest be

supplied by this company may be determined only by experience. The board finds no conditions in the Worcester case which tend to establish a different limit than that used in the Fitchburg case."

The board has, therefore, issued a decree granting the Transmission company the right to sell power in Worcester to consumers of the 300-hp class and to sell to the Worcester Electric Light Company. The limited franchise granted by the authorities is set aside in favor of an indeterminate franchise.

The Massachusetts Gas and Electric Light Commission has issued a decision under date of Nov. 4, upon the complaint of the Selectmen of Leominster that the Leominster Electric Light & Power Company has disregarded the recommendation of the board made on May 29 relative to the price of electricity supplied by the company. On the latter date the board recommended that on and after June 1, 1909, the net price charged by the company for electricity should not exceed 16 cents per kw-hour. The Selectmen complained that, notwithstanding the board's action, the company continues to charge customers for light and power certain fixed or minimum rates, so that the customers have no benefit from the order, but are charged more than 16 cents per kw-hour.

The commission states in part: "On June 1 the company discontinued the schedules of prices for commercial lighting theretofore prevailing and adopted a gross price of 18 cents per kw-hour, with a discount of 2 cents per kw-hour for prompt payment and a minimum monthly charge of $1. No change was made in the power rates which are set out in detail in the board's decision and include a monthly service charge based upon the horse-power of the consumer's motor, independent of and in addition to the charge for the current consumed. Under it a power customer has no choice between paying the service charge or the maximum net price of 16 cents, but must pay the service charge and the kw-hour price if he desires to use electricity for power.

"During the hearings in the original case there was no complaint of the minimum monthly charge of $1 made to the lighting customers. A charge of this character is a common feature of electric light schedules. It is not a service charge or meter rent imposed in addition to the actual charge for energy.

"The board, therefore, recommends, in furtherance of its decision of May 29, 1909, that the company immediately offer to sell electricity for any use at a net price not to exceed 16 cents per kw-hour with such minimum monthly charge not exceeding $1 per month as it is now employing with respect to its lighting customers; that the company adjust with its customers, who elect to be served at the rate fixed by the board, any excess actually charged them over and above the amount which they would have been charged had the foregoing recommendation been put in force on June 1, 1909; that if a customer elects to be served under such other schedules for lighting or power as are now or may hereafter be in force, whenever the charges for such service for any year thereunder aggregate more than 16 cents per kw-hour for the electricity so supplied to him, the company shall restore to him such excess; and that the company, shall, as promptly as is consistent with the fulfillment of current contracts, if any exist, discontinue giving or offering any advantage to one customer not open to all who enjoy or seek the company's service under like conditions."

The Massachusetts Gas and Electric Light Commission gave a public hearing on Nov. 5 upon the petition of the Edison Electric Illuminating Company, of Boston, for authority to issue 19,452 shares of capital stock at $215 each, in connection with the purchase of the suburban electric lighting companies in Newton, Waltham, Brookline and Chelsea, approved by the board on Aug. 20, 1909. The case for the company was conducted by its general counsel, Mr. Everett W. Burdett, of Boston. He stated that the Edison company desires to capitalize these properties at their full value, as indicated by the purchase price, issuing the stock to its own stockholders and not to the former owners of the properties. There has been expended for the purchase of these properties, $2,750,000, but to complete the transaction there would be a total capitalizable liability on Dec. 31, 1909, of $4,355,963.79. The chief question at the hearing was whether there is any reason why the fair value of the properties should not be capitalized.

The Railroad and Transit Commissions, sitting jointly, gave a hearing Nov. 4 on the proposition of J. F. Cronin and others that a subway be built under Washington Street in place of the present elevated structure of the Boston Elevated Railway Company, between Castle and Dudley Streets. The scheme was denounced as impracticable by Corporation Counsel Babson, who emphasized the permanent rights of the company in Washington Street, through legislative sanction, and who condemned the financial aspects of the project, even if legally possible. Counsel F. E. Snow, for the Boston Elevated Railway Company, urged the unconstitutionality of the proposed measure, and emphasized the approval of the public authorities of the details of the structure at the time it was erected. The commission will report its finding to the Legislature of 1910, in connection with the consideration of other transportation questions in the Boston district.

The Gas and Electric Light Commission issued an order Nov. 8 approving the issue of new capital stock by the Brockton Gas Light Company to the par value of $59,000, the proceeds to be applied to payments on account of plant additions.

CURRENT NEWS AND NOTES.

MARYLAND INDEPENDENT TELEPHONE SYSTEM SOLD TO BELL COMPANY.—The Chesapeake & Potomac Telephone Company has purchased the Frederick County Telephone Company, which heretofore has been in competition with the Bell Company.

A. I. E. E. NEW YORK MEETING.—At a meeting of the American Institute of Electrical Engineers to be held in the Engineering Societies Building, New York, on Nov. 12, a paper entitled "The Electric System of the Great Northern Railway Company at Cascade Tunnel" will be presented by Dr. Cary T. Hutchinson.

ELECTRIC VS. GAS METERS.—The report of the New York City Public Service Commission for October on tests of gas and electric meters shows that of meters tested on complaint, 40.8 per cent of the gas meters were fast and 9.5 per cent slow; of the electric meters only 3.4 per cent were fast while 6.9 per cent were slow.

FUEL TESTS.—"Fuel Tests with Illinois Coal," by L. P. Breckenridge and Paul Diserens, is the title of Circular No. 3 just issued by the Engineering Experiment Station of the University of Illinois. It consists of a compilation of data relating solely to the coals of the State of Illinois, selected from the complete reports of the Government investigations on the fuels of the United States.

MADISON (WIS.) OVERHEAD LINE ORDINANCE.—The street committee on the Madison City Council has taken favorable action of an ordinance which provides that all telegraph, telephone and electric light poles and wires shall be removed from State Street, a thoroughfare nine blocks long, within six months after the ordinance's passage. The Wisconsin Telephone Company operates in this city. The ordinance also provides that the Southern Wisconsin Railway Company erect iron trolley poles on this street. Action will be taken Nov. 12.

SPECIAL LIBRARIES ASSOCIATION.—The first annual meeting of the Special Libraries Association was held in New York, Nov. 5, with a large attendance. The object of the association is to bring about specialization so far as possible by present libraries, and the creation of libraries in large centers making a specialty of a branch of knowledge. Public Service Commissioner Maltbie made a plea for the establishment in New York City of a library devoted to municipal matters. Engineering was not represented on the program nor in the proceedings.

ELECTRIC VS. NAVIGATION RIGHTS ON CAPE FEAR RIVER.—Vessel owners have filed a complaint at Washington against the Carolina Electric Power Company on the grounds that it renders navigation on Cape Fear River impossible at stated periods each 24 hours.

ACCURACY OF WATT-HOUR METERS.—The New York Public Service Commission's Bureau of Gas and Electricity has reported that of 29 watt-hour meters tested upon complaint in October only one was passed by more than the legal rate of 4 per cent.

ILLUMINATION OF DENVER AUDITORIUM.—A trial installation is being made of an outlining lighting scheme for the Denver Auditorium. Some 10,000 low candle-power lamps will be so arranged as to emphasize the architectural features of the building. If the trial proves satisfactory to the city authorities they will authorize the permanent installation of a decorative lighting system along similar lines in conduit.

BALTIMORE ELECTRIC SIGN TAX.—The law officer of Baltimore has decided that while an existing ordinance imposing a license fee on signs is illegal so far as it applies to ordinary signs, it must be enforced with respect to electric signs. As a consequence a tax of $5 per year is now collected from owners if a sign projects less than 2 ft. over the building line, or $10 if it projects more than 2 ft.

ILLUMINATING ENGINEERING.—At the meeting of the New York Section of the Illuminating Engineering Society, to be held on Nov. 11, the subject of division of membership of the society will be discussed, together with the topics "What is an Illuminating Engineer?" and "What Qualifications Should a Person Possess Before He is Entitled to Assume the Title of Illuminating Engineer?"

LONG-DISTANCE WIRELESS.—According to reports from San Francisco, the long-distance transmission of wireless messages by the steamship *Minnesota,* mentioned in our issue for Nov. 4, has been surpassed to the extent of several hundred miles by a transmission over a distance of 4720 miles by the steamship *Korea.* This vessel was equipped with apparatus rated at only 5 kw and provided with an antenna less than 100 ft. in height.

NEW MEXICO HYDROELECTRIC PLANT.—One of the largest power projects ever started in New Mexico is under way at High Rolls, near Alamogordo, where the Alamogordo Water Power Company is building a plant which will utilize the water from a mountain stream through pipe line to generator of 5000 hp for furnishing the towns of Alamogordo and Tularosa with light and power. Power will also be supplied for irrigation pumping plants all through Tularosa Valley.

AWARD OF A. I. E. E. EDISON MEDAL.—We are informed by the University of Illinois that Mr. Trygve Jensen, a graduate of the department of electrical engineering of that university, has recently been awarded the prize offered by the Edison medal committee of the American Institute of Electrical Engineers for the best thesis presented in competition under the conditions specified by the committee. The title of Mr. Jensen's thesis is "The Operation of a 100,000-volt Transformer." The prize consists of a diploma and a cash award of $150.

PREVENTION OF INDUSTRIAL ACCIDENTS.—The Fidelity & Casualty Company, New York, has issued a 200-page book in paper covers which deals with the prevention of industrial accidents in general. Ten pages with the heading "Electrical Apparatus" contain precautions for the avoidance of danger from electric shock. We note that the grounding of alternating-current secondaries up to 250 volts is urged. The present publication will be followed by others dealing singly with specific industries. The work is excellently compiled and reflects credit on the editors, Messrs. Frank E. Law and William Newell, of the Fidelity Company.

PROPOSED ABSORPTION OF CENTRAL-STATION PROPERTY BY JAMESTOWN (N. Y.) MUNICIPALITY.—By a vote of 11 to 1 the Common Council of Jamestown, N. Y., decided on Nov. 1 to call a special election for Nov. 20 to let the taxpayers decide whether they want to buy the franchise and property of the Jamestown Light & Power Company and consolidate them with the municipal plant at a total cost of $120,000, $90,000 for the property and $30,000 to consolidate the two plants. The details of this unusual proposal that an American municipality obtain a monopoly of electric service by buying out its private-owned rival in the commercial light and power business were given in *Electrical World* of Oct. 28, page 1020.

TO SMOKE OR NOT TO SMOKE.—As previously announced, smoking cars have been abolished on the Chicago & Oak Park Elevated Railroad. Men accustomed to smoking on the train view the change with entire disfavor, and the company has experienced considerable trouble in enforcing the order. A number of men passengers in the car, which would have been the smoking-car under the old order, have persisted in smoking despite the conductor's warnings and commands. Ejections and arrests have followed. Signs announcing the change have been torn down, and indignation meetings are threatened. Women passengers are still rather dubious about entering former smoking-cars, which have been treated with oil of sassafras, it is said, to remove the odor of tobacco smoke. One expedient of conductors to subjugate smokers is to hold a train at a station until the offenders put away their cigars or pipes, at least temporarily.

BRITISH WELSBACH LAMP LITIGATION.—The entry of the British Welsbach Gas Company into the lighting field with an electric lamp, previously noted in these columns, has now become a subject of litigation. The gas company has been haled into court by an electric lamp company which manufactures tungsten lamps under rights acquired from the German company which owns the patents of Baron Welsbach on electric lighting. The charge is made that while Welsbach invented the osmium metallic-filament lamp, he has not invented a tungsten lamp; and that the advertisements of the gas concern are so written as to convey a contrary impression, to the injury of the interests of the English company making tungsten lamps under rights acquired from the German company, which manufactures tungsten lamps not invented by Welsbach, and owns the patents of a Welsbach metallic-filament lamp which are not manufactured.

COMMONWEALTH EDISON EMPLOYEES' SAVING FUND.—The offer of the directors of the Commonwealth Edison Company to receive savings from employees, operative July 1 last and heretofore outlined in this journal, is appreciated by the employees, as shown by the fact that about 50 per cent of them have taken advantage of it. Employees may subscribe 3 or 5 per cent of their salaries. The subscription period is for five years, or until the subscriber leaves the company or is discharged. At the end of the period the subscriber or his estate will receive back all money paid in with interest compounded semi-annually at 6 per cent. If the subscription period continues for the full five years, the subscriber may, at his election, receive, instead of cash, as much of the company's capital stock as the amount of his principal and interest will then purchase at par if the stock is then selling at or above par, or at the average market price during the two preceding months if the stock is then selling below par. If the stock is than selling at about 120, as at present, this arrangement will net the employee a return of about 16 per cent.

DR. STEINMETZ'S CHICAGO LECTURE.—The date of Dr. C. P. Steinmetz's forthcoming lecture in Chicago has been definitely fixed for Nov. 16. Dr. Steinmetz will speak in Fullerton Hall, Art Institute, before a joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers. His subject will be "The Conservation of Energy."

NEW POWER PLANT FOR UNIVERSITY OF ILLINOIS.—The University of Illinois will begin construction at once of a new power plant, arrangements for which are in charge of a committee consisting of Mr. W. L. Abbott, of the board of trustees; Prof. W. F. M. Goss, dean of the College of Engineering, and Prof. James M. White, supervising architect, of the university. Mr. W. H. Zimmerman, of Lansing, Mich., is consulting engineer for the plant.

NORMALLY UNNAVIGABLE STREAM.—In the account given last week of the important decision permitting a dam to be erected in the Desplaines River, the word "unnavigable" instead of "navigable" should have appeared in the head. The whole case, as indicated in the article, turned on the navigability of the stream, and the court upheld the contention of the Economy Light & Power Company that as it was navigable in its original state when the riparian rights were acquired, the right to erect a dam could not be successfully contested.

TUNGSTEN ORES.—The U. S. Geological Survey reports that in 1908 the domestic production of tungsten ore, reduced to an equivalent of ore carrying 60 per cent of tungstic trioxide, the ordinary commercial basis in the United States, was 671 short tons, valued at $229,955, as against 1640 tons, valued at $890,048, in 1907. The statistics at present available from foreign countries show a similar decline. By far the largest part of the tungsten produced is used in making tool steel.

FISK STREET A WINTER PORT.—Fisk Street station of the Commonwealth Edison Company, Chicago, lies on the South Branch of the Chicago River, and for several years Mason's Slip, just east of the property, has been the winter quarters of yachts and other craft in which electrical men are interested. A number of the Edison "boys" are members of the Illinois Naval Militia, and the U. S. steamship *Nashville* is tied up at Fisk Street for the entire winter. Other boats in the slip are Mr. E. C. Noe's 65-ft. gasoline launch *Diana*, Mr. G. H. Atkin's 45-ft. schooner *Nomad* and Dr. W. L. Baum's 90-ft. schooner *Amorita*.

NEW TELEGRAPH LINES AT PANAMA.—A contract has been entered into between the Panama Railroad Company and the Republic of Panama, providing for the construction and maintenance of a telegraph line between Panama and Colon and between Panama and Empire. Each line consists of two No. 10 copper wires, to be erected and maintained by the railroad company for the use of the Panama Government, and it is agreed that no message shall be transmitted by the Government over these lines at a rate lower than that charged by the railroad company. The Government is prohibited from doing a telephone business over the new circuits. The existing telegraph rate of 25 cents for a 10-word message, with 2 cents for each additional word, is to be maintained.

DENVER STEAM-TURBINE ACCIDENT.—On Saturday evening, Oct. 30, at 6 o'clock, the west side plant of the Denver Gas & Electric Company was shut down by the short-circuiting and consequent burning out of the 2000-kw steam-turbine unit. The station was at the time running at its full capacity and the disconnection of this unit caused the shut-down over the entire system, which, because of the testing necessary before putting back the generators on the line and the necessity for phasing in the power derived from the Central Colorado Power Company's substation, caused Denver to be without lighting service for some 35 minutes. This is the second burn-out of this machine within a year, the former occurring at a time when the accident did not cause such serious consequences.

'PLAN OF CHICAGO."—Mayor Busse has appointed a commission consisting of more than 300 citizens of Chicago, to study the elaborate "Plan of Chicago" presented by the Commercial Club of Chicago for the systematic improvement and beautifying of the city. This plan, which has been briefly described in these columns, represented three years' work and an expenditure of about $100,000. The commission is intended to represent every section of the city and every element in the population. It contains very few distinctly electrical men, however, about the only one being Mr. Bernard E. Sunny, president of the Chicago Telephone Company. Other members are Mr. Charles G. Dawes, connected with the central-station interests; Mr. George W. Jackson, the constructing engineer, and Mr. Robert T. Lincoln, first vice-president of the Commonwealth Edison Company.

PROPOSED MONTREAL MUNICIPAL PLANT.—The Montreal City Council took another step on Nov. 2 toward the establishment of a municipal lighting plant by giving a by-law the second reading providing for the raising of about $2,000,000 for a term of 40 years at 4 per cent. The city was authorized by the Legislature at the last session to undertake the manufacture of electric light out of garbage refuse, and the by-law as now prepared authorizes the city to erect, purchase or acquire and operate works for the production of electricity by means of the incineration of garbage, or water-power, or by means of coal. In the meantime, pending the completion of the city's plans for the construction of its own plant, the Council has decided, after much discussion and delay, to offer to the Montreal Light, Heat & Power Company the price of $75 per arc lamp per annum for a period of five years.

A LONG-FOUGHT ELECTRICAL ACCIDENT CASE.—After being fought for years through every Canadian court up to the Imperial Privy Council in England, then sent back to Canada for a new trial and appealed once more to the Court of Appeal, the latter court on Nov. 2 gave a decision in a case claiming damages for the death of a husband from electric shock. After a long course of litigation against the Montreal Light, Heat & Power Company, the case went back to the Superior Court, this time against the C. Martineau Company, the contractors who owned the derrick which caused the fatality, and the jury there found the Martineau company responsible for Curtis' death, when a verdict for $3,000 damages was rendered in Mrs. Curtis' favor against the Martineau company; the latter then appealed to the Court of Appeals, which confirmed that judgment. As it now stands the Martineau company has 15 days in which to serve notice of appeal to the Supreme Court or direct to the Imperial Privy Council. Curtis was killed nearly five years ago by contact with a live wire at Point St. Charles. Construction work was being carried on there by the C. Martineau Company, when a derrick chain swung against a power wire killing the man at the chain. Another man went to his assistance and was stunned by the current through the first man's body. Then Curtis went to assist the second man and in turn was killed by the current passing through his body, although the second man was merely temporarily stunned. Mrs. Curtis then entered action against the Montreal Light, Heat & Power Company. The first jury exonerated the Martineau firm, and the fight as to the liability of the power company was carried to the Privy Council in England, where the company won, it being shown that its charter entitled it to string live wires as it had done. The whole matter as to the responsibility of the Martineau firm was referred back to the Canadian courts and fought to the Supreme Court, where a new trial was ordered. On this being heard in Montreal the jury gave judgment against the Martineau company for $3,000 damages, which the Court of Appeal has now sustained.

An Oil-Engine Central Station.

AN interesting example of the utility of electrical service in a prosperous industrial community of moderate size is afforded by the district centering about the town of Westerly, R. I. Westerly has a population of about 9000 inhabitants throughout the year; it is located in a region well supplied with granite quarries, and is situated on the shore line of the New York, New Haven & Hartford Railroad between Boston and New York, having excellent shipping facilities and passenger-train service. A number of textile manufactories are located in the town, with a variety of other industries of diversified power requirements. The generation, transmission and distribution of electricity throughout the district is handled by the Westerly Light & Power Company, under the general management of H. B. Rust & Company, of Providence, R. I., Mr. M. H. Spellman having immediate charge of the administration of the property as local manager with headquarters at Westerly.

The present property is the result of a consolidation of five old and weak companies which formerly attempted to occupy the field, and the service supplied extends radially from Westerly to points from five to ten miles distant, a considerable part of the business being in the bordering State of Connecticut. The present management was established about three years ago, and at that time the territory was wholly unexploited in a commercial way, there being practically no motor load whatever and a commercial lighting business of indifferent character. Under the present management the connected motor load has advanced from nothing to over 400 hp; the street lighting has been modernized throughout the territory now covered; commercial lighting customers have been afforded the use of the most improved equipment; inefficient generating equipment has given place to an economical plant supplying energy throughout the entire territory; transmission lines have been co-ordinated into a comprehensive system with control of the service at modern transformer stations and at the main generating station; and the earnings of the district have been increased nearly 30 per cent and operating expenses reduced 6.5 per cent. The actual cash collections from the sale of

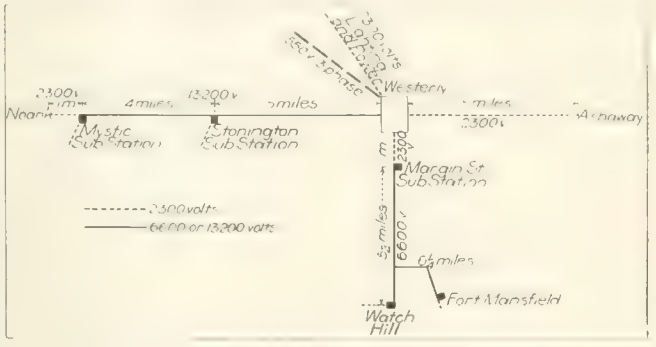


FIG. 1 SKETCH OF WESTERLY TRANSMISSION SYSTEM.

energy for lamps and motors increased from $66,547 in the year ending Aug. 31, 1907, to $85,390 in 1909; actual operating expenses, including taxes, were $45,603 in 1907 and $42,562 in 1909, including all repairs and maintenance. Bond interest each year remained stationary at $18,700. The surplus for 1907, taking into account all income, was $2,245 and for 1909 $25,600. The company feels that it has only fairly begun to tap the motor business in the territory, and is now making active efforts to secure the motor business of the principal quarries of the district. The present motor load centers among

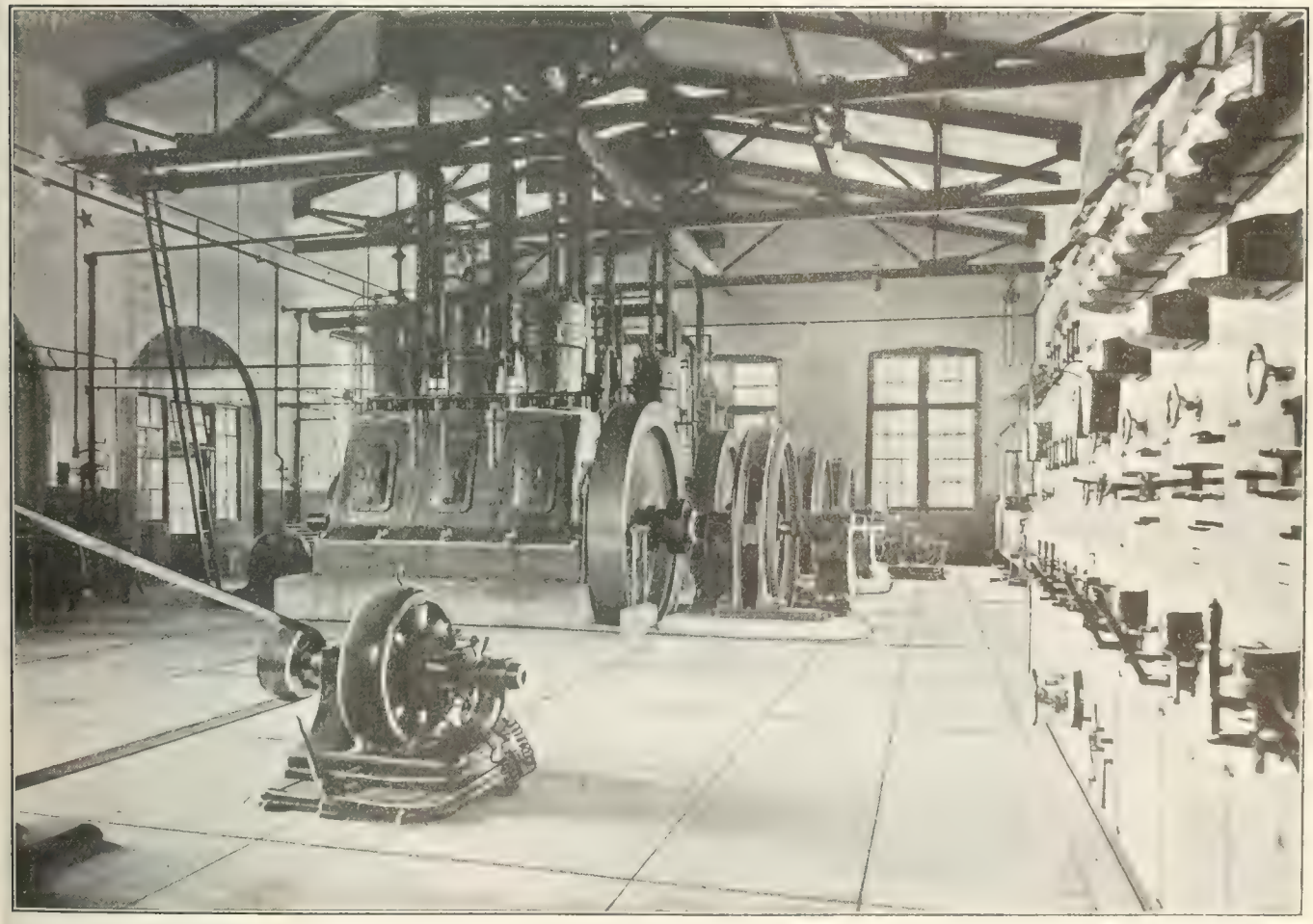


FIG. 2 VIEW OF INTERIOR OF WESTERLY OIL ENGINE PLANT.

the stone sheds and miscellaneous industries, and the prospects are excellent for the wider introduction of the motor drive in the company's field.

The main offices of the company are located at Westerly, but the financial administration is directed from Providence. At the Westerly offices the local accounts are handled, and the local manager has his headquarters, a small display space being in use here, with stockroom facilities and a repair bench for meter testing. The exhibit consists of modern energy-consuming equipment of the small-power type, including vacuum cleaners, vibrators, electric heating apparatus and other appurtenances. The apparatus is displayed in a commodious window on the street level in the central part of the business district of Westerly, and the window is wired for 110 volts alternating-current service, so that any equipment can be demonstrated at sight before prospective customers. The offices are provided with both local, automatic and long-distance telephone service by the lines of the Providence Telephone Company. In connection with the commercial work of the company, advertisements are carried in the local press, these being changed frequently to meet the conditions.

The company supplies electricity to Westerly, Watch Hill, Richmond and Ashaway, in Rhode Island, and to Stonington, Pawcatuck, Mystic and Noank, and Groton, in Connecticut. Outside of Westerly the principal center reached is Mystic, which has a population of about 5000. The total population served is about 25,000. At Watch Hill a considerable summer business is developing.

A diagram of the company's transmission system is shown on page 1163. The lines are all radial from the power house in Westerly, three different voltages being used, according to the distance of the various load centers from the station. Stonington, Mystic and Noank are supplied with energy by a three-phase, 13,200-volt line of No. 4 copper, B. & S., Stonington being five miles from the Westerly station and Mystic four miles beyond Stonington. From Mystic the service to Noank is effected by a three-phase, 2300-volt line of No. 6 copper, the distance being about one mile. Another line runs southward from Westerly to Watch Hill and Fort Mansfield. The first three-fourths mile is of No. 4, 2300-volt, three-phase service, terminating at a substation on Margin Street, Westerly, where the company has a temporary auxiliary installation of 160-kw



FIG. 3.—VIEW OF EXTERIOR OF PLANT FROM CONNECTICUT SHORE

generating equipment driven by steam engines. The Margin Street substation is owned by the Norwich & Westerly Street Railway Company, this being the generating plant for the local traction service. At Margin Street are installed transformers which raise the voltage to 6600 for transmission to Watch Hill and Fort Mansfield. The line runs direct to Watch Hill, 5.25 miles, with a branch outside Watch Hill to Fort Mansfield, the distance to the fort from Margin Street being 6.25 miles. No. 4 copper is used for all this service. There are also a No. 6, three-phase, 2300-volt line five miles long from Westerly to Ashaway, and several 2300-volt circuits in the Westerly district delivering energy to commercial customers and taking care of the street illumination.

The street lighting of the company's territory is effected mainly by the use of series tungsten lamps of 32 cp and 40 cp, each taking 5.5 amp. In general, the lamps are installed 16 ft.

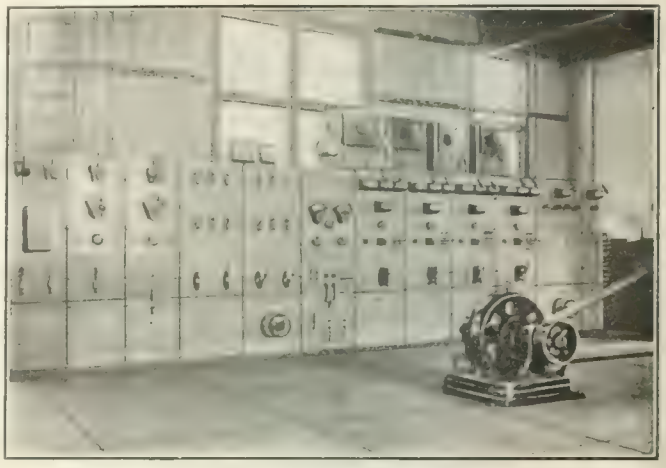


FIG. 4.—VIEW OF SWITCHBOARD.

above the streets and are equipped with Wheeler reflectors. All-night and every-night service is given in the towns. Westerly is served by 290 lamps, Watch Hill by 120, Pawcatuck by 133 40-cp tungstens; and Stonington, Mystic and Noank by 72, 145 and 32 32-cp incandescents, respectively. The company receives $15 per year each for the 32-cp lamps and $18 for the 40-cp units. In each case the contracts call for only 25 cp and 32 cp, respectively, so that under the present management the different towns are getting from 25 to 28 per cent more light for the same money than when carbon lamps were used in the street-lighting service. Westerly is supplied with 35 6.6-amp arc lamps of the series alternating-current type, mounted 21 ft. above the street, and there are three of these lamps in Pawcatuck, on the opposite side of the river from the Westerly station. A satisfactory street illumination in Westerly has been accomplished in one instance by the use of a cluster of three series tungsten lamps of 5.5-amp rating, 50 watts each, located 21 ft. above the street, on a corner where an arc lamp would have given too much illumination and a single tungsten lamp too little.

The power house at Westerly contains a Diesel oil-engine equipment, having a present rating of 640 kw, installed in four similar units of the revolving-field, direct-connected type. The plant is located on the north bank of the Pawcatuck River in the center of Westerly, and the gas generating and storing plants of the company are situated on the same area. The building is a one-story brick structure with granite trimmings, and it consists of an engine-room, 80 ft. long by 43 ft. wide, and a compressor-room, 30 ft. long by 17 ft. wide, with an overhead transformer gallery in the engine-room and oil-storage facilities under the ground outside the station building. A slightly sloping tar-and-gravel roof is carried on a steel-truss framework. Three of the four units are grouped close together, a space being left between the third and fourth units for the installation of a new engine and generator in the immediate future. Each of the present generating units consists of a 160-kw, three-phase, 2300-volt Fort Wayne alternator directly driven by a three-cylinder 16-in. x 24-in. American Diesel oil engine running at 164 r.p.m. The engines burn crude oil costing about 2.9 cents per gallon. The oil is stored in a tank of 10,000-gal. rating mounted on a concrete base 8 ft. thick and set with the top of the tank about 4 ft. below the surface of the ground. The tank is of sheet-iron construction, 28 ft. long and 8 ft. in diameter, and is equipped with about 50

ft. of 1-in. steam pipe from the boiler of the gas plant to enable operation to be carried on in the coldest weather without danger of freezing. Steam at 120 lb. pressure is turned into this pipe coil whenever the weather requires. The tank is supplied with oil by a pipe connecting with a nozzle-and-valve stand beside a spur track of the New York, New Haven & Hartford Railroad, which permits gravity delivery from tank cars. The railroad siding is about 200 ft. away from the power house, and the oil-supply pipe is carried in a wooden-box conduit with a 1-in. steam line to prevent freezing. The cost of handling the oil is thus reduced to a minimum. From the tank in the yard, which is covered with grass to form a parked approach to the station, a 1.25-in. pipe is run to a hand pump in the compressor-room, and from here the oil is pumped into a 75-gal. tank located in the upper part of the room so that delivery can be effected by gravity to the engine cylinders. Each engine is supplied through a 1-in. pipe leading to the cylinders from the smaller tank. A float and index are provided so that the oil can be kept at the proper level without difficulty. On a recent day's run, Oct. 15, the station generated 5340 kw-hours and consumed 555 gal. of fuel oil, the unit consumption being 9.6 kw-hours per gallon. There were also required on this day 2 qt. of engine oil, 2 qt. of crank-case oil, and ⅛ qt. of compressor oil. Unit No. 1 ran 20.5 hours; unit 3 ran 6.4 hours; unit 4 ran 22.45 hours, and unit 5 ran 7.1 hours. Unit 2 is not yet installed.

Cooling water for the engines is supplied by the Pawcatuck River. Two 2-in. pipes are carried from the river into a well outside the station and thence pumped through the circulating

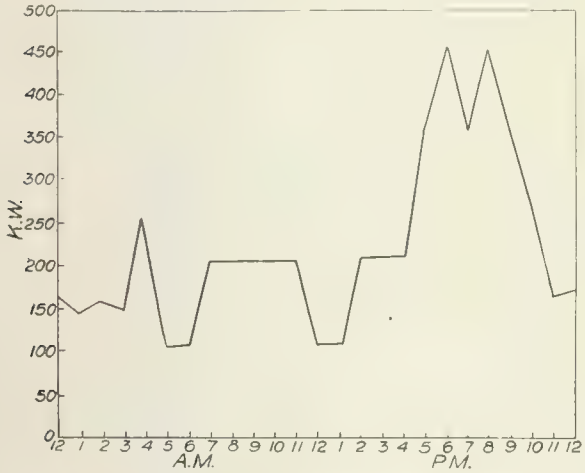


FIG. 5.—WESTERLY LOAD CURVE, OCT. 15, 1909.

system. The well is about 6 ft. long, 5 ft. wide and 10 ft. deep, the average depth of water being 6 ft. Beyond the pumps the two supply pipes are joined in a 3-in. main from which lateral branches 1.5 in. in diameter are taken off for the supply of each engine. The heated water is discharged from each cylinder by 1.5-in. pipe, and the drains are then collected in a 6-in. trunk line which is turned to the river below the suction lines mentioned above. All these lines are suitably valved so that different sections can be cut in or out at the will of the operating engineers. The engine exhausts are collected in a water muffler outside the station, and the operation of the plant is practically noiseless. Above each engine an I-beam is installed, with a traveling tackle to facilitate the removal of any part of the machine when necessary.

The compressor-room contains three 8-in. x 8-in. three-stage Norwalk air compressors, each directly driven by a 25-hp Fort Wayne 550-volt induction motor, and supplying air to the engine cylinders and to 14 steel tanks used for storage and starting up the plant in case of a shutdown. The compressors deliver air at 1200 lb. per square inch for use in the usual Diesel cycle. In case the plant should be completely shut down and the bottles empty, compressor gas can be obtained from a soda-water carbonating plant in the immediate neighborhood. The compressor-room also contains the water-circulating pumps, which are two in number and of the Douglass type, with split shells and centrifugal action. Each is directly connected to a 2-hp induction motor of Fort Wayne make, mounted on a horizontal shaft conection with the pump in each case. Under normal conditions an engine can be started from a cold state in about two minutes.

The engine interiors are inspected on alternate days, special attention being given to the bearings and crank-pin boxes. The valves are reground every two weeks, if necessary, and a general overhauling is carried out once a year. The plunger packing on all engine pumps is renewed every six weeks. Needle valves are withdrawn and atomizers inspected every fortnight. The compressor valves are withdrawn and cleaned weekly, and soap and water are fed through the lubricator on each compressor weekly, for one hour at a time. The engines are put in the starting position when stopped.

A new type of oil-burning engine will shortly be installed in the plant at Westerly, according to the designs of Mr. George F. Murphy, of the Fuel Oil Engine Company, of Providence, R. I., and formerly with the American Diesel Engine Company, New York. The engine is equipped with two cylinders 18 in. in diameter by 28-in. stroke, and is to be operated at a normal speed of 165 r.p.m. It is to be of the double-acting, two-stroke-cycle type, with ignition by compression, as in the Diesel engine, but is to be built with a horizontal Tangye open frame and equipped with Corliss valve gear. The exhaust and air inlet ports are cast in the center of the cylinder and are covered and uncovered by the piston, thus eliminating any form of poppet valve. All the working parts are exposed to the full view of the operating engineer, and any part can be removed and repaired without disturbing any other. In operation the engine will compress to about 500 lb. per square inch, starting on air, as with the Diesel engine. The engine is provided with a front and a rear cross-head, and these are adjusted so that the piston is kept floating, thereby eliminating the possibility of cylinder wear and the necessity for reboring the cylinders. Water circulation will be provided through the piston and the piston rod. The crankshaft is built in one straight piece to avoid breakage. The governor is of the enclosed Jahns type, and the speed regulation is designed to permit the operation of alternating-current generators in parallel. The engine will use the heaviest grades of crude oil, and it is expected that it will show good operating results on oil of a specific gravity as high as 10 Baumé. The presence of sulphur or acidulous matter in the oil is expected to cause no trouble in operation, and the anticipated consumption is less than 8 gal. of crude oil per 100 hp-hours. The engine is now being set up at the works of the builders, and will be directly connected to the alternator now at the Margin Street substation, and installed in the main power house at Westerly.

The exciter equipment of the plant comprises two 15-kw belted units and a 35-kw generator driven by a directly coupled induction motor. The machines are excited at 125 volts. The switchboard at Westerly contains nine blue Vermont marble panels, with a central section devoted to generator busbars and switches, and on each side of the generators a section devoted to motor and commercial lamp loads and to street lighting. A totalizing watt-hour meter is installed on each side of the generator section, and these meters are read hourly throughout the entire day and night. Mounted on a gallery above the east end of the engine-room are the transformers for street lighting and transmission service. These include three 100-kw, oil-cooled Fort Wayne units for raising the potential from 2300 volts to 13,200 volts for transmission to Stonington and Mystic; three 100-kw, 6600-volt transformers for the Watch Hill line, and three tub transformers aggregating 75 kw, two being used for incandescent service and the third for arc lighting in Westerly.

The line construction embodies the use of chestnut poles with a minimum length of 30 ft., six-pin cross-arms and insulators of porcelain and glass designed for operation at 20,000 volts. There is no underground construction on the system.

The various centers of load on the system are supplied with energy through step-down transformer substations without the use of rotating machinery of any kind, which arrangement minimizes the attendance necessary. At Watch Hill two 75-kw transformers handle the service; at Fort Mansfield, where about 150 persons reside, a 30-kw transformer is sufficient; at Stonington three 25-kw transformers meet the requirements, and at Mystic three 75-kw transformers handle the business. All of these transformers step the potential down from that of the incoming lines to 2300 volts for local service. There are also at Stonington an 8.8-kw tub transformer for street lighting and a 17.5-kw tub transformer at Mystic for the same service. All of the line work of the system is handled from Westerly, five employees taking care of it. In general, the company strives to do away with small and relatively inefficient transformers, replacing them by fewer larger units and concentrating the loads in groups. The power house requires a staff of six men. One man handles the work at Mystic and two employees take care of the office work at Westerly. Each transformer substation is inspected every other day. The street lamps in the outlying towns are turned on and off by persons of responsibility who are not regular employees of the company, but who are hired to handle this work daily.

The following table gives the operating results at the power station in Westerly of a 640-kw Diesel engine plant for the eight months ending Aug. 31, 1909:

OPERATING COSTS.

Total kw-hours generated	1,233,590
Energy required for operation of compressors, circulating pumps and exciters kw-hours	312,880
Total kw-hours available for distribution	920,710
Gallons fuel oil used	113,708
Gallons fuel oil per available kw-hour	0.12
Cost of fuel oil, including lubricating oil and water	$3,632.—
Cost of fuel oil (as above) per kw-hour available	0.0039
Cost of generating energy, total	8,750.67
Cost of generation per available kw-hour	0.009
Cost of distribution	6,335.73
General expenses	6,462.31
Total cost of energy	$21,548.71

DETAILED COST OF ENERGY

Generating.	
Operating:	
Fuel oil	$3,356.10
Lubricating oil	236.75
Water	39.37
Labor	3,685.43
Miscellaneous	68.52
Total	$7,486.22
Maintenance:	
Engines and compressors	$915.34*
Electrical equipment	58.96
Miscellaneous	[illegible]
Total	$98[illegible]
Superintendence	375.00
Total generating	8,750.67

*Includes general yearly overhauling.

DETAILED COST OF DISTRIBUTION

Operating:	
Street labor	$ 4[illegible]
Street miscellaneous	[illegible]
Commercial labor	1,[illegible]
Commercial miscellaneous	[illegible]
Total	$[illegible]
Maintenance:	
Poles and lines	$2,339.73
Meter and transformers	[illegible]
Miscellaneous	[illegible]
Total	$[illegible]
Superintendence	[illegible]
Total distributing cost	[illegible]
Total cost of energy, generating and distributing	15,086.40
Total cost of energy, including general expense	[illegible]

The company had 1242 customers on Aug. 31, 1909, and of these 70 were motor users, having a connected load of 458 hp. The rates for motors are, in general, from 5 cents to 1.75 cents per hp-hour, with a minimum monthly charge varying from $2 for a 0.25-hp motor to $25 for a $25-hp connected load. The net rate in the stone yards averages from 2 cents to 3 cents per hp-hour. About 250 hp of the company's connected load is located in Westerly, and in Noank a load of 110 hp connected is in service at a shipyard. The motor service usually is provided on the basis of a shutdown of the motors in the stone sheds at about 4 p. m. daily, so that the lighting and the motor peaks do not overlap. The motors in the stone sheds are used mainly for operating air compressors, and the prospects for increased service in this line are attractive. The long steam lines formerly required for this work were expensive to operate and maintain. In the shipyard service the company operates tools in the carpenter and blacksmith shops, and enables the shipbuilding company to work without burning up valuable timber as fuel. In Westerly 26 gasoline engines have been displaced by electric motors, largely on the grounds of superior economy and greater reliability of service. This has been done in the face of the fact that there are two active agencies in the town for the sale of gasoline engines. In several cases motors are used to hoist boats out of the water, the work formerly having been done by gasoline engines. In one representative case a 20-hp gasoline engine in a wheelwright's establishment was replaced by two motors rated, respectively, at 1 hp and 7.5 hp. Four men were formerly required to start the engine in this installation. In the stone yards the speed with which the motors can be started has been found to be valuable, compared with the delays incidental with steam machinery fed through long, crooked and often cold pipes.

The lighting rates run from 16 cents per kw-hour downward, according to consumption, with a minimum charge of $1 per month. Short-time customers at the shore are charged at the initial rate of 25 cents per kw-hour, with a minimum bill of $2 per month, and a 20 per cent discount up to a bill of $12.50. An additional 5 per cent discount applies for prompt payment, and the all-the-year-around customers have discounts of from 5 per cent to 50 per cent according to their utilization of energy. About 300 electric flatirons are in service on the company's circuits. A special rate of 5 cents per kw-hour is made for tailor irons, and these are put on separate meters. A fair average revenue from each of these is $35 per year. Ten such irons are now in service. A rate of $1 per month is also made for meat choppers and coffee grinders, up to ½ hp. The largest motor in service at present is rated at 35 hp, in a stone yard, and the largest individual consumer's transformer is rated at 20 kw. The company supplies 40-watt to 100-watt tungsten lamps for commercial service and sells them at the list price. Free renewals of carbon lamps are made from 4 cp to 32 cp. In general, the maximum rating in a motor permitted on a lighting circuit is about 0.25 hp.

The officers of the company are: President, Mr. William Clark, Westerly; vice-president, Mr. W. L. Mauran, Providence; treasurer, Mr. Thomas E. Steere, Providence; general manager, Mr. H. B. Rust, Providence; local manager, Mr. M. H. Spellman, Westerly. The engineering of the entire plant and the installation of the station was done by H. B. Rust & Company, Providence.

Electric Cranes.

By Warren H. Miller.
Electrical Engineer, Standard Oil Company.

For the purpose of establishing a basis for the discussion of the various types of cranes, it seems well to present first a table giving a fair idea of the 20-ton hand-operated traveling cranes in the market as shown by proposals submitted in a recent competition for a contract, indicated in Table I. The hand-operated crane is well adapted for use in power houses and small machine shops. Moreover, this type of crane costs not over one-half as much as does an electric crane for the same service.

In a hand-operated crane the gear ratio of the overhaul of the bridge should be about 9 to 1, and that of the trolley 6 to 1. It is exceedingly important to have large wheels—not less than 24 in. in diameter—for the bridge; the larger the wheels the easier will be the traveling. When a heavy crane must be operated with a 40,000-lb. engine frame hanging to it, the least inequality of the track becomes a serious obstacle if the wheels are too small. The drum type of hoist is well worth its extra cost over the chain block type. It will not stick at critical

moments, nor let things down with a jar just when smooth, fine handling is desired, and in many ways it has much to commend it over the chain block. The width under the hook, as shown in the table, is of importance, as when multiplied by the length of travel, it gives the number of square feet served by the crane, which should be checked to see that all important machinery can be reached by the hook. Power-house transformers, which must be lifted vertically out of their

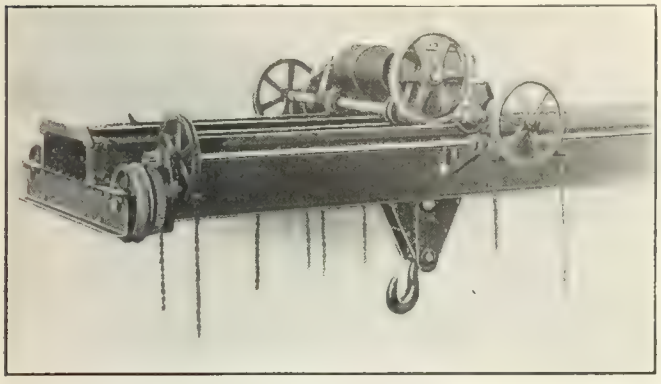


FIG. 1.—HAND-OPERATED 20 TON DRUM HOIST CRANE.

shells, are the most frequent offenders in this respect, being generally placed against walls or in cubby holes or buried under a mass of wires.

In addition to the bare figures of the competition tables, there are many points in all classes of cranes which must be carefully compared. The rigidity of the bridge connections to the end trucks, and the size and arrangement of gears to operate the travel of the bridge, must be carefully studied to see that the crane will have no tendency to twist or run with one side ahead of the other, thus binding the wheels on the runway. The casting of the gears and wheels in one piece is a bad feature, for the loss of a single tooth will mean discarding the whole wheel. The axles, bearings and attachment of the bearings to the truck should be examined to see that it is rigid, will not shake or rattle apart, and will permit rolling the wheel out by some such simple operation as driving a wedge in between the truck and the rail, thus taking the weight off the wheel. The bearings should be so designed as to permit sliding them out horizontally, or else the pin itself should be capable of easy removal for freeing the wheel. Much attention should be given to the strength, ease of removal of wheel and of removal and repair of gears. The

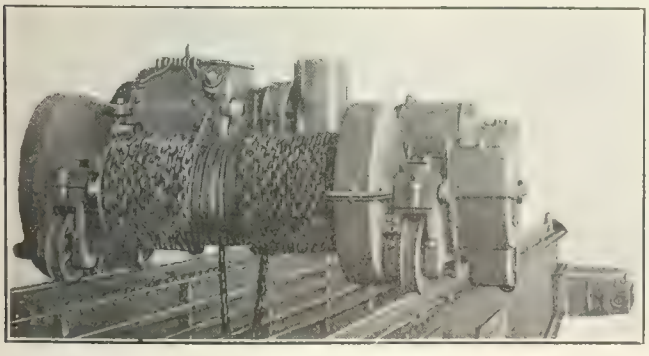


FIG. 2.—DRUM AND GEAR BOXES, ALTERNATING-CURRENT CRANE.

frame should be of either cast steel or structural steel—too many disastrous accidents are already on record from the snapping of cast-iron trolley frames. The gears, if "dust-proof," should be really dust-proof, or else they will prove to be simply dust reservoirs, and the parting lines of the gear casings should be so placed that the oil cannot drip down into the shop below. All of the motors should be checked for strength. A good set of rule-of-thumb formulas for this purpose is here given:

$$\text{Horse-power of hoist motor} = \frac{\text{speed in feet per minute} \times \text{load (tons)}}{11}.$$

$$\text{Horse-power of bridge motor, or of trolley motor} = \frac{1/10 \text{ total weight (tons)} \times \text{diameter axle} \times \text{speed}}{\text{Diameter trolley wheel} \times 13.2}$$

The rating of the generator needed to operate the crane = ⅔ total horse-power of the motors on the crane.

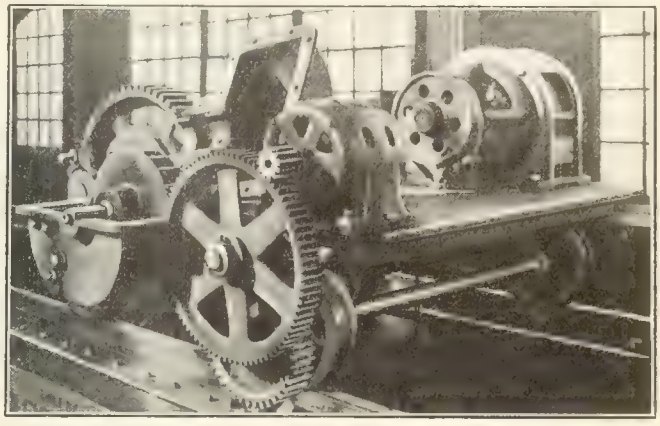


FIG. 3.—FREIGHT SHOP ALTERNATING-CURRENT CRANE.

The next features to be considered are the magnetic and mechanical brakes. The alternating-current and the direct-current magnetic brakes are equally simple and reliable, the former consisting of a solenoid with a core which it tends to draw into the central position with respect to the coil. When three-phase current is used the magnet is connected as a single-phase device; as the total current is only a few amperes, its unbalancing effect is entirely negligible. In the mechanical-hoist brake the idea is to insure the maximum of safety, and to that end the brake in some cranes is set to hold the load up at all positions and the hoist motor simply forces the load up or down over the resistance of the brake. A more durable



FIG. 4.—ALTERNATING-CURRENT GANTRY CRANE.

brake is one in which the wood and steel disks are released at the will of the craneman, but they are normally set.

The function of the magnetic brake is principally to prevent automatically any overtravel of the motor armature or rotor. Its solenoid core is attached to horns which surround a flanged wheel on the stub end of the motor shaft, and releases this wheel when there is current in the circuit. At any other time the motor is locked and cannot turn. In fact, the whole idea of movement control in a well-designed crane is that of

having everything tied up and secure except when released for operation.

Another feature which should be subjected to scrutiny is the provision made by the designer to give access to the motors, gears, and moving parts. The platform reaching the bridge motor should extend completely across so as to allow prompt and easy access to the gears and trucks of the crane at the end opposite the cage, and, of course, the cage itself should be hung at one side of the crane so as not to interfere with the hook when hoisting is being done at the cage end of the crane. As regards the crane girders, for loads exceeding 15 tons, there are available both box and plate girders, full depth and fish belly, and also truss girders. It is a realm of structural engineering where one can choose nearly as fancy dictates, since all have points of excellence, except that there is little excuse for the full-depth girder, as it is unnecessarily unwieldy. The truss type gives a light, rigid crane. With any great depth or length, the plate I-beam type cranes show a very noticeable flabbiness, and the men cannot be induced to accelerate them to full speed because of nervousness as to the safety of the trolley engendered by the quivering and wabbling of the long flat plates. For maximum rigidity, lightness and strength, and good, firm connections to the end trucks, the fish-belly box girder type is excellent.

TABLE I.—HAND-OPERATED CRANES, 20-TON, 63-FT. SPAN.

Maker	Hoist		Bridge Ratio of Overhaul	Price, Dollars	Delivery, Days	Clearance		Type of Hoist	Extra Charge for Erection, Dollars	Type of Plate Girder	Weight, Lbs.	Clearance Under Hook, Feet
	Height, Ft.	Speeds				Side, Ins.	Head, Ins					
A1	15.25	2	..	1,590	14	7.00	51.25	Block	200	Fish belly	32,800	57.7
A2	17.25	2	..	1,520	14	7.00	57.75	Drum	200	Fish belly	32,800	58.0
B	17.25	3	7:1	1,985	30	7.25	46.25	Drum		Fish belly	28,000	57.8
C	19.00	2	9:1	1,815	30	7.00	64.00	Block		Girder		59.2
D	15.25	..	..	2,103	21	7.00	51.00	Block	200	Fish belly		59.2
E	19.00	2		2,195	30	6.62	61.50	Drum	225	Girder	33,800	57.7

The contract was given to A2.

TABLE II.—THREE-PHASE CRANE MOTORS FOR 220 OR 440 VOLTS.

25-Cycle Crane Motors				60-Cycle Crane Motor			
H.P.	R.P.M.	Weight lb.	Price	H.P.	R.P.M.	Weight, lb.	Price
4.5	650	745	$236	3.0	950	470	$111
7.5	670	1,010	264	4.0	950	550	132
15	680	1,570	345	7.5	1,450	580	153
22	690	1,720	390	11	820	1,060	287
27	460	2,510	501	15	820	1,110	294
37	680	2,250	492	18	650	1,410	362
				22	1,100	1,150	303
				22	650	1,600	394
				37	550	2,380	540

Direct-current cranes are so well known that only a few comments are needed here. Five years ago they were more or less of a nuisance, as the gears were poorly protected and the motors less so. At least once a day compressed air had to be used in cleaning the motors and gears, particularly in foundry and forge-shop service, and all motor commutators, brushes, controller fingers, etc., had to be inspected and cleaned, oiled or adjusted. The direct-current cranes of the present day are far neater and more dust-proof than the earlier designs, but the commutator and controller troubles have not been eliminated, and they bid fair to remain because of the persistency of the direct-current arc.

The principal advantage of the direct-current series motor is that it will increase its speed at light loads, and the heavier the load the slower the lifting and the stronger the pulling. As the vast bulk of shop loads are much lighter than the full rating of the crane, the tendency of the series motor to run at high speed under light load results in a great saving of time. This is the only real advantage of the direct-current over the alternating-current crane, and it may be completely offset by the fact that since the bulk of shop loads are light the speed of the hoist can be designed accordingly, dependence being placed upon the big overload range of the alternating-current hoist motor for the heavier loads. The writer has installed and used alternating-current cranes ranging in rating from 120 tons down to 5 tons for all services including such delicate work as setting flask copes in a foundry, and the weight of experience with both types, extending over a number of years, is entirely in favor of the alternating-current crane. It is not strange that the reverse opinion should be almost universal. Most of the crane companies build their own direct-current motors and, naturally, their effort toward the engineering public, ignorant of this specialty, is to suggest the use of direct-current cranes as much as possible for the sake of the motor and repair sales. One is told that the alternating-current cranes are slow in starting, have little or no overload range, fail to hoist whenever something a little above normal is needed in emergency, are clumsy and inaccurate in handling the hoist, and represent only about 4 per cent of the crane business. Even the magnetic brake is harped upon, and the purchasing engineer is scared into believing that it has special and dreadful troubles of its own.

Here are facts taken from practical experience: A 20-ton, alternating-current crane, constantly handling large castings in a machine shop, has lifted pieces weighing up to 28 tons as part of its daily work during the last five years. A 15-ton, alternating-current crane handles all classes of fine-plate fittings in a boiler shop, and as part of its regular work carries the curved plates out of the bending rolls—an operation requiring the most exact handling, because both the crane hoist and the bending roll motor must work at precisely the same speed of the plate will be defective. A 5-ton and a 30-ton alternating-current crane, working together in a foundry, per-

TABLE III.—THREE-PHASE, 25-CYCLE CRANES, 15-TON, 47-FT. SPAN.

	Hoist		Trolley		Bridge		Price, Dollars	Delivery, Days	Clearance			Weight, Lbs.	Gear Covering
	H.P.	Feet	H.P.	Feet	H.P.	Feet			Side, Ins.	Head, Ins.	Rail to Top, Ins.		
A	27	16	7.5	100	20	250	4,720	40	8.5	48	78	45,000	Enclosed
B	22	14	4.5	125	15	250	6,150	90	10.5	42	84	45,500	
C	22	14	3.0	100	18	250	4,690	90	8.0	40	70	34,900	Enclosed
D	27	18	6.0	100	22	250	4,600	45	8.0		82	42,000	Enclosed
E	22	18	3.0	125	20	320	4,692	104	6.6		74	38,000	Open
F	27	16	4.5	100	22	275	4,700	45	8.5	..	81	48,000	Open
G	37	23	4.0	100	18	250	2,600	60	9.0	..	81	34,000	Open
H	25	16	5.0	100	25	250	4,595	90	7.5	58	84		Open

The contract was given to D.

form all the delicate work, such as hoisting and setting large copes, etc. All of these cranes start and stop with the same promptness as do direct-current cranes. Repairs were never more serious than a few controller fingers in two or three years. No one has been near the motors of the crane in the boiler shop during the last seven months, except once to fill the oil reservoirs of the journals. In the case of this same crane, some trouble was at first experienced with the speed, which was set at 18 ft. per minute for 15 tons. Since an induction motor cannot go faster than synchronism, 18 ft. per minute was the limit of hoist speed, no matter how light might be the plate. This speed was entirely too low, and hence the gearing was at once changed to give a speed of 40 ft. per second. With this speed all of the regular shop work is conducted smoothly, and for a large part of the time 10-ton or 12-ton loads are being lifted with no abnormal heating of the motor. What actually happens is that the speed of the motor decreases under such loads and the motor carries about 40 per cent overload for the short time while load is being lifted. When it is recalled that all induction motors are sold with a 25 per cent continuous overload guarantee at 50 deg. C. rise, it will be appreciated that the extra 15 per cent is no especial hardship, whereas with the direct-current motor the limit of its practical load is soon reached because of the excessive sparking of the brushes. The temperature of the induction motor may increase slightly, as will also that of the direct-current motor, but it is not necessary to sandpaper any commutator, and no one worries about the extra heat in the least. The above-mentioned crane has been in operation for two years and gives entire satisfaction with the 40-ft. speed of hoist, the overload range of the motor being utilized for lifting heavy loads.

Concerning the magnetic brake, a moment's consideration of the fact that a solenoid works equally with alternating current as with direct current will convince one that no particular trouble may be expected from that source, nor has any been yet reported among the cranes under the writer's jurisdiction.

Table II will serve to give an idea of prices and other data relating to three-phase cranes.

All alternating-current crane motors are induction machines with provision for inserting resistance in the secondary circuit. The controllers are of the usual street-car drum type and the rheostats are hung in the crane cage. As the alternating-current arc is not nearly so persistent as is the direct-current arc the depreciation of controller fingers is much less than with direct-current controllers. Table II gives a list of alternating-current crane motors designed for 60-cycle and 25-cycle, with approximate prices. Table IV is laid out with a set of suitable crane rails, runway girders and wheel loads for various sizes of cranes, either alternating current or direct current.

TABLE IV.—CRANE INSTALLATION DATA.

Tons	Span, Feet	Rail, Lbs. per Yard	Rail, Height, Inches	Truck Wheel Span, Feet	Clearance Side, Inches	Wheels		Runway Girder			
						Number	Load on Each, Lbs.	Web, Inches	Flange, Inches	Top, Inches	Bottom, Inches
10	72	40	3.5	15	5	2	22,600	80-lb I-beam	80-lb. I-beam	80-lb. I-beam	80-lb. I-beam
15	47	50	4.9	15	9	2	22,000	30 x 0.50	5 x 3 0 x 0.375	12 x 20 lb.	
20	65	60	4.25	22	10	2	39,900	30 x 0.50	5 x 3.5 x 0.5	12 x 0.375	12 x0.375
30	70	60	4.25	22	12	2	58,000	33 x 0.50	5 x 3.5 x 0.5	12 x 0.375	
100	72	100	5.75	22	18	4	51,000	45 x 0.75	5 x 5.0 x 0.75	15–50 lb.	12x1

In conclusion, it may be stated that where direct current is immediately available there is no especial disadvantage in using direct-current cranes, but where alternating-current is used it is unnecessary to install special converting machinery or extra circuits from the exciter generators for supplying energy to direct-current cranes, because alternating-current cranes give even better service.

Electrical Engineering at the University of Birmingham.

By J. H. Aswell.

During the present year there has been inaugurated in England a university which provides an education of a more commercial character than that provided by the older universities of Oxford and Cambridge. Commerce and engineering are the outstanding items in the curriculum of Birmingham University. Of the applied science side, electrical engineering is certainly catered for to a very large extent.



FIG. I.—GENERAL VIEW OF BIRMINGHAM UNIVERSITY BUILDINGS.

The full courses extend over four years, and should the student have matriculated before entering, he is, on the completion of that time, eligible for the degree of Bachelor of Science

in Engineering, provided the necessary examinations and practical work have been successfully completed. In his first year the student attends special classes in mathematics, physics and chemistry in addition to engineering lectures, drawing and workshop. Chemistry is dropped in the second year, and further lectures in mathematics, physics and engineering are taken. In his third year he devotes his whole time to engineering and mathematics, accounting taking the place of the latter in the fourth year.

The university has been fortunate in securing the services of men well known in engineering circles. Professor Kapp and Dr. Coales are at the head of the electrical section, and, needless to say, the students benefit to a very large extent by the world-wide experience of the former.

Turning now to the actual equipment. In the power house, which supplies energy for lamps and motors required by the whole of the extensive buildings, are machines of widely divergent types, which are tested by the students under working conditions. They are coupled to high-speed and low-speed steam engines and gas engines and to turbines. There are high-voltage and low-voltage machines, of both the direct-current and alternating-current types. Alternating current is supplied to a Siemens machine in the storage-battery house, which drives two 240-volt generators for charging the respective halves of a 440-volt battery of E. P. S. cells which is used for lighting several of the buildings and the women's hotel. Ample means are provided for giving any of the machines artificial loads, inductive or non-inductive. In the power station is Professor Burstall's "Premier" gas engine on which he has obtained the record thermal efficiency of 42 per cent.



FIG. 2.—BATTERY HOUSE.

The main electrical laboratories occupy a block of the main buildings about 900 ft. away, and cover an area of 10,000 sq. ft. On the lower ground floor is the senior laboratory; in one corner is a small workshop for making new apparatus that may be required for the department or for carrying out repairs to that already in use. One side of this floor is reserved for cable and transformer testing, while the other is fitted with testing beds and fixed machines, as shown in Fig. 3.

At the present time there are on the test beds many types of generators and motors; among the chief are: a Déri single-phase commutator motor; a Winter-Eichberg single-phase motor controlled by movable brushes; a small Westinghouse rotary converter; a 10-hp Holmes-Lundell motor; a meter-testing set comprising three machines—the generator has a swiveling stator so that any phase difference can be obtained. There are also tramway, crane and induction motors of various types, and a Rosenberg train-lighting generator in addition to other small motors and generators.

Before detailing the fixed machines it will be necessary to enumerate the different currents and voltages which may be obtained within the laboratory, namely: direct current up to 250 amp at 110 volts or 220 volts, and from 300 amp to 600 amp at from 2 volts to 12 volts; three-phase, 50-cycle and 30-cycle current at 200 volts up to 40 kw.

A battery-room is situated below the large switchboard at the south end of the laboratory. The main battery consists of 112 cells of the E. P. S. central-station type, having a normal discharge rate of 40 kw at 220 volts. There is also a battery of six cells for obtaining low pressure of from 2 volts to 12 volts. The leads from these latter are connected to a plugboard close to the main board and distribution to the isolated laboratory circuits is effected from that point.

The main switchboard of seven panels is used for controlling the battery charging and the various supply leads. It was designed by Messrs. Siemens Brothers, of Stafford, and is equipped with many styles of instruments so that students may compare them under actual working conditions. All the currents stated above may be obtained even while the battery is being charged. The various pressures are regulated by the apparatus and machines in the laboratory, so that no one portion of the battery will become discharged more than another. This arrangement avoids any deterioration due to constant overcharging, which would accrue if the current was drawn from different points.

The battery is charged from the direct-current 110-volt supply system by a British Thomson-Houston 28-kw set. If it is necessary to charge from the alternating-current side a 30-kw rotary converter, made by Brown, Boveri & Company, is available. Hence the charging of the battery is not so dependent on the power station as would be the case if energy was procurable from only one source.



FIG. 3.—SENIOR ELECTRICAL LABORATORY.

The fixed machines are run to deal with the various supplies as follows:

The 220-volt direct-current supply is obtained from a battery, pressure variations being taken up by a Thury automatic reversible booster, built by the Compagnie de l'Industrie Electrique, of Geneva. A 30-kw motor-generator set enables energy at 220 volts to be obtained while charging, the critical pressure being regulated by the Thury booster. For the 110-volt supply the rotary converter is run from the direct-current side and current is taken from the middle point of the auto-transformer as a neutral point and from one main lead. The low voltage direct-current supply is obtained from the battery, but where special regulation is required the main booster can be utilized in addition to the large cells mentioned above.

For 50-cycle alternating current a direct-current motor run from the 220-volt system drives a 25-kw alternator. This set was built by the Brush Electrical Company, of Loughborough. The 30-cycle supply is obtained by running the converter from the direct-current side.

In addition to the connections to the main board, each set has its own special switchboard; Fig. 4 represents the panel of such a board, which is provided for the alternator of the [illegible]. The alternator can be star-connected or delta-

connected, giving either 70 amp or 103 amp at from 30 cycles to 50 cycles. It is driven by a "Castle" type 220-volt motor. The terminals on the lower portion of the right-hand panel enable the alternator to be coupled up to any of the three-phase loads or ring mains. These auxiliary panels enable any experimental work to be carried on without interfering with the routine work

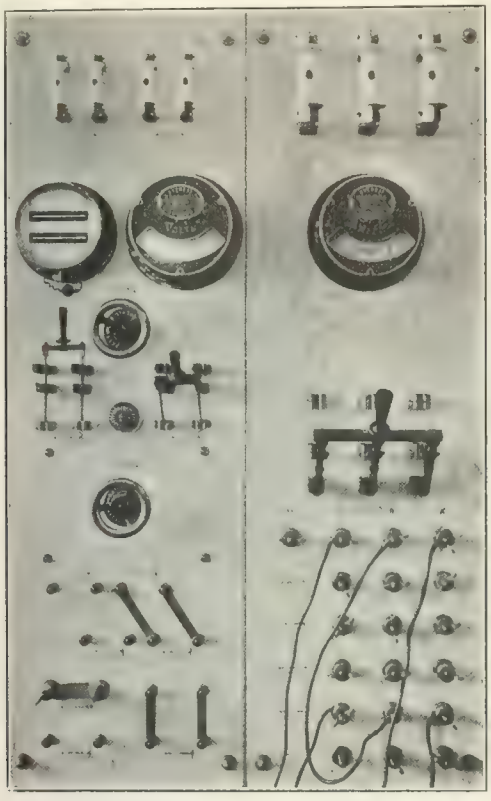


FIG. 4.—A MACHINE SWITCH PANEL.

of the department. On each panel are terminals which permit any pressures or currents to be transmitted to a standardizing-room which contains accurate standard instruments, oscillographs and other special apparatus. All of the switchboards within the building are protected at the rear by expanded-metal guards, so that they may be examined by the students without danger.

On the upper ground floor are the professors' rooms, stores,

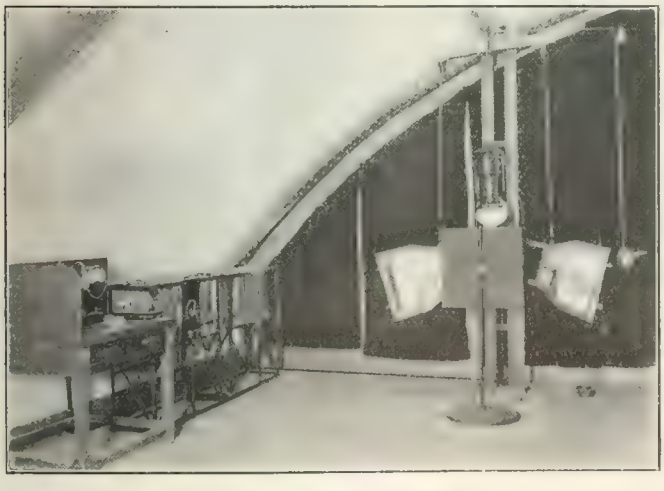


FIG. 5.—ARC LAMP PHOTOMETER.

departmental library, research and junior laboratories. Rooms are equipped for photometric and ballistic work. Many of the fittings are decidedly novel and speak volumes for the efficient organization of the department. In all of the laboratories are boxed switches and terminals so that energy can be obtained in any form desired. The lecture-rooms, the largest accommodating 400 students, are similarly equipped with switchboards so that any desired current can be obtained for demonstration purposes.

On an upper gallery is the arc-lamp photometer, shown in Fig. 5. The arc is shielded from the photometer by an opaque screen, the light being reflected from mirrors which may be adjusted to any angle. The bench to be seen on the left of the illustration is used by the operator controlling the arc being tested. A Lummer-Brodhun photometer is 10 m distant, a carbon-filament lamp being used as standard. A museum contains samples of materials for the construction of electrical apparatus, besides many spare parts of small machines. These have been presented or loaned by firms anxious to show their appreciation of the work undertaken by the university; an especially interesting exhibit is the first Edison "Z"-type dynamo, made in New York in 1881.

The chemistry department is well equipped for conducting research in electrochemistry and metallurgy. The equipment, which is almost identical with that of the physics department, consists of a 240-amp-hour battery of Tudor cells; a motor-generator giving 100 amps at 65 volts; a motor-alternator set running at 750 r.p.m., giving 35 kw, single-phase. The

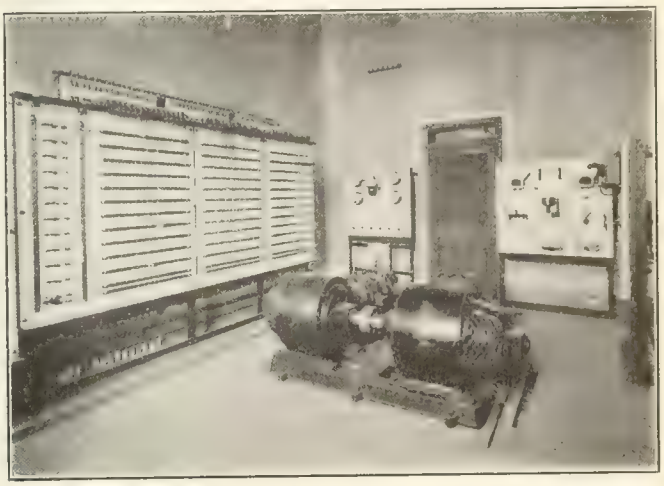


FIG. 6.—MACHINE ROOM AND PLUGBOARD IN PHYSICS DEPARTMENT.

armature of the latter is made in four sections, each giving 350 amp at 25 volts, which can be put in series or parallel. The field current is obtained from the battery.

The main plugboard, illustrated in Fig. 6, is in the dynamo-room; it distributes energy to the subsidiary boards in the laboratories. Heavy bars extend to the electrochemical laboratory, for a Moissan furnace, capable of carrying 1500 amp. The equipment of these two latter sections—physics and chemistry—has been entirely in the hands of Messrs. Steinthal & Boydell.

Mention must be made of the University of Birmingham Engineering Society, which is responsible for that most creditable production, the *Birmingham University Engineering and Mining Journal*, and for the holding of various meetings and visits, so that the students may discuss questions and obtain knowledge of such a kind that is not usually imparted in the regular lecture courses.

Alternator Giving a Sinusoidal E. M. F. Wave.

In a patent issued on Oct. 5, 1909, to Dr. C. P. Steinmetz, upon an application filed Aug. 13, 1908, there is described a method of so arranging the armature winding of an alternator that the e.m.f. wave will be substantially free from all of the harmonics below the thirteenth. Use is made of a three-phase star-connected winding, which produces no third or ninth harmonic in the e.m.f. wave. There are nine slots per pole and each coil spans seven slots, or has a 7/9 pole-pitch. Since this value is approximately 4/5, the fifth harmonic is

eliminated in each coil and hence does not appear in the phase e.m.f. The conductors of each phase winding are not grouped in the usual manner with three coils at each pole, but the groups at the several poles differ in the number of coils per group, so that half of the coils of the phase winding are displaced from the other half by 1/9 of the pole-pitch. This value is sufficiently near 1/7 to eliminate substantially from the e.m.f. wave both the seventh and the eleventh harmonics.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Tungsten Lamp Prices in Chicago.

Tungsten lamps are now supplied by the Commonwealth Edison Company, Chicago, at reduced prices in renewal for standard carbon lamps. When carbon lamps are returned by the customers tungsten lamps are given in exchange at the following prices:

25-watt	clear	$0.45	
40	"	0.50	(small size)
40	"	0.55	(large size)
60	"	0.60	
100	"	0.80	
150	"	1.10	
250	"	1.60	
40	Meridian	0.65	
60	"	0.85	

The company makes an additional charge of 5 cents a lamp for frosting.

Central-Station Exhibit at Local Fire Company's Indoor Fair.

The Columbia Electric Light, Heat & Power Company, of Columbia, Pa., recently took advantage of an excellent opportunity for inexpensive but valuable advertising, when, in connection with an indoor fair held by a local fire company, it conducted a most attractive exhibit and demonstration of electric household appliances. The illustration shows the excellent arrangement of the booth, which always held the attention of many interested onlookers.

The fair was held from Oct. 14 to 25, and in view of the worthy cause, attracted large crowds, among whom were the city's best and most substantial householders. The display, which was an expense of less than $50, was pronouncedly the "hit" of the fair, and the company has been the recipient of many expressions of congratulation from both public and press.



CENTRAL-STATION EXHIBIT AT COLUMBIA, PA.

Electric Energy Used in Government Work at Buffalo.

The United States Government is spending $1,000,000 in deepening the channel from the foot of Main Street to Black Rock, Buffalo, and in building a ship lock. The lock will be 817 ft. long, 70 ft. wide in the clear, the walls are to be 26 ft. at the base, 8 ft. at top and 53 ft. high. In pumping the water electric motors were used, energy being supplied by the Cataract Power & Conduit Company from the Ontario Street terminal house. The pumping equipment was as follows: Two 12-in. Buffalo Pump Company's centrifugal pumps, one belted to a 200-hp Westinghouse three-phase, 25-cycle induction motor, and the other to a 100-hp motor of same make and type, and a 15-in. pump driven by a 200-hp motor. These were installed at one end of the cofferdam, while another is now being installed near the other end to pump out the water which comes from springs and leaks. The motor is rated at 200 hp. The lift is 45 ft. and the rating of the pumps are as follows: 12-in., 4200 gal. per minute and 15-in. pump, 7000 gal. per minute. A temporary transformer station was erected, the transformers stepping the e.m.f. from 11,000 volts to 2200, which was used at the motor.

Central-Station Float in Industrial Parade.

During the recent industrial exposition held in Rochester, N. Y., the Rochester Railway & Light Company in addition to supplying the energy gratis used in the illumination, had a float in the industrial parade forming part of the exhibit. The float, which is shown herewith, was built on a two-ton electric truck, the battery of which furnished energy also for a motor-driven triplex pump, shown on the rear of the wagon. The pump was employed to circulate water over a cascade, the water being collected in a tank at the bottom of the vehicle and returned to



FIG. 1. FLOAT ON ELECTRIC TRUCK.

the top again. Along the line of march three barrels of water were kept in readiness as a make-up for whatever water was spilled from the wagon en route. On either side of the front of the wagon was a model holding a wand tipped with a 60-



FIG. 2.—VIEW OF ELECTRIC PUMPS ON FLOAT.

watt tungsten lamp. Suitable signs were displayed on the sides of the float so that they who ran might read, and the cascade was appropriately set off with branches and rustic foliage.

Discussion on Consumers' Deposits at the Illinois Convention.

At the Illinois Electric Association convention in October there was some discussion of the question of requiring a cash deposit from new consumers of electric lighting companies in order to secure the company against bad debts. Mr. David Davis, of Litchfield, said that at Litchfield he had adopted the plan of the Laclede Gas Company, of St. Louis, of requiring either a deposit from a new consumer or the signature of the owner of the property on the application. He argued that since the owner of the property, or landlord, is usually much better posted as to the credit of a prospective tenant than is the manager of a lighting company, it is logical to require his endorsement of the application. In fact, in the case of one water company the water bills are made out against the property owners only and are included in the rent. He thought that gas and electric service might come to be considered the same way. Mr. E. W. Smith said that the plan of requiring a deposit is used at Kewanee. Mr. N. M. Argabrite, of Belvidere, accepts the signature of any property holder in the town, because sometimes a tenant does not like to go to a new landlord for such signature, and he might be scared away from the company's service. Mr. F. H. Golding, of Rockford, said that it costs his company 0.4 per cent to collect its bills, and that the losses are not over 0.25 per cent. Mr. Frank J. Baker, of the North Shore Electric Company, Chicago, said that the Wisconsin commission had upheld the policy of requiring a deposit of new consumers. The consumers submit more gracefully to making such a deposit if that fact is known. However, Mr. Baker did not favor the deposit scheme for general application, and his company requires deposits only in extreme cases, where the credit is known to be bad. It creates a bad impression on a consumer to be met with a demand for a deposit as soon as he starts to do business with the company. It is one of the things which make people wish for a competing company in a town. The company should not err on the side of being narrow. In the electric lighting business, where people do not have to use electric light, they do not seem to object so much to the deposit as in the water business, where the consumers feel that they are entirely in the power of the company, because water is a necessity.

Mr. H. J. Pepper, of Champaign, said that he did not think much of the deposit scheme when the parties are known. Mr. E. L. Brown inquired: "Why require a deposit from a new consumer when other lines of business do not?" A man starting in business in a small town is given credit by everyone for a time. The electric lighting company takes smaller chances than many other tradesmen with a new customer, and it creates a bad impression if a deposit is required.

Mr. John F. Gilchrist, of Chicago, called attention to the fact that the People's Gas Light & Coke Company, of Chicago, with its thousands of consumers, requires no deposit from new consumers, unless they have been previously connected to the company's mains and failed to pay their bills. The Commonwealth Edison Company, with its thousands of consumers, does the same thing. He did not favor starting relations with new consumers by treating them as suspicious characters. In cases where the new consumer's credit is known to be bad, a deposit is required, but if his bills are paid promptly for a period of 18 months this deposit is returned with 5 per cent interest.

Electric Power at the Illinois Convention.

Mr. F. H. Golding, manager of the Rockford Electric Company, presented a paper entitled "Power" at the Illinois State Electric Association convention at Alton, in October, of which an abstract follows:

Mr. Golding said that a decade ago the value of a power consumer, and consequently his rate, was based entirely on kw-hour consumption, but since people have come to realize that to give an improved station load factor, thus also bettering the net returns to security holders, more careful consideration must be given to the other vital elements governing the desirability of power business. The most important of these greater considerations are hours of usage, load factor and capacity demand.

Hours of usage can probably be taken as the most important factor in making a power rate, and the consumer whose business can be regulated to suit an "off peak" schedule as well as the 24-hour consumer with a fair load factor, such as a paper mill, refrigerating plant or knitting mill, must be considered as much more desirable than the 10-hour consumer whose power overlaps the lighting peak, and should in consequence be entitled to a much lower rate.

The load factor is a very essential feature of power business and should receive careful attention. The burden imposed on the central station by an installation with a low load factor should be, at least in part, borne by the consumer in the form of a proper adjustment of rate.

In determining a rate the capacity demand is a question which requires judicious handling, as if a general rule basing it on horse-power connected is followed, a hardship is imposed on the consumer with individual motor drive and on the one who purchases larger motors than are necessary at the time, with a view of providing for the future expansion of his business. Undoubtedly the most satisfactory method of arriving at the capacity demand element is by the installation of recording maximum demand indicators, the demand being based upon the average of a predetermined number of peaks, of three or five minutes duration each, occurring in any one month. In cases where the cost and maintenance of maximum demand indicators would not be justified, fairly good results may be obtained by basing the capacity demand upon the connected transformer capacity when alternating current is used and upon control of

fuse sizes or with a circuit breaker when direct current is used.

The most equitable power rate is one which embodies a suitable readiness-to-serve charge per kilowatt of maximum demand plus the current consumed at a meter rate, the flat charge to cover a proper proportion of general expense, distribution expense and investment charges and the meter rate to be based on station costs plus a suitable profit. In cases wherein the central station can control motor sizes and thus assure a reasonably high load factor, a demand rate with readiness-to-serve charge based on horse-power connected is applicable, but such a rate cannot in fairness be used to cover all installations.

In planning a systematic power campaign it is well to obtain complete and accurate data on each plant which may be considered a prospect. This data should embrace operating costs in detail, size, make, age and condition of the various classes of equipment, original cost of equipment, general condition of power plant and any other pertinent or unusual facts which might have a bearing on the subject. If possible the engine, or engines, should be indicated and a record of the average and maximum loads thus obtained. It is seldom wise to accept the prospective consumer's estimate of his requirements in lieu of the engine indication, as the average manufacturer will invariably overestimate the horse-power used in his plant.

Information of this character is not usually difficult to obtain, because as a general rule a factory manager either has so little knowledge of his costs that he is glad to have an expert work them out for him, or else he thinks he is making power cheaper than the central station can sell it and will give the desired data for the purpose of demonstrating to the power man that he (the factory manager) knows the business better than the central station does.

With an accurate report of this nature before him it is comparatively easy for the central-station man, before opening negotiations with the prospect, to determine whether a proposition can be made which will interest him and can also avoid the humiliation of submitting a power proposal to a manufacturer only to be shown that he is already making his own power cheaper.

Soliciting power does not bring as quick returns as the same effort on light solicitation, because as a rule a considerable investment on the part of the prospective consumer is involved and the average manufacturer must be convinced that the expenditure of a large amount of money is justified. One company which kept a man on power exclusively for two years is now trying the experiment of training lighting solicitors in power work and eliminating the special power man, with excellent results thus far, the theory being that, whereas the power man's frequent rebuffs tend to cause him to lose heart, the mixing up of light solicitation with power enables the representative to secure some business and so keeps him from becoming discouraged.

In the effort to secure the larger plants, it should not be lost sight of that it only takes a few little fellows to equal a big one, and that the former is usually much more profitable than a single consumer. One Illinois company recently decreased its direct-current district and in the course of reconstruction replaced about 350 hp in direct-current motors with alternating-current units. This company's restricted direct-current district was generally supposed to be "saturated," but within three months every one of the motors involved in the 350-hp exchange had gone back on the company's lines and the largest single installation was not over 15 hp. The average revenue from this lot of motors is easily 7 cents per kw-hour, whereas the company would undoubtedly be glad to get a single installation of the same size and load factor as this aggregate, at little more than a third of 7 cents.

DISCUSSION.

Mr. Golding was asked whether at Rockford it is the practice to collect a fixed charge from a consumer. He replied in many cases such a rate prevailed, the charge being $25 per horse-power connected per year, plus 3 cents per kw-hour for motors of less than 50 hp. A certain New York State company which buys from Niagara purchases and sells by what is called a firm horse-power, a term apparently peculiar to the locality of Niagara. This firm horse-power is determined by taking the average of three five-minute peaks during a month. In determining maximum demand at Rockford a curve drawing watt-meter is frequently used. Mr. Frank J. Baker, of Chicago, said that it is desirable to have some uniform method of determining peaks of consumer's loads. Connected load is not a correct basis.

Mr. H. C. Morrell, of Whitehall, told of a flour mill running constantly which has a steam plant costing its owner $100 per month to operate. He wanted to know whether he could safely agree to operate a motor at that figure. Mr. Baker suggested that the best plan would be to put a motor in on trial. This would demonstrate two things. It would tell the amount of power actually required and show the owner the convenience of the motor so that he would not be willing to give it up. Another member testified that motors put in on trial always stay. Mr. Linn, of Bloomington, said that motors put out on trial in his experience never come back.

Mr. J. G. Learned, of Chicago, suggested that a good move for a company just entering the power field is to try to secure the contract for pumping city water. Besides being a good kind of load to have it has a good moral effect on other power users, and helps to inspire confidence in electric power. When putting in motors on trial it is sometimes a good plan to give the consumer a year to pay for his motor. If a motor has only been in operation for several months the consumer's power plant gets so disorganized that he cannot start it up again.

Mr. N. M. Argabrite, of Belvidere, said he found that in building up an electric power load it was necessary for the company to take most of the chances, as the consumer will not take any.

Mr. H. R. Kingman, of Mt. Vernon, reported operating a 40-hp Wagner single-phase motor from a 75-kw generator. The motor is on its own feeder and runs 24 hours per day, pumping water. This was in answer to a question of a member as to the largest size of a single motor connected to a given generator capacity as operated by members.

INTERIOR WIRING AND ILLUMINATION

Electrical Wiring in Denver.

City Electrician J. F. Reardon, of Denver, Col., in a recent paper read before the business department of the Denver Gas & Electric Company, stated that during 1908 6000 permits were issued by his office and over 10,000 installations were inspected. The fees derived from these permits were about $10,500, making the electric inspection department self-sustaining.

The strict enforcement of the present wiring ordinance has been, he said, the means of establishing a better grade of wiring, and the wiring installed at the present time in Denver is on a par with that of the largest Eastern cities.

The city wiring ordinance gives the city electrician the power to decide all questions not provided in the ordinance and to make rules and regulations of a technical nature that may be deemed necessary to make the installation of electrical conductors and appliances as safe as possible. Under these sections several circular letters have been issued from time to time to electrical contractors interpreting the rules of the ordinance, thereby helping the electric wiremen in their work.

From time to time these letters have established a conduit system of installation in different classes of buildings with the result that at the present time all wiring in new buildings must be in iron-armored conduits. In old buildings concealed wiring must be installed in an iron-armored conduit where possible. Switch loops and wall outlets may be installed in flexible metal

conduits and open wiring in an approved metal molding.

The National Code, which is a part of the electric wiring ordinance, allows 1320 watts on a circuit for temporary work. To encourage the use of sign and display lighting the electrician has ruled that the same amount of watts may be used permanently on this class of work. All signs now used in Denver are made complete of metal with all wires concealed. This makes a first-class job of wiring and eliminates any fire hazard that might exist from wooden construction.

Special attention is paid to the inspection of theaters and moving-picture shows. Inspections are made weekly of the electrical apparatus of traveling companies to prevent, if possible, a repetition of the Chicago Iroquois fire. A licensed electrician is required to stand at the switchboard on the stage during all the performances, also a man at each arc lamp. These men are trained in their duties and feel the responsibility for them.

Lamp cord of any description is not allowed to be used on the stage except for low-voltage battery work. Exposed live contacts, such as switches, binding posts for wires and the like, are entirely eliminated. All such apparatus is enclosed in metal cabinet. A fine wire mesh is required in front of an arc lamp to prevent sparks from flying to the scenery. Exit lights are kept burning during the whole of the performance and are controlled independently of all house switches. In moving-picture theaters the arc lamp for the picture machine is enclosed in a large sheet-iron cabinet. The doors of the cabinet are held open and arranged to close automatically with cotton cord and fusible link.

Denver, he said, has been very fortunate in not experiencing any severe fire from this class of building. The films used in picture shows are very inflammable. Several serious fires with loss of life trace their origin to picture films. In the city of Old Mexico about a year ago 300 lives were lost in a theater where a special picture was being exhibited for the benefit of some high officials of the State. Only a short time ago an explosion occurred in a film factory which carried with it the loss of a dozen or more lives and the total destruction of the building. Mr. Reardon considers that too much caution cannot be used in the inspection of moving-picture theaters.

Electricity in Buffalo Churches.

For many reasons lighting by electricity is favored by churches. Central stations also look upon this business in a favorable way as the energy is used mainly on Sundays when mercantile establishments are closed. Besides lighting the interior, churches now use electric signs and other electrical decoration outside. Most large churches having pipe organs also use motors for pumping the organs, and some use them in connection with the ventilating systems. Of the 200 churches in Buffalo, 78 use electricity. All new churches are now wired. The Buffalo General Electric Company supplies energy, to 60, one gets energy from a downtown office building, while the others have private plants. St. Ann's and Corpus Christi churches have the largest plants, the first having two dynamos of 35 kw and 15 kw, respectively, connected directly to two gas engines, a one-story concrete building in the rear of the church being used to contain this equipment. At this church two motors, one 5 hp and one 7 hp, are used. The electrical equipment installed in Corpus Christi, which has just been completed, consists of two direct-current generators, one Allis-Chalmers 30-kw directly connected to a 55-hp Bruce-Meriam-Abbott Company's vertical, twin-cylinder gasoline engine, and one 9-kw Bruce-Meriam-Abbott unit driven by a 15-hp vertical twin-cylinder gasoline engine. The gasoline is kept in a buried tank, about 15 ft. from the building, and small pumps on the shaft of the engines are used to draw it as needed. The engines are started by air, a 1-hp motor being used to run the compressor. In a separate fireproof room a storage-battery equipment is located. The rear of the basement of the church is used for the plant and it is the intention also to supply the rectory, convent and parochial school with electricity.

Large Electrical Sign on an Atlanta Dry Goods Building.

By S. Mays Bell.

The sign as shown in the accompanying photograph was recently erected on the top of the building of the Bass Dry Goods Company, Atlanta, Ga. The monster "B" in the picture is the first of four letters which complete the word "Bass." When the lights were first turned into the great sign in the middle of September last—over 250 electric lamps in full glow—the sign was easily visible 20 miles away from Atlanta. The sign in Atlanta can be easily seen and read in Marietta, Decatur, Lithonia and other suburban towns within an average radius of 20 miles away.

The sign as shown in the picture is composed of only four letters, but each letter is 12 ft. high and the width of the single word, B-A-S-S, is nearly 50 ft. The "B" letter itself contains 77 electric lights. The stem of this letter is 14 in. wide. It occupies 8 ft. of space and fills a total area of 64 sq. ft. The bottom of the letters in the sign is 30 ft. above the roof of the



VIEW OF ELECTRIC SIGN COMPOSED OF 12 FT. LETTERS, IN ATLANTA, GA.

building. The sign itself is erected upon a steel frame which can be seen in the picture.

The sign was erected and equipped for the Bass Dry Goods Company by the electric sign department of the Georgia Railway & Electric Company, of Atlanta. It was made in Knoxville, Tenn., by the Greenwood Advertising Company, to whom we are indebted for the photograph used. Thirty days were required for building the sign, which was shipped to Atlanta in a specially constructed furniture freight car. For the present the sign is burning with a steady light, but it is so wired that flashes may be used.

There are two capital letters of a sign in Memphis, Tenn., which are larger than these letters in Bass' sign, but with this exception, the one here illustrated is the largest in the South.

Mr. F. H. Lansdell, electrician of the Georgia Railway & Electric Company, Atlanta, together with a force of seven skilled electricians, were busy for five days in putting this sign in place and completing the wiring. Of course, there are many larger signs in the East and North, but nothing in the South as yet that can touch Bass' sign.

Electrical Inspection.

At the recent meeting of the Western Association of Electrical Inspectors, Mr. Alex. Henderson, of New York, gave an interesting address on "The Influence of Inspection Upon Manufactured Electrical Appliances," in the course of which he traced the history of electrical inspection from the earliest days. Electrical inspection appears to date from the spring of 1881, when a conference was held in New York between representatives of the fire insurance interests, the Western Union Telegraph Company and the Brush Electric Illuminating Company. One of the results of the interview was that electric light wiremen in New York City received stringent orders to stop the use of double-pointed tacks in putting up conductors. The first printed rules were issued by the New York Board of Fire Underwriters under date of Oct. 19, 1881. These rules consisted of only five paragraphs, and among the provisions were that wires should have "50 per cent excess of conductivity above the amount calculated as necessary for the number of lights to be supplied by the wire"; and that incandescent light wires should be placed 2½ in. apart, and arc-light wires 8 in. apart. Early in 1882 the Boston Manufacturers' Mutual Fire Insurance Company issued several rules on wiring, one of which provided for a separation of 1 ft. between conducting wires, and ⅛ in. to ¼ in. between conductors and adjacent walls, ceilings, etc. These rules also specified that "soldered joints are desirable but not essential."

In 1882 the first rubber-covered wire was used in New York for a day circuit on a pole line, but in the course of a few months the insulation was hanging from the wires in long shreds, and the conductors were replaced with the older "Underwriters' wire." The work of changing conductors went on while the circuit was alive, the voltage being 1800; and while the workmen learned to expect a kick every time a new section of wire was cut in, everything went along smoothly until within a day or two of the completion of the job, when one of the wiremen was killed. This was the second serious electrical accident on record, the first having occurred in February or March of that year in Pittsburgh.

On one occasion it was necessary to run a circuit under water for about 75 ft. or 100 ft., and three different cables ordered from manufacturers lasted from 6 to 10 days each. A cable was then manufactured by stretching No. 6 copper wire tightly between two poles, then parceling it with a layer of white cotton laid up in shellac and covered with friction tape, which process was repeated three times on each wire. They were then paired and treated as before, and connected to a circuit carrying at first 720 volts and later 2700 volts. Twelve years later this cable was still in successful use.

Prior to 1889 the New England Insurance Exchange and the New York Board of Fire Underwriters placed electrical inspectors in the field, and following 1891 many municipalities created inspection organizations, and underwriters' inspectors began to appear throughout the country. Difference of opinion soon arose between the underwriters and contractors; insurance interests in one section were not in full accord with those in another; some municipal bureaus and underwriters' departments attempted to create and enforce rules of their own and in many cases insurance and municipal authorities failed to agree upon interpretation. These chaotic conditions were finally taken in hand in 1895, when insurance men came to the rescue and invited a number of competent authorities to meet them in conference, and a year or so later published the national code.

Referring to the present status of electrical inspection, Mr. Henderson said that whereas formerly the electrical inspector depended largely on what scraps of information he could gather from the wiremen and others whom he found on the job, he now enters the field, usually as a graduate from some competent school of electrical engineering, spends a short time familiarizing himself with the practical side of electrical construction, and when he finally takes up the real inspection work he finds that he is backed up by one of the most complete systems of testing and inspection that can well be imagined; and when he discovers he is short of information he has but to communicate through his headquarters with the Underwriters' Laboratories, where he is in immediate touch with the best engineering talent.

Mr. Henderson says that such a process of evolution from the days of the double-pointed tack to this age of porcelain and steel could not have been accomplished in so short a time without the spur of electrical inspection.

Street Arches at Norfolk, Va.

The continuous and united efforts on the part of the merchants and property owners of Granby Street, Norfolk, Va., to do something which would contribute to its realty and mercantile value gave conception and birth to the Granby Street White Way, the success of which could no longer be doubted by the sceptical and non-progressive merchants, when, a month or more ago, this popular, but poorly lighted, thoroughfare was converted into one of the best and most artistically lighted streets in any city south of New York. The crowds that gath-



FIG. 1.—GRANBY STREET, NORFOLK, VA., BY DAY.



FIG. 2.—GRANBY STREET, NORFOLK, VA., BY NIGHT.

ered to witness and welcome the success of this enterprise were only larger during the busiest period of the Jamestown Exposition.

As a result of several informal conferences and interchanging of ideas as to the value of such a movement, a meeting was called and two committees of two members each were appointed from the merchants and real-estate owners to investigate and report the possible resources. After a careful investigation as to the number of merchants and the owners of the property in the district to be lighted, a report was made and each merchant was assessed $60 and each realty owner 50 cents per front foot. A prospectus, setting forth that the subscription was to cover construction work and maintenance for one year, was prepared for each committee. There was much disappointment over the response of the property owners, but the merchants responded nobly.

When all resources had been exhausted, the committee found itself several hundred dollars short of what appeared to be the lowest possible price, and it was largely due to the liberal spirit with which the Norfolk & Portsmouth Tarction Company met the committee, that the Granby Street White Way was finally made possible. As a protection to each subscriber against a possible liability beyond his subscription, the "Granby Street White Way" was incorporated and subscribers' stock certificates were issued for the number of shares at a par value of $1 per share.

Many suggestions as to the design of construction were discussed, but the one submitted by Mr. R. S. Scott, the illuminating engineer of the Norfolk & Portsmouth Traction Company, and his associate, Mr. A. J. Amm, of the General Electric Company, was accepted. Flat steel arches, with a span of 40 ft., width of 12 in. and a rise of 4 ft., were placed across the street attached to the iron railway poles located every 100 ft. The arches were made up of two 2-in. x 3-in. angles, rolled to the proper radius and laced together. A ½-in. steel span wire was run over the arch from top to top of the supporting poles and a messenger dropped to the arch to take care of wind strains. Ten General Electric series-incandescent center-span suspension outfits were attached to a ½-in. steel cable run 12 in. above the top of each arc hand supported by I-bolts fixed to the lacing. The lamps were thus protected from any violent shocks which the arch might receive and still the structure possessed the necessary element of rigidity. The lamps and reflectors alone hang below the arch, and the whole presents a very attractive appearance in the daytime. Twenty-seven such arches were placed between Main and Bute streets, each arch having 10 60-cp, 75-watt, 6.6-amp General Electric street-series lamps with automatic cut-outs and radial-wave reflectors. The neat yet substantial design, the graceful and symmetrical curve of the arch and the regularity and the adjustment of the lamps have created a comment which indicates that the public is highly pleased and reflects much credit upon the engineers. That the merchants are pleased is proved by the fact that the business men of Main Street and those of Church Street have taken steps to makes these thoroughfares more attractive. The arches were made and erected by the Etna Iron Works, a local concern, for $45 each.

Norfolk is a city from which radiate eight railroad systems, having a total mileage of over 25,000 miles in all directions, and 20 steamship lines to the North, South and East. The population of the city has increased from 22,000 in 1880 to 120,000 (including suburbs) in 1909. The city's marine tonnage exceeded that of New York Harbor in 1908, and it is the largest coal exporting point in the Western Hemisphere. Norfolk is fast becoming a great manufacturing center. Electricity for all purposes is generated by the Norfolk & Portsmouth Traction Company in a magnificent $1,500,000-power station, capable of an output of 11,000 kw, minimum, which is distributed to the consumer from six modern substations. The company operates 143 miles of electric railway, and brings the remotest suburbs within a few minutes of the central business section. Its overhead and underground transmission lines cover an area of 150 sq. miles.

New Telephone Patents.

NEW TRANSMITTING DEVICES.

The microphone as a physical laboratory instrument has been studied very thoroughly, and our present transmitter is to a considerable extent the outgrowth of laboratory work. It was early discovered that there was but a small distance through which microphonic action takes place. This distance had different values as the substances in contact varied. Carbon has a very large microphonic distance.

It has also been found that the microphonic action varies with the medium filling the space about the contact for telephone working, it of course always being essential that this medium be a gas or in the gaseous state. Messrs. C. E. Egner, of Stockholm, and J. G. Holmström, of Saltsjöstorangen, Sweden, have applied the use of such media to the telephone transmitter. According to their joint patent, the air must be exhausted from the transmitter, or partially so, and there must be substituted some other gas—preferably hydrogen or a hydrogen compound, which of all other gases gives the maximum microphonic action. The transmitted must then be sealed.

Another transmitting instrument, the invention of Mr. C. D. Babcock, of New York City, depends upon a different physical phenomenon, namely, the property of some substances of great changes of resistance relative to temperature, provided the substance be at a certain critical temperature. It will be seen that if the telephone currents generated by the transmitter can be made to affect the temperature of the sensitive substance a multiplied resistance change will occur in its local circuit. Mr. Babcock's patent is assigned to the United Wireless Telegraph Company.

NEW APPARATUS.

With certain types of selective signaling systems of wiring it is necessary to give a "bias" by means of springs applied to the armature. Mr. N. P. Jenson, of Waterloo, Ia., has now conceived the idea of making the cores of the ringer magnets hollow and concealing in each a spiral wire spring. These wires project against the armature ends and their tension is

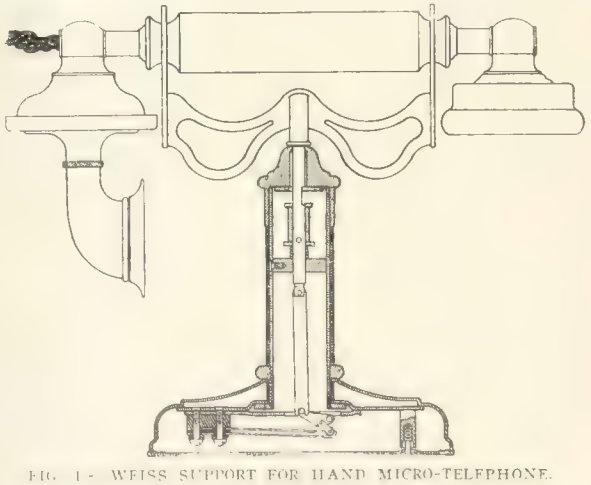


FIG. 1.—WEISS SUPPORT FOR HAND MICRO-TELEPHONE.

adjusted by means of screws bearing down from the yoke end of the cores upon the upper ends of the springs.

Mr. W. K. Howe has patented a combination telephone circuit with a low-inductance relay of a special type in circuit. The relay core has two limbs, each carrying one coil and each coil included in one side of the circuit. A copper shell is inserted between the core and the winding, which, acting as a short-circuiting secondary, cuts down the reactance of the winding proper.

In Fig. 2 is shown an instrument support for use with the hand micro-telephone. The head of the apparatus is elevated by a spiral spring about the stem, except when this latter is overpowered by the weight of the instrument. It will be seen that the spindle drives the switch springs with considerable leverage. This support is the invention of Mr. A. H. Weiss,

of Chicago, Ill., the patent being assigned to the Kellogg Switchboard & Supply Company.

Mr. E. A. Metcalf, of Forbes, Mo., has devised a combined desk-stand set and receiver support. A projection of the stem beyond the transmitter lug carries the support for the receiver arm. This latter is so shaped and supported that swinging it about a horizontal axis causes the receiver to be presented to either ear of the user. A ring sliding on the stem tube controls the switch springs. A spring impels it upward to the normal position. A latch holds it in the talking or depressed position when required.

Mr. C. S. Coom, of Rockledge, Pa., is the inventor of a different type of set of the same kind. In this the switch lever

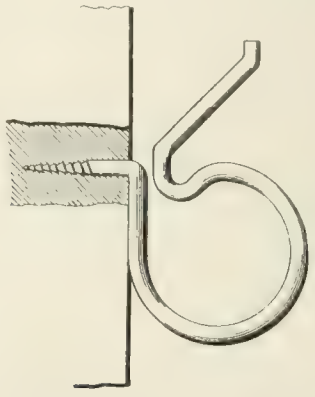


FIG. 2.—WILSON WALL DISTRIBUTING RING.

is made part of the receiver support, and a toggle lever coacting with it, serves to hold the lever in the "up" position when required for conversation.

A bridal and cable ring is the invention covered in a patent granted to Mr. J. H. Wilson, of Rome, Ga. The ring is formed of a single piece of wire, and has the form shown in Fig. 2. It will be seen that there is space for cable and wires in the ring and additional wires in the "V."

PARTY-LINE APPARATUS.

A very interesting party-line system of the step-by-step type has been patented by Messrs. F. J. Mersman and Joseph Mersman, of Ottawa, Ohio. A central-office operator does the selection by the use of impulses of current of two strengths. A low-voltage impulse actuates a stepping mechanism only while a high-voltage impulse actuates it, and in addition a cut-off switch. For example, one high-power impulse advances all stations one notch, and at No. 1 station the cut-off switch is not blocked, and it, therefore, operates to clear the station from the line. All other cut-off switches are blocked, a second high-power impulse advances all stations and cuts off No. 2. A low-power impulse advances all stations, but fails to cut out any station, hence the selection. It will thus be seen that any desired set of stations from one up may be left in and all others locked out. Means are also provided by a block mechanism for synchronizing all stations by a series of low-powered impulses, stepping all forward by the block, and thus into action with a single high-powered impulse.

LETTERS TO THE EDITOR.

Errors in Testing Sources of Light.

To the Editor of Electrical World:

SIR:—The writer has read with much interest the editorial on "Errors in Testing Sources of Light" in your issue of Oct. 14 and Mr. Carl Hering's letter in regard to this editorial.

The matter of rigor in engineering mathematics is emphasized in the editorial. In effect, the question is broached, Is it necessary or even advisable to seek for a rigorous method where rigor can only introduce complications into the results that may vitiate their practical utility, particularly where the agreement between the calculated and actual results must of necessity be approximate? The writer believes, and his belief is borne out by practically all writers on the mathematics of engineering, that rigor is generally of academic value only. Mathematics is common sense expressed in shorthand, and just as we find non-grammatical idioms so much more generally useful in every-day life than well-thought and polished periods, so in the practical application of mathematical physics we often find the shorter and less elaborate treatment of non-rigorous abstraction of greater pragmatic value.

It is not necessary to consider the fact that a so-called linear light source has body, if the results obtained by treating it as a mathematical line give results reasonably close to the actual illumination produced. The question is, Will the more complex and rigorous investigation give results that agree more closely with the necessarily approximate results of measurement? So with surface sources. Can we gain any practical advantage by taking into consideration the fact that the body of the source emits some of the light that eventually radiates from the bounding surface and that the cosine law is not an accurate statement of conditions; or is it sufficient to consider for the sake of conciseness that all the light is emitted directly by the bounding surface, and that the cosine law holds for surface elements?

The answers to these questions cannot be supplied by any such blanket clause as the editorial contains—they can be answered only by a study of the nature of the results desired and a proper proportioning of means to ends. We know that even so great a mathematician as Maxwell threw rigor to the winds where his insight showed him the less tedious path. To Heaviside rigor was a bugbear. It will be justly said that in certain cases Maxwell's inrigorous analysis gave results that lacked the generality they were later found to possess. But from the standpoint of what he wanted to show his analysis was ample and its abstraction justified. All mathematics deals with abstractions. It selects the features of the problem important for the end in view and ignores everything else that is not immediately related to the underlying motive. If it did not follow this process it would be impossible for any human brain to encompass the solution of even a comparatively simple problem.

It must be understood that this is not an appeal for carelessness in mathematical work. In most important cases it takes the keenest insight to sift out the inconsequential factors—a work entirely preliminary to the statement of the problem and not fully realized because never written down. Involved work is almost a certain indication of poor ability and is generally due to the inclusion of unnecessary elements.

Mr. Hering's method as evidenced in his paper is perfectly adequate and proper when we consider the results he sought. His method of abstraction is perfectly legitimate when looked at from his conclusions, but may seem incorrect when looked at from other conclusions derived by a more complete method but with an entirely different end in view.

Theoretical correctness is all very well in its place, but it has no place in any branch of applied physics where all results are inherently approximate. The man who breaks the bank at faro depends entirely on his native practical judgment of conditions. He who guides himself solely by the mathematical laws of probability comes away with empty pockets.

The editorial also speaks of "the application of mathematics" to physics somewhat as if mathematics were a sort of paint that can be applied in coats. I do not mean to split hairs as to the meaning of terms. But is it not true that it is in just the attitude expressed by these words where lies the principal shortcoming of most mathematical teaching? One can no more analyze a given set of conditions by applying mathematics to them than one can produce the outcome of a given set of situations in the form of a story by applying the rules of grammar. Grammar may aid us in giving suitable expression to the thoughts aroused by the situations. So mathematics can only aid us in expressing the logical concurrence or sequence of events following the occurrence of certain physical conditions. The defect of attitude mentioned above is a legacy of "pure" mathematics carried over into practical work. It produces the

same sort of pedantic reasoning that we find in the writings of grammarians.

Finally, the writer cannot see any present practical value to be attained by introducing the idea of volume into the study of light sources that is not entirely offset by concomitant complications.

New York. Bassett Jones, Jr.

[In organizing the body of knowledge pertaining to a branch of science, no principle can be rejected, even though at the moment it may appear to have little or no commercial or practical bearing. Each may then extract from the complete body for practical application only so much as may suit his needs. The stub end of a tallow dip rescued from an ash-barrel may suffice for practical illumination measurements, while in the absolute comparison of sources of light, no principle involved can be ignored, and no refinement in method can be too great. As to our correspondent's mathematical discursion—which appears to proceed from a complete misunderstanding of the editorial commented on—while his remarks may apply to the use of mathematics by amateurs with reminiscences of text-book instruction on the subject, they appear to have no bearing on the value of this powerful weapon to physical science and to engineering, when wielded by those skilled in mathematical analysis and cognizant of its limitations as fixed by the conditions of a problem, as well as of its potency within such limits. Our correspondent appears to construe the recognition of these principles by great masters of mathematics like Maxwell and Heaviside as evidence of "inrigor" on their part. Rigor is a relative term and should be construed for each case of analysis, and not condemned for its disparity with, for example, "non-grammatical idioms."—Ed.]

Polyphase Magnetomotive Forces.

To the Editor of Electrical World:

Sir:—In Mr. Henry Hermann's letter in your issue of Oct. 14, discussing a paper entitled "Polyphase Magnetomotive Forces" which appeared in the issue of Aug. 26, several statements are made to which the undersigned must take exception.

The equations given in the letter are in common use for obtaining the effective value of an alternating wave in which harmonics occur; Mr. Hermann's attempt to use these equations for obtaining the counter e.m.f. of an induction motor is probably based upon the assumption that the harmonics in the motor flux-wave give rise to similar harmonics in the counter e.m.f. wave—just as, in the case of an alternator, the "single conductor e.m.f." contains all the harmonics of the field. This assumption is incorrect; in an alternator the whole field, harmonics and all, moves as a unit in one direction, but in the induction motor each harmonic component of the field moves in its

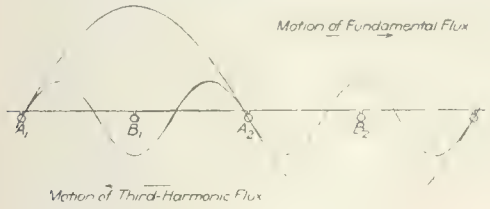


Fig. 1.—Fundamental and third harmonic fluxes in a two-phase motor.

own direction at its own speed. The effect of this action may be seen by a consideration of Fig. 1, which represents the fundamental and third harmonic fluxes in a two-phase motor with full-pitch concentrated winding at the instant when the current in one phase, B, is zero. These fluxes move in opposite directions, as indicated by the arrows, and the speed of the third harmonic flux is one-third of that of the fundamental.

At the given instant conductors A_1 and A_2 of phase winding A are without e.m.f. In phase winding B conductor B_1 is being cut by the positive half-wave of the fundamental flux moving toward the right hand, and by the negative half-wave of the third harmonic flux moving toward the left hand; the two resulting e.m.fs. are, therefore, of the same sign. An instant later conductor A_1 will undergo cutting by the negative half-wave of the fundamental moving toward the right hand, and by the positive half-wave of the third harmonic moving toward the left hand, and the e.m.fs. will be again of like sign Moreover, the two e.m.fs. will have the same frequency, since a half-wave of the third harmonic cuts a given conductor in exactly the same time as is required by a half-wave of the fundamental.

This proof may be generalized, and it will then appear that

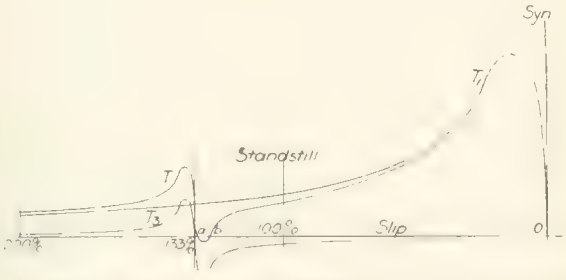


Fig. 2.—Torque due to fundamental and third harmonic fluxes.

in a motor having any number of phases and any distribution of pitch of winding, the counter e.m.f. due to any flux harmonic is always positive in sign, of fundamental frequency, and adds directly to the counter e.m.f. due to the fundamental flux component. It is obvious, therefore, that Mr. Hermann's equations are not applicable in this connection.

Several errors occur in the diagrams given by Mr. Hermann for explaining the phenomenon of a two-phase motor running against its field; backward running is confused with negative slip, and the direction given for the rotation of the third harmonic flux component is wrong. Mr. Hermann has treated this harmonic as if it rotated forward, and has placed the point of third harmonic synchronism at 66.6 per cent slip instead of 133.3 per cent, where it properly belongs. The correct representation is given in Fig. 2, in which curve T_1 gives the torque due to the fundamental flux, curve T_3 the torque due to the third harmonic flux, and curve T the combined torque of both. To simplify the diagram harmonics of higher order are left out. Between points a and b the total torque T is negative, which means that within this range of speed the motor exerts torque in a direction opposite to the motion of the fundamental flux.

If the motor is brought up to synchronism, and the connections of one phase winding are then reversed, for the instant the slip will be 200 per cent, which means full speed backward. The load torque, fundamental torque and third harmonic torque combine to bring down the speed to a point slightly under 133.3 per cent slip, not far from point a. As the slip passes the 133.3 per cent value, the third harmonic torque reverses, and thus at point a the third harmonic torque acts against the fundamental torque, and tends to keep the rotor running backward. The speed cannot go much below this point unless the fundamental torque plus the load torque is greater than the pull-out torque of the third harmonic; if not, the motor will keep this speed indefinitely, running "against the field." If a load is put on which requires a torque equal to or greater than the negative maximum of curve T between points a and b the motor will be enabled to reverse, the speed falling to zero and rising to synchronism in the reverse direction—that is, "with the field."

This phenomenon does not exist in two-phase motors when the third harmonic is wiped out more or less completely through the use of fractional pitch. In three-phase motors the fifth harmonic produces effects similar to those produced by the third harmonic in two-phase motors, but in lesser degree on account of the comparatively smaller value of the fifth harmonic.

Chicago, Ill. John D. Nies.

Commutation in Direct-Current Machines.

To the Editor of Electrical World:

Sir:—Your issue of Sept. 2, page 563, contains an abstract (page 563) of Rüdenberg's paper in the *Elektrotechnische Zeitschrift,* wherein it is said that "the article is an advance on the usual theories of commutation in so far as it considers the important part played by the paths in parallel with the armature coils as they leave short-circuit." This assertion of Rüdenberg's is positively inexact, for the important part played by the paths in parallel was for the first time discussed in my article in the *Elektrotechnische Zeitschrift,* 1906, page 1127. Therein I proved that when the *true* "paths in parallel" which exist *in reality* in the dynamo-circuit are taken into account, then the formula for the current density at the brushes never becomes infinitely great. The infinity criterion hitherto admitted and the dynamo theories based thereon, as, for instance, Arnold and Rüdenberg's theories, are therefore certainly untenable.

Rüdenberg's recent article is, however, in so far essentially different from mine that Rüdenberg now *assumes fictitious paths* in parallel with the armature coils, to which he ascribes a fictitious *constant* resistance, while I have taken into account the *really existing bypath in the dynamo circuit with its essentially variable resistance during commutation.* That Rüdenberg arrives again at the infinity criterion is, therefore, merely a consequence of certain mathematical formulas, so arranged as to conduce to that result; but this does not represent a peculiarity of *the real, of the actual existing dynamo.*

A discussion of the question, with a reprint of my original paper from the *Elektrotechnische Zeitschrift,* has been published on pages 10-21 of my pamphlet "Kommutierung, Kompensierung und Wendepole," which, together with a reprint of my paper from *The Electrician,* of London, 1908, Vol. LX, page 719, as an introduction to it, may be consulted at the library of the American Institute of Electrical Engineers, New York.

Scheveningen, Holland. C. L. R. E. Menges.

Formula for Cost of Steam Heating.

To the Editor of Electrical World:

Sir:—In studying the very valuable articles on exhaust steam heating in the issue of Oct. 7, I find that on page 830 in the formula $C = 0.2\,S \div e$ the value of C is not fully given. Does it mean tons of coal per heating season or for some other period of time?

Philadelphia. James A. Brown.

[The formula in question is based on the use of live steam for heating. Expressing its terms in more amplified form, C = tons of coal required per heating season; S = square feet of glass surface plus 1/10th of the wall and roof surface, while e = number of pounds of steam per pound of coal. It may be added that the factor 0.2 is based on the average temperature in Chicago, and should probably be modified if the formula were to be used in Philadelphia, where the average winter temperature is probably somewhat higher than in Chicago. The proportion could be arrived at approximately by ascertaining the mean winter temperature in Philadelphia and comparing it with the corresponding temperature in Chicago.—Ed.]

Machine vs. Manual Telegraphy.

To the Editor of Electrical World:

Sir:—We desire to thank you for publishing in your issue of Oct. 21 my letter relative to the results attained by this company in its experimental trial of the Rowland printing telegraph, although it was sent you in the belief that a full and fair statement on the subject would be of interest to your readers, and therefore worthy of space in your columns.

It is stated in a note commenting on this letter that—

"Until our telegraph systems are radically reorganized from top to bottom on the basis of machine telegraphy, and manual telegraphy is finally consigned to the tomb that has been yawning for it for the past 30 years or more, the telegraph industry will continue to lag far behind all other electrical development. Almost necessarily machine telegraphy 'cannot be conclusively advantageous under present traffic-handling methods.'"

These remarks evince comprehensive ignorance of telegraph requirements and methods. It is hard to believe that the responsible editor of any electrical paper would be willing to acknowledge authorship of them. I do not desire to make them the basis of a controversy.

But if, by any possibility, any of your readers should be disposed to take them seriously, I trust that they will not be accepted as conclusive. It is a fact that machine telegraphy is not now adaptable generally to the requirements of telegraph systems in the United States; it is a fact that the telegraph industry does not lag far behind all other electrical development, and it is a fact that the present traffic-handling methods in this country are efficient and the best that have so far been devised.

New York, N. Y. Chas. P. Bruch.
Vice-President Postal Telegraph-Cable Company.

The Light of the Fire Fly.

To the Editor of Electrical World:

Sir:—I have read with interest the report of the I. E. S. convention and the editorial on the fire fly in your issue of Oct. 14. You may be interested in the fact that several species of the fire fly are very abundant here and may be seen by hundreds on the city parking and lawns, while in the open fields it is no exaggeration to say that they may be found by the thousands. They abound during July and August, and their departure is as sudden as their arrival. They must have impressed Professor Langley deeply, and no doubt he would have devised methods for studying them if it had not been possible to obtain the Cuban genus, which emits a continuous glow.

The consideration of the problem of measuring radiometrically the energy emitted by these insects has interested me for several years, and with reference to your editorial a few remarks on the difficulties involved may be of interest. The sensitiveness of the radiation meter must be so high, while the physical strain to handle it is so great, that one familiar with these instruments does not undertake problems, such as the one on the fire fly, without first trying to gain the information indirectly, even if it is not so convincing. Measuring the light from stars or of the fire fly is more or less spectacular and appeals to the mind where many laboratory experiments, requiring equal delicacy of measurement, go unnoticed.

To give you some idea of the sensitiveness of the instruments required for measuring these weak radiations, I would state that the sensitiveness of the radiometer used in measuring the heat from stars was about one-fourth that used in measuring the spectral distribution of energy from gases in vacuum tubes. For the vacuum-tube measurements 1 mm deflection on the scale represented a rise in temperature of only 1/200,000 deg. There are a few reliable records of work with instruments sensitive to 1 mm deflection = 1/1,000,000 deg. On several calm, cloudy days, with window blinds closed and doors bolted against possible visitors, the writer found it possible to work with a sensitiveness of 1 mm deflection, equivalent to seven-ten-millionths degree; the time required to obtain an observation being about one minute. In ordinary routine work difficulty is experienced when using a sensitiveness of 1/50,000 deg.

From the foregoing comments it is evident that there is no hope of obtaining reliable quantitative measurements on the fire fly with instruments less sensitive than 1 mm deflection equal to one-millionth deg., which will require a half minute or more in which to get an observation. It is evident that only an insect emitting a continuous glow can be investigated radiometrically. The photographic method (a happy thought of Dr. Ives) is preferable since it gives us a more reliable record of the energy distribution in the visible spectrum, and, incidentally, it answers

the question whether the spectrum is simply one of low intensity—which it is not. It cannot tell us whether there is infra-red radiation. However, there are data available from which we can form some estimate of the improbability of emission of energy outside of the visible spectrum. The color of the emitted light varies from green to yellow and red (the latter is very rare I am told by Dr. Swartz, of the National Museum) which may be due to absorption in passing though the chitinous layer. While it would evidently be poor economy for (hence not to be expected) these insects to produce light covering a wide range of the spectrum, and then absorb all but the part observed, it was of interest to examine into this question. Through the courtesy of the National Museum I was recently enabled to examine several species of elaters from Cuba and Guatemala, which emit a yellow-green light.

In all cases, including our native genus of fire fly, the outer integument covering the insect, the chitinous layer, was found to be perfectly transparent in the regions covering the luminous organs, while elsewhere the integument was a deep reddish brown. From this it is evident that the color of the emitted light is not due to absorption in passing through the chitinous layer, and that it is the sum total of all the light coming from the photogenic cells. While the photographic plate shows that the light is not subjective due to low intensity, the transparency of the integument indicates that if red light had been present it could have passed out into space. Of course, this does not settle the question regarding the possible absorption of certain waves in the photogenic organs themselves; but why do we expect to find that the generation of the emitted light must be accompanied by a generation of radiant heat? We might as well suppose that the combustion of food in our bodies (with the resultant formation of CO_2 and H_2O) or that the combustion in a growing plant leaf must be accompanied by a rise in temperature and emission of radiant energy (other than "animal heat") because we observe the latter phenomenon when we light a candle or heave coal into the fire.

But let us suppose that the fire fly does generate heat waves in his photogenous organs. Then what is the probability of these waves getting out into space? It is an observed fact that the more complex the organic compound, the more opaque it is to heat waves, especially of wave-lengths greater than 2μ. The chitinous layer is chemically more complex than any substances yet examined for transparency in the infra-red. In addition to this, water is also very opaque to radiation beyond 1.5μ in the infra-red. The presence of the two makes it quite certain that no heat waves greater than about 2μ can pass out of the insect, even if produced in the photogenic cells. If infra-red emission bands are found they will in all probability be due to selective absorption of the chitinous layer. The radiation from the insect due to its natural body temperature, "animal heat," must have its maximum radiation at 8μ to 10μ, so that instead of attempting to confirm Langley's observations on the infra-red radiations, as suggested in your editorial, the problem is to search the spectrum at 1μ to 2μ. As a first approximation find the radiation from the fire fly, using a piece of clear glass to absorb the radiation beyond 3μ, the "animal heat," and then absorb the visible radiation by means of Schott's red glass, which is unusually transparent at 1μ to 2μ.

Considered as a whole, it seems to me that the difficulty lies in our knowledge of the fact that in many cases the emission of light is accompanied by the emission of heat waves, and in our expectation to find similar conditions to obtain in the fire fly. If such conditions did obtain, and if the radiant heat were present in the proportion that it is in the Hefner flame or in carbon dioxide in a vacuum tube, judging by the intensity of the visible radiation emitted by the fire fly, it is safe to say that if such a vast amount of heat waves were absorbed without doing internal work, the rise in temperature would be such that his life would be speedily ended by desiccation. To produce radiant energy of long waves, only to absorb it, seems a cumbersome operation, because of the high mechanical equivalent of heat waves (energy comprised between λ_1 and λ_2), such as commonly observed in the spectral radiation from solids.

The fire fly's light stops abruptly in the red, and its spectral-energy distribution is similar to that of fluorescent light (see observations of Nichols and Merritt) which is generally a transformation *downward* from an excitation of shorter wave-length. Why not credit the fire fly with a step-down process of excitation, the resultant (emitted) waves being similar to our common fluorescence spectra, as observed? In this connection papers by Watase (Biological Lectures, 1895, Marine Biol. Lab. Woods Holl) may be of interest to readers of your journal.

WASHINGTON, D. C. WM. W. COBLENTZ.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Cost and Efficiency of Electrical Machinery.—L. CROUCH.—An article giving diagrams of the weight, speed and cost, efficiency and power factor of direct-current and alternating-current generators and motors, which may be taken as typical of modern design. Two of these diagrams are given herewith.

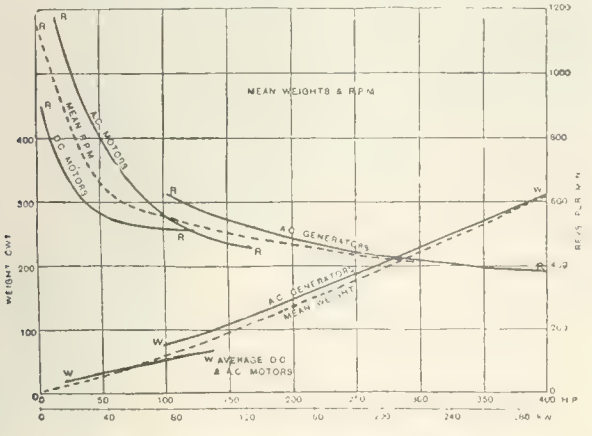


FIG. 1.—WEIGHT, SPEED AND OUTPUT.

The curves *R* in Fig. 1 give the r.p.m. and the curves *W* the weight as a function of the output. The curves in Fig. 2 give the total cost in pounds sterling and total cost per horse-power as functions of the output in the British market. The curves are otherwise self-explanatory. Similar curves are given concerning efficiency, power factor and slip.—Lond. *Electrical Review*, Oct. 22.

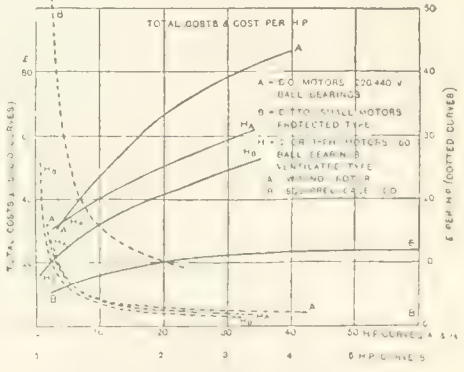


FIG. 2.—COST AND OUTPUT.

Iron Losses.—E. ROTHER.—Methods for determining the

hysteresis and eddy current losses in iron in the stationary field cores of direct-current machines or in the practically circular rotary-field cores of polyphase induction motors have long been known. With the introduction of single-phase commutator motors, which are operating partly with pure alternating magnetic fields and partly with elliptic rotary magnetic fields, the determination of the iron losses in the field cores has become of importance. The author describes a series of experiments on this subject. In the present installment he describes the arrangement of the experiments and gives some of the results in form of diagrams. The article is to be continued.—*Elek. und Masch.* (Vienna), Oct. 17.

Direct-Current Generator or Motor.—A note on a recent British patent (20,098, 1908, and 72, 1909; Oct. 14, 1909, of A. Boeckel, O. Grünberg, J. K. Krukoviski and E. Luxembourg. The armature and field system are geared together and rotate at the same speed in opposite directions, while the brushes remain stationary. The number of commutator segments is twice the number of armature coils, each of which is connected to the two segments at opposite sides of the commutator. For a two-pole machine, four brushes are placed at right angles, the opposite brushes being connected together. If the field were to rotate at twice the speed of the armature, the commutator would have to be divided into three parts. The second specification describes a construction in which the rotary field is produced by means of a three-phase stationary winding receiving energy from the armature by means of slip-rings. The armature is connected to the commutator as above, and commutating poles projecting over an extension of the armature are provided. A compensating winding is also provided on the stator. The machine is applicable as a motor or a generator, and the high relative speed effects a reduction in the cost of material. —Lond. *Elec. Eng'ing*, Oct. 21.

Lamps and Lighting.

Electric Lighting.—L. Gaster.—A continuation of his Cantor lectures on modern methods of artificial illumination. He

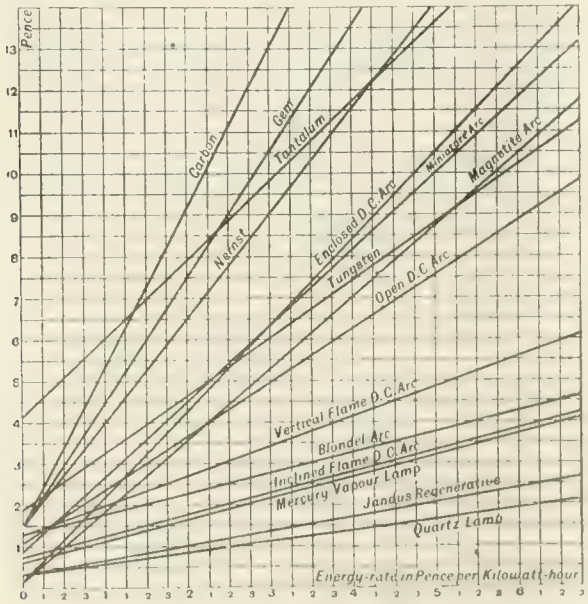


FIG. 3. COMPARATIVE COST OF THE VARIOUS ILLUMINANTS

compares the condition of the lamp industry in the United States with that in England, where there are many small makers, importers and dealers competing with each other, while the variety of pressure on lighting systems is "marvelous." The author emphasizes the good work done by the National Electric Light Association of the United States. He then reviews new developments in arc lamps and in vapor lamps, and finally gives, in a diagram, a comparative cost of the various illuminants. (Fig. 3.) The cost of renewal and maintenance is taken as $\frac{P \times 1000}{l \times L}$, where L means the mean spherical candle-power; l the life of lamp in the case of incandescent lamps; glower, in the case of Nernst lamps; electrode, in the case of arc lamps; vapor tube, in the case of vapor-tube lamps; P the price of bulb in the case of incandescent lamps; renewal of glower and ballast in the case of Nernst lamps; renewal of electrodes and trimming for arc lamps; tube for vapor lamps. He also gives the following comparison of the cost of gas lighting and electric lighting on the basis of figures of Blondel, assuming gas costs as 0.2 franc (4 cents) per cubic meter ($1.13 per 1000 cu. ft.), electricity at 0.7 franc (14 cents) per kw-hour:

			Incandescent electric lamps.			
			Carbon,		Tungsten,	
	Incandescent gas.		32 cp for 300 hrs.		32 cp for 1000 hrs.	
	Upright. Liters.	Inverted Liters.	110 volt. Watts.	220 volt. Watts.	110 volt. Watts.	220 volt Watts.
Hourly consumption in watt-hours or liters	80	80	100	100	35	45
	Franc.	Franc.	Franc.	Franc.	Franc.	Franc.
Corresponding cost in francs	0.016	0.016	0.07	0.084	0.0245	0.0315
Cost of renewals per hour	0.0025	0.004	0.0017	0.003	0.0037	0.0062
Total cost of lighting per hour	0.0185	0.020	0.072	0.087	0.028	0.038
Mean spherical cp.	55	50	28	28	28	28
Cost per mean sph. cp per hour	0.00032	0.00040	0.00258	0.0031	0.001	0.00136

Assuming cost of gas 0.10 franc per cubic meter, electricity 0.70 franc per kw-hour.

Cost of gas consumed	0.008	0.008	0.01	0.011	0.0035	0.0045
Total cost, including renewals	0.0105	0.012	0.012	0.014	0.0072	0.0107
Cost per mean sph. cp. per hour	0.00019	0.00024	0.00043	0.0005	0.00026	0.00038

In the above table 1 franc = 20 cents; 1 cu. ft. = 28 liters. The following formula enables one to calculate running costs of electric lamps:

$$C = \frac{p}{TL_o} + \frac{p'W}{1000}$$

where p = cost of lamp, p' = cost per kw-hour of electrical energy, L_o = mean spherical candle-power, T = life before lamp is discarded, W = watts per mean spherical candle-power. —Lond. *Electrician*, Oct. 22.

Metallic-Filament Lamps.—A note on a recent British patent (19,847, Oct. 14, 1909) for lengthening the life of metallic filaments granted to the Glühlampenwerk Anker Gas. Blackening of bulbs can be prevented by admitting a small quantity of phosphoretted hydrogen or arseniuretted hydrogen into the vacuum.—Lond. *Elec. Eng'ing*, Oct. 21.

Generation, Transmission and Distribution.

Liquid Fuel.—J. S. S. Brame.—An abstract of a lecture on the economic aspects of liquid fuel. As a fuel for steam raising, oils of high calorific value, cheapness and high flash point are demanded, while for internal-combustion engines oils of high volatility are generally requisite in order that they may readily form explosive mixtures with air in the cylinder. The main advantages of liquid fuel over coal may be summarized as: Superior evaporation to coal in the ratio of 1.6 to 1; ease of handling; facility of stowing on ships in situations where coal could not possibly be stored; less space required than for coal, one ton of oil requiring only about 38 cu. ft., while coal requires about 43 cu. ft. per ton. The many advantages of liquid fuel have created such enthusiasm in its favor that the important questions of supply and prices have frequently been overlooked. The total oil supplies of the world, taking the figures for 1907, amounted to 34,569,500 tons, which in terms of coal, since it has such superior calorific value, would be equivalent to 51,854,250 tons of coal, or only one-fifth of the coal output of England alone. Further, only a portion of the crude petroleum is suitable for fuel. Liquid fuel, therefore, cannot compete with coal, and is not a fuel for general use, but for employment in special cases. For use in internal-combustion engines the lighter petroleum distillates are almost universally employed. England's annual importation of oil has now reached the total of about 33,500,000 gal. By the introduction of the spray carbureter a heavier grade of oil can

now be utilized, a factor of considerable economic importance as regards supplies. Moreover, since the calorific value of oils of varying gravity is practically the same per unit weight (20,000 thermal units) it follows that as they are bought by volume, the heavier grades are more economical. Paraffin-driven motors are valuable engines for many purposes, notably where a portable engine is required, or for boats where safety is a factor of great importance. Paraffin engines work best at constant speeds and are not suitable for cars. One important point with all engines using petroleum oils is that high compressions are out of the question, since at a little over 4.5 atmospheres there is a risk of premature ignition, hence the efficiencies obtained are low. As a substitute for gasoline, the claims for benzine (or benzol) and alcohol must be considered. The calorific value of benzine per unit weight is 18,540 thermal units, but per unit volume, owing to its higher gravity, it has a higher value than many oils. In practice, benzol gives most excellent results without any special alteration of the carbureter designed for oil. For motor use alcohol has many advantages over oil or benzine; it is far less inflammable, and if a fire does arise, it can more easily be extinguished; its combustion leaves no evil-smelling products; engines run more quietly on alcohol, and it will withstand higher compressions in the cylinder, thereby giving such greater efficiency that the effect of its low calorific value is almost counterbalanced. For equal weights, the calorific value of oil to alcohol is 20,000 to 11,000 thermal units—that is, a ratio of 1.8 to 1—but if considered by volume the ratio is reduced to 1.6 to 1. Since the thermal efficiency of alcohol is greater than oil in the ratio of 3 to 2, it is evident that, volume for volume, the same power can be obtained from alcohol as from petrol. At present the cost of alcohol is prohibitive, and it is unlikely that it can for many years reach the position of a commercial fuel.—Lond. *Electrician,* Oct. 22.

Refuse Destructor.—A note on the working of the refuse destructor plant at the Greenock electric central station, in England, during the last year. Sixteen thousand six hundred and ninety-eight tons of refuse were destroyed; the works costs amount to 48.5 cents per ton. The total number of kw-hours generated from the destructor steam amounted to 1,097,232 units, or 65.5 kw-hours per ton, and the value of the steam so supplied is put down as $8,000, or about 0.7 cent per kw-hour. From the figures that are given it would appear that the cost of fuel per kw-hour generated by coal is 0.4 cent. To this must be added the cost of labor, maintenance and capital charges on boiler plant. Whether this will bring the figure up to 0.7 cent, the price paid for the refuse steam, is perhaps doubtful, more particularly when it is remembered that the refuse steam is used on a plant running more or less on a 100 per cent load factor. What one really desires to know is whether the cost of generating these units beyond the cost of those generated by coal would have amounted to as much as the sum allowed for the refuse steam if they had been generated with the ordinary plant by means of coal.—Lond. *Electrician,* Oct. 22.

Cascade Induction Motor.—W. I. Williams-Ellis.—An illustrated description of testing two 70-hp cascade-motor haulage sets for a British mine. The motors are connected to a 500-volt, 50-cycle, three-phase circuit, and as a drop in the line had to be allowed for, the machines were designed for a pressure of 485 volts. The chief advantages for the work are total elimination of slip-rings, with the full characteristics of a slip-ring motor. The windings on both stator and rotor are of a simple nature, and each machine is controlled through 12 tappings taken from the parallel windings of the stator and worked in pairs, each pair being finally short-circuited when the machine has reached approximately its final speed. Both machines are of the 12-pole type, while the air-gap is kept very short. Each of the above motors is connected through double-reduction gearing to a set of four drums, giving a rope speed suitable for roads laid in this class of quarry work. Efficiency figures of the electric machines are given as follows: Full load efficiency, 88.5 per cent; half-load efficiency, 87 per cent; 1.5-load efficiency, 89 per cent. The specified overload was 100 per cent; the actual overload developed on test was 110 per cent. Final temperature reached after 4.5 hours' run: stator winding, 62 deg. rise; surface of stator winding, 49 deg. rise; stator core, 67 deg. rise; rotor copper, 46 deg. rise; rotor core, 55 deg.—Lond. *Elec. Review,* Oct. 22.

Electric Motors in Steel Mill.—The electrical equipment of the Lanarkshire Steel Works includes provisions for electrical machinery of great variety, but the main mills are still steam driven. An interesting feature is the control of an electrically driven auxiliary hydraulic pumping plant. Energy for lighting is obtained from the company's own generating plant, but the supply for the motors is principally taken from the mains of the Clyde Valley Electrical Power Company.—Lond. *Elec. Eng'ing,* Oct. 21.

Steam Turbines.—G. Stoney.—The first part of abstracts of Cantor lectures on the subject of steam turbines. The author first makes a comparison with reciprocating engines, briefly describes several types of steam turbines, and then gives a mathematical theory of steam turbines referring to their coupling with electric generators.—Lond. *Elec. Review,* Oct. 15.

Gas Turbines.—E. K. Scott.—The author thinks that the gas turbine will finally replace the gas engine. He thinks that the gas-turbine problem is now being investigated in a haphazard fashion and should be investigated more systematically. He recommends that various institutions should combine and start a fund and form a gas-turbine research committee.—Lond. *Elec. Review,* Oct. 22.

Air Compressor.—An article giving numerical details of a test on an air compressor for a mine to determine efficiency and quantity of air compressed in a certain time.—*L'Industrie Elec.,* Oct. 10.

Traction.

Electric Traction Experiments in France.—A note on an electric locomotive designed by the Alioth Company for use on a section of the Paris, Lyons & Mediterranean Railway. Experiments are now being made on the Grasse-Mouans-Sartoux section, which is very convenient for the purpose, as it includes some of the steepest grades and the sharpest curves, and is also not crowded with traffic. The overhead wire is suspended flexibly by means of a system of the Alioth Company, which does not involve the use of separate suspension wires. Wooden poles are used at present, but these are to be replaced by metal lattice-work supports later on. The locomotive used weighs 140 tons, and it is approximately the same length (65 ft.) as the normal steam locomotive in use on the road, including the tender. There are eight axles, of which the four central ones are driving axles with large wheels. The overhead line is supplied with single-phase alternating current at 12,500 volts, but this is converted on the locomotive by means of a special permutator, devised by Auvert and Ferrand, into direct current at an e.m.f. adjustable between 0 volt and 600 volts at will. The motors are of the ordinary direct-current type of 450 hp each, and there are four to each locomotive. They are flexibly geared by means of spur gear to the four driving axles. The total drawbar pull exerted by the locomotive is 16,400 lb. at a speed of 37 miles an hour, and 10,600 lb. at a speed of 62 miles per hour.—Lond. *Electrician,* Oct. 22.

Buffer Batteries and Electric Traction.—A. W. E. Harris.—The first part of a paper in which the author deals with the general considerations governing the installation of a battery, and emphasizes the need of designing it as an integral part of the whole scheme. The necessity for using an automatic booster is indicated, and the principal types of booster are then described, diagrams of each being given. The paper is to be concluded.—Lond. *Electrician,* Oct. 22.

Single-Phase Traction.—W. Wechmann.—The continuation of his illustrated article on electric traction on the Blankenese-Ohlsdorf-Hamburg line of the German railways. In the present instalment the equipment of motor-cars is described. The latest motor-cars of the Allgem. Elek. Ges. have only two motors, just like the Siemens car. Each motor has a guaranteed capacity of 180 hp per hour, but tests have shown a capac-

ity of 200 hp. The motors are artificially cooled. The article is to be continued.—*Elek. Zeit.*, Oct. 21.

Electric Locomotive.—F. Gubler.—An illustrated description of the construction of some electric locomotives which are used on the electric street railways of the city of Brünn, in Austria, for freight transportation. The locomotive has four 42-hp motors.—*Elek. und Masch.* (Vienna), Oct. 17.

Installations, Systems and Appliances.

Electrical Engineering in the United States and Germany.—W. Fellenberg.—The first part of a statistical article on the development of the electrical industries in Germany and in the

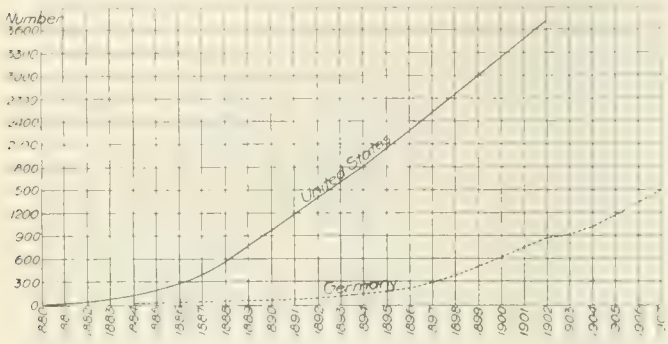


FIG. 4.—COMPARATIVE CURVES OF CENTRAL-STATION DEVELOPMENT.

United States. A comparison is given of the wages paid in both countries. Unskilled labor is paid almost the same wages in Germany as in the United States, while for the higher skilled labor (locksmiths, toolmakers, etc.), the American wages are about twice those in Germany. However, manufacturers in Germany have not only to pay the wages to their workingmen, but also their insurance for old age, accidents and sickness, since such insurance is made obligatory by the Government. The cost of this insurance may be estimated as about 3 per cent of the wages paid. The area of the United States is 13 times that of Germany, but the population is only 50 per cent greater. The track length of railways in the United States is 6.5 times that of Germany. But the track length of trunk railways per unit of area in Germany is 100 times greater than in the United States. The development of street railways has been larger, relatively as well as absolutely, in the United States than in Germany. The track length of street railways in the United States is 14.3 times that of Germany. There are 9.7 km (5.8 miles) of street railways per 1000 sq. km (386

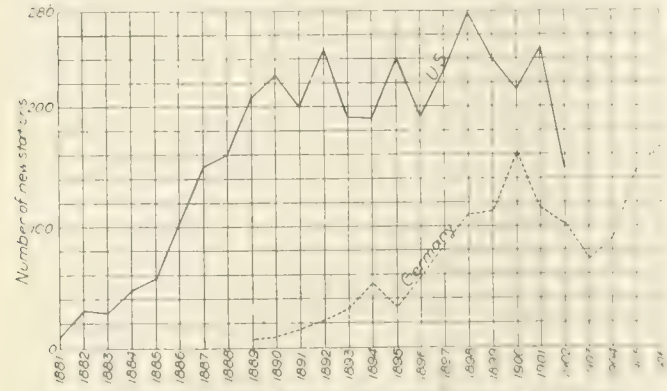


FIG. 5.—COMPARATIVE CURVES OF NEW CENTRAL STATIONS.

sq. miles) and 48 km (29 miles) of trunk railways in the United States, while the corresponding figures for Germany are 9 km (5.4 miles) of street railways and 100 km (60 miles) of trunk railways. The capital invested in the iron and steel industry in the United States is 130 per cent higher than in Germany. The copper production of the United States is 13 times that of Germany. The capital invested in the electrical industries of the United States is only about 30 per cent higher than in Germany. Fig. 4 gives comparative curves of the development of central stations in the United States (drawn-out line) and in Germany (dotted line). The abscissas are the years and the ordinates the number of central stations. Fig. 5 gives comparative curves for the number of new central stations opened each year in the two countries. The article is to be continued.—*Elek. Zeit.*, Oct. 21.

British Central Stations.—A statistical table giving data on recent progress of 12 representative central stations in England. Three of these are owned by private companies, the other nine are municipal. Seven are in the provinces and five in London. The growth of many undertakings has been very rapid, Birmingham showing an increase from 4,645,027 kw-hours per year in 1904 to 24,406,227 kw-hours last year. The largest output of any municipal supply undertaking is now Manchester's 66,924,864 kw-hours recorded last year; this is equivalent to over 100 kw-hours per head of population. If account is taken of the smaller outputs and load factors of the electricity supply undertakings at Leeds and Glasgow, the total cost (excluding capital charges) per kw-hour sold in these towns—namely, 1.34 cents and 1.42 cents, respectively—compares not unfavorably with the figure of 1.32 cents per kw-hour at Manchester. The lowest cost recorded, however, is 1.04 cents per kw-hour for the combined lighting and traction supply undertaking at West Ham, while at Bolston a figure as low as 1 16 cents is reached. As to the effect of the capital charges it is pointed out that the station showing the lowest capital expenditure per kilowatt of plant installed also records the lowest average price per kw-hour sold for private supply, namely, 2 cents per kw-hour at West Ham; while the station showing the second lowest capital expenditure, namely, Bolton, also occupies the second place as regards the lowest average price charged per kw-hour.—Lond. *Electrician*, Oct. 22.

Refrigerating Machinery.—F. H. Davies.—Some notes on refrigerating machinery, its installations and uses, and its usefulness as a load for electric central stations.—Lond. *Elec. Review*, Oct. 22.

Interlocking.—T. Toldin and O. C. Dinerman.—An illustrated article on methods of effective interlocking of motor starters and shunt regulators.—Lond. *Elec. Review*, Oct. 15.

Record Charts for Central Stations.—An illustrated note recommending a simple system of filing and storing record charts for central stations.—Lond. *Elec. Review*, Oct. 22.

Electrophysics and Magnetism.

Damping of Electric Oscillations.—C. Richter.—An account of experiments in which the author investigated the damping of electric oscillations, if the sparks are produced in different gases. The author used air, carbonic acid, oxygen, nitrogen, hydrogen and illuminating gas. The damping is greatest in hydrogen and smallest in oxygen. But the difference between oxygen and air is almost insignificant.—*Phys. Zeit.*, Oct. 15.

Electrochemistry and Batteries.

Electrolysis of Hydrochloride Acid.—F. A. Gooch and F. L. Gates.—An account of an investigation of the electrolytic decomposition of hydrochloric acid with special reference to the question of the ions carrying the current and of the speed of transportation of the hydrogen and chlorine ions. The authors criticise a recent investigation of Doumer.—*Amer. Jour. of Science*, November.

Units, Measurements and Instruments.

Gas Tests.—J. B. C. Kershaw.—A description of the gas-testing apparatus designed by the Hamburg Smoke Abatement Society. It is used for the control of boiler and furnace firing like the automatic CO_2 recorder. The apparatus is shown in diagrammatic form in Fig. 6. The sample of gas is drawn constantly (using natural or artificial draught) from the exit flues by means of the pipe *L*, and as it passes over the aspirator *C* a small portion of the gas-flow is sucked down into this by the action of clockwork on the bell *E*. The aspirator above this bell is filled with water covered with a film of paraffin oil, and the rate at which the bell sinks and the gas is sucked into the space *G*, above it, is controlled by a pendulum and simple clockwork arrangement at *U*, the speed of which can be varied to suit the length of the firing shift. At the end of 8 or 12 hours (that is, when the firemen change) the clockwork is stopped and the average sample of gas stored in the space *G*

is tested for carbon dioxide and for oxygen by aid of the Orsat apparatus, shown on the right-hand side of the aspirator, a rubber tube being employed to connect the aspirator and the Orsat apparatus. Two tests of the average sample of gas are made, and the aspirator is then emptied by raising the bell *E* and by opening the taps *a*, *c* and *d*. By closing *a* and opening *b*, and by starting the pendulum of the clock again, the appa ratus is set for taking the next average sample—no attention being required for 8 or 12 hours—according to the length of the firing shift. The pipe *L* is kept free from soot and rust deposits by blowing steam or compressed air through it (at

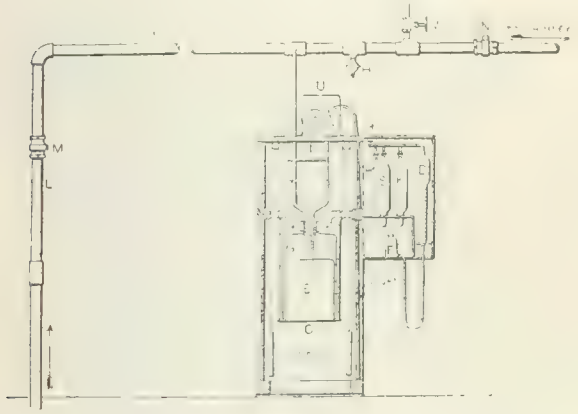


FIG. 6.—ARRANGEMENT OF APPARATUS FOR GAS TESTS.

regular intervals) by means of the tap at *V*; and snap samples of the exit gas can be taken when desired without stopping the aspirator by connecting the cock at *H* with the tap on the Orsat apparatus at *d* by means of a thick rubber tube. The absorbing solutions used in the Orsat apparatus are caustic potash for the CO_2 and an alkaline solution of pyrogallic acid for the oxygen. These solutions require renewal every three or four weeks. It is recommended to grant a bonus to firemen for high percentages of carbon dioxide, and tables are given showing the value of fuel saved and the corresponding bonus recommended. Lond. *Elec. Review,* Oct. 22.

Meter.—A note on a new electric meter designed by Fery, of Paris, and based on the same principle as the Aron pendulum meter. The meter comprises two independent sets of apparatus, which may be installed at a distance from one another. One of them is a system of two equal pendulums, in which the mass consists of a curved solenoid with an iron core. In the center of each core is a polarized block which is exposed to the effect of a fixed coil, opposite the lowest point of the pendulum's travel, through which the current flows. The movable solenoids of both pendulums are polarized by the weak current of a shunt circuit. These pendulums do not come in contact with any fixed parts. A small auxiliary pendulum is used, consisting of a bare copper ring, into which projects the pendulum-solenoid. The oscillation of the auxiliary pendulum is displaced by one-quarter period with respect to that of the main pendulum; when the latter, therefore, reaches its maximum velocity, the auxiliary pendulum is at its minimum. The contacts are made by the auxiliary pendulum. One of them is used for sending a weak current into one of the fixed coils, surrounding the other pole of the solenoid, during one-half oscillation. The other contact sends a current through the second part of the apparatus, the function of which is the addition of the oscillations of the pendulums. The adding device is a rotary-field motor, the stator of which carries four poles. Two of its coils are traversed by the interrupted currents of one pendulum, and the other two coils by those of the other pendulum. When the current impulses of one pendulum arrive before those of the other, the rotor will revolve, say, from left to right. The rotation will change in direction when the second pendulum has come up to and passed the first. The rotor revolves only by the small angle necessary for advancing the integrating clockwork by one tooth by means of a ratchet. The pendulums start automatically as soon as current flows through the apparatus; they require very little energy for maintaining their movement and there is no friction between the moving parts.—Lond. *Electrician,* Oct. 22.

Melting Points.—W. P. White.—An account of an investigation of melting-point determinations. One of the interesting points brought out by the author is that actual melting and freezing-point curves are nearly oblique—that is, they show, not the constant temperature called for by elementary theory, but instead an interval within which the temperature continuously rises or falls. The prime cause of obliquity in melting curves is the obliquity of the melting itself, due to impurity. The true melting point is the high end of the oblique melting interval. Electrical conductivity in the melt produces an error in the reading of bare thermo-elements, thus far negligible in small charges of salts. Contaminated elements, besides reading false, read so as to increase obliquity.—*Amer. Jour. of Science,* November.

Cable-Fault Localization.—E. Raymond-Barker.—Continuations of his long illustrated article on cable-fault localization graphs in practice. The author deals with the polarity of test currents, the effects of "telluric" currents on cable-break localization, and graph proofs of cable-break test conditions.—Lond. *Elec. Review,* Oct. 15 and 22.

Series Transformer.—W. Genkin.—In accurate electric measurement it is often important to know the error introduced by a series transformer. The use of a wattmeter has certain disadvantages. The author describes a new method which is essentially based on the mathematical theory of the series transformed.—*La Lumière Elec.,* Oct. 16.

High-Tension Oscillograph.—An illustrated description of a Duddell oscillograph for use on a 50,000-volt circuit.—Lond. *Electrician,* Oct. 22.

Telegraphy, Telephony and Signals.

Electric Clocks.—An illustrated description of some new master clocks of special construction to be used for electric time service in connection with the astronomical installation at the observatory in Mauritius.—Lond. *Elec. Review,* Oct. 15.

Miscellaneous.

Corrosion of Copper and Brass.—E. L. Rhead.—An abstract of a paper read before the (British) Institute of Metals, which is of interest in connection with condenser tubes. Copper and copper-zinc alloys in contact with saline solutions, such as sea water, corrode in a peculiar manner. Brass condenser tubes exhibit deep pits on the side next the water. These often occur in lines. In other situations and under other conditions copper enrichment takes place. The pits in the case of condenser tubes are commonest on the side of the tube lying undermost when the tube is in position. The corrosion is most erratic. It is generally attributed to selective chemical action and to electrolytic effects due to the duplex structure of the alloy. In the experiments mentioned in the paper samples of hard copper and brass were submitted to corrosion in various saline solutions and their behavior noted. Some of the solutions were saturated with carbonic acid gas. The figures obtained showed the greater tendency of the hard material to corrode. The edges and parts of brass plates that were scratched showed deposition of copper. Strips of hard brass were softened at one end and bent into U-shape. When the free ends were put into corroding solutions the hard limb dissolved more extensively and rapidly than the soft limb, the hard metal appearing to form an electric couple with the soft metal. Corrosion occurred in lines parallel with the direction of rolling. The surface of the hard metal was made very rough and irregular. That of the soft metal remained smooth. These roughnesses may form points from which the disengagement of gases dissolved in water flowing through condenser tubes may take place, thus facilitating the pitting and hastening the corrosion and failure of the tube. From this it would appear that the final cold drawing of a tube to produce stiffness is liable to produce irregularities that may increase the rapidity of attack.—*Electrochem. and Met. Industry,* November.

NEW APPARATUS AND APPLIANCES

Commutating-Pole Traction Motors.

Of the many improvements made in direct-current machinery during recent years not the least important is the commutating pole, the most prominent advantage of which is the freedom from sparking. The commutating pole has been widely adopted for constant-speed and adjustable-speed shunt-wound motors, and is now being used with pronounced success on series-wound railway motors. Commutating-pole railway motors are forced to operate without the slightest sign of sparking at any output up to 50 per cent overload. The present description deals with a line of commutating-pole railway motors rated at from 22.5 hp to 145 hp for e.m.fs. up to 900 volts, recently placed on the market by the Siemens Brothers Dynamo Works, Ltd., Caxton House, Westminster, S. W., London, England.

The general features of the design are shown in Figs, 1, 3 and 4. In Fig. 4 it will be seen that there are the usual four main poles, and, in addition, two commutating poles, one between the main poles in the upper half of the motor and the other between the main poles in the lower half. In order to provide as much room as possible for these commutating poles and their windings, the main poles are given a special shape, such that the magnet coils are not symmetrical about the center lines of the poles, but are displaced sideways. The pole faces, however, are spaced symmetrically round the armature, so that there is no interference with the proper distribution of the magnetic flux. The main field coils and the commutation coils are specially wound to such a shape as to fit into one another, so that practically no extra space is required for the additional coils.

Traction motors of the ordinary type, without commutating poles, are naturally sensitive to sparking, and for this reason the early attempts at some degree of control by varying the strength of the field in relation to the armature current were practically abandoned. As soon, however, as there were introduced motors in which there was no fear of sparking, even when 50 per cent of the field current was shunted, the objections urged against this method of control were no longer valid. For use with the motors described above there has been designed a controller in which provision is made for shunting the field windings in varying degrees as may be suitable for any particular case, such for example as 25 per cent and 50 per cent. In this way there is obtained a controller in which, instead of there being as usual only two economical running positions, namely, full series and full parallel, there are at least five, for example: (1) full series, full field; (2) full series, field coils shunted 50 per cent; (3) full parallel, full field; (4) full parallel, field coils shunted

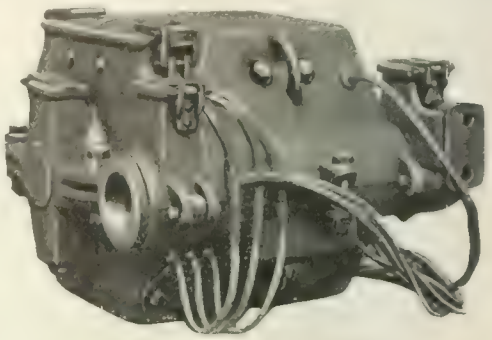


FIG. 1.—EXTERIOR OF MOTOR.

25 per cent; (5) full parallel, field coils shunted 50 per cent.

This system of control offers two important advantages, namely: (1) The driver has a more complete control over his car, having the choice of five different speeds under any given

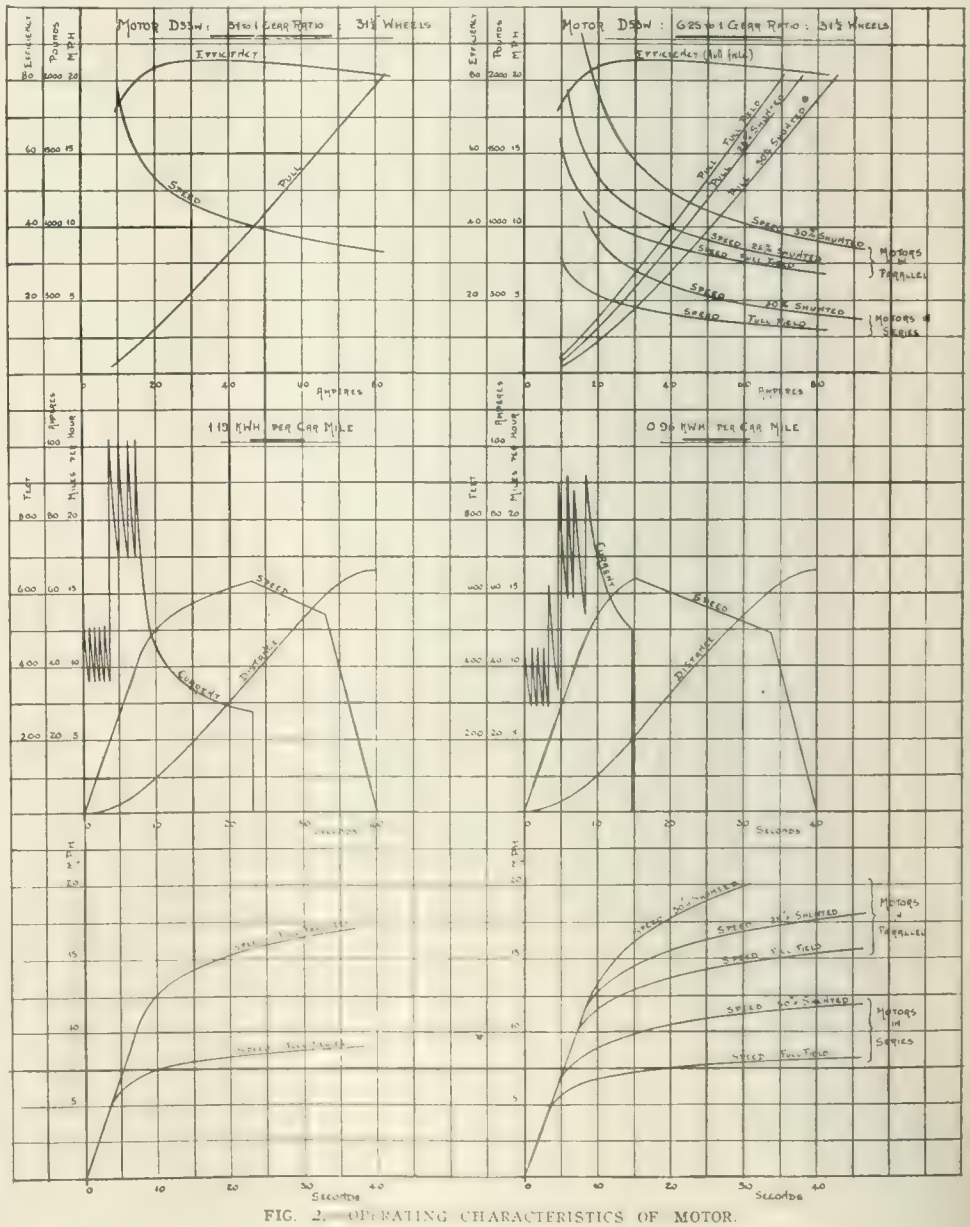


FIG. 2.—OPERATING CHARACTERISTICS OF MOTOR.

conditions; (2) a considerable economy in consumption of energy is made possible.

The curves shown in Fig. 2 will serve for illustrating the advantages just mentioned. These curves relate to a 10-ton tramcar, equipped with two 38-hp commutating-pole motors. Two sets of performance curves for these motors are given, one for the motor geared with a reduction of 97:19 and the other

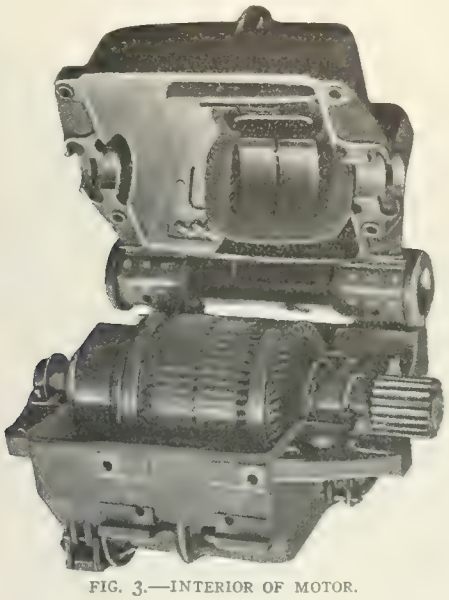


FIG. 3.—INTERIOR OF MOTOR.

with a reduction of 100:16, the diameter of the driving wheels in each case being 31½ in. In the first case, the speed and pull curves are given for the full parallel position of the controller; in the second case, speed and pull curves are given for the five running positions of the controller. With these two sets of curves a sample run has been worked out, as shown in the diagrams, in accordance with the following particulars:

Tractive resistance assumed to be constant at 20 lb. per ton; number of stops per mile, 8; average speed, including 5-second stops, 10 miles per hour; maximum speed, about 16 miles per hour.

The energy consumption has been worked out with the following results:

With field coils not shunted, 1.19 kw-hours per car-mile.

With field coils shunted, 0.96 kw-hour per car-mile.

In the case chosen, therefore, the change of gearing and the different method of control make possible a saving of about 20 per cent in the energy consumption. This may possibly be regarded as an extreme case; but the matter may be put in an-

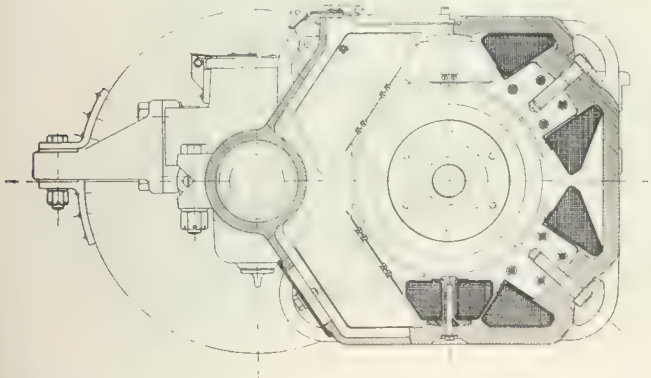


FIG. 4. CROSS-SECTION OF MOTOR.

other way. The energy imparted to the car between standstill and the time when it reaches a speed of 12 miles per hour is in the one case 82 watt-hours and in the other case 68 watt-hours, so that, on the assumption that this is repeated at regular intervals of 45 seconds—that is, 80 times per hour—the energy saved per car during that hour is 1.12 kw-hours. Thus, quite apart from the question of the energy absorbed by the brakes, which will vary according to the particular circumstances of the case, there is a clear saving of 10 per cent of the energy consumption in imparting to the car a speed of 12 miles per hour.

The flexibility of the system of control by means of shunting the field coils is clearly seen by reference to the remaining curves. These two curves show speed-time curves for the two cases. In the first case there are only two speed-time curves, namely, that in which the motors are in full series and that in which the motors are in full parallel; in the second case there are five speed curves corresponding to the five running positions of the controller. The comparison between the two sets of curves requires no explanation. The degrees of shunting assumed for the purpose of the above calculations are not necessarily fixed, but may be modified to suit each particular case for which the equipments are desired.

Circuit-Breaker for Mill Use.

Where circuit-breakers are installed in central stations and where they are operated by skilled attendants they give very little trouble, and even comparatively complicated pieces of mechanism will operate year in and year out successfully. Where, however, breakers are mounted in mills where they are subject to the elements, to dust, and to handling by unskilled operators, the case becomes quite different, and the circuit-breaker which is the simplest and has the fewest pivoted parts is the most satisfactory, other things being equal.

Realizing that a mill and a switchboard circuit-breaker are really two different classes of apparatus, the Condit Electrical



CIRCUIT-BREAKER FOR MILL USE.

Manufacturing Company has developed the circuit-breaker illustrated in this article for mill work. The main difference between it and other forms on the market lies in the omission of the toggle or power multiplying device.

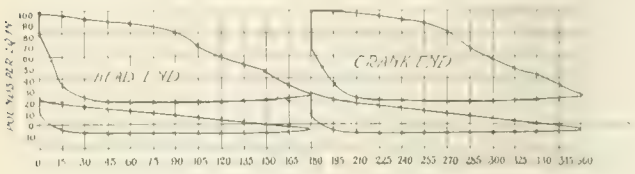
On account of the pressure exerted by the laminated brush, some multiplying device heretofore has been considered necessary, but by the employment of the flexible laminated brush, and by taking advantage in the shape of the handle of the natural toggle of the arm, circuit-breakers up to 2000 amp in capacity are now made without a toggle.

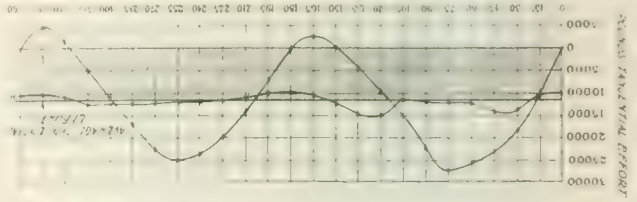
As will be seen from the illustration, the circuit-breaker is graceful in its lines and extremely simple in its construction. The interlocking features, the coil per pole, maximum-contact minimum-resistance carbons, and the general mechanical design of the older Condit circuit-breakers have all been retained in this new type. It is made in all of the forms, including overload, underload, shunt trip, no-voltage and reverse current; and all of these forms are so arranged that the operation of any one pole will open all poles of the circuit-breaker.

The makers claim that the new, simple mechanism which obviates the chance of mechanical difficulties on circuit-breakers, combined with the coil per pole feature, which obviates electrical difficulties, combine to make this circuit-breaker one which will positively operate under all conditions.

Arrangement of Engine Cylinders to Produce Uniform Torque.

One way to produce a more even turning moment of an engine-driven shaft is to connect several cylinders to a single crank shaft. This gives numerous impulses per revolution and each being of the same intensity and occurring at equal intervals of time, produces a practically uniform turning effort and also has the further advantage that for a given amount of work the thrusts given by the separate cylinders can be smaller than if all were delivered by one. While the above point is well known, it will, however, be a surprise to many to know how uniform a turning moment can be produced in a two-cylinder engine having the cylinders correctly located and the load properly divided between them.





FIGS. 1 AND 2.—INDICATOR CARDS AND CRANK EFFORT DIAGRAMS.

In the angle-type engine, illustrated herewith, the low-pressure cylinder is placed vertically on the same bedplate with the high pressure and exactly 90 deg. to it. In this case it will be seen that the maximum thrust, due to the admission of steam to the low-pressure cylinder does not occur until after the high-pressure cylinder has finished half its stroke, and the pressure in it is rapidly falling off. Then maximum pressure occurs in the low-pressure cylinder and after it has finished half of the stroke, steam is again admitted to the other side of the high-pressure piston, and so on. It will thus be seen that instead of the two maximum thrusts occurring at the same time there are four which follow one another with uniform regularity. This arrangement tends to produce a more uniform turning force, and the following diagrams have been worked out accurately to show how the force actually varies in the two cases.

The four indicator cards in Fig. 1 are from a compound engine and the same cards were used in figuring out both curves in Fig. 2.

The position of the cards, as shown in Fig. 1, represent the events as they occur in a tandem engine. Curve *A* was plotted from the cards in this position. The ordinates for each card were taken for every 15 deg. turned through by the crank and multiplied by the corresponding piston areas. The sum of these two gives actual pounds thrust on the piston. This was then corrected for angularity of piston rod, so that of the total thrust only that portion was plotted which tends to push the pin in a circular path.

It is seen that with the tandem engine, the tangential force delivered to the crankpin at first rises very rapidly, then quickly falls to zero and when the crank has turned through an angle of approximately 150 deg., or is very nearly at the end of one stroke, the force becomes negative. This is due to the fact that the steam pressure resulting from expansion is rapidly becoming lower while the steam on the other side of both pistons is being compressed at the same time; hence, at this point, instead of the pistons tending to drive the pin forward, they become a drag and have to be carried to the end of the stroke by the inertia which is stored up in the flywheel.

Curve *B* shows the crank effort from an American Ball angle compound engine. Here the low-pressure cards are moved forward 90 deg. and the tangential efforts were figured out separately for each cylinder for every 15 deg. and then added together. The remarkable thing about this curve is its extreme "flatness," which shows how small the variation in turning moment is in this engine.

The cards were taken from an American Ball angle-compound engine, in which the piston areas, points of cut-off and division of the load have been carefully worked out with a view of producing this uniform torque. If the effects of inertia had been taken into consideration, the results would have shown up still more favorably to the angle-compound engine, as the masses moving in the same direction are smaller and the fact that they are separated 90 deg. allows of perfect balancing, which is impossible with either the tandem or cross-compound construction.

The line of average tangential effort was located in the force diagram by means of a planimeter, and was found to be the same for both engines, showing that the total amount of energy delivered by both is the same. This line is at the top of the shaded area and represents the continuous pressure necessary to carry a given load; when this necessary crankpin pressure is exceeded in one part of a revolution there must be a corresponding deficiency in another part. From curve *A* it is seen that the turning pressure on the crankpin of a tandem engine rises very greatly above the average amount twice in every revolution and falls not only to zero, but becomes negative due to the compression at the end of the stroke. The only practical way to try and smooth out the turning moment delivered by one of these engines is to use a heavy flywheel, which takes the excess energy represented by the area of one

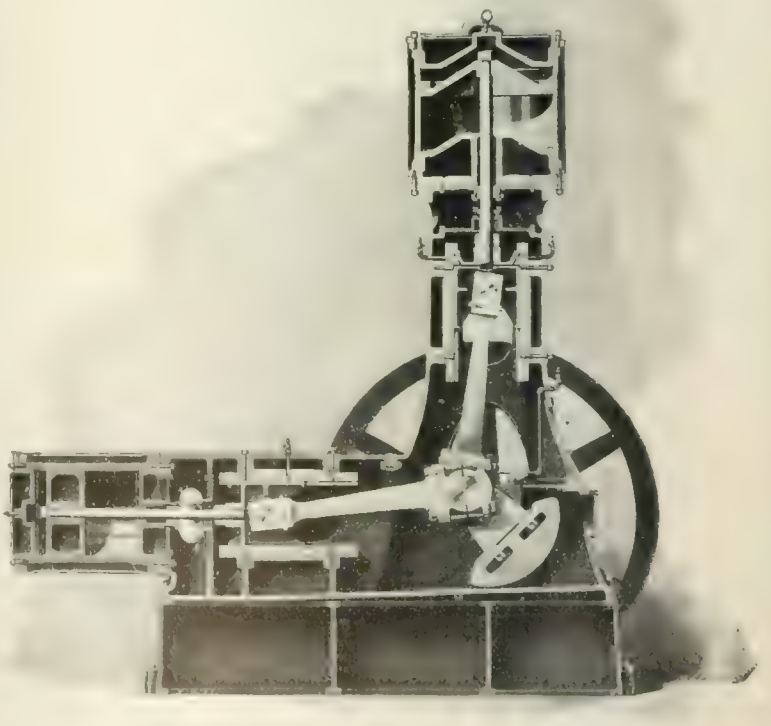


FIG. 3.—CROSS SECTION OF ANGLE-COMPOUND ENGINE.

peak of the curve above the line of average pressure and carries it over to fill in the deficiency represented by the "valley" in the next portion of the curve. Of course, the larger the variation, the larger the flywheel will have to be, and where heavy flywheels are used, the wear on bearings is faster and more oil for lubrication is necessary.

Uniform turning moment is very important where alternators are to be run in parallel, as the variation in angular velocity, such as occurs in either simple or tandem-compound engines, sets up cross-currents, which cause heating of the generator armatures and interferes with the regulation.

The American Engine Company has realized the special adaptability of this type of engine for small high-speed units and has perfected designs and is now building units of from 100 hp to 500 hp to run at speeds of 250 r.p.m. to 325 r.p.m., and for condensing or non-condensing service. These engines are suitable for any class of service, but are especially adapted for isolated-plant work, such as carrying hotel, apartment-house and office lighting loads. For this purpose their freedom from vibration especially recommends them. An ordinary lead pencil, it is stated, will stand balanced upright on one of these engines when it is running at 325 r.p.m.

It has been suggested that small turbines might be used for isolated-plant work, and in this connection the makers of the present engine point out that small turbines are not economical, especially when running non-condensing, as they consume 50 lb. to 70 lb. of steam per hp-hour when exhausting to the atmosphere, whereas one of the angle-compound engines, if supplied with steam at the same pressure, will, it is stated, furnish a hp-hour on 25 lb. A small-sized turbine to be run as economically as this would have to exhaust to a high vacuum This introduces the extra complication and expense of condensers and air pumps and leaves no exhaust steam available for heating, which is generally considered as desirable in isolated plants.

Automatic Typewriter Telegraph.

Messrs. George C. Cummings and John A. Kick, of Chicago, have invented an automatic telegraph system which, it is claimed, will do away entirely with the services of expert telegraphers in sending and receiving telegraph messages. A single-keyboard typewriter of any standard make can be attached to one wire by means of this invention and the telegraphing is done automatically by simply operating the keys of the typewriter by any person who can manipulate the typewriter keyboard.

At the receiving end the message is received on another typewriter, and is printed in the ordinary characters of the typewriter on telegraph blanks supplied preferably from a continuous roll of paper. At the receiving end all that the attendant has to do is to cut one or more of the messages from the roll as they are typewritten.

The inventors of this system are practical telegraph men. Mr. Cummings is circuit manager in the telegraph department of the Chicago, Burlington & Quincy Railroad, and Mr. Kick has just resigned his position as inspector of telegraphs for the same railroad to further the interest of a company formed to exploit this and other inventions. This company is the Charter Electric Company, recently incorporated under the laws of Illinois, with $100,000 7 per cent preferred stock and $150,000 common stock. The company has its office at 184 Dearborn Street, Chicago. Mr. Cummings is president, Mr. Archibald Wray is vice-president, and Mr. Kick is secretary and treasurer. These gentlemen, with Mr. J. G. Wray, of Chicago, and Mr. T. M. Haston, of Galesburg, Ill., constitute the board of directors. The company also owns other electrical inventions, but will devote most of its attention, perhaps, to the automatic telegraph system.

It is asserted that the typewriter telegraph can be operated at a speed of from 60 to 75 words a minute—that is, the apparatus is capable of all the speed which the typist can use in operating the typewriting machine. It increases the working capacity of the line wire and does away with the necessity of employing telegraphers, as stated. While the sending operator is writing out the message on her machine, the message is being automatically transmitted and is being received on the typewriter at the receiving end. Another feature of the machine, according to the inventors, is that it can be duplexed; that is, it may be worked both ways simultaneously. But one wire is needed.

Some patents of this system have been allowed and others are pending, so that the inventors do not care to make any detailed description public at the present time. However, it may be stated that alternating currents are used, and by means of various combinations of frequency the selective apparatus picks out the character at the receiving end corresponding to that on the key struck by the operator of the typewriter at the sending end. Sixty combinations can thus be made. The sending instrument is so constructed that it is in electrical step with the receiving end.

The characters are transmitted by selecting one of the 60 combinations. By varying the operating voltage, say, from 75 volts to 290 volts, and by the use of a common relay, the electrical impulses select at the receiving end the character corresponding to that desired by the sending operator.

It is said that if the machines get out of step the only trouble that will result will be the transmission of one wrong character, for the line is "cleared" after the transmission of each character in the message. The apparatus has been tried on the telegraph circuits of the Chicago, Burlington & Quincy Railroad, and it is believed that it will work on a line 500 miles long without a relay. Automatic repeaters can be used as in ordinary telegraphy. The same electrical energy is required as with the polar duplex.

The instrument is not in commercial service as yet, but the fact that reputable telegraph men of long practical experience say that the apparatus has worked satisfactorily on trial makes the announcement of the appearance of this automatic typewriter-telegraph system of much interest. Of course, if the inventors are not oversanguine, the advent of this system may work a revolution in telegraph service where there is sufficient business to warrant the expense of introducing the apparatus. It is said that the price of a set of instruments, consisting of the sending instruments and the receiving instruments, will be about $5,000.

The other patents controlled by this company are also of considerable ingenuity and interest. One device by Messrs. Cummings and Kick relates to an electric typewriter which can be arranged without the telegraphic selective apparatus, so that two typewriters can be installed in different departments of a commercial house—say, between the order-room and the shipping department—and the operation of one machine will simultaneously operate the other in the distant room.

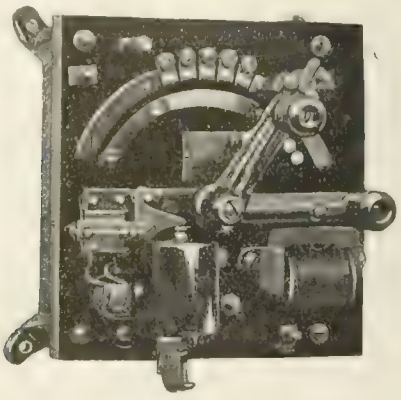
The Cummings-Wray train-dispatching system, which has been in use for some time, is also owned by this company. This system is used in connection with train dispatching by telephone.

By its use the dispatcher at the main office can, by pressing a row of buttons on the instrument, cause a 4-in. gong to ring on all of the stations of the line represented by the buttons pressed. If he presses buttons 1, 2, 3 and 4, for instance, the gong at the distant station 1 will begin to ring, and 1½ seconds later the gong at distant station 2 will begin to ring, and so. These gongs will continue to ring until the telephone train operators at the distant stations answer the call. By this means a great saving of time on the part of the train dispatcher is effected where he wants to communicate with several distant station operators at nearly the same time, as is often the case.

Another invention owned by the company is the Cummings "booster telephone," by which it is said to be possible to connect 25 or 30 telephone stations on one line, extending the party-line idea much farther than anything known at present for efficient service.

Field-Control Motor Starters.

The cut shows a Ward Leonard motor starter with no-voltage release and overload circuit-breaker equipped with steps of resistance for speed control by field regulation. This rheostat is equipped with 16 steps of field resistance designed to give 2 to 1, 3 to 1 or 4 to 1 speed control, as may be specified, and with but five steps of field resistance to give approximately 30



FIELD-CONTROL MOTOR STARTER.

per cent field control. The rheostat is so arranged that the motor will not be started under conditions of weakened field. The resistance is entirely enclosed. The field resistance consists of standard Ward Leonard enameled resistance units. The resistance in the armature for starting is a low-temperature coefficient wire or strip.

The Dynatak.

A novel instrument, the invention of Prof. N. Monroe Hopkins, of the George Washington University, Washington, D. C., has recently been put upon the market under the trade name of "Dynatak." The instrument is a combination power indicator and precision speedometer without a flexible shaft, and when the equipment is installed upon a stationary engine, automobile, motor boat or aeroplane indicates as follows:

First, what the cylinders of the engine are doing separately or together; second, which, if any, cylinder is missing fire; third, the power of the engine, and the conditions under which it is doing the most useful work; fourth, how to adjust the carburetor perfectly when the engine is idle as well as under load; fifth, speed with absolute precision from 1 mile to 60 miles or 100 miles per hour and mileage; sixth, revolutions per minute of the propeller in aeroplane and marine work.

The instrument is an original application of the fact that an electric current is produced by the simple heating of the junction of two dissimilar metals, and the magnitude of the current so generated is proportional to the junction temperature.

Ordinary thermo-couples as evolved by Becquerel and used for general temperature measurement in the arts and sciences would never "live" or operate under the high temperature and peculiar chemical conditions in a gasoline-engine cylinder, because they would become so heated as to pre-ignite the charge and cause the gas engine to buck, hitch or back-fire, and in addition would become brittle and drop apart either through oxidation or the absorption of carbon after a short period of use. Actual temperature measurements by means of thermo-couples or thermometers could not be made in gasoline-engine cylinders.

As a result of years of experimentation, Professor Hopkins, the inventor, has developed a type of thermo-couple of special design and original construction which gives an index of the temperature in a gasoline engine without actually attempting to measure it. The instrument continuously shows by modified temperature readings the working conditions of gasoline-engine cylinders. It is stated that the Hopkins "thermo-plugs" give the same "electrical pressures" after 50,000 miles' use on an automobile as when first applied.

The "Dynatak" equipment has these specially constructed thermo-couples in each spark plug. They may be selectively or collectively connected with an electrical indicating instrument which gives an accurate reading of the current delivered by one

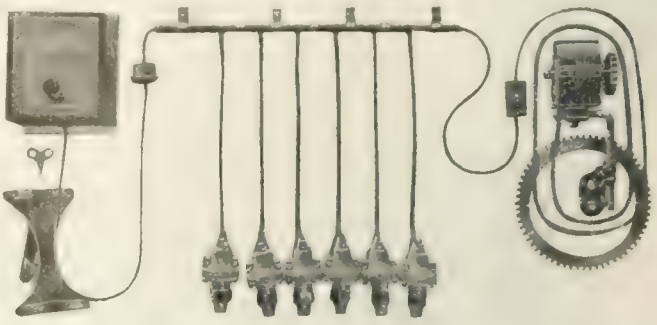
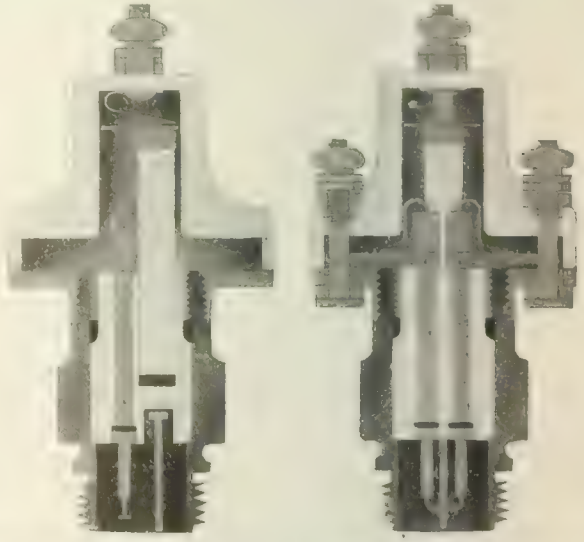


FIG. 1.—THERMO-ELECTRIC COUPLES AND INDICATING APPARATUS.

particular cylinder or by the combined cylinders if the spark plugs be connected in series.

There is a switch on the instrument for obtaining separate or combined cylinder indications. The instrument has two scales, the upper a speed scale and the lower a power scale. On the switch there is also a speed contact *S* which connects a small magneto-dynamo with the indicating instrument, and electrical current is furnished in direct proportion to the speed at which the dynamo is driven.

In addition to this combination speedometer and dynamometer, Dr. Hopkins has also invented an electric speedometer indicator and tachometer of great sensitiveness and accuracy.



FIGS. 2 AND 3.—SECTION VIEWS OF THERMO-ELECTRIC COUPLE AND SPARK PLUG.

This instrument is mounted in a circular brass case of the finest construction.

The instruments are handsomely made, the index being pivoted in sapphire bearings and the little dynamo having platinum commutator and gold brushes.

The "Dynatak" is manufactured by the Electric Speedometer & Dynamometer Manufacturing Company, of which Prof. N. Monroe Hopkins, the inventor, is president.

Individual Motor Drive in a New Structural Steel Plant.

The Lackawanna Bridge Company, of Buffalo, located near the Lackawanna steel plant, expects to begin operations in the first of its six buildings before the first of the year. This building, which is almost completed, is about 700 ft. long by 300 ft. wide. The electric motor and lighting equipment will

be installed in accordance with the latest methods. Individual 220-volt direct-current motors with remote control will be used throughout for the shop cranes, yard cranes, reamers, gantrys, riveters, and all the machines necessary in structural steel plants. The pilot wires on the remote control switches are to be operated by one wire running from one side of the switch to the switchboard in the power house, and the other side of the switches will be connected to the other side of the line at locations nearest the switches. The main switchboard will be located in the power house, where the 220-volt direct current will be generated. The 54 motors which will be installed, ranging from 1½ hp to 85 hp, total up to about 800 hp. The majority of these are between 5 hp and 30 hp, only four being above 50 hp. The lighting will be principally by 110-volt arc lamps (two in series on 200-volt circuit) or by 220-volt enclosed arc lamps.

Transformers for Making Steel.

Steel making by means of the electric furnace, although at present in a pioneer stage, promises soon to be accepted as the best and cheapest method of manufacturing steel of certain grades. Numerous forms of electric furnaces for this work have been developed, all of these having in common the application of large currents at low voltage. It is evident that alternating current is the best for such work, on account of the fact that the heavy currents necessary may be taken from suitable transformers located close to the furnace. The illustration shows a transformer manufactured by the Pittsburgh Transformer Company which was especially designed for the purpose of operating electric furnaces for steel making. Two of the largest equipments of these Pittsburgh transformers are now in operation, one of these supplied through the Central Electric Company, Chicago, being in service at the South Chicago Works of the Illinois Steel Company, and the other at the American Steel & Wire Company's plant in Worcester, Mass.

These transformers are oil-insulated, water-cooled, and are of core-type design. It is stated that these are among the largest, if not actually the largest, core-type transformers in successful operation in this country at the present time, especially in view of their liberal capacity for overloads. In the design and construction, it was necessary to keep prominently in mind the fact that steel furnace work is of an exceptionally trying nature, with loads fluctuating rapidly from zero up to momentary overloads of several times the rated capacity of the transformers. The mechanical arrangement of these transformers is such that all parts of the windings are rigidly braced and held against any movement which might be caused by sudden current rushes.

On account of the large currents used in these electric furnaces, approximately 30,000 amp, very careful provision was made in the arrangement of the secondary coils and current-carrying cables to avoid serious induction trouble. The illustration of the low-tension terminal board shows the construction employed to feed from the transformer secondary into the copper busbars leading to the furnace. Except for certain special features mentioned, these transformers follow closely the standard practice of the Pittsburgh Transformer Company. Boiler-iron tanks of oval section are used, which are held between cast-iron tops and bases. The water-cooling coils are of heavy seamless copper tubing. The steel used in the cores was the latest formula silicon-alloy, which enabled high electrical efficiency to be secured.

The illustration showing the low-tension terminals for connection to the furnace busbars indicate the massiveness of the current-carrying parts, and a still better idea of this will be gained when it is understood that these low-tension terminals contain 800 lb. of copper.

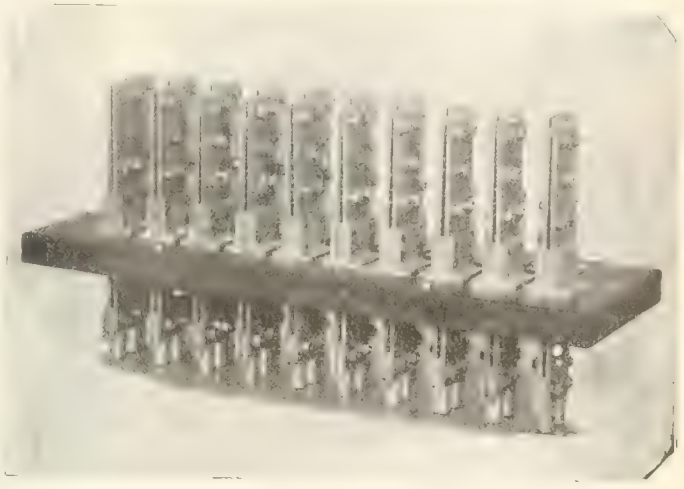


FIG. 2.—LOW-TENSION TERMINAL BOARD.



FIG. 1. PITTSBURGH TRANSFORMER FOR STEEL MAKING.

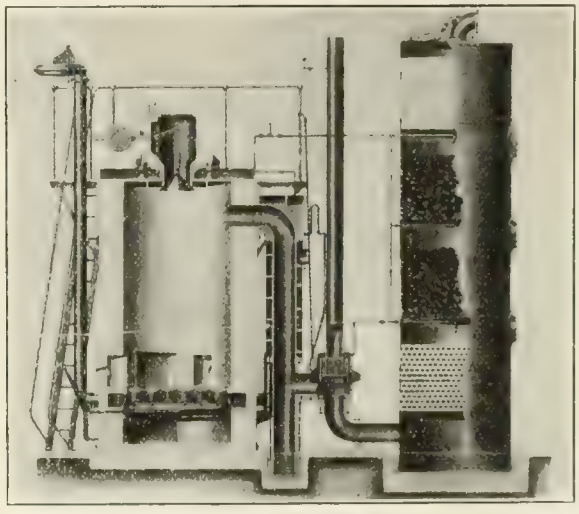
The transformer differs from the standard core type of the Pittsburgh Transformer Company only to the extent in which it becomes necessary to meet the special conditions of the electric steel furnace.

Anthracite Gas Producer.

The producer-gas plant illustrated herewith consists principally of a "generator" in which gas is made, an "economizer" in which the waste heat of the gas is utilized, a "wet scrubber" in which the gas is cooled and practically cleaned, and a "dry scrubber" in which the gas is dried and where it is thoroughly cleaned from dust and moisture.

The generator is made of a steel shell, cylindrical in form and lined with firebrick, and provided with a water-cooled top. At the top is a hopper of the self-locking type, so arranged that it is impossible to dump while the top is open. The grate is of the shaking type operated by a lever arm on the outside of the generator shell.

In passing from the generator to the scrubber, the gas is led through the economizer, the top of which is a water compartment provided with a subdividing wall extending to within 2 in. of the bottom. The cooling water from the top of the generator is admitted into one side of the economizer head, the inner chamber of which is provided with two pipes connecting to the economizer proper. The center of the economizer consists of an iron casting provided with projections in the form of a spiral. The hot water trickling down this spiral is flashed into steam. The bottom of the economizer is connected to the tuyeres in the generators so that the suction on the producer forms a partial vacuum in the closed compartment of the



PRODUCER GAS PLANT.

economizer head, thereby raising the water level in direct proportion to the load, and varying the suction directly therewith. Air is admitted into the outer shell of the economizer through a door provided with an adjustable weight, and is mixed with the steam and drawn into the tuyeres by the suction on the generator.

In the wet scrubber the temperature of the gas is lowered to within a few degrees of that of the cooling water. In the dry scrubber, where the dust and moisture is removed, there are two baffle plates between which is a filling of excelsior, the top of which is soaked in oil. The gas passes through this scrubber at a velocity of not over 20 ft. per second.

It is claimed that at 100 per cent load a brake hp-hour can be produced by 1.058 lb. of coal containing 13,000 thermal units per pound; at one-fourth load, 2.607 lb. is required. The above-described plant is manufactured by the Hill-Hupfel Engineering Company, 30 Church Street, New York.

Dial Decade Testing Set.

A testing set with several devices for facilitating quick and accurate measurements is being put on the market by the Leeds & Northrup Company, Philadelphia, Pa. It is designed for a full range of measurements, which include resistance measurement from 0.01 ohm to 10,000,000 ohms, and fault location by the Murray and the Varley loop tests. This set is designed particularly for the class of measurements which are necessary in maintaining telephone and telegraph lines, and in clearing trouble in them. It is said that the new model has many features which are decided improvements over older types. The preliminary models were submitted to several well-known telephone and telegraph engineers for test, and valuable suggestions made by them were embodied.

The case has been made shallow—only 5 in. deep—so that it can be carried easily, in contrast to those that are almost square. The battery is fastened by two screws to the rubber plate and controlled by a knife switch. This arrangement makes it very easy to lift out the rubber plate complete, with battery, galvanometer and coils all in plain view and easily accessible. In this connection, it might be said that the galvanometer is completely protected and made dustproof by a strong metal case, so that no dirt can enter when the set is opened.

The dial switches can be rotated continuously, and no backward motion is necessary in going from the "9" point to the "0" point. The laminated brushes used in these switches are not bent square at the contacts, but at a slight angle, thus making a brush contact that, instead of wearing a groove in the studs, will simply tend to clean the whole surface. The set is built on the four-coil decade plan. There is, therefore, no crowding of parts and the coils may be easily replaced by the operator if one should be burned out. Metal spools are used throughout, the conductors having a carrying capacity of four times that of conductors on the usual wooden spool. The conductors are of manganin wire wound on brass spools, silk insulated and thoroughly baked in shellac.

The galvanometer in this set is of the suspension type, the



DIAL DECADE TESTING SET.

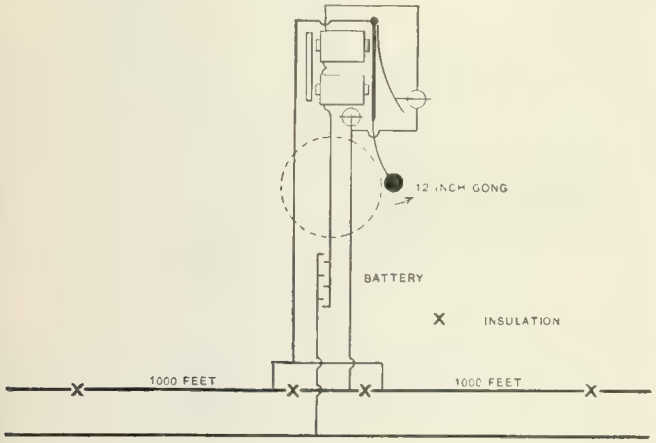
old-style pivot-and-jewel instrument having been entirely discarded on account of its susceptibility to jars which blunt the pivots and make the pointer stick. In the suspension type there is no such trouble. The instrument will actually withstand more rough usage than an ordinary portable voltmeter on account of the spring suspensions; moreover, the galvanometer will deflect for the most minute current that can be put through it, there being no initial friction to overcome. Its sensibility is ample for all ordinary work.

The arrangement of ratio coils is a new feature. These coils are controlled by a single rotary switch that makes contact on ratio studs as follows: 0.01, 0.1, 1, 10, 100 and 1000. The rheostat reading is then simply multiplied by the value indicated by the dial switch, and one is never in doubt as to whether to multiply by arm "A" or arm "B." This arrangement gives a range of from 0.01 times the rheostat reading to 1000 times, this being as large as can be accurately used with any set of this type. The contact resistance, which is so minute as to be negligible and will remain so, is in only the battery circuit, so that even should it be high, it would not affect the galvanometer sensibility.

An improvement in this set is the absence of all flexible cords. All connections for the loop tests, for outside battery and for outside galvanometer are made simply by means of knife switches located on the rubber plate of the instrument.

Railway-Crossing Alarm.

A device is being exploited by Alexander & Keim, of Denver, in the form of a railway-crossing alarm. The alarm consists of a bell actuated by magnet of which the circuit is closed by the car axle from one rail to the other. The distinctive feature is the fact that upon reaching the crossing itself, and during any time spent on the crossing, the ringing of the bell ceases and does not start again until the train has passed out of the block. A train coming in the opposite direction on a single track rings an alarm as it approaches the crossing and the bell will again be silent while the train is at the crossing or leaving it. The annoyance of a bell ringing where stops are made is thus done away with. The diagram of connections is shown in the accompanying sketch. The alarm is actuated by an ordinary dry battery or gravity battery. The circuit through



RAILWAY-CROSSING ALARM.

the middle section of track is direct through coils, not passing through a vibrating contact, the armature being thus held down.

Electrically Heated Oil Tempering Bath.

It has been common practice to heat by gas the oil tempering bath used by manufacturers for the purpose of tempering steel tools or dies, but as very close regulation of temperature is essential for a uniform quality of product, gas heating has not proved satisfactory. Added to this is the ever-present fire hazard when gas is used. As is often the case, the use of electricity has been advocated as a solution of the problem of proper oil tempering, and the General Electric Company has recently perfected an electrically heated oil bath which seems to meet all the requirements of such apparatus. The general appearance of this device is shown in the illustration herewith.

The bath proper consists of a cast-iron tank or pot having 12 lugs evenly spaced around the sides. These lugs are drilled to receive standard cartridge units, and it is found by thus distributing the units that an even temperature can be maintained in all parts of the oil. Around the pot is placed a heat-retaining jacket consisting of an inner and outer wall of sheet metal, the space of 3 in. between the walls being filled with mineral wool. The jacketing on each side of the pot is easily removable, thus allowing quick access to the internal connections of the units. Around the top of the pot there is a wide flange to which are secured four cast-iron legs. A drain pipe controlled by a globe valve provides a means for drawing off the oil. There is a protected recess in one end of the pot in which a thermometer can be placed to indicate the temperature of the oil.

There are two methods of using the oil bath. In the first method, the temperature of the oil is raised to about 250 deg. Fahr., the work is placed in the bath and full heat turned on. When the oil reaches the desired temperature, the work is removed and the current turned off. This method requires a single heat bath. The second method is to turn on full heat, bring the oil to the desired temperature, then introduce the

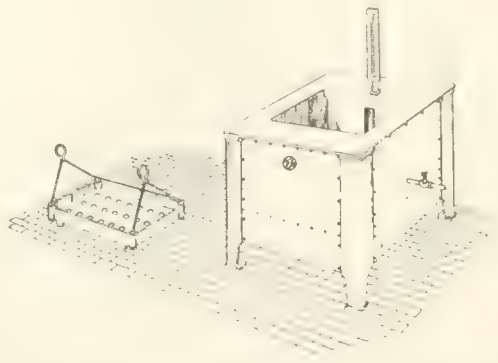


FIG. 1.—ELECTRICALLY HEATED OIL-TEMPERING BATH SHOWING REMOVABLE TRAY.

work, and by means of regulating switches maintain that temperature constant any length of time desired.

Where desired, a cast-iron basket or tray is supplied in which the work can be placed. The basket has eye bolts at each end to facilitate handling. The bottom of the basket is perforated with ⅞-in. holes, permitting free circulation of the oil. There are also legs on the bottom of the basket which keep the work an inch or more above the bottom of the bath.

The heating units are connected in groups according to the size of the bath, and the leads are brought out to the thermal block. In the single-heat device, each group is protected by a fuse. In the multiple-heat device, the leads are carried to the switchboard, the latter being so arranged that the energy input can be varied in small steps from zero to a maximum. A switchboard is not necessary for the single-heat bath, but is required where a multiple heat device is wanted.

Any desired temperature is obtained by throwing in the necessary number of units to give the approximate value. Close regulation is then secured by varying the voltage impressed on one of the units. This is accomplished by means of the rheostat mounted on the board. As a result of this method there is a negligible loss of energy in the regulating device.

The oil capacity and energy consumption of the three sizes in which the bath is made are respectively as follows: 9 gal. and

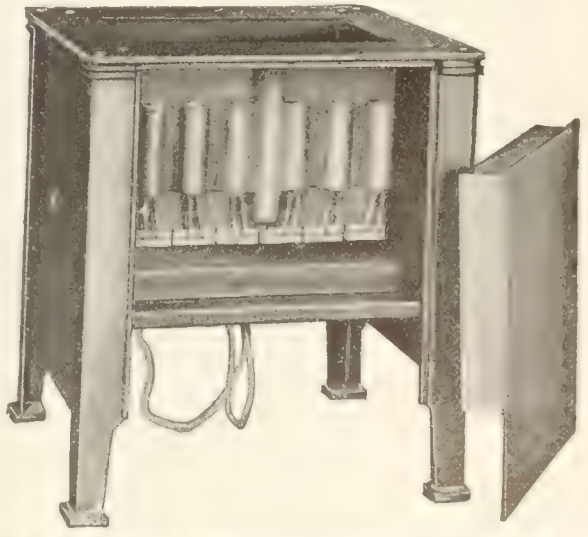


FIG. 2. ELECTRICALLY HEATED OIL TEMPERING BATH SHOWING RENEWABLE CARTRIDGE UNITS.

6 kw., 11 gal. and 7.2 kw and 37 gal. and 20 kw. The energy consumption is sufficient to heat the oil to a temperature of 450 deg. Fahr. in less than one hour, starting cold.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The condition of trade during the past week continued to be all that could be hoped for. There is a steady development in every industrial line, and wholesalers and jobbers report excellent business. Especially in drygoods, millinery, shoes and clothing there has been active buying. The retailers throughout the country, who for the larger part of the past year have been very conservative, are generally short of stocks, and this means that they are ready to buy at the present time more liberally than is usual at this period. The orders now coming in might properly be referred to as filling-in orders, but they are really purchases made to meet the holiday trade by people who had not sufficiently provided themselves with stocks. Prices continue to be unusually high in all commodities. The only cloud on the present industrial situation is the fact that the cotton mills, both in the North and South, have been compelled to curtail their output. This is due to the fact that the price of cotton goods has not kept up with the advance in raw cotton. It is not believed that this curtailment will be of very long duration, because the country in general is in a buying mood. In the iron and steel industry it is the same old story; the mills are full of orders, and are now taking business that will run well on to the middle of next year in delivery. Collections are so much improved that there is no longer any complaint heard in this direction. The early movement of crops and the increase in retail trade have enabled the Western merchants to meet all of their bills promptly. There are not a great many important business troubles, and the failures that are occurring are usually those of small concerns. For the week which ended Nov. 4 the failures reported by *Bradstreet's* were 212, as against 217 the previous week; 205 the same week of last year; 226 in 1907; 146 in 1906, and 166 in 1905.

THE COPPER MARKET.

After a week of considerable activity and strengthening of prices, the copper market on Nov. 8 suddenly became considerably excited over the large buying orders that were received from Europe. Merton & Company, of London, who a few days previous had contracted with the United Metals Selling Company for 10,000 tons at £59, came into the market again on the date mentioned ready to buy all the standard copper available, regardless of quantity or price. It is said that the transactions for the day amounted to more than for any day of the year, and some estimates placed the amount taken for shipment within the next three months at 50,000,000 lb. In the meantime there is no change in the adverse aspect of copper statistics. The figures for October indicate that domestic consumers took about 50,000,000 lb., and that exports were about 60,000,000 lb. This, it is estimated, is at least 20,000,000 lb. above the actual melting, indicating an accumulation in consumers' hands in the two countries of that amount. The estimated figures of production for the month are 122,000,000 lb., so that in spite of the liberal takings for the month above actual demand there appears to be an increase in the surplus in producers' hands of about 12,000,000 lb. There continue to be all sorts of rumors regarding a trade agreement among the great copper producers, and this may be responsible for the foreign buying. Few of the well posted copper men in this market now believe that a merger into one giant company is probable, but it is generally expected that a price agreement will be reached that will steady the copper market, like the price agreements that control the iron and steel markets. The exports for the month, including Nov. 8, have been 2,290 tons. The daily call on the Metal Exchange quoted Standard copper as follows:

	Bid	Asked	Settling
Spot	12.62½	13.00	[illegible]
November	12.62½	13.00	12.82½
December	12.75	13.05	[illegible]
January	12.87½	13.15	[illegible]
February	12.90	13.00	[illegible]
March	13.00	13.12½	13.05

The London prices for Nov. 8 were as follows:

	Noon.	Close.
Standard copper, spot	£ s d	£ s d
Standard copper, futures	58 2 6	58 12 6
Market	59 7 6	59 17 6
Sales of spot	Strong	Firm
Sales of futures		800 tons
		2,200 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13 -	12.12½
London, spot	£64 - 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

INSULATED WIRE PRICES.—The demoralization in prices of rubber-covered wire, which was referred to last week, is explained by an authority in the trade as being due to the fact that crude rubber has recently been not only very high, but very uncertain in price. "The demoralization in the prices of our goods," he says, "is due entirely to the price of rubber. Regularly organized manufacturers of rubber-covered wire have had difficulty in competing with various other manufacturers who pretend to be offering the same goods. The difference has been in the quality of the rubber-covered insulation. While the well-known makers are putting out the same rubber insulation to-day that they did a number of years ago, there has been, however, introduced into the trade a lot of manufacturers who claim to have the same product, but who are putting out a rubber-covered wire, the covering of which is made up of cheap compositions. Within the last year the price of rubber has been so erratic that rubber has become the most important ingredient. This is the reason that there have been cuts in prices and many prices quoted. In manufacturing this product there is no chance to change the quality of the copper, but there is every chance to change the quality of insulation; so when the insulation has become the chief factor of value, it is very easy to see how prices can be cut to almost any figure."

SUBWAY FOR CINCINNATI.—Comprehensive plans have been presented to the City Council of Cincinnati providing for a subway system to connect the business section with the outlaying residential districts. The plans were drawn by City Engineer Sundmaker, and have the approval of the city administration. They involve an expenditure of from $10,000,000 to $15,000,000. The project is entirely one of municipal ownership, although it is proposed that the roads shall be operated under lease. There is practically no doubt that the Council will pass the necessary ordinances, and it is expected that the work of construction will begin next spring.

SOUTHERN COLORADO POWER COMPANY.—The Southern Colorado Power Company, of which Frank P. Read, Denver, is general manager, is steadily proceeding with the development of its system. Considerable work is now under way, and immediate plans for the future include the addition of several steam turbines; the construction of complete fireproof vaults for transformers and for high-tension switching apparatus, and a complete unit arrangement for the various turbines, and the extension of a number of outside lines to feed mining districts now operating with steam plants.

SIEMENS BROTHERS IN CANADA.—The Siemens Bros. Dynamo Works, of London and Stafford, have opened a Canadian office in Toronto, in the Birbeck Building, in charge of A. S. Herbert. Electrical equipment of all descriptions will be imported from the English works of Messrs. Siemens Bros. companies, and branch offices will be established at Montreal and Winnipeg.

RENO (NEV.) POWER, LIGHT & WATER COMPANY.—Work will soon begin on the dam of the Reno (Nev.) Power, Light & Water Company on the Truckee River. This dam will cost about $1,000,000 and will provide a hydroelectric power station that will furnish energy for many of the mining camps in that section. The Reno Company will also probably erect a plant in the neighborhood of Ely.

TELEPHONE TRAIN DISPATCHING ON NICKEL PLATE.—The New York, Chicago & St. Louis Railroad Company—"Nickel Plate"—is planning a telephone train dispatching equipment for its line from Conneaut to Bellevue. This circuit will be the first one installed by the company, and if it proves satisfactory the company may equip its entire line with telephone train dispatching apparatus. The total length of the experimental line is 132 miles, and there will be 28 regular station equipments, with a number of special siding telephones so located that the train crews can get in direct communication with the dispatcher. The equipment used will consist of the standard Western Electric telephone train dispatching apparatus and Gill selectors. The siding telephones will be mounted in telephone booths which will offer shelter for the train crews when reporting to the dispatcher, or receiving orders from him. Arrangements are made so that the telephone sets at these sidings are automatically cut free from the line when the telephone sets are not in use.

NEW PLANT ON THE FRENCH BROAD RIVER.—The North Carolina Electric Power Company, subsidiary to the W. T. Weaver Power Company, it is announced, will shortly begin the construction of a mammoth power plant across the French Broad River near Marshall, N. C., west of Asheville. The plant will develop 4600 hp, the dam being 30 ft. high and 500 ft. in length, with 18,000 yd. of concrete work in the construction. There will be two 2200-hp generators, the completed plant representing an expenditure of about $400,000. This is the plant from which, it was stated, power for the new electric line from Asheville to Galax, and tapping the new Carolina, Clinchfield & Ohio Railroad, will be derived. Another site a few miles up the river offers further power if such shall be found to be required in carrying out the company's plans. The electric road will be known as the Asheville & East Tennessee, with Galax as the terminus.

IMPROVEMENTS IN HELENA, ARK.—The Helena (Ark.) Gas Company is contemplating the rebuilding of its plant (which includes electric light and power service) at an expense of about $200,000. A new electric power station and new gas works will be built on a new site, concentrating the generating activities of the company, heretofore scattered in separate plants. The property is owned by local bankers, who are negotiating with Chicago and Grand Rapids (Mich.) capitalists to secure funds to finance the rehabilitation. An examination of the situation by engineers and accountants is now under way. If favorable reports are received, the project will undoubtedly be carried out. Mr. E. C. Horner is president of the Helena Gas Company.

CONNECTICUT RIVER TRANSMISSION COMPANY.—The Gas Commissioners of Massachusetts have approved of the action of the Mayor and Board of Aldermen of Worcester granting the Connecticut River Transmission Company the right to erect and maintain poles and wires over certain avenues and streets in Worcester. This right was protested by the Worcester Electric Light Company, which claimed an exclusive privilege in that city. This approval by the Gas Commission means that the Connecticut Company will enter into competition with the Worcester Company for the sale of energy, but it cannot supply customers who want less than 300 hp.

LOS ANGELES FIRE-ALARM CONTRACT.—It is reported that the contract for supplying fire-alarm and police-alarm signal systems in the University District of Los Angeles, to which reference was made in these columns last week, has been awarded to the Cregier Signal Company of Chicago, which, it is said, is to furnish and install 100 boxes at a cost of $29,274. It is believed to be the intention of the city to abandon the automatic system and to install district manual stations.

TWIN CITY RAPID TRANSIT COMPANY.—The contest between the Twin City Rapid Transit Company and the City of Minneapolis will come up before the Supreme Court of the United States within the next few days. The city endeavored to enforce a six for a quarter fare ordinance some years ago, and the United States Circuit Court decided in favor of the company. Since then the matter has been in the Supreme Court, and a decision is expected some time this month.

DENVER GAS & ELECTRIC COMPANY BUILDING.—The contract for installing feeders, panel boards and decorative outside lighting in the Denver Gas & Electric Company's 10-story office building now under construction at Denver, has been given to J. Fischer, electrical engineer, of Denver. Mr. Fischer largely assisted in the design of the special outlining for the building, and in many details of the specification. The completed installation will cost in the neighborhood of $30,000.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in our present issue are announcements of proposed new plants or considerable extensions of present plants at Almorgordo, N. M.; Marblehead, Mass.; Montesano, Wash.; Meredith Center, N. H.; Lorain, Ohio; Massapequa, N. Y.; Marshall, N. C.; Greenville, S. C.; Dublin, Ga.; Blackwell, Okla.; Sandpoint, Idaho; Spirit Lake, Idaho; Redlands, Cal., and Reno, Nev.

ALLIS-CHALMERS COMPANY.—The Allis-Chalmers Company is perfecting plans to make extensive improvements in its Cincinnati plant. It is given out that the business in the electrical manufacturing branch of this company has increased so rapidly that the present plant is inadequate to take care of it. In consequence quite extensive additions are to be made in Cincinnati, and several hundred additional workmen will be employed.

NEW YORK ELECTRIC CONSUMERS' LEAGUE.—A company was incorporated in Albany last week with a nominal capital of $500 to be known as the "State Electric Consumers' League" of New York. The purpose of this company is to furnish inspection and auditing for private consumers of electric energy or gas for power or lighting, and to examine wires, pipes and conduits.

ELECTRIC FOUNDRY ADDITION.—Preparations are being made to open the new foundry addition to the Fort Wayne (Ind.) Electric Works, which was finished several months ago. Expert workmen have been working on the installation of the necessary apparatus, and a narrow-gage railroad will be built from the present factory buildings to the foundry.

FABIUS HENRION CARBONS.—The Edward E. Cary Company, importer, which controls the "Fabius Henrion" lamp carbons in this country, has just closed a contract with the Stuart-Howland Company, of Boston, by which that company became the exclusive selling agent of these carbons in New England.

ISTHMIAN CANAL SUPPLIES.—The Isthmian Canal Commission, Washington, invites proposals until Nov. 12 for a 6-in. induction-motor driven pump, with transformer, switches, etc.

Financial Intelligence.

THE WEEK IN WALL STREET.

During the week the stock market has been rather dull in trading, but a confident tone has prevailed, and the majority of the net changes for the week have been slight gains. There might be given as the principal feature of the market the widespread spirit of conservatism that apparently dominates all transaction. The bankers are conservative about placing loans, the large traders are conservative in assuming heavy commitments, and the small traders are compelled to be conservative because they can only expend when the banks are liberal. The entire situation is the result of the unsettled condition of the European money market. Our own money market is in an exceptionally good condition for the season of heaviest demand from the West for crop moving purposes. We have met this demand without strain, and but for the fact that our market is very sensitive to European conditions there would be no fear of stringency here. As it is, there is the ever present fear of further advances in the discount rates of the German Imperial Bank and the Bank of England, with rates of exchange already so high as to bring about exports of gold. It is this uncertainty, more than the present price of money, that unsettles trading and induces conservatism. The important features of the week were the proposed new stock issues of the Pennsylvania and New York Central Railroads, aggregating $124,000,000—each of which will be an added strain to the money market—and the evident negotiations among the great copper producers to form a trade agreement or possibly a pooling arrangement. This latter had the effect of strengthening Amalgamated copper stock and making it one of the most active

issues on the list. The activity of Interborough-Metropolitan continues to be a noticeable feature of the trading, although there has been no advance. Bonds continue to be in good, although less urgent, demand for investment purposes. Money was quoted Nov. 8: Call, 3¼ @ 5 per cent; 90 days, 4¾ @ 5 per cent. Quotations in the table are those of the close, Nov. 8.

NEW YORK.

	Oct. 30.	Nov. 8.	Shares sold.		Oct. 30.	Nov. 8.	Shares sold.
All.-Ch.	15½	15¾	8,800	Int.-Met., pfd.	50⅜	50⅛	22,600
All.-Ch., pfd.	52½	54¾	17,058	Mackay Cos.	91¼	94⅛	4,500
Amal. Cop.	80¼	89	411,200	Mackay Co., pfd.	75½	76*	600
Am. D. T.	20½*	20½*	.....	Man. Elev.	142	142¾*	10
Am. Loc.	62	62⅛	20,825	Met. St. Ry.	24*	24¾*	100
Am. Loc., pfd.	116	116	400	N.Y. & N.J. Tel.	139¼*	139¼*	.....
Am. Tel. & C.	85*	85*	.....	Steel, com.	90⅛	90¾	765,650
Am. T. & T.	141¼	140¼	8,250	Steel, pfd.	128	127	15,267
B. R. T.	76	76¼	8,515	W. U. T.	77	77¼	2,200
Gen. Elec.	164	163¾	2,545	West'h., com.	87	86½*	7,800
Int.-Met., com.	19¾	20	67,400	West'h., pfd.	140*	140*	400

PHILADELPHIA.

	Oct. 30.	Nov. 8.		Oct. 30.	Nov. 8.
Am. Rys.	45½*	45⅛	Phila. Elec.	13⅛	13¼
Elec. Co. of A.	12½*	12⅜	Phila. R. T.	25¾	27½
Elec. St. B'ty.	58*	58½	Phila. Trac.	89½*	89*
E. S. B'ty, pfd.	30*	30*	Union Trac.	51¾	53½

CHICAGO.

	Oct. 30.	Nov. 8.		Oct. 30.	Nov. 8.
Chi. City Ry.	180*	180*	Chi. Tel. Co.	136½	136½
Chi. Rs., Ser. 1	108*	108*	Met. El., Com.	16½*	17*
Chi. Rs., Ser. 2.	35½*	34*	Met. El., pfd.	51¾	52
Com. Edison	119¼	119½	Nat'l Carbon	97	97*
Chi. Subways	7*	7¼	Nat'l Car., pfd.	120*	120*

BOSTON.

	Oct. 30.	Nov. 8.		Oct. 30.	Nov. 8.
Am. T. & T.	141½	140	Mex. Tel.	3¼*	3¼*
Cum. Tel.	147¼	146	Mex. Tel., pfd.	6*	6*
Edison E. Ill.	252*	250	N. E. Tel.	135	134
Gen. Elec.	163*	162	W. T. & T.	10⅞*	11
Mass. E. Ry.	18½	18½	W. T. & T., pfd.	89*	89*
Mass. E. R., pfd.	82	84			

* Last price quoted.
Shares sold are for week of Nov. 1 to Nov. 6.

HILL ACQUIRES SPOKANE & INLAND EMPIRE ELECTRIC LINES.—It is practically admitted that James J. Hill, representing the Northwestern Improvement Company, a subsidiary of the Northern Pacific Railroad, has acquired the holdings of Jay P. Graves in the Spokane & Inland Empire Railroad Company. As the Great Northern already owned a large interest in the stock of this company, this purchase gives Mr. Hill control of the property. It is said that the Chicago, Milwaukee & Puget Sound Railroad Company, part of the St. Paul system, was negotiating for the Graves interests. The Inland Empire Company is capitalized at $10,000,000 preferred and $10,000,000 common stock. All of the common is issued, while half of the preferred is still retained in the treasury. The company has a total of 390 miles of track in operation, and has constructed extensive hydroelectric plants on the Spokane River. In addition to a full equipment of cars, it possesses 76 motor cars, nine electric and five steam locomotives. Although several recent dividends have been passed, the company is said to be in a very prosperous condition and in excellent physical shape.

COMMONWEALTH EDISON COMPANY'S REPORT.—The annual report of the Commonwealth Edison Company, of Chicago, for the fiscal year which ended Sept. 30, 1909, just made public, shows gross income of $10,639,448, an increase of $1,138,339 over the previous year. The operating expenses increased only $268,115, and the net earnings were $3,996,753, an increase of $870,424. During the year a sum of $427,250 was charged off for depreciation, and the net balance at the end of the year for dividends was $2,386,996, being equal to 7.95 per cent on the $30,000,000 capital stock. The report indicates that the business of the company has increased rapidly during the year, and that there is every promise of further development. At the end of the fiscal year the company had connected the equivalent of 4,920,800 standard 16-cp lamps, an increase of 783,150 over the previous year. At a special meeting of the stockholders an increase of $10,000,000 was authorized in the capital stock. This new stock will be issued as needed, and it is said that the company proposes to supply its needs for capital hereafter by increasing its stock rather than by issuing bonds. The managers believe it is better to pay 6 per cent on bonds owned around Chicago and non-taxable rather than 5 per cent on bonds mainly owned by outsiders.

NEW HAVEN COMPANY BUYS TROLLEY LINE.—Richard Sutro, of Sutro Brothers, representing the New York, New Haven & Hartford Railroad Company, purchased last week at foreclosure sale the greater part of the Tarrytown, White Plains & Mamaroneck Railroad. The price paid was $825,000, and the sale was made to cover a $500,000 foreclosure action brought by the Knickerbocker Trust Company. The line was sold in three sections, the first two of which were purchased by Mr. Sutro. Section one extends from Mamaroneck to Tarrytown, a distance of 16½ miles; section two extends from White Plains to Scarsdale, a distance of five miles; and the third section of the road, which extends from Mamaroneck to Larchmont, two miles, was purchased by F. J. Littlebrook, representing the bondholders' committee of the Third Avenue Railroad Company. These purchases are supposed to be part of the plan of the New Haven railroad to control the traction situation in Westchester County.

TO BUILD WHITE PLAINS ROAD.—President L. S. Miller, of the New York, Westchester & Boston Railway Company, announces that he will proceed at once with the construction of a line to White Plains, in addition to the line that is now being built through the Bronx and the Sound shore section of Westchester County. The White Plains division has been divided into two sections, one of which will be built by the Ferguson Construction Company and the other by Henry Steers. The branch leaves the main line near Columbus Avenue, Mount Vernon, and will be about 10 miles in length. Its northern terminus will be White Plains. Work is already well advanced on the main line of the road between 135th Street and the Harlem River, and New Rochelle. This road is unique in the fact that it is being constructed fully up to the standard of heavy steam railroads, but is intended for electrical operation exclusively to handle suburban traffic. It is the property of the New York, New Haven & Hartford, and the construction is being financed by that company.

BAN ON TRACTION MERGERS.—Attorney-General Stead, of Illinois, has rendered an opinion in which he holds that a "commercial" railway company and a street railway company cannot legally consolidate. This bars interurban and street railways from merging, as well as steam railways and street railways. It is expected that the matter will be threshed out in the courts.

OKLAHOMA GAS & ELECTRIC COMPANY.—N. W. Harris & Company have purchased $1,600,000 of the first mortgage 5 per cent 20-year bonds of the Oklahoma Gas & Electric Company, of Oklahoma City. These bonds will probably be offered to the public in the near future.

MASSACHUSETTS ELECTRIC COMPANIES.—For the 12 months which ended Sept. 30, 1909, the Massachusetts Electric Companies reported a surplus, after having paid preferred dividends, of $1,083,860. This is the largest surplus that the company has ever earned, and equals 5.2 per cent on the $20,557,400 of preferred stock of the holding company. During the year the company charged off something like $200,000 for maintenance expenses.

BOSTON ELEVATED REPORT.—The report of the Boston Elevated Railway Company for the fiscal year ending Sept. 30 shows gross earnings of $14,493,853, or 2.9 per cent better than for 1908. The operating expenses were $9,488,483, or 65.4 per cent of the gross, compared with $9,454,385, or 67.1 per cent of the gross for the previous year. The operating ratio is the lowest in the history of the company. In the year the company carried 281,000,000 passengers, an increase of 8,000,000. This traffic was handled by a car operation of 51,127,000 car miles, compared with 51,625,000 car miles the year before.

ST. LAWRENCE RIVER POWER COMPANY.—The Canadian and American Interests which are seeking authority to develop the water-power by damming the St. Lawrence River at Brockville have applied to the Canadian Government with a revised plan. They propose to dam the whole river from the Canadian to the New York shore, and to make use of the entire power of the Long Sault Rapids. The dam will raise the river at Ottawa about 18 in. This new movement is a combination of the interests of the St. Lawrence Power Company, of Canada, and the Long Sault Development Company, of New York.

MEXICAN NORTHERN POWER COMPANY BONDS.—A meeting of the bondholders of the Mexican Northern Power Company, Limited, will be held at the company's office in Montreal on Nov. 17 for the purpose of increasing the bond issue of the company to $10,000,000.

INCREASED EARNINGS FOR MACKAY COMPANIES.—The new cable of the Commercial Cable Company between New York and Newfoundland has proved a great success, according to statements made by officials of the Mackay companies, has added a large amount to the earnings of the Cable company and has enabled it to handle business with much greater facility. It is not improbable that within a short time another cable connection will be made over practically the same route. The only thing that is deferring this work at the present time is the complication with the Government of the Province of Newfoundland. While there has been a decided increase in the entire business of the Mackay companies, it is said that at the present time there is no intention of increasing the dividend rate beyond the 4 per cent which has prevailed since 1904. This rate is paid on both preferred and common stock. Mr. Mackay has just finished an 8000-mile inspection tour of the Postal Telegraph lines. In discussing the conditions in the Far West, he said that within the last 12 months the business of his lines in that section had increased remarkably, and that within a short time he would complete the construction of a new transcontinental line direct between San Francisco and Salt Lake, via Reno. He said the construction of this line had been a serious undertaking on account of the difficulty of obtaining private rights-of-way, and the necessity of imbedding the poles in solid rock across the Sierras for about 40 miles. Messages are already being sent over this new line between San Francisco and Reno.

ROCKINGHAM (N. C.) POWER COMPANY.—A further statement relative to the recent Supreme Court decision in the case of Worth vs. the Knickerbocker Trust Company, Warner, Mitchell and Hugh McRae & Company, in the Rockingham (N. C.) Power Company case, has been made by an attorney for the trust company, who thinks that the first publication might have been misleading. He states that the sale was made by the court's order and the property purchased by a reorganization committee having in hand all of the bonds except a few held by Mr. Worth. The suit in the Supreme Court is that of Mr. Worth, who is seeking damages, alleging false representations as to the value of the stock he purchased. This statement, says the attorney, is an injustice to the Rockingham Power Company and its successor, they not being affected by the decision.

MORE STOCK FOR NEW YORK CENTRAL.—The New York Central & Hudson River Railroad Company has applied to the Public Service Commission of the Second District of New York for permission to issue 446,580 shares of new stock. The present outstanding stock of this railroad is $178,632,000, and the new issue represents a 25 per cent increase. It will be offered to the present shareholders at the ratio of one share of new stock for each four shares now held. The majority of this new issue is to be used for taking up outstanding obligations. Six million dollars will be devoted to the electrification of the Harlem Division to North White Plains. The $25,000,000 worth of new equipment which has recently been ordered by the road will not be paid for by the proceeds of this new issue of stock, but will be taken care of by some other plan of financing.

TELEPHONE CONSOLIDATION HALTED.—An application has been made for a receiver at Cleveland for the Youngstown Telephone Company, the Columbiana County Telephone Company and the Intercity Telephone Company. This application was made by the National Telephone Company, of Wheeling, W. Va. This action was thought to have a bearing on the recent deal in which James Brailey, Jr., of Toledo, obtained control of the United States Telephone Company. The lines named are owned by the United States company, and the National company declares that a contract of sale to it had been made which has now been violated. The receivership is asked only for a period sufficient to cover the time necessary to enforce this contract.

CAROLINA TRACTION COMPANY.—The Carolina Traction Company, of Rock Hill, has been chartered in South Carolina by W. S. Lee, Jr., manager of the Southern Power Company, Charlotte, S. C.; George Stephens, president of the American Trust Company, Charlotte, and J. M. Cherry, Rock Hill. The capitalization will be $500,000. This company proposes to develop a system of rural trolley lines radiating from Rock Hill, and to build lines to Charlotte, 25 miles north, and to Lancaster, and to tap the Seaboard Air Line in Chester County. It is believed that energy for the system will be derived entirely from the Southern Power Company.

CUBAN TELEPHONE COMPANY.—The recent bond issue of the Cuban Telephone Company has been placed in London. The authorized issue was for £2,000,000, and the price at which it was offered to the English investing public was 92 per cent. At this time £1,050,000 have been placed. These are 5 per cent bonds, and are redeemable by the company at 105 after June 30, 1921. The principal subsidiary of this company is the Havana Telephone Company, which, it is said, is earning at the present time $200,000 per year above its fixed charges.

CONTINENTAL TELEGRAPH & TELEPHONE COMPANY.—Negotiations have been completed whereby the control of the Interstate Telephone & Telegraph Company, of New Jersey, will pass to the recently organized Continental Telegraph & Telephone Company. The purposes of this company were outlined in a recent issue, and it is expected that it will eventually become the holding company for the independent telephone interests between the Atlantic Ocean and the Rocky Mountains.

THIRD AVENUE FORECLOSURE SALE.—The foreclosure sale of the Third Avenue Railroad Company has again been postponed. Judge Lacombe, of the United States District Court, has now set Jan. 11, 1910, as the date of the sale. This postponement was made in order to permit the bondholders committee to formulate a new plan of reorganization, the plan proposed several months ago having been turned down by the Public Service Commission.

WESTBORO (MASS.) GAS & ELECTRIC COMPANY.—The Westboro Gas & Electric Company has applied to the Gas Commissioners of Massachusetts for permission to make a new stock issue of $29,500. The company will buy its energy from the Connecticut River Power Company.

DIVIDENDS.

American Smelters Securities Company, quarterly, 1½ per cent on preferred A, 1¼ per cent on preferred B, both payable Dec. 1

American Telegraph & Cable Company, quarterly, 1¼ per cent, payable Dec. 1.

Columbus (Ohio) Edison Company, quarterly, 1¼ per cent, payable Dec. 1.

Massachusetts Gas Companies, preferred, semi-annual, 2 per cent; common, four months, 1 per cent, both payable Dec. 1.

National Carbon Company, preferred, quarterly, 1¾ per cent, payable Nov. 15.

Niles-Bement-Pond Company, preferred, quarterly, 1½ per cent, payable Nov. 15; common, quarterly, 1½ per cent, payable Dec. 20.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Changes.	Surplus.
Boston & Worcester Street Railway Company:					
Year ended Sept. 30, 1909	$577,510	$321,093	$256,417	$178,954	$77,463
Year ended Sept. 30, 1908	553,613	282,917	270,696	155,965	114,731
Boston Elevated Railway Company:					
Year ended Sept. 30, 1909	14,493,853	9,488,484	5,005,369	4,163,951	841,417
Year ended Sept. 30, 1908	14,074,696	9,454,386	4,620,310	3,780,246	840,064
Commonwealth Edison Company:					
Year ended Sept. 30, 1909	10,639,446	6,642,693	3,996,752	1,182,506	2,814,246
Year ended Sept. 30, 1908	9,500,907	6,374,578	3,126,329	1,032,625	2,093,704
Cumberland Telephone & Telegraph Company:					
September, 1909	533,329	342,981	190,348	.....	.....
September, 1908	508,130	332,485	175,645	.....	.....
Montreal Street Railway Company:					
Year ended Sept. 30, 1909	3,874,838	2,255,019	1,619,819	445,749	1,229,676
Year ended Sept. 30, 1908	3,677,432	2,158,394	1,519,038	454,638	1,136,411
New York, New Haven & Hartford Railroad Company:					
September, 1909	5,354,172	3,164,420	2,325,057	.....	.....
September, 1908	4,819,232	3,157,212	1,799,854	.....	.....
Philadelphia Company:					
Nine months ended Sept. 30, 1909	13,210,150	7,527,754	5,682,396	3,437,624	2,466,871
Nine months ended Sept. 30, 1908	12,261,314	7,453,833	4,807,481	3,351,513	1,649,892

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—It is reported that the Corey Land Co., organized with a capital stock of $[illegible], has purchased a tract of land adjoining that recently purchased by the Tennessee Coal, Iron & Railroad Company as a site for large coke plant. The Corey Land Company, it is said, will build a large industrial city to provide for the employees of the Tennessee company's plants. Among the improvements to be installed will be electrical service, electric-car service and water and gas supply. The town site is located between Ensley and Wylam and will be named Gary. Robt. Jemison, Jr., is president of the company and A. B. Tanner is secretary and treasurer.

GADSDEN, ALA.—Local business men are considering the question of constructing an electric railway from Gadsden to South Gadsden, for which $50,000 has already been pledged. It is thought that an attractive bonus may be offered to the Alabama City, Gadsden & Attalla Railway Company to extend its railway system to that section of the city. The company is now building an extension from Gadsden to Attalla.

PARKER, ARIZ.—The Arizona Empire Copper Mines Company contemplates the installation of a power plant, the equipment of which will include an engine, generator, motors, air compressor and ore reduction machinery.

STODDARD, ARIX.—The Stoddard Mines Company is reported to be making preparations for the construction of an electric power plant.

HOT SPRINGS, ARK.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 6, for the construction, including heating apparatus, electric conduits and wiring, gas piping, etc., of an extension, remodeling, etc. to the U. S. post office at Hot Springs, Ark., in accordance with plans and specifications, copies of which may be obtained from the custodian at Hot Springs or at the above office. James Knox Taylor is supervising architect.

NASHVILLE, ARK.—B. H. Rainwater, of Junction City, Ark., is contemplating installing an electric light plant in Nashville.

CASTELLA, CAL.—Benjamin Johnson has appropriated 8,000 cu. in. of water on Castle Creek, near where Echo Lake empties into the creek. It is said that the water will be conveyed a mile and one-half to the North Star group of mines, where it will be utilized to generate electricity to operate the mill and mines.

GENESEE, CAL.—The construction of an electric power plant and concentrating mill is under consideration by the Five Bears Mining Company, in Genesee.

INDEPENDENCE, CAL.—J. E. Eibeshutz has been granted permission to erect transmission lines on the public highways in Independence.

LEASTALK, CAL.—The Garavanza Mining & Milling Company, of Leastalk, is contemplating the construction of a new power plant.

LOS ANGELES, CAL.—The Board of Supervisors has granted W. M. Bowen a franchise for the extension of the street railway system on West Adams Street from the present terminus. Mr. Bowen bid $100 for the franchise.

OAKLAND, CAL.—The City Council has granted the Great Western Power Company a franchise to erect transmission lines in Oakland for the distribution of electricity for lamps, heat and motors. It has not yet been decided whether the company will be permitted to erect its high-tension lines from the head of Fourth Avenue over Fifth or Thirteenth Avenue to its distributing station at Session's Basin. The company paid $200 for the franchise.

OROVILLE, CAL.—The Sacramento Valley Power Company, which proposes to extend its transmission lines from Redding to Chico, also plans to extend its service to Oroville. The company will not only furnish electricity in Oroville but will also furnish electrical service to farmers to operate pumping plants. The transmission line will pass through Anderson, Cottonwood, Red Bluff, Tehama and Corning.

PETALUMA, CAL.—The Highland Pacific Electric Railway Company, which is now securing rights of way from Lakeport, via Cloverdale to Santa Rosa, to construct and operate an electric railway in this district, is contemplating extending the railway to Tidewater, via McNear's Point. A movement is on foot to secure control of the Santa Rosa, Sebastopol & Petaluma Electric Railway, or to provide traffic arrangements over it. The company is capitalized at $2,500,000, and proposes to construct about 75 miles of road. Dr. A. Dickinson is president of the company.

REDLANDS, CAL.—The Holton Power Company, it is said, is planning to increase the equipment of its power plant, which will include a hydraulic turbine unit of 1000 hp, transforming apparatus, etc.

SAN FRANCISCO, CAL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 18 for power plant, including boilers, engines, electric generators, switchboard, conduits, wiring, heating and ventilating apparatus, deep well pumps and vacuum cleaning apparatus for the United States custom house and appraiser's stores building in San Francisco, Cal., in accordance with plans and specifications, copies of which may be obtained at the above office or at the office of the architects, Eames & Young, Wright Building, St. Louis, Mo. James Knox Taylor is supervising architect.

YOUNTVILLE, CAL.—It is reported that the directors of the Veterans' Home have contracted with the Snow Mountain Power Company to furnish electricity to the institution for lamps and motors.

CEDAR, COL.—Plans have been filed with the state engineer for the Custer reservoir in San Miguel and Dolores counties, work on construction of which was commenced in October. The dam will be 110 ft. in height and will create a storage capacity of 756,800 cu. ft. of water and will cost about $200,000. The water will be used for the development of power and for irrigation purposes. M. J. Bailey, of Cedar, Col., is interested in the project.

COLORADO SPRINGS, COL.—Twelve miles of the pipe line from the Nederland to the Kosler reservoir has been completed by the Central Colorado Power Company, by which a drop of 1860 ft. to the power house on Middle Boulder Creek is secured. The steel pressure pipe, which will sustain a pressure of 800 lb. to the sq. in., is now being placed. The power house is completed and most of the machinery installed. With the exception of the dam the power project will be practically completed by Jan. 1. The initial installation will be 10,000 kw, supplementing the Shoshone plant of the Central Colorado Power Company, now furnishing energy to the Denver Gas & Electric Company, of Denver.

DENVER, COL.—The Williamson-Hafner Printing Company, of Denver, Col., is having plans and specifications prepared for a new building, 225 by 125, two-story, of fire-proof construction and sprinkled; the entire plant is to be equipped to be operated by electricity. A 2200-volt motor will drive a 110-volt, direct-current generator and individual motor drive will be utilized throughout. The motor arrangements will include enclosed type motors and geared connections. The building will be lighted by a system of tungsten lamps planned by the illuminating engineer of the Denver Gas & Electric Company.

GEORGETOWN, COL.—Extensive improvements and changes are being made to the American Sisters' power plant in Georgetown, for the purpose of improving the service.

LAMAR, COL.—The Lamar Electric Light Company is contemplating extending its transmission lines.

ORDWAY, COL.—The Ordway Electric Light & Power Company is extending its transmission lines to supply electricity in the town of Sugar City, some five miles distant. Both these towns are in the sugar district and considerable irrigation load is being developed. It is claimed that service will be furnished in Sugar City by Jan. 1, notwithstanding that the Ordway power plant was badly damaged by fire on Nov. 2. Machinery for the temporary replacing of the plant is being rushed to Ordway by the Hendrie & Bolthoff Manufacturing & Supply Company, of Denver.

ROUSE, COL.—The town of Rouse, Col., is being wired for the distribution of electricity for lamps and motors. The service will be supplied from the high-tension lines of the Southern Colorado Power Company, which have been extended to include this district.

COLCHESTER, CONN.—Plans are being considered by the National Shoe Supply Company for the installation of an electric plant to furnish electricity for lighting its works. If sufficient encouragement is given the company will install a plant with sufficient output to light the town.

NEW HAVEN, CONN.—The contract for the construction of the electric railway which is to extend from New Haven to Irvington, Conn., has been awarded to Joseph Lyons.

PORTLAND, CONN.—Arrangements are being made by the Rogers & Hubbard Company to install both electric light and gas lighting systems in its large plant, recently erected. The equipment of the electric plant will include a generator, which has already been purchased; also two 60-hp gas engines and a 10-hp steam engine.

ELLENDALE, DEL.—The question of establishing an electric light plant in Ellendale is reported to be under consideration.

WILMINGTON, DEL.—The Board of Water Commissioners on Nov. 1 awarded the Westinghouse Electric & Manufacturing Company the contract for generator and switchboard for the filter plant, at $1,510; the contract for installing the plant was awarded to Garrett, Miller & Company, for $4,072.

GREEN COVE SPRINGS, FLA.—At an election held recently the citizens voted to issue bonds to the amount of $45,000, the proceeds to be used for the erection of a municipal electric light plant, water works system and building new roads and sidewalks. The town has not yet decided whether it will purchase the present system or build a new plant. The cost of the electric light plant is estimated at about $10,000.

DUBLIN, GA.—The City Council is considering plans for improvements to the municipal electric light plant and water works system;

which will include the installation of a 500-hp boiler, engine and generator.

HAWKINSVILLE, GA.—The City Council has employed J. B. McCrary & Company, of Atlanta, Ga., to take charge of the construction of the municipal electric light plant, contracts for construction of which were recently awarded.

WAYCROSS, GA.—Application has been made to the City Council for a franchise to furnish electricity for lamps and gas for fuel in Waycross, by Burdette Loomis, president of the Waycross Gas & Construction Company. It is reported that the company has made arrangements for financing the construction of a wood-distilling plant, to cost $500,000, to be located in the pine belt, between Savannah and Jacksonville. The company proposes to utilize large quantities of refuse wood for generating electricity and fuel gas. Negotiations, it is said, are now under way for purchasing the property for the plants.

GREER, IDAHO.—The Lolo Milling & Mining Company is reported to have secured water rights on the Lolo River and an option on the Carlson farm, where it proposes to erect a large power plant.

SANDPOINT, IDAHO.—The Idaho Power & Concentrating Company is reported to have completed plans for its proposed construction work next spring. It is said that contracts will be awarded at once for the construction of dams and flumes on Trestle Creek, the cost of which is estimated at $12,000.

SPIRIT LAKE, IDAHO.—The Panhandle Company, of Spirit Lake, is reported to be preparing to increase the output of its power plant for operating its planing mill. The equipment will include two 100-hp steam turbines, with exciters, condensers and motors.

CHICAGO, ILL.—The directors of the Commonwealth Edison Company have recommended to the stockholders an increase of $10,000,000 in the company's capital stock, to be issued from time to time as deemed advisable by the directors. If the recommendation is adopted by the stockholders it is probable that an increase of $3,000,000 will be offered for subscription to the stockholders at par in February, to be paid in instalments.

CLINTON, ILL.—The City Council is considering an ordinance to issue $20,000 in bonds for the construction of an electric light plant and water works system. The question will be submitted to a vote of the people. L. W. Lemon is city engineer.

BRAZIL, IND.—The Vigo County Electric Company, which recently secured control of the plant of the Brazil Electric Light Company in Brazil, has been granted a franchise by the County Commissioners to erect a high-tension transmission line through the county. The company proposes to erect a transmission line to Greencastle, Ind., for the purpose of furnishing electricity for lamps and motors in that city. Work on construction of the line will commence at once.

ELKHART, IND.—The Nickel Plate Railroad contemplates the use of telephones in dispatching trains in Indiana. Twenty-eight regular stations are to be equipped with a number of special siding telephones. The equipment used will consist of the standard Western Electric telephone train-dispatching apparatus and Gill selectors.

FT. WAYNE, IND.—The directors of the Home Telephone & Telegraph Company have announced that new equipment will be purchased for the South Branch station on Calhoun Street, which will involve an expenditure of $4,000.

ROANOKE, IND.—The Ft. Wayne & Wabash Valley Traction Company has contracted with the Town Board to furnish electricity to light the streets of the town. Lamps of the Wood magnetite type will be installed. The company is also negotiating with the Town Trustees of Ossian to furnish electrical service in that town. If present plans are carried out the Traction company will soon be furnishing electrical service in all the towns on its system between Ft. Wayne and Lafayette.

BETTENDORF (P. O. DAVENPORT), IA.—We are informed that the Bettendorf Axle Company will furnish power for operating the plant of the Bettendorf Improvement Company which proposes to furnish electricity for lighting the town of Bettendorf.

DES MOINES, IA.—Bids will be received by the City Council at the office of George F. Poorman, city clerk, until Dec. 1, 1909, for the construction of a city hall, including heating, electrical work and plumbing, as per plans and specifications now on file at the office of the city clerk.

DES MOINES, IA.—An agreement has been entered into between the Red Oak & Western Railway Company and the Des Moines, Council Bluffs & Western Railroad Company whereby an interurban railway will be built from Des Moines to Red Oak in the near future. According to the present plans the Red Oak company will build the railway from Red Oak to Stuart, and the Des Moines company will start at Des Moines and connect with the Red Oak company at Stuart. It is understood that the two companies will eventually consolidate. The combined capital of the two companies amounts to $500,000.

DES MOINES, IA.—William B. McKinley, president of the Illinois Traction System, Champaign, Ill., and associates, who have secured an option on the property of the Des Moines City Railway Company and the Inter-Urban Railway Company have agreed to make the following improvements to the railway system in Des Moines in return for a 25-year franchise in this city: To remove all present unused tracks, rebuild at once 10 miles of track with 120-lb. girder rail on paved streets and 80-lb. T-rail on unpaved streets, purchase 50 new cars, construct 50 miles of new track within the city limits, cast or electrically weld all joints on new track, construct a new power house to cost $250,000, place all feed and transmission wires underground in the fire district and use iron poles wherever there is permanent construction and paved streets. The question of fare, the division of gross receipts and the right of the city to purchase the property in the future have not yet been agreed upon.

KENSETT, IA.—The directors of the Kensett Mill & Light Company have decided to enlarge and improve its electric plant. A new generator will be installed.

OTTUMWA, IA.—Frank Turner is reported to be interested in a project for the construction of an interurban railway to Iowa City.

SIOUX CITY, IA.—The electric department of the Sioux City Gas & Electric Company will be sold to the Sioux City Service Company if the citizens will allow the sale. At the time the question of the sale of the plant is submitted to the people the gas company will ask for a new franchise omitting the clause giving the city permission to purchase the plant. In order to make the proposed sale it will be necessary for both companies to ask for new franchises. It is said that the companies are willing to continue paying the city 2 per cent of the gross earnings, but neither is willing to grant the city the right to purchase the plants within the period of the franchise, which will be 25 years.

MARION, KAN.—Plans are being prepared by Burns & McDonnell, consulting engineers, Kansas City, Mo., for an electric light plant and water-works system for Marion. The cost of the electric plant is estimated at $12,000 and the water works at $48,000. Bids for the construction of the plant will be called for in the near future. Thomas W. Bowen is city clerk.

CARLISLE, KY.—The City Council has passed an ordinance providing for the sale of a telephone franchise, which is said to have been applied for by the East Tennessee Telephone Company.

PORTLAND, MAINE.—Bids will be received by the city hall building committee until Dec. 1 for electric work, heating and ventilation of the new city hall in Portland, Maine. Plans and specifications can be seen at the offices of the architects, Carrere & Hastings, 225 Fifth Avenue, New York, N. Y., or John Calvin Stevens and John Howard Stevens, 187 Middle Street, Portland, Maine. Full set of plans and specifications may be purchased at actual cost for personal use. Proposals must be submitted on blanks provided by the architects. Adam P. Leighton, John F. A. Merrill and Richard C. Payson are commissioners.

POCOMOKE, MD.—Plans for the construction of an electric light plant in Pocomoke are being prepared by Theodore W. P. Pietsch, of Baltimore, Md.

MARBLEHEAD, MASS.—At a special town meeting held recently the citizens voted to appropriate $30,000 for the reconstruction of the municipal electric light plant as recommended by the committee appointed to investigate the plant. The municipal electric light commissioners and the investigating committee were appointed to take charge of making the improvements.

PITTSFIELD, MASS.—P. J. Moore has petitioned the City Council for a franchise to construct and operate a gasoline-electric railway in the eastern portion of Pittsfield, Mass.

WESTBORO, MASS.—The Westboro Gas & Electric Company has applied to the State Board of Gas and Electric Light Commissioners for permission to issue $29,500 additional capital stock, the proceeds to be used for refunding $9,000 in bonds and coupon notes amounting to $9,000 and the balance for additions and improvements to its system. The company has recently closed a deal whereby it will secure electricity from the Connecticut River Power Transmission Company through the Marlboro Electric Light Company, of Marlboro, Mass.

WORCESTER, MASS.—The Connecticut River Power Transmission Company is reported to have accepted the franchise granted by the City of Worcester, as modified and approved by the State Board of Gas and Electric Light Commissioners. The franchise gives the company permission to furnish electricity to consumers of not less than 300 hp.

BAY CITY, MICH.—The Eastern Michigan Power Company has purchased the property of the New York Salt Works, south of the Interurban bridge, on which it will erect a substation for the distribution of electricity in the Saginaw Valley cities. The company has also decided upon the location of its first dam on the Au Sable River. The dam will be erected in what is known as "Cooke's" in Iosco County, about 14 miles above Au Sable. It is stated that this dam will develop from 3500 to 4000 hp. The cost of the dam, power plant and transmission lines is estimated at $500,000. Electricity generated at the plant will be transmitted to Bay City, Saginaw, Flint, Lapeer, Owosso, Flushing and to cities in other parts of the State.

ECORSE, MICH.—C. E. Haight, proprietor of the local electric light plant, has submitted a proposition to the Village Council for lighting the streets of the village by electricity. At present the streets are lighted by gas, at a cost of $1,000 per year.

GRAND RAPIDS, MICH.—Bids will be received by the city clerk until Nov. 15 for $280,000 in bonds, the proceeds of $100,000 to be used for the purchase of a pumping engine, including electric equipment for the municipal electric light plant.

LANSING, MICH.—The Seager Engine Works, of Lansing, Mich., is reported to be making improvements in the equipment of its plant and will install additional motors.

MT. CLEMENS, MICH.—It is reported that the St. Clair Edison Company contemplates the construction of a large power plant for furnishing electricity in this city and surrounding territory. The present plans contemplate the dismantling of the large plant in Mt. Clemens and furnishing electrical service from the proposed new plant.

SAGINAW, MICH.—The City Council has rejected the franchise submitted by the Chippewa River Power Company asking for a 30-year franchise to furnish electricity for lamps and motors in Saginaw, the service to be furnished within three years, with the privilege of fixing its own prices. It is said that Mr. Pleasant and Alma have granted the company franchises asked. W. F. Davidson is vice-president of the company.

FERGUS FALLS, MINN.—It is reported that the Red River Mill dam, estimated value, $10,000; the Rice dam, valued at $52,000, and the woolen mill dam, valued at $6,000, which were destroyed at the same time the concrete dam owned by the city, together with electric generating machinery, valued at $60,000, owing to the foundation of the city dam being rebuilt on quicksand, will be rebuilt. The city is securing estimates on the supply of electricity to operate the municipal electric system.

MINNEAPOLIS, MINN.—Plans are being considered for extending the illuminating system on Sixth Street from First Avenue South to Fourth Avenue South, and if possible to Sixth Avenue.

SARTELL, MINN.—Preparations are being made for installing a power plant in the new straw board mill of the Watab Pulp & Paper Mill Company, in Sartell, Minn, the equipment of which will include an 800-hp generating unit, a large line of motors for both direct and alternating-current.

WAYZATA, MINN.—Plans are being prepared by the Lake Minnetonka Public Service Company for the construction of a power house, the equipment of which will include two producer gas engines. The cost of the plant is estimated at $20,000. The company was recently reported incorporated to construct an electric light plant to furnish electricity to resorts along the shore of Lake Minnetonka. Henry W. Benton is interested in the project.

GULFPORT, MISS.—The Gulfport & Mississippi Coast Traction Company is contemplating the installation of coal-handling apparatus in its power plant and would like to correspond with manufacturers of coal-handling equipment.

FESTUS, MO.—It is reported that the citizens have voted to issue $15,000 in bonds for a municipal electric light plant.

BILLINGS, MONT.—It is reported that the Billings & Eastern Montana Power Company is contemplating the erection of a transmission line from Billings to Big Timber, work on which will begin at once.

COLUMBIA FALLS, MONT.—The North Idaho & Montana Power Company has applied for a franchise in Columbia Falls to furnish electricity for lamps. The company promises to erect a substation in the town if granted a franchise.

LAUREL, MONT.—A company has been formed by W. R. Westbrook and L. A. Nutting, of Laurel, Mont., for the purpose of constructing an electric railway from Billings and up Clark Fork and Rock Creek.

OAKLAND, NEB.—Negotiations have practically been closed whereby the Oakland Independent Telephone Company will take over the exchange of the Nebraska Telephone Company in Oakland. The closing of the deal, it is said, relies on the decision of the City Council to grant the new company an exclusive franchise to operate in this city. The new company promises to extend and improve the service and reduce rates.

RENO, NEV.—The Reno Power, Light & Water Company, it is reported, will soon commence on the construction of a large electric power plant, west of Reno, on the Truckee River. The proposed plant will cost about $1,000,000, and will furnish electricity to mining camps in different parts of the State. It is also stated that the company will erect plants in other parts of the State to supply electricity in Ely and other cities in that part of Nevada.

BERLIN, N. H.—The Burges Sulphite Fibre Company, of Berlin, N. H., is planning to install two oil-filled, water-cooled 1000-kw transformers in its substation.

MEREDITH CENTER, N. H.—Arrangements are being made to construct an electric light plant in Meredith Center. A dam is being built at Lake Wicwas, which will furnish power to operate a large saw-mill and the power plant. The proposed plant will furnish electricity in this village and in Meredith, which now secures electrical service from the Laconia Electric Lighting Company, of Laconia, 10 miles distant.

MT. VERNON, N. H.—It is reported that the question of installing an electric lighting system in Mt. Vernon is under consideration. If it is decided to establish the system the service will be supplied by the Milford Light & Power Company, of Milford, N. H.

BRIDGETON, N. J.—The contract for lighting the streets of the city for a term of five years was granted to the Bridgeton Electric Company at $10,100 per year.

COLUMBIA, N. J.—It is reported that the Easton Consolidated Service Corporation has consolidated with the Eastern Pennsylvania Power Company, which was incorporated a short time ago, with a capital stock of $2,000,000. The last named company is constructing a large hydroelectric power plant at the mouth of the Paulins Kiln Creek, in Columbia. The company is said to have secured water rights on the Big Bushkill River, in Monroe County, where it will erect another large power plant.

HIGH BRIDGE, N. J.—The Borough Council has granted the Lebanon Telephone Company a 40-year franchise to erect telephone lines on certain streets in the borough.

SOUTH RIVER, N. J.—The Borough Council is considering the question of establishing a municipal electric light plant in South River, the cost not to exceed $12,500. Plans have already been prepared for the plant and are on file at the office of Charles Anderson, city clerk.

ALAMOGORDO, N. M.—The Alamogordo Water Power Company is constructing a large power plant at High Rolls, near Alamogordo, where it will utilize the water from a mountain stream through a pipe line, by which 5000 hp will be developed. The company will supply electricity in the towns of Alamogordo and Tularosa for lamps and motors and also for operating irrigation pumping plants throughout the Tularosa Valley.

DEMING, N. M.—It is reported that contracts have been awarded to the Western Construction Company, of Wichita, Kan., for the construction of an electric pumping plant for the Mimbres Valley. It is said that 40 or 50 wells will be sunk; the initial equipment will include two 400-hp units; about 50 miles of transmission lines will be erected from the plant to the various wells, where direct-connected generators will operate the pumps. For further information address P. M. Shull, of Deming, N. M.

COOPERSTOWN, N. Y.—The property of the Otsego Home Telephone Company will be sold at auction at the court house, Cooperstown, N. Y., Dec. 14, in pursuance to a judgment of foreclosure granted in the Supreme Court at Oneida, Oct. 16. James J. Byard, Jr., of Cooperstown, has been appointed referee and will conduct the sale.

GLOVERSVILLE, N. Y.—The Garoga Light & Power Company, recently incorporated with a capital stock of $50,000, is contemplating asking for a franchise in Johnstown and Gloversville, N. Y. The company proposes to construct a large dam in Garoga Creek and erect a power plant to generate electricity to be transmitted to Gloversville, Johnstown, Fonda, Ephratah and Fultonville. Mortimer Everest, of Gloversville, is interested in the company.

MASSAPEQUA, N. Y.—Plans are being prepared for a water-supply system and an electric light plant in Massapequa to provide both water and electrical service in connection with the development of the Queens Land & Title Company. Both plants will be operated by the Massapequa Water, Light & Power Company, recently incorporated, when completed.

NEW YORK, N. Y.—Contracts have been awarded by the New York, Westchester & Boston Railway Company for the construction of its railway through the Bronx and South shore section of Westchester and to White Plains. The White Plains division has been divided into two sections, one of which will be built by the Ferguson Construction Company and the other by Henry Steers. Work will commence on construction of the railway at once.

NEW YORK, N. Y.—The New York Central Railroad Company has applied to the Public Service Commission for permission to issue $44,658,000 in new capital stock, of which the proceeds of $8,000,000 will be used for new equipment, curve elimination, signal improvement and grade revision on the main line; $6,000,000 will be used for equipping the Harlem division to be operated by electricity, four-tracking on the Hudson division and two-tracking on the Pennsylvania and Rome, Watertown & Ogdensburg divisions.

OSWEGO, N. Y.—Bids will be received at the office of the Department of Public Works until Nov. 23 for lighting the streets and public buildings for a term of five years. The present contract expires Feb. 20, 1910.

PORT JEFFERSON, N. Y.—The North Shore Electric Light & Power Company has applied to the Public Service Commission for permission to construct and operate an electric light plant in Port Jefferson. The town already has electrical service furnished by the Port Jefferson Electric Light Company.

ROCHESTER, N. Y.—Plans are being prepared by the Rochester Railway & Light Company for the illumination of the Cobb Hill reservoir. It is proposed to install 90 large arc lamps or 180 smaller lamps on the crown of the hill, which will be placed on ornamental poles set from 20 to 40 ft. apart.

WILLIAMSVILLE, N. Y.—The Buffalo & Williamsville Electric Railway Company is in the market for a 200-kw converter and three 100-kw transformers.

ANDREWS, N. C.—Plans are being made by the city for the construction of hydroelectric power plant and water works system. The plant will be located about 2½ miles from the city where about 300 hp will be developed. Electricity generated by the plant will be utilized for street and commercial lighting and for industrial plants. H. N. Wells is mayor.

CHARLOTTE, N. C.—Preparations are being made by the Charlotte Consolidated Construction Company for the construction of a short line out of First Street, which will divert a large part of the street railway traffic from a grade crossing to the proposed electric railway to be constructed to the Catawba River, 12 miles distant.

ELIZABETH CITY, N. C.—The exchange of the Elizabeth City & Norfolk Telephone Company was recently damaged by fire to the extent of about $2,000.

MARSHALL, N. C.—Preparations are being made by the North Carolina Electrical Power Company for the construction of a hydroelectric power plant on French Broad River, 2½ miles from Marshall, which will include a dam 500 ft. long and 30 ft. high; stone power house and

the installation of two 2200-hp generators, driven by vertical turbines developing 4600 hp for electrical transmission. High-tension transmission lines will be erected to the company's plant at Ivy, N. C., five miles distant, and from there extending to the plant of the W. T. Weaver Power Company, located five miles from Asheville. The Ivy plant will be the central station for the distribution of energy. Electricity not utilized in Marshall will be transmitted to Asheville, a distance of 19 miles. The company's plant located at Mountain Island, 15 miles from Marshall, has an output of 10,000 hp and will be held in reserve. The cost of the plant is estimated at $400,000. W. T. Weaver, of Asheville, N. C., is president of the company and Charles E. Waddell, of Biltmore, N. C., is engineer in charge.

ROCKY MOUNT, N. C.—Plans have been completed by the Home Telephone Company for extensions to its system through Nash and Wilson counties, extending to the exchange at Spring Hope, Bunn and other points. F. C. Toppleman, of Henderson, N. C., is general manager.

CINCINNATI, OHIO.—Plans have been prepared by City Engineer Sundmaker for the construction of a subway to connect the business section of the city with the outlying part of Cincinnati, which will soon be presented to the City Council. The plans, it is said, have the endorsement of the city administration and will involve an expenditure of from $10,000,000 to $15,000,000 and also contemplates municipal ownership of the proposed subway and urban and interurban traction terminals.

COLUMBIANA, OHIO.—The Columbiana County Telephone Company has installed a new switchboard in its local exchange. Work will soon commence on the erection of an additional toll line from Columbiana to Lisbon, and another from Columbiana to New Waterford.

COLUMBUS, OHIO.—The contract for the construction of the new power plant for the penitentiary has been awarded to R. H. Evans & Co., of Columbus, Ohio, for $53,597, by the Board of Penitentiary Managers. The plant will furnish electricity for lamps and motors for the penitentiary and all of the State buildings in Columbus.

EAST LIVERPOOL, OHIO.—The East Liverpool Traction & Light Company, it is reported, is contemplating extending its interurban railways, the terminals of which are now in Steubenville, Ohio, and Beaver, Pa., from Beaver over the Ohio River at that point and up the river to Aliquippa.

LORAIN, OHIO.—The City Council has voted to appropriate $6,000 for the purchase of a new engine and generator, switchboards, etc., for the municipal electric light plant.

SPRINGFIELD, OHIO.—The American Seeding Machine Company is contemplating increasing the output of its power house and will install a generating unit with a rating of 300 hp.

TIFFIN, OHIO.—The plant of the Consolidated Gas & Light Company was sold by Special Master J. W. Harbaugh at auction Oct. 22 in pursuance of an order from the United States Circuit Court. The consideration was $20,000.

BLACKWELL, OKLA.—The contract for improvements to the electric light plant and water works system has been awarded to Lund & Cunyon, of Blackwell. The power house will be enlarged; generators with a rating of 75 kw and 150 kw will be installed; also Corliss engines and boilers. Plans were prepared by Burns & McDonnell, of Kansas City, Mo.

OKLAHOMA CITY, OKLA.—The Oklahoma Railway Company will place contracts in the near future for stokers and coal-handling apparatus for boilers with a rating of 1600 hp.

OKLAHOMA CITY, OKLA.—At an election held Oct. 29 the citizens voted to grant the Oklahoma Gas & Electric Company two 21-year franchises. Under the terms of the franchises the city will have the right to purchase the lighting plant any time within four years of the expiration of the franchises.

SUPPLY, OKLA.—Bids will be received by the State Board of Public Affairs, Guthrie, Okla., until Nov. 22 for the installation of a heating and power plant at the Hospital for Insane, at Supply, Okla.; plans and specifications will be furnished by P. H. Weathers, architect. Guthrie, Okla. Plans and specifications may be seen at the office of E. G. Newell, superintendent, Supply; State Board of Public Affairs and architect of State Board, Guthrie, Okla. Bidders are asked to include a proposal for a two-ton ice plant to be installed in the same building, plans for which shall accompany bids. Proposals are to be addressed to T. A. Chandler, acting secretary, Guthrie, Okla.

BAKER CITY, ORE.—The report of the water committee submitted to the Council recommends the construction of pipe line about 14 miles in length to secure additional water supply. It is estimated that 6,500,000 gallons daily could be secured and electricity generated to the extent of 512 hp. Estimates of the cost are now being prepared by engineers.

JUNCTION CITY, ORE.—The Northwestern Gas & Electric Company, successor to the Willamette Valley Company, has purchased the electric plant in Junction City, owned by the Howard Electric Company. It is said that the company will soon establish a 24-hour service.

MEDFORD, ORE.—Application has been made to the City Council by John R. Allen, of New York, N. Y., for a franchise to operate an electric railway in Medford. Mr. Allen will apply for similar franchises in Grants Pass and Ashland and intermediate points for the purpose of constructing an electric railway to connect all points in Rogue River Valley.

BENTLEYVILLE, PA.—Arrangements are being made for the construction of an electric light plant and water-works system in Bentleyville. It is understood that the Bentleyville Water Company will install the plant.

ETNA, PA.—A proposition to purchase the municipal electric light plant and water works system is reported to have been submitted to the Borough Council by a company which proposes to construct a large hydroelectric power plant on the Kiskiminetas River and furnish electrical service to towns in the Allegheny Valley. The amount offered by the company will leave a surplus of $60,000 after paying off the bonded indebtedness on the plant. If the Council decides not to sell the plant, it will be necessary to make extensive repairs and improvements, which will involve an expenditure of about $60,000.

EVANS CITY, PA.—A company has been organized in this city under the name of Evans City Light, Heat & Power Company for the purpose of constructing an electric power plant in Evans City to furnish electricity for all purposes. The headquarters of the company will be located in Elwood City. Samuel A. Roelofs, of Elwood City, is interested in the project.

PHILADELPHIA, PA.—George E. Stearns, director of Public Works, has awarded the contract for the installation of the power plant at the Queen Lane filtration plant, now in course of construction, to M. L. Bayard, of Woodbine, N. J., for $76,000.

PHILADELPHIA, PA.—Bids will be received by Joseph H. Klemmer, director of Department of Supplies, until Nov. 15, for supplies for use during the coming year, including under class E, electric cable, wire, lamps, supplies, telephones and instruments. Specifications may be obtained at the office of the director, City Hall, Philadelphia, Pa.

POTTSVILLE, PA.—It is reported that Messrs. Sturges, Haley and other capitalists from Scranton, Pa., are negotiating for a tract of land near Pottsville, where it is proposed to erect a large power plant. The plant, it is said, will be built and operated by the Cass Township Electric Company, recently incorporated. It will furnish electricity to all towns in and around Schuyler County.

CHESTER, S. C.—Both the new and old sections of the Eureka mill plant are being equipped for electric motor drive. It is proposed to operate the entire plant by electricity.

GREENVILLE, S. C.—It is reported that the capital stock of the Broad-ax Power Company will be increased to $250,000 and bonds issued to the amount of $500,000. The holdings of the company were purchased by the United States Guaranty Company, of which John V. Ryan, of Mobile, Ala., is president. The power company proposes to construct a hydroelectric plant on the Saluda River, about six miles from Greenville, where from 4000 hp to 4500 hp can be developed for electrical transmission at a cost of about $1,000,000. It is said that hydraulic and electrical machinery have not yet been purchased.

GREER, S. C.—The City Council is contemplating placing a contract with the Southern Power Company for supplying electricity for lighting the streets and public buildings, or erecting a municipal plant. The city is now negotiating with the company.

FORT MEADE, S. D.—Bids will be received at the office of the constructing quartermaster, Fort Meade, S. D., until Dec. 6, for constructing one double set of quarters for two company officers and four cavalry stables and for installing heating, electric wiring and electric lighting fixtures, etc., in buildings specified. Plans and specifications may be seen at the offices of the chief quartermaster, Department of the Missouri, Omaha, Neb.; Department of the Colorado, Denver, Col.; Department of the Lakes, Chicago, Ill.; Department of Dakota, St. Paul, Minn., and at the above office.

DICKSON, TENN.—The capital stock of the Citizens' Telephone Company has been increased from $3,000 to $6,000.

EAGLE PASS, TEX.—The Chamber of Commerce, of Cuidad Porfirio Diaz, Mex., and the Industrial League of Eagle Pass, are reported to be considering the question of securing the construction of an electric railway to extend from Eagle Pass to San Carlos, a town on the Mexican side of the Rio Grande River. The proposed railway will be about 50 miles long and will run through the irrigated lands of General Lorenzo Trevino, which include about 200,000 acres.

TEXAS CITY, TEX.—The Galveston-Houston Interurban Railway Company has secured a site in Texas City on which it will erect its power plant to furnish electricity for its proposed railway. It is understood that the plant will cost from $750,000 to $800,000.

LOGAN, UTAH.—The Telluride Power Company has submitted a proposition to Governor William Spry and the Trustees of the Utah Agriculture College offering to supply electricity for lamps and motors for the college. The trustees are contemplating installing an electric plant at the college and the company claims it can furnish the service for less than it would cost to install a plant.

BELLINGHAM, WASH.—Notice of appropriation of additional water rights on Lake Whatcom has been filed by W. R. Hill. He also asks for permission to construct a dam at the outlet of the lake.

CHEHALIS, WASH.—The Twin City Light & Traction Company is reported to have awarded the contract for grading the proposed electric railway from Chehalis to Centralia to A. J. McCabe, of Portland, Ore.

MONTESANO, WASH.—Plans are being prepared for the construction of an electric light plant for the Montesano Planing Company, to

cost about $10,000. Bids for the construction of the plant will be asked for in about 30 days. A. Foss is president and manager of the company.

OTHELLO, WASH.—The R. S. King Company, of Seattle, is reported to have purchased the townsite of Othello from the Chicago, Milwaukee & Puget Sound Railway Company. The new owners propose to make improvements to the settlement, including the installation of an electric lighting plant.

PORT TOWNSEND, WASH.—The Irondale Steel Company is reported to have placed contracts for two open-hearth furnaces. Additional equipment, including electric motors, it is said, will be purchased later. The company is also contemplating the installation of a gas engine and generator.

TACOMA, WASH.—The Commissioner of Public Works has recommended to the Council the purchase of another carload of copper wire for use in connection with the municipal electric lighting system.

TACOMA, WASH.—Plans are being considered by the Union Mill Company, of Tacoma, Wash., for rebuilding its lumber mill located on the Northern Pacific spur, this side of Olympia. The work will be done by day labor under the supervision of George C. Moore. The mill will cost about $150,000 and will be equipped for electric motor drive. The apparatus will be installed by the Allis-Chalmers Company, of Milwaukee, Wis.

GREAT CAPACON, W. VA.—We are informed that the Hydro-Electric Developing Company will receive bids for the construction of its proposed plant at Fort Edes, on the Great Capacon River, about March 1, 1910. The proposed plant will cost about $60,000, and will develop about 3000 hp. For further information address Samuel R. Boyer, secretary, 2643 South Third Street, Steelton, Pa.

WHEELING, W. VA.—The City & Elm Grove Railroad Company is contemplating making improvements to its water works system, at a cost of $50,000, to supply its patrons along the National Road, east of Wheeling. The new pumping station will be operated by electricity and will be located in the vicinity of Fulton instead of Elm Grove, where the present station is located.

HATFIELD, WIS.—It is reported that it is proposed to erect another dam in Hatfield above the present one, to cost about $100,000. The proposed dam will have a head of 32 ft., creating a lake about seven miles in length.

MADISON, WIS.—The contract for additional electric fixtures in the east wing of the new state capitol has been awarded to Mitchell, Vance & Company, of New York, N. Y., for $9,000, by the executive committee of the State Capitol Commission.

MARINETTE, WIS.—The Northern Hydro-Electric Company is contemplating the erection of transmission lines to the towns of Green Bay, De Pere and Manitowoc from its hydroelectric power plant at High Falls, on the Peshito River. If the output of the plant is not consumed in these places the transmission line will be extended to Oshkosh, Wis. Work on the constructon of the line, it is stated, will commence in the near future. The plant at High Falls has an output of 7000 hp and the plant at Johnson Falls generates 4000 hp.

WINNECONNE, WIS.—Local business men are contemplating the construction of an electric railway to Oshkosh, Wis., to be extended later to Waupaca.

DOMINION, C. B., CAN.—An agreement has been made between the Corporation of Dominion and the Sydney & Glace Bay Railway Company, of Sydney, whereby the railway company agrees to furnish electricity delivered at the town line at the rate of seven cents per kw-hour, for a term of five years. Arrangements have been made with the railway company and the telephone companies for the privilege of erecting transmission lines for the distribution of electricity on the poles of the companies. It is said that the town proposes to install about 650 incandescent electric lamps for domestic and commercial lighting and 52 incandescent lamps of 32 cp for street lighting.

NEW WESTMINSTER, B. C., CAN.—The British Columbia Electric Railway Company has awarded the contract for the construction of five substations, to be erected along its extension from New Westminster to Chilliwack, to T. R. Nickson & Company.

REVELSTOKE, B. C., CAN.—At an election held recently the citizens voted in favor of the by-law to issue $89,000, for enlarging and improving the municipal electric light plant.

BRIDGEBURG, ONT., CAN.—The Canadian Niagara Power Company, of Niagara Falls, Ont., has applied to the Village Council for a franchise in Bridgeburg.

ST. THOMAS, ONT., CAN.—The Council is contemplating making improvements to the street railway system, which will involve an expenditure of about $10,000. The ratepayers will be asked to vote on the proposition in January.

STRATFORD, ONT., CAN.—A by-law has been passed by the City Council authorizing execution of an agreement with the Stratford Gas Company referring to arbitration of three electrical experts the amount to be paid by the city for the company's electric lighting plant and equipment. After the price has been decided upon, the question will have to be submitted to a vote of the ratepayers as to whether the city will purchase the plant on the terms of the award decided upon.

TORONTO, ONT., CAN.—The Board of Contral has awarded the contract for the motors in connection with the pumping equipment for the main and high-level pumping stations to the Canadian Westinghouse Company for $107,000. The contract for the pumps will be awarded later.

TRENTON, ONT., CAN.—The ratepayers will vote, on Nov. 15, on a by-law passed by the Council authorizing the execution of an agreement between the corporation and the Trenton Electric & Water Company whereby the corporation transfers certain rights in a water lease from the Dominion Government at Dam No. 2 on the Trent River to the company; in return for which the company agrees to furnish electricity to consumers within the limits of Trenton at the following prices: For 1 hp to 15 hp $20 per hp per year; from 15 to 100 hp $17 per hp per year, and all over 100 hp $16 per hp per year, for a 24-hour service based upon the maximum demand for the year. The lease from the government is for 21 years and renewable.

WALKERVILLE, ONT., CAN.—The Walkerville Light & Power Company has been incorporated by Hiram Walker & Sons for the purpose of taking over the local electric light plant heretofore operated by the firm.

HULL, QUE., CAN.—The Hull Electric Company has made arrangements with the Ottawa Electric Company, of Ottawa, under which the last-named company will furnish electricity to operate the system of the Hull Electric Company, while the company is rebuilding its power house, located on Lake Deschenes, which was partially destroyed by fire on Oct. 18.

QUEBEC, QUE., CAN.—Plans are being considered by the Quebec Railway, Light & Power Company for the construction of a substation in St. Anne de Beaupré, Que., contracts for which will probably be placed this year. The company has recently purchased a 500-kw motor generator set from the Canadian General Electric Company.

DUBLAN, MEX.—Plans are being considered by the Hidalgo Cement Company for the construction of a large hydroelectric plant on the Montezuma River, located about three miles from Dublan. The cost of the construction of the dam is estimated at $500,000 and the power plant and electric equipment an additional $200,000. The plant will have an output of 1200 hp. which will be utilized to operate the cement works of the company in Dublan and also furnish electricity for lamps in Dublan.

MEXICO CITY, MEX.—The syndicate of Montreal and Toronto capitalists recently awarded a contract for the construction of a large dam across the Conchos River in the State of Chihuahua for the purpose of furnishing power for a large hydroelectric power plant. A separate company has been formed to carry out the project, which will be known as the Compania de Fuerza Electrica. The contract was awarded to S. Pearson & Son, Ltd., and will cost about $7,500,000 in gold, and includes the construction of a system of irrigation canals and ditches, which will be operated in connection with the electrical project. The hydroelectric plant will develop about 25,000 hp, which will be transmitted to towns and mining camps within a radius of 200 miles. The dam will be over 200 ft. high and will form a reservoir having a capacity of [illegible] cu. m. of water.

New Industrial Companies.

THE ALDRICH CONTRACTING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $10,000 for the purpose of doing a general contracting and engineering business. The incorporators are: A. Bennett Aldrich, Elinor M. Kalstad, of New York, N. Y., and E. A. Whitman, of Jamaica, N. Y.

THE AMERICAN ELECTRIC MACHINE & ELEVATOR COMPANY, of St. Louis, Mo., has made application for articles of incorporation. The company proposes to manufacture and deal in elevators. The capital stock is placed at $10,000. The incorporators are John T. Burke, William A. Krauss and John W. Fierce.

THE BURTON ELECTRIC CLOTH TREATING COMPANY, of Boston, Mass., has been incorporated with a capital stock of $100,000 for the purpose of dealing in patent electric machinery. G. D. Burton, of Boston, Mass., is president of the company, and L. Harris, of Jamaica Plain, Mass., treasurer.

THE CENTRAL WIRELESS COMPANY, of New York, N. Y., has been incorporated with a capital stock of $1,000 by James R. McLean, Orley Granger, of New York, N. Y., and Richard E. Nebel, of Brooklyn, N. Y. The company proposes to manufacture telephone and telegraph devices and appliances; also electric and mechanical apparatus.

THE COLT-STRATTON COMPANY, of New York, N. Y., has been chartered with a capital stock of $125,000 by W. L. Colt, H. L. Stratton and S. H. Veal, of New York, N. Y. The company proposes to manufacture motors, engines, machines, etc.

THE CUSHNOE MOTOR COMPANY, of Augusta, Maine, has filed articles of incorporation with a capital stock of $100,000. The purpose of the company is to manufacture all kinds of engines. The incorporators are: C. B. Burleigh, W. J. Skehan and L. A. Burleigh, of Augusta, Maine.

THE DOUGLASS ENGINE & MANUFACTURING COMPANY, of Birmingham, Ala., has filed articles of incorporation with a capital stock of $15,000 for the purpose of manufacturing engines. The officers are: R. H. Hamrick, president; C. P. McCurry, vice-president; J. S. Kennedy, secretary and treasurer, and J. E. Douglass, general manager.

THE DUPLEX VACUUM ENGINE COMPANY, of Chicago, Ill., has been incorporated by L. Kessler, J. Reckinger and A. L. Luessenhop, of Chicago, Ill. The company is capitalized at $30,000 and proposes to manufacture and sell mechanical devices.

THE FISH SYSTEM COMPANY, of Indianapolis, Ind., has been incorporated with a capital stock of $50,000 by George L. Fish, R. C. Davis, H. F. Huster and E. A. Leeson. The company proposes to manufacture and sell electrical and power apparatus and supplies.

THE FORT WAYNE ELECTRIC SUPPLY & FIXTURE COMPANY, of Fort Wayne, Ind., has been incorporated with a capital stock of $25,000 by S. M. Foster, F. H. McCulloch and H. L. Taylor. Mr. McCulloch will be manager of the company and will have offices in the Minuet Building, East Washington Street, Fort Wayne, Ind.

THE GARBUTT MACHINE & FOUNDRY COMPANY, of Ogdensburg, N. Y., has been incorporated by Max A. Jameson, Myron E. Gray, William O. Ingram, all of Ogdensburg, N. Y. The company is capitalized at $10,000 and proposes to do an electrical and mechanical engineering and mechanical business.

THE GLEESON-BROKAW ELECTRIC COMPANY, of St. Louis, Mo., has made application for articles of incorporation, with a capital stock of $2,000. The object of the corporation is to manufacture and deal in electrical fixtures. The incorporators are: Thomas P. Gleeson, Paul V. D. Brokaw and Linn R. Brokaw.

THE GREENWOOD ENGINEERING & CONSTRUCTION COMPANY, of Dover, Del., has been chartered with a capital stock of $50,000 by E. H. Greenwood, of Camp Hill, Pa.; J. R. Barber and R. W. Dunlop, of Harrisburg, Pa. The company proposes to do a general engineering business.

THE HAWHURST WIND TURBINE POWER COMPANY, of Los Angeles, Cal., has been incorporated with a capital stock of $200,000 by the following directors: H. I. Hawhurst, George Humphries and T. M. Webster. The company proposes to manufacture wind turbines. It is said that the company has taken an option on a site and building where it proposes to install a plant.

THE MOTOR & MACHINE COMPANY, of Red Springs, N. C., has been chartered with a capital stock of $25,000 by James A. Lane, W. E. Garrett and L. M. Cook. The company proposes to manufacture motors and machines.

THE MOTOR PARTS COMPANY, of West Orange, N. J., has been incorporated with a capital stock of $125,000 to manufacture motors, engines, machines, etc. The incorporators are: W. D. Sargent, West Orange, N. J.; G. M. Judd and E. H. Fallows, of New York, N. Y.

THE NEWPORT BATTERY COMPANY, of Newport, Wash., has been organized with a capital stock of $7,000 for the purpose of manufacturing dry cell batteries, gasoline engines and auto battery sets. R. S. Anderson is interested in the project.

THE NORTHEAST ELECTRIC COMPANY, of Rochester, N. Y., has been chartered with a capital stock of $125,000 for the purpose of doing electrical work. The incorporators are: E. A. Halbleib, J. J. Stafford, of Rochester, N. Y., and J. C. Halbleib, of Cleveland, Ohio.

THE ODIN DRY BATTERY COMPANY, of New York, N. Y., has been chartered with a capital stock of $25,000. The company will do general electrical engineering work and also manufacture electrical supplies. The incorporators are: Benjamin Colby, Harry C. Adams and H. R. Berlincke, all of New York, N. Y.

THE STATE ELECTRIC CONSUMERS' LEAGUE, of New York, N. Y., has filed articles of incorporation, with a capital stock of $500. The incorporators are Howard H. Sherrard, Walter L. Dreyfus and George J. Schroeder, all of New York, N. Y. The purpose of the league is to inspect and audit charges of heating, electric, gas and power companies, and to examine wires, pipes and conduits.

THE SUBURBAN MOTOR TRANSIT COMPANY, of Jersey City, N. J., has been chartered with a capital stock of $100,000 by J. A. McClary, of Rahway, N. J.; G. L. Burton, of New Brunswick, N. J., and T. J. Gantly, of Jersey City, N. J.

THE TAIT PRODUCER COMPANY, of Montclair, N. J., has been incorporated with a capital stock of $100,000 by E. Benjamin, L. M. Takacs, of Newark, N. J., and F. Benjamin, of East Orange, N. J. The company proposes to manufacture and deal in gas power engines and gas producer engines.

THE UNIVERSAL HARTEL LIGHT COMPANY, of Dover, Del., has filed articles of incorporation with a capital stock of $100,000. The company proposes to exploit Hartel light patents. The incorporators are: J. F. Alee, J. F. Alee, Jr., of Dover, Del., and E. B. Davis, of Wilmington, Del.

THE UNIVERSAL TIRE PROTECTOR COMPANY, of Angolia, Ind., has incorporated to establish and equip a factory for the manufacture of certain automobile accessories known as the "Universal" adjustable full tread and the "Universal" emergency tire sleeve; also for the manufacture of other accessories, electric supplies, etc. The capital stock is placed at $30,000. Samuel C. Wolf, F. S. Croxton, James R. Nyce and W. W. Love are directors.

THE WILLIAM H. KING COMPANY, of Newark, N. J., has been incorporated by William H. King, William T. Leary and Alice A. King, of Newark, N. J. The company is capitalized at $50,000 and proposes to manufacture boilers, hardware, machine specialties, etc.

New Incorporations.

HELENA, ARK.—The Interurban Railway Company has been chartered, with a capital stock of $10,000, for the purpose of constructing a street car and interurban railway in Helena; also operating a railway from Helena to a new addition to the city. The incorporators are: E. C. Horner, John S. Horner and C. H. Purvis.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Highland Pacific Railroad Company for the purpose of constructing an electric railway from Lakeport to Clear Lake. The company is capitalized at $2,500,000, and the directors are: J. E. Fulton, D. F. McIntyre, J. R. Garner, W. P. Mariner and A. E. Dickinson. J. R. Garner is treasurer. The main office of the company is in San Francisco.

BOISE, IDAHO.—Articles of incorporation have been filed for the Gooding, Soldier & Boise Interurban Railway Company for the purpose of constructing a railway to be operated by steam or electricity to connect Boise and Gooding with the Idaho Southern into the Twin Falls country. The company is capitalized at $1,000,000.

OKAWVILLE, ILL.—The Okawville & Southern Telephone Company has been chartered, with a capital stock of $2,000, by Herman H. Brockmeier, William Grewe and William Randall.

VERGAS, MINN.—Articles of incorporation have been filed for the Vergas Telephone Company, with a capital stock of $10,000. The officers of the company are: W. B. Carman, of Detroit, Minn., president; James Nesbitt, of Vergas, secretary, and A. G. Schwarzrock, of Vergas, treasurer.

TEGARDEN, IND.—The St. Joe County Mutual Telephone Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $1,000 and proposes to build and operate a telephone exchange and system in Tegarden and St. Joe County. The directors are, W. C. Divine, C. F. Ruple, J. S. Davis and Frank Retter.

THURMONT, MD.—Articles of incorporation have been filed for the Citizens' Electric Light & Power Company by John R. Rouzer, Morris A. Birely, Martin L. Creager and others. The company is capitalized at $15,000 and proposes to establish a hydroelectric power plant to furnish electricity for lighting the streets and residences of the town.

BUTTE, MONT.—Articles of incorporation have been filed for the Inter-State Consolidated Telephone Company in Butte, Mont. The company is capitalized at $5,000,000 and has already acquired the Home Telephone Company, of Spokane, Wash. The company will operate in the Northwest, taking over the Independent Telephone Company of Montana. The corporation is backed by San Francisco, Los Angeles, Spokane, Portland, Butte and Missoula capitalists.

BYRON, MO.—The Byron Water Power Company has been incorporated with a capital stock of $1,000 by George M. Clark, Allen W. Hetrick and George F. Bunn.

ST. JOSEPH, MO.—The St. Joseph Long Distance Telephone Company has been formed, with a capital stock of $1,250,000, by Theodore Geary, of Macon, Mo.; Walter S. Dickey, of Kansas City, Mo.; W. F. Rankin, of Tarkio, Mo.; G. H. Davis, of Kansas City, Mo., and R. W. Frey, of St. Joseph, Mo. The company proposes to absorb, it is said, a large number of independent telephone systems in northwest Missouri.

ST. LOUIS, MO.—Articles of incorporation have been filed for the St. Louis-Kansas City Electric Railway Company for the purpose of constructing an electric railway to connect St. Louis and Kansas City, Mo., with a branch from Glasgow, through Charitor to Brookfield. The railway will be 295 miles in length and will be capitalized at $5,000,000. The directors are: D. C. Nevins, Charles A. Loomis, of Kansas City, Mo.; H. V. Johnson, W. Weston and B. L. Dorsey, of Denver, Colo.; W. A. Hamilton, of Chicago, Ill.; L. M. Nevins, Seldon P. Spencer, of St. Louis, Mo., and others

VINELAND, N. J.—The Northern New York Construction Company has been organized to construct an electric railway extending from Vineland to Bridgeton. George E. Stevenson is president of the company; B. F. Patterson, of New York, N. Y., and Frank Parvin, vice-presidents; T. H. Coggey, of New York, N. Y., secretary, and H. C. Bartlett, treasurer. Surveys are now being made for the railway.

CATTARAUGUS, N. Y.—The Cattaraugus Union Telephone Company has been incorporated, with a capital stock of $50,000, to operate in the counties of Niagara, Erie, Chautauqua, Cattaraugus, Orleans, Genesee, Wyoming, Allegany, Livingston, Steuben and Monroe. The directors are: Charles M. Beattie, William T. Farrell and W. Roy McCanne.

NASHVILLE, N. C.—The Nashville & Castalia Telephone Company has been organized for the purpose of erecting a telephone line between Nashville and Castalia. S. J. Bartholomew is president of the company, and S. F. Austin, secretary and treasurer.

DOUGHERTY, OKLA.—The Arbuckle Water Power Electric Company has been chartered, with a capital stock of $10,000, by W. T. Croslen, of Chickasha, Okla.; W. F. McCormick, W. J. Williams, of Sulphur, Okla., and S. A. Newland, of Ardmore, Okla.

PHILIPSBURG, PA.—The Philipsburg & Susquehanna Valley Railroad Company has been chartered to take over the properties of the Philipsburg Railroad Company, the Center & Clearfield Street Railway Company, the New Steam Company and the Philipsburg Electric Light, Gas, Power & Heating Company. A bond issue of $2,000,000 has been

authorized. The officers of the company are Thomas F. Barrett, of New York, N. Y., president; Charles H. Rowland, of Philipsburg, vice-president; W. W. Cole, second vice-president and electrical engineer; Howard M. Van Court, of Philadelphia, Pa., treasurer; George W. Zeigler, secretary, and J. O. Reed, general manager.

ROCK HILL, S. C.—The Carolina Traction Company has been granted a charter with an initial capital stock of $150,000 and ultimate capital of $500,000 for the purpose of establishing a rural car system radiating from Rock Hill, taking in Charlotte, Chester and Yorkville, and to tap the seaboard in Yorkville County. The incorporators are: J. M. Cherry, of Rock Hill; W. S. Lee and George Stevens, of Charlotte, N. C. The charter of the company gives it power to lease and build power plants, own and operate gas and lighting plants, also telephone and telegraph lines.

MEMPHIS, TENN.—The Tennessee Traction Company has been incorporated, with a capital stock of $50,000, for the purpose of constructing a traction line between Memphis and Nashville, Tenn. George E. Bushnell, consulting engineer, of Indianapolis, Ind., is interested in the project.

SALT LAKE CITY, UTAH.—The Meteor Electric Company has been incorporated, with a capital stock of $10,000, and the following named officers: L. E. Bedford, president; J. J. Campbell, vice-president; L. D. Gordon, secretary and treasurer; J. C. Cumo and E. J. Kingsley are directors.

SPOKANE, WASH.—The Mattawa Power & Irrigation Company has been chartered with a capital stock of $500,000 by Edward Campbell, E. L. Campbell and William J. Sanderson.

SPOKANE, WASH.—The Columbia River & Mt. Adams Railroad Company has been incorporated with a capital stock of $2,000,000 to construct an electric railway from some point on the Columbia River in Klickitat County through parts of Klickitat, Yakima and Skomania counties to a point in the vicinity of Mt. Adams. The company also proposes to operate steamboats on the Columbia River and to furnish electricity for lamps and motors. The trustees of the company are: Adolph H. Suksdorf, Edward H. Suksdorf and Oswald N. Suksdorf, all of Spokane, Wash.

Personal.

MR. OSCAR T. CROSBY is being prominently mentioned among those who are being considered by President Taft for appointment as Minister to China.

MR. E. J. DEUTH, formerly assistant manager of the tungsten department of the German-American Electric Company, has been appointed manager of that company.

MR. W. H. FELLOWS, superintendent of the Leavenworth Light & Heating Company, of Leavenworth, Kan., is visiting Eastern cities on a business trip. On Nov. 3 he was a guest at the meeting of the Electric Club in Chicago.

MR. W. S. DIX, who was formerly connected with R. Thomas & Sons Company, and later engaged in hydraulic developments on the Pacific coast, has returned to New York. Mr. Dix has made no definite plans for the immediate future.

MR. HARVEY N. SMITH, for a number of years connected with the Wheeler-Green Electric Company, of Rochester and Syracuse, is now engaged in general electrical engineering and contracting under the name of the Conduit Electric Company, Syracuse, N. Y.

MR. J. STEWART THOMSON, formerly vice-president and treasurer of the New York Safety Steam Power Company, has associated himself with the Harrison Engineering Company, to develop the Harrison air-tube system of heating and ventilating, with offices at 42 East Twenty-third Street, New York.

MR. CHARLES P. HIDDEN has become associated with Rosenbaum & Stockbridge, patent attorneys, New York. Mr. Hidden, who is a graduate in mechanical and electrical engineering, has until recently been an examiner in the United States Patent Office, and has also qualified for the practice of patent law.

MR. EDWARD BENNETT, of Jeanette, Pa., recently appointed associate professor of electrical engineering of the University of Wisconsin, has begun his work. Professor Bennett, who has been located at Telluride Institute at Ohmstead, Utah, was graduated from Western University of Pennsylvania, now the University of Pittsburgh, several years ago with the degree of electrical engineer.

MR. E. A. LOF has resigned as head of the commercial switchboard department of the Western Electric Company to accept a position in the power and mining engineering department of the General Electric Company, at Schenectady. Mr. Lof had been connected with the power apparatus engineering department of the Western Electric Company for six years or more, latterly as head of the switchboard branch.

DR. ERNST J. BERG, consulting engineer of the General Electric Company, Schenectady, has been appointed professor of electrical engineering in the University of Illinois, at Urbana, Ill. Dr. Berg graduated from the Royal Polytechnic Institute of Stockholm in 1892, and came to the United States a year later. He has been associated with the General Electric for 17 years. In the last three years he has been a special lecturer at the Union University, Schenectady. Dr. Berg succeeds, as head of the department of electrical engineering, Professor Morgan Brooks, who is now absent on leave for foreign study. It is announced, however, that the coming of Dr. Berg will not deprive the university of the services of Professor Brooks, who, at the expiration of his leave will continue as a professor in the department.

MR. LOUIS C. FRITCH, consulting engineer of the Illinois Central Railroad, has resigned to become chief engineer of the Chicago Great Western Railway, the new appointment to be effective Nov. 15. Mr. Fritch, who was formerly assistant to President Harahan, of the Illinois Central, has been the company's electrification expert for several years, and as such has been much in the public eye. As the directors have decided to make no immediate use of his plans for electrification, the scope of his work has been diminished. Mr. Fritch is vice-president of the American Railway Engineering and Maintenance of Way Association and is chairman of that association's committee on electrification.

MR. ARTHUR J. SWEET will leave the Westinghouse Lamp Company on Dec. 1 to join the engineering department of the Holophane Company. In his new position Mr. Sweet will have charge of important new development work which the Holophane Company has long planned to undertake. Mr. Sweet is a graduate of Cornell and also completed three of the four years' course in electrical engineering at Massachusetts Institute of Technology. After a shop apprenticeship course he spent three years with the Westinghouse Electric & Manufacturing Company, nine months with the Western Electric Company and about two years and a half with the Westinghouse Lamp Company. His work throughout has been along lines of practical and theoretical development. In the lamp works he gained an intimate knowledge of photometric methods and equipment and did considerable work in illumination design.

Obituary.

MR. PAUL SHEEHAN, a well-known telegrapher and one of the night chiefs in the Western Union Telegraph office at 195 Broadway, New York, died at his home in Brooklyn, Nov. 2, after an illness of several months. He had been in the Western Union Company's service for nearly 40 years. He is survived by a widow and four children.

MR. ARTHUR H. EDWARDS, general purchasing agent and storekeeper for the Montreal Light, Heat & Power Company, died on Oct. 28. Mr. Edwards suffered four years ago from a severe illness with complications of the heart, and eight weeks ago the trouble recurred, resulting in his death. He was 38 years of age, and left a widow but no children.

MR. W. W. CARGILL, a prominent business man of La Crosse, Wis., and identified with several electrical enterprises, died on Oct. 17. Mr. Cargill was vice-president of the La Crosse City Railway Company and a heavy stockholder in the La Crosse Gas & Electric Company. He was also president of the Vote-Berger Company, which manufactures telephone apparatus, and prominent in the affairs of the La Crosse Telephone Company.

MR. GEORGE F. DURANT, general manager of the Bell Telephone Company of Missouri, which he founded in 1878, died Oct. 31, at the Boulder Sanatarium, in Boulder, Col. His death was unexpected. Heart failure is given as the immediate cause of death. He suffered a sunstroke last summer in St. Louis, but never fully recovered from the stroke and his health declined rapidly until October, when he went to Boulder. His body was cremated and was brought to St. Louis by Mrs. Durant. Mr. Durant installed the first telephone exchange in St. Louis in 1878. When this pioneer company was absorbed by the Bell Company, he became general manager of the Bell, and was also a director of the corporation. He had been a director in the Lincoln Trust Company and was also the vice-president of the Lakeside Sugar Refining Company. Mr. Durant was born in Jersey City, N. J., March 26, 1842, and was educated in the New Jersey private schools. He married twice, first, Mrs. Alice Smith, of Moriches, N. Y., and second, Miss Annie Fell, of Bloomington, Ill. He began his business career by learning the printer's trade. During the civil war he became a telegrapher on the Union side and was in the battle of Gettysburg. In 1870 he became superintendent of fire-alarm telegraph at Jersey City, N. J. Four years later he came West to St. Louis and installed the District Telegraph. In 1878 he installed the first telephone exchange and largely to his management the present company owes its efficient service. At the start the company was a very small institution, and as a business venture did not attract capital. With rare skill at organization, he began the work of extending the lines of the company. At the time of his death he was working upon plans for additional extensions, particularly in the West. He intrusted little of his work to subordinates, and was perfectly informed even in minor mechanical details of the operation of a telephone system.

Trade Publications.

SUCTION SWEEPERS, of the electric motor-driven type, are briefly outlined and illustrated on a calendar card of the Electric Suction Sweeper Company, New Berlin, Ohio.

COPPER-CLAD STEEL WIRE, for trolley circuits where tensile strength is of importance, is illustrated in a folder of the Duplex Metals Company, 149 Broadway, N. Y.

MINIATURE ELECTRIC RAILWAYS.—The Central Electric Company, Chicago, Ill., has issued a 16-page catalog devoted to a description of miniature electric railways suitable for electrical gifts at Christmas.

VEHICLE BATTERIES.—The Electric Storage Battery Company, Alleghany Avenue and Nineteenth Street, Philadelphia, has issued bulletin No. 116, containing a paper by Mr. H. M. Beck, on the care and operation of vehicle batteries.

RHEOSTATS FOR PLATING.—The Ward Leonard Electric Company devotes several sections of its new perpetual catalog to rheostats for the control of plating generators, of which diagrams and descriptions are given with potentiometer connections.

GAS ENGINES.—Bulletin K-21 of the Du Bois Iron Works, Du Bois, Pa., contains a detailed description of single-cylinder throttling gas engines rated at from 5 hp to 100 hp. These engines are well adapted for use in small industrial and private lighting plants.

WIRING CONDUIT.—The National Metal Molding Company, Pittsburgh, Pa., is distributing folders for calling attention to its "Sherarduct" conduit. This conduit is a mild steel pipe, both the inside and outside of which contain coatings of alloyed zinc and iron.

INDUCTION MOTORS of the polyphase constant-speed type rated at from 0.25 hp to 250 hp are fully described in bulletin No. 115 of the Crocker-Wheeler Company, Ampere, N. J. Descriptions are also given of starting devices, including star-delta switches and auto-transformers.

GAS PRODUCERS for bituminous fuels are well discussed in circular W.M. 503 of the Westinghouse Machine Company, East Pittsburgh, Pa. It is claimed that with Pocahontas coal averaging 13,983 thermal units per lb. a consumption as low as 0.996 lb. per brake hp-hour has been obtained under test conditions.

STATIONARY TRANSFORMERS of the oil-insulated self-cooled type are well illustrated and described in an instructive manner by the Pittsburg Transformer Company, Pittsburgh, Pa. The coils in these transformers are wound directly upon the laminated core of silicon steel. The transformers are built in ratings up to 500 kw.

ARC LAMPS.—The General Electric Company has issued bulletin No. 4676 illustrating and describing various types of enclosed arc lamps for use on direct-current and alternating-current circuits for interior illumination. The publication includes a description of the use of these lamps for blue printing work. It contains also illustrations and descriptions of lamp hanger boards, globes and reflectors.

METER TESTING.—The Central Electric Company, Chicago, Ill., has issued a 16-page circular entitled "Economical Meter Tests Made with P-M Meter Connection Blocks." This publication gives full directions for testing all types of meters by means of the new P-M system. It is claimed that the adoption of this system will reduce meter testing expense from 15 to 40 per cent, and will absolutely prevent theft of current.

ORGAN REGULATORS.—The Ward Leonard Electric Company devotes section D-12 of its new perpetual catalogue to organ regulators. These regulators are a new design, a special feature of which is that a customer can order an organ regulator by simply stating the horse-power and voltage of the motor driving the bellows. There is sufficient resistance in the rheostat to give 50 per cent speed control under full load conditions and to stop the motor under practically no load conditions.

ELECTRIC VEHICLES.—The General Vehicle Company, Long Island City, N. Y., has issued some instructive and convincing publications relating to electric vehicles and their advantages from a business point of view. A neatly executed general catalog gives views of numerous electric vehicles built for industrial service. The various types of vehicles are described in detail in service bulletin No. 1, while the business features of the electric vehicle for trucking and delivery service are outlined in a special booklet.

SEVENTY-FIVE YEARS OF ENGINE BUILDING is the title of a handsome publication just issued by the C. & G. Cooper Company, of Mount Vernon, Ohio. A large proportion of the book is devoted to a historical account, describing the humble beginnings of the original foundry of Charles and Elias Cooper in 1833. There is a chapter descriptive of the company's works, their location and facilities, and the various classes of engines they are capable of producing. The booklet is profusely illustrated, the effect of the decorative scheme being to convey to the reader an impression of the progress which has characterized these 75 years of engine building.

STORAGE BATTERIES.—The increasing demand during the past few years for electric lighting and power plants in factories, institutions, residences, etc., where service from central lighting stations is not available has led to the installation of many isolated generating plants operated by gas or gasoline engines in connection with storage batteries. The development of the high economy metallic filament lamp has materially broadened this field of electric lighting and the storage battery has become a standard part of an installation of this kind. The Electric Storage Battery Company, of Philadelphia, has issued two publications, which cover the requirements for this service, in the form of illustrated booklets containing details of installation and the switchboard and generator requirements with prices covering complete equipments of battery and switchboard. These publications are entitled Hand-books IP and LV.

PORTABLE SUBSTATIONS.—The General Electric Company has designed and developed portable substations consisting of specially arranged cars containing complete substation equipments including a rotary converter or motor-generator set of the required capacity, transformers, switchboards and accessories, to provide for a temporary supply of energy. These substations are equipped with trucks adapted for short radius curves, and may be conveniently moved to any section of the road requiring energy temporarily. Connections to the high-tension lines and direct trolley or feeders are all that is necessary to render the portable station ready for immediate service. An interesting bulletin on this subject has just been issued by the General Electric Company as No. 4694. This bulletin contains a plan and elevation of a portable substation and other illustrations, both interior and exterior.

Business Notes.

MESSRS. BENNETTS & KEEGAN are entering upon the electrical contracting business in Cheyenne, Wy.

THE DI-EL-ITE MANUFACTURING COMPANY, of Philadelphia, has opened a New York office at 120 Liberty Street, to be in charge of Mr. G. R. Hall, secretary and treasurer of the company.

THE APPLETON ELECTRIC COMPANY has recently moved into larger quarters at 25 West Broadway, New York, where it carries a complete line of unilets, outlet boxes, fixture studs, locknuts and bushings.

THE DUPLEX METALS COMPANY has taken offices on the thirty-second floor of the Singer Building, 149 Broadway, New York. The offices of the company have been on a lower floor of the same building since last May.

THE W. MONTELIUS PRICE COMPANY has moved from 525 New York Block, Seattle, Wash., to 524 First Avenue, S., same city. The firm represents a number of prominent manufacturers of electrical apparatus and supplies.

EDWARD E. CARY COMPANY, importer of electrical specialties, 59-61 Park Place, New York, reports a considerable demand for enameled steel reflectors for tungsten lighting. Among other large contracts it is supplying the domes and deflectors for the parks of New York City, for the tungsten lamp posts.

PANEL BOARDS.—Bulletin No. 4681 of the General Electric Company, illustrates and lists all of the panel boards designed by this company. The line of boards includes designs selected after careful study of all general requirements. The bulletin will be of service to architects, builders and jobbers in general.

GARWOOD ELECTRIC COMPANY.—The Garwood Electric Company, which is the successor to the C. & C. Electric Company, reports that its business is now first-class. It has recently installed in New York in the Ritz-Carlton Hotel and the new Hotel Martinique, thorough systems for ventilation and heating. This ventilating business is one of the chief features of the Garwood Company.

ANGLE-COMPOUND ENGINES.—As evidence of the satisfaction that Angle-Compound high-speed engines are giving, the American Engine Company, of Bound Brook, N. J., report orders for two 500-hp Angle-Compound engines to be used for running centrifugal pumps of the Interborough Rapid Transit Company power plants. This order is the result of the good performance of similar engines installed earlier in the season. Bloomingdale Brothers have installed a 400-hp engine of the same type, and the three lighting units installed in the Belnord Apartments are now in continuous operation.

THE CARB-OX COMPANY, of Rogers Park, Ill., a suburb of Chicago, has been formed to take over the patents and business of Joseph W. Hayes, of Chicago, who has for several years been developing and selling a line of apparatus for use in studying the composition of boiler-flue gases. Mr. Hayes has made a specialty of furnace and flue-gas engineering for several years. The new company will make gas analysis instruments of all kinds, including CO_2 detectors, gas-sampling apparatus, damper regulators and automatic indicating and recording gas calorimeters, which will indicate continuously the thermal units per cubic foot. This is a class of apparatus for which there is a rapidly increasing demand, owing to the deserved attention which the question of furnace efficiency is receiving.

WESTINGHOUSE BALTIMORE SHOW-ROOM.—The Baltimore office of the Westinghouse Electric & Manufacturing Company, as part of a vigorous campaign for business, has established a display room on the principal street of the city, and demonstrations in the window have attracted much attention, the crowds attracted frequently blocking the sidewalk. The demonstrations of the use of electric cooking utensils have been especially appreciated. The window displays are changed twice weekly, and passers-by have become accustomed to stopping to see the latest exhibits. Last week the advantages of Westinghouse tungsten lamps were brought out by means of a meter which was automatically connected for short intervals to banks of carbon and tungsten lamps, and registered for each interval the respective consumptions of energy. The passer-by noted that with a larger candle-power in tungstens the consumption was half that of carbon-filament lamps.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV. 2, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

938,471. GROUNDING DEVICE OF TERMINAL FOR LINE-WIRES; William R. Garton, Brooklyn, N. Y. App. filed Nov. 12, 1908. Consists of a terminal of hydro-scopic material and non-hydro-scopic material made up in units with a metal rod extending through them.

938,477. FUSE HOLDER; J. E. Graybill, York, Pa. App. filed July 5, 1904. A fuse block consisting of a block with a recess, a terminal thereon, the terminal having collapsible walls enclosing the socket and a washer enclosing the walls.

938,501. ADDING MACHINE; F. R. McBerty, Evanston, Ill. App. filed Feb. 27, 1904. Electric means for operating adding machines, in which a motor circuit with a motor operates the driving member, the circuit being closed by a hand-operated switch and a magnetic switch.

938,541. TELEPHONE EXCHANGE SYSTEM; C. L. Zahm, Los Angeles, Cal. App. filed Sept. 19, 1905. Subscribers working on an automatic system can trunk directly into a manual system by a selector switch controlled by a subscriber's line and a manually operated switchboard, the switch first displaying a signal, thus indicating when a connection is desired on the switchboard.

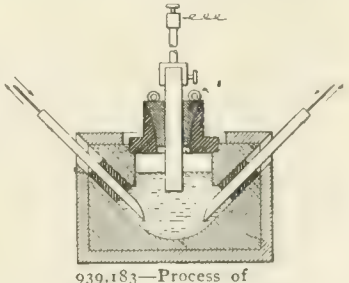
938,553. PRIMING CHARGE FOR MINES; Louis Cahuc, Neumarket, Germany. App. filed June 15, 1908. Aluminum powder in a state of fine division lies between the bared portions of the wires.

938,558. DYNAMO-ELECTRIC MACHINE; A. L. Cushman, Concord, N. H. App. filed May 27, 1907. Makes use of interpolar or commutating magnets in a magnetic circuit independent of the field magnetic circuit, thus preventing sparking.

938,575. TUBING; E. T. Greenfield, Kiamesha, N. Y. App. filed Oct. 3, 1908. A spirally formed strip of metal to form a series of interlocking convolutions, certain of them being cut or weakened so that they may be broken.



938,553—Priming Charge for Mines.



939,183—Process of Generating Electricity.

938,581. CARBID AND METHOD OF MANUFACTURING SAME; Herman L. Hartenseting, Constantine, Mich. App. filed Feb. 23, 1907. Produces a fused liquid mass of carbid and agitates it while solidifying it.

938,631. WIRELESS CLUSTER; R. B. Benjamin, Chicago, Ill. App. filed June 10, 1907. The supporting base carries conducting plates, an insulating ring is arranged in each opening of the casing and has two diameters, the larger portion being confined between the casing and block and the smaller portion extending outwardly through the casing with a threaded contact in the ring engaging a plate carried by the block.

938,632. CLUSTER LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Oct. 28, 1907. An insulating threaded lamp holder in each opening, each lamp holder comprising a ring having two diameters and having its smaller part passed outward through one of the openings of the casing, the larger portion of the ring being held between the casing and the insulating block.

938,634. METALLURGICAL PROCESS; A. G. Betts, Troy, N. Y. App. filed Nov. 30, 1906. Makes aluminum by reducing aluminum ore in the presence of iron to an alloy containing iron and aluminum, adds iron sulphite, reducing the iron, and then decomposes aluminum sulphide electrolytically.

938,635. PANEL BOARD; A. E. Blackman, Mount Vernon, N. Y. App. filed Oct. 15, 1908. Avoids the necessity of keeping the door open to get at the switches by making use of a single set of switches wholly within the compartment and having operating members extending therethrough surrounded by the metal.

938,649. CONTROLLER FOR ELECTRIC MOTORS; F. Diehl, Elizabeth, N. J. App. filed May 11, 1908. The motor frame has a switch-box with fixed and movable contact plugs connected with the branches of the motor circuit and controlled by a lever lying in the path of movement of the clutch operating lever.

938,663. BATTERY CONTACT; J. H. Gugler, Minneapolis, Minn. App filed Feb. 21, 1908. A battery having an annular well in the bottom containing a body of mercury with which the lead wire connects.

938,664. ELECTRIC SWITCH; G. W. Hart, West Hartford, Conn. App. filed May 5, 1909. Double throw push button switch whereby the actuated member may be moved beyond the end of the stroke without effect, thus avoiding defects in the positioning of the switch.

938,671. RESISTANCE UNIT; H. W. Leonard, Bronxville, N. Y. App. filed Nov. 13, 1905. A reflex ribbon conductor and two protected sheet metal supports, the ribbon being supported edgewise.

938,672. BINDING POST; H. E. Leppert, New Britain, Conn. App. filed April 2, 1908. A binding post with a screw having an enlarged shoulder adapted to clamp a conductor between it and the inside of one of the walls of the stationary member of the post.

938,[illegible]. OUTLET BOX; J. T. Meleady, Newark, N. J. App filed May 20, 1908. An outlet box having a perforation for receiving the conduit, a sleeve thereon embracing the conduit, said sleeve being provided with a radial lug having a slot and inclined face together with a screw and ribs.

938,708. ELECTROMECHANICAL DEVICE; G. H. Rowe, Riverside, Ill. App. filed June 19, 1908. A stamp mill consisting of a magnet and reciprocating armature and a secondary circuit in which current is induced by the slip between the magnet and the armature.

938,709. ELECTROMECHANICAL DEVICE; G. H. Rowe, Berwyn, Ill. App. filed June 11, 1909. A reciprocating drill having a casing, a magnetizing coil, a movable hollow core within the coil, a plunger in the core having a striking part and a motor to reciprocate the core.

938,723. COUPLING FOR FISH TAPES; F. A. Swan, Cliftondale, Mass. App. filed Feb. 19, 1909. Two fish tapes inserted into the conduit from opposite sides are automatically coupled by means of a hollow head on one, which engages a hook on the other.

938,740. ELECTROMAGNETIC DEVICE; E. A. Brofos, Chicago, Ill. App. filed May 23, 1908. Relay for telephone which is uniformly responsive to alternating currents when used as a pilot relay in an alternating current ringing circuit. Uses two electromagnets, one receiving current from the fluctuating source and the other inductively from the former.

938,752. METHOD OF WORKING METALS, ORES AND THE LIKE; O. Frick, Saltsjobaden, Sweden. App. filed Aug. 31, 1905. An electric transformer furnace in which the principal part of the charge in one furnace is conveyed to another adapted to hold a larger charge than the former one.

938,768. METAL MOLDING; P. T. Kenny, New York, N. Y. App. filed Nov. 24, 1908. For conveying electric light wires and serving as a picture molding consisting of a trough-shaped body of sheet metal and a cover therefor.

938,811. BOX; J. H. Baker, Philadelphia, Pa. App. filed April 8, 1909. A terminal fuse or switchbox made up of sides held together by right angular brackets.

938,830. ELECTRICAL APPARATUS FOR TRANSMITTING AND RECEIVING SIGNALS; A. T. Dawson and G. T. Buckham, London, Eng. App. filed Nov. 27, 1905. For use on shipboard for transmitting from the conning tower the range and signals for gun crews.

938,865. ELECTRICAL SYSTEM OF DISTRIBUTION; A. S. Hubbard, Belleville, N. J. App. filed March 18, 1908. A storage battery and generator are used, the booster being in series with the battery. Means are provided for removing the hysteresis effect from the booster.

938,918. POWER GENERATOR; C. C. Tuch, Honolulu, Territory of Hawaii. App. filed July 29, 1907. A series of planetary gears driven from an internal gear to transmit power to a generator.

938,992. TELEPHONE TRANSMITTER; C. E. Egner, of Stockholm, and J. G. Holstrom, Saltsjo-Storangen, Sweden. App. filed Feb. 18, 1909. A telephone transmitter with a diaphragm strained with its center toward the periphery and a disk forming an electrode secured to the diaphragm.

939,006. STORAGE BATTERY; G. M. W. Goettling, Brookline, Mass. App. filed Jan. 4, 1909. For preventing breakage of the insulating plates of glass by using an insulating bar with a recess fitting over the top edge of the plate and having notches to receive and space the glass plates.

939,054. ELECTRIC WATER HEATER; P. P. Meyers, Grinnell, Iowa. App. filed Jan. 2, 1909. Two electrodes are contained within a casing and a number of electrode members are detachably connected with each elctrode, the water flowing around the electrodes.

939,095. ELECTRIC FURNACE; H. Rochling and W. Rodenhauser, Volkingen, Germany. App. filed Sept. 7, 1906. For converting iron into steel in which an electric transformer induces current in the bath. It has a main field and a leakage field and a conductor arranged in the leakage field, with means for leading the current induced therein to the melting channel to heat the material.

939,128. FIRE ALARM; W. Goodchild, New York, N. Y. App. filed March 18, 1909. An electrically actuated fire alarm in which a mercurial thermometer controls the circuit.

939,154. ELECTRIC CONTROLLING AND SIGNALING SYSTEM FOR RAILWAYS; H. E. McDonnell, Leominster, Mass. App. filed Jan. 26, 1907. A third rail co-operates with a contact carried by a switch tongue, thus completing a short circuit and operating controlling mechanism upon the car.

939,183. PROCESS OF GENERATING ELECTRICITY; Henry Spencer, Blackmore, Mount Vernon, N. Y. App. filed April 18, 1903. Exposes a molten electrolyte to the action of a carbide electrode and a more electro-negative elctrode.

939,186. SELECTIVE APPARATUS FOR SYSTEMS OF COMMUNICATION; E. E. Clement, Washington, D. C. App. filed Oct. 11, 1906. For telephone systems in which a less number of relays than the total number of circuits is used, the relays being actuated in order by circuit closers, preferably push buttons.

939,187. METHOD OF SELECTION IN SYSTEMS OF COMMUNICATION; E. E. Clement, Washington, D. C. App. filed Oct. 11, 1906. Selects circuits for telephone systems by relays less in number than the total number of circuits, which relays are actuated by push buttons. Thirty circuits are divided into three groups of ten each, normally disconnected. Each group is controlled by a relay.

939,188. METHOD OF SELECTION IN SYSTEMS OF COMMUNICATION; E. E. Clement, Washington, D. C. App. filed Oct. 11, 1909. Segregates successive groups of circuits by means of relays which are selected in proper combinations by switches controlled by keys or push buttons.

13,[illegible] (Reissue) TELEPHONE TRANSMITTER, W. W. Dean, Elyria, Ohio. App. filed May 17, 1909. Has a vibrating diaphragm with an independently supported cup containing granular carbon, an electrode supported by the cup, springs pressing the cup against the diaphragm and a second independent rigid electrode, the carbon granules lying between the electrode.

1017 New Weekly Subscribers

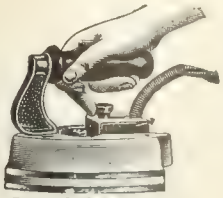
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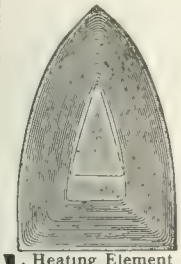


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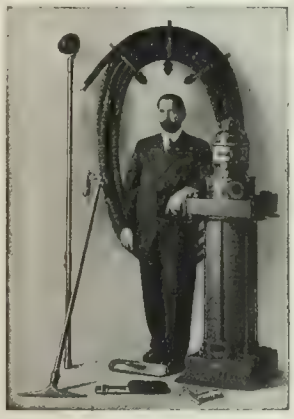
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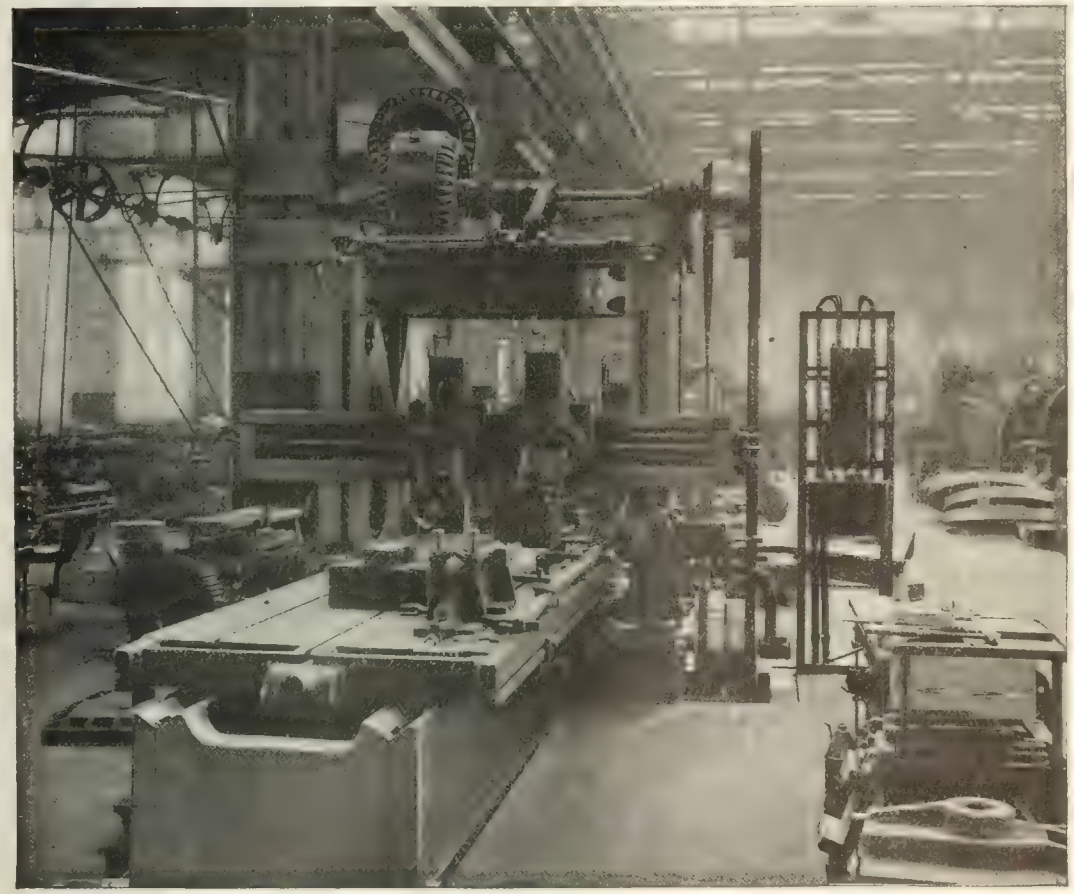
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Vol. LIV. NEW YORK, THURSDAY, NOVEMBER 18, 1909. No. 21.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Thursday of the same week.

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NEW YORK, THURSDAY, NOVEMBER 18, 1909.

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The Cascade Tunnel Railway.

Dr. Hutchinson's admirable Institute paper on the electric system employed in the Cascade Tunnel of the Great Northern Railway Company is of particular interest as describing the first big three-phase traction plant put into operation in this country. American engineers have been inclined to turn the cold shoulder on the three-phase traction, particularly on a large scale. Their foreign confrères have, however, thoroughly demonstrated its success and anyone who has seen the smooth and beautiful performance of the Simplon Tunnel locomotives working on this system acquires abundant faith in three-phase traction for this heavy work. The Cascade Tunnel seems to have been a peculiarly suitable spot for the trial for three-phase traction in this country. It was in the first place such a tunnel where electric traction was acutely needed. Its range over 2½ miles was so great as to make the ventilation problem extremely difficult, and the considerable grade in the tunnel put such heavy work on the locomotives as to render the smoke danger somewhat appalling. When one realizes that the temperature in the locomotive cab rose at times as high as 200 deg. Fahr. in an atmosphere surcharged with smoke and gases from fuel, the seriousness of the situation is at once obvious. After considerable discussion it was decided to apply electric traction to the tunnel and to use the three-phase system as Dr. Hutchinson says, "on account of its greatest simplicity and less cost"; and it is pleasant to be able to record that experience since last July seems to bear out the wisdom of the choice. The locomotives are of the familiar articulated type, each section having two driving axles, to each of which a three-phase motor good for 375-hp continuous output is coupled by twin gears. The locomotive complete weighs 230,000 lb. and has been tested to a maximum tractive effort to nearly 80,000 lb. The primaries of these motors are the stators, wound for 500 volts. The motors are cooled by forced-air circulation.

The control system is of the simplest character, consisting of the familiar resistances in the rotors, a system which secures the variation on just about the same terms as with the old series direct-current motors with rheostatic control. The resistances themselves are iron grids having 13 steps. The total length of track electrified is about six miles and the overhead system is a cross-catenary suspension for the two working wires, so far as the parts of the track external to the tunnel are concerned. Within the tunnel the wires are supported from insulators projecting vertically downward a little over 5 ft. and carrying with them parallel to the wire a flexible link suspension from which the trolley wire proper is supported. Within the tunnel it was necessary from the standpoint of the railway company to space the wires 8 ft. apart in order to obviate danger to brakemen who might rest upon the tops of the freight cars. Hence, the otherwise very desirable bow trolley could not be conveniently used and heavy wheels are employed, but apparently give little trouble. The working efficiency of a locomotive is approximately 80 per cent, including gears, and

it is most interesting to record the fact that the power factor of the system as shown by the switchboard instrument in the power house is 85 per cent, which is excellent even for a 25-cycle plant like this one. The motor efficiency itself is very high, rising at the maximum to nearly 95 per cent, while the maximum power factor coincident with the motor efficiency of a little over 90 per cent is about 88 per cent. The total efficiency when the plant is delivering 4000 kw is 70 per cent from the low-tension busbars at the power house to the driving axles of the locomotive. Two locomotives are commonly used for the heavy trains. The typical train that goes through the tunnel is equivalent to a little short of 2000 tons, excluding the electric locomotives. On occasion three locomotives are set for the heaviest trains, while the passenger trains are ordinarily pulled by two, but one is sufficient in most instances.

The plant has now been in operation since July and there have been no delays in all this period due to failure in the electric locomotives. Two slight delays due to the transmission line are all that have been recorded against the plant, although for a short period trouble with the water-wheels led to complete suspension of the service. The east-bound service, which involves the grades, is now wholly handled by the electrics and the passenger trains west bound down-grade are so handled at the present time. There has been no trouble from the residual smoke in the tunnel due to the inactive locomotives hauled through it, although the trolley suspension is doubly insulated to give additional security against this element of mischief. The standard heavy-service locomotives used prior to the installation of the electric service require, according to Dr. Hutchinson's computations, nearly twice as much coal in proportion to the output as would be demanded in a steam station used on this plant in place of the hydroelectric station, and the locomotives here considered are compound locomotives of late type and admirable construction. In summing up the advantages of the system, Dr. Hutchinson lays great stress on the extreme electrical and mechanical simplicity and upon the enormous continuous output which can be obtained from the three-phase motors for a given space available in the locomotives. The electrical efficiency of the motors is high for a wide range of load. He also is of the opinion that the tendency to constant speed in the three-phase motor is a distinct advantage, especially in mountain service where the limitation of down-grade speed is sometimes of extreme importance. The matter of regeneration of power on down grades to which the three-phase system lends itself has not been gone into to any considerable extent in this plant. A 2500-ton train on the down grade would deliver about 1400 kw. Taken altogether, this initial three-phase plant for heavy traction seems to be doing sterling service and its future performance will be watched with great interest, particularly as it is expected that the electric service will be extended to the entire mountain division.

Electricity on the Farm.

Heretofore the electric light and power plants installed on farms have been rather scattered and sporadic. But it seems to be evident that there is bound to be a great increase in the number of electrical installations on the premises of well-to-do farmers. In these days there is really no reason why the farmer in comfortable circumstances, no matter where he may be located, should not have all the conveniences of a city residence in his home, with the added advantages of electric power to drive many kinds of farm machinery. The rapid advance of the gas engine with gas producers, or the gasoline engine, the possibilities of damming some creek or stream on the farm to produce sufficient power to run an electric generator, with the added consideration that the advent of the tungsten lamp has made it possible to secure electric lighting with a greatly decreased consumption of electrical energy, make it feasible for the farmer who is alive to modern opportunities to secure the advantages of electricity for light, power and heat at a not prohibitive cost. This tendency is greatly enhanced by the efforts of the great manufacturing combination which supplies the bulk of the agricultural machinery used in this country, as well as much that is exported. This great house, with its thousands of salesmen, catalogs gasoline engines and also supplies its men with price-sheets of gas engines, electric generators and motors and storage batteries. It will furnish the farmer anything he may need in this line. As the salesmen for this large organization penetrate to nearly every hamlet in the United States, they can and do exert an enormous influence for the introduction of electrical apparatus among the farmers. These salesmen are not electrical men, of course, but they carry with them a price-sheet so skilfully arranged that they can give an estimate of cost for a rural electrical equipment of almost any size, from 10 lamps up. Gas engines are used for power as a rule, and a special type of generator with flywheel is connected to them. Storage batteries are often included in the equipment, so that light may be had when the engine is not running.

Electricity is applied to feed-cutters, corn-shellers, pumps, grinders and other small machines in the farm power house, while it is more rarely used to operate field agricultural machinery, as plows, harrows, rakes, cultivators, binders, mowers, and the like. The threshing machine can be operated with advantage by electric energy when available. In the dairy, churns and cream separators are frequently electrically driven, and electricity is also used to milk the cows by the intervention of an air pump. From the little power plant electricity is supplied for lighting the house and premises, and the farmer's wife may have her electric flatirons as well as her sister in the city.

The number of electrical plants installed for farms is increasing with marked rapidity, and it seems probable that the time is coming when well-to-do farmers everywhere, no matter how remote from a city or village containing a central station, will consider electricity as a necessity. At first the current for these country equipments will be generated by plants on the premises; but as the movement becomes more general, central-station companies favorably situated will no doubt find it to their interest to extend their lines along the rural highways to a far greater degree than is done at present. In this a lesson might be taken from Northern Italy, some sections of which are networked with distribution lines for village and rural supply. The extension of the rural telephone has shown what can be done in this direction, and there is no reason to doubt that a similar extension of electric light and power circuits will gradually be made. The up-to-date farmers who are now putting in their own plants in increasing numbers are simply the pioneers who are demonstrating to the small central-station companies

scattered through the country that the farmers in the areas tributary to their plants want electricity and are willing to pay for it.

Electric Power Transmission in Southern France.

During the last 10 years there has gradually developed an extensive system of hydroelectric power transmission in the departments Bouches du Rhône, Basses Alpes, Var, and Alpes Maritimes, of Southern France, as detailed in a recent number of the *Elektrotechnische Zeitschrift* and abstracted in the Digest. The total amount of water-power available at the generators of the system is stated to be about 90,000 kw, with 21,000 kw of auxiliary reserve steam-power. The high-tension network extends from Arles nearly as far as the border of Italy on the Mediterranean Sea, including 600 km of high-tension lines. As at present projected, the network is expected ultimately to extend practically from the Italian to the Spanish border. The system is interesting not merely on account of its industrial importance to Southern France, but also on account of its electrical type. Hitherto the field of long-distance power transmission in France has been hotly contested by the high-tension direct-current system, and there are several examples of that system which have been in industrial service for some years. In fact, the advocates of the high-tension direct-current system have tried to exploit it in other parts of the world, basing their contentions upon its success in France and Switzerland. It cannot be denied that direct-current power can be carried at, say, a constant current strength of 100 amp, and a variable voltage up to, say, 100 kv, the power being generated in a single station and delivered to another single station. But the tendency of all modern hydroelectric systems is away from the single transmission line, and toward the multiple transmission network of lines, connecting a plurality of generating stations and delivery stations. This ramification network is quite unadapted to direct-current high-tension systems, whereas it is well adapted to the polyphase alternating-current system. It seems as though the triumph of the polyphase transmission system in the high-tension network of Southern France, with its eight generating stations and numerous consumption points, heralds the destiny of the direct-current system to disappear. The highest voltage in the Southern France system is stated to be 50 kv, which is coming to be regarded as a moderate voltage in this country. Shorter lines are operated at 30 kv, 13.5 kv and 10 kv. Secondary distribution circuits operate at 2200 volts, and tertiary distribution circuits at 230 volts and 115 volts. The frequencies employed are mainly 25 cycles per second for the long-distance transmission lines, and 50 cycles per second for the shorter transmissions. There is abundant evidence that no country remote from coal mines need despair of industrial development if it possesses high mountains and waterfalls.

Graphical Methods for Determining Flux Paths.

It fortunately happens that the formula for computing the electric resistance of a uniform straight wire of given length, cross-section and resistivity, is very easy, because the electric stream lines are all parallel to one another and to the axis of the wire, while the equipotential surfaces are consequently all equidistant planes perpendicular to the axis. The moment the conductor leaves the straight prismatic form, and disports itself in two dimensions, as, for example, where a straight wire terminates in a plate, we get into trouble in computing the resistance of the system, owing to the curvilinear form of the flux lines and equipotential lines; while if the conductor stretches itself into three dimensions, the computer generally shuts his book in despair. Nevertheless, there are certain cases of complicated flux distribution in which it is important to obtain a reasonably correct notion of the distribution. For example, in the case of water flowing over a dam, it is desirable for the engineer to know the contour of the stream lines of the water on the dam, in order that the surface of the dam may be made to correspond to a flow line, in which case there will be minimum friction, disturbance and tendency to erosion in the flow. Again, in the case of a dynamo machine, it is desirable that the designing engineer should know the distribution of the magnetic flux through the air, not merely in the air-gaps, but also in the stray paths surrounding the poles and teeth, in order to enable the amount of leakage flux to be computed, or the true reluctance in the magnetic circuit to be ascertained.

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Unhappily, the general problem is one of great mathematical difficulty. It might, at first thought, be supposed that given, say, a set of known geometrical surfaces, between which flux passes—as, for example, the magnetic frame of a dynamo-machine—that it would be fairly easy to compute the distribution of the flux-paths in the three-dimensional space between them. So difficult is the task, however, that there are only comparatively few cases in which it has yet been worked out, and some of these present formulas that deter the engineer, owing to their complexity. It is a remarkable fact that we are constantly beset by fluxes of gravitational force, heat, electricity, magnetism, water and air, yet we are powerless to cope mathematically with the distribution of these fluxes, except in certain elementary cases. However, ground is being broken for the road of the engineer over this vast untraversed territory, by empirical methods which promise useful results. These new methods depend upon graphical cut-and-try processes, in such a manner that after the attempt has been made, the outlines carry their own evidences as to precision. If they are found to be seriously inaccurate, they can be erased and redrawn more nearly correct, and then used as stepping-stones to the next set of contours. One such plan has recently been developed for deriving the proper contour of a dam, by commencing with a known stream-line of water on the upper and free surface of the overflow, and then working down graphically into the water, to derive successive lower stream-lines, correcting the outlines as they are produced, by geometrical theories connecting curvilinear and equivalent rectilinear flow. The bottom stream-line, finally worked out graphically, is the best contour for the head of the dam. Another such plan has recently been suggested by Dr. Th. Lehmann, in an article abstracted in the Digest from the *Elektrotechnische Zeitschrift*, with particular reference to magnetic flux distribution in dynamo machines. Here again two-dimensional flow is discussed, and the air-spaces are laid out into equivalent cells of unit reluctance. A unit reluctance block in two-dimensional flow would have a length of 1 cm and a width of 1 cm. In curvilinear quadrilaterals, the sides are chosen, by compasses, to conform approximately to the equivalent unit-reluctance block of simple outline. As the graphical work advances, it develops its own checks and evidences of accuracy. The method is well worth studying.

Bell Telephone and Western Union.

As we go to press, the newspapers print what purports to be an official statement from Mr. Theodore N. Vail, president of the American Telephone & Telegraph Company, to the effect that the latter has purchased a substantial minority of the stock of the Western Union Telegraph Company. This appears to confirm many recent rumors that the telephone company was planning to take over the telegraph service of the country, having already a strong hold on the Postal Telegraph Company through the Mackay interest in that company.

Brailey Independent Telephone Situation.

Suit was entered at Cleveland, Ohio, on Nov. 9, against both the Cuyahoga Telephone Company and the United States Telephone, their transfer agents and the American Telegraph & Telephone Company to prevent the acquisition of the independent companies by the Bell interests. The suit against the Cuyahoga company was filed in the name of Mr. J. W. Otto, and in that of Mr. Samuel J. Schweer, of St. Louis, against the United States company. These men are supposed to represent the minority stockholders in the two companies who are seeking protection from any step that might be against their interests. Mr. Schweer filed a similar suit in the United States Court at St. Louis against the United States Telephone Company.

The defendants are the Cleveland Trust Company and the Mississippi Valley Trust Company, of St. Louis, with which the stock of the companies was deposited in 1906 under a voting trust agreement; the American Telephone & Telegraph Company, the Central Union Telephone Company and the Bell long-distance lines; voting trustees of the Cuyahoga Telephone Company, consisting of Messrs. H. A. Everett, E. W. Moore, B. Mahler, James S. Brailey, Jr., H. C. Stifel, M. C. Harvey, C. W. Wason, J. B. Hanna and H. R. Newcomb; and voting trustees of the United States Telephone Company, consisting of Messrs. A. H. Bauer, James S. Brailey, Jr., Clarence Brown, Claude Ashbrook, M. C. Harvey, J. B. Hoge, F. R. Huntington, H. A Everett and E. W. Moore.

The petition explains the voting trust agreement entered into as a step to prevent the independent properties from falling into the hands of the Bell interests, 51 per cent of the stock being voted to that end. The services of the trust companies might be dispensed with at any time on vote of 90 per cent of the stock, and consolidation with other companies was prohibited by the agreement except on vote of all the voting trustees. The petition then states that Messrs. Everett, Moore and Brailey, and possibly others, sold the controlling interest to Brailey, who transferred it to the Bell people. When 90 per cent of the stock is thus acquired, it is stated, the voting trust will be abolished. While profits will go to the trustees who had part in the transaction, the minority stockholders will be ravaged and a monopoly will have been established.

An injunction against the Cleveland Trust Company and the Mississippi Valley Trust Company is asked to prevent them from delivering to any other parties the stock they hold, that the sale to Brailey be set aside, that the Bell people be restrained from receiving the stock, that the voting trustees be removed and that a receiver be appointed for the stock in question. Judge Vickery, of the Common Pleas Court, at Cleveland, issued a temporary restraining order to prevent the exchange of stock, and the same action was taken by Judge Williams in St. Louis.

In an interview following the filing of the suits Mr. James S. Brailey, Jr., stated that he welcomed a restraining order to prevent him from handing over the stock to the Bell interests, that they had not purchased a cent's worth of it and none would be delivered to them. He said that the identity of the interests associated with him were becoming known to the independent telephone men and that they are well satisfied. It is stated that the stock held by the Cleveland Trust Company has already been transferred. The only ground, it would seem, on which the sale of the stock could be set aside is that the voting trustees should know what was going to be done with it before they voted for the sale.

District meetings of the independent telephone men have been held in Cleveland, Toledo, Lima and other places within the past week or two, and at every one of them Brailey has reiterated the statement that no sale has been or will be made to the Bell people. A plan is on foot, however, to consolidate a number of the companies in Ohio in order to secure better control of the independent situation. There has always been a desire to keep them separate, but the conditions confronting them now is urging the matter of consolidation.

Some people believe that the Postal Telegraph Company is the actual purchaser of the stock of the two companies and the New Long-Distance Telephone Company, of Indiana, which Mr. Brailey has announced that he has lately acquired. This is merely a surmise, however, as no information can be secured by interested stockholders regarding the matter.

It is also rumored that a holding company will be organized to take over the companies of which Mr. Brailey has secured control and that it will hold the stock until such time as the actual purchasers desire to come to the front.

Central-Station and Power-House Insurance.

There has been considerable discussion of late over the question of insurance of electric traction and lighting properties. The original controversy arose over the question of commission for local agents. Risks written on properties in various places were frequently placed by owners in New York and other financial centers, and insurance brokers in these centers collected the commissions. This led to a protest from the local representatives of the companies in which the policies were written, who claimed that their territories were being invaded by outsiders. It has now practically been decided by all of the stock companies that hereafter, when risks are written outside of the location of the property, the outside broker shall divide his commission with the local agent.

This discussion has led to a plan on the part of Mr. H. N. Staats, who has been more or less identified with the insurance business, to organize two new companies, to be called the American Railway Insurance Company and the Electrical Insurance Company, the purpose of which will be the placing of all the risks on traction and lighting properties. According to Mr. Staats's plan, as it is understood, these two companies will take charge of the insurance of this class of property, and will place the majority of it with standard companies. The two new companies are expected to retain 25 per cent of all the risks. Mr. Staats claims that he has secured the consent of a number of the principal stock companies to this arrangement. Mr. E. H. A. Correa, vice-president of the Home Insurance Company, declares that his company will never have anything to do with this kind of an agreement, and that he does not believe many other standard companies will go into it. He says that the Staats companies, while organized with a capital stock, are in reality mutual, from the fact that it is expected that the stock shall be placed entirely with the owners of the traction and lighting properties that are to be insured. He also says that the old companies, which have large capital back of them, are ready to take the insurance on as reasonable terms as any new company can do, and he sees no reason why the brokerage should be divided.

Fire Insurance of Central-Station and Electric Railway Properties.

Representatives of a number of underwriters' associations of the country met in New York last week and organized the Central Traction & Lighting Bureau, which, it is planned, will handle all questions pertaining to insurance policies upon traction and central-station properties throughout the entire country. The meeting was held at the office of the National Board

of Fire Underwriters, and was the result of several months planning and negotiation. Among the associations represented were the Fire Underwriters' Union, the Western Union, Southeastern Underwriters' Association, Underwriters' Association of the Middle Department, Board of Fire Underwriters of the Pacific, Underwriters' Association of New York State, and the Board of Fire Underwriters of Allegheny County.

After having adopted a constitution and by-laws for the government of the new bureau, Mr. E. G. Richards, of the North British & Mercantile Insurance Company, was elected president, and General Agent Cofran, of the Hartford Fire Insurance Company at Chicago was elected vice-president. An executive committee was selected as follows: Messrs. R. M. Bissell, vice-president of the Hartford Fire Insurance Company; A. B. Andrews, manager of the Southeastern Underwriters' Association; Secretary Weiderhold, of the Underwriters' Association of the Middle Department; F. W. Jenness, secretary of the Underwriters' Association of New York State; George W. Law, of Law Bros., of Chicago, managers of the Western Department of the Royal Insurance Company of Liverpool; J. H. Lenehan, of Chicago, general agent of the Western & Southern Department of the Phenix Insurance Company of Brooklyn, and Charles G. Smith, secretary of the German-American and German Alliance Insurance companies of New York. At a subsequent meeting subcommittees were named and Mr. Bissell was chosen chairman of the executive committee and Mr. Smith vice-chairman. The secretary, who will be in active charge of the headquarters, has not as yet been chosen. The headquarters of the Bureau will be in New York City, but offices have not as yet been selected.

In speaking of the purpose of the Bureau, Mr. Charles G. Smith, one of the most prominent promoters, said that it was intended to govern and simplify the writing of risks upon traction and electric light and power properties. Heretofore, he said, these policies had always been subject to the various local boards throughout the country, involving varying conditions and lack of uniformity. In many instances properties scattered all over the country belong to the same owners, and it was confusing to have these varying conditions applied. Under the control of the Bureau, he said, the inspection of electric properties and the terms of policies would be made uniform. Official blanks would be furnished inspectors which would apply for all parts of the country alike, regardless of regulations of local organizations. He said that practically all of the insurance companies in this country were represented in the present movement, and that hereafter all risks taken on electric properties would be subject to the same conditions.

Bronx Electrical Inspection Bureau.

Commissioner O'Brien, of the Department of Water Supply, Gas and Electricity, New York City, announces the establishment on Dec. 1, 1909, of an independent office for the Bronx, to be located at the Municipal Building, 177th Street and Third Avenue.

The chief engineer of light and power has ordered Inspector Francis J. Fitzpatrick, with 21 years' experience in the department, to take charge.

On and after that date all applications for permits and certificates relating to work in the Bronx will be filed at the new office, instead of at the Park Row Building, Manhattan, as formerly, and all permits and certificates for the Bronx will be issued directly from the Municipal Building in the Bronx.

Inasmuch as heretofore it has been necessary for persons located in the upper part of the Bronx to journey clear across two boroughs to transact business with the Bureau of Electrical Inspection, it is hoped that this change will operate to the convenience of the public.

For many years the Bronx office has been a suboffice merely, and much interchange of papers between the Municipal Building and the Park Row Building has been necessary. Delays attributable to this cause will be eliminated after Dec. 1.

Quebec Electrical Companies Consolidate.

A merger of power and lighting and street railway companies operating in Quebec and adjoining territory has been effected at Montreal, the negotiations having been completed on Nov. 10. Application has been made to the Dominion Government for incorporation of the Quebec Railway, Light, Heat & Power Company, with a capital of $10,000,000.

The companies which will be taken into the combination of interests are the Quebec Railway & Power Company, whose directors have been the moving spirits in the consolidation; the Jacques Cartier Power Company; Quebec Gas Company; Frontenac Gas Company; Canadian Electric Light & Power Company, operating in Levis on the south shore opposite Quebec; the Seven Falls Company, owned by the Quebec Power Company, and a number of lesser concerns.

The controlling interests in the new organization are Senator Robert MacKay, Messrs. Rodolphe Forget, J. N. Greenshield, K. C., and W. G. Ross, managing director of the Montreal Street Railway Company, these gentlemen having a short time ago gained control of the Quebec Railway & Power Company. The principal executive head will be Mr. C. E. A. Carr, formerly manager of the Quebec Gas Company. Mr. Carr was for some years manager of the London Street Railway Company and later manager of the Helena (Mont.) Light & Traction Company. It is expected that the consolidation will be completed in time to enable the new company to commence business in January.

Chicago Traction Situation Discussed.

Mr. M. B. Hereley, traction expert for the city of Chicago, addressed the Electric Club of that city at the weekly luncheon Nov. 10. He gave a history of the local traction situation, mentioning that there were 140 miles of elevated railways and 800 miles of surface street railways in the city. He thinks that Chicago needs a unified system of street railway operation. There are now five elevated railways, two surface street-railway systems, besides several minor roads within the bounds of the municipality. The joint ownership and operation of these roads was advocated by Mr. Hereley. The proposed subway should not be definitely planned until the capacity of existing elevated and surface roads is ascertained with joint operation and through routing. To ascertain that capacity would not appreciably delay the beginning of work on the subways, for it could be determined in 90 days. When built, the subway, elevated and surface lines should be operated in conjunction. The surface roads should have the short-haul business preferably, the elevated roads the long-haul, while the subway should supplement both when their capacity is exhausted. The Union Loop should be abolished, for it is an anomaly to have a railway terminal or switchyard in the heart of the city. It will be but a few days now before the plans being prepared for the subway will be announced by the local transportation committee of the City Council. Mr. Hereley closed by speaking of the progress of the extensive work of rehabilitating the street railways of Chicago under the direction of the Board of Supervising Engineers.

In the discussion the point was brought up that surface cars, at any rate within the "loop" district, will stop at "near" crossings on and after April 1, 1910. To one question Mr. Hereley said that he thought the proposed subways would extend south to Twenty-second Street and north to Chicago Avenue. The question of the speed of automobiles was brought up. One member of the club said that as street cars are regulated as to speed, why not put a similar and effective regulation on automobiles, which are causing an alarming number of accidents? Mr. Hereley said that it would come with good grace from the Automobile Club to suggest some effective method of regulating automobile speed that would actually work out in practice. He pointed out, however, that the speed of automobiles is regulated by State law, while that of street cars is prescribed by municipal ordinance.

Proposed Electrification of Railroad Terminals in Chicago.

The local transportation committee of the Chicago City Council has the subject of the electrification of Chicago railroad terminals still under consideration, but at a recent meeting action was deferred in order to give the railroads opportunity to state in writing their position on the subject and send delegations to address the committee if they desire to do so.

Delegations of railroad trainmen—conductors, brakemen, engineers, firemen and switchmen—are making known their opposition to electrification. They deny that their action is inspired by their employers, but assert that electrification would increase the danger of railroad operation to employees and also that many of them would lose their positions. This possible loss of employment seems to be the principal apprehension; but it is also contended that the third-rail, even if protected, is a source of danger, while, if the overhead trolley wire is used, men standing on cars are apt to be struck by the sagging wire. The men seem to think that it is impracticable to switch cars without men standing on the car roofs.

Railroad electrification has been brought up in the executive committee of the influential Chicago Association of Commerce, which is formed of the leading business men of the city, and has about 3000 members. The committee referred the subject to a special committee to report upon the general problem of railroad terminal electrification. This committee consists of Mr. A. Bement, consulting engineer; Mr. W. L. Abbott, chief operating engineer, Commonwealth Edison Company; Mr. Bion J. Arnold, chairman of Board of Supervising Engineers, Chicago Traction; Mr. Paul P. Bird, smoke inspector; Dr. W. F. M. Goss, dean of College of Engineering, University of Illinois; Prof. Charles E. Merriam, Chicago University, and alderman from Seventh Ward, and Mr. John M. Ewen, consulting engineer and building contractor. Mr. Ewen is the chairman of this strong committee, whose report will be awaited with interest.

Central-Station Power for Railroad Traction.

Contracts have been closed with the Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., by the Baltimore & Ohio Railroad Company for electric power to operate its trains through the Belt Line tunnel, and by the Maryland Electric Railways Company to operate all of its trains running between Baltimore and Annapolis. The Belt Line's power house at Camden station will be maintained to light the Camden roads, the station and various other buildings, and to supply power to stationary motors.

With the exception of the United Railways of Baltimore, these companies are the largest users of power in that city, and the signing of these contracts is a recognition of the fact that it is more economical to purchase energy from a modern central power station than to generate it in individual plants.

More power was required by the Baltimore & Ohio to provide for the rapidly increasing traffic and new electric locomotives which have been ordered by the railroad. The contract with the Maryland Electric Railways Company is an extension of a former contract. This company has, from the beginning of its electric service on the Annapolis Short Line, secured all of its power from the Consolidated Company. The Baltimore & Ohio office building has continuously used the service of the Consolidated Company for several thousand lamps and a number of electric motors of 100 hp and under.

Guessing Contest on Chicago Maximum Load.

For a number of years the employees of the Commonwealth Edison Company have been much interested in a guessing contest during the closing months of the year to see who would come nearest to the maximum load. This maximum is expected to occur between this time of the year and Christmas, and the 1909 contest is now on. Contestants, who must be connected with the company, contribute 50 cents to a pool on making their guesses, and not more than five guesses are accepted from any one person. When the exact maximum is determined by the statistical department the person who makes the most nearly correct guess will receive 50 per cent of the pool; the next nearest, 30 per cent, and the third 20 per cent. The load to be considered will be the maximum kilowatts generated by the company's stations plus the storage-battery discharge.

Some information given for the benefit of those wishing to enter the contest is, perhaps, of more general interest to outsiders than the contest itself. Thus, it is noted that the highest total output maximum up to Nov. 1, 1909, was on Oc. 28, 1909, nearly 131,090 kw. With this as a guide, and assuming the same rate of increase as last winter, the maximum for this winter would be 161,990 kw. If the rate of increase is the same as that of two years ago, the 1909 maximum will be 151,780 kw. The maximum as calculated in a careful estimate made by the statistical department of the company on May 7, 1909, was 147,150 kw. Estimates based on the increase in connected load for the year ended Oct. 2, 1909, would indicate a maximum of 148,150 kw.

These figures are not only interesting themselves, but the study given to them in connection with this contest indicates a keen interest in the growth of the company's output of electrical energy on the part of its employees.

Electric Railway Electrolysis.

The United States Bureau of Manufactures recently submitted for investigation by American consular officers in 10 of the largest European cities several questions on the subject of electric railway electrolysis submitted by Mr. E. N. Lake, chairman of the electrolysis committee in Chicago. A summary of the replies received is given in the following table:

City.	Permissible drop in potential over street railway return circuits.	Potential difference between track rails and contiguous pipes.	Electrical connections between negative return and contiguous pipes.
London	7 volts, maximum drop.	Pipes, + 1.4 volts; pipes,—4.2 volts.	Permitted under special regulation.
Paris	1 volt per kilometer; 5 volts maximum.	Average of 1 volt normal operation.	No information.
Berlin	No specific regulation.	No specific regulation.	Not permitted.
Vienna	5 to 7 volts at maximum traffic.	Maximum observed, 1 volt.	None used.
St. Petersburg	1.5 volts maximum in city; 3 volts maximum in suburbs.	No regulation	Not permitted.
Moscow	Maximum 1.5 volts in city; 3 volts in country.	Ditto.	Not used.
Glasgow	volts, maximum	Maximum observed, less than 1 volt.	Permitted, but not practised.
Liverpool	Ditto.	Maximum, volts. 4.5	None used.
Brussels	No specific regulation.	No specific regulation.	Ditto.
Budapest	Maximum drop about 1.5 volts.	Maximum about 5 volts.	No information

The following notes taken from the information received from abroad are given in addition to the table:

Paris.—When electrical installations are in public highways or are for electric railways, applications for permits must contain complete information and specifications as to the proposed installation. These are passed upon by the several departments, and when permits are issued provision is made for close supervision by the Governmental department interested. A three-wire system at 1200 volts between trolley wires is permitted, provided the track rails are used as the neutral conductor. The resistance of a rail joint, where the track is used for return circuit, must not be greater than that of 10 m (32.8 ft.) of unjointed rail.

Berlin.—Grounding of rails to earth or to pipes is not permitted, and artificial earth plates are prohibited. The city

exercises a supervision over the matter of potential differences in the earth through the official engineers. No specific potential differences or potential drops are mentioned in the requirequirements, but power is reserved by the city to investigate and prescribe in accordance with the conditions applying to each individual case.

Vienna.—The license regulations of the Austrian railway ministry provide for supervision of the return circuit conditions in a manner similar to that noted with reference to Berlin except that in Vienna there is a municipal street-railway system. A periodical examination is made by means of a test car of the electrical condition of track joints and return circuits.

St. Petersburg.—The maximum potential drop in return circuits was originally specified as 5 volts per verst in suburbs and 2½ volts in city. This is equal to about 7.5 volts and 3¾ volts per mile, respectively. This is now 3 volts and 1½ volts maximum between any two points on the system.

Moscow.—Equalizing rheostats are used in the negative return cables. Underground pipe systems are divided into sections by insulating joints.

Glasgow.—The Glasgow authorities consider the Board of Trade regulation of 7 volts maximum drop between any two points of the return circuit as far too high, and have limited their drop to 2 volts and 3 volts. The lead sheaths of their own cables are connected by the tramway department to the track rails at every manhole, or at an average interval of about 350 ft.

Liverpool.—Board of Trade regulations apply and are the same as in London.

Brussels.—There is only a general regulation without specific requirements as to potential differences or drops, which provide that the electrical conductivity of the return shall be such as to avoid all harmful "electrolytic actions."

Christiania.—In addition to the bonded rails for the return circuit an auxiliary copper conductor, about No. 8 B. & S. gage, is soldered to the bonds at each rail joint.

London.—Return feeders may be uninsulated if laid within 3 ft. of the track rails and electrically connected thereto at intervals of not more than 100 ft.; otherwise they must be insulated unless they are of such sectional area that they will reduce the difference of potential between the ends of the uninsulated parts of the return below the maximum limit of 7 volts. If any part of the return circuit is uninsulated it must be connected with the negative terminal of the generator, and the negative of the generator must also be grounded through an ammeter to two separate earth connections, one of which may be a water main.

Boston Electrical Show.

The Boston Electrical Show was opened with great enthusiasm on the evening of Nov. 15, in the presence of thousands of visitors from all parts of eastern New England. Special electric cars were run to the Mechanics' Building from the city and suburban points reached by the Boston Elevated Railway Company, and hundreds of interested persons lined Huntington Avenue as the doors were opened to the public. A special installation of flaming arc lamps was thrown into service in the early evening on the trolley poles in the center of Huntington Avenue, creating a thoroughfare of light for a distance of half a mile on each side of the Exhibition Hall. Flaming arcs on the roof also drew attention to the exhibition.

At 5 p. m. a meeting of the Massachusetts Press Association was held at Talbot Hall, adjoining the exhibition space, and at 6 o'clock 250 newspaper men and their wives, with employees of the Edison Electric Illuminating Company of Boston, proceeded into the banquet hall as the guests of the company at dinner. At the conclusion of the banquet an address of welcome was given by General Superintendent W. H. Atkins, of the Edison Company. President George C. Fairbanks, of the Massachusetts Press Association, made a felicitous reply. The entire company then adjourned to the Exhibition Hall and witnessed the opening of the show to the public.

The decorations and lighting of the hall combine artistic and utilitarian effects. The center of interest was a superb Italian garden erected and maintained by the Boston Edison Company. Here young ladies in Italian costume, representing the 33 municipalities of the company's territory, received guests. Each visitor on registering was presented with a handsome booklet describing his home city. A troupe of seven Italian musicians furnished entertainment during the evening, and by the use of dimmers and switches a moonlight effect of unusual beauty was produced. Many of the higher officers of the company were present as hosts to the throng which visited the show on its opening night. The exhibits, floors and galleries were filled with an interested crowd throughout the entire evening.

Lightning Arrester Experience at Colorado Convention.

As is usual, the Colorado Electric Light, Power and Railway Association held an experience meeting on lightning arresters at its recent annual convention in Denver. Mr. John A. Clay, manager of the Animas Power & Water Company, operating in the Silverton district, at very high altitudes, where lightning troubles are the most severe in the State, last year gave the results of his first experience with aluminum-cell arresters, which was very satisfactory. This year he was called upon to tell the convention his experience down to date with the aluminum arrester and other lightning troubles. An account of discharges has been kept at one of the substations by recording the discharges on the arrester on the telephone line on the same transmission poles. It has been found that discharges on the transmission line arresters occur at the same time as on the telephone arresters. At the Silverton substation previous to installing the aluminum-cell arresters there were a number of lightning discharges on the high-tension busbars. The past season there had been none. This season on one line there had been one shut down due to lightning where the aluminum arresters were installed. This was probably a direct stroke.

Mr. W. T. Wallace, of the Colorado Light & Power Company, transmitting from Canon City to Cripple Creek, reported not as much trouble as usual this season. Aluminum arresters had been used this year. He thinks that the ends of the lines and the low points must have arresters if there is to be protection. His lines are sometimes run past a substation several poles and arresters placed at the end.

Mr. W. N. Clark, of Victor, reported that the Pueblo & Suburban Traction & Lighting Company on its high tension lines over the mountains has had the aluminum-cell arresters installed on a 24,000-volt line into Cripple Creek. These arresters have improved conditions, but they cannot be depended upon to protect the line from breaking of insulators by lightning for more than a few miles each side of the arresters. Most trouble has been experienced with a 6600-volt distribution system in the Cripple Creek district. The aluminum arresters have helped, however.

The Engineer and the Community.

At the annual commencement of the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y., Dr. William McClellan, vice-president of the Campion-McClellan Company, New York City, in an address entitled "The Engineer and the Community," examined into the cause of the relatively minor professional status of the engineer in the eyes of the public, which he considered resulted to some extent from the present system of engineering education.

Addressing the graduates, he said that they will find that the world does not look on their profession the same as on that of the law, the ministry, or medicine. "You will find that the engineer seldom takes part in public affairs. You will find that in the great majority of cases the engineer is in the position of a trusted employee or adviser, but seldom has complete control of affairs with which he is connected. You will hear him

called narrow in his ideas, lacking in comprehensiveness, and not to be trusted with administration. In this or that situation, a 'man of affairs' is needed, which an engineer is not. Finally, you will note a great agitation among engineers in general that they are not receiving proper recognition from the community in view of their knowledge and experience. Why should such a condition of things be? Why should engineers be complaining, and the community apparently unresponsive?"

After reviewing the many reasons which have been offered to account for the public view of the engineer, he says that this view is confirmed by the action of many engineers in keeping hard after the material things, and that there is no question that the engineer has a tendency to become absorbed in his work and forgetful of other relations.

"Compelled as he is to pay great attention to details, he is prone to get his eyes too close and lose all perspective and comprehensiveness. His relations to large undertakings which he is discussing with financiers, owners, lawyers, promoters, and the like, are often to make sure that every link is sufficiently strong and in thus necessarily delving into detail he is likely to give false impressions as to his whole faculties. The lawyer, minister, and doctor, all must attend to details no less than the engineer, but they all deal with men, their opinions and actions primarily, whereas the engineer deals with things, and herein lies the great difference.

"And then there are so many kinds of engineers, mechanical, electrical, civil, hydraulic, mining, military, marine, illuminating, heating and ventilating, and so on, ad nauseam, like so many trades. How many times have I seen bright, educated, young electrical engineers who could not calculate whether certain floor beams could carry the generator they wish to erect on them. I have seen young civil engineers who did not know an ampere from a horse-power, and wondered how heavy a kilowatt was. There are various divisions in the medical profession, but all study medicine and specialize afterward. The law has many departments, but all study practically the same fundamentals at school and specialize in practice. Engineering has been different because of its origin from the mechanic, and our methods have unconsciously fostered this condition. The profession of engineering stands as it does, because in reality it has not unity as a profession. We have still to develop it—not mechanical, electrical, etc., mind you, but *engineering,* using this term in its widest sense."

Taking up the subject of improving the status of the engineer, Dr. McClellan says it is, of course, assumed that he needs a general education in the humanities just as much as any man. These, however, have more to do with making him a man than with making him an engineer, but a certain minimum amount of this work in general culture must be a part of every engineer's training. The real solution, however, appears to lie, first, in training men to become *engineers*—not mechanical, civil, electrical, etc., but *engineers;* and second, in teaching them at school what they cannot acquire after graduation without great difficulty—namely, fundamental principles.

"I say, train men to become *engineers,* and it cannot be said too emphatically. Let us not have a misunderstanding. Men will always specialize, and will always know considerably more of one subject than another. But the specializing in education should begin late. Every student should come out thoroughly drilled in the fundamental laws and principles of mechanics, mechanics of materials, hydromechanics, heat and thermodynamics, light, and electricity. These should be taught and retaught with example and experiment intensively, not extensively. It matters little whether a man has spent much time in school on the transformer if he has been drilled and drilled in the principles of alternating current and electromagnetic induction. The transformer, induction motor, etc., are easy after that. If a man has been well grounded in mechanics, stress, strain, and elasticity, instead of designing imaginary suspension bridges with a Carnegie Handbook, he will understand what we mean when we tell him in the office that reinforced concrete design is the same as plate girder design. Let us not try to turn out classroom engineers, for the offices do not want them, and no sane chief would trust fledglings. What we want are men who know fundamental principles of all engineering and are not half-educated, lop-sided mechanical, civil, and electrical mechanics. A man will find it hard to get these principles after he leaves school, but if he has them practice will get him everything else he needs and make him an engineer.

"I believe in this feature so thoroughly that I would abolish all departmental degrees, and give all graduates the one degree of 'Bachelor of Science in Engineering,' and I would see to it that he had a right to this title in its broad sense. Beyond this, I would not have the school go, but would leave the higher degree of 'Engineer' to his fellows who could properly estimate his practice. I think to-day that full membership in the American Society of Civil Engineers is considered more valuable than any college degree of C. E."

Referring to the present methods of engineering education, he says that in all engineering courses many subjects aside from those specifically attaching to the practice of a given profession are studied by means of lectures, recitations, and experiments in the departments of physics and chemistry. "Somehow the student gets the idea that in these departments the subjects suddenly become theoretical or abstruse, and will have little value for him in his practical engineering work. He does the work in the physical laboratory and in the chemical laboratory in a rather perfunctory way. He even hears men in the engineering department say that 'over there' it is not taught right for engineers, and that it is more or less useless. Then when he comes out and strikes the real problems, he finds in 9 cases out of 10 that those are the very things that he needs, and that the hours and hours he spent on so-called practical things are of no use to him in the commercial world. It is very likely to have quite different methods which he must learn anyway. In the meantime he has lost his only opportunity to get laws, and fundamental relations, not handbook formulas, well arranged in his mind."

Concerning the claim sometimes made that all teaching of subjects to engineers should be done by engineers or from the standpoint of engineers, Dr. McClellan says there could be no greater fallacy. "A man develops largely by the absorption of ideas from others, and by the study of their ideals. If he is trained wholly by engineers and from their standpoint, he is very likely to be one-sided, strongly developed along certain lines, and very deficiently along others. Perhaps English, for example, can be taught, as has been suggested, by the engineering instructors in connection with reports on experiments, but we shall be more hopeful if the teaching is placed in the hands of men who are primarily interested in good literature."

In conclusion Dr. McClellan says: "To sum it up, the schools, and we ourselves after we leave school, must distinguish between *engineers* and high-class mechanics, and must train *engineers.*"

Annual Dinner of the Electrical Trades Association of Chicago.

Held in the beautiful new University Club, with several speakers of distinction and with songs and good fellowship, the fourteenth annual meeting and dinner of the Electrical Trades Association of Chicago on Nov. 12 was successful in a business sense, as well as a pleasing social affair. After an excellent dinner had been served the president of the association, Mr. William A. Browne, presided at the brief annual meeting. The first order of business was the report of Mr. Frederic P. Vose, secretary and treasurer, who gave some interesting, and, indeed, rather surprising, figures showing the extent of the association's activities. From this report the following facts are taken:

The Chicago association was established in 1896, in which year it had 18 members. The growth has been steady, until the membership for 1909 has reached 205. In 1896 21 claims were reported to the association on what is known as No. 2 form, amounting to $714.33. In 1909 the number of such claims was

3857, aggregating $338,423.68. During the 13 years of the association's existence the total number of claims reported on No. 2 forms was 23,537 and the amount involved was $1,741,661.30. The total claims reported confidentially to members for their mutual protection and to safeguard them against making unsatisfactory credits amounted in number to 2270 in 1909 and to 14,033 for the whole 13 years. The total claims adjusted and settled by the use of the association forms No. 3 and No. 6 were 2247 in 1909, the amount being $189,862.79. For the 13 years the total number of such claims was 14,640, and the total amount $1,184,979.29. The estimated amount of claims settled by the use of all the forms of the association since its organization amounts to the large total of $4,520,700.

The election of officers for the year 1909-1910 resulted as follows: President, Mr. Frank M. Pierce, Manhattan Electrical Supply Company; vice-president, Mr. Frank Horton, Moran & Hastings Manufacturing Company; national representative, Mr. James Wolff (re-elected), New York Insulated Wire Company. Mr. Vose, the secretary-treasurer, who conducts the affairs of the association so efficiently, is appointed by the executive committee. The two new members of the executive committee are: Mr. Thomas I. Stacey, Electric Appliance Company, and Mr. A. O. Kuehmsted, Gregory Electric Company. Mr. William A. Browne, M. B. Austin & Co., retiring president, was elected a member of the executive committee in place of Mr. Harry R. Parsons, resigned owing to removal from the city.

Mr. Pierce offered a resolution, which was adopted, raising the annual dues from $30 to $40 a year. The business of the association has become so extensive that the larger sum is considered necessary.

Mr. W. W. Low, of the Electric Appliance Company, urged a closer co-operation between the sales and credit departments of member companies. He brought up the question of uniform practice in the matter of cash discounts, and also of charging interest on overdue accounts, both of which he favored. After some discussion these subjects were referred to the executive committee.

There is a possibility that the name of the association may be changed to "Electrical Credit Association of Chicago," and, on motion of Mr. Wolff, the executive committee was authorized to make this change whenever the national association shall deem such a course advisable.

Mr. Kuehmsted urged that a concerted effort be made to increase the membership of the association, and he also moved a vote of thanks to the retiring officers, which was carried unanimously.

After the adjournment of the business session, Mr. Charles E. Brown, of the Central Electric Company, took charge of the dinner as toastmaster, and a number of excellent speeches were made. The first speaker was Mr. Samuel Insull, president of the Commonwealth Edison Company, whose subject was "Thirty Years of Electrical Development—1879-1909." Mr. Insull, who received a great ovation, gave in most interesting manner an account of the rise of the great electrical industry, with which his own experience has been coincident and with which he has been so conspicuously associated. He reviewed the progress of the art and paid a glowing tribute to Edison. A report of Mr. Insull's address will be printed in another issue.

The next speaker was Mr. James Wolff, national representative of the local association, who told of the organization and work accomplished by the national body. Mr. Wolff also gave a report of the action of the national association at the recent Boston convention, and he told of its bearing on the local bodies and its effect on individual members.

Judge Frederick L. Fake, Jr., of the Municipal Court, Chicago, with the subject "Observed from the Bench," was the next speaker introduced by Toastmaster Brown. The judge said that he had been very much impressed by Mr. Insull's address, and in a happy vein he reviewed some great historical events which might have been modified if the electrical inventions of to-day had been available in the past. For instance, the mind of Columbus, he thought, might have been greatly relieved in his first voyage of discovery across the Atlantic if he could have sent a "C. Q. D." message by wireless. The remainder of the judge's speech was principally devoted to an account of his interesting and varied experiences with humanity at the Harrison Street Police Court. He contrasted the United States Supreme Court, with its 300 or 400 cases a year, with the Harrison Street Court, where the speaker holds forth, and which passes often on 150 to 200 cases a day.

Mr. H. E. Hackenburg, treasurer of the National Carbon Company, Cleveland, took for his subject "Our Association." Referring to Mr. Insull's historical review, Mr. Hackenburg made the interesting statement that in 1882 copper-coated carbons made from coke for arc lamps, 7/16 in. in diameter and 12 in. long, sold for 10 cents apiece in lots of 1000. Carbons of the same type, but ½ in. in diameter, sold for 12 cents apiece. The speaker referred to the great value of the interchange of credit information, and praised the usefulness and efficiency of the association. He also told how sales orders were handled by his own organization.

Mr. C. E. Kremer, of the Chicago bar, was down for "The Humor of It," and he made a clever speech, interspersed with several good stories.

Mr. W. W. Low concluded the program with a bright speech in his characteristic vein, in which he said that the organization was doing a great work, of which he gave some instances. He had never attended a dinner, he said, which he enjoyed more, and, on his motion, thanks were extended to the committee in charge and to the toastmaster. After singing "Illinois," without which no banquet in that State is complete, the gathering dispersed. The entertainment committee in charge consisted of Messrs. W. P. Crockett, A. O. Kuehmsted, J. M. Gilchrist, W. P. Johnson and H. F. Holland.

Amortization Rule of New York Public Service Commission, Second District.

The following rule of the Jamestown (N. Y.) Light & Power Company for the treatment of the account "General Amortization—Electric" has been filed by Mr. Albert S. Price, secretary and treasurer, with the New York Public Service Commission, Second District:

"The Jamestown Lighting & Power Company, excluding the assessed value of the franchises and the estimated value of the real estate, estimates the replacement value of its remaining property conservatively at $80,000. We charge as amortization 3 per cent of this amount, or $2,400 annually. The operation is performed monthly by charging one-twelfth of the whole amount, or $200."

November Meeting of the New York Section of the I. E. S.

At the meeting of the New York Section of the Illuminating Engineering Society, held on Nov. 11, considerable discussion was given to the topic, "What Is an Illuminating Engineer?" The aesthetic and engineering features of the work were contrasted by Mr. Bassett Jones. Mr. W. H. Gardiner discussed the practical and theoretical features of the work, while Dr. A. H. Elliott called attention to the fact that engineering is concerned largely with the economies of the problem. None of the speakers offered a specific outline of the qualifications to be possessed by a person before he is entitled to assume the title of illuminating engineer.

A second question relating to the division of membership of the society brought forth marked differences of opinion as to the advisability of making a distinction between the members at the present time. Mr. E. L. Elliott, as chairman of the committee appointed to investigate the subject, stated that the committee's report at the next annual meeting will suggest changing the constitution so as to provide for a grade of membership to be known as fellows. A motion of Mr. A. J. Marshall, seconded by Mr. T. I. Jones, expressing the sentiment of

the New York Section in opposition to the division of membership as being premature, was carried with apparently no dissenting vote.

The secretary announced that the next meeting of the section will be held on Dec. 17 in Madison Square Garden in connection with the meeting of the National Commercial Gas Association. Papers will be read relating to gas lighting in Europe and to the illumination of the building of the Consolidated Gas Company, of New York.

Great Northern Railway Electric Equipment.

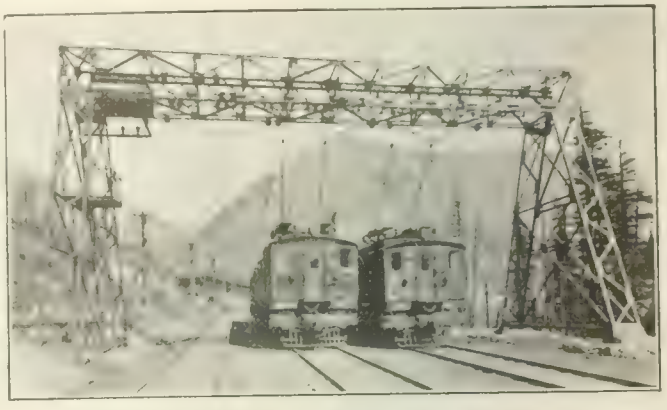
At a meeting of the American Institute of Electrical Engineers, held on Nov. 12, 1909, Dr. Cary T. Hutchinson presented a paper descriptive of the electric system of the Great Northern Railway Company at Cascade Tunnel. The section equipped for electric haulage is about six miles, 13,870 ft. of which is within the tunnel, where the track grade is 1.7 per cent. Use is made of three-phase locomotives designed for a speed of 15 miles per hour, which haul the trains through with their steam locomotives as dead loads. On account of the smoke and heat within the tunnel—the temperature at times reaching 200 deg. Fahr.—the traffic over the whole road was limited by the haulage through the tunnel. The electrical equipment has been designed for use over the total mountain section of 60 miles, throughout which there is an up-grade in each direction to the tunnel at the summit.

The locomotive built for the initial service has a total weight of 230,000 lb., all of which is on the drivers. There are two trucks connected by a coupling, each truck having two driving axles. To each axle there is connected by twin gears a 500-volt, 400-hp, 25-cycle, three-phase induction motor having a synchronous speed of 375 r.p.m. The gear ratio is 4.26 to 1, and with 60-in. drivers the no-load locomotive speed is 15.7 miles per hour. The motors are completely enclosed and air-cooled. Each locomotive is equipped with two 400-hp, three-phase transformers for reducing the e.m.f. from the trolley value of 6000 volts to 500 volts for the motors. The rating of the locomotive is put at 750 tons trailing load on the mountain division.

No provision is made for tandem, or concatenated, connection of the motors, the locomotive being designed for only one efficient running speed. By means of iron-grid rheostats in the secondary circuit of each motor the accelerating torque can be kept at the maximum value from standstill to the full running speed at constant power input and power factor. In passing from step to step on the controller a change is made in the resistance of only one secondary phase circuit at a time. The slight dissymmetry in the currents and elements of the torque is fully compensated by the gain in simplicity in control apparatus, 56 contactors being sufficient for the duty which would require 128 if a symmetrical arrangement were used.

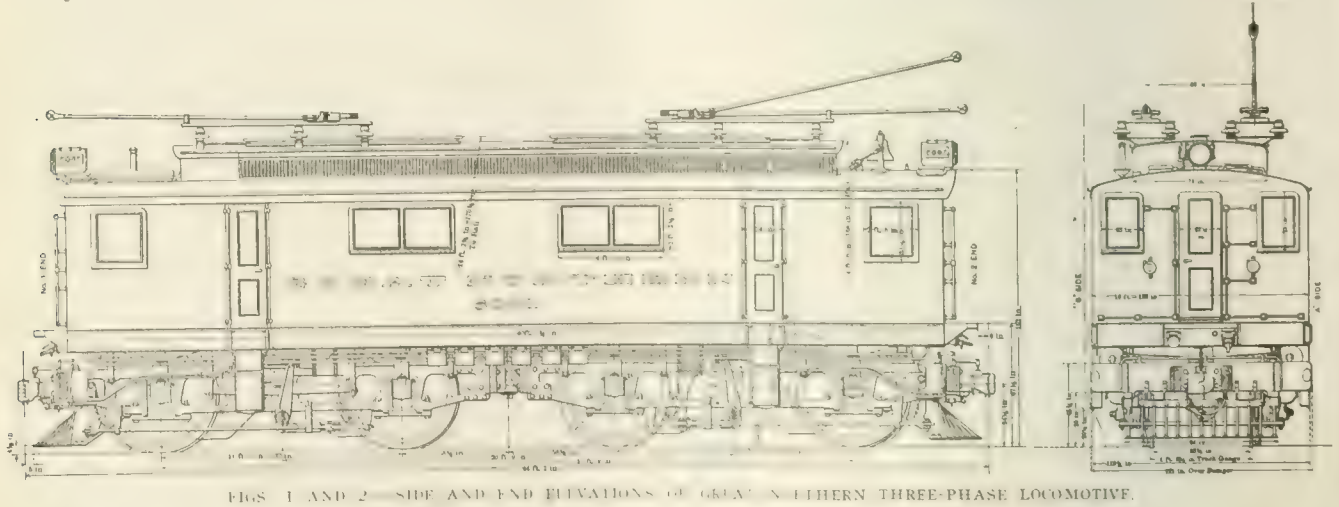
For the three working conductors use is made of two overhead wires and the rails. Within the tunnel the overhead wires are placed 17.3 ft. above the top of the rail and 8 ft. apart, while external to the tunnel the contact wires are suspended 24 ft. above the rails and 5 ft. apart. The wide separation of the wires within the tunnel was selected in order to permit brakemen to walk upon the top of the freight cars. The change in separation from 8 ft. to 5 ft. dictated the use of trolley wheels instead of bow collectors.

The energy for the locomotive is derived from the Wenatchie



[illegible]-ANCHOR BRIDGE IN WELLINGTON YARD.

River, the hydroelectric generating station being located about 2.5 miles west of Leavenworth. The power house is designed for three main 2500-kw units and two 125-kw exciter units; the latter two units and two of the former have been installed. The operating hydraulic head is 180 ft. An automatic water rheostat is installed in the power house for absorbing any excess energy generated by the three-phase locomotives when descending grades. When a train is on a down-grade the electrodes of the rheostat are automatically lowered by an amount proportional to the excess speed of the induction motors. Three 833-kw single-phase transformers, with a fourth for reserve, are used in the power house to increase the e.m.f. from the generator value of 6600 volts to 33,000 volts for transmission to a substation at the east portal of the tunnel; this substation contains transformers which are duplicates of those in the power house.



FIGS. 1 AND 2—SIDE AND END ELEVATIONS OF GREAT NORTHERN THREE-PHASE LOCOMOTIVE.

The locomotives have been in service since July, and have caused no delay. There have been only two trifling delays due to the failure of the electric plant, both being chargeable to unavoidable accidents to the transmission line. The locomotive efficiency is approximately 80 per cent, and the efficiency of the whole system is about 70 per cent.

The author claimed that for the particular service for which it has been selected, the three-phase motor has marked advantages in specific output, reliability, simplicity and general trustworthiness when compared with any other motor.

The discussion was opened by Mr. W. S. Murray, who expressed his belief in the better service to be obtained in general railway work from single-phase motors, although admitting that for the Cascade Tunnel problem three-phase motors are excellent. The single-phase motor admits of maintaining nearly constant power input under varying conditions of grade, while an induction motor requires a load varying over exceedingly wide limits. When hauling a train up a 2.2 per cent grade the Cascade locomotives require from six to seven times as much power as when hauling the same train on level track.

Mr. E. B. Katte expressed the opinion that the use of direct-current locomotives with storage batteries would have made unnecessary the use of steam locomotives in starting the trains drawn by three-phase locomotives. Experience on the New Haven road has shown that the "flashing-over" voltage on insulators covered with soot, even when saturated with water, is several times the normal working e.m.f. of 11,000 volts.

Mr. B. J. Arnold stated that from a personal observation of the Cascade Tunnel three-phase installation he was led to conclude that it operated as successfully as any direct-current or single-phase installation he had even seen. However, in many cases the necessity for two overhead conductors with the three-phase would render a single-phase installation preferable, for example, where there are many yards.

Mr. F. N. Waterman called attention to a characteristic of the induction motor which renders it advantageous where many locomotives are used simultaneously. When the generating equipment is supplying energy to several locomotives, the starting of an additional locomotive does not increase the load on the station to the extent represented by the power taken by the locomotive, because the speed of the generators decreases and each of the locomotives already in service consume less power on account of the decreased frequency.

Mr. J. H. Davis compared the conditions at Cascade Tunnel with those existing in Baltimore, where direct-current locomotives have been in service for 14 years. In Baltimore the length of section equipped electrically is 3.7 miles, the ruling grade 1.5 per cent, the average grade 1 per cent, and the length of the longest tunnel 7400 ft.; there are 49 trains handled per day with a total tonnage of 36,230, as compared with 6.5 trains hauled at Cascade with a total weight of 8350 tons. The Baltimore service requires five 90-ton, 1100-hp passenger locomotives and five 80-ton, 800-hp freight units as compared with four 115-ton, 1900-hp locomotives at Cascade Tunnel.

Mr. L. R. Pomeroy gave estimates to show that the saving in coal consumption alone over a mountain section of a railroad would often pay for the necessary equipment for electrical operation. Recent annual reports from four railroads show that the average consumption of coal by a steam locomotive in actual service is from 9.6 lb. to 12.9 lb. per hp-hour, as compared with values of from 4 lb. to 8 lb. frequently reported from individual tests.

Mr. W. N. Smith said that in the Cascade Tunnel problem the disadvantages of the three-phase locomotive as to its constant speed and necessity for two trolley wires are at a minimum, while its advantages are at a maximum. He expressed the opinion that the next locomotives to be built for the Cascade installation, or a similar one, will be fitted either with pony wheels or with side-rods for coupling to motors placed on top of the frames.

Mr. F. S. Denneen explained that the self-supporting type of trolley construction was adopted on account of the necessity of insulating two overhead wires from each other and from grounds. Either of two insulators at each supporting point can fail without causing a break-down. In the tunnel the porcelain insulators are capable of working at 20,000 volts, and the wooden strain link at 10,000 volts.

Mr. W. I. Slichter outlined the limitation imposed by the necessity for constant accelerating torque and described the secondary rheostatic arrangement employed with the three-phase induction motors for producing this result. He stated that with the unbalanced arrangement adopted for the sake of simplicity, the torque per ampere is never less than 90 per cent of that with a balanced arrangement. During acceleration the tractive effort is kept within the limits of 41,000 lb. and 35,000 lb.

Mr. C. L. de Muralt stated that the three-phase system possesses advantages that will cause it to be used extensively. However, there is no universal electrical system, and both the single-phase and the direct-current systems will be used also. In the matter of efficiency, the three-phase systems is much ahead of the others, and especially so when recuperation of energy is availed of.

Mr. Calvert Townley remarked that the road installing the three-phase system will find that it has been advantageous to substitute electricity for steam, and the system will be extended. This fact is of much greater importance than any distinction between the several electric systems. Of all motors the polyphase induction is the simplest; for traction work it is somewhat disadvantageous in running economically at only one speed.

Dr. C. P. Steinmetz attributed to the development of the rotary converter in America the slow progress made in three-phase traction in this country. For general railway work, as now carried out, the three-phase locomotive is not so well suited as is the direct-current and the single-phase locomotives except in certain special locations. It is not self-evident, however, that the constant-speed method of operating trains would not be preferable to the variable-speed methods now in use. Doubtless the haulage capacity of the tracks could be increased by adopting the power method.

Mr. Frank J. Sprague called attention to the three railroad tunnels where electric traction has been introduced within the past years, namely, the Sarnia Tunnel with single-phase locomotives, the Detroit Tunnel with direct-current locomotives, and the Cascade Tunnel with three-phase locomotives. In each case electricity has successfully replaced steam by permitting higher speeds, higher capacity, greater safety and greater cleanliness. The speaker outlined the limitations in haulage along 140 miles of single-track of the Central Pacific Railroad over the Sierra Nevada, and expressed the opinion that this section will be provided with electric locomotives.

Massachusetts Commission News.

Hearings have been concluded by the Massachusetts Railroad Commission upon the petition of the Boston, Lowell & Lawrence Electric Railroad Company for permission to build a high-speed interurban railroad between the cities named in the company's title. At the final hearing on Nov. 12, arguments in opposition were heard by the commission from Mr. William H. Coolidge, counsel for the Boston & Maine Railroad; Mr. C. M. Hight, of Boston, for the Lexington & Boston Street Railway Company, and attorneys for the city of Somerville and the towns of Arlington and Winchester. In conclusion Counsel James F. Jackson and J. W. Farley argued on behalf of the petitioners.

Mr. Coolidge argued on the basis of the adequacy of the existing facilities, stating that there are already five steam lines and four trolley lines in the district. He urged that the running time of the proposed road will not be less than that of the present steam lines and that the fares will be higher than the existing commutation rates. He stated that there has been no complaint of the existing facilities, nor any recommendation by the commission that the present companies should modify their service, or that new facilities should be added on the existing lines.

Mr. C. M. Hight emphasized the injury to the earnings of that line which would follow the establishment of service by the new company.

Mr. Jackson emphasized the earnestness of the petitioners, and the improvement in the preparation of the present case, especially from the engineering point of view, compared with the first petition. He urged that the new road will furnish an entirely improved form of transportation; that the existing facilities cannot meet the need of the situation, and that the enterprise will benefit the present roads by its entrance into

the field and general stimulation of travel, aside from the releasing of present trackage for larger through service. Mr. Jackson said that President W. C. Brown, of the New York Central Lines, informed him within the past two weeks that electric railroads of the Boston, Lowell & Lawrence type will meet a need in general railroad work. Mr. Jackson said that the present steam roads show no evidence of intending to electrify their suburban lines out of Boston; that the Railroad Commission cannot order the companies to spend $20,000,000 for improvements; and even if the roads planned to electrify, it would have to be done by very slow degrees, and all sections would have to be treated alike. If the petition is refused, the people of Lowell and Lawrence will not see an electric train for 10 or 15 years to come. The contentions of the opposition in regard to interference with the present elevated traffic between Sullivan Square and Boston would prove unfounded after the terminal changes now planned were put into effect, and the use of more cars in the Boston elevated trains would help. Mr. Farley closed with a short review of the case and a discussion of the general demand for the road. The commission then took the case under advisement.

The Massachusetts Railroad and the Boston Transit Commissions gave a hearing as a joint board, on Nov. 11, on the various rapid transit measures referred to it by the Legislature of 1909. Mr. Moorfield Storey appeared on behalf of the Boston & Eastern Electric Railroad Company and urged the necessity of permitting that road to enter the city of Boston independently of the system of the Boston Elevated Railway Company. He argued that rapid transit would be defeated if a separate tunnel and subway were not authorized. The Public Franchise League of Boston was represented by Mr. Joseph B. Eastman.

Mr. Frederic E. Snow appeared for the Boston Elevated Railway Company. He contended that the company will stand committed to pay fixed charges on an investment of $111,000,000 by 1913, and that additional commitments to subway and tunnel construction cannot be made at present. Mr. Snow stated that the population of Boston and its immediate suburbs has not increased fast enough to compensate for the company's enormous increases in investment. During the past 10 years, by the most rigid economy, the company has been able to reduce the operating expenses per passenger from 3.62 cents to 3.46 cents. The enormous extension of the free transfer system has become a great handicap. Mr. Snow stated that in order to obtain the necessary revenue to enable the company to pay its reasonable dividends and charges patronage must be gained by the establishment of through service from points beyond the Boston Elevated system into Boston. He advocated a law to permit the Boston Elevated to own a controlling interest in the outlying companies, but urged that actual consolidation be avoided, in order to protect the 5-cent fare provision in the Boston Elevated charter. He urged approval of the Boston Elevated and the West End consolidation as a matter of the public interest, saving $600,000 a year in power plant charges alone. The Boston Elevated is not opposed to the Boston & Eastern project, except that it desires to handle all the traffic of the latter road within the city limits. The company contends that it cannot afford to maintain costly terminal facilities in Boston for the use of foreign companies. Concluding, Mr. Snow stated the prohibitive cost of building certain new subway and tunnel lines to the suburban districts of Boston, as proposed in various irresponsible bills filed with the last Legislature. In his opinion the demand for a $3,000,000 tunnel from Park Street to the South Station has been greatly exaggerated. The hearing was then closed, and the joint board will report its findings early in 1910.

New York Public Service Commission News.

With public ceremonies at which thousands of Brooklynites were in attendance, work was formally begun, Nov. 13, on the Fourth Avenue subway. Chairman Willcox, of the Public Service Commission of the First District of New York, turned the first spadeful of earth and there were speeches and merry-making. All of the six contracts for this work have been signed and the proper bonds executed. The contracts require that work must begin in 60 days and be completed in two years. At a banquet in Brooklyn, Mr. Willcox declared that the commission had in mind a comprehensive plan for connecting subways in the three principal boroughs of New York which included the Broadway-Lexington route in Manhattan and the Bronx and the Broadway-Lafayette route in Brooklyn. Mr. Willcox said that the extension of the Fourth Avenue route to Fort Hamilton and Coney Island would probably be undertaken at once and intimated that after that it would be easy by means of a tunnel under the Narrows to furnish rapid transit to the Borough of Richmond. Mr. Willcox expressed himself as in favor of the city building and owning the subways and thought that the earnings of the present subway showed that it would be a safe investment which would eventually return to the city a large revenue.

The commission received last week a letter from the Edison Electric Illuminating Company of Brooklyn offering to supply light and power to the Fourth Avenue subway which has just been undertaken. This communication, like the one from the New York Edison Company, received the week previous, was referred to the Committee of the Whole.

The Public Service Commission of the First District has adopted an order granting approval to the construction of the South Shore Traction Company's line through Queens Borough and across the Queensboro Bridge. This action was taken as soon as the decision of the Court of Appeals, ordering the commission to grant the franchise, was received.

The Board of Estimate granted last week a franchise to the New York & Queens County Railway Company to run its cars across the Queensboro Bridge, the matter having been already acted on by the Public Service Commission.

A hearing was held, Nov. 9, on the matter of regulations for heating closed cars in New York City in the winter season. All of the traction and rapid transit lines in Greater New York are interested in this matter and they were represented by counsel at the hearing. Mr. E. C. Connette, transportation engineer of the commission, testified that he had examined the cars of the New York & Queens County Railway Company. The metal cars, he said, were equipped with heaters entirely too small, which in two hours had only increased the temperature of the car 20 deg. In addition to this he expressed the opinion that the heater required for a metal car should be much larger than that of a wooden car of the same size on account of the conductivity and radiation of the metal car. The engineer suggested that further comparative tests be made.

Corporation Counsel Pendleton reported favorably last week to the Board of Estimate and Apportionment the preliminary contract with the Third Avenue Bridge Company, a subsidiary of the Third Avenue Railroad Company, giving it permission to run cars over the Queensboro Bridge. This contract lasts for 25 years and provides for transfers to all the lines of the Third Avenue Railroad. This is another franchise which the Public Service Commission has refused to sanction. Under the contract the city receives a percentage of the gross earnings.

Wisconsin Rate Commission News.

The Wisconsin commission has authorized the Northern Hydroelectric Power Company to issue $1,000,000 par value of bonds of the denomination of $1,000, which bear interest at the rate of 6 per cent per annum, payable semi-annually. The purposes for which the bonds are to be issued and sold are to supply the company with funds to pay its outstanding indebtedness; to construct dams at High and Johnson's Falls on the Peshtigo River, in Marinette County, Wisconsin; to construct power houses and substations; to purchase all necessary power-house machinery; to purchase all right-of-way; to construct all transmission lines, and to purchase all property incident to the construction of the plant of the company.

The Fort Atkinson Gas Company has been authorized to issue

$18,750 in bonds of various denominations, the funds received to be used for constructing a gas plant in Fort Atkinson.

The Burlington Heating Company has been authorized to issue $2,000 worth of stock for the purpose of supplying the company with funds for acquiring the necessary property and constructing a heating plant in the city of Burlington, Wis.

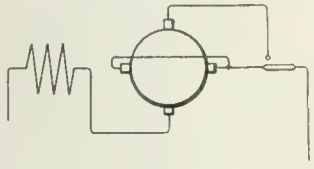
Canadian Hydroelectric Commission News.

Although the by-laws authorizing the town of Port Arthur to execute contract for power with the Hydroelectric Commission was passed by an overwhelming majority two weeks ago, the town is not yet free to make the contract. The Ontario & Michigan Power Company has made application for an injunction to restrain the town from entering into the contract with the commission, and argument was heard in the case at Toronto on Nov. 12. The judge granted an injunction preventing the city from entering into the contract with the commission until the trial of the action entered against the town to determine its right to make such a contract. The town has decided to ask the Court of Appeal next week for leave to appeal from the decision of Justice Clute. It is stated that the Hydroelectric Commission and the Attorney-General will become parties in the action on the appeal.

The decision of the judge was that although the by-law was published continuously for two weeks previous to the voting, it did not comply with the statute requirements. It did not contain estimates of cost of constructing, erecting, installing, and maintaining the buildings, works, plant, etc., for the purpose of supplying the amount of electrical power required by the municipality. Neither did it state the terms and conditions upon which such electrical power can be transmitted and supplied, nor the form of contract to be entered into between the municipal corporation and the commission, and no contract was ever furnished to the corporation by the commission.

Speed Control of Compensated Repulsion Motor.

For the purpose of changing conveniently the effective number of turns on the armature of a compensated repulsion motor Mr. Frederick Eichberg, of Berlin, Germany, has invented the



COMPENSATED REPULSION MOTOR.

arrangement shown in the accompanying illustration. The invention consists in employing the short-circuited brushes as one rotor terminal at starting, and employing the two brushes of the second set as the two terminals for running. When the switch is in the position shown one-half of the rotor turns are cut out of circuit; this is the starting position. When the switch is thrown into its other position for running, all of the rotor turns are in circuit. A United States patent covering this invention was issued on May 4, 1909.

Indiana Court Decides Against Municipal Merchandising.

An Indiana Circuit Court has overruled the demurrer of the city of Frankfort, Ind., to a complaint denying the city's right to engage in the sale of incandescent electric lamps. The court held that if a city had the right to engage in the sale of electric lamps, it had also the right to sell gas stoves and gas fixtures when gas was piped into houses in the city. The court also held that the city had no right to use money collected by taxation with which to purchase electric lamps for sale to the public to the detriment of electrical supply dealers.

CURRENT NEWS AND NOTES.

BALTIMORE UNDERGROUND DISTRIBUTION SERVICE.—A portion of the northwestern section of Baltimore is being changed from the overhead to the underground system and it is planned to furnish consumers in this section with alternating current. There will be two transformers to each block placed in manholes located at regular intervals. The residents of the section have been notified that the company will make connections for the new service by Feb. 15. It is planned to remove overhead wires and poles wherever practicable within the city, thereby rendering impossible the inconveniences that were encountered during the great blizzard of March 4.

CHICAGO ENGINEERS TO DISCUSS CIVIC IMPROVEMENTS.—The Engineers Club of Chicago, which has handsomely appointed rooms in the building of the Automobile Club, has begun a movement to enlist the interest and talents of the engineers of the city in the various plans for civic improvement pending in Chicago. The plan is to hold a series of monthly luncheons at which men of authority will speak on the subjects involved. At intermediate meetings the members of the club will discuss the engineering features of the projects. On Nov. 9 President F. A. Delano, of the Wabash Railroad, outlined his plan for a series of railroad passenger terminals at Twelfth Street.

AMERICAN SHOW-WINDOW LIGHTING IN LONDON.—Mr. H. G. Selfridge, formerly of Marshall Field & Company, Chicago, but now at the head of "Selfridge's," a modern department store in London, recently revisited his native country, and in the course of an interview on differences in merchandizing methods in England and in this country, made the following interesting statement: "We've done another thing we were told we couldn't do. We've had 'American' window displays and kept them brilliantly lighted at night. The other London shops don't do this; they have great iron shutters outside their windows and pull these down every afternoon at the close of business. It is a survival of the old days when it was not safe to leave windows unprotected."

GYROSCOPIC MONORAIL CAR.—A car 40 ft. in length, 10 ft. wide, 13 ft. high and weighing 22 tons, equipped with two 1500-lb. gyroscopes, has been operated successfully at Chatham, England, on the War Office grounds, by the inventor, Mr. Louis Brennen. The car is constructed according to the same plan as was the inventor's model which was shown in London about 18 months ago; it differs therefrom in being full-sized and capable of carrying 40 passengers. A gasoline engine is used for driving an electric generator which supplies energy for driving the gyroscopes and the propelling motors. It is stated that when all of the passengers on the car moved over to one side of it the car automatically adjusted itself to a new balance, by reason of the action of a pneumatic device controlled by the gyroscopes.

RADIUM INSTITUTE.—The Radium Institute of America has been incorporated in New York through the efforts of Prof. William Hallock, of Columbia University. The officers elected are: Dr. C. F. Chandler, president; Dr. Robert Abbé, vice-president; Prof. Hallock, secretary; Dr. G. B. Pegram, assistant secretary, and Dr. Hugo Lieber, treasurer. One important object of the Institute will be to explore the sources of radium and of radioactive minerals as they occur in the United States and to control them exclusively for philanthropic purposes. Waters which have radioactive properties will be examined. Among such waters which will be put to an official test are those of the Saratoga and Blue Lick springs. One of the principal objects will be the protection of the public from quackery, for, owing to the small supply of the substance, which is quoted at $18,000,000 a pound, unwarranted pretensions have been made by charlatans.

GAS-ENGINE SERVICE.—During the fourth annual meeting of the National Commercial Gas Association, which will be held at Madison Square Garden, New York, from Dec. 14 to 21, a paper entitled "Gas Engines in Competition with Central-Station Electric and Isolated Steam Plants" will be presented by Mr. W. W. Cummins.

UNIVERSITY OF COLORADO AUDITORIUM.—Plans and specifications are being drawn up for a fireproof auditorium building being constructed for the University of Colorado at Boulder, under the Mackay bequest. This building will be one of the finest university auditoriums in the country and the illuminating and stage control arrangements will embody the latest developments in such construction.

BALTIMORE N. E. L. A. SECTION.—The Baltimore Consolidated Electric Light & Power Company section of the N. E. L. A. is making every effort to increase its membership. At present the attendance at meetings is about 100, and recently the entire second floor of the Martland Telephone Building was secured for a meeting-place, where double that number can be accommodated. The entrance fee has been waived until Jan. 1, and a series of lectures being delivered by Prof. Sydney W. Ashe has largely increased the membership.

RETURN OF FARES TO DELAYED PASSENGERS.—By an ordinance recently passed by the Chicago City Council fares are to be returned to passengers when a surface or elevated car is delayed for 10 minutes or more. It does not appear to be clear whether fares must be refunded in case the delay is not the fault of the traction company, but is caused by a wagon breaking down on the tracks, a fire blockade or some similar cause. Hitherto, although the conductors have usually given transfers to the nearest available line by which passengers could resume their journey, there has been no ordinance requiring fares to be refunded.

OVERHEAD WIRES IN MADISON, WIS.—The City Council of Madison, Wis., has ordered the removal of all telegraph, telephone and electric light wires from State Street between the Capital Square and Park Street, a distance of nine blocks, Park Street from State Street to University Avenue, a distance of one block, and University Avenue from Park to Charter Street, a distance of five blocks. The poles must be moved by Aug. 10, and failure to do so by that time will make the companies liable to a fine of $10 to $100 a day for each day thereafter until it is done. It is stated that the Wisconsin Telephone Company will raise no objection to this ordinance. The Southern Wisconsin Traction Company is ordered to place iron trolley poles along its line on State Street and University Avenue, a total distance of 15 blocks. The same time limit and fines apply to this clause of the ordinance.

INDISCRIMINATE STREET EXCAVATION RESTRAINED.—In the future the Board of Local Improvements of the Chicago municipal government will send notices to all public-service corporations when a special assessment roll for the paving of a street is filed in court. Then if any corporation desires to do work in the street it must proceed with it within 60 days from the date of the notice. This rule will not apply to cases of emergency, such as the bursting of a water-main, in which event it is within the discretion of the commissioner of public works to award a permit. It would seem also that similar latitude must be allowed after the street has been paved for several years, and the growth of population requires an increase of public-service utilities. However, the main intent of the new regulation is to cause all the work required in street excavation to be done before new paving is put in, thus preventing tearing up new pavements so frequently as is done at present—a practice which could be prevented, no doubt, by a little forethought.

ENGINEERS AND THE PUBLIC.—In an editorial on the influence of the engineer on public affairs—which influence is declared to be practically nil at the present time—*Engineering*, of London, refers with warm approval to the recent action of the American Society of Mechanical Engineers in the appointment of a committee to watch legislation and other public matters, and call the attention of the Council to those which affect the interests of engineers, or in which engineers should intervene for the benefit of the body politic. Reference is made to the effect of the work of the British Standards Committee in showing that there exists a body which can speak with a single voice in the name of engineers, and can impose its opinions upon the units that make up the general body, and the Institute of Civil Engineers is complimented upon its action in making certain recommendations with respect to a building bill before Parliament of importance to engineering construction in the future. While not strictly an engineering body, the National Electric Light Association of this country has recently taken up several matters along the lines of work advocated in the editorial.

ELECTRIC SHOP BOOKLET—Electric Shop is the name given to the display-rooms de lux of the Commonwealth Edison Company, Chicago, which were described and illustrated in a previous issue of *Electrical World*. The company has now issued a handsome booklet, with numerous well-executed pictures, describing the shop and setting forth its purposes. The pamphlet is written with the idea of appealing to women as well as men, and an edition of 50,000 has been printed to be distributed to residence customers of the company. The booklet is a tasteful, high-class production of 34 pages, bearing the embossed crest of Electric Shop in colors on a cover of French gray. To issue a large edition has cost many thousand dollars; but, as in all connected with Electric Shop, the company is planning and executing on a large scale. The idea is to demonstrate the varied uses of electricity in the home. Referring to the use of electrical energy in replacing manual labor in the household, the writer of the booklet says: "It is not to be forgotten that these applications, which many people look upon today as luxuries, will be the everyday necessities of the next generation. Revolutions do not go backward, and labor-saving in the home is just as inevitable as it was, and is, in the factory."

ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The thirtieth annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, Dec. 7 to 10. The entire social entertainment will be in charge of the members resident in and about New York. For Wednesday afternoon, Dec. 8, an excursion is planned which members and guests will be asked to attend in a body, and during the remainder of the time there will be opportunities for smaller parties to visit places of interest. In the evening, there will be a lecture for members and guests upon the subject of agricultural machinery. The professional papers assigned to the meeting are as follows: "Tests on a Venturi Meter for Boiler Feed," by Mr. Chas. M. Allen; "The Bitot Tube as a Steam Meter," by Mr. Geo. F. Gebhardt; "Efficiency Tests of Steam Nozzles," by Messrs. F. H. Sibley and T. S. Kemble; "An Electric Gas Meter," by Mr. C. C. Thomas; "Tan Bark as a Boiler Fuel," by Mr. David M. Myers; "Cooling Towers for Steam and Gas Power Plants," by Mr. J. R. Bibbins; "Some Studies in Rolling Mill Engines," by Mr. W. P. Caine; "An Experience with Leaky Vertical Fire-Tube Boilers and the Best Form of Longitudinal Joint for Boilers," by Mr. F. W. Dean; "Testing Suction Gas Producers with a Koerting Ejector," by Messrs. C. M. Garland and A. P. Kratz; "Bituminous Gas Producer," by Mr. J. R. Bibbins; "The Bucyrus Locomotive Pile Driver," by Mr. Walter Ferris; "Line-Shaft Efficiency, Mechanical and Economic," by Mr. Henry Hess; "Pump Valves and Valve Areas and a Report on Cast-Iron Test Bars," by Mr. A. F. Nagle. In addition to the above papers there will be several reports submitted by committees of the Gas-Power Section.

Hamburg (Germany) Single-Phase Suburban Traction System.

By Frank Koester.

DURING the early part of the present year the complete electrification of the Hamburg-Altona & Suburban Railway, between Blankenese and Ohlsdorf, Germany, was accomplished. This railway connects with the twin city Hamburg-Altona, the suburban towns of Blankenese lying in one direction and Ohlsdorf in another direction.

The main passenger station, which lies in the Altona district, serves also as terminal for several steam railroads which were successively entered into this station as a terminal point as follows: The Berlin-Hamburg in 1842, the Altona-Kiel in 1844, the Hamburg-Luebeck in 1865, the Altona-Hamburg connecting link in 1866, the suburban railway Altona-Blankenese in 1867 and the Altona-Hanover Railway in 1872.

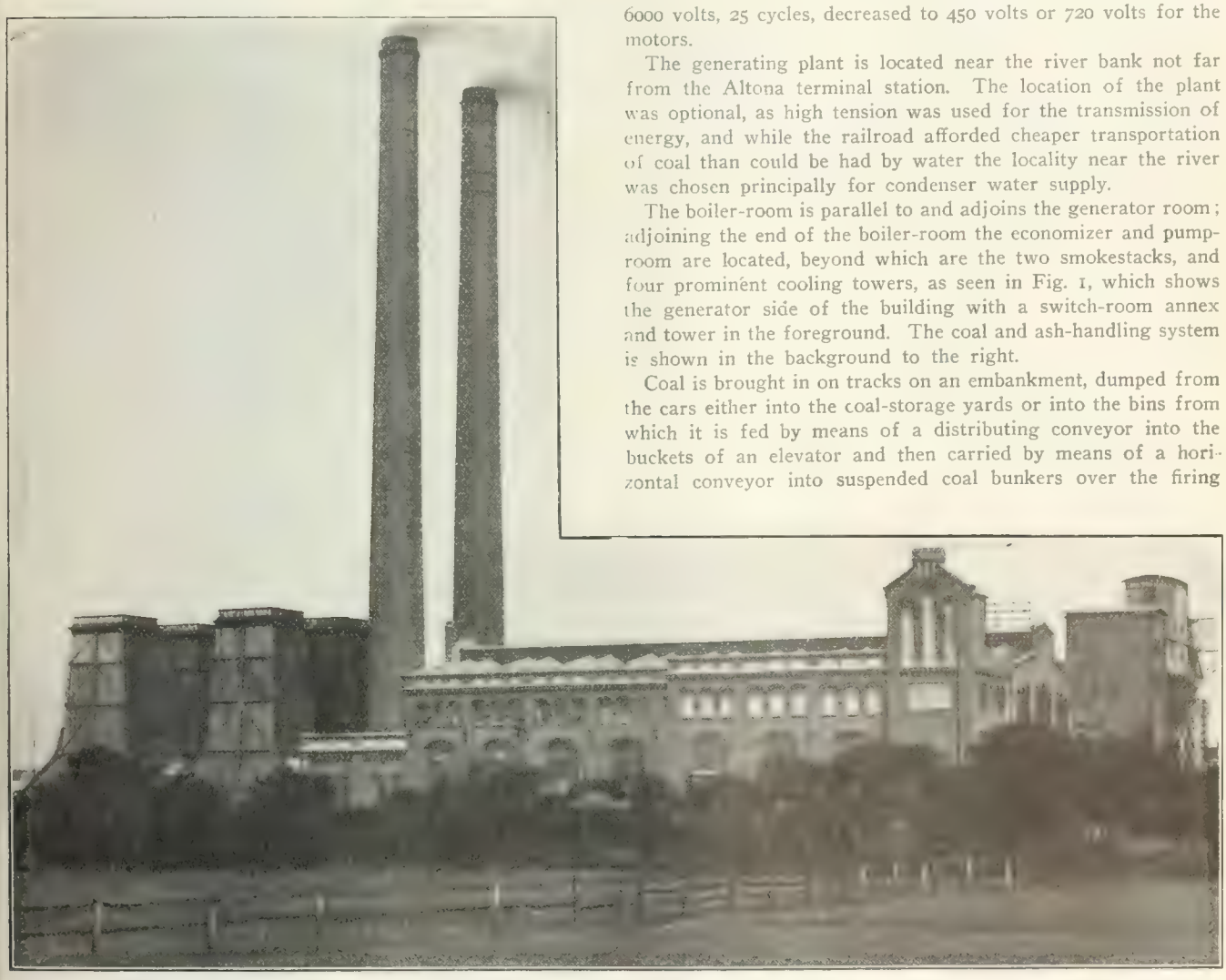


FIG. 1.—GENERAL VIEW OF GENERATING STATION SHOWING COOLING TOWERS AND SWITCH ROOM ANNEX.

Since the latter date extensive reconstruction has taken place and in December, 1906, the main station at Hamburg and the Ohlsdorf branch of this new system were formally opened to the public, so that now all the long-distance railway systems pass through the main station at Hamburg and connect with the terminal station at Altona without crossing any thoroughfares at grade level, while the new Blankenese-Oldsdorf branch has an independent electric system of tracks connecting both main stations at Hamburg and Altona.

The electrification of the Blankenese-Ohlsdorf road has quite a history. The management of the Altona Railway, as far back as 1894, desired to take up the electrification of the Blankenese-Ohlsdorf line, specifying a passenger traffic haulage of 5000 persons per hour in one direction and calling for trains made up of several motor-cars controlled from one point similar to the present electric lines. This condition could not at that time be fulfilled by the manufacturers, as the industry was not sufficiently advanced. After further progress was made and satisfactory experiments were conducted from 1900 to 1902 on the Wannsee Railway, near Berlin, and subsequent to the opening to the public, in 1903, of the Gross-Lichterfelde Railway, and after the successful experiments made with single phase current (Winter-Eichberg system) on the Niederschoeneweide-Spindlersfeld stretch in the summer of 1903, the electrification of the Blankenese-Ohlsdorf Railway for single-phase current was ordered. In the meantime, however, in October, 1902, steps had been taken looking toward the electrification of the road with a direct-current system, only to give way finally, as stated, to the more suitable single-phase system, the trolley e.m.f. being 6000 volts, 25 cycles, decreased to 450 volts or 720 volts for the motors.

The generating plant is located near the river bank not far from the Altona terminal station. The location of the plant was optional, as high tension was used for the transmission of energy, and while the railroad afforded cheaper transportation of coal than could be had by water the locality near the river was chosen principally for condenser water supply.

The boiler-room is parallel to and adjoins the generator room; adjoining the end of the boiler-room the economizer and pump-room are located, beyond which are the two smokestacks, and four prominent cooling towers, as seen in Fig. 1, which shows the generator side of the building with a switch-room annex and tower in the foreground. The coal and ash-handling system is shown in the background to the right.

Coal is brought in on tracks on an embankment, dumped from the cars either into the coal-storage yards or into the bins from which it is fed by means of a distributing conveyor into the buckets of an elevator and then carried by means of a horizontal conveyor into suspended coal bunkers over the firing aisle of the boiler-room. The coal from the storage yard is also delivered to three bunkers in the boiler-room by the same manipulation, while, in reverse order and by the same machinery, the ashes are delivered to a bin above the tracks and dumped into the cars.

The boilers are arranged in two rows, two in a battery, with a firing aisle between the two rows of boilers. At present there are installed nine Borsig water-tube boilers, each with a heating surface of 3220 sq. ft. Superheaters are located between the nest of tubes and the drums. Steam at 225-lb. pressure and a total temperature of 660 deg. Fahr. is used. The guaranteed efficiency of the boilers is 72 per cent, and they are capable of evaporating between 4 lb. and 6 lb. of water per hour per square foot of heating surface. The amount of superheat is regulated

by means of a damper by deflecting a part of the gases to by-pass the superheater.

The gases from each row of boilers before entering the chimney are conveyed through flues under the boiler-room floor to an economizer for each row, each economizer having 6420 sq. ft. of heating surface. The chimneys, which are of radial brick, have a diameter at the top of 8.8 ft. and are 233 ft. high.

Four main turbo-generators are installed at present, of 1250



FIG. 2.—SWITCHING-ROOM OF ALTONA POWER HOUSE.

kw each. They are equipped with surface condensers which are located in the basement between the turbo-generator foundations. The cooling water is supplied by motor-driven centrifugal pumps; the water of condensation is pumped into the cooling towers by means of wet vacuum pumps. This water, together with that to supply the loss, is pumped back into the boilers through the economizers.

The main generators for railway service are designed for a normal rating of 1250 kw, with a power factor of 0.75 and a 36 per cent overload range. They are two-pole, 6000-volt, 25-cycle machines.

The excitation of each main generator is accomplished by what is known as the Danielson system, one main and one



FIG. 3.—BOILER-ROOM AT ALTONA POWER HOUSE.

auxiliary exciter being mounted on a smaller shaft, which is coupled to the end of, and forms an extension to, the shaft of the main generator, as may be seen from Fig. 6. The field of such main generator is excited by the main exciter, which operates by current from the auxiliary exciter, which is a single-armature converter, whose fields are excited by current from a storage battery and having on one side a commutator and on the other side collector rings which receive alternating current through step-down transformers from the main generator. The alternating current produces an auxiliary field so that the voltage at the commutator is regulated according to the needs of the line and influences the main exciter and consequently the main railway generators, each of which has its own



FIG. 4.—30,000-VOLT OIL CIRCUIT-BREAKERS.

transformer, these being interconnected and thus equalizing the work performed by the generators.

While the railway generator sets were guaranteed not to fluctuate more than 12 per cent with a load from zero to 1500 kw, with a power factor of 0.75, it was found in actual opera-

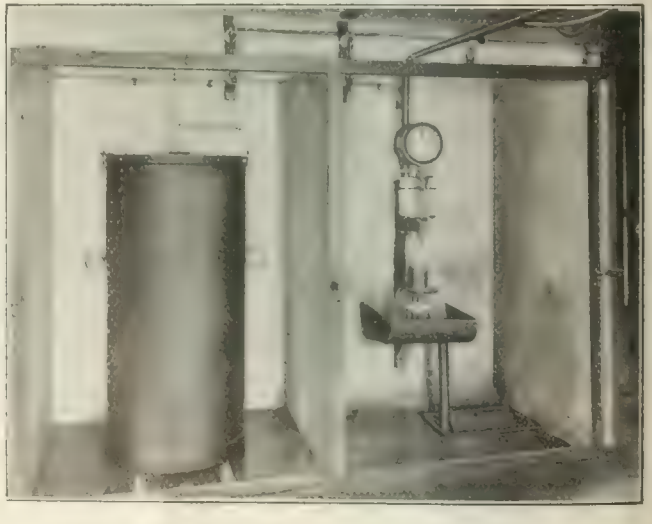


FIG. 5.—OIL RHEOSTAT AND WATER-FLOW GROUNDER.

tion that with the above fluctuation in load and a power factor of 0.8, the fluctuation in voltages was even less than 4 per cent. Such close regulation in excitation is, however, not adhered to, as it is not necessary under ordinary operating conditions.

There is also installed a 600-kw turbo-generator set for lighting purposes, and in connection with it there are two rotary converter sets working in parallel with the generator and which also may supply current to the various motors in the plant. These rotary sets are of different ratings, the large unit consist-

ing of three machines mounted on one shaft, namely, one 25-cycle, 600-kw alternator with one 50-cycle, 600-kw alternator, and one 250-kw, 220-volt, direct-current machine. The small converter unit also consists of three machines similarly mounted on one shaft, namely, one 250-kw, 25-cycle alternator; one 150-kw, 50-cycle alternator, and one 250-kw, 220-volt, direct-current machine.

A booster is also installed in connection with a 110-volt, 814-amp-hour storage battery.

It was considered expedient, for the purpose of supplying energy to the motor-driven auxiliaries, such as boiler-feed and condenser pumps, coal and ash-handling machinery, etc., to install an independent 350-kw turbo-generator set, this being a direct-current generator.

The switchroom is adjacent to the generating room and its switchboard gallery overlooks the latter. The cables from the generator room lead through a well lighted passage to the bus-bars. The main oil switches are of the remote-control, motor-operated type, provided with time-limit relays.

The e.m.f. from the generators is stepped up from 6000 volts to 30,000 volts by means of oil-cooled, water-circulated transformers for transmission along the line. The outgoing lines are protected against lightning by means of horn-gaps and water-flow grounders, while the generators are protected by horn-gap oil rheostats and choke coils.

In some cases the old signal towers could be utilized for transformer stations, while at some distributing points, as at Barmbek, new substations were erected. The Barmbek station had two 650-kva water-cooled transformers, for which a continuously operating pump had to be installed. Other transformers are installed at the stations and car barns, at which points only low-tension voltage is used.

The feeder lines to the trolley wire, as a general rule, are carried on the same poles as the latter. The high-tension trolley line in the open (6000-volt) is suspended 17 ft. above the rails, while the lowest point, under bridges, is 15.75 ft. The low-tension trolley line (300-volt) is 14.75 ft. above the rails, and is placed off the center of the track from 2 ft. to 3 ft. In order that the contact bow may wear uniformly the trolley wire runs in a serpentine or wave-like path, so that it extends on both sides of the center line of the track, the extreme dimensions from this center line being 20 in., and the wave-length 450 ft.

The overhead construction is made up of a catenary, a contact wire and an auxiliary wire between the two. The standard arrangement supporting the contact wire is supported from the auxiliary wire at intervals of 10 ft. by means of short loops, while the hangers between the catenary and auxiliary wires are 19.6 ft. apart. With this arrangement double insulation is provided. The double insulation, furthermore, permits each insulator to be tested in service at higher voltages than the operating one. Another advantage of the system is that in case of a break in the contact wire the ends of the broken section cannot fall low enough to make any dangerous contact.

The standard spacing of the main catenary is 131 ft. and in erecting it a sag of 4.92 ft. is allowed. This deep sag is purposely made so that expansion and contraction will have very little influence, and proper contact is obtained under varying conditions of weather.

The supporting of the main catenary is accomplished either by cross-wires in the open or by bridges or cross-arms in sta-

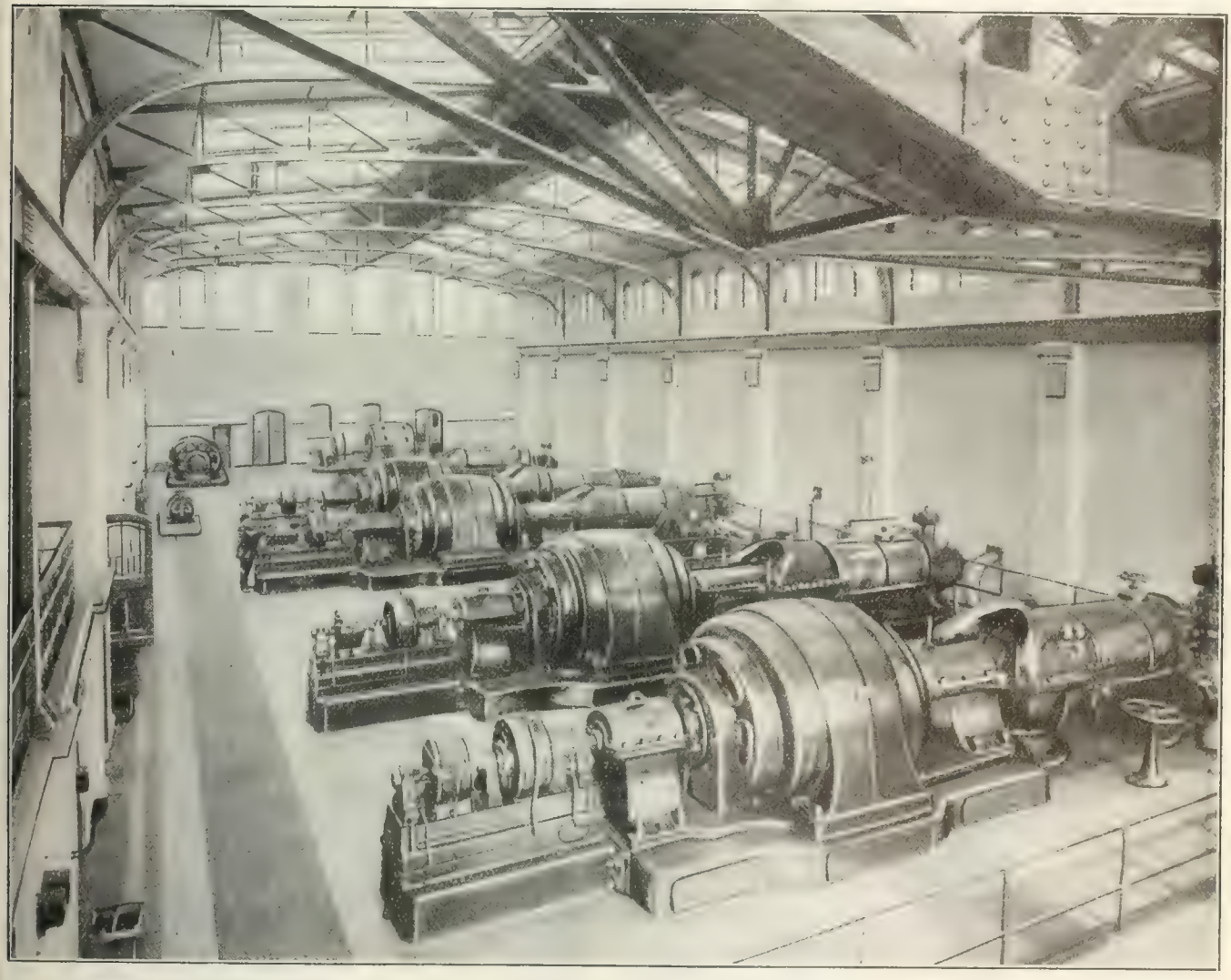


FIG. 6.—INTERIOR OF ALTONA GENERATING STATION.

tions or yards. In the last two cases the catenary is supported on a strap-iron stilt which can be shifted on the cross-arms or bridges as desired. The catenaries are made up of short stretches and are attached to the cast-iron caps of the insulators carried on these stilts

The expansion, or stretch, of the auxiliary wire and conductor is taken up by a special automatic tension device located at intervals of from 2600 ft. to 4200 ft. At these points the ends of both auxiliary as well as contact wires, all of which are made in sections, overlap each other for this purpose. The stretch is taken up for each section by a weight connected to each overlapping end by chains running over sheaves arranged by the side of the poles, the weight being 180 lb. As these wires are made in sections, three points serve simultaneously for the installation of section-breakers.

The standard poles are composed of two channel irons with lattice bracing, and are usually set in concrete about 6 ft. deep and are grounded to the rails by copper wire. Some of the poles, as those at the Lombard Bridge, are of special, artistic design, and the feeders are arranged on an extension of the pole, above the arms. At crossings or at other dangerous points are arranged guard wires upon which the ends of broken wires may be caught up.

At some of the stations which, as stated, are used in common for the steam railroad trunk lines and the electric system, the catenaries are made of silicon-bronze to preserve them from the destructive action of the smoke of the locomotives.

For inspection and testing of the lines two special tool cars are held in readiness. Each is equipped with a 160-cell, 183-amp-hour storage battery, and two 15-hp motors, able to give a speed on a straight stretch of 11.5 miles per hour. The car is similar to a box freight car, and is surmounted with a swiveling gallery, while at each end of the car is a grounded contact bow for the protection of the workman on the gallery.

The repair shops are located at the north end of the Ohlsdorf station. The car barn is arranged for 30 motor-cars, and is to be enlarged so as to accommodate a total of 48 motor-cars under repair.

A notable feature of the repair barns is the jacks in use for raising the body of the car for the purpose of removing the trucks. Such a procedure occupies less than five minutes. The screw spindles of the jacks are motor-operated. The jacks consist of four uprights, two on each side of the track, which are



FIG. 7.—SUBSTATION AND RAILWAY FEEDER POINT.

mounted on a sub base on the side of the tracks in such manner that the jacks may be shifted to positions which will accommodate different designs of cars. The maximum lift is 3 ft.

Other buildings consist of assembly-rooms for the employees, foundry, wheel shops, machine shops and others necessary for an up-to-date and well-equipped electric traction system.

The original rolling stock consists of 60 motor-cars of the so- called twin-car type, being a double-body, close-coupled car having no platforms between the two bodies; in accordance with German railway practice, these are coupé cars with side-door entrances and a side corridor extending the full length of each body of the twin car. Each body is divided into second-class and third-class coupés, the corridor communication being closed off between. The single body is about 46 ft. long, the space between bodies being about 14 in., so that the total length of the car is about 93 ft., not including the buffers between cars, for



FIG. 8.—MOTOR-OPERATED CAR JACK.

which 4 ft. must be added. The car body is 8.5 ft. wide, while the width across the steps is 10.3 ft. The top of the car stands 13 ft. above the rails.

These cars are of two different makes, 54 cars having been supplied by the Allgemeine Elektricitäts Gesellschaft and six by the Siemens-Schuckert Werke. These makes are alike in their principal features.

To provide economical operation and in order to compete successfully with the regular street railways, a twin car is so designed as to be a unit within itself to serve during non-rush hours. Therefore, a twin car is provided with two motorman's cabins so arranged that the one not in use may be used as a third-class compartment. Some of the third-class compartments have folding seats so that they may serve for carrying baggage. The seating accommodation of such twin cars is 120 passengers.

Fifty of these cars are so divided as to have five second-class, eight third-class and one baggage compartment, together with two motorman's cabins, while 10 of these cars have only third-class compartments and those for baggage and motorman.

The longest trains used at present consist of three twin cars, but arrangements are now being made for four-car trains. Each



FIG. 9.—CATENARY LINE INSTALLATION.

body of a twin car is provided with a four-wheel truck at its outer end and a single axle at the end adjoining its twin body.

The cars furnished by the Allgemeine Elektricitäts Gesellschaft are equipped with three 115-hp motors of the Winter-Eichberg type, two of which are mounted on the four-wheel truck and one on the two-wheel end, being geared to the axles in the ratio of 1:422. The wheels are 1 m (3.28 ft.) in diameter and the schedule speed is 30 miles per hour. It might be added

here that the experimental car was originally equipped with two 200-hp motors.

The cars are normally operated at 6000 volts, but at the stations and at car barns the trolley potential is only 500 volts. The high-tension current is collected by two bows at one end of the twin-body cars, which bows are raised and lowered by compressed-air mechanism, while the low-tension current is collected by a wheel collector, the highest attainable position of which is such that it at no time can reach the high-tension wire. The bows are provided with interchangeable aluminum strips 4.25 ft. long.

The 6000-volt current of the trolley passes successively from the collector bow through a switch, lightning arrester, choke coil, fuse and an automatic oil circuit-breaker, and then to the transformer from the low-tension side of which current may be drawn at 300 volts, 450 volts and 720 volts.

The motors are of the compensated-series type and rated at 200 hp for one-hour duration when making 500 r.p.m. and 100 hp for continuous operation. The stator winding consists of main and interpole coils connected in series. The interpole winding is connected to taps of the exciter transformer, which influences it so as to deliver a practically correct cross-field to counterbalance the transformer e.m.f. The interpoles simultaneously give a component field for taking up the commutation voltage, as in a direct-current motor. This design of motor permits unusually large air-gaps without loss of efficiency. Each



FIG. 10.—TRAIN ON HAMBURG SINGLE-PHASE ROAD

of the six main poles of the stator winding has three coils, there being three communicating poles. The windings of the armature are of the normal direct-current form. A centrifugal ventilator at the side of the armature forces air through the armature and commutator, but air is not permitted to come in contact with the current-carrying parts.

The Siemens-Schuckert cars are equipped with two 150-hp motors geared to the shaft in the ratio of 1 :3.65. The electrical equipment of these cars weighs 15.5 metric tons, while that of the Allgemeine Elektricitäts Gesellschaft weighs 17 metric tons, the total weight of the former car being 69.5 metric tons and of the latter 71 metric tons.

The 300-volt auxiliary circuit supplies energy for lighting and heating the cars and for operating the air compressor; electrical air brakes are not used, although provision is made for them. The heaters are cut in only when the motor current is cut out, and are controlled from the motorman's cabin. However, the heat in each individual car may be controlled by a switch provided for this purpose. Each coupé is provided with two heaters, one of 2 kw and the other of 1 kw, thus providing three stages for heat, viz., 1 kw, 2 kw and 3 kw, while the motorman's cabin has a heater of 2 kw. When all heaters are cut in and with 6000 volts on the trolley, the heaters consume 43 kw.

There are two distinct lighting circuits, one for signals and one for lighting the cars.

For operating on low-tension (300 volts), the high-tension or bow collectors are lowered and the low-tension wheel collectors are raised by means of a voltage-changer, which consists of two magnetic coils, one of which is connected to the 300-volt coil of the main transformer and the other to the low-tension trolley line. The action of these coils is such as to lower one collector when the other is raised.

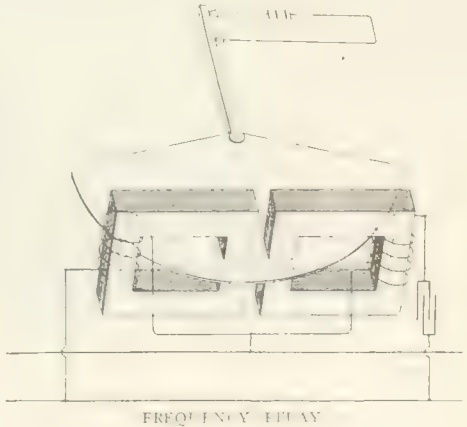
During light-traffic hours, as stated, the line is operated with single twin cars, while at other times trains are made up of two or three twin cars. The minimum schedule headway is four minutes, while the average daily run of a car is 279 miles and the average total per day (working days) is 432 trains. The average week-day train would consist of 1½ cars.

Since the electrification was completed, traffic has steadily increased so that it was found necessary to increase the original equipment by 42 cars, which were ordered in part from each of the two companies named.

The principal contractors for the entire equipment, power house, transmission, substations, overhead construction, motor-cars, etc., were the Siemens-Schuckert Werke, the Allgemeine Elektricitäts Gesellschaft, Brown, Boveri & Company and Felten & Guilleaume-Lahmeyer Works.

Frequency Relay.

The frequency relay shown by the diagram herewith is based upon the principle of "resonance," so-called. It operates when the fluxes in its two separate magnetic cores are in time-quadrature and are of sufficient strength. In series with one of the exciting coils is placed a condenser, the capacity of which is so adjusted that its condensive reactance is equal to the inductive reactance of the exciting coil at the chosen frequency; hence, the current in this circuit depends only on the resistance and is in time-phase with the impressed e.m.f. In the other exciting circuit the current is in time-quadrature with the



FREQUENCY RELAY

e.m.f., so that the phase relations and current strengths are correct for operation at the chosen frequency. At any other frequency the current in the condenser circuit is much decreased in value and shifted in time-phase, so that the relay is unable to operate. This relay, which was patented on July 20 by Mr. D. J. McCarthy, is intended for use with block signal systems on electric railways employing either direct or alternating current.

Tests of a Small Steam-Turbine Plant.

By George W. Martin.

In the issue of the *Electrical World* of Feb. 29, 1908, details were given of a combined water-works and electric plant to be erected at Pine Bluff, Ark., by Ford, Bacon & Davis, for the Equitable Securities Company, of New York. With the recent completion of the plant, data of tests of the boiler and steam-turbine equipment are now available and are here given as being of possible interest to construction and operating engineers.

Before taking up the details of the tests, it will be of interest to discuss certain points which were brought out in the preliminary runs made before the final tests. The condensing equipment for the turbines consists of two sets of Alberger "centrifugal" barometric jet condensers. Each condenser is provided with a dry-vacuum pump and a centrifugal pump, the latter being located on the discharge side of the condenser. Two cooling towers, each with a fan driven by a 12-hp induction motor, are provided to cool the condensing water.

It is obvious that with this arrangement of condensing apparatus the steam consumption of the turbine could not be ascertained by weighing the water of condensation. The only other means of arriving at the desired result was by weighing the water fed to the boiler. Owing to the excellent design of the main steam header and the flexible arrangement of steam and feed-water piping this was easily accomplished. As the design of the feed-water piping affords an interesting example of flexibility combined with the greatest simplicity under the circumstances, a description of it at this time will be of interest. The outline sketch shown in Fig. 3 represents the suction and discharge lines to and from the two boiler-feed pumps. Hot water may be drawn from the heater or cold water from the reservoir, and may be discharged through either a line running over the boilers or a line running in a trench in front of the ash-pit doors. From these lines connections are made to the drum in the rear of each boiler, as shown in Fig. 4. Any one of the boilers may take its feed-water supply from either of these lines. It is an easy matter, then, to take hot water from one source and discharge it over one line, and take cold water from the reservoir by means of the second pump and discharge it through the other discharge line. The practice followed during the tests was to feed the cold water through the lower supply line and discharge the hot water from the heater through the overhead feed-supply line.

The water fed to the boiler was weighed in a barrel placed on platform scales, the water after weighing being allowed to run into a tank 5 ft. in diameter by 4 ft. deep. The lower suction line of one of the feed pumps was interrupted at the T shown at the left in Fig. 3, and a connection was made from the tank to this point. The discharge from a relief valve in the discharge line from this pump was piped back to the tank, so that none of the water weighed might be lost. The measuring of steam consumption by this method has some disadvantages not encountered where a surface condenser permits the measuring of the water of condensation. In the first place, special care must be exercised in regulating the supply to the boiler, as the cold water expands considerably on heating, and if the firemen let too much water in the boiler the expansion of the water will fill the boiler and necessitate blowing down. If this happens during the test it is obvious that the results will be valueless. Care must also be exercised to prevent any popping of the safety valve due to excess pressure, resulting in loss of steam. When the boiler only is being tested, the safety valve may be allowed to pop at will, as the evaporation is ascertained by weighing the water fed to the boiler.

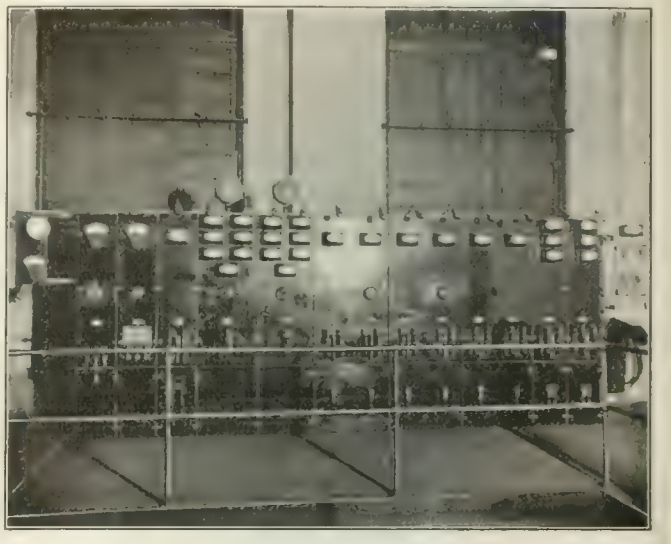


FIG. 2.—SWITCHBOARD.

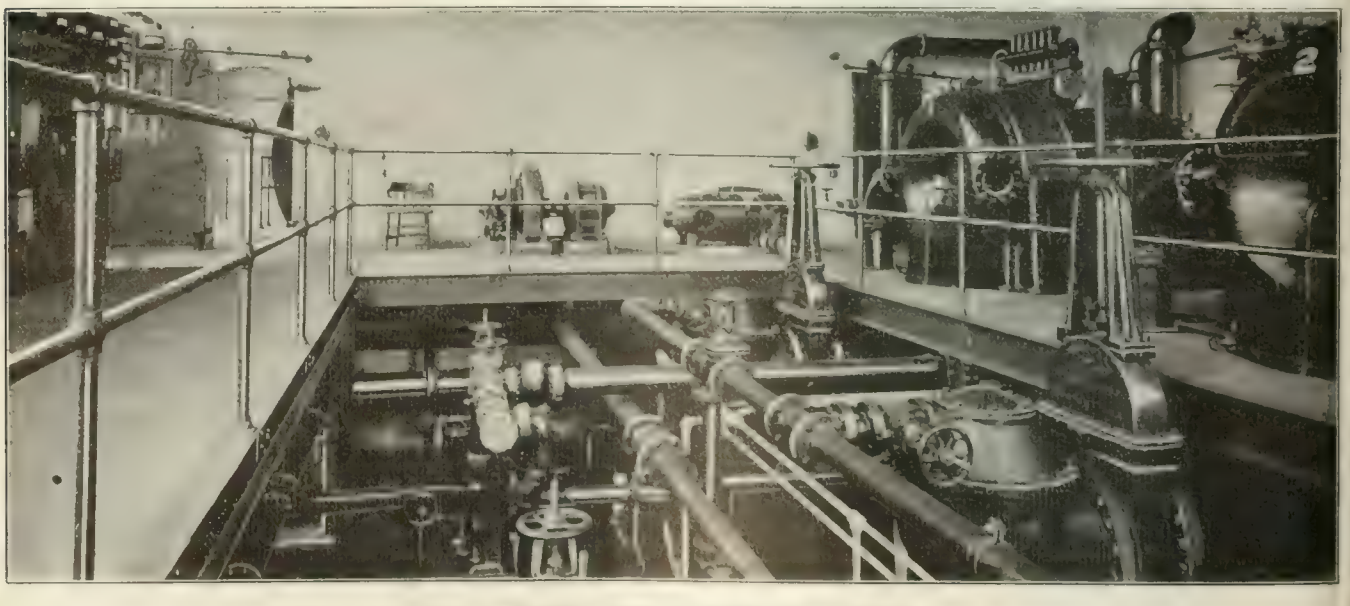


FIG. 1.—GENERAL VIEW OF GENERATING STATION.

Between the weighing tank and the boilers there is also a possibility of loss by leakage. As already mentioned, one source of loss would be from the overflow or discharge of an automatic relief valve in the feed-water discharge line. With

outside-packed plunger pumps—as installed in the present instance—the change from hot to cold water will necessitate tightening up the packing. This can readily be accomplished if the proper kind of packing is used. It was found that the comparatively inelastic canvas packing was unsuitable for this

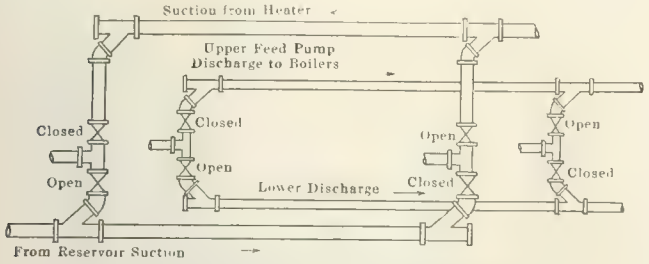


FIG. 3.—ARRANGEMENT FOR FEED-WATER PIPING.

work, the material finally selected being a combination as shown in Fig. 5.

The weight of the plunger in outside-packed plunger pumps appears to wear the packing thinner on the bottom side. When it is desired to take up on the packing, the latter must have an elastic quality, as otherwise equal compression on the thicker top part and the thinner bottom part will cause the plunger to bind if the packing is compressed enough to prevent leaks at the bottom. The necessary elastic quality is largely obtained in the packing illustrated by means of the triangular sections sliding on their hypothenuse.

Another disadvantage of this method of measuring steam consumption is the difficulty of determining the exact amount of steam used by the turbine during each hour. Although during the test the water in the boiler was brought to the same height in the gage glass at the end of each hour, the expansion of the cold water, after entering the boiler, offered an opportunity for error. Moreover, a difference of a small fraction of an inch in the level would make an appreciable difference in the amount of water fed to the boiler. If it had been possible to run the feed pump at constant speed and maintain a continuous supply to the boiler, the results would have agreed more closely. As it was, however, in some cases with a greater load the consumption per kw-hour increased, and decreased on lighter load, while, on the other hand, the consumption decreased in some cases with greater load and increased with lighter load, as was to be expected. This fact necessitated making a curve of average consumption by means of a gun-shot diagram. Open to criticism as these curves may be, their close agreement with the manufacturer's guarantee proves their accuracy in a sufficient degree.

It will be noticed that the turbine tests were made with the all-day commercial load on the unit instead of running with a

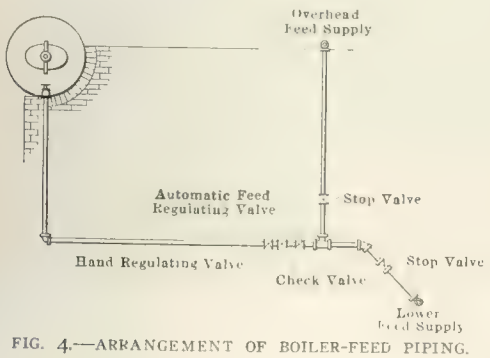


FIG. 4.—ARRANGEMENT OF BOILER-FEED PIPING.

steady load at one-half, full or 1½ rated load. When arrangements were made for these tests it was found that the unit in reserve needed some adjustments which would take some few days. As the other unit was in regular service it was, therefore, necessary to use the regular commercial load. As the greatest load at the time of the test reached only 250 kw, a short run was made later at full load using a water rheostat to obtain points farther along the curve.

BOILER EFFICIENCY AND OUTPUT TESTS.

The boiler installation consists of four 300-hp Babcock & Wilcox units set in two batteries of two boilers each. Each boiler contains 2979 sq. ft. of heating surface consisting of 140 4-in. tubes arranged in 14 sections, each section being 10

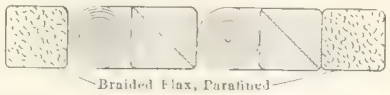


FIG. 5.—PACKING FOR OUTSIDE PACKED PLUNGERS ON FEED PUMPS.

tubes high; and one steam and water drum 54 in. in diameter and 9½ ft. long placed across the setting at the rear. The boilers are designed for a working pressure of 200 lb. per square inch, but are now operated at 150 lb. Each boiler is fitted with "Ajax" shaking grates, 59.6 sq. ft. in area.

The guarantee called for an efficiency of 57.5 per cent when the boilers are fired with bituminous coal containing not less than 12,000 lb.-Fahr. units per pound of dry coal, and an efficiency of 67.5 per cent when fired with bituminous coal containing not less than 14,000 lb.-Fahr. units per pound of dry coal.

The output guarantee called for an evaporation of not less than 15,700 lb. of water per hour from and at 212 deg. Fahr. with coal containing not less than 13,500 lb.-Fahr. units per pound. During both efficiency and output tests, however, the same coal was used—Arkansas slack averaging slightly over 12,000 lb.-Fahr. units per pound of dry coal.

The guarantee of moisture in the steam was to the effect that when a boiler was operated within 10 per cent of normal rating (300 hp) the steam should not contain more than 1 per cent of moisture, as measured by calorimeter at the boiler outlet, and when evaporating 15,700 lb. of water per hour from and at 212 deg. Fahr., the steam should not contain over 2 per cent moisture. Taking 34.5 lb. per hour evaporation from and at 212 deg. Fahr. as a boiler horse-power, the rate of 15,700 lb. per hour would give an output of 450 hp, or 50 per cent above rating. It was not possible to reach this output on test, however, owing to the fact that coal of 13,500 lb.Fahr. units was not available.

The firing during the tests was done by one of the operating firemen under the direction and with the assistance of a representative of the boiler contractors. The coal was weighed in wheelbarrows and dumped on the firing floor in front of the boiler.

The layer of coal during the efficiency test varied from 12 in. to 14 in. in thickness. The fire was not cleaned during the test, the grates being shaken from time to time to work the ash through. After the test was completed the fire was cleaned to determine the amount of clinkers on the grate. A large portion of the grate was found to be covered with a clinker from 3 in. to 5 in. thick, but of a porous nature, so that apparently the draft was not materially diminished; in fact, the draft during the latter half of the test remained practically constant, while the output during the last hour was greater than that during the two hours preceding. During the third hour of the test the damper was closed further to keep the boiler from running too much above rating and remained this way until the end of the test.

For the output test the coal used was the coarsest of the slack used for the efficiency test. The fire was carried about 10 in. thick. Early in the test a hard clinker formed on the grates, so that they could not be shaken. A steam jet was, therefore, turned into the ash pit, resulting in softening the clinker so that the grates could be shaken. From time to time during the test a few clinkers were taken out, and at the end the fires were cleaned. The steam jet softened the clinkers so that almost all the ash could be worked through the grate.

Previous to the final output test a preliminary test was made, using MacAlester gas coal, a selected lump bituminous variety, containing about 14,000 lb.-Fahr. units and only 5 per cent ash. This ash formed a thin but dense clinker on the

grate, which stopped the flow of air, and could not be removed until the clinker had cooled. The first hour of this preliminary test showed an output of 50 per cent above rating, but at the end of the third hour the output had dropped below rating.

DATA OF EFFICIENCY AND OUTPUT TESTS.

	Efficiency	Output
Make of boiler tested	Babcock & Wilcox	B. & W.
Grate	Ajax Shaking	Ajax
Boiler output, hp	297.9	297.9
Grate area, sq. ft	59.5	59.5
Water heating surface, sq. ft	2,979	2,979
Ratio grate to heating surface	1:50	1 : 0
Duration of test, hours	8	7
Kind of coal	Arkansas Slack.	

AVERAGE PRESSURES.

Steam (Gage) lb. per sq. in	149.2	150
Steam (Absolute), lb. per sq. in	163.9	164.7
Draft (In Furnace), in. water	.35	.39
" (Middle Pass)	.42	.47
" (Rear Pass)	.47	.54
" (In Breeching)	.59	.58
" (In Stack)	.60	.60

AVERAGE TEMPERATURES, DEG. FAHR.

Boiler Room	63	73
Flue Gases in Uptake	533.6	633
Feed Water	71	73
Steam	365.5	365.6
Calorimeter	293.50	300.7

FUEL DATA.

	Efficiency	Output
Total weight of coal as fired, lb.	10,500	8,850
Surface moisture in coal, per cent.	3	3
Total dry fuel consumed, lb.	10,185	8,584.5
Total ash and refuse, lb.	1,575	1,314
Per cent of ash and refuse in dry coal	15.5	15.3
Total combustible consumed, lb.	8,610	7,270.5
Dry coal per sq. ft. grate per hour, lb.	21.4	21.0
" " " hp per hour, lb.	3.96	3.76

WATER.

Total weight of water fed to boiler, lb.	74,712	66,332
Moisture in Steam, per cent.	0.88	0.54
Water Evaporated, lb.	74,055	65,974
Factor of Evaporation	1.1953	1.1934
Equivalent Water from and at 212° F., lb.	88,518	78,733
" " per hour " " " "	11,065	13,122

EVAPORATION PER LB. OF FUEL.

Water Evaporated per lb. of coal as fired	7.11	7.43
" " " " dry coal	7.27	7.68
" " from and at 212° per 16. dry coal	8.69	9.17
" " " " per 16. comb'st'ble	10.28	10.83

HORSE-POWER.

Horse-Power Developed, A. S. M. E. rating	320.7	380.3
Percentage of rating developed	107.7	127.7

EFFICIENCY.

Lb.-Fahr. units per lb. dry coal (approximate)	12,000
Efficiency of boiler and grate, per cent.	69.9

COST OF EVAPORATION.

Cost of coal per ton (2,000 lb.) at power house	$2.50
Cost of dry coal per hp-hour	0.00495

COAL CONSUMPTION TESTS.

While on the subject of boiler tests it may be of interest to describe briefly the measures taken to cut down the amount of fuel consumed. All the coal was weighed for 72 hours, divided into three periods of 24 hours each. No special attempt was made at damper regulation. The test was started immediately after cleaning fires.

As the load on the water-works end of the plant is practically constant from day to day, the electric load is specified in the following table to show any possible variation in the total load during each period:

	Kw-hours	Lbs. Coal	Surface Moisture	Lbs. Dry Coal
1st Period	2,530	36,400	7%	33,861
2nd "	2,410	43,500	7%	40,325
3rd "	2,420	36,000	3%	34,929

Note: The large percentage of surface moisture during the first two periods was due to rain.

In looking for the cause of the increased consumption during the second period it was found that the damper on one of the boilers had been left almost wide open after cleaning fires at the beginning of the period. The damper was readjusted with the result as shown.

Some weeks later other tests were made to see if the dampers could not be adjusted to give more economical results. It had been the practice of the firemen to carry a heavy fire with the damper more than half open, except that when cleaning the fires the dampers were opened wide and later closed to the former position when the fires had been again built up.

The plan adopted to find the best position of the damper was to close the damper by steps until a point was reached where the steam pressure could not be held up. The damper was then opened just enough to carry the pressure easily and the position of the damper rod was marked on the brickwork. When cleaning fires it was found advisable to open the damper a greater amount and afterward bring it back to its former position.

It had also been noticed that the fire was not raked over

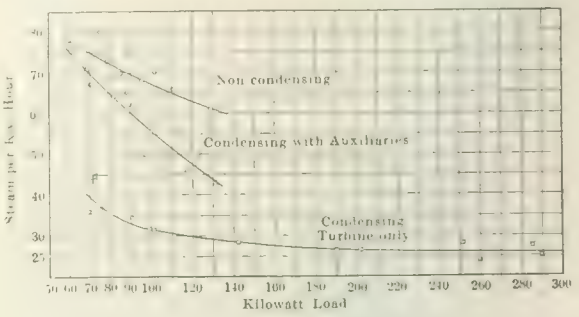


FIG. 6.—LOAD TEST OF STEAM TURBINE.

except at long intervals, the practice being to break up the fire by slicing it when it became too thick. The change adopted was to rake over the fire a few minutes after fresh coal had been thrown on, breaking up the caked coal and enabling it to burn freely. On light load it was found that a light fire, about 4 in. thick, could be carried, raking over the fire after each fresh supply of coal. On heavy load a thicker fire, about 8 in., was necessary, the damper being opened a little more and the coal raked over after two or three fresh firings.

With this method of firing the change in the amount of clinkers was very noticeable. On cleaning the fires on light load during the first 24 hours hardly any clinker was found. On heavy load the amount of clinker decreased considerably. During the second 24 hours, when cleaning fires on heavy load, one fire showed little clinker and the other less as compared with former instances.

The results obtained on this test were as follows:

	Load on Turbine kw hours	Coal Consumed lb.
1st Period	2,100	33,250
2nd Period	2,340	31,750

The reduction in the amount of clinker should prolong the life of the grates. With the old method of firing, also, it was necessary at times to make a battering ram of the slice bar to break up the clinkers.

It was observed that not once during the test did the safety

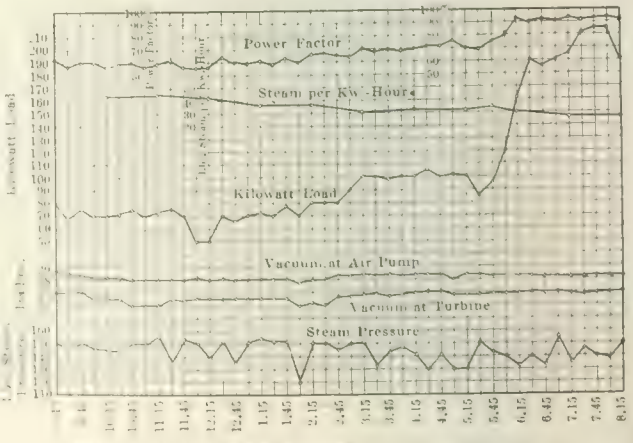


FIG. 7.—LOG OF TEST OF 300-KW STEAM TURBINE.

valve open, resulting in a saving in steam generated. The nicety of adjustment of the dampers was evidenced by the fact that when a hissing at the safety valves warned the fireman, closing the ash-pit doors for a few seconds brought the steam down enough to prevent popping off.

STEAM TURBINES AND GENERATORS.

The turbine installation consists of two 300-kw Curtis hori-

zontal units directly connected to 2300-volt, 60-cycle, three-phase alternators running at 1800 r.p.m. A 20-kw turbine-driven exciter set held in reserve has a rating of 160 amp, volts at no-load being 115 and 125 at full-load, the speed being 4500 r.p.m. For normal use exciting current is supplied by a motor-generator set running at 1200 r.p.m. The motor is a 30-hp, three-phase, 60-cycle machine.

The guarantee specifies that with 150 lb. gage pressure and 27 in. vacuum, the alternating-current generator shall be capable of delivering 75 amp per terminal at 60 cycles and 2300 volts and unity power factor, the exciting current being 65 amp at 90 volts. With a vacuum of 26 in. the unit is guaranteed to deliver continuously 500 kw with a temperature rise not exceeding 50 deg. C., and to deliver momentarily 600 kw. The exciters are guaranteed to furnish current for excitation when the alternators are operating under all variations of load from no-load at 2080 volts to 150 per cent of rated load at 2300 volts and 90 per cent power factor.

The guarantee as to steam consumption requires that the steam consumption per kw-hour, when operating at 150 lb. steam pressure, with saturated steam, shall not exceed the following:

	Kw.	Vacuum, in.	Lbs. steam per kw-hour
One-half load	150	27	29.0
Rated load	300	27	28.3
One and one-half load	450	26	26.0

Should the average steam pressure vary from 150 lb., as specified, the steam consumption per kw-hour shall be corrected in the proportion of 1 per cent for every 6.7 lb. variation from 150 lb. between the limits of 135 lb. and 175 lb., the correction being added to the pounds per kw-hour obtained on test if the pressure averages over 150 lb. Should the average vacuum vary from 27 in. or 26 in., as specified, the steam consumption per kw-hour obtained on test shall be corrected in the proportion of 1¾ lb. for every inch variation from 27 in. or 26 in., the correction being added if the vacuum averages over 27 in. or 26 in. and deducted if the vacuum averages under 27 in. or 26 in. This correction applies only to a vacuum over 25 in.

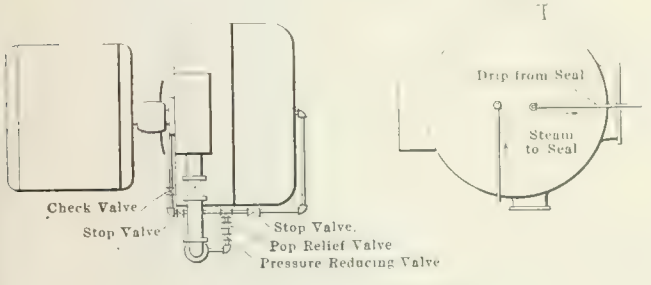


FIG. 8.—ARRANGEMENT OF CARBON-SEAL PIPING.

Should the steam contain moisture the steam consumption should be corrected by a 2 per cent increase for each 1 per cent of moisture in the steam. All the guarantees of steam consumption given in the foregoing include all the steam used by the turbine and all the leakages and losses of steam in the turbine.

During the turbine guarantee test the main steam header was sectionalized so that the turbine was operated from one boiler. The feed water was weighed before entering the boiler and the water in the gage glass was brought to a marked point at the start of the test. On the all-day test the water was brought to this point at the end of each hour, and on the full-load test at the end of each half hour. Thus the tests were divided into hourly and half-hourly periods and the steam per kw-hour was calculated for these periods.

All drips from the steam header and the separator on the turbine steam line were discharged into barrels, the amount being deducted from the total amount of water fed to the boiler.

The following table gives the results obtained by hourly periods:

Periods in hours.	Average load kw.	Total Steam. lb.	Steam per kw-hour, lb
1	72.8	3,145	43.2
½	72.3	3,181	44.0
3	61.2	2,558	41.8
4	69.3	2,495	36.0
5	74.5	2,697	36.2
6	87.5	2,739	31.3
7	99.3	3,184	32.0
8	101.5	3,177	31.3
9	116.0	3,387	29.2
10	196.3	5,129	26.4
11	208.5	5,525	26.5

The average results obtained at half load were as follows:

Steam pressure, lb	143.7
Vacuum at Turbine, in	26.6
*Corrected Vacuum at Turbine, in	27.5
Vacuum at Air Pump, in	28.2
Load, kw	104
Steam per kw-hour, lb	32.4

*The corrected result was found by calibrating the gage with a mercury column.

The corrections specified under the guarantee may then be applied as follows:

Consumption obtained from curve, Fig. 6, at 150 kw, lb	28.2
Correction for boiler pressure—subtract 0.94 per cent, lb	=0.26
Correction for vacuum—add, lb	0.87
Corrected consumption, lb	28.81

As the guaranteed consumption at 150 kw with 150 lb. boiler pressure at 27-in. vacuum was 29 lb., the result obtained on test is 0.19 lb. better than the guarantee. No corrections were necessary for moisture in the steam as calorimeter readings taken at intervals indicated dry steam.

The average readings obtained on the full-load test were as follows:

Steam pressure, lb	136.8
Vacuum at Turbine, in	26.9
" " Air Pump, in	27.9
Load, kw	273.0
Steam per kw-hour, lb	26.3
Power Factor, per cent	100

The corrections specified under the guarantee for full load may then be applied as follows:

Consumption obtained from curve, lb	25.9
Correction for boiler pressure—subtract 1.9 per cent, lb =	0.49
Correction for vacuum—subtract, lb	0.17
Corrected Consumption, lb	25.24

This is 0.06 lb. better than the guarantee of 25.3 lb. at 300 kw with 27-in. vacuum.

A study of the load curve in Fig. 7 for the period of the test is interesting as affording some idea of the daily life of the city. During the morning, and up to the middle of the afternoon, the load is mostly due to motors in mills or in elevator service. At noon the motor load falls off rapidly, and as half an hour for lunch is the rule in mills, the motor load rises at 12:30 p. m. About the middle of the afternoon some lighting load comes on, bettering the power factor, which up to that time averages 60, due to the inductive load of the three-phase motors.

At 5:30, due to the shutting down of the mills, the load again falls, but rises rapidly until the peak is reached about 8 o'clock Usually on nights other than Saturday the load falls off at 8 or 9 p. m., continuing all night at about 60 kw. On Saturday night the peak continues until about 11 o'clock. As will be seen, with a load almost entirely free from motors, the power factor reaches 92.

In conclusion, it may be of interest to mention a few points brought out in the tests regarding the operation of the turbines

A positive lubrication of all the bearings is maintained by means of an oil pump driven from the main shaft through gearing, this pump also supplying oil under pressure for operating the valve-control mechanism. The necessity of care in the selection of an oil for turbine use was forcibly illustrated by the trouble met with in the use of a good quality of engine oil which was also supplied to the reciprocating engines and pumps in the plant.

In attempting to drain off the oil from the chamber in the base of the unit, it was found that the drain pipe was clogged Examination revealed a dark jelly-like mass in the pipe and the oil was found to be of a light yellow, soapy appearance—in short, "saponification," as it is termed, had taken place. It was thought that the trouble was caused by the churning action of the pump acting on a vegetable component of the oil. A gas-

engine oil was then tried with good results, but the oil finally employed was one compounded especially for turbine use, and this gave entire satisfaction.

Some trouble was encountered in obtaining a good vacuum, the gage on the air pump showing no higher than 25 in. at no-load. Reference to Fig. 8 will give some idea of the cause of the trouble. A tap is made in the line supplying steam to the turbine to furnish steam for pressing the carbon-seal packing rings against the turbine shaft. A ¾-in. pipe is taken off the steam line close to the turbine, a globe valve, a reducing-pressure valve and a pop relief valve being located, as shown. The boiler pressure is reduced to about 12 lb., the relief valve serving to keep the pressure at this limit. At first a ½-in. branch, with a check valve, supplied the carbon seal at the high-pressure end of the turbine and a ¼-in. branch without any valve supplied the carbon seal at the low-pressure or exhaust end. Drips from both seals extended to a trench in the floor below, only that for the exhaust end being shown in the sketch.

It was surmised that the reason for the low vacuum was that air leaked in through the carbon packing at the exhaust end through the drain pipe, the end of which was open in a trench. A joint was broken in the drain pipe near the turbine and the end was plugged. The vacuum immediately increased to 29 in. The carbon packing was then examined and found to fit perfectly as far as could be seen.

A number of pockets were milled in the plate retaining the carbon packing to allow steam to condense in them and aid in making the packing tight. The steam branch was increased to ½ in., a globe valve being placed in the branch to both packings better to regulate the pressure. After this no further trouble was encountered and the vacuum was maintained at the guaranteed amount.

The plant is the property of the Equitable Securities Company, of New York, and is operated by the Pine Bluff Corporation, of Pine Bluff, Ark. Ford, Bacon & Davis, of New York, were the supervising engineers.

Experience with the Crystal Type of Wireless Detector.

By L. W. Thomas.

HAVING tested and tried out thoroughly several of the numerous types of crystal detectors put on the market in the last couple of years, there were found three that are superior to any of the others, namely, the Pickard perikon, the carborundum and the silicon. The carborundum and the silicon are very similar in their action, sensitiveness and manner of use, except that the carborundum is more reliable and dependable. As the carborundum and silicon detectors have a field of their own distinct from that of the perikon, the silicon will be eliminated and there will be discussed below the relative merits of the perikon and carborundum crystal, or, as sometimes called, thermo form of wireless detector.

The perikon detector, when correctly operated, was found to be superior to any other form of detector for long-distance work now in use, not excepting the most sensitive electrolytic or the DeForest "Audior." This detector, however, requires very careful handling, and its sensitiveness is so easily destroyed that a person not familiar with, or properly instructed in, its use is often disappointed and discards it as worthless or at best inferior to the other common form of detectors.

The perikon detector should be used only for long-distance work and kept free from sparks of any strong intensity. Even a testing buzzer connected directly instead of inductively will keep the crystals deadened, so that a sensitive place cannot be found. The spring tension between the two crystals also has considerable to do with the results obtained.

The perikon detector proper consists of two crystals or minerals, one of them being chalcoprites ($Cu_2SFE_2S_3$) and the other zincite (ZNO). A good form for mounting them is shown in the sectional diagram of Fig. 1.

From six to seven small pieces of the zincite are secured by mercury amalgam in a brass cup-shaped disk, 1⅛ in. in diameter, the disk being held stationary by a screw, as shown. The chalcoprites is mounted singly and eccentrically in the same manner in a cup ⅝ in. in diameter, and by a slight spring tension it is made to press lightly against the zincite. This crystal is mounted eccentrically and the holder on a swivel so that it can be swung and tuned and the most sensitive point of contact thus found. Usually there are found one or two places that are extremely sensitive.

The complete connections for the detector with a transformer type of timer are shown in Fig. 2. This diagram also shows a carborundum detector shunted around the perikon. A battery is not essential, but a single dry cell around a rather high-

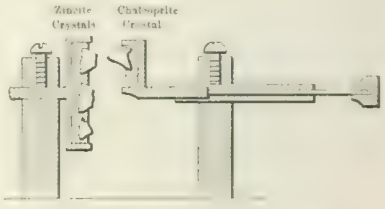


FIG. 1.—PERIKON DETECTOR

resistance potentiometer, allowing about 0.05 volt across the crystals, keeps them livened and liable to less variation. The direction of current must be from the chalcoprites to the zincite A low-resistance telephone (of 400 ohms to 600 ohms) is preferable to a high-resistance telephone on account of the high resistance of the crystals, the resistance being in the neighborhood of 3000 ohms when making sensitive contact.

Should a strong spark or signal be received across the perikon it will instantly become deadened, the incoming signal being reduced in intensity as much as 65 per cent, but upon giving it a short rest—depending upon the intensity of the shock—its sensitiveness is restored. As the zincite is the only one of the crystals affected, by moving the chalcoprites to one of the other zincite crystals another place of sensitive contact may be found. Flat pieces of zincite, free from any foreign substance, and clear-pointed pieces of chalcoprites give the best results. When

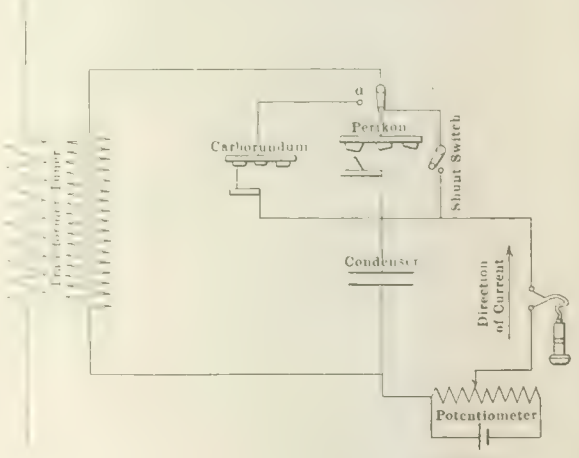


FIG. 2.—DIAGRAM OF CONNECTIONS OF DETECTOR.

transmitting is being done, the detector needs, of course, to be short-circuited or shunted.

While the perikon detector is adapted for long-distance work or for signals of weak intensity, the carborundum detector has its field in short-distance work, as it can withstand a spark of any intensity without being weakened in any way and thus making it extremely valuable for use aboard ship or where there are two or more stations in close proximity. While not as sensitive as the perikon and, therefore, not capable of doing the long-distance work of the perikon, signals from 1200 miles have been received on a very sensitive piece; the ordinary extreme range is not more than 300 miles.

An excellent way of making up a carborundum detector is

in the style of the perikon. A number of small pieces of the carborundum are mounted similar to the zincite crystals and a common steel needle, about 0.5 in. in length, takes the place of the chalcoprites and are soldered to the rim of the cup so that any piece of the carborundum can be reached and the most sensitive plate thereby located.

Carborundum varies greatly in its sensitiveness, but a somewhat flat, bright piece usually gives the best results. The spring tension of the needle against the crystal needs to be just sufficient to keep the needle from being easily disturbed by a jar. The carborundum detector does not require a battery, and, as with the perikon, a low-resistance telephone is preferable. There is very little, if any, difference whether the needle point or the crystal side is connected to aerial.

By using the carborundum in connection with the perikon detector there is obtained a most satisfactory combination which will receive signals of the strongest or weakest intensity, the carborundum detector being simply shunted around the perikon, as shown in Fig. 2. A switch shown at *a* is used to cut in either detector, depending upon the character of the signal being received. The carborundum needs no short-circuiting switch when transmitting, as it is not affected by the spark. The receiving signals of both the perikon and the carborundum can often be improved by cleaning the crystals with carbon disulphide.

No-Load Conditions in Self-Excited, Single-Phase, Shunt-Induction Motors—I.

By Val. A. Fynn.

IT is of interest to consider just how the no-load conditions and the design of self-excited, single-phase, shunt-induction motors are affected by the torque conditions existing in such machines and which have been discussed by the author in a paper read before the Birmingham Local Section of the British I. E. E. on Dec. 11, 1907. The partly or self-compensated motor shown in Fig. 1 will be considered first, the investigation being afterward extended to the wholly or artificially compensated motors shown in Figs. 2, 3, 4 and 5. It is to be understood that those of the considerations here set forth which relate to Fig. 1 apply equally to machines of that type, but provided with a squirrel-cage or with a slip-ring rotor.

The terminology employed by the author is that proposed by him in "Classification of Alternate-Current Motors." Thus the "self-excited, self-compensated, single-phase, shunt-induction motor" is the machine commonly referred to as the "single-phase induction motor." Fig. 1 illustrates that form of this machine in which the induced member is short circuited by way of a commutator along two stationary axes displaced in space with respect to each other. In the more common form of this machine, the induced member is short circuited along at least three axes, which do not alter their relative position with respect to the induced member, whether the latter revolves or not; such motors generally have either a short circuited, three-phase winding or a squirrel-cage on the induced member.

The author has shown elesewhere that these induction motors have limited self-compensating properties; these will be referred to later. They become "wholly or artificially compensated" when there is added some compensating device such as is shown in Figs. 2, 3, 4 or 5; such devices necessitate the use, on the induced member, of a winding connected to a commutator, but do not exclude the simultaneous use of a secondary winding short circuited independently of a commutator.

In order to fix ideas, consider first an *ideal* motor of the type shown in Fig. 1—that is, one which is entirely devoid of losses and is quite symmetrical in all directions, and let this machine be *mechanically driven*, not only at an absolutely synchronous speed, but also with a constant angular velocity. The diagram illustrating the performance of such a machine under the conditions stated becomes very simple and is shown in Fig. 6. An e.m.f. P impressed on Z_1 will determine the

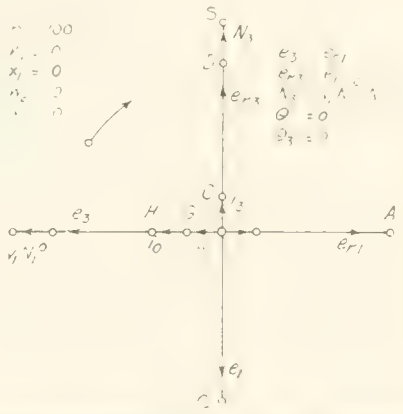
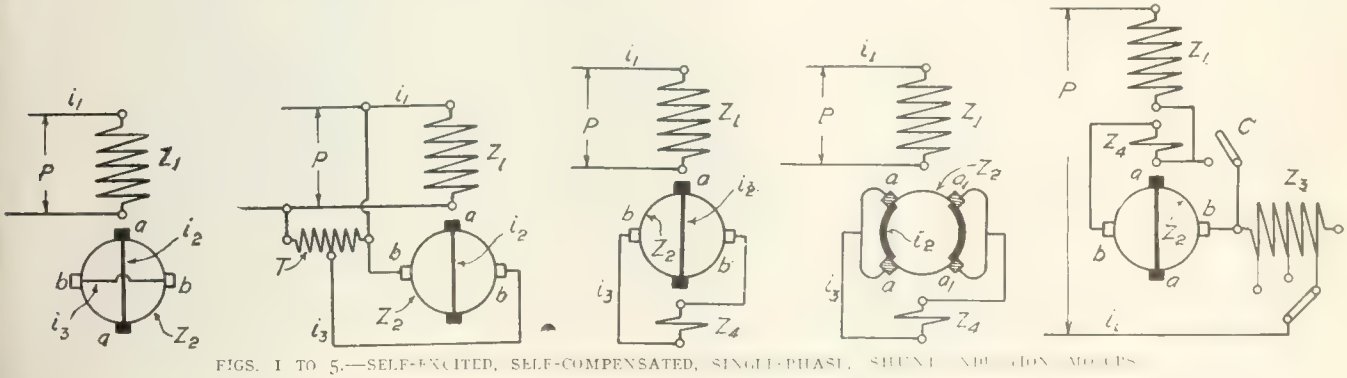


FIG. 6.—TIME PHASE DIAGRAM OF AN IDEAL MOTOR OF THE TYPE SHOWN IN FIG. 1 WHEN MECHANICALLY DRIVEN AT A SYNCHRONOUS AND UNIFORM SPEED.

magnetizing current i_m and produce a flux of mutual induction $v_1 N^0_1$ along the axis *a a*. This flux will induce the working e.m.f. e_1 at the brushes *a a*. By rotation of the rotor conductors in $v_1 N^0_1$ an e.m.f. shown at e_{r1} is generated at the brushes *b b*. This e.m.f. determines the rotor magnetizing current i_3 and produces the motor flux N_3. By rotation of the rotor conductors in N_3 the back e.m.f. e_{r3} is generated and appears at the brushes *a a*. The magnetizing current i_3 is reflected along the rotor axis *a a* in a manner presently to be explained and is counterbalanced by an equal and opposite component in Z_1; the total primary current is here equal to the sum of i_m and i_3. Such a motor will require no irrecoverable energy to run it light, hence the product of the effective component t_{i2} of the armature current i_2 multiplied by the back e.m.f. (e_{r3}) should be nil.



FIGS. 1 TO 5.—SELF-EXCITED, SELF-COMPENSATED, SINGLE-PHASE, SHUNT-INDUCTION MOTORS.

Since the motor field N_3 has a definite value, then e_{r3} will be greater than zero and consequently t_{i2} can be zero when e_{r3} equals e_1 in magnitude and exactly opposes it in phase. If sinusoidal time-values be assumed for all fluxes, an assumption which must be adhered to throughout in order to simplify matters sufficiently, then this condition will be reached at synchronous speed for, say, $n = 100$. At that instant, and for the direction of rotation of the motor which has been

chosen, $e_{r3} = e_{r1} = e_1$; also $i_2 = i_3 = im$, $i_0 = im + i_3$ and $N_3 = v_1 N^0_1$; furthermore, the motor field N_3 leads the transformer field $v_1 N^0_1$ by exactly 90 time-degrees, as shown in Fig. 6.

Before proceeding, the writer would like to take this opportunity to dwell at greater length on some points connected with the diagram shown in Fig. 6, and about which questions have often been asked.

The conventions he generally makes use of in constructing vector diagrams are as follows: A direction from left to right and from top to bottom of the paper is considered positive, as

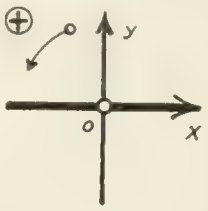
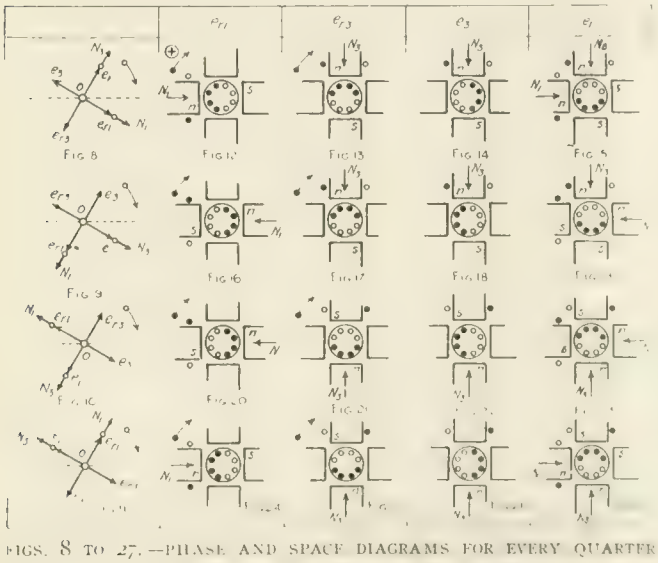


FIG. 7.—CONVENTIONS UNDERLYING FIGS. 8 TO 47.

shown in Fig. 7, by the co-ordinate axes X and Y. The X axis, shown thick, is taken as reference line. The positive direction of rotation of a vector, or the progress of time, is clockwise. This is indicated in Fig. 7 by an arrow provided with a small circle. Similarly, a clockwise rotation of the rotor is termed positive, while counterclock rotation is referred to as negative. The direction of rotation of the rotor is indicated in the following figures by an arrow provided with a small black dot.

With these conventions in mind, one can now show how the phase and direction of the principal vectors in Fig. 6 can be arrived at with the help of the ordinary rules governing electromagnetic phenomena. While the vector diagrams Figs. 8 to 11, in the first vertical row, show phase, direction and magnitude of all the vectors at every instant, the space diagrams of Figs. 12 to 27, and all similar figures, can only show the relative directions of e.m.fs., currents and fluxes at any selected instant. All the space diagrams in the same horizontal row (Figs. 12 to 27) are, therefore, directly comparable. All space dia-



FIGS. 8 TO 27.—PHASE AND SPACE DIAGRAMS FOR EVERY QUARTER CYCLE AND A CLOCKWISE ROTATION OF THE MOTOR SHOWN IN FIG. 1.

grams in the second vertical row are specially devoted to a representation of the instantaneous direction of e_{r1}, the e.m.f. generated in the rotor along the motor-field axis $b\,b$ of Fig. 1. Those in the third vertical row are devoted to a representation of e_{r3}, and so on. It is assumed that the transformer axis $a\,a$ of Fig. 1 coincides with the X axis of Fig. 7. Since for the moment an ideal motor is assumed, the whole of the flux due to Z_1 must thread both the stator and the rotor, and $v_1 N^0_1$ will equal N_1. All the figures from 12 to 27 refer to a positive rotation of the rotor, and it will soon be recognized that these figures give a complete graphical representation of the manner in which the motor shown in Fig. 1 really operates.

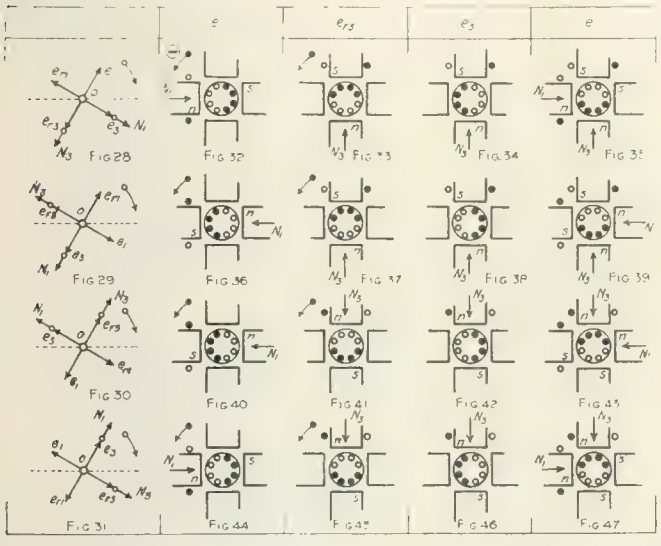
Assume that the vector N_1, representing the maximum amplitude of the transformer flux, has the position shown in Fig. 8 Referring this vector to the X axis, it will be seen that its value at that instant is a positive one. The direction of the flux N_1 in Fig. 12 will accordingly be from left to right, thus the pole to the left of the rotor will be a north pole. It will be appreciated that the direction of an e.m.f. *generated* in a conductor revolving clockwise past a north pole is *downward* through the plane of the paper; and the e.m.f. generated in a conductor revolving in the same direction past a south pole is *upward*, through the plane of the paper. The direction of the e.m.f. in all the rotor conductors to the left of the vertical axis may then be indicated by black dots (downward); that to the right by circles (upward). To establish a correspondence between the direction of an e.m.f. (or a current) in the rotor conductors and the direction of a flux, such as N_1, it is only necessary to determine the direction of that flux which would be produced if it were due to a rotor current of same direction as that of a given rotor e.m.f. It is clear that in the case of Fig. 12, such a flux would be positive—that is, directed from top to bottom of the paper; therefore, the direction of e_{r1}, in Fig. 12, is referred to as positive, and the vector of e_{r1} must be shown as coinciding with N_1 in Fig. 8. In this case the e.m.f. due to rotation in N_1 is consequently not only of the same phase, but also of the same direction as N_1. The stator winding producing N_1 is indicated by a dot and a circle at either side of the pole n in Fig. 12. The magnetizing current i_m is of the same phase and direction as N_1, and, therefore, positive at the instant under consideration. This positive current i_m (not shown in Fig. 8) must flow *up* (circle) above n and *down* (dot) below n.

Since the flux lags 90 time-degrees behind the impressed e.m.f., N_3, due to e_{r1}, will lag 90 time-degrees behind the latter, as shown in Fig. 8. Referring N_3 to the X axis, it is found to be positive, and is accordingly shown in Fig. 13 as being directed from top to bottom of the paper. The magnetizing current i_3 (not shown in Fig. 8) being of the same phase and direction as N_3, in Fig. 13, is directed *up* on the right of the north pole n and *down* on the left of it. (As a matter of fact, i_3 flows *in the rotor* along the axis $b\,b$ and not in the winding disposed on the stator, as shown in Fig. 13, and in other figures. In order to show clearly the direction of i_3 in the rotor it would have been necessary to add another vertical row to each set of these space diagrams; to avoid doing so, the direction of i_3 has been shown on the stator instead. If diagrams of this kind are ever used for teaching purposes it will no doubt be preferable to add a vertical row of diagrams for every factor it is desired to illustrate, thus, for i_3, i_2, i_0, and so on. By showing the direction of i_3 on the stator, as in Fig. 13, without further explanation, the erroneous idea might be conveyed that a two-phase motor was being dealt with). The e.m.f. *generated* in the rotor conductors by rotation in N_3 must be directed downward in the top half and upward in the bottom half of the rotor. A field produced by a current distributed and directed, as indicated, would be directed against N_3; e_{r3}, is, therefore, negative. It is known that e_{r3} must be of the same phase at N_3, and having found that it is negative, the position of its vector is undoubtedly defined as being in opposition to that of N_3—that is, of the same phase as, but opposite in direction to, N_3, as shown in Fig. 8. It will now be understood why e_{r1} is of the same phase and direction as N_1, whereas e_{r3} is simultaneously of the same phase as, but of opposite direction to, N_3.

Reverting to *induced* e.m.fs., it is known that the latter lag 90 time-degrees behind the fluxes to which they are due; thus e_2, in Fig. 8, lags 90 time-degrees behind N_3. By referring e_2 to the X axis it is seen that e_2 is negative; the distribution of this e.m.f. is shown accordingly in Fig. 14. Fig. 15 shows in the same manner the distribution of e_1, which is positive, at the instant chosen, since it lags 90 time-degrees behind N_1, as seen in Fig. 8.

Comparing Figs. 12 and 14, also 13 and 15, it may be noted that e_2 opposes e_{r1} and that e_{r2} opposes e_1. These same figures

also give every information as to torque conditions. It has been said that a current of the same phase and direction as the working e.m.f. (e_1) should produce the main or positive torque of the machine in conjunction with the motor field N_3. A reference to Fig. 15, where both fluxes N_1 and N_3 have been indicated, shows that a current of same direction as e_1 would flow *up* under a *north* pole and *down* under a *south* pole of N_3; these conditions result, as is known, in a pull on the conductors in a clockwise direction, which in this case is the positive direction. The direction of other torques, when such exist, can be ascer-



FIGS. 28 TO 47.—PHASE AND SPACE DIAGRAMS FOR EVERY QUARTER CYCLE AND A COUNTER-CLOCKWISE ROTATION OF THE MOTOR SHOWN IN FIG. 1. CONVENTIONS AS LAID DOWN BY FIG. 7.

tained in like manner and will be found to agree exactly with the statements contained in the author's Birmingham paper.

The three succeeding horizontal rows show the conditions obtaining after the lapse of one, two and three quarter-cycles, as reckoned from the position of the vectors shown in Fig. 8, and clearly illustrate the various stages through which each of the factors involved passes during one complete revolution of a two-pole rotor. It is thought that these diagrams do not require further explanation.

The effect of reversing the rotation of the rotor is shown by means of the space diagrams Figs. 32 to 47, the corresponding phase diagrams being those of Figs. 28 to 31. Fig. 28 corresponds exactly to the diagram shown in Fig. 6, which, therefore, depicts a counter-clockwise rotation of the motor. One of the points of interest is that e_{r1} is now of the same phase as, but of opposite direction to, N_1; whereas e_{r3} is not only of the same phase as, but also of same direction as, N_3.

The conventions underlying the above diagrams may be

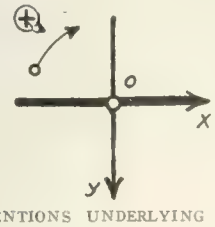
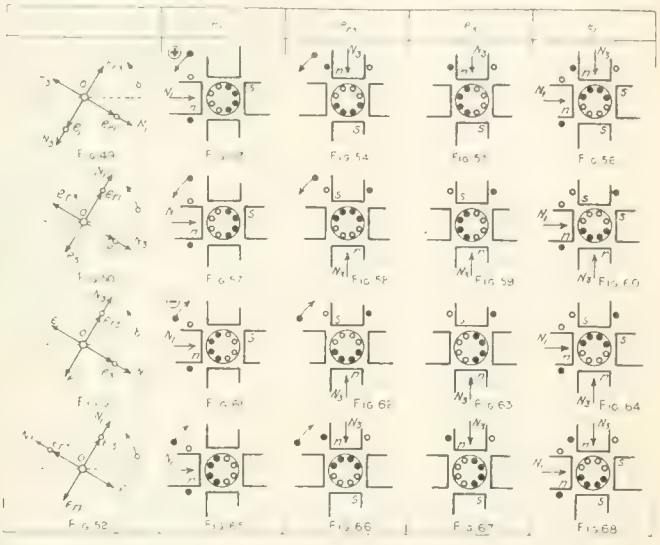


FIG. 48.—CONVENTIONS UNDERLYING FIGS. 49 TO 68.

altered without in the least vitiating the results. Very often the direction from left to right and from top to bottom of paper is taken as positive, while the progress of time is measured counter-clockwise, as shown in Fig. 48. The positive rotation of the rotor is then said to be counter-clock. It was thought useful to illustrate also the performance of the motor by means of diagrams based on the last-mentioned conventions. These diagrams are represented in Figs. 49 to 68, and show conclusively that results identical to the previous ones are obtained for both directions of rotation.

Figs. 49 to 50 show vector diagrams for two instants differing in time by one-quarter of a cycle, and Figs. 53 to 56 and Figs. 57 to 60 represent the corresponding space diagrams, the rotor revolving in a counter-clock direction. The phase diagrams Figs. 51 and 52, and the corresponding space diagrams, Figs. 61 to 68, indicate the conditions when the direction of rotation of the rotor is a negative one or clockwise. All these diagrams should be understood without further explanation after what has already been said.

There remains just one more point to consider when applying



FIGS. 49 TO 68.—PHASE AND SPACE DIAGRAMS AT AN INTERVAL OF ONE-QUARTER CYCLE AND COUNTER-CLOCKWISE ROTATION OF THE MOTOR SHOWN IN FIG. 1.

these diagrams to an actual machine: this refers to the direction in which the rotor is wound. In Fig. 69 is shown what is termed a *right-hand* Gramme ring. If the current is to be sent through that winding in a positive direction, such, for instance, as shown in Fig. 15, then, according to the conventions adopted by the author, this current must enter at the brush a_1 and leave at a_2—that is, it may be said also to pass the brushes in a positive direction. If the armature is a *left-handed* one, as shown in Fig. 70, then the current must pass the brushes in a negative direction in order to flow through the rotor windings in a positive one.

Reverting to Fig. 6, it is quite clear that when the machine is driven at a strictly synchronous speed in a field $v_1 N^0_1$, then e_{r1} must be generated at the brushes *b b*, in Fig. 1, and this must cause a current i_3 to flow in the rotor along that axis *b b*. When the local impedance of the rotor circuit is zero, as is the case in the ideal motor being considered, then i_3 will lag just 90 time-degrees behind e_{r1}, and the flux due to i_3 will induce an e.m.f. (e_3) of exactly equal magnitude and exactly opposite phase to e_{r1}. The resultant e.m.f. in the rotor along the axis *b b* will be zero and yet i_3 will exist; indeed, i_3 must exist in



FIGS. 69 AND 70.—RIGHT-HAND AND LEFT-HAND ARMATURE WINDINGS.

order that e_3 may exist and the magnitude of i_3 will reach its limit when N_3 has become sufficiently large to induce an e_3, which is just equal and opposed to e_{r1}. Here, then, is a case where zero e.m.f. divided by zero impedance results in a current of quite definite magnitude. This case is, in fact, identical with that of an ideal transformer the secondary of which is on open circuit.

The vectorial difference between the two e.m.fs. (e_1) and e_{r3} acting in the rotor, along the axis *a a* is also nil and so is the local impedance in that axis, and here again one is confronted

by the indefinite expression "zero e.m.f. divided by zero impedance."

In the case of the axis $b\,b$ there is an essential physical reason why a current i_3 of a definitely limited value should flow. Here there is no such reason, because e_1 is due to $v_1 N^0_1$, and e_{r3} to N_3. If a current does flow along the axis $a\,a$, the field it produces will have to be immediately and fully neutralized, otherwise the operation of the motor must be impaired. All that can be said in this case is that there is no apparent physical reason why a current should not flow *if* provision can be made for neutralizing the magnetization due to it. It will be shown later that in the case of a practical machine having local impedance in the rotor, e_3 is not quite in phase opposition to e_{r1}, nor is it quite of the same magnitude as e_{r1}. The vectorial difference is of just the magnitude and phase required to produce a current i_3 of the required magnitude, and this difference is faithfully reproduced in the rotor along the axis $a\,a$, as the vectorial difference between the e.m.fs. (e_1) and e_{r3}, with the result that i_3 is also more or less faithfully reproduced along that axis, the more faithfully the smaller the rotor impedance. Dr. A. S. McAllister has shown that since i_3 is more or less faithfully represented by a current i_2 along the axis $a\,a$, when the local impedance is not zero and since i_2 approaches the magnitude of i_3 the more closely the smaller the local impedance of the rotor, then i_2 must exactly equal i_3 when that impedance becomes zero in the case of a motor *driven by external means* at a uniform and synchronous speed. But if a current i_2 equal to i_3 in magnitude and in phase and space quadrature thereto is present in the rotor along the axis $a\,a$, then the ampere-turns due to it must be neutralized and the primary winding Z_1 consequently takes a current $i_0 = 2\,i_m$, or, more generally, a current $i_0 = i_m + i_2$, thus.

The no-load current required by an ideal self-excited, single-phase, shunt-induction motor driven at a strictly uniform and synchronous speed is equal to the sum of the stator and rotor magnetizing currents.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Electric Light in Baltimore Markets.

Several of the largest markets of Baltimore are now undergoing an electrical renovation. A few months ago Lexington Market, one of the largest open markets in the country, was thoroughly overhauled by the city, the old wiring was removed and each stall was put on a separate meter. In addition to this, a large electric sign was placed at the main entrance. The electrical work involved a considerable outlay and the city did not intend to make at this time similar improvements in other markets; demands, however, were so urgent that suitable appropriations were made and the work of giving Broadway and Cross Street markets better electric service has been begun. All of the open wiring is being replaced by conduit, the fixtures will be of a uniform design and each stall will have its individual meter. Large-size tungsten lamps will be used for the general illumination. The merchants in the vicinity of other markets are desirous of having these supplied with the same type of sign as that erected over the Lexington Market, and the Board of Estimates has this matter under advisement. The second floors of these markets are utilized for halls in which to hold various public meetings, and these rooms are also being newly wired and supplied with the most modern fixtures.

Electrical Energy Required for Water Pumping.

Electric light and power companies which are figuring on securing water-pumping contracts will find of interest the following figures, which were obtained in actual practice: At Columbus, Neb., Mr. John T. Burke, manager of the Columbus Light, Heat & Power Company, which has a contract to pump electrically the water for the water works, recently made a careful test on the electrical energy required to pump a given amount of water. Mr. Burke finds that under the conditions at Columbus it requires 700 watt-hours to pump 1000 gal. of water against 100-ft. head. The measurement was taken by noting the rise of water in a standpipe. The pump used is of the triplex type, motor-driven, rated at 390 gal. per minute. The suction lift is 10 ft. and the discharge 90 ft. The pump is equipped with a 35-hp motor. Under ordinary conditions (which prevailed during the test) only 15 hp is required. The extra motor capacity is provided so that the pumps can be made to do fire service at high pressure.

Mr. H. C. Morrow, manager of the Whitehall Electric Company, stated at the recent convention of the Illinois State Electric Association that at Whitehall, Ill., 22 kw-hours are required to pump 15,000 gal., or 1333 watts per 1000 gal. with 120-ft. lift.

Whitehall (Ill.) Single-Phase Transmission.

The Whitehall Electric Company, of Whitehall, Ill., supplies electricity to the Greenfield Light & Power Company and also to the Winchester Electric Company. Greenfield is 12 miles from Whitehall and Winchester is 13 miles. Both are supplied with electricity by a 16,500-volt, single-phase transmission line. The transmission lines are built just outside of railroad right-of-way, the right to set such poles being given by the farmers. In distributing these poles an arrangement was made with the railroad company whereby a freight train was run at slow speed over that part of the railroad to be paralleled by the transmission line. A car loaded with the poles was placed in this train, and four men were provided to unload these poles at regular intervals. The points to throw off poles were marked by pieces of red cloth tied to the fence. In this way the poles were distributed at comparatively slight expense.

Electric Power in the Black Hills Mining District.

The famous Homestake mine at Lead, S. D., the largest gold mine in the United States, is preparing to develop a water-power for its own use on the Spearfish River in the Black Hills. This water-power will have 700-ft. head, and the amount of power available will vary from 3500 hp to 10,000 hp. This mine has already made a good start in the introduction of electric power, and purchases considerable quantities from the Consolidated Power & Light Company and the Black Hills Traction Company, both of which have distributing and transmission lines over the Black Hills mining district. The Homestake mine now has 16 25-hp motors, operating one of its stamp mills with power purchased from the Black Hills Traction Company. In equipping a stamp mill with motors the practice has been to operate one bank of 10 stamps from one motor. When a stamp mill is steam-driven, it is operated from a lineshaft with a steam engine at one end. In another mill the Homestake mine has 10 25-hp motors which are operated from a small water-power plant owned by the mining company. A contract has recently been let to electrically equip a third stamp mill, and it is likely that the work of electrically equipping much of this mining company's machinery will go steadily on from this time in preparation for the electric power to be supplied from the new plant. A plant for the treatment of

slimes operated by this company at Deadwood is electrically operated with power purchased from the Consolidated Power & Light Company.

The Black Hills Traction Company and the Consolidated Power & Light Company have until recently operated independently. They are now operating in parallel, which gives both systems a chance to operate more economically. The Consolidated Power & Light Company has a thoroughly modern steam turbine plant at Pluma. This has two 1500-kw, 11,000-volt Curtis turbo-alternators and one 500-kw, 2300-volt turbo-alternator. Distribution to the various lines is accomplished at 11,000 volts. The local lighting and power distributions in Deadwood and Lead are the standard 2300-volt systems. The Black Hills Traction Company has a 1000-kw water-power plant and a steam plant employing a 500-kw Westinghouse turbine. Its transmission lines operate at 24,000 volts. This company does practically nothing but a wholesale business, selling power to mines. Some of this mining business has an excellent load factor, records showing from 69 to 90 per cent load factor, estimating the maximum load as being the connected horse-power. This is the ratio of the average load to the connected horse-power.

Heating Devices and Increase of Residence Revenue in Denver.

Mr. C. N. Stannard, secretary of the Denver Gas & Electric Company, says that about half of the residence customers of that company are supplied with electric irons. The work of introducing them still continues. The irons recently placed are the American and the Pelouze, the sale price being $5 for the American and $5 for the Pelouze.

The company is just starting to put out 1000 General Electric vertical toasters. These will be put out on 30 days' trial, like the irons.

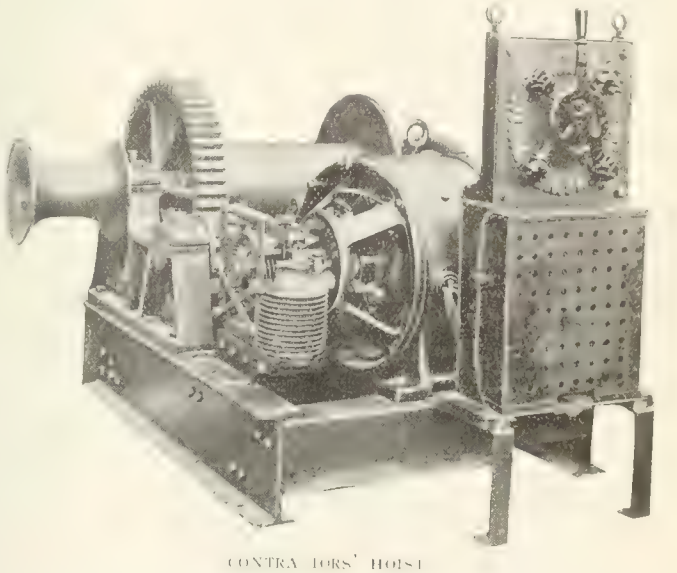
The company still continues the practice of employing a certain number of service supervisors whose duty it is to visit consumers having electric service, with a view to correcting any defects in service and getting in as many new energy-consuming appliances as possible. The plan, which has been described before in these columns, is to assign to each of the seven service supervisors a certain number of consumers, which they are supposed to visit within a certain period. This service supervision work has now gone on a sufficient time, so that the supervisors are on their second round; thus all the consumers have been visited once and are now being seen again. A gratifying thing about this work is that the supervisors are making more money for the company on the second than they did on the first trip.

An Enterprising Small Central Station.

The possibilities of electric lighting in small communities is illustrated by the history of a small electrical generating plant established the present year at Intercourse, Lancaster County, Pa. The owners of a grist mill in the town, which has a population of less than 1000, installed last summer a 50-kw, three-phase alternator, switchboard and 90-hp engine, and upon starting up had a large store, which they equipped throughout with tungsten lamps, as the only customer. At present a considerable number of residences, hotels, stores and factories are connected. Moreover, a transmission line 2¾ miles long is being built, over which will be supplied neighboring towns, namely, Leaman Place, Paradise and Gordonville. The line will be operated at 2300 volts, and quite a considerable power business is anticipated, as when the transmission line is completed the plant will be in operation 24 hours per day. A recent addition to the customers is the Woods Lane duck farm, which is one of the institutions of that section of the country. Tungsten lamps are being installed throughout, and the electric light will be used in connection with feeding the ducks after dark, as a means of getting them on the market earlier than usual. The plant is operated on the meter basis, which has been found entirely satisfactory. In taking on a customer the connection to his place is installed free of charge if within a reasonable distance of the main line. The rates are 12 cents per kw-hour up to 50 kw-hours per month, and 10 cents per kw-hour beyond that consumption. Mr. Enos L. Zimmerman is manager and part owner of the plant.

Renting Electrical Hoists at Rochester, N. Y.

In most of the smaller cities, the building contractors have not enough capital to enable them to invest in the ordinary, though expensive and excellent, hoists developed for electric service, the use of which is thoroughly justified in larger cities. Moreover, construction work in smaller cities is not continuous enough to warrant carrying this expensive equipment owned outright by each individual contractor. The Rochester Railway & Light Company has therefore been forced into the development of a cheap, assembled hoist made from standard parts and which is capable of adaptation to direct-current or alternating-current circuits. Complete control is had by means of a rheostat of the railway type, the motor being reversed in



CONTRACTORS' HOIST

direction of rotation for descending loads. A solenoid brake is substituted for the ordinary foot-lever brake and standard back-geared motors are employed, the back-gear bearings being made to fit an intermediate shaft from which the motor swings much in the same way as does a street-car motor. The outboard end of the motor is flexibly attached to the bed plate and in place of the control arrangement shown in the illustration it is proposed to attach the controller to the motor body and to suspend the control resistance from the bottom so that either motor with its resistance control and solenoid brake complete may be removed by lifting the caps on the intermediate shaft bearings. The hoist will also be provided with complete cast-gear cases, as the common practice in the use of exposed gears is felt to be grossly inhuman. Enclosing shields are used on the motors to protect the commutator, etc.

Direct current is available in certain sections of Rochester and alternating current in other sections, so the base has been arranged for the substitution of a direct-current for an alternating-current motor or vice versa. In approaching building contractors the following points are emphasized by the solicitors: The hoist is compact, portable and self-contained; there is no fuel to cart; no smoke nuisance; a maximum facility of control is afforded; the apparatus is equally economical at all loads; in lowering loads, the electric meter runs backward; the power control and brake are both operated by one hand; the brake is absolutely automatic in case of service interruption.

The hoist weighs 3300 lb. and is equipped with a 15-hp motor. Its hoisting capacity is 2200 lb. at 175 ft. per minute, or 4400 lb. at 88 ft. per minute. The contractor, if he so desires, may purchase the hoist complete with controller for $675, or the company will rent the hoist for $2 a day with a minimum charge of $10, and will deliver the hoist on the site of operations ready for work. The company also holds in stock an alternating-current motor with which to replace the direct-current motor when the apparatus is used in the outlying districts of Rochester. The substitution is made without cost to the contractor and the rates for energy are those approved by the Public Service Commission and published by the company. Based on the daily use of the connected load the rate varies from 8 cents to 2½ cents per kw-hour subject to various discounts. The Rochester Railway & Light Company has gone into the question of rates very extensively from the viewpoint of both the company and the consumer, and details of its system of rates were published in the Feb. 4 number.

Electric Vehicle Discussion at Illinois Convention.

At the convention of the Illinois State Electric Association, held at Alton in October, Mr. H. W. Dickerman, of Rockford, Ill., in a paper entitled "The Relation of the Electric Vehicle to the Central Station," reviewed the results of a set of inquiries directed to central-station companies in Illinois. The writer seven years ago was in the employ of the Rockford Edison Company, where he became enthusiastic over the electric automobile and took an agency with the consent of the management. The first electric vehicles received were crude. The total business the first year consisted of the sale of two vehicles; the second year 17 vehicles were sold. After getting a good start in Rockford other towns were visited, but with much disappointment. When he first visited St. Louis the central-station management showed no interest in the electric vehicle, but later the Union Electric Light & Power Company established one of the largest electric vehicle garages in the country, which has resulted in the extensive development of the business in St. Louis. In Kansas City, also, no encouragement was received at first, but for two years past the central-station management there has operated an electric garage.

The mercury-vapor rectifier sets brought out in recent years for charging vehicles from alternating-current supply are excellent aids to the business, on account of their low cost and automatic features which prevent the overcharging of a battery. Central stations are giving much attention to pushing the sales of flatirons and small appliances, but a few electric vehicles will take more electrical energy than many flatirons.

Mr. F. H. Golding, of Rockford, said there are 57 private garages and six public garages now connected to the Rockford Electric Company's lines. The average yearly revenue for all vehicles in the city was $60 per vehicle, and for cars kept in private garages, $48 per vehicle. In the private garages there is no need of watching consumers to see that they do not use electricity during peak-load hours on a non-peak contract. This takes care of itself automatically, because the user seldom wishes to charge his vehicle early in the evening, since it is not convenient to do so. He prefers to set it to charging the last thing at night and leave it charging all night or until it is cut out automatically. The rate for charging to electric vehicle owners is 6 cents per kw-hour. Public garages get 1 cent discount to provide for resale at 6 cents to the vehicle owner. The garages are on a non-peak contract providing that electricity shall not be used for charging from 4 p. m. to 9 p. m. The public garages are not so careful about observing the non-peak clause as are the private garages. The central-station company took charge of the batteries of vehicles operating in the city for a number of years, and owners now understand the care of batteries better than formerly. Although the Rockford Electric Company has discontinued the care of vehicles and batteries, it has had virtually to resume this work again, acting through a former employee who understands battery maintenance. In general, Mr. Golding favored the care of vehicles at public garages, as the batteries are then more likely to receive proper attention. Mr. Dickerman on the other hand favored the keeping of vehicles at private garages on the ground that they are likely to receive better care.

Mr. John F. Gilchrist, of Chicago, reported that the Commonwealth Edison Company is operating 18 3000-lb. wagons in its supply department, and has found that they are more economical than horses where they are in service where speed is possible. There are about 2300 electric passenger vehicles in Chicago. The possibilities of income from the electric vehicle can be seen when the amount of money spent annually in feeding horses at present is considered. There are said to be 80,000 horses in the city of Chicago, costing an average of $125 a year each, or a total of $10,000,000. While one can hardly figure on displacing all horses, the revenue by displacing even a part by electric vehicles would be considerable.

Mr. Golding said that some Rockford people have both electric and gasoline vehicles, but the gasoline vehicle is used very little as compared to the electric. Mr. E. W. Smith, of Kewanee, reported one consumer who has two electric vehicles and one gasoline vehicle. The electric vehicles are used all the time, but the gasoline touring car is seldom taken out. Mr. Smith's own electric vehicle has been run six years with two sets of batteries. The rate for charging is 6.3 cents per kw-hour on a non-peak contract. The attention of consumers is called to the non-peak clause by means of a card.

Mr. J. G. Learned, of Chicago, spoke of the plan of having a regular flat-rate sign patrolman turn off garages during the peak-load period. One member inquired as to how many electric vehicles one man could take care of. Mr. Golding thought 40 to 50. In Rockford the man doing this work charges 50 cents per week for inspection and small repairs, and has 50 cars under his care, which are brought in for his inspection. Mr. Dickerman reported that in St. Louis a man makes a business of visiting cars in private garages once a week for inspection at a charge of $5 per month. Mr. N. M. Argabrite said that a special direct-current automobile charging feeder which was maintained at Winona, Minn., showed that automobile charging is not usually done on the peak.

Gas and Gasoline Competition.

Mr. John G. Learned, of the North Shore Electric Company, Chicago, read a short paper on "The Advantages of the Tungsten Lamp" at the Illinois State Electric Association convention at Alton in October. He summed up the advantages of the tungsten lamp as follows: Better color value than other illuminants; higher efficiency than carbon-filament lamps; saving in the original cost of wiring installations because of the decrease in necessary wattage, and ability to compete with gas. So severely have the gas interests felt tungsten-lamp competition that numerous imitations of the tungsten lamp have been brought forth. Inverted mantles in clusters, with reflectors, were brought out to try to supplant the now common tungsten clusters. The latest is the new "tungsten" gas mantle. The number of consumers who will put up with the inconvenience of gas lighting are becoming less and less. The gas companies have a serious problem to contend with, in the inherent difficulties of their product when used for lighting. The advantages which the tungsten lamp has over the gas-mantle burner were brought out in some recent competitive tests of the series tungsten lamp versus the gas-mantle burner, in which it was discovered that it was impossible to maintain the rated candle-power of the mantle under actual conditions in the street, as compared with the series tungsten lamp. Until the coming of the tungsten lamp, the majority of places using carbon-filament lamps were not sufficiently lighted, and when the central station offers three times the light for the same money it is eagerly accepted. It is to the advantage of the central station to recommend the liberal use of high-effi-

ciency lamps. It is needless to advise the general use of the lamp, as it seems inevitable that with proper exploitation the income will materially increase as business on the lines becomes more dense.

In the discussion of the paper, Mr. F. H. Golding, of Rockford, said he had found the tungsten lamp a great help in competing with gas. Lighting solicitors are required to study and apply illuminating engineering, using Cravath and Lansingh's book on "Practical Illumination" and their tables. The general aim is not to reduce a customer's bill, but to produce more light. In case it is found that a customer is about to make an installation in which the light will surely be insufficient, the solicitor writes the customer a letter of protest. This puts him in a better position to talk after the lighting installation has been tried and found wanting than if he allowed it to go in without comment. In regard to the making good of broken tungsten lamps brought back by purchasers, Mr. Golding said that if a tungsten lamp burns out within three days, or blackens, his company will renew it. Many lamps, however, are put out through the local contractors, who purchase them at the company's office. Mr. Hadley, of Canton, thought it best to sell to the contractor only in standard packages, so as to prevent controversies. Mr. Golding replied that it was a great convenience to the contractor to be able to purchase lamps in small quantities. Mr. N. M. Argabrite, of Belvidere, stands back of lamps sold for a few days. The lamps are dated with the date of sale in an inconspicuous manner. Mr. F. M. Sinsabaugh, of Carrollton, also makes it a practice to date lamps when sold. Mr. E. G. Schmidt, of Springfield, said that companies need not be afraid of reduction of wattage with tungsten lamps, as people want more light rather than lower bills. Mr. Sinsabaugh had found the same thing. Mr. E. W. Smith, of Kewanee, said that if a ½-watt per candle lamp came on the market it would be welcome; it would still further help the business. The effect of the tungsten lamp at Kewanee has been to broaden out the daily peak load. One member reported some trouble from an "anti-wattage" contractor. Mr. F. H. Golding reported very cordial relations between his company and the four contractors in the town. The company acts as adviser to a consumer, drawing plans and specifications for wiring. Of all specifications, four copies are made, so that all the contractors can bid on them if they desire. The company supervises the installation for the consumer. The aim is to make the consumer's lighting as near right as possible, without regard to whether it increases or decreases the connected load.

Mr. J. R. Cravath, of Chicago, reported that at Lawrenceville practically all of the gasoline lighting had been displaced with tungsten lamps, and that electric lighting is used in practically all stores in the business district. This is also in competition with 30-cent natural gas.

GASOLINE COMPETITION.

Mr. David Davis, of Litchfield, gave a talk on "Gasoline Lighting." A gasoline lighting plant factory is located at Litchfield and numerous exhibition plants are maintained there by the factory. There have been perhaps one dozen explosions and one $50,000 fire as the result of gasoline lighting plants.

Mr. John G. Learned, of Chicago, reported having used "Scott's Digest" with success. Copies of this digest are sent to owners of the gasoline lighted buildings. The tenants are then seen and persuaded to put in tungsten lamps. In some towns in his territory gasoline plants have all been driven out.

Mr. C. W. King, of Lewiston, makes it a policy to purchase occasionally a gasoline plant of some user who takes electric light and advertise it extensively. He thought it safer to handle powder than gasoline.

Mr. J. T. Calloway, of Greenfield, reported having 10 or 12 gasoline plants in a town of 1500 inhabitants. He found that whenever the user kept an accurate account of the expenses of his gasoline plant, the tungsten installation had figured out cheaper at a 10-cent rate.

Mr. William H. Brown, of Peoria, reported about 400 gasoline plants in that city. He would like very much to secure a solicitor who could succeed in getting these plants out.

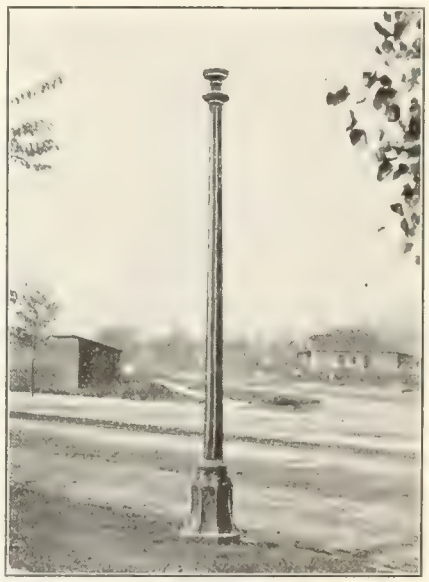
INTERIOR WIRING AND ILLUMINATION

Artistic Post Lighting for Omaha.

A movement for better lighting of down-town streets has begun in Omaha, Neb. One block has been equipped with handsome five-lamp iron posts having one central upright lamp and four lamps on short goosenecks. Each socket contains a 60-watt tungsten lamp. A movement is on foot among the business men to adopt this plan for lighting all of the principal business streets.

Unprotected Buried Cables in Denver Parks.

The Denver Gas & Electric Company is experimenting with unarmored lead-covered cables buried directly under the sod along the parkways of certain parks and boulevards, the cable having been used for supplying series Nernst street lamps on Cherry Creek Boulevard. Recently another circuit has been installed at the new entrance to City Park, to supply series tungsten street lamps. The cable used has a lead covering, with insulation about ¼ in. thick, consisting of 5/32-in. cambric and



BOULEVARD PARKWAY WHERE CABLES ARE BURIED

3/32-in. rubber. The lead sheath is 1/16-in. thick. Outside of the lead sheath is one layer of treated paper and two layers of jute. On Cherry Creek Boulevard one mile of this cable has now been in service over 18 months, buried 18 in. below the surface. In some exposed places a board is laid over the cable, and in some other places fiber conduit is used for its protection. Where the cable comes up inside of the posts, connection is made to the wires, which run up the post by means of soldered joints taped with varnished cambric. This work has been done under the supervision of Mr. W. A. Carter, electrical engineer, by whose courtesy this information was furnished. The accompanying illustration shows one of the boulevard lamp posts on the parkway under which this cable is buried and gives an idea of the conditions under which this cable is being used.

Central-Station Illuminating Engineering Methods in Denver.

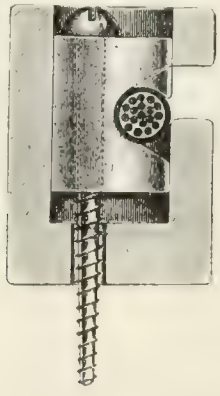
The illuminating engineering department of the Denver Gas & Electric Company, in charge of Mr. C. F. Oehlmann, has been referred to a number of times previously in these columns.

This department was established primarily for the purpose of introducing electric lighting where gasoline plants exist and satisfying complaining customers already using electric light. The general methods of this department are similar to those used in working up sign business under the supervision of Mr. George E. Williamson.

First a careful survey of the consumer's premises is made and the illumination equipment is passed upon. Draftsmen and fixture sketch artists are employed to draw up complete floor plans of the store or building to be lighted, showing the location of the outlets and the various store fixtures, tables and desks. Handsome drawings are also made of the fixtures recommended. By going into the matter thoroughly in this way, the customer is impressed with the fact that the company has been giving the matter considerable attention and that the company's engineers know what they are talking about when they approach him with the final plans. He falls under a certain sense of obligation for the attention given to his installation, and usually will accept the recommended plans. Most of the store-lighting plans now being drawn up provide for either tungsten lamps with Holophane reflectors or Westinghouse Nernst lamps. The central station keeps a stock of the tungsten lamps and reflectors and the Nernst lamp business is handled by a special representative of the Nernst Lamp Company in Denver, who keeps in close touch with the illuminating engineering department of the central station.

Insulator for Surface Wiring.

Although the tendency in this country within the past few years has been away from the cheaper classes of wiring toward the more expensive conduit installations, there has been a marked movement on foot in England and on the Continent for cheaper wiring schemes which would not necessarily embody the element of danger. It is necessary, of course, with the latter systems to use exposed wiring and to have fittings which will enable the work to be performed rapidly, so that the item of labor will not be a serious factor. The accompanying illustration shows a single grip insulator of white porcelain which is said to be used extensively in connection with these cheaper



SECTION THROUGH GRIP INSULATOR.

systems of wiring. The insulator is made up in two parts, the inner sleeve being free to move within the cylindrical shell. In using the device the cable is passed into the slots in the two parts, and these are clamped together by an ordinary wood screw, which also serves to attach the insulator securely to the wall.

The design is quite simple, and the cable is held rigidly without any danger of its insulation being damaged—the bearing surface being large and without sharp edges. As shown in the illustration, the wood screw is separated from the cable by a porcelain partition, so that even if bare wires were stretched from the insulator there would be no danger of leakage to the screw or over the surface of the porcelain, which is glazed throughout. The device has found a wide application for warehouse and factory lighting, as well as for temporary outdoor installations.

Tungstens Displace Gasoline Lamps in New York City Parks.

The Park Department of New York City has given orders to replace the present gasoline lamps in Central Park, Manhat-



FIG. 1.—POST ON RIVERSIDE DRIVE, NEW YORK.

tan and Prospect and Ft. Greene Parks, Brooklyn, by 60-watt tungsten lamps mounted on suitable standards furnished by the



FIG. 2.—ANOTHER STYLE OF POST, RIVERSIDE DRIVE.

city. Work on all installations is now under way and it is expected that by the new year, the lighting scheme will be com-

pleted. Central Park, which now has 400 gasoline lamps, is to have 1477 electric lamps such as are at present in use on Riverside Drive and in Riverside Park. The posts themselves will be of a design sanctioned by the Municipal Art Commission and will be a great improvement over the old, not only in service but in appearance. They are constructed of cast iron with a verdi-bronze finish. Along the Mall and about the public buildings round white globes will be employed to diffuse the direct glare of the light and to add to the artistic treatment; while along the paths and roads, a clear glass globe like that used in the present form of city street lamps will be employed.

The reason for the change is three fold. In the first place, the parks have always been poorly lighted and have been in many places dangerously dark. In the second place the Welsbach gasoline lamps cause the destruction of the grass in a 3-ft. circle about every lamp-post, the gasoline used in filling the tank over each lamp being more or less inadvertently spilled or allowed to drip on the turf; this blights the sod almost instantly. In the third place, it is found that the lamplighters in going from lamp to lamp make patches across the public lawns by following the same paths evening after evening. The use of electricity will obviate all these defects.

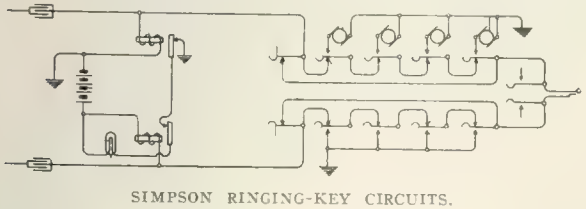
The lamps will be fed from underground armored cable placed directly in trenches dug in the soil and afterward covered over again and sodded. The circuits will be controlled in sections from a central point. The direct-current series arc lamps used around the lakes in Prospect Park will not be displaced by the tungstens and will remain as they are. These are hung from arms extending out over the lake so as to offset the effect of the trees, and are especially useful in lighting the lake during the winter when it is frozen over and given up to skaters. The New York Edison Company furnishes the energy used by the Manhattan Parks, and the Brooklyn Edison Company that used in the Borough of Brooklyn. It is expected that eventually every gasoline lamp in New York's numerous public parks will be displaced by tungsten lamps.

New Telephone Patents.

IMPROVED APPARATUS.

Whenever a ringing key is inserted in a circuit, its inner contacts being connected to open the circuit behind the point of attachment of the ringing current, a chance for trouble is introduced. When a gang-ringing key is required, however, each key, introducing contacts between itself and the key preceding, the chances for trouble from a faulty contact are greatly multiplied. To obviate this difficulty there were introduced special gang keys wherein a single cut-off key served to do the circuit opening for all the ringing contact keys, it being necessary, of course, to so arrange the parts that the cut-off key responds to the depression of any of the ringing contact keys.

Mr. C. A. Simpson, of Chicago, Ill., has now come forward with an improvement upon this scheme, by so arranging his gang key that there are two sets of cut-off contacts in parallel



SIMPSON RINGING-KEY CIRCUITS.

arrangement, so that both branches of the circuit must fail at the same time to cause trouble. Fig. 1 shows the circuit through the key, it being understood that the mechanical arrangement of parts is the usual one, viz.: a rocking bar which serves as a latch to the last, depressed push, and which also, in giving away before the plunger, serves to actuate the auxiliary or cut-off key. In the figure this latter is the key to the extreme left. The Kellogg Switchboard & Supply Company has been assigned Mr. Simpson's patent.

In ordinary commercial telephone working it usually suffices to determine upon a satisfactory efficiency for the receiver and then to maintain this constant not only for each individual instrument, but for all instruments. For the audiphone, with its over-excited receiver, it is necessary to adjust the operating efficiency to the particular state of hearing of the user. A very simple way to accomplish this has been devised by Mr. C. E. Williams, of Natick, Mass., which is simply a magnetic shunt about the diaphragm. Suppose the pole pieces elongated beyond the receiver coils sufficiently to be drilled. An iron cylinder is inserted in the drilling in one pole, the other not being drilled, and a screw device, which can be operated from without the receiver shell, serves to drive the cylinder forward and back as desired, thus providing an adjustable magnetic shunt about the diaphragm. It will be seen that the receiver is thus adjustable from nothing to its maximum efficiency.

Most receiver-supporting arms have been invented as auxiliary attachments for telephones, but recently there has been a tendency toward making them an integral part of the set, and several patents recently have described arms of this type. The latest is an arm patented by Mr. Henry Eccles, of Laclede, Mo. This arm attaches to the usual transmitter-supporting arm between the arm proper and the transmitter case. The receiver arm is hollow and projects at right angles to the transmitter arm for a short distance, where it turns at right angles and extends forward so that the receiver at its end is at a proper position for the ear. At the elbow or right angle is a hinge, the forward arm swinging horizontally thereon a few degrees between stops. A spring impels the arm inward and the ear of the user impels it outward. Within the arm, which is hollow, are the switch springs which control the circuits and the arm in its positions controls the arrangement of the circuit.

Mr. L. H. Webster, of Belvidere, N. Y., has obtained a patent for what he calls a telephone guard—viz., a wire device to be clamped to a transmitter mouthpiece to receive the lips of the user and thus serve as a gage for distance, preventing contact with the mouthpiece, yet encouraging close proximity. An antiseptic device is the subject of a patent granted to Mr. F. Schilling, of Nuremberg, Germany. He does away with the ordinary transmitter mouthpiece and substitutes therefor a sheet-metal mouthpiece, the wide end of which is closed. That is to say, the mouthpiece is bottle shaped, the neck attached to the transmitter and the flat bottom toward the user. This bottom serves as an auxiliary diaphragm. It may be readily kept clean by wiping.

STEP-BY-STEP PARTY-LINE APPARATUS.

A sending apparatus for a step-by-step system forms the subject of a patent granted to Mr. Nils Norstrom, of Chicago, Ill., and assigned to the Anderson Electrical Manufacturing Company. This apparatus is provided with a separate lever for each number to be sent. When the lever for any number is actuated, the motor spring of the contact-maker is wound and this proceeds to send out a series of makes and breaks. This causes all stepping devices at the several stations to advance synchronously. The selection of any one of these depends upon the sending of an extra impulse when the stepping devices have advanced to the point corresponding to that station, as each is adjusted to a different distance. Each lever provides for sending this auxiliary impulse for the station with the number of which it corresponds.

Mr. W. W. Hill, of Sumter, Minn., has also obtained a patent for a step-by-step system. In this system a spring-driven motor actuates the make-and-break arm whenever its latch is sprung. Each station corresponds to its own angular distance from normal and the calling keys are spaced similarly.

The patent granted to Mr. R. Hamilton, of Boston, Mass., relates to improvements in a previously patented system. The controlling or operating magnets of the various stations are in the main circuit, and shunts are provided about these to improve the transmission. The circuit is normally open, so that there is no loss of current when not in use. Two break-wheels are used. One steps the instruments up to selection, and the

second steps all home to zero automatically as soon as the connection is no longer desired.

SWITCHBOARD CIRCUITS.

With the magneto system there have been numerous suggestions to do away with the hand generators at the stations, using instead a momentary contact during the transition of the switchhook. Usually there has been a battery or direct-current generator connected to the circuits in a manner such that this contact completes a ground connection to operate the drops. Mr. F. C. Unger, of St. Louis, has substituted an alternating generator with a condenser in its ground connection and has patented such a system. Offhand, it would seem that this generator would cause noise, as it remains connected throughout conversation, although through heavy retardation, which operates differently to the ground connection and cumulative to the talking circuit.

The usual operation of trunking on the calling circuit basis involves one-way trunks and is a separate group of trunks for business in each direction. These groups may be combined, if each trunk is equipped at both ends with both types of terminal, the one first used protecting the trunk from use at the other. In other words, if a trunk is picked up "incoming" at one exchange, it must be protected against assignment as "incoming" at the other. In order to accomplish this Mr. C. A. Simpson has arranged a signal at each incoming terminal, its lamp glowing to guard the trunk whenever it is in use at its outgoing terminal in its own exchange. He has assigned his patent to the Kellogg Company.

Letters to the Editor.

Norwegian 170,000-kva Nitrogen Plant.

To the Editor of Electrical World:

Sir:—Under the heading "Atmospheric Nitrogen" in your issue of Oct. 14 it is stated that the order for generators for the Rjukanfos nitrogen fixation plant was given to a Swiss firm, which statement is not quite correct. Our firm, the Allmänna Svenska Elektriska Aktiebolaget, received an order for five three-phase generators, 17,000 kva, 11,000 volts, 250 r.p.m., for this plant at the same time that five similar machines were ordered from Brown, Boveri & Company. The above-named generators are now being built in our works at Westeras, Sweden, after our own design.

Allmänna Svenska Elektriska Aktiebolaget.
Westeras, Sweden.

Some Errors in Testing Sources of Light.

To the Editor of Electrical World:

Sir:—I have read with much interest the editorial on "Some Errors in Testing Sources of Light" in the issue of Oct. 14, and also the letters relative to this editorial in the subsequent issues of Oct. 21 and Nov. 11. Although I should not desire to be misunderstood as attempting to give a complete statement of the problem, which would be a very difficult task and entirely unsuited for presentation either in an editorial or in a letter to an editor, I should like to add a few words to the discussion which, in my judgment, has wandered considerably from the apparent intent of the editorial.

It would seem to me that the editorial was meant to be a practical statement to practical men of some of the errors involved in testing practical sources of light, and to this extent was very pertinent in the light of some recent attempts to investigate mathematically the distribution of light from extended sources. In the last analysis all practical luminous sources must be divided into *surface* and *volume* sources, since we cannot conceive of *material lines* or *points*, and all practical sources, whether primary or secondary, consist of *matter* radiating or reflecting luminous energy. As a matter of fact, if we view radiating surfaces as was done by Fourier, Poisson, Zöllner, Lommel, and others, even so-called *surface* sources are reduced to *volume* sources in which the emitted energy comes from the elements of volume lying to a greater or less distance beneath the surface.

In cases, however, where the capacity is such that practically all of the energy emitted comes from those elements lying quite close to the surface, the distribution around an infinitesimal element of surface follows approximately the cosine law. This is the case in practically all radiating solids, and the character of the radiation, following approximately the cosine law, is so distinct from the radiation from unsaturated luminous gases, as in the case of the Moore tube or the mercury vapor tube, that it would seem expedient to distinguish *surface* sources from *volume* sources, as is done in the editorial.

It has been the general custom, and until within a few years ago, the almost universal custom, to consider all practical luminous sources as points to which the law of the inverse square of the distance applies. Although in reality there are no real *point* sources, this convention is, in my judgment, quite permissible in many cases, since the resultant errors are negligible. As new sources having relatively large dimensions have been introduced, and as new interest has been aroused in the consideration of such secondary sources as diffusing skylights, it becomes necessary to keep in mind the limitations of the inverse square law. I think, therefore, that the editorial is very much to the point in dividing practical luminous sources into those which may, for practical purposes, be considered as points, and those which, even for practical purposes, may not be considered as points, subdividing the latter into those which must be considered as *surface* sources—i.e., those to which the cosine law applies approximately and those which must be considered as *volume* sources—i.e., those to which the cosine law does not apply even approximately.

Although I appreciate the point which Mr. Hering has raised in reference to including *line* sources, I am inclined to think that, from a practical standpoint, the inclusion of *line* sources would complicate rather than simplify the classification. As stated above, there are no real *line* sources, and it is impossible to conceive that there ever can be any material sources which would have the characteristics of a geometrical line. In every case the source will be either a *volume* source or a *surface* source, and it will be necessary, in calculating the distribution, to determine whether the source is an unsaturated radiating gas or whether it is a radiating surface. Moreover, if a surface, it will be necessary to know whether it is a long slender strip or a long cylinder of small diameter, for the distribution will be different in the different cases. It does not seem to me desirable therefore in a practical classification to lay any emphasis on *line* sources, since in all practical consideration of such sources it will be necessary to analyze them further into *volume* or *surface* sources.

There is one word that I should like to add regarding the letter from Mr. Bassett Jones, which deals more with generalizations regarding the relation of physics to mathematics than with the specific point in question. I shudder at the thought of assuming the responsibility of urging publicly a lack of rigor in mathematical treatment of physical problems. Far more serious consequences result from inexact mathematics than from unwarranted rigor. Master minds, such as those mentioned by Mr. Jones (Maxwell and Heaviside), recognize the limitations of natural phenomena and mathematical analysis and might with least chance of error bridge the gaps in analysis with scientific intuition.

Mr. Jones would take exception to the usage of the term "application of mathematics to physics," but it would seem to me that the basis of criticism comes from a self-imposed idea of the meaning of the phrase. Mathematics, it is true, is frequently applied as thick coats of "green" paint that entirely hide the object coated and might deceive the less careful observer as to the true nature of the hidden substance. But I am inclined to think that even a moderately competent person

would be quite able to ascribe the "greenness" to the paint, and would not mistake the painted object for *real* mathematics, which has been called by Carlyle, "the greenest of all vegetables," and has hence been depicted by Maxwell as a cabbage. Mathematics *should* be applied to physics as a chisel to a piece of marble, which adds nothing, but by the process of elimination, uncovers an otherwise hidden face or figure.

Cleveland, Ohio. Edw. P. Hyde.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Magnetic Flux in Air.—T. Lehmann.—For the determination of magnetic stray fluxes the distribution of the lines of magnetic flux in air is of fundamental importance. The author describes an exact graphical method for plotting the lines of magnetic flux in air-gaps. His method is based on subdividing the air-gap into tubes of magnetic lines with unity reluctance so that the mean length of each tube equals the mean cross-section. Various examples are given to illustrate the method.—*Elek. Zeit.*, Oct. 21 and 28. The first part of the article also in *La Lumière Elec.*, Oct. 23.

Iron Losses in Elliptic Rotary Fields.—E. Rother.—Since the introduction of single-phase commutator motors which are operated partly with alternating fields and partly with elliptic rotary fields, the problem of determining the iron losses in such fields has increased in importance. The author describes a method of measuring the iron losses in elliptic rotary fields. After a general discussion of the changes of magnetism in elliptic rotary fields and in its special cases (the circular rotary field and the alternating field) he gives the loss of the change of magnetism of an iron particle rotating in such fields. On the basis of the results of measurements the author describes a method of calculating the iron losses in elliptic rotary fields. In conclusion, he compares and discusses his results with formulas and measurements of the iron loss in pure alternating fields.—*Elek. und Masch.* (Vienna), Oct. 17 and 24.

Starting Induction Motors.—C. Rey.—A mathematical study, illustrated by diagrams, of the rôle which the higher harmonics played in the starting of squirrel-cage induction motors.—*L'Industrie Elec.*, Oct. 25.

Lamps and Lighting.

Metallic-Filament Lamps.—Blondel.—A review of the present status of metallic-filament lamp manufacture. The author distinguishes two different methods of manufacture. The first is a direct method in which the filament is made directly from the desired metal or its compounds. Tantalum may be drawn into wire in pure metallic state. One company claims that filaments of molybdenum and tungsten, with a small amount of carbon, can be drawn; the carbon is to be removed afterward. Singer claims that an addition of 1 per cent of aluminum (which has otherwise no bad effect) makes metals ductile which otherwise could not be drawn into wire. This method, however, has proved successful so far only with tantalum. In other direct methods the filaments are pressed from a plastic paste and then sintered together. The most general method is the manufacture of compressed filaments from mixtures of the metal and its oxide and a binding material. When finished these filaments must be reduced and decarbonized. The second general class of methods comprises the indirect methods in which the filament produced is not homogeneous. The metal may be deposited, for instance, on a carbon core, the core being afterward removed. This method has been employed for thorium, zirconium and tungsten, also for the preparation of a composite filament of tungsten with a tantalum core. The specific watt consumption of this filament is stated to be between that of the pure tungsen and that of the pure tantalum filaments. The ratio of the initial current when the circuit is closed and the current when the lamp is in regular operation is between 0.7 and 0.54 for carbon lamps, between 4.6 and 4.9 for tantalum lamps, and 7.3 for tungsten lamps. With alternating current the metallic-filament lamps show oscillations of the candle-power. These are greater for 25 cycles than for 50 cycles, and amount to 37 per cent with tungsten lamps at 25 cycles and 17 per cent at 50 cycles. Tantalum filaments suffer from these oscillations and they are, therefore, unsuitable for alternating current. The curves giving the distribution of light of metallic-filament lamps follow almost exactly the law of Lambert, according to which $J\alpha = J_h \cos \alpha$, where α is the angle with the horizontal plane. Most light is, therefore, radiated in the horizontal direction. The ratio of the mean spherical candle-power to the horizontal candle-power varies between 0.6 and 0.9; this coefficient increases with the number of hours for which the lamp is used. It is recommended to use 110 volts instead of 220 volts as the supply e.m.f. for new direct-current stations. With the present condition of incandescent-lamp manufacture the cost of energy at 220 volts would have to be 25 per cent less than at 110 volts in order to get the same cost of illumination in the two cases. In alternating-current plants, the voltage is of less account since small transformers can be used advantageously.—*Bull. de la Soc. Int. des Elec.*, Vol. 9, 1909, page 79; abstracted in *Elek. Zeit.*, Oct. 28.

Metallic-Filament Lamps.—B. Duschnitz.—The first part of a serial on the latest processes for making metallic filaments. The article seems to be based chiefly on patent specifications of the last year. No further suggestion has been made during the last year on the manufacture of filaments directly from the oxides of pure rare earths. Various propositions have been made, however, for making filaments with the aid of organic substances and binding materials. The manufacture of metals in colloidal state or from paste has been further developed. Most interest is taken at present in the addition of easily fusible metals to refractory metals in order to permit a good sintering of the refractory material. The intention is chiefly to produce filaments directly from the powdered metal by pressing, drawing or rolling. In the present instalments the author describes the latest method of making filaments with the air of organic substances, and the latest methods of making filaments by wet methods, either with the aid of colloids or the production of filaments from liquid metallic compounds.—*Elek. Anz.*, Oct. 17 and 28.

Train Lighting.—An illustrated article on the train-lighting system of Brown, Boveri & Company. Each car is lighted independently by means of a shunt-wound generator driven by an axle of the car and joined in parallel with a storage battery. A regulating apparatus operates in such a way that the lamps are always supplied with current at the correct voltage and that the battery is being regularly charged and discharged without being overloaded. The article deals especially with some recent improvements in the regulating apparatus.—*Elek. Anz.*, Oct. 21.

Illumination of Rooms.—An article, illustrated by diagrams, on the economy of electric illumination of rooms by means of incandescent lamps.—*Elek. Anz.*, Oct. 24.

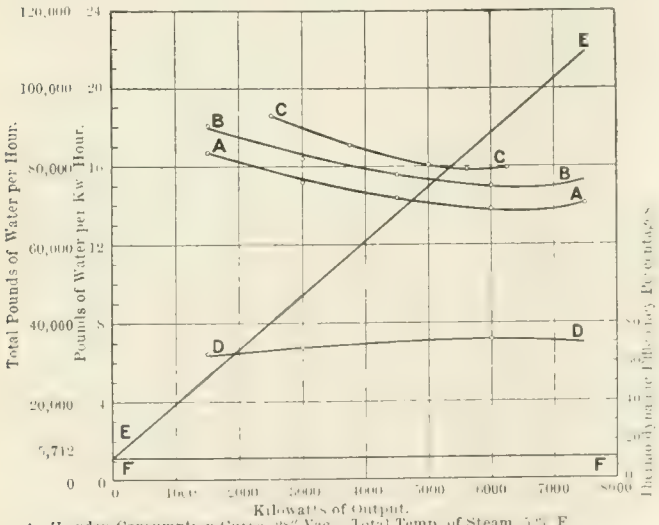
Generation, Transmission and Distribution.

Transmission System in Southern France.—An illustrated description, with a map, of the very extended energy transmission system of the Société d'Energie Electrique du Littoral Méditerranean. It comprises 19 generating stations with an aggregate of 91,800 kw in water-power and 22,000 kw in steam-power as reserve. Some notes are given on the voltages, which range from 50,000 to 10,000, the frequencies (25 or 50), etc. The company supplies energy chiefly in bulk. It supplies energy to 10 tramway systems and 16 companies for local distribution of the energy. Among the latter is the Sud Electric Company, which supplies energy over a district having 400,000 inhabitants. —*Elek. Zeit.*, Oct. 28.

Electric Operation in Collieries.—W. H. Patchell.—The first part of an illustrated article on the electrification of the Ferndale Collieries, in South Wales. A description is first given of the generating station and the distribution system, after which the author proceeds to describe the various applications of electric motors. These include electrically driven fans, haulage, pumps and winding equipments. The paper is to be continued.—Lond. *Electrician,* Oct. 29.

Steam Condensers.—F. Hodgkinson.—The conclusion of his long illustrated serial on the choice of a steam condenser. While the author thinks that every case is to be considered on its own merits, he gives the following general governing rules: "Do not use a surface condenser unless condensed steam must be returned to the boilers and it is sure to be a paying investment, remembering that in the surface condenser the cooling medium does not intimately mix with the steam. Choose a plain jet or centrifugal condenser rather than barometric unless the advantages in the particular layout in favor of the barometric are very certain."—*Elec. Journal,* November.

Steam-Turbine Set.—An illustrated description and account of tests of a new 6000-kw Howden (Zoelly)-Siemens turbo-generator at the Manchester electric station. Its steam consumption is even less than the very low figures obtained with the Willans-



A. Howden Consumption Curve, 28" Vac. Total Temp. of Steam 525° F.
B " " 27" Vac. " " 487° F.
C Willans Siemens (5000 Kw. Turbine, 6600 Kw. Alternator.) 27" Vac. Total Temp. of Steam, 483° F.
D. Howden Thermo-dynamic Efficiency Curve.
E. " Total Water Consumption
F. " No Load Consumption

FIG. 1.—STEAM CONSUMPTION CURVES.

Siemens 5000-kw set at Stuart Street last year. A record of these tests is given in Fig. 1, which shows the steam consumption of the new and old sets, the results being corrected so as to be comparable. It is seen that the extremely low figure of 13.8 lb. per kw-hour was obtained at full load with a 28-in. vacuum and 140 deg. Fahr. of superheat, and the results at quarter-load are also excellent. The construction of the Zoelly turbine is described and illustrated.—Lond. *Elec. Eng'ing,* Oct. 28.

Steam Turbine.—J. Reyval.—In an article on the International Electrical Exhibition, in Nancy, the author describes the exhibit of the Electra steam turbine. The problem caused by the excessive speed of steam turbines has been attacked in different ways; for instance, by the division of the speed into several stages, as in the Curtis turbine, or by the subdivision of the pressure as in the Rateau and Zoelly turbines. Both of these methods are combined in the Electra turbine.—*La Lumière Elec.,* Oct. 23.

Steam Turbines in Mining and Metallurgy.—A. P. Chalkley.—An illustrated article in which the author considers the very large economies to be effected by installing exhaust-steam turbines in collieries, rolling mills and other situations, particularly where reciprocating engines are working under favorable conditions.—Lond. *Electrician,* Oct. 29.

Baltimore Power Plant.—H. A. Foster.—A Franklin Institute paper on "power-house economics in Baltimore." The author gives a review of the complete reorganization of the system supplying energy to the Baltimore tramways.—*Jour. Franklin Inst.,* November.

Water Supply and Power.—B. A. Heinly.—An illustrated article on the plan, construction and purposes of the Los Angeles aqueduct, which is a combined water supply, irrigation and power project.—*Eng. Mag.,* November.

Traction.

London Tramways and Tramway Fares.—Statistical notes on the financial returns of the London Council Tramways during the past year. The total length of the tramways is 127.6 miles, of which 76 miles are on the electric underground-conduit system and 9.5 miles on the overhead trolley system, and the remainder is horse traction. In an editorial note it is pointed out that the most striking feature of the statistics is the decrease, during the past year, of nearly 17,000,000 in the number of passengers paying 2-cent fares. At the same time the number of 1-cent tickets issued shows an increase of about 13,000,000, while the number of passengers paying 3-cent and 4-cent fares also shows increases of about 5,000,000 and 17,000,000, respectively. From these figures, and also others showing the rapid growth during recent years in the number of passengers paying 1-cent fares, it is evident that the question of fares should receive the careful consideration of the Council. It is thought that the tramway fares need also reconsideration in the United States. In England the 2-cent fare has been the mainstay of most tramway systems, and efforts have usually been directed to increasing, as far as possible, the facilities afforded to "penny" (2-cent) passengers. It is obvious, however, that where 1-cent fares are in vogue this policy must be considerably curtailed.—Lond. *Electrician,* Oct. 29.

Multiple-Unit Control.—L. M. Aspinwall.—An illustrated description of the multiple-unit cars of the New Haven railroad.—*Elec. Journal,* November.

Installations, Systems and Appliances.

Electrical Industries in the United States and Germany.—W. Fellenberg.—The conclusion of his article. The author discusses the use of electricity for industrial purposes and claims that in this respect Germany has made the greatest progress not only by the widest introduction of electricity in mines, metallurgical works, rolling mills and in agriculture, but also by insisting at an early date on the superiority of individual motor-drive over group-drive in many industrial works. It is claimed that in this respect the development has been more rapid in Germany than in the United States. On the other hand, it is stated that from 1890 to 1905 the use of electricity for energy transmission in the industries of the United States has increased from 15,569 hp to 1,592,483 hp, and has, therefore, increased by more than 10,000 per cent within 15 years. This is said to be the most rapid development of any invention on record. The author then gives a review of the use of electricity on board ship and, finally, some notes on water-powers. He thinks it is a conservative estimate to assume for Europe and the United States an average of 6 hp per square km (about 16 hp per square mile). He estimates that about 60,000,000 hp could be made available in Europe, and 120,000,000 hp in the United States and Canada.—*Elek. Zeit.,* Oct. 28.

Development of Electric Supply Stations in England.—S. J. Watson.—A review of the development of electric supply stations in England during the past 15 years. The amount of capital invested has increased from 4,000,000 to nearly 60,000,000 of money in 15 years. In the case of the author's own undertaking, for example, during the last seven years the output has increased nearly tenfold, and large extensions had been carried out. The extra generating costs amounted to 0.586 cent per kw-hour, the extra capital charges on plant to 0.308 cent, the extra distributing costs to 0.468 cent and the extra management charges to 0.174 cent, so that the total additional cost of supplying the extra units amounted to 1.536 cent per kw-hour. The

load factor of the increased output had been 23.3 per cent. The average capital cost per kilowatt of plant and mains installed had decreased from $695 in 1894 to $360 in 1909; the number of units sold per $5 of capital invested had increased from 3.4 to 14.2; the average price charged had been reduced from 12.32 cents to 4.32 cents per kw-hour, and the gross profit had gone up from 3.3 per cent to 6.6 per cent. Also, whereas the cost of the plant and mains added during the period from 1894 to 1899 was $460 per kilowatt, the cost of the additions during the period from 1904 to 1909 was only $285 per kilowatt; and the additional working expense for the increase in the output between 1894 and 1899 was 4.26 cents per kw-hour, while the cost for the increase in output between 1904 and 1909 was only 1.36 cents per kw-hour. He pointed out that there was a difference of 293,095 kw between the total rating of the plant installed and the maximum load recorded—that is to say, that no less than 37 per cent of the total plant was provided as reserve. This represented a capital expenditure of over $6,000,000 which was entirely unproductive, a figure which, he thought, could have been considerably diminished by the more general adoption of interconnection. The reductions in average cost per kw-hour were due to a variety of causes, not the least among which had been the increase in the size of generating sets. The author discusses at some length the subject of steam turbines, and thinks it is a sign of the times that the impulse machine is being used to an increasing extent in the large sizes. The tendency of turbine construction is to increase the clearances, reduce the number of stages and to shorten the length between bearings, and progress along these lines is likely to be more successful with the impulse than with the reaction turbine. Speaking generally of rates for energy supply he expressed the view that the figure of 0.6 cent per kw-hour sometimes given as the price above which it would not pay a manufacturer in Lancashire to enter into a contract for a supply of energy was too low. Many large manufacturing concerns have found it remunerative in the long run to purchase from outside sources at prices varying between 1.5 cent and 1 cent per kw-hour, and such a price is quite sufficient to enable the most of the larger undertakings to maintain and even improve their financial position, as with the excess of the motor load at these low prices the working expenses per unit are very largely reduced.—Lond. *Elec.*, Oct. 29, and Lond. *Elec. Eng'ing*, Oct. 28.

British Station.—An illustrated description of the newly opened Blyth's Wharf generating station of the Stepney Borough Council. The reinforced-concrete building contains one 1000-kw double-current turbo set, which was moved from the old station, and a new 2000-kw turbo-alternator. A feature of the station is the 6000-volt switchboard on the Reyrolle ironclad system, and the use of the Merz-Price protective system throughout. Continuous current at 2×240 volts is provided for, as well as a high-tension supply.—Lond. *Electrician*, Oct. 29, and Lond. *Elec. Eng'ing*, Oct. 28.

Parallel Operation of Series Machines.—H. L. Beach.—A description of the difficulties in the parallel operation of

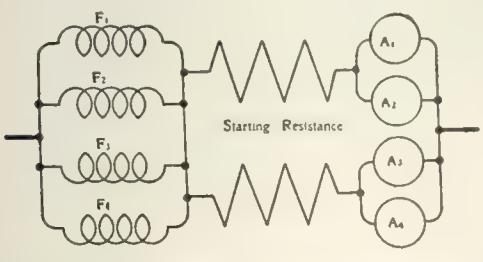


FIG. 2.—FOUR SERIES MOTORS IN PARALLEL.

machines with series-field coils. He first discusses series-wound and compound-wound generators. When two or more series-wound or compound-wound generators are operated in parallel it is necessary to use an equalizer between the various machines. The object of this connection is to maintain the desired equilibrium of loads between the generators in parallel under all conditions. In some cases the equalizer is in the form of a low-resistance cable running directly from machine to machine; in others it is desirable to have an equalizer bus-bar on a switchboard. The adjustment of the series-wound machines is far more difficult than that of the compound-wound machines. If the two machines in question are located so that the leads from one machine to the switchboard are twice as long as the corresponding leads of the other machine, resistances must be added to the leads to the latter

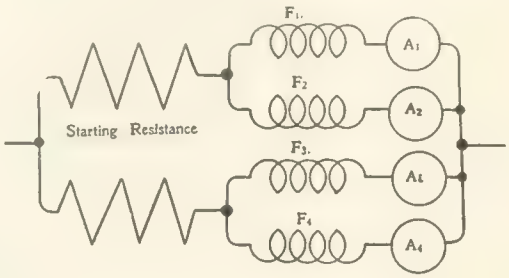


FIG. 3.—FOUR SERIES MOTORS IN PARALLEL.

machine so as to make its field-circuit resistance exactly equal to that of the other machine. To divide their load properly, it is necessary that the series-wound generators be at the same temperature when adjustments are made. The author then takes up the parallel connection of series-wound and compound-wound motors. He deals with the case in which four motors of about the size of the ordinary street-car motors were geared permanently to the load, the control apparatus being simplified by connecting the four field coils in parallel. The connections were essentially as shown in Fig. 2. Thus far the apparatus has been working very well, but careful field-circuit adjustments are necessary, which, in practice, are not always practicable. Should a field coil become partially open-circuited on any motor, the weakened field would cause the armature at once to take all the load and unless the trouble was discovered at once, the armature would burn out. Suppose that a field-circuit lead becomes broken, for example, F_1, armature A_1 would take all the current in its part of the circuit, since it would generate no counter e.m.f. The other pairs of motors, 3 and 4, would run the machine, and armature A_2, being in a strong field, would pass current through armature A_1, acting as a short-circuit on No. 2, thus giving rise to an excessive current. If there were no circuit-breakers or fuses in this current, armature A_1 would, of course, be burned out. In this case, if the field coils were separated from each other and reversed separately, the opening of a field-circuit could do no harm, since the corresponding armature would be open-circuited at the same time. This scheme of connection, which is shown in Fig. 3, is considered a safe and more correct method for the parallel operation of four series-wound motors. In paralleling any two compound-wound motors it is only necessary to have the speed regulation exactly alike to make them divide the load properly. With single-phase commutator motors another factor enters into the problem which tends to reduce the necessity of resistance equalization. This is the inductance of the field coils, which is of such a constant and reliable value that the field-coil resistance can be practically neglected. Thus the motors on the cars and locomotives on the New Haven railroad have their field coils connected in parallel pairs when running on alternating current.—*Elec. Journal*, November.

Regulation of Power Factor.—A note on a recent British patent 25,556, Oct. 21, 1909) of the British Thomson-Houston Company (General Electric Company of this country). The excitation of a synchronous motor taking a leading current and thus improving the power factor of an alternating-current system, is automatically regulated by means of a Tirrill regulator having, in place of the usual alternating-current control magnet, a solenoid with two windings receiving energy through a series transformer. The floating coil is mounted on a rod joining the cores of the two shunt windings, and the effect of

the arrangement is to hasten or retard the time of the closing of the main control contacts in accordance with fluctuations in the power factor so as to vary the field excitation of the synchronous motor.—Lond. *Elec. Eng'ing,* Oct. 28.

Recording Meters for Motor Installations.—A. G. Popcke.—An article in which the author endeavors to show how a study of existing conditions can be made by automatically recording the operations of industrial plants by the use of graphic electric meters, and that by such a study valuable information may be obtained as to the best methods of economizing in operating expenses and improving equipment. In investigating the economy of motor drive too much stress is often laid upon the cost of energy. The three important items to be considered in determining the relative advantages of different means of equipment are: first, the total hourly operating cost; second, the percentage of the total time consumed in actual work; third, the rate at which an equipment is operating while actually running. For a given equipment the first item can be determined from the wages of its operators and the overhead operating cost. The second is a direct check upon the number of delays and requires personal observations and clerical records, thus increasing the overhead charges, unless there is some means of using an automatic recording device. Where individual motors are employed, this percentage may be determined directly from the records obtained by means of graphic meters, since these show all idle and no-load intervals. The third item is a direct check upon whether or not the rate of output is the maximum under the given conditions; determined in most cases by the mechanical strength of the parts operating, the accuracy of the workmanship required and other local conditions. With individual motor drive and the graphic meter, the magnitude of the records obtained in many cases indicates at a glance the rate of working.—*Elec. Journal,* November.

Electric Cables in Collieries.—W. R. Morton.—An article on the selection and installation of electric cables in collieries. In speaking first of shaft cables, the author compares the advantages of paper-insulated lead-covered cables, paper-insulated cables sheathed with vulcanized bitumen, and vulcanized bitumen cables. He explains that for shaft cables carrying ordinary motor loads at e.m.fs. up to and including 3000 volts he recommends the use of double-wire armored solid bitumen three-core cables, with the strands "filled" for three-phase work, and double-wire armored single bitumen cables strand filled for direct-current work. With respect to underground distributor cables the question is whether to use armored or unarmored cables. Armored cables are less liable to damage when properly installed, and if the armor is properly grounded and bonded they provide a ready and sufficient means of grounding the motors, etc., and far-distant points. Various rules are then given on the laying of cables on the surfaces, in shafts and underground and on the joining of cables.—Lond. *Electrician,* Oct. 29.

Metal Sheathing of Insulated Wires.—A note on a recent British patent (24,348, Oct. 21, 1909) of J. J. Rawlings, H. W. Handcock and A. H. Dykes. Hard-metal sheathing comprising a metal strip with the two edges overlapped and soldered is liable to buckle. According to this invention a tinned metal strip is wrapped at least twice round the insulated conductor, so that the finishing edge lies parallel along the commencing edge. A set is put in the strip so that the finishing edge does not project above the even surface of the sheathing, and the joint is treated with soft solder. The folded strip is drawn through a heated die, the conductor being drawn in at the same time. The previous tinning of the sheath causes it to become solid and equivalent to a solid-drawn sheath.—Lond. *Elec. Eng'ing,* Oct. 28.

Calculation of Transmission-Line Regulation.—A. Blondel and C. LeRoy.—A continuation of their paper on the calculation of transmission lines for alternating currents, taking into account the distributed capacity and leakage. The method is essentially a graphical one. In the present installment the authors illustrate the method by the numerical calculation of an overhead line for a transmission of 20,000 kva of three-phase currents over a distance of 1200 km (720 miles) at a tension of 120,000 volts with a frequency of 25 cycles.—*La Lumière Elec.,* Oct. 23.

Electrophysics and Magnetism.

Beta Rays of Radium.—O. Hahn and L. Meitner.—It has so far been assumed that the beta rays of radium have their origin in radium B and radium C and radium E_2. The authors show, however, that radium itself gives typical beta rays, which, on account of their high penetrative power, can be distinguished with certainty from the other beta radiations. The authors have advanced the working hypothesis that complex rays are due to complex substances and they now conclude from the existence of this beta radiation of radium that radium itself must be a complex substance.—*Phys. Zeit.,* Nov. 1.

Electrochemistry and Batteries.

Electrolytic Hypochlorite as Disinfectant.—The report of the public health committee of the Poplar Borough Council, in England, on the working of the electrolytic plant during the past summer shows that the demand for the fluid could not be fully met, although the plant was worked overtime. The stability of the fluid during the hot weather was found to be very good. The total output for the year to the end of August was 17,794 gal.; during August the output was 4326 gal. The cost per gallon was slightly over 1 cent for the materials and electricity (3 cents per kw-hour). The plant is in good order and extensions are under consideration with a view to meeting the increased demand. By far the largest item of cost is that of wages, mainly incurred in bottling and issuing the fluid, and amounted to $2,080 for five men (apparently from January to August, 1909, inclusive). This, on the basis of 18,000 gal., means over 10 cents a gallon issued, and including sundry expenses the total cost appears to be about 12 cents per gallon. The works department is supplied, however, at 2 cents a gallon. The hypochlorite has also been used for disinfecting and deodorizing the water in public swimming baths, using only a comparatively small quantity of hypochlorite, namely, about 40 gal. to a bath of 75,000 gal. on the first day and 20 gal. the day afterward, the same water being used for three or four days. It was found that the water remained unpolluted for several days when thus treated, and the bathers expressed their appreciation of the improvement.—Lond. *Elec. Review,* Oct. 29.

Units, Measurements and Instruments.

Meters for Rectified Current.—P. MacGahan.—In view of the extensive use of rectified currents for illumination, for battery charging and other purposes, the question of proper meters to use in measuring these currents is one of considerable importance. A rectified current is a superposition of alternating current on direct current. There are two different types of indicating meters available. First, those meters in which the torque is proportional to the first power of the current—that is, permanent-magnet moving-coil meters designated as operating on the D'Arsonval principle; second, those meters

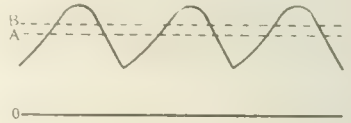


FIG. 4.—CHARACTERISTIC WAVE-FORM OF CURRENT IN RECTIFIED CIRCUIT.

in which the torque is proportional to the square of the current, such as the hot-wire meters, the dynamometer meters, which have a coil moving in the field of the stationary coil and a movable iron needle or vane which actuates the pointer. The first type measures the average mean current, which is equal to the value of a constant current having the same chemical effect, as in charging storage batteries. This is indicated by the dotted line *A,* in Fig. 4. The second type of meter measures the square root of the mean square value of the current. It

is indicated by the dotted line *B* in the illustration. If a meter of the first and one of the second are connected in series in a rectified-current circuit their indications will differ according to the relation which the ripple bears to the total current and the form factor. This discrepancy may be in the neighborhood of from 2 per cent to 5 per cent under commercial operating conditions, as shown by actual tests. Alternating-current ammeters operating on the induction principle will measure with accuracy the square root of the mean square or effective value of the ripple only, and will not be affected by the main portion of the rectified current.—*Elec. Journal,* November.

Telegraphy, Telephony and Signals.

Detector for Wireless Telegraphy.—A description of a new form of magnetic detector invented by A. G. Rossi and based on the fact, discovered by Prof. A. Sella in 1903, that the magnetic state of iron is sensitive to electromagnetic waves when the hysteretic cycle is due to elastic deformations. A fine iron wire, 0.03 mm in diameter, is stretched between two points,

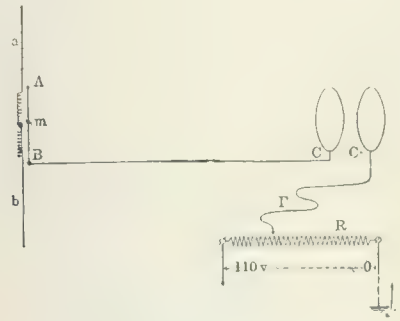


FIG. 5.—DIAGRAM OF DETECTOR CIRCUITS.

A and *B* (Fig. 5), and is magnetized with a pole in the middle by means of two bar magnets fixed parallel to it, their like poles being adjacent. An oscillograph mirror *m* is attached to the wire at its middle point and reflects a beam of light from a Nernst lamp and slit onto a galvanometer scale. In consequence of the Wiedemann phenomenon an alternating current in the wire will set up torsional oscillations, whose amplitude will be the greatest when the frequency of the current is the same as that of the free vibrations of the wire, producing on the screen a horizontal band of light. To provide this current one end of the wire was connected to a plate *C* of an air condenser *CC'*, the other end remaining free. The plate *C'* was connected to the sliding contact of a rheostat, *R*, which had 110-volt, 42-cycle alternating-current impressed across its terminals, one of which was grounded. The small capacity current surging in and out of the condenser was found to be quite sufficient to set up torsional oscillations of considerable amplitude, which could be varied by moving the sliding contact. The iron wire is inclosed in a small glass tube, which is wound with a magnetizing coil *a b;* this coil is divided into two equal parts which are arranged in opposition—like the bar magnets—and is connected with one end to the air wire and the other to earth. Atmospheric discharges produce no visible effect. However, for a series of sparks in rapid succession, especially if its frequency is the same as that of the wire, the instrument is very sensitive. Used in this manner it is necessary to have at both the winding and receiving stations a source of alternating current of definite frequency to which the wire can be tuned, and which feeds the spark-gap of the send ing apparatus, thus producing the proper frequency of wave trains. Later experiments have shown that it is not necessary to supply the wire with an alternating current in order to use it as a detector. A series of strongly damped wave-trains, having a frequency equal to that of the wire, is itself sufficient to set the latter in vibration. In this simplified form the instrument serves as a detector for a new system of wireless telegraphy in which no high-frequency tuning of the receiving apparatus is necessary, but only of the low-frequency vibrations of the wire, which may be done very readily by altering its length, and in which the signals are read directly by observing the band of light on the screen.—Lond. *Electrician,* Oct. 29.

Miscellaneous.

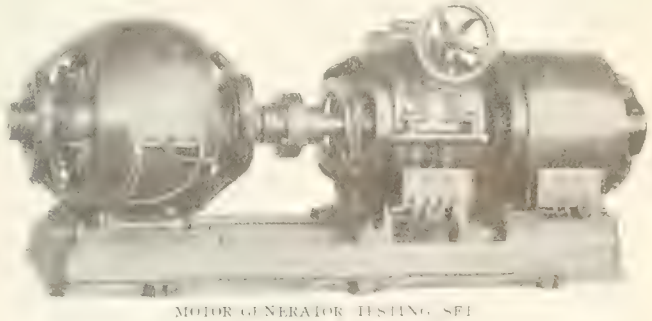
Fundamental Reasons for the Use of Electricity.—C. F. Scott.—Extracts from his Seattle paper on the trend in electrical development. The author discusses the possible fields of electric service, the conditions underlying the application of electricity, the methods and effects of using electricity, the methods of applying electricity effectively, cost of energy, new fields for central station activity, and electric heating.—*Elec. Journal,* November.

NEW APPARATUS AND APPLIANCES

Varying-Frequency Motor-Generator Testing Set.

An interesting motor-generator set recently installed in the testing department of the Commonwealth Edison Company, Chicago, is illustrated herewith. The unit was especially designed for its purpose, and it required careful calculation and accurate execution. The direct-current motor is of the adjustable-speed type capable of operating the two alternating-current generators at a speed varying from 750 r.p.m. to 1800 r.p.m., thus giving frequencies ranging from 25 cycles to 60 cycles. The generators furnish alternating current of true sine wave. The one at the extreme right is wound for 110 volts and the other for 50 volts. The 50-volt machine is arranged in such manner that the field rings supporting the pole-pieces may be rotated through 180 deg. The frame is supported on substantial bearings contained in the end brackets and is rotated by a worm-gear attachment operated by hand-wheel.

This testing set, designed and manufactured by Roth Brothers & Company, of Chicago, is used for calibrating alternating-current wattmeters. The pressure coil of the wattmeter is connected to the high-voltage machine through suitable transformers. The current coil of the wattmeter is connected to the low-voltage machine through other suitable transformers. The power factor of the load of the wattmeter may be varied from unity to zero by rotating the field ring and poles of the generator connected to the current coil. Thus artificial loads of all power factors can be readily obtained without excessive con-



MOTOR GENERATOR TESTING SET.

sumption of energy and with the greatest exactness. The points of zero and unity power factor may readily be found by means of electrical testing instruments. The field ring is provided with a graduated scale which moves past the zero mark on the end rings and give an indication of the angle of lead or lag.

Electric Railway Tower Wagon.

A very convenient method of application of trackless electric vehicles for electric railway service is indicated in the accompanying illustrations of an electric tower wagon manufactured by the General Vehicle Company, of Long Island City, N. Y. The entire equipment of this wagon is mounted on the standard two-ton chassis of that company. All spring supports and special parts are vanadium steel castings, and all renewable parts are accurately machined to size. Friction has been minimized by the use of Hess-Bright ball bearings on the armature shaft, and Timken roller bearings for all wheels and countershafts.

Figs. 2 and 3 show the entire construction of the chassis. The frame is constructed of steel channels of such proportions as will best support the mechanism and carry the load. The 44-cell storage battery which furnishes electricity to the motor at 85 volts is suspended below the main frame in a substantial cradle where it can be reached easily. The battery is in sectional form in crates of such weight and size as can be easily removed and replaced from either side of the vehicle.

The controller is of the continuous-torque type which changes the motor speeds by degrees without interrupting the flow of energy. This arrangement gives a smooth, even acceleration, without jar or strain of any kind, and thereby increases the life of the controller, battery, motor, chains, sprockets, gears and tires.



FIG. 1.—TOWER WAGON.

The single electric motor used has been especially designed by the General Electric Company for the sort of service demanded in electric transportation. It is built along the lines of an electric railway motor. The armature shaft turns on ball bearings, which increase the value of the other advantages of this design. The motor is suspended on a cross-bar pivoted to the side frames in front of the rear axle. The pivoted suspension keeps the motor shaft parallel with the countershaft throughout the entire range of chain adjustment, and permits the successful use of an efficient silent chain drive. The motor is totally enclosed and protected from water and dirt at all times. It is high above the ground and may be easily examined from the rear by opening a hinged cover in the motor frames.

Easy-running roller-bearing chains drive the rear wheels from the countershaft. Large diameters and properly designed teeth, combined with the chain, decrease transmission losses to a minimum. A single broad silent chain of the tooth-link type drives the countershaft from the motor-pinion. A rigid adjustment is provided to keep the chain in its best operating position.

The wheels are of the artillery type and have roller-bearing hubs. Solid rubber tires are used on all wheels. Half-elliptic springs are used both front and rear. Internal-expansion leather-faced brakes on both rear wheels are controlled by a foot lever at the base of the steering post. The steering gear is wheel-operated through a vertical steering column.

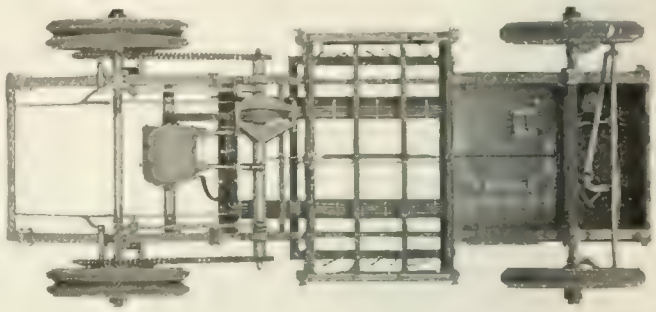


FIG. 2.—MECHANISM OF ELECTRIC VEHICLE.

The tower wagon has a speed of 12 miles per hour, and a range of service of 40 miles on one charge of battery. The wagon has sufficient space for seven men in addition to the driver, as well as space for tools and materials for repairs.

One of the important advantages of the electric wagon is its immediate readiness for service. Where adopted it will not be necessary for electric railway companies to maintain a team of horses constantly harnessed ready for emergency service; the constant care of horses can be eliminated. A broader adoption of electric vehicles by street railway companies will enable them to discontinue horse service entirely. The electric emergency wagon can be held always ready for immediate service, and it drives at a speed equal to the limit of safety for city traffic.

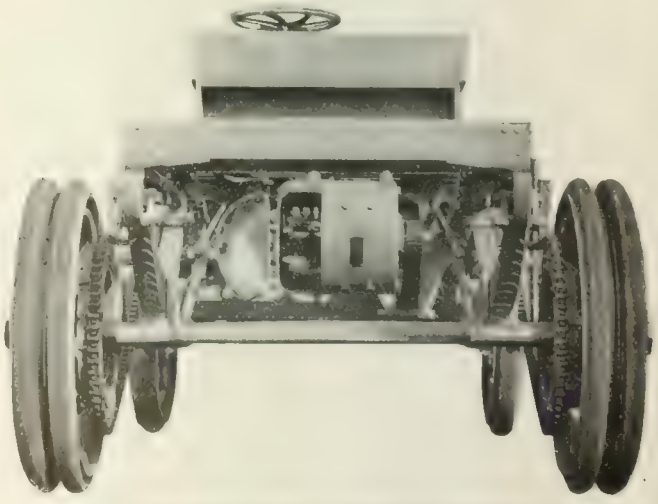


FIG. 3.—REAR VIEW OF TWO TON CHASSIS.

Magneto and Plug for Slow-Running Internal Combustion Engines.

The Bosch Magneto Company, of New York, has brought out a magnetic plug-ignition system for single-cylinder, producer-gas, suction-gas and other engines, in which not more than 250 explosions per minute obtain. The current is produced by an oscillating motion of the armature between the pole shoes of permanent steel magnets, and the movement of the armature is brought about by two springs operated by a belt-crank lever from the camshaft of the engine. The magneto has no advance and retard, and the plug is connected to it with single-wire cable, the contacts of the plug between which the spark

occurs projecting into the interior of the combustion chamber of the engine. Fig. 1 shows a cross-section of the magneto. There are three steel magnets 1 between the pole shoes of which oscillates the armature 2. The latter is moved out of its normal position to an angle of 30 deg. at the moment of ignition, and is pulled back to its original position by the balance springs. This movement is caused by the operation of the camshaft of the engine by means of a rotating thumb-piece or other suitable appliance. For this purpose a double-belt crank lever is attached to the armature spindle, to the horizontal arm of which are fixed the balance springs 3, whereas the vertical portion of the belt crank lever is actuated by the attachment on the camshaft. By the movement of the crank lever a tension is brought onto the springs 3, which are released again at the moment the camshaft thumb passes out of engagement with the lever. The springs thus cause the armature to return quickly to its original position again, and by this movement an e.m.f. is set up by reason of which a current is produced. One end of the armature winding is connected to the magneto body, where as the other end is connected to an insulated brass plate 4, which has a tube-shaped extension reaching through the hollow armature spindle. A brass cap 5 is screwed over the end plate, but insulated from it, and on the inside has a brass projecting piece which reaches into the tubular sleeve of the armature spindle. Between these projecting pieces and the tubular sleeve is a spring 6 which conducts the current from the end of the armature winding to the brass end cap, the spring being pressed into

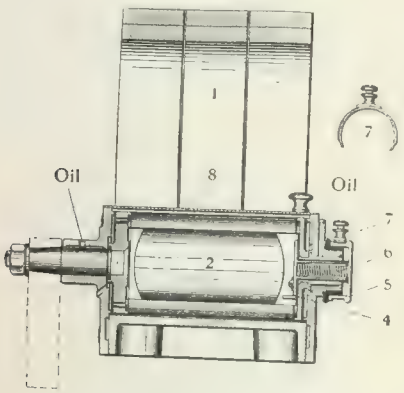
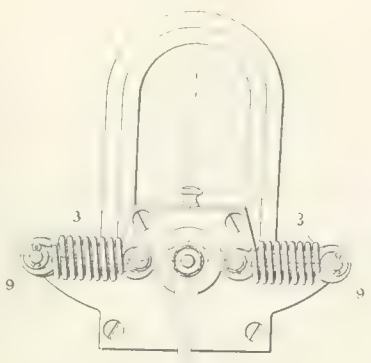


FIG. 1.—LONGITUDINAL SECTION.

the bore of the tubular sleeve on one end and over the brass projecting piece of the cover 5 on the other. This spring follows the oscillating movement of the armature, thus conducting the electricity from the moving parts of the magneto to the fixed terminal without the necessity of brushes or similar devices. The cover 5 has a flat groove in its outer rim, which receives the spring clip 7, which, when in position, makes contact more than half-way around the brass cap 5, and also carries the terminal screw for connecting the cable to the spark plug of the engine. Since this spring clip can be placed in any position on the brass cover, the cable can be connected from any convenient point. The circuit runs from the armature through the spiral spring 6, through the spring clip 7 to the wire and the plug, through the coil of the latter, through the interrupter to the engine and magneto body, and thence to the armature winding.

The magnet plug used in connection with the magneto is shown in Fig. 3. The interrupter lever rests on a steel-knife edge, and also on the contact block. One end of the spring 3 is pressed against the contact of the interrupter just inside the knife edge, this arrangement facilitating the movement of the interrupter and spring, and reducing the wear to a minimum. The spring has a very slight movement, and is protected from hot gases by being placed within the coil body. The latter has its lower end screwed to the pole-piece of the plug, thus forming a complete system, the armature of which is the upper part of the interrupter lever. Contact pieces 20 and 21 are mounted upon the interrupter lever and the plug body, the latter reaching into the interior of the combustion chamber of the engine. The two contacts are pressed against each other by means of the spring 3, and are separated only at the time of sparking, at which moment the coil is energized. For this purpose one end of the winding is in connection with the ring 6, and through this to the terminal 9, while the other end is in electrical con-



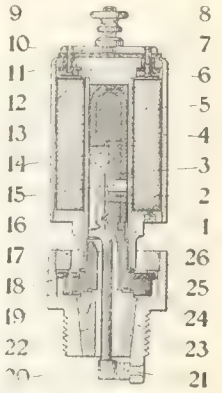


FIG. 2.—REAR VIEW. FIG. 3.—SECTION OF MAGNET PLUG.

nection by means of a screw 26 with the body of the coil. The latter, as well as the pole-piece and the interrupter, is insulated from the plug body by means of a steatite cone 23 and mica washers 18. The two contact pieces on this plug have a special form, inasmuch as the fixed contact takes the form of a V into which the moving contact drops. The interrupter level also has a slight side play. If, for instance, the left side of the contact should be insulated, owing to soot or deposits from burning oil, etc., the flats would be cleaned by the downward movement of the hammer, thus procuring a contact on the other side, one side of the V-shaped groove acting as a reserve contact.

Steel Reflectors.

A line of new "Extensive" and "Intensive" type of Holophane-D'Olier steel reflectors, manufactured by the Holophane Company, Newark, Ohio, has been designed to render practical the use of standard voltage tungsten lamps for industrial lighting. The new reflectors give the characteristic distributions of the Holophane "high-efficiency" glass reflectors, and enable the illuminating engineer to undertake mill and factory lighting problems in the same way as he would handle a residence or commercial problem.

Tungsten lamps have heretofore not been largely availed of for industrial lighting because of the high percentage of breakage, as workmen could not be taught to handle the lamps carefully. It is claimed that the new Holophane-D'Olier steel reflectors enable the lighting engineer to install tungsten lamps safely, as these reflectors give the best results when the units are hung high and out of the workmen's reach; and that while



STEEL REFLECTORS.

they are of such exact design as to commend themselves to the illuminating engineer, it requires no expert skill or deep engineering knowledge to use them with complete satisfaction wherever the "group lighting" or "distributed unit" system of lighting is desirable.

Adjustable-Speed, Single-Phase Commutator Motor.

The single-phase commutator motor illustrated herewith is of the repulsion induction type particularly adapted to the operation of machines requiring constant or variable speed

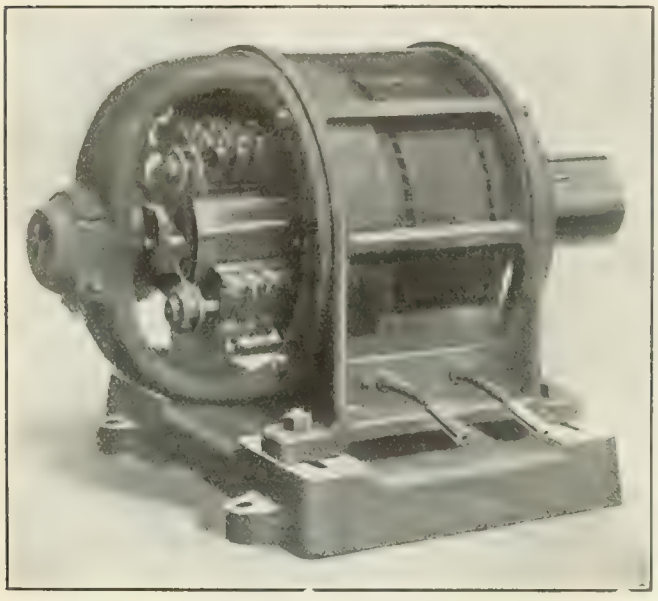


FIG. 1.—VIEW OF REPULSION-INDUCTION MOTOR.

and moderate or heavy starting torque. It is entirely automatic and may be connected to the line without the interposition of any starting box, clutch coupling or other external device.

The motor is made exceedingly compact by the use of the

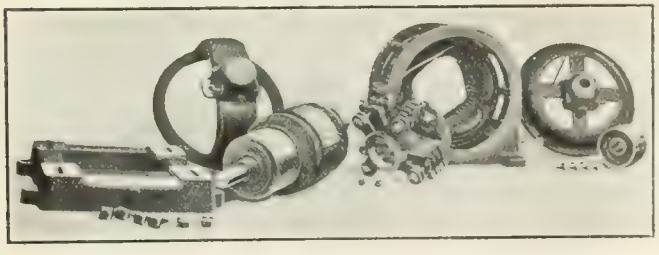


FIG. 2.—CONSTRUCTIVE DETAILS OF MOTOR.

open frame form in which the laminations of the stator core are clamped between cast-iron held in the frame to which the end-heads are secured. The field core of the motor is provided with a single-phase winding of the concentric type, each coil

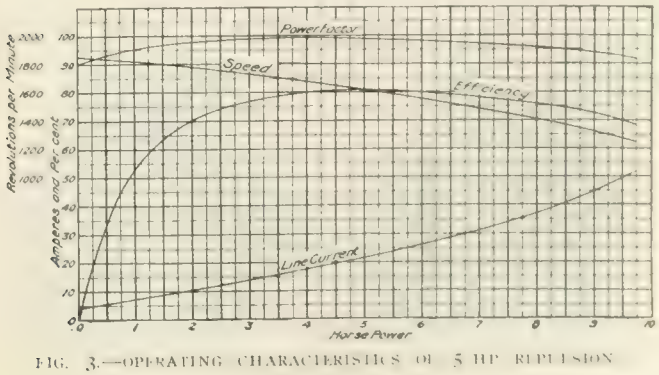


FIG. 3.—OPERATING CHARACTERISTICS OF 5 HP REPULSION INDUCTION MOTOR.

being taped and insulated separately; the coils can be arranged in series for 220 volts, and in parallel for 110 volts.

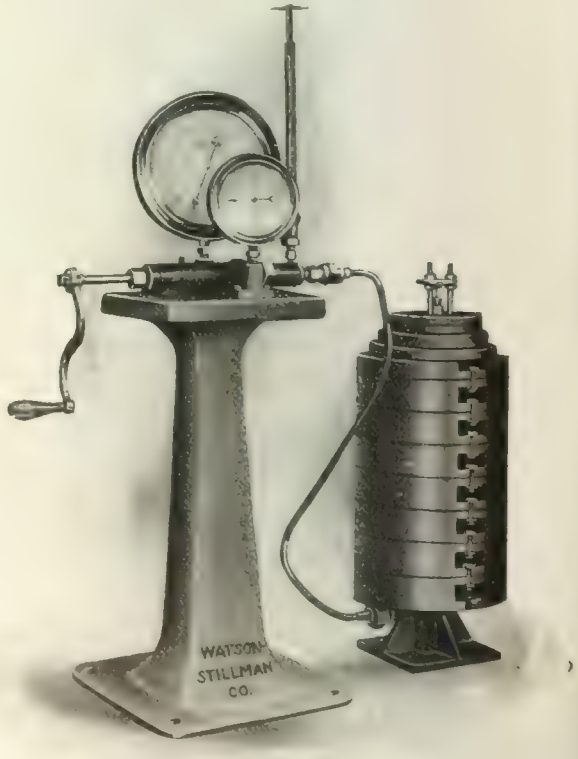
The armature winding is of the series drum type connected to a commutator carrying two sets of brushes, each set being displaced electrically from the other by 90 space degrees. The first set, known as the energy brushes, is permanently short-circuited and disposed at an angle to the lines of field or primary magnetization, as in an ordinary repulsion motor. The second set, or compensating brushes, is connected to a small portion of the primary winding included in the field circuit, so as to impress upon the armature an electromotive force which serves both to raise the power factor and at the same time maintain approximately a constant speed at all loads.

By the use of the proper controllers the motor speed can be adjusted by as much as 50 per cent below the synchronous value by inserting resistance or reactance in the energy and compensating circuits. With the exception of the leads brought out from these circuits the constant-speed and variable-speed motors are identical.

These motors are built in five sizes rated at 0.5 hp, 1 hp, 2 hp, 3 hp and 5 hp respectively. The advantages claimed for this type of motor by the manufacturers, the General Electric Company, Schenectady, N. Y., are noiseless operation, attractive design, improved ventilation, excellent cooling and overload characteristics, compact and rigid construction, least weight consistent with proper mechanical strength and the sustaining of high electrical constants, self-starting with rapid acceleration, and wide speed control.

Calibrating Apparatus for Hydraulic and Other High-Pressure Gages.

Under higher hydraulic pressures, it is frequently the case that the same pressure gage will show different percentages of error at different pressure readings, and these can be compensated for in ascertaining the true pressure only by comparing with a "master" gage of known accuracy or by loading with a known pressure. The outfit which we illustrate performs these two functions of testing by comparison with a master gage and of testing the accuracy of the master.



CALIBRATING APPARATUS.

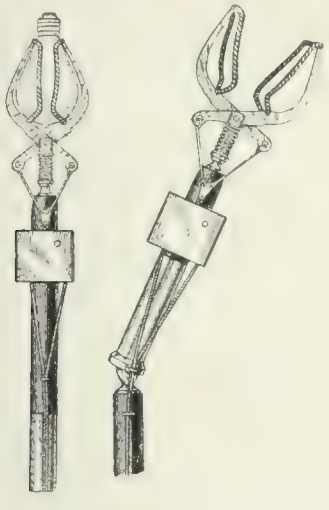
For the first, only the part on top of the stand is required. This consists primarily of a cross made of hydraulic bronze. The gage being tested, which may register any pressures up to 16,000 lb. per square inch, and the master, are attached to the front and back ends of the cross respectively. At the left

is a crank-operated screw displacement piston, by means of which the desired pressure may be produced within the pressure chamber. A suitable stuffing box prevents leakage past the piston. To the right end is connected a stop valve and filling cylinder. This permits (1) some of the liquid to be withdrawn from the pressure chamber before removing the gage being tested, and (2) filling after a gage is put on. There is thus no danger of spilling the oil.

For testing the master gage, the special weight-loaded, hardened and ground-steel piston and cylinder are attached at the right by means of flexible copper tubing, as shown. These parts are cut out by a stop valve when not testing the master. The cylinder is long enough to have the center of gravity of the weight below the center of support. When the weights are revolved, the friction due to lifting the weight is practically eliminated. The apparatus is made by the Watson-Stillman Company, of New York.

Device for Removing or Cleaning Lamps.

The accompanying illustration shows an electric lamp remover and cleaner made by E. E. Edgerton, Chicago, Ill. It is adapted for lamps ranging from ½ in. to 4 in. in diameter and 6 in. long. The clamps are covered with rubber, and are



LAMP CLEANER AND ADJUSTER.

made to grip the lamp by a pull of a cord. Once fastened the clamps are held by a ratchet until released by another cord. The clamp is attached to a light wooden pole of suitable length, and made in two forms, one for removing lamps which project vertically downward, and the other for removing lamps which are placed at an angle. The details of the device are clearly shown in the engravings.

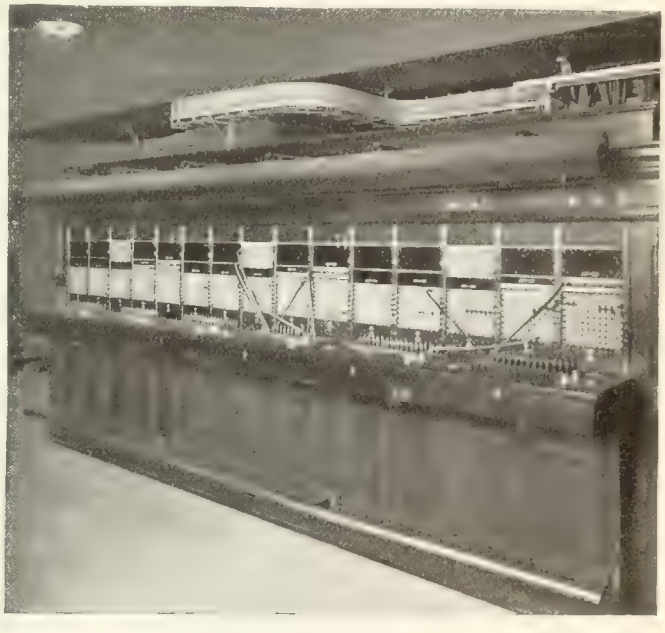
A Chicago Hotel Telephone System.

The La Salle Hotel, which has recently been erected at the corner of La Salle and Madison Streets, Chicago, was opened to the public Sept. 8. The structure is 20 stories, or 260 ft., high, exclusive of the basement and sub-basement. The architecture is that of the French renaissance, and the interior finish and furnishings have been made according to special designs, following as closely as is consistent the style of the same period as the building.

All the guests' rooms are provided with the most up-to-date conveniences, including local and long-distance telephone service. The hotel has its own private branch exchange, consisting of a six-position Western Electric switchboard. This switchboard is of the latest relay type for hotel use, and connects 1100 instruments for inside service and has 22 trunk lines leading to the Main-Franklin exchange, through which long-distance and local service is furnished.

The installers usually require three months' time for such an equipment. The hotel corporation could give the telephone company, however, in this case but four weeks' preparation and 14 hours' notification to begin work, and this notification was given but five days before the hotel was to be opened to the public. As soon as the specifications were available, a complete switchboard was set up on an assembly floor and all the cables formed out, tagged, taped into their relative positions, and then taken down and rolled carefully on separate reels. All of the house-wiring cable was cut to exact lengths, the terminal ends formed out, shellacked and taped, then put on reels properly tagged with contents, floor number and location at which it was to be used.

The work was divided into three main parts, the first taking in the switchboard proper, the second the telephone power plant, and the third the instruments' setting and conduit wiring. For handling the cables a gang foreman was appointed, with enough helpers to take charge of each cable splice to be made. Very explicit instructions, with blue prints detailing what they were to do, were given each gang. For the house wiring and instruments' setting each installation foreman was assigned several floors. Sub-foremen were appointed for each vertical shaft on each floor, and specific written instructions and blue prints of the conduit layout at their particular positions were furnished. A force of 50 equipment men, divided into two shifts, took charge of the telephone power plant.



HOTEL SWITCHBOARD.

At 5:30 p. m., Sept. 2, instructions were given to commence work. All that night the material was being disassembled and loaded on trucks. At 8:30 the following morning the first of the 18 truck-loads of material was unloaded. By 3 p. m. all of the material had been unloaded and distributed, and by evening the force of workmen had been gradually increased until 500 men were at work, each one having gone to his previously assigned position as soon as he entered the building. Twenty-four hours after work began, the 22 trunk lines, to the Main-Franklin exchange, connecting the switchboard in the building with the city exchanges, were operating. Forty-two hours after the work began the entire switchboard installation, except fitting the operators' foot rail and similar minor details, was completed. Thirty hours later the greatly reduced force of installers had spliced the last cable and the complete equipment of a six-position, common-battery switchboard, and a complete telephone power plant, was installed. The whole was in operation two days before the hotel was opened, although but three days previous to completion the entire equipment was on the Western Electric Company's shipping floors.

Electric Water Heater.

While electrical heating apparatus possesses an efficiency of 100 per cent, the cost of operating such devices has always been considered expensive. Messrs. Spagnoletti, Ltd., Goldhawk Road, London, Eng., have introduced the "Therol" electric water heater, which differs essentially from other apparatus of



FIG. 1.—ELECTRIC WATER HEATER.

this class, and by means of which the expense of heating is said to be reduced. In its simplest form, the apparatus consists of a block of iron cast about a coil of pipe. This block is embedded and covered with a layer of magnesia lagging 2 in. thick. The top of the block is hollowed out into a cylindrical form, and in this hollow is placed the heating element, consisting of four coils of iron wire insulated with mica. The block of iron is continuously heated by means of electricity, and water as required is passed through the pipe. By this means electricity is taken constantly from the mains, and hot water is always available in any quantity, provided the average daily amount does not exceed a certain volume depending upon the fixed amount of electricity consumed. A further economy is effected by introducing between the lagging and the outer

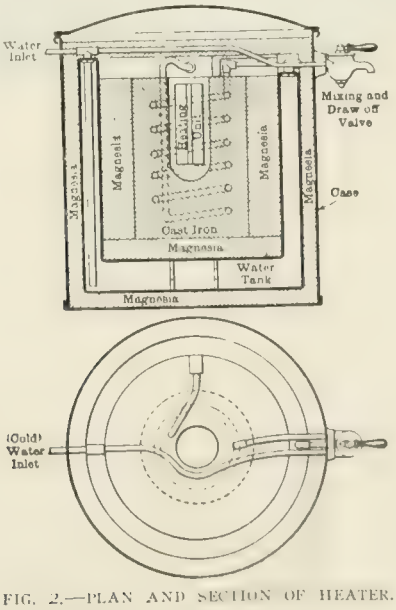


FIG. 2.—PLAN AND SECTION OF HEATER.

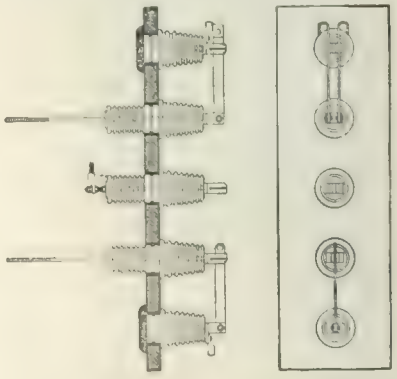
cover a small reservoir, which is in turn insulated from the outer surface of the heater. In this chamber the temperature of the incoming water is raised slightly before it is introduced to the heater proper. This will be evident from an examination of Fig. 2, which shows a plan and section of the device. Since the cooling pipe through which the water passes must have sufficient surface for heating the water when the block is comparatively cool, it follows that when the latter is very hot the water will be converted into steam. It is necessary therefore to mix the issuing steam with water, and thus reduce it to a suitable temperature. For this purpose a valve has been designed by the use of which it is claimed a mixture of the steam and water is completely effected, and the temperature of this mixture adjusted at will. No 1 heater is cylindrical and is 2 ft. in external diameter and height. When consuming 200 watts, if the initial temperature of the water is 50 deg. Fahr., 25 gal. of water at 110 deg. Fahr. may be obtained per day; while if only warm water is required a very much larger quantity may be obtained. In every case the amount of water available may be drawn off all at once, or in smaller quantities at any time during the 24 hours. The heating resistances are made readily accessible, so that by the mere substitution of a larger heating element the supply of hot water can be increased within certain limits. The manufacturers state that the basic idea of the "Therol" system is to meet the demand for a 24-hour constant supply of electricity giving a 100 per cent load factor. The idea is that a constant supply of electricity will be available for lighting, cooking, heating and other domestic applications when these are required, and at all other times during the 24 hours it will be stored in the heater for the supply of hot water. This disconnection of the heater from the mains for short periods does not interrupt the supply of hot water, but only slightly reduces the average amount available.

Combined Disconnecting and Transfer Switch.

The requirements of modern distributing systems necessitate more flexible and selective control than is afforded by the usual system of circuit-breakers, switches, etc., and this need has resulted in the development of many special forms of switching devices. In many cases it is important that these auxiliary devices shall not only possess the desired flexibility, but also shall be of such dimensions that they will not interfere with existing apparatus, the physical arrangement of which cannot be changed.

A recent requirement for combined disconnecting and transfer switches was met by the design illustrated herewith. The lower switch is of the single-pole, single-throw type and arranged to be connected in series with the lightning arresters, thus permitting the arrester circuit to be opened for inspection, replacement, etc., of arrester units. The upper element of the device consists of a double blade, single-pole, double-throw transfer switch, enabling connection to be made to either the upper or lower contacts, as desired.

By use of a double set of lever blades and contacts, it is possible to transfer the circuit without interruption, or subject-



DISCONNECTING AND TRANSFER SWITCH.

ing the switch to destructive arcing. It will be noticed that the switch is a combined front and back-connected device, and the lever blades are provided with off-set extensions, thus permitting them to be operated in the usual manner by means of an insulated pole, or hook. This combined device has a carrying capacity of 300 amp at 13,200 volts, and was developed by the Central Electric Company, Chicago, Ill.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The general tone of commercial affairs continues to be buoyant, and every report shows that business on the whole is improving. The continued mild weather throughout the country has acted both as a stimulant and as a check to different lines of trade. It has increased retail sales, has facilitated the fall work of the farmers and has aided in getting their products to market. On the other hand, the warm weather has retarded the sale of heavy clothing, and the wholesalers and jobbers are complaining that orders are showing some falling off in this line. In the South especially the continued high price of cotton has had the effect of furnishing plenty of money to the planters and has added very materially to retail trade and to the payment of outstanding bills. This is also reflected in the export report, the value of cotton being the principal item of advance over last year. In the industrial field the reports are still that order books are filled up and that mills are running full time. There is not, perhaps, the same rush that was witnessed in October, but new orders are coming in, and there is in sight enough work to run far into the spring. The continued improvement in business has had its effect upon collections, and they are now all that wholesalers could expect. Business failures for the week ended Nov. 11 were 221, as against 212 of the previous week, 216 the same week in 1908, 259 in 1907, 222 in 1906, and 198 in 1905.

THE COPPER MARKET.

In spite of adverse statistics and a disappointing report from the Copper Producers' Association, there has been during the past week a decided improvement in the tone of the copper market and some improvement in price. Electrolytic on Nov. 15 sold around 13¼ cents. This is due entirely to the faith placed by the public in the reports that some extensive combination of interests is in process of formulation. While it is explicitly denied that a great central combination similar to the Steel Trust is in contemplation, and while the third largest producing interests in the country declare that they are not concerned in any agreement of any kind, there is a widespread belief that in the near future the copper market, both in the matter of production and price, will be in perfect control. The consumers, both in this country and in Europe, have been industriously warned that this was their last chance to get metal at bargain prices. The rapid advance of the shares of copper companies has added weight to these warnings, and the result has been much more liberal buying by the melters. These larger purchases are regarded as purely protective measures and not as an indication that the demand for finished goods has suddenly increased. They are purchases which do not mean a reduction of the visible supply of copper but a shifting of its ownership. The figures of the Association for October showed that the record for production had again been broken. The total for the month was 124,657,709 lb. The deliveries were reported as 122,620,855 lb., the heaviest since July, leaving an addition to the stocks in this country of 2,036,854 lb. At the end of the month the total stocks in producers' hands are reported as 153,509,626 lb, the heaviest since the June report, and 25,000,000 lb. more than the amount on hand at the beginning of the year. The exports for the month, including Nov. 15, have amounted to 10,030 tons. The daily call on the Metal Exchange Nov. 15 quoted standard copper as given in the table.

	Bid.	Asked.	Settling price.
Spot	12.60	12.75	....
November	12.60	12.75	12.67½
December	12.60	12.75	12.67½
January	12.70	13.00	12.85
February	12.80	13.10	12.95
March	12.60	13.15	13.02½

The London prices on Nov. 15 were as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	59	0	0	59	0	0
Standard copper, futures	60	5	0	60	2	6
Market	Firm			Steady		
Sales of spot	400 tons					
Sales of futures	1,000 tons					

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13 00			12.12½		
London, spot	£64	2	6	£54	12	6
London, futures	64	17	6	55	10	0
London, best selected	67	15	0	59	0	0

COLORADO RIVER POWER PLANT.—Plans have been prepared by Colonel C. E. Apponyi for the development of a hydroelectric plant upon the Colorado River at the first rapids above the head of high water navigation, about 180 miles above Needles, Col. The point selected for the plant is between Lincoln County, Nevada, and Mojave County, Arizona. Water rights for a strip of five miles have been secured, and it is estimated that at least 30,000 hp can be generated by the use of four successive turbo-generator units, each working under a 50-ft. head. Energy will be transmitted to Tonopah, Nev., 170 miles away, and to Prescott, Ariz., 160 miles away, and will also be sold to intermediate mining camps.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—The East Pittsburgh shops of the Westinghouse Electric & Manufacturing Company began work last week upon the heavy order for motors and equipment for the Long Island Railroad Company. This order calls for 130 car equipments, of two 200-hp motors each, together with controls, wiring, conduits and airbrakes. The total amount of the contract amounts to almost $1,000,000. The apparatus will be delivered early in 1910, in time for the installation of electrical operation on the Long Island system, in connection with the completion of the Pennsylvania tunnels.

GALVESTON-HOUSTON ELECTRIC RAILWAY.—The new interurban line which will be constructed between Galveston and Houston, Tex., will be about 45 miles long, and will be constructed entirely on private right-of-way. The main power house will be located in Texas City, in Galveston Bay, and will include two turbo-generators rated at 100 kw and 500 kw. The line will be operated at 600 volts, direct-current, using the overhead trolley system. Four substations will be provided along the line, located about 10 miles apart. The company will operate over the tracks of the local companies in both Galveston and Houston.

ELECTRIC POWER FOR COKE FURNACES.—The Board of Trade of Big Stone Gap, Va., writes that it desires to direct attention to the opportunity for the development of cheap electric power from the waste gases of coke furnaces There are about 3800 coke furnaces in the vicinity of Big Stone Gap, which would supply sufficient gas for use as fuel or in internal-combustion engines to operate a large electrical generating plant, which could sell its product in the vicinity or transmit it to a distance.

PITTSBURGH STREET LIGHTING.—The Public Works Committee of the Pittsburgh Council has recommended that the city enter into a contract for a period not exceeding three years for lighting the streets by electricity at a cost not to exceed $325,000 per year. The ordinance for the lighting of some of the streets and alleys by incandescent gas mantle was amended to include also electric lamps, provided that the expenditure did not exceed $100,000 per year, and the contract was for not more than three years.

GENERAL ELECTRIC BRANCH MANAGERS.—The branch managers of the General Electric Company held their meeting in Schenectady Nov. 9. All sections of the United States were represented, and the business situation was thoroughly discussed. The general sentiment expressed by these men was that the electrical trade is rapidly improving, and that the return to normal conditions is practically in sight.

APACHE FALLS (ARIZ.) POWER PLANT.—Plans have been drawn for the construction of a hydroelectric plant at Apache Falls, Ariz., which is 30 miles above the Roosevelt Dam on Salt River. The plant will cost about $600,000, and the energy will be transmitted to Globe, Ariz., 35 miles away. Globe capitalists are backing the enterprise.

RECENT ALLIS-CHALMERS ORDERS.—The Allis-Chalmers Company reports the following orders: The Providence Gas Company, of Providence, R. I., two Corliss engines direct-connected to 300-kw, 240-volt, direct-current generators with barometric condensing equipment to be used in connection with an electric system for handling gas. C. A. Borst, who has secured the contract for municipal lighting in Clinton, N. Y., has ordered a 100-kw, 2300-volt, 60-cycle, two-phase, belted alternator, engine, exciter and switchboard equipment. The Rapid Motor Vehicle Company, of Pontiac, Mich., is enlarging its plant by the addition of two 600-kw, 240-volt, 60-cycle, three-phase machines and cross-compound engines. The City of Thomasville, Ga., has placed an order for electrical equipment for the municipal lighting plant. This consists of one 250-kw, 2300-volt, three-phase, 60-cycle generator, one 200-kw generator and two exciter sets. The Marion Steam Shovel Company is building an electric shovel for the Casparis Stone Company, which is equipped with two 75-hp, series-wound, direct-current motors and one 150-hp motor with the necessary controlling apparatus. The Land & Power Company, of Arkansas City, Kan., is extending its activities, and has purchased a 500-kw turbine and a 2300-volt, 60-cycle, three-phase machine, exciter and control board. The Delaware, Lackawanna & Western Railroad is about to install two 500-kw, 6600-2300-volt, three-phase, 60-cycle transformers at Kingsland, N. J. The transformers will be water cooled.

WESTERN ELECTRIC COMPANY'S BUSINESS.—The October sales booked by the Western Electric Company amounted to nearly $4,500,000, or at the rate of about $53,000,000 per year. The October gross was the largest in any single month since May, 1907. For the 11 months period the Western Electric's sales have been at the rate of a little more than $47,000,000 per year, which is an improvement of 43 per cent over the same 11 months last year. In the company's fiscal years which ended Nov. 30, 1907, and Nov. 30, 1908, the earnings failed to show the full 8 per cent dividend on the $15,000,000 capital stock. It is probable, however, that the earnings this year will show the full dividend. It is stated that the steady advance in prices, not so much in telephone supplies as in general electrical apparatus, has very greatly benefited the earnings of the company, and that the sales of apparatus for the 11 months are 40 per cent greater than last year.

AMERICAN TRADE IN JAPAN.—The electrical trade of American manufacturers in Japan is reported to be steadily increasing. There have not been within the last two months any particularly large orders which are worthy of note, but one of the largest export firms in New York says that all through Japan the electrical development is increasing, and furthermore that Japanese manufacturers are not popular. The contest for trade is between the Americans and the Germans. In many cases heretofore the Germans have underbid the Americans, especially for large orders. This American exporter claims that the German goods have proved unsatisfactory in a number of instances, and that therefore the Japanese are particularly looking for American products. Within the last three months there has been considerable exports of electrical apparatus to Japan, but most of it has been for small appliances, generally motors under 100 hp.

WESTCHESTER LIGHTING COMPANY.—At the investigation into the affairs of the Westchester Lighting Company, which is being conducted by the Public Service Commission of the Second District on the complaint of the residents of White Plains and Port Chester, it has been testified to that the company has various rates for certain sections of its territory. The attorney for the complainants stated that the company sold gas at 80 cents in the Bronx, and at $1, $1.10, $1.40, $1.50 and 90 cents in various villages in Westchester County. It was stated that the rates for electricity were 10 cents in the Bronx; 13 cents in Mt. Vernon; 13 cents in New Rochelle; 15 cents in Rye, and 5 cents in Greenwich. The same attorney also urged that the company now had $12,500,000 in stock and $7,307,000 in bonds, and that the value of the property was about $5,000,000.

NEW HAVEN SUBWAY PLANS.—At the hearing before the Massachusetts Railroad Commission, concerning the taking over of certain properties by the New Haven road, Charles S. Mellen, president of the company, protested against the law which required the company to secure the consent of Massachusetts authorities before it could issue securities to pay for improvements in New York. Mr. Mellen said: "Our company has tremendous interests in the State of New York. We are at present expending $35,000,000 there, and it may be that we shall be obliged in the near future to build a subway into the city to take care of our suburban business. It is not fair to our patrons who are benefited by these improvements that we should be obliged to ask the consent of Massachusetts authorities before we can undertake them."

CLEVELAND CENTRAL-STATION TAX VALUATION.—A board of review has increased the tax value of the property of the Cleveland Electric Illuminating Company, Cleveland, Ohio, from $3,136,510 to $3,500,000, an addition of $363,490. Some time ago the Ohio Light & Power Company brought a protest against the valuation placed on the property of its rival. Experts were employed to go over the property and arrive at a valuation for the board of review, and members of the board themselves did quite an amount of work on it. The addition is small, in comparison with the figure set in the protest, and the officers of the company feel that they really won a victory after all because of the small change made.

NEW CANADIAN TRACTION LINE.—The purchasers of the Southwestern Traction Company at London, Ont., have made application to the Dominion Parliament for the incorporation of the London & Lake Erie Railway & Transportation Company, with a capital of $2,000,000. The company proposes building a road north of the Grand Trunk to Ingersoll, where it will absorb the Ingersoll and Woodstock electric lines. The line will probably be pushed eastward to Brantford over the proposed Hamilton and Windsor route. This will give it connection at Brantford with the Niagara power companies. Several other branches are also contemplated.

SOUTHERN POWER COMPANY DEVELOPMENT.—The Southern Power Company, Charlotte, N. C., is making surveys with a view to extending its transmission service to the upper Catawba. A substation at Greenville will be completed Dec. 1, when electric power will be supplied to the Monaghan and Woodside cotton mills. A number of Albemarle cotton mills have closed a contract for electric power to be delivered from an 80,000-volt line passing through the town. A $600,000 cotton mill will be erected at Great Falls by the Duke interests, to be operated by electric power. The Southern Power Company now supplies power to more than 100 cotton mills.

HYDROELECTRIC PLANT IN CENTRAL IDAHO.—Plans have been perfected for the construction of a power plant on the Salmon River in central Idaho which will be one of the largest in the country. It is proposed to build a dam on the Salmon River, 40 miles below Grangeville, Idaho; to run a tunnel seven and one-half miles long under the mountains to the Snake River. It is estimated that a fall of 530 ft. will be secured and that 280,000 hp can be developed. R. J. Zell, of Spokane, Wash., is the engineer of the project, and Spokane capital is backing the enterprise. The company which is being organized will be capitalized at $6,000,000.

CHIPPEWA POWER COMPANY.—The application made to the authorities of Bay City, Mich., by the Chippewa Power Company for a franchise to furnish electricity has been withdrawn. This action was taken because the company concluded that it could not accept the rates which the city committee proposed in the franchise which was submitted to a vote of the people. The city owns and operates a municipal plant. The rates demanded by the committee were 7 cents per kw-hour for 100 kw or less; 5 cents from 100 to 150 kw, and 4 cents for all above 150 kw.

NEW YORK & NORTH SIDE TRACTION COMPANY.—A site has been purchased at Bayside Meadows, L. I., for the erection of new car barns and also a big power house to supply energy to the New York & North Side Traction Company's lines from Whitestone Landing to Flushing, and on other lines in Nassau and Queens counties.

NEW BUCKEYE LAMP FACTORY.—The Buckeye Electric Company, of Cleveland, Ohio, has arranged to build a factory at Hough Avenue and East Forty-third Street, that city, to cost $75,000. The building will be 122 ft. x 265 ft., three or four stories high, and will adjoin the Prospect factory.

CATALOGS WANTED.—The Schenectady Electric Clock Company, Schenectady, N. Y., desires to receive catalogs and quotations on material necessary in the manufacture of small motors.

ADVANTAGES CLAIMED FOR THE MOVING PLATFORM.—The Continuous Transit Securities Company, which proposes to build a moving platform system of rapid transit under Broadway, and has had its plans approved by the engineer of the Public Service Commission, claims that this method of construction has many advantages over any other. The company is headed by Max E. Schmidt, and quite a number of prominent railroad men are interested in the enterprise. The officials of the company claim that the moving platform can carry 125 per cent more passengers than can be carried by trains. In addition to this vastly increased capacity, it is claimed that there will be seats for all; no delay in waiting for trains; passengers may board or leave the platform at any point at will, and that exits can be made at every street crossing, instead of every one-third of a mile as on the present subway. The mechanism of this platform is similar to those exhibited at the World's Fair in Chicago in 1893 and at the Paris Exposition. It is claimed that on the highest speed platform, 16 miles per hour, 63,500 seated passengers can be carried past a given point every hour. The estimated cost of the construction under Broadway from Tenth Street to Forty-second is $11,000,000, and the money, it is promised, will be furnished by private parties, but the ownership of the line will be vested in the city.

CANADIAN ELECTRIC STEEL COMPANY.—A contract for 1000 hp has been made by the Electric Steel Company, of Canada, Limited, with the Falls Power Company, the local end of the Ontario Power Company, of Niagara Falls. The steel company has just been incorporated with head office in Toronto, by the following interests: Tyson S. Dynes, St. Louis, Mo., president; Geo. G. Goodrich, Saratoga, vice-president; A. S. Ramage, Ph. D., secretary. The company intends putting up a large plant for the manufacture of finished products in iron and steel, and the smelting will be done by means of electric furnace, the plant having been designed by Dr. Ramage. Work on the billet mill will be commenced in a few days, and the other buildings erected next year. The plant is to be located just outside Welland, at the junction of the Welland Canal proper with the feeder, the company having secured 50 acres with excellent shipping facilities by rail and water.

N. Y, N. H. & H. R. R. ADOPTS THE TELEPHONE FOR TRAIN DISPATCHING.—The New York, New Haven & Hartford Railroad Company has placed orders for telephone and selector apparatus for equipping the Northampton Division for telephone train dispatching. The equipment consists of Gill standard bridging selectors and Western Electric telephone apparatus. This will be the first circuit so equipped on the New Haven road, and covers a total of 77 miles, with 29 stations. From the success attending the installation of telephone train dispatching equipments on the other large roads which have adopted this system of handling train movement, the indications are that after the completion of the first circuit by the New York, New Haven & Hartford Railroad it will extend the system to other divisions of the road.

FOR BETTER FIRE FIGHTING FACILITIES.—A movement has been started, engineered by the fire underwriters and others interested in the amendment of the building code, to urge upon the new city administration, after it goes into office, the necessity of improving the fire fighting facilities in New York City. It is urged that the fire-alarm system is old-fashioned and worn out, and a report of experts made two years ago, and approved by the city engineer, calls for an expenditure of $2,500,000 for the installation in Manhattan of a new system, with headquarters in some place isolated from the risk of being thrown out of service by an adjacent fire. This report was never acted upon by the city authorities, and the present movement is intended to bring it to life.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in our present issue are announcements of proposed new plants or considerable extensions of present plants at St. Petersburg, Fla.; Springfield, Mass.; Big Pine, Cal.; Granite Falls, Minn.; Waverly, Kan.; Ralston, Okla.; Athens, Ga.; Valentine, Neb.; Beaver Falls, Pa.; New Castle, Col.; Winchester, Va.; Meriden, Conn.; Gulfport, Miss.; Bristol, Tenn.; Thurmont, Md.; Still Pond, Md.; Apache, Okla.; Poteau, Okla.; Aberdeen, S. D.; Gouverneur, N. Y.; Globe, Ariz.; Beaufort, S. C.; Erie, Kan.; Lincoln, Neb.; Hemlock, Mich.; Florida, N. Y.; Chico, Cal.; Manti, Utah; Columbus, Ohio, and Potomac, Va.

CARNEGIE AND PITTSBURGH TROLLEYS.—Andrew Carnegie has announced that he will add 20 per cent to any fund which the Civic Commission of Pittsburgh may raise for the betterment of traction conditions in that city. It is said that the commission intends to attack the 99-year franchise now held by the Pittsburgh Street Railways Company, and to make a vigorous fight for the betterment of transportation conditions.

Financial Intelligence.

THE WEEK IN WALL STREET.

The history of the past week in the stock market was neither very instructive nor very interesting. The money market continued to dominate the situation, and the fact that neither the English nor the German bank felt called upon to advance its rate of interest was taken as a distinct bullish influence. This contributed, on the whole, toward strengthening the market. Advances in price, however, were not marked, except in copper shares, for there was an uncertainty with regard to the policy of American banks, and the demand from the interior for crop moving purposes was greater than had been expected. While this restraining influence was still felt at the end of the week under review, on Nov. 15, the last day, there was an increase of activity and more buoyancy. The main feature of the market is the strength of the copper stock. Within the past three weeks Amalgamated has advanced 14 points and the volume of trading has been very heavy. Other copper shares have also shown marked advances. This is not due to the improved condition of the copper metal trade, but to the confidence felt by Wall Street in the reports that a copper agreement is near at hand which will control production and maintain a price for the metal that will insure profits for the producers. Among the other issues the industrials were particularly strong. This is a condition in keeping with the remarkable industrial revival the country is now enjoying. The outside demand for gold continues, but so far the drain has not been sufficiently heavy to cause alarm. Money Nov. 15 was quoted: call, 4 @ 5¼ per cent; 90 days, 5¼ @ 5½ per cent. The quotations in the table are those of the close, Nov. 15.

NEW YORK.

	Nov. 8.	Nov. 15.	Shares sold.		Nov. 8.	Nov. 15.	Shares sold.
All. Ch.	15¼	15⅝	2,700	Int.-Met., pfd.	50⅛	55⅛	88,350
All. Ch., pfd.	54¼	54⅞	2,900	Mackay Cos.	91⅜	93¼	1,500
Amal. Cop.	89	94	379,790	MackayC.,pfd.	76*	75*	200
Am. D. T.	20½*	20½*	.....	Man. Elev.	142¾*	140¼*	760
Am. Loc.	62⅜	62½	4,200	Met. St. Ry.	24¼*	27	650
Am. Loc.,pfd.	116	116*	477	N.Y.&N.J.Tel	130¼*	130½*	.....
Am. Tel. & C.	85*	85*	.....	Steel, com.	90¼	90⅞	555,570
Am. T. & T.	140¼	142⅞	23,320	Steel, pfd.	127	126¾	4,525
B. R. T.	76¼	76⅛	22,670	W. U. T.	77¼	83½	6,600
Gen. Elec.	163¼	162*	1,500	West'h., com.	86½*	85½	5,770
Int.-Met.,com.	20	23	303,170	West'h., pfd.	140*	134½*	200

PHILADELPHIA.

	Nov. 8.	Nov. 15.		Nov. 8.	Nov. 15.
Am. Rys.	45⅛	45	Phila. Elec.	13¼	13⅛
Elec. Co. of A.	12⅜	12⅜*	Phila R. T.	27½	26¾
Elec. St. B'ty.	58½	58½	Phila. Trac.	89*	89*
E. S. B'ty, pfd.	30*	30*	Union Trac.	53½	52¾

CHICAGO.

	Nov. 8.	Nov. 15.		Nov. 8.	Nov. 15.
Chi. City Ry.	180*	180*	Chi. Tel. Co.	136½	136
Chi. Rs., Ser 1.	108*	108*	Met. El., com.	17*	17*
Chi. Rs., Ser. 2.	34*	33½	Met. El., pfd.	52	52½*
Com. Edison.	119½	119	Nat'l Carbon.	97*	97
Chi. Subways.	7¼	6½	Nat'l Car., pfd.	120*	120*

BOSTON.

	Nov. 8.	Nov. 15.		Nov. 8.	Nov. 15.
Am. T. & T.	140	142½	Mex. Tel.	3¼*	3*
Cum. Tel.	146	146*	Mex. Tel., pfd.	6*	6*
Edison E. Ill.	250	250	N. E. Tel.	134	134¾
Gen. Elec.	162*	162*	W. T. & T.	14	13¾
Mass. E. Ry.	18⅞	16¼	W. T. & T., pfd.	80	80*
Mass. E. R., pfd.	84	80			

* Last price quoted.
Shares sold are for week of Nov. 8 to Nov. 13.

NEW JERSEY PUBLIC SERVICE CORPORATION EARNINGS.—A circular letter has been sent to two important banking firms by Thomas N. McCarter, president of the Public Service Corporation of New Jersey, which shows that the gross earnings of that company have increased steadily during the last five years, and that on Nov. 1 the surplus over interest charges was $1,133,234. Mr. McCarter expressed the opinion that the funds of the corporation available for interest on the bonds will be at least three times the amount required. The official report of the company for the year ended Sept. 30, 1909, just made public, shows gross receipts of $25,921,892, and total expenses, including taxes, rentals and fixed charges of subsidiary companies of $23,235,533.

COPPER INTERESTS GET TOGETHER.—The much-talked-of negotiations which have been pending between leading copper men and representatives of the Amalgamated interests have reached the point where alternative plans are being considered. The first of these plans is the formation of a holding company along the lines of the United States Steel Corporation, the securities of which would be transferred for the securities of the producing companies. Another plan suggests the formation of a general selling agency, which would control the output of leading mines and be able to regulate production according to the market demand. Still another suggestion is for the organization of several groups of copper producers in various sections, with an understanding or agreement between the several groups. Of these three plans the one most generally favored is that of a holding company. The adoption of any one of these plans would mean the settlement of the smelting competition between the Guggenheim and Amalgamated interests. John D. Ryan, president of the Amalgamated Copper Company, while not giving out which of the plans he favors, has announced himself as positively in favor of restricting the output of copper, in order to prevent the accumulation of surplus stocks. A representative of Phelps, Dodge & Co. says that his firm has not been invited to participate and would not go in if invited. In connection with this amalgamation it is stated that the principal copper producers of British Columbia are about to be merged or come to an agreement. Such a consolidation would have a thorough understanding with American producers.

NEW YORK EDISON COMPANY SURPLUS.—According to the report for the year 1908 filed with the Public Service Commission, which has just been made public, the New York Edison Company had a corporate surplus on Dec. 31 of $14,835,546. Assets on the balance sheet showed a grand total of $131,764,516. The total funded debt is $44,062,395. Figures bearing on operation show that during the year the company delivered 252,416,153 kw-hours of energy, for which it received $15,228,716. The company at the end of the year had 73,522 consumers, an increase during the year of 8284, of which increase 7163 were in Manhattan and 1121 were in the Bronx. The company had 90,283 meters in service, and a connected load at a 16-cp equivalent of 6,729,926. There were 41,822 arc lamps and 3,429,266 incandescent lamps in service. The report of the Long Acre Electric Light & Power Company for the same period showed assets of $684,955, of which $566,313 was the estimated value of the franchise. The gross operating revenue was $3,804, and the total operating deficit was $20,586. The company had 10 consumers and 11 meters in Manhattan.

BRAILEY BUYS ANOTHER TELEPHONE COMPANY.—It has been announced in Indianapolis that James S. Brailey, Jr., of Toledo, has purchased a controlling interest in the new Long Distance Telephone Company of Indiana. The stock was owned largely by Indianapolis interests, and the price paid by Mr. Brailey for these holdings is said to have been about 60 cents on the dollar. The report published in Indiana that Mr. Brailey was acting for Bell interests is explicitly denied by him. In our issue of Oct. 28 was pubished a personal denial from Mr. Brailey that in his acquirement of the Ohio Home Telephone Company, and other Independent concerns in the neighborhood of Cleveland, he was acting for Bell interests. In this statement Mr. Brailey said that he had been for two years organizing a consolidation of Independent telephone interests in the Middle West.

QUEBEC RAILWAY, LIGHT, HEAT & POWER COMPANY.—The consolidation of the public service properties at Quebec, referred to in the issue of Nov. 4, has been effected and articles of incorporation filed for the Quebec Railway, Light, Heat & Power Company, the new holding concern. The properties taken over are the Quebec Railway & Power Company, the Quebec Gas Company, the Frontenac Gas Company, the Canadian Electric Company, the Seven Falls Company and several smaller concerns. The capital stock of the new company is to be $10,000,000. It was announced that the Quebec-Jacques Cartier Electric Company was also included in the deal. Emerson McMillan, of the American Light & Traction Company, which controls the Jacques Cartier company, denies that the property is involved.

ALUMINUM COMPANY TO INCREASE CAPITAL.—Notice has been filed with the Secretary of State of Pennsylvania by the Aluminum Company of America of an increase of the capital stock of the company to $20,000,000. At present the capital is $600,000 preferred and $3,200,000 common. When asked as to the purpose of the increase one of the officials of the company said: "We have made no plans for extensions or the expenditure of the proceeds of the sale of stock. We have simply applied for the right to increase, but I would not say that we had made any plans for getting any money for the stock."

KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY.—The stockholders of the Kings County Electric Light & Power Company met Nov. 11 and authorized an issue of $5,000,000 of 6 per cent convertible debenture bonds. The proceeds of these bonds are to be used for the acquisition of property, new construction and the improvement of the plant. An application was made some weeks ago to the Public Service Commission for an approval of this issue, and several hearings have been had upon the subject, but no action has as yet been taken.

DOHERTY & COMPANY BUY MARYLAND TRACTION.—Henry L. Doherty & Company have purchased control of the Cumberland & Westernport Electric Railway Company, with headquarters at Cumberland, Md. This road has 26 miles of track and runs from Cumberland to Lonaconing, Md. The company is a consolidation of several small traction properties in that section. It has outstanding $625,000 of stock and $230,000 of bonds. Doherty & Company promise to improve the condition of the property and expect to operate it.

HEAVY EARNINGS FOR BELL COMPANIES.—During the first nine months of the current year the associated Bell operating companies of the United States, not including the long-distance lines, showed gross earnings of $99,834,450, which is an increase of more than 7 per cent over the previous year. The operating expenses and taxes were a trifle more than $40,000,000, and there was charged off $31,271,194 for maintenance and depreciation. The net earnings after all of these charges were $27,448,113.

ATLANTIC CITY GAS COMPANIES SOLD.—Clarence H. Geist, of Philadelphia, has purchased both the Consumers' Gas Company and the Atlantic City Gas & Water Company, which are operated in Atlantic City, the price paid being approximately $3,500,000. Mr. Geist now has a large number of gas enterprises throughout the Middle West, and last August took over the Wilmington Gas & Electric Company. The new owner contemplates extensive improvements in the Atlantic City properties.

SOUTHWESTERN TELEPHONE & TELEGRAPH COMPANY.—H. H. Patterson, Augusta, Ark., has sold his telephone system, consisting of about 100 miles of long-distance lines and local systems at McCrory, Cotton Plant and Augusta, to the Southwestern Telephone & Telegraph Company. The price paid was $25,000. Mr. Patterson retains control of the farmers' lines.

CONSOLIDATED LIGHT COMPANY, OF KANSAS CITY.—The Consolidated Light & Power Company, of Kansas City, has applied to the Council for a renewal of its franchise, which expires next February. The company asks for permission to charge the same rate as at present prevailing for domestic lamps, and to make a sliding scale of from 4 to 9 cents for commercial lighting.

GREAT WESTERN POWER COMPANY BONDS.—Kountze Bros., of New York, and E. H. Rollins & Sons, of Boston, are offering to the public $3,000,000, 5 per cent, first mortgage bonds of the Great Western Power Company of California. These bonds are offered at 96 and interest, yielding the purchaser 5¼ per cent.

DIVIDENDS.

American Railways Company, quarterly, 1½ per cent, payable Dec. 15.

Columbus (Ohio) Railway Company, quarterly, 1¼ per cent, payable Dec. 1.

International Smelting & Refining Company, quarterly, 1½ per cent, payable Dec. 1.

Kings County Electric Light & Power Company, quarterly, 2 per cent, payable Dec. 1.

Mobile Electric Company, preferred, quarterly, 1½ per cent, payable Nov. 16.

Norfolk Railway & Light Company, semi-annual, 2 per cent, payable Dec. 6.

GENERAL NEWS

Construction News.

AUGUSTA, ARK.—H. H. Pattrson, of Augusta, Ark., has sold his telephone system, consisting of 100 miles of long-distance line and the local systems at McCrory, Cotton Plant and Augusta, to the Southwestern Telephone & Telegraph Company, for $25,000. Under the terms of the sale the Southwestern company becomes sole owner of the Patterson lines, with the exception that Mr. Patterson retains control of the farmers lines.

GLOBE, ARIZ.—Plans are being considered for the installation of a hydroelectric power plant at Apache Falls, 30 miles above the Roosevelt dam on Salt River, to furnish electricity in Globe, 35 miles distant. The cost of the plant is estimated at about $600,000. George Hill, J. B. Newman, P. Jones, E. Stewart and George Shanley, of Globe, are interested in the project.

ALAMEDA, CAL.—The Pacific States Telephone Company has notified the Council that it will place all its wires underground in Alameda. It is said that work will begin within 30 days and wires on Oak Street will be the first to be placed underground.

BIG PINE, CAL.—The Buckeye Mining & Smelting Company is reported to be in the market for equipment for a power plant, which will include a 400-hp electric unit, with exciter and other auxiliary apparatus.

CHICO, CAL.—The Sacramento Valley Power Company has secured a franchise for erecting a system for the distribution of electricity in Chico. The company was the only bidder for the franchise advertised by the City Trustees. It expects to have its transmission line extended from Redding and to furnish electrical service in Chico by February, 1910.

LOS ANGELES, CAL.—Plans are being prepared by Col. C. E. Apponyi for harnessing the Colorado River to develop the water power to be utilized to generate electricity for transmission to mining camps of Arizona and Nevada. The plans contemplate the construction of a hydroelectric plant at the first rapids above the head of high water navigation, about 180 miles by river from Needles, Cal., and between Lincoln County, Nev., and Mojave County, Arizona, where water rights have been secured on a strip of five miles at the place where the plant is to be established. It is estimated that the proposed plant will generate at least 30,000 hp. It is proposed to install four successive turbo-generator units, each working under a 50-ft. head. Electricity can be transmitted to Tonopah, Nev., 170 miles distant, and to Prescott, Ariz., a distance of 160 miles, and intermediate points.

MARTINEZ, CAL.—Sealed bids will be received by the Board of Supervisors until Dec. 6, at the office of J. H. Wells, clerk of board, for a 50-year franchise to erect poles and wires over the roads and highways in Contra Costa County, application for which has been made by H. B. Kinney.

MARYSVILLE, CAL.—The Northern Electric Company has practically completed its transmission line between this city and Meridian, a distance of 20 miles. The company expects to be ready to furnish electrical service by the first of the year. It will furnish electricity for operating irrigation and pumping plants.

OAKLAND, CAL.—Owing to the protest of the property owners on Fifth Avenue against the erection of poles along that thoroughfare, between East Twentieth Street and the water front by Great Western Power Company to carry its high-tension transmission wires, the City Council has authorized the Board of Public Works to take action immediately to insure the removal of the poles.

OROVILLE, CAL.—The Oro Water, Light & Power Company is making preparations for the construction of a large power plant at the mouth of Yellow Creek, a few miles south of Butte Creek.

SAN BERNARDINO, CAL.—The City Council has granted the Southern California Edison Company a franchise to erect and maintain transmission lines over and under the county roads and highway in the County of San Bernardino for the distribution of electricity for lamps and motors.

SAN DIEGO, CAL.—Plans are being made by the Pacific States Telephone & Telegraph Company for general improvements to its system in San Diego, including placing its wires in underground conduits, work on which will commence in the near future.

SANTA ROSA, CAL.—Application has been made to the Board of Supervisors by the Cloverdale Light & Power Company, of Cloverdale, Cal., for a franchise to erect poles and wires for the transmission of electricity, also telephone and telephone wires on certain roads in the county. Andrea Sbarboro is president of the company.

SEBASTOPOL, CAL.—The Board of Supervisors has accepted the bid of H. C. Eastman for a franchise to erect transmission lines for the distribution of electricity from Sebastopol to Graton, Forestville, Occidental, Camp, Meeker, Guerneville and other places in the western part of Sonoma County. The amount paid by the company for the franchise was $250.

FORT LOGAN, COL.—Bids will be received until Dec. 14 by Capt. Chase Doster, constructing quartermaster for the construction of a pump house at Fort Logan. Separate bids to be received in the following sections: Construction of building, plumbing, electric light wiring, boilers and appurtenances, air compressors, steam pumps and pipings. Alternate bid for electrical installation, including electric motors, air compressors, pumps, piping, etc. Plans and specifications may be had on application.

NEW CASTLE, COL.—Sealed proposals will be received at the office of J. E. Smith, town recorder, for furnishing and delivering f.o.b. New Castle, Col., machinery and equipment for the proposed municipal electric light plant as follows: Item 1—Steam engine and belts. 2—Alternating-current generator and exciter. 3—Switchboard. 4—Transformers and series lighting equipment. 5—Line material and supplies. Specifications may be obtained from town recorder.

MERIDEN, CONN.—The Meriden, Middletown & Guilford Railway Company has decided to proceed with the final survey for its proposed railway from Durham to North Branford. Work will commence on that section as soon as the survey is completed.

MERIDEN, CONN.—Plans are being considered to organize a company to operate a small electric light plant in the rear of the Cahill Block to furnish electricity for lamps to the merchants in the Cahill Block and possiby to Poli's theatre in Meriden. E. F. Donahue and the M. W. Booth Company are interested in the project.

ST. PETERSBURG, FLA.—Preparations are being made by the St. Petersburg Electric Light & Power Company for the construction of a new generating station which will be driven by a Corliss engine or steam turbines, with turbo jet condensers. The equipment will include boilers, steel stocks, automatic stoker furnaces, pumps, feed water heater, generators, exciters, switchboard apparatus, transformers, converter, lightning arresters, etc.

ATHENS, GA.—The Athens Electric Railway Company has secured control of Barnett Shoals, near Athens, Ga., where it will in the near future develop 4000 hp for electrical transmission to Athens.

MARIETTA, GA.—The underwriters of the bonds of the old Marietta Public Service & Manufacturing Company, operating the Marietta electric and water plants and paper mills, which went into bankruptcy, have reorganized the company. Application has been made for a charter under the name of the Kennesaw Paper Company, with a capital stock of $302,000. H. T. Inman and others are the incorporators. The head office will be located in Atlanta, Ga.

BOISE, IDAHO—Application has been made to the City Council by Dean Perkins, representing eastern and local capitalists, for a franchise for a new suburban electric railway, which will extend from Boise to Kuna, Idaho.

GRANGEVILLE, IDAHO.—Plans are being made for the construction of a large hydroelectric power plant in Central Idaho, for which purpose, it is said, a company is now being organized to be capitalized at $6,000,000 by capitalists of Spokane, Wash. A. W. Trine, 1815 Boone Avenue, and G. F. LaFrenz, 1632 Elm Street, Spokane, Wash., are said to have located a site for a dam and power plant on the Salmon and Snake rivers, about 40 miles south of Grangeville, Idaho. The plans call for a combination tunnel and dam, which will develop 280,000 hp. The dam will be 100 ft. high and located on the Salmon River about one-quarter of a mile from the point where the tunnel will leave the waterway for the Snake River. The tunnel will be built through solid rock, seven and one-half miles in length, and it is estimated that a fall of 530 ft. will be secured. Water rights for 8000 second ft. of water have been secured on the Salmon River and 2800 second ft. on the Snake River side. R. J. Zell, of Spokane, Wash., engineer, is preparing plans and estimates for the proposed plant.

SHOSHONE, IDAHO.—The Southern Idaho Telephone Company has secured a franchise to erect telephone lines over various roads in Lincoln County.

SHOSHONE, IDAHO—The Great Shoshone & Twin Falls Water Power Company has been granted the right of way for its transmission lines over certain roads in Lincoln County.

GRANITE CITY, ILL.—The National Enameling & Stamping Company, of New York, N. Y., is reported to be contemplating the construction of an electric light and power plant at its stamping works in Granite, Ill, to cost about $30,000. O. B. Niedringhaus is superintendent.

HOMER, ILL.—The Homer Telephone Exchange has been purchased by J. H. Culver, of Decatur, Ill., one of the largest stockholders of the Douglas County Telephone Company, with headquarters at Tuscola, Ill. The Homer exchange will probably be absorbed by the Douglas County system, which operates from 12 to 15 exchanges in Douglas and adjoining counties. It is understood that the local exchange will be rebuilt.

JOLIET, ILL.—The Chicago, Blue Island & Joliet Electric Railway Company has filed a mortgage in the office of the county recorder in favor of the American Trust & Savings Bank to secure a bond issue of

$500,000. The company was recently organized to construct an electric railway to connect the Chicago & Southern with the Joliet & Southern roads, near Frankfort. Work will commence on construction of the road immediately. W. H. Conrad is president, and W. H. Merrill, secretary.

OTTAWA, ILL.—The Northern Illinois Light & Traction Company has applied to the City Council for a renewal of its franchise for a term of 20 years.

ROBINSON, ILL.—The capital stock of the Southeastern Illinois Long Distance Telephone & Telegraph Company has been increased from $30,000 to $50,000.

BREMEN, IND.—A company is being organized to construct an electric railway from Bremen to Milford Junction, 14 miles in length, to connect with the Winona line. The company will furnish both a passenger and freight service, and will also furnish electricity for lamps and motors along the route of the railway.

BUCK CREEK, IND.—The Eckert Telephone Company is in the market for a new switchboard and exchange equipment to replace the loss of similar equipment by fire.

FRANKFORT, IND.—It is reported that the Great Western Smelting & Refining Company, of Chicago, Ill., has decided to reopen and put in operation the Frankfort Brass Works, which has been in the hands of a receiver for a year or more. The plant will be operated by electricity. The new company has applied to city for rates for electrical service, and if satisfactory arrangements are made, it is said that the plant will be started by Dec. 1.

INDIANAPOLIS, IND.—The Peacock-Woolley Company, of Chicago, Ill., has withdrawn its offer to install a free lighting system in the down town district in consideration of the advertising privileges on the lamps. As a result the City Council will proceed with a plan to install a large number of arc lamps suspended from poles heavier than are now used to support street lamps and trolley wires, at a cost of about $14,000.

INDIANAPOLIS, IND.—The Shore Line Traction Company has been granted a franchise by the Commissioners of Marion County for the construction of an electric railway in Churchman's Pike, from Indianapolis to Beach Grove, a distance of nine miles. The company, it is said, has not yet decided whether it will seek an independent entrance into Indianapolis and build a power house at Beach Grove. Louis McMains is interested in the project.

JASONVILLE, IND.—The Indiana Electric Transmission Company, of Terre Haute, Ind., has issued bonds to the amount of $70,000, the proceeds to be used for the installation of a water works system in Jasonville.

LOGANSPORT, IND.—The Commissioners of Cass County have granted the Indiana & Northwestern Traction Company a 75-year franchise to construct an electric railway through the county.

NEW ALBANY, IND.—The Board of Public Works has rejected the bid submitted by the United Gas & Electric Company for furnishing electricity for street lighting for a term of ten years, beginning Sept. 1, 1910.

NEW CASTLE, IND.—The New Castle Independent Telephone Company is asking for an extension of franchise for 50 years. The present 12-year franchise will expire next year. The company promises in case of an extension to make extensive improvements and extensions to its system.

SOUTH BEND, IND.—The City Council has ordered the Central Union Telephone Company, which is building a new exchange here, to proceed with the construction of its underground system.

TERRE HAUTE, IND.—The Indiana Electric Transmission Company, of this city, has amended its charter so as to enlarge its field of corporate operation, enabling the company to extend its system to any county in the State. Thomas Duncan is president.

COIN, IA.—The citizens of Coin are considering the question of installing an electric lighting system, water works and sewers.

PELLA, IA.—The City Council has engaged the Iowa Engineering Company to supervise the installation of the municipal electric light plant and water works system.

WATERTOWN, IA.—The Village Board has granted the United Light & Power Company, of East Moline, Ill., a 25-year franchise to furnish electricity for lamps and motors in Watertown. Under the terms of the franchise the village is given the privilege of purchasing the plant and equipment at the expiration of the franchise. The company agrees to furnish arc lamps for street lighting at the rate of $70 each per year on all lamps under 25; all over that number will be supplied at the rate of $65 per lamp per year.

EMPORIA, KAN.—Negotiations are under way between the Emporia Business Men's Association and the Anderson Electric Light Company in connection with the company locating in Emporia. The company wishes to locate in this city and is seeking inducements. It is understood that the company will erct a building at a cost of $10,000 and install a $5,000 plant.

ERIE, KAN.—At a special election held Nov. 2 the citizens voted to issue $50,000 in bonds, the proceeds to be used for the construction of a combined electric light and water works system.

GREENLEAF, KAN.—A movement is on foot for the installation of an electric light plant in Greenleaf.

MINERAL, KAN.—The City Council has granted Henry Arnold & Company a franchise to construct and operate an electric light plant in Mineral.

NICKERSON, KAN.—At an election held Nov. 2 the citizens defeated the proposition to issue $35,000 in bonds for the construction of an electric light plant and water works system.

WAVERLY, KAN.—Extensive improvements will be made to the municipal electric light plant, which will include the installation of complete new power equipment, consisting of engine, generator, boiler, pump feed water heater, exciter, etc. The machinery, it is said, will be purchased by Dec. 1.

NEWPORT, KY.—The Board of Aldermen has authorized the Citizens Telephone Company to install and operate a telephone system in Newport.

PLAQUEMINE, LA.—The power plant of the municipal electric light plant and water works system was destroyed by fire on Nov. 1. The town at present is without lighting facilities. Temporary arrangements have been made with the Wilberts Sons Lumber & Shingle Company to supply water to the town.

PORTLAND, MAINE.—The contract for installing special electric fixtures in the new county building, bids for which were opened Nov. 1, was awarded to the McKenney & Waterbury Company, of Boston, Mass., [illegible].

FREDERICK, MD.—Negotiations have been closed whereby the Chesapeake & Potomac Telephone Company has purchased the plant and holdings of the Frederick County Telephone & Telegraph Company. The consideration is said to be about $125,000.

STILL POND, MD.—Plans are being considered by Rev. John H. Beauchamp and Barnard Harper, of Still Pond, for the establishment of an electric plant at Urieville, Md., to furnish electricity for lamps in Still Pond, Betterton, Kennedyville and Lynch. The cost of the plant is estimated at $12,000.

THURMONT, MD.—The Citizens Electric Light & Power Company, recently incorporated, is reported to have awarded a contract for the construction of power house and furnishing equipment to cost $16,015. The plant will be located on Hunting Creek, near Thurmont. John R. Rouzer, Morris A. Birley and others are interested in the company.

SOUTH BARRE, MASS.—The new mill building of the Nornay Worsted Company, of Providence, is expected to be completed by Dec. 1. The machinery will be operated by electricity, which will be generated by the company's own plant.

WORCESTER, MASS.—The Worcester Consolidated Street Railway Company has closed its power plant on Brigham Street, Westboro. The plant will be dismantled and the equipment placed in the Westfield power station on the Woronoco Street Railway.

ALPENA, MICH.—Prof. D. W. Mead, of University of Wisconsin, Madison, Wis., is reported to have completed plans for the construction of a large hydroelectric power plant on Thunder River for the Alpena Power Company, of Alpena, Mich.

BAY CITY, MICH.—The Chippewa Power Company has withdrawn its application for a franchise to furnish electricity in Bay City, advising the committee that it could not accept the rates that the committee proposed in the franchise which was to be submitted to a vote of the people. The city owns and operates a municipal electric light plant. The rates demanded by the committee were seven cents per kw-hour for 100 kw or less; five cents per kw-hour from 100 to 150 kw and four cents for all used above 150 kw. The company offered to furnish electricity at the rate of eight cents per kw-hour for 100 kw or less and all in excess of that for five cents per kw-hour. W. F. Davidson, of Port Huron, Mich., is vice-president of the company.

HEMLOCK, MICH.—The Wilsterman Electric Company is reported to have secured the contract for the installation of the new power plant in Hemlock; also the contract for commercial wiring.

TRAVERSE CITY, MICH.—Plans are being prepared by the Traverse City Refrigerator Company for the construction of a new plant in Traverse City. The equipment will include steam boilers and motor driven blowers for the refuse disposal system.

AURORA, MINN.—The Village Council is considering the question of establishing a municipal electric light plant.

GRANITE FALLS, MINN.—The question of purchasing a new water wheel for the municipal electric light plant is reported to be under consideration.

WHITE BEAR, MINN.—The Washington County Light & Power Company of Stillwater, Minn., is reported to have acquired the electric plant of the White Bear Company. It is said that the local steam plant will be abandoned and electricity for operating the system will be furnished from the power plant in Stillwater, Minn.

ACKERMAN, MISS.—The contract for construction of the municipal electric light plant and water works system is reported to have been awarded to Walton & Wegner, of Atlanta, Ga. X. A. Kramer, of Magnolia, Miss., is engineer.

GULFPORT, MISS.—Sealed proposals will be received by the Mayor and Board of Aldermen until Dec. 7 for one direct-connected, two-stage turbine centrifugal pump and motor, pump to have a capacity of 1500 gal. per minute, under 100 lb. pressure, speed not to exceed 1200 r.p.m.; [illegible] alternating current type, three phase, 60 cycles. Also one

constant duty, single suction volute pump, having a capacity of 350 gal. per minute, under 25 lb. hydraulic pressure. Pump and motor to be direct connected; motor to be alternating-current type, three-phase, 60 cycles, 220 volts, speed not to exceed 900 r.p.m. Specifications and blank forms of proposals may be obtained from the city engineer. Proposals to be addressed to N. D. Goodwin, city clerk.

TYLERTOWN, MISS.—The Cumberland Telephone Company has been granted a franchise to erect a telephone system in Tylertown.

TYLERTOWN, MISS.—The Pike County Lumber Company has applied for a charter with a capital stock of $150,000 for the purpose of engaging in a lumber business. The company also ask for the privilege of operating railroads, light and water plants and other utilities necessary to conduct a lumber manufacturing business. R. H. Cline, A. W. Cline, R. P. Holmes and R. S. Holmes, all of Hattiesburg, Miss., are incorporators.

ASH GROVE, MO.—The question of establishing an electric light plant in Ash Grove is under consideration.

KANSAS CITY, MO.—The Consolidated Light & Power Company has applied to the City Council for a renewal of its franchise, which expires Feb. 20, 1910. The company asks for permission to charge the same rate for electricity for domestic lamps and a sliding scale of from four to nine cents per kw-hour for commercial lighting.

ST. LOUIS, MO.—The Kansas City & St. Louis Electric Railway Company, which proposes to construct an electric railway from St. Louis to Kansas City, has increased its capital stock from $5,000,000 to $15,000,000. D. C. Nevin is president of the company and H. E. Insley, secretary and treasurer.

ST. LOUIS, MO.—The Light & Power Development of St. Louis has renewed its application for a 30-year franchise to enter into competition with the Union Electric Light & Power Company to furnish electricity in St. Louis. The Light & Development Company owns and operates the Cape Girardeau Light & Power Company, Cape Girardeau, Mo., and is operating the Paris Electric Light & Power Company, of Paris, Tex., and also the Paris Transit Company, of the same city. The company also operates light and power plants in the Wright and Chemical buildings, and the plant in the Famous and old Grand Leader buildings in St. Louis.

DILLON, MONT.—Plans are being prepared by the Montana Independent Telephone Company to install a system in Dillon. The company will also erect cross-country telephone lines from Butte to Twin Bridges, Sheridan and Virginia City to connect with Dillon.

LINCOLN, NEB.—The committee appointed by the City Council to investigate the municipal electric light plant has recommended the installation of an additional 500-hp engine and generator and other equipment to increase the output of the plant to meet the increased demands made upon it. The cost of the work is estimated at about $40,000.

VALENTINE, NEB.—Bids will be received at the office of the village clerk until Nov. 29 for the construction of the whole or parts of the water and lighting systems of the proposed municipal electric light and water systems, including furnishing and installing of all machinery and apparatus in accordance with plans and specifications prepared by the W. K. Palmer Company, engineers, Kansas City, Mo. Specifications are divided into seven different sections and bidders are invited to submit bids for any or all sections or for the system complete as follows: Section 1—Earth dam and spillway. Section 2—Wells complete ready for equipment. Section 3—Concrete reservoir, power house, wheel pit and pump house. Section 4—Pole line equipped complete. Section 5—Water mains and distributing system. Section 6—All power equipment, installed complete. Section 7—Tank and tower (Alternative for concrete reservoir in section 3). Plans and specifications are on file at the office of the village clerk and at the offices of the W. K. Palmer Company, engineers, Dwight Building, Kansas City, Mo. Copies of complete plans will be furnished by the engineers upon payment of $5 to cover cost of preparation; sections 3, 5 or 6 for $2 each, and $1.50 for sections 1, 2, 4 or 7.

YORK, NEB.—The York County Independent Telephone Company has decided to increase its capital stock by $50,000.

CARSON CITY, NEV.—It is reported that the construction of a large power plant in Mono County is under consideration. J. S. Cain, president of the Mono County Bank and the Cain & Comstock Mining & Milling Company is interested in the project.

RENO, NEV.—Surveys have been completed for the construction of an electric railway connecting Ely, East Ely, Smelter, Ripetown and the mines at Ely. The cost of the railway is estimated at about $300,000. Work on construction of the road will soon commence. G. L. Rickard is president.

NEWARK, N. J.—The contract for the installation of the new electric light plant at the jail was awarded to Storms & Company, of Newark, N. J., for $10,478.

BINGHAMTON, N. Y.—The Board of Managers of the Binghamton State Hospital has submitted recommendations to the State Commission in Lunacy asking the commission to petition the State Legislature for $150,000 for improvements for the hospital, of which $55,000 is asked for the construction of a new lighting plant.

BROOKLYN, N. Y.—Bids will be received by Nicholas J. Hayes, fire commissioner, at his office, 157 and 159 East Sixty-seventh Street, New York City, until Nov. 23 for furnishing and delivering 21,000 ft. of underground lead covered cable for fire alarm telegraph. Blank forms and further information may be obtained at the above office.

BROOKLYN, N. Y.—All contracts for the construction of the Fourth Avenue Subway in Brooklyn, have been signed and work will soon commence on construction of the same. The Edison Electric Illuminating Company of Brooklyn has asked the Public Service Commission for permission to furnish electricity for lighting and operating the whole or part of the proposed subway.

CENTER MORICHES, N. Y.—The citizens of Center Moriches have petitioned the Town Board for permission to form a street lighting district.

DUNDEE, N. Y.—Negotiations have been closed between the Village President and E. L. Bailey, owner of the Dundee electric light plant, for substituting the present incandescent street lamps of 25 cp for 80-cp tungsten lamps, which will give the village a much better service at an additional cost of $300 per year, making the total cost $1,800 per year. The new lamps will be installed at once.

FLORIDA, N. Y.—The Public Service Commission has authorized the Orange & Rockland Electric Company, of Monroe, N. Y., to construct and operate an electric light system in the village of Florida, and has also approved of the franchise granted to the company by the Town Board of Warwick. The company furnishes electrical service in Monroe and other towns in Orange County.

GOUVERNEUR, N. Y.—Preparations are being made by the Oswegatchie Light & Power Company for the construction of an electric power plant in Hailesboro, two miles distant, on the site of mill No. 5, next spring. The water has a natural fall of 25 ft., to which will be added a 7-ft dam, which will develop over 3000-hp. Electricity will be transmitted from Hailesboro to Gouverneur.

LITTLE FALLS, N. Y.—Preparations are being made by the Utica Gas & Electric Company, of Utica, N. Y., for the construction of a hydroelectric plant to be erected on the "Old Lovenheim Mill site" at Little Falls, N. Y., at a cost of about $100,000. H. W. Dennis, of Niagara Falls, N. Y., is engineer. N. J. Brayton, of Utica, is president of the company.

MINEOLA, N. Y.—The New York & North Shore Traction Company has purchased a site on Alley Creek, Bayside Meadows, where it proposes to erect a power plant. Electricity generated at this plant will be utilized to operate the new railway extending from Whitestone Landing to Flushing, and the railway connecting Nassau and Queens counties.

NEW YORK, N. Y.—The Board of Estimate has approved the plans of the White Plains Avenue extension to the Westchester Avenue subway route.

NEW YORK, N. Y.—The Public Service Commission, First District, has granted the South Shore Traction Company permission to construct its railway through Queens Borough and across the Queensboro Bridge.

NEW YORK, N. Y.—Preparations are being made to improve the lighting systems in the parks, which will include the installation of about 1500 tungsten lamps of 60 cp to replace 400 or more gasoline lamps now in service. New lamps will also be provided for Prospect Park, in the Borough of Brooklyn. Henry Smith is park commissioner.

NIAGARA FALLS, N. Y.—The Niagara Falls Hydraulic Power & Manufacturing Company has installed another 10,000-hp unit in its plant, making the seventh unit in the station. Contracts have already been placed for the additional output.

PAINTED POST, N. Y.—The Corning Cut Glass Company has installed an engine and dynamo in its plant to generate electricity for lighting its factory.

TALCVILLE, N. Y.—The dam and power house of the Uniform Fibrous Talc Company, located near Talcville, is nearly completed. The plant will furnish electricity to operate the new talc mine and mill of the company. Connell & Connell, 90 West Street, New York, N. Y., are engineers.

ALBEMARLE, N. C.—Local cotton mills are reported to have closed a contract with the Southern Power Company to supply electricity for operating several textile mills in Albemarle. The town recently voted to issue bonds to install an electric lighting system. It is now thought possible that a contract may be made with the Southern Power Company to supply electrical energy to operate the same.

CANTON, N. C.—Mr. McCormick, of Chicago, Ill., is reported to be interested in a project to construct an electric railway to connect Asheville and Waynesville, for which surveys have already been made. It is understood that the railway will leave the Southern Railway at Canton and follow up the Pigeon River and through the Davis Gap route to Waynesville.

HICKORY, N. C.—The Southern Power Company is reported to be considering extensive developments on the upper Catawba River, near Hickory, including the erection of another transmission line, surveys for which will soon be made. The company already has a contract to furnish electricity in Hickory.

FORT LINCOLN, N. D.—The contract for electric wiring and installing electric fixtures in buildings at Fort Lincoln was awarded to the Electric Construction Company, of St. Paul, Minn., for $24,998. J. D. Elliott is constructing quartermaster.

GRAND FORKS, N. D.—It is reported that the ways and means committee of the City Council has recommended holding an election to

vote on the proposition to issue $141,000 in bonds, of which $25,000 will be utilized to increase the output of the municipal electric light plant.

COLUMBUS, OHIO.—The Columbus & Cincinnati Air Line Traction Company is making preliminary surveys for its proposed electric railway to connect Columbus and Cincinnati, a distance of about 100 miles. The Riggs & Sherman Company, of Toledo, Ohio, are engineers. For further information address W. J. Sherman, of Toledo, Ohio.

COLUMBUS, OHIO.—Bids will be received until Dec. 10 by the Board of Managers of the Ohio Penitentiary for power equipment in accordance with specifications prepared by Marriott & Allen, architects, 20 East Broad Street, Columbus, Ohio, and the Osborn Engineering Company, engineers, Osborn Building, Cleveland, Ohio, from whom plans and specifications can be secured. The equipment will include two direct-connected units consisting of alternating-current generators and cross compound Corliss engines, turbo-generators, two boiler-feed pumps, one feed-water heater, one electric traveling crane and four automatic stokers. Bids must be made on blank forms, which will be furnished on application to the architects or engineers. George U. Marvin is secretary.

FOSTORIA, OHIO.—We are advised that the Fostoria & Fremont Railway Company will commence work on construction of its proposed electric railway, which is to extend from Fremont and Fostoria, a distance of 21.4 miles, within 30 days. The company has taken over the property of the Fremont City Street Railway, now in operation between Fremont and Ballville, 2.5 miles in length, which will be used for an entrance to Fremont. It is expected to have the railway completed by July, 1910.

SHARON, OHIO.—Plans are being considered by the Mercer County Telephone Company for extensive improvements to its entire system throughout Mercer and Lawrence counties which will involve an expenditure of thousands of dollars. The present plans contemplate the erection of a telephone exchange in Sharon and the installation central energy system. The lines in Mercer County will be reconstructed first.

SPRINGFIELD, OHIO.—The Springfield Light, Heat & Power Company, it is reported, will be in the market for power equipment for its new plant, including condensers, pumps and electrical apparatus. The company has already placed some orders in connection with its new power station to be erected this winter.

WILLSHIRE, OHIO.—The Willshire Telephone Company has received authority from the Secretary of State to increase its capital stock from $20,000 to $35,000.

APACHE, OKLA.—The City Council has engaged the Southwestern Engineering Company, of Oklahoma City, Okla., to prepare plans for the construction of an electric light plant and water works and sewer systems. The proposition to issue $54,000 in bonds for construction of the improvements will be submitted to a vote. H. Peeper is mayor.

CHEROKEE, OKLA.—The City Council has called for an election to vote on the proposition to issue $30,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system.

DURANT, OKLA.—The citizens are reported to have voted to issue $50,000 in bonds, part of which will be used to establish an electric light plant.

EL RENO, OKLA.—The contract for the completion of the interurban railway of the El Reno Interurban Railway Company from El Reno to Yukon has been awarded to the Adams Construction Company. It is said that most of the right of way from Enid to this city has been secured.

LEXINGTON, OKLA.—The Oklahoma City, Lexington & Sulphur Springs Electric Railway Company has submitted a proposition to the citizens of Wynnewood to extend its proposed electric railway through Wynnewood, on condition that the people of the town subscribe to $25,000 in capital stock. The proposed railway will extend from Oklahoma City to Sulphur. James Sherman, of Lexington, is president.

POTEAU, OKLA.—The Poteau Electric Light & Ice Company is reported to have engaged H. L. Nichols & Company, engineers, of Muskogee, Okla., to prepare plans for its proposed electric light plant, water works system and ice manufacturing plant.

RALSTON, OKLA.—M. A. Earl & Company, of Muskogee, Okla., have been engaged to prepare plans and take charge of the construction of the proposed municipal electric light plant and water works systems for Ralston.

BEND, ORE.—Application has been made to the City Council by Louis Doonar, vice-president and general manager of the Pioneer Telegraph & Telephone Company, for a franchise to construct and operate an electric plant in Bend to furnish electricity for lamps and motors. If granted a franchise Mr. Doonar agrees to begin work on the plant within 90 days.

MEDFORD, ORE.—C. E. Sharpe is reported to have been granted a franchise to erect a telephone system in Medford.

PRINEVILLE, ORE.—Plans are being made for the construction of an electric railway from Opal City, the new town on the north side of Crooked River to Prineville, via Lamonta Gap and McKay flat. Electricity for operating the railway will be generated at Oden Falls, where the power plants will be located. Contracts have been awarded for the construction of the power plant.

WALLOWA, ORE.—Preparations are being made by the Home Telephone Company to erect a telephone line to Lower Valley. The company will also install a copper circuit on the main line from Le Grande to Joseph.

ALIQUIPPA, PA.—The Jones & Laughlin Steel Company, which is erecting a new plant in Aliquippa, will equip its plant for electric motor drive. It is said that the company will soon place orders for electrical equipment amounting to over $100,000.

BEAVER FALLS, PA.—The Beaver Valley Traction Company has decided to make improvements to its power house and storage battery equipment, which will involve an expenditure of about $10,000.

FREIDENSBURG, PA.—The Pinegrove & Cresonna Telephone Company contemplates extending its telephone lines to Friedensburg by the way of Black Horse.

INTERCOURSE, PA.—We are informed that work will commence immediately by the Intercourse Electric Light, Heat & Power Company on the extension of its transmission lines to Leaman Place, Paradise and Gordonville, a distance of three miles, for the purpose of furnishing electrical service in those towns. The cost of the work is estimated at $3,000. Emos L. Zimmerman is interested in the company.

JOHNSTOWN, PA.—The Johnstown & Altoona Street Railway Company has completed arrangements for the sale of $1,500,000 in bonds. It is said that work will commence on construction of the railway in the spring.

LEBANON, PA.—It is reported that the American Iron & Steel Manufacturing Company is planning to erect a steel billet mill in Lebanon in the near future, which will involve an expenditure of about $500,000. Announcement has been made that steel billets will be manufactured by an electrical process.

PHILADELPHIA, PA.—The Councils have passed the ordinance providing for the erection of 171 additional electric lamps on Market Street, between Second and Sixteenth streets. It is expected that the Council will authorize the installation of additional lamps in Walnut and Chestnut streets and around Independence Hall and Independence Square. The cost of additional lamps on Chestnut and Walnut streets is estimated at $55,000. It is said that action on the Market Street lighting project was due to the fact that the Philadelphia Electric Lighting Company has voluntarily assumed the cost, which is estimated at $30,000, of erecting the ornamental posts on which the new lamps are to be placed, contract for which has already been placed by the company in accordance with the designs prepared by Chief McLaughlin of the Electrical Bureau.

PITTSBURGH, PA.—Arrangements are being made by the Pittsburgh Railways Company for improvements and extensions to its system, which will include the installation of a 2000-hp motor generator, order for which has been placed with the Westinghouse Electric & Manufacturing Company. Orders have also been given to the same company for 240 motors of 100 hp each. The company is building a new subdivision power house on the Castle Shannon line near the south end of the Mt. Washington tunnel.

PITTSBURGH, PA.—The ordinance authorizing a contract for lighting the streets of the city by electricity for a period of not exceeding three years, to cost not more than $325,000 per year, has been recommended to the Council by the public works committee. The ordinance on the incandescent mantle lighting on some of the streets and alleys was amended to provide for either mantle or electric lamps, not to exceed an expenditure of more than $100,000 per year and the contract not to extend over a period of more than three years.

UNIONTOWN, PA.—A franchise has been granted to William A. Stone to construct and operate an electric railway in Uniontown.

WARREN, PA.—Plans are being considered by the Warren & Jamestown Street Railway Company for extending its railway from Jamestown to Dunkirk, passing through Ellicott, Gerry, Ellery, Stockton, Charlotte and Pomfret.

ANDERSON, S. C.—The Anderson Water & Light Company is sinking 60 additional wells for the purpose of increasing its water supply.

BEAUFORT, S. C.—At an election held Nov. 4 the citizens voted in favor of the proposition to issue bonds for the construction of an electric light plant and water works system. A board of commissioners, consisting of W. F. Marscher, W. J. Thomas and R. A. Long, was appointed to sell the bonds and to construct the plants and operate them.

CAMDEN, S. C.—The city would like to correspond with parties interested in a franchise for an electric lighting system. For further information address the mayor.

GREENVILLE, S. C.—The transmission lines of the Southern Power Company, from the power station at Great Falls to the new substation at Greenville, which were to have been completed two months ago, will not be ready before Dec. 1. The company will furnish electricity for operating the Monaghan and Woodside cotton mills.

HARTSVILLE, S. C.—At an election to be held Nov. 23 the citizens will vote on the proposition authorizing the Hartsville Electric & Water Company to construct an electric light and power plant.

ABERDEEN, S. D.—The plant and holdings of the Aberdeen Electric Light & Power Company are reported to have been sold to the Union Company, of Omaha, Neb. It is said that improvements will be made to the system and additional equipment installed, which will involve an expenditure of about $100,000.

CENTERVILLE, S. D.—The South Dakota Interurban Railway Company, which proposes to construct an interurban railway from Sioux Falls to Bijou Hills, 160 miles in length, announces that a survey has been made as far as Parkston, which town has donated $50,000 for the railway. Right of way has been secured as far as Freeman and, it is

said, that fully a third of the money required to promote the project has already been subscribed. W. E. Miller is president of the company.

MILBANK, S. D.—Work is progressing rapidly on the construction of the new electric light plant in Milbank. The company expects to have the plant in operation by the middle of December. The wires will be placed underground in Main Street.

SPRINGFIELD, S. D.—Bids will be received by the regents of education of the State of South Dakota for furnishing and installing equipment for an electric lighting plant at the State Normal School, at Springfield, S. D., according to plans and specifications now on file at the office of the State Normal School, Springfield, S. D., the office of Regent T. W. Dwight, Sioux Falls, S. D., and the office of Chairman A. E. Hitchcock, Mitchell, S. D. E. C. Ericson is president.

BRISTOL, TENN.—The Bristol Gas & Electric Company is reported to have made arrangements with another corporation for the construction of a hydroelectric plant, at a cost of about $250,000, to increase its present output and to provide for future demands. Electricity will be transmitted to a substation near the city for distribution for lamps, heat and motors. It is understood that work will soon commence on construction of the plant and will be completed about July 1, 1910.

OBION, TENN.—The question of issuing $30,000 in bonds for construction of an electric light and water works system is under consideration and will be submitted to a vote.

RICHARD CITY, TENN.—Preparations are being made by the Dixie Portland Cement Company to equip its machinery for electric motor drive, using direct-current motors.

ELGIN, TEX.—It is reported that K. F. Leggett, of Livingston, Tex., is contemplating the installation of an electric light and ice plant. A conditional franchise has been granted to Mr. Leggett to establish an electric plant.

GALVESTON, TEX.—The Galveston-Houston Electric Railway Company, which contemplates the construction of an electric interurban railway connecting Galveston and Houston, a distance of 45 miles, will build the road entirely on private right of way. The main power house will be located in Texas City on the water front of Galveston Bay, about three miles from the main line of the railway. The initial installation will include two turbo-generators rated at 1000-kw and 500-kw, respectively. The railway will be operated by a 600-volt, direct-current overhead trolley system, using catenary suspension; electricity will be provided from four substations located about 10 miles apart. Plans as yet have not been prepared, or any time set for receiving bids for equipment. In Galveston the company will operate over the tracks of the Galveston Electric Company, a distance of about three and one-half miles, and at Houston over the tracks of the Houston Electric Company for about the same distance.

ROSCOE, TEX.—The Roscoe, Snyder & Pacific Railway Company has placed a contract with the Balsh Brothers, of Hermleigh, Tex., for the erection of about 50 miles of telephone and telegraph line between Roscoe and Snyder. The line will be used exclusively by the railroad company and for the present will be used for telephone service only.

MANTI, UTAH.—The Manti Light & Power Company has filed application with the state engineer for 10 cu.-ft. of water per second in Manti Creek in Sanpete County, to be utilized to generate electricity. The plant will be equipped with Pelton water wheels 60 in. in diameter to be operated under a head of 444 ft. The plant will develop about 430 hp. Electricity generated at the plant will be utilized for lamps and motors in Manti and other towns in this vicinity.

MARYSVILLE, UTAH.—Application has been made to the State engineer by H. E. Smith, of Duluth, Minn., asking for 100 cu. ft. per second of the flow of the Sevier River on Plutte County, to be utilized for power purposes. The application states that the diverting works will consist of a dam about 16 ft. high across Sevier River and a diverting channel 42,000 ft. long. The power plant will be equipped with 72-in. Pelton water wheels operating under a 330-ft. head. It is estimated that 1500 hp can be developed. Electricity generated at the plant will be transmitted to Marysville, Kimberly, Richfield, Milford, Frisco, Sevier and intermediate points.

SALT LAKE CITY, UTAH.—The Salt Lake & Ogden Railway Company has commenced work on the construction of its power station at Lagoon, which with equipment complete, will cost about $200,000. The company will erect substations costing $25,000 each at Stockdale, Lagoon, Clearfield and Ogden.

SALT LAKE CITY, UTAH.—Application has been made to the State engineer to impound 615 acre-ft. of water to be obtained from the flow of North Dry Creek in Salt Lake County. The plans call for the construction of four dams, intake works, flume, pipe, reservoirs, gates and spillways. The plant to be erected will operate under a head of 2145 ft. and, it is said, will be located at a point south of Little Cottonwood Canyon. The proposed plant will furnish electricity for lamps and motors in Salt Lake, Bingham, Canyon, Garfield, Alta, Park City and other places in Utah.

SALT LAKE CITY, UTAH.—Samuel Russell, of Salt Lake City, has filed a notice of appropriation of 25 cu. ft. of water per second of the flow of Little Cottonwod Creek in Little Cottonwood Canyon, the water to be utilized to generate electricity, which will be distributed throughout Salt Lake County for lamps and motors. The diverting channel will be 6000 ft. in length and will carry water under a head of 500 ft. to 60-in. Pelton water wheels. It is estimated that 1100 hp can be developed.

SALT LAKE CITY, UTAH.—Application has been made to the State engineer by L. B. Spencer of Salt Lake City for two water rights in South Fork Canyon, to be utilized to generate electricity to be transmitted to Huntsville, Ogden, Salt Lake City and other towns. One of the applications asks for 20 cu. ft. per second of the flow of the South Fork of the Ogden River.

WOODSTOCK, VT.—The Woodstock Electric Company has filed a certificate with the Secretary of State of an increase in capital stock from $22,000 to $40,000.

DANVILLE, VA.—The Dan River Power & Manufacturing Company is contemplating the installation of a centrifugal pump direct connected to an induction motor for circulating feed water at its plant.

FORT MEYER, VA.—Contracts have been awarded by W. W. Whitside, constructing quartermaster, for the installation of an electric lighting system at Fort Meyer, Va., as follows: Wiring buildings for electric lighting, installing watt meter connections, furnishing and installing fixtures in buildings, to J. F. Buchanan & Company, Philadelphia, Pa., for $14,788; constructing underground conduit system, with all manholes and junction boxes, etc., to McCay Engineering Company, Baltimore, Md., for $8,500; constructing underground and aerial system of transmission and service lines, complete street lighting system, poles, brackets, etc., to McCay Engineering Company, Baltimore, Md., for $14,000; for furnishing and installing all tungsten lamps and apparatus for basement of building No. 8, to the National Electric Supply Company, Washington, D. C., for $[illegible].

POTOMAC, VA.—The Town Council has granted the Alexandria Electric Light & Power Company a 30-year franchise to construct and operate an electric lighting system in Potomac. The Council also authorized the Mayor to enter into a contract with the company to furnish 44 incandescent lamps for lighting the streets of the town.

RICHMOND, VA.—The committee on electricity has adopted the report recommended by E. W. Trafford, consulting engineer, for additional excavations to provide for possible future enlargements to the municipal electric plant. The proposition for excavating for an additional tail race and to provide for an additional wheel chamber, which would allow the installation of an additional generator later, has not been acted upon by the committee. Bids have been received by the committee for the condenser system for the plant and for the steam and water piping, the boiler feed pump and heater, but owing to the delay in furnishing some contractors with blue prints, it was decided to return the bids unopened and to call for new proposals to be opened Nov. 22.

WINCHESTER, VA.—The Winchester & Washington City Railway Company, which is preparing to construct an auxiliary steam-generating plant in Millville during the coming year, expects to have plans and specifications ready to ask for bids for construction of the plant about Jan. 1, 1910. It is expected to have the plant completed by June 1 so as to provide energy for its system during the summer months. A consulting engineer will soon be selected to take charge of constructing the plant. The company now operates a hydroelectric plant on the Shenandoah River. D. M. Swink is superintendent.

ENTAIT, WASH.—The Gullage tract, consisting of 225 acres, at the mouth of the Entait River, has been purchased by Charles Gray and associates, where they propose to build a dam and erect a power plant to furnish electricity to operate a proposed electric railway to extend from Douglas to Waterville.

KENT, WASH.—Arrangements are being made to form a company for the purpose of raising $100,000 and securing the right of way for constructing an electric railway from Kent to Renton, where it will connect with the Seattle, Renton & Southern Railway. The proposed railway will be seven miles in length and will cost about $100,000. Thomas Chapman, of O'Brien, Wash., and Henry Madison, of Kent, Wash., are interested in the enterprise.

OAKVILLE, WASH.—The City Council has granted to W. A. Shoemaker a franchise to construct and operate an electric light plant and water works system in Oakville, Wash.

SPOKANE, WASH.—The Washington Water Power Company has applied to the City Council for a franchise for an extension of its railway on several streets in Spokane.

SPOKANE, WASH.—The Yakima Valley Power Company has filed application with the State land office for a right-of-way across shore lands in Grant County.

CLARKSBURG, W. VA.—Plans are being considered by the United States Aluminum Company for the construction of a plant in Clarksburg, W. Va., which will be equipped for electrolytic refining, similar to its plant in Massena, N. Y. The equipment, it is said, will include direct-current generators, with extra wide commutators, and other apparatus.

KENOSHA, WIS.—The Cooper Underwear Company, of Kenosha, Wis., it is said, will soon be in the market for equipment for its new factory, which will include an engine, generator, boilers, motors and electric elevator.

OSHKOSH, WIS.—The Northern Hydro-Electric Power Company has been granted permission by the State Commission to issue $1,000,000 in bonds, the proceeds to be used to pay outstanding indebtedness; to construct dams at High and Johnson's falls on the Peshtigo River in Marinette County; also for the construction of power houses and substations and necessary equipment and for the purchase of right of way and erection of transmission lines, etc.

RACINE, WIS.—The F. J. Greene Engineering Works, which is erecting an extension to its plant, will require additional power equipment and is contemplating the installation of a gas producer, gas engine, electric generator and motors, but may install a boiler plant and Corliss engine.

SUPERIOR, WIS.—The Berwind Fuel Company, which is building a 600-ft. extension to its dock at Superior, Wis., is reported to have decided to install an electrical system for controlling unloading operations.

NELSON, B. C., CAN.—The Bull River Falls Power Company is reported to be building a large flume at Fort Steele which will provide for 10-000-hp at the lowest water periods.

VICTORIA, B. C., CAN.—The Vancouver Island Power Company is applying for permission to develop water power on the Jordan River.

VICTORIA, B. C., CAN.—The British Columbia Electric Company is asking permission to increase its capital by $2,500,000.

PHOENIX, B. C., CAN.—It is reported that the Canadian Pacific Railroad Company is considering the question of equipping its branch into Phoenix, to be operated by electricity.

BRACEBRIDGE, ONT., CAN.—The Town Council on Nov. 9 awarded contracts in connection with the additional electric power development at Wilson's Falls, as follows: For building dam, intake and power house foundations to the Canadian Contracts, Limited, of Toronto; water wheels to William Kennedy & Sons, of Owen Sound, and for electrical machinery to the Canadian General Electric Company, of Toronto.

BRANTFORD, ONT., CAN.—Dennie Hogan, of Brantford, is seeking to restrain the Council from carrying out the contract made with the Western Counties Power Companies to furnish electrical service in Brantford. Last January the ratepayers voted to authorize the City Council to enter into a contract for a term of five years with Western Counties Power Company, the local distribution end of the Cataract power system of Hamilton.

FORT FRANCIS, ONT., CAN.—The power dam has been completed, and the lighting load will be taken on within a month. The charge for power from this plant is $12 per hp per year.

INGERSOLL, ONT., CAN.—The purchasers of the plant and holdings of the South Western Traction Company have applied for a charter under the name of the London & Lake Erie Railway & Transportation Company. The new company proposes to build a railway to Ingersoll, where it will connect with the Ingersoll & Woodstock Railway. From Woodstock a road will be built to Brantford, where the railway company will get into connection with the Niagara Power Companies. The distribution of electricity is specially mentioned in its charter, and the company may prove a strong competitor of the Government line.

LONDON, ONT., CAN.—Proposals will be received by the city until Nov. 22 for transformers, motor-generator set, voltage regulators, switchboard, lightning protectors, instruments, arc and incandescent street lighting systems and other electrical equipment. E. L. Sifton is electrical engineer.

NORTH BAY, ONT., CAN.—The Nipissing Power Company has offered to pump the water for the town on a 10-year contract at 2 cents per thousand gallons or 2 cents per thousand for a stated amount and 1¾ cents per thousand for any in excess of this amount.

TORONTO, ONT., CAN.—A bill will be presented to the Dominion Parliament by F. L. Fowke, M.P., asking for a charter for the Toronto & Eastern Railway Company, which proposes to construct an electric railway connecting Cobourg and Toronto, passing through Port Hope, Newcastle, Bowmanville, Oshawa and Whitby.

TORONTO, ONT., CAN.—The Board of Control awarded the contracts for electric pumps for the city water works Nov. 10 as follows: Section A—To Iens Orten Boving, of London, Eng., for $14,800. Section B—To the Caledonia Iron Works for $11,703. Section C—To Iens Orten Boving, of London, Eng., for $6,500. Section D—To the Caledonia Iron Works at $7,385. Section E—To the Canadian General Electric Company for $4,882—making a total of $45,210.

MONTREAL, QUE., CAN.—Proposals will be received by the Saraguay Electric and Water Company for water tube boilers with a rating of 1000 hp. Charles Brandeis, of Montreal, is engineer.

MONTREAL, QUE., CAN.—The Canadian Light & Power Company is hurrying plans for its power development at the Beauharnois Canal. The present plans call for the installation of ten 5000-kw generators. Electricity generated at the plant will be transmitted to Montreal for distribution.

LA TUQUE, QUE., CAN.—The Quebec & St. Maurice Industrial Company has started work on the development of the Falls of the St. Maurice, at La Tuque, Quebec, where it is estimated that 50,000 hp can be developed. The power will be used to generate electricity to operate the pulp mills.

QUEBEC, QUE., CAN.—The Quebec Electric Railway is contemplating extending its system to Cape Rouge.

QUEBEC, QUE., CAN.—Articles of incorporation have been filed for the Quebec Railway, Light, Heat & Power Company, which is a consolidation of the Quebec Railway & Power Company, the Jacques Cartier Power Company, the Quebec Gas Company, the Frontenac Gas Company, the Canadian Electric Company, the Seven Falls Company and several smaller companies. The company is capitalized at $10,000,000.

QUEBEC, QUE., CAN.—The Canadian Westinghouse Company is installing an 8000-kw generator in the power house of the Shawinigan Water & Power Company. This addition will bring the output of the station up to 38,000 kw.

ST. TIMOTHEE, QUE., CAN.—The Nova Scotia Construction Company has been awarded a sub-contract amounting to approximately $200,000 in connection with the hydroelectric development of the Canadian Light & Power Company.

SHERBROOKE, QUE., CAN.—It is reported that the Sherbrooke Street Railway will shortly change hands. The Montreal Street Railway Company is said to be behind the deal and that options have been secured on several water power sites.

New Industrial Companies.

THE ELECTRIC DEVICE COMPANY, of Los Angeles, Cal., capitalized at $25,000, has been incorporated by F. A. Corbutt, E. J. Covington and S. C. Hall.

THE NATIONAL ELECTRIC DISPLAY COMPANY, of Fort Collins, Col., has been incorporated with a capital stock of $100,000 by W. C. Le Master, R. H. Snell, R. W. Lawson, H. B. Snell and H. P. Hurley.

THE PACIFIC ELECTRIC MOTOR COMPANY, of San Francisco, Cal., capitalized at $20,000 has been incorporated by W. A. L. Miller, O. W. Nordwell, J. W. Carmany, H. S. Meyer and A. P. Dessonslavy.

THE POSITIVE ELEVATOR SAFETY COMPANY, of New York, N. Y., has been chartered with a capital stock of $30,000 by A. W. Koening, of Orange, N. J.; H. L. Murdock, E. R. Huckel, of New York, N. Y. The company proposes to manufacture elevators and safety devices for elevators.

New Incorporations.

LA JARA, COL.—The La Jara Telephone Company has been chartered with a capital stock of $3,000 by Daniel E. Newcomb, Calvin L. Smith and William A. Braiden.

GAINESVILLE, GA.—The Lebanon Telephone Company has been organized by Homer Langford, Jesse L. Thompson, F. H. Hudgins and J. G. Allen.

MADISON, ILL.—The Madison Light Company has been incorporated with a capital stock of $10,000 by Andrew M. Lawrence, Roy D. Keehn and H. M. Campbell. The company proposes to generate and sell electricity for lamps and motors.

SHERIDAN, ILL.—The Fox River Hydro Electric Company has been incorporated with a capital stock of $54,000 by Jesse W. Carr, Robert J. Rowe. The company proposes to develop water-power to be utilized to generate electricity.

GESSE, IND.—The Citizens Telephone Company has filed articles of incorporation, capitalized at $30,000. The company proposes to build and equip a telephone exchange and system in Gesse and throughout Vermillion County. A. R. Peterson, A. W. Banks, W. F. Clem and F. L. Vawler are directors.

COVINGTON, KY.—Articles of incorporation have been filed for the Covington & Big Bone Railway Company for the purpose of constructing an interurban railway from Covington to the Big Bone Springs in Boone County, a distance of about 22 miles. The incorporators are: M. J. Crouch, J. J. Weaver, J. W. Kennedy, Orlando P. Schmidt, R. S. Holmes and others.

LYONS, NEB.—The Burt County Telephone Company has been incorporated with a capital stock of $100,000 by A. G. Hess, E. L. Whitman and others.

PAXTON, NEB.—Articles of incorporation have been filed for the Paxton & Sutherland Telephone Company with a capital stock of $5,000. The incorporators are: Howard Miles, H. D. Lute and others.

TRENTON, N. J.—The Great Falls Power Company has filed articles of incorporation with the Secretary of State with a capital stock of $17,000,000. The purpose of the company is to acquire and deal in water, water rights and power and to generate electricity by water power. The incorporators are: W. C. Parker, L. J. Relyea and F. W. Griswold. The office of the company is located at 76 Montgomery Avenue, Jersey City, N. J.

WALTON, N. Y.—The Citizens' Home Telephone Company has been incorporated with a capital stock of $100,000 for the purpose of operating in Delaware, Broome, Otsego, Chenango, Green, Schoharie, Ulster and Sullivan counties. The directors are: George O. Mead, of Walton, N. Y.; Theodore M. Brush and Irving H. Griswold, of Elyria, Ohio; Irving R. Coughley and George H. Rymers, of Albany, N. Y.

ATKINSON, N. C.—The Pender Telephone Company has been organized with a capital stock of $10,000 by E. E. Murphy and associates.

DOUGLAS, N. D.—Articles of incorporation have been filed for the Douglas Telephone Company by George W. Kinney, James Hanlon, A. Johnson and others. The company is capitalized at $25,000.

OKLAHOMA CITY, OKLA.—The Citizens Traction Company, of Oklahoma City, has been chartered with a capital stock of $300,000 for the purpose of building an electric interurban railway between Oklahoma City and Shawnee; Oklahoma City and Sulphur, 111 miles in length. The directors are: Alfred Hare, of Shawnee; John F. Winans, L. E. Patterson and W. F. Harn, of Oklahoma City, and H. S. Hurst, of Holdenville.

MART, TEX.—The Limeston Telephone Company has been incorporated with a capital stock of $4,500 by Richard Blackwood, E. F. King and F. B. Moore.

Personal.

MR. H. McL. HARDING delivered an illustrated lecture on "Electrical Transference and Transshipment of Freight at Railway and Water Terminals" before the Central Railway Club, Buffalo, N. Y., on Nov. 12.

MR. H. E. RICE, of the Philadelphia Electric Company, is acting as manager of the Electrical Exhibition Company of America, which is promoting the Philadelphia Electrical Show.

MR. HORATIO A. FOSTER is the author of a paper in the November issue of the *Journal* of the Franklin Institute entitled "Power House Economics in Baltimore."

MR. HARRY V. JAMISON has assumed charge of the department of advertising and printing of the American Sheet & Tin Plate Company, Pittsburgh, in place of Mr. Wilson, who has resigned on account of poor health.

MR. LEONARD S. HORNER has resigned his position with the Crocker-Wheeler Company as branch manager for the State of Connecticut and has joined the Acme Wire Company, of New Haven, Conn., as manager of sales.

MR. C. E. ELWELL, of San Francisco, has returned from a European trip, during which he purchased the American rights for the Poulsen system of wireless telegraphy. He has taken offices in the Foxcroft Building.

MESSRS. C. H. HUGHES & COMPANY, engineers, formerly at 120 Broadway, have moved to the U. S. Realty Building, 115 Broadway, New York, where they will continue their practice as engineers for electric railways and lighting companies.

MR. ROBERT J. McCUEN, superintendent of lamps and lighting of Baltimore, Md., has returned to his office after an illness of several weeks. He is now engaged, with Building Inspector Preston, on the location of a suitable site for a municipal lighting plant.

MR. C. E. ALLEN has been appointed to the transformer sales department of the Westinghouse Electric & Mfg. Company. Mr. Allen was formerly connected with the General Electric Company in a similar capacity, but resigned from that company during the past summer.

MESSRS. SMITH, KERRY & CHACE, whose head office is in Toronto, with a branch at Winnipeg, have recently opened a branch office in the Fairfield Building, Vancouver, B. C. Mr. H. J. Haffner is in charge of this branch. Considerable work on irrigation and hydroelectric projects is being handled.

MR. EDWARD P. THOMPSON has returned from a combined pleasure and business trip through Europe which has lasted for seven months. Mr. Thompson has removed his main office to Washington, owing to greater accessibility to the Patent Office, but until December his address will be Morristown, N. J.

HERRICK & STEBBINS.—A partnership for the practice of electrical engineering has been formed, with offices at 14 Church Street, New York, and under the firm name of Herrick & Stebbins, by Messrs. Albert B. Herrick, Theodore Stebbins, Clarence G. Boyden and John G. Rockwood. A feature of the practice will be physical reports based on continuously recorded measurements.

MR. J. KOBORI, M. E., chief electrical engineer of the Uji River Electric Company, Kyoto, Japan, has sailed for Europe after a stay of some weeks in this country, during which he consulted with manufacturers concerning machinery for the 40,000-kw Uji hydroelectric plant, eight miles from Kyoto. The work on the hydraulic system, which includes two tunnels, is now in progress. The greater part of the power developed will be transmitted at the generator voltage of 12,000 to Osaka, 22 miles distant.

MR. T. R. CUMMINS, formerly engineer of maintenance of way of the Chicago, Lake Shore & South Bend Railway, has become associated with Warwick, Mitchel & Company, chartered accountants, New York, and will devote his time to the valuation of engineering properties. Mr. Cummins was for seven years with the Illinois Central Railroad and for two and one-half years with J. G. White & Company, and for a time served as first-grade assistant engineer with the Isthmian Canal Commission at Panama.

MR. FRANK L. PERRY, of Chicago; who has a wide acquaintance among electrical men owing to a long connection with electrical journalism, is giving full swing to a long-standing liking for experimental research. He has a laboratory at his home, and the Chicago Sunday *Tribune* of Nov. 7 printed a two-page article based on his investigation of the possibilities of "wireless" in connection with aerial navigation. This article contained an announcement that will be of interest to Mr. Perry's electrical friends. "I am not ashamed to say," he is quoted, "that it is my hope to be able to spend the rest of my working life investigating electrical waves, pulses and mechanical oscillations, and seeking to make them do something practical and for the good of humanity that has not already been accomplished."

MR. SAMUEL INSULL is not often taken back; he is usually thoroughly at ease in any situation in which he finds himself. But he was completely surprised on Thursday of last week when about 25 members of his executive staff filed solemnly into his office in Chicago while he was discussing business affairs with Mr. Louis A. Ferguson, vice-president of the company of which Mr. Insull is the head. "What's this?" he inquired in some alarm, evidently fearing that something very unusual had happened. The visitors were the bearers of good tidings, however, for they had remembered Mr. Insull's fiftieth birthday, and the surprise was carefully planned. Mr. Ferguson rose to his feet when the invaders were lined up, and in a few earnest words told his dumbfounded chief that his men took a very real pleasure in signalizing the anniversary by uniting in a gift to a man whom they truly esteemed. He then handed Mr. Insull a watch. The recipient was so surprised that he could hardly speak, but he was immensely pleased, nevertheless, and he managed to return his thanks in accents that left no doubt of their sincerity. The watch is a very fine one, made by Patek, Philippe & Co., of Geneva, Switzerland. It is a split-second minute-repeater, having an open face and an 18-carat case. Inside the case is this inscription: "Samuel Insull, president Commonwealth Edison Company—From his advisory staff on his fiftieth birthday, November 11, 1909."

Trade Publications.

AUTOMATIC MOTOR-STARTING APPARATUS.—The Ward Leonard Electric Company, of Bronxville, N. Y., devotes sections A15 to A20 inclusive, in its new perpetual catalog, to automatic motor-starting apparatus for machine tool, open and closed tank and air compressor systems. These are new designs and new tabulated data are included in the sections.

BLUE PRINTING.—The Buckeye Engine Company, Salem, Ohio, has issued a pamphlet giving information concerning the rapid and economical production of blue prints. As illustrating the economy of the Buckeye electric blue printing machine a letter is reproduced from the Pittsburgh Gage & Supply Company relating to results obtained from the use of a Buckeye machine bought April 1, 1908. The machine cost $172.50, and paid for itself in 8 months, thus saving $21.50 per month. At this rate in the past 18 months the profit has been $387, or more than five times as much profit as made by the makers of the machine, which is still good for an indefinite time.

Business Notes.

THE CRESCENT COMPANY, 514 W. Monroe Street, Chicago, has been appointed agent for Central and Western States for the Cross staple.

THE BRYAN-MARSH COMPANY will establish a district office for the Pacific Slope. Mr. R. M. Cole recently visited San Francisco to complete the details.

MR. J. E. LAUNDER, secretary and treasurer of the Independent Electric Machinery Company, of Kansas City, Mo., is on a business trip visiting Chicago, Springfield, Mansfield, Ohio, and St. Louis in the interest of his company, which is Western distributor for the Ideal Electric & Manufacturing Company, of Mansfield, Ohio, for its line of alternating and direct-current motors and generators. Mr. Launder reports business very good in the Central West, the factories working 15 hours per day trying to keep up with orders.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV. 9, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

939,217. MANUFACTURE OF CEMENT; S. O. Cowper-Coles, Westminster, London. App. filed Jan. 17, 1908. Makes Portland cement from blast furnace flag by subjecting the fused mixture to an electric current of high temperature.

939,223. PROCESS OF ELECTROLYTICALLY REMOVING IRON-OXIDE SCALE; Charles W. Danforth and Noble Jones, Sharon, Pa. App. filed June 25, 1909. Process of electrolytically removing iron oxide scale from iron by subjecting the same as a cathode to an electric current while submerged in a solution containing by-sulphate of an alkaline metal in water.

939,224. PROCESS OF ELECTROLYTICALLY REMOVING IRON-OXIDE SCALE; Charles W. Danforth and Noble Jones, Sharon, Pa. App. filed Aug. 28, 1909. See 939,223. The solution consists of the by-sulphate of an alkaline metal dissolved in diluted sulphuric acid.

939,258. ELECTRIC SWITCH; F. Hoerle, Plainville, Conn. App. filed Nov. 12, 1907. A snap switch having a pivoted arm oscillating between contacts for motor carriages, etc., the base carrying a slot with the switch carrying post fitting the slot.

939,292. TEST FOR FIRE ALARM APPARATUS; J. G. Nolen, Chicago, Ill. App. filed Sept. 24, 1903. A normally wound master signaling device normally closing the circuit, a test device comprising a circuit breaker and short circuiting means for the circuit breaker when the master signaling device is run down to predetermined degree.

939,293. FIRE PROTECTION SIGNAL SYSTEM; J. G. Nolen and J. E. Shepard, Chicago, Ill. App. filed April 25, 1904. Includes a water tank and a float valve, a sprinkler and a signal system associated with the water tank float, with a battery and circuit connections.

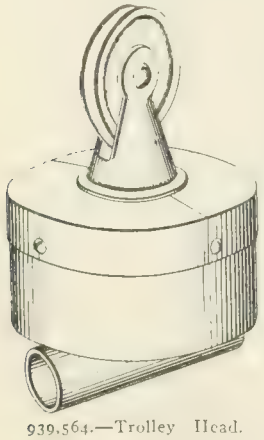
939,331. ALTERNATING-CURRENT ELECTRIC MOTOR; J. T. Schaaff, Washington, D. C. App. filed March 9, 1906. Includes a plurality of separate electrical magnets spaced apart, a single armature actuated thereby and a phase retarder in the circuit of one magnet.

939,338. ELECTRICAL TRANSMISSION OF GRAPHIC MESSAGES; G. Sellers, Chicago, Ill. App. filed July 29, 1907. Improvement in systems of apparatus. Makes use of a light chamber, a slotted aperture in the chamber, a source of light, a series of revolving cells located above the aperture, a motor and means for moving a message strip below the aperture and above the source of light.

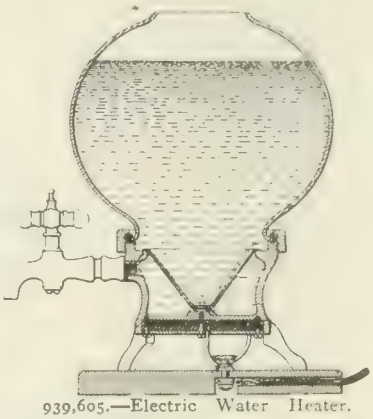
939,339. ELECTRIC TRANSMISSION OF MESSAGES; G. Sellers, Chicago, Ill. App. filed Nov. 5, 1908. Makes uses of transparent cylinder of glass rotated by a motor, the message being wrapped around the motor and a pencil of light passing through the message. This strikes an electrical conductor within the cylinder whose resistance varies according to the amount of light received. The conductor forms part of the local circuit which operates an electric motor for moving the cylinder with its message sheet.

939,370. BLOCK SIGNALING APPARATUS; S. A. Wood, Providence, R. I. App. filed May 14, 1906. A target arm with magnetically actuated means for actuating the target operating means.

939,383. ELECTRIC TRANSMITTER; B. F. Bellows, Cleveland, O. App. filed July 29, 1907. A semi-automatic transmitter for making a succession of short impulses by a single movement of the key. Uses a vibrator carrying a weight, which continues its vibration when started.



939,564.—Trolley Head.



939,605.—Electric Water Heater.

939,401. TELEGRAPH SYSTEM AND APPARATUS; T. B. Dixon, New York, N. Y. App. filed Nov. 25, 1904. Multiplex telegraph for transmitting a plurality of distinct and separate messages over a single wire. Transmits one message by a weak current, two other messages by stronger impulses in pairs, the one message being transmitted by positive impulses and the other by negative.

939,409. ELECTROMAGNET RELAY; D. I. Garretson, New York, N. Y., and Marcus O. Anthony, Englewood, N. J. App. filed Oct. 27, 1908. For telegraphs. Uses an elastically mounted contact connected to an armature, a stationary contact and an electromagnet so located that the armature may approach the magnet pole pieces without touching them.

939,439. TELEPHONE ATTACHMENT; H. R. Palmer, Seattle, Wash. App. filed March 3, 1908. The receiver of a desk set is adjustable to sustain itself in proper relation to the ear by means of a clip and strap, the receiver being mounted upon a tubular standard made of telescopic sections.

939,441. APPARATUS FOR PRODUCING ELECTRIC DISCHARGES; H. Pauling, Gelsenkirchen, Germany. App. filed Dec. 18, 1905. For treating gases by stationary electrodes separated to prevent ignition and a conductor successively passing the electrodes, thus increasing and decreasing the distance between the electrodes and blast pipes which extinguish the discharges.

939,442. PROCESS FOR PRODUCTION OF VOLTAIC HIGH CURRENT ARCS; H. Pauling, Gelsenkirchen, Germany. App. filed Aug. 13, 1906. For treating gases. The arcs are elongated by causing them to move along the electrodes and by passing the gas to be acted upon in an inclined direction against each other, meeting in the plane of the electrodes.

939,501. COUPLING FOR ELECTRIC CONDUCTORS; J. L. Hinds, Syracuse, N. Y. App. filed April 1, 1909. The ends of the conductor pass into a compressible sleeve surrounded by sleeve nuts which compress the sleeve against the conductor.

939,507. TELEGRAPH SENDING MACHINE; J. A. Hulit, Topeka, Kan. App. filed Sept. 3, 1908. An automatic telegraph sender driven by a motor which runs only during the transmission of a signal and operates a mechanism making dots, with which a mechanism is associated for making dashes, the spaces being always the same.

939,523. MAGNETIC ORE SEPARATOR; W. D. Ludwick, Seattle, Wash. App. filed Sept. 22, 1906. A pan, a rotating drum, with part of its periphery enclosed by the pan and rotating electromagnets carried by the drum, with means for supplying and removing ore to and from the pan.

939,564. TROLLEY HEAD; T. R. Stam, West Union, Ia. App. filed April 13, 1909. The wheel is so mounted with respect to the body that it rights itself. It is mounted on a turntable.

939,599. TWO-POLE SNAP SWITCH; L. Kellner, New York, N. Y. App. filed Dec. 5, 1908. Insures a 90-deg. throw, thus securing the greatest possible break in the circuit. Uses a blade engaged by a spring and having pins which permit a limited longitudinal movement of the sleeve which turns the switch elements.

939,605. ELECTRIC WATER HEATER; Hugo G. Levy and Geo. N. Blanchard, San Francisco, Cal. App. filed March 29, 1909. A reservoir having a bottom with a recess, a heating coil therein and an inverted conical valve in the reservoir.

939,625. APPARATUS FOR STRENGTHENING WEAK ELECTRICAL CURENTS; A. Pollak, Paris, France. App. filed Aug. 7, 1908. A telephone repeater in which a movable contact is introduced into a magnetic field and attached to the membrane of a microphone, and the current passing through the microphone passes through a second strengthening coil, using a single battery for both coils.

939,626. ELECTRICALLY ACTUATED TRAIN SWITCH; J. Y. Porter, Detroit, Mich. App. filed Dec. 10, 1908. For trolley roads in which the current may be used to shift the switch. Controlled by the motorman.

939,650. ELECTRICAL CONTROLLING SYSTEM FOR ROLLING OR SLIDING SHUTTERS, ELEVATORS, ETC.; L. G. Wilson, Larchmont, N. Y. App. filed May 23, 1908. A shunt-wound electric motor drives a vertically movable shutter and is controlled by a knife switch.

939,658. TROLLEY HEAD; J. J. Bennett, Pittsfield, Mass. App. filed Dec. 3, 1907. The wheel is carried by the fork at the top of the post, so arranged as to rotate about a vertical axis when a car passes a curve.

939,659. RAILWAY TRAFFIC CONTROLLING SYSTEM; H. Bezer, Newark, N. J. App. filed Jan. 18, 1907. A main railway line, with a track switch, a signaling system controlling the traffic, a movable member controlling the signaling system, an electro-translative magnet controlling the member, the magnet being in the rail circuit, which circuit includes a pole changer, the track switch and the pole changer acting in conjunction.

939,672. ANNUNCIATOR CASE; H. D. Crouch, Montreal, Canada. App. filed March 25, 1907. A waterproof case for shipboard use, the meeting edges being watertight, and watertight plates dividing it into compartments.

939,683. TELEGRAPH TRANSMITTER; G. M. Goddard, Rutland, Vt. App. filed May 29, 1908. Includes a keyboard which controls cams which control a telegraph key lever, the cams being provided with character faces and being connectable with the shaft by a clutch.

939,689. COUPLING FOR ELECTRIC CONDUCTORS; J. L. Hinds, Syracuse, N. Y. App. filed April 1, 1909. Comprises an outer section, an inner section and a compressible sleeve. Receives the ends of the electric conductors.

939,708. MERCURY AND OTHER VAPOR ELECTRIC LAMP; H. A. Kent, Bound's Green, and H. G. Lacell, Finchley, Eng. App. filed Dec. 1, 1908. The negative electrode and the positive electrode are closely adjacent so as to keep their temperatures substantially equal, and the negative electrode is heated to prevent the cooling and condensing of the mercury.

939,719. REMOTE ELECTRIC CONTROL SYSTEM FOR SEARCHLIGHTS AND THE LIKE; A. LeBlanc, New York, N. Y. App. filed Feb. 5, 1909. Means for starting, stopping, reversing, regulating and controlling the direction and speed of the motors which operate the gears that manipulate the searchlight.

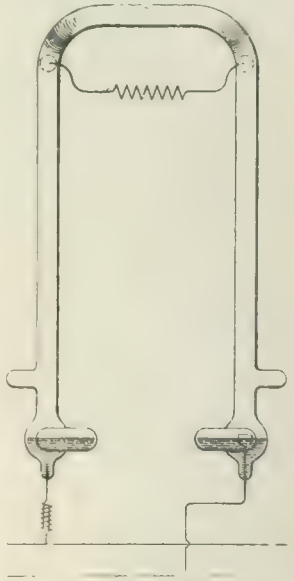
939,753. ELECTRIC MOTOR FAN; N. A. Locke, Fulton, N. Y. App. filed Oct. 27, 1908. A motor fan with a frame and a vane wheel with a power transmission between the motor and the wheel and a switch for the motor, the frame in the wheel being movable toward and from each other by the switch.

939,730. AUTOMATIC ELECTRIC CURRENT BREAKER; W. F. Meter and W. L. Rideout, Oshkosh, Wis. App. filed July 22, 1908. A switch, an electromagnet which opens the switch and breaks its own circuit before the switch contacts are broken and a non-inductive shunt for the magnet.

939,756. TELEPHONE SYSTEM; F. E. Summers, Scotland County, Mo. App. filed March 10, 1908. For permitting two parties to communicate and prohibiting the others from overhearing the conversation.

939,791. SELF-WINDING MECHANISM; A. D. Blodgett, Newton, and F. S. Atkinson, Brookline, Mass. App. filed March 1, 1909. For clocks. The winding is accomplished by an electromagnet which winds a spring and is intermittently excited.

939,863. ELECTRIC SWITCH; J. H. Rusby, Nutley, N. J. App. filed Feb. 22, 1907. Push-button snap switch having an actuating finger piece with a one-piece lever and a spring surrounding it, together with a latch piece and a blade actuating piece, having an extension engaged by the spring.



939,912.—Gas or Vapor Electric Lamp.

939,910. MAGNETO GENERATOR; R. H. Hassler, Indianapolis, Ind. App. filed March 23, 1908. For producing the igniting spark in a gas engine in which a high number of alternations are produced at a low armature speed, by providing a series of magnets forming a multipolar field. Also improves the lubricating means.

939,912. GAS OR VAPOR ELECTRIC LAMP; P. C. Hewitt, New York, N. Y. App. filed June 29, 1905. For starting vapor lamps by passing the starting current between the electrodes within the container for a portion of the way adjacent to the electrodes and for the remainder of the way passing the current outside of the container.

939,957. THERMOSTAT; H. G. Geissinger, West Orange, N. J. App. filed Nov. 30, 1908. A straight flexible member which is normally arched; with two other flexible members, one on each side and having a different rate of thermic expansion therefrom, together with connecting devices connecting the ends of the members.

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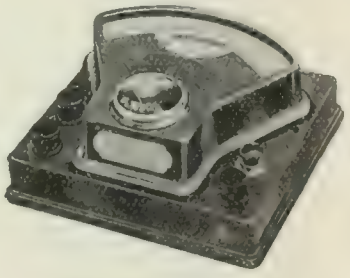
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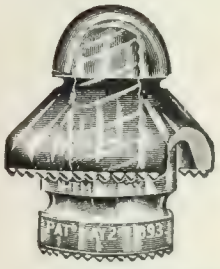
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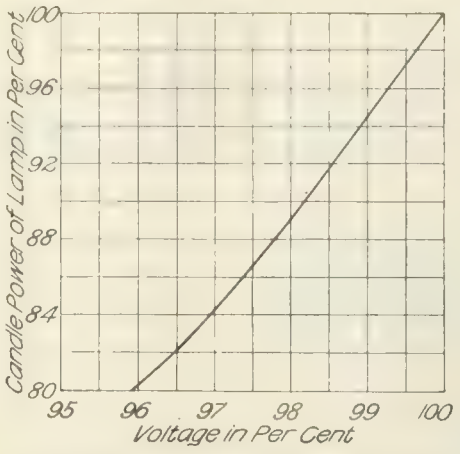
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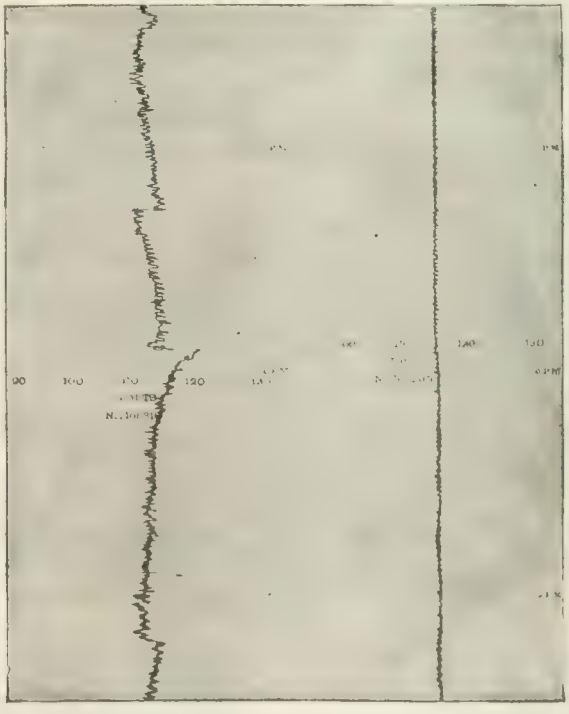
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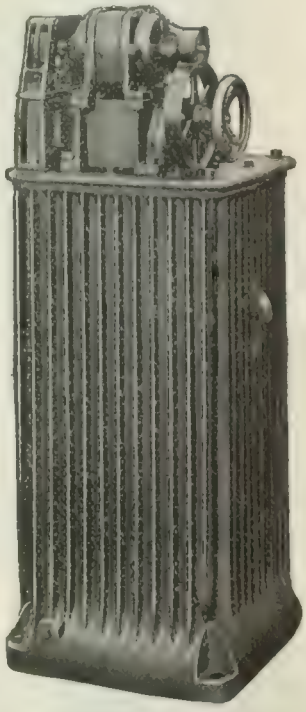


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THE TELEPHONE ON TOP.

Another "thirty years' war" may be said to have just ended, in the passing of the control of the Western Union Telegraph system into the hands of the management of the American Telephone & Telegraph. The announcement of the change came almost 30 years to a day after the signing of the famous contract of Nov. 10, 1879, under which the Western Union Company gave up the 85 telephone exchanges it had already created in opposition to the Bell and withdrew from the field. At the time, it seemed to have the best of the bargain. In return for its voluntary retirement from the telephone field it received a royalty of 20 per cent of all the Bell telephone earnings while the Bell patents ran, and thus came to enjoy an annual income of several hundred thousand dollars for agreeing simply to sit still, with folded hands. Moreover, it has had a lump sum of several millions added to that under settlement of a dispute as to what that clause meant. In addition, it got a neat sum in cash for its Edison, Gray and Phelps apparatus. Further, it secured 40 per cent of the stock of the local telephone systems of New York and Chicago. Finally, to satisfy the Gould appetite, the Bell interests agreed to stay out of the telegraph field.

We are now witnessing the dramatic epilogue to that transaction, and see the telephone interests which were thus "trimmed" so unmercifully return after three short decades and take virtual possession of the concern that mulcted them. It may be said that in purchasing less than a 30 per cent interest from the Gould and Sage estates, the Bell interests do not secure a majority control; but that has never been necessary even back to the time when Gould ousted the Vanderbilts from ownership, for the reason that the stockholding has always been of a scattered character. It is obvious that the telephone people can really do anything they like with the property, short of wrecking it, and they will not do that. The press has been swift to assume the existence of a general telegraph and telephone merger; but in fact there is nothing of the kind. It is true that Mr. Mackay or his company is a large holder of telephone stock, but this is not an alliance, though it may be an entanglement. The Postal Telegraph system remains free, separate and distinct, and, for aught we can see to the contrary, may go on competitively active for many years to come. We hope it will. But there is nothing in the situation to justify the prolonged rumors as to "vast merger" and "big monopoly," although there may come an adjustment of which both the telephone and telegraph industries have stood in need, as to circuits, offices, rates and other matters that affect the public.

For a long time past the telegraph has been relatively becoming more insignificant, while its profit as an enterprise has shrunk visibly from year to year. Much of this may be

attributed to lack of managerial courage and ability, but a great deal has doubtless been due to the sapping of the telephone, which has rapidly taken business away from the telegraph just as the interurban trolleys have taken passenger traffic away from the steam railroads. According to some of the stories, heads are to go off wholesale in the telegraph ranks; while the real truth is that no one will welcome the change so heartily as the live men still left in telegraphy. With the two systems of operation brought into closed touch, efficiencies and economies undreamed of can be attained. Numberless small offices carried on at a loss can be wiped out; circuits can be interchangeably worked, and the saving with one set of construction gangs instead of two may be characterized as simply enormous. The public will gain by having a telegraph wire practically in every house and office, besides gaining in time of message delivery, for it is notorious that the delays do not come on the wire, but in handling dispatches before and after transmission. All this should involve further benefit in a lowering of rates, and probably will.

Some aspects of the "deal" can hardly be discussed at this juncture; not enough is known of all the sides of the transaction. One or two points may be assumed. The first is that while there is no general merger, a most friendly *entente cordiale* exists between the three great systems affected. The second is that if a vast monopoly were attempted, the Government would have something to say about it; but it does not follow that such a unification would necessarily be bad. The third patent inference is that the development of independent telephony must be rather vitally affected. That competition has done wonders, but it has already lost its initial motive and impulse and has itself entered on the path of big consolidations tending to create a fourth big system. When that system comes finally into existence it must co-operate with the other three or go under.

Marine Propulsion.

The application of steam turbines to marine work was not welcomed with any great enthusiasm by naval architects and marine engineers. In fact, the keenness of competition for ocean passenger traffic, rather than considerations of a kind that have influence with professional men, has been the deciding factor in many decisions of steamship companies to discard the older for a newer type of vessel or equipment; and when one company adopts the latest "modern" improvement other companies are constrained to follow its lead in order to retain their standing with ocean travelers. The public then naturally expects the designers of war vessels to follow suit, if in its opinion a new system thus adopted would improve such vesels; and in case of hesitancy to act, the newspapers add the weight of their authority, deplore the inefficiency of naval designing bureaus, and rally politicians to the navy's need. That the steam turbine in its present form is not the ideal means of propulsion that has been asserted by its advocates for marine use, follows in great part from the very reason that makes this prime mover ideally applicable to electrical generation, namely, its inherent high speed. The efficiency of marine propellers is vitally dependent upon the efficiency of the screw propeller, and this in principle has a descending value at speeds beyond a critical one. The principal problem in this branch of engineering has thus been to adapt, directly or indirectly, the steam turbine to an efficient speed of propeller shaft.

It is a matter of no small gratification that the only solutions to the problem thus far offered and which are presented almost coincidentally, are both connected with names closely identified with the electrical industry. Moreover, both are presented, not as suggestions having to wait development, but in a state of elaboration which enables their immediate application aboard ship. One of these, the invention of Rear Admiral George W. Melville and Mr. J. H. McAlpine, has been developed through the agency of Mr. George Westinghouse, and consists of a remarkably interesting helical gearing arrangement between the turbine and propeller shaft, whereby the speed of the latter is reduced to that corresponding to the highest propulsive efficiency. That the invention is a remarkable one is obvious when we learn that in experimental operation the gearing has transmitted 6000 hp under practical working conditions at an efficiency of 98.7 per cent, the revolutions being reduced in the ratio of 5 to 1. The design of an arrangement capable of transmitting quietly and without destructive wear such enormous power at almost negligible loss is certainly a great achievement, which will still further enhance the reputation of the masters of marine engineering design to whom it is due.

The second solution forms the subject of a paper read by Mr. W. L. R. Emmet, of the General Electric Company, at a meeting in New York last week of the Society of Naval Architects and Marine Engineers. This is purely an electrical method, and while, in view of many previous suggestions along similar lines, it is not novel in conception, the system has been worked out in full engineering detail for immediate application to war ships. As will be seen from an abstract of Mr. Emmet's paper, printed elsewhere, the plan involves the installation aboard ship of a steam turbine electrical generating station for the supply of power to electric motors driving the propeller shafts. In both of these systems not only are conditions of the highest generating economic and propulsive efficiency secured, but a great saving of machinery weight is effected—a consideration of the highest importance, since it involves an advantage in speed, or cruising radius, or thickness of armor, or gun equipment.

The Single-Phase Induction Motor at No-Load.

The main operating features of the single-phase induction motors are not difficult of comprehension by one familiar with the polyphase induction motor. On the other hand, the secondary features, which differ essentially from those found in the polyphase machine, have given rise to numerous contentions among persons well informed concerning the phenomena of the latter. These secondary features, as existing in the machine operating without load, are treated in great detail in an instructive article by Mr. Val A. Fynn, the second and concluding part of which appears in this issue. In the earlier section the author dealt with the secondary and tertiary currents in the rotor, and their reflected values in the primary circuits, while in the present issue he discusses the fluctuating rotor torque and shows in what way this torque affects the flow of

energy supplied to the primary. Since the torque fluctuates at double the circuit frequency, it would seem that a rotor of any appreciable weight would be unable to vary its speed to any marked extent in conformity therewith, so that for all practical problems one can safely assume a uniform rotative speed. However, a complete analysis of the internal action of the single-phase motor is of much value from an instructional point of view, and the author is to be commended for the thoroughness with which he has completed the task undertaken by him. The representation by the author of the secondary of the motor as the armature of a commutator-type machine may lead to some confusion at first glance, but a little study will show that the commutator arrangement with short-circuited brushes is the equivalent of the squirrel-cage single-phase induction motor. The representation possesses the advantageous features of allowing the characteristics of the machine to be investigated with the maximum of simplicity, and to be compared most readily with those of single-phase machines in which use is actually made of commutators.

A New Type of Exploring Coil for Use with Underground Cables.

Ever since cables of insulated wires were first laid underground, which is more than 50 years ago, means had to be found of identifying individual conductors, for the purposes either of orderly connection or of disconnection for repairs. The earliest underground cables consisted of gutta-percha covered copper wires, about 1 mm in bare diameter, used for telegraphy. In order to identify the individual conductors it became customary to apply a few volts at the station to the particular conductor required, and for the wireman at the manhole to use a galvanoscope as a detector. He grounded one terminal of this galvanoscope, and, with a pin connected to the other terminal, pierced the gutta-percha envelope of each wire in turn, until he found a current flowing through the galvanoscope. This process of pricking pinholes in the insulation soon led to the development of faults at the manholes, even when an effort was made to seal up and mend the pinholes with the aid of a hot jointing-tool. Even the low-tension systems of those days would not tolerate such injurious practices. The pinsticking habit had to be prohibited, but the necessity for identifying wires was so great that pinholes frequently developed into faults after it had become a general order to dismiss linemen convicted of pin pricking. It was only after an electromagnetic method of identifying wires had been developed that the foregoing objectionable method entirely disappeared. The magnetic method employed a galvanoscope with a needle suspended in such a manner that each wire could in turn be inserted close to the suspension without cutting the wire. Either a steady current, or a current applied at successive, regular short intervals, then produced a deflection on the galvanoscope that was readily detected.

Later on, when telephone cables were introduced, identification of wires was effected partly by color variations in the coverings, and partly by electromagnetic devices. An exploring coil was introduced, consisting of a secondary winding connected to a head telephone, the primary winding being the particular wire of the cable, on which a rapidly fluctuating voltage was impressed at the station. By listening to each wire in turn, the wireman could identify the particular wire carrying the testing current. When electric light cables came into use, the conductors were too heavy to subject to the treatment previously imposed by such methods, and new devices had to be arrived at. In most cases the number of conductors in a single cable was limited to three, so that the identification problem became of lesser importance; while the cables, when numerous, occupied individual ducts in a conduit, readily permitting of identification, either from records or from a regular plan of construction. In place of the identification problem, however, there arose the fault-localization problem. If a ground occurred, the fault was hard to localize electrically, because of the low linear resistance of the large conductors, and of the large error in distance that a small electrical error in localization-resistance entailed. Once more the plan of sending a readily recognizable type of current from the station over the faulty wire was resorted to, with some means of detecting this current electromagnetically, either at the surface of the cable-trench or in the manholes. When a large current could be sent into the faulty cable, and the current could be forced to distribute itself through the ground at the fault, a compass needle placed on the ground surface has often served to detect the current impulses along the line of cable up to the fault, these impulses disappearing after the fault had been passed. Or, an exploring coil might sometimes be employed with advantage in a similar manner.

With the introduction of high-tension cables in continuous leaden sheaths, new difficulties arose in the application of the above methods, owing to the return of a large portion of the outgoing current through the sheath, and the cancellation thereby of a large part of the magnetic field produced by the current of identification. In this week's issue, Mr. William A. Durgin describes a new type of exploring coil, in which the winding is laid transverse to the cable, and the core parallel to the cable. It depends for its application upon the fact that the conductors in all three-wire cables are, in practice, laid up helically with a lay of some 20 in. By using one pair of the three conductors as the conducting loop, over which testing currents are sent from the station, the magnetic field due to sheath currents or to currents through neighboring cables in the conduit is eliminated, and only the transverse field component due to the lay of the spiraled conductors in the cable tested is brought into action. This is a very ingenious method, although it calls for a relatively powerful identification current in the conductors. It would probably be impracticable to apply this exploring coil except close to the cable examined, so that all tests made from the surface of the ground over the cable trench must be given up. Since, however, in each manhole the wireman can bring the coil into close proximity to each cable in turn, and since, in practice, it is only necessary to locate a fault in a cable between adjacent manholes, so as to be able to draw out the defective section and replace it by a sound section, the need for a device that will indicate at the street surface is much lessened. The old Latin proverb said in effect that he gives doubly who gives promptly, and it may certainly be said, in imitation thereof, that he repairs doubly who localizes a fault promptly in power-distribution work. Every practicable device for such purpose should be widely made known.

Bell Telephone and Western Union.

The announcement that the American Telephone & Telegraph Company had purchased a large interest, the Gould holdings, in the Western Union Telegraph Company, was made in our last issue. This deal, while not involving direct majority control, is now said to give the practical control of the Western Union to the telephone company. Recent acquisitions amount to about 280,000 shares, or 28 per cent of the outstanding $99,787,000 of capital stock of the Western Union. It is also stated that previous to this purchase the telephone company had taken over other holdings, and that at this time it controls, directly or indirectly, a voting majority of the outstanding stock.

Official announcement of the deal was first made by Mr. Theodore N. Vail, president of the American Telephone & Telegraph Company, who said that his company had obtained control of "a substantial minority interest" in the shares of the Western Union. He said: "From the very commencement of the telephone business it has been thought that a close corporation, the making of one business an auxiliary to the other business, would give additional public service, as well as result in larger economies both to the public and to the companies. This is the reason for our acquisition of Western Union stock. There is much to be gained by joint construction and maintenance of plant and by its common use to the greatest possible extent, but the greatest advantage would follow the placing of the millions of telephone subscribers in close and reliable connection with the receiving and dispatching offices of the telegraph companies. While some provision for this, after a manner, exists to-day, the lack of harmony and co-operation between the companies, and the inability to agree on methods of fixing responsibility have limited its utilization to cases of absolute necessity. The harmony and co-operation necessary, it is believed, can now be established and the resulting advantages may be available for the public. While there is a common feature in the use of wires strung on poles or in cables, the similarity ends there. The circuits and methods used for the telegraph and the telephone are entirely distinct and different, and each business requires especial equipment, operating forces and general business organization. It seems not only to be good policy, but a duty to increase the service and advantages to the public by utilizing present unutilized business, and at the same time benefit property and increase revenue."

In a further statement several days later Mr. Vail said: "It will be possible in many places to have the telegraph and telephone business in the same or an adjoining building, so that the sender of a message may forward his dispatch by telephone without the necessity of using messenger service. As far as I can see, there is no occasion for an investigation by the Government. We have been feeling our way, and in my opinion there could be no valid reason for Federal action. There has been no merger of rival and competing companies, and the action we have taken is merely the acquirement of stock in a telegraph company by our corporation. There are to be no changes in the official management of the companies, although we hope to elect some of our representatives to the board of directors of the Western Union. No new financing on our part will be necessary, as the Western Union stock was purchased with treasury funds."

Mr. George J. Gould admitted the sale of the holdings of his family to the American Telephone & Telegraph Company, and said: "I believe this will inure to the benefit of both the public and the Western Union stockholders, as the business of both companies can be handled so that they form a complement to each other, thus giving to the fullest extent prompt and satisfactory service to their patrons." Mr. Gould did not state the amount paid for his holdings, but it is generally understood in Wall Street that the price was about $85 per share

There were many reports concerning the deal in the financial district, one of the most persistent being that the American Telephone & Telegraph Company would soon make a contract with the Western Union Company by which it would guarantee dividends on the stock of the latter company. The Western Union is now paying at the rate of 3 per cent, but during the latter half of 1908 and the first half of 1909 it only paid at the rate of 2 per cent. It formerly paid 5 per cent. The American Telephone & Telegraph Company has been a regular dividend payer for a number of years at the rate of 8 per cent.

For many years a suit has been pending between the two companies involving royalties upon telephone patents. During the summer a special master in chancery decided that the American Telephone & Telegraph Company owed to the Western Union Company about $6,000,000. This decision was appealed, and the case will finally be carried to the United States Supreme Court. In regard to this Mr. Vail said: "The so-styled suit between the Western Union and the Bell interests has been decided twice in favor of the Bell company and once partially in favor of the Western Union. It has been in the courts now 28 years, and it will be appealed. The suit in reality is against the American Speaking Telephone Company, which was organized by the Gold & Stock Telegraph Company, as a subsidiary of the Western Union, and the Harmonic Telegraph Company, a company organized by Dr. White, of Pennsylvania, to exploit Professor Gray's telegraph patents." The recent transactions in stock will have no effect upon this litigation, according to Mr. Vail's statements.

The purchase of the control of the telegraph company by the telephone company gave rise to many rumors that a telegraph merger was contemplated which would involve the Mackay Companies, as well as the Western Union. This opinion was given special strength from the fact that the largest individual stockholder in the American Telephone & Telegraph Company is the Mackay Companies. Mr. Vail, however, made explicit denial that any merger of telegraph companies was contemplated at this time. He declared that the purchase by the telephone company was chiefly to improve the service, and had nothing to do with any other telegraph companies. In this connection, Mr. Clarence H. Mackay, president of the Mackay Companies, made this statement: "We have had nothing to do, either directly or indirectly, with the combination of the American Telephone & Telegraph Company with the Western Union Telegraph Company. We have not wished to join it, and have not been invited to join it. There have been no negotiations whatsoever with us in regard to the matter, and there is every reason why we should not have had anything to do with it. We knew nothing about it until the day when it was publicly announced.

"It is true that we own a large block of stock in the American Telephone & Telegraph Company, but we never have had and have not now any representation on the board of that company, and our stock is not consulted or considered any more than the stock of any other stockholder, as you will see from the fact that we knew nothing about this deal until it was publicly announced. Neither have we had anything to do with the purchase of telephone companies in the Middle West. Our company is slow and conservative in its investments, but aggressive in its service. We are not disturbed in any way. We have successfully met hard competition for over 25 years and have prospered, and are in first-class financial condition, better than ever before. Competition will continue, and it will be real competition the same as heretofore."

The effect of this deal upon the stocks of the two companies was not particularly important. For several days prior to the announcement of the sale Western Union stock had advanced, and had been particularly active. During the week which succeeded the announcement the stock receded in price, and practically lost all of its gain. The effect upon American Telephone & Telegraph Company stock was to push it up two points. There has been some increase of activity in both stocks since the deal became known. It has been both asserted and denied that the Federal Government has taken steps toward an investigation of the details of the transaction, with a view to action should there appear to exist a combination against the interests of the public.

Merging of Municipal and Underwriters' Electrical Inspection.

Commissioner O'Brien, of the New York City Department of Water Supply, Gas and Electricity, has concluded a working agreement with the New York Board of Fire Underwriters, to go into effect Dec. 1, whereby the commissioner will certify, and therefore legalize, the certificates of the New York board for electrical equipments installed in premises involving fire risks only, such as private buildings and small stores. The New York board certificate thus endorsed by the department becomes legally the latter's own certificate. It will be necessary, however, for all persons installing electrical wiring or appliances in the city to continue to file the usual application for inspection, as, in order to keep legal control of the situation, the department will decline to place its certification upon an underwriters' certificate unless the usual application for inspection shall have been filed with the Bureau of Electrical Inspection. The agreement makes exceptions of equipments in buildings owned or controlled by the city, theaters, moving-picture machine establishments, churches and other places of public assemblage where it is believed that a panic, as well as a fire hazard, may exist. In the case of these buildings the department's individual certificate will be required as formerly.

Incident to the establishment of this working agreement a joint advisory board of engineers has been constituted, consisting of Messrs. Lacombe, Sever and Wynkoop, for the city, and Messrs. Stewart, Forsyth and Bruen, for the New York Board of Fire Underwriters. The purpose of this advisory board is to consider and report on all matters relating to the electrical inspection service in the City of New York. Since these reports will be prepared in duplicate, one copy being submitted to the Commissioner of Water Supply, Gas and Electricity, and the other to the head of the New York Board of Fire Underwriters, a uniformity of rules, interpretations, approvals and inspection methods, which has not existed hitherto, may now be anticipated.

Secretary of the A. I. E. E. on Tour of Middle West.

At a meeting of the board of directors of the American Institute of Electrical Engineers held Nov. 12, Mr. Ralph W. Pope, the secretary of the Institute, was authorized to make a tour of the Middle West. Mr. Pope left New York on Nov. 14, going direct to Urbana, Ill., where he addressed the Urbana Section of the Institute. On Nov. 16 he visited the Chicago Section, the principal speaker at that meeting being Dr. Steinmetz. From Chicago Mr. Pope proceeded to Madison, Wis., and thence went to St. Paul, at which city he presented Dr. Cary T. Hutchinson's recent paper on the electric system of the Great Northern Railway Company at Cascade Tunnel. The secretary will also visit the Iowa State Section at Ames, Ia., and returning will address the Fort Wayne Section. Mr. Pope expects to be at his desk again on Nov. 29. This tour promises to be no less beneficial to the Institute than a recent one by Mr. Pope to the Far West, through the extension of the personal acquaintance of the permanent officers of the body among the membership.

Proposed Railroad Terminal Electrification in Chicago.

The subject of compelling the railroads in Chicago to electrify their lines within the city limits has reached the stage of public hearings, and the first meeting of this character was held by the local transportation committee of the City Council on Nov. 17. Representatives of the railroads and railroad trainmen were heard on the one side, while on the other speakers for the people of Chicago presented their case. The proposed ordinance was first read. It provides that within six months after its passage the railroads must submit plans to operate their lines within the city of Chicago by means other than steam and without the production of steam, noxious gases or noxious vapors. It is also stipulated that by Jan. 1, 1912, all trains must be operated by means other than steam on penalty of a fine of $200 a day.

The first speaker was Mr. P. J. Calkins, representing the Brotherhood of Locomotive Engineers, who said that the railroads and their employees were doing their best to abate the smoke nuisance. He could see no reason for the ordinance, against which he protested vigorously. Electrification in New York, he said, has resulted in loss of life and injuries to trainmen. Furthermore, the Chicago situation is very different from that in New York. Many locomotive engineers live here, and they would have to leave the city if the railroads electrified, for their occupation would be gone. To do away with a little smoke, it is proposed to imperil the lives of many men employed on the railroads. The end does not justify the means.

As a representative of the Anti-Smoke League, Judge A. N. Waterman addressed the committee. He pointed out that every great reform has been strenuously, even violently, opposed. The locomotive engineers are entitled to consideration and so are the mine operators and the dealers in soft coal. Nevertheless, the soft-coal burning locomotives constitute a great nuisance, and the speaker made a plea for the homes of the people constituting the community of 2,000,000 men, women and children in Chicago.

For the Illinois Central Railroad, Mr. Blowett Lee, a lawyer, suggested some modifications of the ordinance. He said that the railroads of Chicago were so interlinked by interchange of traffic that the subject of electrification should be considered by all of them together and not by any one railroad. He thought also that the time limit of the ordinance, Jan. 1, 1912, gave altogether too short a time to make such an extensive improvement. The penalty of $200 a day he also thought excessive. The proposed ordinance apparently prohibits the burning of hard coal or coke to get smokeless operation, as it expressly mentions noxious gases and vapors, as well as smoke; the speaker thought that this should be modified. Furthermore, he was of the opinion that the measure should only apply to thickly populated districts, and that no hardship would result if steam locomotives were permitted in the outlying parts of the city.

Mr. A. P. Kelly, vice-grand-master of the Locomotive Firemen's Union, made a witty speech, in which he opposed the proposition. He said that smoke was not unhealthful, and offered himself in evidence of this fact. He said that he had "fired" for 15 years, and as he is a sturdy man, weighing perhaps 250 lb., he put himself in as an exhibit. The firemen, according to Mr. Kelly, are very much opposed to the electrification proposition. The speaker referred to the dangers of railroading, and said that electrification would increase them tenfold. He repeatedly referred to the Anti-Smoke League as the "ladies' society." Hard coal is used on the switching locomotives in New York City, and if used in Chicago would prevent smoke.

Mrs. F. G. Culver represented the Outdoor Art League, and she was followed by Mr. W. A. Gardner, vice-president of the Chicago & Northwestern Railway, who read a paper giving many interesting details of practical railroad operation in Chicago. The railroads, he said, are bound up intimately with the industrial and commercial life of the city, and it will be impossible to effect this great change without affecting the business interests. The Northwestern Railroad alone has approximately 375 miles of track in the city, and it has never less than 10,000 freight cars on these tracks. Considering all the railroads, 2000 passenger trains enter and depart from the city every day, and there is a movement of no less than 65,000 freight cars in and out of Chicago daily. The change proposed in the ordinance is a revolution, and should receive very careful and long-continued investigation. Conditions in New York and Chicago are very different. For instance, there are 13,000 track

switches in Chicago, and every one of them means a complication of the electrification problem. The speaker opposed electrification. He said that his company makes some smoke, but less than it ever made before, and it promises to make still less in the future. Smokeless coal is used, for which the company pays $3.05 a ton, although Illinois soft coal could be bought for $1.70.

Mrs. John B. Sherwood, from the Chicago Women's Club, made an earnest plea for a cleaner Chicago, and at the conclusion of her speech the chairman of the committee announced that others desiring to be heard would be given an opportunity at the next hearing, the time of which was not announced.

Ohio Independent Telephone Situation.

Mr. F. R. Huntington, vice-president of the Huntington National Bank, of Columbus, Ohio, has closed negotiations for the purchase of a controlling interest in the Columbus Citizens' Telephone Company, the large independent plant of Ohio's capital city. This includes the lease of the Franklin County Telephone Company also. Mr. Huntington has refused to state the principals behind him in this deal, but the general supposition is that the interests are the same as are involved in the purchase of the United States, Toledo Home and Cuyahoga Telephone companies in Ohio, and the New Long-Distance Telephone Companies of Indiana, which are represented by James S. Brailey, Jr., of Toledo. The cost of the controlling interest is said to be about $1,500,000.

Mr. Frank A. Davis, president of the company, stated that Mr. Huntington had assured him that the interests for whom he is acting will continue the company as an independent organization. He had been asked, he said, to continue as president of the company, and that he thought the other officers and the directors will be continued as they are. He said the owners had received what they consider a good price for their holdings, but that further than this they could say nothing at this time. Mr. Frank L. Beam, president and manager of the Ohio Independent Telephone Association, is a member of the board of directors of the Columbus Citizens' Telephone Company. He said he felt sure that this and the other companies purchased recently would be continued on an independent basis. The company was owned mostly by local men in Columbus. It was promoted, with others, by the Everett-Moore syndicate, but the stock was sold to local people in 1900. It owns the London Telephone Company, of London, Ohio, and an interest in the Home Telephone Company, of Washington C. H., Ohio. Through the Franklin County Telephone Company it operates 14 exchanges. A bond issue of $650,000, bearing 5 per cent interest, is due in 1920. There is outstanding $676,800 of 6 per cent cumulative preferred stock and $750,000 common stock on which 1¾ per cent has been paid quarterly.

At a meeting on Nov. 17 at the Chittenden Hotel in Columbus, the sub-committee of five, appointed at a meeting of telephone men some time ago, made a report to the committee of fifteen, which was promptly adopted. This report recommends the merging of all the independent companies of the State into one corporation. It is proposed that the stock of the various companies shall be exchanged for the stock of the larger company on an appraised value, and that the bonds shall be exchanged for bonds given by the new organization. This report was formulated after receiving an opinion upon the matter from almost every independent company in the State, a letter of inquiry having been sent out some days previous to the meeting. It is the general belief that the organization of a company to take over all the small companies will be brought about at once as a matter of protection against any move that might injure the independent companies.

Opinions are prevalent throughout Ohio that the Postal Telegraph Company is the real interest back of the purchases that have been made, although there has been no statement made by any officers of that company, so far as known. It is alleged that this company is getting together all the telephone interests possible in order to compete with the Bell interests both in the telephone and telegraph field. If the independent telephone companies of the State could have full information on this matter, with assurances that their properties would be used to forward the independent movement and never be turned over to the Bell people, there might not be so much objection to its acquiring them.

It was announced the latter part of the week that Mr. F. R. Huntington had also made a proposition to purchase a controlling interest in the Dayton Home Telephone Company, Dayton, Ohio. For the preferred stock he offered $90 per share and for the common $20 per share. This company has not been as prosperous in the way of returns on investments as the Columbus company, so the offer was less favorable. It is thought, however, that the controlling interest will be secured by him. The terms and conditions were about the same as in the case of the Columbus company.

Some of the telephone men feel that the merging of all the small companies in the State into one large corporation will place the properties in position to be easily acquired by the same interests that are taking over the large companies. If this is a friendly interest, there will be no trouble, but if the whole list should finally go to the Bell, as is believed they will in some quarters, the intentions of the independent men for the past 10 or 15 years will have been shattered.

It has been announced that the properties of the Central Union Telephone Company and the Tiffin Home Telephone Company at Tiffin, Ohio, have been consolidated and taken over by the Tiffin Consolidated Telephone Company. It is said that the stock of the new company has been apportioned about equally between the independent telephone men and representatives of the Central Union. The officers are as follows: President Arthur A. Cunningham, Tiffin; vice-president, Louis Selle; secretary, A. J. Mellen, Toledo; treasurer, J. J. Fleck; Tiffin. This is rather a peculiar move to be made at this time and has not yet been explained by anyone.

Deep Waterways and Hydroelectric Power.

Mr. W. Clyde Jones, of Chicago, is not only a practising lawyer and the State Senator from one of the Chicago districts, but he is also a man who has been particularly interested in electrical pursuits, with which he is rather intimately connected. He is, therefore, no stranger to many of the members of the Electric Club of Chicago, whom he addressed on Nov. 17 on the subject of "The Deep Waterway." He is a good extemporaneous speaker, and he presented his subject forcibly and attractively. He said that the coming generation will be a generation of conservation; the last two generations since the Civil War have been generations of destruction. Now, however, the conscience of the country is aroused. Among other evidences of this tendency is the undoubted fact that the Government will curb the power exercised by the railroads and develop the waterways of the country. Through the deep-waterway conventions and by other means, the people have become deeply interested in this subject.

The railroads have conducted a systematic warfare against waterways for a long term of years, and water-borne commerce, particularly in the Mississippi Valley, has decayed during the last 40 years. But the railroads cannot take care of the increasing traffic of the country in good times, as is shown by the famine in freight cars. It is, therefore, necessary, merely on this ground, that the waterways should be developed. The Chicago Drainage Canal, costing $58,000,000, 30 miles long and 24 ft. deep, has been built by the people of Chicago to connect Lake Michigan with the Desplaines River at Lockport, Ill. This is at one end of the Lakes-to-the-Gulf waterway project, and it may be said that the Panama Canal now being built by the United States Government is at the other end. The speaker described the various deep-waterway proposals in the Mississippi Valley. The project of deepening the Illinois River and connecting it with Lake Michigan is only one of these. There are also projects for deepening and improving the Ohio River, the upper Mississippi and the Missouri River. Outside of the

Mississippi Valley there are also proposals to construct inner channels along the Atlantic, Gulf and Pacific coasts.

But the advantages to commerce are only one recommendation for these proposed deep waterways. River improvement means the controlling of floods, the prevention of the waste due to erosion of the soil and the reclamation of many millions of acres of submerged or partially surbmerged lands. Then, too, there is the possible water-power development. In Illinois it is proposed to build a deep river channel in the Desplaines and Illinois rivers from Lockport, the present terminus of the Drainage Canal, to Utica, which is the present head of navigation on the Illinois River. It is calculated that 140,000 hp can be developed at various points along this channel. It is proposed that the State build this canal at a cost of $20,000,000, and it is said that the revenue from the sale of water-power would net $2,500,000, or sufficient to pay interest on the bonds and establish a sinking fund. Senator Jones told of the work of the Sanitary District in building the present Drainage Canal, and of some conflict that has arisen between its present water-power development and its future plans in that direction and the water-power developments of private owners on the Desplaines River. The people of the State had voted in favor of a constitutional amendment to allow the issue of $20,000,000 worth of bonds to build the proposed deep waterway from Lockport to Utica. When the Legislature considered this question, the Senate was decidedly in favor of it, but the lower house voted in favor of waiting until the Federal Government could be induced to cooperate with the State by extending the deep waterway from Utica down the Illinois River to the Mississippi and improving the Mississippi so that there would be a continuous channel, perhaps 14 ft. deep, from Lake Michigan to the Gulf of Mexico. In the proposed deep waterway from Lockport to Utica, Ill., it is planned to extend the depth of the present Drainage Canal, 24 ft., as far as Joliet, and from there dig a 14-ft. channel to Utica. The Lockport-Utica channel would constitute a second link in the Lakes-to-the-Gulf waterway, making, with the first, already built, a channel with a minimum depth of 14 ft. and over 90 miles long.

The question now arises: What shall the people of Illinois do? Shall they wait for Federal assistance, or shall the State proceed to construct, at an expense of $20,000,000, the second link in the deep-waterway project? It has been estimated by Government engineers that it will cost $30,000,000 to deepen the Illinois and Desplaines rivers to the end of the Chicago Drainage Canal at Lockport. If that estimate is correct, and if the proposed Lockport-Utica link can be built for $20,000,000, it will only leave $10,000,000 to do the rest of the work from Utica to the mouth of the Illinois River. The trend of the speaker's remarks indicated that he was decidedly in favor of carrying out the expressed will of the voters by authorizing the constitutional amendment permitting the issuing of $20,000,000 in bonds for this purpose.

In answer to Mr. Harold Almert, Senator Jones explained the recent decision of the Illinois Supreme Court in which the complaint of the State against the Economy Light & Power Company for obstructing the Desplaines River at Dresden Heights was dismissed. This decision was summarized in a previous issue of the *Electrical World*. The speaker explained how the Desplaines River was not navigable before the Drainage Canal water was turned into it; after that time it became a very respectable stream. The Supreme Court has held that it is not a navigable stream, and that, therefore, the private owners at Dresden Heights owned the land to the middle of the river, and the State has no right to remove the obstruction of the private owners on the ground that the river is navigable. The decision means that the Dresden Heights property must be condemned and purchased at its fair value if the deep-waterway project is endorsed by the Legislature, following the approval of the constitutional amendment by the voters. Senator Jones' speech was clear and convincing, and was received with manifestations of approval.

It happened that there were several distinguished visitors at this meeting of the club, and President Vose alluded to the presence of Dr. E. J. Berg, the new professor of electrical engineering at the University of Illinois, before he introduced the next speaker, who was Dr. Charles P. Steinmetz, of Schenectady. Dr. Steinmetz, who was received with great applause, said that the citizens of the United States are deeply interested in seeing the waterways of the country restored to their former importance. Engineers are also interested in the subject, both as citizens and as specialists. "For instance, as engineers," said the speaker, "we are all interested in seeing every drop of the water of Niagara going through turbines rather than pouring over the cliff as a cataract; as citizens, however, we may not desire to go as far as this." He spoke of the preservation of the waterways, the forests, the watersheds and the coal supply as being all interlinked; each feature of the program is intimately connected with the others. "When we survey a large hydroelectric plant, with its big power house, its long transmission line and its extensive hydraulic works, and observe that in summer the water is so low that coal, itself not inexhaustible, must be used to supplement the diminished water-power, we must realize the importance of equalizing the flow of water throughout the whole year. Furthermore, the improvement of waterways will prevent the erosion of soil, which is an important consideration. From various points of view, it is time to look to the preservation of natural resources. We may disagree, perhaps," said Dr. Steinmetz, "on the question of how far the Government should go in utilizing and protecting water-powers without injuring legitimate private interests. Nevertheless, as citizens, we all must agree in conceding the gravity and importance of the problems presented."

Mr. B. J. Arnold, who was present, was called upon, but as he is to address the club soon, he excused himself from making any extended remarks.

Grounded Secondaries.

Mr. W. J. Canada presented a paper on Nov. 12 before the Denver N. E. L. A. branch in which the subject of grounded secondaries was thoroughly treated. After giving a résumé of the objections of both underwriters and lighting companies to grounding, it is stated that all of these have practically been done away with. In the first place, the normal ungrounded secondary suffers so chronically from the accidental ground at one point or another that the condition of a normal ungrounded secondary may be considered very uncertain and this opinion is concurred in by two-thirds of the lighting companies whose opinions have been obtained on the subject. Therefore, the theoretical advantage of the ungrounded secondary over the grounded—that of minimizing short-circuit arcs due to grounds into buildings—may be stated to be to a large extent fictitious.

In the second place, the breakdowns which occur with alarming frequency all over the country when primary voltage enters on secondary wiring in buildings were either not anticipated by the underwriters in making their objections, or the frequency and severity of these troubles in the causing of fires and consequent losses to insurance companies were not sufficiently reckoned with. At present the underwriters' interests are very generally of the opinion that grounding secondaries actually reduces the fire hazard and their objection from being a very active one has passed through the stages of being passive and then complacent, and they are now the whole country over becoming favorable to grounding. While the underwriters have thus far objected to the requirement for grounding being made mandatory in the National Electrical Code of which they are the principal sponsors, this is simply for the reason that in their utilization of the "Code" as a standard for fire hazard they cannot, without definite information that fire hazard has increased by the non-grounding, enforce a grounding which is popularly presumed to be a purely life measure.

The objection on the part of lighting companies to grounding, that the grounding is of considerable initial expense, increases maintenance troubles, injures the continuity of service, etc., is directly refuted by the action of the great majority of companies in grounding, mostly of their own volition; by their

written statements, in favor of grounding, many of which have been published from time to time throughout the country, and by the organized action of their national associations, such as the National Electric Light Association, the Association of the Edison Illuminating Companies, etc. Out of some 40 companies written to, 95 per cent reported that no noticeable increase in maintenance has been observed since the grounding of secondaries, that lightning troubles no longer exist, or are in many cases less frequent, than previous to grounding, and that minor troubles in consumers' premises are much more readily checked with the grounded system than with the ungrounded. All these companies give their unqualified approval of grounding and state that under no circumstances would they return to the use of an ungrounded system.

The question as to the limiting voltage of secondaries where grounding should be required is not so essential as might appear, although its discussion has delayed the definite recommendations of some of our engineering societies in this matter. Ninety per cent of all building wiring would be protected with the grounded secondary limited to secondaries of under 300 volts. The general tendency seems to be toward grounding secondaries of higher voltages as well, and then depending on insulation and covered contacts for part of the protection to life from these higher voltages in rooms with grounded surfaces. The decrease in probability of fire by the grounding of a 220-440-volt secondary would hardly be considered less than the decrease in this probability when a 110-220-volt circuit is grounded. Lighting companies at present can make no mistake by following the unanimous engineering opinion that circuits up to 150 volts should be grounded, and this will take care of 90 per cent of all circuits entering buildings.

The experience of lighting companies which have operated with both grounded and ungrounded secondaries develops the fact that the general maintenance costs are not increased with grounded secondaries, that fewer transformers are lost, and that troubles from high voltage in customers' premises are entirely eliminated, whether affecting life or property.

In the discussion of the paper no opposition developed to the grounding of secondaries at any voltage, and the point was brought up that the limitation to 150 volts when grounding would be in entire contradiction of European practice.

Steinmetz on Law of Conservation of Energy.

Dr. C. P. Steinmetz lectured on the "Law of the Conservation of Energy" before a joint meeting of the Chicago branch of the A. I. E. E. and the electrical section of the Western Society of Engineers at Chicago, Nov. 16. Dr. Steinmetz's lectures have come to be an annual event in Chicago and always serve to bring together the largest crowd of electrical men of the year in that city. Mr. W. L. Abbott introduced as chairman of the meeting Mr. Bion J. Arnold as the one most entitled to preside at the joint meeting, owing to his being an ex-president both of the American Institute of Electrical Engineers and the Western Society of Engineers. Before the speaker of the evening was introduced Mr. Ralph W. Pope, secretary of the A. I. E. E., was announced as another guest of honor of the evening and made a few remarks.

Dr. Steinmetz began his lecture by calling attention to the fact that the law of the conservation of energy and the law of conservation of matter have been known for many years. The aid they may give to engineering calculations has not always been appreciated. The law of conservation of energy teaches us that energy can never be destroyed. It can only be changed in form. When a revolving balance wheel is gradually brought to rest by friction the mechanical energy stored in it is transformed into heat. We speak of the energy being lost because it is changed into a form in which it is of no practical use because the heat is so much dissipated or "spread out so thin" that it cannot be utilized. The units of electrical energy can be transformed into the equivalents of mechanical and heat energy. If the c.g.s. system of units is used the calculation is simple. If the ordinary commercial units are used the calculation of one into terms of the other is more cumbersome.

The law of conservation of energy can be used to simplify greatly calculations by taking the input to a machine and the output, or by taking the losses and the input to get the output. For example, in calculation of dynamo or motor losses we measure any two of the three factors, input, output and losses, to obtain the third factor. This is much simpler than trying to calculate in detail the various losses in different parts of the dynamo structure. One might calculate such losses if he had sufficient information as to the structure of the machine and the losses taking place in various parts and, as Dr. Steinmetz puts it, "if he lives long enough to do it." The law of conservation of energy, however, gives us the short cut. Likewise, magnetic pull, losses in transformers, and energy dissipated upon the interruption of a circuit can be calculated on similar principles, thus doing away with inconvenient and cumbersome calculations.

Meeting of Ohio Society of Mechanical, Electrical and Steam Engineers.

The twentieth meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers was held in Lima on Nov. 19 and 20. The address of welcome was delivered by Dr. Bowser, president of the City Council, and was responded to by Mr. F. W. Ballard, president of the society.

In his presidential address on "Power Costs for Factories," Mr. Ballard discussed the utilization of exhaust steam for heating buildings, which he estimated to be worth 2 cents per month per square foot of radiating surface for six months in the year, and outlined the advantages arising from keeping accurate detailed records of the costs of operating machines in a factory. He stated that the steam consumption of steam pumps is often at least five times that required by large central engines driving generators for supplying energy to motors for doing the same work, and in extreme cases with long lines of steam pipe and intermittent service the steam consumption has been found to be 10 times what would have been required by central units for the same service. The speaker claimed that the first requisite of low-service cost is a system of accounting and follow-up records. The individual motor drive was advocated only in cases where one machine, taking a large proportion of the power necessary to drive a group of machines, is used intermittently, and the motor driving the entire group evidently would operate at only a fraction of the rated load for the larger portion of the time.

In the discussion Messrs. O. F. Rabbe and Grant Miller and Prof. W. T. Magruder claimed that the charge of 2 cents per square foot for steam heating was too low. Mr. Miller stated that from 30 cents to 35 cents would be more nearly correct.

Professor Magruder reported the results of an investigation which showed that the cost of operating a certain boiler plant for steam heating alone, in the winter time, was nearly equal to the cost of running the plant for both the motor service and the heating service combined. In speaking of group drives, Professor Magruder cited a case where 800 hp was required to run the shafting during the noon hour while only 1000 hp was needed to operate the shop during working hours. With mechanical transmission the losses may be from 40 to 50 per cent, while with electrical transmission the losses may be reduced to 15 per cent.

Mr. David Gaehr remarked that the value of the losses in shafting and belts is often greatly exaggerated. Even when test results indicate excessive losses, they may be attributed to poor design, inadequate bearing surfaces, insufficient contact between belts and pulleys and poor alignment of shafting. Attention was called to the "balancing" of drives by which as many belts are on one side of the shaft as on the other, in which case the pressure produced by the pull of the belts on the hangers will be balanced, or nearly so.

Mr. Ballard said that a fair estimate of the loss in shafting, etc., is from 30 to 35 per cent of the total load.

A paper by Prof. E. A. Hitchcock, descriptive of the new laboratory of the department of mechanical engineering at the Ohio State University, on account of the absence of the author, was presented in abstract by Professor Magruder. The building is of modern factory construction with saw-tooth roof. The paper contained outlines of the testing apparatus with which the laboratory is equipped.

A paper on the Darling oil gas producer was read by Mr. A. B. Davis, a paper on turbine pumps by Mr. Wetmore H. Titus, and one on coal-handling and ash-handling equipments by Mr. David Gaehr. Mr. Gaehr gave data showing that the cost of handling coal and returning ashes by manual labor varies from 18 to 55 cents per ton, while the cost for the same service performed by machinery varies from 1 cent to 10 cents per ton. Particular emphasis was placed on the electrically driven monorail crane which possesses many advantageous features in the handling of coal and ashes.

The members were afforded opportunities to visit the oil manufacturing plant of the Solar Refining Company, the Lime Locomotive Works and the cigar factories at Lima.

Officers for the next year are as follows: President, Mr. O. F. Rabbe; vice-president, Mr. Grant Miller; managers, Messrs. Ira Cole, C. Thomas Baker and E. E. Adams; secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. The next meeting will be held in Cincinnati on a date not yet determined.

Electric Propulsion of Naval Vessels.

Two applications of electricity to propulsion of naval vessels were described in a paper presented by Mr. W. L. R. Emmet at a meeting of the Society of Naval Architects and Marine Engineers held in New York on Nov. 17 and 18. The applications were designated as the "combination drive" and the "electric drive" respectively. In the former, use is made of both electric motors and low-pressure steam turbines for driving the propeller shafts, while in the latter the propulsion is wholly by electric motors. The first of these plans has been made the subject of a proposition to the Government for one of the new battleships, the turbine part being designed by the Fore River Shipbuilding Company and the electrical part by the General Electric Company. The second plan has been applied on a small scale to two fireboats in Chicago, and is being elaborated for application to war vessels.

In the combination drive it is proposed to use twin screws and to mount upon each propeller shaft a low-pressure turbine and an electric motor. The motor would receive energy from a generator driven by a high-pressure turbine which would exhaust through the low-pressure turbine. The adjustments would be so made that at full speed the motor would deliver two-fifths and the low-pressure turbine three-fifths of the power taken by the propeller shafts. At low speeds the low-pressure turbine would carry no load. The motors would be of the two-speed squirrel-cage induction type without provision for reversal; the low-pressure turbine would be fitted with two reversing stages similar to those that would be adopted with direct turbine drive.

In the complete electric drive, as applied specifically to naval vessels, it is proposed to mount on each propeller shaft two motors, one of which would be arranged with pole-changing switches so as to adapt it to use at lower speeds, this motor being similar in construction and performance to that proposed with the combination drive. The other motor would have only a small number of poles for use at high speeds, but would be of the wound-rotor type adapted to producing the high torque desirable in rapid changes of the ship's direction.

The author stated that the electric speed change involves no kind of complication, difficulty or uncertainty. The efficiency of the electric speed-reducing arrangement was said to be 92 per cent, which is higher than any other arrangement that can be used for the same service.

The results of calculations are given showing that with the electric drive there would be a reduction in the machinery weight from 520 tons for the steam turbine drive to 354 tons; a decrease in the steam consumption from 25.6 lb. to 17.8 lb. per hourly horse-power; and with the same boiler equipment, an increase in cruising range from 4700 to 7600 miles at 12-knot speed, or in maximum speed from 20.5 to 21.2 knots.

Meeting of the American Association of Electric Motor Manufacturers.

The semi-annual meeting of the American Association of Electric Motor Manufacturers was held at Planters Hotel, St. Louis, Mo., Nov. 15-18. The reports of committees on standard motor speeds, standard pulleys and standard motor dimensions were received, and the committees reappointed to complete their work. These committees are working in conjunction with committees from the National Machine Tool Builders' Association. The American Association of Electric Motor Manufacturers also has a committee working in conjunction with a committee from the National Electric Light Association, for the purpose of making a tabulation of motor data and applications, which will be published jointly in an edition on "Power." When this is published it will be the most reliable tabulation extant. The committee on standard motor speeds has been working assiduously for over a year, and, although much work has been accomplished, it was not possible to take definite and final action on this important subject.

On Nov. 16 a theater party attended the Century Theater, and on Nov. 17 the delegates visited the plants of the Century Electric Company, the Emerson Electric Manufacturing Company and the Wagner Electric Manufacturing Company, after which luncheon was served in the Glen Echo Country Club. In the afternoon golf and shooting tournaments were held, and a banquet was given at the Planters Hotel on the evening of Nov. 17.

The next meeting of the association will be held at Hot Springs, Va., in May, 1910, and the exact date will be chosen so as not to conflict with other conventions which will be held at that time. The officers of the association are: President, Mr. S. L. Nicholson, Pittsburgh; vice-presidents, Messrs. C. W. Holtzer, Brookline, Mass.; J. C. Hobart, Cincinnati, Ohio; J. W. Ham, Schenectady; the secretary-treasurer is Mr. W. H. Tapley, Engineering Societies Building, New York City.

Philadelphia Electrical Show.

The electrical show to be held in Philadelphia beginning Feb. 14, 1910, is the first exhibition of the kind given there, and its probable success is indicated by the fact that almost one-half of the available space has already been engaged. One of the features of the show will be the provision of special nights in the interest of various electrotechnical and commercial organizations, engineers, central-station men and other classes interested in electricity from a commercial or technical standpoint. Many novel features and exhibits are being planned, and arrangements for an exceptionally artistic scheme of decorations and illumination are being completed. One of the objects of the exhibition is to encourage the use of electric vehicles throughout this territory, and there will be a large showing of both commercial and pleasure cars.

Convention of the National District Heating Association.

The first annual convention of the National District Heating Association was held in Columbus, Ohio, on Nov. 10 and 11. The convention was called to order by the president of the association, Mr. A. C. Rogers, to whom is due the credit for its organization. Mr. Rogers took as the subject of his presidential address "The Objects of the Association, Past, Present

and Future." He stated that in Ohio there are about 50 district steam-heating companies that are in reality auxiliaries to electric lighting companies belonging to the Ohio Electric Light Association. A few of these companies formed the temporary organization which developed into the National District Heating Association. He said that there are about 500 district heating companies in the United States, the larger number of them being in the States of New York, Pennsylvania, Ohio, Indiana, Michigan and Illinois.

Mr. H. W. Hillman remarked that the association will be heartily supported by many electrical engineers and solicitors of electrical generating companies. He called attention to curve-drawing steam meters that are now being developed. These instruments will be of immense value to district steam-heating companies.

A paper entitled "The Venturi Meter and Its Use in Power Plants" was presented by Mr. C. G. Richardson. The author discussed the discovery by Venturi in 1797 of the sucking action of fluids in motion through a contracted section of pipe, and the application of this principle by Herschel in 1886. Various types of the Venturi meter were then described from the smallest up to one 17 ft. in diameter capable of measuring more than 1,000,000,000 gal. per day. He predicted that the Venturi meter will be recognized as the universal meter for indicating the velocity of anything that flows in pipes.

In reply to a question by Professor Knight, Mr. Richardson said that the evaporation of water into steam introduces a slight error when a Venturi meter is used with hot water.

In a paper by Professor Knight, entitled "Deterioration in Underground Heating Mains," much data were given relative to the exact deterioration of a certain heating system where use was made of steel pipe laid in wooden conduit and surrounded with oil-treated shavings. Examination made five years after the pipes had been installed indicated a yearly depreciation varying from 1.82 per cent for a 12-in. pipe to 4.70 per cent for a 1.5-in. pipe. The life of the conduits was placed at values ranging from 30 years for the 12-in. to 16 years for the 15-in. conduit.

Mr. Harding claimed that unless the velocity of water in the pipes is at least 3 ft. per second there will be a sediment from decayed vegetable matter that will corrode the bottom of the pipes. Deterioration depends to a great extent also on the character of soil in which the pipes are laid.

Mr. Gifford expressed the opinion that of all soils clay is the best in which to lay heating mains. Sand and cinders are disadvantageous probably by reason of this porosity. Oil-treated shavings offer excellent protection for iron pipes.

Mr. W. E. Taylor read a paper on "Thermostats and Thermostatic Action," in which the three standard systems of heat control were outlined. In one system use is made of a strip of brass and steel welded together, the curvature of the strip depending upon the temperature. In another system use is made of a liquid which evaporates and operates a valve by its expansion. In the third system advantage is taken of the expansion of air in a cylinder to move a piston connected to a valve. Mr. Taylor said that the saving in coal when automatic heat control is employed amounts to from 30 to 35 per cent of the coal used when the control is manual.

The subject of air leakage around windows was treated in a paper by Mr. Harold McGeorge. Test data were given to show that from 12 to 15 per cent can be saved by using weather strips around windows. Moreover, when strips are used, the calculations of the steam required for heating a building can be made with a high degree of accuracy.

Mr. A. C. Rogers expressed the belief that the leakage is essential for changing the air in a room in houses where no other provision has been made for ventilation.

Mr. H. W. Hillman stated that from his own experience he had found that when a house is provided with proper weather strips it can be heated with electricity at 1 cent per hp-hour at a price to compete with coal.

Mr. Sawhill cited a case where weather strips had made almost 50 per cent difference in the costs of heating two identical houses in the same locality.

In response to an invitation from the president, Secretary Gaskell, of the Ohio Electric Lighting Association, discussed the methods that should be employed for improving the interest in the National District Heating Association, and increasing the membership.

A paper entitled "Advantages to Electric Companies of Central-Station Steam Heating" was read by Mr. Kline, of the American District Steam Company, Lockport, N. Y. A paper on heating and ventilation was read by Mr. Woodward.

Mr. A. C. Rogers, Toledo, was re-elected president of the association. The secretary is Mr. William Wolls, Columbus, Ohio. The next convention will be held at Toledo, Ohio, in May, 1910.

Meeting of the Empire State Association.

The fifth annual meeting of the Empire State Gas and Electric Association was held at the United Engineering Societies Building, New York, on Nov. 17 and 18. The meeting was called to order at 2 p. m. on Nov. 17 by Mr. R. M. Searle, of Rochester, vice-president, who, in the absence of the president, Mr. William T. Morris and of Mr. M. J. Brayton, also a vice-president, presided at all of the sessions.

Reports of various officers and committees were presented at the opening session. Mr. C. H. B. Chapin, the secretary, reported an increase of six active and three associate members in the year. The report of the treasurer, Mr. T. O. Horton, who resigned on account of ill health, was read by Mr. Chapin. It showed that all dues for the year had been paid.

The report of the accounting committee was presented as a tentative report by Mr. E. C. Scobell, of Rochester, the chairman. It referred to the classifications of accounts adopted on Dec. 18, 1908, by the Public Service Commissions of both the First and Second Districts, for gas and electric corporations under their jurisdiction. While the companies of the State were divided into four classes according to their gross income, the committee endeavored to have the most condensed classification still further reduced for the smaller companies, but without success. The Public Service Commissions have, however, signified their willingness to give every aid in their power to the smaller companies in their difficulties.

Shortly after the orders of Dec. 18 were issued, inquiries began to be received at the office of the association, chiefly from the smaller companies, as to where they could obtain the forms necessary for use in keeping the classification prescribed. Investigation showed that a very large number of the smaller companies were in no way prepared to undertake any such elaborate scheme of accounting as that required, and, in fact, it was found that many of them are at the present time keeping merely a record of their receipts and disbursements, or, in other words, keeping their books according to single-entry method.

As the demand for forms continued, the accounting committee felt that it would be advisable in preparing the report for the annual meeting, to submit a simple set of forms, and also to explain not only the forms themselves, but the method in which they should be kept. It was also felt that a simple explanation of double-entry bookkeeping would be found of value to small companies. Such an explanation is incorporated in the report.

The committee held a large number of meetings, devised and discussed several different schemes, conferred with the Public Service Commission at Albany and finally adopted the plan of assigning to each member of the committee a subject or department of the business on which to prepare a paper that would meet with the approval of the committee as a whole. The committee has also recommended for use in general offices forms and methods of accounting that have been selected from various schemes suggested and discussed, and feels confident that the recommendations are thoroughly practical and can be followed by the majority of the smaller companies of the State to their ultimate great benefit.

The papers and forms recommended have been approved by the Public Service Commission. The statisticians of both commissions have received inquiries as to the interpretation of portions of the accounting order. Some of these questions, with the tentative answers given, are printed as an appendix to the report. The committee expressed its thanks to the commissions for permission to publish these questions and answers and its appreciation of the very courteous treatment it received from the commissions and their representatives, and also extended to Mr. Chapin, the secretary of the association, unqualified thanks and appreciation for his painstaking efforts in helping with this work.

The report is signed by Messrs. Scobell, the chairman; A. S. Cook, G. W. Curran, F. L. Dame and T. W. Summers.

At an ensuing session it was decided by the association to receive the tentative report of the committee and make it available for distribution. It is understood that copies of the report and the forms, which have been prepared full size, may be purchased at the office of the association. The report is divided into various sections, the first of which gives comments on the capital accounts prescribed by the commissions. Other subjects which are taken up are general office accounting and bookkeeping and commercial department, storeroom and job order accounting and payroll accounting.

A list of the forms as recommended follows: Form A, cash book; B, journal; C, general ledger; D, accounts payable voucher; E, check voucher; F, voucher record; G, expense and improvement ledger; H, transfer voucher; I, trial balance and summary sheet; J1 service order—gas; J2, service order—electric; K1, meter application—gas; K2, prepayment meter application—gas; K3, meter application—electric; L1, set and remove meter order—gas; L2, set and remove meter order—electric; M1, meter set report—gas; M2, meter set report—electric; N1, meter record—electric—book; N2, meter record—electric—card; N3, meter record—gas; O, meter set and removed report—gas and electric; P, meter reading sheets—gas and electric; Q1, consumers' ledger—bound, gas; Q2, consumers' ledger—bound, electric; R1, consumers' ledger—loose-leaf, gas; R2, consumers' ledger—loose-leaf, electric; S1, bill forms—gas; S2 bill forms—gas; S3, bill forms—electric; T, sales order and storeroom requisition—gas and electric; U, merchandise sales book; V, miscellaneous accounts receivable ledger; W, storeroom requisition; X, stock sheet; Y, job cost sheet; Y1, cost sheet and storeroom requisition; Z, daily time slip; Z1, payroll books.

Mr. Searle made a verbal report as chairman of the committee on sectional arrangements. The plan is to have three or four sectional meetings annually in the State. It is believed that by careful selection of the localities for the meetings many small companies that cannot afford to send representatives to New York City will be reached. The idea is to have an informal discussion of one subject at each meeting of this character. The committee will plan to hold the meetings during the coming year.

The report of the committee on insurance was devoted to liability insurance. It was presented by Mr. R. A. Davidson, the chairman, and recommended that if a number of companies would act together they could secure lower rates.

Mr. T. R. Beal, of Poughkeepsie, presented, as chairman of the committee on taxation, a report giving a digest of new laws on this subject passed at the last session of the Legislature and a number of decisions rendered by the courts during the last year.

At the electrical session which followed Mr. P. T. Glidden, vice-president and general manager, Binghamton Light, Heat & Power Company, read a paper on "An Electrical Show in a Community of 45,000." Mr. Glidden described a show which followed the decision last spring that some plan other than newspaper advertising must be devised to enlighten and instruct the general public as to the various uses of electricity in the home. The co-operation of the leading firms of decorators, furniture dealers, plumbers, furnishers, fixture dealers, etc., was invited and each of these bore part of the expense. A large hall on the ninth floor of an office building was rented and a model eight-room apartment built. In addition to this, in two rooms connecting with the hall, there were a demonstration booth and a showroom. In the booth two expert demonstrators showed practical cooking by electricity.

In the showroom all kinds of current-consuming devices that could be used in the home were exhibited. The show was planned to remain two weeks. The attendance increased daily to such an extent that at the end of that time it was decided to continue for two weeks more with a complete change in decorations and electrical effects. In the four weeks very close to 25,000 people attended the show. The firm that made the exhibit of furniture sold $2,000 worth at the exhibition and the decorators did even better than this. The cost of the show to the company was about $900 and it could be produced again for about one-half this amount. A permanent show of this nature has been installed in a town of about 8000 with the assistance of the local merchants.

An abstract of the paper by Mr. C. G. Durfee, chief of the meter department, Rochester Railway & Light Company, on "Electric Meter Testing," will be given in a later issue.

The paper of Mr. C. H. B. Chapin, on "Electric Light and Power Development in New York State," was next on the program. From September, 1907, to April, 1909, according to the *McGraw Electrical Directory*, the number of central-station companies in New York State increased from 318 to 358, and investigation showed that almost all of the new properties operated in communities of from 1000 to 5000 population. Of the total number of companies 275 supplied either single communities or groups of communities having less than 5000 population. About 200 of the companies supplied communities of less than 2000 inhabitants. The report of the Public Service Commission for the year ended June 30, 1907, indicated that a large number of the small companies showed a deficit each year. The real reason for the increase in the number of plants, notwithstanding the financial results indicated, seemed to be ignorance of the results of other undertakings of a similar character combined with pressure from the residents of the community or from a promoter who was looking out for merely his own interests. The reports required by the Public Service Commission may be of value in giving greater publicity to the facts and thus preventing the increase in the number of small companies, which, by their failure to become successful commercial enterprises, had kept the industry from attaining the standing it should properly have with the investing public. At the same time, the demand for service must be met and if the number of small plants was not to be increased some other means must be suggested to meet the situation. The solution of the question seemed to be the combination of a large number of small properties into one and the supply of service to all of the communities from some central point at which a large generating station can be located. There should also be a willingness on the part of the large combined properties to extend into new territory and thus meet the increasing demand for service. The entire State of New York could easily be covered by 20 to 25 plants having a distributing radius of 50 miles each. While it would not be possible to cover the territory under existing conditions as economically as if no companies were operating at the present time, the figures gave some idea, Mr. Chapin said, of the enormous economic waste which the large number of properties now operating must necessarily entail. It was difficult for the managers of large or even moderate-size companies to appreciate the difficulties attending the operation of properties in communities of 5000 or less. Many letters had been received from small companies in reference to accounting subjects, and some of these gave statistics to show that it was impossible to employ expert accountants or even to expend any considerable amount of money on books and forms.

The morning session on Nov. 18 was devoted to the gas section. At a luncheon at the Engineers Club, which followed this session, 48 were present.

At the concluding session in the afternoon the election of

officers resulted as follows: President, Mr. Charles R. Huntley, president Buffalo General Electric Company; vice-presidents, Mr. M. J. Brayton, secretary Utica Gas & Electric Company, and Mr. R. M. Searle, vice-president Rochester Railway & Light Company; treasurer, Mr. G. W. Curran, comptroller, Syracuse Lighting Company; secretary, Mr. C. H. B. Chapin. Mr. L. C. Purdy, Orange County Lighting Company, was elected a member of the executive committee to fill the unexpired term of Mr. T. O. Horton. A telegram expressing the regret of the association at the ill-health of Mr. Horton was sent to him.

Convention of Alabama Light and Traction Association.

The second annual convention of the Alabama Light and Traction Association was held in Birmingham on Nov. 15 and 16. On the afternoon of Monday, Nov. 15, a paper was presented by Mr. C. C. Henderson entitled "'Some of the Worries and Duties of a Central-Station Manager in a Small Town" and one by Mr. C. D. Armstrong entitled "Public Service Possibilities."

On Tuesday morning a paper, the object of which was to instruct the teacher, having the title "School for the Manager," was read by Mr. T. K. Jackson. "A Visible Side of Accounting" was the title of a paper by Mr. G. S. Emery. In the afternoon Mr. C. M. Cory discussed the corporation tax law and Prof. E. E. F. Creighton delivered a lecture on lightning arresters.

The entertainment features included a theater party on Monday evening, followed by visits to electric lighting plants; a luncheon at the Southern Club on Tuesday given by the officers of the Birmingham Railway, Light & Power Company.

The following officers were elected for one year: President, Mr. J. Howard Wilson; vice-president, Mr. R. L. Rand; secretary-treasurer, Mr. Lloyd Lyon, of Mobile; directors, Messrs. L. J. Davis, R. J. Chambers, A. H. Ford, R. L. Ellis and A. M. Cranford. The next meeting will be held at Anniston.

The Boston Electric Show.

The first annual electrical show to be held in Boston was opened to the public in Mechanics Building, Huntington Avenue, on Monday evening, Nov. 15, to continue until Nov. 25.

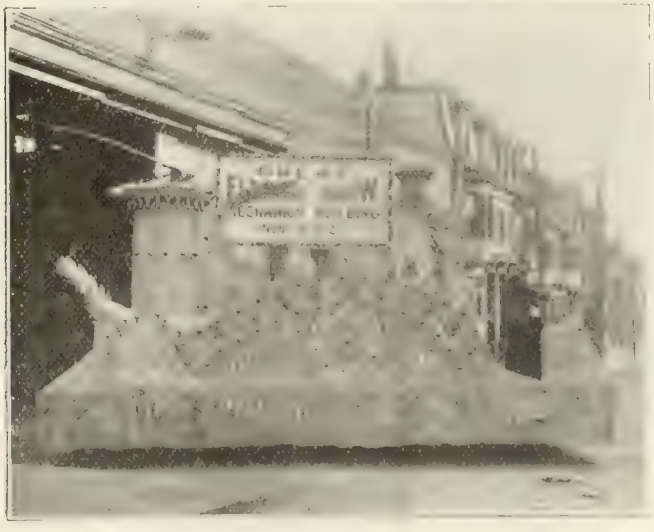


FIG. 1.—ONE OF SIX FLOATS RUN OVER BOSTON ELEVATED RAILWAY'S SYSTEM.

The show, which is the first of its kind ever held in the New England States, is fostered by the leading electrical interests of Boston with the object of exhibiting to the public the latest applications of interest to consumers stimulating the rapidly growing demand for electrical service of all kinds. Manufacturers and public-service corporations have combined their efforts to produce an exhibition of high quality rather than one of mere magnitude, and the artistic character of the decorations and illumination and the representative nature of the apparatus displayed render the show second in interest to none that has been given in the country in recent years.



FIG. 2.—ENTRANCE TO EDISON COMPANY'S BOOTH.

The decorations of the exhibit hall combine to produce a form and color scheme of much beauty. The entire show has been laid out in the form of an Italian garden dotted with natural and artificial flowers and foliage interspersed with white columns and balustrades, which form the exhibition spaces. Pillars of staff surmounted by clusters of translucent lighting bulbs serve to mark the aisles, and festoons of tungsten and carbon incandescent lamps with various prismatic shades furnish local lighting of the booths. Potted plants and flowers soften the harder outlines of the balustrades, and the exhibit floors are covered with grass matting to harmonize with the staff structures. The roof of the hall is concealed by three sweeping folds of light-blue cheesecloth extending from side to side, and the woodwork of the balconies is covered with red-striped awning interspersed with potted greenery. The general lighting of the hall is effected by 10 chandeliers equipped with clear and translucent-bulb lamps in green and white, and by 20 festoons of frosted incandescent lamps carried across the arena in arches between the chandeliers. There are also two rows of frosted incandescent lamps carried longitudinally along the balconies above the main floor and at the rear of the seats.

The entire stage and an extension into the main hall are occupied by the Edison Electric Illuminating Company of Boston, and the company's exhibit is the central feature of the show. A beautiful replica of an Italian garden has been constructed according to the plans of Architect Campbell, of the Atlantic Decorating Company, of Boston. The woodwork of the garden is in pure white, while overhead is a characteristic trellis draped with artificial verdure and tinted incandescent lamps, with clusters in the form of bunches of grapes and festoons of colored bulbs hung in chains from post to post. At the rear a temporary switchboard has been installed to permit flooding the garden with soft shades of light representing gradations from dawn to moonlight. The front of the garden is built in the form of a terrace with a trellised summer house at each side and a passageway bordered with potted plants and small nested incandescent lamps inserted in the interstices of the foliage. The two outer summer houses are specially set apart for visi-

tors of the company residing in Boston proper, and the balance of the garden, with colored electric fountains in the center, is devoted to reception tables for the company's customers and friends in the rest of the 33 municipalities which make up its present territory of over 500 sq. miles. The visitor from each town is welcomed by a young woman from his municipality dressed in Italian costume, and registration facilities are provided at each table. The municipality having the largest number of registrations per day receives each day from the company a substantial sum of money for charity. In the afternoon tea electrically steeped is served by the young women to all visitors, and there are daily concerts on the garden floor by a troupe of Italian singers and instrumentalists engaged by the company for the show. At these concerts moonlight effects and other attractive spectacular features are introduced. Each adult visitor on registering is given a handsomely prepared and illustrated booklet describing his home city or town, the series forming a most valuable library descriptive of suburban Boston. A printed technical description of the present Edison system is also available. At the rear of the garden the company has established quarters for its officials in attendance upon the show, with telephone service and writing facilities. Over the main entrance to the garden, which is reached by a short flight of stairs, the words "Edison Light" are emblazoned in incandescent letters. The company is also distributing badges for encouraging the growth of its territory, and practically the entire sales department is in attendance, either in the afternoon or evening of each day. A bulletin board placed on the side of the garden shows the number of visitors registered each day, the amount of new business secured by the company daily, and the special days and nights assigned to the different towns and departments. In the company's office at the show flag and sign decorations are in evidence with photographs of the L Street station, maps showing the growth of the underground and general system in recent years, special desk and general office lighting.

A complete list of the exhibits is given on another page.

Proposed Change in Baltimore Electrical Regulation.

A subcommittee of the Charter Commission, recently appointed in Baltimore, Md., has recommended the abolition of the City Electrical Commission. This is in line with other recommendations which the committee will make with a view that all of the engineering departments of the city shall be placed under the direction of the Board of Estimates. The suggested creation of a public service commission for Baltimore has thus far not received much support from the public, and the object of the Charter Commission is thought to be to invest some board that has already been created with the same authority that the Utilities Commission is clothed with in other cities.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission has issued a decision modifying the method of imposing a minimum monthly charge per meter, as petitioned by various customers of the Edison Electric Illuminating Company of Boston. The board says in part:

"The company has made a minimum charge of $1 per month per meter to all customers who have not signed a yearly lighting agreement. The petitioners were disposed to concede that some minimum charge was not unreasonable, but they claimed that it should approximate as nearly as possible the actual expense of maintaining a meter upon a customer's premises, and that the charge in question is excessive and should be greatly reduced or abolished.

"Wherever a meter rent or a service charge is imposed it appears to be as much for the express purpose of raising a definite revenue as the price per kw-hour for electricity consumed. On the other hand, the facts show that as a revenue producer, the minimum monthly charge is almost a negligible factor. In the fiscal year 1908 the receipts of the company from these minimum charges were about $20,000 as compared with a total revenue of over $4,000,000. In October, 1908, 4572 customers paid the minimum charge, of whom 576 used no energy and the others consumed in all 18,208 kw-hours, or an average of 4.36 kw hours per customer.

"From the experience of its department heads and computations from its books the company contended that the annual expense of maintaining a meter for a customer paying a minimum monthly charge was as follows:

Interest and depreciation	$2.79
Testing and repairs	.77
Reading	.42
Depreciation and loss of lamps per meter	.32
Accounting and billing per customer	2.44
Postage	.36
Stationery	.15
	$7.25

"To this the company added a charge for about 40 kw-hours consumed in every meter installed, independently of whether or not energy is used by the customer. As a matter of fact, however, the charge of $1 was first imposed by the company several years ago, and was then fixed arbitrarily and with little or no attempt to base it upon the expense actually incurred.

"The contention of the company, that whatever may be said as to the matter of expense, the real and important purpose of this charge is to prevent the accumulation of dead investment, is, however, entitled to serious consideration. There can be little question that it has this effect. Such a charge tends to discourage those who expect to be only slight users of electricity from seeking a connection with the company's lines and to induce those who, being so connected are not actual users, to discontinue the service. At the same time the company is bound to supply even small and occasional users of electricity and must not be permitted to evade this duty by imposing a minimum charge unreasonable and prohibitive in amount.

"On examination of the petitioners' accounts it was found that out of 16 who were customers during the whole of the year ending June 30, 1909, only five had used less than $12 worth of electricity at the established price of 12 cents per kw-hour. While there is no legislation with respect to a charge of this character for a supply of electricity, it is provided with respect to gas (Revised Laws, Ch. 58, Sec. 12) that 'no charge for the use of a meter during any portion of 12 consecutive months shall be made if the consumer during said time uses gas to the value of $7.' This provision seems to indicate clearly the legislative approval of a reasonable minimum charge for a public-lighting company's service. It has been in force for more than 20 years with no serious demand for its revision or repeal by either the public or the companies. The reasons for permitting such a charge in the case of gas companies have even greater force in the field of electricity supply.

"For these reasons the board recommends that, if the company shall continue to impose a minimum monthly charge upon its customers who pay the prevailing maximum net price, such charge shall not exceed $1 per month per meter; and that, if on any thirtieth day of June it shall appear that a customer has, by reason of said charge, paid or become liable to pay during the year immediately preceding an amount exceeding the minimum monthly charge multiplied by the number of months in which he has been a customer and an average price for electricity supplied by meter exceeding the prevailing maximum net price per kw-hour, the company shall refund all such excess; provided, however, that nothing in this recommendation shall be construed to require the company to render its service at an average charge per month less than the minimum monthly charge or at an average price per kw-hour less than the prevailing maximum net rate. The board further recommends that, whenever any person entitled to the refunding above described shall cease to be a customer of the company, such refunding shall be made imemdiately instead of upon the thirtieth day of June following."

Canadian Hydroelectric Commission News.

A conference was held in Toronto, on Nov. 15, of the accountants of the different Ontario municipalities who have agreed to take electric power from the Hydroelectric Commission. The meeting was held with a view to determine a standard system of accounting to be followed, and a committee was appointed to prepare the system using the form of report adopted by the Ontario Railway & Municipal Board as a basis. When the report of the committee is prepared it will be submitted to the different municipalities interested. The meeting was presided over by Mr. W. S. Andrews, who is engaged on a similar accounting work for the Hydroelectric Commission.

Counsel for the town of Port Arthur has served notice of appeal from the decision of Justice Clute granting the injunction restraining the town from entering into a contract with the Hydroelectric Commission for power. Meantime the power company has asked the Council to take into consideration an offer for delivery of power by his company, and a public meeting has been called for discussion. The Council, however, is preparing a new by-law for submission to the people for the adoption of hydroelectric power in case the injunction against the town is sustained by the Court of Appeals, and it is intended to invite Hon. Adam Beck, chairman of the commission, to speak at Port Arthur should the question be again put to a vote of the people.

A meeting was held in Toronto on Nov. 17 of the engineers of the various municipalities who are to take power from the commission. The system proposed to be adopted in Toronto for rates for domestic lighting did not meet with approval, and the members present decided to recommend that instead of charging for each room and also so much per kw-hour, the rate be based on the floor space of the house with an additional charge of a certain sum per kw-hour. It was pointed out that a large house might have fewer rooms than a small house, and thus the rich man would have an advantage over the poor. It is likely the Toronto electrical department will reconsider its proposed residential charges, as it is intended that the same system of charging shall apply to all the municipalities using cheap power, although the charges will vary according to local demand and consumption.

The meeting also reported in favor of the adoption of a luminous arc lamp in the business districts and the tungsten incandescent lamp in the streets of the residential districts. The lamps in the residential districts should, it was decided, be placed from 125 ft. to 150 ft. apart, so as to avoid any interference from trees.

An action was begun in the non-jury court, on Nov. 16, by Walter D. Beardmore, asking that the act giving the city of Toronto power to sell and distribute electric energy be declared *ultra vires*, and that the contract be declared illegal, since it is inconsistent with the by-law of last January naming $18.10 per horse-power per annum as a maximum figure. Mr. Beardmore asks an injunction restraining the city from entering into the business of distributing electric power. During the hearing of argument by counsel it was brought out that the city had already spent in cash and contracts executed for plant and equipment a sum of $313,000. Judgment was reserved by Chancellor Boyd.

On Nov. 17 a deputation, consisting of the Mayor and several aldermen from the city of Hamilton, waited on the commission to endeavor to obtain some further concessions for the city prior to Hamilton entering into a contract for cheap power. Hamilton wants the contract amended so that while taking 1000 hp from the Hydroelectric Commission they may be at liberty to take any further supply from the Cataract Power Company, thus giving that city the benefit of competition between the company and the commission while all the other 12 municipalities have agreed to take power exclusively from the commission.

The decision of the Hydroelectric Commission was contained in a letter from Hon. Adam Beck, chairman, to the Mayor of Hamilton, stating that the commission would not grant any better terms to Hamilton than those accorded to the other municipalities which have banded together to take cheap power, other than the possibility of extending beyond Dec. 31, 1910, the time when the city may decide to go in with the other municipalities and take power exclusively from the commission. The chairman in his letter states that while Hamilton is in a different position from the other places on account of its present contract with the Cataract company for street lighting at a low figure, he maintains that this advantage was secured to the city directly through the action of the other municipalities in joining together and applying to the Hydroelectric Commission for a supply of power.

New York Public Service Commission News.

The preparations for subway building in New York City are progressing rapidly toward a point where something tangible is about to be accomplished. The Public Service Commission sent to the Board of Estimate and Apportionment last week a requisition for $13,039,381, the amount of money needed to complete the contracts already let for work in Brooklyn, the board having only appropriated $2,850,000 at its former adoption of the contracts. At the same time the commission wrote a letter in which it expressed the opinion that it was inexpedient to appoint condemnation commissioners at this time for the Fourth Avenue route, because a suit known as the Joralemon case, fixing the status of the city with regard to the streets of Brooklyn, has not yet been decided by the Court of Appeals. Preliminaries for the actual work are actively under way and engineers of the commission are busy laying out the route of the tube.

The Public Service Commission is said to be maturing plans for the extension of the present Brooklyn subway from Flatbush Avenue and Fourth Avenue down to Sheepshead Bay. It is proposed that a major portion of this route will be on an elevated structure and it will traverse a section now poorly supplied with transportation facilities.

During the past year the Public Service Commission has received many complaints in regard to the insufficient lighting of trains on the Interborough-Rapid Transit, especially in the subway. It is claimed that only 10-cp lamps are used in the subway. The commission has ordered a hearing on the subject for Nov. 29, at which time the whole question of train lighting will be taken up.

Theodore P. Shonts, president of the Interborough Company, has had several conferences with Chairman Willcox, of the Public Service Commission, concerning the subway situation and it is now understood that the Interborough will be ready to bid on any future building of rapid transit lines in Manhattan or the Bronx.

The South Shore Traction Company has paid to the city $70,000 and obtained its franchise to operate cars from the Queensboro Bridge to Jamaica, a distance of about 18 miles. The company is now running cars across the bridge. When its line is completed it promises to carry passengers from Jamaica to the Manhattan side of the bridge for 5 cents. This is the rate that the New York & Queens County Railroad charges.

At the hearing on the question of heating cars, before Commissioner Eustis, of the First District, on Nov. 16, E. C. Connette, traction engineer of the commission, testified that since the previous hearing he had made tests to show the difference in the heating apparatus required in wooden and in metal cars. He estimated that metal cars would need about 23 per cent greater capacity to secure the same amount of heat. He also said that his investigations showed the majority of cars were equipped now with only about one-half the necessary capacity of heaters. When it came to discussing the definite question of temperature it was practically agreed that a minimum of 45 deg. Fahr. should be maintained when the outside temperature was 15 deg. or more above zero and 40 deg. when the outside temperature was less. No order has as yet been issued by the commission to this effect, but the representatives of the

traction companies were assured that sufficient time would be given the companies to equip their cars with additional heaters. The hearing on the subject was closed.

The Public Service Commission of the Second District has given its permission and approval to the Buffalo, Lockport & Rochester Railway Company to exercise the franchises granted it by the village of Middleport, Niagara County, on Oct. 25, 1909. The approval is upon the condition that prior to the construction of its transmission line pursuant to the terms of the franchise the railway company shall submit to the commission plans and specifications for such construction, and that no construction be made until such plans and specifications are approved. The commission has also approved of the contract between the Niagara, Lockport & Ontario Power Company and the Buffalo, Lockport & Rochester Railway Company leasing and granting to the Niagara, Lockport & Ontario Power Company the right and privilege of using the excess capacity of the transmission line of the Buffalo, Lockport & Rochester Railway Company for the purpose of transmitting and selling power to persons, corporations and firms other than the railway company in the locality traversed by said transmission line.

The Northern Westchester Lighting Company, of Ossining, has been authorized to issue $124,000 5 per cent gold bonds maturing June 1, 1950. The bonds are to be sold at not less than 90 per cent of their par value. The capital to be secured by the sale of the bonds is to be used to discharge indebtedness of the company incurred in making certain additions and betterments to its plant and distributing system.

CURRENT NEWS AND NOTES.

ELECTRIC LAMPS IN GASOLINE GARAGES.—The city of Denver has adopted an ordinance requiring all electric lamps installed in gasoline garages to be enclosed in vapor-proof globes.

N. E. L. A. COMPANY SECTIONS.—The organization of N. E. L. A. Sections at Buffalo and Toronto has been completed. The president of the former is Mr. Roscoe McMillan, and of the latter Mr. J. J. Wright.

SAN FRANCISCO ELECTRICAL SHOW.—An electrical exhibition will be held from Jan. 29 to Feb. 5 in the Coliseum, San Francisco. Of a total floor space of 40,000 sq. ft., 26,000 have already been engaged. Mr. E. M. Scribner is chairman of the committee in charge.

ROTARY CONDENSERS.—In our issue for Nov. 4 in an article entitled "Effect of Rotary Condensers on Power Factor," it was incorrectly stated that the average demand on the substations of the National Acme Manufacturing Company was 300 kw, the average demand being, in fact, about 500 kw.

MEETING OF THE A. I. E. E.—The next meeting of the American Institute of Electrical Engineers will be held Dec. 16, on the third Thursday instead of the second Friday of the month. A paper, entitled "Comments on Development and Operation of Hydroelectric Plants," will be presented by Mr. Henry L. Doherty.

NEW CHICAGO SUBURBAN ELECTRIC RAILWAY.—Mr. Eugene Purtelle, president of the Chicago Heights & Eastern Electric Railroad Company, has applied to the Board of Commissioners of Cook County, Ill., for a franchise for an electric railway from Chicago Heights east to the Indiana-Illinois State line, the route to be adjacent to the Elgin, Joliet & Eastern steam railroad.

N. E. L. A. SECTION MEMBERSHIP.—The November Bulletin of the Brooklyn Edison Section of the National Electric Light Association contains the following analysis of the membership of the section, which numbers 289: electrical construction, 56; operation, 49; distribution, 45; inspection, 37; sales, 25; purchasing, 22; fiscal, 22; engineering, 11; engineers of distribution, 9; auditing, 5; advertising, 2; executive, 2; general superintendent, 1; general, 1.

COLUMBIA ENGINEERING LECTURES.—Mr. Robert T. Lozier gave a lecture before the Electrical Engineering Society of Columbia University on Friday evening, Nov. 19, on the "Commercial Phases of Engineering." On Dec. 10 Mr. J. W. Lieb, Jr., associate general manager of the New York Edison Company, will lecture to the Electrical Engineering Society on the subject of "Electric Lighting." All the alumni of Columbia University, as well as others, are invited to be present. The lecture will be held in the Engineering Building, Columbia University, at 8:15 p. m.

BALTIMORE A. I. E. E. SECTION.—The Baltimore Section of the American Institute of Electrical Engineers held a meeting last Friday evening, Nov. 19, in the Physical Laboratory of the Johns Hopkins University, at which a paper was read on "The Relation of Synchronous Apparatus to Power Factor Adjustment," by Mr. L. F. Deming, district engineer of the General Electric Company. The reading of the paper was followed by a general discussion in which lively interest was shown. The committee on papers and meetings has arranged a program of papers to be presented during the next six months. A committee on sociability was also appointed to provide opportunities for social intercourse among the members of this section.

PERILS OF THE TELEGRAPHER.—The current issue of *Everybody's Magazine* contains an article entitled "Heroes of the Telegraph Key," which should serve to attract to the telegrapher's calling youths whose inclinations have been toward the career of a pirate of the Spanish main or a scout of the bloody trail. The writer apparently exhausted the dictionary in his search for lurid words, and the tale has the movement of a Bowery drama, to the patrons of which it should strongly appeal. The following is an extract somewhat less hysterical in tone than the article in general, and relates to a fire which occured over a room in which telegraphers were working: "In a corner of the room stood the dynamos that generated the current unleashed in dots and dashes through wires crisscrossing the earth. Water on these, and they, too, would have been short-circuited and the terrific voltage necessary to hurl the current throughout the system would have been shot through the bodies of the men. With a roar, out of each key would have sizzled a white-hot flame, and like the snapping of fingers the 800 would have been flashed into eternity as if they had been strapped in so many executioners' chairs."

MUNICIPAL EFFICIENCY.—A municipal efficiency commission, appointed by Mayor Busse, of Chicago, earlier in the year, has made its report. Various recommendations are made for the improvement of the municipal service. One of these is that the police patrolmen be required to do a greater amount of routine inspection in relation to sidewalks, pavements, hydrants, sprinkling, street lights, building construction, sanitary conditions, danger to persons and property from overhanging signs, etc., speeding vehicles and the smoke nuisance. It is proposed that the patrolmen make daily reports on these subjects on blanks provided. The police reports will greatly enlarge the city's general inspection service. All departments will have valuable first-hand sources of information, to be followed by technical departmental inspection. For instance, public-service companies will be required to exhibit permits for street opening and the policemen will also report street lights out of service, broken lamp-posts, etc. The commission is composed mainly of city officials, but Mr. B. E. Sunny, president of the Chicago Telephone Company, and Mr. Charles G. Dawes, interested in several public-utility companies outside of Chicago, are also members.

OHIO ELECTRIC LIGHT ASSOCIATION.—The executive committee of the Ohio Electric Light Association will early in January fix the place for the next meeting of the Ohio Electric Light Association. The choice will probably lie between Cleveland and Cedar Point.

DEMAND FOR TECHNICAL GRADUATES.—The demand for this year's graduates from the Massachusetts Institute of Technology was much greater than could be met. Of the 61 receiving degrees as mechanical engineers, each man had the choice of at least two positions; and the summer school of mining engineering had to be abandoned because of the imperative demand for mining engineers.

STREET-LIGHTING TROUBLES IN WAUKEGAN, ILL.—As a result of the action of the voters of Waukegan, Ill., in defeating a $55,000 bond-issue proposition the Mayor of that city, it is reported, has directed that all street lights be put out of commission. The North Shore Electric Company does this lighting, and it has agreed not to turn off the lights at present. It will continue the service and take its chance of collecting its pay.

DROUGHT AFFECTING WATER-POWERS.—Drought conditions throughout the country are already causing some alarm among water-power companies, and unless copious rains come soon many industries depending upon water-power will be forced to suspend. In Sussex County, N. J., only one electric light company among all those in the county depending upon water-power has thus far held out from resorting to steam. This is the Branchville Electric Light Company, which is run by water drawn from Culver Lake.

CHICAGO JOINT ENGINEERING MEETING.—The next joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers will be held at the rooms of the former in the Monadnock Building on Dec. 17. The speaker of the evening will be Mr. R. H. Rice, assistant division engineer of the Board of Supervising Engineers, Chicago Traction, whose subject will be "Low-Tension Street-Railway Feeder Systems." These joint meetings in Chicago are proving very successful and will no doubt be continued throughout the winter.

CHANGING 100,000 TELEPHONE ADDRESSES.—The new system of street numbering adopted by the city of Chicago and effective Sept. 1, 1909, has made a great deal of work for the telephone company. There are over 200,000 addresses in the Chicago telephone directory, and more than half of these were changed by renumbering. In order to issue the fall edition of the directory without delay, the work of changing the addresses was done under great pressure. It will be remarkable if no errors are found in the new directory, and the Chicago Telephone Company requests that it be notified in writing of any discrepancy that may be discovered.

ELECTRICAL GROWTH IN MEMPHIS.—According to records kept by the city officials, the year 1909 promises to be a record-breaker in the amount of electrical construction in Memphis, Tenn. During the year 1908 2861 permits were issued for electrical work in Memphis, and judging by the number so far recorded, the total for 1909 will run to 3000 or over. Probably by the end of the year electrical work to the amount of nearly $1,000,000 will be under way in Memphis. It is also noticeable that the demand is for a better class of electrical work than ever before. A number of large buildings have been wired during the year, and there has been a decided increase in the number of electric elevators installed in buildings.

CHICAGO ELECTRICAL SHOW.—Prospects for the fifth annual Chicago Electrical Show to be held in the Coliseum on Jan. 15 to 29, 1910, appear to be bright. It is said that little effort will be required to fill all the available space in the large building with exhibits, and that 30 per cent more exhibitors have signed applications for space for the 1910 show than had signed for the 1909 show at the corresponding time last year. An entirely new scheme of decorations is being prepared, and so far as can be judged, the exhibition will be attractive and successful. The electric-vehicle people appear to be manifesting more interest than in previous shows, and there will be undoubtedly a number of exhibits of electric automobiles and auxiliaries.

PITTSBURGH A. I. E. E. MEETING.—At the regular meeting of the Pittsburgh A. I. E. E. Branch, on Nov. 9, papers were presented by Mr. H. N. Muller, electrical engineer of the Allegheny County Light Company, on "Applications of Concrete to Central-Station Systems"; by Mr. F. W. Scheidenhelm, consulting construction engineer, on the "Uses of Reinforced Concrete in Railway and Power-House Work," and by Mr. Stephen Q. Hayes, engineer with the Westinghouse Electric & Manufacturing Company, on "Concrete Construction in European Power Plants." The papers were discussed by Messrs. W. M. Kinney, of the Universal Cement Company, and Mr. B. P. Rowe, of the Westinghouse Electric & Manufacturing Company.

A BOY'S FATAL DARING.—The necessity of teaching children, particularly boys, the danger of touching any electric wires was again illustrated by the recent death of a boy named Gustave Nash in Chicago. The boy was 12 years old, and was the leader in the familiar boys' game known as "follow the leader." To accomplish an extra-hazardous feat, he climbed an electric-light pole and when near the top lost his balance and, to save himself from falling, seized with both hands a wire carrying electricity. The boy fell to the ground heavily and struck on his head and died in a hospital two days later. The moral of such incidents as these is obvious: Instill in the minds of children such a wholesome respect for electric wires that they will keep away from them.

A REMINDER OF THE "COLD MOTOR."—A receiver's notice in relation to the claims against the Bidwell Electric Company, an insolvent corporation, brings to mind the litigation growing out of the exploitation of the notorious Benson "cold motor," as a result of which the Bidwells, father and son, received penitentiary sentences for operating a confidence game. The receiver gives notice to all persons having claims against the Bidwell Electric Company to present them in writing to the Circuit Court of Cook County, Ill., on or before Nov. 29. Claims must also be filed with Mr. H. R. Kent, 134 Monroe Street, Chicago, who is the ancillary receiver. Not only creditors but stockholders are notified, and stockholders are further informed that their claims must be limited to the actual amount of money they have paid for their shares of stock.

LIGHTNING ON THE ISTHMUS OF PANAMA.—Accidents due to lightning are rather numerous on the Isthmus of Panama, and a committee of engineers has been appointed to consider the practicability of installing lightning arresters on telephone and electric light lines. During the last three summers over a dozen men have been struck by lightning and killed or injured. The division engineer of the Central Division, Department of Sanitation, Isthmian Canal Commission, expresses the belief that some of the men who died might have been saved had there been present at the time persons familiar with the proper means of resuscitating human beings injured by lightning. There seems to be a general opinion among the canal employees that there is no use in attempting to do anything for a man injured by lightning except to take him to the nearest hospital. Rules for resuscitation of persons struck by lightning have now been printed in English, French and Spanish and posted at conspicuous places along the line of the canal.

Central-Station System of the Easton Gas & Electric Company.

EASTON, Pa., has a population of 35,000. The city is situated at the forks of the Lehigh and Delaware Rivers and is in the center of a thickly settled section with a population of 60,000 comprising the city of Phillipsburg, N. J., which is on the opposite side of the Delaware River and the former borough of South Easton across the Lehigh River from the city proper. Closely adjacent is the center of the cement industry of the United States and also one of the greatest slate-producing regions of the country. The city is rich in pole lines, for it possesses two telephone companies, two telegraph companies and three electric light companies, and all the circuits are overhead. The public lighting in the city of Easton is looked after by the municipality, there being 325 Westinghouse magnetite arc lamps fed from a municipal plant equipped with four Western Electric arc machines rewound for the 4-amp lamps; but the city is not a competitor for commercial or private lighting.

The two electric light companies operating in Easton besides the municipal plant are the Easton Gas & Electric Company and the Eastern Pennsylvania Power Company. The latter company has acquired the steam generator plant of the People's Consolidated Service Corporation of Easton. This company has a station on Dock Street and the Lehigh River in which 700 kw in direct-current machinery and 100 kw in alternating-current machinery is installed. The station is operated non-condensing and the exhaust steam is sold for heating purposes. At present the station is being enlarged by the addition of a 750-kw Curtis turbine set and the necessary boiler equipment.

The Easton Gas & Electric Company is the largest operating company in Easton and has two electric stations. The electrical department is a consolidation of the Edison Illuminating Company and the Easton Power Company. From the Edison Company it acquired the steam plant on Ferry Street, and from the Easton Power Company the water-power plant in South Easton. At the time, the Ferry Street plant was equipped with the usual multitude of high-speed simple and compound engines, belted to Edison bi-polar generators for 110-220 volt lighting circuits, and a 550-volt generator for street railway work. The water-power plant at South Easton was equipped with three McCormick turbines belted to alternating-current generators.

When the present company assumed control neither of these plants was in a satisfactory condition, both as regards capacity and economy. Two years were spent in experimenting with gas engines and producers, and although the fuel economy of the gas-engine plant was good, the installation was in other respects a failure. It was then decided to have one generating plant by adding to the water-power station in South Easton a steam-turbine equipment, and to convert the Ferry Street station into a substation. Accordingly, in 1905, two 500-kw Curtis turbines, with boilers, condensers, etc., were installed, and two years later this equipment was doubled and the entire hydraulic plant at South Easton rebuilt. Last year step-up transformers were added to the station equipment in South Easton, and transmission lines built to the old Moravian city of Nazareth and to Butztown. Two 1100-volt, three-phase lines run from the generating station to the latter cities, which are about eight miles away. At Nazareth the voltage is stepped down to 2300 volts, two-phase, to supply the electric load through the local electric light company's station, and at Butztown a synchronous converter is installed for feeding the railway.

The South Easton generating station is located on a strip of land between the Lehigh Coal & Navigation Company's canal

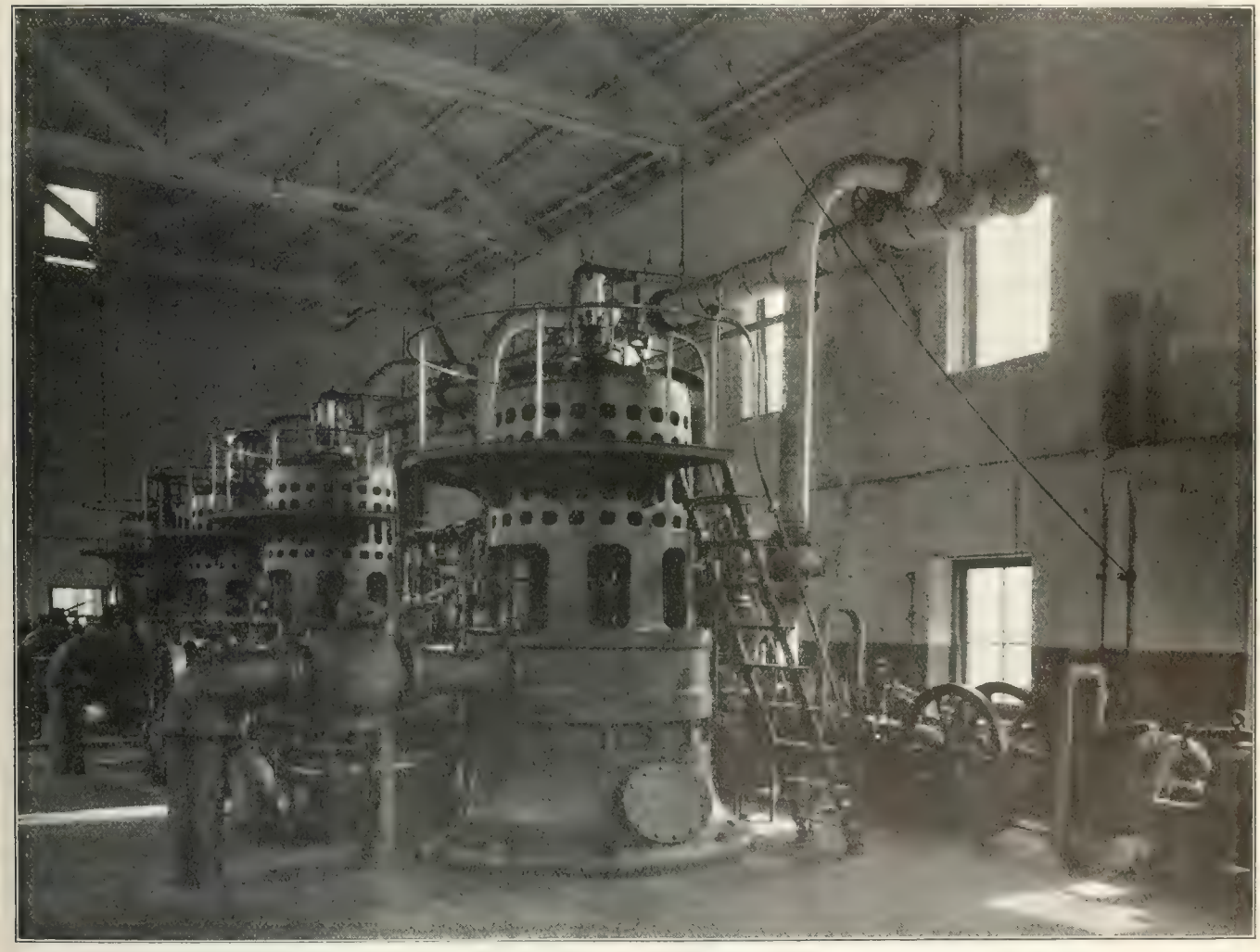


FIG. 1.—GENERAL VIEW OF STEAM-TURBINE ROOM IN EASTON GAS & ELECTRIC COMPANY'S STATION.

and the Lehigh River. The present hydraulic equipment comprises two double-runner, 48-in. Smith horizontal water turbines, direct-connected to two 500-kw General Electric, 2400-volt, two-phase, 60-cycle, revolving-field alternators, and one 24-in. McCormick turbine belted to a 120-kw Westinghouse alternator of the same characteristics as the other units. The turbines are connected to the forebay in the Lehigh Coal & Navigation Company's canal by 11-ft. steel penstocks 150 ft. long. The wheels are controlled by Lombard governors, but, owing to the difficulty experienced from time to time with water, the steam turbine units are permitted to do the governing. The plant operates under a head of about 20 ft., the tail race emptying into the Lehigh River, and the distance between the forebay and the tailrace at the site being about 200 ft.

The steam portion of the station consists of four 500-kw, two-phase, 60-cycle, 2400-volt Curtis turbo-generator sets, equipped with oil step bearings and hydraulic valve gear. Steam for these units is supplied from four 400-hp B. & W. boilers, fitted with superheaters and Treadkill shaking grates. Buckwheat coal for the plant is received in canal boats on the Lehigh Coal & Navigation Company's canal. A clam-shell bucket and a Hunt automatic railroad are used in unloading the boats, and the fuel is dumped in a storage yard capable of holding about 10,000 tons. During the navigation season the coal runs by gravity from the yard to a bucket elevator, which delivers it to an overhead tank, whence it is discharged into charging cars through chutes. These cars pass over scales and are weighed on their way to the boilers. The latter, needless to state, are hand fired directly from the charging cars. Two 7-ft. A. B. C. fans furnish forced draft for the furnaces. The ash pits have inclined bottoms, so that the ashes are discharged by gravity into ash cars in the basement, which are dumped on the land back of the plant. Up to the present time contractors have hauled the ashes away as fast as they have been deposited without cost to the company. Feed water is pumped from a tank connected to the hot well by two outside center-packed Fairbanks-Morse pumps, controlled by Vigilant feed-water heaters.

The steam turbines are equipped with Alberger counter-flow surface condensers, with automatic hot wells and two-stage, dry-vacuum pumps. Because of the peculiar location of the plant circulating pumps are not required, the cooling water be-

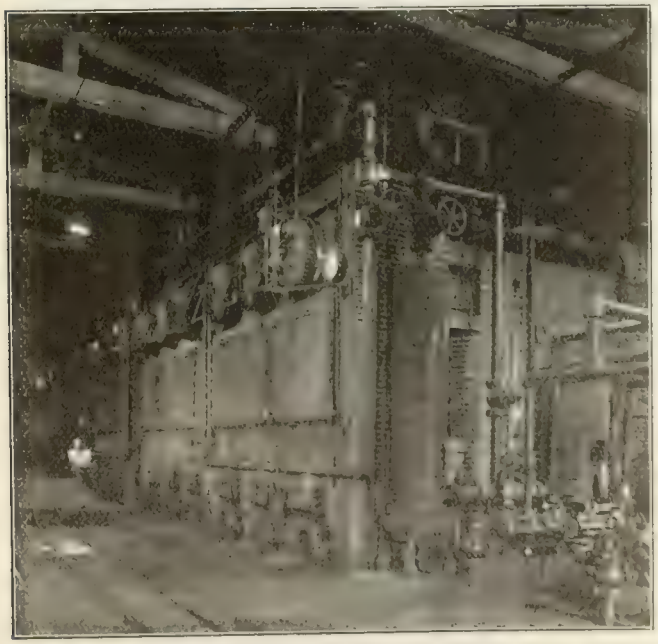


FIG. 2.—BOILER ROOM EQUIPMENT.

ing siphoned from the canal through the condenser to the Lehigh River. Jacket water for the vacuum pump is obtained in the same way. Make-up water is added to the condenser by means of a by-pass between the steam and water chambers, which also serves to keep the siphon free from air. In the condenser arrangement the water from the canal enters at one end and at the top of the condenser, and is discharged at the bottom of the opposite end. The steam enters at the bottom, and the dry vacuum pump connection is made at the top, so that the air removed by the pump is dry and cool. The auxiliaries, including the dry-vacuum pumps, hot-well pumps, step-bearing pumps, boiler-feed pumps and blower engines are steam driven,



FIG. 3.—MOTOR-GENERATOR EXCITER UNITS.

and their exhaust is passed through a closed feed-water heater. The exciter equipment comprises two 40-kw, motor-driven machines, controlled by a Tirrill regulator, and a 35-kw steam-turbine set, which is used as a reserve or to start the plant in case of a complete shut-down. The hydraulic and the steam-driven generators are run in parallel at all times.

Eight sets of feeders leave the generating station at South Easton. The territory immediately surrounding the station is fed through three two-phase lines. There are triplicate sets of feeders running to the Ferry Street station, where motor-generator sets convert the energy into direct current for the Edison and railway services. There is about 200-kw in Edison machines in the Ferry Street station, and the railway load carried is approximately 700 kw. A Gould storage battery with booster is used to even up the load on the railway circuits. The territory for the most part is served by a system of alternating-current distribution, the three-wire, direct-current system only covering the lower part of the town, and serving an area of about five blocks long by four blocks wide. Phillipsburg and the borough of South Easton are served wholly by alternating current, which is transmitted at 2200 volts, two-phase, 60-cycle. The company has the public lighting contract in the city of Phillipsburg, which calls for 135 6.6 amp, alternating-current, series-arc lamp.

In October, 1908, the Easton Gas & Turbine Company passed under the control of the Doherty Operating Company. A new business department was immediately formed under the supervision of Mr. D. M. Coughlin, who was formerly associated with the Denver Gas & Electric Company, and a corps of 10 men, each expert in his particular line, is maintained. The campaign conducted during the past year has been almost wholly devoted to fuel gas appliances, although some time has been given to the electrical development to advantage. As showing what has been accomplished in this direction, it might be stated that during the past year a trifle less than 2000 kw has been added to the connected motor load. A large portion of this business has been obtained in silk mills, of which there are quite a number in Easton. Mr. Roy A. MacGregor, the power specialist, has given his time to developing as high a load factor as possible with the opportunities of business at hand. One very desirable feature which has been added consists of 200 kw in motors connected to pumps, which run between the hours of 10 p. m. and 7 a. m., and serve to fill up, to some extent, the midnight valley of the load curve. There is more of this business to be had around Easton, which will be acquired shortly. Since the Doherty interests have taken control, the station has

increased its output 45 per cent over the same period last year. The load factor at the present season is between 60 and 70 per cent.

Up to this time the spectacular electric lighting end of the business has received no great amount of attention, owing to the

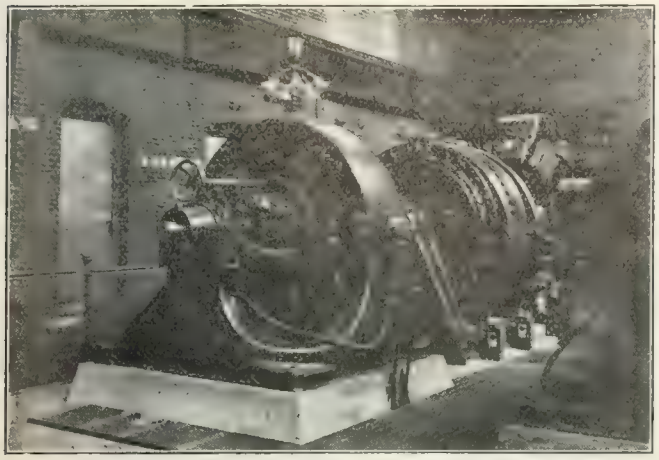


FIG. 4.—SUBSTATION EQUIPMENT IN FERRY STREET PLANT.

fact that the acquisition of an outline sign and decorative lighting load has been seriously handicapped by a restricting sign ordinance, and owing to the opportunities for the development of the gas end of the business nearly all of the energies of the new-business department have been exerted in this field. The increased electrical load has been acquired wholly by personal solicitation, and in no case has it been found necessary to loan equipment or to place motors on trial. All motors have been sold outright, and thus far are giving excellent satisfaction, which is borne out by a series of testimonials and photographs on file in the Easton office. The energy base rate for lamp circuits is 7 cents, subject to varying discounts, and the base rate for motor circuits is 5¾ cents.

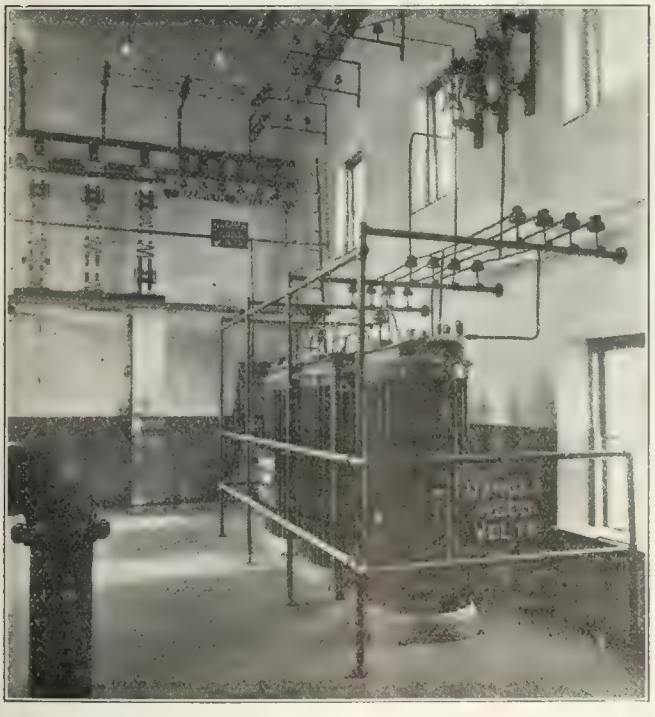


FIG. 5.—STEP-UP TRANSFORMERS FOR NAZARETH AND BETHLEHEM LINES.

The company operates two immense signs in Easton, one over the old office on Center Square, 25 ft. by 20 ft., and containing some 600 lamps. A flasher is installed in connection with the sign. First a goddess appears in white frosting, then a flash of green forked lightning shoots from her hand and the word "Easton" appears; successive strokes of lightning throw out two additional lines: "Gas & Electric Company" and "Come In," followed by a red border. A big slogan sign erected on the roof of the company's storehouse on the river front, and facing all of the railroads coming into Easton, was presented to the



FIG. 6.—SWITCHBOARD IN MAIN STATION.

city by the company about a year ago. The sign measures 54 ft. x 45 ft., and contains 2000 lamps. The slogan reads, "Easton, City of Resources," and the sign has a rising sun effect and double arrows. First the arrows shoot out from the center, and then a red sun, shading off in the rays to a pale pink, appears, and as the words come the sun dies out, leaving the slogan burning. Mr. B. F. Cresson is general manager of the company, and Mr. E. L. Franklin is superintendent of the electrical department.

On the first of the month the company moved its offices to the old post-office room in the Seip Building, adjacent to its old office in Center Square. The office measures 37 x 117 ft., and extends from the Square to Church Street. Two large display windows front on the Square, and afford ample room for exhibiting appliances for home use. The front half of the office is fitted up as a sales display room, and a partition in Mission effect, studded with leaded glass, separates the sales-

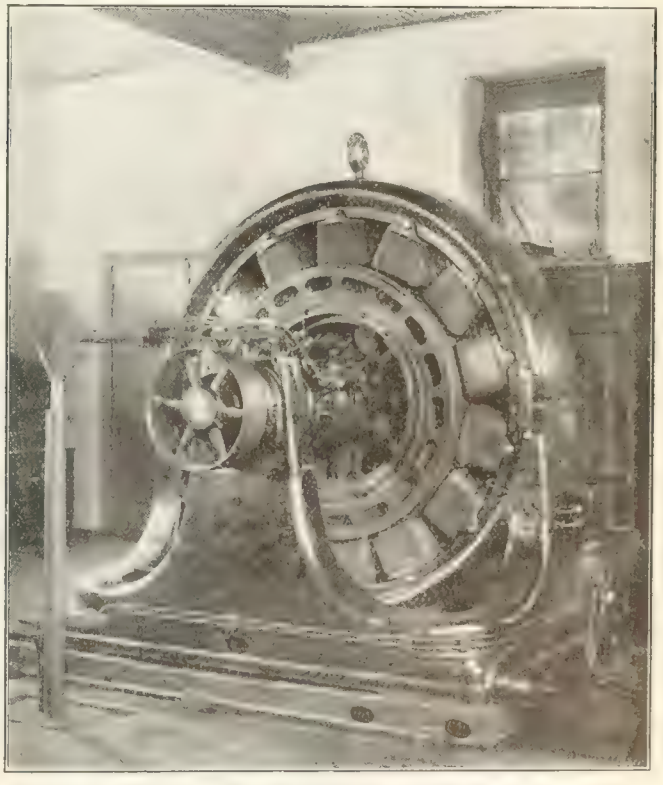


FIG. 7.—VIEW OF 120 KW UNIT DRIVEN BY WATERWHEEL

room from the executive offices. A feature of the general office is a dark room fitted up for displaying gas and electric fixtures. On the first of the month invitations to the opening were extended to the public through the daily papers, and the crowds that responded were a revelation to the company. Its new offices are among the handsomest in Pennsylvania.

Location of Faults in Underground Cables.

By William A. Durgin.

With the increasing use of high-potential underground circuits for energy transmission in large cities and the multiplication of substations and the consequent complication of the cables in duct lines and manholes, the need has been felt of a test method by which any given cable can be identified throughout its length. Disasters to the system, and even fatalities, have resulted from wrong identifications which, unfortunately, can never be entirely eliminated by the most careful system of records and drawings.

Such a test method must evidently consist of some form of signal which can be sent over the cable from one terminus with sufficient strength to affect a receiving apparatus held on or near the sheath at any point. Various combinations have been suggested from time to time in connection with schemes for fault location, the signal-sending devices ranging from a series-arc generator, as described in Mr. Henry G. Stott's paper, page 829, Volume 18, A. I. E. E. *Proceedings*, to an electrolytic interrupter, and the receivers from an ordinary compass to some form of exploring coil, with or without iron core, in combination with a telephone receiver. However, all these methods depend on detecting the variation in the magnetic field of a pulsating or interrupted current, and all are subject to serious interference from sheath ground currents which either produce erratic phantom signals or a marked diminution in the sensitiveness of the receiver. In all, too, the sending device is limited in capacity to currents of a few amperes, so that under the best conditions the signal is extremely weak.

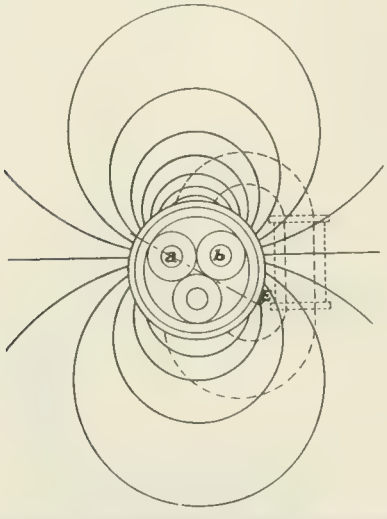


FIG. 1.—MAGNETIC EQUIPOTENTIAL LINES FROM TWO-CONDUCTOR SIGNALING LOOP IN PLANE PERPENDICULAR TO CABLE AXIS.

As in general the cable to be identified will be the only one available for testing purposes between the given termini, the complete signaling circuit must consist of some combination of the conductors or of the conductors and sheath of this cable connected together at one end. Earth, of course, may be used for one side of the circuit, but as the sheath is grounded at many points, "earth" and sheath are practically identical. Investigation of the m.m.fs. resulting from these various available signaling circuits has led to the design of an exploring coil, to be used with a telephone receiver, which entirely eliminates the effect of sheath ground currents—a result completely verified by experiment. For illustration of the method employed, a three-conductor, No. 2-0, 20,000-volt cable will be considered. Each conductor is insulated with 9/32 in. of paper and all three are then enclosed in a 6/32-in. paper belt and a ⅛-in. lead sheath is applied; these relative dimensions are shown in Fig. 1. Of the eight possible signaling loops in this cable, three only need be investigated: (I) that consisting of two conductors—that is, a circuit out over one phase and back over another; (II) that consisting of two conductors in parallel, in series with the other conductor, and (III) that consisting of one conductor and the sheath.

The magnetic equipotential lines in a plane at right angles to the axis of the cable resulting from a direct current over the two-conductor loop are shown in Fig. 1, where *a* and *b* are the current-carrying wires. This is the well-known distribution with opposite currents in two parallel wires and is chiefly of interest here as indicating the correct form of core for a transverse explorer to be used with this circuit as shown by the dotted lines. The magnetic potential at the surface of the sheath beginning at the point *E* and passing around the circumference in anticlockwise rotation is shown in curve *I*, of Fig. 2, an arbitrary unit of potential being used, as relative values only are of importance. Working from this curve it will be noted that an explorer core to connect points of maximum difference of potential must have a span of 180 deg., while the face at the positive maximum must be narrower than is allowable at the negative maximum in order that these faces may short-circuit minimum differences of potential; this interpretation, of course, agrees with that of Fig. 1. However, such an explorer, although much more efficient than any of the forms previously used, is considerably affected by sheath ground-currents. For, since the sheath is strictly equivalent to a conductor at the axis of the cable in producing a magnetic field, the equipotential lines of the ground currents are radial to the cable or the lines of force are circles concentric with the sheath. Many of these lines of force thread the coil of the explorer and, in practice, the composite sheath current produces such loud noises in the receiver that the signal is heard with difficulty.

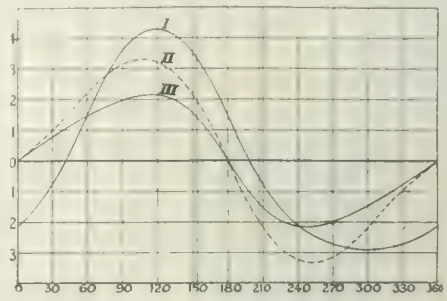


FIG. 2.—DISTRIBUTION OF MAGNETIC POTENTIAL ALONG SHEATH WITH SIGNALING LOOP OF (I) TWO CONDUCTORS, (II) THREE CONDUCTORS AND (III) ONE CONDUCTOR AND SHEATH.

Fortunately, however, cable manufacturers have found it necessary to spiral the conductors, the length of "lay" or of one complete turn of the spiral in the cable under discussion being 20 in. Furthermore, this dimension is approximately the same in all high-voltage three-conductor "power" cables. That is, the field about the entire cable may be represented by the surfaces obtained by moving Fig. 1 along the cable, simultaneously revolving it about the cable axis at the rate of one complete turn for each 20 in. of advance or, passing along a line drawn from the point *E* on the sheath parallel to the axis, the potential again varies according to curve *I* of Fig. 2, the length of lay in an axial plane being equivalent to 360 deg. in a plane at right angles to the axis. If the magnetic equipotential curves in such an axial plane are plotted, the distribution shown in Fig. 3 is ob-

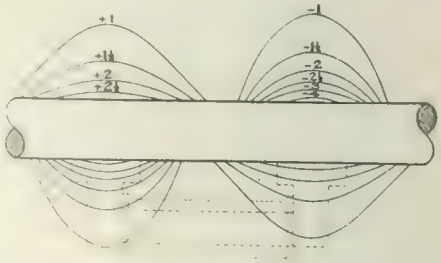


FIG. 3.—MAGNETIC EQUIPOTENTIAL LINES FROM TWO-CONDUCTOR SIGNALING LOOP IN AXIAL PLANE.

tained, and it is at once apparent that an explorer of the form indicated by dotted lines will be as effective in receiving signals as that of Fig. 1, except in so far as the length of air-path for the flux is increased. This new form of explorer, however, has the magnetic circuit at right angles to the sheath ground-current lines of force and consequently is entirely unaffected by them. Fig. 4 shows the explorer as actually constructed, the core having a length over all of 11 in., or slightly more than one-



FIG. 4.—LONGITUDINAL EXPLORER.

half the length of lay. Used in conjunction with a double telephone receiver of about 2000 ohms resistance and a signaling current of 30 amp, a signal of sufficient intensity to be unpleasant to sensitive ears is obtained when the explorer is on the sheath. Consequently, the signal is still loud and unmistakable when the explorer is held about ¾ in. from the sheath or outside the duct tile, every trace of ground current noise being readily eliminated by slightly adjusting the position of the explorer.

The two-conductor circuit considered above is the best loop connection available, not only because it affords the greatest difference of magnetic potential for any given current, but also because the points of maximum and minimum potential are spaced at equal intervals along the sheath, and, with an explorer length equal to one-half that of the lay, points of maximum sound occur twice in each 20 in. Using the loop consisting of two conductors in parallel, in series with the third conductor, the distribution of magnetic potential is as shown in curve *II* of Fig. 2. The greatest difference of magnetic potential is nearly 92 per cent of that obtained with the two-conductor loop, but the maximum and minimum points are spaced alternately 40 per cent and 60 per cent of the lay apart, so that an explorer designed for either interval will be ineffective at the other, and points of maximum sound with either explorer occur consequently only once in 20 in. With the "one-conductor and sheath" loop the maximum difference of potential is reduced as shown in curve *III*, Fig. 2, to 60 per cent of that available with curve *I*, and the maximum and minimum points are spaced alternately 35 per cent and 65 per cent of the lay apart.



FIG. 5.—CARBON-BREAK INTERRUPTER.

It is necessary to use this last circuit at times, however, and it will be considered again below.

To interrupt the signaling currents of from 1 amp to 40 amp there has been developed a motor-driven carbon-break "flasher" (Fig. 5), which makes and breaks about 70 times per minute and gives a signal resembling the ticking of a clock. The time of break is shortened to about 0.015 second by the use of a combination of the magnetic and fan blow-out, the cooling action of the fan also serving to increase greatly the life of the carbons. Using ⅝-in. carbons the device will run for five hours or interrupt 40 amp at 120 volts 20,000 times without readjustment. This interval is sufficient for the identification of a 20-mile line throughout its length, and eliminates the uncertain interpretation of receiver silence incident to the use of any form of interrupter which may fail during the test. By the use then of the new form of explorer, together with this interrupter, multiple-conductor lead-sheathed cables can be identified with certainty at any point where one side of the duct or sheath is exposed.

The apparatus is also adapted to the location of certain classes of faults in these cables. When the faulted conductor is burned open the Murray loop method, or any of the various modifications used for fault-location tests, are inapplicable and in most such cases the "cut-and-try" method has been used. This method is, of course, generally very expensive and slow, 8 or 10 cuts being sometimes required before the trouble can be located between successive manholes. However, if the conductor is grounded through a sufficiently good path to allow an interrupted current of 8 amp or 10 amp to flow for some time, the explorer method can be applied to locate the point at which the signal stops—that is, the fault which forms the end of the signaling loop. This loop consists of one conductor and sheath and if all the current returns over the sheath the magnetic potential varies, as shown in curve *III*, Fig. 2. The explorer consequently must have a length of 35 per cent or 65 per cent of the length of lay, the shorter being used on account of the less reluctance.

When, however, the sheath of the injured cable is bonded to

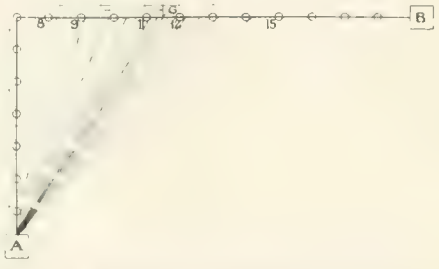


FIG. 6.—FLOW OF SIGNALING CURRENT WITH ONE CONDUCTOR GROUNDED AT "G."

other sheaths to prevent electrolysis, or when the ducts are partially filled with water, the signaling current may spread out over a large sheath network or over the contiguous earth, thereby resulting in a distribution somewhat as shown in Fig. 6. Here the cable connecting the stations *A* and *B* is assumed as broken down at the point *G* between the eleventh and twelfth manholes from *A*. Signaling current is sent from *A* over the conductor, as shown by the long inner arrows, to the fault, where it passes to the sheath and divides, as shown by the outer arrows, a gradually decreasing portion continuing along the sheath toward *B*, while another decreasing portion returns over the sheath toward *A*, all the current eventually reaching *A* over earth paths, as indicated by the dotted lines. Exploring the cable with the old form of coil, a loud signal predominating over sheath ground current noises, will be heard in the first eight manholes. In the ninth, the signal will begin to diminish due to the neutralizing effect of the return current in the sheath, growing weaker in succeeding manholes until at the fifteenth it disappears entirely. No sudden reduction will be observed between the eleventh and twelfth manholes as, if X per cent of the current returns along the sheath toward *A*, $(100 - X)$ per cent of the conductor current is unneutralized and effective in the eleventh manhole in producing approximately concentric lines of force, while in the twelfth manhole nearly $(100 - X)$ per cent of the sheath return current is similarly available. The fault then is located between the eighth and fifteenth manholes.

With the new form of explorer held at right angles to the cable, signals are heard just as outlined above, but when held longitudinally along the cable no signal is obtained in the first

eight manholes, as the longitudinal distribution of flux only holds for a spiraled loop and there is practically only one side of the circuit in this part of the cable. In the ninth, however, a slight return sheath current produces a distinct longitudinal distribution and there is heard a signal which increases with increasing sheath current until in the eleventh manhole it is apparently louder than the transverse signal. In the twelfth and all succeeding manholes, however, the longitudinal position again gives absolute silence and the fault is located with certainty in a single cable length between two successive manholes.

This application has been entirely successful in practice, the only limitation being the occasional difficulty of establishing a good current-carrying ground at the fault. It is sometimes necessary to keep the current within 8 amp to obviate burning off the ground connection, and this limit so reduces the intensity of signal when the explorer is used outside the duct that some skill is required in determining the location. In several cases where two conductors have been open-circuited at the fault it has been possible to fuse them together by means of a high-tension testing set and to use the two-conductor signaling-loop method for location test. In short, although this method does not entirely supplement the Murray loop method, it can be used successfully on "power" cables in a large percentage of the cases heretofore requiring the "cut-and-try" method of location.

The Flicker Photometer.

By Sydney W. Ashe.

THE subject of color photometry has received much consideration of late, the most recent contribution being an editorial in the issue of the *Electrical World* for Nov. 4. In discussing color photometry the flicker photometer is usually suggested as a possible instrument for the purpose, as it is a well-recognized fact that all direct-comparison photometers introduce serious errors. In discussing the direct-comparison methods, the writer always refers to the conclusion* arrived at by Helmholtz, one of the greatest investigators and authorities on physiological optics that the world has ever known, where he states: "I must explain that, personally, I put no confidence in my judgment concerning the equality in luminosity of differently colored surfaces. I admit, however, that of differently colored fields, one can be so much darkened that there remains no doubt that the other is brighter.

Other methods have been suggested besides that involving the use of the flicker photometer, such as the acuity method, for the comparison of differently colored fields. The writer's conclusion in this direction, as a result of many acuity tests, is that they are not sufficiently consistent to be used commercially owing to physiological changes in the individual from day to day, and also to the effects of accommodation and eye fatigue making them unsuitable for commercial testing.

It would seem from a general study of the research work on the subject of color photometry, and from the conclusions of many authorities in reference to this subject, that the only available method is one employing the flicker photometer. It may be that the difficulty with the direct-comparison method lies in the fact that the instant the eye attempts to compare two differently colored fields, the element of fatigue enters the problem, the eye being fatigued more quickly and in greater proportion for one color than for another. It has been shown by Allen, in the *Physical Review* for January, 1909, that it is impossible to fatigue the eye for some colors, such as blue, and also that the amount of fatigue for some other colors, such as yellow, is practically zero. On the other hand, for colors, such as red, the fatigue is quite marked. After an interval of three minutes it is impossible to increase the fatigue of the eye; seemingly there is a saturation point.

Suppose that a red and a blue light are being compared by the direct-comparison method; the red would probably fatigue the eye much more quickly than the blue, which would result in an inability of the eye to compare the two properly. With a flicker photometer the change in fields, say, from red to blue is so rapid that the element of fatigue is undoubtedly eliminated. In the paper previously referred to, the author also noted that the element of flickering for a given intensity of light seemed to be greater for excentric vision. This same phenomenon has been observed by Tufts and many others. In view of the Von Kries theory of rod and cone vision, which has withstood the test of many years, in which color vision appears to be concentrated in effectiveness in proportion to the number of cones, it would seem that for excentric vision the sense of luminosity is greater than for color vision, owing to the absence of the cones. In the early work of Professor Rood, the inventor of the flicker photometer, many experiments were performed to show that the flicker of the flicker photometer was solely a function of brightness. Among these experiments was one in which two differently colored fields were photometered and then superimposed upon each other, the colors being complementary. This color was then photometered with the flicker photometer. The results of this experiment showed that the total luminosity of the resulting color was equal to the sum of the individual luminosities. Professor Rood also held that all individuals were slightly color blind. Dr. Tufts, following up this discovery, obtained by the spectro-flicker photometric method luminosity curves for various individuals, including a few who were badly color-blind. Upon plotting the luminosity curves over one another on the same curve sheet it was noticed that, while the maximum values of the various curves did not coincide, their areas were equal. Each individual seemed to have the same total appreciation of luminosity, but the distribution of appreciation was different.

An interesting experiment has suggested itself to the writer which is now undergoing test, and it is mentioned here so that others may try the same experiment with a view to adding evidence to the proof of the accuracy of the flicker photometer. Upon the two sides of the V of a plaster-of-paris wedge, such as is used in a flicker photometer of the Rood type or a shaped piece of wood, are pasted two colors, a Hering red on one side and a Hering green on the other side, which, to an individual color-blind for these colors, will appear the same. Both colors are illuminated with tungsten lamps of equal candle-power, and the 10 deg. prism of the flicker photometer is set so that it will not rotate. The individual is then requested to make a sitting by the direct-comparison method. As both colors will have slightly different coefficients of reflection, the color-blind person will obtain a balance which will not be midway between the two lights. The position of balance is noted, and the flicker is then placed in operation and a new balance is obtained. The coincidence of this position with the previous setting will lend new evidence to the proof of the accuracy of the flicker photometer. Another test which the writer suggests is to attempt to balance the flicker photometer as ordinarily used, but by looking excentrically, and to compare this setting with the ordinary setting.

In considering the advisability of using the flicker photometer it is well to realize that, while it is not looked upon with favor by some photometrists, it has received the endorsement of many celebrated physicists and psychologists. In discussing a paper in which the flicker photometer had been used as the standard method, attention was called by one of the discussers to the fact that the method was in favor only at Columbia University and in England. Considering that these two places rank among the highest in the world with physicists, the author feels that this criticism of the flicker photometer, instead of being adverse, is decidedly favorable.

The flicker photometer is an instrument which must be used to considerable extent before an individual can obtain the best results with it. It should not be used in photometering some illuminants, such as an alternating-current arc, a Moore tube or a Cooper Hewett tube, where the illuminant possesses an inherent flicker, as this inherent flicker may not only counteract the flicker due to a difference in luminosity, but exceed it.

* Handbuch der Physiologischen Optik, second edition, p. 440

Span Over Black River, Port Huron, Mich.

The Port Huron Light & Power Company, of Port Huron, Mich., under the management of Mr. A. C. Marshall, has recently erected two 130-ft. steel towers to carry the company's wires over Black River. This river divides Port Huron into two approximately equal parts. This new overhead crossing replaces a lot of wornout submarine cables and provides for two additional circuits. These towers and the company's power plant is shown in Fig. 1. Mr. Marshall says that the towers figured out considerably cheaper in first cost than a



130-FT. TOWERS TO CARRY WIRES OVER BLACK RIVER AT PORT HURON.

good modern submarine cable job, and also make a generally more satisfactory crossing owing to the peculiar local conditions of river bottom and frequent dredging. The towers are 130 ft. high; length of span, 400 ft.; number of wires, 12; largest wire, No. 4-0; smallest wire, No. 6; highest voltage circuit, 11,000; lowest voltage circuit, 500; maximum sag, 12 ft. The strain of the 4-0 wires is held with 10-in. General Electric porcelain disk strain insulators, the same as are used on the Grand Rapids-Muskegon 110,000-volt line. A No. 0 copper ground wire or lightning rod has been run up the entire height of the towers, projecting 8 ft. above the top and grounded in the mud of the river bottom.

No-Load Conditions in Self-Excited, Single-Phase, Shunt-Induction Motors.—II.

BY VAL A. FYNN.

IN the section of this article which appeared in the previous issue, an analysis was given of the conditions in the single-phase shunt-induction motor when driven uniformly at the exact synchronous speed. Being now thoroughly at home with the diagram shown in Fig. 6 one can go one step further —that is, assume *the motor to run without being mechanically driven* and proceed with the investigation of the true no-load conditions of an ideal motor of the type indicated in Fig. 1 of the previous issue. It has been stated that such a motor requires no *irrecoverable energy* to run it light at a synchronous speed; in other words, the machine will absorb no energy if time intervals covering one or more complete cycles are considered, but the machine may, and does, instantaneously require *recoverable energy*.

Imagine, to begin with, that the rotor is on open circuit and that Z_1 is connected to the mains; then Z_1 will only take a magnetizing current i_m lagging 90 time-degrees behind P, as shown in Fig. 71, page 1288. The same is also indicated in Fig. 72, where the progress of time is measured from left to right, which means that the *lag* is also in that direction. It is well known that when the magnetic field N_1 is being built up, a certain amount of kinetic energy ($W = \frac{1}{2} L \cdot i_m^2$) is stored, which energy is liberated when the magnetic field is destroyed. When the current is an alternating one, as in this case, then the energy taken from the mains and stored during one quarter-cycle is returned to the mains in the next quarter-cycle, and so on.

This is well illustrated in Fig. 72. When the *acting* force, here P, is in the *same* direction as the current, here i_m, then positive work must be done on the field N_1, energy being stored therein. This happens in the time intervals t_2, t_4 . . . During such times work must be done by the alternator feeding energy to the circuit, and the prime mover must exert a torque and act *as a motor*. When the *acting* force is *of opposite* direction to the current, as in the time intervals t_1, t_3 . . . . . then it is N_1 itself which does work, returning energy to the alternator, causing the latter to *drive* the prime mover. The energy returned is proportional to the product, within the times t_1, t_3 . . . . . of the current i_m and of the counter e.m.f. set up by N_1. No energy is wasted in this ideal case, yet a certain amount of energy must be available and that is transferred from the prime mover by way of the mains to N_1 and back again at double the frequency of the impressed e.m.f. (P).

Another point to note is that although Z_1 is entirely devoid of resistance, yet the magnitude of i_m is distinctly limited. This current cannot increase beyond that value which corresponds to an N_1 of such magnitude as will induce a counter e.m.f. exactly equal to P. If i_m were to increase beyond that point Z_1 would be sending more energy back into the mains than it received from the latter. The phase of i_m is determined by the fact that P must not only equal, but also oppose the counter e.m.f. set up by N_1, and since this back e.m.f. lags 90 time-degrees behind i_m, then P must lead i_m by that amount.

Bearing this in mind, consider the motor when running synchronously with short-circuited rotor as shown in Fig. 1. Since N_1 (which, as has been pointed out before, is equal to $v_1 N_1^0$ in an ideal case) is present as before, then the exchange of energy referred to in connection with Figs. 71 and 72 must continue and the same current i_m will flow through Z_1. Along the axis $b\,b$ of the motor there now exists a field N_3 due to the e.m.f. (e_{r1}) impressed on the rotor winding along that axis, the rotor winding along the axis $b\,b$ thus doing duty as a magnetizing winding. When N_3 is being built up, a certain amount of energy must be stored therein, this energy being afterward liberated.

The diagrams of Figs. 73 and 74 illustrate the requirements of the magnetic field N_3, and are drawn in correct time-phase relation with Figs. 71 and 72, as well as with the following figures, so that all of these may be directly compared, the one with the other. It is seen that energy must be stored in N_3 during the time-intervals t_1, t_3 . . . . and that N_3 liberates energy during the time-intervals t_2, t_4 . . . . The question arises as to the source of and return of this energy for the rotor winding along the axis $b\,b$ is not in inductive relation with Z_1, and no direct transfer of energy can, therefore, take place between the mains and the field winding by way of Z_1.

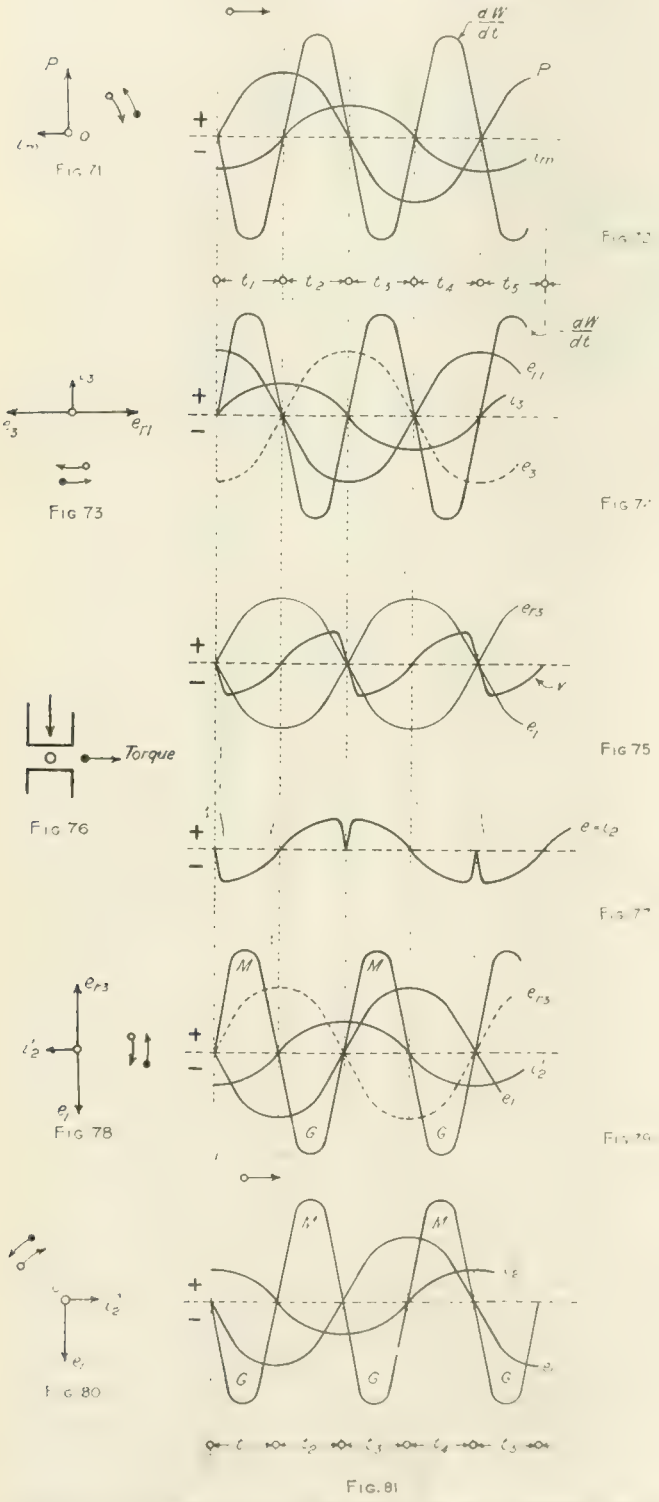
The only possible link between the mains and the field winding is the rotor winding along the axis a. This winding is in a position to receive energy from the mains *inductively* through Z_1 and to transmit this energy to the field winding in the form of *mechanical torque*, or vice versa. Another possibility is an interchange between the kinetic energy stored in the rotor itself ($W = \frac{1}{2} m v^2$) and the kinetic energy of N_3.

It will be appreciated at once that since the rotor will neither receive nor yield kinetic energy without a variation in its velocity, it will never be in a position to supply the whole of the energy required by N_3, nor will it ever be able to absorb all of the energy liberated by N_3 as long as the brushes $a\,a$ are short-circuited. The reason is that as soon as the rotor speed departs ever so little from the synchronous value, the equilibrium between e_1 and e_{r3} must be disturbed, producing a rotor current along the axis $a\,a$, which current must yield a torque in conjunction with N_3 in one direction or another. It is not quite simple to work out this hypothesis, and the author will be very glad indeed if the train of thought by which the result is here reached be carefully checked by others.

Perhaps the quickest way to arrive at a solution is to consider extreme cases. Let, then, the brushes $a\,a$ be left open circuit and imagine the rotor of the ideal motor to be running at synchronous speed; let this rotor have a certain weight and be left to itself after being brought up to synchronism. As soon as the brushes $b\,b$ are short-circuited, and Z_1 is connected to the mains, N_3 will appear along the axis $b\,b$. The whole of

the energy required by N_3 when e_{r1} is in the same direction as i_3 (time t_1, t_3 . . . .) must be supplied by the kinetic energy stored in the rotor and will be returned to the latter in full when i_3 is of opposite direction to e_{r1} (time t_2, t_4 . . .).

A reference to Figs. 30 and 40 will show that during the time-intervals t_1, t_3 . . . , when e_{r1} is of the same direction as i_3, the torque due to $i_3 z_2$ and N_1 is negative, but when i_3 is of opposite direction to e_{r1}, during the time-intervals t_2, t_4 . . . . then it is seen, from Figs. 31 and 44, that the torque between $i_3 z_2$ and N_1 is positive. The number of turns in the windings Z_1, Z_2 are designated throughout by z_1, z_2. In reading the diagrams referred to it should be remembered that i_3 is of the same phase as N_3 and coincides in space with e_{r1}, and that the rule as to the direction of a torque is illustrated in Fig. 76. If e_{r1} and i_3 vary harmonically with time, then the impulses on the rotor will vary likewise and the velocity v of the latter will presumably oscillate harmonically about the synchronous speed with the same frequency as that of e_{r1}. A sine curve leading e_{r1} by 90 time-degrees may then represent the variation of v. The amplitude of v will depend on the mass of the rotor and will be infinitely small if m is infinitely large. No irrecoverable energy being expended, the rotor will continue to rotate indefinitely, but its velocity will not be uniform. If m is zero, the rotor must come to a stop, for it cannot supply the energy required at the time when N_3 is building up.



FIGS. 71 TO 81. TIME PHASE RELATIONS IN SELF-EXCITED, SELF-COMPENSATED, SINGLE-PHASE SHUNT INDUCTION MOTORS.

Consider, now, m to be zero while the brushes $a\,a$ and $b\,b$ are short-circuited and the rotor is running at synchronous speed. Such a rotor will have no kinetic energy stored in it. Since in the time-interval t_1 (Fig. 74) energy is being stored in N_3 it is certain that the rotor speed will drop during that time. This drop in speed will not affect the magnitude of e_1, but will reduce that of e_{r3}, which is proportional to the square of the instantaneous speed, the synchronous being taken as unity. The resultant e.m.f. in the rotor along the axis $a\,a$ will now differ from zero and be of same direction as e_1, thus $e = e_1 - e_{r3}$. The rotor along that axis being devoid of reactance, a current, i_2', proportional to and cophasal with e will result and be of same direction as e_1. Now a current of same direction as e_1 produces, as is known, and as is shown, for instance in Figs, 35, 39, 43 and 47, a torque of such a direction as to accelerate the rotor—that is, a positive torque and i_2' will consequently be in a position to yield the energy momentarily required by N_3, this energy being derived from the mains by way of Z_1. In fact, the product $i_2' \times e_1$ (which represents energy) must at every instant be such as to equal the rate $\frac{dW}{dt}$ at which energy is being stored in N_3 during the time t_1, and which rate is shown in Fig. 74. This relation gives a criterion as to the manner in which the speed must vary about the synchronous during the time t_1; the resulting speed variation is indicated in Fig. 75 on an exaggerated scale. The simultaneous variations of e_1 and e_{r3} are also roughly shown in that figure, but the effect of the speed variation on e_{r3} is not indicated.

During the next interval of time, t_2, energy is being liberated by N_3 at the rate at which it was stored during the time t_1, for i_3 is now of opposite direction to e_{r1} and produces, in conjunction with N_1, a torque in such a direction as to accelerate the rotor. The speed rises, owing to this acceleration, causing e_{r3} to exceed e_1; the resultant e along the rotor axis $a\,a$ now coincides in direction with e_{r3}, and i_2' being cophasal with e is also of the same direction as e_{r3}. However, a current of the same direction as the back e.m.f. e_{r3} produces a negative or retarding torque, for the machine then acts like a generator, returning energy to the mains by way of Z_1. It is in this manner that the energy liberated by N_3 is returned to the mains.

The above process repeats itself in the next half-cycle, and as a result of the velocity v oscillates about that corresponding to the synchronous speed at the rate indicated in Fig. 75, the frequency of these oscillations being double that of e_1 or P. The actual speed n, or the revolutions per second, remain constant.

The resultant e, however, varies somewhat differently. When the speed drops during the time-interval t_3, e_1 exceeds e_{r3}, as was the case within the time t_1, but since e_1 is now positive and not negative, as was the case then, e itself becomes positive. Similarly, e will be negative during the time t_4, whereas it was positive during the time t_2. The actual variation of e and, to a different scale, also that of i_2', is shown in Fig. 77. Of course, i_2' is faithfully reproduced in Z_1, but appears there as being of opposite phase to i_m on account of the transformer relation between the stator and the rotor. The presence of i_2', therefore, reduces the actual current taken by Z_1.

In an ideal motor the necessary variation of v, when $m = 0$ for the rotor, should be infinitely small and it is a question whether it cannot then be said that the current i_2' is equal in magnitude to i_3 and leads e_1 by 90 time-degrees, as indicated in Figs. 78 and 79. A reference to Figs. 30, 43 and 76 will show

that the torque due to $i_2' z_2$ and N_3 is positive during the time-intervals t_1, t_3 . . . . , and Figs. 31, 47 and 76 show that it is negative during the time-intervals t_2, t_4 . . . . . This torque is, therefore, in a position to supply the *recoverable energy required by* N_3.

If such is the case, then we may say that *the recoverable energy required by* N_3 *in an ideal shunt induction motor, the rotor of which is infinitely light, is represented in the primary winding of the machine by a current vector equal in magnitude to the magnetizing current of the motor field and of opposite phase to the magnetizing current of the transformer field.*

If m is not zero, then it would appear that the energy periodically required by N_3 must in general be partly derived from the kinetic energy of the rotor, being restored to the latter in due course, and partly derived from the mains by way of the rotor axis $a\,a$ and the primary winding Z_1, being eventually restored to the mains through the same vehicles. Under these conditions the amplitude of i_2' would be diminished by an amount corresponding to the energy stored or liberated by the rotor during the variations of v. When the kinetic energy stored in the rotor is infinitely large, then i_2' becomes infinitesimal.

In a practical machine $\frac{1}{2} m v^2$ will, as a rule, be great as compared to $\frac{1}{2} L i_3^2$, and the rotor will have ohmic resistance; the variation of v must then be comparatively great in order to produce a current i_2' of appreciable magnitude; it is, therefore, reasonable to suppose that in some cases nearly the whole of the recoverable energy required by N_3 will be supplied by the kinetic energy of the rotor.

The velocity of the rotor of such a machine cannot be constant unless a current i_2'*, equal in magnitude to* i_3 *and leading* e_1 *by 90 time-degrees, is present in the rotor along the axis a a.*

Assuming that $i_3 = i_m$ and that a current $i_2' = i_3$ does exist at no-load in the rotor along the axis $a\,a$, then the primary no-load current of an ideal motor, the rotor velocity of which is constant, will be zero. If this velocity is not constant, then the primary no-load current will increase with increasing amplitude of v, but will never reach the value $i_m + i_3$. It will approach this value more and more as $\frac{1}{2} m v^2$ increases in comparison to $\frac{1}{2} L i_3^2$.

It will be shown in a subsequent article that in the case of a rotor having ohmic resistance, the phase relation of e_1 and e_{r3} is such that the synchronous value of i_3 always tends to be faithfully reflected in the rotor along the axis $a\,a$ by a current which will be referred to as i_2''. The phase position of i_2'' relatively to e_1 is indicated in Figs. 80 and 81. When a current, such as i_2'', is present in the rotor along the axis $a\,a$ then it may be seen by reference to Figs. 30, 43 and 76 that the torque due to $i_2'' z_2$ and N_3 is negative during the time-intervals t_1, t_3 . . . , and Figs, 31, 47 and 76 show that this torque is positive during the time-intervals t_2, t_4 . . . . . It is clear, therefore, that the presence of i_2'', or a component thereof, only intensifies the difficulty of the recoverable energy. The variation of v must now be so much greater, for the presence of a current such as i_2'' along the axis $a\,a$ of the rotor is equivalent to increasing the energy stored or liberated by N_3.

The difficulty connected with this recoverable energy required by the rotor also exists in the case of practical machines. All of the latter run more or less "uneasily," owing no doubt to the periodic variation of the rotor velocity. One notable exception to this rule is the author's artificially compensated motor, as shown in Figs. 2 to 5, inclusive. When this machine is fully compensated, then the conditions illustrated by Figs. 78 and 79 are fulfilled and the recoverable energy is transferred from the mains to the motor field winding and back again, whilst v remains quite constant.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

"Arc Avenue."

Atlanta's "Great White Way," established at the time of the recent automobile show in that city, has been named "Arc Avenue." It begins at the Terminal Station and runs east along Mitchell Street to Whitehall, north along Whitehall to Peachtree and in the same direction to Ellis Street. Marietta Street, from Peachtree to the Grady Monument, is also included in the scheme of illumination. Flaming-arc lamps are used.

Quick Results on Day Service at Montrose, Col.

The Montrose Electric Light & Power Company, of Montrose, Col., operating in a town of 2500 population, began day service June 1, 1909. Sept. 1, 1909, 154 electric irons had been sold and motors aggregating 86 kw were connected. The revenue from the day service averaged $200 per month from the start, which is enough to pay the expenses of the day run. Such quick returns from a day service are most unusual. Mr. C. K. Durbin, of Denver, secretary of the company, states, however, in this connection that the situation was canvassed very thoroughly in advance and as much day load as possible was secured before service was begun.

Free Wiring at Hobart, Okla.

The following figures regarding free wiring done by the Hobart Light & Power Company, of Hobart, Okla., are furnished through the courtesy of Mr. C. K. Durbin, of Denver, secretary of the United States Light & Traction Company, which controls that property. Over a year ago 42 houses were wired free, the houses containing a total of 216 drops or outlets, or an average of five drops per house. A deposit of $1 per drop was required of the consumer, this deposit to be returned at the end of the year. The total cost was $383, an average of $9.21 per consumer and $1.79 per drop, this covering all the cost of the inside work. The cost of running the outside services, which the company would have to stand in any event, was $4.49 per consumer, and the estimated cost of a meter set was $13. This makes an average total cost of $26.70 per consumer. From these 42 consumers the gross revenue the first year was $784, or $18.65 per consumer. The consumption of energy was 4645 kw-hours.

Since these 42 houses were wired, 100 more houses have been wired for consumers who paid cash for the installation, but got credit on their first year's bills up to an amount not exceeding the cost of the wiring. In other words, these consumers were given current free each month until their aggregate bills equaled the cost of the wiring, after which they would pay the regular rates.

Construction Cost Data of a Municipal Lighting Plant.

The following cost data appear in the first annual report of the Fort Wayne, Ind., municipal electric light and power plant as for the year ending Sept. 1, 1909. The report shows that the original cost of the municipal plant was $165,439.93, to which is added $23,937.71 for service lines, making a total of $189,377.64.

The cost of constructing and equipping the plant is itemized in the report as follows:

Plans and supervising engineer	$6,400.00
Building and grounds	15,906.01

Boilers and attachments	$2...470.67
Machinery	11...26.80
Spy Run dam and basin	2,550.70
Chimney	4,7...34
Switchboard, lamps, transformers	29..81.40
Pole lines, towers, conduits	38,0...35
Tools, supplies, etc	...0.11
Incidentals	27.67
Pay roll	334.49
Liability insurance	202.50
Total	$165,...4.10

The cost of extending lighting lines and installing commercial service up to Sept. 1, 1909, was as follows:

Poles	$1,7...40
Wire	4,1...40
Meters and transformers	10,894.12
Cross-arms, insulators, supplies and tools	2,217.16
Pay rolls	4,833.79
Wattmeters, lamps, transformers, etc	1,193.28
Total	$2...0.1

The cost of operating and maintaining the plant from and including September, 1908, until February, 1909, was $12,273.10. After Feb. 1 the plant had monthly receipts for services rendered for commercial purposes, in addition to receipts for street lighting at $53 per arc lamp, the total being $20,285.91. The total expenditures were $18,164.88, thus leaving a book surplus of $2,121.03.

Free Show-Window Displays at Rockford, Ill.

The Rockford Electric Company is giving the advantages of its show window for a number of weeks to the various manufacturers in Rockford using electric power. Any manufacturer in the city using electric power may obtain the use of the Rockford Electric Company's show window for one week, the purpose being to enable the manufacturer to familiarize the public of Rockford with the various articles of merchandise manufactured in that city. Incidentally, of course, it familiarizes the public with the large number of factories using electric power. The window is engaged steadily for a period from the latter part of October until well into January, 1910. The window illustrated is the third of the series. The manufacturers when first offered the use of the window were almost unable to understand that the display would cost them nothing but the expense of trimming the window. The illustration is furnished through the courtesy of Mr. F. H. Golding, manager.



WINDOW DISPLAY, ROCKFORD, ILL.

Hotel and Church Signs in Denver.

The accompanying reproduction from a night photograph of the Savoy Hotel, of Denver (Fig. 1), is interesting as showing how thoroughly the Denver hotels have become educated to the importance of electric signs. The Savoy Hotel was one of the first to appreciate this, and the sign on the roof of this hotel, seen in the accompanying engraving, has been one of the landmarks of Denver for a number of years. It is of such size as to be easily read from the Union Depot about a mile distant. The Savoy Hotel being at one end of Seventeenth Street, and the Union Depot at the other, this sign appears to be directly across the end of the street. Besides this roof sign, there is a vertical sign reading "Savoy Café,"



FIG. 1.—SAVOY HOTEL SIGNS, DENVER.

a sign reading "Savoy" over the hotel entrance at the right, and a "Café" sign at the left over the café entrance. The Shirley Hotel sign can be partially seen beyond the Broadway Theater sign at the left, and the sign over the Shirley Annex is barely visible at the extreme right. This being an important corner at the intersection of several streets, the Broadway Theater, which is half a block distant, has placed a sign on the roof at the corner at the left to direct those leaving the cars at this corner to the theater, and to be seen down Seventeenth Street.

Fig. 2 shows how churches and theaters advertise alike in Denver with electric signs. The Trinity Methodist Church, located at the end of a certain street near the down-town district, has placed a very conspicuous sign on its building, so that it can be read by anybody crossing this street within a distance of a half mile. Near it is the sign of the Broadway Theater. Electric signs for churches are used more extensively in Denver than in any other city. The Denver Gas & Electric Company has 8 or 10 church signs, some of which are on the regular flat-rate sign contract and are lighted from dusk to midnight every night, while others are on a meter and lighted only meeting nights. One of the first electric signs in Denver was used for church purposes at the time the old Haymarket Theater was made into a mission. These photographs are furnished by the courtesy of Mr. C. N. Stannard, secretary and contract agent of the Denver Gas & Electric Company.



FIG. 2.—CHURCH AND THEATER ADVERTISE ALIKE IN DENVER.

A Factory Lighting Banquet at Grand Rapids.

On Wednesday evening, Nov. 3, the Grand Rapids-Muskegon Power Company gave a banquet to upward of 200 manufacturers from Grand Rapids, a few from Lowell, Mich., and Big

Rapids, and a number from Muskegon, Mich., where the power company furnishes energy for manufacturing purposes to the extent of several thousand horse-power.

One of the objects of this meeting was to stimulate good feeling between the representatives of the power company and the representatives of the manufacturers. The power company, therefore, had about 25 of its different heads of departments present, while many of the guests were superintendents of factories and engineers. In addition, a goodly number of the factory proprietors accepted the invitation sent to them and were personally present.

When the guests entered the banquet hall they saw the tables prettily decorated with Christmas-tree outfits, with the red, white and blue lamps, and about 50 or 60 beautiful portable table lamps with colored shades. After the first course the lights were turned off, and the big manufacturers' monogram of electric lamps was switched on, reading G-R-M, standing for Grand Rapids Manufacturers. This created considerable applause. Among the decorations of the room was the new city flag in numbers. Grand Rapids is proud of its new city flag, and this was the first occasion on which the flag has been in evidence.

Another interesting feature was the installation of several mercury arcs in different parts of the room. All incandescent lamps were thrown off, and the room lighted with these arcs. At first it produced a sensation, and considerable mirth, when it was noticed that the tomatoes were green instead of red, and that the radishes looked like olives. While this created considerable amusement, it nevertheless turned out to be a source of education, as the principal speaker later discoursed on the subject of color values of various lights.

After dinner Mr. H. W. Hillman, who acted as toastmaster, introduced the speaker of the evening, Mr. C. A. Howe, of the Holophane Company. Mr. Hillman reviewed the advances in the art of artificial illumination from the candle to the tungsten lamp. He called attention to the various lighting demonstrations of the evening, and said it was not the intention to conceal the high efficiency of tungsten lamps. The room, it seems, was illuminated with the old-style carbon-filament lamps, consuming practically 3000 watts, and then the same illumination was shown from tungsten lamps, illuminating the room in a better manner, yet consuming a little less than 1000 watts. Another demonstration along similar lines showed equal wattage for both systems of lighting, and gave the manufacturers an idea of the wonderful increase in illumination at the same cost.

Mr. Howe held the close attention of the audience and his remarks were of practical value to all present. The Mayor of Grand Rapids expressed the opinion that it was a good thing for a public-service corporation to entertain its customers in this manner. It could not help but further cement the pleasant relations. He was surprised at the splendid demonstration which could be made with electric lighting.

One of the prominent manufacturers in the audience asked the question, "Why should the power company demonstrate so boldly the economy of tungsten lamps compared with the carbon-filament lamps?" Mr. Howe answered this question in a straightforward, satisfactory manner to the effect that the more the people studied and took advantage of the economies of electric light, the more users would be found for it. Old customers would tell prospective customers of their experience, and the power company would gain new customers. If the people could be educated to use more light, then the power company would be benefited.

In talking with Mr. Hillman after the banquet, he expressed the opinion that lighting and power companies in other sections of the country could hold such banquets to their great advantage. He said they should strike while the iron is hot. Just now the tungsten situation offers an opportunity for the central station to talk superiority and low cost of operation, and the gas companies cannot follow them. He said it would be difficult for a gas company to give such a demonstration. The cost of piping a large room for individual gas mantles to prove equal distribution of light would be prohibitive, if it were possible even to demonstrate by gas. Difficulties of distribution of gas light in factories by individual burners would defeat the purpose of the demonstration. If a gas company was to try such a demonstration it would have to depend upon electric lamps for table decorations. There are so many arguments to prove that a gas company cannot compete with electric companies at the present state of the art that it is wise for the lighting and power companies to take advantage of the opportunity now before them in the matter of tungsten lighting and demonstrations thereof. The electric company is after the factory power, and the expense of such a banquet, as well as the expense of the demonstration, would be well warranted because of the power business which better acquaintance with the manufacturers will bring.

At the speaker's table there were five brass manufacturers. They took particular interest in the new metal reflectors which Mr. Howe demonstrated. These reflectors caused very general and favorable comment. If anyone doubts the question of the ability of gas companies to follow and compete with the tungsten system of lighting, let him think how the Welsbach mantles would operate or fail to operate with the various reflectors which are designed for reflecting the light at any angle wanted for the multitude of machine operations in a factory.

Papers on Rates at Illinois Convention.

At the convention of the Illinois State Electric Association held at Alton, Ill., from Oct. 26 to 28, two papers were given on the subject of electric lighting rates. Mr. M. G. Linn, of the Bloomington & Normal Railway & Light Company, took up the subject for towns of over 15,000 population, and Mr. W. J. Whetzel, of Eureka, Ill., dealt with lighting rates in small towns. Mr. Linn stated that he believes that the two-rate basis is the one that is fair to the consumer and will protect the interests of the stockholders. The two-rate basis encourages the long-burning customer, whether he be a large or a small user, and the long-burning customer is the one to whom energy can be sold at a low rate.

In establishing the two-rate or primary and secondary rate basis, the first thing to be considered is the fixed charges for the primary rate. The secondary rate should be as low as can consistently be made based on the cost of the plant's output.

To determine the fixed charges for the primary rate, one must first determine what is the amount of the investment. For station equipment $125 per kilowatt is usually considered a fair average for this investment for the business district. On this investment one should be allowed a reasonable rate of interest, depreciations and profit; 5 per cent for each of these items should be fair, making a total of 15 per cent. Fifteen per cent of $125 is $18.75 per annum, which is $1.56 per month. The amount to be charged to each customer for the investment in machinery made to serve him may be estimated on the basis of 30 hours use of his connected equipment per month. On this basis the fixed charge would be $1.56 ÷ 30 = 5.2 cents per kw-hour. The secondary rate should be based on the actual cost of energy at the consumer's meter, plus the profit needed.

For example, assume that the secondary rate is found to be 5 cents per kw-hour; the total rate for one hour's use per day would be 5.0 + 5.2 = 10.2 cents per kw-hour. At a discount of about 10 per cent for prompt payment, the following rates could be offered for the indicated hour's use of the connected apparatus: One hour, 9 cents per kw-hour; two hours, 6.75 cents; three hours, 6 cents; four hours, 5.6 cents; five hours, 5.4 cents, and six hours, 5 cents per kw-hour.

The above method of rate making is new to a large percentage of towns in Illinois, and a campaign of education would be needed to insure its adoption. It is in successful use in such cities as New York, Chicago, Des Moines, Omaha and Cleveland.

On account of the larger investment in station apparatus for service in a residence district as compared with a business

district, it is proper to make a larger rate for the residence service. In a town where a rate of from 10 cents to 5 cents could be offered for business service, a rate of from 15 cents to 7 cents could be made for the residence service.

Mr. W. J. Whetzel, in his paper on "Lighting Rates in Small Towns," said that reports received from about 50 central stations in the smaller towns in reply to questions sent out show that there is considerable difference in the charges for energy and in the methods of determining the charge. These variations are evidently not due so much to natural conditions affecting the stations as to the individuality of the management.

The central-station industry would be financially and generally improved by more uniformity of management. The time is in sight when this will be required by law in Illinois as well as in other States. It will remove the opportunity for undesirable comparisons of central stations and result in greater harmony between them and greater equity between them and their customers.

As to the method of determining charges, it is apparent that rates should be computed as simply as the conditions will permit and expressed as simply as possible. This is more essential in a small town than in a city, because customers are not accustomed to dealing with complex problems. However, rates should be revised and devised to prevent waste and encourage more desirable use of energy. If a careful survey of the whole field be made it will be found that rates should be based on the cost of service. Rates so based and properly adjusted afford the best means of meeting competition, since the costs of the several means of producing light and power run nearly parallel.

For the consideration of rates as based on, and adjusted to, cost of service, the following classification of elements of cost will be sufficient. Under the first class are grouped those elements incident to the operation of a plant. Under the second those elements which depend upon station capacity or connected load, being mainly independent of the operation of the plant.

Running Cost		Standing Cost	
Labor,		Depreciation,	
Fuel,		Profit or Dividend,	
Repairs,		Interest,	
Operating Supplies	Water, Oil, Packing, Waste, etc.	Insurance,	Fire, Boiler, Damage, Life,
Miscellaneous Items.		Management, Advertising, Rent, Miscellaneous Items.	

All of the elements of cost are variable, hence the impossibility of fixing an exact rate. A closely approximated rate cannot be determined unless the elements of cost are considered for not less than a year's time in order to include the variation of the seasons. In a growing plant the elements are more variable and the problem is more difficult. However, the rate may be practically approximated.

The variation between standing cost and running cost is so marked that in order that a rate may be equitable, it must be dual—one part based on the standing cost, the other on the running cost.

A well-equipped plant in a small town requires an investment of about $200 per kilowatt of equipment or connected load. The standing cost as enumerated is about 15 per cent of the investment, or $30 per year per kilowatt of equipment. A consumer who uses 1 kw-hour per day or 365 kw-hours per year should pay as standing charge $30 ÷ 365 = 8+ cents per kw-hour.

The reading of a switchboard meter showing the whole station being divided into the total running cost gives the running cost per kw-hours. With a running cost of 4 cents and a standing cost of 8 cents the total will be 12 cents per kw-hour. The rate for a consumer using his full equipment for two hours per day would be $(8 \div 2) + 4 = 8$ cents per kw-hour. For four hours' use the rate would be $(8 \div 4) + 4 = 6$ cents per kw-hour.

If the maximum demand of each consumer came at peak load, then a simple and equitable way of determining a rate could be arranged according to the preceding illustration. In practice there are many variations. These variations make it difficult to determine the individual dual rate based on standing and operating costs.

Various systems have been devised, each with its own defects. There is the competition plan of getting what can be obtained from each consumer; this plan deservedly and invariably leads to financial ruin. The old flat-rate plan, if followed far, leads the same way by encouraging wastefulness, except when a fixed number of lamps are used for a fixed number of hours under the control of the central station. There is what is known as the discount plan. A straight maximum rate is charged with discount increasing at steps with the increasing amount used. This plan causes overlapping whereby a consumer may, by using just beyond a step, get service for less than if he had ceased before reaching the step. This objection is sometimes overcome by a tabulated charge. This plan with a proper minimum and careful grading has the advantage of uniformity and simplicity and may be so arranged as to conform fairly to cost. The author expressed his preference for a maintenance charge plus a straight rate.

DISCUSSION.

Mr. E. W. Smith, of Kewanee, said that very few companies know what it cost them to produce electrical energy per kw-hour either at the switchboard or at the consumer's meters, and few also know the average rate received per kw-hour. All stations should have switchboard watt-hour meters. At Kewanee the watt-hour meters are read three times each day. By reducing motor rates to a low figure the company had succeeded in filling in the valleys of the load curve during the day.

Mr. John F. Gilchrist, of Chicago, said that the two papers just read indicate a very satisfactory condition throughout the State, because they show that central stations are giving more thought to logical rate making and are coming nearer each year to a uniform basis for establishing rates. The papers bring out the fundamental principle that there should be two factors in the make-up of any rate. One factor is the fixed expense for interest and depreciation and the other factor is the variable or running expense, which is proportional to the kw-hours generated. The problem of universal, uniform rates presents difficulties similar to the adoption of a universal language. Every man thinks his own language or his own system of rates is the best, and does not want to give it up. The speaker then took up the problem of estimating the actual maximum demand of a consumer from his connected load. In a residence the maximum demand is usually from 20 to 30 per cent of the connected load, whereas in stores the maximum may be 60 or 70 per cent. The maximum demand may be measured by means of a demand meter, but the installation of demand meters means additional investment. The investment for meters and service wires for small consumers is already too high. If service is to be extended to large numbers of small consumers, the investment per consumer must be kept at the lowest possible point. The Commonwealth Edison Company in Chicago until recently had maximum-demand meters for each of its lighting customers. During the past year, in accordance with the terms of a recent franchise ordinance, the company has discontinued the use of the demand meters on all installations where the connected load in lamps is 1 kw or less. Having had such a large number of maximum-demand meters in use for a number of years, the company has a large amount of data upon which to base estimates of maximum demand. Accordingly, for consumers of 1 kw and less, the maximum demand is now estimated by means of a table prepared from the averages of 30,000 customers formerly equipped with demand meters. In answer to a question as to the reduction of rates in Chicago, he said that in four years the rate had been reduced from a primary charge of 20 cents for the first 30 hours' use of the maximum demand and 10 cents for the balance, until on Aug. 1, 1909, the rate was made 12 cents for the primary charge and 6 cents for the balance. He called attention to the urgent need for lower-priced meters for small customers to meet present conditions, since electric service is

being extended to a larger number of smaller customers each year. Furthermore, with tungsten lamps, the meter must register accurately for lower current values than formerly. The investment in meters for small consumers may run up as high as $100 per kilowatt of station equipment. A modern steam generating plant can be built for $100 per kilowatt or less, including land, and the distributing system, if overhead, can be built for $100 per kilowatt of station equipment; or $150 if underground. The investment in meters under certain conditions may, therefore, be disproportionate to the rest of the system.

Mr. J. R. Cravath, of Chicago, told of the residence rate used at Lawrenceville, Ill., in which a consumer's maximum demand is estimated to be in proportion to the number of rooms in the house, and not a certain percentage of the lamps connected. The number of rooms is multiplied by 1200 watt-hours each month to get the amount to be billed at 15 cents per kw-hour. A second similar amount is billed at 6 cents, and the balance at 5 cents. This essentially is the plan first adopted in Detroit.

Mr. David Davis, of Litchfield, expressed the opinion that the Detroit system is based on the correct principles.

Mr. E. C. Jenks, of Chesterton, said that it usually costs from 2.5 to 10 per cent to collect bills. His company has successfully worked a plan whereby the regular rate is 20 cents per kw-hour, with a discount of 33 per cent or more according to the size of bill if paid within 10 days. Mr. Frank J. Baker, of Chicago, asked if Mr. Jenks was able to employ such a large discount without complaint. Mr. Jenks replied that he was, and Mr. Baker offered his congratulations. In Mr. Baker's experience it is an absolute impossibility to cause consumers to pay such a large penalty for failure to pay bills promptly. The customers maintain that it is unreasonable to give such a large discount, and he agreed with them.

A question was asked of Mr. Linn as to the investment per kilowatt of station equipment mentioned in his paper. Mr. Baker thought the value too low for average conditions. As Mr. Gilchrist has recently said, the investment in meters alone might amount to $100. In taking over and consolidating a large number of small electric lighting properties, Mr. Baker had found the greatest element of weakness to be the inaccuracy of consumers' meters. If a consumer's meter is slow, the company is unwittingly discriminating in favor of that consumer. When consumers compare notes the difference in bills is evident and creates dissatisfaction.

Mr. H. J. Pepper agreed with Mr. Baker as to the impracticability and undesirability of a large discount for prompt payment. If a consumer who had forfeited such a large discount should take his case to court the company would undoubtedly lose on the grouunds that so large a penalty is not reasonable.

Mr. Warren Partridge, of Springfield, thought that rates should be simply expressed. While the Wisconsin commission had come out in favor of the readiness-to-serve rate, he had observed that commissions usually concerned themselves most with the maximum rates, leaving discounts and lower rates to the companies. He thought that the important thing is for central stations to arrive at some system of rate-making which all can endorse, and thus be in a better position when rate legislation is proposed than if the companies could not agree among themselves.

Mr. E. L. Brown, of Elmwood, said regarding investment per kilowatt of equipment that the figure to his knowledge runs from $200 to $400. Mr. Baker thought the value given by Mr. Linn was very low. Mr. Linn said that he did not intend to cover more than one specific case. He had found among six plants in central Illinois a difference of 200 per cent in the cost of the plants. Mr. H. R. Kingman, of Mount Vernon, spoke in favor of companies uniting on a uniform method of determining rates, even though the exact figures of the different cities might vary to suit local conditions.

On motion of Mr. McAfee, of Galesburg, it was voted to appoint a committee of five to make recommendations on a system of determining rates to report at the next convention. Mr. R. S. Wallace, superintendent of the Peoria Gas & Electric Company, is its chairman.

INTERIOR WIRING AND ILLUMINATION

A Holiday Wiring Warning.

A timely warning is sent out by the Chicago Board of Underwriters in relation to special holiday window displays of merchants. This letter is issued about the middle of November, and is of widespread application. Electrical men are particularly interested in it, because of the extensive use made of electric-light effects and occasionally of electric motors in Christmas show windows.

The underwriters point out that the use of Christmas greens, harvest specimens and other inflammable materials, such as scenery, cotton to represent snow, etc. (especially in connection with electric or other lighting systems), is an increase to the fire hazard. Continuing, the letter says:

"The most rigid safeguards against fire should be used in connection with any special displays and additional fire protection provided in the immediate vicinity. Electrical wiring and apparatus used in this connection should be as well installed as if it were to be permanent and should be carefully inspected by one familiar with the subject before the current is allowed to be turned on. We would call particular attention to the fact that the use of flexible cord and flexible cord miniature Christmas-tree outfits is not approved for show-window decorations or interior decorations in mercantile risks. The custom of wrapping incandescent electric lamp globes with cotton, cheese-cloth, etc., or even of allowing inflammable materials of this kind in close proximity to such lamps, is extremely dangerous and should be discouraged. Special watchmen or firemen should be detailed to watch places where these displays are installed, not only to prevent spread of fire, but to avoid panics, which are almost sure to result from any fire starting where a considerable number of people are gathered together."

The State Street merchants of Chicago take pains to comply with the requirements of the fire underwriters and the city electrical inspectors in making their Christmas window displays, and fires are almost unknown. This is the time, however, when attention should be directed to the subject, so that electrical contractors and others may exercise all due diligence.

Compulsory Use of Iron Conduit in Winnipeg.

An ordinance, which becomes effective on Jan. 1, has been passed by the Municipal Council of the City of Winnipeg, Can., requiring the use of iron conduit in all kinds of electrical wiring in buildings within a defined central area, excepting dwelling houses and private barns. The regulation also applies to certain buildings outside of this proscribed area, such as churches, schools, public halls, etc. The ordinance stipulates that no building situated within the boundaries of the underground-wiring district for the city of Winnipeg shall be wired for electricity, used for any purpose whatsoever, unless the conductors are enclosed throughout in approved metal conduit or consist of approved armored cables, or in the case of exposed-surface work on walls or ceilings, are enclosed in approved metal conduit or metal molding. This rule does not, however, apply to frame or brick dwelling houses or private barns in the underground-wiring district.

All the buildings having basements and situated within the underground-wiring area must have all main electric feeders so arranged that connection can be readily made between them and the service wires that they may enter such basements. The feeders must run in the basement to the front or rear wall, whichever is selected as the most suitable point for the service entrance. From the basement the conduit must extend in a vertical direction to a suitable point above the ground and termi-

nate in an approved service cap. The conduit mains may be carried either on the exterior surface of the walls or be concealed. In the latter instance the main line cut-out and switch must be placed as close as possible to the point of entrance of service, but not higher than 8 ft. from the floor. In the former case the main line cut-out and switch must be placed at the point where the conduit is brought through the exterior wall into the basement. In either case the cut-out and switch are to be enclosed in an approved iron cabinet. Where minor additions or alterations to existing systems are contemplated, the City Council intimates that modifications may be permitted.

All churches, schools or colleges seating over 100 persons, all apartment buildings, all public halls, lodge rooms or dance halls, all wood-working shops or factories, or factories or buildings where especially inflammable goods are handled or stored, all packing houses and abattoirs outside of the underground wiring district must conform to the regulations also. In the wiring of basements of all buildings other than dwelling houses or private barns iron conduit is compulsory.

Discussion of Factory Lighting.

The Chicago Section of the Illuminating Engineering Society met for luncheon at the Great Northern Hotel at noon, Nov. 11, for the purpose of discussing the paper on "Factory Lighting," by Mr. L. B. Marks, presented at the recent annual convention of the society. Chairman Albert Scheible presided.

Mr. J. E. Moore, of the Western Electric Company, in the discussion, first gave some figures obtained from tests made in the factory of that company. He said that they prefer a general illumination sufficient for most operations which are conducted in a department, supplemented occasionally with individual lamps where some special illumination is needed. He gave figures from one department in which 40-watt tungsten lamps with Holophane reflectors are studded over the ceiling a distance of 9 ft. 8 in. above the floor, spaced about 7 ft. 10 in. apart. The watts per square foot are 0.68. The foot-candles vary from 3 immediately under the units to 2.1 midway between four of them. With this intensity of illumination most of the work in the department can be done, although some individual lamps are needed. He also gave some figures from the coil-winding department, where the requirements of illumination are fairly exacting. In this department a measured illumination of from 2.1 foot-candles to 1.3 foot-candles has been found sufficient. He said that no trouble had been experienced from the breakage of tungsten lamps due to the vibration of the building, although no special precautions are taken to protect them from jar.

Mr. J. R. Hubbard, of Cleveland, of the Adams-Bagnall Company, was called on to give some facts about the use of flame-arc lamps in factories and foundries with high ceilings. He said that recently flame-arc lamps had been brought out in this country which will operate from 70 hours to 100 hours on one trimming, which places the flame-arc more in accordance with American ideas of maintenance cost than formerly. As an interesting fact he mentioned that the Jones & Laughlin Company, at Pittsburgh, has some flame-arc lamps installed 78 ft. above the floor in a certain building.

Mr. George C. Keech emphasized the point made by Mr. Marks in his paper regarding the interference with clear vision caused by the reflection of light from bright parts of the work to the workmen's eyes. A great deal of trouble from artificial illumination may be traced to this reflection, which detracts so seriously from the ability to see clearly, and sometimes gives rise to a complaint of insufficient light when really there is too much.

Mr. L. G. Shepard, describing some of the general lighting with tungsten lamps in the Federal Electric Company's factory, noted that no trouble had been experienced from breakage of these lamps due to vibration, even where placed on rigid fixtures under floors where heavy stock is being unloaded.

Mr. J. R. Cravath agreed with Mr. Marks in the condemnation of factory lighting altogether by individual lamps placed over the work. He said that plenty of general illumination is always desirable, and in some cases the general illumination may be made sufficient for all purposes. However, many cases arise where individual lamps are absolutely necessary. In such cases they should be properly shaded, fitted with heavy reinforced cord, shade holders which will hold the reflectors firmly, and devices for the quick adjustment of the height of the lamp that will not be misused and take up the valuable time of the workmen.

The recent meeting held under the auspices of the electric power company at Grand Rapids, to which the factory managers and superintendents were invited, and the discussion of the same paper by Marks on "Factory Lighting" is a gratifying indication that this much-neglected subject is being vigorously taken up. Regarding the Grand Rapids banquet, the attendance and interest on the part of the factory superintendents at Grand Rapids shows that they are not indifferent to the subject. Incidentally, such meetings as this offer excellent opportunities for electric power company representatives to get acquainted with the factory managers with whom they must expect to have dealings on the electric power question.

The lighting of different kinds of factories calls for great differences in treatment. Some general illumination can be provided which will do away with a multiplicity of individual lamps and the nuisance and expense of many drop cords. In some cases the individual lamp and drop cord are absolutely necessary. There is, however, no excuse in any event for the old practice of hanging rows of bare lamps on drop cords about on a level with the workmen's eyes without any shading whatsoever. There should be, first, in any event, plenty of general illumination. Then if it is not possible to do good work without additional light, special illumination by individual lamps may be provided, but in such cases many of the former objections to special illumination disappear. In a factory lighted altogether by individual lamps, all of which are shaded, there is not the glare from the lamps in the eyes of the operators, but conditions are still very bad, because of the intense light in some places and the general surrounding darkness. The reflection or glisten of the work if bright metal or white-paper surfaces are being worked, are almost as trying as the bare lamp in some cases. The remedy for this is more general illumination from lamps placed high and some distance from the work and less special illumination from lamps hung close to the work. It is gratifying to note that this element of reflection from the work is being more generally recognized as a source of trouble with artificial illumination. Doubtless some cases of complaint of insufficient light are really due to inability to see, because of too much light being thrown on the work from some particular angle, which causes reflection into the eye of the worker from the objects upon which he is working. With diffused illumination, as from daylight, there is little of this trouble. It becomes more pronounced the more localized the source of light. It is found in its most aggravated form with the single incandescent lamp placed a few inches from the part illuminated.

Insurance Men Instructed in Rules of Electrical Construction.

As the fifth in his course of lectures explaining the rules and regulations of the National Electrical Code, Mr. B. E. Blanchard, chief electrical inspector of the Chicago Board of Underwriters, addressed the Fire Insurance Club of Chicago on Nov. 9 on the subject, "Low-Potential Systems," with particular reference to show-window and display lighting. Mr. Thomas Cooper, president of the club, presided, and there was an attentive audience of insurance men who listened carefully to Mr. Blanchard's lucid explanation of the requirements of the underwriters in the matter of electrical construction.

Mr. Blanchard exhibited a collection of antique electrical fittings made by Mr. Forsyth, of the Boston Board of Fire Underwriters, which were truly "horrible examples," often

amusing, representing the crude electrical wiring devices of perhaps a quarter of a century ago. These fuse blocks and switch bases, rosettes, etc., were mostly of wood, and Mr. Blanchard remarked that the carpenter had almost as much to do with electric interior wiring in those days as did the electrician. The contrast between these early attempts and the carefully protected apparatus of to-day shows in a marked degree the advancement of the electrical industry.

The speaker defined all potential systems as those having dynamo potentials of 600 volts and less. He explained the code rules in relation to these systems. Taking up first concealed and open wiring, he spoke of the difficulty of determining the condition of concealed wiring in buildings, and said that that was one of the chief difficulties the electrical inspector has to encounter. He gave a drawing showing the manner of protecting wires passing down sidewalls and through floors in open work. Wooden boxes afford the best means of giving this mechanical protection in damp places, while metal pipe should be used in all others. Referring particularly to open-work wiring, Mr. Blanchard described the various kinds of molding, and, referring to metal ceilings, which have lately come into extensive use, he said that they must not be made to conceal metal molding or wooden molding. The rules relating to conduit work were explained, and next the lecturer gave a drawing showing the essential features of a fixture canopy and also explained how these canopies are tested. A vapor-tight globe is required for incandescent lamps where inflammable gases are present, and a drawing of this fixture was given.

Sockets were next taken up, and the requirements in relation to these devices were gone over. Keyless sockets should be used wherever there are extra fire hazards from combustible dust in the atmosphere, as in grain elevators, for instance. Ceiling rosettes, lamp cord and wire guards for portable lamps were also considered. One interesting fact mentioned by the speaker was that in lighting installations only one service switch is required by the underwriters for the entire equipment; all others are placed for convenience. The construction of a typical arc lamp was illustrated by a diagram, and the speaker explained why in some lamps of the older construction it was necessary to require wire-gauze spark arresters.

As to show-window lighting, Mr. Blanchard made particular mention of the additional hazard due to temporary holiday installations at this season of the year, and he said that only thoroughly competent electrical men should be allowed to install holiday lighting. The merchant should employ someone of established reputation to do this work. He should see that the proper permit is obtained from the city Department of Electricity before the work is done, and after it is completed he should also see that city inspection is made. It is a good practice not to pay all of the amount called for by a contract of this nature until after final approval is obtained from the city inspectors. This subject is called to the attention of merchants and department-store managers about this time of year, and the larger establishments are careful to comply with the requirements of the city and underwriters' inspectors. For these holiday displays the use of flexible cord is not approved, and among other precautions care should be taken that tinsel be kept away from incandescent-lamp sockets.

One point made by the speaker, referring now to general conditions of wiring, is that when a fuse blows it should never be replaced without ascertaining the cause of the trouble. In lieu of an extended discussion, Mr. Blanchard explained the oddities of the loan collection of curiosities in the way of early electrical fittings.

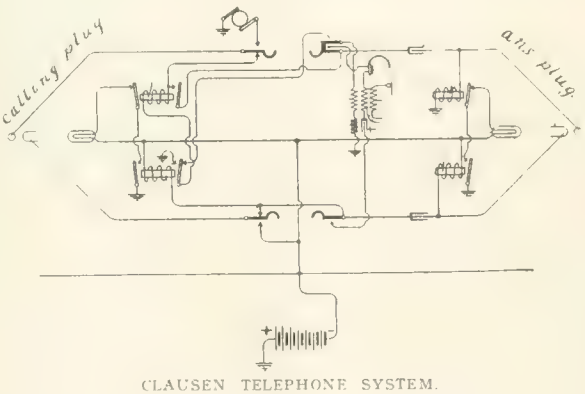
New Telephone Patents.

FOUR-PARTY SELECTIVE SYSTEM.

In four-party selective working many different systems of current supply have been suggested and used, but the combination selected by Mr. Klas Weman and recently patented by him is quite novel. He uses a very high-frequency current for two stations and a regular 16-cycle current for two stations. At each station a bridge is made across the line comprising a retardation coil, a condenser, a second condenser and the ringing or signaling device. This bridge is grounded between the two condensers. For the first station the signaling device is between the ground and one side of the line, and for the second station the signaling device is between ground and the other side of the line. For both these stations a high-frequency horn or "howler" is used. These respond to high-frequency current only and either may be selected at will by the application of high-frequency current on the proper side of the line. For the other two stations the same respective relations of station and line are maintained as for the first two; ordinary ringers are used, which respond to the 16-cycle current, but fail on the high-frequency.

BUSY-TEST SYSTEM.

Mr. H. P. Clausen, of Chicago, Ill., has patented an arrangement of central-energy cord circuit with special reference to the busy test. The circuit is shown below. It will be seen that the tip contact of the calling plug, with which the testing is



CLAUSEN TELEPHONE SYSTEM.

done, is connected to the contacts of two relays. The coils of these relays serve as the battery feed coils of the calling side of the circuit and their contacts also serve to control the supervisory circuit. These relays are not operated until the calling plug is inserted in the jack, at which time the testing circuit is not required. Tracing the testing circuit, we find it goes from the relays to the listening key and thence to the testing winding of the operator's induction coil.

REPEATER SYSTEM.

In connection with the introduction of the telephone repeater in commercial service, there arise special conditions due to the variation in the electrical constants of the various lines to be interconnected. One of these has been a sort of interference between the original and reinforcing currents due apparently to a difference in the phase of these two, introduced by the repeater. To overcome the difficulty it is suggested by Mr. H. E. Shreeve, of Wyoming, N. J., that the original current arriving at the repeater must not pass beyond the repeater, leaving the forward section of the line free for the reinforced current sent out by the repeater. He has devised circuits for carrying out this idea and has patented his system, the patent being assigned to the American Telephone & Telegraph Company.

SOUND MUFFLER.

A patent issued to Mr. C. J. Kintner, of New York City, and assigned to the Miniature Telephone Booth Company, describes a sound deadener and muffler. A felt-lined metal stand is provided upon which the telephone desk stand may be set with its transmitter mouthpiece within a conical enclosure, the bottom of which becomes sealed by the face of the transmitter. The other end has a hollow rubber ring adapted to seal up the front by flexible contact with the face of the user.

CIRCUIT-FINDER.

What might be called a circuit-finder has been patented by Mr. A. T. M. Thomson, of London, England. It is used to connect a single circuit to any one of a group of circuits which may need it. These latter are connected in suitable series to

a set of contacts arranged in a circle. A trailer connected to the single circuit is continuously driven over this through a clutch. An auxiliary device serves to stop the arm upon any set of contacts where connection is desired, the clutch giving way during the interim.

Letters to the Editor.

Some Errors in Testing Sources of Light.

To the Editor of Electrical World:

Sir:—By your comments on my letter in the Nov. 11 issue I judge that you imagine my appeal to be for the abandonment as useless of all scientific investigation that cannot be made to "gee" with practice—using the word "practice" in the narrowest sense. Nothing could be farther from the fact, for I conceive that there is a practical side to all so-called purely theoretical work. Perhaps this can be made clear by a concrete example.

In the mathematical investigation of finite surface light sources the exact expression for the intensity at any point under, say, a flat circular source may be found in two ways: (1) By direct integration of the algebraic expression for the intensity due to an infinitesimal element of the source, or, (2) by the use of zonal harmonics. By either method a result is obtained the actual numerical computation of which for any specific case is prohibitively clumsy and subject to great inaccuracy within wide limits due to the necessity of interpolating trigonometric functions to small decimals of a degree. If, in addition to this, the mathematical work is complicated by the idea of the volume of the source as effecting the distribution of the flux, the testing of the result by actual computation becomes almost impossible except for a few values. Such a result is useless and vitiated by its so-called correctness. Furthermore, the errors inherent in the experimental work, due to the impossibility of constructing a perfectly diffusing source, are of such a nature as to make their accurate determination out of the question, and they are of a magnitude much greater than the difference between the results of a rigorous mathematical analysis and the results of a less rigorous treatment of the problem. If, then, we are searching for practical means of studying finite surface sources, which method is of greatest value both to science and to engineering?

My "mathematical discursion" was perhaps an unsuccessful effort to show that your stricture of those who have attempted to investigate light sources mathematically was probably due to lack of knowledge of the difficulties inherent in the use of results obtained by a rigorous treatment of the problem, and to show that the use of less exact and less tedious methods, where nothing was to be gained by introducing complications, was sanctioned by the highest authority.

I was not aware that I had undertaken the amazing task of construing the attitude of either Heaviside or Maxwell on this question of rigor. Nothing could be more emphatic or require less construing than certain remarks made by Heaviside in Section 224 of the "Electro-Magnetic Theory." "To have to stop to formulate rigorous demonstrations," he says, "would put a stop to most physico-mathematical inquiries" and, quoting Lord Rayleigh, "the physicist may occasionally do well to rest content with arguments which are fairly satisfactory and conclusive from his point of view."

New York. Bassett Jones, Jr

The Inventor and the Patent Situation.

To the Editor of Electrical World:

Sir:—Inventors are proverbially poor in earthly goods, while modern business corporations are proverbially unscrupulous in the ways and means of advancing their interests. Such corporations are in a position to employ experts, whose duty consists in making discoveries and inventions. These experts once in a while actually do make discoveries and inventions of some value to the arts, and most of the time believe that they do it. Modern corporations are also in a position to employ patent experts, who have gained a thorough knowledge of all the intricate technicalities and routine of the United States Patent Office practice, frequently from serving there as assistant examiners. It is the express duty of these patent attorneys to monopolize by letters patent the actual or imaginary inventions of the professional inventors employed by the corporations. Moreover, it is the duty of the patent experts to secure as many as possible "paper patents" calculated to block the way of future bona-fide inventions in order to avoid possible future competition in a special line of production.

Any invention of some importance in the arts is, therefore, certain to get into interference with the actual or alleged inventions of the servants of the corporations.

The man who finds himself in antagonistic relations to a powerful corporation, in consequence of an interference, finds, if he did not know it previously, the delusive nature of abstract equality before the law of all citizens of the Republic. Let us cite one instance.

The offices of the examiners of the Patent Office are legally open to all citizens. This seems to be fair on the surface. However, the average individual inventor is seldom in a position to avail himself of this privilege, if at all. At the same time the powerful corporations maintain a regular staff of patent attorneys, recruited from former employees of the Patent Office in one capacity or another. These able and willing representatives of the interests of corporations use the privilege of personal contact with the examiners whenever and wherever they see fit. Indeed, the examiners who could avoid being subtly influenced by such constant contact would have to be more than human. In order to insure impartiality of judgment all communications with the Patent Office ought to be limited to written or printed documents.

Another point to be subjected to criticism is the excessive secrecy of the Patent Office.

The German or new English patent systems seem to be much more in the interest of the inventors and the public at large than the present American system.

Cleveland, Ohio. Isador Ladoff.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

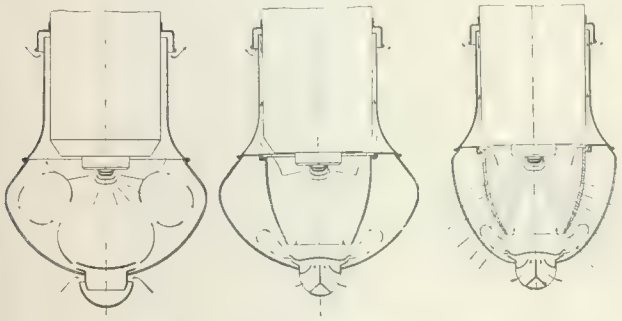
Generators, Motors and Transformers.

Burning Out of Oil Transformers.—G. Molnar.—Since the inflammation temperature of a good transformer oil is about 250 deg. C., and the oil temperature, even in warm rooms, is hardly liable to increase above 100 deg. C. under normal conditions, the danger of an inflammation of the oil is never great. The author describes, however, a peculiar case in which an oil transformer burned out several hours after operation had ceased. The transformer delivered energy to a factory and was connected up to the supply circuit of the municipal central station. At 6 o'clock in the evening the secondary circuit was disconnected. The primary of the transformer was not disconnected, but was protected by fuses according to existing regulations. At 10 o'clock the transformer was discovered to be on fire. The author shows that the only possible cause for the accident was a short-circuit of a few turns of a winding. If more than a few turns have been short-circuited, the primary current would probably have been large enough to cause the

fuses or automatic circuit-breaker to act. In spite of the fact that with a short-circuit of a few turns the current remains at a small value, the heat produced is sufficient to raise the temperature of the oil above the ignition point. Some speculations are added as to what might have caused the short-circuit of a few turns.—*Elek. und Masch.* (Vienna), Oct. 31.

Lamps and Lighting.

Flame-Arc Lamps.—P. Heyck.—The first part of a paper read before the Dresden Electrical Society on new flame-arc lamps of Koerting and Mathiesen. It is well known that in the old flame-arc lamps there were evolved vapors which deposited on the inside of the globes, thereby decreasing its transparency and etching the glass so that after some 17 hours the candle-power of the lamp decreased by 30 per cent or 40 per cent. This result is attributable to a defective circulation of the air and vapors in the lamp. The old construction of the flame-arc lamps is shown in Fig. 1. The circulation of the air vapors is indicated by arrows, and it will be seen that the hot vapors come into contact with the cold surface of the globe, which results in the detrimental deposit. The new arrangement, which avoids this defect, is shown in Fig. 2. There are two globes used and the space between the inner and the outer globe is tightly closed at the upper end. It will be seen that when the air has become mixed with vapors from the impregnated carbon electrodes, it has no opportunity to come again in contact with the cold outer globe. The arrangement also insures that when the lamps are used in the open air, even with strong winds, the circulation of the air is from the bottom upward and not the other way; this fact has been established in 1½ years' practice. On account of this new construction the candle-power does not decrease. While formerly a lamp which



FIGS. 1, 2 AND 3.—FLAME ARC LAMPS

gave originally 2400 hefner cp would give only 1600 candles in a few weeks, the new lamp maintains continually its original candle-power of 2250 (this is less than the other older value because there is a loss of 7 per cent due to the inner globe). The attendance of the lamp is also simple, because there is almost no need of cleaning the globes. A further new development is due to the use of specially cut glass for the inner globe. The distribution of light from flame-arc lamps with inclined electrodes side by side has the disadvantage that the maximum is at an angle of 60 deg. below the horizontal, so that the illumination of the floor is non-uniform. This disadvantage has been overcome by using the "dioptric" globe (a globe in which are cast prismatic rings) for the inner globe, as shown in Fig. 3. There is no refraction of light rays in the upper part of the globe, while in the lower parts of the globe the light rays are deflected upward. The result is indicated in Fig. 4, which shows in curve *a* the distribution of light with an old Excello lamp and in curve *b* the distribution of light with the new dioptric lamp. The degree of uniformity of illumination of the streets has been greatly improved thereby. Some figures are given of volts, amperes, watts and hefner candles of direct-current flame-arc lamps. For an Excello lamp with inclined electrodes side by side the specific consumption for yellow light varies between 0.24 watt and 0.17 watt per mean hemispherical candle-power. For white light it varies between 0.32 and 0.22. The watts given are the total watts of the circuit divided by the number of lamps. The specific consumption includes the loss in the series resistance. The candle-power is measured with clear globes in hefner candles. The Excello lamp is built both for direct current and alternating current. For the alternating-current series lamp there is employed a new arrangement, shown in Fig. 5. Formerly series alternating-current lamps were mostly used in shunt with an inductance

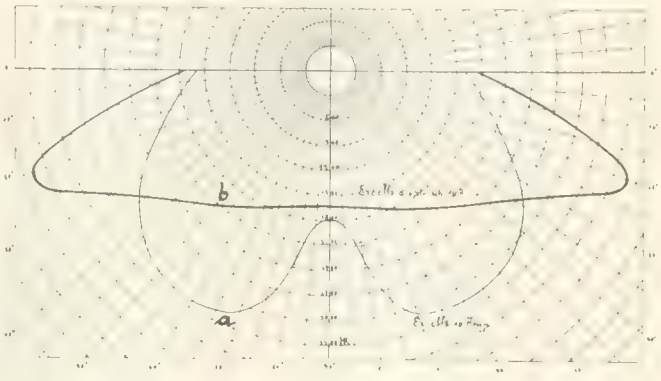


FIG. 4.—PHOTOMETRIC CURVES OF FLAME ARC LAMPS

coil, through which a current of 0.5 amp or 1 amp was continually passing. When the electrodes of the lamp were consumed the inductance coil would carry the whole current, but this would cause a distinct change in the electrical conditions of the circuit. When about one-half of the lamps of a circuit were extinguished, all the other lamps (which had already carried much less than the normal current) would be extinguished. In the new arrangement, as shown in Fig. 5, *h* is the magnet in the main circuit and *n* the magnet in the shunt circuit. The oscillating armature is placed between the two. Above the armature there is an iron core *k* with two windings. At *s* is a contact, which is either closed or open. When the lamp is lighted the current passes from terminal *a* through *k*, one electrode, the arc, and the other electrode to the terminal *f*. A shunt circuit connects the terminal *a* through *n* and *de* with the other terminal *f*. When the voltage of the lamp rises to a certain value above normal, the shunt magnet *n* attracts the armature and the contact *s* is closed, thereby closing a second circuit, *a*, *b*, *c*, *s*, *f*, for the main current, so that the arc is extinguished. The main current which now passes through the winding *bc* magnetizes the core *k*, the apparatus becomes a transformer and produces at its secondary terminals *be* a voltage which is higher than was the voltage *af* at the lamp terminals. This voltage *de* is impressed on the magnet core *n* so

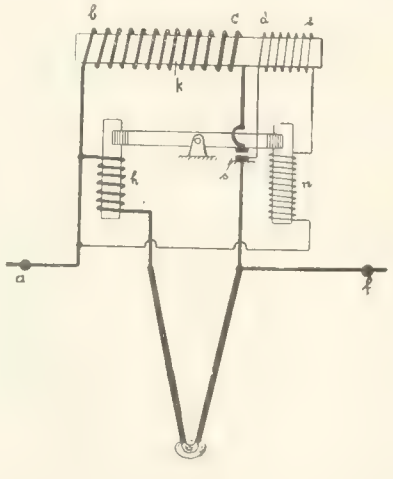
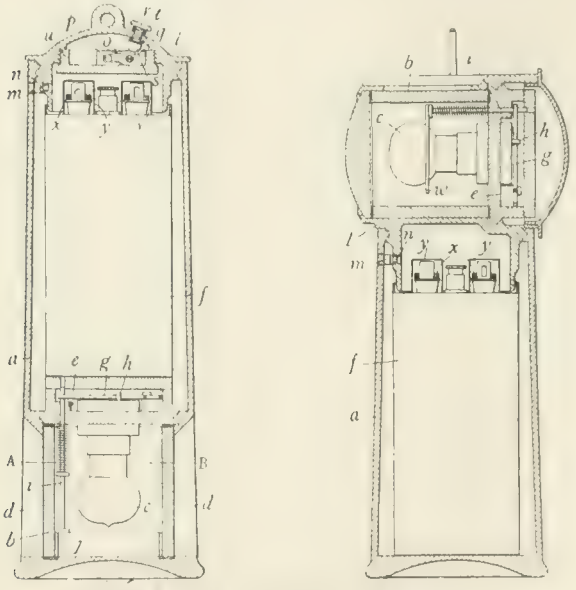


FIG. 5.—ARRANGEMENT OF ALTERNATING-CURRENT SERIES LAMP

that the latter attracts the armature with great force and closes the contact *s* tightly. The voltage *bc* is thus substituted for the lamp voltage. This arrangement has the following advantages: The whole mechanism is placed within the lamp and is so simple that the appearance of the lamp is just like that of an ordinary lamp. The inductance coil is disconnected while the

lamp is burning. All of the lamps of a circuit except one can be extinguished without changing the electric conditions of the circuit. The inductance coil consumes only 40 watts, while the burning lamp consumes from 300 watts to 600 watts. The paper is to be concluded.—*Elek. Zeit.*, Nov. 5,

Safety Lamps in Mines.—A description of a new electric safety lamp devised by C. V. Ely and T. P. Brady. A cylindrical case of iron, brass or aluminum is extended at one end in the form of a stout glass cylinder enclosed by metal bars and a cap formed in one part with the case. As shown in Fig. 6, a small metallic-filament lamp is mounted on a disk which forms part of a porcelain box *e* containing an automatic cut-out. This box is screwed into the end of the case just below a secondary cell. The cut-out consists of a spring-controlled switch *g*, kept closed by a vertical sliding rod *i*, which is held in position either by a thin ring of glass *j* in the lamp chamber or by a metal ring *w*, placed over the lamp bulbs, as shown in Fig. 7. This rod is controlled by a spring, and if the main glass-enclosing cylinder *b* is broken, the thin ring also breaks and the switch is opened. In the case where the rod bears on a ring on the lamp bulb, the breakage of the lamp releases the cut-out. In the construction shown in Fig. 6 the upper part of the case is provided with a screwed cover *l* which is secured



FIGS. 6 AND 7.—SAFETY MINE LAMPS.

in position by a concealed spring catch *m* in the interior of the case. This catch can be released only by means of a magnet or a special key. The cover is hollow, and contains a spring contact switch operated from the outside by means of a close-fitting thumb-screw *r*. The chamber in the cover is made gas-tight by means of rubber washers *t* on each side of the thumb-screw. Plugs and sockets of a special design are provided for charging the cell, and a fuse is enclosed in one of the plugs.—Lond. *Elec. Eng'ing*, Nov. 4

Metallic-Filament Joint.—A note on a recent British patent (20,915, 1908; Oct. 28, 1909) granted to T. McKenna (Glühlampenwerk Anker-Ges.). A coating of the metal, of which the leading-in or supporting wire consists, is electrolytically deposited on the end of the filament. Fusion of the filaments to the wires is then effected in a blow-pipe flame without oxidation of the filaments and a good conducting joint is obtained.—Lond. *Elec. Eng'ing*, Nov. 4.

Electric Gas Igniters.—Wendt.—An illustrated description of the most common systems for igniting or extinguishing gas lamps from a distance by electrical means. The author thinks that on account of their convenience and greater protection against fire electric igniters should be introduced on a larger scale.—*Elek. Zeit.*, Nov. 5.

Generation, Transmission and Distribution.

Reversing Rolling Mills.—C. A. Ablett.—A paper read before the Institution of Engineers and Ship-Builders in Scotland on electrically driven reversing rolling mills. The author described the working of the Ilgner system with flywheel converter, and gave some particulars of the latest forms of rolling-mill motors with forced ventilation. He explained also the control and safety devices employed. It was mentioned that the flywheel sets could be driven directly by steam turbines, and the use of exhaust-steam turbines for such work was suggested.—Lond. *Elec. Eng'ing*, Nov. 4.

Boiler-House Losses.—O. L. Peard.—The writer describes the various fuel losses occurring in daily practice, and deals with the facilities for their detection, allocation and reduction. To increase as much as possible the over-all efficiency it is necessary to investigate the losses taking place, which lie chiefly in heat radiation, flue-gas thermal losses, combustible in ash and clinker rejected.—Lond. *Electrician*, Nov. 5.

Traction.

Single-Phase Traction in Germany.—W. Wechmann.—A continuation of his illustrated article on single-phase traction on the Blankenese-Ohlsdorf-Hamburg Road. In the present instalment the author concludes the description of the new motor-cars. The total weight of each car is 61 tons. The complete electrical equipment of each car weighs 12.5 tons, of which 6.6 is the weight of the motors with gearing; 2.4 that of the main transformers, and 3.5 that of the balance of the electrical equipment.—*Elek. Zeit.*, Nov. 5.

Single-Phase Traction in Holland.—The first part of an illustrated description of the single-phase railway between Rotterdam, The Hague and Scheveningen. The length of double line is 20 miles and of single line, including that in the stations, about 47.5 miles. The three-phase currents are generated in the power station and are changed to two-phase currents at 10,000 volts. The line is divided into two parts, corresponding to two phases. The article is to be concluded.—Lond. *Electrician*, Nov. 5.

Installations, Systems and Appliances.

Association of Austrian Central Stations: Oil as Fuel.—The sixth general convention of the Association of Austrian and Hungarian Central Stations was held from Sept. 26 to 29 in Meran. In view of the rapidly increasing price of coal in Austria, the general subject of discussion was the possibility of using oil as fuel. Sauer reported on extended experiments made at the Vienna municipal central station with oil firing of boilers. While definite results have not yet been obtained, the thermal efficiency is between 72 per cent and 74 per cent. More, the cost for attendance is low, since one fireman can attend to six boilers; the nozzles remain stationary and the attendant has only to regulate a valve. It depends on his skill to maintain a bright flame and to assure smokeless consumption. The chief trouble with oil is due to the rigid official regulations requiring the bringing of the oil to the central station and storing it. Engelmann reported on the use of Diesel engines in various central stations. Detailed experiments have been made at St. Polten with two 800-hp, four-cylinder Diesel engines. At full-load the consumption of 185 grams of oil per hp-hour has been guaranteed; this figure, or even less, has been obtained in practice. At three-quarter load the crude oil consumption was 290 grams per kw-hour. Tests by Ross of two 300-hp Diesel engines and one 500-hp Diesel engine showed a consumption of 266.4 grams of crude oil per kw-hour at full-load, 275.2 grams at three-quarter load and 312.8 grams at half-load (453 grams = 1 lb.). Results from Diesel engines in other stations are also given. In summing up, their disadvantages are said to be the small overload range and the necessity of very careful attendance. The advantages are their high economy and ease of starting quickly. For this reason they are especially useful as reserve machines in stations of medium size. Diesel engines up to 400 hp give excellent results, especially if care is taken in attendance, lubrication and cooling. The saving compared with steam power is quite considerable and amounts in the stations mentioned in the report to from 30 per cent to 55 per cent. Concerning Diesel engines of larger size no definite conclusions can yet be stated, since there is not yet sufficient experience with

such engines in commercial operation over a long time. The storing of the oil requires much less space than that of coal, and the oil can be stored at any distance from the engine. Loaker reported on the possibilities of developing water-powers in Austria. Several reports were submitted concerning the calibration of electricity meters, electric regulations and accident insurance. The large water-power stations in the neighborhood were visited.—*Elek. und Masch.* (Vienna), Oct. 24.

Electricity Supply in England.—W. M. ROGERSON.—His inaugural address to the Leeds Section of the (British) Inst. Elec. Eng. The author gives a short restrospect of the supply of electrical energy for lamps, motors and railway, comparing the present position with that in the early days. Ten years ago there were in Great Britain 93 municipal and 70 private electric supply undertakings; at the end of 1908 the respective numbers were 338 and 203. Taking six typical generating stations, the average cost in cents per kw-hour sold in 1908 was: Coal, 0.92; oil, wages, repairs, etc., 1.40; works costs, 2.32; total costs, exclusive of interest and sinking fund, 3.70; while the average costs in the same generating stations to-day are: coal, 0.52; oil, waste, repairs, etc., 0.60; works costs, 1.12; total costs, exclusive of interest and sinking fund, 1.56, or roughly, each kw-hour sold in 1898 cost over 3.5 cents to produce, while to-day the cost has almost come down to 1.5 cent. Notes are also given on engines, electrical machinery, switchgear, storage batteries, mains, meters and railway apparatus.—Lond. *Electrician,* Nov. 5.

Glasgow.—An account of last year's financial report of the municipal central station of Glasgow. Reduction in the charges for energy, the extensive use of metallic-filament lamps, and the general trade depression are responsible for a deficit of $17,725, the revenue showing a decrease of $38,645 compared with the income recorded a year ago; but in spite of an increased output the working expenses show a reduction of $52,075. The quantity of electricity sold to private consumers during the year ending May 31 last was 32,736,058 kw-hours, compared with 31,087,322 kw-hours during the previous year, being an increase of 5.34 per cent. Public lamps required 1,555,150 kw-hours and 173,703 kw-hours were sold by contract, making the total quantity of electricity sold 34,464,911 kw-hours, an increase of 1,670,104 kw-hours compared with the previous year. The load factor has increased, being now 18.35 per cent. The generating cost per kw-hour sold was 0.84 cent, the distribution cost 0.16 cent, the management cost 0.14 cent, the total cost, excluding capital charges, 1.46, and the total cost, including capital charges (interest and sinking fund) 2.72 cent. The depreciation was 0.74 cent. Since the total receipts were 3.42 cents, there was a deficit of 0.04 cent per kw-hour sold.—Lond. *Electrician,* Nov. 5.

Synchronizing.—J. TEICHMÜLLER.—An article illustrated by diagrams. For alternating-current plants containing more than two machines the problem of devising connections for synchronizing can be solved in many ways. Since many solutions are dangerous and others are inferior, the author gives a systematic review and describes a standard method for the simplest case.—*Elek. Zeit.,* Nov. 5.

Electric Equipment of Tunnel.—E. G. MEYER.—An illustrated description of the equipment of the new tunnel under the Elbe River, in Hamburg, connecting St. Pauli with Steinwärder, for passenger and freight transportation. It is a tube road with elevators at both ends. Under the supposition that each trip takes about two or three minutes, it is estimated that at times of greatest traffic from 6000 to 7000 passengers can be carried over in half an hour. The author describes especially the equipment of the elevators.—*Elek. Zeit.,* Oct. 28.

Wires, Wiring and Conduits.

System of Wiring.—An account of recent developments in the "O. S." system of wiring. Three separate systems are involved under the name of "O. S.," the first of which, the "Kuhlos," has had some vogue in Continental Europe and consists of a plain brass or copper sheet wrapped round ordinary rubber-insulated conductors, while the second system, the "Stannos," is in principle also the same, though tinned copper is used as a covering and is lapped twice round the cable and rendered watertight by a special process. Both of these systems, when erected, are continuous throughout; to allow for this fact numerous special fittings were designed. The third system is the "Kalkos" conduits. The new developments of this system refer to various fittings and accessories.—Lond. *Electrician,* Oct. 29.

Magnetic Properties of Enameled Wire.—R. GANS.—"Enamel wire" (copper with a layer of enamel) as made by a German company, has the two advantages that the space is better utilized and that the wire can be used with a higher current density than if cotton or silk is used for insulation. The author shows that it is also very useful for magnetic experiments in which the utmost utilization of the space is important. Such wire has a magnetic susceptibility of less than 0.0000295. Even for precision measurements the wire may be considered to be non-magnetic.—*Elek. Zeit.,* Nov. 5.

Calculation of Transmission Lines.—A. BLONDEL AND C. LEROY.—A continuation of their serial. In the present installment they give a second example of the application of their method. It relates to an underground transmission line of 100 km (60 miles) length at 10,000 volts with a frequency of 50 cycles.—*La Lumière Elec.,* Oct. 30.

Municipal Wiring.—An article on the pros and cons of the hiring out of apparatus and the wiring of installations by municipal supply stations in competition with private enterprise. The opinions of 19 British municipal central-station engineers are given. The great majority of supply engineers are in favor of hiring out apparatus and of working in conjunction with contractors in preference to municipal wiring. The subject is also discussed in an editorial.—Lond. *Electrician,* Oct 29.

Electrophysics and Magnetism.

Alternating-Current Spark Potentials.—J. DEKOWALSKI AND U. J. RAPPEL.—A paper in which the authors define first a method intended to give as high an accuracy as possible for determining alternating-current spark potentials. The measurements obtained are utilized to examine more closely the theory of the relation between spark potentials and the radius of curvature of the electrodes. Previously it was commonly accepted that the spark would jump when the maximum electric intensity between the electrodes had passed certain definite limits. Since this theory failed to explain all observed facts, A. Russell has added an hypothesis of his own. He assumes that for explosive distances greater than 0.1 cm a certain value is to be deducted, in the determination of the maximum stress, which he terms "lost volts." For air he assumes this value to be 800 volts. The results of the present authors, however, show that the claims of Russell are not justified regarding the constancy of the maximum stress. The results show rather a certain regularity, and for a definite explosive distance a minimum seems to exist. The theory of Russell is, therefore, not a satisfactory explanation of the relations.—*Phil. Magazine,* November.

Crystal Rectifiers.—A. E. FLOWERS.—G. W. Pierce has formally investigated a number of rectifiers, consisting of points resting on crystals. The crystals were anastase, brookite and molybdenite. Of these the molybdenite was by far the most sensitive and possessed the largest current-carrying capacity. The present author has made a further research for a rectifier of large capacity and thinks that galena crystals are the most promising. He uses them in contact with a copper point. The volt-ampere characteristics curves determined show a distinct point at which breakdown occurs. The point occurs at a fairly definite current for any given set of conditions of setting. In general, however, each crystal and each setting will have its own breakdown point. This point may be 15 or more volts with from 30 to 40 milliamperes flowing from point to crystal on fresh rectifying spots and may be as low as 5 volts and 90 milliamperes after several breakdowns. In general, the higher breakdown voltages are reached when the current is small. The material of the point, whether copper, steel, platinum, etc.,

does not seem to matter, nor does the shape of the point or the ratio of contact areas. The chief results are summed up as follows: The rectifying action is produced at the surface, or, in a surface film, and is not due to the point employed. The rectification is not an effect of the sharpness of the point or the ratio of contact areas. The rectifying film will break down at a moderate e.m.f. (6 to 15 volts), which is higher the smaller the current. The rectifying film can be destroyed by the action of the electric current. The feeble evanescent e.m.f. existing after the passage of current in either direction through the rectifier is insufficient to account for the rectification, and its direction is opposite to that which would be required for rectification. There is apparently no difficulty in rectifying currents of very high frequency. The rectification disappears at high temperature—that is, about 270 deg. C., but is partially regained on cooling. The rectifying film can be produced artificially by electrochemical treatment with amorphous sulphur. The rectification is probably due to the electrochemical formation of a resisting film at each reversal.—*Phys. Review,* November.

Crystal Rectifiers.—G. W. Pierce.—A third paper of the author on this subject. In his former work he had obtained the best results with molybdenite in contact with copper. He now finds that iron pyrites in contact with copper are even more effective. He concludes that the rectifying action does not take place through the intermediation of thermoelectricity, but rectification and thermoelectricity may have a common basis. "For example, if we suppose that the surface of separation of two conductors has such a character as to permit the passage of electrons more easily in one direction than in the opposite direction, the boundary will act as a rectifier for alternating currents; it will also give rise to a thermo-electromotive force when heat is applied to the boundary, provided the velocity of the electrons is increased with an increase of temperature."—*Phys. Review,* November.

Musical Arc Oscillation in Coupled Circuits.—E. T. Jones and M. Owen.—If the primary of a pair of coupled circuits, in series with a condenser, forms the shunt to a Duddell musical arc, and if the secondary coil is connected to another condenser, either of two notes may under certain circumstances be heard. The frequencies of the electrical oscillations in the circuits corresponding to the two notes are generally much lower than those calculated for the circuits from the inductances of the coils and the capacities of the condensers, the resistances being neglected. In the present paper the influence of the resistances of the circuits is considered. It is found that the great differences between the observed frequencies of the electrical oscillations in coupled circuits produced by the musical arc and the values calculated from the inductances of the coils and the capacities of the condensers, cannot be accounted for merely by allowing for the resistances of the circuits. The principal cause of the difference is the fact that the arc behaves as if it has self-inductance, which is constant during any particular train of oscillations (though different under different circumstances) and which must be taken into account in calculating the frequencies. Any one of the harmonics of the arc-note up to the sixth can be strongly reinforced by suitably adjusting the ratio of the two frequencies of the system. If the two notes of the arc are equally stable, and if the interval between them is a perfect fifth, a third note may be heard, which corresponds to an electrical oscillation of frequency equal to the difference of the frequencies of the two primes.—*Phil. Magazine,* November.

Multiple Atomic Disintegration.—F. Soddy.—A paper advancing a new suggestion in radio-active theory. The conclusion seems inevitable that the cause of disintegration is apart from the atom. It is difficult to believe that the cause is resident in space external to the atom. It seems more probable that it exists within the atom and at the same time is uninfluenced by it. The author investigates whether necessarily only one mode of instability can exist within the atom at one time. He suggests that multiple modes of disintegration may be proceeding simultaneously and independently within the same atom. There is nothing in this idea opposed to all that is known of the character of atomic disintegration. On the other hand, it is shown that such disintegrations would simulate closely in many respects simple disintegration.—*Phil. Magazine,* November.

Units, Measurements and Instruments.

Measurement of Mechanical Pressure by Electrical Means.—A Lafay.—An account of a paper read before the French Academy of Sciences. The author measures high mechanical pressures by the change of resistivity which electric conductors subjected to the pressure undergo. The following two formulas are given for platinum and for mercury. For pure platinum in the form of a wire of 0.03 mm, the relation is

$$\frac{r - r_0}{r_0} = -1.86 \times 10^{-6} p$$

where r is the resistance and p the pressure in atmospheres. For mercury at a temperature of 15 deg. the pressure p is given by the formula

$$\frac{r - r_0}{r_0} = -32.7 \times 10^{-6} p + 1.1 \times 10^{-9} p^2,$$

the pressure being measured in this case in kilograms per square centimeter.—*La Lumière Elec.,* Oct. 23.

Electromagnets.—A. Berninger and R. Edler.—For the correct design of electromagnets as used in modern apparatus, switches, etc., it is of importance to determine the effect of the Joulean heat produced in the magnet winding upon the operation of the electromagnet, and secondly the relation between the number of amp-turns, the size of the air-gap and the tractive force. In the present installment the authors discuss the effect of the heat of the magnet coils and give the results of their theory in tables and diagrams. The paper is to be concluded.—*Elek. und Masch.* (Vienna), Oct. 31.

Demonstration Apparatus.—R. van Canwenberghe.—An illustrated description of an apparatus for demonstrating alternating-current phenomena and electromagnetic oscillations in the lecture-room.—*Elek. Zeit.,* Oct. 28.

Telegraphy, Telephony and Signals.

Wireless Telegraphy.—von Lepel.—An illustrated article on the Lepel system which is used by the British army. The generator for the production of electrical oscillations consists of two electrodes between which an electric discharge takes place, and with which one or more oscillating circuits are connected in parallel. The working surfaces of both electrodes, of which the negative must be metallic, are parallel to one another and are separated by a gap which is small in comparison with their area. The parallelism of the electrodes renders it possible for the discharge which takes place between them to wander over

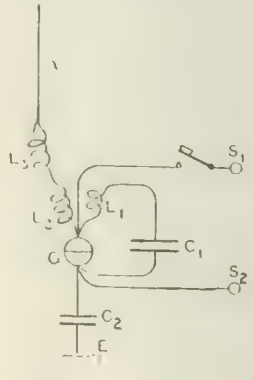


Fig. 8.—Diagram of Wireless Transmitter.

their surfaces without suffering any alteration in length, while the distance between them must be so small—only a fraction of a millimeter—that the heat caused by the discharge is quickly carried away. The voltage on such a generator is, therefore, limited. The two electrodes are separated by a flat ring of solid insulating material (paper) having a hole in the center so as to prevent the discharge from reaching the edges of the plates. It is advantageous to have the materials

of the electrodes different for direct current and the same for alternating current. Thus, for alternating current, pure electrolytic copper may be used for both electrodes, while for direct current it is better to have the positive of copper and the negative, particularly for e.m.fs. below 500 volts, of a specially dense bronze. In order to carry away the heat produced the electrodes are either made hollow and cooled by means of liquid circulating through them, or provided with cooling flanges exposing a large surface to the air. Fig. 8 is the diagram of the usual connections of the transmitting circuits. A is the aerial wire, G the generator, C_1 C_2 capacities, L_1 L_2 coupled inductances, I_3 aerial inductance, S_1 S_2 supply terminals. The current in C_1, L_1 and G has usually the same frequency as that in A, L_2, L_3, G and E.—Lond. *Electrician,* Nov. 5.

Measuring Wave-Lengths.—A. CAMPBELL.—An account of an investigation carried out in the (British) National Physical Laboratory on the measurement of wave-length for high-frequency oscillations as used in wireless telegraphy. The author describes two wave-meters and gives the results of tests. It appears that within the limits of wave-length used, a wave-meter with coils of well-stranded wire gave results in close agreement with theory, while in the case of an instrument with coils of solid wire the agreement was as close as could be expected, as the correcting formulas are only strictly applicable to long solenoids.—*Phil. Magazine,* November.

Automatic Telephone Exchange.—A. KRUCKOW.—An illustrated description of the first small automatic telephone exchange in Germany, which connects a small agricultural district automatically with the next long-distance line. The system is essentially that of Strowger, with some modifications of Siemens & Halske.—*Elek. Zeit.,* Oct. 28.

Wireless Telegraphy for Air-Ships.—K. SOLFF.—An illustrated article on wireless telegraphy between the earth and air-ships. The author makes some suggestions on the arrangement of the aerial wire on Zeppelin's air-ships in order to decrease the danger of ignition and at the same time produce the most favorable electrical conditions.—*Elek. Zeit.,* Nov. 5.

Telegraphy in England.—Extracts from the annual report of the British Postmaster-General on wire and wireless telegraphy in Great Britain.—Lond. *Electrician,* Nov. 5.

Miscellaneous.

Graphical Analysis of Public Service Operations.—L. R. NASH.—The author strongly recommends the use of curves for the general study of operating accounts of large companies. The set of such curves should include figures of the company's earnings, operating expenses, and ratio of expenses to earnings. On account of the importance of proper maintenance in preserving the value of physical property, as contrasted with the transient value of other expenditures, the latter should be shown separately together with their ratio to earnings. This group of curves, which reflects general conditions, should be followed by an analysis of each month's expenses. Maintenance is first deducted, and the remainder divided into standard groups, which for a combined railway and lighting company are energy costs, operation of cars, distribution costs, and general expense. Each of these groups is further divided in turn into suitable component parts. Maintenance is separated into standard divisions, some of which are further analyzed to see that a sufficient amount of work has been done or that it has been done efficiently. Track maintenance is expressed in cost per mile of track per year and compared with a "bogey" by which is meant a carefully predetermined standard. Rolling-stock maintenance is shown in 12 months' perspective and also in monthly costs per car-mile under separate expense account. Power-station operation is shown in monthly unit costs of various separate expense accounts in addition to the 12 months' total. General expenses are not divided so completely, some items, such as rent and insurance, not being subject to fluctuations. Car operation is shown in part on a car-mileage basis. In connection with these curves certain physical data intimately related thereto are given, such as car-miles, power-station output, energy per car-mile, etc. Such a set of curves permits the quick location of operating irregularities, and the quick grasp of operating conditions gives leisure and stimulus for attacking vital problems of policy and expansion without which successful administration is impossible.—*Stone & Webster Pub. Serv. Jour.,* November.

Military Corps of Engineers.—An illustrated article on the work of the London Division of the Corps of Royal Electrical Engineers, describing competitive work recently carried out by the different companies.—Lond. *Electrician,* Nov. 5.

BOOK REVIEW.

DIE ENTWICKELUNG DER TELEGRAPHIE UND TELEPHONIE. By Richard Hennig. Leipzig: Johann Ambrosius Barth. 199 pages, 61 ills. Price, 4 marks.

This volume constitutes a member of the Barth *Wissen und Können* series of volumes. It is a historical review of the development of the arts of telegraphy and telephony up to the year 1879. That is to say, the book is a history of early telegraphic and telephonic development from the earliest times. Reference is made to the early optical and acoustical telegraphs of Greece, Rome and other ancient civilizations. The book will have great interest to the student of the history of electrotechnics.

NEW APPARATUS AND APPLIANCES

Continuous Blue-Print Machines Equipped with Cooper Hewitt Lamps.

BY DR. JOSEPH C. POLE.

As a cheap and convenient way of copying drawings, the method of blue-printing has always been of very valuable assistance to the engineer; its development, however, has not always kept in line with the growth of engineering. Only recently, chiefly in the United States, and there principally forced by the high cost of labor, more attention has been paid to blue-printing apparatus, which within a comparatively short time have advanced to a high degree of efficiency. Lately, others besides engineering trades have taken up this convenient method of reproduction and now there are already many concerns which are using it for copying office records that are changed daily and that have to be made in large quantities.

The need for an increase in copying speed and for independence of daylight and weather naturally led to the use of artificial light, and the mercury-vapor lamp in a short time occupied an important place and also influenced the construction of blue-print apparatus.

The mercury-vapor lamp transforms a very high percentage of the power consumed into actinic radiation and for photographic purposes is more economical than any other known source of light. Another advantage is its long life, thus doing away with operating expenses, and, furthermore, it can be handled by unskilled workmen if the construction of the machine itself is sufficiently simple. As the efficiency of transformation of electrical energy into light in the mercury arc is very high, the production of heat is a minimum, so that the paper may be brought quite near the lamp, thereby obtaining a compact construction with concentrated light effect, and still excluding the danger of paper or celluloid being set on fire

as with arc lamps. The long light column of the mercury-vapor tube, being adaptable to any paper width and being of uniform surface intensity, represents, when in a rotary blue-print machine, a source of light which, as to equality, can compete with diffused daylight. Because of the even illumination the

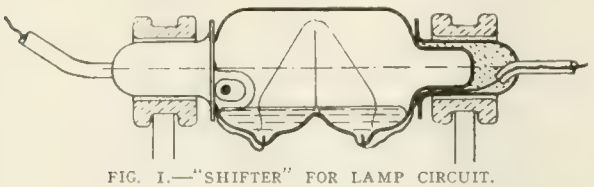


FIG. 1.—"SHIFTER" FOR LAMP CIRCUIT.

copying process need not be watched; it is sufficient to work with ordinary copying frames according to a certain set time or with automatic printing machines after having once determined the proper speed according to the transparency of the tracing and the sensitiveness of the paper.

Of the contrivances developed for blue-printing with Cooper Hewitt lamps the continuous blue-print machines are especially worthy of notice. Two different principles of construction are employed. In the first the lamps are placed inside of a glass cylinder which rotates on its axis and, by means of belts, carries along the tracing and paper pressed on from the outside. In the second kind, the glass cover surrounding the lamps is stationary and merely serves as a guide as the paper passes (and need not, therefore, be made in one piece and of a circular cross-section).

The rotating cylinder has the advantage of small friction and does not cause any tractive strain on the paper. On the other hand, the cylinder must have an exactly equal circumference at all points, and is, especially with the large diameters, expensive and difficult to manufacture.

The arrangement with stationary glass cover admits, on the contrary, the use of cheap glass that is not injured by slight unevenness and when normally annealed is not especially inclined to crack. With the application of three or four lamps in one machine with this arrangement the light is utilized better than with the first mentioned, as each of the mercury-vapor tubes does not absorb so much of the effective light of the others. Yet there is the disadvantage of the paper being pulled over the glass causing a greater friction and strain.

THE ELECTRICAL PART OF THE BLUE-PRINT MACHINES.

The lamps manufactured by the Cooper Hewitt Electric Company for blue-printing purposes are exclusively the stationary

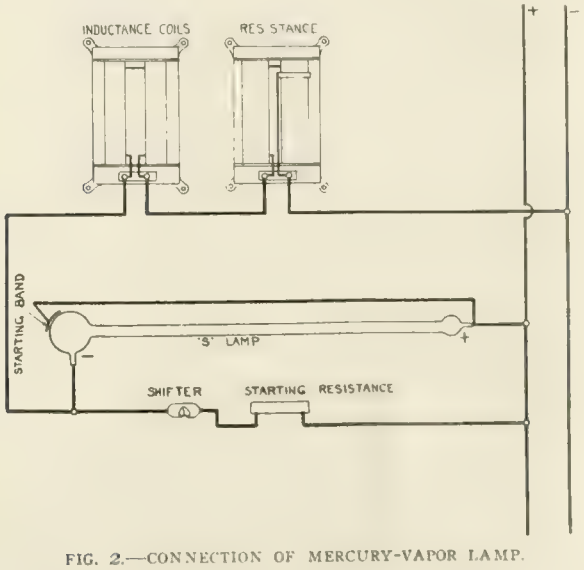


FIG. 2.—CONNECTION OF MERCURY-VAPOR LAMP.

horizontal-burning type for direct current. They may be connected on alternating-current lines by means of mercury-arc rectifiers.

The starting of the lamp is performed by means of a high-tension kick, created by quick interruption of the magnetizing current of an induction coil which is in series with the vacuum tube. The interrupter for this purpose, or so-called "shifter," consists of an evacuated glass vessel, as appears in Fig. 1, with two mercury electrodes, the contact of which is closed or opened by turning the shifter-holder by hand.

The electrical connections of the lamp are indicated in Fig. 2, which shows a single lamp on 110 volts. Inductance that serves for starting and steadying the mercury arc and a regulating resistance are in series with the lamp tube; in the shunt are the shifter and a shifter resistance that limits the magnetizing starting current to about 1 amp.

Machines for greater printing speeds are provided with two tubes that are connected in multiple on 110-volt or in series on 220-volt lines. In both of the latter arrangements use is made of a "starting inductance." This is a coil of great self-induction coefficient which in order to obtain an effective high-tension kick for starting, the lamp, is brought in series with the main inductance, and after the mercury arc is created is short-circuited.

THE MECHANICAL PARTS OF THE BLUE-PRINTING MACHINES.

(a.) The first and original continuous machine which has led to the development of all other similar types was the

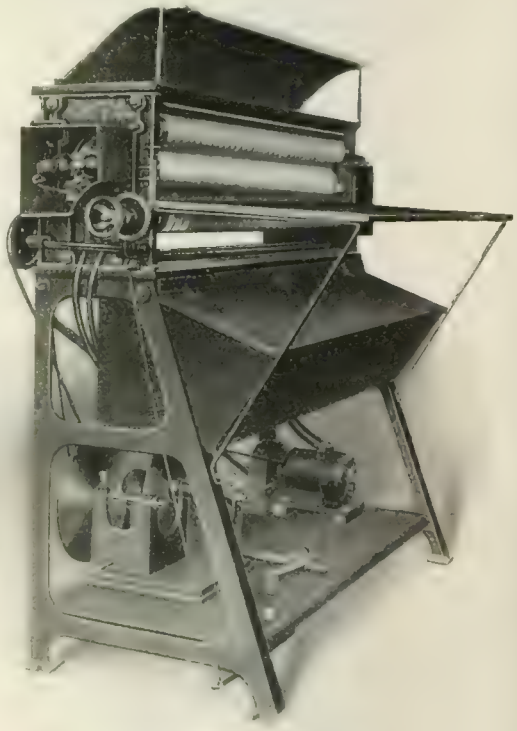


FIG. 3.—BLUE-PRINTING MACHINE.

Everett-McAdam machine, manufactured by the Revolute Machine Company, New York, N. Y. In this machine a horizontal glass cylinder containing generally two Cooper Hewitt tubes, as described above, lies in a series of 30 narrow belts which traverse three-fourths the circumference of the cylinder and return over wooden rollers. Paper and tracing are inserted between the belts and the glass cylinder, and rotate together with it. After a three-fourths revolution they are delivered into a receiving box. The last quarter of circumference that is not flanked by the paper is utilized by a reflector. Of the four rollers one is a drive roller, the other idlers. The first one is driven by a worm from a ⅛-hp electric motor by means of several pulleys and friction wheels.

The regulation of the paper velocity is accomplished at constant motor speed by a lever which moves a leather-shod wheel running between two friction disks. The rotation of the cylinder may be instantly stopped by pressing the handle down, thus lifting the worm off its gear, whereupon the glass cylinder can easily be turned in either direction by hand, if necessary to straighten the paper.

The traveling belts are of white-cotton webbing, and their tension can be changed by adjusting one roller with a screw.

The subdivision into many narrow belts is to secure a good contact of the paper and to allow the escape of air. The motor drives, in addition to the cylinder, a small fan for the ventilating of the lamps and glass cylinder. The machine is sometimes equipped with a feeding table, as in Fig. 3, and with a top

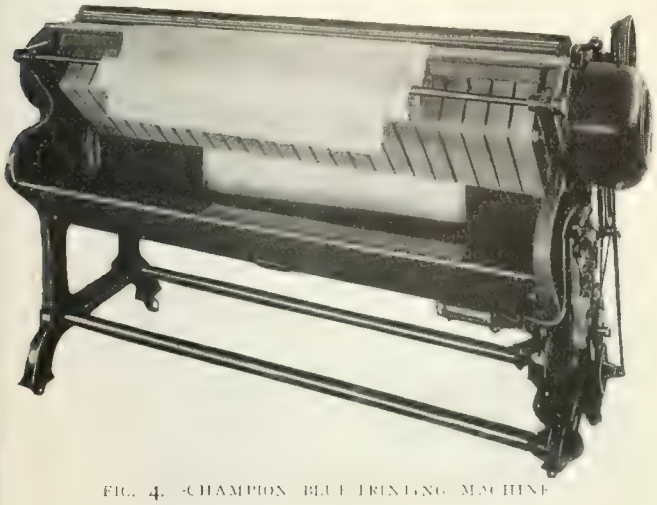


FIG. 4. CHAMPION BLUE PRINTING MACHINE.

casing, from which the sensitized paper is directly fed to the lamps.

The standard machine of this type has two lamp tubes, the light column of which is about 12 in. longer than the paper; a third lamp may be added when increased printing speed is wanted. The maximum paper width is 42 in. or 54 in., and the printing velocity from 3 ft. to 5 ft. per minute; the total power consumption is 1700 watts (including the motor).

(b) It is upon similar principles that the "Champion machine," made by the Keuffel & Esser Company, Hoboken, N. J., is based. The main difference between this and the above-described machine can at once be perceived by comparison of Figs. 3 and 4. In the Champion machine the space between feed-



FIG. 5.—"DUPLEX" BLUE-PRINTING MACHINE.

ing-in and unrolling paper edges is reduced to a minimum by placing the upper rollers close together, thus saving the light lost in the reflector. The traveling belts of rubber are, as above, driven, by rollers by means of a worm gear and step pulleys from a small motor. One roller is adjustable by screws in order to give the belts the proper tension. The paper width is 54 in.; the copying speed and watt consumption are about the same as in the Everett-McAdam machine.

(c) To the second kind of construction mentioned in the introduction belongs to the "Tec Duplex" machine, made by the Technical Supply Company, New York. Two strong glass panes, Fig. 5, of an elliptic shape, the lower one being fixed in the machine frame, and the upper one movable, surround from two to four Cooper Hewitt tubes. Twenty-five narrow rubber belts for the upper glass cover and as many for the lower one, each moved by a drive and two guide rollers, seize the paper which is fed in at the front and pass it over the glass across the lamps. The belts are stretched by adjusting the bearings of the middle rollers. The upper machine frame, being equipped with a roll top, is suitable for storing prepared paper and is so arranged as to be turned on pivots, thus making both glass covers accessible for cleansing, even while the machine is in operation.

As is evident, it was the designer's object to make the two halves of the machine perfectly independent, and the same idea is followed out in the driving mechanism. A ⅛-hp motor operates the driving rollers through step pulleys, bevel gears and a double worm gear. By means of spur and chain gears

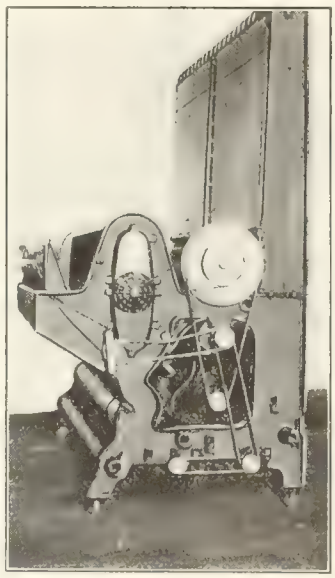


FIG. 6.—DE LUKACSEVICS BLUE PRINTING MACHINE.

connected to clutches and operated by two levers, the two driving rollers may be coupled in the following ways:

1. In series; that is, both rollers having the same speed and feeding in the same direction, the paper thus performing a full revolution (with double velocity). 2. In multiple; that is, the rollers having the same speed, but feeding in a different direction; thus two tracings can be printed at the same time, each of them performing half a revolution (with single velocity). 3. Independently; the rollers feeding in different directions and with speed ratios of 1:4 or 1:8 for simultaneous printing of two papers with different sensitiveness—that is, blueprint and Vandyck.

The lamps are ventilated by a fan situated at the negative lamp end and enclosed in a hopper.

The glass panes measure 24 in. x 56 in., respectively, for a paper width of 54 in. The maximum obtainable paper velocity is about 3.5 ft. per minute for two tracings or 7 ft. per minute for one tracing.

Mr. Charles de Lukacsevics, to whom is due the design of the "Champion" and "Tec Duplex" machines, has recently developed an excellent type, made by the Acme Engineering & Machine Works, New York, as represented in Fig. 6.

The principle of the bipartite elliptic glass cover is retained also in this machine, but by reversing the axis of the ellipse a handy paper feeding and convenient arrangement of the driving mechanism is reached. The back part of the glass is again

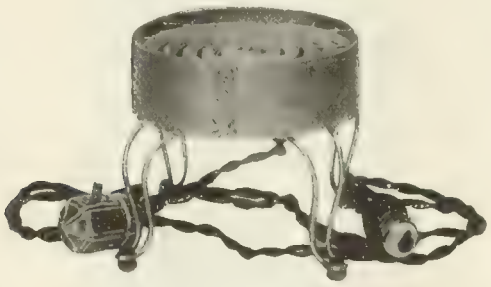
fixed in the cast-iron frame of the machine, the front part being arranged for opening.

The Cooper Hewitt tubes are placed inside in well-insulated clamps, one above the other. Paper and tracing are inserted on the top, guided by 25 rubber belts which travel across the glass until after a full revolution they run off near the starting point. The belts are kept in tension by the adjustable roller bearings, and are driven by bevel and worm gears by means of a chain and two cone pulleys from the electric motor, the latter also driving a fan for the lamps. The paper velocity is controlled by adjusting the belt, coupling the two cone pulleys.

A principal part of the machine is the contrivance for sensitizing the paper. Plain paper runs from the storing roll over two preparing rollers, where it receives the sensitive coating from the bath. It is then led over a series of guide rollers and dried by electric heaters, finally feeding directly into the exposing contrivance. The heating is done partly by the current of the lamp resistances and partly by extra current. The preparing and exposing apparatus can be run together or independently, so that it is possible to make extra blue-print paper.

Electric Toaster.

The Hoskins Manufacturing Company, of Detroit, has just placed on the market its first domestic, electrically heated appliance—the "Toastove." This device has a spirally coiled, exposed heating element, indented in the surface of the white composition heat-insulating block. The flexible twin-conductor cord with lamp plug, to fit any standard Edison socket, and the included pendant switch, that lays on the table beside it, combine to make the "Toastove" an attractive and useful addition to the dining table. The wire used for the heating element of the stove is that which has been used for years in the Hoskins electric furnaces. This first application of the electric furnace resistance element to comparatively low-temperature uses should prove an important step in the production of successful electrically heated appliances.

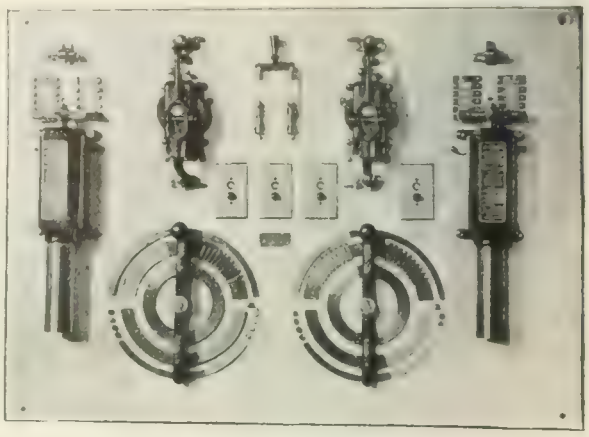


ELECTRIC TOASTER.

Controlling Panel in "New Theater," New York.

The controlling panel shown in the accompanying illustration is used in connection with the drape curtains in the New Theater, recently opened in New York City. This panel is on the stage director's board just back of the proscenium arch at the left. It comprises separate control for one 5-hp and one ½-hp motor, the former operating two pairs of front curtains which are pulled up diagonally, while the ½-hp motor operates a pair of curtains which are slid sideways from center to open. The timing of the movement of the back curtains is automatically accomplished by mechanism on the controlling apparatus, so that the third, or back curtain, begins to open a certain length of time after the front curtains have opened a certain distance.

On the panel are shown two "Clapper" switches with dynamic brake contacts, two "Acme" solenoid starters, two reversing speed-regulating hand controllers and four push buttons controlling the main magnet switches. The button in the center is a master button to control the buttons each side of it. The one at the extreme right is a button which permits the movement of the back curtain when the front curtains are closed. The direction and speed of the motor operating these curtains



CONTROLLING PANEL IN "NEW THEATER."

are set by the position of the hand-speed regulating arm. Limit switches are provided to slow down automatically the motors as the curtains approach their limit of movement, and other limit switches are provided to stop automatically the motors when the curtains reach their open or their closed positions. The use of such controlling panels is becoming general in modern theaters, and the extent to which such elaborate forms of control may be used is rapidly becoming more appreciated.

Power Plant at Argo Works of the Corn Products Company.

Among the private power plants in the Chicago area it would be difficult to find one more carefully designed to give the greatest economy in operation than that supplying steam and water, electrical energy and compressed air to the new works of the Corn Products Refining Company at Argo, Ill. Argo is a suburban settlement about two miles west of Chicago, and here the company has 124 acres of land in a strip nearly a mile long, extending from the Joliet highway to the Drainage Canal. With Indian corn as its raw material the company manufactures glucose, starches of all kinds, syrups and sugar. It has several large plants in the West, that at Argo, which is still unfinished, being the newest. It is said to be the intention of the company to make Argo the center of the glucose industry. There will be about 30 buildings in the establishment, all of steel and concrete, and such a liberal provision is made for daylight lighting that the walls have the appearance of being simply casings for windows, which form so great a proportion of the wall area that the visitor realizes he is in a region of glass houses. The lump-starch department is now running, and many of the other buildings are nearly completed.

The power house is placed at about the center of the property and, like the other buildings, is of steel and concrete construction and notable for the abundant provision of natural light. The engine room and boiler house are parallel to each other, and ample space is left for extension, the present engine plant being about one-fourth of the completed plant, while the equipment of boilers is about 30 per cent of the ultimate plant. The firing floor in the boiler room is placed about 12 ft. above the level of the engine-room floor. There are four round stacks built of radial brick. They extend 180 ft. above the grate bars of the furnaces and have an internal diameter of 7 ft. The stacks begin at the roof of the boiler house, 46 ft. above grade, and are supported on a massive steel structure.

The breeching from the boilers goes directly upward into the stack, with only one bend, making a very direct draft. One stack is provided for every two boilers, and every boiler in the whole station will have exactly the same draft as every other boiler. The placing of the stack on the roof saves floor space and makes the arrangement of the engine and boiler rooms more compact. There is simply a concrete wall between the two divisions of the power house.

Only about one-half of the steam generated in this station is used for power purposes. The remainder is supplied to various departments for cooking and evaporating purposes. The present power plant includes eight water-tube boilers, two large electric generators, an outfit of pumping machinery of impressive size, a cross-compound Corliss air compressor built by the Allis-Chalmers Company, having a capacity of 3000 cu. ft. of air a minute; a 20-ton overhead traveling crane, a large switchboard and the various exciters and boiler-room auxiliaries needed for the operation of a large plant. Ultimately the power house will contain 28 500-hp boilers and four 1500-kw generating units, while the other equipment will be correspondingly increased.

In the engine room a railroad switch track extends for one car length at the west end of the building and permits machinery to be unloaded easily. In the boiler room a railroad track extends the full length of the room. This is provided for emergency coal supply should anything happen to the coal-handling apparatus. It is interesting to note that the foundations for this track are entirely independent of those for the building and boilers, so that the running of loaded cars in the boiler room will not cause the setting of the boilers to crack from the vibration. There are separate toilet rooms with shower bath for the engine-room and boiler-room crews, and each division also has a separate toolroom. The floor of the engine-room is of compressed black and white cement tile, and the whole appearance of the plant is spacious and airy. Wherever the concrete foundations for machinery extend above the floor line they are enameled in black, so that they will have the appearance when finished of cast iron.

The coal and ash-handling apparatus is elaborately and carefully worked out. There is a gantry coal-handling equipment on the roof of the boiler-house, with two-ton grab buckets which hoist the coal from cars on a track outside the power-house and discharges it in 50-ton bunkers flush with the roof. There is one of these bunkers for each boiler. Below it is a 25-ton scale hopper for each boiler, so that the coal consumed can be individually weighed for each boiler unit. The coal is distributed to the chain grates of the boiler furnaces by fan-tail chutes attached to the bottom of the scale hoppers. The firing floor is 12 ft. above grade. The ash and fine-coal hoppers below the boilers are made of concrete. The empty coal cars are run underneath the boiler-room floor, and by a system of cast-iron valves the entire bottom of the ash hopper can be opened to dump the ashes into the cars. The fine coal sifted through the chain grate falls into the fine-coal hopper and is lifted up by grab buckets and returned to the coal-handling apparatus above.

At present there are eight 500-hp Babcock & Wilcox water-tube boilers provided with chain grates, as stated. All boilers are set singly, with a full set of clean-out doors on each side. On the steam line of each boiler is placed a Golden-Anderson cushioned, triple-acting, non-return valve, with pilot valve placed in a position to be readily accessible and convenient to the firemen. Each boiler is equipped with a recording flue-gas thermometer and a recording draft gage; also with recording CO_2 indicator. All of the indications from these instruments are shown in a case at the boiler front, and the arrangement is exceptionally accessible and convenient. All boiler-room auxiliaries, as feed pumps, feed-water heaters, oil filters and the like, are placed in a room with a 22-ft. ceiling under the boiler-room. The boiler-room is so high above the ground that the auxiliary room under it is amply lighted by windows at grade.

In the engine-room there is a 1500-kw, 600-volt, 25-cycle, three-phase alternator directly connected to a cross-compound engine turning at 107 r.p.m. Both engine and generator were built by the Allis-Chalmers Company. This is the principal generating unit of the present plant, and three others like it are to be added as the plant is extended. In addition, in the present plant, there is a 600-kw Allis-Chalmers alternator similar to the 1500-kw unit, only of smaller size. This is the auxiliary or reserve unit and it is operated when the large machine is shut down. The plant is run non-condensing. Both engine-driven and motor-driven exciters are provided, the latter having synchronous motors. There is also a direct-current generating set driven by a synchronous motor for supplying electricity to variable-speed motors in the toolroom. When the plant is finished there will be at least four of these sets, and the synchronous motors will improve the power factor.

The switchboard is of slate and is composed of 30 panels, blank panels being left for future generating units. A panel is provided for each of the 14 departments of the works, and there are individual recording and integrating wattmeters for each department, so that the consumption of electricity can be accurately determined. The motor and lighting circuits are wired directly from the switchboard, there being no other center of distribution about the premises.

Nearly 400 25-cycle General Electric motors will be installed in the various departments. These range in size from 110 down to 5 hp. Twenty-four of the motors are directly connected to pumps, five of these being vertical motors driving vertical pumps of the Byron-Jackson type operating in wells 1600 ft. deep. The remaining motors drive machinery for the various departments in the different mills, as starch-grinding mills, vertical stone mills, attrition mills, long line of shakers and conveyors, corn-cleaning machinery, elevator machinery, etc. The electric cables from the switchboard are laid underground, either in separate clay conduits or in fiber conduits, both embedded in concrete. Manholes leading to the electric cable conduits are provided for every building. The plans for lighting are not fully determined, but the yards and power-house will be illuminated by arc lamps, while incandescent lamps will be used in the other buildings. Two mercury vapor lamps are used in the lump-starch house.

The water supply in a manufacturing establishment of this character is of great importance, and very careful attention has been paid to this feature in designing the works. There are two sources of supply. One is the water from the Drainage Canal, which is used for boiler feed and also for condensing purposes. At the bank of the canal there have been installed three pairs of centrifugal pumps driven by electric motors. One pair of these pumps has a capacity for delivering 3,000,000 gal. of water a day; one pair is of 2,000,000 gal. capacity, and the third set is of 5,000,000 gal. capacity. The canal water is brought to a concrete tank 40 ft. x 20 ft. x 15 ft. located in the basement of the engine-room. From this tank Laidlaw-Dunn-Gordon Corliss cross-compound pumping engines of 5,000,000 gal. capacity force the water to the points where it is needed about the premises at a pressure of 50 lb.

The other source of water supply is from five deep wells 16 in. in diameter and 1600 ft. deep, driven by vertical electric motors, as previously mentioned. The well water is used in the manufacturing processes, as for steeping corn, etc. It is also used for fire protection, and a storage reservoir of 100,000 gal. capacity in an outdoor concrete tank, 60 ft. x 100 ft. by 15½ ft. deep, is provided for this purpose. A pumping engine similar to that used for the canal water, but having a capacity of 2,000,000 gal., forces the well water about the premises at a pressure of 75 lb. As an auxiliary to both of these pumps a Burnham twin-tandem compound pump of 5,000,000 gal. capacity can be used for pumping either canal or well water. It is arranged so that the entire pump or either side of it can be used for this purpose. Additional pumping equipment to be

added to the complete plant comprises a 5,000,000-gal. pump for well water and a 7,000,000-gal. pump for canal water.

A tunnel 12 ft. high and 16 ft. wide extends from the power-house in either direction, and through it all live-steam, water and exhaust-steam headers extend to all buildings. In this tunnel is also placed the compressed air piping and, in fact, piping of all descriptions necessary to connect the power-house center with the remainder of the works.

For fire protection a separate concrete building with roof flush with the ground has been erected just outside of the power-house and adjoining it. This contains three steam fire pumps, each having a capacity for supplying 1000 gal. a minute. Connected with this fire-pumping station is a complete system of hydrants and sprinklers located about the premises and in the various buildings. Great pains have been taken to comply with the requirements of the underwriters in every respect.

The whole engineering equipment is most complete, modern and carefully planned. It was designed and constructed under the direction of Mr. J. J. Merrill, chief engineer of the Corn Products Refining Company, of Chicago, who has charge of the electrical and mechanical engineering features of all of the company's plants.

A Large Self-Cooling Transformer.

The maximum size for which a transformer can be built self-cooling is limited by the amount of heat-radiating capacity for which the case can be designed. Standard cases with corrugated sides are regularly supplied with transformers up to about 600 or 750 kvâ, but beyond this size the weight and size



SELF-COOLING TRANSFORMER.

of the case became so great that some method, other than mere increase in size, must be resorted to in order to get the necessary radiating surface.

A type of case recently developed by the Westinghouse Electric & Manufacturing Company overcomes this difficulty and is capable of being designed for a greater radiating capacity than has ever been attempted for a self-cooled transformer. It consists simply of a plain boiler-iron case, to the outside of which are welded a number of radiating tubes. These tubes are in the vertical position and are given a 90-deg. bend at the top and bottom where they enter the case. The mechanical construction is very strong, so that there is practically no chance of the case leaking. Because of the ease with which the tubes can be widely separated from one another, the air circulates very freely among them, and the efficiency of the radiating surface is considerably higher than for the ordinary corrugated case.

There is a growing demand for large self-cooled transformers in substations and other places where water for cooling purposes is either not available or else very costly, or where weather conditions are so severe that water-cooled transformers may give trouble, or where it is desirable to have as little attendance as possible.

The Westinghouse Electric & Manufacturing Company has just built 12 1000-kw, 100,000-volt transformers of this type, shown in the illustration, for the Southern Power Company; three of these transformers are for outdoor service and nine for indoor.

Exhibits at the Boston Electric Show.

In addition to the central exhibit of the Edison Electric Illuminating Company of Boston, described elsewhere, which is in charge of Mr. Herbert W. Moses, many of the prominent electrical manufacturing companies have noteworthy exhibits at the Boston Electrical Show.

The General Electric Company's booth is located in the central part of the hall to the right of the middle aisle. A large variety of lamps, motors and heating equipments is shown, including motor-driven tools, heating equipment for domestic and industrial service, flaming, intensified and multiple-arc lamps, sewing-machine motors, tungsten lamps of all sizes and for various voltages, automobile lamps, switchboard instruments and mechanisms, motor-starting compensator panel for remote control, Christmas-tree lighting outfits and street series tungsten-lamp bracket, miniature and sign lamps. Among the newer features is a 2-hp, 220-volt repulsion-induction motor with a commutator for starting and taps for alternating-current operation alone at full speed. A full line of small induction motors, from 1/30 hp up, is shown, with a display of large and small electric fans in operation. Ceiling fans and blowers are shown, with a variety of starting boxes and rheostats. The electric heating exhibit comprises a full line of cooking utensils, including a new chafing dish with extra cooking pan, an attached switch preventing the necessity of withdrawing the plug when cutting it out of service; a new 700-watt sealing-wax heater with three-heat switch attached, and a percolator with single drip. Toast is made electrically for visitors. The heating division is in charge of Mrs. Howard Collins, of the Boston office, assisted by Miss Schobecker, of Schenectady. Other representatives present are: Messrs. F. H. Gale, manager advertising department, Schenectady, in general charge; C. B. Davis, manager Boston office; J. P. Felton, manager supply department, Boston; Messrs. Brown, D. G. Brokaw, R. B. Hampson, George Hunter, S. W. McCollum, Jr., O. F. Brastow, Boston; F. W. Willcox, Harrison, N. J., and C. W. Bettcher, Harrison, N. J. The exhibit was installed by Mr. L. W. Shugg, Schenectady.

The Westinghouse Electric & Manufacturing Company is occupying a large booth on the left side of the center aisle, and is making a specialty of household devices, including electrically heated and motor-driven utensils and equipment for a wide variety of domestic service. Industrial applications are also shown throughout an extensive range. The company has four demonstrators. One operates the Westinghouse toaster stove, which is used for corn popping for the first time in public, and the second the electric flatirons displayed. The third operates a motor-driven sewing machine, and the garments made are ironed electrically and then donated to charity. The fourth demonstrator operates a "Free" sewing machine in connection with the making of fancy patterns. The electric motor display includes a variety of machines for direct connection power service. Among these are the Pittsburgh rotary air pump, Royal meat choppers and coffee grinders, Burroughs electric adding machines, Sirocco fans and blowers for portable and stationary services, erasing outfit for draughting-rooms, American forge blower, and Miller-Tyson ice-cream freezer. Th

company is represented by Messrs. G. M. Bates, manager of the Boston office; R. Barnes, Jr., of Pittsburgh, and Messrs. C. P. Wahn, I. P. Sprague, M. B. Chase, S. S. Bell, George Gibbs, George C. Ewing and S. S. J. Morgan, of the Boston office.

The Electrical Testing Laboratories, New York, exhibited a large cabinet showing the effects of different illuminants on the colors of the spectrum. A new device shown by this organization consists of a portable testing box containing a millivoltmeter, battery of three cells, resistance shunt, 75-ft. tape and small tool compartment, the outfit being only 7¼ in. square by 11 in. high. All the resistance is in when the cover is closed to protect the photometer lamps. The laboratory is also showing a standard Sharp-Miller portable photometer.

The Engineering Department of the National Electric Lamp Association is showing a full line of tungsten, tantalum and Gem lamps. A new feature of the exhibit is a cabinet showing the different stages in the manufacture of a carbon incandescent lamp, from the cotton to the completed bulb and filament. A similar cabinet shows 13 different steps in the preparation of a tungsten filament, from wolframite to the final treated wire. The organization is represented by Messrs. P. F. Bauder, A. C. Andrews and C. O. Brandell, all of Cleveland.

The Westchester Appliance Company, Boston, features a line of its No. 6 square and round dry batteries. A seven-tube vacuum lighting outfit is installed and operated by a small motor. The current for the tubes is supplied through an induction coil connected with the company's batteries.

The Boston Elevated Railway Company has taken a large exhibit space and is showing a complete automatic working model of the company's elevated track and third-rail construction, equipped with an electric locomotive and full-sized block signals. A full-sized working electro-pneumatic interlocking track switch of manganese steel is also shown, with a display of all the kinds of wire and cable used by the company. The exhibit was prepared in a week by the inspector of signals, Mr. W. C. Smith, and the roadmaster, Mr. H. M. Steward, assisted by a force of 50 men. The signals are of the Union Switch & Signal Company's make. The exhibit is in charge of Mr. George Sabin Brush.

Elaborately decorated floats are operated on the lines of the Boston Elevated Railway Company each night to advertise the show. These are equipped with electric signs, ornamental lamps, tastefully draped curtains and artificial sprays of leaves.

The Invincible Electrical Renovators Sales Company, Boston, is exhibiting domestic and junior machines for vacuum cleaning. These machines are of the two-stage turbine type with a single moving element, aluminum casings and pipes. The company is represented by Messrs. A. W. Patterson, Jr., manager, and C. F. Patterson.

The Albert & J. M. Anderson Manufacturing Company, of Boston, displays a full line of electric time switches, knife switches for single and multiple-blade service, switchboard and copper fittings, trolley insulating material and cell switches, and a 400-amp remote-control switch and circuit-breakers. Representatives in attendance are Messrs. Andrew Anderson, George Crane and Alf. Anderson.

The Allis-Chalmers Company, Milwaukee, is exhibiting a line of power equipment, including direct-current and alternating-



GENERAL VIEW OF BOSTON ELECTRICAL SHOW.

current motors, transformers of various sizes, air compressors and a motor-driven installation of line shafting, coupling and clutch equipment. Mr. Frank Bolles is in charge of the exhibit.

The Duntley Manufacturing Company, of Chicago, is exhibiting five sizes of its electrically driven pneumatic cleaner outfits, including a cleaner installation for domestic service and a carriage plant for industrial operation, hotels and large mercantile establishments. It is represented by the Edison Electric Illuminating Company, of Boston, agents for the Duntley company in the territory served by its lines.

The Stuart-Howland Company, of Boston, is showing a full line of Paiste wiring material, Excello arc lamps for alternating-current and direct-current service, "Daylight" arc lamps, heater, motor and lamp supplies at its booth on the center aisle of the show. Among the specialties exhibited are flatirons, the "El Tosto" toaster and miscellaneous small domestic heating appliances made by the Pacific Electric Heating Company, of Ontario, Cal.; Allen-Bradbury controllers for heavy motor starting on the carbon-disk principle, Fabious-Henrion carbons, Hartford time switches, Krantz switchboard material, Chase-Shawmut fuses, Crous-Hinds condulets, Carey inner globes and enameled-steel reflectors, the Ilg Electric Ventilating Company's (of Chicago) motor-driven fans and blowers, the Gray telautograph, American arc rectifier for storage-battery charging, Holbrook excess-current register and Sterling line of lamps and ornamental shades. The company is represented by Messrs. G. M. Stuart, A. H. Howland, A. E. Payne, C. R. Fish, G. H. Wahn, J. T. Hessel, F. Mullock, S. P. Thierman, H. McKay and J. B. Bailey.

The Boston Electrical Contractors' Association is occupying an illuminated arbor near the entrance of the hall, the exhibit covering wooden-molding, iron-conduit cleat and metal-molding wiring systems, enclosed fuses, sign flashers, fan motors, cabinets and cut-out boxes, ornamental hanging lamps, Christmas-tree electric lighting, electric fountain and a Standard Electric Time Company's clock. Mr. T. W. Norris is in charge.

Mr. Leon W. Bishop, of the Tri-Mount Wireless Supply Company, of Boston, is showing in operation at the exhibition the Bishop wireless telephone. Mr. Bishop is also giving lectures at the hall in connection with his exhibit on the subject of wireless telephony and telegraphy. In attendance are Messrs. L. W. Bishop and Robert A. Chandler.

The Edison Manufacturing Company, Orange, N. J., is showing a line of moving-picture machines and giving six exhibitions of dramatic subjects in the lower hall each day. The Edison Business Phonograph Company, of Orange, through its New England representative, the Eastern Talking Machine Company, of Boston, is exhibiting motor-driven phonographs for mercantile use, the motor being of the universal type and capable of operating on a direct-current or any alternating-current commercial lighting circuit without regard to voltage and frequency. The two companies are represented by Mr. M. J. Reid, of Boston.

The National-Acme Manufacturing Company, of Cleveland, is showing a motor-driven screw-making machine. The company is represented by Messrs. Henn, Judd and Brunner.

The Stackpole Battery Company, of St. Marys, Pa., is featuring its arc-lamp carbons, dynamo brushes and carbon brushes for moving-picture machine motors. The company is represented by Messrs. H. E. Stover and O. L. Turgeon.

The Bay State Electric Company, of Boston, is displaying ornamental lamps for banquet table use. The company is represented by Mr. C. A. Rounds, manager.

The J. H. Day Company, Cincinnati, is exhibiting a full line of motor-driven bakery machinery, including dough mixers as used on the battleships of the United States Navy; icing machines, kneaders, pulverizers, churns, driers and also paint and ink-making machinery. In attendance are Messrs. G. H. Petri and E. A. Johnson.

The W. S. Quinby Company, Boston, is showing motor-driven coffee roasters. It is represented by Mr. Elmer French.

The Electric Boat Company is exhibiting a model electric submarine torpedo boat by its representative, the Electric Storage Battery Company, of Philadelphia.

The Electric Cleaner Company, of Chicago, exhibits a line of portable cabinet cleaners of the motor-driven, closed type, with parts of the apparatus thrown open for inspection. The company is represented by Mr. A. B. Cousin, of New York.

The Shelton Electric Company, Boston, is displaying vibrators, hair driers; and Knight & Lowenburg, Boston, are exhibiting x-ray cabinets, fluoroscopes and a static machine using mica plates instead of glass. The company is represented by Mr. A. S. Moffat.

Mr. Earle L. Ovington, New York, is giving several daily lectures at the show on high-frequency phenomena. Mr. L. D. Gibbs, assistant advertising manager of the Boston Edison Company, is giving lantern-slide lectures on the "Home Electrical" and kindred topics.

The Condit Electrical Manufacturing Company, of Boston, is showing a full line of Chase-Shawmut wiring material, Boston cable clips, rail bonds of the Shawmut type, Condit oil circuit-breakers, carbon brake-breakers, the new Burnham regulator, a new Condit electrically operated remote-control oil switch. In attendance are Messrs. S. B. Condit, Jr., Badeau, Burnham, Green and Masterson.

S. B. Condit, Jr., & Company, Boston, are showing Alphaduct, Sterling flexible steel conduit, conduit fittings, and Orangeburg fiber conduit. The company is represented by Messrs. Condit and Dow.

The Clapp-Easthan Company, Boston, is showing a complete line of wireless telegraph apparatus. The company is also showing in operation Prof. Elihu Thomson's induction motor. In attendance are Messrs. M. Eastham and R. B. Hoit.

The Simplex Electrical Company, Boston, is displaying a wide range of special cables for high-tension and low-tension service including three-phase and single-phase lead-covered, armored and paper-insulated cable, telephone pairs, and rubber-covered wire. Messrs. Stone, Ingalls and Emerson are in attendance.

The Simplex Electric Heating Company, of Cambridge, Mass., is showing practically every standard device which it produces for domestic and commercial service. There are also shown a full line of flatirons, kettles, chafing dishes, percolaters, heaters for industrial service and domestic appliances of great variety.

The Hurley Machine Company, Chicago, is exhibiting two sizes of electric washing machines and the Thor-Electric clothes wringer. The company is represented by N. H. Haberle.

The Dow Surgical Battery Company, Boston, exhibits the Arnold massage vibrator, Arnold electric cleaner, and batteries. The company is represented by Messrs. Williams and Harrington.

The Holtzer-Cabot Electric Company, of Brookline, Mass., is showing a large assortment of telephone, signaling and power equipment of both standard and special design. The company is represented by Messrs. C. W. Holtzer, T. W. Ness, Archie Ness, M. J. McElroy, A. P. Waterman and Balcomb.

G. M. Gest, conduit engineer and contractor, New York, is showing a full-sized partially completed brick and concrete manhole, equipped with Gest adjustable cable racks. Mr. Gest is represented at the show by Mr. H. H. Stannard.

The Diehl Manufacturing Company, of Elizabethport, N. J., is showing a full line of motors for sewing machine and fan service, with alternating-current and direct-current motors for miscellaneous small machine tool operation. A special exhibit is the company's "Universal" type of fan motor of the oscillatory design. The company was represented by Mr. W. P. Miner. In the same booth the Singer Sewing Machine Company, New York, displayed its motor-driven products for domestic and industrial service. Mr. T. H. Madigan was in attendance.

The International Correspondence Schools, of Scranton, Pa., are displaying books, instruments for drawing service, instruction course matter and pictorial outlines of its work. Mr. R. Burnham is in charge of the exhibit.

The Blake Signal & Manufacturing Company, Boston, is showing insulated staples, tube flux (Blake type), compressed wood cleats, and snap extension curtain rods and holders. Mr. Frank Macomber is in charge.

The H. B. Camp Company, Boston, is exhibiting a full-sized brick manhole equipped with Camp duct, single and multiple stacks of duct, cables and concrete. The company is represented by Mr. Kirlsey.

The Franklin A. Snow Company, Boston, contractors for underground construction, is showing a full-sized Edison manhole cover as used in Boston, and is represented by Mr. F. A. Snow.

The Electric Storage Battery Company, of Philadelphia, shows a cell of type H-77 Exide battery. The company was represented by Mr. Frank J. Stone, New England manager, and Messrs. Luther, Bedford and Kerrick, of the Boston office.

The Burlingame Telegraphing Typewriter Company, Boston, exhibits two machines in operation, and distributed folders describing this invention. The company was represented by Mr. J. H. Bowling.

Fred T. Ley & Company, Springfield, Mass., was represented by Messrs. M. W. Denman and A. E. Rock.

The Campbell Electric Company, Lynn, Mass., show an eight-day time switch, portable X-ray outfits by which the physician can apply radiographic treatment to the patient at the latter's residence, medical glass-ware, a bell-ringing transformer cutting the voltage from 110 to 21.14, or 7 volts, and a low-voltage transformer or economy coil for use in low-potential tungsten lighting. The company was represented by Mr. L. E. Gott.

The Radio Reflector Company, New York, is showing its reflectors on both carbon and tungsten lamps. A cabinet has been erected in the company's booth which shows 27 16-cp carbon lamps with the reflector attachment and 27 lamps bare, flashing alternately. Mr. S. S. Adams is in charge of the exhibit.

The American Flaming Arc Company, Boston, is showing 5½-amp to 10-amp, 80-volt, multiple, direct-current arc lamps of the flaming type, and also 9-amp to 10-amp, alternating-current, multiple arc lamps, operating on 72 volts at the arc. The arc in these lamps is controlled magnetically, and the arc striking and extinguishing mechanism are mutually independent. The arc is spread out by a pair of series magnets located near the horizontal plane of the electrode ends. The arc runs with maximum steadiness as a result of this magnetic control. Inner globes are eliminated. The company is represented by Messrs. C. D. Lanning, J. D. Robinson and W. H. Baker.

Durent & Kendall, of Boston, are showing the "Santos" vacuum cleaner, the apparatus having glass windows so that full detailed operation may be observed. The portable outfit weighs only 50 lb. Messrs. Durent, Kendall and Mr. and Mrs. R. M. Kitson are showing the apparatus to visitors at the booth.

The "1900" Washer Company, of Binghamton, N. Y., is displaying a line of motor and water-driven washers, with a hand machine in addition. A power wringer, electrically driven, is also shown. In attendance are Messrs. Terry and Bedore.

The Baker electric vehicles are exhibited by Mr. A. F. Neale, of Boston. The display includes a 1910 model victoria and a 1910 model extension front coupé, interior driven.

The Dodge Motor Vehicle Company, Boston, is showing a line of "Waverly" electrics. The company is represented by Messrs. H. W. Lincoln and R. L. Pope.

S. S. Bailey & Company, Amesbury, Mass., are showing a car that ran 175 miles on a single charge, with Edison battery equipment. Forty cells are installed. In attendance are Col. E. W. M. Bailey and Mr. P. E. Whiting.

The Dearborn Drug & Chemical Works, of Chicago, exhibits its products and is represented by Mr. P. H. Hogan, of Boston.

The Anderson Carriage Company, of Detroit, Mich., is exhibiting the well-known "Detroit" electrics. The company is represented by Mr. J. A. Binney.

The Studebaker Brothers Company, New York, are displaying a 1500-lb. delivery wagon of the electric type, and a landaulet, with spring-supported battery and swinging adjustable top. The company is represented by Messrs. H. L. Converse and S. G. Thompson.

The Rae Electric Vehicle Company, Boston, is showing a victoria which has run 16,621 miles, and which made 150 miles on a single charge. In attendance is Mr. H. C. Welch.

P. R. Ziegler & Company, of Boston, show four cows in "Snow" sanitary stalls. These cows are kept close by a model dairy and are electrically milked daily. The dairy is operated by D. Whiting & Sons, of Boston, a well-known milk house.

The Edison Electric Illuminating Company, of Boston, has fitted up a complete five-room electric house in the basement of the hall, the rooms being equipped with innumerable electrical conveniences.

The Ever-Ready Flash Light Company, Boston, shows its specialities for hand and pocket service. It is represented by Mr. S. S. Shepard.

C. S. Knowles, Boston, occupies a large space in the basement, and is showing a full line of Klaxon automobile horns, railway fittings, line material, high-tension insulators, conduit, and "Excel" electric heating devices. The new Klaxon automobile tail lights are shown, with a railway semaphore lens and downward reflector. A spring is provided to prevent the jarring loose of the lamp and consequent loss of the light. The house is represented by Messrs. Sabin, Kennedy and Ober.

W. J. Murdock & Company, Chelsea, Mass., show a line of wireless telegraph apparatus in operation and on display. Mr. J. A. McCarron is in attendance.

The Rudolph Wurlitzer Company, New York, shows a line of electric self-playing instruments, including a player piano, piano orchestra, and violin piano. In attendance is Mr. L. S. Lockwood.

The Poole Printing Company, Boston, shows a complete job printing establishment. The motors in the exhibit are mainly of the C & C type, supplied by the Garwood Electric Company, of New York.

The Electro-Radiant Sign Company, of Boston, is showing a motor-driven sign for barber-shop service.

The Invincible Electric Renovator Sales Company, Boston, is showing a portable vacuum cleaner outfit in large and small sizes. Mr. A. W. Patterson, Jr., of Boston, is in attendance.

The Massachusetts Fan Company, Watertown, Mass., is showing motor-driven Davidson ventilating fans for industrial service.

The Boston Lightning Rod Company is exhibiting copper and galvanized iron lightning rods, Mr. H. L. Willard being on hand to greet visitors.

The Perfection Manufacturing Company, of Portland, Me., is showing a motor-driven dish washer of large capacity. Mr. G. M. Cram is present in the interest of the company.

The Cyphers Incubator Company, Boston, showed an electric incubator hatching 155 chicks per day. The incubator was fitted with glass so that all the operations incidental to hatching could be seen readily.

The Positive Electric Vacuum Cleaner, built by the Electric Cleaner Company, of Chicago, was shown by Mr. A. B. Cousin, New York. A special feature is the cabinet construction of the device.

Fox Brothers & Company, New York, displayed the new German "Polar" flaming arc, which is stated to burn 20 hours per trim, and to have a low-maintenance cost. Sunray electric lamps were also shown in this booth. The booth is in charge of Mr. Eugene Godfrey.

The Alternating Target Company, Boston, showed an electric baseball alley, Mr. W. H. Bryant being in attendance.

The Baker Vacuum Cleaning Machine Company, Boston, was represented by Mr. Benjamin Sargent.

The *Electrical World* was represented by Messrs. Elliott and Knowlton.

Service and Meter Box.

The service and meter box shown has been designed by the Detroit Fuse & Manufacturing Company to meet a demand for a box that will alone serve as a main switch and cut-out, prevent theft of current and provide proper terminals for meter

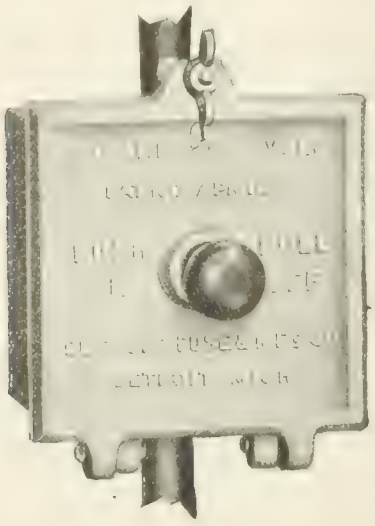


FIG. 1.—SERVICE AND METER BOX.

testing. The box is compact and substantial, yet allows plenty of room for wiring and testing, and complies with all requirements as to spacing.

The main switch and cut-out embodies the knife-switch mechanism of the "Detroit" ironclad fused switch, which is absolutely positive in its action, which mechanism is controlled by a plunger from the outside of the box. It is claimed that

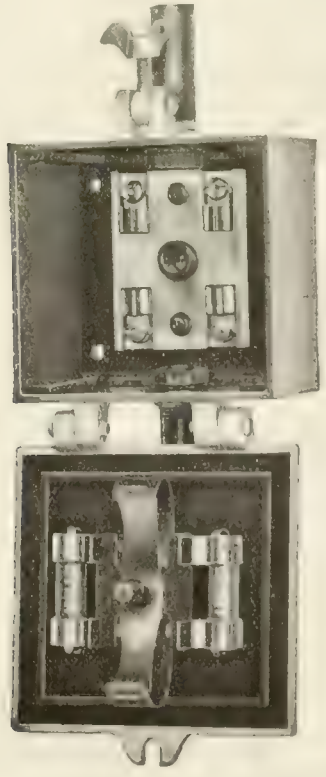


FIG. 2.—SERVICE AND METER BOX OPEN

this is the only switch that can be sealed against tampering and yet is instantly accessible to the consumer. The switch, moreover, gives complete protection from moisture, dirt, fire and fumes, and all live terminals being completely enclosed, there is no possibility of accidental contact in operating the switch. The fuses are mounted on the inside of the cover, swinging away from all live terminals when the cover is opened, and eliminating all danger when replacing blown fuses.

The inspection or meter chamber at the bottom of the switch is provided with a separate seal and allows of testing the meter without interfering with the service to the consumer and at quite a saving in time over old methods. This feature is of special value, as most lighting companies realize that the frequent testing of meters is decidedly advantageous, and the saving in time from using this device, it is stated, will soon pay for its cost.

Fig. 1 shows the switch as designed for entrance in conduit and open-work after leaving the meter box. It will be noted that conduit is also run from the meter box to the meter, thus preventing theft of current or tampering. The meter box is drilled on both sides, one side being plugged, making it possible to install the meter in any location.

Fig. 2 shows the mechanism of the "Detroit" ironclad fused switch; it will be noted that the fuses are mounted on the switch blades, making this portion of the service box very compact. The mechanism is simple in construction, and the spring is of sufficient strength to control the switch independent of outside pressure.

Automanual Telephone Equipments.

The relative simplicity of the so-called "automanual" telephone installation in comparison with a manual equipment will be appreciated when one considers the appearance of a manual operator's switchboard while examining the key bench of the

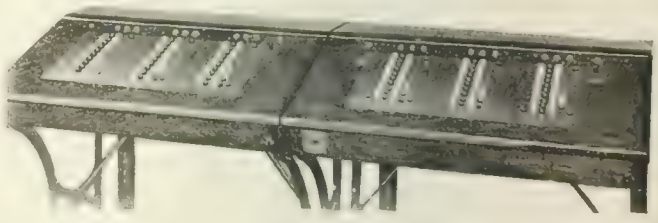


FIG. 1.—KEY BENCHES FOR TWO OPERATORS.

automanual system illustrated in Fig. 1. The bench contains only three simple sets of keys and three sets of lamps.

The system can best be explained by outlining the operator's duties. An entering call causes the lamp of one set to be lighted; the operator presses her listening key, thereby connecting her head set to the calling line and, having ascertained the number of the subscriber desired, she presses keys corresponding to this number and touches a starting key which releases the relay brought into service by the listening key and starts the calling connection through automatic switches, where it is completed. All conversations between subscribers are absolutely private, it being impossible for two sets of subscribers to be joined to the same circuit, and even the operator cannot overhear the conversation.

The subscriber's equipment consists of telephone apparatus identical with that used with the ordinary common-battery system. His metallic circuits enter the exchange building and pass through the usual main frame terminals and protectors to be ended upon the usual line relays and cut-off relays; the local trunks or link circuits between the primary selector and first selector switches are provided with condensers, and sleeve and tip relays bridged on the main battery, so that the circuit conditions are identical with those in standard common-battery manual boards. All of the switches and relays are mounted in the usual manner upon iron racks apart from the operating-room.

The details of the automanual equipment will be understood from a description of the various operations performed thereby. When a subscriber calls by taking down his receiver, his line relay causes a primary selector switch to connect his line with an idle local trunk or link circuit, and at the same time starts

a secondary selector switch which immediately connects the primary trunk and the calling line to an operator's idle-key set. The key-set lamp then lights, thereby indicating a call, the operator presses her listening key as usual, ascertains the number desired, and depresses the corresponding buttons, thereby determining the number of impulses to be sent to the selector

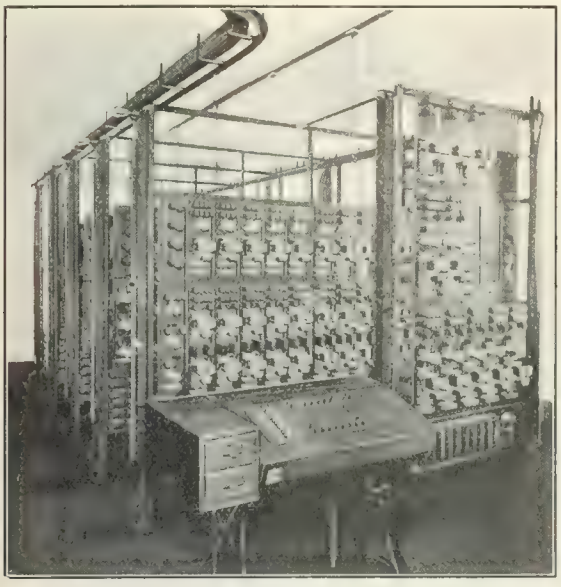


FIG. 2.—WIRE CHIEF'S DESK AND AUTOMANUAL SWITCHING EQUIPMENT.

and connector switches to make the desired connection. The sending machine transmits the predetermined impulses to the switches, which then select, test and signal the wanted line automatically. As soon as this line is selected, however, the secondary selector or operator's switch is automatically released and restored to normal position, ready for another call.

The subscribers have entire control of their own connection, being in this respect situated precisely as in a full automatic ex-

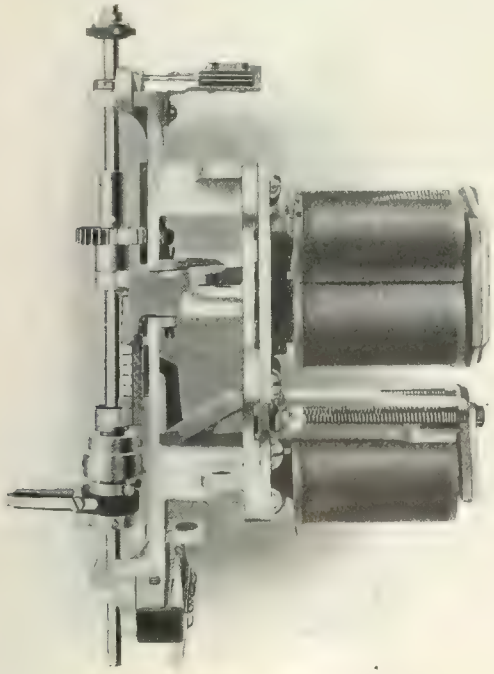


FIG. 3.—TWO-MOTION, 100-POINT SWITCH.

change, and from the explanation given it will be observed that they are secure from interruption. To clear-out or make a recall the subscribers simply hang up their receivers and the switches are automatically restored.

Aside from standard equipment incident to all common-battery installations, such as power plant, protecting and ringing devices, there are only five different pieces of apparatus required to complete an automanual installation, namely: the impulse or sending machine; the operator's keys; the automanual relay; the 100-point two-motion switch, and the 20-point one-motion switch. The sending machine consists of a drum upon

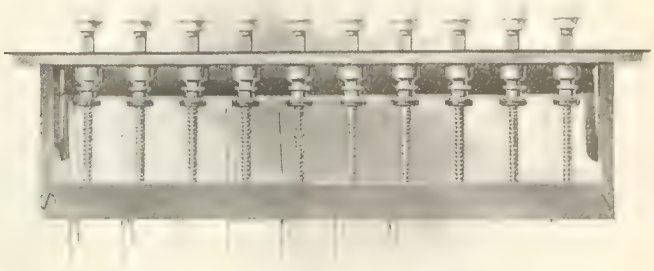


FIG. 4.—STRIP OF OPERATOR'S KEYS.

which are placed cams arranged to furnish impulses from 1 to 10 in accordance with the keys depressed by the operator. It is driven by a small motor receiving energy directly from the storage batteries. This sending machine is common to the entire system and performs for the system the same functions that in a full automatic installation are performed by the dial or sending device, located at each subscriber's telephone, and herein lies one of the distinctive features of the automanual

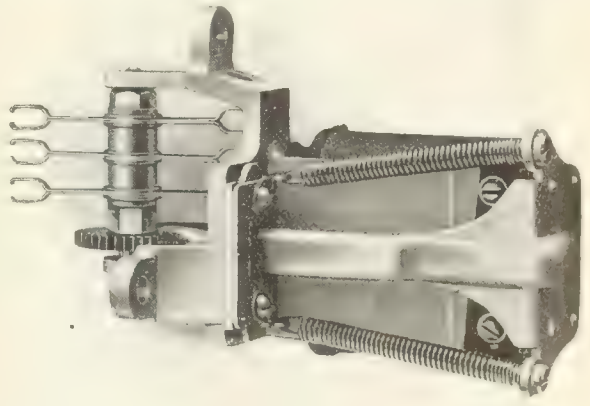


FIG. 5.—DISTRIBUTING SWITCH.

as a system, namely, the elimination of the dial. Sending machines are required at only the point where operators are located, none being used at branch exchanges.

The relay consists of a core upon which the wire is wound, a frame, an armature and a spring block which serves the double purpose of carrying the contact springs and retaining the armature in place, at the same time allowing freedom of movement.

The 100-point switch provides three switch-movements:

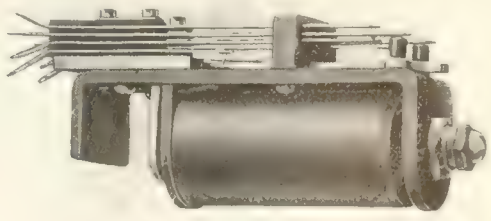


FIG. 6.—AUTOMANUAL RELAY.

rotary, vertical and release, the arrangement being as indicated in Fig. 3. The 20-point, one-motion switch is similar in construction to the 100-point switch. All of these devices are characterized by extreme simplicity.

The first automanual telephone equipment to be placed in

commercial service was that at Ashtabula, Ohio, a city having a population of about 20,000 people, of whom 5000 reside at Harbor, about four miles from the main town. The older manual telephone system required seven operators at Harbor and 30 at the main city exchange. The North Electric Company, Cleveland, Ohio, contracted to re-equip both the main city and the Harbor exchanges, with the idea of starting first at the Harbor with local operators, and after that was successfully working, equipping the main exchange so as to centralize all the operators therein, leaving the Harbor exchange practically an automatic branch. By following this plan, additional economies will be effected in that the day load at the Harbor will require only one additional operator at the main exchange, and the night load will be handled by a single operator at the city exchange. At Ashtabula Harbor there are installed five 100-line units adapted for either single-line or party-line service.

Printing-Press Controllers.

The General Electric Company has developed a complete line of controllers designed to meet the requirements and severe service of small direct-current, electrically operated printing presses. In their design special attention has been given to such necessary features as no-voltage protection, overload protection, push-button stop and jog, ruggedness of construction and accessibility.



FIG. 1.—PRINTING-PRESS CONTROLLER.

All controllers have no-voltage protection, consisting of a contactor mounted in the lower left-hand corner of the slate front. One type is so designed that upon failure of voltage the starting arm returns automatically to the off position. In addition, the controller arm is provided with a movable armature which may be adjusted so that the motor can be run only at a certain predetermined speed. All the other controllers of this line have been so designed that the contactor opens when the voltage fails and the contactor cannot be closed until the controller handle has been returned to the off position.

Since the armature circuit is made and broken by the contactor and not on the switch contacts, there is no arcing on the contacts. This eliminates the burning of the contacts, which would necessarily result in roughening the surface, causing imperfect contact and the rapid destruction of the contact segments. The contactor is provided with a strong magnetic blowout which extinguishes any arc that may result when the armature circuit is opened. When the overload release is supplied in addition to the no-voltage release, it is so connected that when it operates it will de-energize the contactor coil, opening the contactor and thus breaking the armature circuit.

In many installations it is desirable to have push buttons located at various points around the press for stopping the motor or for "inching" the press when necessary. Some of the controllers have therefore been designed to have both push-button stop and go, while others have the stop feature only.

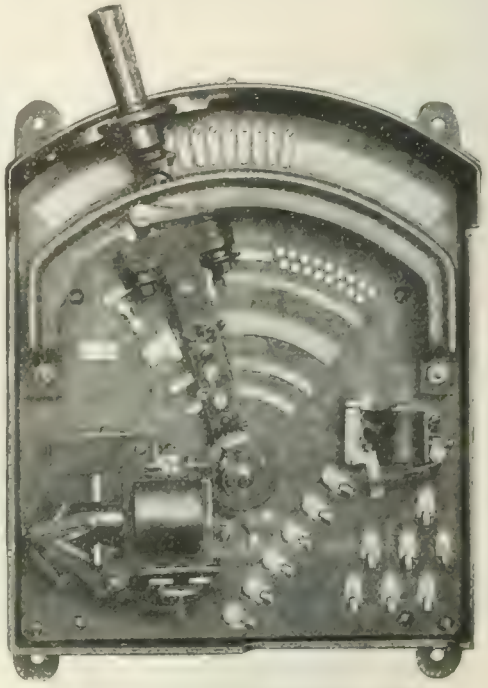


FIG. 2.—CONTROLLER WITH COVER REMOVED.

If the push button is closed while the motor is not in operation the contactor will close, providing the switch is in the starting position, completing the armature circuit through the regulating resistance. This will start the motor, which will run very slowly as long as the push button is held closed. If the push button is closed while the motor is running, the contactor coil will be de-energized, thereby opening the motor circuit and stopping the motor. The same push button can, therefore, be used for jogging or stopping the motor. Each controller which has the stop-and-jog feature is furnished with two buttons, but any number of buttons may be installed.

Standard resistance units are used throughout. In the controllers having a field regulating resistance, the units are assembled upon the back of the slate front, while the armature resistance, whether for starting or regulating duty, is assembled in a separate box. When a dynamic brake is supplied, the resistance is in most cases external, but in some controllers it is self-contained.

The controllers are provided with renewable segments for armature control, while button contacts are used for field control. The starting resistance is designed for starting duty only while the armature regulating resistance is designed for continuous operation, as various speed changes are obtained by varying the amount of resistance in the armature circuit.



FIG. 3.—ARMATURE RESISTOR.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The colder weather throughout the country during the past week has acted as a stimulant to retail trade. While there has been fair trading in this branch of business all during the fall, heavy clothing and underwear were showing a disposition to lag. Not only in these lines, but in shoes and in the coal trade a special improvement is to be noted. Wholesalers and jobbers are receiving much better orders and already holiday orders are received in encouraging numbers. Some reorders are beginning to come in. The change to more seasonable weather has also brought a distinct improvement to the crop situation in the West, checking the too rapid growth of winter wheat and breaking a drought in the Southwest that was threatening damage. From the industrial field the reports of large output and heavy orders continue to be received. In some branches, notably in the manufacture of automobiles, the manufacturers are running overtime. The iron and steel industry is flourishing beyond almost every previous record. Prices for finished products have been steadily advancing, but the rush of orders shows little indication of diminishing. The railroads are buying freely of rolling stock and track equipment. During the past week the Pennsylvania Railroad ordered 10,000 steel cars. New business in steel rails is fair, and orders for quite heavy tonnages are known to be pending. The lumber trade is reported to be in excellent shape, and all kinds of building materials are in demand. Reports from the railroads continue to improve, and already in many portions of the West there is serious complaint over the shortage of cars. Collections as a rule are reported to be excellent and money is in more active demand throughout the West. Business troubles are not particularly numerous, nor are they very serious. Failures for the week ended Nov. 18, as reported by *Bradstreet's*, were 232, as compared with 221 the previous week, 273 in the same week of 1908, 265 in 1907, 212 in 1906 and 224 in 1905.

THE COPPER MARKET.

The past week has been an important one in the copper trade. There was heavy buying both by consumers and by speculators, the former frightened by the advancing prices and the latter eager to get in on the ground floor and reap the advantages that are expected to follow the merging of the big interests. The result of the week's trading has been an advance in the local market of about ⅝ cent per pound. The sales within the past fortnight are estimated to be 120,000,000 lb. In the meantime production is being pushed to record proportions, and actual melting is not materially increased. The accumulation of copper continues, although the ownership is changing. On Nov. 22 the first authentic—although not entirely official—statement concerning the great merger was given out. It is practically admitted that the Amalgamated, Cole-Ryan and Guggenheim properties, together with some South American and Canadian companies, will be included in the consolidations. The capitalization of the companies involved is in the neighborhood of $670,000,000, and they have an annual output of copper of about 765,000,000 lb, or something more than one-half of the American production of refined copper. None of the Michigan properties is expected to join in the merger, and the Phelps-Dodge properties are not included, although it is not expected that these will be operated with any definite antagonism to the allied interests. The decision in regard to the Standard Oil Company has caused some discussion in connection with the copper merger, but has not checked the negotiations. Exports continue to be heavy. Up to and including Nov. 22 the shipments for the month amounted to 16,946 tons. The daily call on the Metal Exchange Nov. 22 quoted standard copper as follows:

	Bid.	Asked.	Settling price.
Spot	13.25	13.60	....
November	13.25	13.60	13.42½
December	13.25	13.60	13.42½
January	13.25	13.60	13.42½
February	13.25	13.60	13.42½
March	13.25	13.60	13.42½

The London prices Nov. 22 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	60 2 6	60 5 0
Standard copper, futures	*61 5 0	61 7 6
Market	Weak	Steady
Sales of spot		2,000 tons
Sales of futures		2,000 tons

*Futures were 15s. higher than here quoted.

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.45	12.12½
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
London, best selected	67 15 0	59 0 0

ALUMINUM COMPANY SELLING WIRE.—The recent business of the Aluminum Company of America in the line of wire for transmission purposes is reported to have been very heavy. This is especially true in regard to the orders from Canada. It is given out that one Canadian order has been placed for 1,500,000 lb. of half-inch aluminum wire, to be delivered as quickly as it can be manufactured. This is to be used for the distribution of the energy generated at Niagara Falls throughout the province of Ontario, and is part of a general plan to induce American manufacturers to locate in Canada. The contract referred to was placed by the Hydro-Electric Company of Ontario, and will amount to about $400,000. The wire will be drawn in the company's plants in Niagara Falls and Montreal. The Canadian commission intends to regulate the rates for energy and deliver it to manufacturing concerns at the lowest possible figure. Taken altogether the Aluminum Company of America has had a very prosperous year, and its output in 1909 will exceed that of 1908 by a considerable amount. In 1908 the company produced 8,200,000 lb. of aluminum. Prices remain about the same, the crude metal selling from 20 to 23 cents per pound.

DENVER GAS & ELECTRIC COMPANY.—Negotiations are on foot through which the Denver Gas & Electric Company expects to purchase the Denver City Steam Heating Company. The stockholders of the latter corporation will meet Nov. 22 for the purpose of voting upon the question of sale. If the transfer is made, it is the purpose of the purchaser to erect a new plant and enter actively into the business of furnishing steam heat to the business section of Denver. The payment for the Steam Heating Company will, it is stated, be made by an addition to the new stock which the reorganized Denver Gas & Electric Light Company was about to issue. The new company will have authorized issues of $10,000,000 in capital stock and $25,000,000 in bonds. The plan of reorganization has been outlined heretofore in these columns.

GENERAL ELECTRIC COMPANY'S SALES.—The gross sales of the General Electric Company for the month of October were slightly less than $4,750,000, which is the heaviest amount for any month of the current year. This is at the rate of about $55,000,000 per year and compares with total sales of $44,540,676 for the company's fiscal year which ended Jan. 31, 1909. The average operating cost for the past five years has been 84 per cent, and on this basis the net earnings should be almost $9,000,000, enough to pay the 8-per cent dividend on the $65,178,800 capital stock and have a handsome surplus.

CONSOLIDATED RESERVOIR & POWER COMPANY.—Surveys have been completed, near Banning, Cal., for the construction of a conduit for the Consolidated Reservoir & Power Company, which will bring the water from Whitewater River, eight miles, to a point near Banning. The intake will be at an elevation of 7000 ft., water being drawn from the three streams which make the South Fork of the Whitewater. There will be half a mile of pressure pipe between the cement conduit and the power house.

ROCKLAND RAILROAD COMPANY.—Construction work will be commenced early in the spring upon the line of the Rockland Railroad Company, which proposes to connect Tappan, Suffern, Stony Point and Nyack, N. Y. The line will build about 40 miles of track. Contracts for the work have not been let.

HYDROELECTRIC DEVELOPMENT ON MANISTEE RIVER.—A franchise has been granted to the Manistee County Electric Company, of Manistee, Mich., to construct dams in the Manistee River for the purpose of developing water-power. Permission is given by the Board of Supervisors of the county to erect no less than six dams at High Bridge, Junction and other places varying in height from 15 to 45 ft. Electrical energy is to be generated, and the city of Manistee and other municipalities in the county shall have the first right to purchase it, and, following them, private business concerns. It is provided that customers in the county taking 100 hp or less shall pay not to exceed 90 per cent of the prices charged outside customers. Local customers taking in excess of 100 hp shall pay not more than 95 per cent of the price charged outside the county. The compensation for the grant is $100, and it is stipulated that one of the dams shall be begun within two years and put in operation within four years. There is no time limit to the life of the franchise. Mr. Clyde J. Holmes was active, on behalf of the company, in procuring the franchise.

NEW STEEL MILLS TO USE ELECTRICITY.—The McClintic-Marshall Construction Company, of Pittsburgh, manufacturer of structural steel, has purchased a tract of ground comprising 50 acres in Indiana Harbor, Ind., at the southern end of Lake Michigan, near the boundary of the city of Chicago. The company will erect a structural steel plant on this site at once, and it is said that the new establishment will be in readiness for manufacturing operations within a year. When the plant is completed, its capacity will be from 60,000 to 70,000 tons of structural steel annually. One thousand or more men will be given employment, and a considerable use will be made of electricity for light and power. From Lebanon, Pa., comes the announcement that the managers of the American Iron & Steel Manufacturing Company have sanctioned the erection at that place of a steel billet mill without delay. It is reported that the plant with its machinery will involve an expenditure of more than $500,000. An extensive use will be made of electricity for operating motors as well as for lighting.

TELEPHONE DISPATCHING ON SANTA FÉ RAILWAY.—A system of telephone train dispatching has recently been completed and put into service by the Atchison, Topeka & Santa Fé Railroad Company on its Illinois division between Chillicothe, Ill., and Dearborn Street, Chicago, a distance of 134 miles. On this circuit the dispatcher is located at Chillicothe. There are 30 way stations in which telephones and selective equipment have been installed. With the completion of this circuit trains on this road running out of Chicago are handled by the telephone as far as Newton, Kan. A total of 660 miles is covered from Chicago to Newton. There are on this section a total of 170 way stations, all equipped with standard Western Electric Company telephone train dispatching apparatus and Gill bridging selectors. Each of these stations has direct communication over the telephone with the dispatcher of its division.

J. G. WHITE & COMPANY.—J. G. White & Company, New York, have been awarded the contract for the double tracking of the Albany Southern Railroad between Rensselaer and Kinderhook Lake, N. Y., as well as the straightening of curves and the rehabilitation of a large amount of the present track of that company. In addition to the operation of its third-rail electric road between Albany and Hudson, N. Y., the railroad company furnishes electric light to the following towns: Rensselaer, East Greenbush, East Schodack, Nassau, North Chatham, Niverville, Valatic, Kinderhook, Stuyvesant Falls and Stottville. It also owns and operates gas plants in Hudson and Rensselaer, N. Y. The above properties are under the management of J. G. White & Company.

SOUTHERN POWER COMPANY'S PLANS.—Surveys are now being made and rights of way secured for a system of trolley lines from Greensboro, N. C., by way of Salisbury and Charlotte, to Spartansburg and Greenville, S. C. The route practically parallels the transmission lines of the Southern Power Company, and it is understood that the power company is backing the project. W. S. Lee, Jr., vice-president of the power company, as well as J. B. and B. N. Duke, are interested in the new electric lines.

RATEAU TURBINES FOR STEEL WORKS.—The Lukens Iron & Steel Company, Coatesville, Pa., will install a complete 750-kw, 250-volt, direct-current Rateau-Smoot low-pressure turbo-generator set, including a Rateau generator and condenser. The Ball & Wood Company will furnish the turbine and the generator. The same company has recently closed a contract with the Maryland Steel Company, Sparrow Point, Md., for two 750-kw, 250-volt, direct-current generators to be direct connected to Rateau-Smoot low-pressure turbines. In each case the units will operate on exhaust steam.

WHITNEY COMPANY.—It is said that J. B. Duke and a party of capitalists associated with him in the Southern Power Company visited the Whitney Company's plant on the Yadkin River, near Salisbury, N. C., one day last week and made a thorough inspection of the development. This visit has given rise to rumors that the Southern Power Company is contemplating taking over the smaller plant. The Whitney Company has been in the hands of a receiver since Feb. 3, 1908, but until recently work has been continued on the dam.

MARKETS FOR ELECTRICAL MACHINERY.—An American consul in Latin America has forwarded to the Bureau of Manufactures the name and address of a business man who has recently been granted a concession for the establishment of an electric light plant. A consul in Canada has reported that a power company within his district will soon begin the erection of a 25,000-hp hydroelectric plant. The Bureau filing numbers of the above reports are 4144 and 4149.

NEW MONTANA POWER PLANT.—Plans are being matured for the construction of a hydroelectric plant at Thompson Falls, on the Missouri River, in Montana. It is expected that enough power will be secured to furnish all the energy needed in the Cœur d'Alene mining district. This comes in competition with the Washington Water Power Company, of Spokane. The new company expects to be able to furnish energy at one-half the present rates.

GARWOOD ELECTRIC COMPANY.—The demand for small motors is reported by the Garwood Electric Company to be so unusually heavy that prices have recently been advanced 5 per cent, and in spite of this it is found necessary to operate the plant both night and day. Officials of the company say that the books are full of orders and that inquiries are coming in from all parts of the country.

AWARD OF CANADIAN CONTRACT.—The Canadian Light & Power Company has awarded a contract for three 5000-kw, 2200-volt generators, and for transformers to step up to 44,000 volts, to the Allis-Chalmers-Bullock Company. The contract for the corresponding switchboard was given to the Canadian Westinghouse Company.

IDAHO POWER & TRANSMISSION COMPANY.—The Idaho Power & Transmission Company has purchased the electric light and power plants at Rexburgh, Sugar City, Teton City and St. Anthony which belonged to Hodgens Brothers, of Butte, Mont. This sale includes the water system at St. Anthony.

ANOTHER BRITISH ELECTRICAL COMPANY OPENS CANADIAN OFFICES.—The Lancashire Dynamo & Motor Company, Trafford Park, Manchester, has sent a representative to Canada and opened a permanent office in the Peterkin Buildings, Toronto.

1000-CP TUNGSTEN LAMPS.—The Electrical Accessaries Company, 1135 Broadway, New York, has recently received a consignment of high candle-power Just tungsten lamps from Germany. These lamps are of 600 and 1000 cp, and are the largest ever imported.

BUENOS AIRES EXPORTERS' AGENCY.—Charles Altschul, formerly connected with Lamm Bros. & Company, exporters, Antwerp, Belgium, has established an office at Buenos Aires, where he will act as an agent for foreign firms.

TUNGSTEN LAMP COMPANY.—It is reported that a company is in process of formation with strong financial backing, for the manufacture of tungsten lamps of a type which has met with much commercial success in Europe.

LUMBERING ELECTRIC PLANT.—The Brooks-Scanlon Company, of Vancouver, B. C., will replace steam with electric power at its camp on Gordon Pasha Lakes, and purposes to install a hydroelectric plant at Powell River.

STUDEBAKER DENVER BUILDING.—The Studebaker Company is building a six-story building in Denver for automobile sales and show rooms. Two floors will be devoted entirely to electric machines.

Financial Intelligence.

THE WEEK IN WALL STREET.

While it cannot be said that the money market has ceased to play an important figure in the stock market, there were developments last week involving important American corporations which practically overshadowed the financial situation. The week was a notable one for big happenings. The purchase of the control of the Western Union Telegraph Company by the American Telephone & Telegraph Company, the declaration of the 300 per cent dividend by Wells, Fargo & Company, the announcement of the new financial plan of the Missouri Pacific Railroad Company, and, most important of all, the decision adverse to the Standard Oil Company, all had distinct effects upon the stock market. The first three of these important happenings affected principally the question of refinancing; the Wells, Fargo dividend liberated a large amount of cash, while the Missouri Pacific financing will require about $30,000,000 in money. If the great copper merger is put through upon the plans which are now reported, there will be a heavy demand for money. Any unusual demand will serve to depress prices and lessen trading. The decision of the Standard Oil case is entirely apart from these other matters. The immediate effect was to start active liquidation, and the market on Nov. 22 showed very heavy transactions, with a general recession in prices. The question which seemed to touch the traders was whether this decision might not be so farreaching as to cover other important corporations of similar organization, and transacting business under similar methods. Such great concerns as the United States Steel Corporation, the American Tobacco Company, the United States Rubber Company and the American Telephone & Telegraph Company are all organized for the purpose of controlling and economizing business in their various lines, and, as far as an ordinary observer can see, they are very little different in purpose and operation from the Standard Oil Company. It is not remarkable, therefore, that such a decision as that rendered by the United States Court in Missouri should be disquieting to the holders of the stocks of these great merger corporations. The financial situation, taken as a whole, is better than it was last week. Money rates have remained about on the same level, and there has been no especial stringency. Quotations Nov. 22 were: call, 4¼ @ 5 per cent; 90 days, 4¾ @ 5 per cent. The quotations in the table are those of the close, Nov. 22.

NEW YORK.

	Nov. 15.	Nov. 22.	Shares sold.		Nov. 15.	Nov. 22.	Shares sold.
All. Ch.....	15⅝	15	4,900	Int.-Met., pfd.	55⅜	54¼	66,020
All.-Ch. pfd..	54⅞	54¼	19,345	Mackay Cos..	93¼	91	9,100
Amal. Cop....	94	92	563,200	MackayC., pfd.	75*	75⅞	2,100
Am. D. T....	20½*	20½*	.....	Man. Elev...	140¼*	140	298
Am. Loc.....	62½	61½	3,738	Met St. Ry..	27	23*	766
Am. Loc.,pfd.	116*	115	100	N.Y.&N.J.Tel.	139¼*	139¼*	.....
Am. Tel. & C.	85*	83*	600	Steel, com....	90⅞	88⅜	446,250
Am. T. & T..	142⅞	142⅝	92,370	Steel, pfd....	126⅜	125	4,600
B. R. T.....	76⅜	77¾	32,095	W. U. T.....	83¼	77⅝	72,250
Gen. Elec....	162*	162	5,840	West'h., com.	85½	85⅞	6,400
Int.-Met.,com.	23	22½	145,387	West'h., pfd..	134½*	134½*	.....

PHILADELPHIA.

	Nov. 15.	Nov. 22.		Nov. 15.	Nov. 22.
Am. Rys.....	45	45¼	Phila. Elec.....	13⅛	13
Elec. Co. of A.....	12⅜*	12⅜*	Phila. R. T.....	26¾	26½
Elec. St. B'ty.....	58¼	58	Phila. Trac.....	89*	89*
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	52¾	52½

CHICAGO.

	Nov. 15.	Nov. 22.		Nov. 15.	Nov. 22.
Chi. City Ry.....	180*	180*	Chi. Tel. Co.....	136	136*
Chi. Rs., Ser. 1.....	108*	100*	Met. El., com.....	17*	17*
Chi. Rs., Ser. 2.....	33½	32	Met. El., pfd.....	52½*	53
Com. Edison.....	119	119*	Nat'l Carbon.....	97	97
Chi. Subways.....	6½	6	Nat'l Car., pfd.....	120*	124*

BOSTON.

	Nov. 15.	Nov. 22.		Nov. 15.	Nov. 22.
Am. T. & T.....	142½	142⅞	Mex. Tel.....	3*	3*
Cum. Tel.....	146*	147*	Mex. Tel., pfd.....	6*	6*
Edison E. Ill.....	250	251*	N. E. Tel.....	134¾	135
Gen. Elec.....	162*	162¼	W. T. & T.....	11¼	12
Mass. E. Ry.....	16¼	16*	W. T. & T., pfd.....	89*	90
Mass. E. R., pfd....	80	80			

* Last price quoted.
Shares sold are for week of Nov. 15 to Nov. 20.

TELEPHONE MERGER IN OHIO.—It is announced at Columbus, Ohio, that preliminary plans have been perfected which will insure the merging of practically all the independent telephone companies in Ohio. A plan has been drafted by a sub-committee of 15, which represents about 100 independent companies. It is expected that this merger will include all of the companies excepting those whose control was recently purchased by James F. Brailey, Jr., of Toledo. Judge Lewis Brucker, of Mansfield, Ohio, who is chairman of the sub-committee, says that ample finances have been obtained to bring about the merger and to insure an excellent service after the companies come together. A new company will be formed which will issue stock in exchange for the outstanding stock of the subsidiary companies.

AMERICAN GAS COMPANY.—The American Gas Company, Philadelphia, has purchased a majority of the stock of the Suburban Gas Company, of Philadelphia; the Jenkintown & Cheltenham Gas Company, the Huntindon Valley Electric Light & Power Company, the North Penn Gas Company, and the Coastville Gas Company. It is proposed to merge all of these properties with the People's Gas Company, of Pottstown, which is already owned by the American company. The new properties will be amply financed, and there will be extensive improvements and developments. The American Gas Company already owns and operates 14 gas and electric plants in various parts of the country. It has outstanding $1,700,000 of stock and $1,500,000 in bonds.

SOUTHERN COLORADO POWER COMPANY.—A number of creditors of the Southern Colorado Power Company are making a fight in court against the foreclosure sale of the property. They ask that the present receiver, Frank P. Read, be removed, and that another receiver be appointed who is not a bondholder in the company. The matter will come up for decision Dec. 1. Plans are on foot for the reorganization of the company, if it is purchased by the bondholders, by the incorporation of a new concern wtih a capital stock of $5,000,000, which is expected to be sufficient to pay the present bondholders and to leave $1,000,000 to be expended in improving the plants and transmission lines of the company.

ALUMINUM COMPANY'S BIG STOCK DIVIDEND.—In the last issue of the *Electrical World* it was announced that the Aluminum Company of America had filed notice of an increase of capital stock to $20,000,000, together with the statement of an official of the company that no plans had been made for the expenditure of the proceeds of the stock for extensions or improvements. It is now announced that $16,000,000 of the new stock will be distributed as a 500 per cent stock dividend on the $3,200,000 of common stock. The last available report of the company, Dec. 31, 1907, showed total assets of $13,190,568, with no outstanding bonds. In 1904 the holders of common stock received a stock dividend of 100 per cent.

WHITE INVESTING COMPANY.—The White Investing Company, which has been formed for the purchase and sale of bonds and securities and for financing, developing and operating approved industrial enterprises, especially mining, and those based on natural resources, has established its main office at 43 Exchange Place, New York. The officers of the company are: William F. White, president; John A. Lovell, William B. Ridgely and Calvin B. Humphrey, vice-presidents; T. S. Huff, secretary and assistant treasurer. A. A. Blow is head of the department of mines.

UTICA SOUTHERN RAILWAY EXTENSION.—The Public Service Commission of the Second District has given permission to the Utica Southern Railroad Company to issue $628,000 of new bonds and to increase its issue of preferred stock $400,000. The proceeds of these new issues will be used to build an extension from Hamilton, via Earlville and Shelburne to Norwich, a distance of 27 miles, and to complete the line from Clinton to Hamilton. A branch will also be built between Deansboro and Waterville.

BOSTON & WORCESTER STREET RAILWAY BONDS.—Application has been made to the Railroad Commission of Massachusetts by the Boston & Worcester Street Railway Company for permission to issue $500,000 additional stock to be sold to the present shareholders at par. This will make the total capitalization of the company $2,525,000. The proceeds of the new issue will be used for extensions, a new car house and additional rolling stock.

POUGHKEEPSIE LIGHT, HEAT & POWER COMPANY.—James A. Hutchinson, of Boston, has purchased from the Poughkeepsie Light, Heat & Power Company $100,000 of 5 per cent bonds. This issue is the remainder of the bonds authorized under the present mortgage. The Poughkeepsie company does the entire gas, electric light and power business of Poughkeepsie and operates under a perpetual franchise. The bonds are being offered to the public at par and interest.

THIRD AVENUE REORGANIZATION PLAN.—A committee of stockholders of the Third Avenue Railroad Company have framed a plan of reorganization, which differs widely from the bondholders' plan, turned down by the Public Service Commission in September. The plan reduces the total outstanding securities of the company from $58,560,000 to $52,000,000, this being done at the commission's suggestion. The plan also calls for an assessment of 50 per cent upon the stockholders and subsequently the scaling down of the holdings 25 per cent. This would mean $8,000,000 in cash, and the reduction of the outstanding stock to $12,000,000. The stockholders are, however, to be compensated for the assessment by being given $9,000,000 4-per cent first mortgage bonds. The holders of the present $5,000,000 first mortgage bonds will be given $6,000,000 of the new first mortgage bonds, and the holders of the present issue of $37,000,000 consolidated bonds will be given $25,000,000 consolidated bonds.

NEW YORK CONDUIT COMPANIES.—The Public Service Commission of the First District of New York has given out the reports for the year 1908 of the Consolidated Telegraph & Electrical Subway Company and of the Empire City Subway Company, Ltd. The former of these companies shows assets of $14,131,658, and the latter $11,768,317. These reports disclose the ownership of the companies. The Consolidated Telegraph & Electrical Subway Company furnishes conduits for all of the high-power wires for light and power, and, out of the 18,750 shares of stock, the New York Edison Company owns 15,160 shares. The Empire City Company, which furnishes conduits for the low potential wires (telephone and telegraph) practically belongs to the New York Telephone Company, this concern owning 38,025 out of a total of 43,240 shares.

MILLIKEN BROS. RECEIVERSHIP ENDED.—The United States District Court has granted a motion to dismiss the petition in bankruptcy filed against Milliken Bros., Inc., in June, 1907. The receivers are directed to return the property and assets to the corporation. In making this order the company is instructed that all non-assenting creditors have their claims secured in a satisfactory manner or paid; that all of the liabilities of the receivers on outstanding contracts or judgments for damages be secured, and that the fees of the receivers and their counsel be agreed upon and paid. During their tenure the receivers have collected more than $6,500,000, and have expended nearly $6,000,000. They have completed successfully 66 contracts which were on hand when they took charge, and have completed 275 other contracts.

INTERNATIONAL STEAM PUMP COMPANY.—The statement of the earnings of the International Steam Pump Company for the seven months ended Oct. 31, 1909, shows net earnings, including those of the Power & Mining Machinery Company, of $852,236, as compared wtih $647,306 for the same period last year. This is an increase of approximately 30 per cent. President Guggenheim, of the company, says that orders taken in recent months are equal to the maximum capacity of the plant.

ELECTRICAL CONSOLIDATION AT MURFREESBORO, TENN.—A deal has been made between the Davis & Elam Electric Light Company and the City Gas & Electric Company, the former company taking over the properties of the latter. During the competition within the past six months the price of electricity has been reduced as low as 3 cents per kw-hour. Since the deal has been consummated the price has advanced to 12 cents.

MEXICAN NORTHERN POWER COMPANY.—At a meeting of the bondholders of the Mexican Northern Power Company held in Montreal, Can., on Nov. 17, authority was given for an increase of the bond issue from $7,500,000 to $10,000,000. The capital stock is also to be increased from $10,000,000 to $15,000,000.

DIVIDENDS.

Brooklyn Rapid Transit Company, quarterly, 1 per cent, payable Jan. 1.

General Electric Company, quarterly, 2 per cent, payable Jan. 15.

Kansas City Railway & Light Company, preferred, quarterly, 1¼ per cent, payable Nov. 30.

Philadelphia Company, quarterly 1½ per cent, payable Dec. 15.

Philadelphia Electric Company, quarterly, 1½ per cent, payable Dec. 15.

Rochester Railway & Light Company, preferred, quarterly 1¼ per cent, payable Dec. 1.

St. Joseph Railway, Light, Heat & Power Company, quarterly, ½ per cent, payable Dec. 1.

REPORT OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Changes.	Expenses.
American Light & Traction Company:					
October, 1909	$313,845	$8,865	$304,982	.....	.....
October, 1908	278,220	4,000	274,220	.....	.....
American Telephone & Telegraph Company:					
Ten months ended October 31, 1909	27,779,879	2,095,191	25,684,687	$6,018,789	$19,665,898
Ten months ended October 31, 1908	24,594,552	1,736,061	22,858,491	6,380,746	16,477,745
Blackstone Valley Gas & Electric Company:					
September, 1909	83,097	41,441	42,556	.....	18,560
September, 1908	70,876	37,056	33,820	.....	.....
Columbus, Ga., Electric Co:					
September, 1909	31,004	18,329	13,675	11,474	1,800
September, 1908	30,304	15,658	14,645	11,687	2,958
Dallas, Tex., Electric Corporation:					
September, 1909	107,569	74,512	33,057	21,775	7,948
September, 1908	95,842	63,097	32,762	24,623	4,805
East St. Louis & Suburban Company:					
October, 1909	191,775	93,206	98,569	49,490	48,079
October, 1908	178,644	90,803	87,841	48,826	38,015
Edison Electric Illuminating Company, Brockton, Mass:					
September, 1909	[illegible]	13,510	8,853	3,159	5,694
September, 1908	[illegible]	8,951	7,519	2,851	4,668
Electric Securities Company:					
Year ended October 31, 1909	368,501	217,600	150,901	.....	.....
Year ended October 31, 1908	349,014	208,195	140,819	.....	.....
El Paso Electric Company:					
September, 1909	[illegible]	29,873	20,626	8,184	12,441
September, 1908	[illegible]	33,338	10,489	7,133	3,356
Galveston-Houston Electric Company:					
September, 1909	[illegible]	56,363	44,474	20,075	24,399
September, 1908	[illegible]	46,620	45,170	17,450	27,720
Keystone Telephone Company:					
October, 1909	[illegible]	45,544	46,016	32,768	13,248
October, 1908	[illegible]	43,420	45,399	34,482	10,917
Minneapolis General Electric Company:					
September, 1909	[illegible]	38,858	55,154	31,528	23,626
September, 1908	[illegible]	34,412	47,485	32,310	15,175
Northern Texas Electric Company:					
September, 1909	[illegible]	57,785	47,042	17,189	29,852
September, 1908	[illegible]	49,315	38,874	15,215	23,658
Puget Sound Electric Railway:					
September, 1909	179,955	[illegible]	72,350	44,452	27,897
September, 1908	[illegible]	90,243	52,877	39,464	13,413
Savannah Electric Company:					
September, 1909	[illegible]	32,030	17,492	15,778	1,714
September, 1908	[illegible]	[illegible]	20,741	15,886	4,855
Seattle Electric Company:					
September, 1909	[illegible]	305,311	263,152	95,221	167,931
September, 1908	385,945	209,951	175,993	86,001	89,992
Tampa Electric Company					
September, 1909	[illegible]	27,253	19,855	3,865	15,990
September, 1908	43,356	26,704	16,651	3,787	12,863
United Railways Company of St. Louis:					
October, 1909	[illegible]	627,968	411,299	232,267	179,032
October, 1908	949,914	572,326	377,588	233,845	143,743

GENERAL NEWS

Construction News.

FORT PAYNE, ALA.—The Fort Payne Fuel & Iron Company is contemplating the installation of an electric light plant to supply electricity to manufacturing plants. E. C. Drew is president

GURLEY, ALA.—The Gurley Light & Power Company, recently incorporated, has been granted a franchise to erect an electric light plant and has secured a contract to furnish electricity to light the streets of the town.

PARAGOULD, ARK.—The Independent Rural Telephone Company, of Marmaduke, Ark., has applied to the City Council for a new franchise which will enable the company to install a switchboard in Paragould. Under its present franchise the company is only permitted to operate one station in the city.

ALTURAS, CAL.—Plans have been prepared by I. W. Gibbins, of Alturas, for filing water rights for a hydroelectric power plant on Silver Creek, in the Warner Mountains. The proposed plant will be capable of developing 4000 hp.

BAGBY, CAL.—Extensive improvements are contemplated by the Lead Mining & Manufacturing Company to its plant in the near future, which will include the installation of power transmission machinery, Faber d'Faure furnaces and other equipment.

BANNING, CAL.—Surveys have been completed by the Consolidated Reservoir & Power Company for conduit which is to bring water from Whitewater River to a point near Banning. The intake at an elevation of 7000 ft. will draw water from three streams which make up the south fork of Whitewater. Beginning at the intake eight miles of cement pipe will be built and a half mile of pressure pipe to a point where the first power house will be located for generating electricity. H. E. Moore and George I. Lamy, of Los Angeles, Cal.; W. B. Scarborough, of Monrovia, Cal., and R. B. Sheldon, of Riverside, Cal., are interested in the enterprise.

LOS ANGELES, CAL.—The Southern Pacific Company is reported to be considering substituting electricity for steam power for switching and yard work in Los Angeles County, especially at the harbor.

OAKLAND, CAL.—The Oakland Traction Company has been granted a franchise to operate an electric railway along Grand Avenue, for which the company paid the city the sum of $500.

OAKLAND, CAL.—Application has been made to the Board of Supervisors by D. U. Toffelmire, representing the United Power Company, for a franchise to furnish electricity in Alameda County in competition with the Oakland Gas Light & Heat Company. The franchise is for a term of 50 years to be offered to the highest bidder.

RED BLUFF, CAL.—The Board of Supervisors has awarded a franchise to the Sacramento Valley Power Company to erect transmission lines in Tehama County.

SAN DIEGO, CAL.—The City Council has granted a franchise to G. W. Pursell to construct and maintain an electric railway in San Diego. The proposed railway will extend from San Diego to Escondido.

SAN DIEGO, CAL.—The Board of Park Commissioners is considering the selection of a design for the electric fountain to be erected on the park plaza, to cost $10,000, funds for which were donated by Louis J. Wilde, president of the American National Bank.

SANTA ROSA, CAL.—The Board of Supervisors has advertised for sale the franchise applied for by A. Sbarboro and A. E. Sbarboro for an extension of the lines of the Cloverdale Lighting Company throughout northern Sonoma County. It is proposed to furnish electricity to light several small towns and also for a number of business enterprises.

SOUTH PASADENA, CAL.—Plans have been completed for the lighting system, which the residents of Fletcher, Electric and Bushnell avenues propose to install, at a cost of from $1,200 to $1,500. The plans include the installation of 20 ornamental poles, on which will be placed two lamps, on each of the three avenues.

VALLEJO, CAL.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Dec. 24 for installing an electric passenger elevator at the Navy Yard, Mare Island, Cal., plans and specifications for which may be obtained on application to the above bureau or to the commandant of the Navy Yard, Mare Island. R. C. Hollyday is chief of bureau.

BOULDER, COL.—The City Council has voted to appropriate $40,000 for the construction of a hydroelectric power plant in connection with the city water system, in accordance with plans prepared by Prof. H. S. Evans, of the State University, about a year ago. The city engineer has been instructed to make surveys, and it is probable that definite steps will be taken at an early date toward the construction of a plant. The project includes utilizing a pipe line which supplies the city with water from Silver Lake for the generation of power. At one point on the line a fall of 1000 ft. could be obtained, and with the present amount of water used by the city 11,000 hp could be developed. With the growth of the city and the increasing use of water, the generating power would greatly increase, as the pipe line has a maximum capacity of 20 cu. ft. An impulse was given to this matter by the adjudication for water rights, whereby the city was given an unconditional decree of 20 cu. ft. for power purposes, but unless the city proceeds, these rights may be forfeited to some private concern willing to act at once.

EVANS, COL.—Prepartions are being made by the Home Light & Power Company, of Greeley, to supply electricity in Evans. Electrical energy for operating the system is purchased from the Northern Colorado Power Company. The Home company is extending a 6600-volt feeder line four miles to supply the Evans service. The right-of-way to be secured for these lines is intended ultimately to be utilized for the 4000-volt lines of the Northern Colorado Power Company in completing a loop from Greeley through La Salle, Ft. Lupton, Platteville and Brighton and back to the generating station at Lafayette.

GREELEY, COL.—Work has begun on the underground-cable system to be established at Greeley by the Colorado Telephone Company, to be connected with its new exchange building, also under construction. The cost of the work is estimated at $25,000.

TRINIDAD, COL.—Plans for reorganizing the Southern Colorado Power Company, which operates the street railway, gas, electric and power systems in Trinidad and the surrounding towns, have been completed and, it is said, that the company will be taken out of the receiver's hands next month. It is understood that a new company will be formed, capitalized at $5,000,000, which will pay off the bonded indebtedness of the old company, and will spend $1,000,000 in improving and extending its system. The property will probably be sold at public auction about Dec. 15 and will be bid in by representatives of the stockholders. Plans have been prepared for enlarging the plant and rebuilding the portion destroyed by fire some months ago. The company also furnishes electricity to the large coal and coke corporations in Southern Colorado.

NEW BRITAIN, CONN.—The Landers, Frary & Clark Company is constructing a large electric power plant which when completed will furnish electricity to operate its entire plant. The main power house will be 104 ft. x 63 ft. and one story high, and the boiler house 87 ft. x 72 ft. The equipment of the plant will include a 1500-hp McIntosh-Seymour cross-compound engine direct connected to 1000-kw, alternating-current generator. An engine will also be installed for auxiliary purposes. Seven 250-hp Manning boilers have been installed. The remainder of the equipment has not yet been decided upon. It is expected to have the plant completed by February, 1910.

NEW HAVEN, CONN.—In the bid submitted to the City Council by the United Illuminating Company, for furnishing electricity for street lighting for a term of four years, the company offers to supply from 625 to 700 lamps at the rate of 20 cents per night per lamp, or $73 per lamp per year; over 700 lamps at 19½ cents each per night. The New Haven Gas Light Company submitted a bid offering to supply gas lamps at $21.80 per lamp per year, of which there are 1300.

SOUTH COVENTRY, CONN.—The Rockville-Willimantic Lighting Company is contemplating the construction of a transformer station on "The Flats," near South Coventry, for the distribution of electricity for lamps and motors in South Coventry.

FORT DU PONT, DEL.—Contracts have been awarded by Lieut. E. A. Stockton, Jr., constructing quartermaster, for construction of electric lighting system at Fort Du Pont, as follows: For inside work to A. D. Granger Company, of New York, N. Y., for $5,073; outside work to McKay Engineering Company, of Baltimore, Md., for $5,369; for supplying apparatus, etc., to the Westinghouse Electric & Manufacturing Company, Pittsburgh., Pa., for $2,490.

WILMINGTON, DEL.—Plans are being considered for establishing municipal conduits for the purpose of placing all wires underground. It is now proposed that the city purchase the conduits already installed by the local telephone companies and rent them with others to be installed to companies maintaining wires. The Street and Sewer Commission is now securing data for the cost of installation and maintenance and the rentals to be charged for space in conduits.

JACKSON, GA.—The Schott Engineering Company, of Chicago, is building the power-transmission lines from the power plant in the Ocmulgee River to Macon, Ga. and other points; steel towers are used costing $500 each, and being set 500 feet apart. The first section of the line will extend from the power plant to Macon.

LA FAYETTE, GA.—An election will be held Dec. 15 to vote on the proposition to issue $12,000 in bonds, the proceeds to be used for the construction of an electric light plant.

MACON, GA.—Work will soon commence on construction of power transmission lines of the Central Georgie Power Company. The first line will be run from the power plant on the Ocmulgee River, near Jackson, Ga., to Macon, Ga., via Bibb and Forsyth, Ga. It has been stated that a line will also be built from Forsyth to Griffin, Ga., and thence to Atlanta, Ga.

MOULTRIE, GA.—The city of Moultrie will receive bids until Nov. 29 for a 100-kw generator direct connected to a four-valve automatic engine, switchboard, arc lamps, etc. Specifications can be obtained by addressing the mayor. W. D. Scott is Mayor.

GRANGEVILLE, IDAHO.—S. C. McDaniels is erecting a new independent telephone system, including about 100 miles of line, into the mining districts of the South Fork country.

REXBURG, IDAHO.—The Idaho Power & Transportation Company, of Idaho Falls, has purchased the electric light and power plants at Rexburg, Sugar City, Teton City and St. Anthony, which belonged to the Hodgens Brothers, of Butte, Mont. The deal also includes the water system of St. Anthony. The headquarters of the company will be retained at Idaho Falls, with a local manager in each town. It is expected that the service will be improved under the new management.

TWIN FALLS, IDAHO.—The publicity committee, appointed by the citizens of Twin Falls to investigate the question of locating and securing a power site at Clear Lakes for the purpose of turning the same over to the County of Twin Falls to be utilized to develop power to operate an electric light plant and other purposes, has submitted its report recommending the county to take over the power rights secured. The committee has offered to turn over the power site secured to the County of Twin Falls for the actual amount paid out to hold the site. The members of the committee are willing to organize and incorporate a holding company to take over the power site and plant until the citizens can organize in districts and be ready to take over said property. It is also proposed to construct an electric railway in connection with the project and to furnish electricity for manufacturing purposes throughout the entire county, as well as for City of Twin Falls. W. P. Guthrie, H. O. Milner and Thomas Costello are members of the committee.

CHICAGO HEIGHTS, ILL.—The Chicago Heights & Eastern Electric Railroad Company has applied to the County Board for a 75-year franchise to construct an electric railway from Chicago Heights east to the State line.

EAST ST. LOUIS, ILL.—The City Council has awarded the contract for lighting the streets of the city for a term of 10 years to the Consumers' Heat, Light & Power Company at the rate of $70 per lamp per year.

EVANSTON, ILL.—The old generating station of the Evanston Electric Illuminating Company, which was absorbed by the North Shore Electric Company, was damaged by fire on Nov. 12. The building adjoins the new Clark Street substation of the North Shore company and was being dismantled at the time of the fire. Considerable equipment was still in the station, including the arc lamp switchboard, which was damaged by water, leaving the city without street-lighting service for one night. All commercial service had been transferred to the new plant. The damage is estimated at about $10,000.

WATERTOWN, ILL.—The Village Board is reported to have granted a 25-year franchise to the United Light & Power Company to furnish electricity for lamps in Watertown.

BROOK, IND.—The Commissioners of Newton County have granted to Cragg Brothers a franchise to erect and operate transmission lines on the county roads between Brook, Morocco and Foreman. The Cragg Brothers, is is said, are in the market for material for construction of the line.

GREENFIELD, IND.—Perry J. Freeman, of Richmond, Stokes Jackson and other local capitalists are organizing a company to build a traction line from Greenfield to Pendleton, a distance of 16 miles. Application for franchises to enter Greenfield and Pendleton have been filed. The company will also petition the Commissioners of Hancock and Madison counties for rights of way across public highways. It is proposed to build the greater part of the line on a private right of way.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company expects to occupy its new power station on West Washington Street by Dec. 1. It is understood that the company expects to abandon its power station on South Jersey Street when the new station is completed. The original plans of the company were to use the new station for electrical service and to supply heat from the South Jersey Street station.

JASONVILLE, IND.—The Indiana Electric Transmission Company has awarded the contract for laying six miles of pipe line in Jasonville, to Larkin Brothers, of Dayton, Ohio.

LAFAYETTE, IND.—The Commissioners of Tippecanoe County have granted the Indiana & Northern Traction Company a 55-year franchise for the construction of an electric railway from the battleground north to the county. Under the terms of the franchise the company is obliged to complete the railway within two years. The headquarters of the company are located at Marion, Ind. The company was incorporated in 1903 with a capital stock of $300,000. George A. H. Shielder, A. H. Shielder, B. F. Burk, E. H. Neal, of Marion, Ind., and George Breed, of Philadelphia, Pa., are interested in the enterprise.

SOUTH BEND, IND.—Preparations are being made by the Northern Indiana Railway Company for improvements to its power plant in South Bend, which will involve an expenditure of about $12,000.

STAUNTON, IND.—The Terre Haute, Indianapolis & Eastern Traction Company is erecting wires along the Staunton road from the company's feed wires on the National road to this city. The company has secured a franchise to furnish electricity to light the streets and for domestic purposes in Staunton. The traction company has purchased the Stewart electric plant and will improve the distributing system.

ADEL, IA.—At a special election held recently the citizens voted to grant the Adel City Railway Company a franchise to construct and operate a street and interurban railway in the town of Adel.

ANAMOSA, IA.—Negotiations have been closed whereby A. E. Anderson, of Chicago, Ill., has purchased the plant and holdings of the Anamosa Electric Light & Power Company in Anamosa, owned by Zinn Brothers, of Oxford Junction, Ia., and Park Chamberlain and George L. Schoonover, of Anamosa, Ia. W. C. Hill, of Chicago, Ill., will be general manager of the new company.

FORT DODGE, IA.—Plans are being considered by the Fort Dodge, Des Moines & Southern Railroad Company for the construction of a large power plant which will be located at Brushy. It is said that the company will commence work on the construction of the plant as soon as the Supreme Court renders its decision in regard to the crossing rights at Gypsum over the Illinois Central Railroad tracks. The Fort Dodge, Des Moines and Southern Railroad Company has secured options on the Crooked Creek Railroad, which extends from Webster City to Lehigh, which it will take over if a favorable decision is given. It is proposed to equip the last-named railroad for electrical operation.

LEON, IA.—Preparations are being made by the Leon Electric Company for the construction of a new power house, to cost about $9,000. Samuel C. Johnston is manager of the company.

MARSHALLTOWN, IA.—A special election will be held Nov. 29 to vote on the proposition to grant three public-service franchises to run for a term of 25 years, application for which has been made for by H. W. Darling and Louis H. Schroeder. One is for electric service, another for gas supply and a third for a street railway system.

ERIE, KAN.—J. C. Denious, city clerk, writes that bids for the construction of the proposed municipal electric light plant and water works system will be opened about Dec. 15. Bonds to the amount of $50,000 were voted for the project Nov. 2. Burns & McDonnell, Scarrett Building, Kansas City, Mo., are engineers.

HILL CITY, KAN.—The construction of a municipal electric light plant in Hill City is under consideration.

MURRAY, KY.—Bids will be received by Joseph T. Parker, city clerk, until Dec. 17 for the purchase of $23,000 water works and electric light bonds.

ALEXANDRIA, LA.—J. P. Turregaus, Mayor, writes that bids will be received until Dec. 20 for extensions and improvements to the municipal electric light plant and water works system, for which bonds to the amount of $40,000 were voted. I. W. Sylvester is city engineer.

LEWISTON, MAINE.—The Union Water Power Company has purchased the water power at Clarks Rips, about eight miles above this city. It is reported that the company will construct a new dam and install an electric power plant which will develop 11,000 hp. Electricity generated at the plant will be used to operate the mills in Lewiston.

ROCKVILLE, MD.—The Town Council has granted the Potomac Power & Electric Company, of Washington, D. C., a franchise to erect transmission lines along certain streets in Rockville to furnish electricity for lamps, residences, business places, etc. The ordinance provides that the company shall erect its lines on Montgomery Avenue and Commerce Street, the main thoroughfares of the town, from the extreme eastern limits to western limits within 60 days. The company's lines already extend to the eastern limits of the town. The streets of Rockville are lighted by the municipal lighting plant.

BOSTON, MASS.—The Boston & Worcester Street Railway Company has applied to the State Railroad Commission for permission to increase its capital stock from $2,025,000 to not exceeding $2,525,000, to be offered to stockholders at par, the proceeds to be used to construct and equip a railway extension and car house and for additional rolling stock.

CHICOPEE, MASS.—The Electric Light Commissioners have awarded the contract for new generating machinery and switchboard for the municipal electric light to the General Electric Company, of Schenectady, N. Y., bids for which were opened on Oct. 11.

FRANKLIN, MASS.—The Union Electric Company has notified the Board of Selectmen that the company will furnish an all-night schedule for street lighting from now until Feb. 1, without extra cost, as the town has no available funds for this purpose. The present contract was made under a moonlight schedule. It is expected that the town will make a sufficient appropriation to cover the expense of an all-night schedule at the town meeting to be held in next March.

MILFORD, MASS.—The Selectmen have granted the Worcester & Blackstone Valley Street Railway Company a franchise to erect a transmission line from a point near the power station to the Worcester line, near Millbury Junction.

SPRINGFIELD, MASS.—The City Council has voted to authorize the street lighting committee to make arrangements with the United Electric Light Company to erect a large sign, between 80 and 90 ft. long and about 3 ft. wide, at the South End bridge. The sign will bear the inscription, "Welcome to Springfield." The company agrees to erect the sign at its own expense and will furnish electricity for lighting the same at the same rate charged for other service to the city, which will make the cost of maintenance about $400 per year. Agitation for a similar sign at the North End bridge is already under way.

MANISTEE, MICH.—The Manistee County Hydraulic Company has accepted the franchise granted by the Board of Supervisors of Manistee County, and will commence work immediately on what is called the "Junction Dam," located about 20 miles east of Manistee. The dam is to be 43 ft. high and will develop 3800 hp.

KALAMAZOO, MICH.—The Grand Rapids Electric Railway Company has applied to the City Council for a 30-year franchise to construct and operate an electric railway in the city limits, with the consideration that all its lines are to be completed within one year from the time the ordinance is passed. The company proposes to construct an electric railway from Bay City to Grand Rapids and thence to Kalamazoo; also to extend the railway from Kalamazoo to Battle Creek, thence to Coldwater, Montgomery and Camden. Jerry W. Boynton is president of the company.

ANOKA, MINN.—The Council has granted the Anoka-Minneapolis Suburban Railway Promotion Company a franchise to construct an electric railway in Anoka. C. J. Swenson, of Minneapolis, Minn., is interested in the project.

BRECKENRIDGE, MINN.—The Wahpeton & Breckenridge Street Railway Company is reported to be considering the construction of a power plant. It is said that a gas engine and gas producer plant may be included in the equipment.

MINNEAPOLIS, MINN.—Arrangements are being made with the Pillsbury-Washburn Flour Mills Company for the construction of a large central power plant adjoining "A" mill in Southeastern Minneapolis, at a cost of $225,000. It is said that about $100,000 will be spent this year and the plant completed in 1910.

MINNEAPOLIS, MINN.—The officials of the Northern Heating & Electric Company have notified Mayor James C. Haynes that they may accept the tentative franchise, which provides for a revocable license until the plant is built, allowing three years for that work, when the franchise proper goes into effect for a definite term. L. L. Brooks, of St. Paul, Minn., is president and James Eddy, of Chicago, Ill., secretary of the company.

WHITE BEAR, MINN.—The Washington County Light & Power Company, of Stillwater, Minn., which recently purchased the property of the White Bear Electric Company, has commenced work on improvements to be made to the White Bear system. The station will, in the future, be known as Station C. The local steam plant will be abandoned and electricity for operating the system will be supplied from Riverside, near Somerset, Wis. The White Bear system will provide electricity for lamps for the cottages along the shore of the lake, including Mahtomedi, Lave View and Dellwood. It is also expected that the service will be extended to the other side of the lake toward White Bear. The new pole line is expected to be completed this fall.

NATCHEZ, MISS.—Additional equipment is being installed in the power station of the Southern Railway & Light Company, including a 300-kw alternating-current generator to furnish electricity for lighting service and a 300-kw direct-current machine for street railway service. A 500-hp boiler has been installed.

PINEBUR, MISS.—The Walworth & Neville Manufacturing Company, of Pinebur, Miss., wishes to purchase at once a second-hand, direct-current dynamo that is guaranteed to furnish electricity for 250 16-cp lamps. Machine to be given a test on the work before final acceptance.

BUFFALO, MO.—It is reported that the Big Naungua Power Company is contemplating the construction of a hydroelectric plant in Buffalo, Mo.

KANSAS CITY, MO.—William M. Hall has withdrawn his application for a general franchise to furnish electricity in Kansas City to compete with the Kansas City Electric Light Company and will only ask for an ordinance that will protect his properties by granting a permit confirming the privileges he now has to supply electricity in the neighborhood of his building at Ninth and Walnut streets.

ST. LOUIS, MO.—The Foresight Investment Company is reported to be contemplating the construction of an electric light plant and cold storage plant near Forsythe Boulevard and Cornet Avenue. James J. Quinn is president and George Lewis, secretary, 608 Liggett Building, St. Louis, Mo.

HARLOWTON, MONT.—The Harlowton Light & Water Company completed its first year Nov. 13, and in extending greeting to its customers hopes for the same cordial relations during the coming year that have existed during the past year.

KALISPELL, MONT.—The Northern Idaho & Montana Power Company has acquired the plant of the Big Fork Water Company at Kalispell, Mont., and will enlarge and improve the system.

MISSOULA, MONT.—Plans are being considered by Senator E. Donlon, of Missoula, for the construction of a large hydroelectric plant at Thompson Falls, to furnish electricity in the Coeur D'Alene's mining district in competition with the Washington Water Power Company, of Spokane, Wash. Senator Donlan has acquired the necessary water rights and the site for the plant and will proceed with the construction of the plant as soon as the weather will permit. It is claimed that the new plant can furnish electricity to the local properties at half the cost of the present rate.

LINCOLN, NEB.—The special committee appointed to investigate the question of installing ornamental street lamps on O Street has decided to authorize the Lincoln Traction Company to secure samples of poles for inspection. The traction company has offered to pay toward the cost of the poles the amount it would cost them to erect iron poles the same distance. Nothing as yet has been done toward securing the necessary means to defray the extra cost for the system, which will amount to about $800 to each block, exclusive of wiring. It is expected that the business men in the district benefited will pay the additional cost. It is understood that the municipal electric lighting plant is taxed to its utmost capacity at present. Both private lighting companies, it is said, are ready to submit propositions for furnishing electricity for the additional service.

GOLDFIELD, NEVADA.—Work is soon to commence on a large power plant in Mono County, to supply power for an electric railroad from Coaldale to Bodie, to connect with the Tonopah and Goldfield Railroad, and also to furnish electricity for the mining camps of Southern Nevada and California. The water for the power plants will be taken from Silver Lake, and will have a drop of 1200 feet. About 33,000 hp. will be developed.

ROSWELL, N. MEX.—The Roswell Commercial Club, it is said, will investigate the feasibility of a plan proposed for developing water power in the mountains, west of Roswell, to be utilized to generate electricity for distribution in the vicinity of Roswell to be used for pumping water for irrigation purposes.

BUFFALO, N. Y.—The Buffalo & Williamsville Electric Railway Company is reported to be in the market for a 200-kw rotary converter and three 100-kw transformers.

CAMILLUS, N. Y.—The Town Board has granted a franchise to Moritz Mayer, of Syracuse, N. Y., to erect a transmission line from the substation of Niagara Falls transmission lines at Solvay to the Village of Camillus. The main purpose of the line is to furnish electricity for lamps and motors for the Camillus Cutlery Works, of which Mr. Mayer is manager. Electrical service will also be furnished to any resident of the town. Negotiations are now under way between Mr. Mayer and the Syracuse Lighting Company in regard to furnishing electricity for the service.

ISLIP, N. Y.—The Board of Trade is interested in a project to bring about the construction of an electric railway across the island. It is proposed to have the railway extend from the railroad station at Islip through to Smithtown or Stony Brook Harbor, and possibly to Port Jefferson.

MONROE, N. Y.—We are informed that the Orange & Rockland Electric Company is in the market for a direct-connected unit of from 500 to 1000-kw, 60-cycle, three-phase, 2200 or 2300 volts. R. W. Smith is president and manager.

NEWPORT, N. Y.—The Newport Electric Light & Power Company has made arrangements to sell $50,000 of the $75,000 first mortgage bonds which the company was recently granted authority to issue by Public Service Commission, Second District. The proceeds to be used for extensions to its property. The company owns valuable water rights on West Canada Creek, in Herkimer County, which, it is estimated, is capable of developing more than 2500 hp. At present less than 500 hp is being used. The present plans include the construction of a new dam and power house and the installation of an alternating-current system, and extension of transmission lines to Cold Brook, Poland and the surrounding country within a radius of from 15 to 20 miles, where franchises and municipal contracts have been secured. Work will commence on these improvements early in 1910.

NEW YORK, N. Y.—The Public Service Commission, First District, has approved the franchise granted the South Shore Traction Company by the Board of Estimate to construct a railway in Queens and run cars across the Queensboro Bridge.

NEW YORK, N. Y.—Announcement has been made that the Rockland Railroad Company, which proposes to construct an electric railway to connect Tappan, Suffern, Stony Point and Nyack, will be ready to begin work on construction of the railway early in the spring. No contracts have been let for the work. The railway will be about 40 miles in length. Headquarters of the company are at 165 Broadway, New York, N. Y. Arthur C. Miller is second vice-president and general manager.

OSSINING, N. Y.—The Public Service Commission, Second District, has granted the Northern Westchester Lighting Company permission to issue $125,000 in bonds, to be sold at not less than 90 per cent of their par value, the proceeds to be used to discharge indebtedness of the company incurred in making additions and betterments to its plant and distributing system.

ROCHESTER, N. Y.—The Public Service Commission, Second District, has given its approval of the franchise granted by the Village of Middleport to the Buffalo, Lockport & Rochester Railway Company. The approval is given on the condition the company shall submit the plans and specifications to the commission for approval before it does any work on the construction of its transmission lines. The Commission also gave its approval of the contract between the Niagara, Lockport & Ontario Power Company and the Buffalo, Lockport & Rochester Railway Company, giving the first-named company the privilege of using the excess capacity of the transmission line for the purpose of transmitting and selling eleectricity not utilized by the railway company to other parties and corporations in the district through which the transmission line extends.

UTICA, N. Y.—The Utica Southern Railway Company has been authorized by the Public Service Commission, Second District, to build an extension of its railway from Hamilton, via Earlville and Shelburne,

through Norwich, a distance of 17 miles. The company had previously been granted permission to construct an electric railway from Clinton to Hamilton, with a branch between Deansboro and Waterville, 27 miles in length. It is also authorized to execute a mortgage and to issue bonds to the amount of $628,000, par value, the proceeds to be used for constructing and equipping the extension from Hamilton to Norwich, and also to issue $400,000 in preferred capital stock, on condition that the proceeds be used for construction and equipment of the extension.

APEX, N. C.—The town has granted a 20-year franchise to A. J. Martin to build and to operate an electric plant in this place. The plant is to be installed by Jan. 1, 1911. It is probable that electricity will also be supplied to industrial plants.

DANBURY, N. C.—A charter has been granted to the North Carolina Traction Company to build a system of electric railways radiating from Danbury, developing surrounding timber lands, etc. H. P. McKnight, of Southern Pines, is the principal stockholder; associated with him are: E. Hillman, of Aberdeen, N. C., and W. C. Reflert, of Harrisburg, Pa., and E. L. Krafft, of Indianapolis, Ind. The company is capitalized at $2,000,000.

FAYETTEVILLE, N. C.—The Raleigh & Southport Railway Company is planning to build an extension of its railway from Fayetteville to Hope Mills, N. C., a distance of seven miles. John A. Mills, of Raleigh, N. C., is president and general manager.

GREENSBORO, N. C.—Surveys are now being made and rights-of-way secured for the proposed electric railway system to extend from Greensboro, N. C., to Spartansburg and Greenville, S. C., via Salisbury and Charlotte, N. C. The route practically parallels the transmission lines of the Southern Power Company, and it is understood that the power company is interested in the project. W. S. Lee, Jr., vice-president of the Southern Power Company; J. B. and B. N. Duke are interested in the proposed railway.

ROXBORO, N. C.—The Town Council has let the contract for installing an electric-light system in Roxboro to J. Maxwell, of the General Electric Company, at Baltimore, Md.

WAYNESVILLE, N. C.—Plans are being considered for the construction of a hydroelectric power plant in connection with an electric railway proposition. It is said that 600 hp will be developed for electrical transmission. W. B. Ferguson, Hugh A. Love, of Waynesville, Ga., and Mr. McCormick, of St. Paul, Minn., are reported to be interested in the project.

COLUMBUS, OHIO.—Plans have been prepared by Howard & Merriam, architects, Capital Trust Building, Columbus, Ohio, for a power plant to be erected on the infirmary ground in connection with the tuberculosis hospital building.

NEW LISBON, OHIO.—It is reported that the electric light plant of the New Lisbon Gas Company was destroyed by fire on Nov. 14.

TOLEDO, OHIO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 20, for the installation of a conduit and wiring system and a standard clock system in the United States post office, Toledo, Ohio, in accordance with drawings and specifications, copies of which may be obtained at the above office, or at the office of the superintendent of construction, Toledo, Ohio. James Knox Taylor is supervising architect.

ALTUS, OKLA.—Plans are being prepared for extensions to the municipal electric system, which will involve an expenditure of about $35,000. An election will soon be called to vote on the proposition.

BEAVER, OKLA.—Plans are being made by the Beaver Valley & Northwestern Railroad Company to commence work on the construction of its proposed railway from Gage to Hooker, via Beaver, before the first of the year. The section from Hooker to Beaver, 40 miles in length, will be constructed first. J. M. Kerns, of Beaver, Okla., is general manager.

DUSTIN, OKLA.—The City of Dustin is contemplating the installation of a municipal electric light plant and would like to receive estimates on cost of installation of the same. For further information address F. P. Hicks, town clerk.

LAIDLAW, ORE.—H. H. Humphreys, of Kennewick, Wash., is reported to have secured options on all available land at Aubrey Falls and secured contract for the sale of the Aubrey Falls site and D. F. Nichols water power on the Deschutes River. It is said that work will commence on the project within 90 days.

PORTLAND, ORE.—The Home Telephone Company is planning to erect three new exchanges on the East Side and greatly increase its system, which will involve an expenditure of $100,000. The exchanges will be erected at Sellwood, Mount Tabor and St. Johns.

IRWIN, PA.—The capital stock of the Irwin & Hermoine Street Railway Company has been increased from $100,000 to $[illegible].

JOHNSTOWN, PA.—The Cambria Steel Company, it is said, has decided to install a 5000-hp steam turbine, with alternating-current generator, exciter, etc., to furnish electricity to operate the machinery in its mills.

MERCER, PA.—The Iron City Engineering Company, of Pittsburgh, Pa., has applied to the City Council for a franchise to construct and operate an electric light plant and street railway system in Mercer.

NANTICOKE, PA.—Bids will be received at the office of the Borough Secretary until Dec. 14 for lighting the streets of the borough for terms of one, three or five years from May 1, 1910, in accordance with specifications on file at the above office. Clem J. Knoll is secretary of Town Council.

PEN ARGYLE, PA.—Orders have been placed by the Slate Belt Electric Street Railway Company with the Electric Storage Battery Company, of Philadelphia, Pa., for a 400-amp. storage battery. The company has recently placed a contract for a new 150-kva, 2300-volt, 60-cycle, three-phase Crocker-Wheeler alternator, direct connected to a Porter Allen engine, to furnish electricity for lamps. The entire lighting system is being changed to 2300-volts, three-phase. J. T. Hambleton is general manager.

PHILADELPHIA, PA.—The Hero Manufacturing Company, it is reported, will install an electric generating unit and motors in its factory.

PHILADELPHIA, PA.—The Philadelphia Electric Company was the only company which submitted bids for lighting streets of the city for the coming year. The prices are the same as paid under the present contract, which will amount to about $1,182,000. For electric lamps in West Philadelphia and in North Philadelphia, north of Allegheny Avenue, the price was 28 cents per lamp per night, and for the remainder of the city, south of Allegheny Avenue, 27 cents per lamp per night. The only exception to these bids was 25 cents for lamps on poles owned by the city and connected with city service cables, and 29 cents for lamps on city poles connected with the company's cables. The number of lamps operated this year throughout the city is 11,807, but next year the number will be materially increased.

PITTSBURGH, PA.—Charter extensions have been taken out by the West Penn Railways Company for extensions of its system from Greensburg to New Alexandria, Pa., a distance of seven miles; from Uniontown to Leisenring, seven miles; from Hunker to West Newton, 10 miles, and from West Newton to Scott Haven, five miles.

STROUDSBURG, PA.—Preparations are being made by the Stroudsburg & Water Gap Street Railway Company for the construction of a new power station, work on which will begin at once.

WYOMISSING, PA.—Application will soon be made for a charter for an electric railway to be known as the Berks County Traction Company, which will extend from Wyomissing to Strausstown, and thence to Fredericksburg, Pa., a distance of about 35 miles. W. C. Riffert, Lewis Crater, A. S. Seidel and Henry Fay are interested in the project.

YORK, PA.—The Edison Electric Light Company is installing a 525-kw engine and generator at its local plant to be used as an auxiliary in case of emergencies and during low-water periods, which handicap the York Haven water and power plant.

FLORENCE, S. C.—A franchise has been granted by the City Council to John L. Barringer, P. A. Willcox, William J. Brown and S. S. Ingman for the construction of an electric railway on all of the streets in the city. It is proposed to build a street railway throughout the city, which will be extended to Darlington, via the Muse Bridge on Black Creek, near which an amusement park will be established.

LEESVILLE, S. C.—The Brodie Light & Power Company is constructing an electric light plant in Leesville.

ROCK HILL, S. C.—The Town Council has rejected three propositions made by the Philadelphia owners of the present city lighting plant, one to sell for $145,000, and the other two for short and long-term contracts, and has voted for municipal ownership. A petition for a $35,000-bond issue for lighting purposes was ordered circulated.

ABERDEEN, S. D.—The Aberdeen Street Railway Company has been granted a 20-year franchise to construct and operate a street railway in Aberdeen.

FORT PIERRE, S. D.—The question of establishing an electric light plant in Fort Pierre is under consideration. It is said that if the City Council can secure a satisfactory proposition from private parties to install an electric light plant a franchise will be granted, otherwise it is proposed to install a municipal plant.

MILBANK, S. D.—An electric light plant is being installed in Milbank, S. D., by Oscar Claussen, consulting engineer, St. Paul, Minn., the equipment of which will include a Muenzel producer gas engine and gas producer plant furnished by the Minneapolis Steel & Machinery Company, of Minneapolis, Minn.

BRISTOL, TENN.—It is reported that the Norfolk & Western Railway Company contemplates the installation of an electric light plant, to cost $3,000. C. S. Churchill, of Roanoke, Va., is chief engineer.

MEMPHIS, TENN.—Contracts have been placed for rails and ties by the Lakeview Traction Company for its proposed railway from Memphis to Lakeview, a distance of 11 miles. The company is contemplating the use of motor cars outside of Memphis. The railway will eventually be extended to Clarksdale, Miss.; another section will run from Memphis to Jackson, via Covington, and a third from Memphis to Collierville.

MURFREESBORO, TENN.—A deal has been consummated between Davis & Elam, proprietors of the Davis & Elam Electric Light Company, and the City Gas & Electric Company, whereby the first-named company has purchased the plant and holdings of the City company. The two companies have been competing with each other for the past six months, with the result of reducing the price of electricity to three cents per [illegible]. Since the consummation of the deal the price has been ad-

vanced to 12 cents per kw-hour. The City Gas & Electric Company had a 10-year contract with the city for lighting the city. It is reported that the consideration was $40,000.

CALVERT, TEX.—The capital stock of the Calvert Water, Ice & Electric Company has been increased from $50,000 to $100,000.

MARATHON, TEX.—Plans are being considered for the installation of an electric light plant and ice factory in connection with the rubber works in Marathon. Mr. Staten is reported to be interested in the project.

MOUNT PLEASANT, TEX.—The City Council has granted M. Greenspun, of Mt. Pleasant, a franchise to erect another electric light plant in this city. An ice plant will also be built in connection with the electric plant, making two electric and ice plants in Mt. Pleasant.

FORT DOUGLAS, UTAH.—Contracts have been awarded for the construction of an electric lighting system at Fort Douglas as follows: For wiring certain buildings and furnishing and installing fixtures, to the Meteor Electric Company, of Salt Lake City, Utah, for $9,418; installing transformers and erecting transmission lines, etc., to the Salt Lake City Supply Company, for $11,749; furnishing and installing equipment and wattmeters for buildings, to the F. E. Newberry Electric Company, of St. Louis, Mo., for $4,065; construction of transformer station, to the Salt Lake Electric Supply Company, for $2,950. Lieut. K. P. Williams is constructing quartermaster.

SALT LAKE CITY, UTAH.—The Salt Lake & Los Angeles Railway Company has applied to the County Commissioners for a 50-year franchise to operate a railway from Salt Lake City to Saltair for the purpose of double-tracking and equipping its railway to be operated by electricity.

HAMPTON, VA.—Announcement is made that the Capital City Beach Corporation, which holds extensive water-front property above Buckroe Beach, has perfected arrangements with the Newport News & Old Point Electric Railway Company to extend its electric lines to its property.

PULASKI, VA.—The Town of Pulaski would like to receive prices on new and second-hand guaranteed machinery with full dimensions and descriptions as follows: one 200-hp tubular boiler complete; one 150-hp horizontal engine, suitable for direct connection to 100-kw alternator, 275 r.p.m.; one 100-kw, 3-phase, 60-cycle alternator; six 5-kw, 60-cycle transformers; one switchboard suitable for above alternator. All prices on second-hand machinery must give full history of machines, together with description and dimensions. For further information address S. S. Wall, Pulaski, Va., superintendent.

RICHMOND, VA.—The council committee on water has adopted the plans presented by E. W. Trafford, consulting engineer, for erection of transmission line from the new electric plant to the new pump house on the upper river to furnish electricity to operate the new pumps recently installed. Bids have been called for the erection of the line.

BURBANK, WASH.—Contracts have been awarded by the Burbank Power & Water Company for the construction of a new pipe line and distributing canal at Five Mile Rapids on the Snake River. The contract for the distributing canal was awarded to Otto Hanson, of Kennewick, Wash., for $30,000. The cost of the entire work is estimated at $50,000. James D. Hodge, of Seattle, Wash., is president.

CHESAW, WASH.—Preparations are being made by the Apex Mining Company for the installation of a power plant in its mine. It is said that another gasoline engine, compressor and an outfit of power drills will be purchased.

NORTH YAKIMA, WASH.—The Union Gap Irrigation Company is enlarging its canal for the purpose of establishing an electric generating plant. It is said that machinery and equipment for the plant will be purchased through local concerns.

POMEROY, WASH.—C. L. MacKenzie, of Colfax, Wash., has secured the controlling interest in the Tucannon Power Company. Plans are being made for constructing a new barrel flume to carry the water on the Tucannon.

SEATTLE, WASH.—Contracts will soon be awarded by the Seattle-Tacoma Short Line for the construction of an electric interurban railway between Seattle and Tacoma, to run along the shore between the two cities. E. J. Felt will have charge of construction of the road.

SPOKANE, WASH.—It is reported that negotiations have been completed between the Washington Water Power Company and the Interstate Mining Company, whereby the power company will furnish electricity to operate the mines of the Interstate Mining Company, located west of the Hercules mine.

WALLA WALLA, WASH.—The Washington-Oregon Traction Company will soon award contracts for the construction of its proposed electric railway between Walla Walla and Pendleton, Ore., a distance of 53 miles. The power plant will be located in Walla Walla. The company expects also to furnish electricity for lamps and motors. S. Drumhiller is president and W. S. Matthias, acting general manager.

WALLA WALLA, WASH.—We are informed that the Washington Traction Company expects to commence work on its proposed electric railway, which is to extend from Dayton, Wallula, Waitsburg, Dixie, Walla Walla, Milton and Pasco, 143 miles in length, in the near future. As yet a site has not been selected for the power house. The repair shops will be located in Walla Walla. Gilbert Hunt, of Walla Walla, is president.

WALLA WALLA, WASH.—The Northwestern Gas & Electric Company has applied to the City Council for an extension of its franchises in Walla Walla, covering its electric light and power service, street railway system and gas service. The extension is asked to make the present franchise correspond with the $5,000,000 bond issue, which is to run for 25 years. The company, it is said, is contemplating the construction of electric railways to Wallowa, Ore., and Dayton, Wash. It is understood that the latter will be the equipping of the Northern Pacific Railroad from Walla Walla to Dayton for electrical operation.

BLACKSVILLE, W. VA.—The Blacksville Street Railway Company has purchased a site in Blacksville, on which, it is said, the company will erect a power plant and car barns for the proposed new street railway, which, according to present plans, will extend from Blacksburg to Waynesburg, thence to Marianna and Pittsburgh. All the rights of way between Waynesburg and Blacksville have been secured.

MARINETTE, WIS.—If present plans mature another large hydro-electric power plant will be erected on the Menominee River within another year. It is proposed to construct a dam capable of developing 6000 hp. A fiber mill is also to be erected, which will utilize part of the power developed and remainder will be sold for manufacturing purposes in Marinette and Menominee. Land needed for the overflow has been secured. Harry J. Brown is interested in the project.

BASIN CITY, WYO.—The City Council has decided to call a special election to vote on the proposition to purchase the electric plant of the Wyoming Electric Light & Power Company, to be owned and operated by the municipality.

CALGARY, ALTA., CAN.—The ratepayers have passed the by-law authorizing extensions and improvements to the local street railway, which will involve an expenditure of $40,000.

NELSON, B. C., CAN.—The Bulls River Falls Power & Light Company, which is constructing a large power plant in the Fort Steel district, proposes to furnish electricity for lamps and motors to all towns in the Pass country from Michel, and eastward to Moyie. The construction of an electric railway from the falls to the Town of Jaffray is also contemplated, which may eventually be extended to Fort Steel and Cranbrook.

VANCOUVER, B. C., CAN.—The Brooks Scanlon Lumber Company is contemplating replacing the steam donkey engines with electrical power for logging on its property at Gordon Pasha Lakes, near the head water of Jarvis inlet. It is said that the company proposes to erect a power plant on Powell River. It is expected that logging by electricity will soon become general throughout British Columbia.

SWAMP RIVER, MAN., CAN.—The ratepayers have voted in favor of the bylaw to issue $15,000 in bonds, the proceeds to be used to purchase a lighting plant, fire engine, etc.

GALT, ONT., CAN.—The report submitted by Engineer E. B. Merrill, of Toronto, to the Council, on the value of the Galt Gas & Electric Light Company's electric-lighting plant, which the company offered to sell to the town for $63,000, exclusive of the water power on the Grand River, states that the amount asked by the company is based on the original cost of the plant, but states that after allowing for depreciation tion the present value is $44,000, and that if the plant were to be operated in connection with the Hydro-Electric Power Commission project, the value for this purpose would be $35,000.

INGERSOLL, ONT., CAN.—The Town Council is taking action in the direction of establishing a plant for the distribution of Niagara power. A by-law is to be submitted to the ratepayers at the January municipal election authorizing the establishment of a distribution plant for hydro-electric power. The by-law is similar to the one voted upon by the other municipalities three years ago. At that time the town voted on a by-law to acquire the existing plant of the Ingersoll Power & Light Company, which was defeated. Two years ago Mayor Sutherland advocated arbitration proceedings with the company and later a by-law was submitted to the people providing for the acquirement of the company's plant for the sum of $50,000, but this was also rejected. In the report submitted by Engineer Yates, of the Hydro-Electric Power Commission, the cost for a civil power distribution plant is estimated at $26,000, and an additional cost of $26,000 for a lighting service, making a total of $52,000 for a new plant.

PORT ARTHUR, ONT., CAN.—At a recent election the ratepayers voted to accept the agreement made with the Ontario Hydro-Electric Commission for electrical power.

TRENTON, ONT., CAN.—The by-law submitted to the ratepayers on November 15, for the purpose of ratifying an agreement transferring from the town its water-power rights to the Trenton Electric & Water Company, was defeated.

TORONTO, ONT., CAN.—The Hydro-Electric Commission has awarded a contract to the American Aluminum Company of America, of Pittsburgh, Pa., for 1,500,000 lb. of ½-in. aluminum wire to be used in connection with the distribution of electricity generated at Niagara Falls throughout the Province of Ontario. The contract will amount to about $400,000.

COTEAU LANDING, QUE., CAN.—The International Waterways Commission presented to the Dominion Parliament on Nov. 16 a recommendation approving of the application of the Cedar Rapids Manufacturing & Power Company to construct power works on the north side of

the Cedar Rapids in Soulanges County near Coteau Landing, about 30 miles above Montreal, and that the company be given authority to divert 56,000 cu. ft. of water per second from the St. Lawrence River at that point.

MONTREAL, QUE., CAN.—The City Council on Nov. 15 decided to postpone its proposed offer to the Montreal Light, Heat & Power Company of $75 per arc lamp per annum for a five-year contract, and a by-law to raise $2,000,000 for the establishment of a municipal lighting plant will be submitted to a vote of the ratepayers on Dec. 21.

LA BARCA, MEX.—A company has been formed in La Barca for the purpose of acquiring the local horse car lines, which will be equipped to be operated by electricity. Application has been made to the State Government for a concession for an electric traction system. The principal car line, which is about three miles in length, connects the town and the National Railways station. Electrical energy for operating the system will be secured from the Guanajuato Power & Electric Company, of Guanajuato, Mex. Fructuoso Castellanos and Luis Navarrete are interested in the project.

New Industrial Companies.

THE ACME GAS & ELECTRIC FIXTURE COMPANY, of New York, N. Y., has been chartered with a capital stock of $30,000 by S. Wallach, S. H. Shiminsky, of New York, N. Y., and H. L. Adelman, of Brooklyn, N. Y. The company proposes to manufacture electric fixtures, gas and electric appliances, chandeliers, etc.

THE BAUER NON-COLLAPSIBLE WHEEL COMPANY, of New York, N. Y., has been incorporated with a capital stock of $150,000 by Matthew Haupt, of Edgewater, N. J.; W. J. Bauer, of New York, N. Y., and J. F. Bolton, of Fort Lee, N. J. The company proposes to manufacture motors, engines, vehicles, wheels, cars, etc.

THE B. & L. AUTO LAMP COMPANY, of New York, N. Y., has been incorporated by Vera Backer, Alexander Backer, of New York, N. Y., and Leon Lapis, of New York, N. Y. The company is capitalized at $3,400 and proposes to manufacture lamps and generators for automobiles, etc.

THE COMPOUND PROPELLER & BOAT COMPANY, of South Berwick, Maine, has been incorporated with a capital stock of $100,000 to deal in boats, engines, motors, etc. The officers of the company are: W. Thompson, president; F. A. Hobbs, treasurer and clerk, all of South Berwick, Maine.

THE CUMBERLAND & SALEM CONSTRUCTION COMPANY, of Vineland, N. J., has filed articles of incorporation, with a capital stock of $10,000, for the purpose of constructing street railways. The incorporators are: George H. Stevenson, Frank Parvin, Thomas Coggey, all of Vineland, N. J.; Benjamin F. Patterson, of Brooklyn, N. Y., and Herbert C. Barlett, of Vineland, N. J.

THE FULTON ELECTRICAL CONTRACTING COMPANY, of New York, N. Y., has been chartered with a capital stock of $100,000 to do a general electrical engineering and contracting business, etc. The incorporators are: Howard L. Judson, Joseph L. Martin and Lester J. Mack, all of New York, N. Y.

THE GREYHOUND MOTOR WORKS, of Buffalo, N. Y., have been incorporated with a capital stock of $100,000 to manufacture automobile vehicles, motors, engines, motor cycles, etc., by Fred P. Fox, W. C. Overman, John W. Van Allen, all of Buffalo, N. Y.

THE A. HOUSTON COMPANY, of Jersey City, N. J., has filed articles of incorporation with a capital stock of $25,000 for the purpose of doing a general mechanical and electrical engineering business. The incorporators are: A. Houston, M. A. Houston, of Jersey City, N. J., and J. B. Spear, of Paterson, N. J.

THE HOOKER ELECTRO CHEMICAL COMPANY, of Niagara Falls, N. Y., has been incorporated with a capital stock of $3,750,000. The directors of the company are: Franklin Remington, Michael Gavin, 2d, Percy K. Hilton, of New York, N. Y.; George E. Veile and Albert H. Hooker, of Niagara Falls, N. Y. The company proposes to manufacture chemical preparations and compounds.

THE H. P. KEANE COMPANY, of Atlanta, Ga., has been chartered with a capital stock of $10,000 by H. P. Keane and J. J. Batterman. The company proposes to deal in electrical apparatus.

THE LUCIUS ENGINEERING COMPANY, of Camden, N. J., has been chartered with a capital stock of $75,000 by A. V. Murray, H. G. Elliott and A. Martin, all of Camden, N. J. The company proposes to do a general engineering, contracting and construction business.

THE MARINE ELECTRICAL COMPANY, of Lorain, Ohio, has been incorporated with a capital stock of $25,000 for the purpose of designing and installing steamship electrical appliances and devices. The company will also manufacture an electrical sounding device operated from the engineer's room by which water levels of the various ballast tanks can be ascertained by simply pushing a button, which was invented by A. B. Walton. A. H. Babcock is president of the company and J. M. Jones, secretary and treasurer.

THE E. M. PECK COMPANY, of Portchester, N. Y., has been chartered by Earl W. Peck, James P. Travers and Richard P. Lydon, all of New York, N. Y. The company is capitalized at $30,000 and proposes to deal in inventions, patents and patent-rights, etc.

New Incorporations.

GROVELAND, GA.—The Magnolia Spring Company has applied for a charter for the purpose of establishing a street railway in Groveland, and also asks for the privilege of erecting power plants. The company is capitalized at $5,000 and the incorporators are: W. Elabee, M. E. Carter, L. Banks, E. A. Proctor, D. B. Warnell and W. C. Perkins.

ALLEGANY, N. Y.—The Allegany Telephone Company has been organized to operate a telephone system in Allegany County. The company is capitalized at $10,000, and the directors are: Robert E. Lang, George J. Fisk and John B. White, of Belfast.

NEW YORK, N. Y.—The Ambato Electric Light Company has been incorporated with a capital stock of $50,000 for the purpose of establishing an electric light, heat and power company in Equador, South America. The incorporators are: F. J. Torpey, J. A. Caras and A. Manley, of New York, N. Y.

SUMMERFIELD, N. C.—Articles of incorporation have been filed for the Farmers' Telephone Company, with a capital stock of $25,000, by C. W. Williams, R. O. Gamble and others.

CLEVELAND, OHIO.—The Ohio Home Telephone Company has been organized for the purpose of taking over the property of the United States Telephone Company, the independent long-distance telephone system in Ohio. The officers of the company are: William Christy, of Akron, Ohio; S. W. Harper, of Wheeling, W. Va., and H. A. Huxhurst, of Cleveland, Ohio.

TIFFIN, OHIO.—The Tiffin Consolidated Telephone Company has been incorporated with a capital stock of $100,000 by Jacob Fleck and others.

SEDAN, OKLA.—The Saddle Mountain Mutual Telephone Company has been chartered with a capital stock of $875 by Amos H. Thompson, A. B. Moiner, of Sedan, and C. M. Evatt of Saddle Mountain, Okla.

YALE, OKLA.—The Yale Electric & Refrigerating Company has been chartered with a capital stock of $10,000 by W. T. Canfield, G. W. Ballinger, F. M. Burdick and E. Covey.

ALLENTOWN, PA.—The Emaus Telephone Company has been chartered for the purpose of constructing and operating a telephone system in Lehigh and Berks counties. The incorporators are: Dr. H. T. Wickert, H. M. Knauss, C. F. Newcomer, C. H. Stoneback, C. D. Brown, Oscar Neumeyer and Ernest Ritter.

PENNSBURG, PA.—The Perkiomen Telephone & Telegraph Company has been organized, with the following officers: Oliver Schantz, president; Eugene Scholl, secretary, and George Hebner, treasurer. The company will be capitalized at $10,000.

PROSPECT, PA.—The Prospect Telephone Company has been organized with a capital stock of $18,000. The company has purchased the local equipment of the Portersville Telephone Company. The officers of the company are: Frank Coats, president; E. Watson, of Isle, Pa., vice-president; A. Bowers, of Prospect, Pa., secretary and treasurer.

SANDY SPRINGS, S. C.—Articles of incorporation have been filed for the Sandy Springs Rural Telephone Company by J. M. McElroy, H. C. Summers, Jr., J. D. Smith and others.

CORPUS CHRISTI, TEX.—The Corpus Christi Street & Interurban Railway Company has been incorporated with a capital stock of $100,000 by Daniel Hewitt, V. S. Heimly and Earl C. Heimly.

LEWISVILLE, TEX.—Articles of incorporation have been filed for the Lewisville Light & Power Company with a capital stock of $2,000 by Guy Bourland, Charles G. Thomas, J. M. Hendrix and others.

HUME, VA.—The Morven Telephone Company has been chartered with a capital stock of from $500 to $5,000. The incorporators are: James R. Green, of Markham, Va., president; E. Marshall Newton, of Hume, Va., secretary and treasurer; C. H. Corder, Edward Ambler and C. J. Yates, of Hume, Va.

QUINCY, WASH.—The Quincy County Telephone Company has been incorporated with a capital stock of $6,000 by E. O. Yeldell, E. I Hoffman, A. Keigley, L. Chaffee, A. R. Smith, W. H. Virginia and J. B. Morrison.

KAUKAUNA, WIS.—Articles of incorporation have been filed for the Kaukauna Telephone Company with a capital stock of $5,000 by J. M. Jansen, E. T. O'Brien, C. E. Raught, J. J. Martens and F. M. Charlesworth.

TWO RIVERS, WIS.—The West Shore Telephone Company has been organized, with the following officers: Nelson LeClaire, president; G. Eggert, secretary, and Peter Schroeder, of Two Rivers, treasurer.

LONDON, ONT., CAN.—Articles of incorporation have been filed for the London & Lake Erie Railway & Transportation Company with a capital stock of $2,000,000. The company, which is successor to the Southwestern Traction Company, has asked for permission to acquire the Woodstock, Thames Valley & Ingersoll Electric Railway as part of its system and to construct railways from Brantford, through Paris to Woodstock, Ingersoll, London, Strathroy and Glencoe, and from Delaware to Lambeth and from Aylmer to St. Thomas. The company will also operate boats on Lake Erie from Port Stanley to Cleveland, Ohio. The directors are: W. K. George, Sidney Jones and George B. Woods, of Toronto, Ont.; Dr. Angus MacKay, of Ingersoll, Ont.; F. G. Rumball and John Purdom, of London, and Albert E. Thompson, Cleveland, Ohio.

Personal.

MR. STEPHEN D. FIELD has sold to the Western Union Telegraph Company his invention of a quadrupled system for cable service. The system has been in use for some time on a cable between Key West and Havana.

MR. H. M. LEVYLIER has delivered a number of lectures before the Union Electricistas in Buenos Aires, Argentina, which have been published in book form by that society with the title "Nocione Elemantales de Electricidad Industrial."

PROF. SYDNEY W. ASHE, of Brooklyn, gave a lecture last Tuesday before the Baltimore N. E. L. A. section on underground conduit systems. Professor Ashe will lecture before the same body on Tuesday of each week until the middle of February.

PROF. CLARENCE E. REID has been appointed head of the Department of Physics and Electrical Engineering at the Mississippi Agricultural and Mechanical College. Professor Reid has, for the past four years, been assistant professor of Electrical Engineering at the Case School of Science, Cleveland.

MR. JOHN L. HALL, for a number of years New York manager for the Eck Dynamo & Motor Company, has associated himself with the Dilg Manufacturing & Trading Company, 401 to 425 East 163d Street, New York, as general sales manager. Mr. Hall has been connected with the electrical industry for more than 30 years, and during the past 15 years has served six years as district manager of the Bullock Electric Manufacturing Company; district manager of the Holtzer-Cabot Electric Company, with prior connections with the C. & C. Electric Company and the Crocker-Wheeler Company, as well as his recent connection with the Eck Company, noted above.

Obituary.

MR. EDWARD CURRY, formerly secretary and treasurer of the Staten Island Ferry and Railroad Companies, died at his home on Staten Island, N. Y., Nov. 17, in his 67th year. He was born near Peterboro, Ont., Canada, in 1843, and early in life became a telegraph operator and clerk on the Canadian Grand Trunk Railroad. In 1860 he was assistant manager of the Montreal Telegraph Company's office at Cobourg, and later became associated with the late Orrin S. Wood, Prof. Morse's first pupil, and was placed in charge of the Northwestern Telegraph Company's office at St. Paul, Minn. While in St. Paul Mr. Curry made a record for rapid telegraphy. He afterward filled important official positions with the Northwestern Company. He came East 25 years ago and organized the State Island Ferry and Railroad companies, with which he was identified until two years ago, when he retired from business on account of ill-health. The deceased is survived by a widow and four sons.

Trade Publications.

LINE MATERIALS are briefly outlined in an illustrated mailing folder issued by the Ajax Line Material Works, South Milwaukee, Wis.

MOTOR APPLICATIONS.—Bulletin No. 88 of the Wagner Electric Manufacturing Company, St. Louis, Mo., is a 32-page publication filled with illustrations of motor applications to various classes of work.

STORAGE BATTERIES.—The Electric Storage Battery Company, Philadelphia, has issued handbook IP, devoted to storage batteries in small isolated lighting plants. Handbook LV of the same company deals with storage batteries for low-voltage isolated lighting plants with tungsten lamps.

RHEOSTATS.—Direct-current motor-starting rheostats is the subject of Bulletin No. 4687, issued by the General Electric Company, which illustrates and describes rheostats designed for the reliable and efficient starting of direct-current motors. These rheostats are not intended for regulating the motor speed.

AIR BRAKES.—The increase in the use of short trains during rush hours and during periods of congested traffic on electric railways which normally operate single cars, and the necessity of a suitable air brake equipment for this service, resulted in the development of the emergency straight air brake system by the General Electric Company. A description of this system is given in detail in Bulletin No. 4701.

PORTABLE INSTRUMENTS.—Circular No. 1181 of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., describes a complete line of portable direct-current ammeters and voltmeters which are of the permanent-magnet and moving-coil type. These meters are of the single-air-gap construction for which permanency of calibration is claimed.

CONDUIT.—The National Metal Molding Company, Pittsburgh, Pa., has issued a two-color folder outlining the advantageous features of Sherarduct conduit. The pipe used for the conduit is subjected to a process in which zinc dust is anchored and impregnated uniformly into the metal over all parts, on both the interior and exterior. The pipe is then given a bath in hot paraffine, which enables it to resist in addition to ordinary corrosion the action of acids found in cinder concrete and building materials.

MOTOR-DRIVEN AIR COMPRESSORS.—The use of the air brake which is a natural result of the adoption of heavy cars not only for interurban but for city traffic is, as is well known, constantly increasing, and the old method of supplying compressed air from storage tanks on the car is being rapidly superseded by the modern and far safer method of employing motor-driven air compressors automatically operated and forming a part of the brake equipment. Bulletin No. 4699, of the General Electric Company, is devoted to a description of motor-driven air compressors which eliminate to a large extent at least, the objectionable features inherent in this type of machine.

Business Notes.

TAKATA & COMPANY, exporters to Japan, have moved their offices to the Hudson Terminal Buildings, 50 Church Street, New York.

J. G. WHITE & COMPANY have opened a branch office in the First National Bank Building, Chicago, Ill., with Mr. Charles T. Mordock as manager.

GAS-PRODUCER PLANT.—The Minneapolis Steel & Machinery Company is furnishing one of its Muenzel producer-gas engines and gas-producer plants for the electric light plant at Milbank, S. D., which is owned by Oscar Claussen, consulting engineer, St. Paul, Minn.

THE W. P. CARSTARPHEN ELECTRIC COMPANY, of Denver, Colo., is having plans made for a four-story building which will include departments for the manufacture of panel boards and cabinets and for storage battery work; a wiring and a contractors' supply department, and an electric garage. The roof of the building is planned for an aeroplane landing platform.

THE ESTERLINE ELECTRICAL COMPANY, of Lafayette, Ind., has closed a contract to install the electric generating equipment in the new plant of the American Box-Ball Company in Indianapolis. The contract calls for a complete set of motor drives for all of the machinery. The company has also secured the contract for an electric light and power plant for the Indiana Institute for the Deaf and Dumb just being completed at Indianapolis.

THE OLIVER ELECTRIC & MACHINE COMPANY, Birmingham, Ala., has succeeded the Oliver Electric Company, but with no change in the personnel of the company. The shop and office are now located at No. 1 South Twentieth Street, where larger quarters and additional machinery give greatly increased facilities for prompt and satisfactory service. In addition to its regular line, rewinding and rebuilding electrical machinery, the company is now giving special attention to engineering work, machine work and the sale of new and rebuilt machinery.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV. 16, 1909.

[Conducted by Wm. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

939,969. INCANDESCENT ELECTRIC LIGHT; J. T. Bigger, Owensboro, Ky. App. filed April 17, 1908. Low and bright light by providing plug with two contacts, each forming a terminal for the respective filaments.

939,973. BLOCK SIGNALING SYSTEM; F. F. Brush, Detroit, Mich. App. filed Aug. 26, 1907. Employs a trip actuated by wheels of train to operate a recording mechanism.

939,984. ELECTRIC RAILWAY SIGNALING APPARATUS; W. J. Cook, Denver, Col. App. filed July 13, 1908. If rocks break the rails, this closes a circuit which releases a signal allowing the latter to assume the danger position.

939,995. CURRENT COLLECTOR; G. R. Forster, Fifthian, Ill. App. filed June 15, 1908. Two trolley wheels are mounted tandem at the top of the pole. Improvements in lubrication therefor.

940,002. CLUTCH; T. H. Gerrard, Troy, N. Y. App. filed April 10, 1908. Clutch for feeding carbon in an arc lamp. A pair of clutch rings are carried by a lifting bell crank.

940,008. COMBINED PRIMARY AND SECONDARY BATTERY SYSTEM; J. H. Gugler, Milwaukee, Wis. App. filed June 17, 1909. For distributing end cells by a multipolar switch.

940,012. CONNECTOR; T. A. Hammon, Passaic, N. J. App. filed March 18, 1908. Terminal connector for batteries formed from a single blank of metal will control shank having perforated gripping jaws at each end.

940,021. LUMINOUS ELECTRIC HEATER; W. F. Howard, West Ealing, and A. B. Cousins, Abingdon-on-Thames, England. App. filed Feb. 1, 1909. A vacuum bulb of glass containing a carbon filament mounted in massive metal terminals.

940,028. THIRD RAIL ELECTRIC RAILWAY SYSTEM; C. Kozesnik, New York, N. Y. App. filed April 25, 1908. The third rail has a box-shaped bottom in which are placed armature supports of insulating material.

940,034. WIRE SUPPORTING DEVICE; J. M. Leadon, Jr. App. filed Feb. 24, 1909. A flattened ring upon each end of a wire, the rings being flexible to clasp the wire.

940,043. SECONDARY BATTERY; W. Morrison, Chicago, Ill. App. filed June 8, 1903. A zinc battery with alkaline electrotype, the zinc being deposited on a wire screen forming the electrotype.

940,112. MOTOR CONTROL SYSTEM; E. F. W. Alexanderson, Schenectady, N. Y. App. filed Sept. 11, 1907. The field and armature are connected in series and the armature of the dynamo is connected in shunt to the motor field. Means are provided connecting the motor to a source of current, for short circuiting it and for varying the armature voltage of the motor.

940,151. RESISTANCE UNIT; H. E. Heath, Lynn, Mass. App. filed Oct. 3, 1906. A sheet of flexible heat refractory material rendered partially conductive by a deposit of metal on the inner fiber thereof.

940,164. MOTOR CONTROLLING DEVICE; C. D. Knight, Schenectady, N. Y. App. filed Jan. 21, 1907. For printing presses running at variable speed. The starting rheostat is so connected that the speed is automatically brought to running value for a definite point of the rheostat. The speed is varied by varying the field strength of the motor.

940,174. COMBINED SWITCH AND FUSE PLUG; F. Mackintosh, Schenectady N. Y. App. filed Sept. 30, 1907. A perpendicular blade switch composed of two sections with ends overlapping and insulation between, the end being clamped together.

940,176. LIGHTNING ARRESTER; C. T. Mason, Sumter, S. C. App. filed May 1, 1908. For telephone circuits. A coil wound with abrupt turns inside a grounding block.

940,209. ATTACHMENT FOR MERCURY LAMPS; C. P. Steinmetz, Schenectady, N. Y. App. filed Oct. 22, 1904. For starting mercury lamps having self-reducing resistance device in shunt with the clamp.

940,211. ELECTRIC RAILWAY SYSTEM; W. M. Stephens, Philadelphia, Pa. App. filed Jan. 4, 1907. Feed wire and contact boxes in which contact elements are located controlled by an armature actuated by a magnet on the car.

940,220. LIGHTNING ARRESTER; E. W. Vogel, Chicago, Ill. App. filed May 5, 1906. For telephone, etc. Has an insulating base, a pair of posts of conducting material, a conducting coil between them and a ground wire near the coil.

940,241. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; A. C. Eastwood, Cleveland, Ohio. App. filed Dec. 3, 1908. A series of electrically operated switches, a control circuit, adjacent pairs of switches having one end of their windings connected to opposite sides of the control circuit and the other end of the windings connected to a control conductor.

940,266. MAGNETIC SEPARATOR; W. B. Moore, Walla Walla, Washington. App. filed Sept. 23, 1907. A tank, a rotating electromagnet therein carrying a wall with its upper portion flared outwardly.

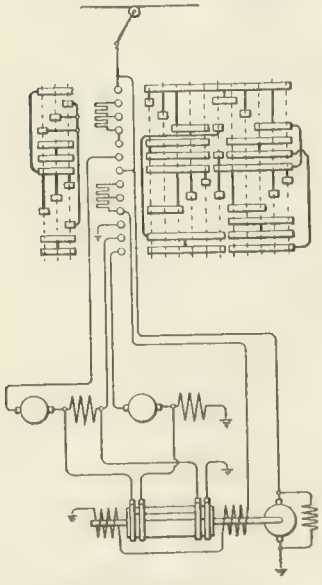
940,282. ELECTRIC SEPARATOR; G. D. Rogers, Gloucester, Mass. App. filed Dec. 30, 1905. A polyphase coil in ring form allows a stream of magnetic material to pass through it. The rotary field produces the separation.

940,288. STORAGE BATTERY; A. O. Tate, Toronto, Ont., Canada. App. filed Feb. 24, 1908. The anode strips are bound together in one plate and the cathode strips in an independent plate so that each plate may be used separately.

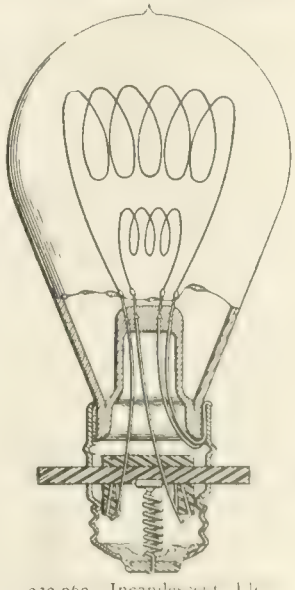
940,309. TROLLEY HEAD; B. F. Foss, Fairfield, Me. App. filed April 7, 1909. A trolley wheel and fork to do away with wear on the bushing by holding the pin in a bearing of large area.

940,311. COMBINATION SWITCH AND BLOW-OUT; W. C. Hafemeister, Cleveland, Ohio. App. filed July 12, 1907. An electric switch with means for blowing out the arc.

940,318. ELECTRIC MEASURING INSTRUMENT; A. H. Hoyt, Penacook, N. H. App. filed Oct. 18, 1907. Ampere and voltmeter



940,112—Motor Control System.



939,969—Incandescent Electric Light.

mounted on a common base with circuits so arranged that either instrument may be thrown in.

940,319. ELECTRIC MEASURING INSTRUMENT; A. H. Hoyt, Penacook, N. H. App. filed Jan. 20, 1908. A permanent magnet and moving coil instrument. Details.

940,328. ELECTRIC SWITCH; O. M. Knoblock, South Bend, Ind. App. filed March 6, 1907. A knife switch on an insulating base. Details.

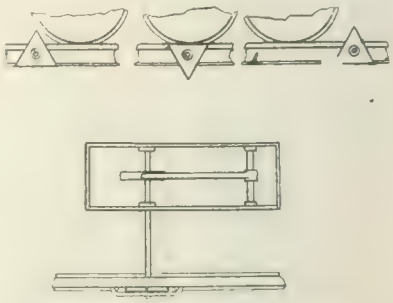
940,335. BINDING POST; H. E. Leppert, New Britain, Conn. App. filed Feb. 25, 1909. For switches. A stationary post with two opposing walls and screw passing through one wall to clamp the conductor against the other wall.

940,392. ELECTRIC GENERATOR; E. T. Kenney, Indianapolis, Ind. App. filed April 16, 1908. Improved magnets with laminated core having three way wings, staggered, and a pair of pole pieces coacting therewith at every 60 deg.

940,393. BRUSH HOLDER; E. R. Knight, Norwood, Ohio. App. filed Aug. 30, 1905. Brush holder of sheet metal stampings with a sheet metal spacing plate having a curved portion and a guiding portion for the brush.

940,397. BINDING POST; A. Lungen, New York, N. Y. App. filed Jan. 16, 1909. For stranded conductors consisting of a post, screw and traveling nut on the screw.

940,408. DOUBLE ACTING SWITCH; C. J. Spellman, Wauwatosa Wis. App. filed Dec. 7, 1908. A pair of stationary mercury cups, a movable mercury cup and depending arms dipping within the pair of cups and stationary contacts dipping within the third cup when the movable cup withdraws the contact arms from the pair of cups.



939,974—Railway Signaling Apparatus.

940,410. PENDULUM ACTUATED CLOCK; E. W. Vaill, Jr., Englewood, N. J. App. filed June 17, 1909. The pendulum is driven by an electromagnet and carries an oscillating weight whose oscillations are prevented when the vibrations of the pendulum are less than a certain amount, the weight closing a circuit when the weight ceases to operate.

940,444. VISUAL SIGNAL APPARATUS; R. Einbigler, New York, N. Y. App. filed April 8, 1909. For stock exchanges, etc., having an annunciator board with a name plate for the person called, station plates, electromechanisms for actuating them.

940,471. PROCESS OF RECOVERING TIN FROM WASTE; A. Nodon, Bordeaux, France. App. filed April 9, 1908. Treats the waste with a solution of stannic sulfate having an excess of sulfuric acid mixed with ammoniacal stannic bichlorid and electrolyzing the resultant liquor.

940,487. ELECTROMAGNETIC TRACTION SYSTEM; G. L. Stanbro and A. D. Wagner, Norfolk, Va. App. filed June 7, 1906. Surface contract railway with a contact plate for feeding the car having a hollow supporting stem, a normally open switch inclosed by the stem, a second normally open switch in series therewith and a magnet on the car for operating the switches one after the other.

940,511. MOTOR VEHICLE; F. E. Chase, Schenectady, N. Y. App. filed Oct. 10, 1906. High speed car using two trolley poles engaging one wire but dependent on each other, a plurality of motors and a controller with means for connecting the controllers in independent motor circuits.

940,525. SAFETY DEVICE FOR OVERHEAD ELECTRIC CONDUCTORS; E. Giraud, Paris, France. App. filed Oct. 4, 1906. An insulator carrying a metal piece with an offset carrying a member for receiving the conductor with a short circuiting device adjacent to the insulator for carrying the current when the conductor is severed.

940,526. ELECTRICAL RECEPTACLE; G. W. Goodridge, Bridgeport, Conn. App. filed May 6, 1909. Screw shell for sockets of lamps having securing flanges, portions of the shell being bent over on the flanges to reinforce them.

940,535. BURGLAR ALARM; M. Korbel, Kingston, Pa. App. filed May 17, 1909. A yieldable safe support normally flush with the floor line to close the circuit when the burglar steps on it.

940,550. APPARATUS FOR STARTING ELECTRIC MOTORS; S. B. Paine, Newton, Mass. App. filed May 28, 1909. A plurality of motors are connected in parallel to three conductors, a switch being in series with each motor and the conductors will overload tripping devices for the switches.

940,555. SUSPENSION DEVICE FOR TELEPHONE AND TELEGRAPH CABLES AND OTHER ELECTRICAL CONDUCTORS; E. C. Read, Franklin, Pa. App. filed Nov. 25, 1908. A strap formed of two clips with ends detachably secured together.

940,561. TAPPING FURNACE; G. O. Seward, Holcombs Rock, Va. App. filed May 3, 1904. Electric furnace in which the tap hole is closed by a rod which can be melted out by an electric arc.

940,574. TROLLEY HARP; J. T. Archer, Champaign, Ill. App. filed Nov. 28, 1908. A trolley pole carrying a rotatable standard in which the wheel is mounted.

940,[illegible]. PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS; S. R. Bergman, Lynn, Mass. App. filed Oct. 13, 1905. An oil bath lightning arrester in which a plurality of conductive plates are mounted adjacent to a fair-shaped plate on a rotary stem.

940,610. GAS LIGHTING AND EXTINGUISHING APPARATUS; W. C. J. Nightingall, Melbourne, Victoria, Australia. App. filed June 8, 1909. For street lamps. A plurality of revolving segmental switches are operated simultaneously by variation of gas pressure.

940,632. DYNAMO-ELECTRIC MACHINE; B. A. Behrend, Norwood, Ohio. App. filed Nov. 27, 1905. Multiphase generator of rotating field type with insulated bolts on the end member for supporting the end turns and end connections.

940,635. ELECTRODE ELEMENT FOR STORAGE BATTERIES; T. A. Edison, Llewellyn Park, Orange, N. J. App. filed Feb. 6, 1908. An electrode element comprising a perforated tubular pocket with a spiral joint containing compressed active material.

940,[illegible]. SWITCH. J. H. Mcarthop, Bridgeport, Conn. App. filed Sept. 12, 1908. Two part button snap switch. Improvement in the escapement for the contact member.

940,647. AUTOMATIC MAGNETIC CIRCUIT BREAKER; W. M. Scott, Philadelphia, Pa. App. filed Jan. 19, 1907. An operating handle with force multiplying mechanism between the handle and the switch controls heavy currents.

Rossiter, MacGovern & Co.

ESTABLISHED 1893 (INCORPORATED)

Electrical Apparatus of All Kinds

WEST STREET BLDG., 90 WEST STREET, NEW YORK **TELEPHONE, CORTLANDT 8376**

ALTERNATING CURRENT MOTORS—60 Cycle, 3 Phase

1—150	HP General Electric, 550 volts, 900 RPM.	1— 15	HP Westinghouse, 200 volts, variable speed.
1—100	HP Westinghouse, 200 volts, 690 RPM.	1— 10	HP Westinghouse, 200 volts, 1700 RPM.
5— 50	HP Westinghouse, 200 volts, 850 RPM.	1— 10	HP Westinghouse, 200 volts, 1120 RPM.
4— 40	HP Westinghouse, 200 volts, 850 RPM.	1— 7½	HP General Electric, 200 volts, 1800 RPM.
2— 30	HP Westinghouse, 200 volts, 850 RPM.	1— 5	HP Westinghouse, 200 volts, 1120 RPM.
1— 20	HP General Electric, 550 volts, 900 RPM.	3— 3	HP Westinghouse, 1700 RPM.
3— 15	HP Westinghouse, 200 volts, 1120 RPM.	1— 1	HP Westinghouse, 1700 RPM.

THESE MACHINES ARE ONLY A VERY SMALL PORTION OF OUR STOCK. WE WILL SEND COMPLETE STOCK LIST ON APPLICATION.

COMMONWEALTH EDISON CO.

REPAIR SHOPS

76 MARKET ST., CHICAGO. TELEPHONE RANDOLPH 1280.

FIRST-CLASS EQUIPMENT THROUGHOUT

DYNAMOS, ARMATURES, MOTORS, ARC LAMPS INSTRUMENTS, HIGH GRADE MACHINE WORK OF ALL KINDS

CORRESPONDENCE SOLICITED

SPARKING

reduces the working capacity of a motor or dynamo, wears out the commutator, wastes power and may cause a fire. All of this may be avoided if you use

GALES COMMUTATOR COMPOUND — DIRECTIONS FOR USE

The only article that will prevent sparking. Will keep the commutator in good condition and prevent cutting. Absolutely will not gum the brushes

It will put that high gloss on the commutator you have so long sought after

Send for Stick **50c. PER STICK** **$5.00 PER DOZ.**

For Sale by All Supply Houses or **K. McLENNAN & CO.** Sole Manufacturers

Room 411—130 Dearborn St., CHICAGO

POSITIONS WANTED

The rate for "Positions Wanted" advertisements of forty words or less is one dollar an insertion; additional words two cents each; payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue. Replies may be sent in care of Electrical World, 239 West Thirty-ninth Street, New York, or 590 Old Colony Building, Chicago, as advertisers may desire.

ELECTRICAL ENGINEER, with highest references, wishes to form connection with good concern, preferably in or near New York. Three years' experience in Mexico, five years in Chili; speaks Spanish and German fluently. Has had wide experience both in selling and constructing electrical, steam and hydraulic machinery. Open for immediate engagement. Address No. 6291, care of Electrical World, New York.

IN THE NORTHWEST.—Electrician open for engagement about Jan. 1, 1910. Hydro-electric work preferred. Familiar with A. C. and D. C. steam, gasoline, producer-gas and tangental water wheels. Present salary $150; salary expected, anything reasonable; best of references. 'Eck Baughn, Concord, Idaho.

POSITION WANTED.—As calculating and designing electrical engineer or chief draftsman by experienced engineer, perfectly familiar with the design of induction motors and generators. Address No. 6306, care of Electrical World, New York.

POSITION WANTED.—Draughtsman wishes steady position in New York City. Experienced on both mechanical and electrical work. Am willing to be rated by firm. Address No. 6025, care of Electrical World, New York.

POSITION wanted by graduate E. E. as assistant superintendent or foreman in lighting or power company where advancement depends upon efficiency; eight years with two large companies; Eastern references. Address No. 6330, care of Electrical World, New York.

EXPERIENCED designing and constructing electrical engineer desires position with manufacturer or contractor; manufacturing and some steam experience; resourceful, accustomed to handling men and systematic production; will contribute one month's services if warranted; require ten days to change. Address No. 6177, care of Electrical World, New York.

GRADUATE Electrical Engineer, age 30, desires position as superintendent of lighting or railway plant. Nine years' practical experience, including two years in the testing department of the G. E. Co. and four years as foreman of construction work for same company. Have executive ability as well as the practical experience. Address No. 6308, care of Electrical World, New York.

POSITION wanted as manager of a new business department in a city of 100,000 or more with either gas, electric or combination company; I am thoroughly acquainted with the Doherty methods and can organize and conduct a department along these lines; I have a good general knowledge of illuminating engineering and power solicitation; will be glad to furnish references. Address No. 6329, care of Electrical World, 590 Old Colony Bldg., Chicago.

POSITION wanted as manager of small plant; graduate E. E. and Asso. Mem. A. I. E. E.; three years' experience in engineering department of large electrical corporation in Northwest; can handle men and am familiar with office, station, line and construction work; references, present employers. Address No. 6327, care of Electrical World, New York.

TECHNICAL graduate, 26, apparatus salesman for large electrical company, desires change; prefer position as power specialist with central station, but would consider position similar to present one; four years' testing and commercial experience. Address No. 6338, care of Electrical World, New York.

POSITION WANTED.—Bookkeeper and general office man desires change; 25; single; competent; five years' experience in bookkeeping; one year's experience in lighting and railway power house; employed at present in East; willing to go anywhere. Address No. 6336, care of Electrical World, New York.

POSITION WANTED.—A first-class armature coil or magnet winder and assembler with 19 years' experience desires a permanent situation; good worker; steady, sober man and reliable; best of references. Address No. 6339, care of Electrical World, New York.

GRADUATE electrical engineer, nine years' experience with manufacturer in power house design and as central station manager, speaking English, German and French, is seeking a position along similar lines. Address all correspondence to No. 6340, care of Electrical World, New York.

FOREMAN of winding department of long experience with best electrical companies will be ready for engagement Dec. 1; have been very successful improving methods and cheapening costs on winding and construction work; have references of satisfactory services rendered former employers. Address No. 6341, care of Electrical World, New York.

IRON and steel electrical engineers: I am a technical graduate with two years' experience in the industry and have also had two years' factory testing of motors and transformers and one-half year of industrial engineering; familiar with Westinghouse apparatus. Address No. 6342, care of Electrical World, New York.

UNIVERSITY man wishes to invest money with services in established business. Have had experience with consulting engineers and central-station company. Prefer connection with electrical engineer in or near New York. Best of references given and expected. Address No. 6343, care of Electrical World, New York.

EXPERT, Hydro-Electrical Engineer, Consulting and constructing—14 years' experience. Thoroughly competent in construction, operation, design and testing, feasibility reports, estimates and specifications. Special attention given large Hydro-Electrical developments and installations operating under high head conditions. Services reasonable, results guaranteed. A1 references. Address No. 6282, care of Electrical World, New York.

(Continued on page 80.)

HELP WANTED

(Continued from page 79)

The rate for "Help Wanted" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical World, 239 West Thirty-ninth Street, New York, or 590 Old Colony Building, Chicago, as advertisers may desire.

(In replying to a "Want" advertisement, original letters of recommendation should NOT be forwarded.)

DESIGNER WANTED.—A particularly able designer of alternating-current generators and motors, for a leading position in a well-known electrical manufacturing company near New York. Address No. 6246, care of Electrical World, New York.

WANTED.—High grade transformer designer experienced in modern practice and methods. State qualifications, which must bear close scrutiny. Address No. 6344, care of Electrical World, New York.

METER MAN.—Wanted, men interested in meter and instrument work, to take up the course on "Electrical Measuring Instruments and Meters," as prepared by the Fort Wayne Electrical Correspondence School, Fort Wayne, Ind. Write for catalogue giving information on meter testing.

WANTED.—A young man with technical training and some experience in New Business Department, to fill similar position with large light and power company near New York. State age, experience, salary expected, etc. Address A. B. C. No. 6256, care of Electrical World, New York.

COMPANY, manufacturing complete line of incandescent lamps, wants to secure services of several first-class agents and salesmen. Address No. 3320, care of Electrical World, New York.

WANTED AS PARTNER.—A high-class Electrical Engineer not less than 35 years of age, extensively experienced in Electric Lighting, Power Plants and Street or Interurban Railways by a firm of Civil Engineers of established reputation located in Middle West. Address, No. 6276, care of Electrical World, 590 Old Colony Building, Chicago, Ill.

WANTED—FIRST-CLASS DRAFTSMEN, Apply Supervisor of Drafting Rooms, G. E. Co., Pittsfield, Mass.

WANTED.—Electrical draftsmen and mechanical draftsmen. Pay from $3.60 to $5.04 per diem. A competitive examination will be held at the Navy Yard, Boston, Mass., November 30, 1909, for the purpose of establishing an eligible register of electrical draftsmen and mechanical draftsmen. For application and further information, address, "Commandant, Navy Yard, Boston, Mass."

WANTED.—EXPERIENCED DRAFTSMAN for dynamos by large firm in Middle West. State particulars in full and salary wanted. Address No. 6305, care of Electrical World, New York.

WANTED.—Electrical Engineer; man having technical education and factory experience to take position in designing and manufacture of Electric Automobiles. Want man of energy and force who will be capable later on of taking charge of department. Also want two men as Electric Automobile salesmen, capable of educating dealers in the charging and care of Automobiles. Address, Columbus Buggy Co., Columbus, Ohio.

ELECTRICAL and mechanical draftsmen wanted. Must be thoroughly capable men. Apply to Allis-Chalmers-Bullock, Limited, Montreal, Canada.

WANTED.—By lamp manufacturing company, foreman to take charge of a department employing female help exclusively. State age, experience, salary expected. Address Lamps, No. 6322, care of Electrical World, N. Y.

WANTED.—First-class draftsman on steam turbine work. State experience and salary expected. KERR TURBINE CO., Wellsville, N. Y.

DRAFTSMAN.—Designer of Motors and Generators. Must be capable of directing men and be familiar with Office and Shop practice. State experience and salary expected. Address No. 6328, care of Electrical World, New York.

WANTED.—Draftsman for electrical work. Preferably one with experience in connection with motor-controlling apparatus, circuit breakers, automatic switches, etc. To a man with sound technical education and experience an excellent opportunity is offered in a very rapidly growing line of work. American Electric Fuse Company, Muskegon, Michigan.

WANTED.—Two experienced meter testers in large lighting company near greater New York. State age, experience and salary expected. Address No. 6321, care of Electrical World, New York.

WANTED.—Two laboratory assistants who are willing to do occasional night work. The line is electrical. Salary $9.00 per week. Apply to Walter E. Holland, at the Edison Laboratory, Orange, N. J.

WANTED.—Young man to specialize in tests of lamps and in photometry. University education desirable. Only those who can call for interview if requested need apply. Address Electrical Testing Laboratories, 80th St. and East End Ave., N. Y.

WANTED.—Electricians, Engineers, Telephone men, and all who are interested in locating concealed trouble quickly and accurately, 6 ft. under ground or overhead, any where, tested method. Send 4 cts. in stamps for particulars. The Marsh Company, 62 Knickerbocker Bldg., Baltimore, Md.

WANTED.—Young graduate electrical engineers for practical and technical work with new electric light. Good salary and an unusually good opportunity for advancement. State age, experience, training and qualifications. Address No. 6337, care of Electrical World, New York.

EDUCATIONAL

The rate for "Educational" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

RENSSELAER POLYTECHNIC INSTITUTE, TROY, N. Y.—Courses in Civil, Mechanical and Electrical Engineering, and General Science, leading to the degrees of Civil Engineer (C. E.), Mechanical Engineer, (M. E.), Electrical Engineer (E.E.), and Bachelor of Science (B.S.). Special courses in Engineering and Science. Splendidly equipped new engineering laboratories. Send for Catalogues to the Registrar.

MISCELLANEOUS

The rate for "Miscellaneous" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

ELECTRICAL INVENTORS should engage a *technical* patent attorney to apply for their patents, because Patent Office Examiners are *technical* experts. No Examiner, nor other attorney than undersigned, is member of both A. I. E. E. and A. S. M. E. Mail invention for free advice, opinion, booklet and estimate to secure patent. Delay dangerous. Edward P. Thompson, M. E., Registered Patent Attorney, 1371 Columbia Road, Washington D. C.

WANTED.—Second-hand leather belting. B. B. Steiner, St. Louis, Mo.

WANTED.—Meter testers to send for our new meter testing book giving full information on connecting and testing meters. This book, sent free upon request, will enable you to increase the efficiency of the meter department. Central Electric Co., Chicago.

NEW ZEALAND.—Progressive firms are invited to send us Price Lists and Catalogues of their Goods. We are open to represent one or two good Houses. Electrical importing Co. of New Zealand, 54 Shortland St., Auckland, New Zealand.

WRITING ADVERTISING

can't be left to everyone, and there are times when neither you nor your engineers have time to change the matter weekly.

We have a copy department in which the writers are graduated engineers as well as thorough advertising men.

We will write your copy, change it as often as you like, and send you matter for approval—say once a month.

No extra charge to our advertisers unless you want engravings made. In that case, just what they cost us.

ELECTRICAL WORLD, 239 West 39th Street, New York

Frank MacGovern J. Warren Archer

MacGovern, Archer & Co.

114-118 Liberty Street Electrical and Steam Machinery **NEW YORK**

DYNAMOS AND MOTORS—ALL IN STOCK PHONE, CORT. 5577

Turbo-Generator Sets

1—5000 KW, Curtis G. E., 3-phase, 60-cycle, 2300-6600 volts.
2—2000 KW, Curtis G. E., 3-phase, 25-cycle, 6600 volts.

A. C. Direct-Connected Units (60-Cycle)

1—300 KW, G. E., 3-phase, ATB, 150 RPM, 2300 volts, with 14&28x30 in. C.C. McIntosh & Seymour engine.
2—300 KW, ATB, 3-phase, 60-cycle, 2300-volt G. E. alter., each direct-connected to a DeLaval steam turbine.
2—250 KW, 2200-volt, 3-phase, 60-cycle Westinghouse alternators, each direct-connected to 16&27x16 in. Westinghouse compound vertical engine.
1—250 KW, G. E., 1-phase, 60-cycle, 2300-volt, 200 RPM, with 15&28x18 Tandem Ideal engine. Can be rewound for 3-phase.
1—150 KW, Westinghouse, 2-phase, 60-cycle, 220-volt, 341 amperes, 240 RPM, with 22x16 Ball & Wood 4-valve horizontal engine. Can be rewound for 2300 volts, 3-phase.
1—75 KW, West., 1-phase, 60-cycle, 2200-volt, 257 RPM, with 13x12 Ames auto. engine. Can be rewound for 3-phase.

Alternating Current Dynamos (Belted), 3-Phase

1—300 KW, 3-phase, G. E., 60-cycle, 2300-volt, 450 RPM, ATB.
1—200 KW, 3-phase, G. E., 60-cycle, 480-volt, 600 RPM, ATB.
1—100 KW, 3-phase, G. E., 60-cycle, 480-volt, 900 RPM, ATB.
1— 75 KW, 3-phase, G. E., 60-cycle, 2300-volt, 900 RPM, ATB.

Alternating Current Dynamos (Belted), 2-Phase

1—100 KW, 2-phase, West., 60-cycle, 2300-volt, 514 RPM.
2— 75 KW, 2-phase, West., 60-cycle, 2200-volt, 720 RPM.

Alternating Current Dynamos (Belted), 1-Phase

1—100 KW, 1-phase, G. E., 60-cycle, 900 RPM, 1150-volt.
3— 75 KW, 1-phase, G. E., 60-cycle, 900 RPM, 1150-volt.
1— 45 KW, 1-phase, G. E., 60-cycle, 900 RPM, 2300-volt.

Direct Current Direct-Connected Units

3—400 KW, Westinghouse, 10 pole, 250 volts, 150 RPM, each direct-connected to an 18&36x30 in. Porter Allen engine.
2—225 KW, Westinghouse, 8 pole, 575 volts, 250 RPM, each direct-connected to an 18&30x16 in. vertical Westinghouse engine (Rites governor).
1—200 KW, Westinghouse, 8 pole, 250 volts, 350 RPM, direct-connected to 18&30x16 in. vertical Westinghouse engine fitted with Rites governors.
1—150 KW, Crocker-Wheeler, 115-125 volts, 6 pole, speed 250, 160 RPM, each with a heavy duty 4-valve type horizontal McIntosh & Seymour engine.
1—100 KW, General Electric, 125 volts, 6 pole, speed 250 RPM, with 16x15 in. horizontal McIntosh & Seymour engine.
1—50 KW, Crocker-Wheeler, 6 pole, 125 volts, 275 RPM, direct-connected to an 11x14 in. horizontal straight line engine.
1—30 KW, 125 volts, 6 pole, G. E., 305 RPM, with 10x12 Ideal engine.

Vertical Direct-Connected Units

3—100 KW, Sturtevant, 250 volts, 350 RPM, engines 10&18x10 in.
1— 50 KW, Sturtevant, 250 volts, 400 RPM, engine 8&14x8 in.
2— 50 KW, Sturtevant, 115 volts, 275 RPM, engines 12x10 in.
2— 35 KW, Sturtevant, 115 volts, 325 RPM, engines 10x9 in.
2— 30 KW, G. E., 125 volts, 305 RPM, engine 11x8 in.
2— 20 KW, G. E., 125 volts, 360 RPM, engine 9x7 in.

250-Volt Direct Current Dynamos and Motors

3—415 HP, Bullock, 10-pole, 155-175 RPM.
1—150 KW, C. W., 6-pole, 550 RPM.
1—125 HP, Bullock, 6-pole, 225 RPM.
1—60 KW, Northern, 4-pole, 800 RPM.
1—56 KW, West, 4-pole, type M, 800 RPM.
1—35 HP, Northern, 4-pole, 875 RPM.
2—25 HP, Sprague, 6-pole, 875 RPM.
1—15 HP, G. E., 4-pole, type CE, form A, 1200 RPM.
1—15 HP, Sprague, 4-pole, type D, 1100 RPM.

500-Volt Direct Current Dynamos and Motors

1—500 KW, G. E., 4-pole, type MP, 350 RPM.
2—300 KW, G. E., 4-pole, type MP, 400 RPM.
1—110 KW, G. E., 6-pole, form A, 600 RPM.
1—100 KW, Edison, bi-polar, 700 RPM.
1—85 HP, G. E., 4-pole, form H, 500 RPM.
1—75 HP, G. E., 4-pole, form H, 800 RPM.
2—55 HP, G. E., 6-pole, type CL, form B, 900 RPM.
1—50 HP, West., 4-pole, type S, 550 RPM.
1—45 HP, G. E., 500 RPM.
1—30 HP, West., 4-pole, type S, 950 RPM.
1—30 HP, G. E., 4-pole, type MP, 1050 RPM.
1—25 HP, C. W., 4-pole, type CM, 780 RPM.
1—20 HP, West., 4-pole, type S, 1040 RPM.
2—15 HP, G. E., 4-pole, type CQ, form A, 1200 RPM.
1—20 HP, Northern, 4-pole, type MP, 850 RPM.
1—10 HP, West., 1800 RPM.
1—10 HP, Northern, 4-pole, 850 RPM.
1—7½ HP, G. E., form A, 1650 RPM.
1—7½ HP, G. E., 4-pole, 800 RPM.
3—5 HP, G. E., 4-pole, type CE, 1800 RPM.
1—5 HP, G. E., 2-pole, type CQ, 2000 RPM.
1—5 HP, Peerless, 1660 RPM.
1—5 HP, Northern, 4-pole, 1000 RPM.
1—3 HP, G. E., 4-pole, 1620 RPM.
1—2 HP, Peerless, 1910 RPM.
1—2 HP, Peerless, 1820 RPM.
1—1 HP, G. E., 2-pole, type CA, form B, 1300 RPM.

3-Phase, 60-Cycle Motors

2—125 HP, West., type C, 2200 volts, 720 RPM.
1—40 HP, G. E., type M, 220 volts, 900 RPM.
2—7½ HP, West., type C, 220 volts, 1120 RPM.
1—2 HP, West., type C, 110 volts, 1700 RPM.

2-Phase, 60-Cycle Motors

2—125 HP, Westinghouse, type C, 2200 volts, 720 RPM.
2—55 HP, General Electric, form K, 220 volts, 514 RPM.
1—40 HP, Westinghouse, type C. C. L., 400 volts, 840 RPM.
1—30 HP, Westinghouse, type C. C. L., 200 volts, 1180 RPM.
3—20 HP, General Electric, form K, 220 volts, 900 RPM.
3—15 HP, General Electric, form K, 220 volts, 1200 RPM.
1—10 HP, Westinghouse, type C, 200 volts, 1120 RPM.
4—10 HP, General Electric, form K, 220 volts, 1200 RPM.
2—7½ HP, General Electric, form K, 220 volts, 1200 RPM.
2—3 HP, Westinghouse, type C, 200 volts, 1700 RPM.
2—2 HP, Westinghouse, type C, 200 volts, 1700 RPM.

All the above Machinery can be delivered immediately and is in the very best of condition

Send for full list of 2 and 3-phase Alternating and 550 or 250 volt Direct Current Motors; also Dynamos, Engines and Electrical and Steam Machinery of every description

GEORGE SACHSENMAIER

1309 Race Street, Philadelphia, Pa.

1—125 K. W., 250-volt, 700 RPM Eddy Generator
1—120 K. W., 2300-volt, 720 RPM, 2-phase Westinghouse Alternator

Large stock of

Small Motors, Generators, Meters and Transformers

Write us if you want to either

BUY, SELL OR EXCHANGE

DYNAMOS, ENGINES, BOILERS

Alterantors	Engines
1-500 K W. G E. 60 cycle, 3 ph.	
1-35 K.W. G.E. 60 cycle, dr. cn. 3 ph.	1 24 x 42 Hamilton Corliss.
1 250 K.W G.E. 60 cycle, dr. cn. 3 ph.	1 22 x 42 Allis Corliss
2 15 K.W. G.E. A T.B. 60 cycle, belted, 3 ph.	2 18 x 42 Hamilton Corliss.
Generators	
1 200 K.W. G.E. 250 volt, d c. dr. cn.	1200 H.P. W.T. Boilers, 150 lbs steam
2 150 K.W. G.E 125 volt, d.c. dr.cn.	
1 100 K.W. W E. 125 volt, d.c belted.	Partial list only. Advise us your wants.

Station Equipment Company, 1228 Marquette Bldg., Chicago, Ill.

125-volt Direct Connected Units.

1—200 K.W. G.E. D.C. Corliss Engine.
1—150 K.W. G.E. D.C. Harrisburg Engine.
1—100 K.W. C.W. D.C. Harrisburg Engine.
1—80 K.W. G.E. D.C. Watertown Engine.
1—75 K W Westinghouse D.C. Westinghouse Engine.
1—75 K.W. Triumph D.C. Harrisburg Engine.
1—50 K.W. Eddy and Watertown Engine.
1—50 K.W. Triumph and Harrisburg Engine.
1—40 K.W. G.E. and Armington & Sims Engine.
1—40 K.W. Sprague-Lundell D.C. Fitchburg Engine

Belted Dynamos

(250 VOLTS)

1—100 K W. Westinghouse, 6-pole.
1—75 K.W. General Electric, 4-pole.
1—50 K.W. Commercial.
1—50 K.W. Westinghouse, 4-pole.
2—30 K.W. Westinghouse, type M.

(125 VOLTS)

1—75 K.W. General Electric, 6-pole.
1—55 K.W. General Electric, 6-pole.
1—25 K.W. General Electric, 6-pole, form H.
1—25 K.W. General Electric, 6-pole, form A.
1—60 K.W. Eddy, type G.

Large stock of Motors, all sizes and voltages, both D.C. and A.C. Engines and Boilers. Send for complete list.

Joseph H. Thompson, Jr., 17 BATTERY PLACE NEW YORK

Bargains in G-I Arc Lamps



5,000 new and used lamps at less than half original cost.

Direct Connected Sets

125-Volt Lighting Sets

1—33 K.W. C & C Generator and 10 x 10 Ames Engine
1—50 K.W. Jenney Generator and 12 x 12 Ames Engine
1—75 K.W. Westinghouse Generator and 13 x 12 Ames Engine.
1—100 K.W. Western Elec. Generator and 16 x 16 N. Y. Safety Engine.
1—200 K.W. Western Electric Generator and 20 x 24 Atlas Engine

250-Volt Power Units

1—60 K.W. Western Electric and 13 x 13 Ideal Engine
1—115 K.W. G. E. Generator and 14 x 36 Allis Corliss Engine
1—175 K.W. G. E. Generator and 18 x 16 Ames Engine
1—300 K.W. Northern Generator and T. C. Russell 4-valve Engine.

250-Volt, 60-Cycle, 3-Phase Sets

1—125 K.W. Western Electric Generator and 16 x 16 Skinner Automatic Engine.

POWER EQUIPMENT COMPANY
1407 Fisher Bldg. CHICAGO

We are glad to send to any interested party the C-W Bulletins on

A. C. Generators
D. C. Generators
D. C. Motors
Rolling Mill Motors
Transformers

Crocker-Wheeler Company
A. C. and D. C. Machinery
Ampere, N. J.

A well-known Western New York Concern writes Electrical World as follows:

"We have been surprised at the great number of replies we have had to this advertisement, and also of the high character of the same."

Your Subscription

to the ELECTRICAL WORLD will prove a good investment. It costs less than one cent a day.

WANTED

One 200 to 300 K.W. 60 cycles 600 v. 3 phase Rotary Converter. Necessary Transformers for 2300 v. A.C. and D.C. Switchboard Panels.

THE GREELEY & DENVER R. R. CO.
Greeley, Colo.

FOR SALE

the following second hand machinery.

1-225 H.P. Cross Compound Buckeye Engine, rope drive.
1-90 K.W. Stanley Inductor Alternator.
1-100 K.W. T-H 500 Volt Generator.
Also steam piping, counter-shaft, belt tightener, etc.

Address: Citizens' Ry. & Light Co., Muscatine, Ia.

BARGAINS

Alternating and direct current motors, dynamos, also plating dynamos at bargain prices. All makes and sizes sold, bought and repaired.

EUGENE L. RICHTER ELECTRIC CO.
N. E. Cor. Uber and Columbia Aves., Philadelphia, Pa.

WANTED.—Generating sets: second-hand, first-class condition, approximately as follows:

125 K.W., 250 volt, direct current generator, direct-connected to a Corliss or compound slide valve engine for 100-lb. steam pressure, non-condensing.

175 K.W., 440 volt., 60-cycle, 3 phase alternator, direct-connected to an engine similar to above.

90 K.W., 250 volt, direct current belted generator, speed not over 400 R.P.M.

Address No. 6331, care of Electrical World, New York.

3 Phase, 60 Cycles

200 K. W. G. E., revolving field type, 2300 volts
150 K. W. " " " " " "
75 K. W. " " " " " "
60 K. W. Bullock " " " " "
30 K. W. F. M. " " " " "

Duzets & Son **Electrical and Steam Machinery**
50 Church St., New York

These Trade Marks Imply Established Standards of Quality

Hawthorn

TRADE MARK

MOTORS, GENERATORS, ARC LAMPS, FANS, IGNITION
BATTERIES, ANNUNCIATORS, BELLS, SOLDERING
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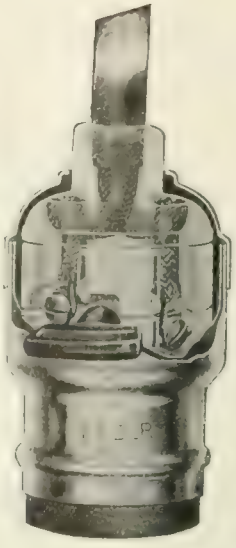
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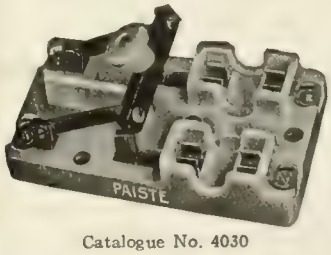
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Getting After the "Electric Trust."

Reports from Washington indicate that Uncle Sam, after having taken a fall out of several prominent trusts, is arming for another fray and proposes to see what is doing in electrical manufacturing and in the development of water-powers for electrical generation, in both of which fields a trust has been alleged to exist. Now, the facts as to electrical manufacturing are, broadly speaking, quite well known, the essential thing being that a large part of the manufacture of heavy electric machinery and of electric lamps is in the hands of several big concerns having more or less friendly relations. Whether the nature of these affiliations constitute a trust in the legal sense of the word is quite another matter, for certainly the relation of the larger to the smaller concerns in the electrical manufacturing business is radically different from any industrial relations the trust suits have heretofore brought to light. Such monopoly as has been secured is largely the direct effect of Uncle Sam's own patent system, which he can hardly be disposed to regard as a proper subject for the action of the anti-trust law. This part of the investigation can at all events go on in a perfectly proper and regular manner, and when the facts are brought to the surface, the rights of the case will be plainly enough seen. With respect to the alleged water-power trust, reputed to be backed by the alleged electric trust, the case is, however, quite different.

There is absolutely no doubt that within the last 10 years business men the world over have awakened to the value of water-powers and to their desirability as investments. Consequently, many of them have been picked up and developed for electric transmission to the great benefit of the territory served, but we do not believe that the people who are howling most loudly about the water-power trust understand what are the real relations between the owners of hydraulic properties and the electric manufacturing companies. The latter are naturally anxious to sell all of the machinery possible, and each of them is anxious also to add to the list of plants regularly using its particular type of apparatus. In such cases a customer once secured almost always remains a customer for enlargements and replacements, on account of the very natural tendency to install one kind of apparatus rather than several kinds that, in theory at least, might introduce complexities in operation and require an appropriate variety of spare parts. Hence, when a hydroelectric proposition is in the air, the manufacturing companies hustle to supply the machinery. Whether the relations between different companies determine beforehand who is to have any particular job need not here be discussed; but we have yet to hear of any case in which a person who wanted to develop a hydraulic proposition, and had the funds at his disposal to do so, had the slightest difficulty in buying on advantageous terms any kind of equipment which he chose to order. Whatever the relations between the big manufacturing companies may ultimately be, it is quite certain

that their representatives hustle vigorously after business and that an astute buyer can do some very keen trading between them.

The reputed connection between the manufacturers and the so-called water-power trust arises largely from the fact that a good many people who own water-powers go to the manufacturing companies or to their immediate backers for aid in financing their propositions, and having received such aid, very naturally fall into line as regular customers and are regarded as being more or less affiliated with those who supply them. So far no objection could properly be made to such a relation, which could only become obnoxious in case a man who attempted to finance a hydroelectric scheme should find his attempts blocked in all directions except that leading to certain manufacturers. This thing is alleged to have occurred, and should there be truth in the allegation, it is time to investigate, not so much the water-power trust, as what one may call the banking trust that, through a community of interests, may attempt to control enterprises of all sorts over a wide territory.

We do not fancy, however, that Uncle Sam cares to investigate this phase of the matter, which might lead to unpleasant revelations. There is, however, one phase of the reputed water-power combination which cannot fairly be considered in the light of a trust at all, although it tends to monopoly, and that is the aggregation of hydroelectric plants in contiguous territory into a single physical system. This tends distinctly toward the conservation of our natural resources, since it is well known to engineers that a group of plants consolidated into a network can produce power more cheaply and more reliably when acting together than when acting independently. The existence of great power networks may tend to the monopoly of the power business in any given territory, which monopoly is entirely susceptible of regulation by the proper authorities; but such a monopoly is economically advantageous in making the most of the power available and must be given this credit in any investigation that may be made. There has undoubtedly been much buying of water-powers for investment, and it is fairly of record that a considerable number of powers have been acquired by those having a community of interest with electrical manufacturing companies. So far, however, as has yet appeared, this action represents a tendency toward a particular class of desired investments rather than a concerted attempt to grasp the hydraulic resources of the country. If there is any actual effort of the latter sort, it must be looked for among the powers higher up, which, in virtue of no definite agreement perhaps, but yet with community of purpose and action, tend to control any and all operations which require large aggregations of capital.

Gasoline Competition.

Some central-station managers seem much at a loss to know why they have so much difficulty in meeting gasoline competition, and a brief consideration of conditions frequently found in gasoline-infested towns may throw some light on the reasons for the anomalous popularity which gasoline lighting occasionally meets. A recent visit about 9:30 p. m. to the business district of a prosperous town of 4000 population in the Central States showed at that hour seven establishments fully lighted up. Every one of these had a private gasoline plant. Not a tungsten lamp was in sight. A visit to other towns of the kind, where gasoline lamps have not yet been run out by the tungsten lamp, usually reveals a similar condition of affairs, namely, that the most desirable long-hour customers are the ones which the company has lost through gasoline. The primary reason for this is often to be found in a faulty system of rates, which makes no distinction between the consumer who burns his lamps an average of one hour per night and the one who burns his lamps an average of four hours per night. As the long-hour users' bills are high on such a schedule, he is much more easily tempted by the wiles of the gasoline plant salesman. Here, then, is one of the fundamental troubles which should be righted if a company expects and desires to hold its most valuable class of lighting business. On top of this oftentimes the electrical service is poor and unreliable and the central station has made no effort to give the consumer more light for his money by introducing tungsten lamps in efficient reflectors. Even if all the foregoing requirements have been complied with, gasoline plant salesmen have a good show in a town if the company discriminates in its rates between customers or fails to meet its customers in an open, courteous, fair-minded way.

After the novelty wears off no owner of a gasoline lighting plant operates it for the supreme enjoyment there is in it. The handling of gasoline is dangerous, the operation of the plant is dangerous, the maintenance of mantles is not pleasant, and with good electric service, tungsten lamps, proper treatment by the company, and above all, a system of rates which automatically adjusts itself to give a low rate to long-hour users, gasoline competition has very little to stand on. It is doubtless true that private gasoline plants should be restricted by legislation as a menace to the surrounding buildings, and should be subject to higher insurance rates, instead of being ignored by insurance companies, as is sometimes the case. Nevertheless, electric lighting men, on account of their peculiar competitive position, cannot, with favor in the eyes of the public, take too active a part in the bringing about of adverse legislation. They can, however, demand better insurance rates for electrically lighted properties than for those near a gasoline plant. The main weapons with which this competition is to be met, however, are a proper business policy, good service and high-efficiency lamps. With these it is only a question of time when the gasoline plants will be run out of any town.

Magnetic Fields Associated with Sun-Spots.

We know from laboratory experiments, as well as from electromagnetic theory, that the motion of electrified particles is equivalent, in its magnetic effect, to an electric current. Consequently, whenever we have motion in a gas, we may expect magnetic manifestations, if the gaseous particles are electrified. At ordinary velocities and electrifications of gases, however, such magnetic effects are very small. There is strong reason for believing that a minute magnetic field component on the surface of our earth is produced by vertical currents in our atmosphere, these up and down currents of air carrying electrified particles. At the sun, everything is on a large scale. Temperatures, velocities, gravitations and sizes are big. Sun spots are either storms in the solar atmosphere, or are associated with such storms, judging from the shapes of the local solar clouds, their rapid movements, and their spectrum indi-

cations. Moreover, we have strong reason to suspect that solar material emanations are electrified. Consequently, with large masses of electrified particles moving at velocities that seem uncanny to our terrestrial minds, it is reasonable to expect that goodly and intense magnetic fields may be generated at these spots. A note by Mr. George E. Hale, in a recent number of the publications of the Astronomical Society of the Pacific, contains a number of interesting statements concerning magnetic fields in sun-spots, as deduced from spectrum analysis of their light. Magnetic flux-densities ranging from 2900 gausses to 4500 gausses are alluded to as maximum inferred values. Such magnetic fields are of ordinary dynamo air-gap intensity, or even of transformer-core effective intensity. If these figures are reliable, it would not be necessary to provide a magnetic field-magnet for a unipolar generator situated near a sun-spot. A rotation of the naked armature at the regular speed would amply suffice to generate the usual voltage. Nevertheless, it is probably better to stay here and keep our field-magnets in service.

Alternating-Current Transmission Line Charts.

Frequent computations of, or designs for, the electrical working of alternating-current transmission lines inevitably tend to incline the engineer toward artifices for simplifying the process, and for making it more definite and swift. There are various stages of line-transmission computation. In the simplest case, nothing is considered but the ohmic drop of potential. In the second stage, inductive reactance is taken into account, in addition to ohmic resistance. In a third stage, applicable to fairly long lines, capacity reactance is included, by assuming all the line capacity collected, either into one middle condenser or into two equal terminal condensers. Finally, in a fourth stage, ordinarily applicable only to the longest lines, the effects of distributed resistance, inductance and capacity are included. For present purposes, however, only the second-stage computations, involving resistance and inductive reactance, are ordinarily considered. The *Revue d'Électricité* recently contained an article by Prof. André Blondel, which has been abstracted in the Digest, on the above type of computation, and on devices for reducing the work to the level of careful inspection of specially prepared charts. The article contains a carefully prepared chart of line impedance-drops, for different sizes of copper wire, at given interaxial distance, at standard frequency. By linking this chart with a second diagram on tracing paper, the conditions of the line can be read off at the junctions of the curves intersecting between the two.

Two cases are considered, namely, first for constant pressure at the delivery end, and second, for constant pressure at the generator end. The construction of the tracing-paper diagram differs in these two cases, but the essential principles are alike in both, and involve vector addition and subtraction. The method described will doubtless be found useful when preparing a large series of line computations. A somewhat similar device by Mr. F. G. Baum was described some seven years ago in our columns. That device was constructed in cardboard with a pivoted celluloid protractor. In the Baum device the line-drop is expressed in percentage, both for resistance and reactance. It corresponds, under that restriction, to the first case of the Blondel discussion. Conditions differ so much in detail between the engineering practice in different countries, or even in different parts of one and the same country, that it is impracticable to work out a device that will meet all demands. Tower line construction, with aluminum cables, at 25 cycles per second, calls for a different set of charts from pole-line construction, with copper wires, at 60 cycles per second. Nevertheless, there is much value in such a device for one set of conditions alone, because it illustrates the conditions of the general problem in a simple mechanical manner, and it gives a swift practical solution for one set of conditions that is very helpful in forming an approximate idea of the solution under variously modified conditions.

German Standard Regulations for Electrical Machinery.

Corresponding to the Standards Committee of the American Institute of Electrical Engineers in this country, there are certain committees of the Verband Deutscher Elektrotechniker in Germany which formulate rules for the classification of rating and testing of electrical machinery. These rules were first reported to, and adopted by, the Verband in 1901, and have since been revised in 1903, 1905, 1907 and 1909. It would seem as though biennial revisions of these rules were incorporated, by tacit agreement, in their text. The salient features of the German standardization rules, as they stood in 1908, appeared in these columns in the issue of June 13, 1908, in comparison with similar standardization rules of England, France and America. Various differences appeared between these schedules, but salient among them was the rule for testing the dielectric strength of the insulation. The German rule called for an application of the testing voltage for 30 minutes, whereas the French rule called for a two-minute application and the American rule called for a one-minute application. In the revised set of German rules as amended this year this regulation has been changed. As it now stands, it calls for a one-minute application of the testing voltage, which corresponds with the American requirement. As regards the magnitude of the testing voltage, there is still some difference in detail between the German and American rules, but the amendment has brought them much nearer together.

If this process of mutual convergence in national standardization rules continues unchecked, the International Electrotechnical Commission will have an easy task. Allowing sufficient time, as the commission seems generously inclined to do, it may only have to take the final standardization rules of any one country, print an international title, and issue them to all in their proper and appropriate tongue. It is, of course, natural that reasonable men, working on national committees, should aim to eliminate from their local rules the needless and the complex, and should seek to incorporate the good and simple provisions of neighboring national rules, so that it is logical to expect that this process of mutual convergence will continue to be manifested.

Considered reciprocally, there are certain provisions in the new German standardization rules that our American standards committee would do well to follow. First among these is a division of electrical machinery into the continuous and discontinuous-service types. At present, only the continuous-service type is standardized with us. All other types are

treated, from the standpoint of our rules, as exceptions and as laws unto themselves. In both England and France the rules provide explicitly both for continuous and intermittent-service machinery, the latter being defined and subclassified more or iess; while in the German rules there are three types recognized, namely, continuous, short-period intermittent, and long-period intermittent. Separate consideration is given to machines of these three types throughout the rules. It would seem that either two types, or three types, of service should be explicitly recognized in our rules. There are so many intermittently working machines that it is almost as incongruous to treat them exceptionally as was the guide-book which mentioned that at a certain well-known health resort 39 out the last preceding 40 winters had been climatically exceptional.

Another point to which the attention of our standards committee might well be drawn is the diversity of German temperature elevations allowed in machines of different insulation construction. In insulated rotating cotton-covered windings they allow an elevation of 50 deg. C.; in paper-covered windings, 60 deg. C., and in mica or asbestos-covered windings, 80 deg. C. In our rules 50 deg. C. is the only temperature elevation specifically mentioned for all classes of insulation construction, although a modest and unobtrusive paragraph says that higher elevations are permissible with special heat-resisting insulations, a truism which is so true as to be meaningless in the absence of quantitative specification. Meanwhile, the rules are subjected to disparagement in the minds of some practical central-station operators, who know by experience that their machines can carry considerably increased temperature elevations without danger. It would be much more direct and effective to specify different elevations of temperature for different specific types of insulation construction. If the above two modifications were made in our own rules, and in the directions already followed by other countries, a still closer approximation would be reached toward mutual international agreement, and the task before the International Electrotechnical Commission would be thereby still further simplified. This suggestion is intended as an incentive to, and not as a criticism upon, the work of our standards committee, which has, in general, been of the greatest and most valued service to the electrical industry.

The Heating of Field-Magnet Coils.

The heating of field-magnet coils in a dynamo is well known to be caused by the joulean action of the magnetizing current, the power so expended being I^2R watts. The cooling of such coils is by no means so simple a matter. It depends upon the facilities possessed for dissipation of heat, by conduction, convection and radiation The temperature elevation of the coils under steady running conditions is always such that the joulean development of heat is exactly equal to the total dissipation of heat by the above three causes combined. Strictly speaking, therefore, it is impossible to predict, or even properly to apprehend, the final temperature rise on the field coils of a dynamo, under given working conditions, unless the amounts of heat dissipated in each of these three ways can be ascertained. As a matter of fact, the subject of heat dissipation is so complex that we have but very imperfect knowledge of it as yet, and, consequently, we are unable to predict such temperature elevations with any attempt at precision; but by many observations conducted on a large number of different machines, we have been able to secure some useful empirical formulas that are not very misleading if carefully watched.

Some measurements have recently been made in the case of one particular 6½-hp motor. These measurements have recently been published in the London *Electrician* in an article by Mr. G. Trevor Williams. The motor was placed in an air-tight cast-iron case, which could be exhausted by an air pump. The motor could either be kept stationary with its field magnets excited, or it could be driven by external power applied to its shaft, through an air-tight stuffing-box. The armature was not excited in any of the tests. The power supplied to the field magnets of the motor was measured electrically, and was adjusted in the different tests until the temperature rise was steady. After reducing the results to the same final temperature elevation, it was estimated that very nearly half of the power dissipated from the field coils under running conditions in air was attributable to convection loss, and the remaining half to conduction and radiation combined. These results indicate, in a general way, how much of the cooling of magnet coils may be attributable to convection. They cannot, however, be expected to determine the true state of affairs under the conditions of practical operation, because, when the armature is heated by its load-current, the distributions of heat, and of heat dissipation, are largely altered, and are altered in a very complicated manner. Nevertheless, these results, piecemeal as they are with respect to operating conditions, and as affecting only one particular motor, are yet the only ones we have thus far seen published on this difficult subject. There is a very large field open to experimental and mathematical investigation on the dissipation of heat from dynamo machines. At present, it is only roughly covered with a few empirical formulas. Nevertheless, with the increasing sizes of dynamos, the question of cooling is of continually rising importance.

Atomic Theories of Matter and of Electricity.

The meeting of the British Association for the Advancement of Science last month, at Winnipeg, is particularly notable for the addresses of the president, Prof. J. J. Thomson, and of the Mathematical and Physical Section president, Prof. E. Rutherford, both of which dealt with atomic theory in a very definite way. The addresses of these two men, who have identified their work so closely with the modern theories of matter and of electricity, are of great interest, and sum up to date the extent of our scientific knowledge on the nature of matter and of electricity.

It has been supposed by some that the discoveries of radioactivity have dismantled the atomic theory; but it is pointed out by Rutherford that, on the contrary, the results of research with radium and its congeners have greatly strengthened this theory in general. They merely indicate that at least some atoms are impermanent structures, and that the proposition as to the indefinite persistence of all atoms in the known universe must now be no longer postulated. We may suppose, therefore, that at least some atoms are born, live and die in a manner roughly analogous to the biological processes of our own existence. The most recent experiments described indicate that atoms may, in a certain sense, be counted. Ordinary non-

electrified molecules can only be rendered evident to the senses when present in vast numbers or complex aggregates. To take an example offered, the smallest quantity of the substance *neon* which can be detected spectroscopically contains about 10 million million neon molecules, or about 7000 times the number of human beings on the earth. On the other hand, it is stated that we can render evident the passage of single electrified helium atoms into a receptacle arranged for their reception, and that they can be counted as they enter.

Many attempts have been made in the past to estimate the number of molecules in a cubic centimeter of gas under normal pressure and temperature. A number of the more recent estimates are collected and compared, taken from different sources and by different methods. It is known that, by Avogadro's law, all gases at like pressure and temperature have the same number of molecules per cubic centimeter, so that what is true of one gas applies to any gas. This number is now regarded as being known within a small percentage. A cubic centimeter is a large volume to discuss in this relation, because the gaseous molecules must be so excessively minute. The unit of linear measure used by microscopists is the micron, or the millionth of a meter. A cubic micron is a volume that is about the limit of visibility in the microscope. Some bacteria have such a volume, or occupy such dimensions, approximately. The number of molecules in a cubic micron, according to Rutherford's estimate, is 27,700,000, or, let us say, about the number of individuals in the population of England at the beginning of this century. The members of this population in the cubic micron are to be considered as flying and oscillating to and fro at great speeds, the volume that they jointly occupy in their own persons being very small compared with the cubic micron that they inhabit.

Not only has the theory of radio-activity done much thus far to place the pre-existing atomic theory on a firm basis of counting and reckoning, but it has also opened up an ultra-atomic world. Infinitesimal as single molecules must evidently be to squeeze England's population into a cubic micron without seriously hindering its whizzing flights, a molecule must be a huge thing compared with a corpuscle. The properties of corpuscles are now engaging the attention of numerous physicists. The destruction of the individuality of the atom by the new radium-born theory that atoms are composite and contain many corpuscles, has created in exchange an atomic theory of electricity. According to recent observations, every corpuscle is endowed with an indentically similar electric charge. It is now supposed that electric charges are all multiples of this corpuscular unit, and that it may be impossible to have a fractional charge left over after all such unit quantities are counted. In this sense, electricity is supposed to be made up of very small unit quantities, each corpuscular in its nature. The estimated magnitude of this unit atom of electricity is 4.65×10^{-10} c.g.s. electrostatic unit of quantity. It is supposed that the structure of the atom is held together by forces that are at least mainly electrical in character. Roughly speaking, then, the corpuscles are cemented into the atomic planetary system by electric forces which are perhaps enormously powerful; so that if an atom disrupts, an explosion occurs with loss of energy, a liberation of particles, and the formation of new elementary substance.

Non-Inductive Water-Cooled Standard Resistances.

The last number of the *Journal* of the Institution of Electrical Engineers of Great Britain contains a communication by Messrs. Patterson and Raynor, of the British National Physical Laboratory, on the construction of certain standard working resistances. These resistances are required to carry alternating currents up to 2500 amp with a rated drop of pressure of 2 volts. The largest capacity of these standards has, therefore, to dissipate 5 kw, which renders water-cooling desirable. Water-cooled resistances are not new, but these new designs are interesting from several standpoints. Each resistance consists of a short vertical length of seamless manganin tube, welded at its ends into heavy, hollow copper end pieces, which serve as the current-terminals and also as nozzles for the internal circulation of the water supply for cooling the manganin tubes under load. It is computed that the inductance of these standard resistances is limited to a few centimeters, or milli-microhenrys. The largest capacity (2500 amp) has a computed inductance of only 3 cm. The time-constants of these resistances are thus reduced to a few tenths of a microsecond. The current density at which the tubes are worked is in the neighborhood of 16,000 amp per square inch.

100,000-Cycle Alternators.

An interesting paper, read at the Frontenac convention of the American Institute of Electrical Engineers, by Mr. E. F. W. Alexanderson, dealt with alternators for a frequency of 100,000 cycles per second. Up to the present time only few small machines, of 1 kw or 2 kw capacity each, have been constructed for this frequency, although a machine of 35 kw estimated capacity is stated to be in course of construction. Heretofore, such frequencies as 100,000 cycles per second have only been obtainable from the excitation of condensers, and the steady generation of such a frequency from rotative machinery forms a distinct step in the advance of alternating-current apparatus, although at this time wireless telegraphy and telephony are the only arts that demand such frequencies Some remarkable properties are likely to be presented in circuits operated at a frequency of 100,000 cycles per second. In the first place, the skin effect in copper is sufficiently marked at such a frequency as to make the ordinary copper wire table of very little use, and to upset the application of the ordinary form of Ohm's law to conductors. Secondly, the effect of inductance is greatly enhanced, so that an incandescent lamp with a couple of turns in its filament is likely to present an impedance distinctly in excess of its resistance; the candle-power of such a lamp might thus be detectably less at a given terminal voltage than when supplied with direct current or ordinary low-frequency alternating current. Finally, small condenser capacities in the circuit would be likely to produce marked changes in the current supplied at this frequency. The mechanical problem of maintaining a rotative speed of 20,000 revolutions per minute itself calls for special considerations in design. The paper points out that there are two critical passing speeds at which shaft vibration is set up, due to the vibration of the rotating system as a loaded string. Fortunately and praiseworthily, the paper is almost entirely written in the metric system, so that the reasoning and numerical checks upon this interesting phenomenon are easy to follow. It is to be hoped and expected that these machines will be of great value in the wireless service for which they were designed.

Central-Station and Railway Power-House Insurance.

The recent renewal of controversy between electric light and traction companies and the old-line stock insurance companies, and the efforts being made by the insurance committees of the electrical and traction associations to secure better treatment, have reached a stage that menaces the business of the stock companies so far as relates to electrical risks. Mr. Henry N. Staats, who, as the insurance expert, has been at work in behalf of the associations for the past five years, makes the following explanation of the present condition. For years, he states, the insurance committees of these associations have been endeavoring to secure better treatment and more uniformity in methods of inspection and rates. In this endeavor there have been organized two insurance companies under the laws of Ohio called the American Railway Insurance Company, the purpose of which is to write risks upon traction properties, and the Electrical Insurance Company, the purpose of which is to write risks upon central stations and light and power properties. Each of these companies is capitalized at $200,000, with the privilege of increasing its capitalization as needed by the growth of its business. These are not mutual companies, but their stock is subscribed for by traction and lighting interests.

It was not the plan, according to Mr. Staats, to cut into the business of the old-line companies, but it was believed that by having in the field insurance companies which were identified with these specific industries better service could be secured. After the organization of these companies a plan of co-operation was drawn up, which was submitted for approval to the governing committees of the old-line stock companies. This plan contemplated the formation of a central inspection and survey bureau for the properties of electric railway and lighting companies. It provided that this bureau should be located in Cleveland as a central point, and recommended co-operation with the regular insurance agents as long as this would tend to promote the interests of the assured. It recommended eliminating the insurance broker, and suggested that the old-line companies should co-operate with the two newly organized electric insurance companies. It also provided that these companies should be the medium for negotiating the business for electric properties, the one for traction and the other for lighting properties; that all railway and lighting business should be distributed from the central bureau, and that all plans, specifications, inspections, etc., should be made under the supervision of this bureau. The old-line companies, in connection with the electric insurance companies, were to contribute to the support of this bureau, their contributions to be based on the gross premiums paid to them by electric properties. Twenty-five per cent of the total amount of insurance on all these properties was to be assumed by the Railway Insurance Company and the Electric Insurance Company.

The plan also provided for the co-operation of the National Electric Light Association, the Association of Edison Illuminating Companies, the American Street and Interurban Railway Association and the Central Electric Railway Association with the old-line companies, by each association employing one of its members as an insurance expert, through whom all complaints were to be made, this expert to confer direct with the board of arbitration. It was furthermore provided that the board of arbitration should be composed of two members of the Eastern Union and two members of the Western Union of the old-line companies, together with Mr. Staats, representing the electric companies, and that the American Railway Insurance Company and the Electric Insurance Company would conduct their business at actual cost, and pay no commissions.

Mr. Staats says that after many conferences with, and at the invitation of, the Western Union Tariff Association, this plan was submitted to the governing committees of the Eastern and Western Unions on Oct. 12. Steps were taken at that time for the appointment of committees for bringing about co-operation. After that date, however, representatives of the Board of Underwriters' Associations met in New York, to which meeting no representative of either of the newly organized electrical insurance companies was invited, and, after considerable discussion, the Central Traction and Lighting Bureau, which was referred to in our issue of Nov. 18, was formed. It is Mr. Staats' opinion that this action was taken by the old-line stock companies for the purpose of forestalling the formation of a similar bureau under the plan submitted by the insurance companies identified with the electrical business, and for the purpose of cutting these companies out of competition.

Mr. Staats also says that since the agitation of the insurance question by the committees of the national electric and traction associations the old-line-companies have reduced rates very materially. In some instances, particularly in localities closely identified with the movement to organize the new companies and to establish a bureau, risks have been written at rates that were below the possibility of profit. He cites as an instance that the Cleveland Railway Company has been given a 15-cent rate upon all of its protected properties. Mr. Henry J. Davies, chairman of the insurance committee of the American Street and Interurban Railway Association, is secretary and treasurer of the Cleveland Railway Company, and has been active in his efforts to better the insurance conditions of traction companies.

It is the present purpose of the insurance committees of the electrical associations, by which Mr. Staats is employed as expert, to continue the struggle to secure the co-operation of the old-line stock companies with the new companies, and to continue the effort to have some voice in the matter of inspection and regulation of rates. Under the plan of co-operation proposed this was contemplated; under the central bureau which has been established by the insurance associations the electrical associations are without representation. According to Mr. Staats, it is feared that if the matter is entirely kept in the hands of the insurance companies the present lowering of rates will not be long maintained.

Definition of Annual Horse-Power.

Though the Canadian Niagara Power Company won the interesting action, recently referred to in these columns, covering the judicial interpretation of what constitutes an annual horse-power, the Niagara Falls Park Commission has applied for a rehearing. Mr. Justice Riddell gave a lengthy judgment in dismissing the plaintiff's claim for $15,217.97 alleged as rental due for excess power generated at the company's power house during the years 1905, 1906, 1907 and 1908, but the Attorney-General, acting on behalf of the commission, has applied to have the action reopened on the ground that the judge held that rate multiplied by time was to govern, and that the actual power used was sold and not the rate.

The plaintiff commission asks that it be allowed to give evidence that in the case of electricity a rate can be sold, namely, a rate of doing work (horse-power); that a substantial portion of the sales of the defendant power company are of such rate that sales or disposals of electricity may and do exceed the maximum horse-power generated; and that evidence may be adduced as to the number of horse-power contained in the sales by the defendants.

The plaintiffs file an affidavit by Frederick A. Gaby to the effect that it is common commercial practice to consider that the rate of work established at any time in a period of a contract should be the basis of computation, either for the future portion of such period, or for the future and the past; and in such sales the permanence or continued use of such rate is not material to the computation of the price charged therefor. The engineer says that all sales of the Hydroelectric Power Commission are based on the highest rate of work established in a certain period—that is, each month payment is made for the entire month for such highest rate of work, or maximum horse-power, known as the peak load, even though such highest rate should be demonstrated and established only on the last day of such month.

If the case is allowed to be reopened argument will probably proceed on Dec. 13. The indications are that the point in dispute will go to the Imperial Privy Council in England.

Decision Under Recent German-American Patent Agreement.

The German Imperial Supreme Court rendered a decision on Nov. 26 in which it interpreted a recent patent agreement between Germany and the United States in favor of an American company, which has a branch office in Berlin.

This branch office secured letters-patent under the German law on an invention, but failed to place the invention on the market within three years, the time specified by the German statute for so doing. Thereupon a German brought suit to vacate the patent rights, and the Patent Office decided in his favor. The American firm, however, took an appeal to the Imperial Supreme Court, and while awaiting a decision transferred the patent rights to its parent company in the United States.

The decision of the court declared that the Patent Office had wrongfully revoked the letters of patent and must renew them, as the German-American agreement guaranteed reciprocal treatment of patents.

The German-American patent agreement was signed at Washington, Feb. 23 of this year, and having been duly ratified by the House of Representatives and the German Reichstag, was promulgated simultaneously Aug. 1 by President Taft and the Kaiser. It became effective immediately.

By its terms American inventors were relieved from the German restrictions which declared patents forfeited if not actually worked in Germany within three years after letters of patent were granted, it being declared sufficient in order to protect patents in both countries that the invention involved be manufactured in either country.

Tax and Rate Value of Public Service Corporations.

A communication from Mr. B. H. Meyer, chairman of the Railroad Commission of Wisconsin, treating of the relation of the tax and rate value of public-service corporations, was incorporated in the report of the committee on railroad taxes and plans for ascertaining the fair valuation of railroad property presented at the meeting of the National Association of Railway Commissioners, in Washington, D. C., on Nov. 16 to 19. The communication is as follows:

"I am free to admit that the identity of what, for the sake of brevity, I shall designate as the 'tax value,' on the one hand, and the 'rate value' on the other is an ideal condition toward which we should move with the greatest possible speed. I hope the time will come in Wisconsin when the value placed upon a utility plant for rate-making purposes will be exactly the value upon which it is taxed, and vice versa. It is impossible of accomplishment to-day. To make the two values identical to-day would be a gross injustice and inequality in many, if not in most, cases.

"As I understand it the taxing authorities endeavor to see to it that all property is made to stand upon a footing of equality in the payment of taxes. The constitutional requirements of equality apply to all dollars irrespective of their owners, and a dollar in a utility plant should bear the same burden that is borne by a dollar in a farm or city lot or factory and all other forms of property, ignoring for the present controversial questions which publicists in taxation have raised regarding the doctrine of equality. This means that the tax value is a commercial value. Commercial value depends primarily upon earning capacity. A utility plant is worth what it can earn. What it can earn and does earn is dependent upon the rate which it charges. To use the earning value of a plant as a basis for determining the rate which creates that value is to attempt to measure a thing by itself. Commercial value, and therefore tax value, being a mere reflex of the rate, can be no guide whatsoever in determining the reasonableness of a rate. As long as the tax value is the commercial value under existing conditions it is obvious that such tax value cannot be the value for rates, or at least that it is not necessarily the value for rates.

"It follows that any discrepancy under these conditions between tax value and rate value is not necessarily injustice. In fact, justice may require just this discrepancy. If the taxing authorities, because of their inability to ascertain the exact commercial value of all forms of property, should, for instance, assess farms or city property at 80 per cent of their respective values, the property of public-utility plants should stand upon the assessment roll at 80 per cent of their value. Because of the publicity and other features attendant upon the conduct of the utility business, it is generally true that the value of the utility property can be more readily ascertained and more generally known than the value of numerous other forms of private property. To assess a utility property at 100 cents on the dollar and industrial or farming property at 70 cents or 80 cents on the dollar would be unjust and unlawful. A commission charged with the duty of prescribing just and reasonable rates could, therefore, not take the tax value as a basis for determining rates."

Drainage Canal Trustees May Finance Chicago Street Lighting.

At a meeting of the Chicago City Council, on Nov. 22, the finance committee was instructed to negotiate with the Sanitary District trustees for the lighting of the entire city, or any part of it, by electricity furnished from the hydroelectric power plant on the Drainage Canal at Lockport, Ill. It will require about $2,500,000 to provide the 17,000 additional street arc lamps, wires and other equipment required to light Chicago properly, and also to provide for changing over from the municipal system now largely in use, by which comparatively old plants supply electricity to open-arc series lamps. These older stations are motor-driven by electric energy furnished by the Sanitary District, but if a comprehensive plan is adopted they will be abandoned in favor of alternating-current transformer substations and alternating-curent, 450-watt lamps, using the Sanitary District energy without the imposition of moving machinery. It is believed that the Sanitary District trustees think that they can finance this proposition, and if they are correct in that assumption, the city authorities will no doubt be pleased to give the matter careful consideration. The trustees will be asked to put their suggestion in the shape of a formal proposition after conference with the finance committee of the City Council, and the matter will then come up for action.

Twelve-Hundred-Volt Connecticut Railway.

The first electric railway in the far East to choose the 1200-volt, direct-current system is the Shore Line Electric Railway, running from Ivoryton to New Haven through Saybrook and Guilford, approximately 52 miles in length. After a careful investigation of the relative merits of both the 600-volt, the 1200-volt direct-current and the single-phase systems, the 1200-volt system was adopted as presenting the advantages of demonstrating reliability, saving in construction cost and in operating expense.

The Shore Line Railway is being constructed and equipped in accordance with the most modern railway practice. A power station is located on the Connecticut River near Saybrook and will contain two 1500-kw, 25-cycle, 11,000-volt, three-phase Curtis turbo-generators with provisions for two additional units. Power will be transmitted three-phase to two stations—one located in the car house at Saybrook and the other at Guilford—each of which will contain three 200-kw, 600/1200-volt rotary converters. Two machines will be oper-

ated in series to supply energy at 1200 volts. The third unit will be used as a spare, the switchboard being so arranged that any two of the three units may be operated together in any relation.

Twelve cars will be operated, each equipped with four General Electric 60-hp, 600/1200 railway motors and Sprague-General Electric control. This equipment is arranged to operate on both 600 volts and 1200 volts. The cars will be provided with straight air brakes with 1200-volt air compressors. The entire equipment of the road will be furnished by the General Electric Company.

It is expected that the road will be in operation the early part of next year. Although 11 roads have adopted the 1200-volt system, the novel methods of construction in this instance will cause the operation of this road to be watched with much interest by railroad operators. As a very high-class service will be maintained and the reliability of service is considered of primary importance, the selection of the 1200-volt, direct-current system indicates the growing favor with which this system is being looked upon as best meeting the requirements of interurban service.

Jamestown (N. Y.) Voters Decide Not to Purchase Central Station.

At a special election held on Nov. 20 the taxpayers of Jamestown, N. Y., rejected the proposition that the city be bonded for $120,000 to provide funds to purchase the plant of the Jamestown Lighting & Power Company and combine it with the existing municipal electric-light plant. Out of about 7000 qualified taxpayers on the assessment roll, only 1211 voted. Of this number, 565 were in favor of the proposition and 646 opposed, making a majority of 81 against the proposed purchase. The election was held in the City Hall, and while the workingmen were in favor of the proposal, the heavier taxpayers were against it, and mustered sufficient votes to defeat the measure. About 100 women voted.

Possibly, if the proposed proposition had been submitted at a general election, it would have been carried. The business men of the city appear generally to have been indifferent to the result, whichever way it turned. The central-station company had previously expressed its willingness to accept $90,000 for its property, the remaining $30,000 to be applied to extensions and improvements necessary to combine the company's service with that of the municipal plant.

Winnipeg Electric Railway Case.

The case of the city corporation against the Winnipeg Electric Railway Company, which has been pending since 1906, was concluded on Nov. 19. It is not expected that judgment will be given for some time, as a great mass of evidence has been taken and a formidable array of arguments presented from counsel for both parties.

The case is an important one to the railway company on account of the claims made by the city. The corporation alleges that the company has failed to keep the conditions of the by-law under which the street railway should be operated, that it brought in power from outside sources contrary to the conditions of the by-law giving the company its franchise, and that it had erected poles and wires in the city without the consent of the municipality, and that in consequence of these acts the company had forfeited its right to do business under its franchise and is a trespasser in the city. The corporation, therefore, sought an injunction to restrain the company from bringing in power from its generating station at Lac du Bonnet, 50 miles east of the city.

Back in 1906 the old Winnipeg Street Railway Company acquired control of the Winnipeg, Selkirk & Lake Winnipeg Railway, as well as the Winnipeg General Power Company, and an amalgamation was effected under the name of the Winnipeg Electric Railway Company. The Winnipeg General Power Company was at that time in possession of a water-power partially developed at Lac du Bonnet, some 50 miles distant from the city, and the local company upon acquisition of the Winnipeg Power Company proceeded with the hydroelectric development and transmitted the power into its substation within the city in order to care for its rapidly growing business and to replace its steam-driven plant. The city corporation has since that period embarked upon a municipal hydroelectric development on the same river, and it has brought the action against the Winnipeg Electric Railway Company seeking an injunction restraining the company from bringing in the hydroelectric power on the ground that this action on the part of the company was contrary to the provisions of the franchise granted, which provided that the company's generating plant should at all times be situated within the limits of the city, thus putting the corporation in a position to collect taxes on the assessed value of the plant and machinery.

The defendant company claimed that by amalgamation they acquired all the rights, properties and franchises of the original company to which the charter or franchise was granted; that had amalgamation not taken place there was nothing to prevent the company from purchasing power from the Winnipeg General Power Company; that the electric power was generated at its power house; that technically in the by-law referring to power, steam-power and not water-power was alluded to, and that, therefore, the company had a perfect right to develop and generate water-power outside the city and bring it into the municipality for their purposes. The company further contended that if an injunction were granted stopping the transmission of electric power from the Lac du Bonnet generating station, 14,000 customers would be affected, and that there would not be enough capacity at its steam-power house in the city to care for the large load of power and lighting connected as well as run the cars of the railway system, which would result in crippling the company's entire system.

Ohio Independent Telephone Situation.

Among the late developments in the Ohio Independent telephone field is the election of Mr. James S. Brailey, Jr., to the vice-presidency of the Cuyahoga Telephone Company at a meeting of the board of directors, held in Cleveland last week. At the same time Mr. H. B. Taylor, treasurer of the United States Telephone Company, of which Mr. Brailey is president, was elected assistant treasurer of the Cuyahoga Telephone Company.

While in the city Mr. Brailey was questioned as to his intentions regarding the stock he holds in the two companies, but he gave little information further than to repeat the declaration that he stands with the Independents. He said he knows nothing about the information which Mr. S. B. Jeffries, attorney for the minority stockholders, claims to possess and can see no reason for his bringing suit in the Supreme Court of Missouri to have a commission appointed to inquire into the proposed merger of the Bell interests with the telephones of Missouri and Kansas. Mr. Jeffries is reported to have made the claim that he has a signed statement to the effect that Mr. Brailey turned over a portion of his United States Telephone stock to the Bell people through Day & Company, of New York.

Mr. Jeffries is said to have prepared a statement of his ideas and information regarding the matter for Attorney-General Denman, of Ohio, asking that proceedings be instituted in that State to prevent the alleged merger. In this he speaks of the transfer of stock to the firm of R. L. Day & Company. Late in the week Mr. Denman had not received the expected communication from Mr. Jeffries. He stated that if it should develop that the large properties of Independents in the State are being purchased for the purpose of combining them with the Bell system, then there would probably be ground for interference under the State laws, but if a syndicate of men is gathering up the properties with the purpose of a combined op-

position to the Bell interests, he did not think that there would be any violation of the law. It is only when competing interests unite that there is a violation of the anti-trust laws, as Mr. Denman sees the matter.

But in order to bring action at all, the Attorney-General must have some positive information as a basis. So far this seems to be lacking. No one has given any specific information as to the identity of the real purchasers of the Ohio companies. So far as the attorneys know, they may be deadly enemies of the Bell interests, while, on the other hand, they may be Bell representatives. Mr. Frank A. Davis, president of the Columbus Citizens' Telephone Company, Columbus, Ohio, is positive that his company has not gone into Bell hands. He says he will remain as president of the company and will have plenty of money for extensions and improvements, but that he does not know who the purchasers are, except that they are not Bell people.

Attorney-General Denman is watching matters closely and has collected some information, but it is not of the positive kind desired. The Department of Justice at Washington is also keeping in touch with matters through Assistant Solicitor-General Wade Ellis, who was at one time Attorney-General of Ohio and is acquainted with the situation in that State. However, there seems to be no information to be secured there, as all the influences at work have effectually covered the identity of those interested in the various purchases made.

It is said that the Independent interests in Ohio have applied to the President and Attorney-General of the United States to take action against the consolidation of the Bell interests and the Western Union Telegraph Company on the ground that they, in connection with the Postal Telegraph Company, are attempting to form a huge trust to control the wire service of the country. While it will not form an absolute monopoly of the business, they say that it will operate in restraint of trade and will prove a detriment in many ways.

At a meeting of 200 Independent telephone men in Columbus on Nov. 22 the committee of fifteen, named a week previous, made a report for a working plan to bring the companies of the State together for consolidation into one large company. The report recommended the employment of an engineer and accountant to examine each property and make a report on the physical and financial condition. From this information the committee and the owners shall agree upon a valuation, and in the event they cannot reach an agreement submit it to arbitration. Such an alliance or amalgamation as proposed shall take place only after companies, firms or individuals operating at least 50,000 telephones in the State shall have agreed. In arriving at values of properties the same methods shall be pursued in regard to all, but all conditions relating to each particular property shall also be taken into consideration. When agreements have been reached with the required number of companies, an Ohio corporation shall be formed which shall issue its 6 per cent cumulative stock, at par, upon the basis of valuation agreed upon for the properties or the majority of the stocks. For the good-will of the companies common stock in such amount as may be agreed upon, not to exceed 25 per cent of the par value of the preferred stock, shall be issued.

This plan was discussed for some time, but it was finally agreed that nothing should be done in the way of contracting or negotiating with any other company or individual for 90 days, so that all representatives might have an opportunity of discussing the matter with their boards of directors. It was also decided that a smaller committee would be able to handle the matter more expeditiously than a larger one, and the following five men were named to act: Messrs. O. M. Bake, Hamilton; Mark Cook, Mount Gilead; Col. H. A. Marting, Ironton; H. P. Folsom, Circleville, and Joseph McKell, Chillicothe.

The plan of the committee of fifteen was received with favor and will be used as a working basis. If the small committee finds that the work is too heavy for it, the members have authority to increase it to nine. Funds have been provided for prosecuting the work.

The greater part of both the preferred and common stock of the Columbus Citizens' Telephone Company was deposited by the date named by Mr. F. R. Huntington, who made the offer of purchase. Stockholders of the Dayton Home Telephone Company, of Dayton, were also depositing their stock rapidly and the indications are that the purchaser will secure practically all of it.

Judge Manton, of the Common Pleas Court, at Toledo, granted a temporary restraining order on Nov. 22 preventing the officials of the Toledo Home Telephone Company from interfering in any way with Herman C. Stifel, of St. Louis, in making an examination of the books of the company. Attorneys for the company filed a motion to dissolve the injunction, but this was overruled. The injunction was suspended for a few days, however, in order to give the attorneys time to prepare a petition for appeal to the Circuit Court.

New Tesla Wireless System.

Mr. Nikola Tesla has announced that as the result of experiments conducted at Shoreham, Long Island, he has perfected a new system of wireless telegraphy and telephony in which the principles of transmission are the direct opposite of Hertzian wave transmission. In the latter, he says, the transmission is effected by rays akin to light, which pass through the air and cannot be transmitted through the ground, while in the former the Hertz waves are practically suppressed and the entire energy of the current is transmitted through the ground exactly as though a big wire. Mr. Tesla adds that in his experiments in Colorado it was shown that a very powerful current developed by the transmitter traversed the entire globe and returned to its origin in an interval of 84 one-thousandths of a second, this journey of 24,000 miles being effected almost without any loss of energy.

Plans of Stevens Engineering Society.

About a year ago the Stevens Engineering Society of Stevens Institute, Hoboken, N. J., an undergraduate organization, became affiliated with the American Society of Mechanical Engineers, which step has led to a great increase in the activity of the body. Among the plans completed for the coming present season is a course of lectures by engineers and others representing the mechanical, electrical, civil, marine and other technical branches of knowledge, to be delivered on Tuesday afternoons from 4:10 to 5:10 p. m.

The body was addressed during October and November by President Jesse M. Smith and Secretary Calvin W. Rice, of the American Society of Mechanical Engineers; Messrs. Frederick A. Waldron, Fred. W. Taylor, Dr. F. R. Hutton, Dr. H. C. Sadler, Prof. Dugald C. Jackson and Mr. C. F. Scott. Among the speakers during the remainder of the season, which extends to May 10, are Rear-Admiral George W. Melville, Messrs. Hudson Maxim, D. S. Jacobus, Frank B. Gilbreth, Naval Constructor D. W. Taylor, U. S. N., John A. Brashear, and the following representatives of the electrical profession: Messrs. H. G. Stott, T. C. Martin and W. J. Hammer.

Electric Service Temporarily Crippled in Winnipeg.

An accident serious in its immediate consequences occurred to the plant of the Winnipeg Electric Railway Company at 4:30 o'clock on the afternoon of Nov. 23, when by the bursting away of either one of the penstocks or waterwheel casting, the generating station at Lac du Bonnet, 50 miles distant, was flooded. The transmission line to the city was immediately shut down, resulting in a complete closing down of the entire power, lighting and street-car service within the city. The first night the city was in almost total darkness, every resident and storekeeper having to revert to candles. The company

made an attempt to cope with the unfortunate situation by supplying steam-power from its reserve generating station in the city, but as this has a capacity of only about 8000 hp and the total peak load in the city is about 20,000 hp, only a partial street-railway service was run to take people to their homes, after which the service had to be reduced in order to care for domestic lighting.

A further trying accident occurred the next day at the steam plant, when a switch burned out, cutting off about 1200 hp. The city corporation came to the company's assistance by offering 100 hp from its steam plant at the water-works, and a rush job was made in order to connect up a line for this purpose. Industrial operations of the city employing electric power have been entirely shut down and a large number of workmen thrown out of employment for the time being.

Mr. R. S. Kelsch, of Montreal, the well-known electrical engineer, who is familiar with the Lac du Bonnet plant of the Winnipeg Railway Company, stated in an interview that he did not think the damage would exceed more than $25,000 to the company's plant. He gave it as his opinion that the accident was probably caused by the breaking of one of the penstocks or the casting of a turbine, resulting in the flooding of the wheelhouse and partially flooding the generating room. The high-tension switches and other regulating apparatus being located on the upper galleries could not be damaged in any way. It would take about a week's time in which to get the generators dried out.

Patents and Patent Law.

Addressing the Electric Club of Chicago, on Nov. 24, on "The Trend of Invention," Mr. George P. Barton, a Chicago patent lawyer, after referring to the fact that the association is representative of industries founded upon inventions that have been patented, said it has been stated that the greatest benefit to society of the patent law lies in the fact that it induces people to think. He then spoke of some of the embarrassments met with in the Patent Office on account of the practice that has grown up of requiring inventors to present a separate application for each small part of the main invention. He also said that he had been informed that one man had written more than 15,000 applications for patents, making $60 a week or 10 per cent of what the advertising patent agency charged. Inventors and those investing in patents in most cases receive nothing; probably not over 10 per cent, and probably less than 2 per cent of the patents issued have been profitable to the patentees.

In the year 1800, 41 patents only were issued by the United States; in the year 1850, excluding patents for designs, there were issued some 884 patents for inventions; during the year 1900 there were issued 24,660 patents, and during the fiscal year ended June 30, 1909, there were granted 34,332 patents for inventions. Perhaps there are now outstanding 400,000 patents. It is safe to say that in the aggregate these patents contain at least 2,000,000 claims. The exact number could be ascertained by counting, and possibly, said Mr. Barton, ironically, this undertaking would be as useful as some of our work in getting and sustaining patents.

In theory of law each of these 2,000,000 claims is a writ of prohibition against each one of 80,000,000 of people, commanding all not to make, use or sell what is thus claimed or patented except with the consent of the patentee, or the owner of the monopoly, for, within his domain, the patentee, in the language of the Circuit Court of Appeals, is czar.

"We must bear in mind," continued Mr. Barton, "that a patent gives the patentee or its owner no right to make, use or sell the invention which he would not possess if there were no patent. But it does give him, in theory at least, the absolute right to debar all others from practicing the invention thus secured. And thus, as I have said, each of the 2,000,000 or more outstanding patent claims, as some look upon the matter, is a menace to the whole people. In order to do business one must run this gantlet of 2,000,000 clubs raised to strike, and wielded with all the power and force of the nation.

"The most striking and marked trend of invention has been divisional. The several points of an invention are attenuated, and often each point is dignified by the red seal and blue ribbon of a separate patent. Some one may ask, 'How did such a system grow up?' I think few will contend that it is a system which is made only for the benefit of manufacturers, dealers and consumers. I do not believe that anyone of experience can seriously contend that such attenuation is beneficial to the inventor. But the system has grown up in a very natural way. In the early days of the Patent Office, there were only 50 or 100 patents a year, and as they were issued without examination, there was no need for 40 examining divisions and 400 examiners, such as are now a part of the Patent Office machinery.

"On the other hand, with 42 separate examining divisions, as is the exact number now, classification is necessary; and where some inventions relate to matters that must be searched for in two or more divisions, the rules and practice have forced inventors and their solicitors to split applications up in the way mentioned. It thus not infrequently happens that the inventor, when he comes to court, finds that he has fallen between two stools. The solicitor of patents, if compensated by a fixed fee for each application, may view with complacency their multiplication by acts of the Patent Office which he cannot control.

"It may be said that there has been a development, not only of examiners in the Patent Office, but also of solicitors of patents, and that the examiners of the Patent Office, in association with the solicitors of patents, have worked out a code of patent law, well understood between themselves, but incomprehensible to the layman, incomprehensible to foreign nations and hardly recognized by the courts."

The speaker referred to a recent case in which the judges of the Court of Appeals said: "This case is a striking example of the unfortunate result of too close adherence to rule. The inventor asked for seven claims. The logical way would have been to include the genus and its varieties in the same patent, and half a dozen claims would have covered every possible combination which he was entitled to hold. But by the time the Patent Office got through with him the inventor was the holder of four separate patents granted upon divisional applications split off from his original one, the four patents containing together 98 claims. It does not seem just that the patentee, who was powerless to obtain any modification of the rule for dividing applications, should be made to suffer from such misdirected energy."

Mr. Barton said that the patent law does not offer much in the way of honors, money or position. But, in spite of this, he likes it. In 1878, when the speaker began the practice of patent law, a friend said to him: "You are too late; all the inventions have been made." During the period that has elapsed from that time to the present, the trend of invention has been, perhaps, toward small improvements; but no doubt a small invention is worth more to-day than it would have been when the population of the country was one-twentieth what it is now.

But, after all, he said, the difficulties experienced by all interested in patent law are not greater than those encountered in other branches of the law. Instances of the technicalities of courts and the law's delays generally were cited. The great expense of patent litigation was also mentioned by the speaker, who referred particularly to the Seldon patent in the automobile cases.

In the discussion, referring to an allusion that Mr. Barton had made to Diana of the Ephesians, President F. P. Vose said that in view of some of the revelations that the speaker had made in relation to advertising patent agents, it was no wonder that Diana, the huntress goddess, should be regarded as the patron saint of patent law. In reply to a question if it might not be advisable to establish a technical court to decide the extremely technical questions involved in patent litigation, Mr. Barton answered that the American Bar Association had recommended the establishment of a Patent Court of Appeals, adding that there are now 10 courts of last resort in this country to pass on

patent questions. Mr. Barton suggested as a possible way of reducing the work of patent litigation, that the court call the parties to the suit before it for a preliminary hearing to see if the issues might not be defined before taking testimony. He also remarked that it had been urged that testimony in patent causes be taken under the direction of a master in chancery, with power to exclude what is irrelevant. The great expense of records of cases should be curbed. Clients are primarily to blame for delays, but it is also to be remembered that judges are only human in their capacity for work, and courts are very reluctant to interfere in cross-examinations. Mr. Vose closed the discussion by speaking of the immense amount of work thrown on the judges in the State courts and the importance of their decisions, also. Mr. Barton's remarks were instructive and were listened to with close attention. He received the thanks of the club.

Residence Lighting.

The regular monthly meeting of the New England Section of the Illuminating Engineering Society was held at the Edison Building, Boston, on the evening of Nov. 16. Mr. T. J. Little, of Gloucester, N. J., discussed gas lighting in the modern home, and Mr. E. C. Kimball, of the Boston Edison Company, reviewed the technique and application of electricity in the best lighting of residences.

Mr. Kimball pointed out that the introduction of high-efficiency lamps has altered the lighting situation with respect to the sufficient and economical illumination of residences. Reflectors have been redesigned and more satisfactory results obtained. The flexibility of electric light makes it most desirable to use this form of illuminant throughout the entire house, and with the proper consideration of color values in the finishings of the woodwork, as well as draperies, it will place itself on a par with any of the other types of illuminants now available. The quantity of light can be regulated to keep the expense of operation down to a minimum. The architect of a residence should, during the early stages of his work, associate himself with one who is by training and practice abreast of the times in regard to illumination, and seek such advice in these matters as will make the house as a whole satisfactory to all parties.

Considering the illumination of special rooms, Mr. Kimball took up the living-room problem and emphasized its predominance over the rest of the house. The reading light is the most important. To illuminate the room at a high intensity and thus make reading possible at any point is too expensive. By equipping the reading lamp with a suitable reflector which will not only concentrate the light enough at a single place for reading, but which will give a good average lighting throughout the rest of the room, the best results will be secured. In small rooms this can be done by ceiling fixtures rather than table lamps, which latter are undesirable from an illuminating point of view. In parlors it is sometimes necessary to modify the light to meet architectural requirements. The degree of light in such rooms is not ordinarily as high as in living-rooms, and chandeliers with small units generally meet the conditions. The dining-room is the simplest problem in residence lighting. If china cabinets, cut-glass, silver cabinets, buffets or fireplaces are to be lighted, care should be taken to avoid exposing the bare lamp or filament to the eyes from any position. A single strong light supplied by a hanging fixture above the table, with a good reflector, will meet the needs of the situation in most cases. Too great intrinsic brilliancy reflected from table linen to the eyes should be avoided. A subduing screen of white silk supported directly below the lamp is often desirable when using high-efficiency lamps. These fixtures are to be considered more from a decorative point of view, and small wattage lamps usually are sufficient.

Mr. Kimball stated that in lighting bedrooms first cost is a vital point. The variety of points at which light is from time to time required make it difficult to provide the requisite service at low cost. The illumination of the dresser by lamps on each side of the mirror, preferably on swinging arms, is desirable. A general illumination of the room by a chandelier or pendant lamp placed above the line of vision and with the medium concentrating shade of the prism type, will permit sufficient light to reach the ceiling to create a general warmth and cheery appearance. Control from the bed is an important point. Small candle-power lamps in closets are very desirable. The best general illumination in a house is required in the kitchen, the maximum flux of light being required at the sink and stove. Clean food and dishes require ample light, and good general illumination has a direct relation to the servant problem. In bathroom lighting the installation of lamps on each side of the mirror is the chief requisite, and the use of a small lamp over the center of the mirror is also good practice. For the general illumination of this room a single unit placed close to the ceiling with a so-called prism reflector, giving a general warmth to the appearance of the room, is desirable. The usual light finish of bathrooms permits the use of low-candle-power lamps in such cases. Ceiling lights give better results than wall bracket units. The latter tend to concentrate the light without giving the widest angle of distribution. The intensity of illumination required in halls is usually much less than that desirable in living-rooms, libraries and kitchens. With short halls equipped with a single outlet, the lamps should be placed close to the ceiling and at an angle, with proper reflector, which will throw the light downward toward each end of the passage. The most desirable method of illuminating porches and piazzas is by a concentrating reflector of the ball or hemispherical type, arranged to throw its maximum light downward on the porch and to illuminate fully any person standing at the door. Basement lighting is a simple problem usually, and here small units may be installed, but these should be of a simple type and easily kept clean.

Concluding, Mr. Kimball pointed out that from 1-foot candles to 2-foot candles are usually satisfactory for residence lighting, the higher intensity being used in living-rooms and libraries. A room with dark furnishings and draperies of a subdued color will naturally need the higher intensities of lighting for satisfactory results.

The Exhaust Steam Turbine for Central-Station Work.

The regular monthly meeting of the Boston Branch of the American Society of Mechanical Engineers was held at the Massachusetts Institute of Technology on Nov. 17, with Chairman Ira N. Hollis presiding. The subject of the evening was the low-pressure steam turbine. Mr. H. G. Stott, superintendent of motive power of the Interborough Rapid Transit Company, New York, was the first speaker, whose subject was the New York Interborough 5000-kw exhaust-steam turbine plant described several months ago in these columns. Mr. Stott emphasized the novelty of the low-pressure turbine at the time of its selection by the company in connection with additional power equipment about a year ago. The Interborough engines in the Fifty-ninth Street station are of the Manhattan type, so-called, with Corliss valve gearing, having a 42-in. horizontal high-pressure cylinder and an 86-in. vertical low-pressure cylinder on the same crank-pin. A duplicate of this equipment is situated on the opposite side of the generator, the latter being located between the two engines. The speed of the unit is 75 r.p.m., and the generator rating 5000 kw. The only flywheel is the revolving field of the generator, and hence an enormous weight was required in the latter, enabling the unit to carry 8000 kw continuously with a temperature rise of only 35 deg. C. The company was, however, unable to make use of the large capacity of the unit on account of the inefficiency of the engine at the higher outputs. The efficient output was secured between 4000 kw and 6000 kw. The water rate was so high at 8000 kw that the capacity was not used.

It was determined that adding a high-pressure turbine would not in any way improve the efficiency of the power plant, which

was good, with the station only four years old; but that adding a low-pressure turbine would increase the capacity and at the same time improve the efficiency of the engine. A vertical shaft, three-stage Curtis turbo-generator was installed, the rated capacity being 5000 kw. This turbine receives steam from the two engines mentioned, and together they make up an 8000-kw unit. The steam at first is let into a separator, which was installed with the idea of separating the oil and the moisture, about 10 per cent oil and moisture being expected. From the separator the steam is taken into the low-pressure turbine, which has no governor, except an emergency equipment to prevent its running away. The dynamo on the turbine is an induction generator, coupled permanently to the leads of the main alternator. The man operating the switchboard does nothing with this generator and does not know it is there except by looking at the wattmeter. The turbo-generator starts as an induction motor, the turbine being picked up and brought up to speed. As soon as the load is on the engine, it is synchronized on the system, the low-pressure turbine taking about 80 per cent of the load. As the total load increases the load on the two units becomes more nearly equal, so that at 15,000 kw total load on the combined engine and turbine, each carries approximately 7500 kw. The load is an exceedingly difficult one to carry, as there is a constant fluctuation plus and minus of 15 per cent, sometimes at three-second intervals, sometimes at five-second intervals and sometimes at 60-second periods, depending upon train movements.

The first separator installed was unsatisfactory. There were numerous baffles which became loosened, and which had to be cut out, leaving nothing but the shell. The whole secret of a separator is to build a receiver large enough, with horizontal baffles to protect the water as it is being trapped out and removed by the pump. The separators now being installed are about 28 ft. long and 8 ft. in diameter, and notable improvements are being expected. The importance of getting rid of the moisture in turbine work is great. For every 1 per cent of moisture in making corrections, 2 per cent must be allowed for friction loss, in addition to the loss in the power of the steam. The separator first installed gave only 88 per cent to 92 per cent of steam entering the turbine. Lately this has been raised to 95 per cent or 96 per cent.

By means of the turbine the old unit has been brought up to a point where the company is able to get full rating out of the generator and still hold extremely good economy. Instead of having 10,000 kw, the company now has a possibility of about 15,000 kw. With the turbine separation of oil from the steam is thoroughly successful. The fuel economy of the plant has been improved about 23 per cent. Including labor and maintenance the net operating economy of the unit is improved about 30 per cent. The cooling surface of the condensers is used about 87 per cent more efficiently than in previous practice. The capacity has been more than doubled.

Mr. W. L. R. Emmet, of the General Electric Company, emphasized the possibilities of the low-pressure turbine in improving reciprocating-engine operation generally. Retention of economy at overload is one of the great points in low-pressure work. The combined engine and turbine is efficient through a wide range of load. The steam engine has a certain capacity in low-pressure cylinders, which is limited by the mechanical possibilities of moving the piston and valves at sufficient speed. If the cylinder is made larger the result is simply an exposure of more surface and a great increase in mechanical difficulties. There are many overloaded engines in the mills of New England, running far beyond the economical point. Where the load is variable a large part of the total energy is delivered inefficiently. The combined plant shows an efficiency of about 22 per cent compared with about 72 per cent actual thermal efficiency of a perfect engine.

Mr. Emmet said that the Interborough boiler plant capacity had been increased by Mr. Stott in connection with the turbine installation. The doubling of the station capacity by ordinary means would have cost probably $200 per kilowatt, including real estate. It is safe to say that everything which has been done has cost under $30 per kilowatt. The same thing is available for anyone who runs a steam engine or has use for electricity. An overloaded mill engine can be increased from 50 per cent to 100 per cent in capacity, or the overload on the engine can be reduced by taking off some of the load and directly connecting it to electric motors, driving the latter from a generator on the low-pressure turbine. In one recent investigation it was estimated that by a certain change in existing conditions an installation of low-pressure turbines and the addition of one or two boilers, filling up the existing station, it would be possible to add 40,000 kw to the plant at a cost of $40 per kilowatt. This would all be accomplished through the capacity of the turbine to handle an indefinite expansion of the steam. The steam engine is more efficient in the high-pressure ranges than any turbine will probably ever be. The steam expands and pushes the piston and the only losses are certain thermal and friction losses. In the turbine the operation of the steam is indefinite. It simply impinges upon a surface and that impact is more or less inefficient. Ideal efficiency can never be obtained with the turbine, but with it one can work through a wide range of steam activity; ranges that an engine is incapable of touching. Most engines will run non-condensing advantageously when necessary. It is possible to use a turbine as a low-pressure machine and have at the same time a reserve high-pressure capacity. The governor will automatically put high-pressure steam in it when the low-pressure steam is inefficient. There is a great field for these machines in New England.

The Electric Vehicle and the Central-Station.

The regular monthly meeting of the Electric Vehicle and Central-Station Association was held at the Edison Building, Boston, on Nov. 22, with President Frank J. Stone in the chair. A large attendance evidenced the interest now being awakened in New England central-station circles in this source of business. Before the meeting began the members and their friends in attendance made a thorough inspection of a number of modern electric trucks lined up in the street below. President Stone then called the meeting to order with a short address on the latest progress in the electric vehicle field. In the past nine months the number of electric vehicles in operation in Boston and vicinity had increased 100 per cent. The interest in the subject is far from being a passing flurry. There are now eight electric vehicle garages where there were but two before, although New England is still far behind in this business in comparison with Western cities.

President Stone announced that later calculations show that the annual current consumption of one light commercial vehicle equals that of 400 incandescent lamps; and that the annual consumption of one of the heaviest commercial vehicles equals a connected load of 935 incandescents. One hundred average electric vehicles would mean a current consumption equal to a connected load of 6670 lamps. The work of the solicitors in getting the second hundred would be easier than the first. What central-station manager would refuse to seek such business and what solicitor would expect to hold his position if he did not go after it?

Mr. Stone urged that a progressive attitude in one commercial house in regard to electric vehicles will force others to follow it. The value of cleanliness, prompt delivery and the reputation of being up to date is great. The taxpayer is bound to assert his rights sooner or later to cut down the cost of street cleaning. In several large cities the transportation companies refuse to admit other than horse-drawn or electric trucks to their warehouses on account of fire risk. This will become more general, in the street as well as in the warehouse. If the horse and his action could be removed from sight and the slow progress made in handling merchandise noted, the situation would at once appear intolerable. The off-peak load of the vehicle charging business should appeal to all. Mr. Stone said in conclusion that while the electric vehicle will make headway independently of the central station, it will make more rapid prog-

ress with its co-operation. The central station should control this business from the start and not allow it to fall in the hands of the isolated plants. The present means of inefficient transportation of freight through cities must give way to electrical methods. After transportation companies deliver freight at their terminals, the work that follows in its distribution is two or three times as great as when there is but one party to deal with, and if this party had a franchise allowing him to handle all the freight, the use of electricity would be imperative.

Mr. Alexander Churchward, of the General Electric Company, then stated that in Chicago there are 2300 electric vehicles and about 250 new ones being added yearly. The East became disgusted over the situation as a result of its early ex-

COST OF OPERATION.

Yearly miles.	Wagon type.	Per day.	Per vehicle mile.	Per ton mile.
10,000	1,000 lb.	$6.85	19.5 cents	39 cents
10,910	2,000 lb.	7.51	21.5	21.5
9,060	4,000 lb.	8.85	39	19.5
*7,800	7,000 lb	10.80	40	11
*6,900	10,000 lb.	11.47	49	10

*Figures on 27 and 25 miles per day respectively.

periences with vehicles of a design not equal to the present-day standards. The energy consumption has been cut from 120 watt-hours to 60 watt-hours per ton-mile in the past four years. Instead of running on a two-hour to three-hour discharge rate, a vehicle now runs well on a five-hour or six-hour rate. Six years ago the cost of running a vehicle was prohibitive. Tires now run 15,000 miles compared with 3000 miles before. The weight of the vehicle has been reduced, longer life obtained in all important parts, and improved controlling apparatus adopted. High speed and spectacular hill-climbing "stunts" are not for the electric machine, but it is the simple, reliable car. It can pull out of a hole where many a gasoline car is helpless. With gasoline at 12 cents per gallon, the electric vehicle will beat it on economy, with energy at 4 cents per kw-hour. The battery up-keep is less than the maintenance cost of gasoline motor and gears.

Mr. Churchward emphasized the importance of low speed in cost reduction, especially in comparing electric with gasoline trucks. The latter cannot be run over city pavements at from 12 to 15 miles per hour without enormous cost. An electric truck will run 40 miles per day against 12 to 15 miles by horse, and at seven to eight miles per hour against 2½ by horse. He stated that the following guarantees could now be made.

Cost of operation, including energy at 4 cents per kw-hour, interest, depreciation, fire and liability insurance, wages of driver, battery-man and assistant, washer, rent at $1 per square foot of garage per year, tire renewals, gears.

In conclusion, Mr. Churchward said that conservative speeds with pneumatic-tired vehicles of the electric type varied from 20 miles per hour with the 1500-lb. wagon to 16 miles per hour with the 4000-lb. truck; and from 16 miles per hour with the solid-tired 2000-lb. wagon to six miles per hour with the 20,000-lb. truck having solid tires.

Mr. C. F. Smith, of the Boston Edison company's automobile department, then presented a number of lantern slides of the

OLD TYPE DOUBLE-MOTOR, PEDESTAL JAW, GEAR DRIVEN, GENERAL VEHICLE COMPANY CAR.

MONTHLY AVERAGE.

Car No.	Year.	Miles.	Kw-hours charge.	Miles per kw.	Battery cost.	Running repair.	Capacity.
1	1907	377	325.	1.1	$36.20	$50.01	2000 lb.
	1908	339	420.	.8	70.72	50.46	
4	1907	181	213.	.8	15.61	29.38	1000 lb.
	1908	194	215.	.8	37.20	44.20	
	1909	272	139.	2.0	26.26	34.34	
9	1907	431	366	1.1	74.80	85.40	2000 lb.
	1908	432	272	1.6	68.69	108.35	
	1909	238	167	1.4	9.81	24.03	

electric vehicles the company has operated in its own service during the past few years. He said that as a result of the electric vehicle's reliability the company has not had an electric automobile laid up for a single day in 1909. These cars are run on a schedule out of the garage which does not vary seven minutes in a month. President Edgar's private electric automobile has run 40,000 miles in the past seven years, and has never been laid up on the road. Mr. Smith paid a tribute to modern designs and the value of acceleration in crowded districts. Here the electric machine is supreme. Various electric cars used in construction service were shown, and the company will shortly place in service a new car for use in pumping out manholes.

NEW TYPE SINGLE MOTOR, CHAIN-DRIVEN CAR.

MONTHLY AVERAGE.

Car No.	Year.	Miles.	Kw-hours charge.	Miles per kw.	Battery cost.	Running repair.	Capacity.
38	1909	548	175	3.1	$5.86	$7.97	1000 lb.
60	1909	453	138.	3.2	.00	5.69	1000 lb.

MONTHLY AVERAGE.

Car No.	Year.	Miles.	Kw-hours charge.	Miles per kw.	Battery cost	Running repair.	Old type 3 ton truck
	1907	236	466.	.51	$39.28	$45.93	Gen. Veh. Co.
3	1908	178	355.	.50	109.32	63.09	New type
49	1909	393	336	1.2	5.05	11.66	3½-ton truck Gen. Veh. Co.

MONTHLY AVERAGE.

Car No.	Year.	Miles.	Kw-hours charge.	Miles per kw.	Battery cost.	Running repair.	
12	1907	310	166.	1.9	$12.39	$68.03	Waverly runabout
	1908	162	85.	1.9	12.47	9.36	
42	1909	683	153.	4.5	10.88	17.81	Baker runabout

COMPARISON OF TWO BOSTON EDISON ELECTRIC VEHICLES.

	Old type.	New type.
Capacity	1,000 lb.	1,000 lb.
Car weight	4,000 lb.	3,240 lb.
Miles per charge	25	40
Battery weight	1,275 lb.	1,050 lb.
Speed	12	12.
Current	42 amp.	23 amp.
Battery life	3,500 miles	7,500 miles

In the course of his description of the vehicles Mr. Smith submitted the above data comparing the cost of repairs and the mileage of the earlier with the latest electric machines, stating that in general the new types have more than doubled the mileage per kw-hour of charging energy.

Thirty Years of Electrical Development.

In an address recently delivered at the fourteenth annual meeting and dinner of the Electrical Trades Association of Chicago, Mr. Samuel Insull gave an interesting account of his connection with the electrical industry and of electrical development during the past 30 years.

It is about 31 years ago, Mr. Insull said, when one night in November, 1878, he was standing upon a dingy platform of the Metropolitan Underground Railroad of London waiting for a train to take him to the house of one of the leading editors of one of the London weeklies, into whose service as shorthand writer, or as it was then called, shorthand "clark," he had entered, to eke out a small salary received for other services in the city during the day, that his eye happened to rest upon an American magazine at a bookstand. As he had a ride of some half or three-quarters of an hour, he bought the magazine, and in it he found, merely by accident, a very entertaining article descriptive of the work of a man whose name, although well known in America, was comparatively little known outside of the United States, but a name that to-day is a household word wherever current literature circulates—Mr. Thomas A. Edison. At that time little was known of the telephone, and but few in the world knew anything about electric lighting, but Mr. Insull said that the article he read that night affected his career in a way then little anticipated, for within three months, purely an accident, after being engaged by an American who had an office in Lombard Street, in London, he found he was private secretary to Mr. Edison's European agent.

Looking back, it seems almost impossible to realize that at that time, when he was on the threshhold of his career in the electrical business (January, 1879), that there was little or nothing in the way of telephone service. There were then a few telephone exchanges in this country. The first one was opened in New Haven some time during the previous year, 1878; but one could not find anywhere outside of the United States in the spring of 1879 a telephone exchange. The first one erected in London was put in service some time in the fall of 1879, and Mr. Insull said it was his privilege to operate it for the first half-hour that it was in operation.

As to electric lighting, in Europe some work had been done by Von Siemens and some of his associates, and there was a distinguished Russian engineer by the name of Jablochkoff, who had produced what was known as the Jablochkoff candle, a form of arc lamp which was exhibited on the Avenue de l'Opéra in Paris in 1878, and a few months later on the Thames Embankment and Waterloo Bridge in London. Mr. Jablochkoff's efforts, although of great consequence in the development of the art, outlived his first experiments only a very few years, and had no effect in this country except that in 1881 a few lamps were put on exhibition by the late Mr. Charles Cheever, who made quite a reputation in connection with the early introduction of the telephone.

It was at the Centennial Exposition of 1876 where Alexander Graham Bell first exhibited an instrument that imperfectly carried the utterances of the human voice electrically over a wire. There are some enthusiastic admirers of Mr. Edison who claim that they saw experimental telephone instruments in use at Menlo Park a little prior to that, which gave as much in the way of conversation as the work of Mr. Bell. Mr. Insull, however, said he had no doubt that all present at the dinner believed that the credit for the invention of the telephone must be given to Alexander Graham Bell, just as he thinks that the credit for the invention of the carbon transmitter that we all use to-day, whatever may be the claims of other inventors, must be given to Thomas A. Edison.

Referring to the electrical supply business represented by the Trades Association, 30 years ago the only material to be sold was that required for telegraphic and house-bell work. There were three supply houses in New York, those of Tillotson, Bunnell and Charles T. Chester. The Western Electric Company, of Chicago, had a branch at that time in Church Street, New York, and also did more or less of a supply business. At that time the greater part of the supply business was done on special orders by mail, and about the only concerns aside from those mentioned were Partrick & Carter, of Philadelphia; Watts, of Baltimore; Buell, of Cleveland, and Charles Williams, Jr., of Boston, who was afterward taken into the Western Electric Company, and E. T. Gilliland, who did more or less of a supply business in Indianapolis.

Mr. Insull said he could remember when he arrived in New York in 1881, Tillotson and Bunnell had establishments somewhere in the neighborhood of the then and present Western Union Building, on the side streets from 195 Broadway. When one went into their stores, they resembled more a storehouse of one of the big iron wire concerns than what one would now consider an electrical supply store. The business was of little or no national consequence, and as it exists to-day is so entirely different that one was forced to the conclusion that it is really a product of the last quarter of a century.

Referring to telegraphy, he said that if one wanted to send a message from London to New York at that time, he believed it cost a dollar a word; he was more familiar with the rate from the other end of the line, which was four shillings a word. As to telegraph tolls, the telegraph rate between New York and Chicago 30 years ago was $1.15 for 10 words, and the rate between New York and San Francisco was $5 for 10 words.

In 1879 the only electric light service that anything was known about in this country was the work of Mr. Brush, of Cleveland, of Elihu Thomson and Professor Houston and a few others who were engaged in the series arc light business. Mr. Edison's work on incandescent lighting was just being talked about, and was first discussed in the public press in December, 1878. This discussion was followed by a rather sensational drop in the price of gas shares the world over, but it was not until about a year later, in 1879, that Mr. Edison made his first exhibition at Menlo Park of his paper-carbon lamp, and it was not until the summer of 1880 that any of these experimental lamps found their way outside of the laboratory. Mr. Insull said that it was his privilege in August, 1880, to see one of Mr. Edison's first lamps lighted up to a dull red in the basement of a building in Queen Victoria Street, London, the energy for lighting the lamp being supplied by about 40 cells of Grove battery.

When Mr. Insull came to this country on the first of March, 1881, the main discussion in the public press with relation to electrical matters turned on whether Edison had, to use a popular expression of that day, succeeded in subdividing the electric light, or whether the claims that he made of success in that direction were simply the vaporings of a very wild imagination.

There were very few people on either side of the Atlantic who had any belief whatever in what had been accomplished up to that time. Notwithstanding the fact that there was then a complete system of two-wire underground distribution, fed by feeders from a central point, and that that system was operating lamps and motors in multiple, out at Menlo Park, there were very few people who had the slightest belief in the commercial value of Mr. Edison's work. Mr. Insull recalled being taken on the second night he was in this country out to Menlo Park by Mr. Edison, arriving there about 9 o'clock in the evening, and spoke of his surprise in seeing the fields around the laboratory, the houses of Edison and his assistants, all illuminated by this wonderful new light, using a carbon-filament lamp, a decided improvement on the paper-filament lamp which he had seen in London the August previous. He took occasion to run down to the depot from the laboratory, about half a mile away, to send a cable to friends in London, telling them that he had seen Edison's system in operation; about 10 or 12 days later an acknowledgment was received from the man to whom the cable was addressed, a man who is now the representative of the Western Electric Company of Chicago in London, who said he supposed Mr. Insull had been in America just about long enough to be able to draw the bow as long as any of those Yankees with whom he had been associating.

It is a matter of very great interest, he said, to those who follow the engineering side of this business to know that this first exhibition of Edison's electric lighting system at Menlo Park obtained its power partly from a direct-connected unit, composed of a dynamo of Mr. Edison's design, and an engine manufactured by Mr. Charles T. Porter, the engine being of the type commonly known throughout the country as the Porter-Allen engine. The engine was possibly of about 60 hp, and ran somewhere between 500 r.p.m. and 600 r.p.m. Mr. Insull said it is rather remarkable that the first engineering effort in connection with the development of the great industry which goes such a long way toward supporting practically all of the businesses represented at the dinner outside of the telephone interest should have been so true as to be composed of a class of apparatus that we have all gone back to upward of a quarter of a century afterward. This he thinks is one of the greatest tributes to Mr. Edison's engineering ability.

In asking to be excused when, in reviewing electrical progress during the last 30 years, he mentioned the name of Mr. Edison so frequently, Mr. Insull said that as he understood electrical development, and according to the annals of the Patent Office of the United States, one is forced to the conclusion that at least from one-half to three-quarters of the electrical development which is enjoyed at the present time can be traced fundamentally to the great intellect, the great genius, of the man under whose name it had been his privilege to work for 30 years.

It was not until 1882 that the first central station for incandescent lighting was put in operation in New York City. At that time the telephone business had attained considerable proportions. The old fight in this country between the Bell interests as represented by the American Bell Telephone Company, and the Edison interests as represented by the Western Union Telegraph Company, had been settled, and the entire telephone business was operated then, as it is largely now, as a monopoly business.

About the same time that the central-station electric lighting plant was started in New York on Pearl Street, just south of Fulton Street, there was a small plant started at Appleton, Wis. Largely on account of its small size and the ease with which

the smaller apparatus could be produced, the chances are that the Appleton plant started before the New York plant, and therefore the Central West probably can claim the honor of starting the first commercial incandescent lighting distribution system in the world. There had been various efforts made in Europe, but they were mainly in the direction of series lamps—that is, lamps of low resistance, run in series; but all systems of that character have long since disappeared as being uncommercial.

Right after the starting of the New York and Appleton plants there were plants started in London, but only for exhibition purposes, and soon plants were started in Santiago, Chile, and in Milan, in northern Italy.

In 1879 the first miniature electric railway carrying passengers was put in operation at the Berlin Exposition, by Siemens & Halske. It was purely an exhibition plant and it was not until two years later that any commercial road was put into operation in Europe, and that was a small one outside of Berlin, a mile and a half long. About the same time, or maybe a year later than the exhibition of the miniature railroad by Siemens & Halske in Berlin, there was a similar exhibition in Chicago on the Lake Front, in the old Exposition Building, of a little circular railroad, but not to carry passengers.

The progress that followed came in rapid succession, but it is an interesting thing to note that it was not until 1881 that there was any official definition of any of the electrical units, and it was at the Paris Exposition of 1881 that the ohm, the volt, the ampere and the coulomb were first authoritatively defined as the basis for legislative action in the various countries.

It was in this same year that the first "box of electrical energy," or what we call the storage battery of to-day, was carried from Paris to Glasgow by Sir William Thomson, afterward Lord Kelvin. It was one of the first storage batteries, and made by Camille Faure, and its unique demonstration attracted a great deal of attention at that time, but it was years afterward before the Faure cells came into general use.

At the Exposition of 1881 was the first demonstration of a direct-connected dynamo and engine, outside of Menlo Park. Mr. Insull said he had the privilege of having a great deal to do with the manufacture of that first unit in New York and its shipment to Paris. Mr. Edison's exhibit in Paris of that unit was made by Mr. Charles Batchelor, an early assistant.

About 1886 the alternating system began to come into general use, and some time prior to that period the three-wire system of Edison's was put into use, and the amount of copper necessary for the direct-current system was cut down about 60 per cent. The introduction of the alternating system and the Edison three-wire system gave a tremendous impetus to the electric lighting business, and one began to see springing up all over the United States establishments for the sale of apparatus. Mr. Insull added that from his own personal experience and much to his own cost, he could assure the audience that at that time a credit association was needed very badly indeed. (Laughter.)

The first serious efforts at electric railway work in this country were in 1888. Some years earlier, in 1880, Mr. Edison had built an experimental road at Menlo Park, and Mr. Stephen D. Field had done some work in connection with electric railways, but it was not until 1888 that Sprague's first electric road was started at Richmond, Va. In the same year, 1888, the first central station was established in the city of Chicago. At that time there was a large number of isolated plants, in fact, more in Cook County for the population than in any other part of the United States, but no effort had been made in the direction of central-station work until some time in 1887, when the Chicago Edison Company was formed. In 1888 its first central-station plant was started at 139 Adams Street, and when Mr. Insull came to Chicago in July, 1892, the plant had arrived at the enormous proportions of somewhere between 3000 and 4000 hp.

In this same year (1888) Mr. Tesla contributed very materially to the development of the alternating side of the business through his polyphase-current inventions, which form the basis largely of the alternating dynamos and motors of to-day.

The first electric power transmission was in 1890, this being a system laid out in a small town at one of the mines in Colorado. The next milestone in the progress of the electric lighting art was signalized by the Chicago World's Fair of 1893. That was, above everything else, an electrical display. One finds that there they got back to the direct-connected dynamos, using marine types of engines for the purpose, and a couple of those engines, which were shown at the World's Fair, are still in use at the Harrison Street Station of the Commonwealth Edison Company. The X-rays were discovered by Roentgen in 1895, and in the same year Marconi effected communication by wireless telegraphy in Italy for the first time.

Since then has been made the most wonderful progress. The first large American steam-turbine unit started in Chicago in 1903. The steam turbine had met with more or less success in different parts of Europe, and especially in England, a number of years prior to that, but the large use, or rather the use of large units as they are now understood, in the central stations of to-day, where units running up to as high as 22,000 hp are used, dates as recently as Oct. 2, 1903, when the first unit was started in the Fisk Street station of the Commonwealth Edison.

Some of the figures of the investments in the electrical business are simply stupendous. In Chicago alone there is probably invested in electric lighting, telephones, the electric portion of the street railways and the elevated railways, and the isolated electric lighting plants throughout the city, a sum which must exceed $500,000,000. "Just imagine for a moment what that means. Here we are, engaged in a business that a little over 30 years ago was never dreamed of, and to-day we have as customers of the concerns which are represented in this room, businesses that employ a capital of $500,000,000. The figures are simply stupendous."

There are at the present time 5,500,000 telephones in use in the United States, and the amount invested in exchanges and the lines connecting them is upward of $550,000,000. There is a track mileage of electric and interurban railways of 40,247 miles, using 89,216 cars, and representing capital liabilities of $4,557,000,000. Mr. Insull said that, of course, those figures represent capital liabilities and probably some of that capitalization is water, but personally would very much doubt if the cash invested in electric street and interurban railways at the present time is less than $3,000,000,000.

Turning again to electric lighting investments, there are about 6000 central stations in the United States to-day. Of this number upward of 3000 of the companies engaged in central-station work are also in the electrical supply business, a business that 25 or 30 years ago the representatives of which could be counted on the fingers of one hand.

The central-station companies of the country have an investment of $1,250,000,000. They have a gross income of upward of $250,000,000 a year, and they develop somewhere between 2,000,000 hp and 2,500,000 hp.

The total investment engaged in the several departments of the electrical business exceeds upward of $6,00,000,000; and that entire business has been created by the inventors of this country, who have no rivals anywhere on the earth in what they have been able to accomplish anywhere; in the ability of these inventors to produce that which would be commercially successful; by the wonderful confidence of the capitalists of the country; and by the adaptability of the people of this country to seize upon new things which are conducive, either to their comfort or to the economy of manufactures or to the improvement of means of communication and transportation.

In conclusion, Mr. Insull said that all in the audience can congratulate themselves, first in being privileged to take part in this remarkable business, and secondly, in being located in a country where whatever new things may come along, if they are things which recommend themselves alike to the capitalists who provide the money and the users, who provide the revenue from day to day, they are promptly adopted. "All I can hope is that the success of the last 30 years is only an indication of the great advances that all of us hope and many of us believe are likely to take place in this wonderful electrical business, in which we are all so proud to be engaged."

Canadian Hydroelectric Commission News.

Disallowance of the Ontario legislation respecting the Hydroelectric Power Commission has been asked of the Government by a deputation from Hamilton, London and Galt, Ontario. It was argued that the legislation was arbitrary, affected foreign investment and that Galt had been forced into the scheme unwillingly. The Premier replied that the question of disallowance was under consideration.

Another attempt has been made to have the Dominion Government disallow the legislation passed by the Ontario Government in connection with the Hydroelectric Commission. As previously reported this question was presented to the Dominion Government some weeks ago by a formidable array of eminent counsel who contended that the acts of the Ontario Government were illegal and urged the disallowance on technical grounds.

On Nov. 24 a deputation of prominent citizens from Hamilton, Galt and London waited upon the Premier and members of the cabinet. They represented that the legislation was arbitrary, illegal and not in the interests of the public as a whole. It was pointed out that the investment of capital from abroad had been injuriously affected, and particularly so in the case of the town of Galt, which had been compelled to join with the other municipalities in the scheme against its will. The members of the deputation declared that if the people of Ontario had real knowledge of the situation, the vast majority would demand the repeal of the act.

Sir Wilfrid Laurier in replying said that there was much force in the arguments advanced, and the question of disallowance was now before the Government, which would have to consider it from both the standpoint of its constitutionality and with due regard to the expediency of disallowing any provincial act affecting principally the people of that province.

Wisconsin Rate Commission News.

A petition signed by the Business Men's Association of Fond du Lac, alleging that the practice of the Wisconsin Telephone Company in issuing telephone directories for its Fond du Lac exchange, containing advertisements of local and foreign business houses, has caused injury to the trade, business and calling of petitioners, and praying for an order compelling respondent to furnish directories free from advertisements, excepting only those which advertise the telephone business of respondent, was acted upon by the commission on Nov. 24.

It was brought out in the hearing that the directories were furnished free to respondent by an advertising bureau, the advertisements being under censorship of respondent, and that it is customary to include advertisements in telephone directories.

The petition was dismissed on the grounds that "any act, practice or collateral undertaking of a public utility, not affecting prejudicially the reasonable performance of its duties and obligations to the public and individuals, although displeasing to some of its patrons because tending to subject them to prejudice in respect to their private interests, is not within the scope of the regulative powers conferred upon the commission; that the universal practice of telephone companies of using their directories as advertising mediums is a practice collateral to the public functions of such companies; and as long as not interfering with its discharge of such functions, is not within the regulatory powers of the commission; that the respondent furnishes adequate directories to the petitioners and to the public and the use of the same as for advertising purposes does not impair its serviceableness to the public."

The State law requiring street railway companies properly to heat all cars between Oct. 15 and April 15 was violated by the Southern Wisconsin Railway Company, and on Nov. 18 the commission ordered the said company to comply immediately with the State law. The cars must be equipped with a reliable thermometer placed in a conspicuous place at or near the center of the car and a temperature of not less than 60 deg. Fahr. at or near the center of the car must be maintained when reasonably possible to do so. A fine of from $50 to $100 is provided for violations, each day such car is operated to constitute a separate offence.

New York Public Service Commission News.

Chairman Willcox, of the Public Service Commission of the First District, last week wrote a long letter to Theodore P. Shonts, president of the Interborough Rapid Transit Company, condemning the proposals made by that company for the construction of subways and declaring that the commission considered them unfair to the city, obstructive of other subways in the future and inadequate to the needs of the people. The letter amounted to a total rejection of the Interborough's plans. The company has as yet sent no response to the commission and has not indicated whether or not it is to be further considered in connection with the construction of new subways.

After many hearings on the question of heating street cars in New York City the Public Service Commission last week issued an order requiring all cars to be supplied with suitable heating apparatus and between Oct. 15 and April 15 to maintain in every closed car a temperature of not less than 40 deg. Fahr. nor more than 60 deg. Fahr., unless temporarily prevented from doing so by storm or accident. The order takes effect on Dec. 10.

The Second Avenue Railroad Company has applied to the Public Service Commission for permission to electrify that portion of its line running through North Street from Chatham Square to Broadway. This track has not been operated for years for traffic, although a horse car has been run over it to preserve the franchise. A hearing was ordered on the application for Dec. 1. The receiver of the company has already been authorized by the courts to equip the tracks for electricity.

Upon complaint of the Board of Trade of the Twenty-fourth Ward, of Brooklyn, the Long Island Railroad Company has been ordered to show cause why it should not be compelled to use electric locomotives only in its subway through the city of Brooklyn.

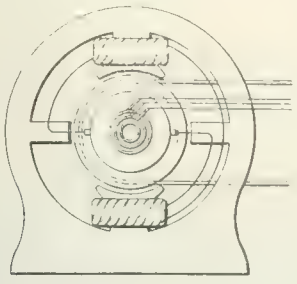
The Public Service Commission has suggested to the New York Central Railroad Company that if it is willing to build tunnels under the streets of Manhattan, for its Eleventh Avenue tracks, under the same laws by which the Pennsylvania Railroad got its franchise, it may apply for the privilege without any further legislation. It is said that the Central has expressed a willingness to spend $60,000,000 on such a project.

The Public Service Commission of the Second District has received a complaint from the residents of the village of Canandaigua against the Ontario Light & Traction Company as to alleged poor service rendered by that company in furnishing electricity for light and power in the village of Canandaigua. It is stated that the company depends almost entirely on Niagara power to furnish service, having but two other stations, one at Canandaigua and one at Littleville, about six miles distant. It is stated that in the past six or eight weeks the quality of electricity which has been given is very bad and that there has been hardly an evening that the service has not been interrupted from one to six times, varying in stoppage from 6 to 40 minutes; that repeated complaints to the company's office have met with promises, but no betterment of service, but, on the contrary, the service seems to be getting worse. The commission has asked the company to answer the complaint within 10 days.

During the present week the Public Service Commission, Second District, will give a hearing on the application of the Genesee Light & Power Company under section 69 of the Public Service Commissions Law for authority to issue capital stock; also, to the East Creek Electric Light & Power Company, under section 69, for authority to execute a mortgage upon all its property for $3,000,000 and to increase its capital stock [illegible] $750,000.

Non-Sparking Synchronous Commutating Machines.

In a patent issued on Nov. 16 to Dr. C. P. Steinmetz a description is given of a machine having interpoles without winding which operates sparklessly. The armature of the machine is of the closed-coil type provided with both a commutator and collector rings. The arrangement for operation is such that the



NON-SPARKING SYNCHRONOUS COMMUTATING MACHINE.

m.m.f. of the current entering by way of the collector rings is greater than that leaving by way of the commutator, and the excess m.m.f. serves for exciting the interpoles to the extent required for sparkless operation. This result is obtained when the machine receives all of its power over the collector rings and delivers only a part over the commutator, the remainder being utilized mechanically at the pulley.

Opening of New Physics Laboratory at University of Illinois.

With dedicatory exercises, held on Nov. 26 and 27, the new laboratory of physics of the University of Illinois, at Urbana, Ill., was formally opened. The dedication proper was held on the afternoon of Nov. 26, President Edmund J. James, of the university, presiding. With an appropriate speech, Gov. Charles S. Deneen, of Illinois, presented the building to the university. As president of the board of trustees, Mr. W. L. Abbott, of Chicago, accepted the building in a speech in which he pointed out that, as the university has no guaranteed income, its work must be extremely practical and kept close to the people to justify the Legislature in continuing to make sufficient appropriations to carry on the work of the institution. Some persons may think that this requirement would discourage abstract research work and college training where the prospect of immediate returns is not great. But the fact that a quarter of a million dollars was given by the Legislature for a laboratory of physics shows that the people of the State are willing to tax themselves to encourage the work of the institution.

President James delivered the charge to the department of physics, and Prof. A. P. Carman, professor of physics, responded in appropriate terms. Following this was the dedicatory address by President H. S. Pritchett, of the Carnegie Foundation for the Advancement of Teaching. One point in Dr. Pritchett's address was that while the college may be an intellectual and spiritual organism, it is still true that it rests for its success on some form of machinery of administration, and that the underlying principles which have to do with efficiency in the administration of a factory may be quite the same as those which have to do with efficiency in the administration of a department of physics.

In the evening there was a second meeting, with Dean W. F. M. Goss presiding, and the American Physical Society and the Illinois Academy of Sciences as guests. Addresses were made by Prof. David Kinley, dean of the Graduate School, and by Prof. Arthur G. Webster, of Clark University. On Nov. 27 there was a regular scientific meeting of the American Physical Society in connection with the formal opening of the new physics laboratory. An informal social gathering was held for guests at the University Club after the addresses at the evening meeting of Nov. 26, and there was also a luncheon for guests at the University Club after the morning exercises of Nov. 27.

Simple, but dignified and imposing, the new physics laboratory makes a notable addition to the engineering group on the campus. It is a stone-and-brick building of three stories, with basement and attic, and the cost of building and equipment has been $250,000.

The trustees of the university have approved the State architect's plans for a new building for general classroom purposes at the University of Illinois, for which the name Lincoln Hall has been suggested. The cost of this building will be $250,000, which was appropriated at the last session of the Legislature. Bids will be asked during the coming winter.

CURRENT NEWS AND NOTES.

BALTIMORE ELECTRICAL CONTRACTOR'S LICENSE CASE.—As recently reported in these columns, the right of the board of electrical examiners and supervisors of Baltimore, Md., to cancel an electrical contractor's license on the ground of alleged poor construction work has been challenged. Last week a contractor thus deprived of a license secured an injunction against the board on the ground that it had no authority to revoke the license after the work had been done according to the specifications and after it had successfully passed the inspection of the city officials.

CANADIAN WATER-POWERS.—In a recent report on the water-powers of the Ottawa and Gatineau Valleys, by Mr. Fritz Cirkle, it is estimated that there are available 306,020 hp on the Ottawa River, and 216,325 hp on the Gatineau River, aggregating 522,345 hp. The location of water-powers available for development are as follows: On the Ottawa, at L'Islet rapid on the Culbute channel, 2000 hp; Sabila rapids, 3800 hp; Timber Slide, 1400 hp; Garvin chute, 5000 hp; Cranfort rapids, 7000 hp; Black rapids, 57,000 hp; Muskrat rapids, 7000 hp; Rocher Frendu Chute, 5600 hp; Grand Calumet Falls, 25,000 hp; Mountain rapid, 13,000 hp; Dagis rapid, 4500 hp; Portage du Fort, 400 hp; Chats Falls, 50,000 hp; Deschenes rapids, near Ottawa, 35,000 hp; Skead's Mills, 25,000 hp; Chaudiere Falls at Ottawa, 70,500 hp; Black River Falls, 21,000 hp; Coulonge River Falls, 24,120 hp. On the Gatineau, six portages below Maniwaki, 2820 hp; The Corbeau, 5520 hp; The Boom, 4960 hp; Les Cedres, 3220 hp; La Passe, 210 hp; Le Bonnet Rouge, 875 hp; the Paugan Falls, 73,500 hp; The Cascades, 9000 hp; Chelsea rapids, 65,044 hp; Chelsea Falls, 50,400 hp.

KINGSTON (CAN.) ELECTRIC RAILWAY DISCONTINUED.—A unique situation has been created in Kingston, Can., by the shutting down of the local street-railway system, owing to the company and the city corporation having been unable to come to terms for the renewal of a contract for power for the railway. The company has been requesting the city to supply it with electric power at 1.20 cents per kw-hour for a term of five years, and stating that as it had lost money in the past and in order to make improvements to the system, it would require a contract for that length of time. The City Council, however, while agreeing to the price, would only consent to a three-year term, feeling that the increase in the demand of the city power service might necessitate the city increasing its plant, and it did not want to make a contract with the railway for any longer period. As a consequence, the street railway company shut down its service on midnight of Nov. 23 and the next day commenced to tear up the ties and rails, as well as to dismantle the substation equipment. The City Council, upon seeing the determination of the company, endeavored to take steps by way of injunction to stop the tearing up of the company's roadbed, but was advised by the city solicitor that according to the terms and conditions of the franchise the company had the right to remove its roadbed and equipment.

ELECTRIC USHER SERVICE.—In the Cohan Theater soon to be erected in New York use will be made of an electric usher call system connected with every seat so that a patron may call an usher by pressing a button.

PROPOSED FEDERAL REGULATION OF TELEGRAPH AND TELEPHONE.—Congressman Mann, of Illinois, who favors placing telegraph and telephone companies under Federal supervision, has had a conference with President Taft on the subject and suggested that a recommendation to that effect shall be included in the President's message.

N. E. L. A. COMMITTEE ON TERMINOLOGY.—The N. E. L. A. committee on terminology has asked the co-operation of the members of the Association in its work, and requested that they shall forward to it a list of such terms as in their judgment may require definition. The work carried on by this committee is similar to that which has engaged the attention of a British Sub-Committee of the Electrotechnical Commission of London.

THE TELEPHONE AND THE TELAUTOGRAPH.—A proposed use of the telautograph is under consideration whereby telegraph messages may be sent by wire to a telegraph office for final transmittal, thus superseding the present call boxes and messenger service. If public telephone offices become connected with the telegraph service, the messages would be sent to such offices also and thence transmitted to the outgoing telegraph message office.

NEW OFFICERS OF COMMONWEALTH EDISON BRANCH OF N. E. L. A.—By a letter ballot the Commonwealth Edison Branch, in Chicago, of the National Electric Light Association has elected the following officers: Chairman, Mr. John C. Manley; vice-chairman, Mr. E. O. Schweitzer; treasurer, Mr. W. A. Fox; secretary, Mr. O. R. Hogue; executive committee, Mr. George E. Burns, Mr. William M. Crane and Mr. H. C. Patterson.

INSURANCE RATES IN ILLINOIS.—The Policy Holders' Union, an organization recently formed in Illinois, is endeavoring to arouse the business interests of the State outside of Chicago to the necessity of some united action on the part of the assured toward securing a voice in the fixing of rates and insurance requirements. It is pointed out that under the present method these rates are made by one man without any consultation with the people who pay the premiums. Mr. George H. Holt is manager of the Policy Holders' Union.

BROOKLYN EDISON TO HELP BUILD THE FOURTH AVENUE SUBWAY.—Contracts have been signed by the Edison Electric Illuminating Company of Brooklyn with contractors engaged in the building of the Fourth Avenue subway covering over one-half of the tunnel route. The Edison company will not only supply energy for lighting the excavation work, but also for motors for hoisting, concrete mixing, temporary railroads and drilling. It is expected by the first of the year that active operation in the use of electricity along the excavation will be begun.

NATIONAL DISTRICT HEATING ASSOCIATION.—At the first annual convention of the National District Heating Association, held in Columbus, Ohio, on Nov. 10 and 11, the following officers were elected: President, Mr. A. C. Rogers, Toledo, Ohio; vice-presidents, Mr. J. H. Harding, La Porte, Ind.; Mr. H. W. Hillman, Grand Rapids, Mich.; Mr. F. E. Reidhead, Paducah, Ky.; secretary-treasurer, Mr. D. L. Gaskill, Greenville, Ohio. The exact date of the second annual convention has not been set, but it will be held at Toledo, Ohio, probably in the month of May, 1910.

TELEPHONES FOR RAILROAD MEN.—The Baltimore & Ohio Railroad entered into a contract for telephones in the residences of all of its employees in Cumberland, Md., whereby the railroad company is to bear the bulk of the expense, the men paying only about 50 cents a month for the service. More than 500 new telephones are being installed under this contract connecting the homes of every engineer, freight and passenger conductor, fireman, brakeman and member of the wrecking crews. It is reported that a similar plan will be put into effect at other Baltimore & Ohio Railroad centers, including Keyser, Piedmont, Grafton, Martinsburg and Brunswick.

BALTIMORE TELEPHONE WAR.—The Diamond State Telephone Company, the branch of the Bell Telephone Company operating in Maryland, has proposed to raise the price of its service, and the subscribers are retaliating in a most unexpected manner by preventing the company from erecting poles in front of their properties. A suit has already been instituted by a property holder claiming $2,000 damage for the planting of 17 poles along his property. The Maryland Court of Appeals several years ago rendered a decision to the effect that telegraph and telephone companies have no right to erect poles and string wires in front of properties without the consent of abutting landowners, notwithstanding that they have been given permission by the county commissioners.

INTERNATIONAL TELEPHONE CONVENTION.—At the annual convention of the International Independent Telephone Association, to be held at the Auditorium Hotel, Chicago, on Dec. 7, 8 and 9, papers will be read as follows: "The Insurance Exchange," Mr. J. D. Hoge, Cleveland; "Is the Telephone a National Monopoly?" Mr. Francis Dagger, Toronto; "Continental Telephone & Telegraph Company," Mr. M. G. Reynolds, St. Louis; "A Strong Financial Institution," Mr. E. H. Moulton, Minneapolis. In addition, there will be various committee reports and a "technical and operating conference" in charge of Mr. G. R. Johnston. Mr. Frank H. Woods, for the auxiliary committee, will discuss proposed changes in the organization and its constitution.

PERFORMANCE OF SMALL TRANSFORMERS.—Messrs. Antonio Guell and Hubert M. Turner have an article in the *Technograph*, the annual publication of the engineering societies of the University of Illinois, on "Tests of a 3-kw Transformer." The tests are of interest because the transformer is of the size much used in residence lighting and from employing the new alloy steel which gives low core loss. The efficiency was found to be 96.7 per cent at full load, 97 per cent at three-fourths load, and 95.7 per cent at one-fourth load. The voltage regulation was 2.1 per cent at 100 per cent power factor and 2.7 per cent at 60 per cent power factor. The exciting current was 2.34 per cent of the full-load current. The latter value is much below the manufacturer's guaranteed value of 3 per cent, and the core loss was 12 per cent below the manufacturer's guarantee. These results are attributable to the use of a voltage wave-form which differed considerably from the sine wave.

TRADE UNIONS FAVOR INDUSTRIAL EDUCATION.—At the recent convention of the American Federation of Labor in Toronto a special committee, of which Mr. John Mitchell was chairman, made a report on industrial education. The committee favors the establishment of schools in connection with the public-school system at which pupils between the ages of 14 and 16 may be taught the principles of the trades. It is recommended that the course of instruction in such schools should embrace English, mathematics, physics, chemistry, elementary mechanics, drawing, shop instruction and specific information in relation to the particular trade taught. The committee also recommends the teaching of "a sound system of economics, including and emphasizing the policy of collective bargaining." In order to keep such schools in close touch with the trades, there should be local advisory boards, including representatives of the industries, employers and organized labor. The committee recommends that as technical education of the workers is a public necessity, it should be not a private but a public function, conducted by the public and at public cost.

Generating Station of the Home Electric Light & Steam Heating Company at Tyrone, Pa.

THE new station of the Home Electric Light & Steam Heating Company at Tyrone, Pa., has many features of interest, and embodies the latest practice in design and construction, being a strictly steam-turbine plant operating condensing, and equipped with economizers and superheaters. The building is of concrete, steel and brick, approximately 80 ft. square, and is divided into boiler and engine rooms. The structure rests on 270 Raymond concrete piles driven to refusal, mainly in groups of four and six. These are capped with concrete on the ground, forming a rigid foundation upon which a solid concrete wall was built to a height of about 8 ft. from the surface of the ground, where the brick walls commence. The roof is very high, and is built of reinforced cinder concrete covered with Carey roofing. The coping, window sills, etc., are also made of concrete. The roof is supported by steel construction extending from the concrete substructure, and provision is made on the steel work for brackets to support the rails for a 15-ton traveling crane in the engine-room. Two floors are provided in the engine half of the structure, the lower or first floor containing the transformers for the rotary converter sets, the hot well and pumps, while the upper floor is reserved for the generating equipment.

Coal is brought to the plant on a concrete trestle 144 ft. long, connected with a spur track from the main line of the Pennsylvania Railroad. Under the trestle there is storage capacity for 2500 tons of fuel. The coal used daily is dumped into a concrete hopper on the trestle, and chuted thence to one-ton charging cars, which pass over an industrial track and scales to the front of the boilers. The ashes are also weighed and carried out at the other end of the building, and dumped into ballast cars for use on the railway line running between Tyrone and Altoona.

The boiler-room equipment comprises two 500-hp Stirling water-tube boilers, equipped with Foster superheaters, and operating at a steam pressure of 160 lb. An extra battery of Marietta boilers is kept in reserve. The smoke flue is built directly behind the boilers, and passes to the end of the building to a Green economizer, the products of combustion escaping in a concrete stack 175 ft. high and 8 ft. in diameter at the top. The steam piping, which was installed by the B. F. Shaw Company, is extra heavy and is equipped with Van Stone joints. Non-return valves are used on each boiler, in addition to the regular gate valves. A 12-in. steel header runs the length of the boiler-room parallel to the partition wall, from which curved-steel supply pipes lead to the steam turbines and the auxiliaries.

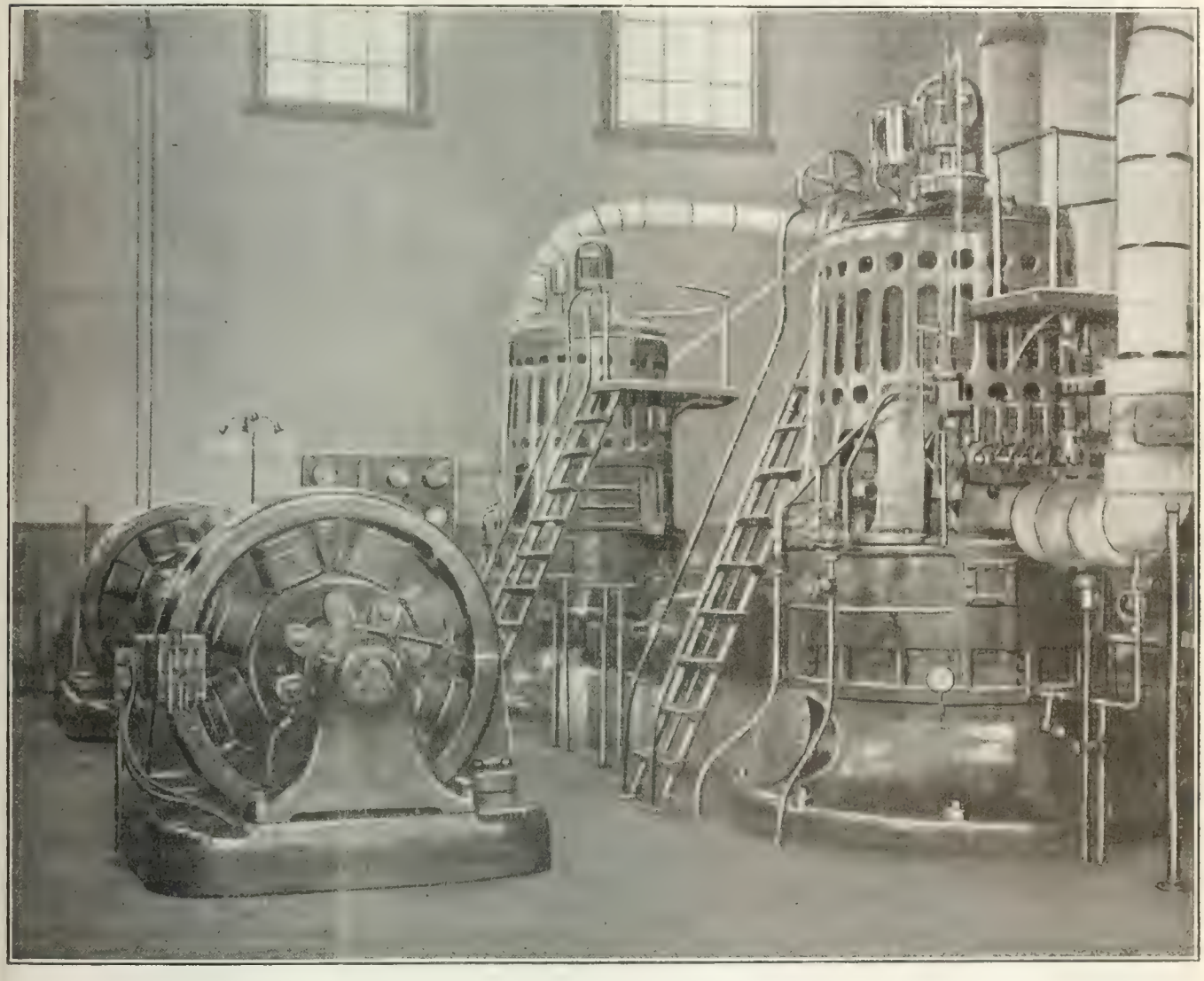


FIG. 1.—GENERAL VIEW OF GENERATOR ROOM.

The electrical equipment consists of two 500-kw, 2300-volt, three-phase General Electric turbo-generators; two 20-kw turbo-exciter units; two 300-kw, six-phase, 60-cycle, 600-volt rotary-converter sets; one 60-hp, 2300-volt, induction motor direct-connected to a 50-kw, 500-volt Western Electric generator

and three oil-cooled, 50-light, 4-amp General Electric mercury arc rectifier sets, besides the transformers for the rotaries. There are also in the plant a 30-hp, slow-speed, three-phase, 220-volt Western Electric induction motor driving a vacuum pump, and a 3-hp, three-phase Western Electric motor for the economizer scrapers. Energy for these motors is obtained from a bank of three 25-kw transformers in the basement. The 220-volt, three-phase circuits from these transformers are also carried out as a distributing line throughout the business section of the town, which is not far distant from the plant, so that all of the motor business adjacent thereto may be operated from one bank of transformers located at the plant, thus eliminating the losses due to small pole-line transformers for each individual installation.

The wiring from the switchboard is carried underneath the operating floor to the ends of the building, where it rises along the wall to a point near the roof. The wires are then carried at right angles to the wall 15 ft. over and dead-ended to a strain insulator on a steel beam. Eighteen inches above this beam is a beam at right angles and 20 ft. from the side of the building, to which the outside line wires are similarly dead-ended. Connection with the line wires is made by means of jumpers between the two sets of wires, so that it is possible to connect the feeders to any set of distributing lines by a few minutes' work inside the station.

The switchboard is of slate construction with ample room behind and in front, and with abundant natural light. The instruments on the board are all secondary. The switch handles of the oil switches are mounted on the face of the board, and the switches themselves on the iron framework at the rear of the board. In the center of the board are the two main generator panels, and on the right of these are the direct-current panels for the exciters, railway feeders, etc., and on the left are the alternating-current distributing panels. On account of the fact that the load on the plant is about equally divided between railway and lighting circuits, and the necessity for the use of a Tirrill regulator, it was found necessary to put in an auxiliary set of three busbars, from which the lighting circuits



FIG. 2.—VIEW OF MAIN SWITCHBOARD AND ROTARY [illegible]

are taken. The transformer for the Tirrill regulator is connected to the line between the main bus and the auxiliary bus, so that the regulation of the plant is maintained for the lighting load, and the Tirrill regulator does not compound for the increased load on the railway side, but only on the lighting side.

The incandescent circuits for Tyrone are carried on four single-phase lines, each controlled by a double-throw oil switch connected to two phases, so that the load may be balanced equally on both phases. A three-phase line extends the length of the town, and supplies energy for both lamps and motors to the Pennsylvania Railroad. A separate panel is used to control energy for the magnetite arc rectifiers, one of which is connected to each of the three phases. Each panel is equipped with an ammeter indicating the current flowing, and a watt-hour meter. Blank panels are placed in the main switchboard for a future third generator with its exciter. There are also

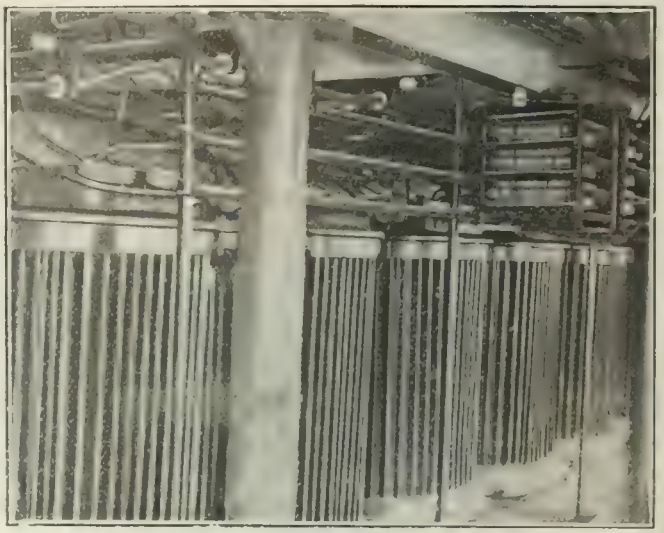


FIG. 3. TRANSFORMERS FOR ROTARY CONVERTERS IN STATION

blank panels for a booster and storage batteries for railway work, should these be found necessary.

The water supply for the station is obtained from a large spring located on Washington Avenue, about 900 ft. from the station. This spring furnishes an ample supply of water the year round at a temperature of about 52 deg. The water is conducted to an intake and dam along the railroad embankment adjacent to the plant, and from there conveyed by a 16-in. pipe under the embankment through a 52-in. iron-pipe culvert into the station, where it is used for condensing and other purposes. The condenser is of the barometric type, built by the Alberger Condenser Company, and is placed on the roof. With inlet water at a temperature of about 52 deg. a vacuum of approximately 27.5 is maintained, the discharge water having a temperature of about 80 deg. A centrifugal circulating pump, built by the Janesville Iron Works, and connected to a Terry steam turbine rated at 60 hp, and running non-condensing, pumps the water for the condenser. The boiler-feed pumps were also supplied by the Janesville Iron Works. Water for boiler-feed purposes is taken from the hot well at between 80 deg. and 90 deg., and passed to a Cochrane feed-water heater, leaving this at a temperature of about 210 deg. It is then pumped through the economizer to the boilers. The temperature of the water when leaving the economizer varies from 300 deg. to 340 deg. By means of a Foster superheater the steam is heated to an average temperature of between 480 deg. and 490 deg. The wiring in the plant is all flame-proof and heavily insulated, so that it may be carried exposed on rack insulators. Lightning arresters are placed on the wall and underneath the outlet for the wires. A small air compressor for supplying air for cleaning the machines is installed in the basement.

The plant was designed and the construction superintended

by Mr. A, S. Kibbe, engineer of the American Railways Company of Philadelphia. The operating force consists of a chief engineer, two operating engineers, two firemen and a helper. The equipment is operated continuously, giving a 24-hour service for general lighting and power work, and also supplying energy to the street railway company. The station was placed in operation July 1, 1908, and has met the expectations of the designing engineer for economical operation and maintenance. Bituminous coal, obtained about 20 miles from the station, is used. This fuel is a fair quality of run-of-mine, and full-load tests on the station show that when operating one turbine at full load the coal consumption varies from 3½ lb. to 4 lb. per kw-hour output, including the steam used by the auxiliaries. A Venturi meter is used on the boiler feed-pipe. Records are kept by the chief engineer of the kw-hour output on the turbines, the coal burned, the ashes, together with the water evaporated by each fireman on his shift, so that it is a matter of a few days only to determine whether a fireman is working economically or not. Ample provisions have been made for the comfort and welfare of all employees, who are provided with individual steel lockers, shower baths, toilet-rooms and wash-rooms.

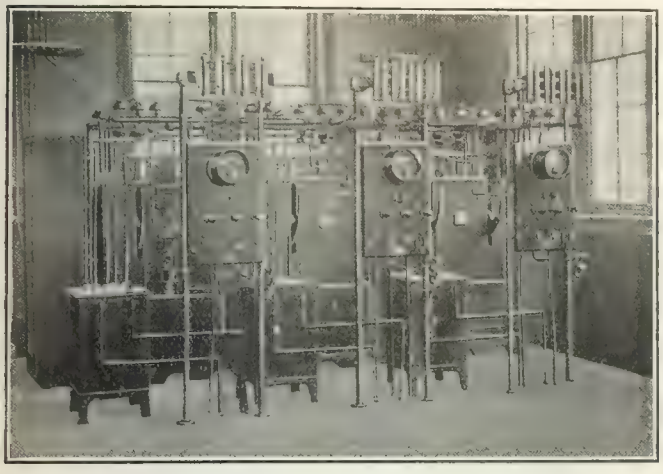


FIG. 4.—MERCURY RECTIFIERS FOR MAGNETITE ARC SYSTEM.



FIG. 6.—EXTERIOR OF STATION SHOWING COAL SIDING.

The Home Electric Light & Steam Heating Company does a general lighting and power business in Tyrone, besides furnishing energy for the Altoona & Logan Valley Street Railway, connecting Tyrone and Altoona. In addition the company supplies 75 4-amp General Electric magnetite arc lamps for the Borough of Tyrone, and 40 lamps of the same type for lighting the yards of the Pennsylvania Railroad Company, together with energy for lighting the shops and operating such motors as the railroad company has. The company also operates a substation at Bellwood, about eight miles from Tyrone, which supplies energy for 50 4-amp, 50-watt, tungsten series lamps, 15 magnetite arc lamps and commercial lighting circuits. The line is carried from Tyrone on the poles supporting the trolley wires, and is operated at 2300 volts, the booster in the power plant being pressed into service at times of heavy load. Three-wire, 110-220-volt, secondary distribution is used in Tyrone for lighting circuits. The company also operates a sign circuit which is turned on and off from the station, the nearness of the business part of the town to the station making this quite feasible. The sign circuit is switched on from dusk to 11 o'clock, and to it are attached numerous signs and considerable outline business, aggregating 1000 6-cp lamps. The company finds it possible to obtain business for this service which could not be obtained on a meter basis. Although the income is practically the same per kw-hour, the merchants appear to be more willing to pay a flat rate for the sign and outline lighting than to have this business fed through meters.

Most of the street lamps in Tyrone are hung from two poles with Cutter pulleys on 5/16-in. galvanized iron span wires, Oneida galvanized chain being used for raising and lowering the lamps. The magnetite arc system has been in use for over three years, and has been very satisfactory. All of the customers, aside from those on the sign and outline circuits, are supplied on a meter basis, and the meters are inspected and tested



FIG. 5.—VIEW OF BOILER-ROOM.



FIG. 7.—SPRING USED FOR BOILER FEED AND CONDENSER PURPOSES.

in the shop at least once a year—the larger meters at shorter intervals. Considerable success has attended the residence lighting business in Tyrone, which amounts to more than the connected load in the business district, and a fair income is derived from this source. Much of the success is due to the installation of electric flatirons and the tungsten lamp, both of which the company offers every inducement to install.

The American Railways Company, of Philadelphia, owns the station. Mr. S. S. Crane, Altoona, Pa., is general manager, and the superintendent at Tyrone is Mr. W. R. Power, to whom much of the operating success of the station is due. Mr. F. W. DeMart is chief engineer. The executive officers are: Mr. J. J. Sullivan, president; Mr. H. J. Crowley, vice-president and general manager; Mr. C. L. S. Tingley, secretary-treasurer, and Mr. F. J. Pryor, comptroller.

Underground Distribution for Small Cities and Towns.

By J Franz.

THE demand for underground distribution is growing every day, not only in congested cities, but also in suburban districts and residence country towns where it is undesirable to mar the beauty of the streets with pole lines. No doubt many central stations are requested by patrons to eliminate overhead wires or are refused grants for further extensions. In cities where consumers are not widely scattered, the central station is often very willing to make a change from pole lines to substantial underground distribution wherever the business warrants the large initial cost. The writer will describe a system which has given very satisfactory service for the past 12 years in a residential town.

A trench 1 ft. 6 in. x 2 ft. deep will be ample for two ducts. The bottom should be graded and a fall of 3 in. to 100 ft. will give the ducts sufficient drainage. On sloping ground no grading will be necessary. Such a trench can be quickly excavated where the digging is fair. Fiber ducts with socket joints will be found most serviceable for this work. The additional cost compared with that of other duct material is compensated for by its lightness, which means reduced freight and cartage charges and practically no breakage. It can be laid very rapidly, and



FIG. 1.—WRAPPING TAR PAPER AT JOINT.

comes in sections 4 ft. 6 in. to 7 ft. 6 in. in length. The joint (Fig. 1) is made by wrapping the butted ends with a piece of tar paper 12 in. x 4 in. dipped in boiling tar or asphalt, which, when properly made, will be water and gas tight.

Some manufacturers recommend making the joint by simply dipping the ends of the duct into the tar; this has not been found advisable by the writer, as the workmen usually dipped the ends carelessly, which resulted in a quantity of undesirable tar getting inside the duct. Another advantage of fiber duct is its high insulating qualities, and it is claimed to be electrolysis proof.

In the system the writer refers to, the fiber duct has been in use for about six years; previous to this cement-lined pipe was laid and the many advantages of the fiber duct was experienced.

If a No. 10 or No. 12 galvanized-iron wire is drawn in the duct while it is being laid it will save time and expense of rodding. The wire will also answer to pull in the cables, weighing as high as 2 lb. to a foot, on sections up to 350 ft.; for larger cables a rope will have to be pulled in with the wire and the cable afterward pulled with the rope. If the wire is handled with a little care it can be used many times over.

When duct is laid on highways or other places where it is



FIG. 2.—CONNECTION TO RESIDENCE.

apt to be disturbed it is well to protect it with a covering of six-to-one concrete about 3 in. thick. By hilling the dirt on each side of the duct very little concrete will be necessary, and the covering will be strongest where most needed. Manholes should be located at all angles and wherever branches are taken off, and should not be spaced over 300 ft. or 400 ft. apart.

It is desirable to run all ducts as nearly in straight lines as possible, although wherever minor obstructions, such as water pipes, sewer manholes, etc., are encountered, a slight sweeping bend will not be objectionable. The manholes can be made of concrete, measuring 24 in. x 36 in. x 24 in. deep, having a 6 in. wall. Such a manhole is sufficient in size for two ducts, and can be covered with any suitable cover of iron or stone or cement. The writer has used cast-iron plates ½ in. in thickness.

The manhole must set deep enough so as to allow about 1 ft. of earth covering on top of the plate. They should be marked with a monument or other prominent marker. In some cases the marker may have to be set some distance from the manhole, in which case the distance should be engraved on its face. Such manholes cannot be as readily opened as those with surface covers, but considering that they do not have to be opened very often, will be found quite practical for the purpose. Indeed, on macadam roads or in lawns even surface manholes become completely covered in a short time. Such roads are continually resurfaced and in such cases manholes might just as well be of the type described.

Drainage of conduit systems is a consideration for each particular locality, but in general it may be said, where the soil is dry, no draining will be necessary, the covered holes will allow little water to get into them, save what will soak through the earth. Where the soil is wet, the manholes should be drained as often as possible, as it is not well to use conduits as waterways. It may be of interest to mention that the writer has installed ducts in very wet places where absolutely no draining was possible, without experiencing any trouble from freezing. This may be laid to the fact of the fiber duct expanding rather than pinching the cable under the pressure of the expanding ice.

Wherever ducts enter houses they should be sealed. Flexible

roofing cement will be found best suited for this purpose. It makes a tight plug, does not affect the lead, will not harden and can be easily removed when necessary without injuring the lead sheathing of the cables. Very often the question of ventilation of a conduit system presents itself, but the writer in his experience has never found any necessity of making any provision for ventilation in the systems installed.

Fig. 2 shows the work under construction where a 3-in. and a 2-in. pipe are being laid to a residence. The larger pipe is used for a 2400-volt, single-phase cable and the small one for a telephone cable, the telephone company requiring 8-in. separation between ducts and separate manholes.

Below is given the cost of such a system as averaged on a four-mile, double-duct line with concrete cover and a two-mile single-duct line with concrete covering.

COST PER 1000 FT. OF LINE.

	Double duct.	Single duct.
Labor installing conduit at $1.75 per day	$120.00	$100.00
Labor putting in cable and making joints	37.00	25.00
3-in. fiber conduit at 6½ cents per ft	130.00	65.00
No. 6 twin lead-covered cable at 12½ cents per ft	251.00	.....
No. 10 twin lead-covered cable at 11 cents per ft	.....	110.00
Gravel delivered at 70 cents per yd	14.00	14.00
3 iron manhole covers 28 in. x 40 in. x ½ in	9.00	9.00
3 marble markers 6 in. x 6 in. x 28 in	3.30	3.30
Cement at 50 cents per bag	10.00	10.00
Teaming, general expenses, etc	25.00	20.00
	$599.55	$350.30

Where street lighting is to be considered, the above costs will be approximately the same; each extra manhole may add about $18 to the costs and lamp posts can be purchased for reasonable prices. The writer has used a post which cost $18 without hood and fittings. It consists of a cast-iron base with a 3-in. steel tube reduced to 2½ in., and a crook with the necessary cast-iron trimmings.

There are also other expenditures, such as installing switches, etc., on long lines. Looping the cables into a suitable vault will be found a wise investment as it helps toward satisfactory operating conditions.

In the writer's experience the consumer bears all the expense of conduits and cables installed on his property and also for the transformer vault. Very often if he is approached properly he is also willing to pay quite a sum toward building an underground line to reach his residence rather than see overhead construction mar the natural beauty of his surroundings.

Depreciation as an Element of Rate-Making.

A decision rendered recently by the Railroad Commission of Wisconsin, in response to a petition filed by the citizens of Marinette alleging that the Wisconsin Telephone Company charged excessive and unreasonable rates, is based in part on the element of depreciation of the plant. In this case a valuation of the physical property of the company was made by the engineering staff of the commission, and an analysis made of the earnings and expenses with consideration of the question of the rate of return. Various other elements which were taken into consideration in the decision of the commission are the subjects of intangible values, going value and the existing rates. It was shown in this case that the Marinette plant, without including anything for intangible values, had been earning an average of 9.1 per cent on the estimated inventory investment, and 8.18 on the book cost. In the judgment of the commission it was better public policy to leave the present prosperous condition of the Marinette exchange undisturbed for the time being, and to watch closely future operations.

The valuation of the physical property of the Marinette exchange, under the direction of the commission, established a value as of Dec. 1, 1907, of $67,738. This was $219 less than the value placed upon the plant by the engineers of the company. The valuation included an allowance of 10 per cent for superintendence, interest during construction and contingencies upon all of the items of physical property excepting stores and supplies. In this valuation the life and scrap values used by the engineers of the commission were as follows:

	Life.	Scrap.
Cedar poles and cross-arms	12 years	0
Iron wire	10 "	0
O. H. lead covered cable	15 "	40 lb.
Switchboards	12 "	20 per cent
Copper wire	25 "	75 " "
Subscribers' sets	10 "	5 " "
P. B. X. boards	10 "	5 " "
Distributing wire	10 "	15 " "
Storage battery	15 "	15 " "
Motor generator, etc	20 "	20 " "

The foregoing data are discussed in the report, which states that the five leading authorities in this country are unanimously in favor of a 12-year allowance for wooden poles. Some difference of opinion existed regarding the life of iron wire, but 10 years represented a fair average. Originally the life adopted for aerial cable was 15 years, but this was reduced to 12 years after a consideration of the opinions of engineers connected with both Bell and independent companies. The life of power plant and storage batteries was adopted as eight years, after considering various data.

Since this valuation was completed additional data have been gathered by engineers of the commission, and the average composite life has been reduced from 12.44 years to 11.13 years As the former life was assumed in the physical valuation, there would necessarily be a revision in the value of the plant in its present condition, although the estimated cost of reproduction new would remain unchanged. The life of 11.13 years necessitated an annual depreciation reserve allowance of 8.98 per cent, assuming that the fund would earn no interest, and 7.32 per cent if it is assumed that the fund would earn 4 per cent annually.

The company charged for current repairs and reconstruction on its entire business in Wisconsin in 1907 the following percentages of the cost of plant and equipment as they stood at the close of the year: Exchange system, 4.6 per cent; toll system, 2.7 per cent; entire system, 4.1 per cent. According to the practice of the company, if the appropriation made in advance from earnings to cover present and deferred reconstruction is inadequate, the excess expenditure is charged to the reserve fund remaining from previous periods and the balance unexpended in a given period is credited to reserve. It was figured by the commission that the company was charging itself about 5 per cent annually for depreciation. If the depreciation fund is invested and a rate of return thereon from 9 to 10 per cent is assumed, the amounts charged by the company for depreciation would reach the level which the figures of the engineers of the commission show should be charged in order to meet the requirements of the law respecting depreciation While the past practice of the company and the computation of the commission suggest a rate of depreciation varying from a little over 5 per cent to about 9 per cent, dependent upon the rate of interest, if any, which the fund would earn, the president of the company and two of the chief experts who testified suggested a higher rate.

Mr. Alonzo Burt, president of the company, during the hearing of the case, defined depreciation as the allowance that must be made for replacing apparatus on account of wear and tear, unforeseen changes in the state of the art, or increase in the traffic, which outgrew the equipment and necessitated replacement with larger and more nearly adequate apparatus. Practically no piece of apparatus lived its natural life. An experience of the company in Green Bay had illustrated how a corporation may be required at any time to replace or reconstruct parts of its equipment on account of legislation. By making allowance for all of the elements that entered into the depreciation of telephone plants—obsolescence, inadequacy, public requirement and casualty—Mr. Burt fixed 10 per cent as a proper ratio for depreciation to constitute an annual reserve for maintenance and reconstruction, over and above any allowance for current repairs. The average life allotted to various portions of the equipment by the valuation staff of the com-

mission was too long. The suggestions of Mr. Burt were:

Subscribers' instruments: Ten years is too high by fully two or three years. Few subscribers would accept second-hand or shop-worn instruments.

Cedar poles: City poles are shorter lived than those in the country by at least several years.

Cables: Taking a whole plant into consideration, the quantity that would remain after 15 years of service was very small.

Switchboards: The ordinary life was from six to eight years, based upon actual experience in a large number of plants Changes in the state of the art, difficult to foresee, were usually potent factors in determining the depreciation of the equipment.

Copper wire: Twenty years of life, with a salvage of 75 per cent, was only a remote possibility and not an average. The chances were that with the growth of the business the wires would come down and cables go up before 20 years had expired.

Storage batteries and motor generators: The life of the storage batteries and motor generators was from seven to eight years; the experiences of the New York and New Jersey telephone companies indicated these figures. Motor generators and batteries may live somewhat longer than eight years, but they usually became too small to supply the current necessary for the community. The experience of New York was that under ideal conditions some machines had given service for about 10 years.

Mr. George Wilkinson, certified public acountant, defined depreciation as a loss in value of the destructible property of a telephone plant over and above what was covered by current repairs. The allowance should protect against losses from wear and tear, obsolescence and inadequacy. Land and buildings excluded, 10 per cent on the diminishing value of the destructible property used to create earnings was a proper allowance.

Mr. W. F. Burgess, an English telephone expert, defined depreciation as a loss in value. Any construction or replacement which was added to a plant without increasing its value was properly chargeable to the reconstruction fund.

The loss in value might be occasioned by various causes: 1. The wear and tear incident to a plant living its natural course of useful life. 2. The necessity of replacing a plant by a plant of larger capacity. 3. Legislation regulating construction and necessitating the removal of certain parts to make way for prescribed improvements. 4. Storms, wind, etc., the acts of God. 5. Changes in the state of the art.

Great importance was attached by this witness to the last mentioned cause, to which he ascribed the greatest loss in value. New inventions and improvements necessitated revolutionary changes in installations and methods after comparatively short periods of time. He had been employed on one improvement for which the Chicago Telephone Company expended $340,000 in experimentation at its Lake Forest exchange. Mr. Burgess reached the following conclusions:

Exchange equipment: The largest item was the switchboard, which practically had a life of only eight years. The scrap value was only about 3 per cent. The rapidity with which old batteries and generators were outgrown would lead to an average life of but seven years.

Poles and cross-arms: The average life of a city pole in Chicago was about eight years. In places of 15,000, the size of Marinette, an additional year might be allowed. More overhead equipment was carried on the poles at Marinette than in Chicago, and this made the wind resistance greater. The liability of legislative direction to remove poles must be taken into consideration.

Wire plant: Fifteen years was suggested for this portion of the equipment, with a salvage value of 60 per cent for aerial cables. Drop wires were less valuable.

Aerial cables: These were good for 11 years. Buildings and real estate were considered as practically indestructible property.

Refrigeration and Electricity Generating Stations.

By Sydney F. Walker.

COLD storage and ice making is developing very rapidly in nearly every part of the civilized world. In the United Kingdom, every town of any size has its own cold-store, and every large town has several. In addition, butchers, poulterers and fish-dealers, who have much business, now have their own cold-store. In all of these, the electric drive should be the most convenient. In the first place the electric motor is a far more satisfactory apparatus to drive a refrigeration compressor than is either a steam engine or a gas engine. In the case of the steam engine, it will be remembered that if the engine is to work economically the cut-off must be early, and the force delivered to the piston gradually decreases in value from the moment of the cut-off to the end of the stroke. On the other hand, the resistance opposed to the piston, by the compressor, increases in value up to the moment when the outlet valve opens, about the middle of the stroke, or sometimes a little later. With an electric motor the force delivered by the axle of the motor is the same at every part of the stroke of the compressor piston. Like the steam engine, the gas engine is also at a disadvantage compared with the electric motor. As is well known, the whole of the energy utilized by the piston of the gas engine is delivered to it during the very small interval covered by the time of the explosion, and a very short period after. From the end of this period to the next explosion, though the rate of delivery of energy is equalized to a certain extent by the flywheel, the force on the piston continually decreases.

Notwithstanding the above facts the electric drive has not yet made much headway in the United Kingdom. There are several reasons for this. One reason, the writer believes, is that the generating stations so far have not been able to get down to the price at which energy can be obtained from steam, or from the suction gas producer. In a great many towns, also, the cost for service by the electric motor is greater than that of a similar service delivered by the town's gas. The greater convenience of electricity would, and will lead, the writer believes, to its greater adoption for driving compressors, as time goes on, and as the publicity departments of the different towns get into operation. Up till recently, the electricity generating stations have not taken very much trouble to look out for business. The keen competition which gas introduced during recent years, especially for lighting, is now obliging electricity managers to look out more for business, and the usual results will doubtless follow.

Another reason for the use of steam instead of electricity, in the case of firms which make ice as well as run cold-chambers, is the fact that the condensed steam, when properly purified from oil, etc., is conveniently employed for making ice. It is usual in ice-making plants, where condensed steam is not employed, to distil the water that is to be converted into ice, and it is also put through a very careful process of purification, to eliminate every injurious substance. It is claimed to be one of the great advantages of manufactured over natural ice, that one cannot tell what injurious substances may be present in natural ice, unless very great care has been taken in watching the streams, etc., from which the ice has been cut.

There is still another reason for the use of steam rather than electricity, namely, the usual difficulty of overlapping. What central-station managers want most is a load that will come on when the peak is not on, and one of the greatest difficulties in providing this load is, as the writer understands it, the fact that nearly all those who require energy during times of small load, also require it during the peak times, and, therefore, the central-station engineer is really not much benefited, because he must provide more equipment to meet the addition during peak time.

In addition to the above, the writer has met with complaints from refrigeration engineers on the one hand, that electric motors rated at a certain number of horse-power would not

carry the load corresponding to this rating. On the other hand, cold-storage managers who are not makers of refrigeration plants, complain, very justly, that makers of refrigeration plants often very much understate the power that is required for driving their compressors. The understatement is unfortunately one that is somewhat common in a great many industries. Agents are too apt, when trying to secure an order, to claim all kinds of things for their apparatus. When a firm is installing a cold-storage plant, and is counting the cost, the question of service naturally comes up, both in the first cost of the apparatus that is to furnish the service, and in the cost of maintaining the service. Naturally the apparatus which is said to use the smallest amount of power is apparently the cheapest, but as a cold-storage manager recently bitterly complained to the writer, the power stated to be required by the compressor is really that required during the most favorable portion of the year. As will be explained later, the power required by the compressor depends upon the temperature of the cooling water available for the condenser. The higher the temperature of the cooling water, the greater is the power required to be delivered to the compressor. Hence, if a compressor has been tested with cooling water at, say, 50 deg., and the only cooling water available is 70 deg., the power required by the compressor is considerably increased.

In the case of either a central-station engineer, or a contractor supplying an electric motor, unless he is familiar with the requirements of a refrigeration plant, and can estimate the power required under all conditions, and can also ascertain the conditions that are likely to rule during the time that the plant will be most worked, namely, during the summer months, he is very apt to be subjected to much contention. Something of the following may easily happen: A central-station engineer, or a contractor, may be asked to supply a 20-hp motor. When the motor is arranged to drive the compressor, it is found that 20 hp is not sufficient. At any rate, the motor will not run the compressor as it ought to be run. The compression is not complete, and a part of the gas in place of being condensed passes over as gas, and considerably reduces the efficiency of the whole plant, and lessens the work done. The cold-storage manager at once turns to the man who supplies the motor, and insists that the motor is at fault. Everyone who has been through trouble of this kind knows how difficult it is to convince the buyer of the motor that the motor is not at fault. The buyer knows nothing about the measurement of power. If a transmission dynamometer is set up, he will not believe that the indications it gives, when worked out, show that the motor is developing the power that has been claimed for it, and everyone who has attempted to do so knows the difficulty in setting up any efficient testing apparatus under such conditions. The current and pressure delivered to the electric motor are, of course, a guide to a certain extent, but the buyer, or whoever might be advising him, might easily retort that the efficiency of the motor was low. The real trouble has not been with the motor, but that the cooling water being of a higher temperature than that at which the maker of the refrigeration plant tested his apparatus more power is required.

CALCULATION OF POWER FOR REFRIGERATION

There are two distinct duties performed by refrigeration firms, namely, the making of ice, and the holding of chambers at a low temperature for the storage of produce. Ice making, as will easily be understood, is confined almost entirely to the summer months. The cold storage goes on throughout the year, but it demands less power during the winter, for the reasons explained below, than during the summer. The two duties differ in their requirement of power, apart from the fact that ice making does not go on in the winter, from the fact that while it can be arranged to take power for cold storage at practically any time that is convenient to the central-station engineer, the power required for ice making must be continuous. Ice is made in various forms, in cans of a slightly pyramidal shape, giving the blocks that are seen in fish-dealers' shops; in plates, and in sheets. In all forms, the action of cooling must be continuous, or the ice would be laminated, and there would be a considerable increase of cost in making the ice. The time required for turning out the ice ranges from 20 hours upward. So that where ice is made the overlapping mentioned in a previous part of the article necessarily takes place.

With cold-stores only, it is possible either to arrange for the temperature of the store to be reduced by a few degrees below the normal working figure, before the time of peak load, or to have a store of cold brine which will be cooled during convenient times and will keep the store below a certain temperature between times of working the apparatus. This last arrangement is generally adopted by tradesmen, butchers, poulterers, etc., who have their own refrigerating plants. The cold chamber is reduced to a certain temperature on Saturday night, and in addition, a store of brine is also reduced to a certain temperature, and the whole thing is left until Monday morning.

The demand for power by cold-stores, however they may be working, is greater in summer than in winter, for another reason; the amount of power required to drive the compressor, which is by far the principal power user in a refrigeration plant, depends directly upon the difference of temperature of the gas at the suction and at the delivery valve of the compressor. The temperature at the suction valve is the temperature to which the gas is reduced in the process of cooling the chamber, and depends upon the temperature at which the air in the chamber is held, or, as explained below, upon the temperature of the brine. The temperature at the delivery valve of the compressor depends upon the pressure to which the gas has to be raised, and this again depends upon the temperature of the cooling water. The gas is condensed by two operations, compression, drawing the molecules of the gas closely together, and the deprivation of their latent heat. Obviously, the temperature at which any given cooling water can extract heat from a gas, and leave it in the liquid state, is higher than the temperature of the water itself. It is usually assumed that the temperature of the gas when liquefied, and the temperature of the liquid is about 10 deg. higher than that of the cooling water. There is a corresponding pressure for every temperature of the gas, and consequently as the temperature of the cooling water rises, so does the pressure at which the gas is liquefied, and the pressure to which the gas has to be raised. An illustration of this relation will perhaps make the matter clear. With cooling water at 55 deg. Fahr., the temperature of the gas as it is liquefied would be about 65 deg. Fahr., and the corresponding pressure for ammonia is 103 lb. per square inch. Taking again a temperature of 5 deg. Fahr. in the gas which has done its work in cooling the chamber, the temperature of the gas at the suction valve as 5 deg. Fahr., the power required to furnish a "ton of refrigeration" (per day) is about 0.66 hp. With cooling water at 90 deg. Fahr., and the temperature of the gas at the delivery valve 100 deg. Fahr., the pressure is 200 lb. per square inch, and the power required per "ton of refrigeration" is about 1.15 hp. Carrying the matter a little farther, if the temperature of the gas at the suction valve is reduced to minus 5 deg. Fahr., the power required when the cooling water has a temperature of 55 deg. Fahr. is 0.8 hp, and that required when the cooling water is 90 deg. Fahr. is 1.33 hp.

The figures taken above, 5 deg. Fahr. as the suction temperature of the gas, is about the usual temperature for holding cold chambers at a temperature of 15 deg. Fahr., which is a common figure when the chamber is cooled by what is termed "direct expansion"—that is to say, when the grid of pipes carrying the expanding gas is fixed in the chamber to be cooled.

As is well known, there are three principal substances employed in refrigeration plant—ammonia, carbonic acid, and sulphurous acid. Ether and other substances are occasionally used. Whatever the substance, it is alternately compressed, condensed to the liquid form, and allowed to re-expand to the gaseous form, again compressed and condensed, and so on. In every refrigeration plant there is a complete circuit, consisting of the compressor which is really a pump, the condenser which is similar to a steam condenser, and what is termed the evaporator, consisting of a grid of pipes, in which the liquid is allowed to assume the gaseous form. In assuming the gaseous

form, it demands the necessary latent heat from surrounding bodies, and so cools the produce, the chamber, etc.

There is another method of cooling that is very largely employed, particularly in stores, namely, by the aid of brine. In place of fixing the evaporating coils in the cold-store, they are placed in a tank through which a solution of a salt, usually calcium chloride, is kept continually circulating. There is a grid of pipes fixed in the cold chamber, or in the ice tank when it is used for making ice, and the brine is kept continually passing through the grid of pipes, through the evaporating tank in which the evaporating coils are placed, and back to the grid of pipes again. As the brine passes through the pipes in the cold-store, or the ice tank, it extracts heat from the air, or the water, and as it passes through the evaporating tank it delivers the heat to the gas in the evaporating coils, thereby causing the gas to expand, just as when in the cold-store. Brine is employed in cold-stores, in preference to direct expansion, because in the case of ammonia, at any rate, if any of the gas escaped, the produce would be tainted. It should be noted, however, that when brine cooling is employed, additional power is required. A small amount of power is absorbed by the brine pump to keep the brine in circulation, and in addition, the gas must be allowed to assume a lower temperature than when direct expansion is employed. It is usually assumed that the brine coils must be at a temperature 10 deg. Fahr. below the surrounding atmosphere, and the evaporating coils 10 deg. below the brine—hence the additional power. In the second set of cases given above, where the suction temperature of the gas was taken as minus 5 deg. Fahr., brine cooling was allowed for.

There is yet a third arrangement, which is very largely employed at the present time, namely, cooling the air which passes through the chamber by passing it over a grid of brine pipes or a grid containing expanding gas. With this arrangement there are no pipes in the cold-store, the whole of the cooling being performed by the continued passage of the cold air through the store. The air is dried at the same time as it is cooled, and this method has a great advantage in the case of some kinds of produce. With this arrangement, a still further increase of power is required. Thus, the temperature of the air must be a few degrees lower than that of the produce carried in the store. The brine must be 10 deg. below the temperature of the air, and the gas 10 deg. below the temperature of the brine. In addition, power is required for driving the fan that circulates the air.

The standard allowance made for power for a refrigerating plant is taken at from 2 hp to 2.5 hp per "ton of refrigeration." The writer would advise any electrical engineer who has to supply power for a cold-store to make a still larger allowance, more particularly if the plant is working in hot climates. Cooling water has been found to vary as much as from 45 deg. Fahr. up to 105 deg. Fahr.

It will easily be understood from what has been said above that a store of brine can be placed in a cold chamber, and its temperature reduced to any value that may be desired, so as to allow for the plant being at rest for any given number of hours, say, during the peak load, or from Saturday to Monday.

THE "TON OF REFRIGERATION."

The term "ton of refrigeration" as used above should be explained. It is the term employed by refrigeration engineers to express the amount of cooling that a given plant will supply. It is taken from the cooling effect of a ton of ice spread over 24 hours. In America a ton of ice weighs 2000 lb., and as each pound will absorb 142 heat units in melting, the total heat absorbed is 284,000 thermal units. This effect is spread over 24 hours, so that the cooling effect produced in one hour is about 11,700 thermal units, and in one minute 1950 thermal units. The "ton of refrigeration" term is apt to be a little puzzling to those who see it for the first time. It is only when the fact is realized that the total cooling effect is spread over the 24 hours that the unit is properly appreciated. It means that by the expenditure of a certain amount of power, depending upon the conditions of the cooling water, the friction of the machine, etc., a plant giving one "ton of refrigeration" (per day) will extract 1950 thermal units per minute from any substance that it cools, such as the air of a cold-store, the brine, and so on. It must be remembered that all of the successive coolings mentioned above, where brine cooling and air cooling are employed, must be allowed for in the calculation.

Another caution must be given, where the power required is for ice making, the plant which is rated as giving one "ton of refrigeration" will only produce ½ ton of ice per day. It may produce a little more than ½ ton, but this is the rule that is adopted by refrigeration engineers. The reason is as follows: The ton of refrigeration is the amount of heat that a ton of ice at exactly 32 deg. Fahr. will absorb in melting to water also at 32 deg. Fahr. When ice is made from water, it must first be cooled from its normal temperature, which may be as much as 80 deg. Fahr., or more in summer, to the freezing point 32 deg. Fahr., and after it is frozen, its temperature must be lowered, usually to the neighborhood of 15 deg. Fahr., in order to make the ice stable. Sloppy ice is of no use to anyone, and ice which is only at or just below freezing point, would be sloppy. The slightest heat, the slightest friction, would cause it to become liquid.

The amount of power employed in the United Kingdom for cold storage is not great. The seaports Liverpool and Hull take most, Liverpool in particular having several plants, up to as much as 80 hp. Hull has plants taking up to 70 kw, and Cork has a total of 185 hp. Bristol has only 30 hp. In nearly all cases there is a difference between the demand for winter and summer, ranging from 2.5 to 1, down to 1.5 to 1. At Liverpool the difference appears to be smallest, mainly because of the very large trade in frozen meat that is carried on there.

In no case does the demand by the cold-storage companies affect the load at the central station, except at Wolverhampton. In Wolverhampton, where the corporation owns the cold-store, the electric light and the tramway service, an arrangement is made by which the cold-store is shut off during time of peak load.

Methods of Drive for Alternators.

By J. E. Latta.

IN the design of steam-driven, alternating-current electric plants of small output the selection of the prime movers is a part of the problem frequently not given the consideration the matter deserves. The following discussion will be confined to 60-cycle alternators. Three different types of reciprocating steam engines will be considered, namely, engines having some form of slide-valve; the engine with Corliss valves, but without the releasing mechanism and dashpots which constitute parts of the valve gear of the standard Corliss type; and, finally, the Corliss engine. These three types will be referred to, respectively, as "the slide-valve engine," "the high-speed Corliss engine," and "the Corliss engine."

If the rating of an alternator be less than 50 kw it is always designed to be belt driven. These small generators are usually either four-pole or six-pole machines, and hence the speed is either 1800 r.p.m. or 1200 r.p.m. Now, unless an automatic belt tightener be employed, the operation of belts is almost certain to be unsatisfactory when the diameter of the larger pulley is more than six times that of the smaller. A Corliss engine for one of these alternators would run at about 100 r.p.m., and therefore the ratio of the diameter of the driving wheel to that of the dynamo pulley would have to be at least 12 to 1. High-speed Corliss engines are not built in such small units. The use of an automatic belt tightener is to be avoided whenever possible, since this piece of apparatus is unsightly, noisy and inefficient. Obviously, then, the best thing that can be done in the case in hand is to belt the alternator to a slide-valve engine.

When the rating of the alternator is 150 kw and the frequency 60 cycles those designed for belt drive generally run at 600 r.p.m., while those arranged for mounting the rotating

member directly on the engine shaft (that is, for direct drive, as this method of drive is termed) have a speed of 225 r.p.m. A 225-hp engine is needed to drive a 150-kw alternator operating at about 100 per cent power factor. Corliss engines of this output can be operated successfully at 100 r.p.m.; 225 r.p.m. is the standard speed of the 225-hp high-speed Corliss engine; and any slide-valve engine of this rating may be run, of course, at 225 r.p.m. It follows, then, that three methods of drive are to be considered here: Belt drive from a Corliss engine, direct drive with a high-speed Corliss engine, and direct drive with a slide-valve engine. Belt drive might be employed, to be sure, with either of the last two prime movers; but the only thing to suggest it is the fact that the belted alternator would be lower in first cost than the other, and the loss of power in the belt would more than offset this advantage. The first cost of the Corliss engine, belt and belted alternator, would be but little less than that of a high-speed Corliss engine and alternator arranged for direct drive. The efficiency of the latter unit would exceed that of the former by the power lost in the belt, the term efficiency here being taken to mean the ratio of the power delivered at the generator terminals to that delivered to the cylinder of the engine. In units of this output there is a difference in efficiency of about 17 per cent in favor of the high-speed Corliss engine and directly driven alternator as compared with the slide-valve engine and directly driven alternator. Hence, unless the load-factor of the plant is very poor or fuel very cheap, it would generally be best to adopt in this case the second of the three methods of drive suggested.

What has just been said concerning the 150-kw generator applies also to machines of ratings up to 300 kw. At 300 kw the field of the steam turbine is entered. The writer is aware that there is a type of steam turbine built in smaller units than this (two different types, in fact), but the use of these turbines as prime movers for alternating-current generators has not become at all general and probably never will become so.

Coming now to alternators having full-load ratings of as much as 50 kw and not as much as 150 kw, it is to be noted that present engineering practice is to employ direct drive for these. However, in more than a few cases proper considerations of economy would demand that the alternator be belted to the engine; not to a Corliss engine, for the speed of this would differ too much from that of the generator; nor to a slide-valve engine, for, if one of these is to be used, the fact that within the rating limits mentioned standard speeds of engines and of 60-cycle alternators are the same, makes direct drive, with the resultant saving over belt drive in coal and floor space, easy and convenient; but to a high-speed Corliss engine. Consider, for instance, a 75-kw alternator of the frequency mentioned. If directly driven, the speed of this machine would be 277 r.p.m., which is altogether too high for a high-speed Corliss engine. Hence, if this latter machine is to be adopted as the prime mover, belt connection must be resorted to. With this belt drive either a six-pole or an eight-pole alternator would be used. The most satisfactory service would probably be obtained with the eight-pole machine, the speed of which would be 900 r.p.m. The best speed for the engine would be about 225 r.p.m.

Let it be assumed that the engine is to be of simple type and is to run non-condensing. Assume further that the boiler pressure is 90 lb., and that the alternator can be operated 10 hours a day on an average load of 50 kw. The engine rating needed for this alternator would be 115 hp, unless the power factor differed considerably from 100 per cent. A high-class slide-valve engine driving the generator in question under the conditions assumed would consume about 47 lb. of dry steam per kw-hour delivered to the switchboard; and any high-speed Corliss engine operated under the same conditions of load, boiler pressure and so on, would develop a kw-hour of energy, measured at the flywheel, on 38 lb. of dry steam. The alternator itself would have an efficiency at 50 kw output of about 90 per cent; and, therefore, the power required to run it would be 55.5 kw. If properly installed and not run unnecessarily tight, the belt for driving the alternator with a high-speed Corliss engine should have an efficiency of 95 per cent. This being true, the engine would be called upon to deliver to the belt an average output of 58.4 kw.

It appears, then, that in the case of the slide-valve engine the average steam consumption per hour would be 50 × 47, or 2350 lb., while with belt drive from the high-speed Corliss it would be 38 × 58.4, or 2220 lb. Thus the saving in steam would be 1300 lb. a day. Assuming that the engine gets 7 lb. of dry steam per pound of coal burned in the boiler, the daily saving in coal would be about 186 lb. If the plant be operated 365 days in the year, the annual saving in coal is thus seen to be approximately 34 tons. Under the conditions relative to water supply usually existing in the average plant, the saving in water would more than cover first cost and maintenance of belts. With coal at $4 a ton (the writer knows of plants that have to pay more than this for good coal), $136 per year would be saved in fuel. The belted unit would cost not over $400 more than the directly connected unit, and the maintenance cost of the two would not differ materially. In a little over three and one-half years, then, the decrease in fuel consumption resulting from the use of the high-speed Corliss engine with the belt drive thus made necessary would repay the $400 and the interest thereon at 6 per cent per annum. During the rest of the life of the engine, which life would be as long as that of a slide-valve engine, there would be a net saving of $136 a year.

It is to be noted, too, that the necessity of securing and maintaining exact alignment of all the bearings in a directly connected unit makes the erection of this unit a rather difficult job and causes the machine to require careful attention while in operation. It is decidedly easier to set up and operate a belted engine. The difficulty of getting three bearings into proper alignment and keeping them there is causing the side-crank engine to make very rapid gains in popularity over the center-crank types. All of the high-speed Corliss machines are built with side cranks, and very many of the steam-engine manufacturers are adopting the side-crank arrangement on slide-valve engines formerly built with center cranks.

The assumptions of the foregoing comparison of the two methods of drive are not foreign to practice. The data as to steam consumption come from trustworthy tests on three different types of high-speed Corliss engines and twice that number of well-known slide-valve engines. The figures concerning the cost of apparatus are made up from actual experience in buying machinery of the kind considered. Where there was any doubt in the writer's mind as to the justness of an assumption, the slide-valve engine and direct drive were given the benefit of it. There are numerous plants in the country where the sort of belt drive just spoken of would result in a greater saving than that figured out here. Where floor space is expensive, however, belt drive for generators may be impracticable. Moreover, this kind of drive should not be adopted if small rotary converters are to be run by the alternator, for the slightest unsteadiness in the belt is almost sure to cause troublesome hunting in the converters. However, belt drive is no obstacle in the way of the parallel operation of alternators; in fact, the belts frequently act as a sort of relief valve to take care of the idiosyncrasies of bad governors or poorly balanced engines.

Protection to Station Apparatus.

By Max H. Collbohm.

THE protection of the station apparatus against high-frequency surges produced by lightning entering over the transmission wires is invariably effected by the use of lightning arresters and choke coils. The latter are placed close to and between the point where the lightning arresters tap off and the station apparatus. The station wiring consists in all cases of copper, with a tendency to employ copper tubing instead of solid wires or cables, as exemplified by prominent stations recently completed, or under construction.

The choke coils commonly used on high potential circuits

consist of about 20 turns of a solid copper wire supported upon proper insulators and having a coefficient of self-induction of about 1 × 10⁻⁴ henry. On transmission voltages above 60,000 volts usually two such coils are used in series. The counter e.m.f. of such a coil in case of a lightning stroke with a frequency of from 500,000 to 1,000,000 cycles is from about 30 to 60 volts per ampere of current passing through the coil, which, being in quadrature with the exciting current, reduces the transient voltage only by a very moderate amount with a corresponding low degree of protection to the station. An increase of self-induction by using a greater number of turns does not appear advisable on account of the difficulty to build such a coil with sufficient stiffness; it would, furthermore, require quite some additional valuable space in the power house and in the form generally built may become subject to flashing over on heavy surges of very high frequency. This phenomenon is very likely on an apparatus of such kind, as it is constantly under a high potential strain and the comparatively still air between the windings may therefore become highly ironized and break down on account of its decreased disruptive strength.

The writer desires to propose a method for station wiring which is free from the before-mentioned disadvantages and which is believed to serve well in such cases where protection is sought by adding inductance to the circuit. This method consists in the use of solid iron wires of high permeability which must not be galvanized or in any way coated with a conducting non-magnetic film. The protection offered by such an iron wire is due to the skin effect which under high-frequency currents will decrease the conductance enormously without offering the least chance for any flash-over. The feature which is particularly valuable in this system is the fact that the ohmic voltage drop in the iron wire, which on account of the skin effect is very great, is practically in time phase with the transient voltage and tends to reduce the latter in a larger measure than a copper choke coil would do with its negligible ohmic voltage drop, although the coil may eventually produce an impedance voltage considerably greater than the iron wire.

The iron wire installation must comprise the whole high-tension wiring; that is, it must extend from the transformer high-tension terminals to the place where the leads to the lightning arrester tap off from the line. In cases where the connection from the outgoing line to the transformer is very short, the choke coils of usual design, but preferably with coils of iron wire, must be used and the iron wire connections may be taken as an additional protection. In cases where electrolytic arresters are used in series with spark gaps outside the iron wires may be extended quite a distance outside the power house by connecting the leads from the arrester spark gaps to a point on the line as far away from the station as practicable (to the next tower, if possible). The leads to the spark gaps and arresters and from the latter to ground must, of course, be of high conductivity and contain a minimum of inductance; that is, they must be of copper, preferably in form of tubing or flat ribbon, and arranged so that the discharge path to ground is as short as possible and in as nearly a straight line as the conditions will allow.

When wiring up an intermediate (second) generating station through which runs the transmission line from another (first) generating station, care must be taken to install the iron wire and choke coils only in the branches connecting to the main line, but not in the main line itself. The reason for this is to allow a lightning stroke entering from the side of the first station to pass through the second station and discharge over the arrester on the line to the substation. This precaution is necessary in cases where on account of the short distance between the two generating stations the second station is not equipped with lightning arresters for the incoming line, but only for the outgoing line. It is, furthermore, of great importance to place all apparatus especially liable to damage under high-frequency surges, such as series transformers and series ammeters, as far back from the line as possible. All apparatus in the main line having series coils (series relays, series transformers, etc.) must be equipped with sensitive spark gaps or much better by a single small electrolytic cell, preferably placed directly in the high-tension bus compartments across the terminals of the apparatus to be protected, to allow the passage of lightning without puncturing the apparatus.

The method before described besides offering superior protection may prove quite economical on account of the saving in copper, and particularly when choke coils may be omitted, by saving in building space, which under circumstances may amount to several thousand dollars. The inductive effect on normal frequencies and the ohmic losses in the iron wires as against non-magnetic conductors can be considered negligible The corrosion of the iron wires may be avoided by coating them with shellac or some rustproof paint.

It appears that the protection given to a transmission system can be considerably augmented by reversing the present methods—i. e., change the iron guard wires over the transmission line to copper or copper-clad steel, as recently discussed by the writer in these columns (*Electrical World*, May 20, 1909) and change the copper wires in the power house to solid iron wires of high magnetic quality.

Alcohol for Internal-Combustion Engines.

The United States Geological Survey has issued a bulletin entitled "Commercial Deductions from Comparisons of Gasoline and Alcohol Tests on Internal-Combustion Engines," by Mr. Robert M. Strong, giving the results of tests made under the direction of Mr. R. H. Fernald at the fuel-testing plants in St. Louis, Mo., and Norfolk, Va.

To determine the relative economy and efficiency of gasoline it was compared with denatured alcohol. When the series of tests was started, it was found that it took from one and one-half to two times as much alcohol as gasoline to produce a given power. With special alcohol engines, entirely suited to the use of alcohol, the latter fuel has been made to do as much work, gallon for gallon, as the gasoline. The bulletin states that by using alcohol in an alcohol engine with a high degree of compression (about 180 lb. per square inch above atmospheric pressure—much higher than can be used for gasoline on account of pre-ignition from the high temperatures produced by compression) the fuel consumption rate in gallons per horsepower per hour can be reduced to practically the same as the rate of consumption of gasoline for a gasoline engine of the same size and speed. The indications are that this possible 1-to-1 fuel consumption, ratio by volume, for gasoline and alcohol engines, will hold true for any size or speed if the cylinder dimensions and r.p.m. of the two engines are the same.

The tests showed that the low heating value of completely denatured alcohol will average 10,500 Fahr. thermal units per pound, or 71,900 pound-Fahr. units per gallon. The low heating value of 0.71 to 0.73 specific gravity gasoline will average 19,200 thermal units per pound, or 115,800 units per gallon. The low heating value of a pound of alcohol is thus approximately six-tenths of low-heating value of a pound of gasoline. It was found that a pound of gasoline requires approximately twice the weight of air for complete combustion as a pound of alcohol.

A gasoline engine having a compression pressure of 70 lb., but otherwise as well suited to the economical use of denatured alcohol as gasoline, will, when using alcohol, have an available horse-power about 10 per cent greater than when using gasoline. When the fuels for which they are designed are used to an equal advantage, the maximum available horsepower of an alcohol engine having a compression pressure of 180 lb. is about 30 per cent greater than that of a gasoline engine having a compression pressure of 70 lb., but of the same size in respect to cylinder diameter, stroke and speed.

Alcohol diluted with water in any proportion, from denatured alcohol, which contains about 10 per cent of water, to mixtures containing about as much water as denatured alcohol can be used in gasoline and alcohol engines if they are properly equipped and adjusted. When used in an engine having a con-

stant degree of compression, the amount of pure alcohol required for any given load increases, and the maximum available horse-power of the engine decreases, with a diminution in the percentage of pure alcohol in the diluted alcohol supplied. The rate of increase and decrease, respectively, is such, however, that the use of 80 per cent alcohol instead of 90 per cent, or denatured alcohol, has but little effect upon the performance of the engine; so that if 80 per cent alcohol can be had for 15 per cent less cost than 90 per cent alcohol and could be sold without tax when denatured, it would be more economical to use the 80 per cent alcohol.

The relative hazard involved in the storage and handling of gasoline and denatured alcohol is of particular importance in considering their use as fuels for marine and factory engines and engines to be placed in the basements of office buildings or in similar places where a general fire would be likely to result from the accidental burning of the fuel stored or carried for immediate supply, or where the forming of explosive or inflammable mixtures of the fuel vapors and air in the immediate vicinity would be hazardous.

In regard to general cleanliness, such as absence of smoke and disagreeable odors, alcohol has many advantages over gasoline or kerosene as a fuel. The exhaust from an alcohol engine is never clouded with a black or grayish smoke, as is the exhaust of a gasoline or kerosene engine, when the combustion of the fuel is incomplete, and it is seldom, if ever, clouded with a bluish smoke when a cylinder oil of too low a fire test is used or an excessive amount supplied, as is so often the case with a gasoline engine. The odors of denatured alcohol and the exhaust gases from an alcohol engine are also not likely to be as obnoxious as the odor of gasoline and its products of combustion.

Very few alcohol engines are being used in the United States at the present time, and but little has been done toward making them as adaptable as gasoline engines to the requirements of the various classes of service. Engines for stationary, marine and traction service, automobiles, motor trucks and motor railway cars designed especially to use denatured alcohol have, however, been tried with considerable success.

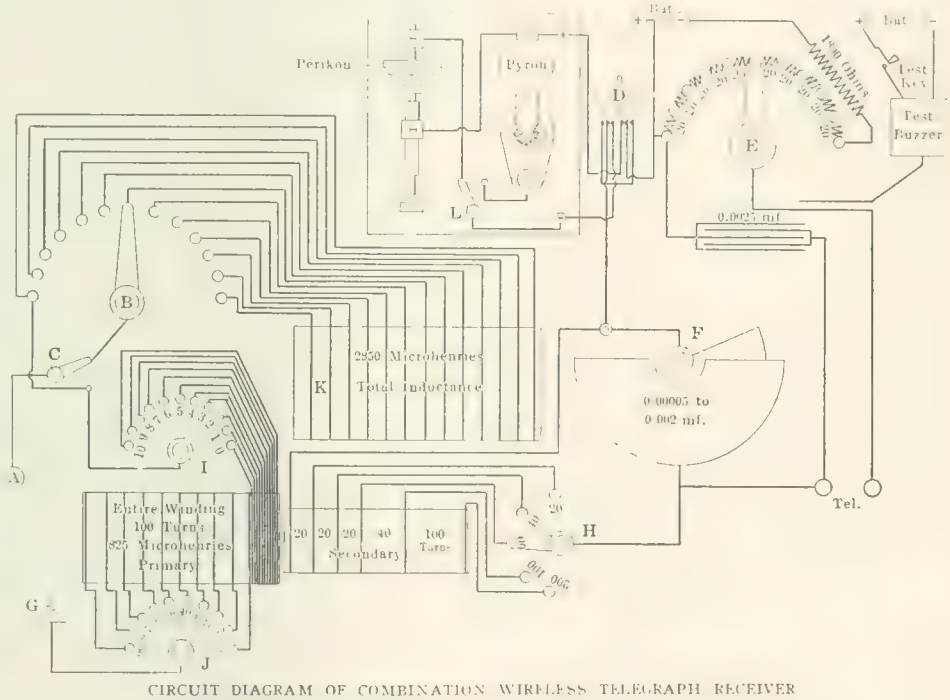
The price of denatured alcohol is greater than the price of gasoline, and the quantity of denatured alcohol consumed by an alcohol engine as ordinarily constructed and operated is in general relatively greater than the quantity of gasoline consumed by a gasoline engine of the same type. Considerable attention is being given to the development of processes for the manufacture of alcohol from cheap raw materials which are generally available, and it seems reasonable to expect that the price of denatured alcohol will eventually become as low or lower than the price of gasoline, especially if the price of gasoline advances. It also seems reasonable to expect a greater general improvement in alcohol engines than in gasoline engines.

When the restrictions placed upon the use of denatured alcohol are less than those placed on the use of gasoline or where safety and cleanliness are important requisites, the advantages to be gained by the use of alcohol engines in place of gasoline engines may be such as to overbalance a considerable increase in fuel expense, especially if the cost of a fuel is but a small portion of the total expense involved, as is often the case. Denatured alcohol will, however, probably not be used for power purposes to any great extent until its price and the price of gasoline become equal and the equality of gasoline and alcohol engines in respect to ability to service required and quantity of fuel consumed per brake horse-power, which has been demonstrated to be possible, becomes more generally realized.

A further general development in the design and construction of engines that use kerosene, or cheaper distillates, and the crude petroleums may be reasonably expected and may delay the extensive use of denatured alcohol for some time to come, but as yet comparatively few data pertaining to this phase of the general investigation are available.

Combination Wireless Telegraph Receiver.

A type of combination wireless telegraph receiver, which is very compact and efficient, is being installed on all the newer ships in the United States Navy and at a good many of the shore stations. Its compactness and absence of numerous connections spread over and under the operating table make it very desirable for use aboard ship. Stations and ships where this new receiver has been installed are receiving signals from a greater distance than previously, and some new records will no doubt soon be established. The U. S. S. *North Carolina*, while returning from the recent Taft celebration at New Orleans, and having on board this new type of receiver, was in communication with Chicago, Ill., while off Charleston, S. C., and it was also in communication with the Norfolk Navy Yard while at the mouth of the Mississippi River, the Navy Yard station also being equipped with this new type.



CIRCUIT DIAGRAM OF COMBINATION WIRELESS TELEGRAPH RECEIVER

A diagram of the connections of the receiver is shown herewith. The receiver proper comprises a telescopic transformer tuner, extra variable inductance for receiving long wave-lengths, a variable-capacity air-condenser for tuning the secondary circuit and the detectors; two detectors are used, namely, a perikon and a pyron or perikon and silicon and associated with them is a potentiometer, a testing buzzer, a condenser of fixed capacity, a battery and telephones.

There are two main circuits, the primary or antenna circuit, and the secondary or detector circuit. The primary coil of the transformer is wound on a hard-rubber hollow tube and is stationary. The secondary coil is also wound on a hard-rubber tube, but is movable in respect to the primary; the coupling between the primary and secondary in this manner can be varied and the tuning thereby made sharp or broad, depending upon the mutual induction between the two circuits.

The primary winding has 100 turns of No. 22 B. & S. wire, controlled by the two dial switches *I* and *J*, these switches adjusting the number of turns in circuit by single turns, and by tens of turns, respectively. Thus, to insert a primary winding of 42 turns, *J* would be set on contact stud No. 40 and *I* on contact stud No. 2. With an antenna of average capacity the primary turns alone will be sufficient for any wave-length up to 1500 m, but in case a longer wave is being sought for, an extra inductance is inserted by means of the key switch *C*, and wave-lengths up to 4000 m can then be received. This inductance, which has the action of a loading coil, is shown at *K*, there being a total inductance of 2850 microhenrys divided into 12 sections and controlled by the switch *B*.

The secondary of the transformer tuner is subdivided into four sections controlled by the dial switch *H*. The studs are marked 20, 40, 60, 100 and 200 and read directly in number of secondary turns. For wave-lengths in the neighborhood of 330 m, 20 turns are sufficient to give the maximum strength of signal; the number of turns increases in direct proportion as the wave-length increases. The secondary is shunted by a variable-capacity air-condenser *F*, with which the greater part of the secondary tuning is done. When tuning, the secondary circuit is first made fairly closely coupled as when the secondary winding is partly inside the primary, and then slowly drawn out, the condenser being readjusted from time to time until the sharpest tuning is obtained. All interference will then be cut out except that from a strong forced wave or waves identical in length with the one being received.

For long-distance work on signals of weak intensity the perikon detector is used, while for short-distance work or signals of strong intensity the pyron or silicon is used, on account of the sensitiveness of the perikon being destroyed by strong signals. The switch *L* is used to throw either one in or out. While transmitting, the detector is put on open-circuit by means of the key-switch *D*. Use is made of one dry cell around the potentiometer so connected that the single or chalcopyrites crystal of the perikon and the steel point of the pyron are positive. The telephones used with this receiver are of a late type in which the electromagnets are adjustable from the back of each receiver, and the distance between magnets and diaphragm may thus be varied. The antenna is connected to the primary winding at *A* and the ground lead is taken off at *G*.

Electric Signaling in Automatic Fire-Alarm Systems.

The sixth and last of the series of lectures based on the National Electrical Code, by Mr. B. E. Blanchard, chief electrical inspector of the Chicago Board of Underwriters, before the Fire Insurance Club, of Chicago, was delivered on Nov. 23. The subject, as announced, was "High-Potential Systems," but more attention was devoted to moving-picture machines, thermostats, inspectors' supervision of automatic sprinklers, valve alarms and journal alarms. There was a good attendance, and, following the pleasant practice of the club, the main features of the evening were interspersed by entertainment—in this case the singing of the Schubert Quartet.

In insurance parlance, high-potential systems mean wires carrying between 550 volts and 3000 volts. Electrical circuits carrying higher voltages are styled extra high-potential systems by the underwriters and their inspectors. Inside buildings the maximum potential permitted by the Code is 3500 volts, and special regulations apply to pressures as high as this. One stipulation is that the covering on the wires must not be relied upon for insulation, which must be provided by approved insulators. The covering on the wires is intended to prevent danger from accidental contacts. Transformers must be placed in a separate fireproof room. In the case of extra high-potential wires, as defined by the underwriters, they must not be brought into buildings at all, except in the case of power stations and substations.

The speaker devoted some attention to the hazards of moving-picture machines and described the construction of the fireproof booth required for the machine. The lamp and rheostat must be installed under the same rules as apply in theaters. During five years Mr. Blanchard has only known of two fires in moving-picture theaters which extended beyond the booth in which the machine was operated. This shows the wisdom of making the booth of fireproof construction. It is essential that the lamp rheostat should be of ample size, and it also must be placed in the fireproof booth. It seems that in some cases these rheostats have been placed in ticket offices of moving-picture shows in order to utilize the waste heat to keep the ticket office warm; but this practice is condemned by the underwriters.

Taking up the thermostat as used in automatic fire alarms and in journal alarms, the speaker described the construction of the device and its method of operation. The essential feature is enclosing a compressed spring in solder, which melts at a predetermined temperature and releases the spring, which closes an electrical circuit and so gives an alarm. Thermostats, when used as fire alarms, are often installed on ceilings, and each one can protect in this way a ceiling area of from 100 sq. ft. to 144 sq. ft. Mr. Blanchard described how the thermostat used in an automatic fire-alarm system may be tested, and he gave a number of diagrams illustrating the parts of the apparatus. Thermostats are useful because they are automatic in operation and give an alarm of fire in its earliest stages, when the alarm should be particularly valuable.

Automatic journal alarms are installed in 17 grain elevators in Chicago. These signaling devices give warning of when bearings are running hot and also indicate the location of the machine with a hot bearing. One electrical circuit may protect 24 journal bearings by means of thermostats adapted for the purpose. If the bearing reaches a heat of 165 deg. Fahr. the solder is melted and a spring released closing the circuit and ringing a bell in the superintendent's office, at the same time dropping an annunciator shutter. It is necessary, of course, to keep the thermostats in the bearings, and the inspector should see that this is always done. The method of testing the system was described in some detail. The thermostats themselves can be tested by placing a piece of jumper wire between the contact points, when, of course, the device should operate in the manner intended. The journal alarm systems in Chicago grain elevators are tested twice a month.

Some attention was devoted to gate-valve signals, tank-level alarms and the electrical inspectors' supervision of automatic sprinkler systems. The methods of testing these appliances were briefly explained. In closing, Mr. Blanchard called his hearers' attention to the fact that while electricity has been accused of causing some fires, it must not be forgotten that it furnishes a valuable defense against fire. When one thinks of the alarms of fire transmitted by the telephone alone, the immense importance of electrical signaling as a protective measure is realized. In many towns the telephone furnishes the only fire alarm. Incidentally, it was mentioned that in six colleges—Armour Institute, University of Pennsylvania, University of Michigan, Case School of Applied Sciences, University of Wisconsin and Leland Stanford, Jr., University—there are 1107 students in the electrical engineering courses. Of these, 178 will graduate next year. These young men, and others taking corresponding courses in other colleges, by their work in the coming years will have a great influence on future electrical development and with their scientific education they may be relied upon to advance the standard of electrical construction.

After the lecture a number of pictures were thrown on a screen illustrating famous conflagrations. After that the reflectoscope was brought into use. This is a stereoscope with the lens in front of a powerful arc lamp, so arranged that the picture itself becomes the reflector and is thrown upon the screen. By means of this instrument any photograph, drawing or half-tone illustration in a periodical can be projected upon a screen before an audience. In this way pictures of wiring conditions in various cities were shown, and also portraits of many electrical celebrities. Mr. Blanchard wound up by dis-

playing a picture of Mr. Thomas Cooper, the president of the club, which was received with great applause. He then retired and Mr. Cooper took his place at the instrument and displayed the pictures of a number of popular members of the club, including that of Mr. Blanchard, whom he styled "the electrical wizard of LaSalle Street."

A Year's Performance of a Double-Zone Gas Producer.

In October, 1908, the Western Chemical Manufacturing Company, at Denver, Col., installed two 175-hp Westinghouse double-zone gas producers for the supply of gas to gas engines in its electric generating plant and for other purposes in connection with its furnaces. Later a third similar producer was added. These producers have been operating on Colorado lignite coal. As they were the first of the new Westinghouse double-zone, or double-flow, producers suited for the use of soft coal to be placed in commercial use outside of the Westinghouse factory, considerable interest attaches to their performance in the Denver plant mentioned.

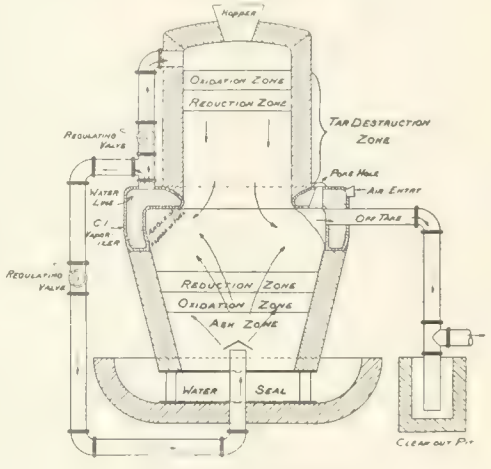
Mr. L. B. Skinner, chemist and metallurgist for the Western Chemical Company, gave a rather complete account of the experience of the company with gas producers for gas-engine purposes in a recent paper read before the Colorado Section of the Western Association of Technical Chemists and Metallurgists. The illustration accompanying this article and some of the facts are taken from that paper, other facts having been obtained by a visit to the plant. The company previously to installing these producers had tried another type of soft-coal producer for some time, and had found it unsatisfactory with Colorado lignite coal. After a trial with Colorado lignite in the double-zone producers at the maker's factory, the results were so satisfactory that two of these producers were ordered.

The accompanying engraving shows diagrammatically principles of construction and operation of the total zone producer. It is like an up-draft producer placed above a down-draft producer. The principal difficulty with bituminous and lignite coal as used in producers has always been the presence of tar in the producer gas. This tar coats up the engine valves, igniters and pistons so as to make continuous operation impossible. If, however, the volatile gases which contain this tar are heated to a sufficiently high temperature when they are in the producer, the tar becomes fixed and will not condense out of the gas after it leaves the producer. The object of the double-zone producer is so to heat the volatile gases given off from the green coal that they become fixed and no tar can be obtained from them. In the illustration it is seen that air is admitted both at the top of the producer above the coal bed and at the bottom of the producer under a cone in the ash bed. Coal is charged through the hopper at the top, as in any other producer, this hopper being provided with an air lock, so that air cannot rush in at the time of stoking.

The producer is of the suction type, and an exhauster is used to maintain suction on the producer continuously. The course of the air and gas through the producer is shown by the arrows. The air is taken from over the surface of the water in the cast-iron vaporizer which surrounds the middle of the producer. The upper part of the producer magazine is smaller than the lower part. The natural angle of repose of the coal is such that there is an open space under the cast-iron vaporizer from which the gas is drawn off. In this way there is no restriction to the passage of the gas except the fuel itself, and the offtake cannot be clogged. The heat of the offtake is reduced by the vapor pan. There is no trouble with the burning out of grates as in some down-draft producers, because the hot gases do not pass through any grate. The steam given off from the water in the vaporizer moistens the air going into the producer in proportion to the rate at which gas is being drawn off, because the more gas being used, the more heat is given to the water in the vaporizer. The outgoing gas is pulled through the usual cooling scrubbers, in which water is kept running over rocks. Suction is produced by a Connersville blower operated by a 15-hp motor. This furnishes suction for the three 175-hp producers. Mr. Skinner states, however, that 5 hp would be sufficient for producing this suction with a suitable type of exhausting apparatus. The amount of gas passing through the producers is regulated by the demand of the engines, as the exhauster is not of the positive type.

The engines are in continuous service 24 hours per day. Ashes are removed and fires worked during running. One man per shift takes care of the three producers. Test runs show a consumption of 1.6 lb. per brake hp-hour of Colorado lignite of 9250 pound-Fahr. units. The gas produced runs about 120 units per cubic foot. Under ordinary running conditions the gas is practically tarless, as is shown by the condition of the engine valves. Chemical tests show that the gas contains only from 0.01 gr. to 0.02 gr. per cubic foot of lampblack and tar. The best evidence of the freedom from tar is the fact that the engines are able to operate continuously without trouble. However, when the producers are run very lightly loaded, as when three producers are used to supply one engine, on a very light load, it is found that the exhauster extracts some tar from the gas. This, of course, is due to the low temperature at which the producers must operate under such conditions, and is obviated by cutting out one or more producers. The temperature of the producer must be sufficient to fix the volatile hydro-carbon gas and prevent the condensation of tar.

When the producers were first started no steam was introduced into the upper fire, as it was thought that the lignite itself attained sufficient moisture. This style of working gave gas



DOUBLE-ZONE PRODUCER.

free from tar in the preliminary test runs at Pittsburgh, but in the rarefied dry air of Denver an oily substance in the gas was obtained. Mr. Skinner found that upon throwing fresh coal on the fire it ignited almost immediately from the volatile products given off, and that the fire left the burning layer below and came up to this fresh material. This produced so much volatile matter that some passed through the hot zone without becoming a fixed gas.

The electric generating plant supplied by these producers consists of one 120-kw, 60-cycle, 220-volt alternator direct-connected to a 16-in. x 18-in. three-cylinder vertical Westinghouse single-acting gas engine, and one 80-kw alternator direct-connected to a 15-in. x 14-in. engine of the same type. These engines are 140 hp and 190 hp, respectively, at sea level, and 120 hp and 160 hp at the altitude of Denver, there being, it is stated, a loss of from 16 per cent to 20 per cent in capacity due to the rarefication of the air at this altitude. The cost of the plant was about $200 per kw, and it is operated on a load factor of about 37 per cent. The engine load factor (that is, the ratio of the capacity of the engines actually in service to the load) is 70 per cent.

After a year of operation, the experience in this plant seems to demonstrate that the double-zone producer worked at the proper load offers a satisfactory solution of the difficulties of

using soft coal for making producer gas for engines. Some mechanical defects have developed in the producers as first installed, which will necessitate some changes, but these are apparently not due to any fundamental difficulties with the apparatus and its principles, but rather with the details of design. The principal defect has been the cracking of the cast-iron vapor pans due to unequal strains. A successful soft-coal gas producer means much to small central stations, and the success obtained so far with this plant is very gratifying.

Central-Station Electrical Motor Service.

By Walter Stuart Kelley.

THE chief advantage possessed by electrical means over others for the efficient distribution of energy is that it allows of any degree of subdivision to eliminate friction and in subdivision can be so advantageously applied as to bring the all-day efficiency very nearly up to full-load efficiency—that is, obtain a high running load factor continuously.

The term "load factor" applies to the average condition for a definite length of time, while "running load factor" applies to a momentary condition and is used more generally for subdivisions of load than for a single prime mover. A plant may have a low load factor, while at the same time, by means of good engineering, maintain a high running load factor; in other words, while the average load is but a small proportion of the maximum load, each motor when running may operate at nearly full-load.

There are two other much used, but much abused, terms that require some consideration; these are "horse-power" and "efficiency." Referred to a steam engine, horse-power, unless otherwise defined, is understood to mean "indicated horse-power"—that is, the horse-power value of the steam as expended in the cylinder. Referred to a motor, horse-power, unless otherwise defined, is understood to mean "brake horse-power"—that is, the mechanical power delivered at the rim of the pulley. The "electrical horse-power" is the input in electrical units at the brushes, of which the brake horse-power may be anywhere from 50 per cent to 90 per cent.

Efficiency is one of the most common technical terms, but is often used without proper discrimination. In the case of a single prime mover, efficiency cannot remain uniform with greatly varying loads, but the term is ordinarily applied in such a manner as to ignore this fact, as will be apparent in what follows.

A given mechanical distribution of energy has, it may be assumed, a full-load efficiency of 60 per cent; in other words, with all the connected machinery in operation 60 per cent of the indicated horse-power is actually applied to the product and 40 per cent is used in getting the 60 per cent to the point where it is turned into the product-goods. It is commonly asserted in such a situation that the plant has a mechanical efficiency of 60 per cent; this statement can be correct, however, only when all of the machinery is being operated. As a matter of fact, scarcely any manufacturing plant operates continuously at full-load—that is, at 100 per cent load factor; indeed, full-load is the exception rather than the rule.

In any machine shop or wood-working shop there will be a number of machines that only require to be operated occasionally, even when the shop is turning out full product; when turning out half its normal output, only from 25 per cent to 35 per cent of the machines will be continuously in operation, but in the case of a single prime mover the friction load is usually constant regardless of the output.

As an illustration assume, to be liberal, that with one-half normal output one-third of the net or effective power is being applied to the machines that are in operation and continuously productive; therefore, one-third of 60—that is, 20 hp, or 20 per cent of the indicated horse-power or full-load power—is now used productively, but 40 per cent of the full-load power is still absorbed in friction.

The mechanical efficiency will now be $20 \div (40 + 20) = 33.3$ per cent. At one-fourth of full-load output we would have $10 \div (40 + 10) = 20$ per cent efficiency.

In any reference to this plant the efficiency would be stated off hand as 60 per cent, whereas it may actually be anything from that value down.

With electric motors for distributing power the rapid loss of efficiency with reduction of output, incidental to plants having a single prime mover, steam engine, gasoline engine or single large motor of any character, may be avoided; with a proper subdivision of the load, the partial-load efficiency can be maintained well up toward the full-load value.

The most accurate method of determining the actual efficiency of any given plant is to evaluate the friction in hp-hours along the lines worked out in the following tables. The first is for a mechanical transmission with a single prime mover, the second shows results with the same plant of machinery equipped with electric motors.

The assumptions upon which results are developed are as follows: Mechanical efficiency at full-load in each case, 50 per cent; number of sections, 10—a section may represent a single machine or several; full load, 100 brake horse-power; all transmission machinery to run 10 hours.

In the tables the column headed "excess" represents the added energy that might have been used productively with no increase in the friction load; the column headed "net" represents the energy used productively.

TABLE I.—ACTUAL EFFICIENCY WITH MECHANICAL TRANSMISSION

Section.	Full-load power.	Hours of work.	Average power used.	Horse-power hours. Friction.	Excess.	Net.
A.....	5	2	4 hp	25	20	5
B.....	5	4	5 "	25	15	10
C.....	5	10	3 "	25	..	5
D.....	5	6	4 "	25	10	9
E.....	10	3	6 "	50	35	3
F.....	10	10	10 "	50	..	50
G.....	10	7	7 "	50	15	14
H.....	15	4	9 "	75	45	6
I.....	15	6	10 "	75	30	15
J.....	20	10	15 "	100	..	50
	100			500	170	165

Table I shows that the actual or running efficiency is less than one-half the full-load efficiency.

A point to be carefully noted in this connection is that the mechanical friction of a plant is almost invariably observed at no-load; in other words, the friction load is taken with nothing but the transmission system running, all belts being on loose pulleys. With all machinery running, the bearings subjected to the heavy strains of belt pull, and, in many cases, the shafts sprung out of line from this cause, the friction is sure to be more than that indicated by the no-load reading. Table I is, therefore, relatively favorable to the mechanical transmission.

TABLE II.—ACTUAL EFFICIENCY WITH ELECTRICAL DISTRIBUTION.

Section.	Hp of motor.	Hours of work.	Average power used.	Horse-power hours. Friction.	Excess.	Net.
A.....	5	2	4 hp	5	..	3
B.....	5	4	5 "	10	..	10
C.....	5	10	3 "	25	..	5
D.....	5	6	4 "	9	..	9
E.....	10	3	6 "	15	..	3
F.....	10	10	10 "	50	..	50
G.....	10	7	7 "	35	..	14
H.....	15	4	9 "	30	..	6
I.....	15	6	10 "	45	..	15
J.....	20	10	15 "	100	..	50
	100			324		165

By comparing Tables I and II it will be seen that for each 10 hours with mechanical drive the friction load totaled 500 hp-hours, while for each 10 hours with electric drive the friction load totaled 324 hp-hours. Hence the saving in friction load with electric drive was 176 hp-hours, or a saving of 35.2 per cent.

An inspection of the "average power" column shows that the running load factor is 75.1 per cent, whereas in a carefully designed plant the running load factor should be 80 per cent or better, barring exceptional conditions, or where practically uniform load conditions prevail. Even intermittent loads may be included with this statement, if the variation is between reasonably fixed limits, as in the case of a pump automatically feeding into a pressure tank, a deep-well pump or even a

planer (metal) by assuming normal full-load of the motor to represent 1700 per cent load factor, the variations extending both above and below.

In the case of the pump, suppose the pressure to vary between 100 lb. and 130 lb.; a motor could be selected of such power and characteristics that a considerable part of the load above 100 lb. pressure would be overload.

In the case of a planer, assuming that the installation is made so that the current rush on reversal is reduced to the lowest limits, the power for the high-speed return can be assumed as the full-load of the motor, then the over-load at moments of reversal will measurably balance the under-load when making a cut. In both these cases, therefore, practically full-load conditions—100 per cent load factor—can be maintained.

In any locality covered by central-station service little effort is needed to connect almost any small manufacturing business just starting.

This situation presents two classes of customers, the small motor user and the industrial building; the central-station argument with the former is along the following lines:

The continuous availability of the service; motors can be used at any time during the 24 hours, the meter taking care of both the time and amount of energy. The area covered generally allows of locating in a section where the rent is less than in the manufacturing district, or a man can build a shop near where he lives without taking upon himself the care and long hours incident to the use of boiler and engine. In either case he avoids the annual shutdown of the industrial building for repairs and overhauling; such shutdowns, lasting for a week or two, are a considerable hardship when customers are pressing for goods ordered.

A noteworthy feature of central-station service is that the cost of energy is measurably in proportion to the business done, whereas with an engine the cost can scarcely be brought as low as one-half of full-load cost. Other well-known stock arguments need not be marshaled here.

Some of the advantages of central-station service to industrial buildings are outlined herewith:

Tenants usually prefer electric motors, and the building thus served is more likely to keep its space occupied. Trouble is avoided whenever a tenant wishes to run overtime, the proprietor of the building has no bother, and the tenant secures the accommodation without unusual expense for service. The occasion for an annual shutdown is removed and the consequent annoyance and loss to the business of various tenants are avoided.

Fire risk is lessened by the avoidance of large belts passing from floor to floor. For the same reason more floor area is available, additional rental space usually being secured by removing engine, jack shafts and large pulleys.

By wholesaling energy to the proprietor on the basis of the aggregate demand registered, the latter is still able to furnish energy to tenants at a profit, and each gets his energy at the same price the central station would have charged the tenants individually.

These features all apply in the case of an old building, but with a new building the advantage is even greater, because usually a much better disposition can be made of the available rental space, together with a considerable reduction in the investment otherwise per square foot of area provided.

Having presented the argument to a prospective large energy customer with more or less elaboration, and the presentation of much evidence as to the greatly advantageous features of electric service, he should be convinced; doubtless he is, for he remarks, "Why, then, should I not put in my own electric plant and be independent of anybody else rather than take energy from the central station?"

This statement brings one to the crux of the whole situation, namely: central station versus isolated plant (a very hardy perennial) which involves a discussion of energy costs at engine pulley and the average efficiency of electrical generation, transmission and distribution.

It will be well to emphasize at this point the fact, which should be constantly kept in mind, that while good engineering will enable a high running load factor to be maintained on individual motors of an installation, this can rarely be done in the case of an isolated electric motor plant considered as a unit; that is, maintain a high running load factor on engine and generator; and the central station wins in the comparison because of this fact.

It is entirely possible, having suitable data at hand, to plot a curve of kw-hour, or annual costs, of an isolated power plant and superpose a curve of central-station costs for the same plant; if the curves cross, all points to one side will represent lower central-station costs and all points on the other side will represent lower isolated plant costs on the same basis.

A great deal has been printed in trade publications as to the cost of energy, both in large and small plants; these show wide variations in plants of the same size even, simply because conditions differ, so after all that has been published it is still necessary to evaluate for a definite set of conditions.

An elaborate presentation of the operating costs of steam-power plants was given in the *Electrical Engineer*, under date of June 26, 1895, entitled "The Cost of Steam Powers in Buffalo."

The first four columns in Table III give in abbreviated form the results for the smaller powers; the last column, for 10 hours, has been added to indicate proportionally the cost where the time reported was for more than 24 hours, although costs would not necessarily be proportional.

TABLE III.—POWER COSTS IN BUFFALO

No.	Hp.	Hours.	Cost per hp-year.	10 hours (proportional.)
1	40-50	24	$145.58	$66.48
4	30-40	24	233.95	103.98
6	50-60	24	131.12	58.27
7	20-30	24	151.24	67.35
9	40-50	15½	76.45	60.00
10	20-30	9	108.27	108.27
11	10-20	9	173.33	173.33

The writer has had the opportunity of culling the actual items of expense from the books of a number of concerns operating steam-power plants rated at less than 100 hp, where normal load conditions prevailed. None of these kept any power account, consequently only such items of cost would be found as represented a cash outlay; missing items, such as interest, depreciation, insurance, floor area, etc., have been supplied. A composite of five of these, operating under fairly uniform conditions, is given in Table IV.

TABLE IV.—POWER COSTS, MEAN OF FIVE PLANTS.

Items.	Cost per annum.	Per cent.
Coal at $4 per ton	$1,495.20	43.1
Engineer (only labor)	922.60	26.6
Water (from city mains)	146.40	4.2
Ashes, removal of	52.60	1.5
Supplies, oil waste, etc	51.20	1.4
Depreciation, 7.5 per cent	213.00	6.2
Repairs	160.40	4.6
Interest, 5 per cent	142.00	4.1
Insurance	32.40	0.9
Taxes	39.00	1.2
Rental	211.80	6.1
	$3,466.60	100

Average hp, 49.28; cost per hp-year, $70.34.

This schedule of costs is for "power" alone; it does not include heating of any sort; if steam heat for building were to be included there would be an increased use of coal. The coal for heating would represent from 15 per cent to 20 per cent of the total coal used, bringing the proportionate cost of coal to over 50 per cent of the total steam-plant cost. The only one of the items that is unduly high is "repairs," because the plants were rather old.

TABLE V.—DATA OF THE INDIVIDUAL PLANTS

	1	2	3	4	5
Total annual cost	$2,761	$3,260	$3,265	$3,540	$1,498
Average hp	33.46	46.26	47.00	53.50	66.21
Cost per hp	$82.51	$70.47	$69.47	$66.33	$67.93

Each of these steam plants is in a building having from three to five floors where "power" is rented to tenants operating mostly light machinery. The last, which is the largest of the five, has 62,786 sq. ft. of rental area, occupied by 20 tenants with from 900 sq. ft. to 7000 sq. ft. each. The steam plants could hardly be considered up to date, most of the engines were rather old and the boilers were return tubular with steam pressures of from 80 lb. to 100 lb.

Each engineer did his own firing, oiling and wiping, for

which there was ample time. Except in the case of the fifth, the steam plants were ample for the duty required.

Taken altogether, the conditions were such as to secure minimum fixed charges, and on the average a reasonably low cost of "power," all things considered.

The following comparison of various quantities and values incident to industrial buildings, both steam and electric, will be found of interest; similar results should be found in other buildings of the same area where light manufacturing is carried on.

TABLE VI. COMPARATIVE RESULTS—INDUSTRIAL BUILDINGS.

	A.	B.	C.	D.	E.	F.	G.
Rental area, sq. ft.	213,280	18,892	27,800	50,000	19,940	27,860	62,786
Rented with "power," sq. ft.	160,182	15,182	16,756	46,500	19,940	27,860	60,000
Electrical hp, per 1000 sq. ft.	1.18	1.06	....	....	....	....	....
Indicated hp, per 1000 sq. ft.	....	....	2.20	.99	2.30	1.92	1.10
Cost per electrical hp, year	$70.32	$90.12	....	....	....	....	....
Cost per indicated hp, year	....	....	$82.51	$70.47	$69.47	$66.33	$67.93
"Power" cost, per year, per 1000 sq. ft., cts.	8.982*	10.215*	16.17†	7.01	16.37‡	12.73	7.49
Average cost of "power" per sq. ft., electric, cents							9.598
Average cost of "power" per sq. ft., steam, cents							12.014
Excess cost of steam over electric, per cent							25.1

*Includes 10 per cent depreciation charge on cost of motors.
†High cost due to small area rented.
‡High cost due to inefficient engine.

It should be borne in mind that the comparison is between individual steam-power manufacturing plants and similar manufacturing plants operating with electric motors on central-station service, at a charge ranging from a little over 3 cents to nearly 5 cents per kw-hour.

These comparative results are interesting but not conclusive, as there are not sufficient cases to establish a rule, although the cases given are fairly representative.

Building (A) is a large establishment equipped entirely with electric motors, with an independent steam-heating plant; building (B) is also equipped entirely with motors, but buys its steam for heating; the cost of "power" is higher as a smaller discount was obtained; all the others are isolated steam plants. The high cost in buildings (C) and (E) partly balances the high cost in building (B). A careful estimate of building (G) equipped with electric motors, worked out in detail for each of the 20 tenants using "power," showed a cost on central-station electric service within the cost of operating as a steam plant.

The collateral advantages of electric drive, at the same cost for "power," make a building of this sort a much more attractive proposition as a revenue producer. An important argument for electric motors in the case of such a building is the ability and the ease of metering the energy, as it eliminates an element of considerable uncertainty in rentals, which occurs in the retailing of "power" from a steam plant. There is no easy and certain way of measuring the power distributed by shafting and belts from an engine to various tenants. By means of an indicator run instantaneously measurement can be made of the power taken by any one tenant, but this measurement can be made only with difficulty, and the operative conditions at the time the test is made may be exceptional and recur but rarely if at all; the watt-hour meter, on the other hand, makes a complete record of the energy used regardless of the time or the amount.

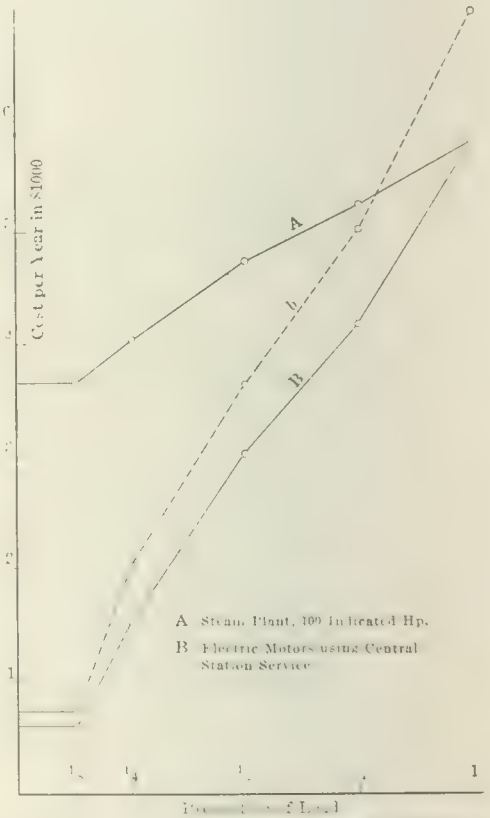
The "power" tenant pays for a certain estimated "power" by the year as part of his rent bill, regardless of whether he uses much or little; with dull business and his shop closed he pays for the "power" just the same, while with electric service from the central station, metered, he pays for just the energy used; if his shop is closed for a month he pays at most a small minimum charge.

The same principle works automatically as between the building proprietor or large manufacturer operating his own plant and the metered central-station service, as will be developed presently.

If a tenant in an industrial building with mechanical transmission is crowded with work and wishes to run over-time, the difficulties are well-nigh insuperable and if "power" is obtained it is at undue expense. The central-station customer has no trouble at all with energy for over-time, the meter takes care of the record, and the cost is no more per unit utilized.

With a knowledge of the conditions underlying the costs in the composite table given of steam "power" costs, it may be stated that a first-class plant rated at 100 hp using a simple, non-condensing engine, installed as part of a factory building, should produce "power" under normal conditions of operation, with coal at $4 per ton, for from $70 to $80 per annum for the ordinary day run, provided a fairly good load factor is maintained.

Suppose, now, that a party about to erect a manufacturing plant or an industrial building that will require 100 hp is willing to concede the commercial advantages of electric distribution, but thinks he will install an isolated plant; he doesn't want to be dependent on any outside source of energy; he wants his plant to be complete in itself. What is the central-station argument? The man must be shown that it is for his advantage to take energy from the central station, and shown in a very convincing way, or he will proceed to carry out his plans for



CENTRAL-STATION ELECTRICAL MOTOR SERVICE.

a fully equipped electrical distribution system. It is just here that the central station is likely to fall down, and after a weak argument gets the business, if at all, by a more or less drastic cut in rates; being driven from a strong position simply through inability to present the strong points of the situation; it is just here that the man who knows is valuable.

Here is the place to present, as forming the essential basis of central-station industrial service, certain specifications that are fundamental and which must be religiously carried out if the business is to be handled with success. First, prime movers ample in rating and equipped with the best apparatus obtainable for speed regulation. Second, ample active generator equipment with suitable reserves to throw into service in case of accident. In case the service is from hydroelectric transmission, character and reliability of service must be assured. Third, a distribution system having abundance of copper properly distributed in mains and feeders, with other essentials that will assure proper potential at the motor terminals.

A central station that does not maintain these three conditions effectively suffers a most serious handicap in getting profitable business. The character of the service, in the line of

reliability and uniform speed conditions for motors, is sometimes of far greater consequence than its cost.

There are two other conditions more strictly in the line of business policy that if observed will contribute not a little in securing business. Some will object to them, but experience has proved their efficacy; a secondary result of their strict observance is the maintenance of a high standard, physically and ethically. They are, first, a schedule of rates, sufficiently elastic to cover a suitable range of operating conditions, which is invariably maintained. Special rates are a snare and delusion. Second, all service contracts to be subject to termination after 90 days' notice from the customer; that is, no long fixed-term contracts, on the principle that it is not a proper policy for a public-service corporation to hold a customer against his will. No contract will yield a profit equivalent to the adverse moral effect of a dissatisfied customer.

Planted squarely on the foundation now laid, there may now be presented an outline of the central-station argument for its service instead of the isolated-motor plant, along the following lines:

The manufacturer is enabled to save a considerable investment which might be used more profitably in business operations or in putting up a larger building; in case of borrowed capital this much liability is saved.

"Power" represents ordinarily from 2 per cent to 5 per cent of the total cost of manufacturing, but in thought, time, annoyance and vexation, care of the various details of an isolated plant represents 25 per cent of what is expended on the entire business; central-station service enables one to avoid largely both the mental and physical strain of the isolated power plant.

Between the continual rise in the price of coal, the occasional interruption of the supply by strikes of miners or of railroad workers and the activity of inspectors in enforcing the ordinance for smoke prevention, the annoyances of the power plant are far greater than the value of the power in the product warrants.

Then there is the unreliable or dissolute engineer whose absence from his post or whose carelessness may result in expense as well as annoyance; the incompetent engineer need only be mentioned.

Coal represents nearly 50 per cent of the cost of service in such plants as are under consideration; labor, 25 per cent to 30 per cent, and both these items are increasing. Central-station rates, however, do not increase, the tendency is always down; the two items named play an insignificant part relatively in the energy costs.

The liability factor in a present-day isolated power plant is an item to be considered, and, other things being equal, to be avoided; true, insurance may be had for the financial risk, but it will not eliminate the personal strain of such events.

The steam-generating plant is a fixed quantity, business is not; the greater the ability of the proprietor the more likely it is to increase. With increase of business the engine and generator must give place to larger ones, involving a loss in the change, a loss in business by reason of a shutdown, together with much trouble, all of which is saved by central-station service.

There is no occasion to change motors with an increase in plant, if the distribution system was properly laid out in the first instance; with more floor area add more machinery and more motors, without interruption to the original plant.

In any generating plant the best economy is obtained when the engine and generator are properly proportioned to the load; in installing a new isolated electric distribution there is considerable uncertainty as to the generating equipment to provide.

Owing to the possibility of saving so large a proportion of the friction load the variation in the load on the engines will be greater in most plants; this condition works to the disadvantage of any but large plants, where the variations in load will result in a fairly stable average.

All uncertainty on the point of generating equipment is avoided by utilizing central-station service; the advantages gained may be specified as: the advantages or disadvantages of central-station service will be practically demonstrated; the actual cost of such service will be learned; actual and positive data will have been obtained as to the generating equipment required, should the decision finally be made after a year's trial, run to install it; the investment will have been deferred for a considerable period and advantage taken of improvements in apparatus.

The freedom of action allowed the customer where the central station negotiates open contracts of this sort results in vesting a decided moral advantage with the solicitor in seeking the business. There is oftentimes a very stubborn hesitancy on the part of a prospective motor user to tie himself up for a term of years to an uncertain and, to a certain extent, unlimited, obligation; estimates of energy cost presented by the solicitor are to him little more than guesses, but by omitting the fixed-time feature of the contract, leaving him free to install his own generating plant whenever he sees fit, after a fair trial of central-station service, his fear of being tied up to a disastrous contract is disarmed and he is more open-minded to the merits of the case. Such a policy, too, puts the central station in a measure under bonds to keep its service at the point of highest efficiency, which in itself is an advantageous feature.

This presentation is not theory, but the result of experience with the method, the writer having assisted in securing contracts for motor service that would not have come to the central station on any other basis, and he recalls but one customer who afterward installed his own generating plant.

TABLE VII.—VARYING LOAD COSTS, STEAM PLANT.

	PROPORTION OF LOAD.				
Items.	1.00	.75	.50	.25	.125
Coal	$2,510	$2,000	$1,560	$936	$624
Engineer and helper	1,560	1,560	1,560	1,560	1,560
Water	245	205	160	100	65
Ashes, removal of..	85	70	50	30	20
Supplies	100	100	100	100	100
Depreciation	500	500	500	500	500
Repairs	150	150	150	150	150
Interest	250	250	250	250	250
Insurance	50	50	50	50	50
Taxes	50	50	50	50	50
Rental	300	300	300	300	300
Total annual cost	$5,800	$5,235	$4,730	$4,026	$3,665
Ratio annual cost...	100	90.3	81.6	69.4	63.2
Net motor hp.	77	56	34	12	..
Cost per hp-year at motor pulley	$75.32	$93.48	$139.18	$335.50	?
Kw hours per month	18,418.4	13,395.2	8,132.8	2,870.4	..
Cost per kw hour, cents	2.62	3.25	4.84	10	..

TABLE VIII.—VARYING LOAD COSTS, CENTRAL STATION.

Kw-hours per mo...	18,418.4	13,395.2	8,132.8	2,870.4	500.†
Cost per kw hour, cents	2.62*	2.60	3.10	4.40	10
Cost per hp-year at motor pulley	$75.32	$74.63	$88.94	$126.31	$295.60
Total annual cost..	$5,800	$4,179	$3,024	$1,516	$600
Total annual cost, 20 per cent added..	6,960	5,015	3,629	1,819	600

*This rate is used because of the assumption of equal full-load costs; as a matter of fact the price schedule used for other loads gives a rate of 2.50 cents.

†This is what the minimum charge would pay for at the flat rate of 10 cents per kw-hour; if the flat rate was less the amount available would be correspondingly increased.

Coming now to particulars as to the cost of service in a plant having electrical distribution and using an ordinary maximum of 100 ihp, as against central-station service for the same motor distribution; like conditions are to prevail as to load, also the cost of service in both cases under full-load conditions is to be the same. Assume that the motor distribution has been so well laid out as to obtain a running load factor of about 80 per cent and that the energy price scale is fairly representative as to flat rate and as to discounts.

Considering the physical factors influencing cost rather than dollars, the inquiry is now as to how a varying load affects the cost of energy.

Quantities will be as follows: Price of coal, $3 per ton; use at full-load, 3 lb. per hp-hour; engine efficiency, 88 per cent; generator at full-load, 90 per cent; three-quarter load, 89 per cent; one-half load, 88 per cent; one-quarter load, 80 per cent; one-eighth load, 55 per cent; investment for engine, generator and switchboard, $5,000. Operating costs are to be distributed similarly to those previously stated for the steam plant.

With a total friction load of 23 hp and the motors operating

on an average of 80 per cent load factor, there will be 96 hp in motors. With 75 per cent to 80 per cent load factor the average motor input should be about 920 watts per horse-power.

With the isolated plant indicating one-eighth-load no power is available, as all is used in friction, although the cost of running would be 63.2 per cent of full-load cost—that is, $3,665 per annum—while in the case of central-station service the minimum charge would be, say, $50 per month, which would allow of running a 2.75-hp motor 10 hours per day, at the usual flat rate of 10 cents per kw-hour.

On page 1360 is presented a curve sheet upon which is plotted the partial load costs in each case; the quantities are as found in Tables VII and VIII. The full line of central-station costs results from applying a price schedule now used by a large central station, in which the flat rate is 10 cents, and by extending the discounts to 75 per cent. Even with costs 20 per cent higher, as shown by the broken line, the comparison is still favorable, because scarcely any manufacturing plant will average three-fourths of full-load for the entire year and the broken line crosses the line of isolated plant costs at 76.5 per cent of full load.

With an isolated plant, steam or steam and electric power, a manufacturer is under heavy bonds to run full time and full power, otherwise his "power" cost mounts up rapidly.

The above illustration of the difference in power costs on partial loads is conclusive. Strangely enough, little attention seems to have been given to the situation, a case usually being on the basis of full-load, although full-load is the exception

With anything like equal costs at full-load, the central station gains rapidly in comparison as the plant load factor decreases, provided the distribution system has been so well laid out that the running load factor of each motor is maintained at a high point, otherwise much of this advantage is lost. The situation affords an elegant illustration of the advantage to a central station of having its customers' plants properly installed

The Prevention and Removal of Boiler Scale—VII.

By W. H. Wakeman.

ONE of the best ways known to engineers for preventing the formation of scale in steam boilers, and incidentally for removing what has already formed on the shell and tubes, is to purify the feed water before it goes into the boiler, thus eliminating everything that can add to the deposit already there, in the case of an old boiler, and making it impossible for scale to form in a new one. This is accomplished in some cases by the use of a filter, which removes certain impurities either before or after the feed water has been pumped through a heater, according to conditions.

Fig. 1 illustrates one of these filters in which water to be purified enters at the right-hand side, and passing downward, as shown by the arrows, is forced through the filtering material, consisting of Turkish toweling or linen Terry stretched over circular sections of bronze lattice work. As the impurities collect on the outer surface of the linen Terry supported by the metal work, it is an easy matter to cleanse it and use it many times over. Some of the more easily separated and heavy impurities settle to the bottom of the large chamber shown, and are blown into the sewer through the lower outlet. The purified water passes out of the left-hand outlet to the boilers.

With every kind of filtering system it is necessary to provide for cleaning the filter while feeding the boilers, provided the plant is run continuously. It requires only a few minutes to clean a filter, but accidents resulting in delays are as liable to happen here as elsewhere, hence it becomes necessary to make arrangements for continuous feeding. With the filter shown in Fig. 1 this is accomplished as follows: The right-hand valve stem is raised as high as possible, thus not only opening the lower passage as indicated by arrows, but at the same time closing the upper passage. When this stem is screwed down the lower passage is closed while the upper is opened, thus allowing water to flow through the horizontal chamber at the top of the filter. The left-hand valve stem is also turned down as far as possible to prevent water from backing up to the filter. This allows the boilers to be fed while the head at the right hand is taken off, the filtering material removed, cleaned and returned. An extra supply of linen Terry ought to be kept on hand in order to facilitate the cleaning process, as one set can be thrown out and a new one put in with the least possible delay. The former can then be cleaned at leisure, and put in place whenever the filter requires cleaning again. This is determined as follows: Two pressure gages are attached to the outer casing, one of which indicates pressure at the inlet, while the other shows it at the outlet. The difference between them represents friction due to the filtering process, and when this is between 20 lb. and 25 lb. the linen Terry needs cleansing. A duplex gage can be used for

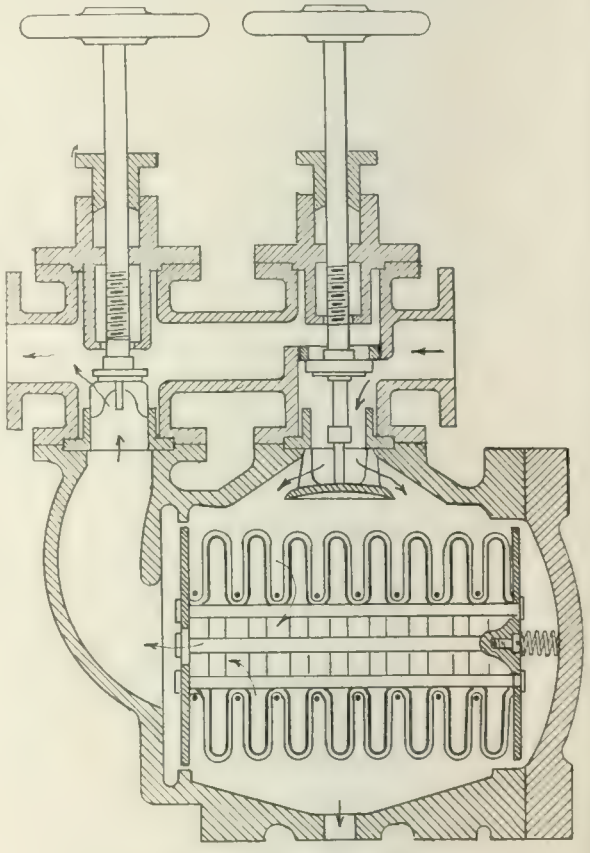


FIG. 1.—FILTER FOR CONTINUOUS FEEDING.

this purpose. By the use of two separate instruments, the engineer is less liable to mistake their comparative readings.

The disadvantage of continuing the feeding process while the filter is out of use is found in the fact that impure water must be used during this time, hence there is a point in favor of shutting down the feed pump until the filter is ready for service. This statement applies to plants that are fitted with tubular boilers, or others which hold a large body of water, thus permitting the feed to be shut off for 20 to 30 minutes. It is out of the question in plants where certain kinds of water-tube boilers are in use, as they do not hold enough water to make the plan practicable. To demonstrate this point a certain engineer filled his water-tube boiler to the top of the water-gage glass, shut down the feed pump and noted the result. In three minutes the water level was down to the bottom of the glass, thus showing the necessity of continuous feeding.

If the feed water is very impure it is advisable to install two filters, each of which is of sufficient capacity to purify the maximum quantity of water required, provided the plant is operated 24 hours per day. This is not necessary in a shop that is run 10 or 12 hours, as the cleaning operation can be done by an assistant engineer while the plant is shut down.

It is practicable to cleanse this filter partially and thus prevent

the friction from rising above 10 lb. or 12 lb. until an opportunity is presented for giving it a thorough cleansing. It operates as follows: With the boiler feed pump in operation, both of the valve stems shown are turned down as far as possible, and a drip valve, the outlet to which is shown at the bottom of the large chamber, indicated by an arrow, is opened. The right-hand valve is then opened slightly, allowing water to circulate over the outside of the linen Terry, washing off a portion of the impurities and discharging them through the drip valve. By closing the right-hand valve and opening the left-hand valve, water is caused to flow opposite to the direction indicated by the arrows. As it now enters the filtering sections of bronze covered by the linen Terry, and flows outward into the chamber, it washes off more of the impurities and disposes of them.

Fig. 2 illustrates another filter that is worthy of consideration. While the valve stem is turned upward as far as possible in the position shown, water from the feed pump enters the inlet chamber 2, flows upward as indicated by arrows, passes thence to the filtering chamber in which are located several cylinders, or cartridges, which retain impurities, but allow clean water to pass into the lower chamber, and thence to the outlet chamber 3. These cartridges consist of two perforated, brass, concentric cylinders, the smaller of which is expanded into the bottom of the filtering chamber. Linen Terry is drawn down over this

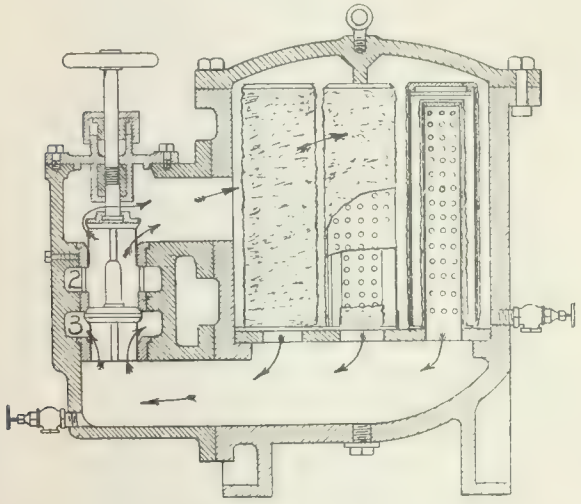


FIG. 2.—FILTER WITH CLEANSING CARTRIDGES.

cylinder, which is in turn covered by the larger cylinder. The linen is then drawn upward until it completely covers the cylinder and a brass cap is fitted over the ends. From this it is plain that water is filtered twice by each cartridge.

A pressure gage is fitted to the filtering chamber, and another to the outlet. The difference between them indicates the condition of the filter, and when it requires cleaning, the valve stem is turned downward, thus bringing the upper disk down to its seat and at the same time releasing the lower disk from its present position and bringing the lower surface of it into contact with the lower seat. The result is that water flows from the inlet passage 2 directly to the outlet 3. Bolts are removed from the cap, and it is lifted off by the eyebolt shown. The outer cylinder of each cartridge is removed, together with the linen Terry, which is replaced by clean linen covered by the larger cylinder, and when the cap is replaced the filter is ready for use.

The double-beat valve is designed to overcome objections to this style of valve as usually constructed, as the two disks are not rigidly connected, hence neither expansion nor contraction of the stem due to changes in temperature can affect the seating of the valves.

When a closed feed-water heater is used the filter must be placed between the pump and heater, thus removing impurities before they go into the heater, and preventing the formation of scale on the tubes or coils of pipe, which will lower the efficiency of the heat-transmitting surfaces. With an open heater this is impractical because water flows into such a heater from external pressure, and after it is duly heated it gravitates to the pump by which it is forced into the boiler. If water is taken from street mains the pressure is frequently sufficient to force it through a filter if desired, but as a general rule an open heater of modern design is also a purifier, hence no separate filter is required.

Fig. 3 illustrates a filter that is fitted with an independent by-pass, to be used when the filtering material must be cleansed. While in regular service water enters the inlet valve 2 and is discharged into the filter chamber 3. Oil and other light impurities rise into the scum chamber shown, which is fitted with a glass gage to show when it is necessary to blow it out through the cock at the top. Just below the filtering chamber and forming part of it is a pocket for catching heavier impurities. It is provided with a blow-off cock. Four perforated metal plates are provided between the chambers 3 and 4 and between these plates woven filtering material is placed to prevent impurities from passing into 4. The metal plates are provided to prevent the cloth from bagging and becoming ruptured by the passage of water after more or less impure matter has collected on it. A hinged door is provided just above these plates, and when it

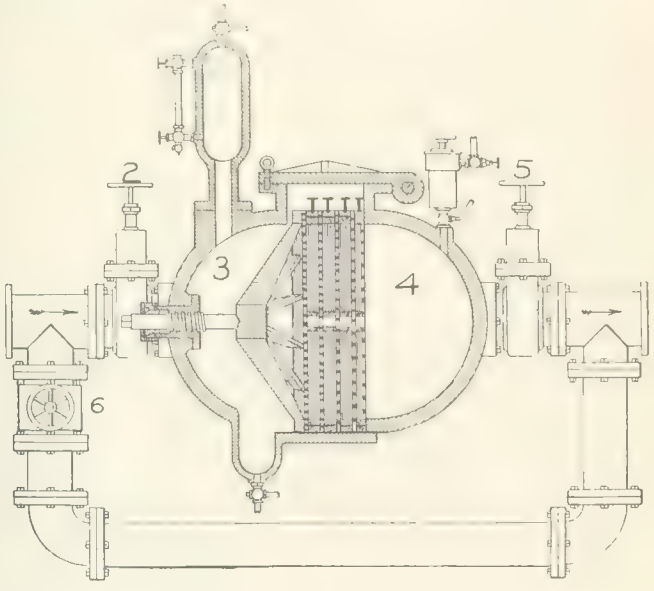


FIG. 3.—FILTER WITH INDEPENDENT BY-PASS.

is wide open the plates can be removed by means of a handle attached to each, new cloth put in and the whole replaced in a few minutes. A cup is provided at the upper part of 4 into which soda is introduced, and when steam is admitted through the angle valve dissolving the soda and blowing it into 4, it cleanses the surfaces and discharges the resulting impure matter through the blow-off cock to the sewer. Pure water passes from 4 through the outlet valve 5 and thence to the heater, as indicated by the arrow. When it is necessary to feed the boiler while cleaning the filter, valve 6 is opened to allow water to flow through the by-pass, but valves 2 and 5 are closed.

Analysis of matter left in a filter showed that more than one-half of it consists of tallow, organic matter and mineral oil, therefore if these were allowed to go into the boilers they would form a very destructive scale, endangering the life of the boiler and greatly increasing the consumption of fuel for a given weight of water evaporated. Such impurities are not always classed under the head of scale-forming matter, but they belong in this class because the sediment resulting from the application of heat to them is a very efficient non-conductor, hence many boilers have been seriously damaged by such accumulations. It is generally not a hard scale, and sometimes it is not easily recognized by an inexperienced engineer as the direct result of allowing oil and grease to go in with the feed separator, or the absence of a filter in plants where the exhaust water, as it appears dry and hard, but it is due to an inefficient separator, or the absence of a filter in plants where the exhaust steam is condensed and returned to the boilers.

LETTERS ON PRACTICAL SUBJECTS

SIDE TROLLEY FOR INDUSTRIAL LOCOMOTIVE.

The following description of a little trolley device may be of interest to some of the *Electrical World* readers: Not long ago the writer had occasion to use an electric locomotive of the industrial type, on a piece of track belonging to the steam road,

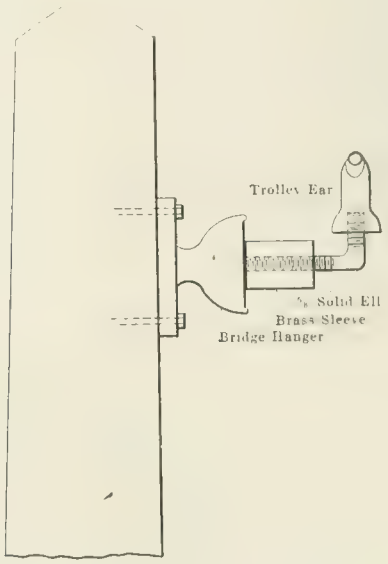


FIG. 1.—ARRANGEMENT OF TROLLEY EAR.

which fortunately was operated by the same company who owned the electrical equipment. It was therefore easy to obtain consent to run the electric locomotives over the steam line, provided a trolley could be arranged that would not interfere with the steam cars. Obviously the ordinary trolley line construction would not do, as the wire would be so low the steam locomotives could not operate. The wire was therefore suspended parallel to the track, about 15 ft. above the rail and 10 ft. to the side. Over this wire the trolley traveler was made to run on top, the trolley ears being inverted and held thus by a bridge hanger, brass sleeve and steel elbow, as shown in Fig. 1. The traveler was constructed from two trolley wheels, three ⅛-in. x 1-in straps, an 8-lb. sash weight and three suitably shaped steel pins. It is shown in Fig. 2. A cable was soldered to the traveler, and by tying the locomotive trolley

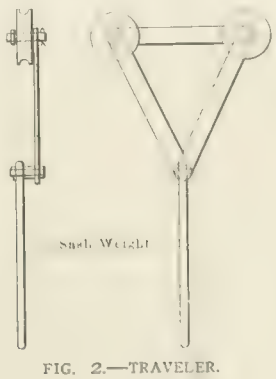


FIG. 2.—TRAVELER.

pole down, and hooking the loose end of the cable into the harp, the locomotive could proceed onto the steam road and "go on its way rejoicing." The above-described device has been in successful operation for over two months, and already has paid for itself many times by eliminating team work which was formerly necessary, to say nothing of time saved and the convenience all around.

Copperhill, Tenn. Jas. F. Watson.

COST OF HANDLING COAL AND ASHES.

At first sight, it seems as though the comparatively small amount of labor and power required to bring fuel to the boilers and to convey away the ashes could be regarded as negligible. When it is realized that fuel is yielding as useful work only about 5 per cent of its actual heat value, then it is in order to take great care that none of these five units saved from every hundred be expended in doing useless work. It costs money to handle coal and ashes; therefore, they should be handled as cheaply as possible, and notes made as to the cost of handling by various methods in order to determine which is profitable and which is too costly to use. As an example, consider the coal and ash-handling proposition of a power plant which consumes 10 tons of inferior fuel per day of 24 hours and also handles ashes to the amount of 20 per cent of the fuel, or 2 tons. The coal is received from a canal boat by means of a clamshell bucket and hoisting rig and deposited in a building on the dock, level with the boilers and 100 ft. distant therefrom. The fireman wheels about 200 lb. at a time and consumes one minute in loading, one minute in wheeling the coal 100 ft., another minute in returning to the coal pile, and one more minute—and sometimes several of them—in dumping his barrow-load. The total time of each 200-lb. barrow-cycle is, then, equal to four minutes, or 15 loads per hour. At 220 lb. per load, 1½ tons will be handled per hour. As there are 2 tons of ashes to wheel out as well as 10 tons of coal to wheel in, the total daily load to be handled is 12 tons. At 1½ ton per hour, it is evident that eight hours will be required for the work, and calling this a day's work at $1.50, the cost of handling coal and ashes manually will be 10 5/12 cents per ton.

Next, let there be considered the cost of handling the coal and ashes by means of a pivoted-bucket conveyor. This installation is to pass over the boilers and the coal and ash storage, also pass underneath each, in order to receive either substance by gravity, and also to discharge either by the same method. The cost of such a conveyor will be found to approximate $1,800 and to require from 5 hp to 7 hp for its operation. The capacity of such a conveyor would be about 8 tons per hour, hence about 1½ hour's operation will be necessary to handle the stated amount of coal and ashes. In order that the fireman may operate the conveying device without neglecting his other duties there must be installed the necessary coal and ash hoppers, which will make the entire system automatic save for the manipulation of the necessary levers and slides by the fireman. The cost of the necessary hoppers, excavations and the installation of the plant may be taken at $2,800. The cost of the conveyor will be about $1,800. The cost of the motor for driving it may be taken at $500 installed and connected. Or the same amount may be allowed for driving the conveyor by means of an engine. If the conveyor can be driven by belt from the main engine, the cost will fall slightly below $500, but not much, and that sum had best be allowed under all circumstances. The total cost is thus $5,100, and the interest, taxes, depreciation and repairs on this investment may be taken at 21 per cent, amounting to $1,071 per year. If operated 365 days in the year this means an expense of about $2.94 per day in addition to the energy required, against $1.50 for doing the same amount of work manually.

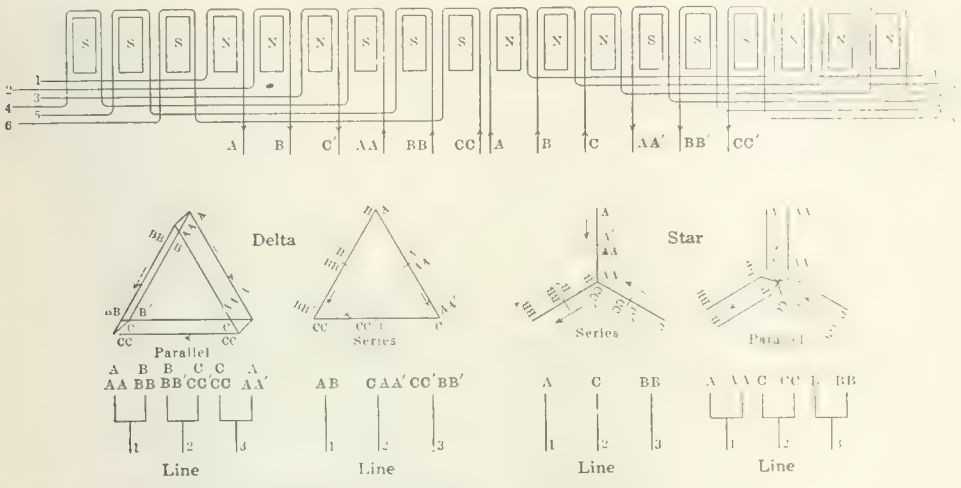
It is evident that it will not pay to use conveyors for so small an amount of coal. But it is further evident that the conveyor can easily handle 10 times the amount of material now handled with it. This would materially reduce the cost when the larger quantity of 120 tons per day is handled. Therefore, when considering the installation of labor-saving appliances, the engineer should make sure that the labor is there to be saved. Sometimes it costs more to save than the saving can possibly amount to. For instance: A fuel economizer will work just as favorably in a little plant as it will in a large one, and it will save the same percentage of fuel; but who wants to save 10 per cent of $10 worth of coal a day by means of an installation costing $5,000 to $6,000? It is the same way with the coal and ash conveyor. It doesn't pay to consider such an installation until its cost falls below 10 cents per ton of material handled.

It may also be interesting to view another phase of the ash-handling problem. In this instance, the boilers are supposedly located in a cellar or a basement, and all the ashes must be hoisted or elevated to the street level and placed in a cart for removal. Here, two methods will be compared: the use of a rope or chain tackle for hoisting the ash buckets, and the handling of the same amount of material by means of a bucket elevator. To this there may be added, if desired, the comparison of doing the same work by means of a "sidewalk elevator," which is an adaptation of the regular platform freight elevator except that it travels only about 10 ft. a minute.

With the hand-operated tackle handling 2 tons of ashes in 200-lb. ash-buckets from a 14-ft. cellar, the cans to be hoisted high enough so that they may be easily dumped into a horse-drawn cart. The matter of power expended in doing the work does not enter, but the matter of time is a very important one. It will require two men to hoist the ash cans, and they can pull about 12 in. of rope at a pull, raising the can 3 in., and requiring about one minute to make 70 pulls on the hoisting rope. Therefore, the velocity of the can is about 17 ft. per minute, or 1.14 minutes for making the 20-ft. trip. Add the necessary time for dumpting the can, lowering the empty can and attaching a loaded one to the hoist and the time has been extended to at least four minutes. But the services of two men are required to do the hoisting. Another man is necessary to dump the cans into the cart, but this can be attended to by the driver. Likewise, the attaching of the full cans and the removal of the empty ones will be attended to by the fireman without extra cost for his time. The cost of the equipment is less than $100. To remove 2 tons of ashes in 200-lb. loads at four minutes each requires 80 minutes' time, to which will be added 10 minutes for getting ready and for cleaning up after the operation, making the time required 1½ hours for two men, or three hours at 15 cents = 45 cents. Add to this the cost of the equipment and the total cost is less than a dollar.

With the bucket elevator, either made as a permanent fixture or to extend itself above the sidewalk when required, the investment will represent, including motor drive, about $400, and it will be required to lift 4000 lb. 20 ft. high with 25 per cent added for friction and other losses, or an equivalent load of 5000 lb. The time for elevating the 2 tons of material will be taken as 20 minutes, allowing 10 minutes more for getting ready and cleaning up. Thus there is one-half hour in which 5000 lb. is to be raised 20 ft. high. The time cost is very slight. The fireman works the lower end of the combination and the driver has nothing to do but to trim the ashes as they fall into his cart for a half hour or so. The bucket elevator holds the driver but 30 minutes, while the hand-hoist requires his presence and that of his team for 1½ hours—a saving of one hour in favor of the bucket elevator. The cost of operation is much less also. In the examples above it is interesting to note that hand labor proves the cheaper in one most unexpected place, while machinery beats hand labor in another place where at first sight there does not seem any chance for a saving.

SOUTH BEND, IND. JAMES F. HOBART.



CONNECTION DIAGRAM FOR STATOR OF A THREE-PHASE INDUCTION MOTOR.

STATOR CONNECTIONS FOR THREE-PHASE MOTORS.

Oftentimes an electrician who has not had very much experience with the internal connection of an induction motor is called upon to rewind one of these machines. Much time is then lost in studying the proper way of making the connections. In such a case the accompanying diagram will be of much value. It is only necessary to tag the leads in the order indicated in the diagram. When the wiring is finished, it can be connected parallel or series, star or delta, by connecting the tagged wires as indicated in the lower part of the diagram. In removing the burned wire it is quite difficult to trace all the connections; but it is quite easy to determine which of the four ways of connecting was employed. If only one wire is found connected to each line terminal, the stator connection is series star. If two wires are found connected to each line terminal and a jumper having six wires connected to it, the connection is parallel star. If two wires are connected to each line terminal and no jumper has more than two wires connected to it, the stator is wound series delta. If four wires are connected to each line terminal, the stator is connected in parallel delta. In the actual motor the coils lap, while in the diagram they are shown following each other to make connections appear more clearly.

LEAD, S. D. J. F. WIGGERT.

DETERMINING CONDENSER LEAKAGE.

Although the number of surface condensers in use in connection with turbine plants has increased rapidly during the past few years, it is doubtful whether any attempts have been made by operating engineers to determine whether or not the condensers are leaky. The usual practice of builders of subjecting the cooling surface side to hydrostatic pressure, and afterward the condensed-water side, observations being taken to determine whether any water trickles through, usually suffices for the operating engineer. If, however, the latter decides upon a separate test, the condensing plant may be run for several hours with only the circulating water going through the cooling surface, and the condenser watched for water in the condensing tubes. The best test, however, is obtained when the condenser is working under full-load conditions, and where salt water is used for condensing purposes a very delicate chemical test may be applied. By means of silver nitrate, sodium chloride, or common salt, may be readily detected, and, inasmuch as condensed water is ordinarily pure and should not contain salt under any circumstances, if the silver-nitrate test shows the presence of salt it may be taken as indicative of condenser leakage. The test, however, is very delicate, so that the leakage, however slight, is quickly disclosed. A standard solution of silver nitrate may be purchased at any drug store, or may be made by dissolving 2.394 grammes of pure recrystallized silver nitrate in a litre of distilled water. A solution of potassium chromate, made by dissolving one part of potassium chromate in 10 parts, by weight, of distilled water, should be used as a color indicator. The chemistry of the test is that the silver combines with the chlorine in preference to the chromic acid, and no red chromate of silver is capable of formation so long as chlorides are in the water. Red chromate of silver instantly forms, however, the moment nitrate of silver is in the slightest excess. If, therefore, water known to contain salt be treated

by adding silver nitrate solution to it, drop by drop, a white precipitate of chloride of silver will form until all the chlorine in the water has been thrown down. Since, however, the exact point at which the formation of the precipitate ceases cannot be accurately observed, the color indicator, or potassium chromate, may be used to determine this state. For the purpose of giving detailed information on the process of conducting such a test the following may suffice: 50 cu. cm of the condensed water should be passed through ordinary filter paper into a clean porcelain dish, and while stirring the water a few drops of potassium chromate should be added. The color will be found to be distinctly yellow. If, then, the silver nitrate solution be carefully dropped from a graduated burette, drop by drop, and the water constantly stirred, the first few drops will become red the moment they touch the water and disappear or fade into a pale yellow on stirring if salt be present. The application of silver nitrate solution should be continued until the water becomes permanently red, and at the very first moment at which the chromate of silver begins to form, or the redness of the solution persists, the addition of silver nitrate should be stopped and the amount used be determined from the graduated burette. This serves as an indication of the quantity of salt present in the water. A cubic centimeter of silver nitrate solution practically corresponds to a grain of salt per gallon of water, so that if the first one or two drops of silver nitrate solution causes the water which has already been treated with the potassium chromate to become permanently red, it is quite certain that there is little or no salt in the water. If, on the other hand, a number of cubic centimeters of silver nitrate solution are required to obtain a permanently red color, the condenser is leaking, and the quantity of salt found to be present will serve as a guide to the extent of the leakage.

Chicago, Ill. Henry Frank.

ELECTRIC THAWING OF WATER PIPES.

The following data on thawing water pipes is written up from notes taken during the months of January and February of this year on work done in a town of about 2500 population, located in the Cascade Mountains, in Washington. The town has a gravity water system. The mains are wood stave pipe

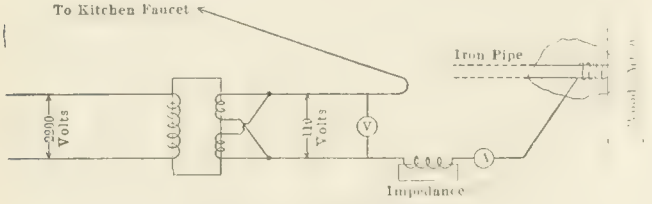


DIAGRAM OF CONNECTIONS.

with branches of 2-in. iron pipe. Energy for thawing the pipes was obtained from the lighting circuit. In some cases connections were made directly to the pole line secondary circuits, while in others a transformer was placed on a sled and a few hundred feet of primary wire run, a No. 12 rubber-covered wire being used for this purpose. The wires were simply laid one at each end of the top cross-arm. Two nails driven at each end of the arm kept them from fouling or falling. The air being clear and dry no insulation other than the wood and rubber covering was necessary.

Besides the transformer the sled was equipped with an impedance coil for regulation, a 500-ft. coil of No. 2/0 weatherproof wire and a quantity of No. 4 scrap wire in about 200-ft. lengths. The impedance coil consisted merely of 20 turns of No. 2-0 wire wound on one leg of the core of a 15-kw transformer, which was burned out by lightning the preceding summer. The equipment of instruments was quite unsatisfactory, the only available ammeter being a switchboard-type instrument reading to 150 amp and a voltmeter with a scale reading to 150 volts. The ammeter had to be short circuited in a number of cases and not infrequently an incandescent lamp was the only voltmeter obtainable. The instruments were in good repair and correct within 2 per cent

The mains being wood pipe it was necessary in every case to dig down to where the iron pipe entered the main. The pipe was carefully cleaned at this point and connection made with several turns of No. 6 wire. The other connection was made at some exposed portion of the pipe, usually at the kitchen faucet, the wire being wrapped around the faucet, insuring a good copper to brass connection. The streets being packed with snow and ice to a depth of a foot or more, no attempt was made to insulate these secondary wires. Owing to the limited current-carrying capacity of the apparatus it was necessary in a few cases to thaw out the pipes in sections, first thawing from the main to the cut-off just inside the yard, then from the cutoff to the kitchen faucet.

The apparatus and connections are shown in the sketch herewith. The method of recording data is shown in the example below, which is a copy of the notes taken on the fourth job done:

(Name.)		(Location.)			(Date.)
C. F. Jones		1147 First St. E.			1/24/09
Workmen	On.	Off.	On	Off.	Total time
B.....	1:30	2:30	....	....	1
S.....	1:30	2:30	....	....	1
C.....	1:30	2:30	....	....	1
W.....	1:30	2:30	....	....	1
Current.....	2:10	2:20	....	....	1/6

Amperes, 100; volts, 120; kw-hours, 2.
Remarks: Size of pipe, ½ in.; length, 125 ft.
Connections made at toilet in rear of lot and at main. This man had already spent $12, with no results. Had all faucets running 10 minutes after current was turned on.

Following are abbreviated records of a few other jobs:

HOTEL, 43 P ST., JAN. 31, 1909.

Workmen, total time, 5½ hours.
Current on, total time, ⅓ hour.
Amperes, 140; volts, 130; kw-hours, 6.1.
Remarks: Size of pipe ½ in.; length, about 60 ft. Connections at main and at cut-off in store on first floor. Connected to 15-kw transformer on nearby pole. Pipe covered with 1-in. packing. Pipe was burst behind range in kitchen and behind heater in chamber. Taped up leaks and left water running on first and second floors.

E. P., FIRST ST., E., JAN. 24, 1909.

Workmen, total time, 10 hours.
Current on, total time, ¾ hour.
Amperes, 90; volts, 130; kw-hours, 8.8.
Remarks: Size of pipe, ½ in.; length, about 75 ft. No results. Pipes were taken up next day and found plugged with sawdust and shavings.

F. W., FIRST ST., E., JAN. 24, 1909.

Workmen, total time, 12 hours.
Current on, total time, ½ hour.
Amperes, 120; volts, 120; kw-hours, 7.2.
Remarks: ½-in. pipe, 125 ft. in length. Left water running in kitchen

M. C., FIRST ST., E., JAN. 28, 1909.

Workmen, total time, 4 hours.
Current on, total time, ¼ hour.
Amperes, 120; volts, 130; kw-hours, 3.9.
Remarks: ½-in. pipe, 120 ft. in length. Pipes frozen under kitchen.

H. W. T., THIRD ST., W., JAN. 30, 1909.

Workmen, total time, 4½ hours.
Current on, total time, 2/3 hour.
Amperes, 110; volts, 120; kw-hours, 6.6.
Remarks: Pipes, ½ in. Length, about 100 ft. Connections at main and faucet on second floor. Pipe burst 6 in. below first floor ceiling. Taped up and left water running.

STORE, COR. 1ST AND P STS., JAN. 28, 1909.

Workmen, total time, 5 hours.
Current on, total time, ½ hour.
Amperes, 175; volts, 115; kw-hours, 10.1.
Remarks: About 75 ft. of 1¼-in. pipe feeding water motor on coffee grinder. Connections at main and at motor.

CITY, COR. FIRST ST., E., AND P ST., JAN. 25, 1909.

Workmen, total time, 7 hours.
Current on, total time, ½ hour.
Amperes, 150;, volts, 130; kw-hours, 9.8.
Remarks: 100 ft. of 2-in. pipe. Connections at main and at valve in street.

SAME.

Workmen, total time, 6 hours.
Current on, total time, ½ hour.
Amperes, 60; volts, 130; kw-hours, 3.9.
Remarks: Connections at valve in street and at faucet in saloon. About 30 ft. 2-in. pipe and 50 ft. ½-in. pipe. Left all valves open in street and left water running in saloon.

CITY, COR. FIRST ST., E., & T. ST., JAN. 26, 1909.

Workmen, total time, 16½ hours.
Current on, total time, 4½ hours.
Amperes, 90 for 1¾ hours; volts, 100; amperes, 160 for 2¾ hrs; volts, 93; kw-hours, 56.8.
Remarks: Had to run 500 ft. of primary. Connected at valve in street near main and at fourth house from corner. No results. Changed connection from fourth to first house at kitchen faucet. Water in one hour, but very little pressure. Valve was frozen solid in street, but opened 20 minutes after current was on. About 120 ft. of 2-in. pipe and 75 ft. of ½-in. pipe.

SAME, JAN. 27, 1909.

Workmen, total time, 14 hours.
Current on, total time, 4½ hours.
Amperes, 100 for 1½ hours, 130 for 3 hours; volts, 110; kw-hours, 59.4.
Remarks: About 30 ft. of 2-in. pipe was burst and flooded street when the frozen ground was dug away from it.

The meter readings were taken a few minutes after the power was turned on. There was very little variation in the

current after it was once steadied. The increase in resistance of the pipe, due to the increase in temperature, was hardly appreciable. In no case did the pipes reach more than a lukewarm temperature. A rough means of determining the relative temperature was to throw a little snow on an exposed part of the pipe and watch it melt.

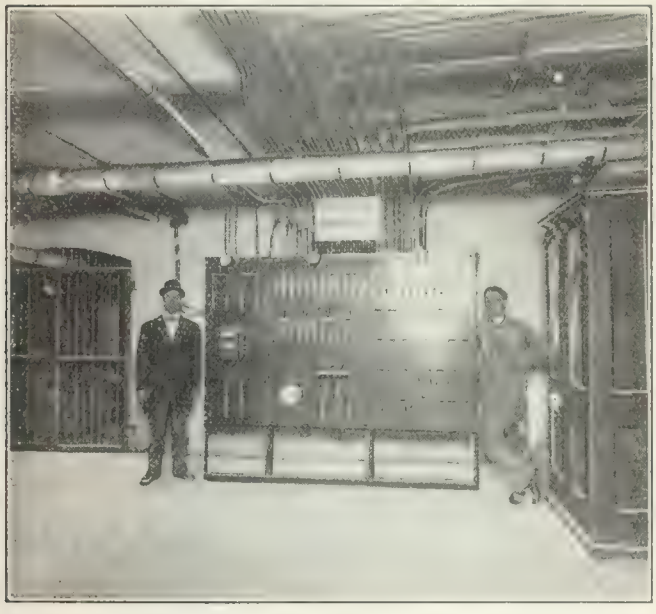
From the above examples it is readily seen that to determine a charge per length and size of pipe would be quite unfair. To charge according to time and energy used would have made great variations in the customers' bills and would probably have led to difficulty in collecting. After the first few jobs the following rates were decided upon and proved very satisfactory:

Charge for thawing ½-in. pipe	$6.00
Charge for thawing ¾-in. pipe	8.00
Charge for thawing 1-in. pipe	10.00

For 1¼-in. pipe and larger a time-and-energy charge was agreed upon. Time was charged at the rate of $1.75 per hour for fireman and helper and energy at the rate of 10 cents per kw-hour. Except when lowering a transformer to the sled two men could easily take care of the work.

The income from the work mentioned in the above examples averaged a little more than $8 per day above all expenses. As there was no initial investment in apparatus and practically no depreciation this was all clear gain.

It will be noticed that most of the work was done on one street. This was because the street was filled in with gravel



REMODELED WIRING INSTALLATION

and the frost penetrated it easily. Roughly estimating, about one out of every four houses on this street had frozen pipes.

ROSLYN, WASH. EDWARD M. BROOKS.

REMODELING A WIRING INSTALLATION.

The illustration above shows a picture of a new switchboard installed in the Custom House at Memphis, Tenn. The board was designed especially to suit Custom House needs and the remodeled installation will doubtless interest readers. The board was made in three panels of extra heavy slate and two panels carry the electric light switches and fuses and also the lamp meters and transformer. One panel takes care of the motor circuits and the motor meter. Each panel is lighted by an independent lamp. The board as a whole is securely anchored to the concrete floor and to the brick wall, and the front is highly polished. A 300-amp triple-pole switch controls the entire installation. The building was rewired and remodeled prior to the installation of the board. Wide brick walls had to be penetrated, heavy plaster cut and the heavy pine flooring removed so as to obtain passageway for the conduit. Ten large subcabinets control the circuits on the three floors. The lighting fixtures were all grouped and rebalanced so that the increase in the number of circuits was over 100 per cent. The Post Office fixtures are controlled by individual flush switches. Curiously enough, with the new wiring the drop in voltage was smaller and the lamps burned more brightly.

MEMPHIS, TENN. F. M. PALMER.

COOLING TOWERS NEAR CULM BANKS.

The great culm banks which surround the mine openings in the anthracite coal regions have usually been looked upon by persons not fully acquainted with all the conditions as ideal sites for the generation of electricity, because the culm can be obtained for little or nothing. Although grates have been devised for burning this cheap fuel, the problem which confronts the operator of a plant located on such a site is to obtain water. The water that is used in the mines and in the breakers, and finally finds its way into small streams, is so charged with dirt and sulphuric acid as to render its use for boiler-feed purposes impossible. In fact, if an ordinary coal shovel were thrown in the water and the site revisited in a year no sign of the shovel could be found, the iron having been completely dissolved by the acid in the water. In not a few locations the water is very much more expensive than the fuel, so that while ordinarily one would expect that power plants located where fuel is cheap could manufacture electricity at a very low cost, such is not the case, a kw-hour of energy being manufactured in large cities remote from the coal fields for considerably less oftentimes than it is manufactured in the mining plants. As a result of the scarcity of water, most of the plants located in the coal regions operate non-condensing. This practice is also partly due to the cheapness of fuel. However, with the use of a steam turbine the best economy is obtained when the plant operates condensing. Despite the cheapness of fuel, it is possible to realize a marked economy with simple engines if these be operated condensing. The problem, however, is to obtain the necessary water for this purpose, and it is surprising that more use is not made of the cooling tower for husbanding the supply. Plants already in operation using circulating water drawn from muddy streams, carrying grit and sand, avoid the cutting of pump pistons and cylinders by using cooling towers. The water coming from the condenser in a heated condition is spread out in such a way as to bring the greatest surface in contact with the greatest quantity of air, so that evaporation takes place quickly and effectively. The cooling tower, of course, does its best work when the surrounding air is dry, but radiation does part of the cooling during the winter season, as does also the contact of cool air with the heated water. Nevertheless, the bulk of work is due to evaporation. Manufacturers of modern cooling towers obtain the necessary circulation by means of fan blowers, and a fan tower is to be commended where the quantity of heat to be removed is great, or where the duty is especially severe in the hot summer months. But the cost of power necessary to operate the fans, and the wear and tear, due to moving parts, has resulted in the production of natural draft fanless towers. The open fanless tower not only dispenses with the fans, but does away with the tank structure entirely. The apparatus is open on all sides to the air, and the natural currents are utilized. Where sufficient ground area is available, as at the mines, this type of tower, which is simple in construction, easy of access and which requires a minimum of attention, should prove efficacious. The tower can be used in connection with either jet or surface condensers, but with the former system an additional pump must be employed to deliver the discharge from the air pump to the top of the tower. A surface condenser is preferable if the tower is located on the roof or otherwise elevated, since the discharge and suction columns balance below the tower, making the work of the pump that due solely to the height of the tower itself. The cooling tower has done much to make feasible the operation of steam engines condensing, in places where the cooling or injection water would ordinarily be too expensive or too scarce.

SCRANTON, PA. JOHN CLARK.

QUESTIONS AND ANSWERS

We have just installed a rotary converter set which pumps very badly and no amount of field adjustment seems to improve operating conditions. Can you suggest a remedy? B. T. A.

Defects of this kind have been overcome by boring out the field structure for a larger air-gap and beveling the pole corners. Copper dampers may then be applied around the pole pieces near the tips. We would suggest, however, that you communicate with the manufacturer of the machine before attempting any remedy.

How are the transformers connected which feed the transmission lines running to Syracuse, N. Y.? S. S. B.

The transformers in the generating station of the Ontario Power Company at Niagara Falls, Ontario, from which the transmission lines passing through western and central New York are supplied, are connected with their low-tension windings in delta and their high-tension windings in star, and step-up the generator voltage from 12,000 to 62,000, the potential at which the lines operate.

What means are taken to prevent the enormous stresses which occur after a short circuit in large 25-cycle generators? T. T.

External reactances are used in connection with some large units of which we have knowledge. These do not affect the regulation appreciably, since this depends on the synchronous impedance which is only slightly increased by the added reactance. The latter is placed in the generator leads and in addition to guarding against mechanical strains protects the generator winding to a certain extent from high-frequency surges from the outside.

How much resistance is usually provided in the field rheostats of direct-current generators? S. N. N.

The field rheostats of direct-current generators are usually designed with resistance approximately equal to that of the shunt field windings of the machines with which they are employed. This will ordinarily allow a range in voltage of over 25 per cent. The resistor is divided into many sections, each of which has a contact point on the face plate. The rheostat must be able to dissipate 25 per cent or more of the field loss continuously without seriously overheating.

Why are the ratings of alternating current units expressed in kilo-volt-amperes instead of in kilowatts? F. F. F.

The kilo-volt-ampere rating does not take into account the power factor of the system to which the alternator is to be attached or under which it is to operate. The output of alternators is limited by the heating and this in turn depends on the voltage and current regardless of the power factor, and hence of the power output. Therefore, a certain generator can be given a definite kilo-volt-ampere rating, but when rated in kilowatts account must be taken of the power factor.

In equipping lighting circuits with potential regulators would the induction type or the step-by-step type be preferable? H. K.

Generally speaking, the induction type of regulator would be preferable to the step-by-step type, since the former is usually automatic in its operation, while the latter is manually operated. The induction regulator used on single-phase lighting circuits effects changes by altering the position of a coil in a magnetic field, and the step-by-step regulator effects a similar result by cutting in and out, by means of taps, sections of the winding of a regulating transformer.

What percentage of voltage variation is usually permitted on lighting circuits feeding carbon-filament incandescent lamps and how will this affect metal filament lamps? G. H.

Edison companies have arranged their circuits for a standard 2 per cent variation of pressure in mains, because of the effect of small differences of potential upon the brilliancy and life of the carbon-filament lamp. Motors and arc lamps give satisfactory service where the fluctuation is twice that which is permitted in carbon-filament lamps. The incandescent lamps having metal filaments do not respond so noticeably to slight variations in voltage.

Can transformers be tested by their own voltage? If so, how is the test made? E. T.

When transformers are used for this purpose, one side of the high-tension winding is connected to the low-tension winding and the iron, and the transformer operated at a potential sufficiently high or above normal to give the necessary test voltage. The other side of the high-tension winding is then connected in the same way and the test repeated. The middle part of the winding, however, receives only half the total test voltage to ground and low-tension coils, there being a uniform grading of test voltage along the winding from the middle point to the outer end.

What advantages are possessed by two single-phase transformers arranged to feed a three-phase load over a single three-phase transformer? W. T. F.

Assuming that two single-phase transformers are connected in open delta to supply three-phase service, the failure of one transformer would interrupt the service until the damaged unit was replaced, and, therefore, this class of installation has no advantage over the three-phase transformer, since in either case a new unit must be provided. With the two-unit method good regulation is not obtained due to the distortion of voltages when the load changes. While this would not be serious on motor circuits, for lamp circuits it would not be desirable.

Should the absence of smoke from a chimney be taken as indicative of complete combustion in the furnace of a boiler? E. E. S.

No. The only way to determine how perfect the combustion is in a furnace is to analyze the escaping gases. To get a fair average and to plot a curve showing what is taking place in a furnace, it is necessary to determine the percentage of carbon dioxide at frequent intervals for about a day or two. An automatic carbon-dioxide recorder will furnish the desired facts regarding combustion, the value of firemen, as well as other information which cannot be secured satisfactorily in any other way. Such an instrument requires little attention and will give quite accurate results. The instrument should be thoroughly understood, however, and the same care and intelligence should be exercised in handling it as is usually accorded to the Orsat apparatus. If treated as an ordinary piece of boiler-room equipment the results will be unsatisfactory.

What effect have variations in frequency upon the performance of watt-hour meters? R. B.

Meters tested on both non-inductive and inductive loads representing 10 per cent variation in frequency, show that for non-inductive loads a 10 per cent variation in frequency has but little effect, the error being materially less than one-half of 1 per cent. On inductive loads, with a 10 per cent variation in frequency and with a power factor of 0.75, the average error was approximately 1.5 per cent and for a power factor of 0.50 3 per cent, the tendency being for meters to run slow on the lower frequency and fast on the higher frequency. In general practice the variations in frequency in normal running conditions tend to make the meters run slow, and as this variation rarely approximates 10 per cent, the error would be less than 1.5 per cent. Variations in frequency of 10 per cent are abnormal.

The oil from the step bearings of two 500-kw turbines oftentimes becomes thick and milky and a change in the oil does not seem to remedy matters, the changed oil becoming just as bad as the other oil after a time. The lubricant is guaranteed by the manufacturer as a pure petroleum distillate with no blending. What should cause the oil to become milky? Does chemical action take place? O. I. I.

The explanation of the formation of the emulsion noticed has been given as follows: Oil having a natural tendency for holding a certain amount of water, the churning effect when it passes through the step-bearing pumps causes a more or less perfect mechanical mixture, thus producing the emulsion. A certain small percentage changes composition by chemical action. It is claimed that if the oil is allowed time for settlement, the emulsion, except for the small percentage changed chemically, will separate into oil and water. If the oil is not used more than 15 times in 24 hours and filtered with proper heating, no trouble should result. Where the oil is used more frequently under high pressure and in bearings where the circumferential speed of the shafts in the bearings may be as high as 2500 ft. per minute, it is best to use two sources of supply alternately.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Coal Consumption in High-Speed Engine Stations.

The coal consumption in the electric lighting plant of the Hobart Light & Power Company, of Hobart, Okla., averages about 10 lb. per kw-hour for each 24-hour run. During the heavy load portions of the day this is as low as 7 lb., and rises to 13 lb. on light load. The station has simple high-speed engines. The Montrose Electric Light & Power Company, of Montrose, Col., which has compound high-speed engines, requires from 8 lb. to 9 lb. per kw-hour. Twenty-four-hour service is given in this plant also. These figures are better than is common among high-speed engine central stations. Close records ar kept in these plants, both of which are controlled by the U. S. Light & Traction Company, of Denver.

Public Service in Aurora, Neb.

Aurora is a little city in Nebraska with a population of about 2500. It has a central-station company—the Aurora Electric Company—which is owned by 14 local business and professional men. This company has now asked the permission of the State authorities to issue additional stock in the sum of $28,000 for the improvement of the plant. The present capital is $32,000, all of which is represented in the property. The company now seeks to install a district heating system, and for this purpose as well as to provide funds for some electrical improvements, it seeks the increased capitalization. It is proposed to lay a 9-in. steam main from the power house around the court-house square, where most of the business buildings are placed. Exhaust steam will be utilized, and the pipe line will be about 2600 ft. long.

Both the stockholders of the Aurora company and the local authorities are proud of the pleasant relations which have always obtained between the company and the city. The company pays taxes on the amount of its capital stock and indebtedness and also on the franchise valuation without protest. Last spring the company volunteered to enter a profit-sharing agreement with the city. This offer was accepted. The stockholders of the company are allowed a dividend of 10 per cent and the city has a share of all net receipts above that amount. For the past three years the net income to stockholders has been from 10 to 12 per cent, and with the additional equipment it is thought that the profits to the city will be of appreciable amount.

Analysis of Discontinuances of Electric Service.

When notifications of discontinuances, or "cutoffs," as they are termed, are received by the Commonwealth Edison Company, of Chicago, the cause is carefully investigated and what is known as a "cutoff report" is made up from the data obtained in this way. Cutoffs are ascribed to seven causes:

(1) Out of business (no successor) or vacated premises.
(2) Seasonable business—that is, such as in its nature might be expected to be temporary.
(3) Change to other electrical service.
(4) Dissatisfaction with bills or service.
(5) Lost to competition.
(6) Moving; business secured in new location.
(7) Non-payment of bills.

Taking October, 1909, as a typical month, it is found that the total number of cutoffs reported is 19,665. Referring to the preceding numbers attached to the various causes of discontinuance, the total number of cutoffs is divided as follows: (1), 8083; (2), 3597; (3), 2643; (4), 701; (5), 221; (6), 3023; (7), 1397; total, 19,665.

It is interesting to note the small number of cutoffs due to causes (4) and (5) respectively, "dissatisfaction with bills or service" and "lost to competition." Nearly half of the cutoffs are due to customers going out of business without leaving a successor, or to vacated premises. By analyzing the cutoffs in this way, the company is enabled to keep very closely in touch with the requirements of its customers.

Cost of Railway Power in Chicago.

As the low cost at which the Commonwealth Edison Company of Chicago sells power to the traction companies of Chicago has been frequently commented upon, the following figures on the actual net cost per kw-hour to the railways will be of interest. Under the contract made between the Commonwealth Edison Company and the Chicago City Railway Company in 1908, the railway is to pay $15 per kilowatt of maximum demand per year plus a charge for energy consumed at the rate of 0.4 cent per kw-hour after Jan. 1, 1911. The maximum demand is determined according to rather elaborate rules, by taking into consideration a number of the maximum hourly outputs in kw-hours. The net kw-hour rate which is paid under such a contract, of course, depends entirely on the load factor of the railway load—that is, the ratio of the maximum to the average load.

The report of the Board of Supervising Engineers, Chicago Traction, for the year ending Jan. 31, 1908, recently issued, shows that the load factors for the Chicago surface roads vary somewhat, that of the largest system, the Chicago Railways Company, being 50 per cent, and 45 per cent for the Chicago City Railway. With a 50 per cent load factor for each kilowatt of maximum demand, there would be consumed 4380 kw-hours, which at 0.4 cent per kw-hour would amount to $17.52 per year. Adding $15 per kilowatt fixed or readiness-to-serve charge to this would make a total annual charge of $32.52 per kilowatt of maximum demand, which is equivalent to 0.75 cent per kw-hour. The energy is measured at the switchboards of the Commonwealth Edison Company's large steam turbine stations, where it is generated. The Commonwealth Edison Company furnishes the high-tension transmission lines from the generating stations to the various substations, which latter are owned and operated by the railway companies.

Testing Electric Meters.

In a paper presented at the recent annual convention of the Empire State Gas and Electric Association, Mr. C. G. Durfee, of Rochester, gave an account of the efforts of the New York Public Service Commission of the Second District, which has jurisdiction outside of Greater New York, to induce central stations to test their electric meters.

Early in 1908 the commission made recommendation to each of the 218 companies found without proper testing standards, indicating the type of instrument best adapted to the need of each company. This resulted in 167 of these companies equipping themselves with satisfactory standards, while 51 companies filed objections to incurring the expense. The records of the commission show that up to the present date 83 of the companies who have purchased standards have made practically no use of them; and that at the present time 223 companies in the Second District are satisfactorily equipped with testing

apparatus, 6 companies are partially equipped, 60 companies operating meters have no testing apparatus, 50 companies have filed objections to the purchase of apparatus, and 12 companies have made arrangements with outside companies to do their testing.

Several of the smaller companies purchased suitable standards merely because they felt obliged by law to do so, but felt that the expense was unnecessary and unwarranted. Several of these companies, however, after purchasing felt that as they had a certain amount of money invested in these standards, it would be well to make use of them and the results shown by tests made by these companies seem to prove beyond question that the purchase of the standards was really a paying investment. Reports filed with the Public Service Commission, Second District, show that some stations found from 30 to 77 per cent of their meters running slow. One station discovered that of its 318 meters, 242, or 76.1 per cent, were 4 per cent or more slow, and that only 14 meters, or 4.4 per cent, of the total number registered within 4 per cent.

Mr. Durfee referred to the case of a large plant, the management of which considered that an organization for meter testing would cost far more than would accrue from corrections of slow meters. The superintendent in order to determine the correctness of this view tested 1000 meters in service, and found that on the basis of the data thus obtained, the company was losing over $40,000 per year through meters unregistering. The result was that the company gave the superintendent full authority to organize an efficient meter-testing department.

Special Street-Lighting Installations in Chicago.

The practice of installing special systems of street light by business men in various localities of Chicago to draw trade, as previously mentioned in these columns, continues to expand at a satisfactory rate. On West Twenty-sixth Street, near Kedzie Avenue, the merchants have installed 62 street-lighting posts, and on Blue Island Avenue, between Sixteenth Street and Twenty-second Street, and also on Commercial Avenue, near Ninety-second Street (South Chicago), there are like installations. The Blue Island Avenue equipment consists of 51 posts and the South Chicago installation of 78. Each post is of iron of attractive design, and supports four 60-watt tungsten lamps in frosted globes. Electricity is furnished by the Commonwealth Edison Company through underground conductors.

In all, five localities in Chicago are now provided with business men's special advertising illumination of this character. The total number of posts installed is 274 for the four-light posts and 50 posts bearing five lights each. Each merchant taking this service pays $1.50 a week, and the lamps burn from dusk to 10 p. m. six nights a week, and from dusk to midnight on Saturday, under a two-year contract. The total income to the central-station company from this class of business is now $411 a week.

Mr. O. R. Hogue, of the Edison Company, gives special attention to this feature of the contract department's activities, and he has devised a demonstrating post of wood which is made in sections and is easily placed in an automobile and carried to any part of the city, where it can be set up, with lamps attached, to give possible customers an idea of what the illumination will be like on their own streets. Business men in several other localities are figuring on adopting this service, for when they see their neighbors on a near-by street drawing customers to their stores by the attractiveness of a brightly lighted and specially lighted thoroughfare, they feel a desire to emulate the example.

In West North Avenue, between Western and California Avenues, the Commonwealth Edison Company has installed and is operating a decorative-lighting installation of different character. Festoons of ordinary carbon 16-cp incandescent lamps are strung across the streets, and the merchants have erected ornamental columns at the curb-line, the whole effect being that of a holiday carnival, as the lighting is to be furnished from Nov. 24 to Jan. 1. The festoons, or stringers, consist of nine having 75 lights each and eight of 60 lights each. They are festooned from a point above the center of the roadway to the sidewalk line and at the central point in each stringer there is a red 32-cp lamp. In all there are 1155 lights in this carnival illumination.

Toronto Electric Sign.

The "new-business" department of the Toronto Electric Light Company has been fortunate in securing many sign contracts in Toronto, the most recent being for a large sign for the Hassan cigarette. The "Hassan" sign is 36 ft. in width, 32 ft. high, and contains 955 2-cp lamps. The top of the sign is 45 ft. above the roof and 110 ft. above the street. The frame contains 3000 ft. of 1-in. pipe. The letters in the word "Hassan" are 4 ft. in height, in "Cigarette," 30 in., and the smaller letters



ELECTRIC SIGN IN TORONTO.

are 2 ft. high. The lamps are frosted tip, the border amber, the leaves and scrolls green, the snakes ruby, the torch amber, and the flame ruby, amber, canary and clear. This sign is the largest in Canada, at the present time. The letters of the sign burn steadily; the border continually changes, the leaves, scroll and flame waving, and the snakes crawling upward. A large sign for the Ramsay Kodak Company has been installed on King Street, and many smaller signs have been placed in the lesser business districts of the city.

Increase in Chicago Central-Station Business Analyzed.

The year 1909 will be a banner year for the Commonwealth Edison Company, judging by the increase of business reported so far this year. Taking the calendar year up to Nov. 20, with six weeks remaining to complete the year, the total increase of business amounts to 910,943 16-cp equivalents. It is interesting to observe how this increase is divided, and the following figures are particularly instructive. It will be understood that in the following tabulation the first figure given refers to the connected load of Nov. 20, 1909, and the second figure to the corresponding total at the beginning of the year 1909.

Low-Tension Direct-Current System.

Incandescent lamps, 1,252,595—1,072,179, an increase of 180,416.

2000-cp arc lamps (575-watt), 9690—8463, an increase of 1227.

1200-cp arc lamps (350-watts), 1696—2634, a decrease of 938.

Battery charging in kilowatts, 6027.2—5116.9, an increase of 910.3.

Motors (General) in horse-power, 66,192.8—53,672.4, an increase of 12,520.4.

Motors (elevator) in horse-power, 39,848.1—33,635.3, an increase of 6212.8.

Alternating-Current System.

Incandescent lamps, 1,568,769—1,284,411, an increase of 284,358.

2000-cp arc lamps (450-watt), 5367—5456, a decrease of 79.

Battery charging in kilowatts, 1668—909.1, an increase of 758.9.

Motors (general) in horse-power, 39,494—27,984.1, an increase of 11,509.1.

Motors (elevator) in horse-power, 1670.6—1409.5, an increase of 261.1.

Series Arcs.

2000-cp arc lamps (575-watt), 1017—1005, an increase of 12.

1200-cp arc lamps (350-watt), 789-817, a decrease of 28.

Total Connected Load.

Reduced to 16-cp lamp equivalents, the total at the beginning of the year was 4,370,772, and at Nov. 20, 1909, 5,325,695, an increase of 910,943. As might be expected, the increasing use of the tungsten lamp and tungsten clusters has reduced the number of arc lamps of some classes in use. In every other class of business a gratifying increase is shown. There are about 8000 tungsten clusters in use. Perhaps the greatest ratio of increase is shown in the amount of alternating current used for battery charging through some form of rectifying apparatus. The figures are very interesting and show in a most convincing manner the varied activities and enterprises of this great central-station company. The growth of the business is marked. During September, as previously noted in the *Electrical World*, the number of contracts closed by the contract department of the company averaged 299 for every working day. In October the number of contracts closed averaged 311 for each of the 26 working days of the month. These contracts are all for new business, although "successors" are included, meaning where a new contract is made with a business successor of a former customer.

An Inexpensive Electric Equipment for Dumb-Waiters.

By S. H. Sharpsteen.

An electric dumb-waiter equipment of more than ordinary interest has been placed in service in the New York Infirmary for Women and Children, on account of the simplicity of the installation.

Fig. 1 shows the arrangement of the motor and gear as it would appear if looked upon from the top, *M* being the motor

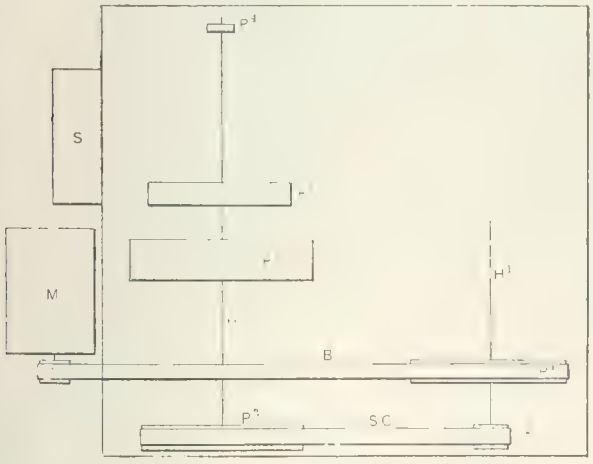


FIG. 1.—PLAN OF DUMB-WAITER INSTALLATION.

placed on a shelf fastened to the outside of the dumb-waiter shaft, *S* the automatic controller secured to the same support just above the motor, H^1 a small piece of shafting on which is fastened pulley P^1, driven by belt *B* from the motor pulley. On the same shaft is a small sprocket wheel P^2 which drives a sprocket chain *SC*, which in turn drives the large sprocket wheel P^3 on the main dumb-waiter shaft *H*.

The 1-hp motor *M* runs at 1400 r.p.m. and transmits power from the pulley *P* to pulley P^1 by means of a leather belt. Use is made of a chain belt for transmitting power from P^2 to P^3

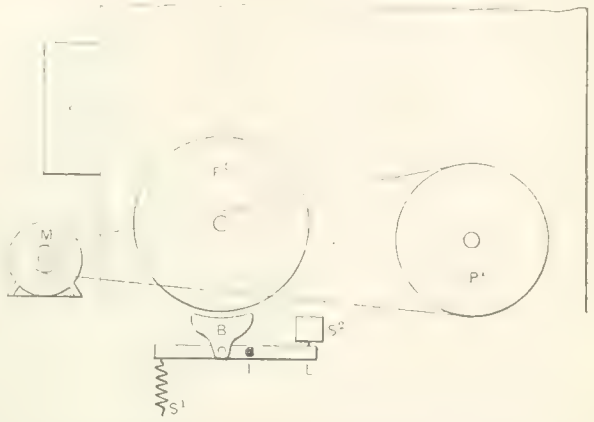


FIG. 2.—ELEVATION OF DUMB-WAITER INSTALLATION.

because the belt speed is too low for a leather belt. P^6 is a pulley 10 in. in diameter with a 4-in. face, to which the brake is applied. P^3 is the pulley over which runs a chain, one end of which is connected to the car and the other to the counterweight. P^4 is a small pulley carrying a leather belt to work an indicator that shows the position of the car at any time.

The shaft *H* is furnished with a hanger on each side of the brake pulley P^6 to keep it from springing when the brake is applied. For the same reason this shaft is heavier than is necessary to transmit the required power. Fig. 2 is a side view showing the brake pulley P^5 with the brake shoe *B* located under it.

The simplicity of the braking devices is the most novel feature of the installation. They were purchased from a motor manufacturing company for $25 each. The brake lever *L* is pivoted at *I* and is held up by the spring S^1, which forces the brake shoe *B* against the pulley P^5 when the circuit is opened and it is desired to have the car at rest. When the starting button is pushed and the main circuit is closed, current passes through the solenoid S^2, which pulls up on the lever *L*, thereby allowing the brake shoe *B* to fall away from the pulley P^5 and permitting it to turn.

The use of solid iron pulleys, well fastened to their respective shafts, is desirable for this service because the strain on the pulleys is more severe than the mere transmission of power required to operate the loaded car. The sudden stopping and the power going on before the brake is off, which is necessary to keep the car from dropping slightly before it starts, tend to loosen the pulleys if they are not securely fastened.

The brake casting with the wooden shoe *B* is pivoted on the lever *L* so that it can adjust itself to the face of the pulley P^5; the contact face of the shoe is lined with leather, which holds better than any other material.

For an indicator to show the location of the car use is made of a common speed indicator, the shaft being lengthened out, as



FIG. 3.—ARRANGEMENT OF INDICATOR.

shown at H^2, in Fig. 3, so that it extends into the waiter shaft and holds the pulley P^5, which is belted to the pulley P^4 in Fig. 1. On the slow-turning shaft of the speed indicator is mounted a pointer *K*, and over the working part of the speed indicator is placed a steam-gage case. The indicators are placed

where they can be easily seen in the kitchen on the sixth floor, from which the dumb-waiters are operated.

The controlling buttons for each of the two cars in use are located side by side in a vertical row; when the top one is pushed the car moves upward, and when the bottom one is pushed the car moves downward, and when the middle one is pushed the car is brought to rest.

When it is desired to send a tray of dishes to a certain floor it is placed on a car, the door shutting the shaft from the kitchen is closed by a vertical movement and the proper button is pushed; when the pointer indicates that the desired floor is reached a second button is pushed and the car comes to rest.

The dumb-waiter doors lift and as they pass upward they open a simple, inexpensive switch which is placed in the motor line to prevent the motor from being started until the door at which the car stands is closed. As the car moves up or down from any one of the doors they are automatically locked so that employees cannot possibly get hurt by the car coming down on them.

The starter is a standard device with four solenoids, one for lift, one for reverse and two smaller ones for varying the resistance in the armature circuit. The simple and cheap braking device holds so well that when a man rides on top of the car the equipment operates in the usual manner. Standard knock-out switches are placed at the bottom and the top of each dumb-waiter shaft to open the circuit and stop the cars in case of necessity.

The arrangement described above was devised by Mr. F. B. Easton, chief engineer of the building, under whose direction the equipment was installed.

A Bachelor's Electric Service.

The Waverly Company, Indianapolis, has had much success in securing newspaper publication of the following clever paragraphs, entitled "Diary of an Up-to-Date Man":

"Some people think it costs a lot of money to be thoroughly well groomed and up to date, but Charles Pinkham Jones—everybody knows 'Pinky' Jones, the 'pink of perfection' his lady friends call him—Mr. Jones, as we were saying, keeps a diary that includes an expense account, with a glimpse of which your correspondent was favored the other day, and from it he is able to give exact figures as to what it costs a bachelor, who uses modern labor-saving appliances instead of a valet, to present himself every morning at the bank, the perfect pattern of a well-groomed man. Here is the record for an average morning:

	Electric current Kw-Hours
Rose at seven and took an electric bath, for which the current used was	.3333
Heated bedroom for ½-hour with electric stove	.5000
Heated water for shaving on electric stove	.0333
Used electric boot cleaner	.0133
Pressed trousers with electric iron	.0400
Ironed silk hat with electric ironer	.0333
Kneaded dough for a loaf of bread with electric kneader	.0066
Boiled a pint of coffee on electric stove	.0666
Cooked a chop by electricity	.0666
Aired my room with electric fan	.0238
Turned on electric piano while I ate my breakfast	.0033
Cleaned the knives and forks with electric cleaner	.0010
Polished the plates with electric polisher	.0050
Curled my moustache with electric curling iron	.0005
Lighted a cigar with electric lighter	.0003
Rode in electric elevator to the basement	.0033
Drove my Waverly electric 4½ miles to the bank	1.0000
Total kilowatt-hours	2.1789

for which I pay 10 cents per hour or 22 cents in all. This does not take account of the current used in my electric clock, but as a single kw-hour will keep that running for 10 years it seems safe to disregard the clock.

"After this who will question the economy of electric power? For the information of any reader who does not understand the term we will add that the kw-hour is the unit of measuring electric current charged for by the lighting company. It means the use of a thousand watts of electricity, or the equivalent of 1⅓ hp for one hour."

INTERIOR WIRING AND ILLUMINATION

Davenport (Iowa) Street Illumination.

Davenport, Ia., is one of the many cities striving to secure better street lighting at the present time. An association of merchants doing business on Brady Street has been formed, and one result of its efforts is a special system of street illumination on Brady Street, from Second to Fifth Streets. In these three blocks there are 48 ornamental iron posts, 16 in each block, each post supporting five tungsten lamps. One 60-watt tungsten surmounts the post, and four are suspended from brackets near the top. All are enclosed in spherical frosted globes. The installation of this special street lighting was marked by a celebration, with a parade, speeches and band music.

Factory Lighting.

Mr. L. B. Marks delivered an address, Nov. 17, on "Factory Lighting," in Washington, D. C., at a joint meeting of the Washington Society of Engineers and the Washington Section of the American Institute of Electrical Engineers. This address contained the substance of Mr. Marks' recent paper on "Factory Lighting" read at the I. E. S. convention, and in addition a discussion of the application for factory lighting of open, enclosed and flaming-arc lamps, Cooper Hewitt mercury arcs, Moore tubes (both yellow and white light), tungsten lamps, etc. The system of indirect lighting by reflection from the ceilings and walls was also discussed. Among the points brought out in the address were that in the average factory (lighted by local lamps) the intensity of artificial light on the work is usually two or three times and often 10 times that of the daylight illumination which is sufficient and satisfactory for the work; and that in the average factory, the glare (due to faulty lighting design) is excessive and accounts in a large measure for the impossibility of properly performing some of the work at night. The outlines were given of a design of a factory lighting installation (using tungsten lamps) in which the glare is reduced to a minimum and the diffusion of light on the machines approximates closely that obtained in daylight.

Street Lighting Versus Policemen.

Grand Rapids has made another notable increase to the span-wire arch system of lighting its business streets. West Leonard Street celebrated the lighting of a mile of that thoroughfare on the evening of Nov. 19. This is the longest single section of street which has yet adopted the system of lighting which is becoming almost universal over the business streets of Grand Rapids. Probably no other city of the size of Grand Rapids in the country has so many miles of specially lighted business streets. In the speeches made during the jollification, Mayor Geo. E. Ellis said: "If you have a place that is of shady reputation, put a light at the front door and another at the back, and that place will become good." The Grand Rapids *Daily News*, in commenting on this, says: "Doing away with dark corners, dark streets and dark places generally means much for the moral condition of a city. The criminals and evil-minded are the ones who do not like too much light. While light will not entirely do away with this undesirable class, it will drive it farther and farther away, until eventually there will be no place left for it." The *News* then favors the extension of the lighting system by the city into some of the streets of shady reputation as a plan of getting rid of their undesirable tenants. It says: "A few extra lamps would not be as expensive as one policeman, and in some cases would prove more efficacious."

Street Illumination.

A lecture on "Street Illumination" was given by Mr. J. R. Cravath, of Chicago, before the Engineers' Society of Milwaukee Nov. 10. He first pointed out the great advances that have been made in electric street illumination the past five years. For many years gas-mantle burners have played a very important part in the economical lighting of the residence streets of the larger cities. The recent improvements in electric lighting, however, have so reduced this cost that it is now cheaper than gas and more desirable in other ways. In the electric street-lighting field changes are going on so rapidly that the situation is almost confusing to those actively engaged in this work. Within three years tungsten street lamps have come into use which give 2½ to 3 times more light for a given consumption that the older incandescent lamps, and are much more efficient than the common enclosed-carbon arc.

He reviewed briefly the history of arc lighting in the past few years, and showed how the magnetite luminous arc, requiring direct current, came to displace the alternating-current enclosed-arc lamps, involving not only a change in lamps, but radical changes in all of the arc-lamp transformers and apparatus. On top of this comes the titanium-carbide arc, involving still different apparatus, as it is suited for operation on 60-cycle alternating-current circuits. The annoying thing about these changes, from the standpoint of the company or of the municipality owning and operating a street-lighting plant, is that none of these new arc lamps can be used interchangeably on the transformers and circuits employed for the preceding best type. He showed by lantern slides the great increase in efficiency of arc and incandescent lamps in a period of five years. He also showed types of ornamental posts which have been installed for lighting the business streets of various enterprising cities.

Regarding the use of arc versus tungsten lamps, he stated that in the outlying districts of large cities where enclosed-arc lamps are placed at every other corner, conditions can be most decidedly improved by the use of 80-cp tungsten lamps on each street intersection. In larger cities, where there is a greater density of population and consequently more money available for street-lighting purposes, the question is not so easy to decide whether it is best to adopt large arc lamps on each street intersection or smaller incandescent lamps spaced more frequently.

One can easily figure from the candle-power of the arc and tungsten lamps offered that more illumination can be given at the darkest points midway between lamps by the use of some of the modern efficient arc lamps at each street intersection than by expending a similar amount of money on the smaller incandescent units at more frequent intervals. In all street-lighting work it is the point of minimum illumination—that is, the darkest point, half way between lamps—which should always receive first consideration. The illumination of the rest of the space usually takes care of itself. As a general proposition, it is not desirable to have the lamp deliver too much light immediately in the vicinity of the lamp, because it produces too great a contrast and makes the dark spaces appear even darker. In general, a much larger total volume of light can be had from the modern arc lamps than from the modern incandescent lamps for a given expenditure of electrical energy. Furthermore, with the present street-lighting devices, an arc lamp hung at street intersections is useful for lighting in four directions, whereas a lamp hung between street intersections is useful for lighting in only two directions. This fact tends in itself to run up the cost of lighting per mile of streets as soon as either small or large units can be introduced between street intersections.

It is easy to figure numerically that more light can be delivered midway between lamps by the use of small lamps scattered along the street, but here the physiology of the human eye intervenes and raises a question. It is obvious that the object of street lighting is to enable one to see along the street. One cannot see as well when facing a few large lamps of high candle-power as when facing a larger number of lower candle-power lamps. It is well known that bright lamps within the range of vision, when there is but little surrounding light, have the effect of greatly reducing the ability to see clearly. Just what bearing this has on the street-illumination problem as regards the use of large arcs at street intersections versus small units, the speaker confessed he did not know, and did not think the matter had ever been properly and scientifically investigated. In the light of present knowledge of lamps, illuminating engineering and physiology, it would not be an extremely expensive matter for any city contemplating a new system of street lighting to conduct some practical experiments under the direction of competent experts, which should settle some of these points.

Mr. Cravath said the electric lighting of streets can usually best be accomplished in connection with the other electric light and power business of the city. The power plant and distribution system required for the supply of electric light and power to the modern city is so large that street lighting represents but a small percentage of this business. It, therefore, is evident that street lighting should be more economically done by the companies having electric light and power business on a large scale than by a company or municipality engaged in street lighting. The existence of two or three electric light and power distributing systems in a city, each with its separate set of conduits, poles and wires, is not only an economic absurdity, but a nuisance. The logical way to handle these matters is by well-regulated monopoly rather than by competition. He congratulated the State of Wisconsin on having established a commission for the regulation of these matters. The controversies which have arisen between cities and electric light companies have sometimes been due to unfair prices or poor service. In other cases they have been the result of the dissemination of misinformation regarding the true costs of electric street lighting. The actual cost of street lighting in Massachusetts in both public and private plants can easily be determined from the report of the Massachusetts Gas and Electric Light Commission. Taking an example nearer home, he cited the example of Chicago, where the cost from 1903 to 1907 was given in the report of Messrs. Arnold and Young to the Mayor as $81.46 per lamp per year, which cost in 1908, when the report was made, was being reduced to $60.56 per lamp. The committee appointed by the Civic League of St. Louis estimated the cost per arc lamp if purchased by a municipal plant in St. Louis would be $69 per lamp per year.

In closing, he made a strong plea for a higher standard of illumination than is now common, and urged that whatever changes are made should be in the direction of higher standards of illumination rather than in a reduction of cost and the maintenance of existing inadequate lighting.

LETTER TO THE EDITOR.

Central-Station Boilers.

To the Editor of Electrical World:

SIR:—Referring to the communication in your issue of Nov. 4, entitled "Economical Methods of Meeting the Maximum and Minimum Demand for Steam," it is not quite clear whether the method therein proposed is to apply to an overload of short duration or to a sustained overload on a plant. In the case of the former one would hardly think of pressing into service one of the reserve boilers. The method proposed by Mr. Williams also presupposes that the fireman will know at just what moment the overload will come on and will have the boilers full of water and everything in readiness to meet the excess demand. While in a general way it is known at about what time the regular maximum peak load will commence, still in every power plant there are always overloads which come on without warning and they may be of long or of short duration. For these it is, of course, impossible to have everything in readiness as suggested by the article.

Then, again, the method of filling up the boilers to the limit

will not meet with favor with the majority of operating engineers; for when a boiler is being forced to take care of an overload, priming will surely result if it is as full of water as it will stand. We do not need to mention the disadvantages of this carrying over of water into either reciprocating engines or turbines.

Our power-plant practice has demonstrated that one of the greatest aids in meeting sudden overloads is a fuel economizer. As ordinarily designed, an economizer usually contains about 30 lb. of water for each boiler horse-power. This is equivalent to at least a one-hour supply of feed water. As the temperature of the water in the economizer is very nearly equal to the temperature of the water in the boiler, there is, therefore, no danger of lowering the boiler pressure or of producing undue strains by feeding the boiler continuously with as much water as may be required. I believe this is a much more satisfactory method of preparing for an overload than that of filling the boiler up and "letting her run."

An economizer, also, has the advantage that this supply of hot water is always on hand, and the attendant does not have to know when a sudden overload is coming. It also has the further advantage that, as the boilers are being forced and the temperature of the escaping gases is considerably in excess of normal condition, the temperature head between the water entering the economizer and the exhaust gases is increased, and consequently a larger flow of heat into the water will ensue.

Thus, while we mentioned that the economizer had enough hot water on hand to supply the boilers for one hour, it will be seen that, due to the higher rate of absorption of heat, the boilers can be fed with water at very nearly the steam temperature for a much longer period. These considerations are well borne out in practice. It might be said that the economizer is to the steam generator what a storage battery is to the electric generator, or the flywheel to the engine.

NEW YORK. G. F. FENNO.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Determining the Flux in Air-Gaps.—R. RUEDENBERG.—Various experimenters have recently endeavored to determine the exact distribution of the magnetic lines of flux in the air-gaps of dynamos by means of testing coils. The author points out that these methods give only approximate values, because the testing coils must have certain dimensions and therefore give only the mean of the fluxes within the space covered. The author shows how to apply a correction to change the curve which is experimentally plotted into a curve which represents more correctly the exact distribution of the flux.—*Elek. und Masch.* (Vienna), Nov. 7.

Compensating Speed Variation of Shunt Motors.—A note on a recent British patent (22,159, 1908; Nov. 4, 1909) of W. Stansfield and J. J. Hatt. To obviate the rise in speed of shunt motors due to the heating of the field coils, two opposing field windings are employed. The weaker is connected directly across the supply mains, and the stronger is placed in series with a resistor having a negligible temperature-resistance coefficient. As an alternative, the weaker winding may be connected in parallel with the resistor. The difference between the ampere-turns of the two windings remains constant for all temperatures.—Lond. *Elec. Eng'ing,* Nov. 11.

Mercury-Vapor Rectifier.—M. LEBLANC, JR.—The first part of an illustrated article in which the author discusses the Cooper Hewitt mercury-vapor rectifier. The object is to explain in detail the part which each of the elements plays in the apparatus and to show how these different elements must be calculated in order to assure a good operation of the converter. The article is to be continued.—*La Lumière Elec.*, Nov. 6.

Lamps and Lighting.

Flame-Arc Lamps.—P. HEYCK.—The conclusion of his paper read before the Dresden Electrical Society, the first part of which has been abstracted in the Digest. If inductance coils are used instead of series resistors for alternating-lamps, the waste of energy is reduced. This is the case both with arc lamps with pure carbon electrodes and with flame-arc lamps. With flame-arc lamps the use of inductance coils has, however, still another effect, since it increases the candle-power of the lamp. Both effects result in a very considerable reduction of the specific power consumption. The explanation is given by the oscillograph curves in Figs. 1 and 2. Fig. 1 gives the curves for the Excello lamp, operated with a series resistor. Fig. 2 gives the curves with an inductance coil. Curve *a* is the voltage of the network, curve *b* is the voltage of the terminals of the lamp, curve *c* the current. The curve of the voltage of the network is almost sinusoidal. With a series resistor the curve of the current is in time-phase with the voltage, but distorted. This distortion is a characteristic feature of the flame-arc lamps. The voltage must have risen to a certain definite value before the current begins to pass. In Fig. 2 the voltage of the network is advanced in time-phase before the current. For this reason at the moment when the current curve passes through zero, the voltage is already sufficient to let current pass through the lamp. The current, therefore, rises

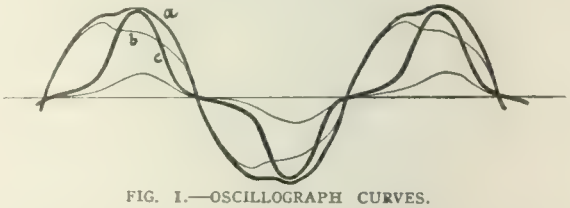


FIG. 1.—OSCILLOGRAPH CURVES.

more rapidly than in Fig. 1. The light period in comparison with the dark period during each full period is lengthened and, therefore, the candle-power is increased. The power factor of the circuit, which was 0.83 with the series resistor, becomes 0.68 with the inductance coil and the candle-power increases from 1620 to 2100 mean hemispherical hefner candles. The specific power consumption decreases from 0.28 watt to 0.18 watt per mean hemispherical candle-power. Another recent improvement in flame-arc lamps is the introduction of lamps with electrodes one above the other. This advance has become possible by the introduction of special "T. B." electrodes, which consist of a thick strongly impregnated core surrounded by a relatively thin cylinder of pure carbon. The "axis lamp"

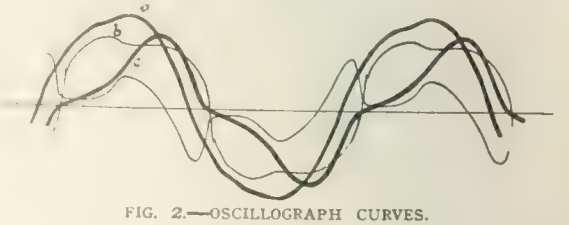


FIG. 2.—OSCILLOGRAPH CURVES.

is of this type, for use both with direct current or alternating current. With direct current either three lamps are connected in series in a 110-volt circuit (the lamp voltage being 30) or two lamps in series in a 110-volt circuit (the lamp voltage being 40). The candle-power of these lamps with direct current is from 1200 to 3900 mean hemispherical hefner candles, with a specific consumption of from 0.24 watt to 0.21 watt per hefner. In alternating-current circuits three lamps are used

in series in a 110-volt circuit with 28 volts at the terminals of each lamp. The distribution of light from different arc lamps is given in Fig. 3. The curves refer to the following lamps:

1	Excello,	10	amp.,	110/2	volt,	550	watt,	2550 cp, dioptric	yellow
2	"	"	"	"	"	"	"	1910 " "	white
3	"	"	"	"	"	"	"	2500 " "	yellow
4	"	"	"	"	"	"	"	1870 " "	white
5	Axis,	15	amp.	110/3	volt,	550	watt,	2150 cp, white	
6	"	10	amp.	110/2	volt,	550	watt,	2050 cp, white	
7	Quartz lamp, 2.5 amp, 220 volt, 550 watt, 1250 cp.								

Finally tables are given stating the total cost of operating different lamps with direct current or alternating current, including the cost of energy, electrodes, globes and attendance. The results are given as follows for direct current, the cost being given in cents for 1000 hefner candle-hours:

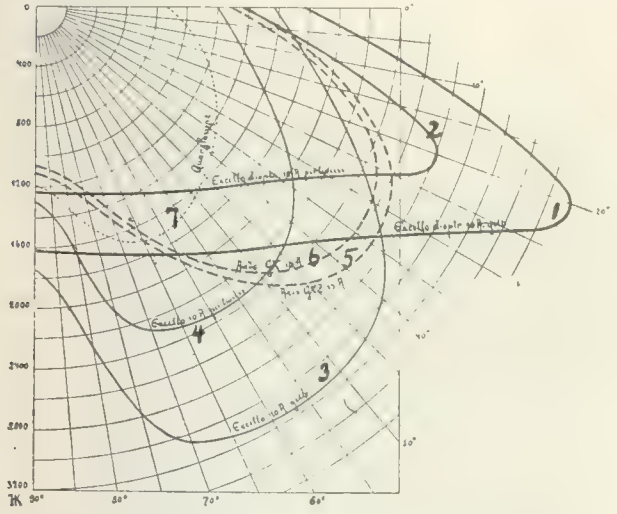


FIG. 3.—PHOTOMETRIC CURVES OF VARIOUS LAMPS.

Excello yellow		Excello white		Axis, three in series.		Axis, two in series.	
1100 cp	3150 cp	825 cp	2350 cp	980 cp	2150 cp	1550 cp	3140 cp
Cost of 1000 hefner-hours, in cents:							
2.225	1.375	3.025	1.875	2.65	1.975	2.2	1.825

For alternating-current lamps the figures in cents per 1000 are given in the following table:

	Excello yellow	Excello white	Axis
With series resistance	1680 cp 2.175 cts.	1250 cp 3.025 cts.	1200 cp 3.225 cts.
With inductance coil	2150 cp 1.475 cts.	1550 cp 2.125 cts.	1400 cp 2.425 cts.

In this comparison the cost of the kw-hour is assumed to be 5 cents; of course, the lower the price of energy the more important becomes the price of the electrodes. This is higher for the Axis lamps than for the Excello lamp, so that the latter seems to be, in general, superior to the former.—*Elek. Zeit.*, Nov. 11.

Metallic-Filament Lamps.—B. DUSCHNITZ.—The conclusion of his review of the latest methods of making metallic filaments. In the present instalment the author describes methods in which the metallic filament is made of carbon-free metal without using any wet process. Of the metallic filaments so far on the market only tantalum can be worked that way, as it is ductile. For tungsten it is recommended to stamp a powder of tungsten metal tightly into a tube of ductile metal and then treat the whole by drawing or rolling. Finally the cover which is not tungsten is removed either chemically or mechanically. It has been found later that it is better to begin with tungsten sponge rather than with tungsten dust. Such tungsten sponge may be made, for instance, by preparing a tungsten alloy and removing the other metal from the alloy by means of a solvent which does not attack the tungsten. Thorium filaments have also been made in this manner. Various other processes of the same general type are described.—*Elek. Anz.*, Nov. 4.

Artificial Illumination.—L. GASTER.—A continuation of his illustrated lecture on modern methods of artificial illumination. The author concludes his description of gas lamps and passes over to acetylene.—Lond. *Electrician*, Nov. 12.

Linear Sources of Light.—E. W. WEINBEER.—An article illustrated by diagrams on photometric measurements of linear sources of light, such as mercury-vapor lamps.—*Zeit. fur Beleucht.*, Oct. 10.

Generation, Transmission and Distribution.

Steam Turbine.—An illustrated description of the steam turbine of the Oerlikon Company. This turbine is of the pure action type, with several pressure stages in a single casing. It is distinguished from other action turbines by the fact that in it use is made of the speed of exit of the steam from the revolving disks as well as of the inlet speed. For this purpose the turbine consists of one or more groups of pressure stages, each having an inlet of constant length, while the successive expansions of the steam are allowed for by increasing the radial length of blade from stage to stage within each group. Once the maximum practical length of the blade has been attained the steam passes to a second group of stages, distinguished from the previous group by an increased inlet arc. This increased arc again remains constant throughout the various stages of the new group. The radial length of blade diminishes in general from the last stage of one group to the first stage of the next, and then increases again gradually from stage to stage. In this way, the turbine makes use in each stage of the exit speed of the steam from the previous stage, except in the case of the last stage of each group.—Lond. *Elec. Review*, Nov. 12.

Rolling-Mill Motors.—W. MANKTELOW.—An illustrated article on the design and operation of rolling-mill motors and their accessories. The author deals with electrical versus steam driving, the energy and horse-power required, power for auxiliaries, types of motor used, gearing and time of reversal, use of flywheel and design of batteries as load equalizers. The author thinks that in general electro-mechanical is preferable to electro-chemical storage.—Lond. *Elec. Review*, Nov. 5.

Destructor Plant.—An illustrated description of the generating plant connected with the destructor plant in a suburb of Melbourne. Electrical energy is furnished to the municipal supply company. In order to avoid the troubles of synchronizing, an induction generator is employed. It has a rating of 125 kw.—Lond. *Elec. Review*, Nov. 5.

Traction.

Single-Phase Traction in Hamburg.—FREUND AND CRONBACH.—The conclusion of the illustrated description of the single-phase system used on the city and suburban railway from Blankenese to Ohlsdorf. In the present instalment the operation and maintenance of the motor-cars is described and the results of tests are given. The mean weight of the car, including passengers, is 74.8 tons. The consumption of energy is 33.6 watt-hours per ton-kilometer. The longest runs on Sundays are 486 km (290 miles), on other days, 410 km (246 miles), while the mean run on Sundays is 330 km (198 miles) and on other days 300 km (180 miles). The part of the motors which gets heated to the highest temperature is the commutator. The rise of temperature was found to vary between 66 deg. and 53 deg. The final temperature was reached after three or four hours of operation. Speed curves and energy-consumption curves of typical runs are given.—*Elek. Zeit.*, Nov. 11.

Single-Phase Railway.—The conclusion of the illustrated description of the single-phase railway between Rotterdam, The Hague and Scheveningen. Each of the motor cars is provided with two 180-hp compensating-series motors.—Lond. *Electrician*, Nov. 12.

Installations, Systems and Appliances.

Statistics of German Central Stations.—E. SCHIFF.—A review of the statistics of the German Association of Central Stations for 1908. The statistics refer to 320 stations and therefore covers only a small part of all the stations. However, it contains many data of interest. Some of these are summed up in three tables. The capital invested varies between $78 and $619 per kilowatt, the average income per kw-hour between 1.46 and 16.55 cents, the total expenses per kw-hour between 0.36 cent and 11.71 cents, the cost of fuel per kw-hour between 0.10 cent and 3.46 cents. The effect of the introduction of metallic-filament lamps is not directly evident

from the statistics. Nevertheless, all the stations with one exception show an increased income.—*Elek. Zeit.*, Nov. 11.

Electric Industries in England.—R. K. Morcom.—A lecture on the present state of "heavy electrical engineering" in England. Fig. 4 gives curves which show the drop in price of moderate-size generators in comparison with the variation and general rise of the price of copper and pig iron. Curve 1 refers to copper and curve 2 refers to pig iron, while curve 3

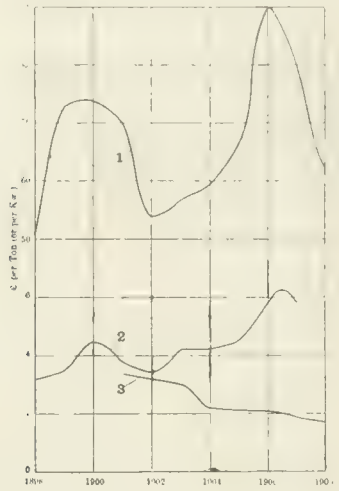


FIG. 4.—COST CURVES.

gives the price of moderate-size generators per kilowatt. Dealing with the distribution of capital in the industry a table of the capitalization of various branches of the electrical industry and a brief review of the developments of the industry are given.—Lond. *Elec. Eng'ing*, Nov. 11.

Buenos Ayres.—An illustrated description of the new power plant at Buenos Ayres. When complete, this station will contain 10 7500-kw turbo-alternator sets, and in addition several smaller sets. The first instalment of this equipment, consisting of five 7500-kw turbo-alternators and two 1000-kw turbo-dynamos, is now being erected.—Lond. *Elec. Review*, Nov. 12.

High-Tension Switchgear.—A. G. Collis.—An abstract of a lecture in which the author advocated ironclad gear for most purposes, and remote solenoid control for heavy feeder boards; he emphasized the necessity of complete provision for isolation, and described up-to-date forms of oil switches, instruments and relays discussing the most suitable arrangement of connections for the latter.—Lond. *Elec. Eng'ing*, Nov. 11.

Tariff for Selling Energy.—A. Vietze.—An article in which the author suggests a new tariff for charging for electrical

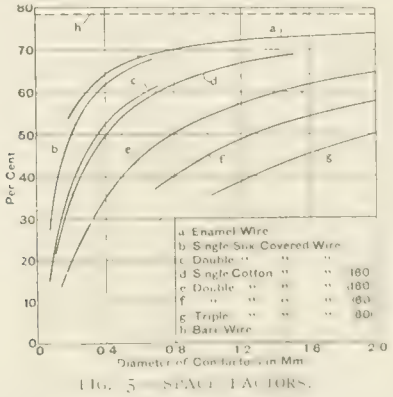


FIG. 5.—SPACE FACTORS.

energy, specially adapted for the needs of co-operative central stations supplying energy over an extended agricultural district. —*Elek. Zeit.*, Nov. 11.

Wires, Wiring and Conduits.

Enameled Wire.—C. F. Upward.—An illustrated article on the properties of enameled wire, the insulating material being similar to ordinary enamel, but of a high flexibility. Fig. 5 gives a series of curves showing the space-factors for enameled wire, single and double, silk-covered wire, also single and double cotton-covered wire, cotton Nos. 20, 160 and 200 being used for the latter. It will be seen that enameled wire up to a diameter of approximately 0.6 mm has a better space-factor than even single silk-covered wire, and that it is considerably higher than all cotton-covered wires, including those insulated with the finest cotton, No. 200. Owing to the methods of manufacture employed, the wire is capable of withstanding very high temperatures, and coils wound with enameled wire may be safely used up to temperatures of 150 deg. C. continuously, or 200 deg. C. temporarily. It is not possible to state the value of the maximum current which is permissible without the given temperatures being exceeded, as the temperature of the coils will be largely dependent upon the cooling conditions prevailing. According to tests carried out, however, it has been found that under normal conditions, with the coils loaded continuously, the watt consumption (continuous current) must be equal to two-thirds of the product of the height h of the coil (in centimeters) and its diameter d (also in centimeters) or $w = 2/3\,hd$. The layer of insulating material is from 0.01 mm to 0.03 mm thick, according to the diameter of the wire. The insulation e.m.f. of single wires in contact with mercury is from 2000 volts to 2500 volts, or with water from 800 volts to 1000 volts after 25 hours' immersion. Enamel insulation is entirely non-hygroscopic.—Lond. *Elec. Eng'ing*, Nov. 11.

Insulation of Windings.—A note on a recent British patent (19,263, 1908; Nov. 4, 1909) of A. J. Boult (Felten & Guilleaume-Lahmeyerwerke Akt-Ges.). Transformer coils and armature windings comprising bare copper wires or bars separated by small strips of insulating material are dipped into a bath of rubber solution, or of acetyl cellulose. The armature or coil is then subjected to a vulcanizing treatment to harden the insulating mass.—Lond. *Elec. Eng'ing*, Nov. 11.

Electrophysics and Magnetism.

Vector Representation of Non-Harmonic Alternating Currents.—B. Arakawa.—A mathematical paper investigating in greater detail a method formerly proposed by Bedell and Tuttle. The chief results are as follows: The relative phase positions of two non-harmonic alternating quantities can be expressed by the term "equivalent phase difference," which is equal to the phase difference between two equivalent sinusoidal alternating quantities that give the same value of mean product of instantaneous values as the chosen non-harmonic alternating quantities. Any non-harmonic alternating quantities can be represented by radius-vectors, if their relative phase positions are expressed by equivalent phase differences between each pair. Generally, a vector diagram in n dimensions is required to show n independent non-harmonic alternating quantities simultaneously; but in special cases they can be shown in a figure of less dimensions. Summation or subtraction of any number of non-harmonic alternating currents can be performed graphically by representing them by radius-vectors and combining first two of them in a plane diagram and combining their resultant with a third, etc.—*Phys. Review*, November.

Gases Absorbed by Anode.—V. L. Chrisler.—An account of an experimental investigation of the absorption of gases by the anode in a luminous current. The results show that hydrogen is absorbed by sodium, potassium, a sodium-potassium alloy and mercury when used as anode in a luminous current, at such a rate as to indicate that with each atom absorbed is associated a negative charge of the same magnitude as the positive carried by it in solutions. The same has also been shown with nitrogen, using sodium, potassium, and a sodium-potassium alloy as anode; and in two cases, with helium, using sodium and mercury as anodes. The fact that nitrogen carries the same charge as hydrogen is consistent with the chemical valence of nitrogen, being in some cases unity. Rutherford has concluded from his experiments that the α article from radium is a helium atom carrying a positive charge of twice the magnitude of that carried by a hydrogen atom in solution, while the results given here indicate, on the other hand, that

with the helium atom is associated a negative charge of the same magnitude as that carried by hydrogen.—*Phys. Review,* November.

Ions Emitted by Hot Bodies.—O. W. RICHARDSON.—A second paper on the kinetic energy of the ions emitted by hot bodies. The chief result of the present investigation is represented in a diagram which exhibits a very close agreement between the distribution of the electrons from a hot platinum strip, in the absence of an external electric field, as found experimentally and that which was predicted in the former paper of the author on the hypothesis that the electrons emitted from the strip left it with a distribution of velocity equipalent to that required by Maxwell's law. The same issue contains a mathematical note of the same author on the kinetic theory of matter.—*Phil. Magazine,* November.

Induction.—P. GIRAULT.—A theoretical note on a law of the variation of induction along the air-gap of dynamos, with reference to a recent paper of W. Crudeli.—*L'Industrie Elec.,* Oct. 25.

Units, Measurements and Instruments.

Frequency Meter and Comparison of Alternating and Direct Current.—C. E. HIATT.—A description of a new frequency meter which depends for its action on the rate at which the heat is generated by the cyclic reversals of magnetic flux in a few milligrams of iron, say, when placed in a solenoid carrying the current whose frequency is to be determined. A fine iron wire, a few millimeters in length, was soldered to a

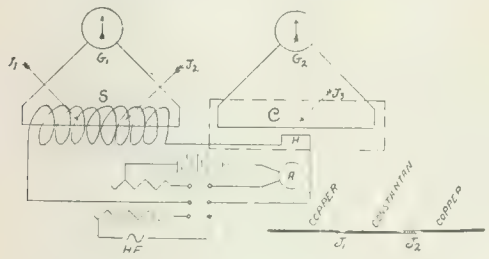


FIG. 6.—DIAGRAM OF ARRANGEMENT.

copper-constantan junction electrically opposed to a similar one, thermally and electrically equivalent, but not containing iron. This is shown in the heavy line detail drawing of Fig. 6. The junction J_2 contains iron, while J_1 does not. This equivalence can be obtained by repeated trials, after which both junctions are placed in a solenoid carrying a constant alternating current. A variation in the frequency of this current causes a proportional variation in the temperature of the junction containing the iron, thus producing a thermo e.m.f. readily observed by a galvanometer. The use of the differential thermo-junction does away with the necessity of excessive shielding and eliminates the troubles which might arise from Joulean heat generated in the coil. Rapidity of action is secured by making the heat capacity of the junctions small and their radiating power high. The alternating current through the solenoid was kept at a constant and known value by means of the regulating resistance and frequent comparison with a standard direct current as measured by the Weston ammeter *A*. This was accomplished with the help of the comparator *C*, shown enclosed by the hatched line rectangle in the illustration. The comparator consisted of a strip of bismuth about 3.5 cm long soldered end-on to a similar one of antimony, forming a junction J_3 just over the heater *H* of manganin. On account of the very satisfactory performance of this simple comparator shown the author has devised a more elaborate and convenient instrument, using the principle of differential thermo-junctions. Fig. 7 is a diagrammatic view of the connections. J_1 and J_2 are delicate, similar and opposed junctions of antimony and bismuth. H_1 and H_2 are similar heaters of a single short length of manganin wire of 0.9 ohm resistance. Slow-motion screws permit delicate variations of distance between the junctions and their respective heaters. The double-throw switch S_1 has two poles above and three below, S_2 is four-pole and double-throw. The two heaters and their corresponding junctions have a heavy shield which is not shown in the diagram. To compare an alternating current with a direct current, the very simple procedure is to put H_1 and H_2 in series by means of the switch S_1 thrown up. The current to be measured, or a stronger one, is then sent through the heaters by throwing S_2 down. The distances of H_1 and H_2 from the junctions are then adjusted until the galvanometer shows no deflection. Now, since

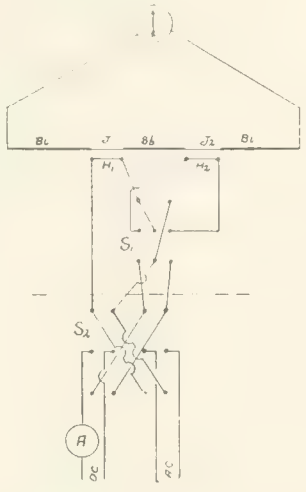


FIG. 7.—DIAGRAM OF CONNECTIONS.

the same current through H_1 and H_2 causes no deflection of the galvanometer, equal currents through H_1 and H_2 will cause no deflection. Then by simply throwing S_1 down the alternating current is sent through H_1 and a direct current through H_2. This equality is secured by adjusting the strength of the direct current. Then the current value is read from the standard ammeter *A*, or by means of a potentiometer and shunt if higher accuracy is desired.—*Phys. Review,* November.

Electrometer.—R M. SAYERS.—The author describes a modified Dolezalek quadrant electrometer which he has found very useful in testing laid submarine cables. The method of using

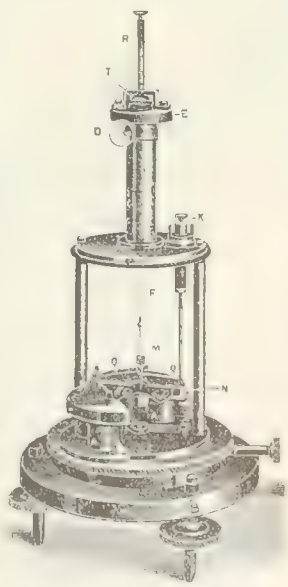


FIG. 8.—VIEW OF ELECTROMETER.

the instrument is given in detail, supplemented by comparative tests made with the galvanometer and the electrometer. Fig. 8 is a general view of the instrument with the case removed. The "needle" *N* (of paper thinly coated with metal, of buckled form, ensuring ample rigidity) carrying the mirror *M* is suspended by a quartz fiber *F*, which is detachable, being provided with a rectangular hook at each end engaging with eyes upon the torsion head and needle respectively. With these hooks,

which are of square section aluminum wire, no slack or backlash is experienced, and fibers of various dimensions may be rapidly interchanged. *QQ* are the brass quadrants mounted on ambroid insulators; *AA*, the opposite pairs of quadrants, being connected as usual. In the figure two adjacent quadrants are shown swung open on a hinge, to allow of access to the needle. The two pairs of quadrants are connected to the terminals on the underside of the base, not visible in the figure. The needle is charged by means of the switch *K*, which consists of an insulated terminal with a brass rod projecting downward and carrying a light strip of phosphor-bronze at its lower end. By turning the terminal the strip can be brought into contact with the needle and then withdrawn. The whole instrument can be rotated in azimuth about the base *B* and clamped in any position by the screw *S*. The ebonite torsion-head *E* is clamped by the screw *D*, and carries a brass rod, *R*, from an eye in the lower end of which the quartz fiber is suspended. This rod has a vertical adjustment controlled by the nut *T*, by means of which the height of the needle in the quadrant box can be varied. The brass cover (removed in the illustration), which serves as a shield from strong electrostatic fields, can be independently turned so as to make the lens *L* face in any desired direction. The author works with a lamp and scale having 500-mm divisions at a distance of 1.5 m from the electrometer. To obtain rapid swings of the needle an electromagnetic damping attachment is provided.—Lond. *Electrician*, Nov. 12.

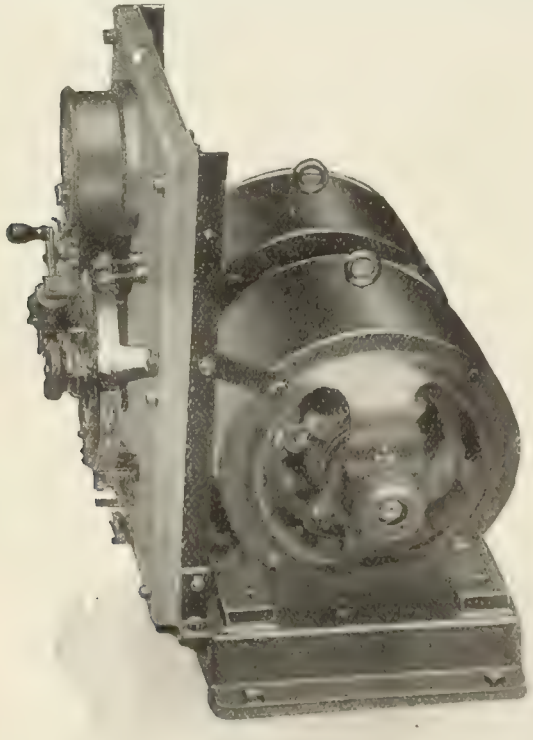
Miscellaneous.

Belgium.—An article on the electrical industries in Belgium in 1906. Belgium electrical industries produced 4000 generators of an aggregate rating of 92,000 kw. In 1906, 150 towns were electrically lighted. In 75 of these there was a power plant More than 200,000 telephones are made per year. The capital invested in various electrical industries in Belgium is $5,000,000 and the number of employees is 6000. Some figures are given on telephony and telegraphy and on technical education in Belgium.—*L'Industrie Elec.*, Nov. 10.

NEW APPARATUS AND APPLIANCES

Lighting System for Use with Hand-Regulated Arc Lamps.

The Helios Manufacturing Company, Philadelphia, Pa., has devised a lighting system for use with all makes and types of hand-regulated arc lamps. A standard motor and generator are coupled together, and controlled from a small operating switchboard. All connections are made on the back of the board, so that the wiring from the main circuit need only be attached to the proper posts, and the wires leading to the lamp to terminals provided for them. When the motor is brought

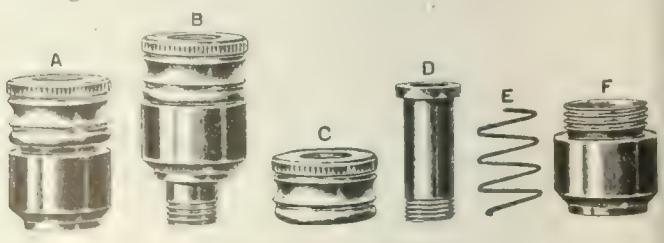


COUPLED MOTOR AND GENERATOR

up to speed in the usual manner, the generator supplies energy to the lamp, and the lamp operates exactly as though fed from standard circuits through a rheostat. All the connections between the motor, generator and switchboard are made complete. The latter contains a voltmeter, which shows the voltage of the generator, and as no resistance is used between the generator and the lamp the voltage of the arc will be indicated also. The starting box for the motor is mounted on the board, and is of the under and-overload release type, so that the motor is fully protected. In addition two sets of fuses are provided, controlled by a double-throw switch, so that should one set blow the other may be at once thrown into service, and the blown fuses replaced at leisure. A field rheostat is mounted on the board to control the shunt circuit of the generator, and thus the voltage at the lamp terminals. The object of the apparatus is, of course, to cut down the losses occasioned by the use of resistances employed for reducing the voltage to that required by the arc.

Shock Absorber for Tungsten Lamps.

The Just-Tungsten Illuminating Company, of New York City, has brought out the lamp protector illustrated herewith. The device is quite simple, and forms a necessary adjunct to the installation of tungsten lamps subject to vibration. As is well known, the tungsten filament is quite brittle, and shocks, jars, etc., soon cause the lamp to become useless. The brass tungsten protector absorbs the horizontal as well as the vertical vibrations, thus guarding the filaments of the lamps against breakage from these causes. The device is installed between



PARTS OF SHOCK ABSORBER

the fixture and the socket. The protector without load is shown at *A*, and with load at *B*. *C* is the detail of the upper part of *A* and *B*, and *D* is the inner brass tube with a thread in the lower end. *E* is the spring surrounding the tube *D*, and *F* is the lower part containing the tube and spring. The upper part is connected with the fixture, and the wire is run through the protector and connected with the lamp socket. The latter is connected with the thread shown in *B*, and when equipped with lamp and shade the flange in the upper end of *D* pulls down the surrounding spring, and holds the load in an elastic swinging state, thereby giving the lamp the necessary protection.

Cable Tester and Trouble Finder.

The location of troubles in telephone cables has always been practically beyond the reach of the manager of the medium and small-size exchange, and there are but few men sufficiently expert with the Wheatstone bridge to enable them to locate troubles such as shorts, grounds and crosses with certainty, and when wet cables are to be tested the majority are unable to effect any test whatever. In most cases they are obliged to locate approximately, and have the troubleman ride the cable to find the fault, and oftentimes if there is no outside indication on the sheath the fault is not found at all. This uncertainty is due to several causes, such as the constantly changing temperature at different points along the cable; the fact that the wires on the outside layers are affected more than those of the core or inner layers; the marked variation in the length of the wires, those near the core being very much shorter than those on the outside, especially in cables of large size, and also to the sag of the cable; so that a combination of these conditions makes it difficult to locate a fault with a bridge exactly. The Electric Specialty Manufacturing Company, of Cedar Rapids, Ia., has brought out a wireless cable tester, the result of several years' experiments by Messrs. George A. Bishton and J. E. Matteson, wire chief and cableman respectively of the Cedar Rapids & Marion Telephone Company. The tester was brought to its present state of efficiency about 18 months ago. It consists of a sender or vibrator, a head telephone receiver and a special selector or detector coil. The latter is so constructed as to kill the inductive effects of the foreign current on the cable sheath, and at the same time to permit the tone from the sender to be distinctly heard. The working of the tester under the many different and difficult conditions is due to the circuits and connections provided, and the manufacturer claims that troubles may be located exactly on all grounded, crossed, short and wet pairs in cables of any length or size. It is said that on grounded, short or crossed lines the tester will locate the fault exactly without exterior evidence on the sheath. Troubles from wet cables are as easily found as some of the other faults. When there is but slight moisture difficulty is experienced, owing to the very high and variable resistance. In such cases the instrument has been used to dry out the dampness and clear the fault. The instrument is usually connected at the office end of the cable to the wire or wires in trouble. The vibrator when started sends out a tone wave of high frequency so regulated, when properly connected, as not to interfere materially with the working lines in the cable. The troubleman usually makes his first tests where the cable leaves the office, or underground, to see that the instrument is working, then by going to about the center of the cable he can, by climbing three or four poles, run the trouble down to a very small space, and finally, by the use of a cable car, locate it exactly. Tests are made by placing the detector coil against the cable sheath, which permits the tone to be distinctly heard in the receiver, and as soon as the fault is passed the tone stops. No bridge measurements are necessary, but where the bridge is being used extensively the tester is of value as an auxiliary, since it is found necessary to make only approximate measurements, and by sending the cableman with his repair outfit to within a short distance of the trouble it can be readily located and repaired. Three good dry cells are all that are necessary to operate the instrument successfully.



FIG. 1—LOCATING TROUBLE WITH DETECTOR COIL.

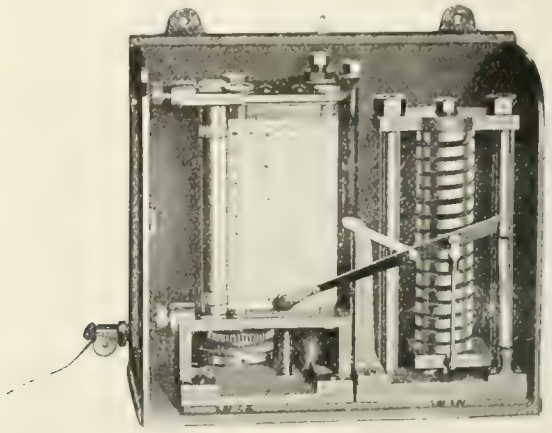


FIG. 2—DETECTOR COIL ON END OF FISH POLE.

Exposed Spring Indicator.

An exposed spring indicator embodying several features of importance has been brought out by the American Steam Gage & Valve Manufacturing Company, of Boston, Mass. Owing to the short piston rod which the spring surrounds, the manufacturer states greater uniformity and accuracy of re-

sults are obtained, since the shorter the piston rod the less liability there is to binding. The new type of exposed spring does not necessitate increased length or weight of the piston rod to any appreciable extent and thus avoids any increase of inertia in the moving parts. The design is said to secure all



EXPOSED SPRING INDICATOR

the accuracy originally gained with a short piston rod, with the advantages which all exposed or outside springs possess of being impervious to the effects of heat or cold and readily changed.

Electric Hammer.

A new electric hammer, produced by the Electro-Magnetic Tool Company, 115 South Clinton Street, Chicago, has recently made its appearance on the market. The principle upon which it operates is that of an electromagnet, but in this tool the difficulties which have heretofore been encountered in applying this principle have, it is stated, been entirely overcome by the employment of a new principle in construction. The product



FIG. 1—ELECTRIC HAMMER IN USE.

of the company is designated as its "Model 5" hammer, recommended for drilling concrete, brick and stone. (See Fig. 1.)

The detail parts of this tool are shown in Fig. 2. The frame consists of two pieces of steel tubing *A* and *B*, separated by a brass gear case *C*, and bound together by two tie-rods *D*. The nose-piece *F* is of cast aluminum. In the lower section of the hammer frame is located an electromagnet *H* designed to exert a pull of 100 lb. Within the solenoid is a sleeve *J*, operated through the gears *M* and *N* and the connecting rod *E* by a series motor *K*, installed in the upper portion of the hammer

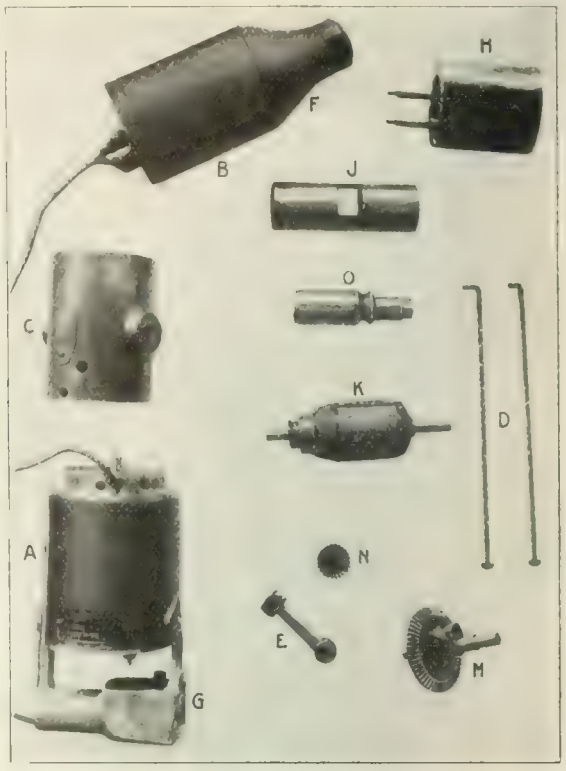


FIG. 2—PARTS OF ELECTRIC HAMMER.

frame. The hammer element *O*, weighing approximately 2½ lb., is located inside the sleeve, and is not connected mechanically or electrically with any portion of the drill, being absolutely free to move. The gears, sleeve and plunger are case-hardened, and all interior nuts and bolts are securely fastened. The bearings are of Tobin bronze and are provided with adequate means of lubrication.

The principle of operation may be readily appreciated by reference to Fig. 3. The sleeve *J*, which lies within the electromagnet *H*, is open in the center; the two ends are held together by three small struts, and the hammer element *O* lies within this sleeve. Current passing through the solenoid *H* produces a powerful magnetic field. The path of this field being through the hammer casing *B*, the steel heads *LL* through the sleeve *J*, till the opening is reached, thence into the plunger *O*, back into the other portion of the sleeve to completion. The plunger, being free to move, will tend to take up a position exactly midway of the sleeve. This sleeve, however, is reciprocated by the action of the motor *K* through the gears *M* and *N*. The sleeve starting on its stroke is not followed directly by the plunger until it has reached a point where the concentration of the magnetic pull is sufficient to overcome the inertia of this element. The plunger will then follow the sleeve on its stroke in an attempt to assume its normal position—that is, exactly midway of the sleeve. Before this has been accomplished, however, the sleeve has started upon its return, and the magnetic pull is gradually concentrated upon the other end of the plunger until this motion is likewise reversed. The hammer element, therefore, flies first one way and then another in an attempt to keep constantly midway of the sleeve. On its forward flight it impinges on the drill shank *P*, delivering a true hammer blow. On its return flight it is automatically brought to rest by the action of the magnetic field; but as the plunger is not mechanically connected to any other portion of the hammer, and as the magnetic pull is not suddenly applied,

but gradually concentrated, there are no sudden strains or jars placed upon the gears or crank shaft by the blow. The magnetic connection acting with a cushioning effect is stated to be even superior to that produced in an air hammer by early admission.

The electric circuit remains unbroken and always in the same direction. Make-and-break contacts and reversing devices are therefore eliminated. The operation of the tool is controlled entirely by the switch in the handle, which is only operated to start or stop the tool. The motor and solenoid being connected in parallel, the breaking of the circuit, in stopping the drill, automatically short-circuits the electromagnet through the motor, thus preventing any inductive kick from the coil.

The placing of wooden strips or inserts in concrete buildings has never been a success, and the practice of laying conduit imbedded in concrete during the construction, in the majority of buildings, has mitigated materially against the flexibility of arrangement. The cost of drilling holes has been so high as almost to prohibit open conduit work. The hammer described, which strikes 1450 blows a minute, so decreases the cost of

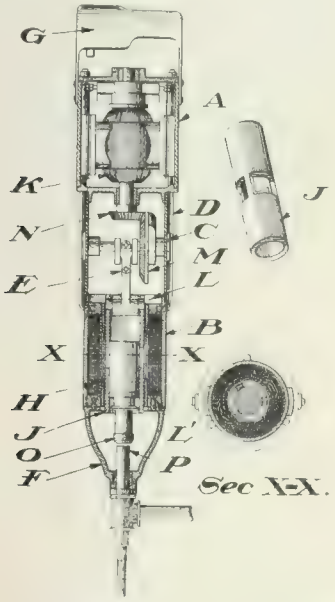


FIG. 3.—SECTIONAL VIEW OF HAMMER.

drilling holes for expansion bolts as to make this practice cheaper than the less satisfactory methods.

It is claimed that the tool can be counted upon to do as much work as five or six men using hand tools. Several companies can now drill 1000 holes per day, 2 in. deep and 9/16 in. in diameter, using this tool, where formerly 50 to 75 holes were a day's work. The amount of power required is so small that the hammer may be operated directly from lighting circuits; and as it is portable and may be operated in any position or at any angle, it makes a particularly attractive tool for contract work.

Three-Phase Transformer.

The three-phase transformer presents certain inherent advantages of compactness in construction and installation, since it supplants with a single piece of apparatus the equivalent group of three single-phase transformers otherwise required for the same service. The simplicity of connections and the better appearance presented by the three-phase transformer when installed on a pole or elsewhere have led many to prefer it for electrical distribution to the equivalent arrangement of three single-phase transformers.

The accompanying illustration shows a Westinghouse Type C three-phase transformer in which, it is stated, marked improvement has been introduced, resulting, besides the advantages already enumerated as inherent to this design, in decided advances in both construction and performance. In these transformers the losses are reduced below those of any ordinary equivalent combination for transforming three-phase power, while experience in design and modern factory methods have produced a highly serviceable apparatus that can be sold below the price of the equivalent single-phase transformer group.

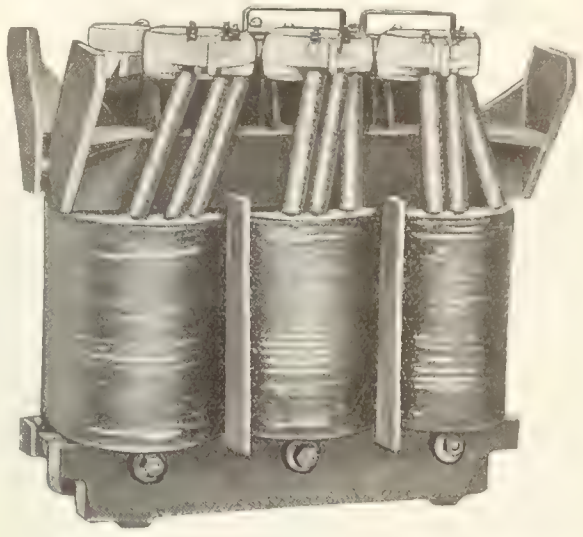


FIG. 4.—THREE-PHASE TRANSFORMER WITH CASE REMOVED.

The transformers are made in sizes ranging from 5 kw to 75 kw capacity, and display very high efficiency at all loads, as well as close regulation when operating on currents having low power factors. These properties of good regulation and efficiency, together with compactness and simplicity, make them especially adaptable for supplying motor loads.

The cast-iron corrugated case employed is quite similar in design to that used in the other recent types of Westinghouse transformers. The three high-tension leads enter from the front side of the transformer, the low-tension secondaries issuing from the pole side of the case. Provision has also been made for bringing out neutral leads, when desired, from both the high-tension and low-tension windings. Separate terminal blocks are provided for both the high-tension and low-tension leads of each of the three phases. Each low-tension winding



FIG. 5.—[illegible] TRANSFORMER.

comprises two coils, which can be connected in parallel for 110 volts or in series for 220 volts, the standard design being for 2200 volts on the high-tension side. In general, the design and construction are developments of the Westinghouse single-phase lighting transformer.

Meter-Testing System.

The accompanying illustrations refer to a meter-testing system designed to solve many of the perplexing meter-testing problems of the past. This new system permits of the installation of meters in more accessible positions and enables the necessary tests to be made without breaking or making the service connections, as is absolutely essential with the older methods.

The principal element of this new testing system is the use of a new special testing device consisting of two elements as follows: A specially designed fused terminal block equipped with a National Code protecting case so designed as to re-

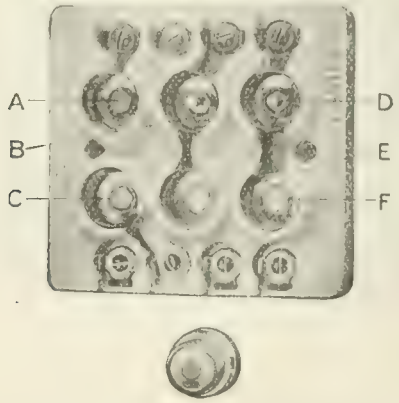


FIG. 1.—PORCELAIN TERMINAL BLOCK.

ceive the terminal block and also to enclose the terminals of the service meter. It is intended that the entire device will be permanently mounted on the consumer's premises and form a part of the service connection.

Fig. 1 illustrates the special porcelain terminal block which, as will be noted, is provided with six receptacles, four of which are of standard and two of which are of special construction. The standard receptacles will thus receive the regular Edison fuse plugs shown in the illustration, while the special receptacles, being provided with center studs, require the use of special testing plugs shown in Fig. 2.

These testing plugs are provided with suitable socket terminals which receive flexible test cords, as shown in Fig. 3. Two forms of plugs are employed, these being known as test plugs and fuse plugs. The fuse plugs are intended to protect the service and test circuits against accidental short circuits during test and the test plugs are employed to make connection between the measuring coils of the service and the standard meters.



FIG. 2.—TESTING PLUG.



FIG. 3.—PLUG WITH SOCKET TERMINAL.

This combined installation and testing scheme, which is being placed on the market by the Central Electric Company, Chicago, is adapted for use with the various types of commercial meters, as many forms of enclosing boxes are supplied to fit the different types. A typical test connection is shown in Fig. 4 in which a service meter is being tested by means of a rotating standard and an artificial load box. It will be noted that the line or load wires have not been disturbed, or the consumer's service interfered with. Furthermore, in connecting up for the test it was not necessary for the meter tester to use screwdrivers or pliers nor untape or retape joints.

It will be understood that the special test plugs and cords are simply in use at the time of making tests and are then replaced by the regular Edison fuse plugs. The special porcelain testing block, in addition to offering facilities for test, also serves as a standard fuse block under regular service conditions. In designing the testing block every commercial meter on the market has been considered and provision has been made for its installation and test.

A permanent installation is shown in Fig. 5, the test having

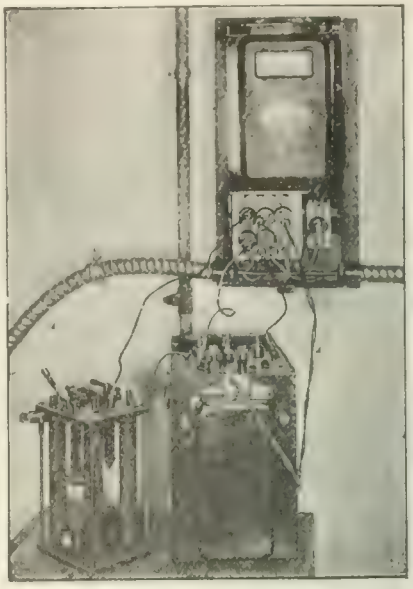


FIG. 4.—CONNECTIONS FOR METER TEST.



FIG. 5.—PERMANENT INSTALLATION.

been completed and the cover sealed in place. Under these conditions service is absolutely protected from danger of current theft, as there are no bare connections exposed from which current can be tapped off.

Electric Drive for Printing Establishments.

The character of the service in printing establishments usually makes it desirable to install the individual motor drive. Among the principal advantages over other drives obtained by



FIG. 1.—ARRANGEMENT OF CONTROLLER AND RESISTANCE ON PRESS.

driving a press by an individual motor are positive and easily manipulated speed control through a wide range, low-operating cost, improved cleanliness, greater safety, decided space economy, and in general, much higher plant efficiency.

The General Electric Company has developed a type of single-phase motors, known as type R I, which is claimed to provide

all these advantages. By means of controllers they give a variation of 50 per cent below synchronous speed with uniform and rapid acceleration and retardation. An installation of motors in the plant of a well-known job printing establishment in Warren, Pa., illustrates the adaptability of this type to work of this class.

The printing plant in question at first operated its press

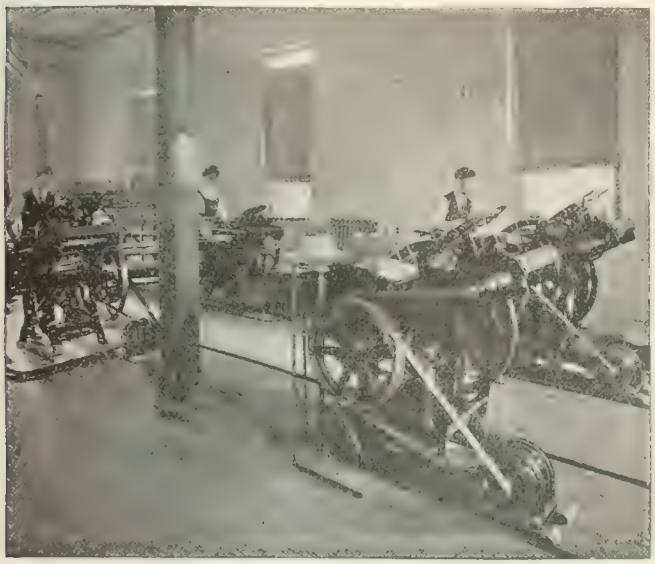


FIG. 2.—½ HP. VARIABLE-SPEED MOTORS DRIVING JOB PRESSES.

equipment by means of a 6-hp gas engine. Owing, however, to frequent shut-downs and generally unsatisfactory operation, the engine was replaced by a 6-hp direct-current motor. The improvement in service was so marked that in order to secure the added advantages of the individual drive in regard to speed control, etc., the proprietors decided to adopt still further refinements and so installed a General Electric single-phase motor to drive separately each of the five presses in use, as well as one stitcher. The final arrangement with individual drive brought about such marked improvements in regard to cleanliness, noise, operating costs, etc., that the owners have



FIG. 3.—SINGLE-PHASE, VARIABLE-SPEED MOTOR ARRANGED FOR BELTED INDIVIDUAL DRIVE.

stated, after a thorough trial, that they are convinced "it is the perfect power. The flexibility of the motor drive makes it possible to get out better and more work at a very low power cost. The motors are little beauties and run like a charm. It is certainly surprising how much lighter, cleaner, and quieter the plant is now than with the old shafting."

Some Special Features in the Design of a 2000-kw Generator.

The power plant which has recently been put into operation at the Packard Motor Car Company's plant at Detroit has several novel features in its design. One of these is the 2000-kw direct-current Hawthorne generator, which is direct driven by



FIG. 4.—PRESSES OPERATED BY SINGLE-PHASE MOTORS.

a Cooper horizontal cross-compound engine. The unusual feature about this generator was the fact that the question of shipment was the chief factor of its design. The whole generator was shipped practically in pieces and assembled at the plant. The frame was 22 ft. 1 in. in diameter, weighing 24 tons, so that one-half of the frame when loaded on the car for shipment stood a little over the railroad limits for clearing. In order to ship the frame, therefore, special arrangements had to be made with the railroads between the shipping point at the Hawthorne works of the Western Electric Company and the works of the Motor Car Company at Detroit.

Another special feature was the dividing of the armature center or spider, and the bolting and keying of it on the engine shaft in a manner similar to the usual method of flywheel installation. The armature core laminations, after punching and japanning at the factory, were packed in boxes, and stacked to form the core after the spider was mounted on the shaft at the plant.

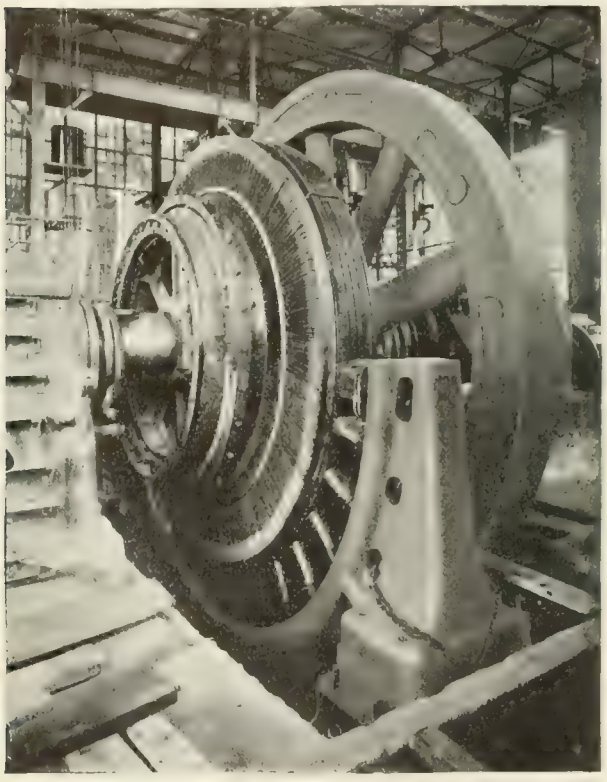
The commutator presented the most difficult problem. While the commutator proper is but 10 ft. 4 in. in diameter, the diameter over the tangs is practically the same as that of the armature, namely, 15 ft. 6 in. It was, therefore, necessary to split it. To divide and ship divided this annular ring built up of 816 copper and an equal number of mica segments was a very undesirable proposition, but it was done successfully. An accompanying illustration shows the generator just after the commutator was placed on the shaft. The ring around it was used to tighten it as much as possible. As soon as the windings were all in place the motor was run with a weak field, separately excited, and short-circuited. By this process the commutator was thoroughly baked. While still hot all the cap screws were brought up as tightly as possible. The commutator was then turned down and trued for operation.

During the time of erection not one part or piece had to be trimmed or fitted. Every part went together and fitted perfectly, although the machine was then being assembled for the first time.

For several weeks previous the Packard officials had planned a banquet on Oct. 8 in the engine-room to celebrate the completion of the installation. As a result the Western Electric Company's installers were so rushed to complete the work that no preliminary testing except for a few minutes to determine

the polarity and make tests for brush position could be made. The work of connecting up was completed but six hours before the banquet was served, yet when President Joy threw full load on the generator his guests saw it carry the load without a spark and without further adjustment.

To practically build a generator weighing complete approxi-

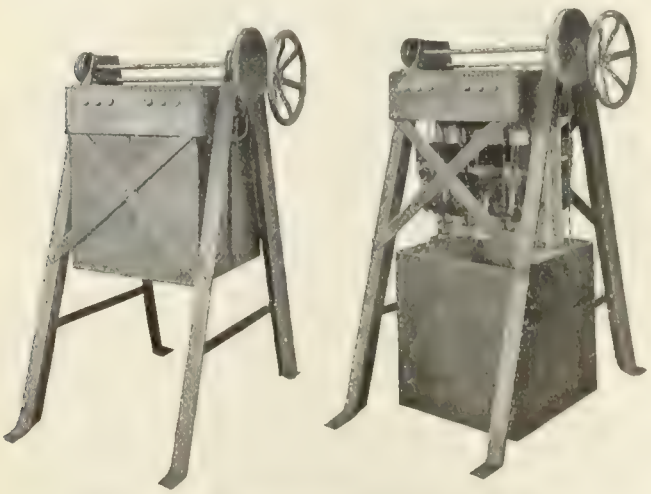


2000-KW, DIRECT-CURRENT GENERATOR.

mately 107 tons and to put it into operation without a single extra fitting or adjustment speaks well of the judgment of the designers as well as the good work of the shop and installing forces.

High-Tension Contactor Panel.

A very desirable feature possessed by the electric motor as a source of power is the ease with which it lends itself to remote



FIGS. 1 AND 2.—HIGH-TENSION CONTACTOR PANEL.

control. The panel shown in the cut is designed to control a 750-hp, 2080-volt, squirrel-cage-type induction motor. This motor drives a centrifugal pump used in connection with a suction dredge to assist in forcing the material through pipes in order that it may be discharged at a distant point. Owing to the high voltage the contactors for connecting the motor to the compensator and to the line after the starting period are oil immersed.

The motor and panel are located at a distance from the dredge, and the panel is designed for control from the dredge, as there will be no attendant at the point where the motor is installed. The overload device on the control panel is so connected that in case the motor becomes overloaded, the control circuit is opened at the dredge and this in turn opens the motor circuit by means of the contactors, thus making it possible in case of a temporary overload to start the motor again from the dredge. In Fig. 2 the oil receptacle is lowered to permit inspection of the contactors. This panel was manufactured by the General Electric Company at its Schenectady Works.

Remote Control Switch.

The accompanying illustrations give two views of a 300-amp, three-pole Darrin magnet main-line switch for the remote control of motors or lamps. These switches are particularly useful in connection with alternating-current motors where it is de-

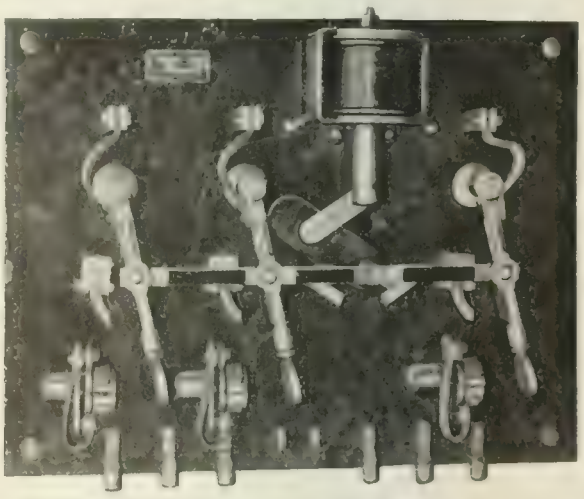


FIG. 1.—REMOTE CONTROL SWITCH.

sirable to do away with the heating and noise occasioned by laminated magnets carrying current continuously. The switch magnet carries current only during the actual operation of throwing the switch open or closed. In the illustrations lami-

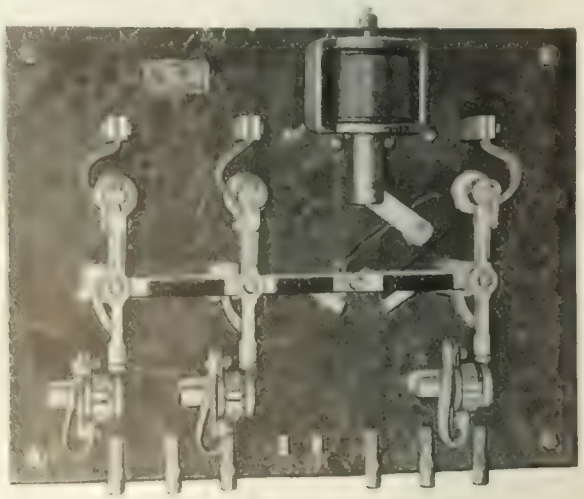


FIG. 2.—REMOTE CONTROL SWITCH.

nated final current-carrying contacts are shown, these contacts being necessary where heavy currents are carried. A large number of these switches will be used in the new building of the Prudential Life Insurance Company at Newark, N. J.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

There was considerable improvement in retail trade during the past week, according to reports received from all parts of the country. Colder weather and the approach of the holiday season have done much to stimulate buying, although in some rural sections continuous rains and snows have made the roads temporarily almost impassable. Wholesalers and jobbers report a fair number of orders, especially reorders, and numerous inquiries for spring business. In manufacturing lines it is the same old story of expansion. This is especially true with regard to the iron and steel business, where the bookings for October and for the first three weeks of November have been so large that it has been necessary to advance prices, and to refuse orders except for distant deliveries. Rail orders during the past week were fairly liberal, and it is known that many heavy specifications have been drawn which will soon materialize into orders for delivery during the first half of 1910. Overtime is the general rule throughout the Pittsburgh section, and there are complaints over the scarcity of skilled labor. The demand for structural material also continues to be very large, and the building industry is almost as flourishing as it was at the beginning of the summer. Railroad traffic continues to expand, the weekly reports show a vast increase in earnings and in some sections there is complaint from the shortage of cars. Collections improve with each week, and are fairly satisfactory at this time. Business failures for the week ended Nov. 25, as reported by *Bradstreet's*, were 217, as compared with 232 the previous week, 193 in 1908, 258 in 1907, 174 in 1906 and 188 in 1905.

THE COPPER MARKET.

The striking buoyancy which stirred the copper market during the past month was checked in a marked degree during the past week by the uncertainty as to the success of the proposed merger of heavy producing interests. Many conservative observers are of the opinion, since reading the decision in the Standard Oil case, that the copper merger as outlined would be a more pointed violation of the Sherman law, as now interpreted, than the Standard Oil. It is being organized for the avowed purpose of "controlling prices" and regulating production. These are the exact crimes of which the oil company has been found guilty. The growth of this impression has not only broken the prices of copper stocks in the Wall Street market, but it has almost stopped all buying in the metal market. Consumers who rushed in alarm to stock up, before the market was "in control," see no reason for haste under existing circumstances, and many of them are beginning to repent their rashness, in view of the adverse statistical position. The negotiators of the merger still assert with confidence that the court's decision does not apply to their plan and that it will be carried out as projected. During the past week prices of copper have been lower and takings light. For the month of November, however, sales have been heavy both at home and abroad. Exports up to and including Nov. 29 were 21,391 tons, indicating shipments of about 50,000,000 lb. The daily call on the Metal Exchange Nov. 29 quoted standard copper as follows:

	Bid.	Asked.	Settling price.
Spot	13.00	13.25	....
November	13.00	13.25	13.12½
December	13.00	13.25	13.12½
January	12.87½	13.12½	13.00
February	12.87½	13.12½	13.00
March	12.87½	13.12½	13.00

The London prices Nov. 29 were as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	58	5	9	58	5	9
Standard copper, futures	59	7	6	59	7	6
Market	Weak			Steady		
Sales of spot				700 tons		
Sales of futures				2,400 tons		

Extreme fluctuations for this year:

	Highest.			Lowest.		
Standard	13.45			12.12½		
London, spot	£64	2	6	£54	12	6
London, futures	64	17	6	55	10	0
London, best selected	67	15	0	59	0	0

UNITED STATES GAS & ELECTRIC COMPANY.—William T. Morris, who was formerly connected with the Associated Gas & Electric Company, has sold out his holdings in that concern. The fact that this company had taken over a number of properties formerly held by Mr. Morris, and would be operated by W. S. Barstow & Company, of New York, was published in our issue of Oct. 14. At that time it was stated that Mr. Morris personally had retained control of the Lyons (N. Y.) Gas Light Company, the Newark Gas Light & Fuel Company, the Oswego Gas Light Company, the Palmyra Gas & Electric Company and the Penn Yan Gas Light Company. Mr. Morris has now formed the United States Gas & Electric Company, incorporated under the laws of New York, with general offices at Penn Yan, to take over and operate these properties. The charters of this company and of the Associated company were issued a number of years ago, but no organization was made until recently.

GENERAL ELECTRIC COMPANY'S ILLUMINATING ENGINEERS.—The General Electric Company has arranged to centralize the department of its illuminating engineers; in other words, all of the illuminating engineers of the company, which number 10 or 12, will hereafter do their work and make their homes in Schenectady. The building which was formerly the power station of the Schenectady Illuminating Company is being transformed into an office building, with laboratories and exhibition rooms, and will be the headquarters of the illuminating engineers of the company. William D'A. Ryan, the chief illuminating engineer of the company, and who has been located at Lynn, Mass., will be in charge of the new offices at Schenectady. The engineers who have been employed at Harrison will also be located in Schenectady.

CROCKER-WHEELER CANADIAN PLANT.—The Croker-Wheeler Manufacturing Company, of Ampere, N. J., has decided to establish a Canadian branch at St. Catharines, Ont. The company has purchased the old Ross factory from the city corporation which it is going to enlarge. The company agrees to begin operations with 100 first-class mechanics, but it is expected that this force will be very greatly increased within the next few years, as the company does a big business in Canada upon which there is a duty of 30 per cent. It is reported that the company has secured a contract for machinery for the Winnipeg municipal plant amounting to about $250,000 which will be manufactured at the St. Catharines works. The company has heretofore maintained an office at Montreal, but it will be removed to St. Catharines.

GENERAL MOTORS COMPANY EXTENSIONS.—Plans have been drawn by the General Motors Company for the erection of a $2,500,000 plant in Detroit. A tract of 50 acres has been secured on which 14 large modern factory buildings will be erected. The company has acquired quite a number of important automobile manufacturing concerns and since it increased its capital stock several months ago it has been the intention of the officials to erect a large central plant in Detroit.

PROPOSED WISCONSIN ELECTRIC RAILWAYS.—John I. Beggs, president and general manager of the Milwaukee Electric Railway & Light Company, in a recent address at Whitewater, Wis., said that he intended to build an interurban line between Watertown, Ft. Atkinson, Jefferson and Janesville in a few years. He stated that spurs would then be built from the main road to Whitewater, Lake Geneva, Elkhorn and Delavan.

QUINCY ELECTRIC LIGHT & POWER COMPANY.—The Gas Commissioners of Massachusetts have been petitioned by the Quincy Electric Light & Power Company for authority to issue $50,000 of additional capital stock, the proceeds to be used to pay off floating indebtedness. The company asks to have the price of the new stock set at 110 per share.

ALLEN & CALVES, COMITAN, MEXICO.—It is announced that Allen & Calves, Comitan, Chiapas, Mexico, have leased for a term of years the electric light plant of Francisco Orozco y Jimenez, and also that of Paniagua y Garcia, in the city of San Cristobal, L. C.

MEXICAN NORTHERN POWER COMPANY.—A meeting of the shareholders and bondholders of the Mexican Northern Power Company was held in Montreal on Nov. 17, when authority was given for an increase in the bond issue from $7,500,000 to $10,000,000, and the capital stock is to be increased from $10,000,000 to $15,000,000. The company has obtained valuable concessions for the erection on the Conchas River in the State of Chihuahua in Mexico of extensive hydroelectric and irrigation projects. An immense dam will be constructed which will probably be the largest in the world, having a sufficient storage capacity to operate a plant generating 40,000 hp. There will be two transmission lines, one to the City of Chihuahua on the north and Peral on the west. Between these places are many towns and mining camps of great importance. A census showed that an aggregate of 30,000 hp is actually installed in these places. The power is now generated by steam from wood and coal, which are exceedingly costly and scarce. The dam will be located about 20 miles from St. Rosalie, an important city on the line of the Mexican Central Railway. The company has also secured a second water-power some 50 miles further up at Lajoca on the Conchas River, which will be developed later as a second installation, and which will when complete double the capacity of the company. It is estimated that within three years 20,000 hp will have been sold at a price of $100 gold per horse-power per annum. Construction operations were begun two months ago by the firm of S. Pearson & Company, Limited. The officers and directors are as follows: C. F. Greenwood, president; E. B. Greenshield, vice-president. Directors: Edwin Hanson, J. S. Moore, B. F. Pearson, Hall Gunther, S. M. Brookfield and J. D. Paterson.

WESTERN ELECTRIC COMPANY.—An official of the Western Electric Company, in discussing the deal between the American Telephone & Telegraph Company and the Western Union Telegraph Company, declared that his corporation had nothing to do with the new arrangement, and will not in any way be affected by it. "The consolidation of interests," said he, "is without any significance as far as the Western Electric Company is concerned. We are manufacturers of telegraph apparatus, and we sell to the Western Union, the Postal and any other customers who desire to buy such apparatus. We are also manufacturers of telephone apparatus, and we sell to the American Telephone & Telegraph Company, which is our largest customer, and we also sell other companies. We expect to maintain our trade entirely upon the price and quality of our products, which compare favorably with those of our competitors." The American Telephone & Telegraph Company owns practically all of the stock of the Western Electric Company, and it is very evident that the new deal cannot be detrimental to the business of the latter.

RUMORED CANADIAN ELECTRICAL MERGER.—The steady buying of shares in the Montreal Light, Heat & Power Company has given rise to a rumor that the Shawinigan Water & Power Company was acquiring the control of the former company. In an interview on Nov. 23, President J. E. Aldred, of the Shawinigan Water & Power Company, stated that the rumor that his company was seeking to obtain control of the Montreal Power Company is untrue. While it is true that the Shawinigan Company had acquired a substantial interest in the Montreal Company, it has been done with the full knowledge of the latter company. The relations between the two companies have been very friendly, and the acquirement of this interest was only a step further toward cementing these friendly relations. Mr. Aldred added that his company still had at its disposal 75,000 hp.

NEW WISCONSIN INTERURBAN LINE.—The Cincinnati Construction Company, recently incorporated to build an interurban line between Madison and Janesville, has made application to the State Railroad Commission for an order of necessity to lay and operate an electric road between these two cities. John A. Aylward, the company's attorney, made the application. An amendment changing the location of the company from Janesville to Madison has also been filed. It is stated that the company has secured the right-of-way of more than half the distance and holds options on the remainder of the route. Attorney Aylward states that a larger part of the construction material has been contracted for, and that work will be started as soon as possible in the spring. Mr. Zigler is president of the Cincinnati Construction Company.

NIAGARA, LOCKPORT & ONTARIO POWER COMPANY.—The American Locomotive Company has just closed a contract with the Niagara, Lockport & Ontario Power Company for energy to operate the former's plant at Dunkirk, N. Y. In addition to this, the Niagara company has extended its contract with the Buffalo, Lockport & Rochester Railway from 3 to 25 years, under an arrangement by which the power company will use the railway company's 60,000-volt transmission line from Lockport to a point within six miles of Rochester. This line will enable the power company to serve a large number of towns along the line of the railway, and will also form an auxiliary to the transmission line of the power company between Lockport and Rochester.

COLORADO TELEPHONE COMPANY.—Plans are being prepared by the Colorado Telephone Company for enlarging and improving the system in Denver, Col., and also in the State of Colorado and in the Territory of New Mexico. The scheme now under consideration will involve an expenditure of about $1,500,000. A new exchange will be opened and a new office building constructed in Denver, and wires will be placed underground in that city. A new system and improvements will be placed in a number of other towns that are reached by the company. It is said that a line will be constructed over the summit of the Cambres Mountain from Almosa to Durango, with an extension to Gunnison, about 200 miles in length.

BIG ORDERS FOR ELECTRIC EQUIPMENT.—It is stated by a financial authority that the makers of electrical apparatus, rolling stock, rails and other supplies for electric railways in the United States have now on hand orders which will amount to about $47,000,000. It is estimated that the electric railways of the United States have to-day an actual physical valuation of $2,250,000,000. In addition to this, important specifications have been approved for the electrification of about 650 miles of steam railroads. Many of these specifications have been held up awaiting the general resumption of business before being carried out.

GREAT NORTHERN ELECTRIFICATION.—Plans are being prepared by the Great Northern Railway Company for the construction of a plant in the Lake Chelan country, which will develop about 80,000 hp. This is in connection with the present plant at Leavenworth, Wash., which has an output of 12,000 hp. It is said that the purpose is to equip the entire western division of the railroad for electric operation. The plant that is now in operation hauls trains through the Cascade Tunnel.

HORNELL-BATH INTERURBAN COMPANY.—Application has been made to the Public Service Commission of the Second District of New York for authority to construct an electric line between Hornell and Bath, in Steuben County, a distance of 23 miles, by the Hornell-Bath Interurban Railway Company. The road will pass through the towns of Hornellsville, Fremont, Howard, Avoca, and Bath. The company has also asked permission to issue $250,000 of common stock and $550,000 of bonds.

CANADIAN WATER-POWER ARBITRATION.—A board of arbitrators has been sitting for several days to determine the value of the water privileges on the Winnipeg River, of which the Hudson's Bay Company and the Kerwatin Power Company were expropriated by the town of Kinora. Three reports on the undeveloped water-power place the value from $5,000 to $48,000.

MONTREAL RAILROAD ELECTRIFICATION.—The Canadian Pacific Railway Company is collecting data relative to the electrification of its Windsor Street terminal in Montreal. The grade from the terminal to the Westmount yards is very heavy and causes the westbound locomotives to produce a great amount of smoke. The electrified section will probably extend to Montreal Junction.

CANADIAN ELECTRIC STEEL PLANT.—Operations were commenced on the building of the Electric Steel Company's experimental plant on Nov. 16. The present building will be 75 x 152 ft. It is expected that by 1912 about $15,000,000 will have been invested here in the company's plant and works. It is reported that there are a dozen very wealthy persons interested in the enterprise.

ELECTRIC MOTOR MANUFACTURERS' ASSOCIATION.—The next meeting of the American Association of Electric Motor Manufacturers will be held at Hot Springs, Va., in the month of May, 1910.

NEW YORK & NORTH SHORE TRACTION COMPANY.—The foundation work has already been completed for the new power house of the New York & North Shore Traction Company at Bayside Meadows, Long Island, and the work of construction will be rushed as rapidly as possible. Contracts for the electrical apparatus have been placed with the Westinghouse Electric & Manufacturing Company, and it is expected to have the station in operation by next February. This equipment consists of two 1000-kw turbine units; two 25-kw turbine exciters; four 300-kw rotary converters; four 333-kva three-phase transformers; one nine-panel and one five-panel switchboard. The surface work on the extension to Whitestone Landing has been done, and the iron poles for supporting trolley wires are being erected.

NEW ELLIS ISLAND ELECTRIC PLANT.—Contracts have been let by the Commissioner of Immigration for the erection of a new power plant on the main island at the Ellis Island Station. The old machinery will be moved to the buildings on the southern island and the new plant utilized for the main buildings. The plant is being constructed by Evans, Almirall & Company, 281 Water Street, and the contract for the electrical apparatus has been awarded to the General Electric Company. The plant will be equipped with one 300-kw and two 125-kw direct-connected horizontal turbine generators and switchboard. The energy will be used for lighting and for operating pumps, including high-pressure pumps for fire service. The plant will be ready for operation about March 1.

BRASS PRICES ADVANCING.—Further advances in commodities in which copper plans an important part have been made within the past 10 days. Brass manufacturers have advanced their prices ¾ of a cent a pound, and the base for brass rods, sheet and wire is now 14 cents. Brazed tubing remains unchanged at 19⅛ cents. The manufacturers of copper wire have made their third advance within the past month of ¼ of a cent a pound, and the base for bare and weather proof wire has now been raised to 15¼ cents a pound. It is said that wire people have been the heaviest buyers of copper within the last few days, and that the wire mills are now preparing to operate on full time.

SWEDISH GENERAL ELECTRIC COMPANY IN CANADA.—Harry D. Bayne, for many years manager of the Canadian branch of the Westinghouse Electric & Manufacturing Company, has acquired an interest in the General Electric Company of Sweden, and has opened an office for the transaction of the business of the company at Montreal. The Swedish Company has been doing business in Canada for some time, but in a somewhat limited way. Application will be made for incorporation in Canada, and under Mr. Bayne's management the business of the company will be vigorously pushed throughout the Dominion.

Financial Intelligence.

THE WEEK IN WALL STREET.

The past week in Wall Street has been one of considerable demoralization and heavy selling pressure. There have also been evidences of more extensive bear operations than have appeared in the Street for many months. On the last day concerned in this report, Nov. 29, the bears made repeated attacks upon the market, and, in spite of some definite efforts to support prices, succeeded in forcing almost the entire list down several points. There was also considerable forced selling due to the exhaustion of margins, and in the present condition of the money market, and with the present uncertainty of financiers, wide margins are universally demanded. This condition in the security market is attributed by almost every trader to the panic created in the minds of many by the decision adverse to the Standard Oil Company. Before that decision the market had been buoyed up and carried along by the copper stocks, which were inflated entirely by the promises of a great merger which would control the copper trade. An analysis of the Standard Oil decision has convinced many that the same conclusions would be reached with regard to the proposed copper merger. This started heavy selling in copper shares, and Amalgamated and other coppers have sold off within the past week from 6 to 8 points. United States Steel, too, it is believed by many, might be in trouble if the Standard Oil decision is sustained by the Supreme Court. For this reason there has been heavy selling of steel shares, and the common closed at 86 Nov. 29, which was several points less than the close the week previous. Aside from this nervousness concerning the future of great industrial corporations, there is no reason for any demoralization in the stock market. Business conditions continue to improve, earnings, both of industrials and railroads, continue to advance and the money market shows no indication of becoming so stringent that operations will be hampered. The situation abroad is improved, and rates in this country are about the same as they have been for the past three weeks. Quotations Nov. 29 were: call, 4 @ 5 per cent; 90 days, 4¾@ 5 per cent.

NEW YORK.

	Nov. 22.	Nov. 29.	Shares sold.		Nov. 22.	Nov. 29.	Shares sold.
All.-Ch.	15*	15½*	2,900	Int.-Met.,pfd.	54¾	54½	31,400
All.-Ch., pfd.	54¼	53¼	5,590	Mackay Cos..	94	92½	4,800
Amal. Cop...	92	84⅛	755,665	MackayC.,pfd.	75⅞	70⅛	800
Am. D. T....	20½*	20½*	.....	Man. Elev...	140	139⅞	400
Am. Loc.....	61½	59¾	7,620	Met. St. Ry..	23*	23*	.....
Am. Loc.,pfd.	115	115	300	N.Y.&N.J.Tel.	139	136¼	.....
Am. Tel. & C.	83*	83*	.....	Steel, com...	88⅜	86	843,400
Am. T. & T..	142⅝	140¼	24,836	Steel, pfd....	125	123½	16,020
B. R. T.....	77¼	77	18,232	W. U. T.....	77⅝	77½	5,390
Gen. Elec....	162	159½	7,000	West'h., com.	85⅞	81⅛	4,800
Int.-Met.,com.	22½	22½	61,020	West'h., pfd.	134½*	136½*	100

PHILADELPHIA.

	Nov. 22.	Nov. 29.		Nov. 22.	Nov. 29.
Am Rys.....	45¼	45⅛	Phila. Elec.....	13	13
Elec. Co. of A.....	12⅜*	12⅜	Phila. R. T.....	26½	25⅞
Elec. St. B'ty.....	58	58	Phila. Trac.....	89*	89*
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	52½	52⅜

CHICAGO

	Nov. 22.	Nov. 29.		Nov. 22.	Nov. 29.
Chi. City Ry.....	180*	180*	Chi. Tel. Co.....	136*	135½
Chi. Rs., Ser. 1.....	100*	98	Met. El., com.....	17*	17*
Chi. Rs., Ser. 2.....	32	32	Met. El., pfd.....	53	51¼
Com. Edison.....	119*	119	Nat'l Carbon.....	97	97
Chi. Subways....	6	5⅛	Nat'l Car., pfd.....	124*	124*

BOSTON

	Nov. 22.	Nov. 29.		Nov. 22.	Nov. 29.
Am. T. & T.....	142⅞	140¾	Mex. Tel.....	3*	3*
Cum. Tel.....	147*	147*	Mex. Tel., pfd.....	6*	6*
Edison E. Ill.....	251*	250*	N. E. Tel.....	135	134¾
Gen. Elec.....	162¼	161¼	W. T. & T.....	12	12
Mass. E. Ry.....	16*	16*	W. T. & T., pfd.....	90	89½
Mass. E. R., pfd....	80	80			

* Last price quoted.
Shares sold are for week of Nov. 22 to Nov. 27.

NORTH SHORE ELECTRIC COMPANY, CHICAGO.—At the annual stockholders' meeting of the North Shore Electric Company, of Chicago, Nov. 29, the report for the year ending Sept. 30, 1909, was presented showing gross earnings of $1,005,432, net earnings of $404,437 and a surplus after paying fixed charges of $214,083. Samuel Insull, president of the company, announced that to provide funds for the acquisition of additional electric light and power properties and for the construction of substations and the enlargement of the company's distribution system, necessitated by the growth of the company's business, an increase in the capital stock of $220,000 and in the outstanding first mortgage bonds of $285,000 had been made. The results of the operation of the new generating station at Waukegan have been very satisfactory and have enabled the company to secure contracts for the furnishing of additional power to interurban railways. There has been a substantial increase in the industrial power business during the year. On Sept. 30, 1909, the connected business of the company, exclusive of railway power business, amounted to the equivalent of 309,786 16-cp lamps. The corresponding figure in 1908 was 263,173 16-cp lamps. The company, which supplies electricity to the suburban villages and towns around Chicago, has five generating stations, located at Waukegan, Evanston, Maywood, Blue Island and Chicago Heights, Ill. There are also substations at Libertyville, LaGrange, Park Ridge, Lake Bluff, Harvey, Evanston (Clark Street) and Highland Park. Of the balance of $214,083 remaining from the net earnings of the year after bond interest had been paid, $75,600 was set aside for a special depreciation reserve, and $103,552 paid in dividends, leaving a balance of $34,930 carried to surplus, making the total surplus on Sept. 30, 1909, $154,000. The balance sheet shows total assets of $8,635,344. The liabilities include $4,000,000 in capital stock, $4,000,000 in bonds, and a depreciation reserve of $267,640.

BRISTOL (TENN.) GAS & ELECTRIC COMPANY.—The plant and franchise of the Bristol (Tenn.) Gas & Electric Company has been purchased by a New York syndicate, the name of which has not been made public. It is said that the price paid was about $400,000. The Bristol company has outstanding bonds to the amount of $325,000, and has in prospect a large water-power development near Bristol.

CONTINENTAL TELEPHONE & TELEGRAPH COMPANY.—It has been announced that the Continental Telephone & Telegraph Company, the new $50,000,000 concern organized to act as a holding company for the Independent telephone interests in the Central States, has purchased control of the American Union Telephone Company, with headquarters at Harrisburg, Pa. The American Union company was formed several years ago to take over the business of various Pennsylvania independent lines. It has an authorized capitalization of $25,000,000 and a bond authorization of the same amount. There have been issued $5,600,000 of stock and $11,000,000 of bonds. The Continental Company now practically controls the Independent telephone situation in Delaware, Maryland, New York, West Virginia, Virginia and New Jersey. Much of this territory was previously controlled by the Interstate Company, which was taken over by the Continental.

WISCONSIN ELECTRICAL PROPERTIES.—The street railway, light, and heat and power companies of Wisconsin show an increased valuation of nearly $3,000,000 compared with a year ago, and the taxes have been doubled by the final assessment of the State Board of Assessment. The sum of $422,015 will be paid in taxes by these companies. Fifteen per cent of the amount, or $62,302, will go to the State, and the remainder, or $358,712.89, will go to the towns, cities or villages where the properties taxed are located. The Milwaukee Electric Railway & Light Company will pay a tax of $249,763. The Southern Wisconsin Railway Company, operating in Madison, will pay $8,001, $6,801 of which will go to the City of Madison.

MACKAY COMPANIES DIVIDEND INCREASED.—Announcement was made last week that the quarterly dividend on the common stock of the Mackay companies would be increased from 1 per cent to 1¼ per cent, putting the stock upon a 5 per cent basis. The dividend on the preferred stock will continue at 4 per cent. The Mackay Companies is not an incorporated concern, although it has $41,380,000 of common stock. It is announced in the concern's literature that it is "a voluntary association created by agreement and declaration of trust." Clarence H. Mackay, president of the company, continues to assert that there is no thought of any merger with the Western Union or with the American Telephone & Telegraph Company.

CHICAGO SUBWAY COMPLICATIONS.—It is said that the managers of the Chicago Subway Company have decided not to pay the interest due Dec. 1 on the $17,000,000 of first lien bonds, and that the appointment of a receiver will be asked for. For some time the price of the stock of this company has indicated that this course would be adopted. It is known that Harriman and Armour interests have advanced about $8,000,000 for the payment of interest heretofore and for development work, but the earnings have never caught up with the fixed charges of the company, and until very recently have been insufficient to cover the cost of operation.

UNION SWITCH & SIGNAL COMPANY.—A semi-official statement from the Union Switch & Signal Company indicates that the company is enjoying the most prosperous period of its history. In addition to the very large order for equipping the Pennsylvania tunnels, the company has a number of important contracts under way. The factory at Swissvale, Pa., is now employing about 1600 men as compared with 700 at this time last year. The company has a capital of $2,500,000 and a surplus of about the same amount. The company has outstanding only $100,000 of bonds and has in cash in bank several times that amount.

METROPOLITAN STREET RAILWAY REORGANIZATION.—At a meeting of the joint committee on reorganization of the Metropolitan Street Railway Company last week, at which representatives of the various bondholders' committees were present, C. E. Tripp, connected with Stone & Webster, was elected chairman of the committee in place of the late John W. Castles. Mr. Tripp has for the past year been devoting himself exclusively to working out a plan of reorganization for the Metropolitan system.

NORFOLK & BRISTOL STREET RAILWAY COMPANY.—A petition has been filed with the Railway Commission of Massachusetts by the Norfolk & Bristol Railway Company asking permission to issue $50,000 additional first mortgage 5 per cent bonds. The proceeds of these bonds are to be used for making further additions and improvements to the property. They are a part of an issue of $200,000, which was previously authorized by the commission, and of which $150,000 has already been issued.

EAST CREEK ELECTRIC COMPANY.—Application has been made to the Public Service Commission of the Second District of New York, by the East Creek Electric Light & Power Company, of St. Johnsville, for permission to issue a mortgage on all its property for $2,000,000, and to increase its capital stock from $200,000 to $750,000. The money is to be used for extensions and improvements.

DIVIDENDS.

Mackay Companies, quarterly, common 1¼ per cent; preferred, 1 per cent, payable Jan. 3.

Massachusetts Electric Companies, preferred, semi-annual, 1¾ per cent, payable Jan. 1.

Norfolk Railway & Light Company, semi-annual, 2 per cent, payable Dec. 6.

Safety Car Heating & Lighting Company, quarterly, 2 per cent, extra 1 per cent, payable Dec. 23.

REPORTS OF EARNINGS

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Cities Railway & Light Company.					
October, 1909	$544,720	$306,999	$217,707	$107,207	$110,500
October, 1908	[illegible]	292,826	188,175	104,472	83,703
American Pneumatic Service Company:					
Six months ended Sept 30, 1909	[illegible]	[illegible]	222,227	120,409	101,817
Six months ended Sept. 30, 1908	[illegible]	[illegible]	131,320	105,748	25,571
Electric Light & Power Company, of Abington and Rockland, Mass.					
September, 1909	7,68[illegible]	4,618	3,062	795	2,266
September, 1908	4,790	3,014	1,776	327	1,448
Jacksonville (Fla.) Electric Company:					
September, 1909	38,375	20,807	17,567	8,480	9,087
September, 1908	[illegible]	18,372	15,645	8,053	7,591
Lowell Electric Corporation:					
September, 1909	29,186	14,82[illegible]	14,363	6,181	8,181
September, 1908	[illegible]	16,138	10,189	2,786	7,403
Michigan United Railways Company:					
Year ended April 30, 1909	[illegible]	568,157	452,971	305,891	152,747
Year ended April 30, 1908	[illegible]	521,728	420,275	262,726	158,876
Montreal Street Railway Company:					
October, 1909	[illegible]	178,734	175,272	27,079	148,192
October, 1908	328,608	168,124	160,484	27,480	133,004
New York City Interborough Railway Company:					
Year ended June 30, 1909	[illegible]	169,015	*10,888	98,810	*109,371
Year ended June 30, 1908	[illegible]	143,071	*36,136	90,000	*126,136
North Shore Electric Company, Chicago:					
Year ended Sept. 30, 1909	[illegible]	600,995	404,437	190,354	214,083
Year ended Sept. 30, 1908	815,550	533,618	281,932	159,282	122,650
Pensacola Electric Company:					
September, 1909	[illegible]	12,828	8,821	4,335	4,485
September, 1908	[illegible]	12,035	5,381	4,351	1,029
Philadelphia Company, of Pittsburgh:					
October, 1909	[illegible]	978,990	662,018	.....	.....
October, 1908	[illegible]	813,132	583,296	.....	.....
Toledo Railway & Light Company:					
October, 1909	[illegible]	129,719	109,655	75,615	34,285
October, 1908	[illegible]	119,982	98,092	71,953	26,326
Twin City Rapid Transit Company:					
October, 1909	[illegible]	277,174	319,787	140,251	179,537
October, 1908	[illegible]	265,892	288,273	138,667	149,606

* Deficit.

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—It is reported that the Birmingham Railway, Light & Power Company will soon build an extension of its lines from Wylam, Ala., to the new plant of the Tennessee Coal, Iron & Railway Company.

GADSDEN, ALA.—The grading for the extension of the Alabama City, Gadsden & Atalla Railway Company's line has been completed near Gadsden, Ala. This railway will extend from Forest Avenue, Gadsden, to the new plant of the Southern Iron & Steel Company.

GURLEY, ALA.—The Gurley Light & Power Company is reported to have placed contracts for a greater part of the machinery for its proposed power plant. The company is in the market for a new or second-hand 100 to 125-hp boiler, complete with fittings. The main office of the company is located at Huntsville, Ala. F. A. Howe, Jr., is president and treasurer.

HAYWARDS, CAL.—D. U. Teffelmier, representing the United Power Company, has filed a petition with the Board of Trustees asking for a franchise for the erection and maintenance of transmission lines throughout the city. The company has already applied to the Board of Supervisors and to the Trustees of San Leandro for a franchise.

NAPA, CAL.—The Napa Gas & Electric Company is planning to extend its transmission line to the Napa Soda Springs. O. E. Clark, superintendent, will have charge of the work.

OAKLAND, CAL.—The citizens on Nov. 16 voted to issue $3,733,000 in bonds for municipal improvements, of which $80,000 will be used for the betterment of the fire, police and telegraph systems.

PASADENA, CAL.—The Southern California Edison Electric Company is planning to install meters throughout the city and will discontinue flat rates after Jan. 1, 1910.

SALINAS, CAL.—The Monterey County Gas & Electric Company has changed its two-phase, four-wire distributing system to a three-phase, three-wire, 60-cycle, 2200-volt system. F. J. Sutherland is general superintendent.

DENVER, COL.—Arrangements are being made by the Denver City Tramway Company for the installation of an additional 3000-hp unit in its plant at Fourteenth and Fifteenth streets and Platte River. An addition will be made to the power house, which will be large enough to accommodate several more units as needed.

DENVER, COL.—Plans are being prepared by the Colorado Telephone Company for enlarging and improving its telephone system in Denver, Col., in the States of Colorado and New Mexico during the coming year, which will involve an expenditure of $1,500,000. The work will include the opening of a new exchange and the erection of a new office building in Denver, and placing its wires in underground conduits. An entirely new plant will be built in Greeley, at a cost of $20,000; new systems and office buildings will be erected in a number of the larger towns in the State and new long-distance lines are to be added to existing circuits. A telephone line will be erected over the summit of Cumbres Mountain from Alamosa to Durango, and from Salida to Gunnison, a distance of over 200 miles. The system will also be extended into New Mexico.

GREELEY, COL.—Work has commenced on developing the falls of the Poudre Canon, located 12 miles above Zimmermans, to be utilized to generate electricity to drive the Poudre portal of the Laramie River tunnel for the Greeley-Poudre irrigation district. Most of the machinery for boring the tunnel is on the ground. A crib dam will be built above the falls and a 22-in. pipe line will extend from the dam to about three miles below the falls, where the tunnel entrance will be made. The water, which has a fall of 300 ft. in this distance, will be utilized to operate a turbine wheel which will generate about 400 hp, which will be used to operate compressed-air machinery for drilling and to light the camp and tunnel. The Laramie-Poudre Company, which is building this system, it is said, may take over the holdings of the Central Power Company in the Poudre Canon, which include the sites of the Roosevelt reservoir to be made in the canon by a large dam near Home, Colo. After the Poudre portal is well under way, work will begin on the Laramie River end of the 12,000-ft. tunnel, to conduct the water of the Laramie River into the Poudre. It is expected to complete the project in two years.

PUEBLO, COL.—Plans are being prepared by the Pueblo & San Luis Valley Electric Railway Company for the construction of an electric power plant to furnish electricity to operate its railway and to drive centrifugal pumps for both irrigation and drainage purposes. It is said that the company is considering the installation of gas engines to drive the plant.

COLCHESTER, CONN.—The citizens on Nov. 11 voted to appoint a committee to enter into a contract with the National Shoe Supply Company to furnish electricity for lighting the streets of the borough. Tungsten lamps of 32 cp will be used. Several residences and public buildings will be wired for electric lamps.

EAST HARTFORD, CONN.—Negotiations are under way between the East Hartford Fire District and the Hartford Electric Light Company for a new contract, under which the old street lighting system will be replaced with a new and up-to-date system. The new contract calls for 100-cp tungsten lamps on Main Street and Burnside Avenue, and 50-cp lamps on other streets. At present arc lamps are used on Main Street and series incandescent lamps on side streets.

NIANTIC, CONN.—The New London & East Lyme Street Railway Company is contemplating extending its electric lighting system through Main Street.

ROCKVILLE, CONN.—The stone mill of the J. J. Regan Manufacturing Company, which was recently acquired by Belding Brothers & Company, is being fitted up for the manufacture of silk thread. The changes include an enlargement of the power plant and installation of a turbine wheel, the erection of a new chimney and interior renovation.

NEW CASTLE, DEL.—The American Power Company has applied for a franchise to erect transmission lines from New Castle to Rogers' Corner, thence to Clarke's Corner, and from the last-named place to Delaware City for the distribution of electricity for lamps, heat and motors in Delaware City, Fort Du Pont and to residents along the road.

WASHINGTON, D. C. (TAKOMA SUBSTATION).—Bids will be received until Dec. 27 at the office of the constructing quartermaster, Washington, D. C., for the construction of an electric lighting system at Fort Washington, Md. Plans and specifications may be seen at the above office and also at the office of the chief quartermaster, Department of the East, Governor's Island, N. Y. A deposit of $10 will be required for each set of plans to insure safe return of same. Captain H. L. Pettus is constructing quartermaster.

LAKELAND, FLA.—At an election held Nov. 22 the citizens voted to issue $65,000 in bonds, the proceeds to be used for the construction of a new electric light plant and extensions to the water-works system.

MARIANNA, FLA.—It is reported that the proposition to issue $10,000 in bonds for consolidation and improvement of electric light plant and water works system will be submitted to a vote of the people.

SENOIA, GA.—W. B. Baggarly, H. L. Ware, A. O. Baggarly, J. A. McKnight and others are organizing a company in Senoia, Ga., to establish and operate an electric light plant and will at once petition the City Council for franchise.

VALDOSTA, GA.—It is stated that J. H. Dasher will construct a 10-mile telephone line, extending from Valdosta in the direction of Bemiss, connection to be made with the system of the Southern Bell Telephone & Telegraph Company.

WAYCROSS, GA.—The Waycross Gas, Electric & Railway Company has been granted a franchise by the City Council giving the company street railway, electric and gas privileges in Waycross. G. W. Deen, of Waycross, is president.

MONTPELIER, IDAHO.—The Bear Lake Power Company has recently placed an order with the Allis-Chalmers Company, Milwaukee, Wis., for 26 transformers of various sizes.

SHELLEY, IDAHO—The Gem Light & Power Company has been granted a permit from the State to develop the water power of Snake River, two miles above Shelley, to generate electricity. The dam is under construction and will be 100 ft. high and 310 ft. long. The plant will cost about $100,000 and will have an output of about 8000 hp. It is expected to have the plant completed about Feb. 1, 1910.

CHICAGO, ILL.—The City Council has directed the finance committee to enter into negotiations with the Board of Trustees of the Sanitary District of Chicago with a view of securing electricity for lighting the streets of the city. It is proposed to install a complete lighting system in connection with the system of sanitary district, at a cost of approximately $2,000,000. The proposition as originally submitted to the city contemplated lighting only Hyde Park with electricity supplied by the Sanitary Board.

FARMER CITY, ILL.—The question of making improvements to the municipal electric light plant is under consideration. C. L. Cravens is chief engineer.

LEROY, ILL.—The plant and holdings of the Leroy Electric Light, Power & Heating Company have been purchased by Wartena Brothers, of Hammond, Ind., for $15,000. It is said that the new owners will establish a day service and may later add a heating system.

DUNLAP, IND.—A mortgage has been placed on the property of the Osceola & Dunlap Telephone Company's plant for the purpose of securing funds for improvements and extensions to the system.

ELKHART, IND.—The Lake Shore Railroad is installing a large electric crane at its shops in Elkhart.

FORT WAYNE, IND.—The directors of the Fort Wayne & Wabash Valley Traction Company have decided to increase the output of its

plants in Huntington and Lafayette to relieve the local plant of part of its load. The company also proposes to erect large car barns at Lafayette and to enlarge the car barns in Huntington. The improvements contemplated will involve an expenditure of about $250,000. Col. J. Levering Jones is president of the company.

INDIANAPOLIS, IND.—The Merchants' Light & Heat Company have completed its conduit system into the State House preparatory to transmitting electricity from its new Washington Street power house. This company has secured the contract to light the building for two years. It is believed the next Legislature will provide for the installation of an electric plant to furnish electricity to light the State buildings and the State soldiers' monument.

KENDALVILLE, IND.—The Flint & Walling Manufacturing Company has recently placed an order with the Allis-Chalmers Company, Milwaukee, Wis., for an additional electrical unit to meet the demands made on its plant. The equipment includes an 18-in. and 30-in. x 42-in. cross compound, heavy duty, non-condensing engine, operating at 150 lb. pressure, direct connected to a 500-kva, 480-volt, 60-cycle, 100 r.p.m. alternator, with exciter and switchboard.

LINTON, IND.—Judge C. E. Davis has refused to dissolve the temporary restraining order issued to prevent the City Council from disposing of the municipal light plant. It was decided that the Council had not complied with the law and consequently the sale could not be made at present. There were a number of bidders for the plant.

WABASH, IND.—Announcement has been made by William L. Moyer, who is promoting the Wabash & Northern Traction Company, that contracts have been awarded for all supplies, except the overhead work, for the proposed railway, which is to extend from Wabash to Warsaw, and that bonds to the amount of $1,000,000 have been provided, of which $250,000 will be available immediately.

GRINNELL, IOWA.—The Grinnell Electric & Heating Company, it is said, is contemplating the installation of an incandescent lighting system. H. M. Radford is proprietor.

IOWA CITY, IOWA.—Plans are being made by the Iowa City Electric Railway Company and the Rundell Land & Improvement Company for the construction of a railway four miles in length, which will connect the Rock Island station with the city park; Rundell's addition to Iowa City and other points. S. A. Swisher is president of the railway company.

OELWEIN, IOWA.—The Oelwein Light, Heat & Power Company is said to be contemplating the construction of a new generating station and the installation of additional machinery.

POCAHONTAS, IA.—An election will be held Dec. 7 to vote on the proposition to install a municipal electric light and power plant in Pocahontas, at a cost not to exceed $14,000.

STRAWBERRY POINT, IA.—The City Council is reported to be considering the installation of an electric light plant. F. Wood is superintendent of water works system.

AUGUSTA, KAN.—S. J. Safford and G. M. Smith have been granted a 20-year franchise by the City Council to construct and operate an electric light and power plant in Augusta.

COLBY, KAN.—Plans are being prepared by Burns & McDonnell, Scarrit Building, Kansas City, Mo., consulting engineers, for the construction of an electric light plant and water works system, in Colby, Kan., to cost about $45,000.

MARION, KAN.—Bids will be received at the office of the city clerk until Dec. 16 for furnishing material and labor for the construction of an electric lighting and water works system, separate bids to be submitted as follows: 1, For furnishing material and labor (except as separately outlined in this notice) and constructing a system of water works and electric lighting; 2, for furnishing material and labor and constructing power house and pump pit; 3, for furnishing hydrants and valves, f. o. b. cars Marion, Kan.; 4, for furnishing two 300-gal. per minute horizontal duplex compound pumps and two boiler-feed pumps, f. o. b. cars Marion, Kan.; 5, for furnishing material and erecting steel tower and tank, 120 ft. high, having a capacity of 70,000 gal.; 6, for furnishing material and erecting radial brick reinforced-concrete or steel chimney; 7, for furnishing two high-speed engines for 75-kw and 50-kw units, f. o. b. cars, Marion, Kan.; 8, for furnishing one 75- and one 50-kw generator and electrical equipment, f. o. b. cars Marion, Kan.; 9, for furnishing arc light equipment, f. o. b. cars, Marion, Kan. All of the above work to be furnished in accordance with plans and specifications on file at the office of the city clerk, Marion, Kan., and at the office of Burns & McDonnell, consulting engineers, Scarritt Building, Kansas City, Mo. Any one desiring extra copies may secure the same by a payment of $5 to cover cost of prints. Thomas W. Bown is city clerk.

OAKLEY, KAN.—The City Council has engaged Burns & McDonnell, consulting engineers, Scarritt Building, Kansas City, Mo., to prepare plans for an electric light plant and water works system for the City of Oakley, to cost about $35,000.

ONAGA, KAN.—The Onaga Light, Heat & Power Company, recently organized, has secured a 20-year franchise for an electric light plant and a contract for lighting the city for a term of five years. It is expected that the system will be in operation within 90 days. Contracts for a large part of the machinery have already been placed.

CADIZ, KY.—A. P. White & Company, of Cadiz, Ky., are contemplating the construction of a hydroelectric power plant, which will be equipped with internal combustion engines to be belted to engines during low water periods.

FRANKFORT, KY.—The contracts for the construction of the heating and lighting plant at the State Normal and Industrial Institute have been awarded as follows: Harry I. Wood & Company for lighting plant; the Marine Electric Company for outside lighting, and A. J. Anderson & Company for heating plant, all of Louisville, Ky.

FULTON, KY.—Preparations are being made to install an electric light plant in the Karmire Mill on the Tennessee side. The plant will furnish electricity for the mill and lumber yards. Most of the equipment for the plant has been purchased. J. W. Stitts, electrician, will have charge of installation of the plant.

LOUISVILLE, KY.—Mayor W. O. Head has vetoed the so-called Fetter lighting ordinance, which was sustained by both boards.

LOUISVILLE, KY.—G. D. Fetter, of the Fetter Printing Company, has been granted a permit to erect a power house in Louisville, at a cost of $27,000.

LOUISVILLE, KY.—The Snead Manufacturing & Building Company, recently organized, it is reported, will construct a large power plant for the purpose of supplying electricity to local industries.

PARIS, KY.—The Paris Electric Light Company is planning to make extensions to its electric light plant, which will include the installation of boilers, engines, generators, feed-water heaters, pumps, etc. S. L. Allen is purchasing agent and engineer in charge of the work.

NEW ORLEANS, LA.—The New Orleans Railway & Light Company has purchased the franchise known as the Villere extension, which runs until 1956, and for which the company agrees to pay the city the sum of one-half of 1 per cent of the gross annual receipts. The line is to be doubled-tracked and begin at the intersection of Villere Street and Lafayette Avenue, extending through Lafayette to Franklin Avenue and St. James Avenue.

DOVER, MAINE.—The Dover & Foxcroft Light & Heat Company is installing a 150-hp boiler at its power station at East Dover, preparatory to the installation of a new 350-hp engine.

TAKOMA, MD.—The Baltimore & Washington Transit Company has been granted permission by the Town Council to extend its railway from the present terminus at the District line over and along Laurel Avenue in Takoma Park and to the south line of Carroll Avenue, to be completed within 90 days.

ANDOVER, MASS.—Preparations are being made by the Smith & Dove Manufacturing Company, of Andover, Mass., for the installation of an electric power plant, the equipment of which will include an engine-driven or steam turbine generating unit with a rating of 750 hp. with exciter, switchboard and alternating current generators.

EAST BRIDGEWATER, MASS.—James Brandley and Charles L. Nutting have been appointed a committee with the Selectmen to confer with the Edison Electric Illuminating Company, of Brockton, Mass., in regard to a new contract for lighting the streets of the town for a period of not more than three years.

FITCHBURG, MASS.—Preparations are being made by the Fitchburg & Leominster Street Railway Company for increasing the output of its power plant, which will include the installation of a 500-kw generator, a 1000-hp Cooper Corliss, cross-compound engine and Dillon boilers of 750 hp. The company originally planned to secure electricity from the Connecticut River Transmission Company, but has decided to enlarge its own plant.

HYDE PARK, MASS.—The Hyde Park Gas & Electric Company has applied to the State Board of Gas and Electric Light Commissioners for authority to issue $21,750 in additional capital stock, the proceeds to be used to enlarge its property.

NEW BEDFORD, MASS.—The contract for electrical work in the New Nashawena Mills has been awarded to F. O. Plummer. The plant will be equipped with 5000-hp motors, ranging from 20 to 200-hp. About 5000 electric lamps will be required for the new mills.

TOPSFIELD, MASS.—The citizens have voted to light the streets and public buildings by electricity. The service will be furnished by the Beverly Gas & Electric Light Company, of Beverly, Mass., which already has its transmission lines extended to the town. The street lighting system will consist of 28 lamps.

CHESANING, MICH.—The Village Council is considering the question of purchasing water power rights with a view of developing the same to furnish power to operate the municipal electric light and water plants. The power house is located along the river within a few rods of the dam.

MENDON, MICH.—The City Council and Business Men's Association have decided to secure a 90-day option on the dam and water rights of the old Stafflet Mill at Parkville, five miles west of Mendon. If it is decided to purchase the property the city will construct an electric power plant and transmit electricity to Mendon for lighting the city and for commercial purposes.

PONTIAC, MICH.—The Detroit Edison Company has asked for permission to build a substation in the central portion of the business district, to cost $20,000.

BARNESVILLE, MINN.—Bids will be received by M. P. Philippi, city clerk, until Dec. 3 for a 110 to 125-hp compound automatic condensing engine; one 75-kw, 250-volt generator, and one panel switch board.

BRAINERD, MINN.—Arrangements are being made by the Northwestern Telephone Company for rebuilding its local system, which will involve an expenditure of about $40,000. The work will include the erection of 60,000 ft. of aerial cable and the installation of a common battery system. J. W. Howatt, of St. Cloud, Minn., is district manager.

FARIBAULT, MINN.—The City Council has brought action against the Polar Electric Company to annul an 18-year lighting contract. For the past year the company has been giving an unsatisfactory service and the Council has refused to pay the company for it.

MINNEAPOLIS, MINN.—The Great Northern Development Company is reported to have located a site for its dam in connection with its proposed electric power plant on Government Lot No. 5, one mile above the mouth of Coon Creek and two miles below Champlin.

CHILLICOTHE, MO.—The Livingston County Mutual Telephone Company has petitioned the City Council for a franchise to install a telephone system in Chillicothe.

COLUMBIA, MO.—Plans are being considered for extensions to the municipal electric light plant and water works system. As soon as plans are prepared an election will be held to vote on the proposition to issue bonds to pay for improvements. John S. Bicknell is city clerk.

KANSAS CITY, MO.—The Toltec Portland Cement Company has placed an order with the Allis-Chalmers Company, Milwaukee, Wis., for induction motors and equipment for its plant at Hidalgo, Mex., as follows: Five 150-hp motors of special design for driving tube mills; two 150-hp motors to be belted to line shafts; two 110-hp motors for pulverizers; three smaller belted motors, and one complete 20-hp single drum hoist.

MARYVILLE, MO.—Arrangements are being made to enlarge the power plant of the Maryville Electric Light & Power Company in the near future to enable it to meet the increased demands made upon it. A new 200-hp engine has been purchased and will soon be installed; the old boilers will be replaced with new ones of greater steam capacity.

PILOT GROVE, MO.—Plans are being considered by the Enterprise Telephone Company for improvements to its system, which will involve an expenditure of about $10,000. Harrison Simpson is manager.

SPRINGFIELD, MO.—Preparations are being made by the Springfield Gas & Electric Company to extend its service to surrounding districts. The company proposes to erect power houses and gas producer plants in a number of cities where franchises have been secured, which probably will ultimately be converted into substations supplied from a large central generating power plant.

TARKIO, MO.—The City Council is reported to be considering the installation of an electric lighting system.

BOZEMAN, MONT.—The Interstate Consolidated Telephone Company is reported to have acquired the long-distance telephone lines of the Haley Telephone Company.

CONRAD, MONT.—Plans are being prepared by C. T. Sacker and C. D. Flaherty, engineers of Livingston, Mont., for an electric light and water works system.

FORSYTH, MONT.—Plans are being considered for extensive improvements to the local telephone system, including the installation of a new switchboard.

LAUREL, MONT.—Application has been made to the City Council by the Eastern Montana Electric Railway Company for a franchise for an electric railway in Laurel. The company proposes to construct an interurban railway from Laurel to Billings, and to extend a line west from Laurel to Red Lodge, crossing the hill to Bear Creek, returning to Laurel by a loop which will embrace the entire Clark Fork Valley. George H. Kessethuth, of Billings, Mont., is interested in the project.

LINCOLN, NEB.—The Omaha, Lincoln & Beatrice Railway Company has petitioned the City Council for a franchise over certain streets in the city. The interurban railway has been using the tracks of the old Citizens' line for an entrance into Lincoln. The contract will expire next August and the company has been notified that it will be expected to find another entrance into the city. The company proposes to tap the business district and to encircle the downtown section by a loop.

GOLDFIELD, NEV.—The New Bonnie Clare Mining Company has entered into a contract with the Nevada-California Power Company for electricity to operate its mill at Bonnie Clare. The transmission line will be extended at once.

CONCORD, N. H.—At the annual meeting of the board of directors of the Concord & Montreal Railroad Company the directors voted to authorize the president to petition the State Railroad Commissioners for permission to sell 2500 shares of its stock, the proceeds to be used to pay for and improve the electric light plant recently acquired in Franklin.

JERSEY CITY, N. J.—The Atlantic & Pacific Telephone & Telegraph Company has filed an amendment to its charter increasing its authorized capital stock from $25,000 to $250,000. Edward P. Meany is president of the company and Richard J. Morgan, secretary.

MORRISTOWN, N. J.—The Morris County Traction Company expects soon to place contracts for the construction of five miles of single track. G. C. Gochnauer is president of the Morris County Construction Company.

ORANGE, N. J.—The Common Council has awarded the contract for construction of the municipal electric light plant and system to Storms & Company, of Newark, N. J., for $82,939. The contract does not provide for an underground distributing system on Main Street.

EAST CREEK, N. Y.—The East Creek Electric Light & Power Company has applied to the Public Service Commission for permission to issue a mortgage on all the property for $3,000,000 and to increase its capital stock from $200,000 to $750,000.

HORNELL, N. Y.—The Hornell-Bath Interurban Railway Company has applied to the Public Service Commission, Second District, for permission to construct an electric railway from Hornell to Bath, 23 miles in length, passing through the towns of Hornellsville, Fremont, Howard, Avoca and Bath. The company has also asked for authority to issue its common stock to the amount of $250,000 and bonds to the amount of $500,000. The company is capitalized at $250,000.

JAMESTOWN, N. Y.—At an election held Nov. 20 the citizens defeated the proposition to purchase the electric plant of the Jamestown Lighting & Power Company and consolidate it with the municipal electric light plant. It was proposed to issue $90,000 to purchase the plant and to appropriate $30,000 for consolidating it under one roof with the municipal plant.

LITTLE FALLS, N. Y.—Arrangements are being made by the Syenite-Trap Rock Company for the installation of a new stone-crushing plant to replace the plant recently destroyed by fire. The entire plant will be operated by electricity. John Thomlinson is superintendent.

MIDDLEPORT, N. Y.—The Niagara Falls Transmission Company has been granted a franchise by the village authorities to cross the streets of Middleport. The company is preparing to extend its transmission lines.

MINEVILLE, N. Y.—The Mineville Light, Heat & Power Company is contemplating the construction of an electric generating station to furnish electricity in Mineville and surrounding districts.

NEW YORK, N. Y.—The Second Avenue Railroad Company has applied to the Public Service Commission for permission to equip that portion of its line running through Worth Street from Chatham Square to Broadway to be operated by electricity. The receiver has already been authorized by the courts to equip the tracks for electrical operation

PORT CHESTER, N. Y.—The Board of Trade has applied to the Public Service Commission for a reduction of rates for both gas and electric service. The citizens ask for gas at $1.10 per 1000 cu. ft. and electricity at 10 cents per kw-hour. The present rates are 15 cents per kw-hour for electricity and $1.40 per 1000 cu. ft. for gas. The petition of the board include Port Chester, Rye, Harrison and Mamaroneck. The service is furnished by the Westchester Lighting Company. The White Plains Board of Trade has also petitioned for a reduction of rates in its section, which is served by the same company.

WILLARD, N. Y.—The contract for the installation of an engine and generator in the Willard State Hospital was awarded to George Sykes, of New York, N. Y., for $3,440.

FRANKLIN, N. C.—Preparations are being made by Henry O. Cozad for the construction of an electric light plant. A dam is now being built across Cartoogechaye Creek to develop from 200 to 300 hp.

AMBROSE, N. D.—Application has been made to the City Council by A. Engstrand for a 10-year franchise to construct and operate an electric light plant in Ambrose.

CASSELTON, N. D.—The construction of an electric light plant in Casselton is under consideration by Minneapolis capitalists.

CROSBY, N. D.—Minneapolis capitalists are reported to be considering the installation of an electric light plant in Crosby.

HETTINGER, N. D.—It is reported that C. A. Meyer, of Clarkfield, Minn., is contemplating the installation of an electric light plant in Hettinger.

MANDAN, N. D.—The North Dakota Independent Company contemplates the erection of 214 miles of telephone lines, which will involve an expenditure of $50,000.

SHERWOOD, N. D.—A company has been organized by the farmers of Winlay, Elmor's and Workman townships, all in Canada, for the purpose of erecting 57 miles of telephone line to connect with the central office in Sherwood.

COLUMBUS, OHIO.—Plans submitted by Samuel Hannaford, architect to Safety Director Small, for the heating and electrical work and for boilers for the power plant of the contagious group of the new city hospital in Burnett Avenue have been approved, and bids for installing the power plant will be called for soon. The plant will furnish electricity for lamps and motors and heat for the entire group of buildings at the hospital.

COSHOCTON, OHIO.—Preparations are being made by the Coshocton Light & Heat Company for the installation of two new generating units, having a combined rating of 1200 hp, together with equipment for auxiliary power plant.

LIMA, OHIO—Announcement has been made by the officials of the Schoepf electric lines that the Lima-Defiance steam railroad will be equipped to be operated by electricity at once. The railway is about 40 miles in length.

NEWARK, OHIO.—The Scott Chair Manufacturing Company is reported to be considering the purchase of a gas producer engine and other equipment in the near future.

NEW KNOXVILLE, OHIO—The Village Council is reported to be negotiating with the Western Ohio Traction Company regarding the installation of an electric lighting system in New Knoxville.

WARREN, OHIO—The capital stock of the Warren & Niles Telephone Company has been increased from $100,000 to $200,000. The company

will the first of the year remove its plant to the Henderson property, recently purchased. A new switchboard will be installed.

WESTERVILLE, OHIO—The City Council is considering an ordinance granting the Municipal Utilities Company, of Columbus, Ohio, a 25-year franchise to construct and operate an electric light and water plant, to cost $23,500.

CHICKASHA, OKLA.—The Oklahoma Cotton Mills Company has purchased equipment for its plant, which will soon be completed, for the manufacture of knit underwear. The machinery will be driven by electricity. A boiler and engine will be installed for use in emergencies.

ERICK, OKLA.—It is reported that electrical equipment will be purchased for the municipal electric plant in Erick about Jan. 1. A bond issue was recently authorized for the installation of the plant.

JENNINGS, OKLA.—The Jennings Electric Light & Power Company, it is said, will purchase machinery for its plant immediately. J. H. Rickard is engineer.

LINDSAY, OKLA.—The municipal electric light plant and water works system has been completed at a cost of $40,000.

MUSKOGEE, OKLA.—Preparations are being made by H. M. Byllesby & Company, who control the Muskogee Gas & Electric Company, for the construction of a large dam on the Grand River. The company has purchased large tracts of land in the Grand River valley above the proposed power site. The Muskogee Gas & Electric Company has applied to the City Council for a new franchise with a long term contract for street lighting. Dennis T. Murphy, of Oklahoma City, is president of the Muskogee company.

NOWATA, OKLA.—The Coffeyville-Nowata Railway & Power Company is planning to commence work on its proposed electric railway by Jan. 1. The road will be 23 miles in length and will extend from Nowata, Delaware, Lenatah, South Coffeyville, Okla., and Coffeyville, Kan. The company proposes to furnish electricity to the cities along the route. The capital stock is placed at $200,000. W. V. Thraves is president and general manager and E. P. Hannaford, of Nowata, chief engineer.

OKLAHOMA CITY, OKLA.—Contracts have been awarded for grading and bridge work by the Oklahoma Railway Company for the construction of its proposed new interurban railway between Capitol Hill and Moore, seven miles south of Oklahoma City. It is expected to have the line completed and in operation by June 1, 1910. John W. Shartel is vice-president of the company.

WESTVILLE, OKLA.—The Westville Electric Light & Power Company is considering the question of installing an engine or small turbine during the winter.

BENTLEYVILLE, PA.—The Bentleyville Electric Light & Power Company, recently organized, is preparing to install an electric light plant, work on which will commence before the end of the year. The officers of the company are: Charles F. Fisher, of Pittsburgh, president, and E. E. French, of Ellsworth, secretary.

PORTLAND, ORE.—The Portland Railway, Light & Power Company, it is said, will require an additional hydroelectric unit for its Cazadero station to furnish electricity for its proposed new extensions and increasing commercial load.

CANONSBURG, PA.—The South Canonsburg Council has granted the National Telephone Company a 25-year right-of-way franchise, in return for which the company is to pay the city $1,000 and a 50-cent pole tax. T. B. Lee is district manager.

CRUM LYNNE, PA.—The Vulcan Charcoal Iron & Steel Company is reported to be in the market for an electric power and lighting unit with an output of about 50 kw; also a three-motor electric traveling crane with a capacity of from 25 to 30 tons, 27 to 35 ft. span.

EAST GREENVILLE, PA.—The Town Council has granted a franchise to a Wyoming, Pa., syndicate to erect an electric light plant within the borough.

HARRISBURG, PA.—The control of virtually all the independent telephone lines in Pennsylvania outside of Philadelphia and Allegheny counties has passed into the hands of the Continental Telephone & Telegraph Company, of New York, N. Y., with the purchase of the American Union Telephone Company, with headquarters at Harrisburg, Pa., which was formed about two years ago for the purpose of continuing the independent telephone lines in Pennsylvania. The Continental Company controls the independent lines in New York, New Jersey, Maryland, Delaware, Virginia and West Virginia, and recently took over the Inter-State Telephone Company of New Jersey.

HUNTINGDON, PA.—The stockholders of the Huntingdon Valley Light & Power Company have called a special meeting to be held Jan. 18 to vote on the proposition to purchase the franchises and other property of the Hatboro Electric Light Company, of Hatboro, Pa., and the Wissahickon Electric Company. The Huntingdon Valley company has already been taken over by the American Gas Company, together with other suburban lighting properties.

MILTON, PA.—The Milton Electric Light & Power Company, which was owned by the Railway Company General, has been sold to Philadelphia capitalists who, it is said, will build a new power plant and reconstruct the entire system.

PHILADELPHIA, PA.—The Lehigh Coal & Navigation Company is reported to be contemplating the erection of an electric power plant on is property near Nesquehoning, Pa., plans for which have not yet been completed. Rollin H. Wilbur is vice-president.

PHILADELPHIA, PA.—The Philadelphia & Suburban Railroad Company has filed an application at Harrisburg for a charter to construct a subway on Broad Street north of the City Hall to a point near Cumberland Street. The new plans provide for an extension of the proposed subway system by elevated roads to Fairmont Park, Frankford and Wayne Junction.

SCRANTON, PA.—Announcement has been made that the Scranton Electric Company contemplates extensive improvements to its plant, including the construction of a large central power plant, which will involve an expenditure of about $500,000.

STEELTON, PA.—The Allis-Chalmers Company, Milwaukee, Wis., has secured a contract from the Pennsylvania Steel Company for a twin tandem, gas-driven blowing engine.

WOONSOCKET, R. I.—The Desurmont Worsted Company is reported to be contemplating the installation of a steam turbine power plant next May to furnish electricity to operate its proposed new mill.

ANDERSON, S. C.—It is reported that the Duke interests, which recently purchased control of the Anderson Traction Company, will make extension to the railway, connecting with the Seaboard Air Line Railroad. It is said that the interurban railway will be extended to Spartanburg, S. C., and Greensboro, N. C., northward and to Abbeville or Greenwood on the east. It is also announced that the railway will handle freight as well as passenger traffic.

BEAUFORT, S. C.—Captain C. C. Townsend has applied to the Town Council for a franchise to erect and operate a telephone system in Beaufort. If the franchise is granted a long-distance service will be established.

LANCASTER, S. C.—Contracts have been awarded for material and equipment required for the construction of an electric light plant in Lancaster. The General Electric Company will furnish all the electrical apparatus. Electricity for operating the system will be furnished by the Southern Power Company. It is expected to have the plant completed in about 30 days. Col. Leroy Springs is interested in the project.

BRIDGEWATER, S. D.—The City Council has granted A. Y. Weidenbach, of Bridgewater, a 25-year franchise to construct and operate an electric light plant in this city. A contract has been awarded for construction of the power house.

HOWARD, S. D.—C. A. Laurson is reported interested in a project to establish an electric light plant in Howard. A company will be organized to operate the plant.

RAPID CITY, S. D.—Bids are asked for the installation of a telephone system by the Black Hills Independent Telephone Company.

RAPID CITY, S. D.—Arrangements are being made by the Black Hills Independent Telephone Company for the construction of its telephone system in this city, contracts for which will be awarded in the near future. The company is capitalized at $50,000.

ROMANO, S. D.—The Citizens Light & Power Company is reported to have awarded a contract to H. P. Mortesen, of Toronto, S. D., for the installation of an electric light plant for $2,000.

TYNDALL, S. D.—Plans are being considered for the construction of a municipal electric light plant, to cost from $16,000 to $18,000. C. H. Stanfield, of Yankton, S. D., is consulting engineer. J. J. Maus is city recorder.

BRISTOL, TENN.—The plant and holdings of the Bristol Gas & Electric Company have been purchased by a New York syndicate for $400,000. The company has outstanding bonds to the amount of $325,000 to cover the cost of a large water power development near Bristol.

JOHNSON CITY, TENN.—Plans are being considered by the Watauga Electric Company for enlarging its electric plant. As yet plans have not been decided upon.

STANTON, TENN.—It is reported that an electric light plant will be installed in Stanton. G. N. Albright is interested in the project.

WINCHESTER, TENN.—It is reported that Miller Brothers are contemplating the installation of an electric power plant in connection with their proposed new factory.

BELLVILLE, TEX.—D. Wilrodt is reported to be interested in the establishment of an electric light and ice plant and creamery.

CHILDRESS, TEX.—Preparations are being made by the Fort Worth & Denver City Railroad Company for enlarging its power plant, which will include the installation of an engine, generator and four boilers. An addition will also be made to the power house.

CLARENDON, TEX.—The Clarendon Water, Light & Power Company, it is said, contemplates making improvements to its system in this city.

DALLAS, TEX.—Arrangements are being made for forming an association for the construction of an interurban railway to extend from Dallas to Terrell. W. H. Gaston, R. H. Stewart and Alexander Sanger, of Dallas, Tex.; Thomas Layden, of Forney, and W. P. Allen, of Terrell, have been appointed as trustees of the association.

HOUSTON, TEX.—Bids will be received by Harris County until Dec. 8 for electric fixtures for courthouse, plans for which may be obtained from Lang & Witchell, architects, Dallas, Tex. The amount to be expended is $15,000. A. E. Amerman, of Houston, Tex., is county judge.

LUBBOCK, TEX.—The Lubbock Light, Power & Ice Company is contemplating increasing its power-plant machinery and refrigerating apparatus.

UVALDE, TEX.—The Uvalde Street Railway Company is preparing to build an extension of its railway from Uvalde to Batesville, a distance of 30 miles. Gasoline motor cars will be used.

SALT LAKE CITY, UTAH.—The County Commissioners have granted the Salt Lake & Los Angeles Railway Company a franchise to double-track and equip its railway to be operated by electricity from Salt Lake City to Salt Air. The commissioners have also granted the amended franchise of the Telluride Power Company for the construction of its transmission lines upon the highways of the county.

BRISTOL, VA.—Preparations are being made by the Cumberland Telephone Company for the construction of a long-distance telephone line from Bristol through the coal fields of Southfield, Va., for which an appropriation has already been made. An additional copper line will be erected from Knoxville to Bristol, a distance of 130 miles, which will be followed by the rebuilding of the line between Bristol and Gate City, Va., and the erection of a line from Gate City to points in Wise and Lee counties. Leland Hume is manager.

COLONIAL BEACH, VA.—The Municipal Council has granted John G. Capers, Evans Building, Washington, D. C., a franchise to construct an electric railway from Colonial Beach to Quantico, a distance of 22 miles.

RICHMOND, VA.—Bids will be received at the office of E. E. Davis, superintendent of Water Department, City Hall, Richmond, Va., until Dec. 14 for construction of electrical transmission lines, plans and specifications for which are on file in the above office.

RICHMOND, VA.—The finance committee has recommended to the Council a supplemental appropriation of $65,000 for the construction of the distributing system in connection with the proposed new electric light plant. This appropriation is in addition to the recent bond issue of $350,000 provided for the erection of the plant and for the installation of water pumps at the new pump house, making the total appropriation for the plant and water pumps to date $415,000.

BAKER, WASH.—The Baker River Power & Light Company has filed notice of appropriation of water rights of the Baker River to the extent of 2000 cu. ft. per second. The company proposes to erect a power station in or near Concrete and supply electricity to the villages along Baker River.

BELLINGHAM, WASH.—A proposition has been submitted to the citizens of Bellingham by L. H. Bean, local manager of the Whatcom County Railway & Light Company, and R. T. Laffin, district manager of Puget Sound, in behalf of the Stone & Webster interests, assuring the construction of Bellingham-Skagit County Interurban Railway immediately by Stone & Webster, provided that the citizens of Whatcom and Skagit counties raise $400,000 of the $1,500,000, the estimated cost of the proposed railway. In consideration of the $400,000 raised preferred cumulative stock of the Whatcom Railway & Light Company will be issued. The road will be about 30 miles in length and will connect Bellingham, Burlington, Mount Vernon and Sedro Woolley.

LEAVENWORTH, WASH.—Plans are being prepared by the Great Northern Railroad Company for the construction of a large electric power plant in the Lake Chelan country, which will develop about 80,000 hp in connection with equipping the western division of the railroad to be operated by electricity. The proposed plant is to be supplemented by the present Leavenworth station, which has an output of 12,000 hp, which is utilized for hauling trains through the Cascade Mountain tunnel. The company has been working on the proposition for some time, locations having been made several years ago by Everett McChesney, of Everett, and others.

PASCO, WASH.—The County Commissioners have granted N. G. Blalock, representing the Walla Walla & Columbia Traction Company, a franchise to enter Franklin County with an electric railway.

SPOKANE, WASH.—Plans are being considered by the lamppost committee of the Chamber of Commerce for removing all arc lamps in the district bounded by Front and First Avenues and Bernard and Cedar streets, to be replaced by 558 cluster lamps. The Washington Water Power Company has submitted a proposition to furnish 180 cp to each post and to maintain the lamps and globes for $50 per year. The committee proposes to have the property owners in the district pay for the installation of the lamps and the city maintain them.

WALLA WALLA, WASH.—The factory of the Washington Weeder Works, which was destroyed by fire last September, has been rebuilt and is ready for the installation of new machinery. The new buildings are twice the size of those burned, and all machinery installed will be operated by electricity instead of by gasoline engines as before.

NEW MARTINSVILLE, W. VA.—The New Martinsville Electric Light, Heat & Power Company has been granted a franchise to furnish electricity for lamps in Brooklyn. It is expected to have the service ready by Jan. 1, 1910.

WHEELING, W. VA.—The Rapid Transit Railway Company has applied to the Board of County Commissioners of Ohio County for a franchise to construct an electric railway on certain streets and highways in the county.

APPLETON, WIS.—A. D. Barnes, vice-president of the Chicago & Wisconsin Valley Railroad Company, has submitted a proposition to the business men of Appleton and Outagamie Counties for the construction of an interurban railway from Appleton northward through Hortonville, New London, Waupaca and to Hancock, where the proposed railway will connect with line of the Chicago & Wisconsin Valley Railroad Company, which expects to have an interurban road in operation from Stevens Point to Chicago before September, 1911.

MILWAUKEE, WIS.—It is understood that a number of improvements will be made to the West Milwaukee shops of the Chicago, Milwaukee & St. Paul Railroad, which will include the installation of electric motor-driven machinery in some departments of the plant.

MILWAUKEE, WIS.—Judge Turner in a decision handed down Nov. 20, refused to dissolve the injunction obtained by J. T. Neacy restraining the city from issuing bonds for the construction of a municipal electric light plant. An immediate appeal will be made to the Supreme Court and if the decision is sustained the proposition to issue bonds will have to be submitted to the people again. The erection of the municipal electric plant will be delayed for at least another year.

LACOMBE, ALTA., CAN.—The Council has awarded contracts for an auxiliary steam plant for the power house and for the repairs to the dam, to cost about $4,000. The Waterous Engine Works Company, of Brantford, Ont., has the contract for steam plant and Councillor Mobley will supervise repairs to the dam.

REVELSTOKE, B. C., CAN.—The contract for the construction of the municipal electric light plant (bids for which were opened Nov. 17) was awarded to the Canadian General Electric Company, Toronto, Ont., Can. Bruce A. Lawson is city clerk.

WINNEPEG, MAN., CAN.—Owing to the bursting of a penstock at the hydroelectric power plant at Lac Du Bonnet, which flooded the generating station, the electric lighting and street car service in Winnepeg has been badly crippled. The steam power plant is supplying power to the extent of 1000 hp and the Canadian Pacific Railway about the same amount, but this is not sufficient to supply more than a partial and intermittant street car service.

BRIDGEBURG, ONT., CAN.—The Village Council has decided not to present a by-law to the ratepayers asking for a franchise for the Canadian Niagara Power Company. The Council will not agree to the present conditions of the franchise. The company asks for a 25-year franchise and makes the price for arc lamps $60 each per year and $20 per lamp per year for incandescent lamps. The Council is not willing to grant a franchise for more than 20 years and will not pay more than $50 per lamp per year for arc lamps and not more than $12.50 each for incandescent lamps.

BROCKVILLE, ONT., CAN.—The municipal light and power department closed its fiscal year on Sept. 30, and the report shows receipts amounting to $51,915. The operating expenses were $43,453, and $7,597 was paid on debentures, leaving a balance of $864. This plant was purchased nine years ago and has since made substantial reductions in the prices of gas and electricity.

EASTVIEW, ONT., CAN.—The Village Council is reported to be in favor of installing a municipal electric light plant to supply electricity to the entire village at the rate of $15 per hp per year.

KINGSTON, ONT., CAN.—The Kingston Street Railway Company has stopped the operation of its cars until it can come to an understanding with the city as to the length of time the contract for electrical power will be granted. According to its franchise the company can cease operation for six months without affecting its franchise.

LONDON, ONT., CAN.—The London Electric Light Company has notified the city that its contract for lighting the streets expires on Nov. 30, and that it will be necessary to make a new contract if the service is to be continued. The company has offered to renew the contract for another year, pending the completion of the city's distributing plant, to light the streets with Niagara power at the rate of 23 cents per lamp per night; but if a contract for a shorter period is desired the company states that a sliding scale of rates must be charged. There are now 342 street lamps in use. The hydroelectric power is promised and expected to be ready for delivery in London early in the spring. A special meeting of the Council will soon be held to consider the question. The amount paid to the London Electric Company for street lighting for last year amounted to $28,146.

PETERBOROUGH, ONT., CAN.—Word has been received from Ottawa that provision has been made in the estimates submitted to Parliament for the electric lighting of the Trent Canal between Peterborough and Lakefield.

WOODSTOCK, ONT., CAN.—The Water and Light Commissioners have awarded the Canadian General Electric Company the contract for supplying the necessary electrical equipment in order that the city may make use of Niagara power under its contract with the Hydro Electric Power Commission. The equipment will include a 5-panel switchboard, with instruments and regulators; three 300-kw transformers; two 1500-gal. per minute turbine pumps, each driven by a 175-hp induction motor, and one 500-hp motor to drive the present generator. The amount of the contract is $20,000.

MONTREAL, QUE., CAN.—The Canadian Pacific Railway Company is considering the question of equipping its Windsor Street terminal for electrical operation, which will probably be extended to Montreal Junction.

MONTREAL, QUE., CAN.—The Canadian Light & Power Company has let contracts for three 500-kw, 2300-volt generators and transformers

to the Allis-Chalmers, Bullock Company, Ltd. The contract for switch board was awarded to the Canadian Westinghouse Company.

SAN CRISTOBAL, L. C., MEX.—Messrs. Allen & Calves, of Comitan, Chiapas, Mex., have leased for a term of years the electric light plants of Francisco Orozco y Jimenez and of Paniagua y Garcia, of San Cristobal.

New Industrial Companies.

THE AERIAL DEMONSTRATION COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 to manufacture cars, vehicles, flying machines, etc. The incorporators are: J. J. Harper, E. J. Forhan and C. F. Martin, all of New York, N. Y.

THE CANADIAN CONSTRUCTION COMPANY, of Lawrence, Mass., has been chartered with a capital stock of $10,000 for the purpose of doing general construction work by William H. Molson, of Boston, Mass.; Joseph A. Clotier, Elzear Thibault and William H. Molson, all of Lawrence, Mass.

THE CHAMPION IGNITER COMPANY, of Boston, Mass., has been incorporated with a capital stock of $100,000 to handle a patent method of igniting. The officers of the company are: H. D. Eminger, of Foxboro, Mass., president; G. M. Faulkner, of Brookline, Mass., treasurer.

THE CHARTER ELECTRIC COMPANY, of Chicago, Ill., has been incorporated by George C. Cummings, John A. Dick and Archibald Wray, all of Chicago, Ill. The company proposes to manufacture and sell electrical appliances.

THE COLONIAL ENGINEERING & CONTRACTING COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $50,000 by J. R. Taft, of New York, N. Y.; N. B. L. Secord, of Grantwood, N. J., and J. S. Frazer, of Brooklyn, N. Y. The company proposes to do a contracting and engineering business; also to deal in engineering and building supplies.

THE CONTINENTAL RAILWAY EQUIPMENT COMPANY, of Wilmington, Del., has filed articles of incorporation with a capital stock of $500,000. The incorporators are: P. A. Neuffer, R. M. Cole and H. M. Phillips, all of Chicago, Ill.

THE ELECTRO INSULATION COMPANY, of Chester, Pa., has made application for a charter at Harrisburg, Pa., for the purpose of manufacturing and selling machinery, electric supplies, equipment and insulation. The incorporators are: John Higley, William W. Hoy, Michael J. Byrnes, Thomas F. Ryan, Michael Shapiro, Daniel J. Rowan and E. L. Brooks.

THE FORBERG-CARLSON MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $50,000 by Charles A. Forberg, Otto B. Carlson and Frederick B. Roos, all of Chicago, Ill. The company proposes to manufacture machinery.

THE HEALEY ENGINEERING COMPANY, of Chicago, Ill., has been chartered by Robert F. Pettibone, John C. Burchard and Harold S. Osborne, all of Chicago, Ill. The company is capitalized at $50,000 and proposes to do a general construction and engineering business.

THE A. HOUSTON COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $25,000 to carry on an electrical and mechanical engineering business, machinists, etc. The incorporators are: Alexander Houston, M. A. Houston, of Jersey City, N. J., and John H. Spear, of Paterson, N. J.

THE HYDRAULIC PROPERTIES COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $100,000 for the purpose of constructing dams, buildings, etc. The incorporators are: F. M. Hoadley, H. L. Seigler, of New York, N. Y., and W. D. Johnson, of Hartford, Conn.

THE INVENTORS' MANUFACTURING COMPANY, of Wilmington, Del., has been chartered with a capital stock of $200,000 for the purpose of buying and selling patents. The incorporators are: J. L. Callam, F. Bayer and R. A. Manery, of Jacksonville, Fla.

THE H. P. KEANE COMPANY, of Atlanta, Ga., has been chartered with a capital stock of $10,000 by H. P. Keane and J. J. Batterman. The company proposes to deal in electrical apparatus, illuminating supplies and to do an illuminating and electrical engineering business.

THE LEARY CENTRIFUGAL MUFFLER & EXHAUST COMPANY, of Portland, Maine, has filed articles of incorporation with a capital stock of $500,000 for the purpose of manufacturing and selling engines. C. E. Eaton is president and T. L. Croteau, treasurer, both of Portland, Maine.

THE LEWELL MANUFACTURING COMPANY, of Chicago, Ill., has been chartered with a capital stock of $30,000 by George E. Chamberlain, C. Eugene Gilman and A. John Ehhenberger, all of Chicago, Ill. The purpose of the company is to design, manufacture and sell machinery.

THE LUCIOS ENGINEERING COMPANY, of Camden, N. J., has been incorporated by V. A. Murray, R. G. Elliott and Archworth Martin, all of Camden, N. J. The company proposes to do a general engineering, contracting and construction business.

THE McCORMICK COMPANY, of Wilmington, Del., has been incorporated with a capital stock of $150,000 by C. W. Comfort, J. J. Morian and W. D. Steever, of Philadelphia, Pa. The purpose of the company is to do a contracting and engineering business.

THE MONARCH AUTOMATIC MACHINE COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $150,000 by William J. Collins, David H. Crown and William Brady, all of Brooklyn, N. Y. The company proposes to manufacture machinery, etc.

THE MONARCH ELECTRIC COMPANY, of Kansas City, Mo., has been incorporated by K. L. Day, E. P. Day, P. B. Chaney and others. The company is capitalized at $75,000 and proposes to deal in electrical supplies.

THE NORTH AMERICAN WIRELESS CORPORATION, of Portland, Me., has been incorporated with a capital stock of $10,000,000 to deal in all systems of wireless telegraphy. The incorporators are: C. E. Eaton, T. L. Coteau and J. E. Manter, all of Portland, Me.

THE OKLAHOMA GAS ENGINE COMPANY, of Oklahoma City, Okla., has been incorporated with a capital stock of $30,000. The company proposes to manufacture gas engines from 2 to 16 hp. Arthur Fishbeck is president and manager; W. H. Clark, vice-president; George W. Lowe, secretary and treasurer, and James Worthington, superintendent.

THE OTTOMAN-ANGLO-AMERICAN COMPANY, of Jersey City, N. J., has been incorporated by P. F. Cook, D. Herr and W. G. Muirheld, of Jersey City. The company is capitalized at $12,000 and proposes to do a general mechanical engineering business, etc.

THE OVERLAND CONSTRUCTION COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $150,000 by J. D. Hubbard, M. A. McCollum and G. Westervelt.

THE POSITIVE ELEVATOR COMPANY, of New York, N. Y., has been incorporated by August Koenig, of Orange, N. J.; Henry L. Murdock and Eugene R. Huckel, of New York, N. Y. The company is capitalized at $30,000 and proposes to manufacture elevators, safety devices, etc.

THE POWELL MACHINE COMPANY, of Fitchburg, Mass., has been chartered for the purpose of manufacturing and selling machinery. The company is capitalized at $50,000 and the officers are: A. M. Powers, of Worcester, Mass., president, and M. A. Coolidge, of Fitchburg, Mass., treasurer.

THE RAE ELECTRIC VEHICLE COMPANY, of Springfield, Vt., has been organized for the purpose of building a new type of electric automobile. The company has acquired a site on the river for its works, and it is said that a good sized plant will be erected. H. K. Parkman, of Springfield, Vt., is interested in the project.

THE STANDARD CONNECTOR COMPANY, of White Plains, N. Y., has filed articles of incorporation with a capital stock of $30,000 for the purpose of doing electrical work. The incorporators are: S. L. Chamberlain, F. J. Danks, of New York, N. Y., and H. C. Chamberlain, of Yonkers, N. Y.

THE SYRACUSE GAS ENGINE COMPANY, of Syracuse, N. Y., has been chartered by F. C. Eddy, L. S. Chapman and E. J. Paradise, all of Syracuse, N. Y. The company proposes to manufacture gas, gasoline and other motors and engines, etc. The capital stock of the company is placed at $150,000.

THE VACUUM LAMP COMPANY, of Newark, N. J., has been incorporated by Jacob Wacchter, Hermann Schramm and Henry Pomerehne, all of Newark, N. J. The company is capitalized at $100,000 and proposes to manufacture vacuum electric lamps, bulbs and fixtures of all kinds.

THE WHEELER ROTARY ENGINE & POWER COMPANY, of Meriden, Conn., has been chartered with a capital stock of $200,000, by W. W. Wheeler, W. H. Way, G. E. Bicknell and Fred Rees, all of Meriden. The company proposes to manufacture an engine of new design, and is now building a demonstrating engine, designed to develop from 200 to 300 hp.

THE WILMINGTON BUILDING & CONSTRUCTION COMPANY, of Wilmington, Del., has been chartered with a capital stock of $50,000 for the purpose of doing a general contracting business. The incorporators are: William Alan Sands, William J. Highfield and George L. Townsend, all of Wilmington, Del.

THE WRIGHT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $1,000,000 to manufacture machines, ships, etc., for aerial operation or navigation. The incorporators are: W. Wright, O. Wright, both of Dayton, Ohio; G. A. Steves, H. S. Hooker and A. F. Barnes, of New York, N. Y.

THE W. H. ZIMMERMAN COMPANY, of Chicago, Ill., has been chartered with a capital stock of $25,000 by E. O. Grassly, E. A. Campbell and W. H. Zimmerman. The company proposes to do a general engineering and contracting business.

New Incorporations.

GURLEY, ALA.—Articles of incorporation have been filed for the Gurley Light & Power Company with a capital stock of $10,000. The officers of the company are: Fred H. Howe, president and treasurer; Frank B. Gurley, vice-president, and G. A. Plummer, secretary.

PETALUMA, CAL.—Articles of incorporation have been filed for the Petaluma Rural Telephone Company with a capital stock of $50,000. The company proposes to construct and operate telephone lines extending from Petaluma to different sections in the county. The incorporators

are: D. M. Winans, T. G. King, George B. Robinson, S. L. Stice, E. P. Long and Frank Whitlach.

VISALIA, CAL.—Articles of incorporation have been filed for the Mt. Whitney Power & Electric Company with a capital stock of $5,000,000 and the following directors: John C. Hays, Thomas J. Broidrick, Fred G. Hamilton and Harry T. Hays, all of Visali, Cal., and Allen C. Chickering, of Oakland, Cal. A deed was filed with the county recorder transferring all of the property of the Mt. Whitney Power Company to the Mt. Whitney Power & Electric Company.

PLYMOUTH, ILL.—The Plymouth Mutual Telephone Company has been incorporated with a capital stock of $1,500 by B. L. Cloud, S. H. Aldridge and A. T. Bartell.

GREENFIELD, IND.—The Citizens Electric Company, of Hancock County, Indiana, has filed articles of incorporation with the Secretary of State, with a capital stock of $1,000. The company proposes to erect and operate transmission lines for the distribution of electricity for lamps, heat and motors throughout Hancock County. Elam M. Leary, John S. Thomas and R. F. Morgan, directors.

ONAGA, KAN.—The Onaga Light, Heat & Power Company has been organized with a capital stock of $6,500, and application will soon be made to the State Board for a charter. The company proposes to furnish electricity in Onaga. The directors are: Peter Gurtler, Peter Gaume, E. L. Frezeires, L. L. O'Meare and Hermann Tessendorf.

PORTLAND, MAINE.—The Ram Island Power Company has been organized for the purpose of furnishing electricity for lamps, heat and motors in Lewiston, Auburn, Minot, Greene, Turner, Leeds, Livermore, East Livermore and Jay. The company is capitalized at $100,000. The officers are: Roscoe T. Hoit, of Portland, president, and John H. Ridge, of Portland, treasurer.

ISLIP, N. Y.—The Islip Electric Light Company has been incorporated by William H. Moffitt, Frank Creamer and John H. Vail, all of Islip, N. Y. The company is capitalized at $20,000 and proposes to furnish electricity for lamps, heat and motors.

CINCINNATI, OHIO.—The Cincinnati, Harrison & Indianapolis Traction Company has been chartered with a capital stock of $10,000 by A. K. Nippert, Charles E. Roth and William L. Finch. The company proposes to construct an electric railway between Cincinnati and Harrison, which may ultimately be extended to Indianapolis, Ind. The old Westwood steam road will be used, but 14 miles of new construction will be required.

RAVIA, OKLA.—The Ravia Telephone Company has been chartered with a capital stock of $5,000 by J. B. Moseley, of Oklahoma City, Okla; J. R. Chitwood and Mrs. N. Chittwood, both of Ravia.

DARLINGTON, S. C.—A charter has been issued by the Secretary of State to the Darlington Water & Electric Company, capitalized at $50,000. The purpose of the company is to do a general power and lighting business. The officers are: A. P. Maloney, president; W. M. Haynesworth, vice-president, and L. C. Ritchie, secretary.

MARION, S. C.—The Marion Water & Light Company has been incorporated with capital stock of $50,000 to conduct a water and light business. The officers are: A. P. Maloney, president; P. A. Willcox, vice-president; J. S. Mitchell, secretary, and L. C. Ritchie, treasurer.

ROCK HILL, S. C.—The Rock Hill Water & Electric Company has been chartered with a capital stock of $100,000 to carry on a general power, light and water business. The officers are: A. P. Maloney, president; W. T. Fewell, vice-president; J. S. Mitchell, secretary, and L. C. Richtie, treasurer.

SALT LAKE CITY, UTAH.—The Castle Valley Railway Company has been incorporated for the purpose of constructing an electric railway from Price to Cedar Creek Canyon. W. C. Rice, of Salt Lake City, is president.

WASHINGTON HARBOR, WIS.—The Washington Island Telephone Company has been organized for the purpose of establishing a telephone service to reach all parts of the island. The officers are: John Goesselson, president; William Foss and B. Johnson, vice-presidents; William Jess, secretary, and George Mann, treasurer.

CHARLESTON, W. VA.—The Consolidated Telephone & Telegraph Company, of New York, N. Y., has filed articles of incorporation with the Secretary of State. The company is capitalized at $25,000 and proposes to operate lines in the United States and Canada. The incorporators are: S. H. Noyes, J. M. Ritz, A. B. Woodruff, J. H. Klieves and Edgar Charnosk, all of Wheeling, W. Va.

Personal.

MR. R. B. OWENS, formerly professor of electrical engineering at Magill University, Montreal, Can., has become associated with the Southern Power Company, Charlotte, N. C.

MR. L. C. KERRICK, formerly with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, has entered the sales department of the Electric Storage Battery Company, with headquarters in Boston.

MR. RALPH D. MERSHON, consulting engineer, of New York, has established a branch engineering office in the Street Railway Chambers, Montreal, Canada, Mr. Harry L. St. George being his Canadian representative.

MR. J. M. GEORGE has resigned his position as manager of the Southern Bell Telephone & Telegraph Company at Tifron, Ga., to accept the position as chief engineer for the municipal electric light and water works plant at Moultrie, Ga.

MR. J. J. WRIGHT, general manager of the Toronto Electric Light Company, Toronto, Canada, has been selected as honorary president of the company's section of the National Electric Light Association, which has been formed with a membership of 45.

MR. PATRICIO A. SUAREZ, a graduate of Manhattan College, New York City, the class of 1904, has been appointed administrator and director-general of the Compania Electrica de Alumbrado y Traccion de Santiago de Cuba, with offices at San Felix.

DR. R. T. GLAZEBROOK, who was a delegate to the Chicago International Electrical Congress in 1893, and the St. Louis International Electrical Congress in 1904, has been awarded the Hughes medal by the (British) Royal Society for his researches on electrical standards.

MR. D. F. FRADETTE, who has been connected with the sales departments of the West Penn Electric Company at Connellsville, Pa., and of the Des Moines Electric Company, Des Moines, Iowa, has been placed in charge of the contract department of the Merchants' Heat & Light Company, Indianapolis, Ind.

MR. J. B. KILMORE, formerly connected with the Scranton Electric Company, has been appointed manager of the Conshohocken (Pa.) Electric Light & Power Company. Both of these companies are owned by the American Gas & Electric Company, and Mr. Kilmore's promotion comes in recognition of good work done in the power department of the Scranton company.

MR. CHARLES ROBBINS, who has for many years been connected with the Westinghouse Electric & Manufacturing Company in the industrial and power sales department in connection with the sale of industrial motors, has recently been appointed manager of this department. Mr. Robbins has been with the company since 1899, in which time he has been in the manufacturing department, the New York district office sales department, and for the past three years in the industrial and power sales department at East Pittsburgh. His headquarters will continue to be at East Pittsburgh.

MR. S. L. NICHOLSON has recently been appointed general sales manager of the Westinghouse Electric & Manufacturing Company, and has direct charge over the sales policies of the entire company. Mr. Nicholson has been with the company for 11 years in many different capacities, as salesman, as district department manager, and as industrial and power sales manager for the past five years, from which last position he resigned to take the present post. Before coming to the Westinghouse Company he was with the C. & C. Electric Company. Mr. Nicholson organized and has been president of the American Association of Motor Manufacturers.

MR. SAMUEL A. CHASE, who for the past few years has been with the Westinghouse Electric & Manufacturing Company in its New York sales office as a special detail and supply salesman, has recently resigned to accept a position with the White Investing Company, of New York City, a financial investment company handling stock of many different organizations. Previous to Mr. Chase's employment with the Westinghouse Company he was a salesman for the Western Electric Company. Mr. Chase will, after Jan. 1, be in charge of the Chicago office of the White Investing Company, having exclusive territorial rights in North and South Dakota, Minneapolis, Iowa, Illinois and northern Indiana.

MR. G. BREWER GRIFFIN has recently been appointed manager and is actively directing the sales policy of the detail and supply sales department of the Westinghouse Electric & Manufacturing Company, in which department transformers, meters, fans, heating appliances, switches, switchboards, railway line material, etc., are sold. Mr. Griffin has been assistant manager of this sales department for six years past, having previously been connected with the sale of detail apparatus in the Boston office, altogether having been employed some seven years with the company. Previous to his connection with the Westinghouse Company, Mr. Griffin was with the Manhattan General Construction Company of New York as a special representative, finally opening an office for it in Boston.

Obituary.

MR. ROBERT M. VAN ARSDALE, proprietor of the *American Engineer and Railroad Journal*, died at his residence, 276 West Seventy-first Street, New York, on Nov. 23.

MRS. T. C. MARTIN.—We regret to announce the death of Mrs. T. C. Martin, which occurred Nov. 25, after an illness extending over several years accompanied by much suffering. The funeral services and interment were private.

MR. ALBERT V. PORTER, who is said to have drawn the plans for the first electric power house built in this country, died at his home in Brooklyn, Nov. 23, at the age of 53 years. He was born in Gloversville, N. Y. He was an architect by profession and was for many years the consulting architect for the New York City Railway Company.

MR. ALFRED BISSELL TALCOTT, who was identified with the building of the early telegraph lines in this country, died at his home in Washington, D. C., Nov. 22, at the age of 84 years. He was born near Glastonbury, Conn., and early in his business career became engaged in electrical work in New York. He took part in rebuilding the old telegraph lines between New York and Washington, and in 1859 was manager of a telegraph office in Washington. He was a newspaper correspondent during the Civil War and for many years afterward. He is said to have operated the first field telegraph line used.

MR. W. McLEA WALBANK, first vice-president of the Montreal Light, Heat & Power Company, died after an operation for purulent meningitis at the Montreal General Hospital on Nov. 28. Professionally, Mr. Walbank was widely known personally or by reputation throughout Canada. He graduated from McGill University in 1877, and after a successful career as a surveyor and architect, he had charge of the Lachine Rapids hydroelectric development, and when the Lachine Rapids Hydraulic & Land Company was amalgamated with the Montreal Light, Heat & Power Company, Mr. Walbank's services were secured as first vice-president, a post he held until his demise. Mr. Walbank was one of the founders of the Canadian Society of Civil Engineers, of which Institution he was president in 1907. He was a member of the Engineers' Club, serving as vice-president of that body in 1904. He is survived by a wife and three sons.

MR. JOHN CALDWELL, treasurer of the Westinghouse Air Brake Company, was stricken with heart disease on Nov. 23 and died in his office before a physician could reach him. Mr. Caldwell was born in the north of Ireland about 70 years ago, his father being a Presbyterian minister. He came to Pittsburgh as a lad of 12, and his first employment was as a clerk in a grocery store. For several years he followed mercantile pursuits, and upon the organization of the Westinghouse Air Brake Company in 1869 he became its bookkeeper, a position he retained for 10 years. He was then elected treasurer, a position he held for the rest of his life. When the Westinghouse Electric & Manufacturing Company was organized Mr. Caldwell was made treasurer of that. He retained the position until the organization was put on a smooth running basis, when he resigned in 1892 to give his entire time to the air brake company. This was also true of the Philadelphia company, to which he was also elected treasurer when this company was organized, resigning in 1899. At the outbreak of the Civil War he was enlisted as a private in Company E, Sixty-first Pennsylvania Volunteers, and was mustered out as a second lieutenant at the close of the war. He was wounded at the battle of Spottsylvania. Outside of his business affiliations, Mr. Caldwell had a worldwide reputation as an art connoisseur and collector of rare books. His collections at his Edgewood home are said to be among the most valuable in existence. He was particularly fond of etchings, and his collection of Whistlers is said to be unequaled. His books have been gathered from all parts of the world and are reputed to be priceless. At his death Mr. Caldwell was chairman of the fine arts committee of the Carnegie Institute trustees and also of the finance committee. He had an appointment to meet with the fine arts committee at Director J. W. Beatty's office on the afternoon of his death.

Trade Publications.

METAL MOLDINGS.—The Fancleve Specialty Company, Jamaica Plain, Mass., has issued a bulletin relating to fittings for metal moldings, including outlet plates, junction boxes and regular and angle-pattern boxes.

SERVICE SWITCHES.—The Central Electric Company, Chicago, Ill., is distributing two new circulars descriptive of D. & W. service switches, fuses and cutouts. These bulletins will be of considerable value to central station managers in that they give information on several new devices for use on highly inductive circuits such as offered by power loads.

PITTSBURGH TRANSFORMERS.—The Central Electric Company, Chicago, Ill., is distributing a new circular descriptive of the Pittsburgh transformer and illustrating various types from 0.6 kw to 1000 kw capacity. This circular shows the various methods of winding employed and calls particular attention to the new type of porcelain bushings and insulation used on the primary leads.

SWITCHBOARD INSTRUMENTS.—Bulletin No. 4700, issued by the General Electric Company, is devoted to a description of voltmeters and ammeters for use on alternating and direct-current switchboards. The features of the instruments are large window openings, wide pointers and legible scales. The ammeters are made in ratings up to and including 200 amp; the voltmeters for e.m.f. up to and including 750 volts.

Business Notes.

THE CROWN WOVEN WIRE BRUSH COMPANY, Salem, Mass., manufacturer of alloy and phosphor bronze brushes, has recently increased its plant to care for a steady growth in business.

MR. WILLIAM S. TAUSSIG, who is a dealer in electrical equipment and also secretary of the Electric Club of Chicago, has removed his office from 448 Commercial National Bank Building to 627 West Jackson Boulevard, Chicago.

THE HOSKINS MANUFACTURING COMPANY, of Detroit, has opened a branch office and exhibition room at 321 Dearborn Street, Chicago, in charge of Mr. W. B. Young. A complete line of the company's electric furnaces is shown in operation.

THE CROCKER-WHEELER MANUFACTURING COMPANY has decided to locate its Canadian works at St. Catherines, Ont., Can. The company has recently secured several large orders for machinery to be used in connection with power developments in Canada.

EDWARD E. CARY COMPANY, Inc., 59-61 Park Place, New York, reports that several large arc lamp makers are testing its "Prima" enameled steel casings for arc lamps. The casings are new in this country, though largely used in England and on the Continent.

HABIRSHAW WIRE COMPANY.—Mr. J. B. Olson, general sales manager of the Habirshaw Wire Company, has recently returned from an extended trip to the West. Among the contracts closed for Habirshaw wire were the Mechanics' Institute, Cincinnati; the New Sherman House, Chicago, and the City Bank Building, Omaha.

THE DUNCAN ELECTRIC MANUFACTURING COMPANY reports that the past two weeks are the banner ones of the entire year in the sale of its Model E direct-current watt-hour meters. The sales include a number of its new astatic switchboard meters with removable armature, as well as many of its new portable test meters with fly-back pointers.

ELECTRIC STORAGE BATTERY SOUTHERN OFFICE.—The Electric Storage Battery Company announces a change in management of its Southern sales office. Mr. H. H. Seaman, the former manager, having resigned, Mr. A. N. Bentley has been appointed to take charge of this office. Mr. Bentley has had a comprehensive storage battery experience as the engineer of the company's Cleveland office.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

Alabama Light & Traction Association. Secretary, Lloyd Lyon, Mobile, Ala. Next meeting, Anniston, Ala., 1910.

American Association of Electric Motor Manufacturers. Secretary, W. H. Tapley, 29 West 39th St., New York. Next meeting, Hot Springs, Va., May, 1910.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, 158 West 76th St., New York City.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 33 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September.

American Street & Interurban Railway Accountants' Association. Secretary, H. E. Weeks, Davenport, Ia.

American Street & Interurban Railway Engineering Association. Secretary, John W. Corning, Boston Elevated Railway Company, Boston, Mass.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Arkansas Association of Public Utility Operators. Secretary, J. E. Cowles, Little Rock, Ark. Next meeting Pine Bluff, Ark., 1910.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, 509 Perry-Payne Building, Cleveland, O.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Los Angeles, Cal., May, 1910.

Association of Car Lighting Engineers. Secretary, C. B. Colegrove, Illinois Central Railroad, Electrical Department, Chicago. Next semi-annual meeting, Buffalo, N. Y., June 7 and 8, 1910. Next annual meeting, Chicago, Oct. 4, 5, 6 and 7, 1910.

Association of Edison Illuminating Companies. Secretary, D. L. Huntington, Spokane, Wash.

Association of Electric Lighting Engineers of New England. Secretary, W. H. Cole, Waltham, Mass. Annual meetings held in Boston, third Wednesday in March.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, A. L. Neereamer, Indianapolis, Ind.

Chicago Electrical Show, Jan. 15 to 29, 1910. Manager, Homer E. Niesz, 115 Dearborn St., Chicago.

Colorado Electric Light, Power & Railway Association. Secretary, J. C. Lawler, Colorado Springs, Colo.

EASTERN STATES INDEPENDENT TELEPHONE ASSOCIATION OF PENNSYLVANIA, NEW JERSEY, MARYLAND AND DELAWARE. Secretary, H. E. Bradley, 135 South Second St., Philadelphia, Pa.

ELECTRIC VEHICLE AND CENTRAL STATION ASSOCIATION. Secretary, H T. Sands, 139 Pleasant St., Malden, Mass.

ELECTRIC CLUB, CHICAGO. Secretary, W. S. Taussig, 448 Commercial National Bank Building, Chicago. Meets every Wednesday noon at Chicago Automobile Club.

ELECTRIC CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Geo. W. Russell, Jr., 25 West 42d St., New York.

ELECTRIC TRADES ASSOCIATION OF PHILADELPHIA. Secretary, J. W. Crum, 1324 Land Title Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary, Francis Raymond, 209 State St., Room 1002, Chicago. Annual meeting, Chicago, January, each year.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Staveley, Royal Insurance Building, Montreal, Can.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederick P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Harding Building, 34 Ellis St., San Francisco, Cal. Monthly meeting, San Francisco, second Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Thursday of each month.

EMPIRE STATE GAS & ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York.

FLORIDA ELECTRIC LIGHT AND POWER ASSOCIATION. Secretary, G. F. Doig, Gainesville, Fla. Next meeting, Tampa, Fla., April 21, 1910.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chabbuck, Peoria, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, P. S. Millar, 29 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, J. W. Fluckner, 503 Fifth Ave., New York.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Fred. Leslie, Muncie, Ind.

INTERNAL COMBUSTION ENGINE ASSOCIATION. Secretary, Walter J. Sittig, 61 Ward St., Chicago.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). Secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. C. Davis. Next meeting, Chicago, Dec. 7, 8 and 9, 1909.

IOWA ELECTRIC ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Ia.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. J. Thill, 208 Des Moines Life Bldg., Des Moines, Ia. Annual meeting, second Wednesday in March each year.

IOWA STREET & INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Sioux City, April, 1910.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Kansas City, 1910.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October, each year.

MAINE ELECTRICAL ASSOCIATION. Secretary, Fred D. Gordon, Auburn, Maine.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. P. Biggs, Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, B. W. Cowperthwait, Faribault, Minn. Next meeting, St. Paul, third week in March, 1910.

MISSISSIPPI ELECTRIC ASSOCIATION. Secretary, J. A. Abbott, Jackson Ry. & Light Co., Jackson, Miss.

MISSOURI ELECTRIC, GAS, STREET RAILWAY & WATER ASSOCIATION. Secretary, C. L. Clary, Sikeston, Mo. Next meeting, Jefferson City, Mo., April 14, 15 and 16, 1910.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL DISTRICT HEATING ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive Secretary, T. C. Martin, 33 West 39th St., New York.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 41 Martin Building, Utica, N. Y. Next meeting, Atlantic City, N. J., July 20, 1910.

NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pliny St., Hartford, Conn.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting, San Francisco, Cal., June, 1910.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, Frank McMaster, Beatrice, Neb.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ORLEANS ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, I. G. Marks, 312 Carondelet St., New Orleans, La. Meetings, second and fourth Tuesdays of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWEST ELECTRIC LIGHT & POWER ASSOCIATION. Secretary, N. W. Brockett, Cataract Building, Seattle, Wash.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus, Ohio. Next meeting, Cincinnati, Ohio, 1910.

OKLAHOMA PUBLIC UTILITIES ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla. Next meeting, Sapulpa, Okla., 1910.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, F. J. Scherrer, 195 Broadway, New York.

PACIFIC COAST ELECTRIC AUTOMOBILE ASSOCIATION. Secretary, J. T. Halloran, 604 Mission St., San Francisco, Cal. Next meeting, Oakland, Cal., February, 1910.

PENNSYLVANIA ELECTRIC ASSOCIATION. Secretary, E. L. Smith, Towanda, Pa.

PENNSYLVANIA STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PHILADELPHIA ELECTRICAL SHOW. First Regiment Armory, Broad and Callowhill Sts., Feb. 14-26, 1910.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Colo. Meetings, second Saturday of each month.

SAN FRANCISCO ELECTRICAL SHOW. Jan. 29 to Feb. 5, 1910. F. M. Scribner, Chairman.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, H. H. Norris, Cornell University, Ithaca, N. Y.

SOCIETY OF WIRELESS TELEGRAPH ENGINEERS. Secretary, E. D. Forbes, 96 Franklin St., South Framingham, Mass. Monthly meeting, first Monday of each month. Next annual meeting, Feb. 28, 1910.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck Hudson, S. D. Next meeting, Jan. 11 and 12, 1910.

SOUTHWESTERN ELECTRIC & GAS ASSOCIATION. Secretary, E. T. Moore, Dallas, Tex.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary G. H. Pardee, care of J. G. White & Co., New York.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, A. B. Marsden, Manchester, Vt.

UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 141 Milk St., Boston, Mass.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 125 Monroe St., Chicago, Ill. Next meeting, Omaha, Neb., 1910.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

WIRELESS INSTITUTE. Secretary, Sidney L. Williams, 42 Broadway, New York.

WISCONSIN ELECTRICAL ASSOCIATION. A consolidation of the Northwestern Electrical Association and the Wisconsin Electric and Interurban Railway Association. Secretary, John S. Allen, Lake Geneva, Wis. Next meeting, Milwaukee, January, 1910.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV 23, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

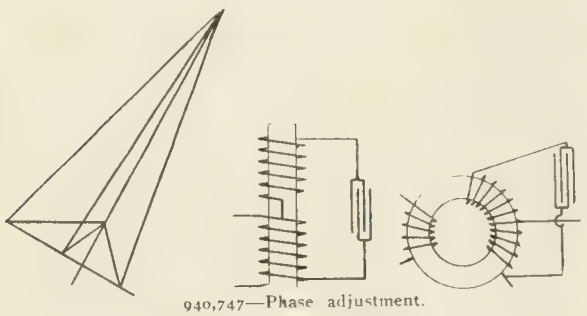
940,718. SELF-RESTORING TROLLEY; H. H. Parker, Cleveland, O. App. filed Nov. 23, 1908. A solenoid magnet shifts the pole vertically and laterally and a special trolley pole with contact arm is provided so that the contacts strike the wire when the wheel leaves it, which closes the circuit through the magnet to restore the pole.

940,734. ELECTROLYTE FOR USE IN ELECTRIC BATTERIES; W. J. L. Sandy, London, Eng. App. filed Aug. 22, 1908. A mixture of sulphuric and hydrochloric acids, water, bichromate of sodium and caustic soda.

940,736. VAPOR ELECTRICAL APPARATUS; H. M. Schiebe, Wilkinsburg, Pa. App. filed Jan. 21, 1909. For automatically starting vapor rectifiers by means of a tilting magnet having an actuating coil and an opposing coil which is effective when the apparatus is tilted.

940,742. WATER RETAINING AND CONVEYING ATTACHMENT FOR CABLE LIGHTNING RODS; H. Simpson, Burlington, Wis. App. filed July 6, 1908. A cable rod with a tubular grounding device, the latter being arranged to collect water so as to improve the ground.

940,747. PHASE ADJUSTMENT; W. E. Sumpner, Moseley, England. App. filed Dec. 4, 1907. For rectifying the phase error in watt



940,747—Phase adjustment.

meters, by means of an auxiliary winding having the same magnetic circuit as the ordinary winding and a condenser in said circuit of the auxiliary winding, the capacity of the condenser and the number of coils of the auxiliary corresponding substantially to the total amount of magnetization required in the core.

940,774. APPARATUS FOR TREATING MOLTEN METALS; F. S. Adams, Leetonia, Ohio. App. filed July 22, 1909. For treating molten metal for eliminating the sulphur by means of a metal pot with means for creating a vacuum, a pair of electrodes therein and electric magnetic solenoids for raising or lowering the electrodes.

940,787. RAILWAY SIGNALING APPARATUS; W. J. Cook, Denver, Col. App. filed Aug. 17, 1908. Means for lighting a lamp ahead of the train which is automatically extinguished after the train passes the lamp by means of track make-and-break devices.

940,800. RAILROAD SIGNAL; L. E. Garnett, Chanute, Kan. App. filed Aug. 14, 1908. For preventing rear end collisions by setting a signal automatically to danger and holding it there for a certain length of time so that the next train will be held until the danger signal is released.

940,821. PROCESS FOR TREATING ORES; J. R. Parks, Spokane, Wash. App. filed Nov. 23, 1906. For reducing precious metal ores by mixing cyanide of potassium and an electrolyte and simultaneously passing a current of air and of electricity through the mixture.

940,831. ASEPTIC LAMP FOR DENTAL, MEDICAL OR SURGICAL PURPOSES; D. Stern, Cincinnati, Ohio. App. filed June 1, 1909. Can be placed in the mouth and consists of a miniature lamp encased in a glass globe.

940,881. AUTOMATIC CIRCUIT BREAKER; W. H. Lawrence and P. Torchio, New York, N. Y. App. filed Feb. 9, 1909. For selective and automatic operation of circuit breakers on alternating-current generators operating in parallel by means of an external reactance coil in each lead and overload relay calibrated to operate at a current in excess of the maximum instantaneous short-circuit current of each generator and its external reactance coil.

940,910. SAFETY ELECTRICAL CIRCUIT BREAKER; W. F. Wocher and L. F. Mortsolf, Indianapolis, Ind. App. filed April 25, 1908. For automobiles so that the owner may leave the machine. Consists in automatic key locking device and an inaccessible grounded wire which is connected automatically when the normal circuit is broken.

940,927. PROCESS OF MAKING SALTS OF AMMONIA, ESPECIALLY SULPHATE OF AMMONIA; O. P. Hurford, Chicago, Ill. App. filed Dec. 12, 1908. Causes the chemical union of nitrogen and hydrogen gas under the influence of electrical discharges in the presence of a suitable acid which combines with the ammonia as soon as it is formed to hold the same by forming a compound of ammonia.

941,002. SAFETY ELECTRICAL CIRCUIT BREAKER; W. F. Wocher, R. E. Lemon and L. H. Mortsolf, Indianapolis, Ind. App. filed Nov. 30, 1908. For permitting the owner of an automobile to leave his machine. A circuit breaker including a locking bolt which when locked grounds an electric circuit and an improved flexible connection between the circuit breaking casing and the ground so as to defeat attempts to restore the circuits.

941,020. FUSE; F. G. Jones, Muskegon, Mich. App. filed March 11, 1908. A porcelain fuse wire support carrying conducting caps terminals within which a tortuous channel is provided for the fuse.

941,039. CABLE HANGER; C. L. Pierce, Jr., Chicago, Ill. App. filed Sept. 13, 1908. A messenger straddling member of sheet metal and U-shaped, together with a pliant suspending cable.

941,113. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Feb. 13, 1909. A main source of electrical energy supplies a consumption current. A storage battery and booster maintain the load on the main circuit substantially constant, the booster having a single armature core structure with brushes for feeding current to the armature for driving the dynamo and brushes for taking off current and field windings for compensating for armature reaction.

941,144. SIGNAL; L. A. Hawkins, Schenectady, N. Y. App. filed Dec. 29, 1908. For controlling a plurality of cars which are admitted into a block, each car being counted by the signal mechanism, the signals not being cleared until the last car has left the block. Uses a differential gear, a signal controlled by one member thereof, a pair of electromagnets, and connections between the other two members of the gear and the magnets.

941,151. THIRD-RAIL ELECTRIC RAILWAY SYSTEM; C. Kozesnik, New York, N. Y. App. filed April 18, 1908. Contact shoe carrying an electromagnet movably mounted therein and carrying a roller adapted to bear against the surface of the rail.

941,156. RECEPTACLE OR THE LIKE FOR CONDUITS; G. A. Lutz, Plainfield, N. J., and C. C. Sibley, Perth Amboy, N. J. App. filed March 5, 1908. A fitting on a conduit having a locking piece with independently movable portions to engage opposite sides of conduit.

941,165. ELECTRIC CUT-OUT; T. E. Murray, New York, N. Y. App. filed June 18, 1909. For enclosing fuses for circuit connections in porcelain. Uses a removable circuit closing plug entering between a fuse support and a circuit terminal.

941,174. INCANDESCENT LAMP SOCKET; F. W. Slady, Bridgeport, Conn. App. filed May 24, 1909. A pole socket having upper and lower insulating buttons, a rotary insulating block, a switch operating mechanism and a spindle of insulating material on which the oscillating member of a ratchet is mounted.

941,180. BRIDGING BLOCK FOR DYNAMO ELECTRIC MACHINES; F. W. Young, East Orange, N. J. App. filed June 2, 1909. A dynamo electric machine with coil containing slots, windings therein and elongated slot closing bridging blocks, each having a forked end.

941,181. LINING FOR SLOTS OF DYNAMO ELECTRIC MACHINE ELEMENTS; F. W. Young, East Orange, N. J., and Edward Heitmann, Montclair, N. J. App. filed June 5, 1909. An armature with coil containing slots, windings therein and slot closing bridging blocks of magnetic material in the slots with insulated metallic windings between the slots and the blocks.

941,182. BRIDGING BLOCK FOR DYNAMO ELECTRIC MACHINES; F. W. Young, East Orange, N. J. App. filed July 19, 1909. A slot closing bridging block consisting of a sheet metal trough and an iron core cast therein.

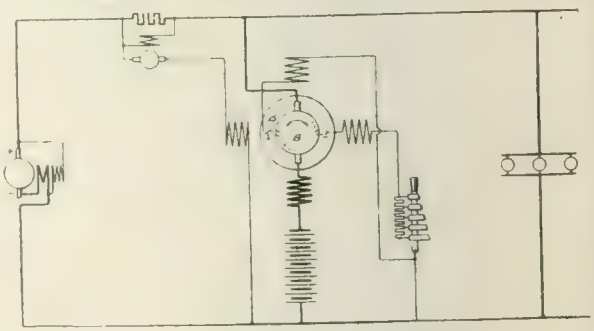
941,211. APPARATUS FOR PRODUCING AUDIBLE MOVING PICTURES, PIECES OF MUSIC, AND OTHER PERFORMANCES; Franz E. Thormeyer, Hamburg, Germany. App. filed March 1, 1909. Apparatus for synchronous working which does away with driving by hand by using a third driving device with an indicator.

941,215. WATER HEATER; G. H. Wade, Atlanta, Ga. App. filed Sept. 2, 1908. A heater having casing with a spiral groove terminating at the center and periphery through which the water passes.

941,216. TROLLEY POLE CATCHER; J. E. Walker, Lexington, Ky. App. filed Dec. 4, 1908. A trolley pole catcher having a rack and carrier frame with a dog carried by the frame engaging the rack and a brake.

941,233. AUTOMATIC SAFETY APPLIANCE FOR RAILWAYS; W. G. Daring, Pittsburgh, Pa. App. filed April 27, 1909. Normally open circuits with a contact block and an equipment on the train having an electrically released valve for releasing the air to set brakes.

941,259. COMBINED SIGNAL AND AIR BRAKE; A. M. Jones,



941,113—Electrical System of Distribution.

Hagerstown, Md. App. filed Feb. 10, 1909. A whistle, a reservoir and train pipe, and a spring actuated track device for actuating the parts.

941,263. RAILWAY SIGNALING SYSTEM; T. MacDougal and James McKinnon, Boulder, Col. App. filed June 16, 1908. Includes a circuit closer, an electromagnet, an indicator associated with the armature of the magnet so as to display a signal and non-electric means to retract the signal.

941,266. ELECTRIC SWITCH; W. W. Morse, Westport, N. Y. App. filed Dec. 28, 1908. For controlling water power plants at a distance by means of a switch lever operated by a solenoid.

941,276. ELECTRICAL RECEPTACLE; F. J. Russell, New York, N. Y. App. filed Sept. 25, 1908. For receiving electrical connecting plugs or lamp bases, the body having a plug receiving socket and a wire plug holder having a single spiral holding loop.

941,332. RAIL FASTENER AND BOND; C. D. McAfee, Burgettstown, Pa. App. filed March 12, 1909. For rail bonds having splice bars bracing the rails, bolts extending through them. Details.

941,339. PROCESS OF PRODUCING SILICON CARBID; F. J. Tone, Niagara Falls, N. Y. App. filed June 14, 1907. Embeds in a charge of silicons and carbonaceous materials a resistance conductor made up of a series of pieces longitudinally in direct electrical contact and arranged in a circuitous line between the terminals.

941,342. ELECTRICAL SAD IRON; W. A. Braun, Fort Wayne, Ind. App. filed Jan. 20, 1908. Automatic apparatus for breaking the circuit when the iron becomes heated, by means of an expanding member controlling the circuit breaker.

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ELECTRIC ENTERPRISE IN NORWAY.

One of the most striking hydroelectric plants which we have yet had the pleasure of recording is the huge Norwegian development which we describe elsewhere in our columns. It is notable not only on account of its extraordinary size, reaching, when the two plants now under construction are complete, 250,000 hp, but also on account of the fact that this development has been almost wholly with the view of furnishing power for the nitrate plants which have come to be a feature of Norwegian industry. The plant from the hydraulic standpoint is somewhat unusual and is besides a typical example of the situation which develops in Norway rather more frequently than elsewhere. Norway is from the hydroelectric standpoint exceptionally well ordered. It is both mountainous and characterized by a heavy rainfall. Its streams are short from the standpoint of the American, at least, not infrequently fed from considerable lake areas in the uplands and presenting heavy falls in a comparatively short distance. In the present case, for example, the River Maane, on which the plants are located, is only 20 miles long, but takes its rise in a lake having a developed surface area of 22 square miles, nearly 3000 ft. above sea level. It thus becomes possible to utilize a large head within a comparatively short length of river, and to obtain an exceptionally uniform flow, the drainage area of the upper lake in this case being 570 square miles.

As a matter of convenience, owing to the topographical situation, the whole power is to be developed in two sections aggregating a quarter of a million horse-power. In the electric plant there are no sensational developments save the extraordinary size of the impulse turbines, which rise to 14,500 hp apiece. Transmission distances being very short, 11,000-volt generators are used directly upon the line. It is the utilization of the power from this great plant that presents to the American engineer the greatest interest and novelty. This power is to be employed by the Rjukan saltpeter works for the production of saltpeter from atmospheric nitrogen. If we remember correctly, some of the earliest, if not the very earliest, work on the fixation of atmospheric nitrogen was done in this country, but the industry has not flourished here and it has remained for European engineers to reduce the process to a commercial success upon a very large scale. The Norwegian plant in question has for its fundamental object the production of nitrates, chiefly saltpetre, while some of the Continental processes have been directed to the production of pure nitric acid, in each case the source being the nitrogen of the atmosphere. Until within a few years the world's supply of nitrates has been entirely from natural sources of somewhat dubious extent and amount; and, inasmuch as nitric acid is a fundamental in the chemical industry, a synthetic source of supply is to be considered as ultimately of enormous importance. Fancy, for instance, what would have been the effect if 10 years ago the world's nitrate supply had given out or had been cornered in the hands of a single aggressive nation. Practically all explosives have to be derived directly or indirectly from nitrates, and the giving out

of the precious supply might have reduced the civilized nations to battling again with spear and bow. There are those, of course, who would have rejoiced temporarily in the absence of "villainous saltpeter," yet the ultimate results upon civilization might have been disastrous in the extreme.

This and other perils have been successfully avoided by the highly successful electrochemical methods of obtaining an adequate supply of nitrates from the nitrogen of the air. One might even pass forward in a speculative way to the consideration of thus keeping the balance of the composition of the atmosphere somewhat nearly in its normal place. Most of the huge natural chemical processes involve the oxygen of the atmosphere, and artificial means of rounding up the nitrogen and making it furnish its share of the world's supplies may be considered of ultimate benefit in preserving the nice balance of Nature. Be that as it may, the artificial nitrates industry is of great importance to the world, first, in that it provides a practically inexhaustible supply of material which might otherwise rise seriously in price; and second, because industries of this character give a beautiful opportunity for utilizing surplus water-power. If one considers the total available water-power of a given watershed, it is then clear that natural conditions usually permit of only very imperfect utilization. The huge run-off at certain times of the year is practically lost, and even aside from this, most plants have from the nature of their market supply a very irregular load factor. If the surplus energy now running to waste in many plants could be transmitted and utilized for nitrate works, there would be opportunity for working the available powers to very much greater advantage than now. With a reliable customer for surplus power of this kind it would probably become possible to reduce the price of transmitted power for manufacturing purposes to the point that would take in new lines of industry. It is this feature of the matter that ought to be investigated by those who are interested in hydroelectric developments.

Characteristics of Single-Phase Induction Motors.

The characteristics of the single-phase induction motor equipped with a commutator furnish the most instructive study possible of the many types of electric motors that have been developed for industrial service. This machine exhibits certain of the characteristics of the direct-current motor, the polyphase induction motor, the single-phase induction motor, the so-called repulsion motor and other motors of the alternating-current commutator type. It will be appreciated at once that a complete understanding of the inter-relations between the electromotive forces, currents, magnetomotive forces and fluxes in a motor possessing the characteristics of the one here mentioned cannot be obtained from a superficial investigation, but considerable study is necessary in acquiring the desired information. An analytical treatment of this machine, which can be studied with the minimum of unnecessary exertion, is given in an article by Mr. Val. A. Fynn, the first part of which appears in this issue. This article deals with actual conditions at no-load and under-load of those types of machine of which the ideal no-load conditions were discussed in an article by the same author which appeared in our issues for Nov. 18 and 25.

In the installment in this issue the author deals more particularly with the no-load conditions of a motor of the type having a commutator short-circuited in line with, and in electrical space-quadrature with, the primary magnetism. This machine is equivalent in operating features to the machine commonly known as the single-phase induction motor. The magnetic field in this motor possesses two components, one in line with the primary coil, which is practically constant at all speeds, and another almost in electrical-space quadrature therewith, which varies directly with the rotor speed. The current which produces the latter field varies directly therewith, but it occupies such an electrical-space position along the rotor as not to react directly upon the primary magnetism. The current in the rotor which does react upon the primary magnetism is produced by an e.m.f. which is the vector difference between the e.m.f. that would be produced by the transformer action of the primary field if it existed alone and the e.m.f. due to the speed action of the magnetism in quadrature therewith. To the extent that the former e.m.f. may be considered constant, the latter varies with the product of the speed and the quadrature magnetism—that is, with the square of the speed. Even at synchronous speed, when the two e.m.fs. may be considered as equal in value, their vector difference is not zero, because they are not in direct time-phase opposition. The relative numerical and time-phase relations here outlined are well discussed in the articles by Mr. Fynn.

The Absolute Measurement of Resistance.

The absolute measurement of resistance is only of secondary interest to the electrical engineer, because he relies upon some national laboratory for the maintenance of his standards, and, as long as his resistances agree with those of everyone else to one part in ten thousand, when great care is required, he is not directly concerned with the question. The subject is, nevertheless, of primary interest to the national laboratories, where the electrical engineering standards are safeguarded and maintained. Up to the present time it has been necessary to make up primary standard ohms in pure mercury, using carefully calibrated glass tubes for the purpose, and verifying the resistance of these mercury standards occasionally by absolute electromagnetic measurements. One of the most satisfactory methods for such measurements is the Lorenz method, which employs a very small dynamo without iron cores, for producing a determined e.m.f. at a carefully measured speed. The armature of this dynamo is a simple rotating copper disk, from the axis and periphery of which the measured e.m.f. is derived. Even at fairly high speeds, however, this little homopolar dynamo delivers but a feeble e.m.f., usually only a small fraction of a volt; whereas a higher degree of precision might be obtainable if the e.m.f. available were a volt or more.

An innovation into this method has been lately proposed by Dr. E. B. Rosa, in the *Bulletin* of the Bureau of Standards. The plan is to use a wound armature, instead of a disk, in the standard dynamo. The wound armature will be two-phase in type, and each of the two phases will be led, through a two-part commutator, to one coil of a three-coil differential galvanometer. By rotating the two-phase armature at 25 turns per second, in a magnetic field produced by a pair of fixed enveloping air-coils, an e.m.f. of several volts may be expected. Another innovation suggested in the article is the measurement of the magnetic flux linked with the rotating armature coils by direct comparison with mutual inductance standards. The ordinary Lorenz method is to compute the inductance from the

dimensions of the field coils and of the disk armature. If it is found practical and reliable to use commutators in the armature circuits of this interesting instrument, great advantage may be hoped for from its use. Hitherto, no one has dared to use a commutator in any such absolute measurements. It is pointed out that it should be possible to standardize wire resistances directly in absolute measure against an absolute resistance machine, and so dispense with the troublesome intermediate mercury ohm. It will be interesting to learn whether such a result can be attained with the new device when completed.

UTILIZING CHICAGO'S WATER-POWER.

It is gratifying to note that a movement is now on foot in Chicago on the part of the authorities which bids fair to give Chicago the full municipal benefit of its valuable Drainage Canal water-power, which has heretofore to some extent gone to waste for lack of utilization on the part of that city. Chicago much needs an extension of electric street lighting to cover the entire city. As we understand it, the amount of water-power available as an immediate result of the building of the Drainage Canal is approximately sufficient to light electrically a large portion of the streets of Chicago. The city of Chicago has lacked funds with which to build the distributing system necessary for utilizing the power which the drainage board has offered at a very low figure. A scheme of financing has now been proposed whereby the sanitary district assumes part of this burden. President McCormick, of the sanitary district trustees, also urges the use of water-power during the daytime for the pumping of city water, as a means of saving fuel at the least efficient pumping stations. This utilization of power which has been created by the money of the taxpayers of Chicago is much more logical than a plan of distributing power and light for miscellaneous commercial purposes at a low-load factor. It is along the lines that we have previously urged as being most logical from an economic standpoint, and the most likely to save the money of the taxpayers of Chicago.

ELECTRIC IGNITION.

At a recent meeting of the Manchester Section of the British Institution of Electrical Engineers a paper was read by Mr. J. W. Warr on the subject of electric ignition in relation to internal combustion engines. Electric ignition systems may broadly be divided into two classes, namely, low-tension and high-tension systems. In low-tension systems a circuit containing a low or moderate voltage and an inductance is broken within the cylinder in the presence of the gases to be ignited, the spark at rupture producing the ignition. In high-tension systems, a jump-spark is produced between fixed electrodes in the cylinder across a definite gas-gap. This calls for a fairly high tension, produced either by a magneto-dynamo, or by a Ruhmkorff cell. The advantage of the low-tension method is that the apparatus used may be of a very simple type, consisting, say, only of a few dry cells, a simple inductance coil and mechanically operated contacts, or spark-plugs. The advantage of the high-tension method is the elimination of the friction and wear of the break-contact mechanisms within the cylinders. Various modern details of structure and arrangement are described in the paper with reference to both systems of ignition. It is evident that although both systems are used very largely in automobile practice there remains considerable room for improvement in electric ignition.

MEASUREMENT OF HIGH PRESSURES BY CHANGES OF RESISTIVITY IN CONDUCTORS.

As mentioned in the Digest, a paper has recently been communicated to the French Academy of Sciences by M. A. Lafay, which deals with the changes in resistivity observed in certain solid and liquid conducting prisms under heavy pressures per unit area. Such measurements have been made by various experimenters on manganin, platinum, mercury, aqueous solution of zinc-sulphate and other bodies. The remarkable fact noticeable in all these measurements is the relatively small amount of the change in resistivity at constant temperature that the pressure is able to effect. The prevalent theory of electric conduction in material conductors is that the molecules form a sort of bucket brigade in which bucketfuls of electricity, or ionic charges, are passed on from hand to hand—that is, from one molecule to the next. On this hypothesis, one would naturally suppose that when the brigade was subjected to pressure, thereby bringing the individuals nearer together, the conductive process would be facilitated and accelerated to a marked degree. In general, it is facilitated—that is to say, the resistivity is reduced, but ordinarily only to a very minute degree. For instance, some data for platinum given in the above-mentioned paper show a reduction of less than 2 per million in the resistivity per atmosphere of applied pressure. In liquid mercury, the change is somewhat greater, being 33 per million per atmosphere. It is evident that we have yet a great deal to learn concerning the constitution of matter before we can understand the nature of such resistivity changes.

CRYSTAL AND SOLID-CONTACT RECTIFIERS.

In the operation of wireless telegraphy, crystal receivers have now been used for several years with considerable success. The receiver consists essentially of a conducting crystal on which rests a metallic point, the pair being connected with the receiving aerial in such a manner that the high-frequency electric currents pass through the contact between crystal and point This contact is also shunted by a delicate telephone receiver The high-frequency currents are unable to pass through the impedance of the telephone, but these currents are partly rectified at the contact, so that the rectified currents pass without difficulty through the telephone and produce audible signals A large number of crystals have been found to possess the above remarkable property of rectification in appreciable degree. Notable among them for effectiveness in this particular are crystals of silicon, perikon and molybdenite. In order to be effective, the conductivity of the crystal has to be fairly large in the favored direction. That is, crystals which are essentially non-conductors are of no use, however great their rectification might be of infinitesimal currents. Strangely enough, it has been found very difficult to explain the rectifying action, which seems in some manner to be associated with the crystalline structure, although a few amorphous substances are stated to possess the property in feeble degree. A recent article by Mr. Alan E. Flowers, in the *Physical Review*, discusses some experimental observations on crystalline rectifiers, and reaches the conclusion that the rectification is probably due to the electrochemical formation of a high-resistance film at each alternate reversal of current. If this view is correct, a crystal rectifier bears close analogy to an electrolytic rectifier with aluminum plates immersed in a suitable electrolyte. The subject is, however, still in a highly debatable state.

New York City Adopts National Electrical Code.

Commissioner John H. O'Brien, of the Department of Water Supply, Gas & Electricity of New York City, has announced the withdrawal of the interior wiring rules of the city, comprising Classes *A* and *C* of the rules and regulations published by the department, and the substitution therefor of the interior wiring rules of the 1909 edition of the National Electrical Code as included in Class *A*, stations and dynamo rooms, and Class *C*, inside work, with such modifications (noted below) as are rendered necessary by local conditions and ordinances.

All of the rules relating to concealed knob and tube work are expunged, since this class of wiring has not been permitted in New York City for many years. The third paragraph of Rule No. 8-*c*, relating to overload release devices and motor-starting rheostats, is omitted, so that these devices under no circumstances can be considered as substitutes for cut-outs in New York. Rule No. 15-*b* has been modified so as to bring out the intention of the rule, that tie wires should have an insulation of the same type as that of the conductors they confine, and must be of such size as to afford ample mechanical security. If interpreted as printed in the new edition of the code, a 5000 circ.-mil cable, for instance, would require a 5000 circ.-mil cable as a tie wire, since the insulation of wires is graded in thickness to the size of the wire, and a wire smaller than 5000 circ. mil would not have equal insulation.

Rules Nos. 21-*a* and 22-*a*, relating to the position of cut-outs and switches on service wires, are open to modification by special permission in writing given in advance, there being so much vault space in New York City that the intention of the rule is best served by certain permissible breaches. Rule No. 21-*d*, relating to link fuses, is omitted from the list of wiring regulations, since the present ordinances do not permit this construction.

Rule No. 24-*g*, calling for wires with approved rubber, slow burning, weatherproof or slow-burning insulation for open work in dry places, has been slightly amended by requiring special permission in writing in advance for wires with slow-burning insulation, the Commissioner doubtless feeling that to specify the best wire and then add that the cheapest wire will do is hardly logical. The third paragraph in Rule No. 24-*h*, which in the revised code reads, "the neutral of an Edison three-wire system may be placed in the center of a three-wire cleat where the difference of potential between the outside wires is not over 300 volts, provided the outside wires are separated 2½ in.," is omitted from the New York City rules, since there are other three-wire systems besides the Edison, and the present rule would infer that the neutral of an alternating-current, three-wire system could not be so placed.

Rules Nos. 24-*A*-*b* and 25-*d*, calling for an outlet box or plate at every outlet, have been slightly modified by the addition of the words "or other approved device," so as to conform with the present rules of the department and present practice in New York.

Rule No. 25-*b*, calling for continuous conduit from outlet to outlet or to junction boxes, which in case of service connections in main runs involves running each conduit continuously into a main cut-out cabinet or gutter surrounding the panel board, as the case may be, has a proviso added that a departure may be authorized under special permission in writing given in advance, so as to conform with the present practice in New York City. Rule No. 25-*A*-*b*, relating to the passage of metal moldings through floors, has been slightly changed by the omission of the first clause in the second paragraph, so that where metal molding has the necessary mechanical strength the modification mentioned in the paragraph is permitted.

Rule No. 27-*b*, relating to sockets in damp or wet places, has been modified by the substitution of the word "weatherproof" for "waterproof," and the proviso that the sockets shall be especially approved for the location. The reason for this is that the approved list of fittings does not mention waterproof but weatherproof sockets, and there are virtually two classes of these, so that while a certain type of weatherproof socket would be approved for an electric sign, an entirely different type might be applicable for a damp cellar, the socket in the first instance being designed to resist driving rains, which do not necessarily occur in the latter location.

Rule No. 31-*A*, relating to theater wiring, has been broadened by omitting from the general note the words "which is capable of seating at least 400 persons." A theater in New York City may seat a lesser number of persons, and the Commissioner feels that especial vigilance should be exercised in protecting patrons of moving-picture shows, many of which are in reality small theaters which do not seat the number of persons specified in the rules governing theater wiring. The notes at the bottom of Rule No. 31-*A*-*a*, relating to theater wiring, stating that the rule solely concerns the protection of the person, and should therefore be left to the discretion of the assured so far as the fire risk is concerned, has been stricken from the city regulations. A note stating that the number of services specified, source of supply, etc., may be modified by special permission in writing given in advance, is added.

Rule No. 31-*B*-*i*, relating to sockets and receptacles for outline work, has been slightly modified to conform with practice in New York City, by stating that only such wires as are connected to open terminal receptacles, and not enclosed in outlet boxes, shall be soldered to lugs on the sockets and receptacles Rule No. 36-*c*, relating to the installation of transformers, has been modified so that transformers inside buildings must be permanently and effectually grounded in New York City.

The Commissioner has taken no action on rules relating to marine wiring, since these are outside his jurisdiction and rest with the Federal authorities. The rules relating to outside work, being so modified by ordinances, etc., in New York City, no immediate action on these will be taken until the men at present engaged in an attempt to harmonize the city rules and regulations with the requirements of the National Electrical Code have reported their recommendations.

New York Public Service Commission Rules for Testing Electric Meters.

The New York City Public Service Commission has issued in printed forms its rules and regulations relative to testing electric meters, which went into effect on Nov. 1. Forms are included for reports on complaint, periodic and office tests of meters. The first-mentioned is defined as a test made by an electrical corporation upon the premises where the meter is installed as the result of a complaint of the customer. A periodic meter test is a test made by an electrical corporation in the regular course of its business upon the premises where the meter is installed, but not at the time of installation, which test is not made as the result of a complaint from the consumer nor by direction of the corporation, of an officer or of an employee that a special test be made. An office meter test is a test made by an electrical corporation, upon the premises where the meter is installed, by direction of the corporation itself, of an officer or of an employee that a special test be made.

The rules require that every electrical corporation operating within the First District shall file with the Public Service Commission monthly reports, in the form prescribed, stating the results of all tests of electric meters tested for accuracy during that month. Such reports shall be made for the calendar month and shall be filed not later than the fifteenth of the following month.

All tests are required to be made with the meter in its permanent position on the consumer's premises and under actual operating conditions as regards voltage, frequency, temperature, stray fields and vibration.

Where shunts, series transformers or shunt transformers are used in connection with a meter, the meter shall be tested from the line side of such apparatus when the voltage

does not exceed 600 volts. In periodic tests where the line voltage exceeds 600 volts, the meter may be tested as a self-contained meter, and the ratio certificates of the transformers may be used in calculating the true line watts, provided said certificates are dated within the five years preceding the time the meter is tested. In complaint and office tests, the commission will accept the ratio certificates of the transformers, provided they are dated within the year preceding the time the meter is tested. When rotating standard meters are used, the connections must be so arranged as to give the tester full control of the starting and stopping of the standard and at the same time allow him to count the revolutions of the meter under test.

Each meter shall be tested independently, and no meter shall be tested while connected in series with one or more other meters unless the potential circuit of each meter is so arranged as not to be fed through the field of any meter under test or rotating standard. All indicating and integrating instruments used as standard instruments in testing meters shall be equipped with scales properly proportioned to the loads measured.

All meters shall be adjusted so as to register with an error of not more than 1 per cent at light load and at full load, and both of these adjustments shall be maintained in this condition as nearly as possible. All meters, whenever possible, shall be tested at three loads: one-tenth of the full rated capacity of the meter, normal load, and full rated capacity of the meter. The average of these tests, obtained by multiplying the result of the test at normal load by three, adding the result of the tests at one-tenth capacity and full capacity and dividing the total by five, shall be deemed the condition of the meter, and such final average shall be reported to the commission on the form prescribed by it. In an installation where it is impossible to obtain a load of 10 per cent of the rated capacity or 100 per cent of the rated capacity of the meter, tests shall be made at the nearest obtainable loads to 10 per cent and 100 per cent of rated capacity of the meter and values given in the ratios.

The following classification, in percentage of installation, shall be used in determining normal test load:

A.	Residence and apartment lighting	25%
B.	Elevator service	40%
C.	Factories (individual drive), churches and offices	45%
D.	Factories (shaft drive), theaters, clubs, entrances, hallways and general store lighting	60%
E.	Saloons, restaurants, pumps, air compressors, ice machines and moving picture theaters	70%
F.	Sign and window lighting and blowers	100%

When a meter is found to be connected to an installation consisting of two or more of the above classes of loads, the normal load used must be obtained by taking the average of the percentages for the classes so connected. Three tests shall be made at each load at which the meter is tested, but should any two fail to agree within 1 per cent, additional tests shall be made until three results are obtained which do not vary one from another more than 1 per cent.

Decision Under Recent German-American Patent Agreement.

Patent Commissioner Moore in commenting on the German decision reported in these columns last week whereby American patentees are awarded valuable privileges in Germany, said that the decision is of far-reaching importance and means millions of dollars to American manufacturers. "The real effect of the decision," said Mr. Moore, "will be to prevent non-forfeiture of 'live' patents granted by Germany to American citizens, both before and subsequent to the treaty of 1908. This instrument, negotiated by the Commissioner, provides that American inventors and manufacturers owning German patents no longer should be required to manufacture their products in Germany, which they had been required to do and which involved a large outlay and a duplication of plants."

Mr. Moore went to Europe this year at the request of the State Department and negotiated with Denmark, Norway, Sweden, Russia, Austria, Italy, Spain, France and Belgium treaties similar to that with Germany.

New Chicago Street-Lighting Proposition.

In a letter dated Nov. 29, Mr. R. R. McCormick, president of the board of trustees of the Sanitary District, Chicago, makes an interesting offer by which he says the street-lighting facilities of the city may be increased without expense to the latter. The letter is addressed to Alderman B. W. Snow, chairman of the finance committee of the City Council. In it Mr. McCormick remarks that the water power of the Sanitary District belongs to the people, and that the best public use to which it can be put is in lighting the streets of Chicago. The city of Chicago is without funds to extend its lighting system; the finances of the Sanitary District are in good condition; therefore, the resources of the District should be used to provide street lighting in so far as such use will not interfere with the acomplishment of the primary purpose of the Sanitary District, which is sanitation.

Mr. McCormick points out that the transmission lines of the Sanitary District and of the municipal plants of Chicago often parallel each other, and that as both are owned by municipal bodies, this duplication is unnecessary, and by doing away with it, in existing lines and in planning for the future, much unnecessary expense may be avoided. For instance, as it is now, the city and the Sanitary District each has a substation on Fullerton Avenue, not a mile apart. The city has a transmission line here and the Sanitary District has two. On Thirty-fifth Street, from Western Avenue to Ashland Avenue, there are two transmission lines on one set of poles belonging to the city; in addition there is one Sanitary District overhead transmission line and another belonging to the same owner carried underground. In this case there is an unnecessary expense approximating 50 per cent of the total cost of the construction. Lincoln Park is lighted by the electricity supplied by the Sanitary District, and in order to reach it the transmission circuits pursue a circuitous route. "There are cases," says Mr. McCormick, "where in its commercial business the Sanitary District is operating distribution lines as much as a mile long to supply customers next door to some city station. The Bloomingdale Road line of the Sanitary District runs directly past the Springfield Avenue power station of the city."

Mr. McCormick says that if no better plan can be agreed upon he will acquiesce in the proposition that the Sanitary District finance the equipment of street-lighting circuits in parts of Chicago where there is no electric street-lighting now. But he prefers an alternative proposition which he makes in the following terms: "Let the Sanitary District purchase from the city of Chicago for cash the 12,000-volt transmission lines necessary to bring the current to the city's substation. Let the Sanitary District purchase the substations and electrical equipment therein and contract to supply the current to the city circuits at the present price, plus an agreed charge to cover the cost of transmission and delivery of current upon the arc systems of the city. I will guarantee that from such an arrangement the city will be given current on its arc circuits at a price less than the present cost. The money paid by the Sanitary District to the city for these transmission lines and substations can then be expended by the city in enlarging and increasing the number of its present arc circuits. This plan will provide the needed lights, will lessen the cost of current to the city and will provide for the Sanitary District transmission lines and substations which are needed for the sale of its surplus current."

The president of the Sanitary District board thinks that the city should begin the work of installing electric motors in its water works pumping stations. To a large extent, the pumping of water is done at night, and the same generating equipment could be used to supply electricity for pumping water in the daytime and lighting the streets at night. The fact that the city is paying $15 a hp year for electricity for lighting and could obtain electricity on a 24-hour basis for $26.40 a hp year should make the proposition attractive, Mr. McCormick thinks. The demand for electrical energy for pumping and for street

lighting will coincide to some extent, but at these periods the steam-pumping engines held in reserve could be used to supplement the electric motors. The writer thinks that the electric pumps should be introduced gradually, replacing at first the oldest and least efficient steam-pumping units. Sufficient steam equipment should be preserved for emergency purposes. Mr. McCormick concludes his letter as follows:

"Aside from whatever profits may be derived from the sale of power, I have no hesitation in saying that a comprehensive use of the water-power of the Sanitary District for public purposes by all the governmental bodies in Cook County will result in an economy of not less than $1,000,000 a year."

Whether the City Council will agree to sell the city's transmission lines and substations to the Sanitary District is unknown, of course, but is perhaps doubtful. The Sanitary District has now about 10,000 hp connected load in commercial power business, supplying alternating current to customers at 60 cycles. This business is reported to be on a satisfactory financial basis. In relation to possible interruptions of service, the Sanitary District officials point out that the records show that the proportion of uninterrupted service to perfectly continuous service is from 98 to 99 per cent. They say that the service of supplying electricity has never been interrupted for more than 10 minutes at a time, unless the telephone service has been broken down also. There are two 30-mile three-wire transmission circuits between the generating station on the Drainage Canal at Lockport and the Western Avenue terminal station in Chicago. If telephone communication can be had between the power house and the terminal station, only a very extraordinary storm would prevent a selection of three wires out of the six by which electricity could be transmitted in proper phase while repairs were being made to the damaged wires. But when the telephone line has gone down, too, owing to sleet troubles, for instance, there is obviously greater delay. To provide a remedy for this state of affairs, the Sanitary District is now putting in an underground telephone line between the Lockport power station and the Western Avenue terminal station, at a cost of about $20,000. This will be a duplicate private line in underground cables, and it should afford uninterrupted communication between the two termini of the transmission line.

President Van Hise on Water-Power.

The importance of reservoirs being erected at the headwaters of streams available for water-power was emphasized by President Van Hise, of the University of Wisconsin, in a recent lecture on the conservation of natural resources. He said that to maintain a uniform flow in streams, the most pressing and necessary need, in addition to forests, is the construction and maintenance of such reservoirs. It was shown that although this work will take a great amount of money, the value of the water-power furnished by them will alone make it profitable. Some work of this kind has been done in Wisconsin by two large water-power companies, which have constructed reservoirs on the Wisconsin River. President Van Hise estimated that about 2,000,000,000 cu. ft. of water are held behind these dams, the largest of which are located at Kilbourn, Grand Rapids and Wausau.

In speaking of the control of water-power, President Van Hise said that it should be controlled entirely by the public to prevent unreasonable charges for power and to keep its control from becoming a monopoly. He stated that the concentration of water-power and the coupling up of dams by companies conserve the power resources, and should be encouraged, but to protect the people the companies should be controlled by them. He declared a franchise tax to be equable and just. Another policy brought out was that of having a careful survey made of the streams, so that water-power sites can be selected with a view of developing the full available power. The inspection and approval of all dams by a State engineer to prevent disasters by their breaking was also recommended.

Brailey Telephone Situation.

A hearing in the case of Samuel J. Schweer against the Cuyahoga and United States Telephone companies and others, involving the recent Brailey telephone deal, and held at Cleveland the latter part of last week, developed nothing for the minority stockholders whose protection is sought by the action. Attorneys for the plaintiff said they had hoped to force the Brailey interests to divulge the names of the men who are connected with the purchase of the controlling interest in these companies, but they did not succeed. The other side won in its fight to prevent witnesses from answering questions. Mr. F. H. Goff, president of the Cleveland Trust Company, on advice of his attorney, even refused to give his name.

The hearing was for the purpose of taking depositions and was conducted by Notary C. W. Chestnutt. Attorneys Brown and Morley argued that demurrers had been filed to the petition which seeks to prevent the Independent companies from combining with the Bell interests and that there is no occasion for evidence being taken before a notary. He stated that it could all be brought out at the trial of the case. Mr. James S. Brailey, Jr., and several other witnesses were not present and Attorney Brown stated that they do not intend to come and that they cannot be compelled to do so.

Messrs. E. W. Moore, J. B. Hoge, F. H. Goff and some of the other witnesses were served with subpœnas to appear in a deposition hearing in a similar case filed in St. Louis to be held before Notary R. R. Alexander. Mr. Goff was sworn, but the others refused to take the oath. Mr. Goff stated that he was ready to testify as soon as required to do so by the notary, but that he was acting upon the advice of his attorneys in refusing until that requirement is made. This argument was continued on Saturday without material results of any kind. Attorney S. H. Folles, representing the American Telephone & Telegraph Company, did the greater part of the talking.

Attorneys for the Toledo Home Telephone Company, Toledo, Ohio, have withdrawn their petition in error from the Circuit Court and an entry has been made permitting Herman C. Stifel, of St. Louis, to make an inspection of the books. This action cannot be explained, as all the interested parties have chosen to remain silent regarding it. The inspection will probably be made this week.

On Wednesday of last week Mr. James S. Brailey, Jr., held a conference with a number of prominent Independent telephone men at the Neil House, Columbus, and it has been widely reported that he proposed a compromise by which the Bell companies would withdraw from the local business in all Ohio towns, with the exception of Cincinnati, on condition that its long-distance lines be used exclusively. This would be accomplished, of course, by the purchase of the Bell exchanges by Independents and the sale of the Independent long-distance lines to the Bell people. Cincinnati has always given its business exclusively to the Bell company, so it would probably continue to serve that city in the event that the supposed proposition was accepted. Mr. Brailey would not affirm or deny the truth of this matter after the meeting, but it is reported that a meeting will be held in Cincinnati this week at which the basis of such an exchange will be discussed. Nothing was said at the Columbus meeting regarding a plan for arriving at the value of the various properties, the only point apparently being as to whether the Independents would accept the proposition.

A report has since been sent out from Toledo to the effect that Mr. Brailey has flatly denied that he made a proposition to divide the business, as reported from Columbus. The only ground for such a report, he is said to have stated, is that the United States Telephone Company has said to the managers of the smaller exchanges in the State that there would be no objection to their connecting with the Bell long-distance lines. He said that the Federal Court had rendered a decision to the effect that the company could not prevent this and that this decision forms the basis for the permission which is offered to the small companies. Those companies which have purchased

Bell exchanges in the smaller towns and established toll connections, he said, are working out their own plans and his companies have nothing to do with it.

The Independent men present at the Columbus conference are as follows: Messrs. H. A. Marting, Ironton; G. P. Thorpe, Wilmington; H. P. Folsom, Circleville; James McKell, Chillicothe; O. M. Bake, Hamilton; Frank L. Beam, Mt. Vernon, and W. G. Thompson, Hamilton. Some of these men are members of a committee appointed at a recent meeting to formulate plans for merging the many small companies in Ohio into one large corporation. No idea of the temper of the Independent leaders could be gained from questions put to them following this meeting, but the fact that another has been arranged for Cincinnati would indicate that they are at least considering the matter. The supposition is that a proposition similar to this will be made in all States where the Independents have gained a foothold, but this, of course, is largely conjecture.

It is argued by some that the Independent telephone men, or at least a large majority of them, will be willing to accept the plan said to have been mapped out by Mr. Bailey, as it will put already prosperous exchanges upon a still better basis and bring the laggards into line as money-makers, since competition will be out of the way. As the Bell interests are said to favor the plan of leaving a large part of the stock in the local companies in the hands of local people, the idea of foreign interests dominating the situation will be softened to a considerable extent. The supposition is that, if the Bell people really do secure the control of the long-distance business, the American Telephone & Telegraph Company will acquire about 25 per cent of the stock of each company, or enough to give it some voice in the management. In a way, then, both the local and long-distance business will be under the same control.

In Ohio there is one drawback in bringing about rates for service that will yield a good return upon investments when the business is merged. In most of the towns ordinances have been enacted which prescribe the rates that may be charged for service and, while the companies have won several points in the courts against the cities and towns in this particular, legal complications might result in many places. This was shown when it was thought that steps were being taken a few days ago to restore the old long-distance rates which were cut some months ago, and again when it was said that the Cuyahoga Telephone Company would probably increase its rates for local service. Cleveland Councilmen then brought forth the claim that the company had agreed to furnish service for $36 per year; that the rate had been increased once and that any further increase would meet with determined opposition. Should the systems in Cleveland be combined the one company would then have about 50,000 telephones and it would probably be necessary to have a higher rate than the Cuyahoga's franchise calls for and even a higher figure than they have been charging since the increase was made.

A story was current a few days ago that the Independent companies at Columbus and Dayton had been purchased by a St. Louis syndicate, headed by Herman C. Stifel, instead of by Bell interests as was at first thought. But people have settled down to the belief that this cannot be true and that the story was perhaps started to lead the opposition off the track. On the other hand, it is rumored that F. R. Huntington, who purchased the stock, represents the same interests as James S. Brailey, Jr., does in the purchase of the Cuyahoga and United States Telephone companies.

Among the various theories which have been advanced in Ohio is one to the effect that the Cuyahoga, United States, Columbus Citizens, Toledo Home and Dayton Home Telephone companies will not go to the Bell interests after all, but to a syndicate which will operate them just as they have been in the past, but whose members stand so close to the Bell people that an understanding may be had that will do away with ruinous competition in the future. The Bell interests wish to accomplish this result even more than the Independents and the plan seems feasible in a way. At some future time it has been suggested that a holding company may be formed to take the various plants over and operate them, but for the present there will be no change of any kind, except in actual ownership. According to this theory, no other purchases will be made at this time.

The Profession of Engineering.

President Jesse M. Smith, of the American Society of Mechanical Engineers, in his presidential address before that body on Tuesday, on "The Profession of Engineering," drew a distinction between the trade and profession of engineering. "If," he said, "we are to have a profession of engineering, as distinguished from the trade of engineer, we must have a broad education befitting men of a learned profession, as distinguished from a narrower education sufficient for men of a trade. President Lowell, of Harvard, in his recent remarkable inaugural address, gave this as his conclusion: 'The best type of liberal education in our complex modern world aims at producing men who know a little of everything and *something well*.' If that conclusion be true of a liberal education leading to the learned profession of the law or medicine or theology, why is it not also true of a scientific education leading to the learned profession of engineering? If preponderance be given to one part of President Lowell's conclusion over the other part, certainly knowing 'a little of everything' leads to superficiality; while just as surely knowing but one thing well leads to narrowness. There would seem to be a happy mean between these two extremes, in the education of the engineer. The engineer knowing something of many things, several things well and one thing profoundly, is, however, still one sided if all this knowledge is confined strictly to his profession. He will be a much broader man, and a better engineer, if in his leisure hours he can turn his thoughts entirely away from his professional work and toward those things in nature and art which give that rest and renewal of the professional mind necessary to continued work."

Combination Lighting and Water-Works Plant.

The city of Clovis, N. M., has completed the erection of a combination lighting and water-works plant which has some unique features for a city of only about 6000 population. All secondaries are grounded in accordance with recommendations of the National Electrical Code, excepting the three-phase motor circuits, which will also probably be grounded if it is determined that this is in line with the best engineering practice.

The two 2300-volt, three-phase, 60-cycle generating units for the lighting station are of 100 kw each and direct-connected to single-cylinder engines. The switchboard is equipped with oil switches. The water supply is from four deep wells, each of a capacity of 50 gal. per minute. The pumps are driven by 15-hp motors. An elevated tank of 100,000 gal. capacity is used as a reserve, the head being 140 ft.

The electric ordinance adopted by the city requires all work to be in accordance with the National Electrical Code, which provides for the submission of all plans and specifications for wiring or rewiring, before a permit is issued, and requires the examination of contractors before issuing certificates to do wiring. Among provisions unusual in a town of this size are the elimination of all wooden molding; the use of porcelain sockets or other safety arrangements in order that persons cannot get shocks in basements, livery stables, and other places where there are grounded surfaces; the use of cabinets in all residences, metal cabinets in all mercantile buildings and the placing of all service wires and meter loops in iron conduits, excepting in residences. Suitable penalties are imposed by the ordinance for any violation of its terms.

Peat for Fuel.

In connection with steps now being taken by the Dominion Government toward the active development of the peat industry, it is of interest to refer to an electric lighting plant in operation for the last five years at Skabersjo, Sweden, using peat supplied by a bog of 37 acres. The peat deposit averages 5 ft. in thickness and it is estimated that there is sufficient fuel in this location to last 30 years. There are two gas-engine units of 150 kw each, which are supplied by two Korting suction gas producers. The current is transmitted three miles to Svedala, where it is used for lighting the streets and for furnishing power to several small industries. At present the only by-product is tar, but the experiments now in progress at different places indicate that the sulphate of ammonia and other by-products that may be recovered in a larger station—one of a few thousand horse-power—will be so profitable that they will pay almost all operating expenses.

Lake Tahoe Power Project.

Senator Newlands, of Nevada, has corrected certain inaccuracies in the newspaper account of his recent speech on the question of the proposed contract between the Reclamation Service and a private electric power company (the Truckee General Electric Company, controlled by the Hammon Syndicate) for the storage of water in Lake Tahoe, to be used first by the power company for generating electricity, and later by the Reclamation Service in supplying the settlers on the Truckee-Carson project in Nevada for irrigation. Mr. Newlands says that in addition to the Government Reclamation Service and a private power company there is a third party—the users and consumers of electric energy, whose rights and interests should be considered. He contends that the proposed contract will give a private corporation the monopoly of the electricity generated by the waters of Lake Tahoe and the Truckee River, and says: "If the President should conclude that the best interests of the reclamation project require that the proposed co-operative contract should be approved and the protection of the public against extortionate charges by conditions in the license granted is not within the power or is no concern of the National Government, then it may be necessary for the State of Nevada to organize a Public Service Commission with power to control capitalization and charges."

Large Irrigation and Power Project at Sacramento.

Judge Jas. A. Waymire is working on a project to tap Lake Tahoe for 500,000,000 gal. of water to irrigate the southeastern portion of Sacramento County, Cal. He is quoted in connection with the project as follows: "There are about 300,000 acres in Sacramento County which are now worth little for agriculture, but which, with water brought on, would acquire a value of $100 per acre at once. Legal obstructions have been overcome, and the engineers have traced the route through the mountains down to Auburn, where an immense reservoir will be constructed. The water will be brought from the lake in conduits that will have a carrying capacity of 500,000,000 gal. daily. A large dam will be built near the entrance of Truckee River at the lake. Thence a tunnel five miles long will be cut through the mountains. From the western terminus of the tunnel the north fork of the American will offer a convenient grade to take the water down to the Auburn reservoir. In the course of the canal or conduit to Auburn there will be five falls or drops at which electric power can be generated to the extent of 230,000 hp. These falls will have a height of 900 ft., 400 ft., 1500 ft., 700 ft. and 500 ft., respectively. The capitalization of the company is placed at $50,000,000.

Judge Waymire says that he has engagements with Eastern financiers to take over the bonds necessary and the stock in the corporation.

Electric Club of Chicago.

Business matters were discussed at the meeting of the Electric Club of Chicago on Dec. 1, there being no announced speaker. Reports were received from various committees, and the treasurer, Mr. J. G. Pomeroy, reported a balance on hand of $2,033.80. Mr. F. J. Postel, from the civic committee, presented a resolution expressing the sense of the club that the offer of the trustees of the Sanitary District to provide funds for extending the street lighting of Chicago by the use of electric energy from the Drainage Canal, either by purchasing the city's existing transmission lines and substations or by financing further extensions directly, be approved. This resolution was referred to the board of managers with power to act. Mr. H. F. Holland, from the membership committee, reported a total of 375 members. He moved that an entertainment be held by the club before the annual meeting in February, and this motion was adopted, details being referred to the entertainment committee. The discussion of this motion involved a spirited debate on the general policy of the club, at the conclusion of which, on the motion of Mr. H. E. Niesz, it was voted to restrict the membership to 500. Others who spoke were President F. P. Vose and Messrs. A. L. Millard, J. G. Pomeroy, W. S. Taussig, F. S. Hickok, E. F. Kirkpatrick and H. W. Young. Mr. C. A. S. Howlett, of Schenectady, former president of the club, was present, and by invitation spoke briefly, referring to similar organizations in Philadelphia, Boston and New York.

Tesla on Wireless Electric Power.

Mr. Nikola Tesla in an interview published Dec. 7 in the New York *Press* discussed the subject of wireless transmission of electric power. He said that he has worked persistently on the wireless transmission of energy since 1893, when he presented a paper on that subject before the National Electric Light Association in St. Louis and the Franklin Institute in Philadelphia. The popular idea, he said, is that the wireless system of transmission is just one invention, but the fact is that it involves in its present state of perfection six fundamental discoveries, or inventions, in combination. They are as follows:

First.—The method and apparatus for transforming ordinary currents into electrical oscillations of great intensity.

Second.—The apparatus for intensifying those vibrations immensely, so that they penetrate into the distance.

Third.—A receiving apparatus which collects and focuses energy which a transmitter supplies to a large territory. For instance, if such receiver, properly constructed, be placed in Ireland it will collect practically the entire energy conveyed to that country from the transmitter.

Fourth.—The method and apparatus for making the electrical impulses secret and non-interferable. That is to say, making it impossible to prevent their passage or to read them. The energy of the transmitter, which is collected by the receiver, only can be released by a sort of safety lock or combination.

Fifth.—The production of stationary waves. That is, waves which excite the entire earth and pass through it under a vibration much the same as though you were to draw a string tight and then strike it. With these waves the distance is absolutely eliminated, as the effects are the same whether the receiver is thousands of miles away or close to the transmitter.

Sixth.—A number of inventions which cannot very well be described in a short interview, but which go together to make the system practically operative.

With a plant constructed under the observance of these principles it will, he said, be just as easy to telephone from here to Melbourne, Australia, as across a room, and there will be absolutely no distortion of the voice, such as is observable now in communication by wire. This, he added, is not a theory, but a fact absolutely demonstrated by his experiments, which have shown that the current passes without loss over the entire extent of the globe and through the globe. He has carried the construction of such an installation very far and hopes to be able to complete its construction during the coming summer.

From that moment every telegraphic, telephonic as well as every wireless station will, he said, be ever so much more valuable, as they will be able to receive messages from any part of the world. All this will be done without the slightest change in the existing equipment.

"Will it be necessary under your plan, Mr. Tesla, to build high towers on the shores of the countries using it, and also in interior points?" the inventor was asked.

As to large towers these, he said, are comparatively ineffective. The tower he has built near Port Jefferson, L. I., is only 187 ft. high, but the plant will produce an effect which can be pushed up to a rate of 1,000,000,000 hp, which is more than all the wireless plants that have been put up so far altogether. This enormous activity is secured by the use of certain artifices on which he also bases a confidence that it will be possible to flash signals through interplanetary space.

Mr. Tesla added that his electric power inventions are not altogether his own, and that he has merely laid the foundation. Great work has been done in perfecting the devices by the staff of engineers of the Westinghouse and General Electric companies, so that at present there are hundreds of millions invested in enterprises in which his alternating system forms the underlying foundation. This has harnessed 6,000,000 hp waterfalls.

There are probably enterprises aggregating 20,000,000 more under consideration. The enormous importance of this water power, or the so-called "white coal," can be understood readily when it is borne in mind that 1 hp for 24 hours is equivalent to the average performance of 24 men. Therefore, the 6,000,000 hp which has been harnessed have virtually added to the world's population from the point of view of labor 144,000,000 of workingmen, who consume no food and need no clothes.

As to power other than that derived from waterfalls, he was happy to say that in this direction also he has been successful, having perfected a new reversible gas turbine of ideal simplicity and beauty, which will permit the harnessing of the waste of the steel and iron furnaces, in which we now are losing in the United States not less than 50,000,000 hp. Mr. Tesla added that he is just about to introduce that invention commercially.

As to his wireless system for the transmission of electric power, he said that if it had not been for unfortunate circumstances a plant of this kind would long ago have been in operation. Just one single plant, of, say, 10,000 hp, would be sufficient to drive several thousand flying machines, aeroplanes and dirigibles anywhere in the world. While supplying them with wireless power it also would keep them in constant touch with the earth by wireless telephone and telegraph.

Referring to interplanetary signals, he said he had in his experiments in Colorado discovered certain planetary disturbances, and attained with his transmitter activities which surpassed in power in many ways those of lightning. In his present plant he will be able to reach a rate of energy-delivery of about 1,000,000,000 hp. A simple calculation will, he said, convince any expert that with such an intensity and energy reaching a certain area of the planet Mars, it is ample to produce a perceptible effect in a delicate instrument there.

In answer to a question as to return signals, he said he believed that these signals are being flashed now and waiting for us to answer.

Meeting of Boston A. I. E. E. Section.

The Boston Section of the American Institute of Electrical Engineers held a special meeting and dinner at Harvard University on Saturday, Dec. 4. In the latter part of the afternoon a large party met at Pierce Hall and was shown through the engineering laboratories of the university by Dr. A. E. Kennelly and Prof. C. A. Adams. At 6:30 p. m. dinner was served in Memorial Hall, the chief dining place of the university, and about 85 men were present. At 8 p. m. a meeting was held in the Jefferson Physical Laboratory, and an illustrated experimental lecture on the "Measurement of the Wave Length of Electromagnetic Waves" was given by Dr. G. W. Pierce, of Harvard University. It is planned to hold similar meetings at other colleges in the vicinity of Boston during the winter.

Rectification of Oscillation Valve.

A paper entitled "Conversion of Electric Oscillations into Continuous Current by Means of the Vacuum Valve" was read by Mr. W. E. Smith at a meeting of the Wireless Institute, held in the Engineering Societies Building, New York, on Dec. 1. The speaker exhibited two Fleming oscillation valves and explained in detail their operation when employed in wireless telegraphy. The valve consists of a low-voltage incandescent lamp, the filament of which is surrounded by a metallic band separated slightly from the filament, the intervening space being exhausted to a high degree. When the filament is heated by means of electric current from a battery of a few cells the space between the filament and the metallic band becomes ionized and possesses practically unidirectional conductivity. When inserted in a circuit subjected to electric oscillations partial rectification takes place on account of the high resistance for current in one direction and low resistance for that in the other. When arrangements are properly made from 80 per cent to 90 per cent of the oscillating current appears as unidirectional current. Either a galvanometer or a telephone receiver can be used as a detector of the received oscillations.

In the discussion of the paper it was stated that the De Forest "Audion" differs from the Fleming oscillation valve in that, with the former, use is made of a second isolated low-voltage battery to effect the ionization of the space between the filament and the metallic plate separated therefrom.

New York Public Service Commission News.

The Public Service Commission of the First District has sent a requisition to the Board of Estimate and Apportionment asking for an appropriation of $1,093,274 to cover the expenses of the commission for the year 1910, except the salaries of the commissioners and of the secretary, which are paid by the State. The commission spent $1,095,000 in 1908, and $1,174,000 in 1909. An additional sum will probably be necessary before the end of the coming year to cover the expense of securing the consents of property owners to new subway routes.

The Brooklyn Rapid Transit Company has outlined extensive rapid transit plans which involve the expenditure of something like $50,000,000. These plans will be submitted to the Public Service Commission within a few days. They include the equipment and operation of the Fourth Avenue subway in Brooklyn, the construction and operation of a line across Manhattan from Canal Street and North River to the new Manhattan Bridge, and the building and improvement of many lines in Brooklyn. The majority of this construction will be done at the expense of the railway company.

After several hearings on the subject of lighting in the subway, the Interborough Rapid Transit management has agreed with the Public Service Commission that it will replace the 10-cp lamps now in use with 16-cp lamps.

The Public Service Commission has issued to the Interborough Rapid Transit Company permission to begin work, with

the $1,500,000 voted by the city, on the lengthening of the platforms in the subway. The work will not be completed until next winter.

Engineers in the employ of the Public Service Commission are making preliminary surveys looking to the construction of a tunnel under the Kill von Kull from Bayonne, N. J., to Staten Island. This is part of a tentative plan for a rapid transit service all around New York Harbor, completing the circle with a tunnel under the Narrows.

The Board of Estimate and Apportionment has adopted a resolution requesting the Public Service Commission to prepare plans for a moving-platform railway under Thirty-fourth Street between Ninth and Second avenues. This is the result of the submission recently to the Board of Estimate of the proposals of the Continuous Transit Securities Company offering to build such a mode of transit under Broadway from Tenth Street to Forty-second Street.

A hearing on the application of the street railways within the jurisdiction of the Public Service Commission of the First District of New York, for modification of the car-heating order recently promulgated, by the elimination of the clause requiring the posting of the order in the cars, was held last week. Representatives of the companies said they would be willing to accept an order similar to that which governs the heating of cars in Massachusetts, which does not require the posting. They felt that in ordering the companies to post the notice the commission was invading the private property of the company and that in the future additional orders might be issued by the commission and the cars placarded with orders which are issued from time to time in the future. He said that as a result of the posting of the notice, the companies and the commission would undoubtedly be flooded with complaints which were not based on facts and that some passengers might even assume that the posting of the order gave them the right to call the conductor to account and that serious altercations might follow. Commissioner Eustis said that if the commission in New York were invested with the same police authority as the commission in Massachusetts and had in its service State policemen who were watching the cars at all times, it would be willing not to require the order to be posted.

Massachusetts Commission News.

The Worcester Electric Light Company has filed with the Massachusetts Gas and Electric Light Commission for the examination of the board an agreement with the Connecticut River Transmission Company relative to the entrance of hydroelectric power into Worcester from the plant and system of the latter organization at Vernon, Vt.

The Massachusetts Railroad Commission and the Boston Transit Commission are holding almost daily executive sessions in connection with the transportation questions referred to the joint board by the Legislature of 1909. Hearings have been concluded upon all the matters referred, and the board will make its report to the next Legislature in January. Among the important matters to be considered are the proposed terms of the consolidation of the Boston Elevated and the West End Street Railway; the proposed entrance of the Boston & Eastern Electric Railroad Company into the Boston metropolitan district; and the proposed bills for the construction of certain new subway lines in Boston submitted to the last Legislature. A petition has been presented to the Railroad Commission asking for a fare readjustment in the Hamilton district of the Boston & Northern Street Railway Company's system. The Boston Elevated Railway Company has secured the approval of the board for the proposed double track line to be laid in the Beacon Hill tunnel, the latter forming the Boston terminus of the subway now being built in Cambridge by the company. The new tunnel will connect Park Street, Boston, with the Cambridge bridge, where the subway lines will join the Boston end of the route. The Boston Elevated has filed plans with the commission asking its approval of the construction of a new station in Causeway Street, Boston, opposite the North Station of the Boston & Maine Railroad Company. The plans for this station include platforms to accommodate eight-car trains on tracks connecting with the East Cambridge extension of the company; a platform connection for the use of the South Station shuttle elevated trains, and passageways connecting with the present North Elevated Station. Detailed plans of the Malden and Everett elevated extension have been filed with the board by the company.

The Railroad Commission recently gave a public hearing on the petitions of the Boston & Worcester Street Railway Company for authority to issue new stock and bonds to the amount of $1,000,000. Among the plans of the company in connection with this issue, President W. M. Butler stated that the road intends to establish a trolley express service in its territory as soon as the legal obstacles can be overcome. A large number of freight stations will be built, and several express cars placed in operation. The chief difficulty at present to the inauguration of this development is the inability of the company to secure express-carrying rights in the cities of Boston and Worcester. It is considering a plan whereby motor trucks will collect and distribute freight outside its immediate system. Possibly the electric commercial truck may be pressed into this service, supplementing the transportation afforded by the interurban line over its own tracks, and thus completing the service from one end of its car routes to the other.

Canadian Hydroelectric Commission News.

The municipalities of Brampton, Milton, Port Credit, Mimico and Toronto townships, are likely to band together for the purpose of securing Niagara electric power through the medium of the Hydroelectric Commission.

Representatives of these places met Hon. Adam Beck, chairman, and the members of the commission in a lengthy conference on Dec. 3, with a view to obtaining co-operative action and determine the price on the aggregate amount of power to be taken. The commission stated that no prices could be quoted for the power until the amount to be taken was determined and how many centers would be on the station supply. Upon receipt of this information the commission will decide on the location of the transformer station. The representatives decided to confer with their respective Councils and prepare by-laws calling for the amounts of power required, which by-laws will be submitted at the January municipal elections.

All the municipalities are in the district between Hamilton and Toronto, so that they will be supplied from the main transmission line running from Niagara to Toronto, which will be completed early in the spring.

A reduction in the municipal electric power rates inside of two years is anticipated by the city electrical engineer. Mr. Aitken states that the municipal plant will be self-sustaining from the start, as the city will take enough power for its own uses to accomplish this.

The long and strenuous conflict which has been going on in Hamilton for the past three years over the question as to whether or not the city should have competition with the Cataract Power Company by taking in a block of electric power under contract with the Hydroelectric Commission, and mention of which has been made in these columns from time to time, came to an end on Nov. 29, when at a meeting of the City Council the Aldermen unanimously decided to enter into a contract with the commission for 1000 hp on the terms submitted by the commission. By the action of the Council the city is placed in an advantageous position, in that while having a contract with the Cataract company for street lighting at a very low price, the corporation has made a contract with the commission for 1000 hp for municipal purposes, including pumping, thus giving it the benefit of competition, while the other municipalities which have entered into contract with the Hydroelectric Commission have been bound to take power exclusively from the commission.

[illegible] Hamilton, in addition, has the right or option

until Dec. 31, 1910, to enter into an exclusive contract with the commission similar to the other municipalities. This question, which has been so prominent an issue in municipal circles, has thus been settled for a year when there will likely be a further contest between the opposing interests should the city corporation at that time wish to enter into the Hydroelectric contract exclusively. In another year the city will have had the use of both Hydroelectric and Cataract power and will be in a position to determine which contract is the more beneficial to the municipality.

The opposition to the Hydroelectric Commission is still endeavoring to secure the disallowance by the Dominion Government of the Provincial legislation. On Dec. 1, Sir Wilfrid Laurier was waited upon at Ottawa by Mr. R. G. Hutchins, Jr., representing N. W. Harris & Company, of New York, who have handled some $6,000,000 of bonds of Dominion Power & Transmission Company, of Hamilton. Mr. Hutchins urged the disallowance upon the ground that the Ontario legislation has had an injurious effect in regard to the securities issued by companies now operating in the territory proposed to be covered by the operations of the Hydroelectric Commission. The Premier informed Mr. Hutchins that the subject had been previously brought to his attention in several ways, and that the matter was under consideration.

Though the town of Port Arthur is still tied up and prevented from signing a contract for electric power with the commission, it has been learned that the commission will proceed with the construction of the power stations, transmission lines, etc., this work, according to Hon. Adam Beck, chairman, being contingent, however, upon the municipality resubmitting a further by-law to the ratepayers. Port Arthur has twice adopted a by-law in favor of hydroelectric power, and each time it has been stopped by technicalities. The contract of the town with Mr. Conmee's concern, the Ontario & Michigan Power Company, expires in March next, and, unless an agreement can be reached with the commission to go into effect before that time, the corporation will be compelled to sign an interim contract with the Conmee Company.

It has been learned that in all probability hydroelectric legislation will be dealt with at the coming session of the Ontario Assembly providing for an equitable and final method of disposing of disputes and differences which arise in the securing of right-of-way for the building of transmission lines. A good many differences have arisen in the past, some over values of property in which expropriation proceedings have been necessary. With a view to simplifying the procedure, expediting the decision and reducing the expense to the parties involved, it is likely that the Legislature will be asked to appoint by statute an official arbitrator, who will have authority to deal finally with all differences or disputes. No name has yet been mentioned for the position.

The commission has made peace with the farmers in the Niagara district who have been resisting the construction of the transmission line across their property, and, as a result of the agreement arrived at, it is expected that the work of installing the towers in that district will be completed within a week.

Wisconsin Rate Commission.

An application for a certificate of convenience and necessity has been filed with the commission relative to a proposed electric interurban railway between Madison and Janesville, Wis. A company composed of local and New York capitalists has acquired control of the Janesville City Railway, together with the present Rockford and Beloit interurban system, will give them an electric interurban service between Madison, Wis., and Chicago. The route as proposed by the Cincinnati Construction Company, which has the work in charge, includes the cities of Stoughton and Edgerton, as well as the summer-resort lake region in the vicinity of Madison. The price paid for the Janesville city system was approximately $45,000, the value fixed by the Railroad Commission.

The commission has authorized the La Crosse Street Railway Company to issue $50,000 par value of bonds of the denominations of $1,000 each. These bonds are to bear interest at the rate of 5 per cent per annum, payable semi-annually on the first day of July and January each year. The money derived from the sale of these bonds is to be used for the purchase of new cars, power-house equipment and for improvements and extensions on the track system.

The Northern California Power Company.

The Northern California Power Company is bringing to completion in northern California a series of hydroelectric power plants for utilizing all the water-power that can be developed from the streams of the Shasta section. The first power house erected was at Volta, on the north fork of Butte Creek, from which place the company began the distribution of power to Redding and Red Bluff. The second unit was begun on South Battle Creek, where a second and larger plant is now installed, the power here being developed from the water brought by ditch from the Volta plant, across Digger Creek around by way of Manton and over to South Battle Creek. It was also planned to use the waters of South Battle Creek, and to do this a ditch was begun some distance higher up in the mountains, and some time during the present month it is hoped to have this finished and water coming through it to augment the power now being created by the water brought from the Volta plant. To bring this water from South Battle Creek was no little undertaking. A pole line was built from Volta to the second unit to furnish power for work there, and now that line is transmitting power from this station to Volta. After the water is used at Volta it is poured back into South Battle Creek.

A third and larger plant is being constructed at Inskip, several miles below South Battle Creek station. A short distance below the second plant a dam is to be built that will divert the water from South Battle Creek, and by canal it will now be carried upon a tableland, the country here being much more level than above, and taken for some distance until it is united with a ditch that brings the water from Digger Creek near Manton, and then it is sent into the canyon to operate the machines at Inskip. The third plant uses the waters for the third time from North Battle Creek, the second time from South Battle Creek, and for the first time all the water that can be collected from Digger Creek and springs along the way.

CURRENT NEWS AND NOTES.

DENVER ELECTRIC CLUB.—Through the initiative of Mr. C. F. Oehlman, of the Denver Gas & Electric Club, and Mr. J. B. Griffith, of the Nernst Lamp Company, an electric club has been organized in Denver, Col. About 100 members have been enrolled, and permanent officers will be elected during the present week.

TOLEDO ELECTRICAL SHOW.—Arrangements have been completed for holding an electrical show in Toledo, Ohio, during the week commencing Jan. 31. The show will be under the auspices of the Electrical Dealers' Association, of which Mr. T. D. Buckwell is president and Mr. Irving R. Golden is secretary. The decorations will be uniform in design, and an amusement program will be a feature.

TELEPHONE BOYCOTT.—The merchants of Westville, Ind., a town of 800 inhabitants with two telephone companies operating therein, signed an ultimatum that unless the two companies consolidated and did away with the annoyance and expense of a dual system they would remove their telephones. The companies did not consolidate and the merchants removed their telephones. Now the people declare they will not trade with a merchant who does not maintain a telephone and there is

NOBEL PRIZE FOR MARCONI.—Mr. William Marconi will be given the $20,000 Nobel prize for physics at Stockholm on Dec. 11, on account of his work in wireless telegraphy.

ELECTRICAL EQUIPMENT FOR COLUMBIA.—An anonymous donor has contributed $5,000 to be applied for equipment in the department of electrical engineering at Columbia University.

WIRELESS TELEGRAPHY.—At a meeting of the Wireless Institute, to be held in the Engineering Societies Building, New York, on Jan. 5, Mr. L. R. Gleason will present a paper entitled "Measuring Instruments and Measurements in Wireless."

WIRELESS TELEGRAPH SCHOOL.—The Maryland Institute of Telegraphy is the name of a new school which has been organized for the purpose of teaching wireless telegraphy. At present there are 12 students, who receive instruction three times each week from Messrs. T. E. Reese and E. J. Quigley, Jr.

A. I. E. E. MEETING.—The next meeting of the American Institute of Electrical Engineers, which will be held under the auspices of the high-tension transmission committee on Dec. 16, will be devoted to the presentation and discussion of a paper by Mr. Henry L. Doherty entitled "Comments on Development and Operation of Hydroelectric Plants."

COLORADO TOWN MAKES GROUNDING COMPULSORY.—The town of Holyoke, Col., has passed an electrical ordinance including the National Electrical Code requirements for spacing between high-tension and low-tension wires and other wires, for the grounding of all secondaries and for the partial support of electrical inspection by fee system.

WISCONSIN ELECTRICAL ASSOCIATION.—The next convention of the Wisconsin Electrical Association (which is an amalgamation of the old Northwestern Electrical Association and the Wisconsin Electric & Interurban Railway Association) will be held at the Pfister Hotel in Milwaukee Jan. 19 and 20. Several members of the Wisconsin Railroad Commission will be present at the meeting. Mr. J. S. Allen, Lake Geneva, Wis., is secretary of the association.

ELECTRICITY IN INDIA.—In discussing the advances made by electricity in India, Mr. H. P. Gibbs, chief electrical engineer of the State of Mysore, said that the Government is now contemplating the conversion from steam to electric operation of a railroad 80 miles in length now operated between Bangalore and Mysore. The former has a population of 200,000 and the latter 125,000. Both of these places are lighted by electricity. Plans are being made for operating by electricity the cotton mills at Bombay.

GOVERNMENT TEST OF WIRELESS.—Two United States scout cruisers, the *Salem* and the *Birmingham*, have been equipped with 10-kw Fessenden wireless telegraph sets for a four-months' test of the equipments under service conditions. The specifications call for the sending and receiving of messages over at least 1000 miles under all conditions and 3000 miles under favorable conditions. The vessels will attempt to remain in communication with each other while traveling through American, European and tropical waters, and to communicate with Brant Rock when within 3000 miles of the station.

GERMAN ARC-LAMP LITIGATION.—The German Imperial Patent Office gave an important decision on Nov. 22 relating to the mechanism of arc lamps. A firm had placed on the market an arc lamp without clockwork for use on direct and alternating current and for series connection. This lamp, it was claimed, infringed a patent of another arc-lamp manufacturer, and the case came before the Patent Office in an action for the cancelment of this German patent on the ground that its claims bearing on the non-use of clockwork were too broad. This contention was accepted and the patent was cancelled.

ELECTRIC RAILWAY RESULTS.—In a paper read by Mr. J. Shaw before the (British) Institution of Civil Engineers the advantages of electric over steam traction on the Mersey Railway in Liverpool were discussed in detail. The summarized comparative results of the change on the working and finances of the railway showed that the average speed, including stops, had been increased from 15.6 to 19.9 miles per hour, and the number of ton-miles per annum from 43,000,000 to 67,000,000, while the total expenses per ton-mile, after allowing interest on additional capital for electric works, had been reduced from 0.688 cent to 0.585 cent.

GERMAN CAPITAL FOR AMERICAN TELEPHONES.—In a report from Allentown, Pa., it is claimed that bankers in Hamburg, Germany, have invested almost $20,000,000 to finance the Continental Telephone & Telegraph Company of New York, which has purchased the American Union Telephone Company, with headquarters at Harrisburg. It is said that the principal object of the merger, which was brought about chiefly through the energy of Mr. Charles West, of Harrisburg, vice-president of the American Union, is the completion of an independent long-distance line from Boston to San Francisco, which already extends as far west as Kansas City.

DENVER HYDROELECTRIC SERVICE.—The Denver Gas & Electric Company and the Denver Chamber of Commerce are having conferences pertaining to the improvement of the electrical service of the former, especially with relation to recent conditions. The recent burning out of the largest steam-turbine unit at the company's West Side plant, and the consequent dependence upon the power of the Central Colorado Power Company, have resulted in frequent interruptions of service during the heavy evening peak over part or all of the city, sometimes lasting for 15 or 20 minutes. The investigation and conference are understood to be of a most friendly character.

BALTIMORE MUNICIPAL METER TESTING.—Inspection of private electric meters will be begun by the Department of Lamps and Lighting of Baltimore, Md., on Jan. 1. If the user of a private meter believes that he has been overcharged he will have the right to ask for an inspection, and if the reading of the meter proves correct he must pay $1 to the department. If the test shows that the meter is giving incorrect readings, he pays the fee, which is subsequently refunded to him and is charged against the company which furnishes the current. When it has been proved that a meter has been registering incorrectly, the company must rebate the consumer at the discovered rate of overcharge for the four months next preceding.

ELECTRICITY DIRECTLY FROM THE COAL MINE IN NOVA SCOTIA.—An electric generating plant using mine refuse as fuel has been placed in operation at the coal mines at Chignecto, Cumberland County, Nova Scotia. The equipment installed consists of a cross-compound condensing engine directly connected to a 750-kw, 60-cycle generator wound for 11,000 volts, and provision has been made for two more similar units. Energy is supplied to Chignecto, Maccan and Amherst, transmission lines having been erected to the latter two places. It is expected that energy will also be transmitted to Oxford, Sachville, Debert and Moncton. The installation is owned by the Maritime Coal Railway & Power Company, of which Hon. Wm. Mitchell, of Montreal, is president. Mr. David Mitchell is general manager, and Mr. Forest H. Mitchell is superintendent of the electric plant. The general offices of the company are at Maccan.

Norwegian 250,000-hp Hydroelectric Development.

By Einar A. Brofos.

NORWAY abounds in waterfalls, the water supply being quite constant throughout the year, partly owing to the high altitude of the water sources and the condition of the climate, with the exceptionally high rainfall. It is thus estimated that the total water-power of Norway amounts to about 7,500,000 hp, giving 3409 hp per 1000 inhabitants of the country. These figures exceed those of any other European country.

The possibility of hydroelectric developments is thus very large. This fact has been recognized in the last few years, several large plants having been erected, some of them ranging among the most important in Europe.

At present there is under construction in the Westfjord valley, in the district of Jelemarken, a hydroelectric plant which in many respects is considered to be the largest in the world. Advantage is taken of the Rjukan Falls in the River Maane, one of the largest waterfalls in Norway. By diverting the water from the river, at a distance above the falls, the available head is increased to about 1800 ft., which is being divided into two steps. Two plants will be erected, called Rjukan I and Rjukan II; the water after passing through the turbines of the first station will be led through a tunnel to the second plant and finally returned to the river. The rating of the plant is estimated at about 250,000 hp. These plants are being erected by the Narsk Kraftaktieselskab, and the power will be utilized by the Rjukan saltpeter works for the production of saltpeter from atmospheric nitrogen.

In Fig. 1 is shown a hydrographic map of the district of development. The River Maane being 20 miles long, and having its source in the Moes Lake at an altitude of 2958 ft., empties into the Tinn Lake. The difference in altitude between the lakes is 2334 ft. Of this head the 1800 ft. to be utilized is within a distance of 5.6 miles of the river. The drainage area of the River Maane is 662 sq. miles, while that at the Moes Lake is 570 sq. miles, the latter area containing a number of small lakes and rivers.

The Moes Lake, having at present a surface area of 22 sq. miles, is being arranged as a storage reservoir. To start with, a dam was erected during the years 1904 to 1906, through public means, for the purpose of serving as a regulating reservoir for the Tinn Lake. The dam, having a height of 57.5 ft. and a length of 427 ft., is a granite-covered concrete structure. The permissible storage height of 32.8 ft. above low water would effect a storage of about 19,800,000,000 cu. ft. of water. However, upon the decision to utilize the Rjukan Falls, the dam was to be enlarged so as to raise the storage height to 47.6 ft., the reservoir thus being able to impound about 28,200,000,000 cu. ft. of water. By this means the ordinary low-water flow, in the River Maane, of 212 cu. ft. per second may be increased to 1660 cu. ft. per second. The stored water may be emptied through two tunnels bored in rock, each 755 ft. long and having a cross-sectional area of 156 sq. ft. The dam has two spillway openings of 92 ft. and 94.5 ft. width and 8.2 ft. below the permissible storage height.

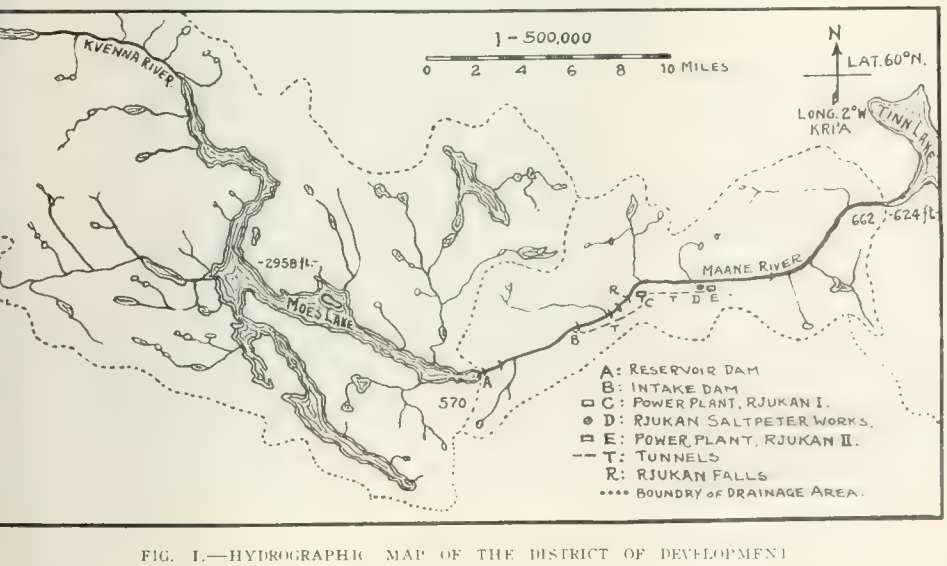


FIG. 1.—HYDROGRAPHIC MAP OF THE DISTRICT OF DEVELOPMENT.

About five miles from the reservoir is built the intake, shown in Fig. 2. A dam is thrown across the river, the water being diverted through a tunnel to a distribution reservoir. The intake dam, which is a concrete structure, about 300 ft. long, rises to a height of 42 ft. above the bed of the river and has a width of 36 ft. at the bottom. The length of the tunnel from the intake to the distribution reservoir is 2.64 miles; it has a cross-sectional area of 280 sq. ft., having a maximum height and width of 18.85 ft. and 18 ft., respectively, the gradient being 1 in 466. The tunnel, which is bored in solid rock for its entire length, is being worked at 20 different places, access to the intermediate points being available from the mountain side by means of nine smaller tunnels. The distribution reservoir, which is also blasted in the solid rock, has a volume of about 565,000 cu. ft. From this place the water will be led through five tunnels, about 80 ft. long, to 10 feeder pipes, about 2300 ft. in length, which will carry the water down to the turbines of the first plant. These pipes are of the seamless-steel type, the thickness of the plate varying from 0.39 in. to 0.98 in., the inside diameter being 4.92 ft. tapering to 3.94 ft. Due to unfavorable conditions of the ground, the feeder pipes have several gradients, the steepest, at the top of the hill, being 72 per cent. Owing to these variations in the slope of the pipes, they had to be securely anchored at the different points of grade variation, which is being done by means of large concrete castings.

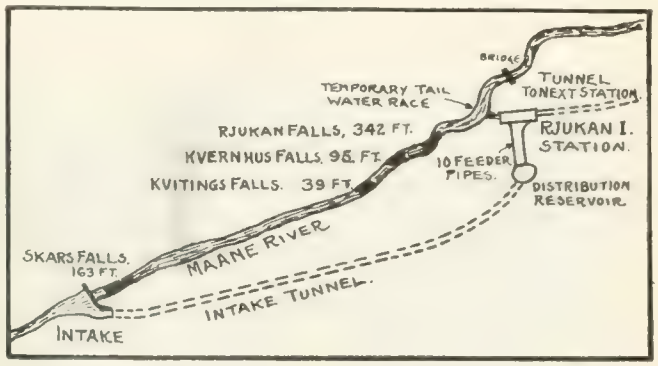


FIG. 2.—PLAN SHOWING LOCATION OF DIFFERENT FALLS AND POWER STATION.

The head of water at the Rjukan I plant is 905 ft. after deducting losses in the pipes, etc., the flow of water being 1660 cu. ft. per second, giving an effective 130,000 hp. The power house, which is situated about 460 ft. above the river, is being built of concrete with some reinforcements. It will contain 10 14,500-hp turbines of the Pelton wheel type, each connected to a 17,000-kva generator. The turbines, which are considered to be the largest yet manufactured, are being made by the firms of J. M. Voith, of Heidelheim, and Escher, Wyss & Company, of Zurich, Switzerland. The generators, which will produce three-phase, 50-cycle current at 11,000 volts, are being made by Brown,

Boveri & Company, of Baden, Switzerland. No transformers will be used, as the energy will be sent directly from the generator to the line. It is understood that the order for electrical machinery of this undertaking is the largest ever placed in Europe.

Figs. 3 and 4 show the location of the Rjukan I plant. Fig. 3 gives a front view of the plant, with the power house



FIG. 3.—VIEW OF POWER PLANT.

during erection and with a portion of the feeder pipes installed. Fig. 4 shows an end view of the same plant. The location of the River Maane is about in the center of the picture. This illustration is a view looking down the valley toward the east. The saltpeter works and the second plant, Rjukan II, will be situated about 3.5 miles down the valley, behind the ridge to the right in the illustration. The tunnel for carrying the water from Rjukan I to Rjukan II will go through this mountain ridge; the length of the tunnel will be 3.42 miles, the cross-sectional area 280 sq. ft. The head of water for the second plant will be 787 ft. after deducting losses, and the plant is estimated to produce 117,000 hp.

The Rjukan I plant has been under construction for about



FIG. 4.—END VIEW OF POWER HOUSE.

two years and is intended to be ready by next fall. As the first plant will be ready for service before the second one, the water after passing through the turbines at Rjukan I will, until the completion of Rjukan II, empty into the River Maane from the end of the power house opposite the tunnel entrance.

It is interesting to watch this new industry of saltpeter production. In the small valley where the works are being erected there were, a couple of years ago, only some small farms; at present this great enterprise is being pushed and a town of perhaps a couple of thousand inhabitants has grown up. Primarily for the purpose of transporting the products of the works to the nearest point of connection to the coast, 28.6 miles of railroad has been built and ferry connection established on the Tinn Lake for a distance of 19 miles. Further down the same water course, at Notodden, for the last three years the company has been operating other saltpeter works, using 35 furnaces of the Birkeland-Eyde method. These furnaces consume from 30,000 hp to 40,000 hp obtained from the new Svaelgfos hydroelectric plant.

Padova-Fusina Single-Phase Railway.

By Mario Stoppoloni.

IN 1886 the "Società Veneta per Costruzione ed Esercizio di Ferrovie Secondarie Italiane" of Padova inaugurated the steam railroad between Padova and Fusina, intended to unite Padova with the Laguna and Venice and the great number of small towns located between on the banks of a navigable canal which units Padova to the Laguna.

Communication between Fusina and Venice is maintained by steamers of the "Società Veneta Lagunare," which cross the canal of Giudecca and land passengers at the pier of Piazza S. Marco. The great growth of industry which has occurred in Padova and its surroundings during the last few years, the great number of tourists who visit the church of St. Antony in Padova and lastly the great number of villas which have been built near this line made it necessary to increase the number of trains, their speed and also the comfort of the passengers. For this reason the "Società Veneta" decided to substitute electric for the old steam trains.

The work of electrifying the line was started at the end of 1907, and in the beginning of 1909 an electric train traveled for the first time over the whole distance from Padova to Fusina.

The line follows for some distance the provincial road of Padova-Fusina and on leaving Stra follows the navigable canal, crossing the River Brenta by an iron bridge.

The line is level the whole way except in crossing the bridge of Brenta, where there is a grade of 3.5 per cent.

The minimum radius of curvature is 180 ft., but due to the construction of the line and to careful study given to the design of the rolling stock, these curves are taken at a speed of 25 miles an hour.

With the electrification of the line, the line was prolonged to the center of Padova. So that starting from Piazza Garibaldi (Padova) one arrives at Piazza S. Marco (Venice) in 125 minutes, change being made at Fusina to the steamer.

The rails from Piazza Garibaldi to the station of S. Sofia are of the girder type of 92 lb., while for the line they are of the T-type of 56 lb. per yard; the rail gage is 4 ft. 9 in. The joints of the rails are connected by copper rail bonds of 0.082 sq. in. cross-section; every 100 yd. there are copper bonds of the same cross-section uniting the two parallel rails.

The trains are of 45 tons weight and reach a maximum velocity of 25 miles an hour. At present a train starts from each terminal of the line every hour with stops of two minutes in four stations, where there is a crossing, and 30 seconds in eight other stations, where there are no crossings.

The speed on the line between Padova (Piazza Garibaldi) and Stanga and on line between Dolo-Caffé and Oriago is very low, due to the great amount of traffic on these roads. The average speed is about 12 miles an hour—that is, the time consumed between Padova and Fusina is about 85 minutes. When the train staff and public have become accustomed to the new method of operation, the speed will be increased and it will be possible to reduce the time to 78 minutes without alternating the number of stops or the length of time spent at each, as has been shown on test runs.

On account of the length of line, about 22 miles, and because

the generating station could not be erected at the center, but had to be placed at Padova, a high-tension service was chosen. The system selected as having given some of the best results of late years was the single-phase. The motors are of the Winter-Eichberg commutator type built by the Allgemeine Elektricitäts Gesellschaft, of Berlin, and have properties similar to direct-current series motors. The e.m.f. is 6600 volts

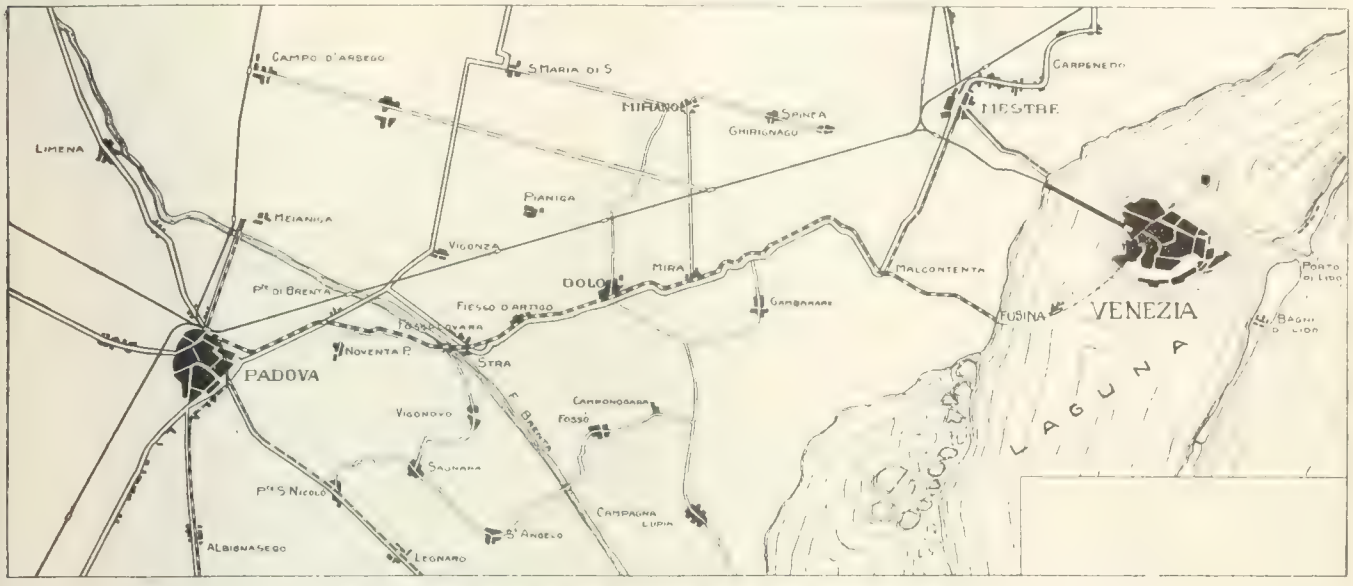


FIG. 1.—MAP OF ROUTE OF PADOVA-FUSINA SINGLE PHASE RAILWAY

for the line between Stanga and Fusina and 600 volts between Stanga and Piazza Garibaldi (Padova), the frequency being 25 cycles.

The high-tension trolley wire is 21 ft. 4 in. from the rails, and the low-tension trolley wire 18 ft. The low-tension pantographs are so constructed that they cannot rise more than 19.5 ft. from the rails, as a safeguard against the low-tension circuit receiving high-tension current.

Use is made of the catenary system consisting essentially of an arrangement of a slack messenger cable and suitable hangers so distributed as to maintain the trolley wire practically without any perceptible sag between the points of suspension.



FIG. 2.—VIEW OF A COMPLETE TRAIN OUTSIDE A STATION SHOWING ALSO 6000-VOLT CATENARY LINE.

This arrangement permits the use of the minimum distance between hangers and necessitates the minimum stress in the trolley wire and thereby reduces danger of break in the line. This system offers the mechanical advantages of a long pole spacing, as the spacing of the poles is only a matter of weight of span which each pole can carry and of sag permissible in the messenger cable; moreover, there is the advantage of having more flexibility in the line which obviates the hammer blow of the collector at suspension points and reduces the danger of mechanical breakage.

On this line the poles are 165 ft. apart. The messenger cable consists of a steel wire 0.0093 sq. in. in cross-section. The hangers are of steel wire 0.00465 sq. in. in cross-section, with a spacing of 10 ft. between adjacent hangers. The messenger



FIG. 3.—GENERAL VIEW OF CATENARY LINE CONSTRUCTION WITH STEEL BRACKET POLES.

cable is supported by brackets and is insulated from them by porcelain petticoat insulators.

The trolley wire is displaced in a zig-zag manner by means of pull-off wires on the poles, so as to obtain an even wear on the pantograph. For curves the alignment of the trolley wire with respect to the center line of the track is maintained by

bridle pull-offs acting on both the trolley wire and the messenger wire. As a safeguard against any danger occurring from breakage of insulation between the poles and the trolley wire the poles are connected to the rails by means of copper conductors.

At the end of the high-tension line there is an inclined section of trolley line, 10 ft. in length, insulated by two insulators, the other end of which is connected by means of an insulator to the low-tension trolley line. If in passing from the high-tension to the low-tension section the motorman has forgotten to lower the high-tension pantograph, the pantograph will be pushed down slowly by the slanting piece section of insulated line and will come into contact with the low-tension line, which is at only one-tenth of the high voltage and nothing will happen. Since the tension will be too low to make it possible for the train to proceed, the motorman will know that he has forgotten to lower the high-tension pantograph and to raise the low-tension one.

On the other hand, if when the train travels in the opposite direction and the motorman forgets to lower the low-tension pantograph on leaving the low-tension line, the pantograph will rise on the sloping insulated line until it reaches its maximum height, but it can never come into contact with the high tension line.



FIG. 4.—UNION BETWEEN 6000 VOLT LINE AND 600 VOLT LINE.

At 6000-ft. intervals there are section switches; each of the sections is protected by one or two lightning arresters mounted on the poles.

The feeder for the high-tension line consists of a copper wire having 0.082 sq. in. cross-section of copper, and is about 1200 ft. in length suspended on special poles. There are two feeders connecting at two different points, in parallel, for the low-tension line, the first being directly in front of the power house and the second about 7500 ft. distant, near the transformer house and car shed at Santa Sofia. The energy is transmitted to this substation over a 6000-volt feeder mounted on the same poles as the low-tension trolley line. The poles along the whole line carry the telephone and telegraph wires.

The rolling stock is composed of 10 motor-cars and five trail cars. All the cars were furnished by Maschinenfabrik Augsburg-Nürnberg, of Nürnberg. Each has seating arrangements for 44 persons and extra room for 12 standing. The first-class and second-class compartments are separated by a baggage-room, which can serve in case of heavy passenger traffic for seats for six persons, folding seats being provided for this purpose. Thus the motor-car can carry without any inconvenience to the passengers about 60 persons. The trail-cars have seats for 38 persons.

Each motor-car has two trucks, on one of which are mounted two 80-hp Winter-Eichberg motors; the other truck has only the air compressor with gear for the air brakes.

The motors are four-pole machines. The stator is wound like the primary of an induction motor, while the rotor is wound like an ordinary direct-current generator. Affixed to the pinion end of the armature is a fan which serves to ventilate the motor. The motors receive 600 volts at the brushes. When on the high-tension line the e.m.f. is reduced to 600 volts by a transformer fixed in the center of the car frame underneath the floor. Close to this transformer is mounted a smaller one which serves, by means of controllers, to regulate the speed of the motors; this transformer is used when running on the 600-volt line.

The energy before reaching the transformers passes through choke coils, before which there are taps connected to lightning arresters.

The high-tension circuit is provided with a fuse and an oil switch. All of the high-tension apparatus is placed in a kind of cupboard in the baggage-room. The door of this cupboard is locked automatically by the compressed-air circuit and the high-tension pantograph and cannot be opened unless the high-tension collector is lowered; for better security the high-tension circuit is grounded on opening the door. The motor and trail cars are furnished with air brakes of the Böcker system, and also with hand brakes.

The generating station is located 1.25 miles from Padova, at Stanga. It contains a machine-room, workshops and living-rooms for the staff. The machine-room contains two groups, each composed of a Woolf steam engine coupled to a 250-kw 6600-volt generator, and a third set, with engine of same type as the others, but an 180-kw generator. The boiler-room contains four Cornwall boilers working at 165 lb. pressure, furnished with superheaters and economizers.

Near the generating sets are two motor-generator sets, one kept as reserve, for charging the battery used for the station lighting.

In the machine-room below the switchboard there are four transformers, two for lowering the e.m.f. from 6600 volts to 600 volts, to feed energy to the low-tension trolley line, and two for lowering the e.m.f. from 6600 volts to 300 volts for the motor-generator sets and for motors in the workshops.

The switchboard is divided into two parts, one being level with the machine-room floor for the low tension, and one raised 9.5 ft. for the high tension. Behind the high-tension board are oil switches, series and shunt instrument transformers enclosed in separate imitation stone cells.

The outgoing feeders are provided with lightning arresters of the Wirt type and disconnecting switches. The tension is regulated by means of Tirrill voltage regulators, which work automatically on the exciter circuits.

Water-Power Resources of Texas.

By James L. Starr.

THE water-power resources of Texas are just beginning to receive some of the attention that their importance justifies, according to the statements of men who have made a study of this feature of the State's undeveloped wealth. The fact has long been known that the available water-power of many of the streams of the State is very large. This is particularly true of the rivers which have their source in the more western and southwestern portions.

It is claimed that there is enough water-power going to waste within a radius of 150 miles of Austin and San Antonio to generate electrical energy sufficient to operate all of the industrial plants in the State. The lack of effort in the past to utilize these natural resources has been due chiefly to the sparsely settled condition of the territory adjacent to the avail-

able power sites. During recent years, however, the former isolated and thinly settled region has attracted the attention of homeseekers with the result that it is rapidly becoming populous with an energetic and progressive element of people who are quick to see the wonderful natural advantages in the matter of water-power that exist along the various streams.

The greatest step ever taken in Texas in water-power development was that made some years ago by the city of Austin when a dam across the Colorado River was built and a hydroelectric plant installed at a total cost of $1,600,000. The conservation of the flow of the river afforded a power for developing electrical energy for supplying the city with electric lights and power and for operating the street railway system. The power was also used by many private industrial plants and there was much more to spare. In 1900 a flood in the Colorado River destroyed this dam and washed away the hydroelectric plant which was situated immediately below it. But for this untoward accident it is believed many large manufacturing concerns would have been attracted to Austin on account of the free power that was offered them. The destruction of the great industrial enterprise left the city in bad financial shape, otherwise immediate steps toward the rebuilding of the structures would doubtless have been taken. The city at last finds itself in position for again considering propositions to replace the destroyed dam and power house and it is expected that some definite plan to this end will be agreed upon before a great while. The original dam was built of granite with a concrete filling. It was 67 ft. high and presented a solid breast to the water. Its destruction was due, it is claimed by engineers, to faults in the foundation underneath the dam, but there were probably other contributory causes. Borings have been made in the bed of the river at several proposed sites for the new dam under direction of the municipal authorities and these faults in the natural formation are found to be general. It is claimed, however, that a reinforced concrete dam can be built which will withstand any flood that may come down the stream and that the faults in the formation underneath the foundation of the dam would not make any difference so far as being a menace to the structure is concerned. According to the estimates that have been made the proposed reinforced concrete structure will cost much less than the original dam.

The Colorado River flows through a hilly country for more than 200 miles of its tortuous course. It enters the rough country a short distance below Ballinger and does not come to the broad valleys and broad scope of level territory until it gets below Austin. It winds between high cliffs and through narrow canyons in many places and at others it rushes furiously over precipitous falls. It is stated that there are many available sites for dams and hydroelectric plants along its course between Austin and Ballinger. In some localities great tracts of land could be irrigated from the water-storage reservoirs in addition to furnishing the power for the hydroelectric plants.

The natural falls at the town of Marble Falls on the Colorado River have long been noted for their power and beauty. In order to make them more effective a reinforced concrete dam is being built at an ideal site. The project embraces the erection of a hydroelectric plant and the building of transmission lines to a number of cities and towns, including Austin and San Antonio. The distance from Marble Falls to Austin in a direct line is about 30 miles, and it is only about 80 miles from the site of the proposed hydroelectric plant to San Antonio in a direct line. It is stated that approximately 25,000 hp can be made available at the Marble Falls plant.

Within a radius of 100 miles of Marble Falls are more than a score of thriving, important towns, ranging in population from 2000 to 100,000, San Antonio reaching the latter figure according to reliable estimate. It is a little less than 100 miles from Marble Falls to Waco in a direct line. In view of the fact that electric transmission lines are being successfully operated in Mexico and this country for distances of 200 miles and more the feasibility of the power project at Marble Falls is unquestioned. If one dam is not sufficient sites are available along that part of the river for the construction of as many more as may be necessary to supply the whole contiguous territory with power. The fact that the water can be used over and over again for this purpose makes its availability almost endless. It is expected that the introduction of cheap electric power will revolutionize industrial conditions in a wide scope of Texas during the next few years.

The Llano, San Saba and Concho rivers, all tributaries of the Colorado, also possess many splendid sites for hydroelectric plants along their respective courses. A large dam across the Llano River was recently completed at the town of that name and is affording the initial power for the electric plant at that place.

In the more western part of the State are the Pecos and Devil's rivers, which flow for great distances through deep, gloomy canyons. These gorges, by means of dams, could be made to store enormous quantities of water for the generation of electric power for turning the wheels of industry. It is said that the water-power resources of these rivers are equal to any in the country, and that in connection with the hydroelectric projects enormous tracts of rich lands could be reclaimed by means of irrigation. This is particularly true along the lower course of the Pecos River, where the water storage capacity is almost unlimited. So level is the land that extends back from the great, deep gap in the earth through which the Pecos River flows, that the water in many places could be brought above the surrounding surface in many places and led through canals and ditches over thousands of acres by means of gravity. The lack of railroad transportation in the Pecos River territory has retarded the agricultural and industrial development of that part of the State, but the Kansas City, Mexico & Orient and other lines of road are now headed in that direction and the big territory will soon fill up with settlers. The land is practically worthless unless irrigated. The river affords an abundant supply of water, and by building dams the storage reservoirs for power and irrigation purposes can be obtained.

Hydroelectric plants are destined to perform an important part in the land reclamation and irrigation enterprises of Texas, it is claimed. It has been demonstrated that where the water for irrigating lands has to be lifted, the pumping can be done cheaper and much more satisfactorily by electricity than by steam or gasoline engines. In the Laredo territory in the Valley of the Rio Grande, many of the Bermuda onion growers get their power for operating their irrigation pumps from the electric plant at Laredo.

The water-power of the Guadalupe River is being used for generating electrical energy at a number of places along its course. This stream rises in the mountains of middle western Texas and has many steep rapids and falls on its way to the Gulf. It was along the Guadalupe River that Mormon settlers of the early days established their grist mills and other industries, using the never-failing water to turn the cumbersome wheels. Between New Braunfels and Seguin, a distance of about 15 miles, following the course of the Guadalupe, is said to be an enormous amount of water-power which is now going to waste. Plans are on foot for utilizing some of this power for generating the electrical energy to operate a proposed interurban railway to be built to San Antonio.

It is within a territory extending west and south of Austin for 100 miles that the greater part of the available water-power resources, except that of the Pecos and Devil's rivers, exists. In the other parts of the State the rivers are slow and sluggish and have banks so low that it would be impracticable to dam them with any degree of success. This is true of the Brazos, Trinity, Neches, Sabine and other rivers.

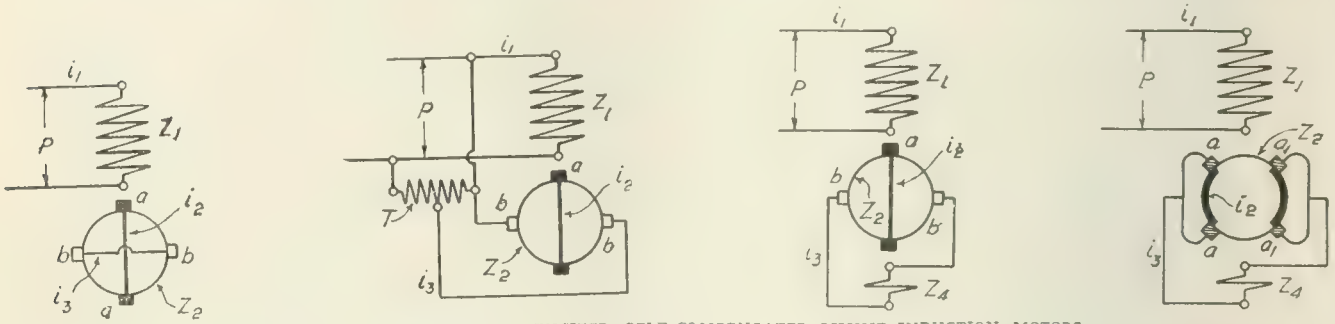
In the absence of any survey of the streams of the State with reference to their water-power resources, it is impossible to give any reliable estimate of the amount of this source of wealth, but it is known to be very great, and more than ample for present industrial needs of the territory that can be reached by transmission lines.

Factors Affecting the Design of Self-Excited, Single-Phase, Shunt Induction Motors.—I.

By Val. V. Fynn.

In an earlier issue the author outlined the no-load conditions in an ideal self-excited, single-phase, shunt induction motor—that is, in the machine known in America as the single-phase induction motor. The present article deals with practical forms of this motor, as shown in Figs. 1, 2, 3 and 4, and discusses the design of such machines.

In turning to the consideration of machines which are *not* devoid of losses, it is thought preferable to treat them as if the question of recoverable energy required by the rotor, as discussed in the previous article, did not exist; this is the more justifiable as this feature of the machine is perfectly independent of all other phenomena taking place in the motor. The foregoing discussion of this question will show how the results which will be arrived at in each of the following cases should be modified in order to allow for the influence of this elusive factor. A knowledge of the value $\frac{1}{2}mv^2$ is necessary in every case.



FIGS. 1, 2, 3 AND 4.—SELF-EXCITED, SELF-COMPENSATED SHUNT INDUCTION MOTORS.

The influence of the recoverable energy on the final results can only be serious if $\frac{1}{2}Li_3^2$ is large; other considerations generally preclude this possibility. When not otherwise stated, the torques to be referred to hereafter will all be average torques referring to irrecoverable energy.

Assume a self-excited shunt induction motor, the rotor windings of which have ohmic resistance, but no reactance and which has no iron losses; thus, say, $w_2 = 2$ ohms, $x_2 = \Theta_1 = \Theta_3 = 0$. As a further simplification and one which in no way affects the deductions, assume the primary winding to be devbid of losses, so that $w_1 = x_1 = 0$.

At no-load speed such a motor must take a certain amount of magnetizing current to supply the "recoverable" energy required by the transformer field. It must also take a certain number of watts and produce a certain torque in order to supply the following irrecoverable energy required by the motor:

(1) The copper losses in the primary.

(2) The copper losses in the secondary along the transformer axis.

(3) The iron losses along the transformer axis.

(4) All negative torques, if such exist.

(5) The friction losses.

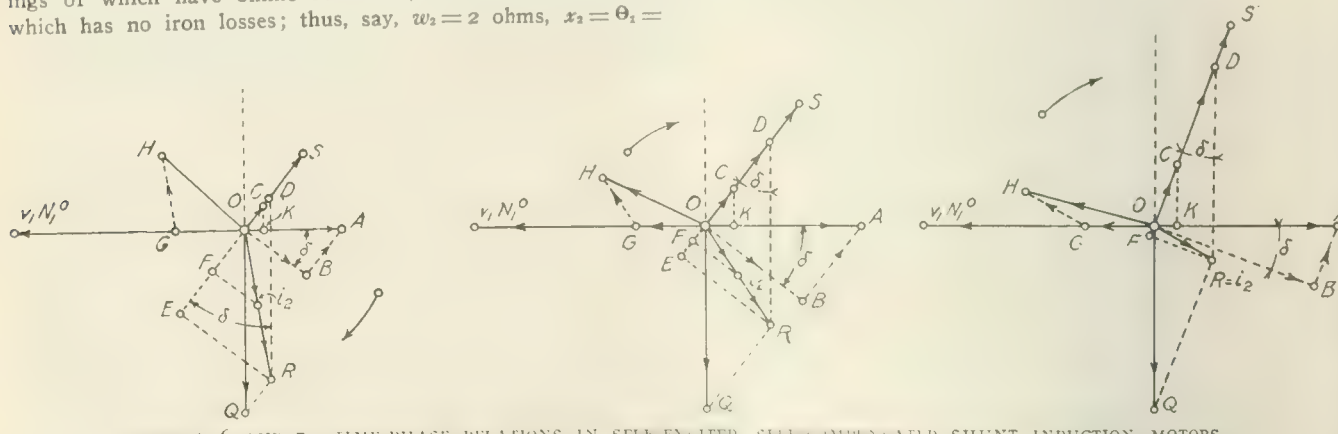
(6) The ventilation losses.

(7) The iron and copper losses in the exciting or motor field circuit.

The recoverable energy required by the rotor, be it by the motor field or by a demagnetizing component of the rotor current along the armature axis, will be at least partly met by a corresponding component of the primary or stator current and will also draw on the kinetic energy of the rotor.

The first three losses will be supplied directly by the primary stator winding, the next four will, as a rule, be entirely met by a rotor current in the transformer axis, which current will, of course, be reflected in the primary both as to phase and magnitude. It will indeed be remembered that the motor acts as a *phase converter* when producing the exciting current i_3 in its rotor along the motor field axis; this converter must be *driven* at a certain speed, and if not devoid of losses, it will require a certain average torque in order to maintain it at that speed. This torque will, as a rule, require a current i_2 flowing in the rotor along the transformer axis and interacting with the motor field N_3. This current i_2 will be reflected in the primary stator winding because it flows through the rotor along the transformer axis.

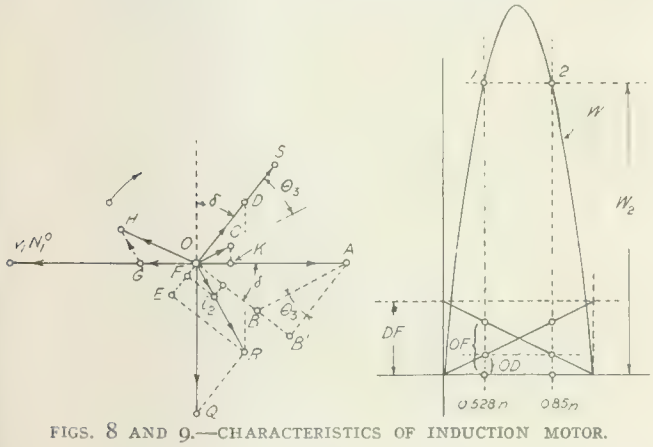
Turning now to the figures illustrating these no-load conditions it should be noted that the rotor resistance chosen for Figs. 5, 6, 7 and 8 is quite abnormally large and has been so chosen in order to make the diagrams very clear. In these figures $OP = e_1$; $OF = i_{12}$; $GH = -i_2$; $OH = i$; $OQ = e_1$; $OS = N_3$; $OB = e_2$; $OC = i_3$; $OK = i_{13}$; $OG = i_m = i_0$; $OA = e_{21}$; $BA = -i_2 w_2$; $w_1 = x_1 = 0$, and $x_2 = 0$. In Figs. 5, 6 and 7, $\Theta_3 = 0$. In Fig. 5, $w_2 = 2$, and $n = 0.528$. In Fig. 6, $n = 0.85\, w_2 = 2$; in Fig. 7, $n = 0.995$ and $w_2 = 1$, while in Fig. 8, $n = 1.00$, $w_2 = 2.667$ and $\Theta_3 = 24$ deg. In these figures the torque D_3, due to the interaction of i_3 and a small part of N_2', must be zero for x_2 and consequently the secondary leakage field N_2' is supposed to be zero. On the other hand, the torque D_1, due to the interaction of $v_1 N^0_1$ and i_3, has a definite and *negative* value, for it is seen that the effect of w_2 is to shift the



FIGS. 5, 6 AND 7.—TIME-PHASE RELATIONS IN SELF-EXCITED, SELF-COMPENSATED SHUNT INDUCTION MOTORS.

phase of N_3 out of its time-quadrature relation to $v_1 N^0_1$, making angle $GOS > 90$ deg.

Although e_{r1} will still equal e_1 for $n = 100$, yet N_3 will be considerably smaller than $v_1 N^0_1$ for it is only proportional to e_3 which equals $e_{r1} - i_3 w_2$. Since the phase of e_{r3} depends on that of N_3 it can in this case never be opposite to the phase of e_1; thus the resultant OR between e_1 and e_{r3} can never be zero and a current i_2 in phase with OR must flow in the rotor along the transformer axis under all conditions of speed and *whether such a current is required for the production of a torque or not.* At synchronism i_3 will have a certain value smaller than i_m in the proportion of e_1 to e_3, it being assumed in this case, as in all the others, yet to be considered, that the primary and secondary windings are exactly equal, that the e.m.fs. are proportional to the fluxes and that the reluctance is constant along all the axes of the motor. The resultant e.m.f. in the rotor along the transformer axis will at synchromism be exactly equal in magnitude to BA, which in this case equals $i_3 w_2$. At synchronism OR will be in time quadrature with BA, leading BA by 90 deg.; in consequence, $i_3 < i_m$ will be exactly reflected in the rotor along the transformer axis and also in the primary stator winding, being there added vectorially to i_m, thus yielding the resultant i or OH. In Figs. 5, 6 and 7 i_2 will at synchronism coincide in phase with e_3 or OB, but i_2 will then also be at right angles to N_3 and the average main torque D_3 of the motor will thus be nil. If the speed be increased beyond synchronous a reference to Figs. 5 and 7 will show that D_3 must become negative. D_3 is due to interaction of i_2 and N_3. Therefore:



FIGS. 8 AND 9.—CHARACTERISTICS OF INDUCTION MOTOR.

The no-load speed of a shunt induction motor, the rotor of which has resistance only, must be below the synchronous. The average main torque D_3 of such a motor becomes zero at synchronism.

Suppose that the motor losses 4 to 7 are such as to require, say, W_r watts in the rotor along the transformer axis, in order to drive the machine light, then $t_{i2} \times e_{r3}$ must equal W_r, where t_{i2} is that component OF of i_2 which is in phase opposition to e_{r3} or OD. Seeing that OE is the torque component of OR, just as OF is the torque component of i_2, the matter resolves itself into the problem of finding that position of the triangle EDR or that rotor speed for which $OE \times OD$ has a given value. It is quite clear that there will always be *two* such positions as long as the no-load requirements are within the power range of the machine, consequently two distinct speeds will correspond to these two positions of EDR. The variation of the individual values of OF and OD, together with the variations of their product, are graphically shown in Fig. 9 for all positions of the triangle EDR—that is, for all speeds up to the synchronous. It is seen that $OD = e_{r3}$ varies as the square of the speed; whereas OF has a definite value $\frac{e_1}{w_2}$ when the speed n is zero and is itself zero when the speed is synchronous. OF varies proportionally with OE and its value at any speed n is $OF = \frac{e_1}{w_2}(1 - n^2)$ where n must be expressed as a fraction of the synchronous speed. The motor diagram for the lower speed, point 1 in Fig. 9, is shown in Fig. 5; that for the higher speed, point 2 in Fig. 9, is shown in Fig. 6. It is obvious that the equilibrium at the lower speed is unstable, whereas at the higher speed it is quite stable. In the first case, an increase in speed causes the power available to increase and vice versa, so that the motor will tend to run beyond point 1 of Fig. 9. In the second instance, a decrease in speed increases the power available and vice versa; these last conditions, therefore, tend to keep the speed constant. Fig. 7 merely indicates that a decrease in the rotor resistance tends to increase the stable no-load speed and also to decrease i_2. Although it has been assumed in Fig. 9 that the no-load watts required at the two speeds are of same magnitude; this is, of course, not generally true; the fact has, however, no bearing on the above deductions. We can say that:

When the rotor of a shunt-induction motor, otherwise devoid of losses, has only ohmic resistance, then its primary no-load current is made up of two components, the primary magnetizing current and a current equal and opposed to the rotor current in the transformer axis. This latter is made up of two components in quadrature relation, the one i_{2v} is constant and equal to the synchronous rotor exciting current i_3 of the machine, the other i_{2w} is equal to $\frac{e_1}{w_2}(1 - n^2)$ where n expresses the speed as a fraction of the synchronous; this no-load rotor current is neither equal to the primary magnetizing current in magnitude, nor opposed to it in phase.

The torques are

$$D_1 = \tau_1 N^0_1 \times i \times \sin \delta$$
$$D_2 = 0$$
$$D_3 = i_{2v} \times e_{r1} \times \cos \delta$$

The influence of iron losses can be ascertained with the help of the diagram in Fig. 8, for which δ is the same as in Fig. 6, but where $w_2 = 2.667$.

Iron losses along the motor field axis increase the watt component of the no-load current along the transformer axis and may be looked upon to some extent as an increased rotor resistance. The torques are:

$$D_1 = \tau_1 N^0_1 \times i \times \sin(\delta + \Theta_3)$$
$$D_2 = 0$$
$$D_3 = i_{2v}(e_{r1} \cos \delta - i_3 w_2 \sin \Theta_3)$$

It is seen that D_3 does not become zero at synchronous speed when $\Theta_3 > 0$, yet the motor cannot run at synchronism, even at no-load, for at that speed $D_1 > D_3$.

It will be shown in a later issue that OR is always equal to BA and in time-quadrature therewith at synchronism (even when $x_2 > 0$), but that BA does not always equal $i_3 w_2$. Although as soon as $x_2 > 0$, that is, as soon as a practical machine is dealt with, the conditions change very materially, yet it is thought that the foregoing considerations will be of material assistance in dealing with the more complicated conditions obtaining in a commercial machine and will be of assistance in ascribing the various effects to their proper causes.

Determining Positions of Vessels by Wireless.

A patent issued on Nov. 30, 1909, on an application filed on Dec. 14, 1904, by Reginald A. Fessenden, relates to a method for locating the position of ships by means of wireless telegraphy. According to the arrangement proposed, signals are sent out at regular intervals from two or more wireless telegraph stations situated at fixed points, each vessel locating its own position by comparing the strengths of the signals received. Each land station sends out a distinctive signal so that it may be recognized immediately by any vessel. Moreover, the strength of the signal from each land station is varied so as to form a succession of signals of gradually varying intensity so that each signal shall produce the same intensity at a point 20 miles farther from the station than the signal immediately preceding it. Thus the operator on each vessel first identifies the station from which each signal is being sent, estimates the relative distances from the vessel to each land station and thereby determines the position of the vessel on the sea.

English Tariff Reform and American Manufactures.

By an English Observer

THERE can be no doubt that the question whether England shall adopt protection is one of the leading political topics of the present day in the old country. At the present moment, of course, the Radical party, which is in power, is making the budget for 1909-1910 the chief plank in its platform. The Prime Minister and those who support him are stanch free traders, and the financial proposals now before Parliament do not involve any departure from the principles of free trade. By means of additional taxes on land, liquor and increased death duties it is hoped to secure sufficient revenue to run the country. At the moment of writing this free-trade budget has been passed by the House of Commons, but it has to receive the sanction of the House of Lords before it can become law. Speculation is rife as to whether it will survive this ordeal. Although it was passed by a huge majority in the House of Commons, that really counts for very little, because the present Parliament was elected in 1906, and since that time there has been a great change in public opinion. The House of Lords, by throwing out the budget, may force another general election, in which case the free-trade government may be turned out of power.

The main item in the program of the party which is in opposition is tariff reform, and, whatever may be said to the contrary, there is undoubtedly a growing feeling in favor of this change.

It is asserted on every platform that England is losing her supremacy as a manufacturing country. The British workingman is told that he is being deprived of his means of livelihood by the free importation of foreign goods. It is pointed out that many industries have been killed in England owing to the fact that German and American goods are allowed to come in without any restrictions, and are sold at prices which ruin the British manufacturer. For instance, in 1907, glass tumblers sold at 2s. in the United States were sold in London at 1s. 3d.—about what they cost to produce including freight. In support of the argument as to England's being cut out by America, figures are quoted to show the enormous expanse in the production of American steel. Thus, during the period from 1880 to 1907 steel production in the United Kingdom increased from 1,000,000 tons to 6,000,000 tons. In the same period the steel output in the United States increased from 800,000 tons to 23,000,000. Finally, the fact is emphasized that in all the skilled trades the rates of pay are much higher in the States than they are in England. Thus, the wages of engineers in America are from 35 per cent to 70 per cent higher than those of men in similar employment in Great Britain.

The present article is not concerned with the proper economic deduction which should be drawn from these facts and figures. The broad point is that they are being emphasized all over England and are drawing her on to tariff reform. The success of protection in America is often looked upon with jealous eyes, and President McKinley's famous decision, "We want no free trade in the United States . . . the capitalist can wait on his dividends, but the workingman cannot wait on his dinner" is freely quoted.

What is the program? What kind of reform will it be? If duties are imposed upon foreign goods, coming into England, what goods will be included in the schedule? Last, but not least, how will such duties affect the position and interests of the foreign manufacturer?

Each of these questions can be dealt with in turn. In the first place, it is by no means easy to define the program of the tariff reformer.

The main features of the program may, however, be thus summarized:

(1) A tax is to be placed on all manufactured articles coming into Great Britain in competition with her products.

(2) Raw materials are to be free.

(3) No extra taxes to be placed on food.

The last item is of no particular interest to the *Electrical World*, but the first two demand some consideration. To begin with, it is clear that all electrical machinery sent to England from the United States will be taxed. The amount of the tax has been vaguely stated to be 10 per cent ad valorem; but whether this figure will be effective to keep out American goods is not yet known.

When one comes to look at figures, it would seem that the imposition of this tariff is not a matter which need disturb the American manufacturer very much. No figures are available to show the actual value of electrical machinery imported into England, but when one views the figures relating to imported manufactures as a whole it would seem that the United Kingdom during the last few years has not become a much better customer for America. Thus, in 1904 England imported American-manufactured goods (that is, articles wholly or mainly manufactured) to the value of $98,000,000. In 1907 this had only increased to $101,500,000. The fact can be explained better in the States than in England, but the plain English of it seems to be that so far as manufactured articles are concerned the Americans have but little to worry about.

Another fact is forced into notice. Suppose this tax is put on, who will pay it? This appears to depend very largely upon the question whether the goods to be taxed can or cannot be manufactured in the United Kingdom. If they are not manufactured in the Kingdom it seems to one who does not claim to be a political economist that for a considerable time at least the American may put up his prices. Of course, if they can be manufactured in the Kingdom, then the English manufacturer will have a preference to the extent of the duty, and the question whether the American goods will continue to come in will depend largely upon their quality and the cost of production.

As to the latter point, it may be remarked that whatever duties are imposed, a certain number of American manufactured goods will continue to come into England and to hold the field. In spite of huge American tariffs certain classes of English goods continue to cross the water.

It has been noted already that, whatever happens, raw materials are to be admitted free. The true importance of this exception could be better gaged if one has a definition of raw materials. Steel plates are the raw material for building ships. Copper wire is some of the raw material for manufacturing dynamos. It is to be noticed that manufactured goods are to be taxed upon a graduated scale. The higher the degree of manufacture the more, it is presumed, will be the duty.

The above somewhat sketchy outline gives a faint idea of what is meant by tariff reform in England. If it means more than this, the meaning has not been divulged. It is wrapt in mystery in its inception; and the consequences which will follow from it are a matter of speculation. It is almost impossible for a political economist to form an accurate judgment in the matter. The case is without precedent. When America adopted a tariff, she was, comparatively speaking, a new country. To encourage manufacture at home she put on protective duties, and the result has been, to all appearances, successful. When Bismarck took the same step, Germany was in her infancy as a manufacturing community. She, too, has reaped a rich harvest. But what will be the result of protection in a country which remained great in spite of free trade? Will protection bolster up declining industries? English free traders say no. They assert that free imports are the lifeblood of England's commercial prosperity. They also argue that import duties raise prices by the whole amount of the duty, and that, therefore, as the price of the untaxed product is raised equally with that of the taxed product, the loss to the community is greater than the gain to the Exchequer. How far these prophecies are true time alone can tell. However, it is certain that there is a strong and growing feeling in England at the present time in favor of tariff reform, and all American manufacturers should begin to consider how they are going to deal with the new fiscal situation to which it will give rise.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

The Electric Automobile in Springfield, Ill.

The Springfield (Ill.) Light, Heat & Power Company has been meeting with gratifying success in building up an electric vehicle charging business. The matter of an automobile load was taken up early in the year and at present the company is charging regularly 22 vehicles. In addition, some vehicles are charged at public or private garages to which the central station supplies electrical energy. The rate to automobile owners is 5 cents per kw-hour.

A Glue-Pot Advertisement.

The Roanoke (Va.) Traction & Light Company recently took advantage of a local fire originating in a glue pot to issue a circular setting forth the advantages of the electric glue pot. The circular has the "scare-head" Fire! followed by a reprint from a local paper giving an account of the fire. Then, after the question in large type, "How is your glue pot heated?" a few sentences set forth concisely the advantages of the glue pot. The design of the advertisement is such that no one could escape being attracted to its brief message.

Prompt Work.

The Lawrenceville (Ill.) Light & Water Company is on the spot ready for business when it gets an order for house wiring, as is shown by a seasonable advertisement being run in Lawrenceville papers, the wording of which is as follows:

"A Lasting Christmas Present and a Most Desirable One for Your Wife Would be Electric Lights in the Home."

"A Proposition.—Get your wife away from home for the day and we will wire the house and have the lights burning by night. Why not surprise her? Women like pleasant surprises."

The Furnace Fan Season.

Central stations and electric supply companies which are making the most of their opportunities are at this time of year preparing again for cold weather by laying in a stock of electric fans for use in connection with hot-air furnaces. An electric fan placed in the air intake of a hot-air furnace to force the hot-air circulation makes it possible to do satisfactory heating with hot-air furnaces where otherwise steam or hot water would be necessary to heat distant rooms. It also facilitates the warming up of a house on cold mornings. The use of electric fans for this purpose by the occupant of a furnace-heated house in northern latitudes is likely to exceed his use of the fan for cooling in summer. This kind of business, however, must be taken at the psychological moment, when the weather is cold, and the only way to be prepared for it is to have fans on hand ready to install. The ordinary 10-in. or 12-in. desk fan can be placed in a box, one side of which is open and the other side is closed except for a circular opening the size of the fan. This can be placed so as to slide vertically or horizontally into the cold-air box of the furnace. Special outfits with slow-speed fans are also made for this purpose now by certain manufacturers.

Low-Voltage Tungstens in Residences.

The question of whether it is advisable to install low-voltage tungsten lamps taking 30 volts or 60 volts instead of the regular 110-volt lamp, which is more fragile, has been coming up frequently. The object of using such low-voltage lamps is, of course, the greater strength of the filament for a given candle-power, which reduces breakages and enables lamps of lower candle-power to be used. Several enterprising central-station companies have installed these low-voltage lamps in small residences at a flat rate per lamp per month, on the theory that this will secure a number of small consumers which would not otherwise be obtained, and the expense of meter investment and maintenance is done away with.

The objection has been raised, however, that the use of low-voltage tungsten lamps for ordinary residence use, either with or without meter, has many drawbacks, about the only substantial advantage gained being the greater strength of the lamp filament for a given candle-power. Low-voltage circuits shut out standard heating appliances. From the illuminating standpoint, there is no great call for tungsten lamps giving less than 20 cp at the present time. To be sure, there are places where much less than 20 cp is sufficient, but in the ordinary house there are places where the lamps are infrequently used, and it is generally better to retain carbon lamps in the sockets which are infrequently used than to make the extra investment with risk of breakage by putting tungsten lamps in these sockets. This virtually means that tungsten lamps, on account of their high price and fragility, will for some time to come be used mainly in the sockets where needed most. In the ordinary small house these sockets are in the kitchen, dining-room and living-room, with occasionally a bedroom. Now, while it is true that with proper observance of the principles of illumination, an 8-cp lamp can be made very satisfactory for lighting a dining-room table or providing enough light for two or three people to read under in a living-room, it is hardly up to present-day ideas of sufficient illumination with electricity. People in general expect more illumination with electric light than with kerosene. As to comparison with gas, the smallest candle-power burner to which gas users are accustomed is 16 to 20, while gas-mantle burners run from 20 cp to 80 cp. It would seem, therefore, that the central-station man in shaping his policy in these matters should seek to cater to the increasing standards of illumination and the demand for more light on the part of the public, rather than to adopt odd voltages and low-voltage lamps.

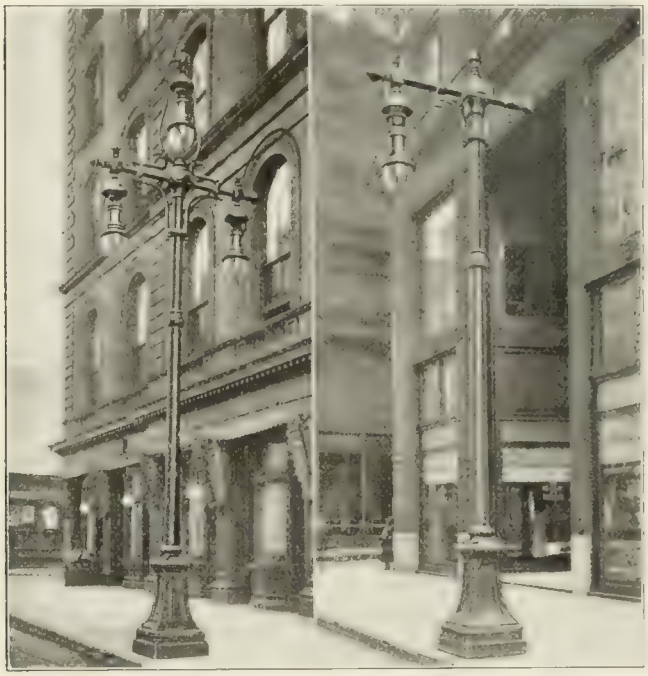
The low-voltage tungsten lamp supplied on a flat rate of about 1 cent per month per candle-power is not without its advantages. It does away with meter investment and other expense connected with meter reading and maintenance. The fact that the cost is known in advance to the consumer appeals to many. As long as low-voltage tungsten lamps are not easily available in the larger candle-powers, it is unlikely that customers will attempt to substitute larger lamps unknown to the company. This, however, is likely to be a temporary condition. Substitution in the long run can only be checked by regular inspections or by the use of flat rate or maximum-demand controllers which allow only a predetermined load to be connected. The cost of these controllers is a partial offset to the saving in meters, although the controller has the decided advantage that it does not need to be read, and costs somewhat less than the watt-hour meter. The point that the low-voltage, small candle-power tungsten lamps can be used in existing old-fashioned fixtures is after all a questionable advantage. These old-fashioned fixtures are likely to be of such unsatisfactory design and equipment that the consumer would do much better with a single tungsten lamp of higher candle-power efficiency installed and equipped.

Improved Street Lighting in St. Louis.

Before the beginning of the new year, St. Louis will have completed and in operation what is said to be the most extensive, most up to date, and most effective street-lighting system of any American city. The work of arousing sentiment

in favor of a new lighting system in the business district of St. Louis and carrying the project to successful completion was placed in the hands of the officers of a voluntary organization, composed of merchants and property owners within the district, known as the Down Town Lighting Association.

It had been realized by the merchants and property owners that a new lighting system was badly needed in the business district, and it was finally agreed that some steps should be



FIGS. 1 AND 2.—THREE-LAMP AND SINGLE-LAMP STANDARDS.

taken looking to the improvement of conditions. The new organization began work immediately after the beginning of the present year. Committees were appointed, to which were delegated the duties of making a thorough investigation of all existing forms of street illumination, and of devising the proper system adapted to conditions in St. Louis.

After more than eight months of labor, it was decided to install an improved form of arc-lamp lighting, and by process of elimination the new magnetite arc lamp was fixed upon as the unit of illumination. This having been established, a committee was appointed to design a suitable lamp standard which could be manufactured and erected at moderate cost, and which would eliminate the unsightly service loops which had heretofore been an unsightly feature of the arc-lamp standards. The new lamp standard called for the fixation of the lamp.

The above points having been settled, the entire plans were laid before the Board of Public Improvements of the city of St. Louis for its approval and adoption, so that the maintenance



FIG. 3.—BROADWAY (ST. LOUIS) BY NIGHT.

charges would be paid by the city under its street lighting contracts with the Union Electric Light & Power Company. The plans were also placed before the executive committee of the Union Electric Light & Power Company, since it was to undertake the installation.

As soon as these details were determined upon, the question of cost was taken up, and it was estimated that the new lamp standards could be manufactured and installed on the streets at a total cost to the property owners and merchants of $30,000. In order to obtain this sum, the officers of the lighting association made an assessment of $1 per front foot against all of the property fronting on the streets to be illuminated by this system. The response received from the property owners to the calls for the funds was more than gratifying, showing that the

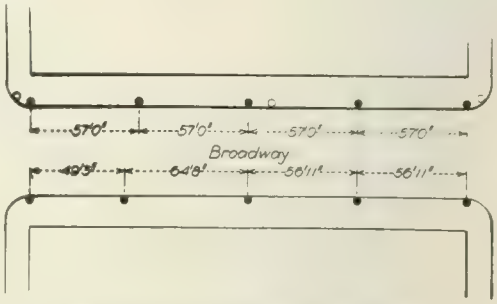


FIG. 4.—PLAN OF BLOCK LIGHTING.

movement for a new street-lighting system in the business district of St. Louis was a popular one.

Actual construction work on the new system was begun in August, and every effort was made by the Union Electric Light & Power Company to have as many streets as possible completed in time for the Centennial Celebration, which began on Oct. 4. On that date, enough work was completed to show what the entire system would be like when installed.

The district illuminated by the new system is bounded by Fourth Street on the east, Twelfth Street on the west, Washington Avenue on the north, and Market Street on the south, comprising a total of 48 square blocks.

Prior to the installation of the new system there were in this district only 138 arc lamps of the old enclosed type, which had been installed 10 years previous. Under the plan of the Down Town Lighting Asociation there are being installed within this district 437 6.8-amp General Electric magnetite lamps. These are placed in a uniform manner on all of the streets in the district, with the exception of Broadway. This street was not included in the general lighting scheme, but was left to the City Improvement Association, composed of property owners and merchants on Broadway. This asociation installed on this street 240 4-amp General Electric magnetite lamps, the maintenance of which is paid for by this association.

The plan of the Down Town Lighting Association calls for

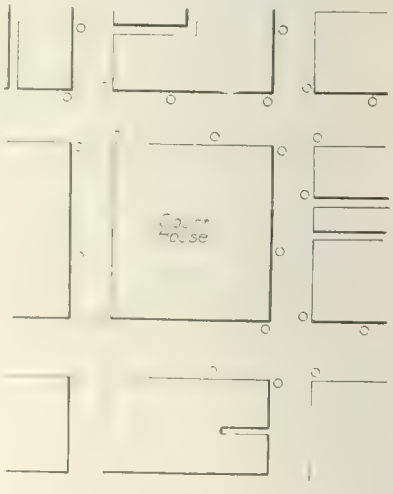


FIG. 5.—DIAGRAM SHOWING POSITIONS OF POSTS.

four lamps at each street intersection, one on each corner and so arranged that two will line up with those on the north and south streets and two with those on the east and west streets. In addition, there are placed two lamps in the middle of the block, so arranged that they are approximately 80 ft. between centers. This arrangement gives a total of six lamps per block.

On Broadway the lamp standards are designed to carry three 4-amp magnetite lamps; the standards are placed opposite each other on both sides of the street, and are on approximately 60-ft. centers. This plan gives a total of 10 standards, or 30 arc lamps per block. The effect of this illumination is exceedingly brilliant, and has transformed the dark Broadway of old days into what is believed to be the most brilliantly lighted thoroughfare in America, if not in the world.

To indicate the magnitude of the new system, it might be mentioned that in the down-town business district there will be installed, when the system is completed, 667 magnetite lamps, of which 427 are 6.8-amp and 240 are 4-amp lamps. There are 14 streets illuminated by the single-lamp and one by the triple-lamp standards. In all, five miles of streets are illuminated.

The cost to the property owners in the district, outside of Broadway, was $30,000, and the installation on Broadway amounted to $10,000. The city having agreed to maintain all of the lamps, excepting those on Broadway, the additional cost to it will be $30,000 per year, to be paid out of the general funds of the city, while on Broadway, where the maintenance is borne by the merchants, the cost is about $9,000 per year.

In order to supply the energy for the new magnetite lamps, the Union Electric Light & Power Company has installed in its station at Tenth and St. Charles Streets, three 75-lamp, 4 amp General Electric mercury-arc rectifiers and regulators, and seven 75-lamp, 6.8-amp rectifiers. Moreover, it has installed additional generators. The company has also, at its own cost, done all of the installation of the new system and has furnished all of the new lamps, the only thing paid for by the property owners in the district being the new ornamental lamp standards. When finally completed the total cost of new equipment and construction, as estimated by Mr. S. B. Way, superintendent of the electrical department of the Union Company, will be fully $100,000, thus making the total cost of the system to the property owners and the Union Electric Light & Power Company in the neighborhood of $140,000.

This new system is permanent and will be in charge of Harry S. Sanderson, supervisor of city lighting.

INTERIOR WIRING AND ILLUMINATION

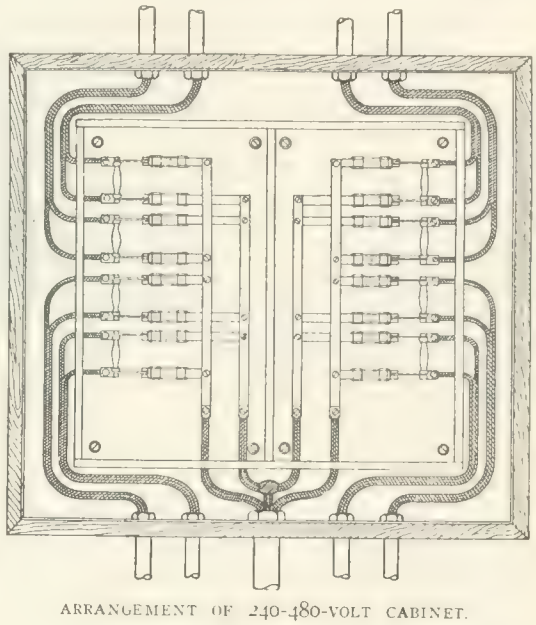
Spectacular Lighting in Denver.

Manhattan Beach, one of Denver's older amusement parks, is about to rehabilitate itself. The grounds and buildings are to be entirely rewired and some very striking illuminating schemes are projected. The rivalry in lighting of Denver's amusement parks has been very keen, as the bulk of business follows largely the adoption of improved lighting effects.

The outline wiring which was decided upon some time ago for the Denver Auditorium is now proceeding rapidly. The columns are emphasized by double rows of lights, the dome by lights outlining the arched ribs. The outlining, some 5000 lights in all, is thoroughly in accordance with Denver's new electrical ordinance. All feeders are in rigid conduit, and circuits are limited to 70 4-cp lamps, reckoning 4.8 watts per candle. The circuits employ screw-type sign receptacles in the cover of a complete metal runway of 24-gage galvanized iron. The entire arrangement is completely water and fireproof, and makes the structure a beautiful spectacle at night.

Arrangement of Three-Wire Cabinets.

Under the old rules of the National Board of Fire Underwriters covering inside work, it was required that wires must be so arranged that under no circumstances would there be a difference of potential of over 300 volts between any bare metal parts in any distributing switch or cut-out cabinet or equivalent center of distribution. This rule was not intended to prohibit the placing of switches or single-pole cut-outs for motor systems of voltages above 300 in cabinets, but required that the cabinets be divided by approved barriers, so arranged that no one section should contain more than one switch or more than one single-pole cut-out. The rule and note were stricken from the Code at the annual meeting in 1908, but provision was made in the rules governing the construction of panel boards, used for the control of lamp and motor circuits, for spacings between bare live-metal parts (busbars, etc.) so that barriers



ARRANGEMENT OF 240-480-VOLT CABINET.

would be unnecessary where the specified spacings were followed.

However, in panel boards of special design, in which the insulation separation between busbars and between other current-carrying parts is secured by means of barriers or insulating materials, instead of by the spacings specified, the cabinet must be submitted for examination and approval before being used.

The cabinet, which is illustrated herewith, shows an arrangement of 240-480-volt panels approved by the Canadian Fire Underwriters' Association. In this panel the three-wire main is divided so that only the 240-volt side of the circuit will enter any one cabinet. This arrangement conforms strictly with Rule 24a of the old edition of the Code, and illustrates what would be considered as an approved cabinet under the new rules governing the construction of panel boards in which the insulation separation between busbars is secured by means of barriers instead of by the required spacings.

Special Lighting with Posts in a Town of Six Thousand.

The two accompanying engravings show night and day views of Broadway in Albert Lea, Minn., a town of about 6000 population, where a system of special lighting has recently been installed for the principal business street. This installation is of special significance as indicating that permanent artistic lamp-post installations with underground supply are now within the reach of small towns, and that they are not necessarily confined to the large cities.

About six blocks of street have been equipped in this way. In that distance there are 50 of the three-lamp posts. The posts are of an inexpensive design, made by George Cutter, of South Bend, Ind. Each of the side arms of the post has a 60-watt tungsten lamp, and the top globe employs a 40-watt lamp.

One of the 60-watt lamps burns all night. The other two burn

until midnight. The wiring for this system is underground. A 1-in. iron conduit was installed under the curb. Branches from this line are taken under the stores to the Albert Lea Light & Power Company's pole lines, which are located in the alley. There is one switch for each block on one of the poles. Switching is done by one of the police officers. All of the tungsten lamps burn tip down, and are installed in Cutter spring sockets. The cost of installation, exclusive of taking up and putting down sidewalks, amounted to $60 per post.



FIG. 1.—VIEW OF A STREET IN ALBERT LEA SHOWING POSTS

The company has made a five-year contract with the city, and the lighting is paid for out of the general lighting fund of the city. This in many ways is preferable to collecting from individual merchants. The company receives $45.10 per annum per post, which is considered a low rate, but the company does not figure to make much profit on the installation, as it looks for new business in window and outline lighting on account of the better illumination and greater attractiveness of the down-town streets. The installation has created considerable favorable comment in the vicinity of Albert Lea. On the opening night a band was secured by the company to play on the streets, and there were several hundred visitors from out of town to attend the celebration. The merchants did some special lighting on this occasion and gave away souvenirs. People came from as far as 100 miles to attend the festivities. Both the general public and the company feel that this lighting will boost the town considerably. We are indebted to Mr. Ludwig



FIG. 2.—NIGHT VIEW OF AN ALBERT LEA STREET

Kemper, the enterprising treasurer and manager of the Albert Lea Light & Power Company, for the illustrations shown herewith.

The Portola Festival at San Francisco.

The festival which was held in San Francisco Oct. 19-23, in commemoration of the discovery of San Francisco Bay by Don Gaspar de Portola, and also to mark the noteworthy rehabilitation and rebuilding of the city since the fire of three years ago, passed into history as one of the greatest events of its kind ever held in the western part of the country. Many who had witnessed the Hudson-Fulton celebration in New York City, and the Mardi Gras celebration of New Orleans were under the impression that these were both surpassed by the San Francisco carnival. From the arrival of Don Gaspar through the Golden Gate on the morning of the nineteenth until the closing of the celebration there was a continuous chain of events, which drew to the city vast multitudes of people.

The electrical illuminations of the city were carried out on a larger scale than had ever before been projected on the Pacific Coast. Starting with the Ferry Building, which was itself very well outlined with lamps, a large court of honor festooned with incandescent lamps led to Market Street, which was bedecked with festoons as far as Van Ness Avenue. Third Street, from Market to the Southern Pacific Depot, and the



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FIG. 1.—NIGHT VIEW OF UNION SQUARE AND ST. FRANCIS HOTEL.

principal streets of the retail district north of Market Street, were similarly festooned with incandescent lamps. The chief



FIG. 2.—SUSPENDED BELL OF ELECTRIC LIGHTS.

electric display consisted of an immense bell containing 2000 lamps located on Market Street at the intersection of Third and Kearney. The bell was 120 ft. high, the top piece consisting of a wooden platform 8 ft. in diameter, from which the streams of colored incandescent lamps drooped to the rim of the bell that reached to the sides of the street, and itself was 40 ft. above the pavement.

The festoons on Market Street were made up of 41 16-cp lamps, and were strung from ½-in. steel cables attached to the buildings on either side of the street. Over 8000 lamps were thus used on Market Street alone. Union Square, where the bandstand was erected, was brilliantly illuminated by 1250 lamps spaced 18 in. on centers. The total number of lamps contracted for during the festival was over 30,000, and the work was executed by the Central Electric Company, although part of it was sublet to other contractors. The general illumination of the principal buildings was also well carried out, the St. Francis Hotel being the most elaborately decorated. Sixteen flaming

ares in the tower of the *Call* Building served as the most brilliant single lighting feature.

An electrical parade on the last night of the carnival proved quite an innovation to San Francisco. Seven large floats mounted on railway trucks, and operated over the tracks of the United Railroads on Market Street, and after the parade stationed at different points on the thoroughfare, formed the most interesting features. The floats were elaborately planned, and the effect produced by them was remarkable. The most conspicuous one was emblematical of the Yosemite. On one side was the Yosemite Falls, while on the other were the Nevada and Vernal Falls, all meeting in the center and forming the Merced River. Water flowed over the falls at the rate of 1500 gal. a minute, pumped from a tank underneath by a 20-hp motor. About 1200 lamps were used to decorate the float, in addition to two search lamps. A similar float depicted Shasta and Moss Brae Falls, while on another was operated an electric fountain. All the floats were constructed at one of the barns of the United Railroads, and represented an expenditure of nearly $20,000. Mr. Otto F. Schiller was the chief engineer of the festival committee and planned most of the electrical features, while Mr. Stanley Hiller directed the electrical work in person.



FIG. 3.—MAIN ENTRANCE OF HOTEL ST. FRANCIS.

The Illumination of the New Building of the Denver Gas & Electric Company.

BY G. E. WILLIAMSON

The new 10-story building of the Denver Gas & Electric Company, now in process of construction, will be the crowning glory of the "City of Lights" idea, started by the president of the company, Mr. Henry L. Doherty, a few years after he took up the work of reorganizing the Denver company.

In the early days of the campaign which was made by the Denver Gas & Electric Company for better lighted streets and more extensive display lighting there were those who looked with disfavor and considerable skepticism on the artistic sentiments expressed by the president with regard to advertising Denver as a "City of Lights." Early and late, in speeches and through the press, he advocated liberal lighting as a municipal feature that would not only attract tourists to Denver, but would be a powerful means of bringing new residents to the city.

The opposition to the lighting scheme argued that if the city went to the expense of putting in new street-lighting systems the taxes would become burdensome, and that in any event no good could come from such a lavish expenditure. Some business men said that private display lighting was an extravagance and would tend to make the city look "circusy." In a speech before the Chamber of Commerce, Mr. Doherty recalled to his audience the pronounced success scored by the St. Louis Exposition and very vividly and plainly showed that the decorative lighting at the Exposition was largely responsible for its popularity. He said that the way people raved about the scenic effects of the lighting at the Fair very forcibly demonstrated that it was something that was pleasing to the people, and that lighting effects on a smaller scale in municipalities would be met with as much favor as was evidenced at the Fair. The seed was well sown in that address, which was widely and favorably commented on by all newspapers in Denver, regardless of political faith, and a short time thereafter the lighting movement was well launched, and since then no one has doubted its successful outcome. The three principal streets of the business section of the city have public lighting systems, which are as artistic, if not more so, than one can find in any other city in the country. It is established beyond question that the private lighting per capita is greater than in any other municipality.

When the plans for the structure were first taken up the illuminating engineers were instructed to draw up plans which would insure exterior lighting of such rich design as would eclipse the illumination of any building in the country. He impressed on them the idea that Denver citizens would expect something of an unusual and extraordinary character in the lighting of the building, and that every effort should be made to meet their expectations. It was not a difficult matter to arrange the lighting for the splendid effects, as the architectural lines permit of an artistic placement of lamps. The face of the building will be of glazed terra cotta, which will provide the most effective and most beautiful reflecting surface. From sidewalk to crown there will not be a dark spot in the entire area of the building as viewed from any point in the city. Every inch of the surface will be illuminated. Beginning at the plane of the sidewalk, the bulkhead windows will be well illuminated with 25-watt tungsten lamps in reflectors. The windows on the first floor are to be lighted with two 250-watt tungsten lamps to each pane of glass, or a total of 8000 cp on the two street fronts.



ILLUMINATION OF DENVER BUILDING.

The exterior decorative lighting begins just below the second floor, where there will be one 250-watt tungsten lamp in an oriental lantern on each vertical column. On the 24-in. lintel, just above the large windows, there will be a changeable letter

electric sign, extending along Fifteenth and Champa streets, which will be used for changeable advertisements each week. On the panels between windows on the second floor will be a cluster of 48-cp and 32-cp tungsten lamps, with an outline of 20 10-volt, 4-cp tungsten lamps forming a frame around the center cluster. Lining the cornice above the second floor 48-cp tungsten lamps will be used about 6 ft. apart. The entire field between the second story and the eighth story will be dotted with 4-cp tungsten lamps, set in a diadem design at regular intervals between windows. These lamps are studded in terra-cotta rosettes and set back until only one-third of the lamp protrudes, thereby heightening the daylight appearance of the scheme. This plan is applied to all the smaller lamps. In the belt course at the ninth floor level is a row of 32-cp tungsten lamps, about 2 ft. apart, and at each panel between windows in the cartouches, extending in a tapering form downward, is a row of lamps, beginning with a 4-cp tungsten lamp at the point, then a 25-watt, a 40-watt, a 60-watt, and finally three 60-watt lamps in a panel 30 in. long and 10 in. wide at the top.

The two top stories and cornices are designed to develop a most striking crown of illumination. Small lamps are used in great numbers close together to emphasize the lines of the architecture. The cornice is coved to act as a reflector to throw the light downward from the numerous lamps. The ornamental pilasters of glazed terra-cotta will be effectively illuminated by vertical rows of lamps studded thickly between them. In the cornice design over the windows, in the center of each cluster, there will be a 200-cp lamp set behind a bull's-eye lens, a reflecting surface being behind the lamp. Below these clusters in the center of panels between windows the same diadem arrangement of lamps as on the second story will be used.

At the top of the cornice line of the building, extending in a continuous row in the cheneau, will be a line of 80-cp lamps, 3 ft. apart, set behind bull's-eye lens or frosted plate glass. In order to take away any offensive glare from the high-candle-power lamps, and to insure a beautiful diffusion, each large lamp installed will be placed behind frosted plate glass, which will be held in place by a hinged copper collar. A large animated electric sign of several thousand lamps will complete the exterior lighting scheme. From time to time, as occasions suggest, the color of the lamps will be changed. The white terra-cotta finish of the building will make it easy to produce a red or green glow over the entire structure, and such spectacular lighting, towering high in the blackness of night, will make a most sublime picture. It is the intention of the light company to keep a lamp lighted in each outside room until midnight, so that the illumination will in no way be marred by dark windows. The elaborateness of the above lighting scheme can be imagined when it is known that approximately 61,000 cp will be required to complete it.

The main features of the building were designed by the Edbrooke Architect Company, according to suggestions from President Doherty and General Manager Frueauff, of the Denver Gas & Electric Company. The lighting arrangements were devised by the latter company, the work being intrusted to its illuminating engineers, Messrs. G. E. Williamson and C. F. Oehlmann.

Letters to the Editor.

The Patent System and Its Relation to Industrial Development.

To the Editor of Electrical World:

Sir:—The prevailing dissatisfaction among inventors and certain classes of manufacturers with the present patent laws, and the unfavorable commercial conditions arising therefrom, have led to many expressions of opinion and suggestions in technical journals and elsewhere. The fundamental causes, however, have usually been lost sight of, and it is the purpose of this letter to touch on some of these; and as presenting the best arguments yet offered in support of the existing patent situation, reference will be made to the paper presented earlier in the year before the American Institute of Electrical Engineers by a distinguished lawyer who has figured as attorney or counsel in some of the celebrated patent cases of the past 20 years.

Among the suggestions made in the discussion of this paper was one to leave changes in patent law to the courts, notwithstanding that the Constitution expressly charges this work on Congress. It also appears to be a mistake to think that "slowness" is a safe means to reach the desired end, in view of the abuses that have developed in the present patent system, and which require the earliest possible correction. Our present patent laws were made sporadically, and as a consequence there is no system or order about them. There is no bureau or commission as in European Governments to keep watch on such of our laws, like those relating to patents, as do not directly enter politics. Patent laws require special means for their intelligent preparation, based on statistics bearing on the prevailing economic conditions. Such statistics should be accessible to Congress at all times, and changes should be proposed to Congress by an institution of this sort of its own creation. It should not take the form of class legislation, such as bills prepared by the American Bar Association, and it should not take 6, 10 or 20 years to obtain a needed change. For many years the circuit courts have handled patent suits, but there has never yet been any pronouncement from this source as to whether our present patent system is detrimental to industrial development, to the manufacturing interests or to the citizens at large.

Following are some examples that point to the desirability of patent reform:

A manufacturer "A" has proved in one Circuit Court that the patent of another firm "B" is invalid, being entirely anticipated by the prior art. The Circuit Court renders its decision in favor of "A." "A" makes shipments of the article involved in the suit to agencies in different parts of the country, and later is informed by "B" that suits in several other circuits are started. If "A" cannot produce the money to defend himself in these other courts, he has to surrender to his opponent and stop the sale of the article, although the law is on his side. For this reason alone, if no other existed, it is wrong to have cases national in their scope passed upon by a court of less than national jurisdiction.

A young man received a grant of a patent, which, after its publication, a large corporation thought to be in its way, although the company had devices almost as good; a patent application was therefore filed in Washington for the same device and with the same claims, which resulted in interference proceedings. The young man stood up for his rights, paid the expenses incidental to such suits, and was gratified by a just verdict from the Patent Office, having established beyond doubt that he was the prior inventor. Did the company buy the patent? No. Did it approach the man with an offer? No; but within two years that company used the device anyhow. Here it is—the law, the Patent Office, is on the side of the inventor, but he is too small to be considered of any consequence by those affected by his patent grant.

In another case an inventor saw his manufacturing processes used by several firms, who paid no attention to his rights or claims, and was unable to stop the practice. When later these patents were acquired by one of the strongest firms in this country, a letter was sent to each of the offenders, and without recourse to any court the wrongful practice immediately stopped.

One ambitious concern has set itself the task of controlling an immense and profitable industry, and has succeeded in doing so, as follows: It hired inventors and mechanics to improve the machines on the market used in this industry and to design additional ones needed for special operations. After a fairly complete line had been produced, it went to the manufacturers of the product involved and showed them how much better and quicker their work could be done with these improved machines. As a further inducement, the manufacturer was not to buy the apparatus at all, but merely pay a royalty for its use; and

to be equitable and really kind to the manufacturer, the concern did not even ask a fixed royalty, but based the compensation on the output of the machines. In this way small concerns or beginners were not frightened by fixed charges. So far everything looks rosy. People could start in this line without paying a cent for their factory full of special machinery, and many availed themselves of the opportunity. Gradually, the independent manufacturers of special machines not covering all operations found themselves crowded out of the market. In due time, the first-named firm, after having gained considerable strength, requested its customers to give them preference when needing any new machine for specific work, as it was willing to furnish all the machinery that was required in the industry. When competition practically ceased, the former requests, however, became demands, and were incorporated in the contracts. Here, then, is an industry of which the independent inventor finds all the doors closed to him. He cannot sell a patent unless the trust wishes to buy it, nor sell a machine after he has built it. Here is an industry controlled indefinitely, first through patents, and later without them. The manufacturer now feels he is powerless against this trust, and realizes that while he is supposed to be a free American, he is in fact a mere industrial serf, and moreover has to pay per year a royalty equal to or twice the price of a machine. He must not complain, however, for if he did the company would withdraw its machinery and he would be without a business. And to what tribunal could he complain if he wished? The courts are not the place to make a complaint of wrong economic conditions; and under present laws neither the royalty system nor the form of contract used contains anything illegal.

In spite of the inflexibility of our patent laws, in spite of the difficulty met with in the introduction of reforms or bills before Congress and years of labor and waiting in the realization of any measure, members of the American Institute of Electrical Engineers are told in the paper above referred to of the great benefit brought about by our present patent system, though inventors as a body and smaller manufacturers bitterly resent the injustice which it works; that the American patent is an exclusive grant for 17 years, when everybody knows who has had any dealings with patents that it is far from being so with respect to the great majority of inventors; and that in the distribution of profits of inventions as between the capitalist, the business man and the inventor, the last mentioned secures "on the average, as large a portion to which he would be entitled under ideal conditions (such as never can be attained) as come to any other workman in our vast industrial army." That the laws are inadequate in many particulars is not pointed out, nor reference made to the conditions arising from enormous commercial industrial development and modern business methods, whereby the rights of individuals and of the financially weak can be overridden in a manner never dreamed of when the laws were enacted.

Trusts and monopolies have come to stay, and we should not be antagonistic to them. This letter is not written with any intention of charging bad faith against the courts, patent attorneys, the Patent Office, Congress nor the large commercial interests. Its purpose is to call attention to basic defects in our patent system, the correction of which must be made to render the superstructure sound. We must look to Congress to improve systematically our patent laws. That body should not give to some few the opportunity of subverting such laws to their own interests. It should create a department representing the people, whose duty it shall be to consider patent laws and their needed changes, to accumulate statistical data, receive complaints, and take account of court decisions, etc., to the end that Congress may obtain an insight into the good or bad effects of a law on commerce or on the people, and to make suggestions and propose bills to enable the swift removal of detrimental laws. The passing of bills presented by any one class of people, such as is represented by the American Bar Association, may be of benefit to the specific class of petitioners, but is not likely to be of benefit to the engineer, to the inventor, to the manufacturer or to commerce in general.

One of the attorneys who participated in the A. I. E. E. discussion almost hit the nail on the head when he ascribed the prevailing discontent as due to patentees or patent owners *who have failed to enforce rights,* because, as a matter of fact, they did not have any rights to enforce. The discontent is, however, not with the man who finds that his patent is of no value, but with the man who finds that it takes all his means to enforce the rights to which he is entitled, against those who would wrongfully profit by an invention of which they recognize the value. In this country the "law" alone does not protect or help to get what is one's due. *You* have to *enforce* your rights, and it takes money, experts, lawyers, etc., to do so in these days. Municipal ordinances would be of no value unless there were a police force behind them; and, similarly, commercial rights are comparatively valueless unless a means is created for patent law supervision and investigation on the order of the Interstate Railway Commission, a bureau where just causes can be filed, and if they are found to involve a principle laid down by the Constitution, or affecting the rights of the people, the Patent Office surplus fund, or some other fund, should be available to cover the cost of investigation and enforcement of the law applying. Millions that could be used in trade expansion are now tied up as reserves for legal expenses in companies, or in factories not properly worked, due to pending suits with no hope of a decision within two, four or more years.

During the A. I. E. E. discussion a past-president of the body made the suggestion that "the board of directors of the A. I. E. E. should appoint a committee to investigate and report upon what reforms in our patent system are desirable, and how they may be best brought about," which suggestion has not, we believe, been acted upon. In this connection the writer may say that almost two years ago he asked the board to take action on the following resolution: *"Whereas,* it has been found that our patent laws are inadequate for present needs; *and whereas* they are the cause, to a considerable extent, of hardship and losses to manufacturers and individuals; *Be it resolved,* that we, the American Institute of Electrical Engineers, herewith express our sympathy with the present movement and with any step taken that will bring this matter before the proper department of our national government and legislative bodies for their consideration and action." After some time, in substance, the following reply was received: "Your letter was referred to the law committee of the Institute, which reported back to the board of directors on Nov. 13, 1908, advising that the general feeling of the law committee was that it was beyond the scope and object of the work of the Institute, as outlined in its constitution. The board of directors accepted the report of the law committee."

In passing, attention may be directed to the anomaly of an apparently dominating legal influence in a body nominally representing a profession and an engineering science, a body which should consider questions brought before it in a manner consonant with professional propriety and with the scientific spirit in which its members are trained. It may also be remarked that the definition of the narrow scope of the Institute is not in accordance with the action of that body several years ago at the Asheville convention, when it appointed a committee on forest preservation, nor with the resolution adopted by the board of directors in January, 1908, which concluded as follows: *"Be it resolved,* that the committee of forest preservation be instructed to communicate the resolution to all members of Congress and to the Governors of all the States"—a resolution, by the way, that was uncalled for and unnecessary as it was passed long after President Roosevelt and public-spirited engineers acting individually had created sentiment which made forest preservation a matter of public policy.

It is doubtful whether any society that claims to be representative of a profession and art and to be national in scope and influence can ignore questions brought to its attention vitally affecting both its members and the art for which it stands, without curtailing its specific usefulness, its reputation and its influence with the public at large.

Concerted action by societies is necessary to bring matters of such professional moment before Congress. Inaction with respect to situations vitally influencing the welfare of those who by their original work further the science and the industry is a

short-sighted policy. Action is required which will lead to the establishment of an office or commission, with necessary authority, accessible at all times to the people, and, as a source of information to Congress. Without supervision of some sort we shall drift more and more toward industrial serfdom, and our present patent system, as shown by examples which can readily be multiplied, is one of the powerful curents in that direction.

St. Louis, Mo. Ludwig Gutmann.

Characteristics of the "Spinner" Motor.

To the Editor of Electrical World:

Sir:—The description given by Mr. Selby Haar in your issue for Sept. 16 of the performance of the "spinner" motor is generally accurate except in that case where the number of poles in the stator is smaller than the number of poles in the spinner winding. Since one would naturally place the larger number of poles on the element of larger diameter, this case is of relatively small importance. However, it may be well to call attention to the actual operation in the case stated.

Imagine, as does Mr. Haar, that the spinner being connected to the mains has run up to nearly the synchronous speed corresponding to the larger number of poles, and assume that it is running counter-clockwise. If voltage is now impressed upon the stator winding, the rotor will be accelerated up to nearly the synchronous speed due to the smaller number of poles and the field will, therefore, have a velocity in space equal approximately to the difference between the synchronous speeds of the stator and the spinner. The rotor will tend to follow this field and will, therefore, rotate counter-clockwise with a speed approximately equal to that of this field. The conditions then prevailing between the spinner and the rotor will be exactly those of an induction motor run with negative slip; that is, when it is acting as a generator. The spinner will return energy to the line, but it is a mistake to say that the machine will be inoperative; on the contrary, the rotor will continue to run at a speed approaching the synchronous speed due to a number of poles equal to the stator poles plus the spinner poles.

It is well known that in the case of an ordinary alternator when the field magnets are driven, the armature, if free to rotate, will tend to follow the field, and this is exactly the action that takes place in the spinner motor. It is difficult to understand what Mr. Haar means by the machine being inoperative; he himself states that the rotor will tend to follow the magnetic field. Since there is nothing to counteract this tendency the rotor will continue following the field, slipping just sufficiently to allow circulating in its windings such a current as will produce a torque equal to that of the load. If, on the other hand, it were possible to make the rotor run rather faster than the magnetic field, the currents generated would be such as to retard the rotor, which must, therefore, immediately drop back to a speed slightly less than that of the field.

It appears from the above that the case when the stator is wound with the smaller number of poles is exactly similar to that when the spinner has the smaller number; in either case when the current is in such a direction as to give the lowest of the three possible rotor speeds, that element having the larger number of poles becomes a generator and returns energy to the circuit, while the other element takes from the circuit a supply of energy sufficient to account not only for the work done, but also the energy returned by the other element and all the losses.

Glasgow, Scotland. W. B. Hird.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Alternating-Current Motors.—G. Kapp.—In his presidential address to the (British) Institution of Electrical Engineers, the author gave a review of various new developments in alternating-current motors. He referred to the induction motor of Hunt, who by a new method of grouping the coils has adapted the cascade principle to one motor only. He is thus able to run an eight-pole motor at the speed of a 12-pole motor while getting a better power factor than is possible with the orthodox way of using two motors in tandem. The system of speed regulation of Aichele and Brown-Boveri for three-phase motors was also referred to. This motor has been applied in the latest Simplon locomotives. The rotor is simply a squirrel-cage, and has no slip-rings and no outside electrical connections whatever. The bars are ventilated copper tubes, and the end connections are designed to withstand a temperature of from 200 deg. C. to 250 deg. C., when an exceptionally large starting current is developed. The stator has two distinct windings, one for 16 poles and the other for 12 poles, and each winding can, by means of a pole changer, be so grouped as to produce half its normal number of poles. (A detailed description by J. Collignon of this motor and of the Simplon locomotives is given in *La Houille Blanche,* November.) An improvement in single-phase motors has been devised by Deri, and practically developed by the Brown-Boveri Company. Two sets of brushes are employed, one being fixed in the polar axis of the stator and the other so adjustable as to include different angles with the fixed brushes. The effect of shifting the brushes is analogous to changing the impressed voltage on an ordinary direct-current series motor, and thus, by adjusting the brushes, the torque and speed may be regulated. This property renders the Deri motor valuable in all cases where delicate speed regulation is essential. It is largely used for working passenger elevators and other hoisting machinery, and also for driving ring spinning frames, the speed regulation in the latter case being automatic. Another application is for electric railway working. The Winter-Eichberg motor as first developed for railway work had a series characteristic; recently Eichberg has altered the winding so as to give the motor a shunt characteristic, so that it runs at constant speed whatever the load is within its range. The motor is started as a series machine, and

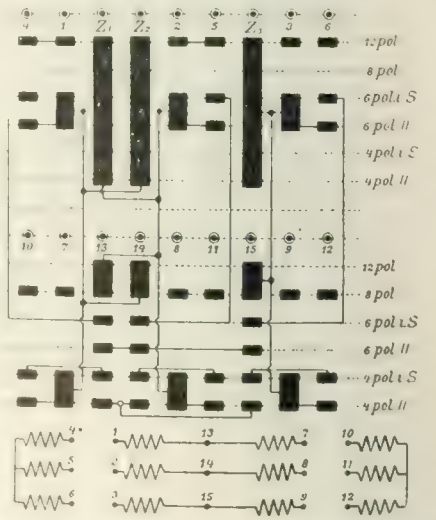


DIAGRAM OF CONNECTIONS.

when up to speed, or nearly so, it is switched over by its controller to the shunt condition. The power factor is very nearly unity at all loads.—Lond. *Electrician,* Nov. 19.

Speed Regulation of Induction Motors.—An illustrated description of various methods of the Oerlikon Company for regulating the speed of induction motors by varying the num-

ber of poles. For two speeds use is made of one drum winding by means of which two numbers of poles in the ratio of one-to-two can be obtained. For four speeds there are two such drum windings in the stator, which can be connected as shown in Fig. 1. The diagram shows all possible connections. If the motor is to be used for constant torque, the first, second, fourth and sixth connections (counted from top to bottom) are used. If the motor is to be used for constant power, the first, second, third and fifth connections are employed. Six speeds can be obtained by means of two drum windings, each of which permits the production of three numbers of poles.—*Schweitz. Bauzeit.*, Vol. 54, 1909, page 170; abstracted in *Elek. Zeit.*, Nov. 18.

Stator Winding.—J. Büchi.—The author points out that the use of high speeds for alternators when driven by steam turbines has caused a considerable change in the design of stator windings. Some numerical figures are given.—*Elek. und Masch.* (Vienna), Nov. 14.

Testing Machinery.—E. F. Collins.—In a continuation of his illustrated article on commercial electric testing, he deals especially with core-loss tests. Field compounding tests and maximum output tests are also referred to.—*Gen. Elec. Review*, December.

Voltage Variation.—E. Place.—An illustrated description of a graphical method for predetermining the voltage variation in direct-current machines. Both shunt generators and compound generators are discussed.—*Gen. Elec. Review*, December.

Lamps and Lighting.

Metallic-Filament Lamps for 220 Volts.—Einberger.—An account of tests of 220-volt metallic-filament lamps. In spite of the difficulties involved in their manufacture, the results are quite satisfactory. In life tests of 50 lamps, furnished by 10 companies, tested on a circuit the e.m.f. of which varied between 216 volts and 225 volts, nine lamps were still burning after 3100 hours. These nine lamps were made by three different companies. Almost all of the lamps of two of these companies had a life of more than 2000 hours. Only two types of lamps had a life of less than 500 hours. The specific power consumption varied between 0.97 watt and 1.47 watts per hefner candle. Blackening in the globe was observed with several types of lamps. The 220-volt lamps are more sensitive with respect to vibrations than are the 110-volt lamps.—*Zeit. d. Ver. Deutsch. Ing.*, Vol. 53, 1909, page 1587; abstracted in *Elek. Zeit.*, Nov. 18.

Metallic Filaments.—A note on a recent British patent of W. Heinrich (7092, 1909; Nov. 11, 1909). A binding agent for forming filaments without carbon, comprises five parts of pure sulphur and six parts of dry amorphous phosphorus. The mixture is heated, and at 2000 deg. C. a dark liquid is obtained. Three parts of this liquid are mixed with 15 parts of tungsten or other metal powder, and the product is squirted into filaments. The greater part of the binding agent is removed by heating the filaments in a vacuum at 450 deg. C., but there is formed a metal phosphide or sulphide which holds the filament together until it is sintered. This last process is carried out in a vacuum, at 1000 deg. C., or more, and the sulphide and phosphide are reduced, leaving pure metal.—Lond. *Elec. Eng'ing*, Nov. 18.

Generation, Transmission and Distribution.

Electric Cranes.—H. H. Broughton.—A continuation of his long illustrated serial. The author begins to discuss several of the problems entering into the design of the slewing mechanism. The method of determining the size of the motor, when the several resistances are allowed for, is described; and the design of the roller bearings is considered at some length. Typical examples by leading British and German firms are given of slewing mechanisms, roller and footstep bearings, pressure rings, pillar bearings and turntables.—Lond. *Electrician*, Nov. 19.

Steam Turbines.—A. Ceytre.—In a continuation of his illustrated article on steam turbines the author deals with the De Laval turbine.—*L'Industrie Elec.*, Nov. 10.

Electricity in Harbor.—O. Heinisch.—An illustrated article on electricity supply in the Ruhrort harbor and its electric equipment. The article, which is profusely illustrated, is to be concluded.—*Elek. Zeit.*, Nov. 18.

Traction.

Single-Phase Traction on Midland Railway.—J. Dalziel and J. Sayers.—The first of three papers on electric traction presented at a recent meeting of the (British) Institution of Civil Engineers. This paper deals with single-phase traction on the Heysham-Morecambe-Lancaster section of the Midland Railway. The paper sets out the disabilities under which it has been variously alleged single-phase apparatus labors—particularly in respect to its asserted unsuitablity for high-schedule speed, frequent-stop, suburban and interurban traffic, necessitating high accelerations, and attempts to prove from the results of special tests, made with a view to ascertaining the accelerating capabilities of the Heysham equipments, that single-phase apparatus is not only equally as capable of working such services as is direct-current apparatus, but that the weight of the single-phase trains is only a very small percentage greater than that of corresponding direct-current trains, and that the energy consumption is appreciably less.—Lond. *Electrician*, Nov. 19; Lond. *Elec. Eng'ing*, Nov. 18.

Electric Versus Steam Traction.—J. Shaw.—This is the second paper of the three electric traction papers at the recent meeting of the (British) Institution of Civil Engineers. The author gives a comparison of the equipment and working results of the Mersey Railway when worked by steam and by electricity. In order to make a comparison between the working results of the railway when operated by steam and electricity, three years' working results under both systems have been analyzed, and for each system an average year of steam and electricity has been arrived at. The working results are compared on the basis of total cost per year, cost per train-mile, per ton-mile and per seat-mile. The costs have been divided under various headings, which make up the total cost of the locomotive and engineering departments. The departments of a railway which are most directly affected by the substitution of electricity for steam are the locomotive and car departments, and the tabulated results show that under electric working these costs have been reduced from 0.234 cent to 0.198 cent per ton-mile. With electric traction, 1 lb. of fuel costing $2.18 per ton moves 1 ton of load 2.29 miles at an average speed of 22.25 miles per hour; whereas, with steam the same weight of fuel, costing $4 per ton, moved the same load 2.21 miles at an average speed of 17.75 miles per hour. The effect of electric traction on the maintenance of the permanent way has been to reduce the cost of maintenance per ton-mile from 0.0416 cent to 0.024 cent. As regards the life of rails under the two systems, the average rolling-load over the track before the rails require renewal is increased from 32,000,000 tons to 47,500,000 tons. The effect of electric working has been to decrease the cost per ton-mile as follows: (1) Total cost of working and maintaining the whole of the locomotive and engineering departments from 0.476 cent to 0.0250 cent, a decrease of 0.172 cent. (2) Total costs of the railway, including general charges, etc. (but exclusive of interest on additional capital for electrification) from 0.688 cent to 0.48 cent, a decrease of 0.208 cent. Summarized comparative results of the change upon the working and finances of the railway are given in three tables, which show among other things that the average speed, including stops, has been increased from 15.6 miles to 19.9 miles per hour, and the number of ton-miles per annum from 43,000,000 to 67,000,000, while the total expenses per ton-mile, after allowing interest on additional capital for electric works, have been reduced from 0.688 cent to 0.5856 cent. In the half year ending June 30, 1908, the number of passengers carried was more than twice as large as in the last half with steam working (ending Dec. 31, 1902) and more than 2.5 times as many season tickets were issued; the seat-miles run per passenger showed a decrease of 30 per cent; and the passenger receipts per seat-mile an increase of 26.5 per cent; while the ratio of expenses to receipts

decreased from 95.3 per cent to 69.8 per cent.—Lond. *Electrician,* Nov. 19; Lond. *Elec. Eng'ing,* Nov. 18.

Electric Traction on Northeastern Railway.—C. A. Harrison.—This is the third paper presented at the recent meeting of the (British) Institution of Civil Engineers. It deals with the results obtained on the electric section of the Northeastern Railway. The total length of the electrified line, including sidings, is 75 miles, and the average distance between the station stops is 1.25 miles. The current, at a pressure of 600 volts, is taken directly from the conductor rail by shoes fixed on the electric cars, the return current passing through the track rails which are bonded similarly to the conductor rail. Although the pressure is 600 volts, there has not been a fatal accident due to electric shock to any of the company's employees, and serious injury due to shock has been very exceptional, the men being provided with insulated tools, rubber gloves, and mats for their protection. Fatal accidents through shock which have occurred on the electrified lines have, in all cases, been due to trespass. The advantages obtained are increased work that can be done at the platforms of the stations, the high acceleration made possible with electric trains and the resulting saving of time, without increasing the maximum speed. The paper gives an estimate of the annual cost of renewals, and concludes by showing that it would have been impossible with the old steam service to carry the number of passengers that are now being conveyed on the Tynemouth lines with the electric service.—Lond. *Electrician,* Nov. 19, and Lond. *Elec. Eng'ing,* Nov. 18.

Electric Traction on Main Line.—Eichberg.—A note on a recent lecture in which the speaker first drew attention to the rapid way in which electrically worked tramways had been developed, compared with the comparatively slow progress made in the same direction on railways. He considered that the reason for this was that commercial advantages in railway work from the employment of electricity were only to be expected when the traffic was heavy, the gradients steep or the use of water-power possible. Another advantage obtained by the employment of electricity was the absence of smoke—a matter which had received great attention in the United States. Dealing historically with the question of electric traction on main lines, the lecturer first referred to the experiments made on the Baltimore & Ohio line in 1894, and to the use which was being made, both in New York and Paris, of electric locomotives for terminal operation. The various features of direct-current, third-rail operation, and of the three-phase and single-phase systems were also described, the great advantages of the last of these as regards simplicity being mentioned.—Lond. *Electrician,* Nov. 19.

Surface-Contact System.—An abstract of last year's financial account of the municipal traction system of Wolverhampton in England. This is specially interesting as the Lorain surface-contact system is in operation and has proved very satisfactory, although the use of this system means an isolation from surrounding tramway systems. The length of single track on which the Lorain system is in use is 20 miles, and the car mileage for the year ended March 31 last was 962,681. Since the number of passengers carried was 9,050,459, the average number of passengers per car-mile was about 9.4. The items of most interest are those of kw-hours used per car-mile and repairs and maintenance. As regards the former item, the total number of kw-hours used for traction and car lighting was 1,502,068, or 1.56 kw-hours per car-mile, which is not an excessive consumption, and is also less than the figure of 1.60 kw-hours per car-mile recorded last year. The working expenses amounted to 12.748 cents per car-mile, as against 13.018 cents per car-mile a year ago, and a reduction has been made in the cost of maintenance and repairs which now totals only 2.366 cents per car-mile. The Lorain track and car equipment (which is included in the last figure) has cost 0.486 cent per car-mile, a considerable reduction on last year's figure. The operating expenses per car-mile were 8.606 cents, the total general expenses were 1.776, repairs and maintenance 2.366, hence the total working expenses 12.748 cents. There were also in operation three motor-omnibuses which were run at a slight loss.—Lond. *Electrician,* Nov. 19.

Brake-Block Coefficients of Friction.—E. Wilson.—As the result of some tests to determine the coefficient of friction of brake blocks under different conditions, the author has found that the effect of water on the blocks is to reduce the coefficient in the case of non-metallic blocks to a dangerous degree. Cast-iron blocks showed little variation. Tests were made at different speeds and with various specific loads.—Lond. *Elec. Eng'ing,* Nov. 17.

Berlin.—E. C. Zehme.—A critical review of the existing and projected electric rapid-transit lines of Greater Berlin.—*Elek. Zeit.,* Nov. 18.

Installations, Systems and Appliances.

Electrical Industry in Great Britain.—G. Kapp.—His presidential address to the (British) Institution of Electrical Engineers. The author reviews the present position of electrical engineering, indicating the more important developments and general tendencies. Generators, transformers and motors are first considered, after which the applications of electricity to industrial developments are reviewed, namely, distribution of energy, electric railways, winding engines, rolling mills, electric steel furnaces, fixation of atmospheric nitrogen and electricity in agriculture. In conclusion, a few remarks are made in regard to the lack of prosperity in the electrical industry, and to the possibility of the Institution doing something to accelerate the introduction of electricity into the great industries. A great many detailed advances are reviewed and some figures are given on the capital invested in electrical industries in Great Britain. The figures for 1899 and the middle of 1909 are as follows: Telegraphs, $171,424,785 in 1899 and $181,415,190 in 1909; telephones, $38,648,130 and $110,663,205 respectively; electricity supply companies, $46,328,965 and $228,718,720; municipal supply stations, $41,755,835 and $258,983,020; electric traction, $104,044,795 and $925,961,480; electric manufacturing, $83,995,760 and $212,431,345; electrochemistry and miscellaneous, $42,790,325 and $61,268,110; total, $529,888,595 and $1,929,441,070 respectively.—Lond. *Electrician,* Nov. 19.

Statistics of German Central Stations.—G. Dettmar.—An article giving some further deductions from the recently published statistical tables of the central stations in Germany on

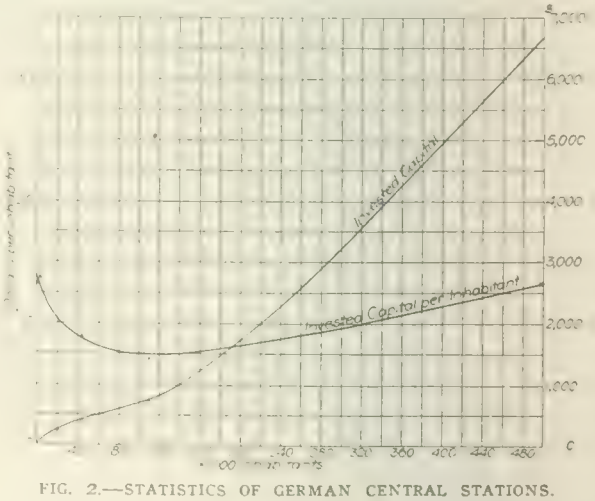


FIG. 2.—STATISTICS OF GERMAN CENTRAL STATIONS.

April 1, 1909. The author has estimated the corrections which must be applied to the figures to take into account those central stations from which no exact figures were obtained in reply to the inquiry. The corrected figures of some main items for Germany are given as follows:

Number of incandescent lamps	14,000,000
[illegible] lamps, kw	700,000
[illegible] and heating apparatus, kw	50,000
Total connections, kw	1,950,000
Central station equipment, kw	1,200,000
Number of meters	675,000
Kw-hours sold	1,250,000,000
Capital invested	$287,500,000

Some interesting data concerning the capital invested are shown

in Fig. 2 and Fig. 3. The former gives the total capital invested and the capital invested per inhabitant as functions of the size of the city in thousands of inhabitants. The second diagram gives the same figures for capital invested as functions of the ratings of machines in thousands of kilowatts. During

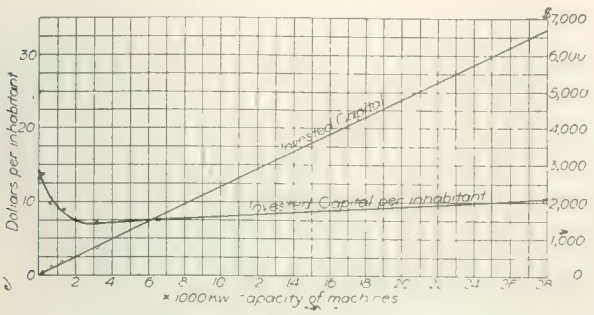


FIG. 3.—STATISTICS OF GERMAN CENTRAL STATIONS.

the last three years the erection of new central stations in Germany has been exceedingly rapid in cities having less than 1000 inhabitants. Approximately one-half of all central stations are in cities between 1000 and 5000 inhabitants. Some figures of maximum load and load-factor as functions of the size of the city are given in the following table:

Number of inhabitants in the city.	Kw-hours ÷ maximum kw.	Load-factor in per cent.	Kw-hour ÷ connections in-kw.	Maximum load ÷ connections.
up to 1,000	808	19.1	288	0.36
1,001 up to 5,000	1,010	11.5	350	0.35
5,001 up to 10,000	1,265	14.4	448	0.36
10,001 up to 20,000	1,450	16.6	475	0.33
20,001 up to 50,000	1,440	16.5	430	0.30
50,001 up to 100,000	1,716	19.6	620	0.36
above 100,000	1,984	22.7	730	0.37

The first column gives the size of the city expressed in the number of inhabitants. The second column gives the total number of kw-hours sold divided by the maximum load in kilowatts. From this figure the load factor given in the third column is found. In the fourth column is given the ratio of the total kw-hours to the connections in kilowatts. The last column gives the ratio of the maximum load to the rating of the connections. The number of central stations owned by municipalities, or by the State, is 632, while the number of central stations owned by private companies is 1328.—*Elek. Zeit.,* Nov. 18.

Regulations in Austria.—The safety regulations of the Vienna Electrical Society, which had already been adopted by the Association of the Austrian and Hungarian central stations, have now also been recommended by the Government for general application.—*Elek. und Masch.* (Vienna), Nov. 14.

Protection Against Lightning Discharges.—R. SÜRING.—A report of the committee of the Berlin Electrical Society on the protection of electric installations against atmospheric discharges.—*Elek. Zeit.,* Nov. 18.

Electrophysics and Magnetism.

Striæ in a Dust Tube.—L. J. RICHMOND.—Under suitable conditions lycopodium powder placed in a glass tube arranges itself in well marked striæ under the influence of an electric discharge. The object of the author's experiments was to ascertain whether the frequency of the electrical oscillations could be ascertained from observation of the striation of the powder under their influence. From the results it appears, however, that the distance between the striations depends very little upon electrical conditions. The matter seems quite complicated.—*Phil. Magazine,* November.

Direct Current from Alternating E.M.FS.—J. VON GEITLER.—A paper in which the author gives the general theory of the production of direct current from purely periodic alternating e.m.fs. when acting in a circuit the resistance of which changes periodically. The theory is believed to contain, as special cases, the rectification of alternating current by means of "valves," and also the production of direct current in commutating generators, etc.—*Phys. Zeit.,* Nov. 10.

Fluorescence and Ionization of Mercury Vapor.—W. STEUBING.—An account of experiments which show that mercury vapor when illuminated with ultraviolet light and fluorescent is ionized. The author concludes that in addition to the negative electrons positive atoms are present.—*Phys. Zeit.,* Nov. 10.

Radium.—J. ELSTER.—The first part of a review of our present knowledge of radium and radioactivity.—*Elek. Zeit.,* Nov. 18.

Units, Measurements and Instruments.

Weston Standard Cell.—C. CHREE.—An abstract of a (British) Physical Society paper on cadmium amalgams and the Weston standard cell. Cadmium amalgams may be solid, liquid, or a mixture of solid and liquid phases, the percentage composition of the phases depending on the temperature. When a completely liquid amalgam is cooled below the lower transition temperature, the center of the resulting solid is of high cadmium concentration, and the outer skin of low cadmium concentration. Diffusion tends to produce uniformity and in consequence the e.m.f. of a cell containing the amalgam is unstable for a considerable length of time. When the amalgam is slowly cooled to a temperature a little below the lower transition temperature the difference of concentration between the inner and outer parts of the amalgam need be only small to enable the outer skin to be a two-phase system. The diffusion process will be slow and the e.m.f. may remain constant for a very long time. Amalgams which were of uniform cadmium concentration throughout were obtained by chilling completely liquid amalgams to a temperature of about —50 deg. C.; although not initially stable, rapid diffusion processes resulted in these amalgams becoming approximately uniform throughout after a few days, and their electromotive properties were markedly different from those of amalgams cooled slowly. If, however, the temperature of such an amalgam is raised until two phases exist, subsequent cooling will not restore the uniform condition, and an unstable amalgam results. The experiments indicate that a 12.5 per cent amalgam may be safely used at all temperatures between 12 deg. C and 60 deg. C., and a 10 per cent amalgam at all temperatures between 0 deg. C. and 51 deg. C. Experiments made on the temperature-voltage coefficients of the anode and cathode limbs of the Weston normal cell show that if a difference of temperature of 1 deg. C. exists an error of about 3 parts in 10,000 is introduced.—Lond. *Electrician,* Nov. 12.

Pressure and Resistivity.—M. A. LAFAY.—A paper read before the French Academy of Science on the measurement of high pressures (mechanical pressures) by the variation of resistivity produced. The author's results of the effect of high pressures on the resistivity of platinum and of mercury have recently been noted in the Digest. Platinum would involve considerable difficulties in practical use on account of the temperature coefficient of resistivity. Mercury can be used with sufficient accuracy, but it would be simpler to use a metallic wire for the construction of a piezometric instrument. Like platinum, almost all metals have a temperature-resistance coefficient sufficiently large to act as a disturbing factor. The best metal to be used is the alloy manganin, which has a zero temperature coefficient of resistivity and which is an alloy of copper, nickel and manganese (Cu 84, Ni 1, Mn 12). The relation between the electric resistivity and the pressure is given in the equation.

$$\frac{r - r_0}{r_0} = 2.23 \times 10^{-6} P,$$

where the pressure P is given in atmospheres.—*L'Industrie Elec.,* Nov. 10.

Selenium Cell.—A. KORN.—A mathematical discussion of the principles of his compensation method (used in his process for transmitting pictures) to reduce the inertia of selenium cells.—*Phys. Zeit.,* Nov. 10.

Wehnelt Interrupter.—P. BARY.—An article on the explanation of the action of the Wehnelt interrupter by the "pinch effect," with reference to a recent article of Ludewig.—*La Lumière Elec.,* Nov. 13.

Measurement of High Inductions.—E. GUMLICH.—The conclusion of his paper describing a modification of Ewing's

isthmus method for testing solid steel and dynamo sheets to determine induction curves from $H = 130$ to beyond the limit of saturation conveniently and with sufficient accuracy. The results are given for a large number of quite different kinds of iron and steel.—*Elek. Zeit.*, Nov. 18.

Meters.—An official communication of the Reichsanstalt by which two types of meters of the German Ferranti Meter Company are admitted for calibration. One is a mercury motor meter for direct current and the other is an induction meter for single-phase and three-phase currents.—*Elek. Zeit.*, Nov. 18.

Meters.—E. P. Austin.—An illustrated article on the principles of mercury motor meters and electrolytic meters.—Lond. *Elec. Review*, Nov. 19.

Telegraphy, Telephony and Signals.

Telephone Trials.—C. Egner and I. G. Holmström.—An account of tests made with the new high-current microphone of the authors which has already been noticed in the Digest. A description of the microphone is not given, but from the results of tests described it appears that the Egner-Holmström microphone enables telephone communication to be maintained on wires with a damping coefficient up to 8.0, the frequency being 800. Commercial telephony has been proved to be possible on a wire with a total damping coefficient of from 6 to 7. The trials showed also that the limit for commercial telephony with the telegraph office's microphone (and generally with all microphones of the type now in use) was reached when the total damping coefficient amounted to 3 or 4. Taking these damping coefficients the distance can be calculated to which commercial telephony will be possible on wires of different kinds, either when using the ordinary microphone or when using the Egner-Holmström microphone:

Type of wire	Ordinary telephone	Damping coefficient	Egner-Holmström telephone
	3	6	7
Copper 3.0 mm.	1,000 km.	2,000 km.	2,500 km.
Copper 4.5 mm.	1,900 km.	3,800 km.	4,400 km.
Iron 3.0 mm.	200 km.	400 km.	500 km.
4.0 mm.	300 km.	600 km.	700 km.

When increasing the distance it must be observed that the strength of the talking current should be increased in greater proportion than the damping coefficient. Supposing, for instance, the strength of the current necessary for a wire with a damping coefficient of 4 to be *a*, the strength of a current for a wire with a damping coefficient of 7 will have to be about 20 *a*, if the sound received is to be of the same strength. Some results are also given of long-distance telephony between Sweden and Germany.—Lond. *Electrician*, Nov. 19.

Miscellaneous.

Solving Equations.—A. Russell and J. N. Alty.—A description of a new electromagnetic method of studying the theory of and solving algebraical equations of any degree. While a former electrical device of A. Wright enables one to find approximate values of the real roots of an equation at once by simple mechanical and electrical operations, the new method gives approximate values of all the imaginary roots as well as all the real roots. It is, however, not as accurate as the other method.—*Phil. Magazine*, November.

Electric Ignition.—J. W. Warr.—A paper read before the Manchester Section of the (British) Institution of Electrical Engineers, giving a description of the most usual forms of high-tension and low-tension electric ignition systems, both with battery and coils, and with magnetos, chiefly with respect to the arrangements employed on automobile engines.—Lond. *Elec. Eng'ing*, Nov. 11.

Vulcanized Fiber.—L. S. Roussau.—The conclusion of his article on the properties of vulcanized fiber. The author discusses the mechanical properties and insulating resistance and the commercial and industrial applications of vulcanized fiber. —*L'Industrie Elec.*, Nov. 10.

Exposition of Nancy.—J. Reyval.—A continuation of descriptions of various exhibits at the international exhibition in Nancy, including piston valves for steam engines of Dujurdan & Company, the Beck arc lamp, and meters for a variable tariff.—*La Lumière Elec.*, Nov. 6.

Kapp.—A biographical sketch with a portrait of Dr. Gisbert Kapp, the new president of the (Brit.) Institution of Electrical Engineers.—Lond. *Elec. Review*, Nov. 12.

NEW APPARATUS AND APPLIANCES

The Storage Battery Installation of the Otsego & Herkimer Railroad Company.

The Otsego & Herkimer Railroad Company operates the electric railway system formerly controlled by the Oneonta & Mohawk Valley Railroad Company, consisting of a main line extending from Oneonta to Mohawk, N. Y., a distance of about 55 miles, with a three-mile spur from Index to Cooperstown and about three miles of track for local service in Oneonta. The electricity is developed at two different power houses, one a steam plant located at Hartwick, N. Y., about 18 miles north of Oneonta on the line of the road, while the other is a water-power station located on the Susquehanna River at Colliers, N. Y., about 15¼ miles from the steam station. Energy from the water-power plant is transmitted at 13,000 volts, three-phase, 25 cycles, to the alternating-curent bus in the steam station and from there over a 1300-volt, three-phase transmission line to the other substation. There are four other substations, one at West Oneonta, about 11 miles south of the power house, one at the power house, one at Schuyler Lake, about 17 miles north of the power house, and one at Henderson, 30 miles north of the power house. The substations are equipped with 300-kw. 600-volt converters, one of these being located at West Oneonta, two at the power house, one at Schuyler Lake and two at Henderson.

In the steam station at Hartwick are installed two three-phase alternators, direct-connected to horizontal, cross-compound steam engines. The generators are rated at 500 kw each. One develops current at 13,000 volts, while the other generates 370 volts, the latter being suitable for direct connection to the alternating-current terminals of the power-house converter. The high-tension and low-tension busbars in the station are interconnected by a set of static transformers permitting electricity to be transmitted between the two buses in either direction, according to the demand, when both generators are in operation; or permitting either generator alone to feed both sets of busbars. Two steam-driven exciters are installed for exciting the generator fields, each having a capacity of 30 kw at 110 volts.

The water-power plant, which was built after the road had been in operation for some years, includes two 1000-kw, 2300-volt, 25-cycle, three-phase alternators, each direct-connected to a hydraulic turbine receiving water under a 33-ft. head. The tension is stepped up to 13,000 volts and electricity is transmitted at that voltage to the steam station. This water-power plant carries the entire load whenever there is sufficient water, while at times of low water supply it operates in parallel with the steam plant.

The battery and auxiliary apparatus are installed at the steam-power house, and were designed to operate in connection with the two steam-driven units. Later, when it was decided to build the water-power plant, the regulating apparatus was modified so as to permit the battery to regulate the load on either of the steam units or on the feeder from the Colliers plant or on any combination of these operating in parallel. The

battery, which was furnished and installed by the Electric Storage Battery Company, consists of 300 cells of "Chloride Accumulator" type G-23, having a capacity of 880 amp for one



FIG. 1.—STORAGE-BATTERY INSTALLATION OF THE OSTEGO & HERKIMER RAILROAD COMPANY.

hour. This battery is illustrated in Fig. 1. For controlling the charge and discharge of the battery a motor-driven booster was installed together with a motor-driven exciter controlled by the Electric Storage Battery Company's carbon regular. This regulator is operated by an alternating-current solenoid connected to the generator circuits in such a way as to respond to small variations of combined load on all of the units which are in operation at any time. The battery with its booster in series is connected directly across the 600-volt, direct-current bus in parallel with the rotary converters which feed the railway circuit at that point. As stated above, however, the operation of the battery is so controlled as to regulate the total load on the system and fluctuations of this total load above or below the average, whether originating at the power-house substation or at one or more of the others, are handled by the battery, which charges from or discharges into the direct-current busbars at the power-house substation to effect this result. Thus, if

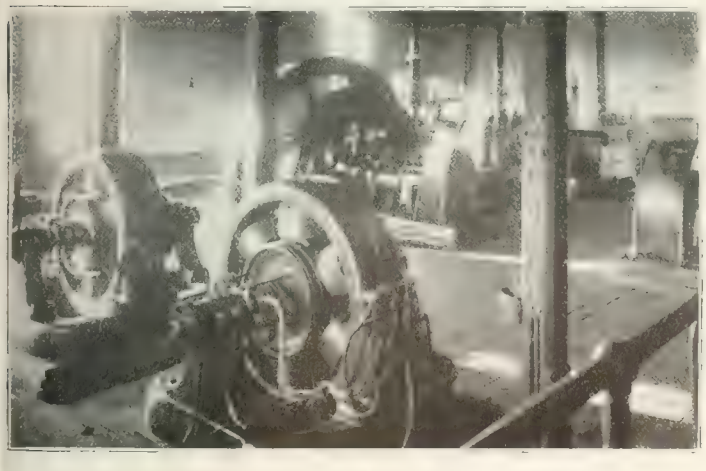


FIG. 2.—INTERIOR VIEW OF STEAM STATION AT HARTWICK.

a heavy increase of load should occur at one of the remote substations, the battery will relieve the direct-current load at the substation where it is located to a sufficient extent to compensate for the increase elsewhere and hold the total load on the system constant. If the increase in load is sufficient, the battery may take the entire direct-current load of the converters

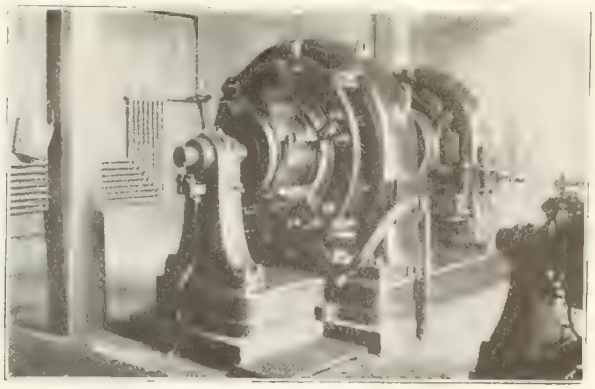


FIG. 3.—MOTOR-DRIVEN BOOSTER SET.

at the power house and upon further increase discharge back through these into the alternating-current circuits.

Fig. 2 is an interior view of the steam-power station showing

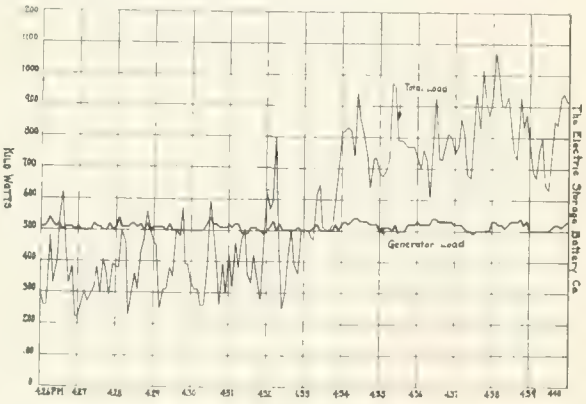


FIG. 4.—LOAD DIAGRAM.

the two steam-driven units, with the two rotary converters in the foreground. Fig. 3 is the motor-driven booster, while Fig. 5 shows the switchboard. Fig. 4 is a load diagram showing the

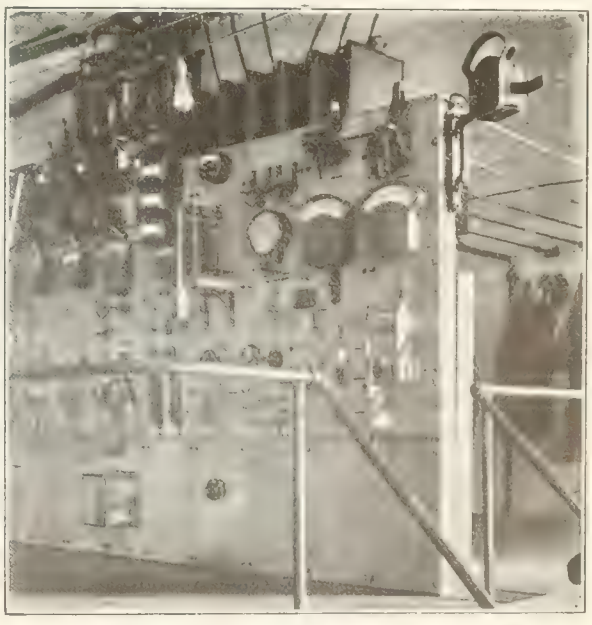


FIG. 5.—SWITCHBOARD SHOWING BATTERY CONTROL PANELS.

results obtained by the battery operation. The heavy line represents the total generator load, while the light line is the total combined load of all the substations, the difference be-

tween these two lines representing the battery charge or discharge. This diagram was taken with one of the steam-driven units in operation. Fig. 6 is a portion of the record of a curve-drawing wattmeter at the water-power plant showing the output of this plant from 4 p. m. to 6 p. m. on June 9, 1909. At this time the steam units were shut down and the water-power plant, in conjunction with the battery, was carrying the entire

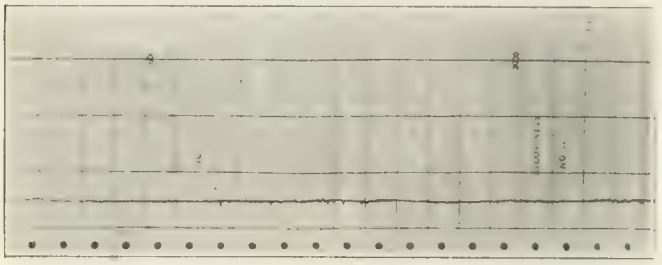


FIG. 6.—RECORD OF RECORDING WATTMETER.

load. When it is remembered that this record shows the output of a generator supplying energy to meet the rapidly varying load of an electric road operating a number of heavy interurban cars, it will be seen how the battery and its regulating apparatus relieve the generating machinery of the severe fluctuations.

Vacuum-Tube Light in Silk Mills.

Dyers, color matchers and textile workers have always been handicapped by the fact that their standard of color value—daylight—varies, and, of course, is only available part of the day. The introduction of the Moore white vacuum-tube light in the dye shop and kindred establishments has worked a marked change in these industries.

For example, silk dyers whose busy season is in winter, very frequently had to shut down part of their plant early in the afternoon on dark days, as matching was no longer possible. This naturally caused considerable loss and annoyance. With the Moore white vacuum-tube light matching is possible at all times, and now dye shops equipped with matching rooms are enabled by means of this light to work on regular schedule, and many have started running nights.

Below is illustrated one of the matching-rooms of the Weidman Silk Dyeing Company, of Paterson, N. J., equipped with two 66-ft. Moore tubes. In this installation the tubes are alternately connected to the two sides of a two-phase, 60-cycle, 220-



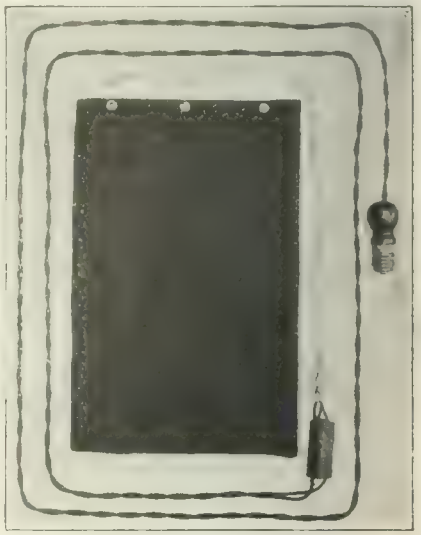
VACUUM TUBE LIGHT IN SILK MILL

volt, alternating-current circuit. Connected in this manner, the stroboscopic effect apparent in alternating-current lamps becomes negligible.

Woolen and worsted mills also use this light at their perches for examining cloths, an operation which heretofore could only be done under clear daylight. Color experts of paint factories, coated-paper mills and color works have also found the Moore white light invaluable to match and standardize colors with. The Moore Electrical Company, of Newark, N. J., manufacturer of the Moore light, has also made a "Daylight Window" for color matching, which is semi-portable and suitable for small plants.

The Electropad.

A new electric-heating pad is being put on the market by the C. A. Shaler Company, of Waupun, Wis. These pads are provided with automatic thermostats which cut off the current when the temperature of the pad reaches 180 deg., so as to



ELECTROPAD

prevent overheating. In their construction wires are wound around an asbestos cord embedded in three layers of asbestos. A three-way switch is provided so as to give three different heats, the switch being cylindrical in shape, as shown in the accompanying engraving. To change the connections from one heat to another one-half of the switch is rotated on the other half without separating the two parts. Knobs projecting from the sides of the switch make it easy to tell on which point the switch is placed in the dark. This is a practical advantage appreciated by those who have used electric-heating pads heretofore and have wished to change connections at night without turning on the light. These pads are made either with silk or rubber covers, either of which can be easily removed.

Electro-Magnetic Alternating-Current Rectifier.

The alternating-current rectifier illustrated herewith depends for its operation on the fact that if the two secondaries of a transformer are alternatively put into circuit at each half period the current in the secondary circuit will be unidirectional. An apparatus built on these lines ought to be particularly efficient, as there will be practically no loss except the ordinary small loss of the well-built transformer, and practice is said to bear out this anticipation, as tests made with this rectifier show a loss of only from 5 to 6 per cent including the energy consumption of the field-magnet coils used to effect the switching in and out of the two secondaries mentioned.

The apparatus consists of two parts, a transformer wound with two secondaries and an auto-transformer with a middle point which acts as a phase divider, and secondly, the rectifier. This latter consists of a polarized armature which is pivoted and free to oscillate. Facing either end of this are two coils $A A^1$, as shown in Fig. 2, fed from one of the secondaries. It will be noticed that these are wound so that the poles facing either end of the armature are similar. The armature carries a contact piece E, which, as the armature oscillates, makes con-

tact alternately at HH^1. Two springs KK^1 bearing on two regulating screws JJ^1 are provided for tuning up the apparatus. It will be noticed that when the coil on the armature is polarized by one of the cells and the two coils AA^1 are fed by alternating current, that the armature will be alternately attracted and repelled. The make-and-break taking place at zero current all sparking is avoided.

The before-described type of apparatus is the one used in all cases where storage batteries are to be charged. In any case where it is required to use a rectifier for running motors, plating, lighting and in all cases where no storage batteries are in

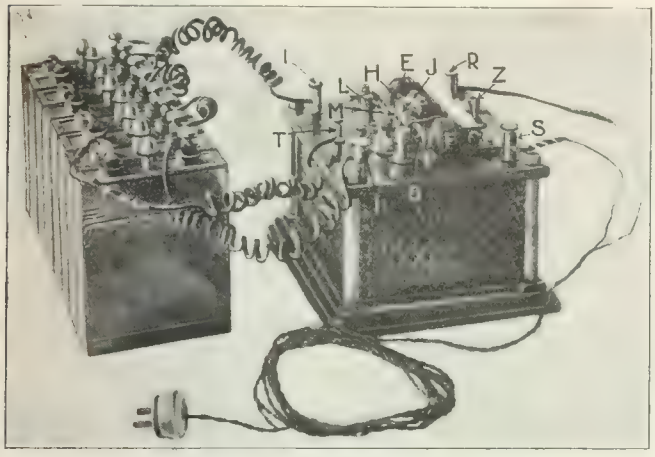


FIG. 1.—ALTERNATING-CURRENT RECTIFIER.

use, the apparatus is built with a permanent magnetic field and the field produced by the alternating current tends to increase or neutralize this magnetic field alternately at each pole, the effect being a synchronous oscillation of the armature. The consumption of the two coils fed with alternating current is about 5 watts and that of the polarized coil is 0.3 amp, supplied by the first cell of the storage battery to be charged, which makes in all a consumption of 5.6 watts, which is practically insignificant. These consumption figures are the same for all rectifiers up to the 500-watt apparatus. It will be noticed that in the case of the 500-watt equipment the loss is about 1 per cent. In larger sizes the loss is proportionally larger.

It is said that all of the rectifiers will start at any load without any sort of auxiliary resistance or anything else. The efficiency of the rectifier is said to be 90 per cent and above.

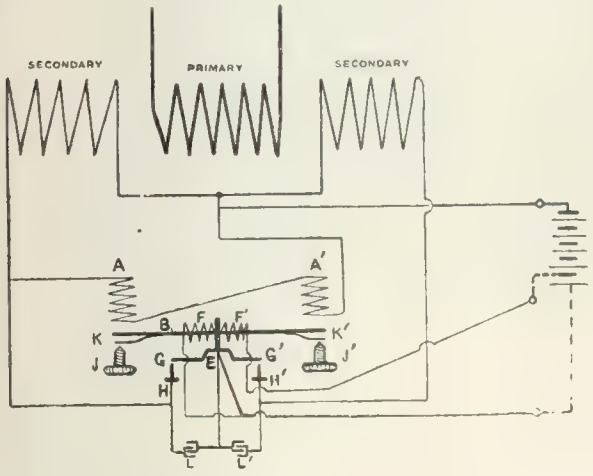
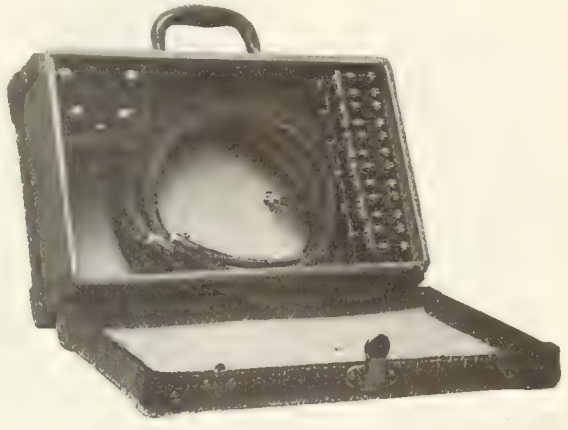


FIG. 2.—DIAGRAM OF CONNECTIONS.

These rectifiers are manufactured in all ranges from 30 watts to 5000 watts. They will also work on any frequency. These rectifiers are also built so that the same machine will furnish any number of different voltages. The apparatus here described has been placed on the market by the Premier Ampero Electric Company, Premier House, Dover Street, London, England

Phantom Loading Device for Testing Meters.

In the testing of wattmeters and watt-hour meters it is not essential for the load registered on the meter actually to be supplied to a consuming device by way of the meter; it is necessary merely for the currents in the series and shunt coils of the meters to have definite values and time-phase relations with respect to each other. Thus, by supplying the current for the series coils from a low-voltage source the energy actually



PHANTOM LOADING DEVICE.

utilized will be only that absorbed by the meter itself, which will be a small percentage of the amount registered by the meter.

In the phantom loading device illustrated herewith the current for the series coils is adjusted by means of resistances in parallel in the secondary circuit of a step-down transformer. When the proper voltage is available, the selective switches shown give current values of 0.5, 1, 2, 5, 10 and 15 amp and any combination thereof. In order to eliminate the difficulty occasioned by the potential drop in the leads interfering with the predetermination of the current, the resistances are contained in the flexible leads used in connecting the instruments. This arrangement allows the space available to be utilized to the best advantage, and insures the minimum of time-phase displacement between the shunt voltage and series current—that is, it insures the equivalent of a power factor of nearly unity at all indicated loads.

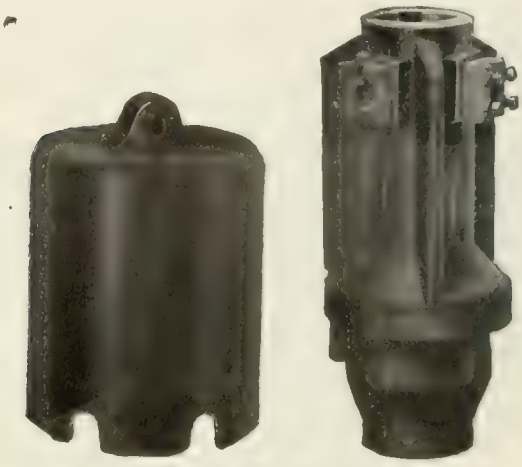
The above-described device has been placed on the market by Henry J. Blakeslee, 603 South Crouse Avenue, Syracuse, N. Y. The apparatus is assembled in a portable leather case in which ample space is provided for all tools, seals, etc., which must be carried when testing meters in place.

Porcelain Pothead.

The Colonial Sign & Insulator Company, of Akron, Ohio, has brought out a new type of overhead, high-tension cable terminal box or pothead made of brown glazed porcelain, the only metal parts being the terminal contact blocks and the supporting clamp ring. The device was developed for the Cleveland Electric Illuminating Company, which has used it during the past year, and one illustration shows an installation on this company's 2300-volt lines. In order to determine the reliability of this type of pothead, some were mounted and subjected by the company's engineers to continuous tests under actual service conditions, on voltages ranging from 6600 to 13,200 for a period of eight months. A laboratory test showed that at 30,000 volts arcs would occur from one terminal to another, but no breakdown would ensue.

As may be seen from the illustrations given on page 1434, the pothead consists of a peculiarly shaped body, with a suitable cover bell. The cable enters the neck of the body or pothead proper, and the conductors separate within the neck, and are then brought out and screwed into the contact blocks through

the slots provided. Barriers between the phases prevent creeping and short circuiting. The overhead leads are led up into the contact blocks through notches in the cover, so as to form a natural drip loop. When paper insulated cables are used, as is the case in Cleveland, the insulation is protected by a wrapping of varnished cambric tape, or by splicing gum tape served with P. & B. paint. This is made to extend somewhat below



FIGS. 1 AND 2.—PORCELAIN POTHEAD.

the end of the lead sheath. The body is fitted with a lug and a clamp, and with a socket to prevent the pothead from turning, and the cover bell is fitted with lugs between which the barriers of the body engage in order to locate the lead openings in a definite position with reference to the conductor slots in the body.

The type illustrated weighs 18 lb. complete, and, while designed for three-phase, 2300-volt circuits, has been found to operate successfully on 6600 volts, and to take cables up to 1⅞ in. outside diameter. Potheads for single-phase, two-phase or three-phase service, and for higher voltage or larger diameter cables, can be furnished in this type if desired. The only compound used in the pothead is about a half teacupful, which is poured into a small pocket formed at the top, into which the bolts holding the terminal blocks converge. No compound is required to protect the end of the cable. The advantages claimed for the pothead are simplicity, compactness, lightness, rigidness and neatness.

The removable cover bell of the pothead permits of rapid inspection; the screw connections in the contact block of



FIG. 3.—PORCELAIN POTHEAD.

quick disconnection for test or other purposes; the manner of bringing in cables and leads prevents the ingress of moisture; the cable sheath does not have to be wiped on to the body, and its outer diameter is immaterial as long as it will enter the neck of the pothead.

A Non-Freezable Oil.

The Ricker Manufacturing Company, of Rochester, N. Y., has had prepared for its fuse boxes a non-acid, high-test, non-freezable oil, known as the "Rochester Fuse Oil." This oil will be of great interest to companies in the colder climates, both for fuse boxes and transformers. It will remain in its normal condition at a temperature of 40 deg. below zero.

Convenient Household Electric Heating Devices.

The accompanying illustrations show three convenient electric heating devices made by the Simplex Electric Heating Company, of Cambridge, Mass. The breakfast room toaster shown in Fig. 1 has a polished metal case, in the center of which an upright electric heater extends from end to end. On each side is a door swinging outward and backward which opens sufficiently to permit the placing or removal of the bread without



FIG. 1.—TOASTER.



FIG. 2.—MILK WARMER.

danger of burning the fingers. When not in use the doors are closed so as to confine all the heat for effective work on the bread.

The flexible conductor cord is provided with a lamp-socket plug and another plug, by which the toaster itself may be switched into or out of circuit. The walls of the casing are doubled with an air space between, and the interior surfaces are brightly polished so as to provide reflectors for the heat. Two large or four small slices of bread may be toasted at one time in from two to three minutes. The construction throughout contains no fragile or delicate parts or soldered joints. The walls and doors are smooth polished, with ebony-finished handles. The crumbs from the bread fall within the casing of the walls and doors on a porcelain enameled base, and by removing the doors the crumbs may be instantly removed.

The nursery milk warmer shown in Fig. 2 consists of a nursing bottle, an electric heating coil and a copper receptacle to contain the bottle and coil immersed in a water bath. The heat is given out uniformly on all sides, so that the milk may be brought to an even temperature quickly without any portion of it being overheated and rendered indigestible. Each milk warmer is furnished with 6 ft. of cord and a lamp-socket plug, arranged so that the lamp itself is lighted while the milk is being warmed.

As electric lighting in hotels is practically universal, the



FIG. 3.—TRAVELER'S STOVE.

traveler's stove, shown in Fig. 3, should find wide use. The stove and cord pack inside the cup, and the cup handles fold up snugly, the whole apparatus measuring 3¼ in. x 5 in., and weighing 2½ lb. An asbestos pad and 6 ft. of cord and a plug form part of the outfit.

Thousand Candle-Power Tungsten Lamp.

The accompanying illustrations show two very large incandescent lamps equipped with tungsten filaments imported by the Electrical Accessaries Company, of New York City. That shown in Fig. 1 is rated at 1000 cp, and that shown in Fig. 2 is rated at 600 cp, the specific consumption in each instance being claimed to be 1.1 watt per candle. In order that some conception may be obtained of the size of each lamp, an ordinary 16-cp carbon-filament lamp is shown to one side of it in each engraving. The 600-cp lamp has a round globe 8 in. in diameter, while the globe of the 1000-cp lamp is 9 in. in diameter. Each lamp is made up of two filaments in parallel, so that if one filament breaks, the other filament will remain in service and the lamp burn at half rating. The lamps are designed to take the place of ordinary arc lamps, and flaming-arc lamps for interior illumination. The filament is anchored in the center and also at the bottom, and the connections at the top are fused electrically. The anchors at the middle and bottom are arranged so that one leg of the filament is in a different plane from the other. This results in obtaining better distribution, and prevents the filaments from touching each other. There are 16 complete loops in the 600-cp lamp, and 20 complete loops in the 1000-cp lamp, the length of the loop being about 6 in. in each case. The anchors are held by a glass rod over ⅛ in. in diameter, as indicated in Fig. 3, which shows the arrangement of one-half of the filament in a 1000-cp lamp. The lamps are fitted with Edison bases so as to screw into an ordinary incandescent lamp socket. They are designed for voltages ranging from 100 to 120, and from 200 to 250. With the introduction of these lamps there are now available tungsten lamps ranging in candle-power from 16 to 1000, those above 100 being rated at 200 cp, 300 cp, 400 cp, 600 cp and 1000 cp.

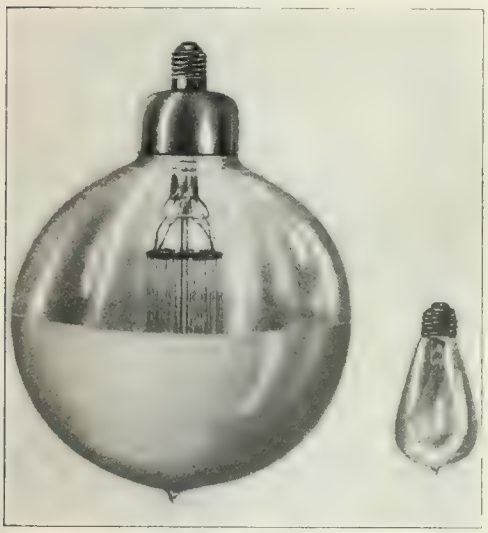






FIG. 1.—1000 CP TUNGSTEN LAMP. FIG. 2.—600-CP TUNGSTEN LAMP. FIG. 3.—ONE HALF OF FILAMENT IN 1000-CP LAMP.

Tailor's Electric Iron.

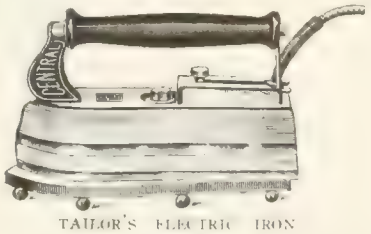
The requirements of a tailor's iron are more exacting than are those of other irons and the faults more or less common to the majority of electric irons are therefore more conspicuous in the tailor's iron. High efficiency is desirable, as the quantity of energy required to do a given work is such that a saving of 25 per cent is important. Another esential feature is quick starting characteristics, the absence of which makes the tailor's iron prohibitive in a job shop where it is required often for only one job taking five minutes to perform. The factor of endurance is of prime importance and necessitates careful design, first, because the nature of the work requires a larger volume of heat and much higher temperature, and second, because of the inherently slow starting ability and the intermittent nature of the work there is more temptation to let the iron stand with the current on, in order that the iron be ready for use. The first of these makes it necessary to wind the heating element for excessively high temperature, and the second increases the danger of burn-out still further.

With a full knowledge of the conditions to be met the Central Electric Company, Chicago, Ill., has placed on the market the "Universal" tailor's goose illustrated herewith, which is a development of its 4-lb. and 6-lb. irons with the necessary changes in design to meet the necessary conditions imposed by the severe service met in tailor shops. A prominent feature of the new iron is the three-heat switch plug, by which all heats can be controlled by a simple motion of the hand while ironing.

This desirable feature is accomplished without withdrawing any plug from the iron, or turning any auxiliary switch. The heating elements are so arranged that the heat is distributed over the bottom of the iron equally well at any one of the three heats, and at the same time maintain an equally high efficiency on any of the three heats.

The advantages claimed for the new iron are that it gives a greater range of control of temperature than can be obtained by ordinary switch-plug, or by other means. The low heat can be so arranged that the quantity of current consumed will just maintain the iron at a temperature while standing indefinitely.

The first advantage is of particular importance to manufacturers who have special temperature requirements and where the nature of the work varies greatly. The second is more important in job shops where an iron is more liable to burn out, which this feature prevents by allowing the iron to stand at a low heat instead of at a high one. Thus the iron is always maintained at the correct temperature while standing between jobs and does not cool off, nor get any hotter. This enables the operator to pick up the iron and go ahead any time without waiting, whereas should the full heat be left on, leaving out the question of consumption, it would become too hot. The medium heat is used only when very light work is to be done, or where only one piece is to be pressed. For continuous wet work full heat is used. The switch-plug works progressively in and out—that is, the first notch is off, the second is for one-quarter or low heat, and the third for half or medium heat, while clear in gives full heat.



TAILOR'S ELECTRIC IRON

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

While the reports from retailers continue to be that business is good, there have been some complaints during the past week concerning the continuance of unusually mild weather and the resulting falling off of sales of heavy clothing and winter underwear. In some sections of the West, also, continuous rain has rendered the roads almost impassable and thereby restricted the sales at county seats, which are dependent upon rural purchasers. In the cities of the country there has been very gratifying holiday business. In fact, the Christmas trade is said to be the best since 1906. Among the jobbers and wholesalers new orders are not very plentiful, a condition which is to be expected at this season of the year, but quite a number of reorders are being received, which indicates that retailers have for the most part been conservative in their original purchases and that at the present time they are not heavily stocked with wares. The industrial condition continues to be enthusiastic. There are few signs of slackening of orders and the iron and steel mills will be running overtime for many months to come on the business already booked. The switchmen's strike in the Northwest has interfered to some extent with a number of flour mills and other manufacturing plants in that section. It has also caused some congestion of traffic. It is not believed, however, that this strike will be serious or that it is liable to spread to other sections of the country. It is not improbable, however, if the present high prices for commodities continue that demands for advance in wages may be reasonably expected next spring. Collections throughout the country are fairly satisfactory and bills are being met with greater promptness than at any period since the beginning of the times of depression. While there were more failures with larger liabilities in November than there were in October, the comparison with the past two years continues to be very favorable to 1909. Failures for the week ending Dec. 2, as reported by *Bradstreet*, were 230, compared with 217 the previous week, 234 in 1908, 272 in 1907, 216 in 1906, and 203 in 1905.

THE COPPER MARKET.

The condition of the copper market during the past week was distinctly better than during the week previous. Prices, however, were slightly lower for a time, and there was more evidence of anxiety on the part of holders to dispose of metal. This may have been the cause of the unusual volume of sales. It was generally understood that domestic melters are using much more raw material than at any previous time within the past two years. Wire drawers, brass foundries and sheet mills are all calling for heavier deliveries. The majority of the domestic consumers have purchased copper sufficient for their needs for delivery during December, January and February, and orders placed now, as a rule, are for spring delivery. On Dec. 6 heavy buying orders were received from abroad, and there was a sharp advance in the London market, followed, of course, by a comparative advance in the local market. The entire undertone is much stronger and more satisfactory than has been the rule during the season. The anxiety concerning the fate of the proposed copper merger, which followed the adverse decision in the Standard Oil case, has almost disappeared, and authorities who are interested in the negotiations now declare that they have no fear of Government interference, and that they are simply resting on their oars waiting for the Supreme Court to hand down a decision in the case of the Tobacco Trust. It is intimated that all of the details in the consolidation have been worked out, but they will not be made definitely public until those interested are sure of the Government's attitude. Exports for the month, including Dec. 6, have been 3718 tons. The daily call on the Metal Exchange Dec. 6 quoted standard copper as shown in the table.

	Bid.	Asked	Settling
Spot	12.75	13.	12.
December	12.75	13.	
January	12.75	13.05	12.00
February	12.80	13.	
March	12.90	13.25	

The London prices Dec. 6 were as follows:

	Noon.	Close.
Standard copper, spot	£ s. d.	£ s. d.
Standard copper, futures		
Market	Firm	
Sales of Spot		500 tons
Sales of futures		

Extreme fluctuations for this year:

	Highest	Lowest
London, spot	£ s. d.	£ s. d.
London, futures		
Standard		
London, best selected		

PARKER-CLARK ELECTRIC COMPANY.—The retirement of W. G. Clark from his connection with the Parker-Clark Electric Company and the election of Dr. George N. Miller to the office of president and director has been announced. In order to be in close touch with their laboratories, the offices of the company have been moved from the Singer Building to the Lincoln Square Building, No. 1966 Broadway. Prof. H. C. Parker continues at the head of the laboratory work, and, with the advent of Dr. Miller as the chief executive, active preparations are being made to at once place the company's products on the market. The Helion resistors manufactured by this company have been developed to meet a definite need in the electrical heating field, and, anticipating a large demand for these resistors, the company plans to start a factory for their manufacture as soon as a suitable location can be selected. Work will also be vigorously prosecuted on the Helion incandescent lamp, which is stated to be now nearing perfection, with the design of offering it to the public the coming Spring. The company is also preparing to manufacture immediately the Helion naval lamp to meet the large demand for an incandescent lamp which will stand the shock of firing large guns on board of men-of-war. The firm, strong Helion filament is stated to meet these demands admirably, even should the glass globe enclosing the filament be broken, the filament will burn in the open air for an indefinite period without apparent deterioration.

TELEPHONES FOR TRAIN DISPATCHING.—The Chicago & Northwestern Railroad Company has recently purchased from the Western Electric Company apparatus for a complete telephone train dispatching circuit extending from Chadron, Nebraska, to Long Pine, Nebraska, a distance of 198 miles. The circuit will be very complete and the line itself has been constructed entirely of new material. The Louisville & Nashville is installing a complete up-to-date Western Electric telephone train dispatching circuit between New Orleans and Mobile. This circuit will be the first to be installed in that section of the country for handling trains. This is the second circuit installed by this railroad, the former one being between Louisville and Cincinnati. The officials report that the service on this circuit is giving entire satisfaction.

NEW GENERATING STATION AT ATLANTIC CITY, N. J.—The American Gas & Electric Company has entrusted to Messrs. Sargent & Lundy, of Chicago, the design of a new 10,000-kw turbo-generator station to be erected in Atlantic City, N. J. The present station of the Atlantic City Electric Company will be abandoned, and, as intimated in the May 27, 1909, number, the new generating station will be built elsewhere in the city, and will be in keeping with the plan for the general beautification of the city by the sea. The general details of the equipment have not yet been definitely decided on.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in our present issue are announcements of proposed new plants or considerable extensions of present plants at Salt Lake City, Utah; Richmond, Va.; New Orleans, La.; Louisville, Ky.; Chambersburg, Pa.; Mason City, Ia.; Windsor, Ont., Can.; Greenville, S. C.; Fort Payne, Ala. Kimball, Va.; Jefferson City, Mo.; Nebraska City, Neb., and Ralston, Okla.

PENNSYLVANIA ELECTRIC ROAD TO NEWARK.—Plans have been prepared by the Pennsylvania Railroad Company for the electrification of its line from Harrison, N. J., where the Thirty-third Street tunnel line joins the main line which has heretofore run into Jersey City, to the Park Place station, Newark. It is proposed on this line to run through trains from Newark to the Hudson Terminal Buildings, at Cortlandt Street, and to transfer passengers at the Harrison, N. J., station to trains that will take them to the main terminal at Thirty-third Street and Seventh Avenue, New York. It is said that later on a local service may be installed between the Thirty-third Street terminal and Newark. All through trains coming into New York over the Pennsylvania line will stop at the Harrison station so that any passengers who desire to go into the lower end of Manhattan can there transfer to the Hudson Terminal station.

SOUTHERN PACIFIC ELECTRIFICATION. — The Southern Pacific Railroad Company is considering the electrification of 110 miles of its main line over the Sierras. This work, which will probably begin in the near future, will be the most important piece of mountain electrification yet installed in any country. It is also likely that, if the work is completed as now proposed, the Southern Pacific will have the longest stretch of electrified main line in this country. The only competitor will be the New Haven Railroad, which is pushing its electric zone east from Stamford. The Southern Pacific in this section of its road has a series of 2 per cent grades, and the heavy 2500-ton freight and 800-ton passenger trains will require larger electric locomotives than any now in use.

NO MERGER OF DENVER COMPANIES.—J. R. McKee, president of the Central Colorado Power Company, of Denver, has specifically denied any community of interest between the Denver Gas & Electric Company, the Northern Colorado Power Company and the Central Colorado Power Company. It has been frequently stated recently that a merger was in progress of formation. Mr. McKee, however, stated that the companies are competing and that outside of the Leadville Lighting Company and the Breckenridge Mining District the only relation the Central Colorado Power Company has with the other companies is the selling of energy to the Denver Gas & Electric Company, as to any other customer.

LIGHTING RIVALRY IN CLEVELAND.—The Cuyahoga Lighting, of Cleveland, Ohio, of which John C. Keyes is president, has carried its fight against the Cleveland Electric Illuminating Company to the State Board of Assessors and Appraisers. Some time ago Mr. Keyes succeeded in inducing the Board of Review in Cleveland to take up the tax valuation of the old company and add several hundred thousand dollars to it. Mr. Keyes states that he will erect a plant on the lake front of 3,000 kw. capacity and a system that will cost $1,000,000. The money, he stated, would come from the East, but he refused to state who is to furnish it.

NEW MEXICO HYDROELECTRIC PROJECT.—Business men of Roswell, N. M., have been in conference with Mr. J. L. Norton, of Chicago, a hydroelectric engineer, on a plan to harness the waters of the Rio Penasco and supply electrical current to light a number of cities in the Pecos Valley and reclaim some 100,000 acres by pumping. The Penasco falls 50 ft. a mile for 30 miles, and it is estimated it would generate 1500 hp every three miles. The project has been endorsed by the Roswell Commercial Club. An interurban electric railway through the valley is expected to be constructed ultimately as a part of the project.

AMERICAN PLATINUM WORKS. — The American Platinum Works, Newark, N. J., have purchased the adjacent real estate and building formerly owned and occupied by the Caffrey Leather Company and J. Liebstein & Sons. The present buildings will be reconstructed and modernized and additional structures will be erected, which, when finished, will give the company one of the most complete plants in the world for the refining of platinum, gold and silver.

CANADIAN ELECTRICAL CONTRACT.—The Canadian Westinghouse Company secured a contract from the London, Ont., Power Committee on Dec. 3, for electrical apparatus for the municipal system, amounting to $51,908. The total tender of the Westinghouse Company amounted to $64,058, but included in this were one motor-generator set and a street arc lighting equipment, awards for which have been deferred.

GREELEY-DENVER ELECTRIC RAILWAY.—Harold K. Knight, of St. Louis, is in Denver looking over the country with a view to building an electric line between Greeley and Denver. Mr. Knight represents Missouri capitalists, and it is understood that he will try to buy out companies which have secured rights of way and other privileges between the two cities and start work on the line within three months.

ELECTRIC LOCOMOTIVES FOR JAPAN.—In a news paragraph, published in the issue of Sept. 16, concerning the sale of 12 30-ton electric locomotives to the Japanese Government it was erroneously stated that the contract had been made with the Siemens-Halske Company. As a matter of fact, the contract was placed with the Allgemeine Elektricitäts Gesellschaft, of Berlin.

COLORADO ELECTRIC PUMPING PLANT.—The city of Montrose, Col., has voted to install a 1500-gal.-per-minute centrifugal pump, to be driven by 2200-volt, three-phase, 60-cycle electric motor direct-connected, the entire equipment to be in strict accordance with the requirements of the National Board of Fire Underwriters for standard centrifugal fire pumps.

HEANY LAMP COMPANY.—The Heany Lamp Company announces that its new factory at Weehawken, N. J., will be completed within a few months and will be turning out 10,000 tungsten lamps daily. The factory at Flint, Mich., is now running full time and is making 10,000 lamps daily. The management of the company declares that the demand for lamps is very satisfactory.

INCREASE CAR BUILDING PLANT.—The Woeber Car & Carriage Company, which has been established in Denver for 42 years, and has built practically the entire rolling stock of the Denver City Tramways Company, has bought 13 acres of land in Adams County, near Denver, and will begin within a year the erection of extensive new car and automobile shops.

SOUTHERN COLORADO POWER COMPANY.—The Southern Colorado Power & Railway Company of Trinidad has been reorganized, and it is stated that $1,000,000 will be spent on improvements at once. Plans for reorganization have been perfected in New York by F. T. Reid, receiver, and Attorney Fred T. Henry, of McKnight & Henry.

Financial Intelligence.

THE WEEK IN WALL STREET.

The stock market last week appeared to have recovered, to some extent, from the extreme nervousness which had been caused by the Standard Oil decision. It seems to take a very small noise to frighten many of the timid traders in these days

NEW YORK.

	Nov. 29.	Dec. 6.	Shares sold.		Nov. 29.	Dec. 6.	Shares sold.
All.-Ch.	15[illegible]*	15½	6,020	Int.-Met.,pfd..	54½	58¼	57,700
All. Ch., pfd	53[illegible]	55[illegible]	4,100	Mackay Cos..	92½	92½	4,000
Amal. Cop...	84⅛	86¼	[illegible]	Mackay Co., pfd.	76⅛	77⅛	[illegible]
Am. D. T.	[illegible]	[illegible]	[illegible]	Man. Elev.	130[illegible]	130[illegible]	1,300
Am. Ice	30¾	30¾	8,950	Met. St. Ry..	23*	23*	[illegible]
Am. Ice, pfd.	15	14¼	420	N.Y.&N.J.Tel.	139¼	139¼*	[illegible]
Am. Tel & C.	82*	83	[illegible]	Steel, com....	86	86[illegible]	94,770
Am. T. & T.	140¼	140	[illegible]	Steel, pfd....	123[illegible]	124[illegible]	10,187
B. R. T.	[illegible]	[illegible]	73,165	W. U. T.....	77½	77[illegible]	5,400
Gen. Elec....	159½	160	[illegible]	West'h., com.	83	84[illegible]	7,800
Int.-Met.	[illegible]	4	[illegible]	West'h., pfd.	136[illegible]*	134*	300

PHILADELPHIA.

	Nov. 29.	Dec.		Nov. [illegible]	Dec. 6.
Am. Rys.	[illegible]	[illegible]	Phila. [illegible]	[illegible]	[illegible]
Elec. Co. of A.....	12⅜	12⅜*	Phila. R. T.....	25⅞	[illegible]
Elec. St. B'ty.....	58	57	Phila. Trac.....	89*	[illegible]*
E. S. B'ty, pfd.....	30*	[illegible]	[illegible]	[illegible]	53¼

CHICAGO.

	Nov. 29.	Dec. 6.		Nov. 29.	Dec. 6.
[illegible]	[illegible]	[illegible]	Chi. Tel. Co.....	135½	[illegible]
Chi. Rs., Ser. 1.....	98	[illegible]	Met. El., com.....	17*	[illegible]*
Chi. Rs., Ser. 2.....	32	[illegible]	Met. El., pfd.	[illegible]	[illegible]
Com. Edison.....	119	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	4½	[illegible]	[illegible]	[illegible]

BOSTON

	Nov. 29.	Dec. 6		Nov. 29.	Dec. 6.
[illegible]	[illegible]	[illegible]	Mex. Tel.....	3*	[illegible]*
Cum. Tel.....	147*	[illegible]	[illegible]	[illegible]	[illegible]
Edison E. Ill.....	250*	250	[illegible]	[illegible]	[illegible]
Gen. Elec.....	161¼	[illegible]	[illegible]	[illegible]	[illegible]
Mass. E. Rys.....	[illegible]	[illegible]	W. T. & T., pfd.....	89½	[illegible]*
Mass. E. R., pfd....	80	[illegible]			

* Last price quoted.

Shares sold are for week of Nov. 29 to Dec. [illegible]

of high prices and uncertain money markets, and the anti-trust decision scared many speculators to cover. After the hurried liquidation of a few days, the sober second thoughts appear to have prevailed, and the fear that the financial world was coming to an end, because of an adverse decision in a lower court, has apparently been assuaged. While the market last week was not particularly active, there was a good buying movement almost every day, and the result of trading for the week was a considerable advance in almost every leading issue. Even the copper shares, which are recognized as the most risky propositions in the market, on account of the well-known overproduction of metal, were strengthened during the close of the week and recorded advances. Talk of the great copper merger was resumed, and people who a few days before were loudly asserting that the Government would never permit such an organization, have changed their minds, and are willing to buy a few shares of the copper companies on the prospect of the controlling amalgamation. Although there was some talk in Wall Street as to what would be said in President Taft's first annual message to Congress, no one seemed to be particularly nervous. It was generally the opinion that the President would not be so radical as to disturb either the industrial corporations or the railroads. The traction stocks, especially Interborough-Metropolitan issues, continue to be very active, and, with the exception of Third Avenue, recorded advances. In the case of the latter the promulgation of a plan which contemplated a $45 assessment was sufficient to cause many holders to sell. The money market has not been particularly interesting during the week. While there have been some shipments of gold to South America, they have not been of sufficient volume to inconvenience the banks. Rates have remained about the same, both in this country and in Europe. On Dec. 6 quotations were: Call, 4 and 5 per cent; 90 days, 4¾ per cent. The quotations in the table are those of the close, Dec. 6.

CHICAGO SUBWAY RECEIVERSHIP.—Judge C. C. Kohlsaat, of the United States Circuit Court, in Chicago, has appointed David R. Forgan, president of the National City Bank, and Charles G. Dawes, president of the Central Trust Company of Illinois, receivers for the Illinois Tunnel Company, and Edwin A. Potter, president of the American Trust & Savings Bank, receiver for the Chicago Warehouse & Terminal Company. The Chicago Subway Company, which in 1904 took over the Illinois Tunnel Company and the Chicago Warehouse & Terminal Company, defaulted upon the payment of its interest on $1,700,000 of bonds that was due Dec. 1. This was done in order that receivers might be appointed, and is the initial step in a plan of reorganization of the company under friendly terms. A reorganization committee of bondholders has been formed, and this committee is practically represented by the receivers appointed. It will enter upon the task of carrying to completion the tunnel and its connecting enterprises. When the Chicago Subway Company was formed in 1904 J. Ogden Armour and E. H. Harriman were the important financial interests back of the enterprise. Mr. Harriman committed the company to a policy which involved the completion of the system, so that it would connect all of the Chicago railroads. This involved a heavy expenditure, and the funds for these improvements were supplied by the Armour-Harriman interests on notes secured by first mortgage bonds of the company. Up to the present time the operations of the company have not been sufficiently lucrative to pay the fixed charges, and since Mr. Harriman's death it has been apparent that a reorganization would be necessary. On the Chicago Stock Exchange the stock of the company has declined until it reached the low point of $3.25 a share. Many stockholders believe that a reorganization would mean the practical elimination of the present outstanding stock. So far no plan of reorganization has been announced.

DENVER GAS & ELECTRIC LIGHT COMPANY.—Temporary officers for the newly organized Denver Gas & Electric Light Company, successor to the Denver Gas & Electric Company, were named yesterday, and are as follows: President, Rodney J. Bardwell; vice-president, H. H. Scott, general manager of the Doherty Operating Company; secretary, Paul R. Jones, auditor of all the Doherty Companies, and Carl B. Gilbert, treasurer. The above officials will remain in power until all the details of reorganization are complete, when the stockholders will meet and elect a board to serve one year. Plans for the reorganization are practically complete. Charles Frueauff, counsel for the company, will leave for the East at once to submit the final details to Henry L. Doherty for his approval. On account of illness, Mr. Doherty was unable to come to Denver as he had hoped to do. A mortgage will be filed shortly to cover the proposed $25,000,000 bond issue of the new company. The certificate of the incorporation of the new company, with an authorized capitalization of $10,000,000 has been filed with the Secretary of State of Colorado. The bond issue is necessary in order to take care of improvements and extensions contemplated for the next few years. The company is taking over the Denver City Steam Heating plant and proposes to enlarge it greatly. Recent investigation by the gas company shows that the growth of Denver has been for several years at a rate of 3½ per cent over each previous year.

ELECTRICAL UTILITIES CORPORATION.—There was recently incorporated under the laws of Maine a holding concern called the Electrical Utilities Corporation. The authorized capital stock is $7,500,000, of which $2,500,000 is preferred. This preferred stock was offered for subscription in London last week at par with a bonus of 80 per cent in common, and it is reported to the officers in New York that the offering was largely over-subscribed. At the office of William P. Bonbright & Company, which firm is the financial representative of the new corporation in this country, it was stated that the purposes of the organization were mainly to buy and to sell the securities of electrical utility concerns. It is not the present purpose of the company to go into the operating business, and for the present no information will be given out as to properties in which the new holding company would be interested. The directors of the company are: S. Z. Mitchell, chairman of the American Power & Light Company; S. W Childs, of William P. Bonbright & Company; A. W. Burchard, assistant to President Coffin of the General Electric Company: A. C. Bedford, of the Standard Oil Company, and W. F Fisher, Owen H. Smith, and L. Egerton of London.

CONTINENTAL TELEPHONE & TELEGRAPH COMPANY.—It is reported in Chicago that the Chicago & Milwaukee Telegraph Company, one of the few Independent telegraph companies of the country, has been purchased by the Continental Telephone & Telegraph Company. The concern has six wires running between Chicago and Milwaukee, and its purchase by the Continental Company would give that concern an entrance into Chicago for Independent telephone and telegraph lines. Inquiry as to the truth of this report at the office of Philbin, Beekman & Menken, the attorneys who represent the organizers of the Continental Telephone & Telegraph Company, and the only representatives of that company whose identity has been made known, elicited the response that the officers of the company were unwilling to either confirm or deny the report.

FIFTH AVENUE COACH COMPANY.—The first annual report of the Fifth Avenue Coach Company to the Public Service Commission, which was for the year ended June 30, 1909, has just been made public. The figures show that the company has at the present time an investment of about $400,000, which is more than double what it was at the end of the previous fiscal year. This increase is represented by new electric motor omnibuses. The revenue from passengers carried amounted to $369,405, and the total expense for operations amounted to $225,556, leaving a net income of about $144,700. The company marked off during the year $65,595 for depreciation, and at the end of the year there was a standing deficit on the books of the company amounting to $458,216

WILKES BARRE & WYOMING VALLEY TRACTION COMPANY.—Negotiations were concluded last week for the purchase by Wilkes Barre interests of the Wilkes Barre & Wyoming Valley Traction Company. The consideration is said to be about $4,000,000. The company operates 99 miles of trolley line in Wilkes Barre and in the Wyoming Valley. Heretofore it has been controlled by the Interstate Railways Company of Philadelphia.

GREAT GERMAN ENTERPRISE PROSPERING.—The annual report for the Allgemeine Elektricitäts Gesellschaft for the year ended June 30, 1909, shows total net earnings, after making liberal charges for depreciation, etc., amounted to 16,384,571 M. The company paid 13 per cent dividends on its 100,000,000 M. capital stock and distributed 1,300,000 M. in bonuses to its officers and employees.

THIRD AVENUE RAILROAD REORGANIZATION.—The bondholders' committee of the Third Avenue Railroad Company, of which James N. Wallace is chairman has filed its second plan of reorganization with the Public Service Commission. The first plan was rejected by the commission in September. The new plan provides for the authorization of a refunding mortgage to secure a total issue of $40,000,000 of 4 per cent bonds. Of these, $15,790,000 are to be issued at once and the balance to be reserved for underlying bonds and for future extensions and betterments. The plan also includes a 50-year adjustment mortgage securing an issue of $22,536,000 of 5 per cent income bonds. It also contemplates an issue of $16,590,000 of stock. This makes a total of $39,126,000 of new securities. The stockholders are to pay an assessment of $45 a share, which would yield $7,200,000 in cash. Of the $15,790,000 to be issued at once, the holders of the present 4 per cent bonds, which amount to $37,560,000, are to receive 15 per cent, or $9,390,000, while the stockholders on the payment of their assessment are to receive the remaining $6,400,000 of the bonds. The bondholders are to have full voting power until full interest, including all accumulations, shall have been paid for five consecutive years.

MORGAN MAY ENTER TRACTION FIELD.—The sale by Thomas F. Ryan of his holdings in the Equitable Life Assurance Society to J. P. Morgan has given circulation to reports in the financial district that the latter is about to enter the New York traction field. It is said that Mr. Morgan may probably take a hand in untangling the present traction muddle and reorganizing the properties. In fact, one newspaper has gone so far as to outline a gigantic plan which, it says, is contemplated by Mr. Morgan for the organization of a great holding company to take over all the traction lines in Greater New York and adjacent Long Island and Westchester territory. This project, it is said, includes the McAdoo tunnels and the Steinway tunnel. The entire system, it is said, will be exploited for the purpose of serving the needs of the public and not for the purpose of enriching the insiders. This project, however, lacks confirmation.

WESTINGHOUSE DIRECTORS' MEETING.—The directors of the Westinghouse Electric & Manufacturing Company met Dec. 2, but, according to the statements made, only routine business was transacted. A report was heard from Pittsburgh that Mr. Westinghouse was about to retire from the presidency, but this was specifically denied by Robert Mather, chairman of the board. Mr. Mather said that if any such step was contemplated he had never heard of it. It was also denied that the board had taken any step, or contemplated any, toward paying, in a lump, the remaining back dividends on the preferred stock. It was given out that there would be no deviation from the announced policy of paying these dividends gradually. Another year will be required to clear off these payments under this policy.

McCALL FERRY POWER COMPANY.—The property of the McCall Ferry Power Company was sold Dec. 7 under foreclosure at the court house door, Lancaster, Pa. The property was bid in by the representatives of the bondholders' committee at the upset price fixed by the court. A plan of reorganization has been already formed. The bondholders' committee represented every outstanding bond, therefore the new plan has the unanimous consent of the bondholders.

NEW HAVEN EXTENDS WESTCHESTER TROLLEYS.—The New York, New Haven & Hartford Railroad Company has filed with the clerk of Westchester County, New York, a certificate of incorporation of the Westchester Railroad Company, with a capitalization of $1,000,000. The New Haven road recently bought at foreclosure sale the property of the Tarrytown, White Plains & Mamaroneck Railway Company. The company just incorporated will take over this property and operate the line. There will be no change of route, but the physical condition of the road will be largely improved.

NORTH AMERICAN COMPANY.—C. W. Wetmore has resigned from the presidency of the North American Company and James Campbell, a prominent banker of St. Louis, has been chosen in his place. Mr. Wetmore's resignation was caused by continued ill health. He will remain as a member of the board of directors, and has been appointed its special adviser. Mr. Campbell is one of the leading members of the syndicate which last week purchased control of the "Frisco" Railroad. He has taken an active interest in the affairs of the North American Company for a number of years.

NEW YORK & QUEENS COUNTY RAILWAY COMPANY.—The Public Service Commission of the First District of New York has given out the figures included in the report of the New York & Queens County Railway Company for the year ending June 30, 1909. This report shows that the total revenue from operation was $948,079, and the total expense was $778,457, leaving apparent net earnings of $169,621. The fixed charges on the funded debt and other debts amounted to $258,104, leaving a net corporate loss on the year's operations of $154,158.

FORTY-SECOND STREET LINE TO BE SOLD.—A decree of foreclosure and sale of the Forty-second Street, Manhattanville & St. Nicholas Avenue Railway has been ordered by the United States Circuit Court, the judge ruling that, in the event of the failure of the railway company to pay within 20 days $1,676,933, all of the property of the road should be sold on Feb. 1. It is said that more than one-half of the bondholders of the company requested the foreclosure sale.

DIVIDENDS.

American Smelting & Refining Company preferred, quarterly 1¾ per cent, payable Jan. 2; common, quarterly, 1 per cent, payable Jan. 15.

Columbus (Ohio) Railway & Light Company, quarterly, ¾ per cent, payable Jan. 1.

Chicago Telephone Company, quarterly, 2 per cent, payable Dec. 31.

Interborough Rapid Transit Company, quarterly, 2½ per cent, payable Jan. 3.

North American Company, quarterly, 1¼ per cent, payable Jan. 3.

Oklahoma Gas & Electric Company, quarterly, 1¼ per cent, payable Dec. 15.

Portland (Ore.) Railway, Light & Power Company, quarterly, 1¼ per cent, payable Jan. 3.

San Diego (Cal.) Consolidated Gas & Electric Company, quarterly, 1¼ per cent, payable Dec. 15.

St. Joseph (Mo.) Light, Heat & Power Company, preferred, quarterly, 1¼ per cent, payable Jan. 1.

Washington Water-Power Company, Spokane, quarterly, 1¼ per cent, payable Jan. 3.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Power & Light Company					
October, 1909	$64,054	$38,992	$25,662	$5,078	$20,584
October, 1908	54,523	38,053	16,470	4,966	11,504
Dallas, Tex., Electric Corporation:					
October, 1909	147,838	80,397	67,441	27,471	39,97
October, 1908	134,140	73,768	60,372	27,554	32,818
Galveston-Houston Electric Company:					
October, 1909	102,014	64,052	37,362	22,486	14,876
October, 1908	94,348	52,843	41,506	20,192	21,313
Massachusetts Electric Companies:					
Year ended Sept. 30, 1909	8,052,351	5,148,393	2,903,958	1,778,129	1,125,829
Year ended Sept. 30, 1908	7,809,010	5,001,517	2,807,492	1,784,437	2,023,054
Minneapolis General Electric Company:					
October, 1909	94,364	37,521	56,843	31,560	25,283
October, 1908	86,670	34,790	51,880	32,500	19,293
Northern Ohio Traction & Light Company:					
October, 1909	184,815	100,866	84,011	44,114	39,903
October, 1908	157,532	90,258	67,273	43,778	23,495
Puget Sound Electric Railway Company:					
October, 1909	170,199	110,591	59,608	49,777	9,831
October, 1908	142,636	91,462	51,174	44,257	6,917
Seattle Electric Company:					
October, 1909	544,077	326,201	217,876	102,169	115,707
October, 1908	401,934	233,624	168,310	97,085	71,225

GENERAL NEWS

Construction News.

FORT PAYNE, ALA.—The City Council has granted a franchise to George H. Edwards, of Birmingham, Ala., to construct and operate an electric light and power plant. A company will soon be formed by the citizens of Fort Payne and Monroe, La. The proposed plant will be operated in connection with the power plant now being installed by the Fort Payne Fuel & Iron Company. The franchise is for a term of five years and under which the company is to furnish the town five arc lamps free of charge. It is understood that work will commence at once on construction of the system. E. C. Drew is president of the Fort Payne Fuel & Iron Company.

GLOBE, ARIZ.—J. B. Girand is reported to be interested in a project to establish an electric street railway in Globe and also a railway to extend from Globe to Miami.

PHŒNIX, ARIZ.—A petition is being circulated in Phœnix, drawn up by a committee appointed by the business men and the officers of the Maricopa County Commercial Club, addressed to the Common Council of Phœnix, asking the Council to request Congress for an authorization of a $200,000-bond issue, the proceeds to be used for the construction of a municipal electric light plant.

WHIPPLE BARRACKS, ARIZ.—The contract for the construction of an electric lighting system at Whipple Barracks, bids for which were opened Nov. 10, was awarded to the Central Electric Company, of San Francisco, Cal., for $12,795. Lieut. William A. Alfonte is constructing quartermaster.

WILLCOX, ARIZ.—It is reported that a power plant will soon be installed at the Mascot Copper Company's mine, near Dos Cobezas.

HOLLYWOOD, CAL.—Bids are being asked for the installation and maintenance of a public lighting system in Hollywood for a period of years. George H. Field is city clerk.

MARYSVILLE, CAL.—The trustees of Reclamation District No. 70, of Sutter County, have awarded a contract for the installation of a new motor and entire electrical equipment, including the transformer, for the large drainage pump of the district. The contract price was $3,650. The Pacific Gas and Electric Company is erecting a new electric line from Marysville to Meridian, a distance of 20 miles, which will furnish the district with electricity for the operation of the pumping plant. The new transmission will also furnish electrical service to all residents of the district along the route.

MERIDIAN, CAL.—The Trustees of Reclamation District No. 70 have awarded a contract for the installation of a 150-hp motor with complete electrical equipment and a 30-in pump for the seepage water pump in the district to Fairbanks, Morse & Company, of San Francisco. Cal.

MONTEREY, CAL.—The Supervisors have granted a franchise for a transmission line between Salinas and Monterey to the Monterey Gas & Electric Company, for which it paid $100.

PASADENA, CAL.—The City Council has established a new rate for electrical energy, making the price three cents per kw-hour to consumers using over 2000 kw per month furnished by the municipal electric light plant. This is said to be the lowest rate for electrical service in the United States. C. W. Koiner is general manager.

REDDING, CAL.—W. P. Hammon is reported to have acquired two valuable water rights in the eastern part of Shasta County, and it is predicted that another electric power development on a large scale will soon come to the surface. Mr. Hammon is the head of a power development project at Lake Tahoe. W. W. Brown, who owned 1,160 acres on Hat Creek, near the town of Cassel, a few months ago, sold his tract for $15,000. The Brown land includes a lake called Brown's Lake and the property carries with it 8000 in. of water that originates in springs on the land. It is learned from San Francisco that J. S. Frick, of Redding, who has spent several months at the bay, has closed a contract to sell 40,000 inches of Hat Creek water to Mr. Hammon for $65,000. Two small payments have been made to bind the contract. The whole amount is to be paid by Jan. 1, or as soon as the titles are cleared up in the Probate Court. The Frick water right adjoins Brown's on the north, and is valuable, because 187 ft. fall can be secured in less than half a mile. By building a 75-ft. dam on the Brown property, a large storage reservoir of 600 or 700 acres can be formed.

SACRAMENTO, CAL.—Bids will be received at the office of M. J. Desmond, city clerk, for lighting the streets and departments of the City of Sacramento for a term of one year from Dec. 31, 1909.

SACRAMENTO, CAL.—Judge James A. Waymire is working on a project to irrigate the northeastern portion of Sacramento County. It is proposed to build a large dam at Auburn, near the entrance of Truckee River. The water will be brought from Lake Tahoe in conduits, which will have a carrying capacity of 500,000,000 gal. daily. The work will also include the cutting of a tunnel five miles long through the mountains. In the course of the canal or conduit to the Auburn reservoir, sufficient fall will be secured to generate electricity to the extent of 230,000 hp. There will be five falls, the first of which will have a drop of 900 ft.; second fall, 400 ft.; third fall, 1,500 ft.; fourth, 700 ft., and fifth, 500 ft. A company will be organized capitalized at $50,000,000 to carry out the project.

SAN BERNARDINO, CAL.—Arrangements are being made by the Arrowhead Reservoir Company for the construction of its large tunnels which are to connect the Deep Creek reservoirs with the main reservoir in Little Bear Valley. The work will be done by the company direct instead of by contract. Preparations are being made for the erection of a transmission line to transmit electricity across the crest into Little Bear and Deep Creek country to operate the drills. It is understood that the Arrowhead company has entered into a contract with the Edison Electric Company to furnish electrical energy for the work. V. C. Smith is general manager of the Arrowhead Reservoir Company.

TEHACHAPI, CAL.—S. A. Barrett, of Los Angeles, Cal., has been making investigations in Tehachapi with a view of furnishing electricity in the town for lamps and motors.

VALLAJO, CAL.—We are informed that work will commence next year on the construction of the Vallejo & Northern Railroad, which will extend from Sacramento to Woodland, Davis, Suisun, Vacaville, Fairfield, Dixon, Winters and Vallejo, a distance of 110 miles. The overhead trolley system will be used on the city lines and the third rail on the interurban lines. The company is capitalized at $2,500,000. T. T. C. Gregory, of Fairfield, is president.

VISALIA, CAL.—The California Hot Springs Company has filed a notice of appropriation of 1000 miners' in. of water in Deer Creek to be utilized for generating electricity and for irrigation purposes, etc.

DENVER, COL.—Plans have been practically completed for the reorganization of the Denver Gas & Electric Company and will be submitted to Henry L. Doherty, president, for approval. The certificate of the incorporation of the new company, the Denver Gas & Electric Light Company, with an authorized capital stock of $10,000,000, has been filed with the Secretary of State. The new company will operate the local steam heating system, which will be thoroughly remodeled. A bond issue to the amount of $25,000,000 has been authorized to take care of improvements and extensions that would be required for a number of years. It is estimated that improvements to the steam heating plant will cost about $750,000.

GRAND JUNCTION, COL.—Preparations are being made by the Grand Junction Street Railway Company for the construction of an electric railway to Fruita, a distance of 15½ miles. Electric locomotives will be used; electricity for operating the railway will be secured from the Grand Junction Electric, Gas & Manufacturing Company. Thomas E. Curtin is president of the company, and E. A. Sunderlin general manager, both of Colorado Springs, Col.

LEADVILLE, COL.—The Leadville Light & Power Company is reported to be extending its transmission lines to the Sugar Loaf mining district to supply electricity in that district for lamps.

BRIDGEPORT, CONN.—Plans are being prepared by the Locomobile Company of America for an addition to its plant at Seaside. The installation of a turbine unit is under consideration.

NEW MILFORD, CONN.—The plant and holdings of the New Milford Electric Light Company have been purchased by Verton P. Staub and E. J. Emmons, representing local business men. The new owners are planning to establish a 24-hour service and will also furnish electricity for both lamps and motors. At present the company only furnishes a lighting service. The price paid for the plant is said to have been about $75,000.

CLARKESVILLE, GA.—It is reported that the Clarksburg Railway Company will enlarge its power plant upon completion of its proposed extension to Nacoochee Valley. The installation of a turbine unit is under consideration.

WEISER, IDAHO.—The Lewishon Brothers, who have purchased the Iron Dyke property in the Seven Devils district, it is said, contemplate the construction of a smelter near Ballard's Landing on the Snake River to handle the ore from their mines and other mines in that district, and will also build an electric line from the Seven Devils district down the Snake River from Huntington to Lewiston. It is reported that they have also secured an option on the Ox River electric project on the Snake River near the proposed site of the smelter. The electric power plant when completed will have an output of about 30,000 hp. A tunnel 35 ft. in circumference is being driven through solid rock for 2000 ft., which will change the channel of the river. Work has been in progress more than three years and the total cost of the work is estimated at $3,000,000.

ALTON, ILL.—Preparations are being made by the Alton Tool Handle Company to remodel its plant and equip it for electric motor drive throughout.

EASTON, ILL.—Plans are being considered by several rural telephone companies which run into Easton to consolidate and operate an

exchange. It is proposed to organize a company and install a switch board and other equipment. Considerable improvements will be made to country lines. J. F. McKinley was appointed president; C. W. Kennedy, secretary, and A. Tomlin, treasurer.

BLUFFTON, IND.—The directors of the Bluffton, Geneva & Celina Traction Company have decided to install the overhead trolley system. The use of self-contained motor cars had received serious consideration.

BRISTOL, IND.—The St. Joseph Valley Traction Company, of Elkhart, has been granted a franchise by the Trustees to build an electric railway through Bristol. H. E. Bucklen is president.

DECATUR, IND.—We are informed that the Fort Wayne & Springfield Railway Company expects to construct 28 miles of track during the coming year. W. H. Fledderjohann is general manager.

EVANSVILLE, IND.—It is reported that the Evansville Railways Company, which operates traction lines from Evansville to Newburg and Rockport, Ind., will extend its system across the Ohio River to Henderson and Owensboro, Ky.

EVANSVILLE, IND.—C. A. Gillham, secretary and general manager of the Central Station Engineering Company, is representing an applicant for a franchise to establish a central heat, light and power plant, which proposes to erect a system in Evansville to cost about $1,000,000. The Board of Public Works is now considering the proposition submitted to the Council.

INDIANAPOLIS, IND.—Plans are being made by the Star Motor Company for the construction of a factory in Indianapolis, Ind., including the installation of a power plant. The plant will be equipped with electric motor-driven machinery.

SOUTH BEND, IND.—The City Council has passed a resolution ordering all electrical wires placed underground, giving the companies four years to do the work.

SYRACUSE, IND.—The hydroelectric power plant of the Syracuse Electric Power Company, located on the Elkhart River, six miles from Syracuse, has been completed. The company has erected transmission lines from the plant to Syracuse, Milford and Benton, 17 miles in length, to supply electricity for lamps and motors to these towns, and also to furnish electrical service to the farmers along the line. J. S. Neff is interested in the company.

DAVENPORT, IA.—A special meeting of the stockholders of the Davenport & Manchester Interurban Railway Company will be held at Monticello on Dec. 14 to vote on the proposition to increase the capital stock of the company to $650,000. The company proposes to construct an electric railway from Davenport to Manchester.

LEON, IA.—The Leon Light, Heat & Power Company has filed amendments to its charter, changing its name to the Leon Electric Company and increasing the capital stock of the company from $15,000 to $30,000.

MASON CITY, IA.—The Mason City & Clear Lake Railway Company will soon place contracts for a 500 or 600-kw, 2300-volt, 60-cycle, three-phase generator, a simple Corliss engine and a 500-kw, 600-volt rotary converter.

OSKALOOSA, IA.—Col. T. P. Spillman, of Ottumwa, Ia., is reported to be interested in the construction of an electric railway extending from Oskaloosa to Ottumwa, for which most of the right of way from Ottumwa to Eddyville, via Kirkville, has been secured.

THURMAN, IA.—The Malvern Light & Power Company is reported to have submitted a proposition to the town officials offering to extend its transmission from Tabor to Thurman, providing a 20-year franchise is granted and the town agrees to enter into a contract with the company to furnish 30 incandescent lamps of 32 cp for street lighting at $1.25 per lamp per month and the people of Thurman to take $5,000 in bonds.

KANSAS CITY, KAN.—Sealed bids will be received at the office of the purchasing agent of the City of Kansas City until Dec. 23 for one 15-ton electric traveling crane and one 15-ton automatic air lift, to be installed at the Turkey Creek pumping station of the Kansas City water works, specifications for which will be furnished on application. E. Winstanley is purchasing agent.

COVINGTON, KY.—The Cincinnati, Louisville, Lexington & Maysville Traction Company has applied to the City Council for a franchise over the streets of the city necessary to secure an entrance through the town to the river.

COVINGTON, KY.—Application has been made to the City Council by the Covington & Big Bone Railway Company for a franchise to construct an electric railway through certain streets in the city for interurban service; also to operate a trunk line over other streets, which will give an entrance for its railway connecting Covington and Big Springs.

LOUISVILLE, KY.—The Kentucky Electric Company is planning to make improvements to its plant in this city, which will involve an expenditure of about $40,000. The company proposes to secure its water supply from the Ohio River and will construct a pipe line 150 ft. in length into the river. The contract for the work has been awarded to the Falkenau Electrical Construction Company, of Chicago, Ill.

LAKE CHARLES, LA.—It is reported that the Lake Charles Railroad & Navigation Company is contemplating the construction of an electric railway from Edna to Kinder, La., six and one-half miles in length.

NEW ORLEANS, LA.—Plans are being made by the stockholders and bondholders of the Consumers' Electric Company to reorganize the company and take it out of the receiver's hands. It is proposed to organize a new company to take over the plant and holdings. The business of the company has increased to such an extent under the administration of the receiver that it is necessary to enlarge the plant, which, it is said, will require an expenditure of about $1,000,000. Samuel Insull, president of the Commonwealth Edison Company, is receiver.

PLAQUEMINE, LA.—The franchise and property of the Plaquemine Electric Light & Power Company was sold at auction on Nov. 27 to Attorney J. H. Pugh, for $8,500. There are judgments against the company for $13,000. The buildings and equipment of the company was destroyed by fire Nov. 1. It is understood that a new company will be organized.

RAMSAY, LA.—It is reported that the Greenlaw Lumber Company is installing an electric light plant.

PORTLAND, MAINE.—Bids for electric work and ventilating and heating the new city hall (which were opened Dec. 1) were rejected and new bids for the work will be solicited. Carrere & Hastings, 225 Fifth Avenue, New York, N. Y., and John Howard Stevens, 187 Middle Street, Portland, Maine, are architects. A. L. T. Cummings is city clerk.

WATERVILLE, MAINE.—The Messalonskee Electric Company, of Waterville, which has purchased the water privilege of Besse & Morrison, located about 1½ miles from Clinton, Maine, is making preparations for cutting a canal and building a concrete dam.

ESSEX, MASS.—The question of lighting the streets by electricity is under consideration. It is said that a proposition has been submitted to light the entire town by the installation of 100 lamps for $1,600 per year. The town now pays $400 per year for the care of 30 lamps lighted 20 nights in the month.

PITTSFIELD, MASS.—The Pittsfield Electric Company is reported to be considering the question of increasing the output of its plant at Silver Lake.

SPRINGFIELD, MASS.—Sealed proposals will be received by the Municipal Building Commission, Municipal Building, Springfield, Mass., until Dec. 22, as follows: Contract No. 3—Heating and ventilating; Contract No. 4—Electric work; Contract No. 5—Plumbing for the auditorium, tower and passage and municipal office building of the new municipal buildings to be erected by the City of Springfield, in Court Street, facing Court Square. Copies of drawings and specifications may be seen at the Municipal Building, at the office of the architects, Pell & Corbett, 122-124 East Twenty-fifth Street, New York, N. Y., or at the office of Hollis French & Allen Hubbard, Albany Building, Boston, Mass., copies of which may be obtained by application to any of the above parties; a deposit of $25 will be required for each set of plans and specifications for any one of the contracts, of which $15 will be refunded on return of the plans in good condition. George Dwight Pratt is chairman Municipal Building Commission.

WORCESTER, MASS.—The contract for electric wiring of the independent industrial school has been awarded to the Coghlin Electric Company for $1,475.

DETROIT, MICH.—Plans are being considered by the Detroit Copper & Brass Rolling Mills for increasing the equipment of its power plant, which will include the installation of alternating-current generators with a rating of about 1500 hp with auxiliary apparatus. The plant will be driven by steam turbines.

GRAND RAPIDS, MICH.—Bids will be received at the office of the Board of Public Works until Dec. 16 for furnishing and erecting mechanical furnace equipments for two boilers at the combination pumping and lighting plant in the City of Grand Rapids, Mich., in accordance with plans and specifications on file at the office of the board. All proposals must be made upon blanks furnished by the board. William M. Gormley is president.

HANCOCK, MICH.—The Board of Public Works has recommended to the City Council the purchase of a pumping engine or a centrifugal pump, motor driven, in connection with the water works system.

LAINSBURG, MICH.—J. Naldrett has submitted a proposition to the village authorities offering to furnish electricity to light the streets of the village. He proposes to furnish 40 lamps for $900 per year.

MINNEAPOLIS, MINN.—Bids for wiring the Seward and Seven Oaks School buildings (which were opened Nov. 30) were rejected. Plans for the work will be revised. W. G. Nye is secretary Board of Education.

THIEF RIVER FALLS, MINN.—The Northwestern Telephone Company has applied to the City Council for a franchise to erect and operate a telephone system in Thief River Falls.

JACKSON, MISS.—The plant and holdings of the Jackson Electric Railway, Light & Power Company, owned by Frank Jones and Gen. Carnes, of Memphis, Tenn., have been taken over by F. B. Prout and H. H. Carson, of the General Electric Company and local capitalists. The price paid for the property was about $1,000,000. The company operates about seven miles of track and furnishes electricity for lighting the streets of the city. Thomas McClelland, it is said, will be president and Mr. Prout, general manager.

BUTLER, MO.—We are informed that the city is in the market for a 50-kw, 125-250-volt, three-wire, direct-current unit with an automatic direct connected steam engine, switchboard, instruments, etc., complete.

tor the municipal electric light plant. A 250-volt unit with balancing set could be used, new or second hand. For further information address H. M. Cannon, superintendent.

FERGUSON, MO.—The City Council has decided that the King Electric Light & Power Company, of St. Louis, Mo., which furnishes electrical service in Ferguson, must reduce the price of electricity from 15 to 10 cents per kw-hour or forfeit its franchise, the new rate to take effect from Dec. 1, 1910.

JEFFERSON CITY, MO.—The Big Naunga Power Company, recently incorporated, is reported to be contemplating the construction of a hydroelectric power plant in Jefferson City. A dam will be constructed at a cost of from $35,000 to $45,000, which will develop from 1600 to 2000 hp. I. Phillips, of Buffalo, Mo., is president.

CLAY CENTER, NEB.—M. M. Johnson, of this city, is installing an electric light plant, which will be operated in connection with his factory. Larger engines are now being installed to furnish power for the system. The distributing system is nearly completed, for which a franchise was secured from the town sometime ago. It is expected that electrical service will commence within 30 days.

NEBRASKA CITY, NEB.—At a special election held recently the citizens voted in favor of the proposition to give the Nebraska City Water & Light Company a 20-year franchise and a contract to supply the city with water and for lighting the city for a term of ten years. The company has agreed to extend its water and lighting systems to all parts of the city not having lighting service and to expend from $40,000 to $50,000 in improvements.

CLAREMONT, N. H.—The Monadnock Cotton Mills are installing a hydroelectric power plant with a rating of 850 hp, in two units, the power to be utilized to operate the mills.

MEREDITH, N. H.—Improvements are being made to the power plant of the Meredith Linen Mills, which include the installation of a new pipe line, a pair of S. Morgan Smith water wheels, which will operate the linen mills and also a small generator, which will furnish electricity to run motors in a wood-working plant.

NEWARK, N. J.—Plans are being considered by the Pennsylvania Railroad Company for the construction of a new branch road to extend from Park Place, Newark, to Harrison, N. J. The tracks from Harrison to Jersey City will be equipped for electrical operation, and a direct track connection made with the Hudson & Manhattan Railroad, east of the Marion station, Jersey City.

PRINCETON, N. J.—Plans are being considered by the Borough Council for improving the lighting system of the borough. It is said that municipal ownership is under consideration. Prof. Howard McClenahan, of Princeton University, is consulting engineer.

BROOKLYN, N. Y.—Sealed proposals will be received by Bird S. Coler, borough president, until Dec. 15 for gas and electric fixtures for the public bath located at Fourth Avenue and President Street, Borough of Brooklyn, N. Y. Blank forms and further information may be obtained and plans and specifications can be seen at the office of the Bureau of Public Buildings and Offices, Municipal Building, Borough of Brooklyn, N. Y.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company is contemplating extensive developments to its system, which will involve an expenditure of about $50,000,000. The plans contemplate the following extensions: To equip and operate the Fourth Avenue subway; to extend its Fifth Avenue elevated railway as an elevated road to Fort Hamilton; to elevate its West End line from Coney Island to Eighteenth Avenue, and depress the tracks from that point north to Forty-second Street, where they will run into the Fourth Avenue subway; to elevate its Sea Beach road from Coney Island to the point where it joins the West End line; to elevate its Culver line its entire length; to extend its Brighton Beach division, as already announced, by subway to Flatbush Avenue and Fulton Street and thence via the Fourth Avenue subway, the Manhattan Bridge and the Canal Street subway to Manhattan, to a loop at the North River; to third track its Fulton Street line; to third track its Lexington Avenue line; to third track its Broadway line; to make various extensions to its elevated system in the eastern district with a view to furnishing the East New York and Ridgewood sections with a much better transportation service than at present exists.

GLOVERSVILLE, N. Y.—The Fonda, Johnstown & Gloversdale Railroad Company has decided to equip the section of its steam railroad lying between South Main Street, Gloversville and the fair grounds crossing, in Johnstown, to be operated by electricity.

KINGS PARK, N. Y.—Bids will be received by the State Commission in Lunacy, Albany, N. Y., until Dec. 15 for the construction of a power plant, connecting mains, electric feeder cables to laundry, transformers and distributing board at the Kings Park State Hospital, Kings Park. Plans and specifications may be seen and blank form of proposal obtained at the Kings Park Hospital, Kings Park, N. Y.; at the office of the State Commission in Lunacy, 1 Madison Avenue, New York, N. Y., and at the office of the state architect. T. E. McGarr is secretary of commission.

NEW YORK, N. Y.—The Board of Estimate and Apportionment has adopted a resolution requesting the Public Service Commission to prepare plans for the construction of a moving platform railway under Thirty-fourth Street extending from Ninth to Second avenues.

NEW YORK, N. Y.—Bids will be received by John H. O'Brien, Commissioner of Water Supply, Gas and Electricity, 21 Park Row, New York, N. Y., until Dec. 14 for furnishing materials and installing two direct connected electrically driven vertical pumping units, complete with all appurtenances, including electric lighting installation in the pumping station to be erected for the sewage disposal plant in Mount Kisco, N. Y. Further information may be obtained upon application to the chief engineer, Room 922, 21 Park Row, New York, N. Y.

NEW YORK, N. Y.—Bids will be received by the Department of Public Charities, foot of East Twenty-sixth Street, New York, N. Y., until Dec. 13 for furnishing all labor and materials required for completion of a hospital pavilion, including lighting, fixtures and all other work in connection with the New York City Home for the Aged and Infirm, Blackwells Island, N. Y. Blank forms and further information may be obtained at the office of Raymond F. Almirall, architect, 51 Chambers Street, New York, N. Y., where plans and specifications can be seen. Robert W. Hebberd is commissioner.

SENECA FALLS, N. Y.—The Geneva & Auburn Railroad Company is contemplating the construction of a power plant with an output of about 1500 hp to furnish electricity to operate a 15-mile extension.

DANBURY, N. C.—We are informed that contracts will be placed by the North Carolina Traction Company within 60 days for the construction of 80 miles of railway. The Traction company is successor to the Crescent Electric Railway Company. E. Hillman is president of the Traction company.

BOWLING GREEN, OHIO.—Orders have been placed by the Lake Erie, Bowling & Napoleon Railway Company for rails to be used for the proposed extension of its railway.

CINCINNATI, OHIO.—The Ohio Electric Railway Company has commenced work on the overhead system of the old Columbus & Lake Michigan Railroad between Lima and Defiance. The company states that steam will be used for hauling freight, and electricity for passenger service.

CLEVELAND, OHIO.—An ordinance granting the Cuyahoga Light Company to extend its heating and lighting system throughout the entire downtown section of the city and easterly to East Fortieth Street has been submitted to the City Council. It is said that the company will commence work on the construction of a large plant on the lake front, to cost $1,000,000, as soon as the ordinance is passed. At present the company's service only extends as far east as East Twentieth Street and is confined to Prospect Avenue alone for the greater part of the distance. A clause in the ordinance makes it possible for the company to make extensions in any direction from this territory. It has only certain rights in the downtown section. Under the ordinance the company is permitted to charge the rate of 5½ cents per kw-hour for electricity, and provision is made giving the Council the right to regulate prices in accordance with the law. It is also stipulated in the ordinance that the Cuyahoga Light Company shall forfeit all rights if it should consolidate or merge in any way with the Cleveland Electric Illuminating Company without permission of the Council. John C. Keys is president of the Cuyahoga Electric Company.

ENID, OKLA.—Application has been made to the City Council by L. J. Downey for a franchise to construct and operate an electric light plant in Enid.

LAWTON, OKLA.—At a recent election the citizens voted to grant a franchise to the Lawton & Fort Sill Electric Railway Company, which proposes to construct and operate a street railway system in Lawton and an interurban line to Fort Sill and Medicine Park, a distance of 20 miles. The company has just purchased property in Medicine Park, in the Wichita Mountains, which it proposes to develop for a pleasure resort. The War Department has granted the company right of way through the Fort Sill military reservation for its proposed electric railway.

POTEAU, OKLA.—C. F. Eshelman, manager of the Poteau Light & Ice Company, writes that as yet no definite plans have been made for the construction of its proposed light and ice plant.

RALSTON, OKLA.—Bids will be received until Dec. 15 for furnishing material and construction of a complete electric light plant and water works system for Ralston. The work will include well, building, triplex power pumps, alternating-current dynamo, oil engine, steel tank and tower, poles, wire, cast iron pipe, etc. Bids will also be received at the same time for the purchase of $25,000 in bonds. M. A. Earl & Company, of Muskogee, Okla., are engineers. T. E. Bryant is city clerk.

OREGON CITY, ORE.—Surveys are being made for the construction of an electric railway from Oregon City to Silverton. F. M. Swift is reported to be interested in the project.

CHAMBERSBURG, PA.—We are informed that improvements will be made to the municipal electric light plant, bids for which will be received until Dec. 23. The cost of the work is estimated at about $25,000. J. H. Mowrey, of Chambersburg, Pa., is chief engineer.

CONSHOHOCKEN, PA.—Preparations are being made by the Schuylkill Valley Traction Company to reconstruct its system through Conshohocken during the coming year, preparatory to an extension of its tracks to Spring Hill. George Hoeger, of Norristown, Pa., is general manager.

DUQUESNE, PA.—The Duquesne & Dravosburg Street Railway Company has awarded contracts for all material for its proposed electric railway, with the exception of overhead material. Electricity for operating the system will be purchased for the present. The proposed

railway will extend from Duquesne to Dravosburg, via Duquesne Annex and Mifflin Township, a distance of three miles.

EAST GREENWICH, PA.—The Borough Council has granted W. R. Chapin, of Wyoming, Pa., a franchise to construct and operate an electric light plant in East Greenville.

GROVE CITY, PA.—Preparations are being made by the Slippery Rock & Grove City Street Railway Company to commence work about the first of the year on its proposed railway between Grove City and Slippery Rock, a distance of nine miles. The capital stock authorized is $55,000. Application will be made at once to increase it to $250,000 H. B. Graves, of Butler, Pa., is chief engineer.

PHŒNIXVILLE, PA.—The construction of an electric railway from Phœnixville to Strafford, a distance of ten miles, is under consideration. Thomas E. O'Connell, of West Chester, Pa., is reported to be interested in the project.

PITTSBURGH, PA.—The Jones & Laughlin Steel Company, which has recently placed large orders for generating machinery for its new plant at Aliquippa, it is said, will purchase motors and other equipment for electric motor-driven machinery.

PITTSBURGH, PA.—Proposals will be received at the office of the controller until Dec. 10 for the gas and electric light fixtures for men's dormitory and buildings 1, 2 and 3 of administration group of the Allegheny County Home, at Woodville, Pa.; also for a telephone system for same buildings. Plans, specifications and blank forms of proposals may be obtained at the office of Andrew McMaster, architect, Curry Building, Four Avenue and Ross Street, Pittsburgh, Pa. R. J. Cunningham is county controller.

SCRANTON, PA.—Among the improvements contemplated by the Scranton Electric Company during the coming year, besides the construction of a central power plant mentioned in the issue of Dec. 1, include an addition to the Suburban plant located on North Washington Avenue for the installation of a new switchboard, engines and generators, and a 5000-kw steam turbine. The company also contemplates tearing down the Dix Court power house and erecting a steel building; the output of the plant has recently been increased from 800 to 1600 hp by the installation of two new engines; a new switchboard is now being installed. At the Lackawanna River plant a 300-hp engine is being installed and a new pump house erected. L. H. Conklin is general manager.

YORK, PA.—Only one bid was received by the City Council for lighting the streets of the city, which was submitted by the Edison Electric Light Company, in which the company asks $60 per year for each arc lamp, which is $11 more than the city is now paying. The company also refuses to sign a contract for less than five years. The Council considers the bid excessive and has instructed the light committee to secure estimates on the cost of the construction of a municipal electric light plant and to compare the cost of street lighting in York with that of other cities.

PEACE DALE, R. I.—The Peace Dale Manufacturing Company is installing a 900-kva, low pressure steam turbo-generator set to furnish electricity for operating the electric motor-driven machinery in its plant.

PROVIDENCE, R. I.—The Narragansett Electric Lighting Company has purchased a site on Bough Street in the Olneyville district, on which it will erect a substation for the distribution of electricity throughout the district.

WOONSOCKET, R. I.—The Woonsocket Electric Machine & Power Company has secured a contract from the Town Council of North Smithfield for lighting the streets of that town for a term of one year. The contract calls for 40 incandescent lamps to be placed in different parts of the town.

GREENVILLE, S. C.—Plans are being considered by the Union Bleaching & Finishing Company for improvements to its plant, including the installation of additional machinery, and changing the motive power of its works from steam to electric motor drive. Electricity will be secured from the Greenville transmission system of the Southern Power Company.

GREENVILLE, S. C.—The interurban line to be built by the Duke interests, starting with the recently acquired lines of the Anderson Traction Company, will be known as the Greenville, Anderson & Spartanburg Railway, the distance between each town being about 25 miles, Greenville being at the apex of the triangle formed by the three towns. It is reported that the system will be extended northeast to Charlotte and Greensboro, 200 miles distant.

ABERDEEN, S. D.—Plans are being made by the Aberdeen Street Railway Company for the construction of a local street railway system, contract for which will be awarded during the winter. The proposed railway will be four miles in length. As yet no definite arrangements have been made for securing electricity to operate the railway. C. N. Herrick is president.

RAPID CITY, S. D.—The Rapid City Electric Light Company is reported to have been reorganized and it is proposed to extend and improve the system.

HENNING, TENN.—Preparations are being made by J. R. Gregory, J. B. Alston and J. W. Wilson for the construction of a 30-kw electric light plant and a 10-ton ice plant. Plans as yet have not been completed.

ANGLETON, TEX.—E. M. Masterson is reported interested in a project to establish an electric light plant in Angleton, Tex.

MINERAL WELLS, TEX.—The contract for the construction of an interurban railway from Fort Worth to Mineral Wells has been signed by the interurban committee of this city, and Judge James A. Watkins and Paul Hurley, promoters of the Mineral Wells & Northwestern Railway Company, which was recently chartered for the purpose of constructing the railway.

MT. PLEASANT, TEX.—The Gilmer Telephone Company has been granted a franchise by the City Council to erect telephone wires in Mt. Pleasant.

PORT ARTHUR, TEX.—Bids have been asked by the Port Arthur Traction Company for the construction of the road bed for its proposed railway from the city limits along the Seventh Street road extension to the docks and the Gulf Refining Company. The road will be built on private right of way.

SALT LAKE CITY, UTAH.—C. J. Petgen, of Pittsburg, Pa., has filed application with the state engineer for permission to appropriate ten second ft. of water from the Cottonwood Creek, in Plute County, to be utilized to generate electricity.

SALT LAKE CITY, UTAH.—Plans are being considered by Mayor John S. Bransford for the construction of a municipal electric light plant, to cost at least $50,000. It is proposed to establish the plant at or near Parley's Canyon reservoir, which will supply electricity for operating the pumps at the sewage plant at Seventh North and Eighth West Streets to the intercepting sewer, also for lamps in the business district. It costs the city $60,000 per year to light the city under the present contract with the Utah Light & Railway Company, and it is estimated that it will cost the city about $15,000 for power to operate the sewage pumping plant.

NORTHFIELD, VT.—Preparations are being made to extend the municipal electric light system to Northfield Junction to furnish electricity for lamps. Several residences and the Davis woolen mill will install electric lamps, and it is expected that street lamps will also be installed.

BEDFORD CITY, VA.—The Town Council has decided to call an election Dec. 29 to vote on the proposition to issue $95,000 in bonds, the proceeds to be used for the construction of a hydroelectric power plant on James River.

KIMBALL, VA.—Surveys have been completed by J. S. Shaw, of Algoma, W. Va., for the proposed electric light plant and water-works system to be established in Kimball. Work will commence at once on construction of the plants. L. Kaufman, of Northport, will do the construction work. The cost of the work is estimated at $100,000.

RICHMOND, VA.—The sum of $600,000 will be expended in general improvements by the Virginia Railway & Power Company, of Richmond, according to an announcement made public by President Northrup, which will include a new terminal station in Manchester, across the James River, from Richmond, and the installation of new high-speed motor equipment for the Richmond-Petersburg 30-mile interurban railway, with terminals in Manchester. Terminal improvements in Richmond are to be included, also the purchase of new cars for local use and other railway equipment and betterment of service.

ROMNEY, W. VA.—The Boston Water Development Company is reported to be interested in the construction of a hydroelectric power plant. Richard F. Barrey is president of the company.

MABTON, WASH.—The Yakima Valley Power Company is reported to have been granted a 15-year franchise by the City Council to install an electric light plant in Mabton.

NORTH YAKIMA, WASH.—The City Council has decided to purchase the electric light plant and water works system of the Northwest Light & Water Company in North Yakima, for $310,000.

SEATTLE, WASH.—The Union Pacific Railroad Company is reported to have purchased the Puget Sound Electric Company's Seattle-Tacoma railway as a part of an electric railway system to be establihsed in the Northwest.

TACOMA, WASH.—The Commissioner of Public Works has asked the City Council to advertise at once for bids for the construction of the power canal and headworks of the proposed municipal electric plant on the Nisqually River. The plant when completed will cost about $2,000,000.

TUMWATER, WASH.—The Tumwater Power Company has offered to furnish several arc and tungsten lamps to the city free of charge, the location of the lamps to be decided upon by the City Council. L. F. Schmidt is interested in the company.

BELLEVIEW, W. VA.—Contracts have been awarded by the Fairmont & Northern Railroad Company for the construction of an electric railway from Belleview to Amos, W. Va., a distance of 12 miles.

KENOSHA, WIS.—Robert D. Wynn, vice-president of the Central Engineering & Construction Company, which has charge of the construction of a belt of electric railways in Northern Illinois and Southern Wisconsin, has presented a proposition to the City Council for the construction of a new electric railway into Kenosha in order to connect with the electric railways now honeycombing the northern part of Illinois. If the proposition meets with the approval of the citizens it is proposed to apply to the Wisconsin Railway Commission for a certificate of necessity and convenience for building a railway to be known as the Kenosha, Rockford & Elgin Electric Railway Company.

LAKE MILLS, WIS.—The question of purchasing the plant of the Creamery Package Company, to be used as a municipal lighting plant, is under consideration. A special election will be held to submit the proposition of the people.

MADISON, WIS.—Application has been made to the State Commission for a certificate of convenience and necessity in connection with a proposed electric interurban railway between Madison and Janesville, Wis. A company composed of local and New York capitalists has acquired control of the Janesville Street Railway Company, which, with its present Rockford and Beloit interurban systems, will give it an electric interurban service between Madison, Wis., and Chicago, Ill. The price paid for the Janesville street railway was about $45,000.

MILWAUKEE, WIS.—The Council joint committee on health and street lights has decided to recommend to the Council the employment of the Power Improvement Company, at a cost of $400, to investigate not only all the uses to which the surplus power of the new garbage plant can be put, but the utilization of surplus power from all city heating and lighting plants.

PORTAGE, WIS.—The Southern Wisconsin Power Company is erecting a substation in Portage at a cost of about $40,000, which will be used for the distribution of electricity generated at the Kilbourne dam.

LARAMIE, WYO.—The plant and holdings of the Laramie Light & Power Company is reported to have been purchased by Denver capitalists. The company has the contract for lighting the streets and public buildings and does a large commercial business. W. C. Parrish will be retained as superintendent.

FRANK, ALTA, CAN.—The Canadian-American Company is planning to install an electric power plant at its works in Frank. The plant will be driven by gas engines, the engines to be operated by waste gas from the coke ovens.

BURNABY, B. C., CAN.—The British Columbia Electric Railway Company has asked the Town Council that it be allowed the option to build an electric railway north of Burnaby Lake.

NEW WESTMINSTER, B. C. CAN.—Notice of application of 1200 cu. ft. of water rights of the Marquam River, to be utilized for power purposes, has been filed by C. T. Dunbar, of Vancouver, B. C. It is said that Mr. Dunbar proposes to organize a company to develop the water power to generate electricity.

PRINCE RUPERT, B. C., CAN.—The electric lighting plant and saw mill at Seal Harbor, owned and operated by the British Columbia Tie Timber Company, was destroyed by fire on Dec. 3. The total loss is $60,000, covered by insurance. The plant furnished electricity in Prince Rupert.

CORNWALL, ONT., CAN.—An agreement has been entered into between Cornwall Township and the Cornwall Electric Street Railway Company, whereby the company receives a franchise to extend its railway up the West Front Road over Wood's Hill to the Ontario & New York Railway depot.

HAMILTON, ONT., CAN.—The City Council has decided to enter into a contract with the Hydro-Electric Power Commission to supply the city with 1000 hp.

LONDON, ONT., CAN.—The Canadian Westinghouse Company has been awarded the contract for the electrical apparatus for the municipal electric lighting system, amounting to $50,908. The total amount of the bid of the company was $64,058, which included one motor-generator set and street arc lighting system, awards for which have been deferred.

LONDON, ONT., CAN.—The City Council on Dec. 1 ratified the agreement with the London Electric Light Company providing for a continuation of the street lighting at the old rate of 23 cents per lamp per night, until the municipal distribution plant is ready to light the streets with Niagara power next year. The agreement, however, provides that in case the city does not take the company's service for a full year that a sliding scale shall be paid according to the proportion of the year for which the company furnishes the service.

PORT ARTHUR, ONT., CAN.—The injunction to restrain Port Arthur from entering into a contract with the Hydro-Electric Power Commission has been made permanent. The injunction was secured on the ground that the proceedings to commit the town to the contract has been irregular and contrary to law and not because it was an unwise undertaking.

STRATFORD, ONT., CAN.—The report of the three arbitrators appointed to appraise the value of the Stratford electric lighting plant has been received by the city authorities. The amount is fixed at $58,800, consisting of $43,800 for plant and $15,000 for good-will. The latter is based on the average yearly profit of $2,324. Accordingly, a bylaw will be submitted to the ratepayers at the January municipal elections to raise this amount in order that the city corporation may take over the plant and business from the Stratford Gas Company.

WINDSOR, ONT., CAN.—The Sandwich, Windsor & Amherstburg Railway Company will soon place orders for two 500-kw, three-phase, direct-connected alternators, and also two 750-hp engines. James Anderson is general manager.

SHERBROOKE, QUE., CAN.—A proposition has been submitted to the City Council by W. Hibbard, of Montreal, Que., representing a new company, in regard to securing control of the local street railway. It is proposed to extend the railway throughout the city and ultimately to Magog. The new company wishes to purchase the Westbury Basin power rights, now held by the city, at $22,000. It also asks for a 50-year franchise, offering to give the city a percentage of the earnings after the first 20 years.

Personal.

MR. E. PINSON has been appointed director-general of the Compania Hidroelectrica e Irrigadora del Chapala, with headquarters at Guadalajara, Mexico.

MR. M. A. GURNEY, formerly representative of the Tungstolier Company in Iowa and Nebraska, has recently been appointed manager of the Chicago office of that company.

MR. O. S. MOORE, formerly a designer for the Western Electric Company, has been appointed chief engineer of the Fairbanks-Morse Electrical Manufacturing Company, Indianapolis, Ind.

MR. OSCAR C. TURNER has resigned from his position with the Warren Electric & Specialty Company to take the presidency of a jobbing company which is being formed in Birmingham, Ala., and which will commence business on Jan. 1, 1910.

MR. D. M. BLISS, formerly chief engineer for the Holtzer-Cabot Electric Company, Boston, and now with the Engineering Specialty Company, Stamford, Conn., has been appointed consulting engineer on the staff of the Edison Works, Orange, N. J.

PROF. B. F. BAILEY has returned to the department of electrical engineering at the University of Michigan, after serving for some time as chief engineer of the Fairbanks-Morse Electrical Manufacturing Company.

MR. SOLOMON A. SMITH was elected a director of the North Shore Electric Company, of Chicago, at the annual meeting on Nov. 29, to succeed Mr. Charles F. Spalding, deceased. Mr. Smith is second vice-president of the Northern Trust Company, of which his father, Mr. Byron L. Smith, is president.

MR. J. H. BRINKEROFF, long superintendent of the Rio Grande Junction Railway, Colorado, owned jointly by the Midland and Rio Grande railroads, has resigned to become assistant general manager and have charge of construction and operation of Grand Junction and Grand Valley electric interurban system.

MR. PERRY O. CRAWFORD, who until the date of its completion on Aug. 20, had charge of the design and installation of the Northern California Power Company's new south power house at Manton, Cal., has taken charge of the installation of the Inskip power house for the same company, with headquarters at Paynescreek, Cal.

MR. FRANK W. FRUEAUFF, president of the N. E. L. A., was married in Denver on the evening of Nov. 30 to Miss Antoinette Perry, of that city. Mr. and Mrs. Frueauff are at present on their honeymoon and will return to Denver again by the end of the present month. Among the numerous wedding gifts was a handsome Tiffany coffee set suitably engraved from the executive committee and staff of the N. E. L. A.

PROF. G. S. MACOMBER, of the Department of Electrical Engineering, Cornell University, gave an illustrated address on "Some Applications of the Cathode Ray Oscillograph" before the Ithaca A. I. E. E. Section on Dec. 3. The apparatus used to illustrate the lecture was that developed by Prof. H. J. Ryan some years ago, and upon which he made his famous determinations of the atmospheric losses on high-tension transmission lines.

MR. W. W. FREEMAN, second vice-president and general manager of the Brooklyn Edison Company, will return on Friday from an extended trip in the West. This trip was largely necessitated on account of important business matters of the N. E. L. A., of which Mr. Freeman is vice-president, and during the trip Chicago, Denver, St. Louis, Cincinnati and Pittsburgh were visited. While in Denver Mr. and Mrs. Freeman attended the wedding of Mr. and Mrs. F. W. Frueauff.

MESSRS. H. P. GIBBS, B. DWARKANATH and G. P. NARSIMIENGAR, of India, are visiting this country for the purpose of studying electrical developments. Mr. Gibbs is an American, but has been located in Bangalore for the past eight years and is now chief electrical engineer of the State of Mysore. He is a full member of the American Institute of Electrical Engineers. Messrs. Dwarkanath and Narsimiengar, who are native Hindoos, are superintendents of electric stations in the Bangalore.

MR. EDWARD H. GALL, general passenger agent of the Washington, Baltimore & Annapolis Electric Railway Company, has tendered his resignation. Mr. Gall will act as the special representative at Washington of a number of railroads and interstate electric railways. Mr. Gall became connected with the Baltimore, Annapolis & Washington Electric Railway soon after the opening of the latter line about two years ago in the capacity of publicity manager. He was soon promoted to the position of general passenger agent and given full charge of passenger traffic, still retaining his duties pertaining to general publicity. Prior to his railroad experience Mr. Gall was a Washington newspaper man.

MR. PAUL M. CHAMBERLAIN has opened an engineering office in the Marquette Building, Chicago. Mr. Chamberlain was graduated from the Michigan Agricultural College in 1888 and from Cornell University in 1890. For several years he was in practical work with the Brown Hoist Company, of Cleveland, Ohio; the Frick Company, engineers, of Waynesboro, Pa.; the Hercules Iron Works, of Aurora, Ill., and then accepted the assistant professorship of mechanical engineering at the Michigan Agricultural College. At the opening of the Lewis Institute in Chicago, he took charge of the engineering work there and coincidently carried on much consulting work with special reference to power production and factory methods. He resigned this position to act as chief engineer for the McCann Mechanical Works, of Los Angeles, Cal. Later he accepted the position as chief engineer of the Under-Feed Stoker Company of America, [illegible] half he has made a special study of

boiler room equipment, economy in fuel burning and smoke abatement. Mr. Chamberlain will devote his time to new designs and improvement of existing installations.

MR. EDWIN E. WITHERBY has severed his connection with the Susquehanna Railway, Light & Power Company and with the Railways Equipment Company, Ltd., of New York, with both of which companies Mr. Witherby has been long affiliated. Although Mr. Witherby's resignation became effective on Dec. 1, he will not actually sever his relationships until the first of the year. When the Union Gas & Electric Company, which was chiefly created by the efforts of Mr. Witherby, was merged with the United Gas & Electric Company, the latter was the holding company up to the formation of the Susquehanna Railway, Light & Power Company in 1906, which took over the operation of the properties of the United Gas & Electric Company. Mr. Witherby was chief engineer and assistant to the president of the Susquehanna organization and was vice-president of the Railways Equipment Company. As general manager of the United Gas & Electric Company, much of the present importance of the electric light companies at Colorado Springs, Col., Elmira, N. Y., Lockport, N. Y., Leavenworth, Kan., Richmond, Ind., and Lancaster, Pa., embraced in this organization, may be traced to his managerial abilities.

Obituary.

MR. L. L. C. BROOKS, of St. Paul, Minn., secretary and treasurer of the Tri-State Telephone & Telegraph Company, died on Nov. 29, of pneumonia, after a short illness. Mr. Brooks was a conspicuous figure in the Independent telephone field in the Northwest, and his death will be sincerely regretted. He was a quiet man, but his associates recognized his judgment as sound, and his opinions carried weight.

MR. J. K. WARNER DAVENFORT, electrical engineer for the Croker Williams Manufacturing Company, Pittsburgh, died suddenly following an operation on Nov. 27. Mr. Davenport was born 32 years ago at South Hadley Falls, Mass. He attended Cornell University and was graduated with the class of 1900, being given the degree of M.E. with special reference to electrical engineering. He leaves a widow and two children.

MR. A. E. DRESSER, manager of the Syracuse office of the Fort Wayne Electric Works, died on Sunday, Nov. 28, of heart disease, and was buried at Ithaca, Nov. 30. He was 46 years of age and had been in the employ of the Fort Wayne Electric Works as manager of their Syracuse office for 10 years, prior to which he was with the Fort Wayne Electric Corporation and formerly connected with the General Electric and Thomson-Houston companies. Mr. Dresser had a wide circle of friends in the electrical trade in central and western New York State, where he always resided.

Trade Publications.

COAL CUTTERS.—Much information relating to electric coal-cutting machines is given in bulletin No. 18, issued by the Jeffrey Manufacturing Company, Columbus, Ohio.

ELECTRICAL SUPPLIES.—The Central Electric Company, 264 Fifth Avenue, Chicago, Ill., has issued a 64-page price-list and discount-sheet applying to its general catalog No. 26.

STREET LIGHTING SUPPLIES, for incandescent lamps, including spring-suspended sockets, heads and brackets, are illustrated in a folder issued by the George Cutter Company, South Bend, Ind.

COPPER-CLAD WIRE.—The Duplex Metals Company, 149 Broadway, New York, has issued an illustrated folder showing the advantages arising from using a copper-clad trolley wire in combination with a feeder wire rather than a large copper trolley wire.

STEAM REGENERATORS.—The Rateau Steam Regenerator Company, 2 Rector Street, New York, has issued a well-prepared bulletin dealing in an instructive manner with low-pressure steam regenerators, steam turbines and direct-current turbo-generators.

HIGH-VOLTAGE DIRECT-CURRENT RAILWAY.—Bulletin No. 4673, issued by the General Electric Company, describes the Pittsburgh, Harmony, Butler & New Castle 1200-volt, direct-current railway. The bulletin contains numerous illustrations and gives a more or less detailed description of the road, its equipment and operation, and should be of interest to railway men.

MOTOR-GENERATOR SETS are important factors in the distribution of electrical energy. The functions of the motor-generator set and the methods of choosing the motor-generator best adapted for each condition have been clearly outlined in bulletin No. 116, published by the Crocker-Wheeler Company, of Ampere, N. J. There is also a considerable amount of interesting engineering information in this bulletin.

Business Notes.

MOORE ELECTRICAL COMPANY, of Newark, N. J., reports a brisk demand for the Moore light. Among recent customers for color matching in dye house and examining departments are: Botany Worsted Mills, Gera Mills, Forstman & Huffmann Company, and Garfield Worsted Mills, all of Passaic, N. J.

ELECTRIC COOKING.—The Central Electric Company, Chicago, Ill., has issued a folder descriptive of a combined electric stove and toaster of a new type. This is a universal device provided with a toasting drawer and a heating plate, so that one can prepare coffee and toast at the same time.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED NOV. 30, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

941,362. SYSTEM OF ELECTRICAL DISTRIBUTION; R. J. Dearborn, Wilkinsburg, Pa. App. filed Dec. 3, 1906. An alternating-current supply circuit, a current rectifier (rotary converter), a storage battery and transformer regulator connected to the circuit between the source of supply and the variable load so that the capacity of the former may be materially reduced.

941,363. TROLLEY CATCHER; C. I. Earll, New York, N. Y. App. filed Sept. 30, 1903. Automatically pulls down the trolley rope when the wheel leaves the wire. Improvements in a spring drum to which the rope is attached.

941,366. PRIMARY BATTERY; C. E. Hite, Burlington, N. J. App. filed April 15, 1907. A liquid tight battery with hard rubber lining and vertical partitions with a hard rubber rod supporting the electrodes.

941,372. SYSTEM OF ELECTRICAL DISTRIBUTION; P. M. Lincoln, Pittsburg, Pa. App. filed Dec. 3, 1906. A rotary converter, a storage battery and a booster generator between the main circuit and the rotary converter.

941,388. CROSS CONNECTIONS FOR DYNAMO ELECTRIC MACHINES; R. Siegfried, Pittsburg, Pa. App. filed Oct. 3, 1905. Uses a solid conducting ring segment which can be radially adjusted on one of the brush holder brackets by circumferential slots receiving bolts.

941,390. UNDERRUNNING CURRENT COLLECTOR; S. B. Stewart, Jr., Schenectady, N. Y. App. filed Nov. 23, 1904. A stand on the car roof carries a set of planeographic levers which support a shoe.

941,391. ELECTRIC CAR CONTROLLING SYSTEM; A. B. Stiszer, Philadelphia, Pa. App. filed Aug. 2, 1909. Enables two cars, which may be operated as units, to be coupled and operated from a single controller. Uses a circuit coupling which connects with the motors independently of the controller or to connect the controller, the coupling and the motors in parallel.

941,397. MOTOR CONTROL SYSTEM; H. E. White, Schenectady, N. Y. App. filed June 23, 1909. A plurality of switches to increase the voltage for starting the motor, step by step. The switches are operated by solenoids, the actuating coil of the first being in shunt to the motor.

941,408. CONTROL OF ELECTRICALLY OPERATED SWITCHES; A. S. Cubitt, Schenectady, N. Y. App. filed May 7, 1908. For successively operating a plurality of switches.

941,412. MOTOR STARTER; M. R. Hanna, Schenectady, N. Y. App. filed Sept. 12, 1907. Automatic starter in which a number of electromagnetic switches short circuit sections of resistance in series with the motor or armature.

941,416. PRIMARY ELECTRIC CELL OR BATTERY; A. Heil, Frankfort-on-the-Main, Germany. App. filed April 6, 1909. Uses a depolarizer consisting of sulfate of mercury, finely divided carbon and free mercuric oxide.

941,418. SLIP INDICATOR; G. A. Johnstone, Revere, Mass. App. filed April 30, 1908. For an induction motor to determine its slip visually by combining with a source of light which varies in intensity in synchronism with an alternating current circuit of means for exposing the source of light at intervals varying in frequency with the speed of an induction motor connected to the circuit.

941,419. ELECTRIC FURNACE; C. A. Keller, Paris, France. App. filed Nov. 4, 1908. A hearth serving as an electrode and comprising a metal plate, a plurality of metallic elements connected therewith and projecting therefrom, a refractory body in the spaces between the elements and surrounding the same and a second refractory body enclosing the first body.

941,425. ELECTRIC CIRCUIT CONTROLLER; H. W. Leonard, Bronxville, N. Y. App. filed April 6, 1906. A motor starting rheostat having a circuit breaker with means for automatically inserting the resistance of the rheostat independently of the circuit breaker and means for automatically opening the breaker if the starting resistance is left in circuit too long.

941,435. INDUCTION FURNACE; M. Unger, Pittsfield, Mass. App. filed May 6, 1908. In which the furnace chamber is placed in inductive relation to the primary of the transformer, the charge serving as a secondary. The furnace consists of a plurality of magnet cores, winding thereon and an annular furnace chamber surrounding the cores communicating with a central chamber.

941,436. ELECTRIC METER; F. M. Vogel, Lynn, Mass. App. filed Sept. 14, 1904. A watt meter for alternating-current in which the rotatable member is acted upon by two magnetic circuits, each completely surrounded by shunt and series windings which act in conjunction on one circuit and in opposition on the other. The torque is produced by the induced currents.

941,439. MOTOR GENERATOR SET; W. A. Danielson, Des Moines, Iowa. App. filed Aug. 18, 1908. A motor generator set operating on a constant potential circuit to supply constant current and in circuit where the resistance varies. The generator has a set of brushes short circuiting the armature 90 deg. from the line of field magnetization and a second set of brushes displaced 90 deg. from the first.

941,441. RHEOSTAT; G. H. Dorgeloh, Schenectady, N. Y. App. filed June 10, 1908. Provides with a starting resistance an unbiased controlling arm interlocked with an automatic circuit breaker which cannot be closed until the arm is moved to starting position. Uses an underload coil.

941,445. ALUMINUM CELL REACTANCE; J. J. Frank, Pittsfield, Mass. App. filed Feb. 2, 1909. A plurality of aluminum condenser cells in series and a plurality of transformers, each having one winding connected across one of the cells and another winding in multiple with a winding of each of the other transformers.

941,450. DYNAMO ELECTRIC MACHINE; F. B. Howell, Schenectady, N. Y. App. filed Aug. 30, 1907. For supporting the fields in which a field coil surrounds a pole provided with a tip, and the coil support has a raised portion fitting over a part of the pole and a flanged portion holding the coil against the pole tip.

941,459. ELECTRIC METER; P. C. Morganthaler, Fort Wayne, Ind. App. filed May 22, 1909. An alternating-current meter having a U-shaped core with double poles, a potential coil carried thereby, a series coil surrounding the inner poles and lagging coils surrounding the outer poles.

941,534. ELECTRIC SWITCH HANDLE; J. G. Peterson, Hartford, Conn. App. filed June 15, 1909. For rotary snap switches in which the handle is made of porcelain and has a socket extending partly through the handle, a yoke in the socket and a headed stem extending through the yoke, with a spring between the stem and the yoke.

941,535. ELECTROPLATING APPARATUS; L. Potthoff, Flushing, N. Y. App. filed Feb. 2, 1909. A horizontally inclined rotary drum with a screw conveyor inside in which the articles are carried.

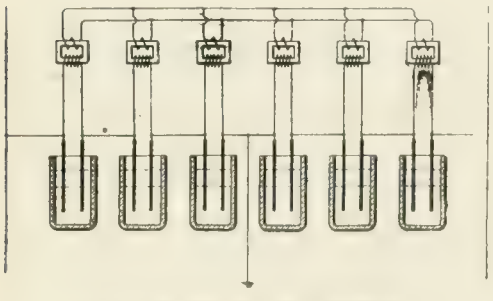
941,541. CAB-SIGNAL CIRCUIT; Paul J. Simmen, Los Angeles, Cal. App. filed June 19, 1908. A signal on the vehicle, means in the track wave for setting the signal at danger, an alarm on the vehicle, means for actuating the alarm when the signal is at danger and for rendering it inoperative when the vehicle is not in motion.

941,553. PROCESS OF PRODUCING LOW CARBON, LOW-SILICON TITANIUM ALLOY; F. M. Becket, Niagara Falls, N. Y. App. filed June 12, 1907. The process of producing a low silicon titanium alloy which consists in producing a high silicon alloy and oxidizing the contained silicon.

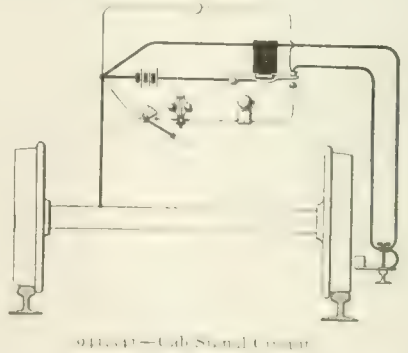
941,576. ILLUMINATING DEVICE FOR KEYHOLES; J. D. Hardin and J. B. De Saussure, Chattanooga, Tenn. App. filed Oct. 2, 1908. For making the keyholes visible at night in which the door knob has a light transmitting portion and which is movable in the direction of the length of the knob spindle, the knob being hollow so as to contain an electric light which is controlled by the longitudinal movement of the knob.

941,593. INCANDESCENT LAMP; R. D. Tiffany, Bellingham, Wash. App. filed Aug. 27, 1908. The lamp has a multiplicity of filaments and a rotating element driven by a gear from the outside so as to throw any one of them into circuit.

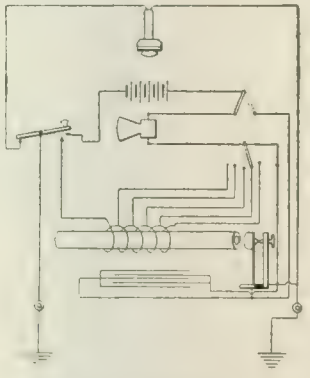
941,599. MEANS FOR RECTIFYING SINGLE PHASE CURRENTS; J. L. Woodbridge, Philadelphia, Pa. App. filed May 4, 1908. An armature surrounded by a squirrel cage, the armature supplied with alternating current and having two sets of electrically displaced brushes, each set interconnected in a circuit with means for producing relative rotation of armature brushes in synchronism with the alternating current.



941,445—Aluminum Cell Reactance.



941,541—Cab Signal Circuit.



942,044—Wireless Telephony and Telegraphy.

941,600. SYSTEM FOR ELECTRICAL DISTRIBUTION; J. L. Woodbridge, Philadelphia, Pa. App. filed April 14, 1909. An electric converter producing a constant direct-current voltage across one set of brushes and a variable direct-current voltage across another set, connected to a regulating storage battery.

941,601. SYSTEM OF ELECTRICAL DISTRIBUTION; J. L. Woodbridge, Philadelphia, Pa. App. filed April 14, 1909. An electric circuit, a storage battery and a booster with means responsive to the charge and discharge of the battery adapted to excite the booster to oppose the charge and discharge.

941,660. ELECTRIC SWITCH; F. W. Smith, New York, N. Y. App. filed Feb. 25, 1909. An electric switch with a pivoted circuit closing switch arm, a fixed guide bar, a link pivoted to the arm and bearing on the bar with means for moving the link along the bar, said means being an electromagnet.

941,673. ELECTROVIBRATORY COUCH; W. A. Church, Los Angeles, Cal. App. filed Dec. 21, 1909. For exercising the muscles and imitating horseback riding. The couch is vibrated by a motor and crank.

941,690. ELECTRICAL SYSTEM OF DISTRIBUTION; W. E. Winship, New York, N. Y. App. filed March 11, 1908. The combination of alternating and direct-current circuits with a converter between them, a battery connected to the direct-current circuit which charges and discharges according to variations of load on either circuit.

941,709. RELAY; T. W. Gleeson, Boston, Mass. App. filed Jan. 29, 1908. Electromagnetic relays for telegraphs in which a magnetically inductive armature has pole pieces and a permanent magnet has one of its poles next to the armature and the other pole separated therefrom with a soft iron member between the magnet and the distant pole.

941,791. RELAY; E. R. Corwin and C. A. Bals, Chicago, Ill. App. filed Sept. 21, 1908. Relays for telephone indicators in which coil may be removed without dismounting the relay. Details.

941,793. BANK OF LOCKING SWITCH KEYS; E. R. Corwin and C. A. Bals, Chicago., Ill. App. filed Jan. 29, 1909. Banks of locking keys of the push-button type arranged over a distributing strip having terminals with a removable casing.

941,768. ELECTRIC FURNACE FOR GAS REACTIONS; O. Dieffenbach and W. Moldenhauer, Darmstadt, Germany. App. filed Aug. 25, 1908. For producing gas reactions, including two electrodes in the furnace, one consisting of fragmentary carbon and made hollow so as to supply the gas there through.

941,777. MEANS FOR CONTROLLING ELECTRIC CIRCUITS; G. W. Hart, West Hartford, Conn. App. filed April 5, 1909. A door lock using two three-point switches with a solenoid for operating, one of them having its winding controlled by a circuit-closer closed by lock on the door.

941,808. CORD TERMINALS; F. Parsons, Boston, Mass. App. filed April 9, 1909. Connecting clip for automobile spark plugs, having a flat body of spring metal specially constructed to surround the head of the plug.

941,810. METHOD OF MAKING INSULATING-COVERINGS FOR ELECTRIC CONDUCTORS; W. A. Phillips and F. Hutchins, London, Eng. App. filed June 8, 1908. Mixes gilsonite and castor oil, heats, cools and mixes with a hydro-carbon.

941,811. KEYLESS SOCKET; C. D. Platt, Bridgeport, Conn. App. filed Oct. 22, 1908. The block may be molded by one compression and the parts secured together by a simple rivet.

941,826. THERMO ELECTRIC GENERATION; J. D. Taylor, Pittsburg, Pa. App. filed May 27, 1907. Thermo couples on a rotary carrier with heating and cooling compartments surrounding the carrier and other heating and cooling compartments arranged interiorally of the carrier.

941,859. TERMINAL FOR ELECTRIC CABLES; C. W. Davis, Edgeworth, Pa. App. filed Aug. 3, 1908. Consists of a sleeve with its lower end equal to the diameter of the sheath of a cable and its upper portion spread out to permit the separation of the conducting cores. The head is closed by a cap.

941,860. TERMINAL FOR ELECTRICAL CABLES; C. W. Davis, Edgeworth, Pa. App. filed March 6, 1909. For a multiple conductor cable, including a casing, an insulator which is perforated larger at one end than at the other, a portion of the surface of the perforation being rough and arranged obliquely to the axis thereof.

941,893. BINDING POST; I. Steinberger, New York, N. Y. App. filed April 2, 1909. A stem with clamping plates encircling the same and means for preventing the easy removal of the clamping plates from the stem and a spring for pressing the clamping plates apart.

941,904. PROCESS FOR TREATING CERTAIN ORES; H. S. Auerbach, New York, N. Y. App. filed Sep. 6, 1906. Reduces galena by forming a body of fused lead, on top of which is a fuse electrolyte, to which body the ore is added, the ore being soluble therein and direct contact between the ore and the electrolyte being prevented. An electric current is then passed through the charge.

941,918. TELPHERAGE SYSTEM; H. Muller, Leipzig, Germany. App. filed Feb. 7, 1906. Reduces the number of conductors and separates the regulating of the electric current taking from the regulating of the mechanical operations. The mechanical movements are regulated by a magnet current closer in the carriage actuated by impulses given at the starter.

941,941. SWITCH FOR INCANDESCENT LAMP SOCKETS; W. A. McDonald, Grampian, Pa. App. filed Feb. 26, 1909. A switch for incandescent lamp sockets comprising a frame having a stationary handle and two movable handles with means for completing the circuit by forcing one of the movable handles toward the stationary handle.

941,979. TROLLEY RETRIEVER; C. Palm, Aurora, Ill. App. filed [illegible]. The trolley is lowered to the roof of the car by a spring-driven drum.

941,979. ATTACHMENT FOR ELECTRIC APPLIANCES; H. W. Denhard, San Francisco, Cal. App. filed Aug. 7, 1908. Takes the strain from terminal conductors by means of a ring or eyelet secured to a twin conductor and a retaining band in the rear of the ring.

942,002. WALL CABINET FOR ELECTRICAL APPARATUS; E. R. Le Manquais, Bellemead, N. J. App. filed May 11, 1907. A container having its side members made into two separable parts recessed along the line of separation to receive bushings which form insulating supports for a cable passing through them.

942,044. WIRELESS TELEPHONY AND TELEGRAPHY; A. W. Sharman, Clapham, London, Eng. App. filed July 16, 1909. For telegraphing through the earth by joining the poles of a low tension current and the two ends of a self induction coil each to earth to a plurality of pairs of contacts. Adjusts resistance of the coil to the rest of the circuit, suddenly reduces the low tension current and when it is at a minimum impresses a maximum voltage from the induced direct current through the coil, on the earth contacts.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Thursday of the same week.

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NEW YORK, THURSDAY, DECEMBER 16, 1909.

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Export Trade Data.

The figures of electrical export trade for October, just issued, parallel closely those of September in their general character, the foreign demand for instruments improving, while that for heavy electrical machinery still shows a small decline as compared with recent years. The exports of the month in electrical instruments and appliances were $683,819 as compared with $432,907; while the exports of heavy electrical machinery were $443,388 as compared with $543,188. There is a total shown of $1,127,207 as against $976,095 in the month of 1908; or, in other words, the gain for the whole electrical exports was slightly over $150,000. The gain in September was nearly 15 per cent, and the October gain is more than 15, so that it is evident the improvement is being maintained. If there were only the foreign demand for American dynamos and motors that existed before the panic, the trade would apparently have exceeded already the old level. We can only hope that this will soon happen, meantime felicitating manufacturers upon the fact that business is so much better and on so much wider a basis, as relates to the exports of miscellaneous electrical goods.

The Lux as the Unit of Illumination.

Our correspondence columns contain, this week, a letter from M. F. Laporte, of the Laboratoire Central d'Electricité at Paris, on the subject of the *lux* as the unit of illumination. The history of this discussion is briefly as follows: In our editorial columns of the issue of Sept. 23, 1909, we summed up the situation concerning the new international candle, and the new international *meter-candle* derived therefrom. We pointed out that this new international candle is no other than the *bougie-decimale*, which is the only unit of luminous intensity that has received international recognition at the hands of an international electrical congress. Our argument was that the term *lux* should therefore be considered as properly defining the illumination produced by the *bougie-decimale* or new international candle at one meter, as exclusively applicable to the new international meter-candle. The custom recently followed by some German photometricians of using the term *lux* for the meter-hefner was criticised adversely.

Herr Monasch took exception to our criticism in a letter published in our issue of Oct. 28. He pointed out that, as early as 1897, the *lux* had been used in Germany as equivalent to the *meter-hefner*, following the proposals of M. Blondel to the Geneva Conference of 1896. At that date it was stated that the *hefner* did not differ appreciably from the *bougie-decimale*. At a later date the *hefner* was reported to be distinctly a smaller unit than the *bougie-decimale*, in the ratio of approximately 0.9. Consequently, it was no fault of German photometricians if the later determinations divorced the *meter-bougie* from the *meter-hefner*, or the *lux* as defined in France from the *lux* as maintained in Germany. M. Laporte now contends that there is no reason to suppose that either the *bougie-decimale* or the

hefner changed 11 per cent in 13 years. His contention is that the ratio of approximate equality assigned between them in 1896 was necessarily imperfect, and that had the specifications for the *hefner* been defined at that time, as they appeared later, the ratio would probably have been found then substantially what it is now. The situation thus presented raises the question if it might not be advisable to state illuminations in terms either of the new *meter-candle,* the old candles having already lighted themselves into the limbo of ancient history, or of the *meter-hefner.* The term *lux* is shorter than either of these, but is open to some ambiguity. A French or English-speaking photometrician would be likely to use the term *lux* as equivalent to the *meter-candle,* and a German photometrician as equivalent to the *meter-hefner,* so that, unless carefully defined, it might be safer to avoid the use of the lux altogether for the present.

German List of Proposed Symbols.

We print this week in our correspondence columns a letter from Herr Strecker on the subject of national and of international electrical-engineering symbology. The German Committee has had this subject under consideration for several years, and has already rendered great service to the technical literature, not only of Germany, but also of other countries, by its care and its spirit of open recognition of general international welfare. We hope that our American Institute of Electrical Engineers may eventually take action to co-operate, both with the German Committee and with the International Electrotechnical Commission, to bring about gradually a much needed unification of notation in electrical-engineering writings. Such movements of international concert are necessarily slow, but at least they should be definitely directed.

There is almost as great a danger of carrying the ordination of symbols too far as of not carrying it far enough. It is manifest, and needs no demonstration, that such simple formulas as Ohm's law, for example, should be printed in the same notation in all languages. Similarly, there are about a score of quantities constantly recurring in the literature and textbooks of electrical engineering, such as magnetic permeability, electric quantity, etc., that should be represented by the same symbols in all civilized countries. The same proposition applies to other well-established branches of technology. In the literatures of dynamics, of statics, of chemistry, of heat, of sound, and of optics, there is the same need for uniformity of symbols in dealing with formulas that are of very frequent occurrence and great utility. Now there are not letters enough in our usually available printing fonts to meet the demands of all these branches of applied science, nor are human memories ordinarily developed enough to retain the complete schedule of a notational system sufficiently large to embrace them all. It is quite sufficient for practical purposes that one and the same symbol be not in joint demand by groups of technologists whose fields frequently overlap. The whole question is one of expedience and convenience for the purposes of technology. On the other hand, the greatest latitude should be allowed in the notation of the pure sciences. No attempt should be made to force mathematicians, physicists and chemists to use rigid notation in their researches and writings. In the first place, the attempt would be futile, because there are more quantities in nature to be symbolized than there are symbols available for clothing them. In the second place, to fetter a pure scientist's mode of notational expression is, in some degree, to fetter his thoughts; and if we are to make progress, we should enjoy and encourage the greatest possible intellectual liberty. Consequently, the notation of applied science should be standardized, but not the notation of the science as yet unapplied.

A New Field-Magnet Design.

Mention is made this week in the Digest of a new design of field-magnets proposed for direct-current machines. In reality it will be seen that, except in regard to commutating poles and their disposition, the design belongs to a well-known type of several decades' antiquity. It consists essentially of pairs of poles applied to the armature, as though from individual electromagnets, instead of at uniform radial intervals around a common yoke ring. The novel elements in this case are associated with the disposition of the interpoles, one to each pair of driving poles. Moreover, the disposition of the field coils is such as to offer a substitute for half the usual number of interpoles. The contentions made on behalf of the new design for saving in magnetic-circuit iron, commutation-copper, reduced magnetic leakage, and facility for ventilation, are worthy of being investigated by designers. They are questions which are sure to elicit much difference of opinion. The only safe way of drawing conclusions in such cases is to build two field frames for one and the same armature, the first field-frame being of approved design and standard radial construction, and the second field-frame of the new construction. The comparative costs, properties and behaviors of the two types are then capable of being rendered evident by testing. The designer of the new type presents evidence of this character.

Illuminating Engineering in England.

The inaugural address of Prof. S. P. Thompson, F.R.S., as president of the newly formed Illuminating Engineering Society, abstracted elsewhere in our columns, states with admirable clearness the objects of the society and the line to be followed in its work. In particular it draws strenuous attention to the importance of diffusion, especially in case of recent illuminants like the metallic-filament incandescent lamps, the Welsbach mantle and the electric flame arcs. In touching upon this matter he has reached perhaps the most vital point of artificial illumination. There is no escaping the fact that daylight is, when judiciously utilized, far superior in point of comfort to even the best and most skilfully arranged artificial lighting. The reason and remedy for this difference is the greatest problem of illuminating engineering. The chief differences between natural and artificial light are three—color, intensity of visible source, and direction. It is easy enough to duplicate the intensity of ordinary daylight; in fact, this intensity is often exceeded. None of the common lamps gives light even approximating it in color when unscreened. What is worse, all artificial illuminants that can fairly lay claim to high efficiency are of so great intrinsic brilliancy as to bring undue strain upon the eye unless used very cautiously; even granting proper screening, artificial light is localized and directed to an extent quite unknown with natural light.

In ordinary daylight, out of the direct rays of the sun the light which enters the eye and falls upon the retina provides a fairly uniform stimulus. When this condition is not fulfilled, as when one reads out of doors with the light filtering through leaves or otherwise coming irregularly, one feels strain very quickly even when there is no flickering. With artificial light

the direction is sufficiently definite to give usually quite irregular stimulus on the retina. If completely diffused, artificial light is apt to give trouble from lack of shadows and consequent difficulty of definition. Whatever may be the exact causes of the marked difference between natural and artificial illumination, the abolition of the difference is the next great step forward in illumination.

Professor Thompson again touches most important matters in a strong plea for better lighting of schoolrooms, and especially for the actual scientific measurement of the conditions in them instead of merely casual inspection. It seems to be well established that certain forms of myopia are greatly aggravated by working in poorly lighted rooms. In this case both natural and artificial lighting have to be taken into account. The former is often faulty in that it is uneven, the room having dark corners and spots exposed to direct sunlight. The former fault is a very common one, and while the latter can be remedied by the intelligent use of curtains, it is at the risk of aggravating the dark corners. With artificial light it is practically possible to produce more uniform illumination than that usually found by day, although the devices necessary to get first-class results sometimes are condemned as "inartistic" by some ignorant critic, and declined in favor of something utterly worthless. We have in mind one high school in which the interior coloring was settled upon by a lady member of the school committee in accordance with the then popular canons of high art, with the result of making the lighting at all times inadequate, and rendering artificial lighting almost impossible. Professor Thompson makes the very sensible suggestion that the time has now come to define the actual conditions of the illumination in schoolrooms not by architectural rules, but by foot-candles, and proposes that a minimum of 1.5 foot-candles should be required at the worst lighted seat in the room. This is getting fairly down to business and were such a rule to be enforced there would be far fewer dark corners than at present. And this sort of thing is really just what the Illuminating Engineering Society should do, to introduce scientific and exact methods in place of rule-of-thumb, and to make artificial lighting as nearly as may be equal in practical results to natural lighting. One cannot rival sunlight in brilliancy, and yet there is no obvious reason why with the present resources of the art at his command he should not by artificial means obtain the modest intensity of ordinary natural lighting within doors efficiently and well.

The Design of Single-Phase Induction Motors.

As the concluding part of his article on the factors affecting the design of single-phase induction motors Mr. Val. A. Fynn gives in this issue a detailed discussion of the advantages to be obtained by providing the motor with a commutator for introducing an exciting magnetomotive force in the secondary circuit. Among the chief results following the application of an e.m.f. to the secondary circuit is the change in the primary power factor, on account of the fact that the magnetic field required for the proper balance between the counter and impressed primary e.m.fs. is produced by a secondary rather than the primary m.m.f. The advantage derived from transferring the exciting m.m.f. to the secondary circuit is attributable to the action of the rotor as a frequency converter; the wattless volt-amperes required for producing a certain value of magnetic field varies directly with the frequency and hence reduces to zero when the secondary frequency has zero value at synchronous speed. Even when the secondary frequency is not zero, and the reactance of the secondary circuit has an appreciable value, it is possible, by the expenditure of a small value of wattless volt-amperes in the secondary circuit, to exert a secondary m.m.f. more than sufficient to produce the field required for balancing the primary impressed e.m.f. and thereby to cause the total motor circuits to take leading wattless volt-amperes from the supply system. In addition to affecting the wattless volt-amperes taken by the machine, the use of an auxiliary e.m.f. in the secondary rotor circuit modifies the speed-torque characteristics of the machine as explained in detail by Mr. Fynn. The exact effect upon both the power factor and the torque depends upon the mechanical position of the secondary axis along which the auxiliary e.m.f. is introduced compared with the primary magnetizing axis, and the time-phase position of the introduced secondary current compared with the time-phase position of the primary counter e.m.f. When the secondary current differs in time-phase from the primary counter e.m.f. by the same number of degrees as there are electrical angular degrees displacement between the secondary axis and primary magnetism, the effect is confined almost wholly to the torque; when the secondary current is displaced by 90 time degrees from this assumed position, with the secondary axis in the former position, the m.m.f. will affect the wattless volt-amperes almost exclusively.

An Interesting Find.

A recent communication in *Nature* bears the news of the discovery of native tantalum, hitherto unknown, as a sort of by-product of a placer gold mine in the Urals. From a commercial standpoint the yield was negligible, the whole amount collected being only a few grains, but scientifically it adds another to the comparatively meager list of native crystalline metals. The tantalum was in this case associated in the crystalline form with a small fraction of niobium. It is a thing worth investigating to determine if possible the source of the supply. Still more, it would seem not impossible that gold-bearing sands and platinum-bearing sands elsewhere may also carry tantalum which has hitherto gone unnoticed, perhaps in very considerable amounts. The mineral in the case cited appeared as a bright grayish-yellow crystalline powder, the microscopic crystals having a specific gravity of 9, which is far below that of the non-crystalline metal and also much lower than the specific gravity of the precious metals expected in placer mines, and hence not unlikely to escape notice. It is not improbable that careful search may bring rewards in a further search, just as it does in the tailings of many a hard-worked mine. The uses of tantalum are sufficient to stimulate prospecting for it, and if by any good fortune a fairly liberal supply should be found its uses would be multiplied. The present scarcity forbids anything like the use in large quantities that is indicated by the very extraordinary properties of tantalum. Truth to tell, there are not a few of the metals at present rare that could be widely utilized if even moderately reliable sources of supply could be found. A systematic search through metallurgical works for casual products is rarely made, and when made is seldom thorough enough to include looking for the altogether unexpected. The present discovery should stimulate curiosity and may lead to finds of further scientific, if not commercial, importance.

International Congress of Radiology and Electricity.

An International Congress of Radiology and Electricity will meet in Brussels in connection with the International Exposition to be held there in 1910. The congress will meet on Sept. 6, 7, and 8, and will have three sections. In the first section general questions of terminology and methods of measurement in radioactivity and subjects connected with ions, electrons, and corpuscles will be dealt with. The second section will be divided into various subsections, dealing respectively with fundamental theories of electricity, study of radiations (including spectroscopy, chemical effects of radiations, and other allied questions), radioactivity, atomic theory, and cosmic phenomena (including atmospheric electricity and atmospheric radioactivity). The third section will be biological, and will be devoted to consideration of the effects of radiations on living organisms, its subsections dealing with purely biological questions as well as with the use of various radiations for medical purposes, both for diagnosis and therapeutics. In order to ensure the success of the congress, committees have been formed in the various countries which will take part in the congress. Anyone wishing to become a member of the congress should communicate his intention directly to the general secretary, Dr. J. Daniel, 1 Rue de la Prévôté, Brussels.

Corporation Tax Law.

Commissioner Cabell, of the United States Internal Revenue Bureau, has drawn up for the guidance of officials of the bureau a synopsis of the corporation tax law in which it is stated that the law is a revenue measure and should be construed liberally for the purpose of producing revenue for the Government. The real intent of the law is to collect a tax of 1 per cent on the net income, less $5,000, of the individual corporation, joint stock company or association liable to the tax. In order to disclose their net incomes the corporations will be required to file certain official forms arranged for the purpose. It is probable that the collection of the tax will be vigorously resisted in a test case before the Supreme Court of the United States.

Proposed Steam Railroad Electrification in New Brunswick.

A conference will be held at Ottawa, Ont., on Dec. 16 between representatives of the Federal, Quebec and New Brunswick governments, the National Transcontinental Railway Commissioners and the Dominion Railway Commissioners, the Alexander Gibson Manufacturing Company, the New Brunswick Lands & Power Company, the Miramichi Lumber Company and the Grand Falls Power Company for the purpose of discussing the proposal that the Grand Trunk Pacific Railway Company should operate its trains through the New Brunswick forest district by means of electricity, for the generation of which there is ample water-power at Grand Falls on the St. John River. This question was discussed in the Legislature of the Province of New Brunswick at the last session, and the proposed conference is the result of a suggestion made at the time that electric power be adopted by the railway company in order that the devastation of the valuable timber limits within the Province shall be prevented.

Business Telephone Service.

The American Telephone & Telegraph Company is offering a new kind of telephone service under a short period contract for a daily long-distance service. The plan is to connect, for instance, the subscriber's New York headquarters with his New Jersey factory, his Pennsylvania mine, or his Chicago selling agency (or whatever other long-distance call is designated in the contract) at a given hour each day, for a given period of not less than half a hour. There is thus no waiting to call and secure connection, the instruments being connected up ready for immediate use at, say, 4 o'clock every day. In view of the service being regular and taken only before 10 o'clock in the morning, between noon and 1 or after 4 o'clock in the afternoon, which hours are outside of the rush hours, the company makes a special rate which is lower than the regular message rates. The whole plan is set forth in a pamphlet recently issued by the commercial department of the company.

Working Independent Telephone System Promised for Chicago.

At the convention of the National Independent Telephone Association held in Chicago last week an announcement was made by Mr. H. D. Critchfield, of the Automatic Electric Company, that was received with great applause. Mr. Critchfield said that he was authorized to state that financial arrangements have been made that will result in an independent telephone system that will be in operation in Chicago by Dec. 1, 1910. The money has been subscribed, he added, by men of unquestioned financial ability, and the company will connect with independent long-distance lines.

Mr. Critchfield did not say so, but it is surmised that an effort will be made to utilize the telephone franchise of the Illinois Tunnel Company recently placed in the control of receivers. This company's predecessor started out to build and operate a competing telephone system in Chicago, placing its conductors in large tunnels beneath the streets. An exchange was established, using automatic apparatus, and several thousand instruments were placed in the central business district. But, in the progress of events, the company developed its tunnels for carrying freight, and the telephone department languished, having been several years in a quiescent state. The Chicago Telephone Company has expressed a willingness to take over the franchise, but the city has so far refused.

The independent telephone operators in Wisconsin, Illinois, Indiana and surrounding States are anxious to secure entry into Chicago for their long-distance lines, and hence they are greatly pleased at Mr. Critchfield's announcement. It is said that the new Chicago system will have 20,000 telephones in operation within a year. The announcement comes at a time when the new Continental Telephone & Telegraph Company, of New York, is active in acquiring independent telephone properties in Pennsylvania and other States. Whether there is any connection between this company and the Chicago project is not generally known. At the independent convention of last week, however, the Continental Company was spoken of as the backbone of the proposed national independent telephone system to compete with the American Telephone & Telegraph Company, which it is hoped to build up by the reorganization of the old International Independent Telephone Association on a contract basis, as related elsewhere in this issue.

Proposed Railroad Terminal Electrification in Chicago.

At a meeting of the local transportation committee of the City Council of Chicago on Dec. 8 to discuss the proposed ordinance to compel steam railroads to abolish smoke in Chicago, a representative of the Illinois Central Railroad made the sweeping statement that that railroad had eliminated 99 per cent of the smoke previously emitted by its locomotives between Sixty-third Street and the Randolph Street station. It was said that this had been done by the use of smoke consumers, training firemen and using coke and the best grade of coal. The speaker said that one objection to coke was that after burning it for six hours or so the accumulation of clinkers was so great that the

locomotive had to be taken out of service and cooled down so that a man could remove the mass from the fire-box.

Mr. F. A. Delano, president of the Wabash Railroad, said that if electrification were applied to passenger trains alone the change might be possible. Mr. L. C. Fritch, chief engineer of the Chicago Great Western Railroad, suggested that a commission of experts be created to make a study of the terminal situation in Chicago for the guidance of the City Council. A union passenger terminal, or a series of terminals connected by belt lines electrically operated, might go a long way toward solving the smoke problem in Chicago, so far as railroads are responsible for the smoke, in the opinion of Mr. Fritch. Electrification of the present maze of tracks within the city would be unwise and impracticable, if not impossible, in the opinion of that gentleman. The committee decided to draw up a series of questions relating to the experiments being made in the matter of methods for the prevention of smoke and submit them to the various railroads. There is, however, more involved in the proposed electrification than the mere abolition of smoke, for the noise, the noxious vapors, cinders and (in winter particularly) steam from locomotives also constitute a nuisance.

New York State Telephone Hearing.

The most important feature last week of the legislative investigation into the telephone and telegraph situation in New York, by the Legislative Committee, was the testimony of Mr. Theodore N. Vail, president of the American Telephone & Telegraph Company. Mr. Vail reviewed the history of the telephone industry in this country from 1877, when the New England Company and the Bell Company were formed, up to the present time. From the start, he said, it was recognized that one large company could handle the telephone business better than a number of small concerns. Mr. Vail admitted that his company made contracts with its engineers and employees by which it was provided that any inventions or improvements that were made by them became the property of the company, but he specifically denied that the company ever purchased patents or improvements that were available and then refused to use them, as the company was always ready and anxious to make use of every improvement that seemed to be practical. The New England Company, he said, was the first company organized to operate a telephone system, but this was after the voluntary so-called Bell Association was formed, in which there were four partners, A. Graham Bell, Gardner E. Hubbard, C. A. Saunders and Thomas A. Watson.

This Bell Association and the New England Company were later merged into the National Bell Company, which controlled the telephone patents and business of the United States and also controlled the patent rights for Mexico and South America. The National had a capital stock of $850,000, of which $650,000 was given, share for share, to the old stockholders and the balance was retained in the treasury. About a year after the formation of the National Bell Company, the American Telephone & Telegraph Company was organized with a capital of $6,000,000. Mr. Vail said that neither the New England, the old Bell nor the National Bell had ever paid any dividends. The American company, he said, had paid dividends practically from its incorporation, paying from 6 per cent up to as high as 15 per cent.

Mr. Vail said that it was not the habit of the American company to acquire stock control of the different concerns licensed to operate under its patents. In most instances the operating concerns gave to the trust from 30 to 40 per cent of their stock in consideration of the permission to use the patents. At the present time, the American company has outstanding about $250,000,000 of stock and up to the present time about $100,000,000 of the company's bonds have been converted into stock.

In speaking of the printing telegraph machines, Mr. Vail said that the first patents were taken out by the Gold & Stock Ticker Company, which is owned by the Western Union Telegraph Company. The American Speaking Telephone Company also held certain patents, and these two concerns entered into an agreement with the Bell Association in 1879 by which an interchange of patent rights was arranged. The Bell Company was to pay a royalty during the life of the patents to the Western Union amounting to 20 per cent of the net income per instrument upon which certain appliances were used. These payments ceased in 1896, and the settlement of the old claims is still in litigation.

The original Bell patents have expired, but the American company owns patents upon improved instruments which have some years to run. Mr. Vail said that there was now but one licensee operating in New York State under authority of the Bell patents. When asked if his company had any interest in any manufacturing concern, Mr. Vail said that it owned 12,000 shares of the 15,000 shares outstanding of the Western Electric Company. He said he preferred not to state the price that had been paid by the American company for the New York Telephone Company's stock which was recently acquired from the Western Union Telegraph Company. When pressed for an opinion as to whether or not it would be a good thing to have the telephone companies and their rates under the supervision of a commission, he said that the theory had not yet been tried out and he did not feel like expressing an opinion.

In one of the sessions of the committee, last week, Senator D. F. Davis, of Brooklyn, made complaint to the committee against the telephone conditions in New York City, and declared that the business is practically a monopoly and that all competition is shut out. He declared that the Public Service Commission had not accomplished the benefits for which it was organized, and he urged that legislation be adopted which would provide for another commission to regulate telephones and telegraphs. He declared that the New York Telephone Company was arbitrary and unfair in its rates and thought that the Lesislature should take hold of the matter and enact some radical governing laws.

During the week it was developed at the hearings that the New England Telegraph Company bears some very intimate relations to the Postal Telegraph & Cable Company, although it was denied that there was a stock ownership. It was admitted that a portion of the money taken in by the New England Company was deposited in bank to the credit of the Postal Company and that salaries were paid from this account. Mr. Theodore L. Cuyler, treasurer of the New England Telegraph Company, testified to these facts, but he failed to give any very clear understanding as to the relations between the two companies.

New England Water-Power Possibilities.

At a regular monthly meeting of the New England Water Works Association held in Boston on Dec. 8 the Committee on Water and Water Power Diversion, Mr. Charles T. Main, chairman, submitted an exhaustive report which summarized the conditions in New England as follows: "For the purposes of general approximation, we may assume that in New England watersheds without a material amount of storage and with a development up to the yield of the seventh month of an average year, arranged in the order of dryness of those months, there can be obtained an average of approximately 0.09 hp (24-hour power) per square mile of tributary watershed per foot of fall; but the minimum power under such conditions may fall to one-third or less of this amount. With storage the above available power would be appreciably increased, the amount of this increase depending upon the volume and the control of this storage. That is, a yearly average of about one-tenth of one horse-power per square mile of tributary watershed per foot of fall (which corresponds to a maximum 24-hour flow or development of water of about 1.4 cu. ft. per second per square mile of watershed, and a maximum 24-hour net power of 0.12 hp per foot of fall per square mile) may generally be obtained economically, and a correspondingly greater rate of output if the power be used for less than 24 hours per day, and sufficient pondage be available to make such con-

centrated use of the water possible. Thus, a watershed having 45 square miles of area tributary to a dam site having an available fall of 25 ft. may be relied upon to develop an approximate average 24-hour power of 112.5 hp.

The Brailey Telephone Deal.

After several days taken up in argument, Notary Chestnutt decided that F. H. Goff, president of the Cleveland Trust Company, would have to testify in the deposition hearing which was begun in Cleveland early in the week in the case instituted by the minority stockholders to prevent the transfer of the United States and Cuyahoga Telephone properties to the Bell interests. Attorneys for the Brailey syndicate argued that there was no need of a deposition hearing, and that witnesses subpœnaed to testify before the notary could and would refuse to do so. Mr. Chestnutt ruled that he had the authority to require Mr. Goff and other witnesses to testify, or, in case of refusal, to punish for contempt. This was followed by further argument, but the decision was not altered.

Mr. Goff stated that he had sold the United States and Cuyahoga Telephone securities held by the Everett-Moore interests to R. L. Day & Company in the offices of the American Telephone & Telegraph Company. He said he had first approached E. J. Hall, president of the New York Telephone Company, with a proposition to sell him the stock, but after a day or two Mr. Hall replied that the American Telephone & Telegraph Company would not purchase the stock, either directly or indirectly. Mr. Hall then introduced Mr. Goff to W. H. Remick representative of R. L. Day & Company, and the deal was then consummated. The understanding given Mr. Goff was that the firm would act for the interests of the minority as well as the majority stockholders, and that the companies would be strengthened rather than allowed to degenerate.

Mr. Goff told of a conference of the members of the Everett-Moore syndicate in November, at which he was present. He said he had acted as attorney for the syndicate before taking the presidency of the Cleveland Trust Company, and to some extent afterward. He was asked to take charge of the sale of the stock of the syndicate, but at first refused. Later he agreed to do so, because of the failing health of Mr. Everett and his desire to clear up his business affairs. He was furnished with options by the individual members of the syndicate, including H. A. Everett, E. W. Moore, Barney Mahler, H. M. Hanna, C. W. Wason and J. B. Hoge. The stock optioned consisted of 19,000 shares, or less than 50 per cent of the United States Telephone stock, and some Cuyahoga Telephone stock. There was some stock not held under the voting trust agreement. The minimum price given him for preferred stock was $80, and for common stock $40. The option was to continue for five days, and no limitation as to purchasers was made.

Attorney S. H. Tolls, former law partner of Mr. Goff and attorney for the American Telephone & Telegraph Company, accompanied him to New York for the purpose of introducing him to Mr. T. N. Vail, president of the American Telephone & Telegraph Company. He met Mr. Vail, and later submitted the proposition to Mr. Hall. At the second conference with Mr. Hall, the following day after the proposition was submitted, the refusal was made,, but Mr. Hall stated that possibly some other New York men might be interested. On expressing his willingness to meet the other gentlemen, Mr. Hall conducted Mr. Goff through the reception room of the American Telephone & Telegraph offices to a room adjoining, where he was introduced to Attorney Leverett, counsel for the company. In the room at the time was W. H. Remick, who explained that he was a representative of R. L. Day & Company. The deal was closed there and at that time. Mr. Leverett took part in the conference and drafted the agreement, but Mr. Tolles was not present. He stated that he saw James S. Brailey, whom he knew slightly, in the reception room when he had occasion to step in there, but that they did not discuss the business in any way. Mr. Goff said he agreed to sell the firm 1000 shares of stock in addition to what he had proposed, and these shares were secured from the syndicate and a Cleveland firm. The price was $1 per share above the minimum figures given Mr. Goff. None of the stock was delivered by Mr. Brailey, he said. Arrangements were made for the delivery of the stock and payment for it through the Chase National Bank, correspondent of the Cleveland Trust Company in New York.

Under the agreement Mr. Goff was to secure the resignations of the members of the Everett-Moore syndicate as voting trustees. He said he did this, but that J. B. Hoge objected for some time, and insisted upon knowing the purchasers. This information was not given, as, he said, he felt that he owed it to the purchasers not to make public the information on this point but that he had told Barney Mahler, who represented the syndicate for this purpose.

At the hearing on Saturday J. B. Hoge testified that he objected to giving his resignation as a voting trustee until he knew who had purchased his stock. He said he had been led to believe that it was to go into the hands of the Independent telephone people. He stated that he had been fighting the Bell interests for 15 years, and that he did not think it was right to sell out unless he knew where the stock was going. At a meeting of the trustees he was finally told that all the others had resigned, and that under the circumstances he could do nothing. Mr. Hoge showed considerable feeling in his testimony as to the manner in which he had been treated in the matter.

B. Mahler, another one of the voting trustees, stated that he is still a director of the United States Telephone Company, although he holds but one share of stock. He told of attempting to sell his stock to A. H. Bauer, of St. Louis; Claude Ashbrook, of Cincinnati, and James S. Brailey, of Toledo, some time before the negotiations with Mr. Goff were taken up, but nothing came of it. Later on, he said, he sold the stock to Mr. Goff. Mr. Mahler complained that he should be asked to divulge his private business, but the notary ordered that he answer the questions.

W. L. Carey, secretary of the United States Telephone Company, testified that B. Mahler had led in the attempt to raise the toll rates since Nov. 1. He and Mr. Brailey, Mr. Carey said, are members of a committee which now has this question under consideration. The idea of the attorney for the Independents in bringing up this point is to show that Mahler is now serving the Bell interests in endeavoring to restore the rates to the figures used before they were cut in competition with the Bell companies.

E. E. Newcomb, of the Cleveland Trust Company, was instructed to bring all the records pertaining to the transfer of the stock and such other books and papers as bear upon the case into court. He was on the stand for a short time Saturday.

Attorney J. H. Price has been attending these hearings as the representative of the Attorney-General's office, and Saturday evening was in consultation with that official at Columbus. The Independents believe that as soon as sufficient evidence is brought out to show that the Bell interests are the real purchasers the Attorney-General will take action. Attorney-General Wickersham will be asked to bring suit in the Federal courts also, in an attempt to oust the Bell if it is shown that this sale of stock is to result in a merger.

It is stated here that the Independents have agreed to spend a large amount of money in opposing the Bell companies, and that plans have been made for the reorganization of the national association in such a manner as to bind the Independents together into one powerful rival of the Bell. This will be done by contracts which will be binding even if the stock of the companies is purchased by the opponents.

H. A. Hauxhurst and F. C. Belser, representing Herman C. Stifel, of St. Louis, have begun an examination of the books of the Toledo Home Telephone Company, Toledo. For some reason the company withdrew its appeal to the Circuit Court, and the injunction issued by the Common Pleas Court, preventing interference of Mr. Stifel in his work of examining the books, went into effect. Although it is not known just what the stockholders expect to find from this examination, the supposition is that they will learn something of the disposition of the stock of the company.

Data for N. E. L. A. Meter Committee.

In order that the good features of meter practice by individual companies may be placed before the association, and in keeping with its desire to make the work of the organization cooperatively helpful to the fullest extent, the chairman of the N. E. L. A. Meter Committee is endeavoring to collect additional information for the next report. As suggestive of the class of data required, the committee points to the need of information on meter accuracy and the effect of a testing system upon such accuracy; meter installations, meter testing, tools and appliances; local laws governing meter testing, descriptions of potable inductive loads for testing meters for accuracy on different power factors, frequency for tests of different types of meters, records of jewel life, including polished jewels, diamonds, effect of oil on jewels, etc.; original systems of keeping meter accuracy records, and practice regarding reading meters. The list is by no means exhaustive, and the committee solicits further suggestions. Mr. G. A. Sawin, of the Public Service Corporation of New Jersey, is the chairman of the committee.

An Electric Gas Meter.

At the recent annual meeting of the American Society of Mechanical Engineers, Prof. Carl C. Thomas, of Madison, Wis., presented a paper which describes a meter for measuring the rate of flow of gas or air, and which can be adapted for use as a steam meter or as a steam calorimeter, taking the quality of all the steam passing through a pipe instead of that of a sample of steam. The operation of the gas meter depends upon the principle of adding electrically a known quantity of heat to the gas and determining the rate of flow by the rise in temperature of the gas (about 5 deg. Fahr.) between inlet and outlet. The meter consists of an electric heater formed of suitable resistance material disposed across the gas passage so as to impart heat at a uniform rate to the gas. The resulting rise of temperature is measured and autographically recorded by means of two electrical resistance thermometers, one on each side of the heater. These consist of resistance-wire wound upon metal tubes so placed that all the gas passing through the meter comes in close proximity to the thermometers. The adoption of this principle of operation permits the construction of a very accurate and sensitive autographic meter of large capacity containing no moving parts in the gas passage; independent of fluctuations in pressure and temperature of the gas, and capable of measuring gas or air at either high or low pressures or temperatures. The electrical energy required is about 1 kw per 50,000 cu. ft. hourly capacity, at the pressures ordinarily used in gas mains.

Decorative Lighting.

At the meeting of the New York Electrical Society on the evening of Nov. 30, held in the Engineering Societies Building, Mr. Albert J. Marshall delivered a lecture on public decorative lighting. Mr. Marshall showed lantern views of special street lighting and decorative lighting in various cities throughout the country, and commented upon the features of each. In introducing his subject he stated that New York was behind other cities in the country in the matter of special illumination and decoration. Newark, N. J., he said, was the first instance of special street lighting on a large scale with flaming arc lamps. Many views of the Hudson-Fulton illuminations in New York were also shown.

In the discussion Mr. T. I. Jones spoke favorably of the flaming-arc lamp, and stated that this type of lamp promised to become extensively used in street lighting. These lamps are to be used in the excavation work in the new Brooklyn subway. Referring to streamers in decorative lighting, he stated that it was not advisable to use them for permanent installations. He did not agree with the lecturer that New York was behind other places in the matter of special illumination, and cited "The Great White Way" as an example, although it was only a limited area. Taking the city as a whole, however, the results compared favorably with those in other cities.

Mr. H. T. Owens pointed out that the flaming-arc lamp would not give the best results if hung low. With the ordinary arc lamps this did not make so much difference.

Prevention of Smoke.

At a recent meeting of the Western Society of Engineers, at Chicago, devoted to a discussion of Chicago's smoke problem by the operating engineers of Chicago's large boiler plants, Mr. A. J. Saxe, of the Corn Exchange Building, gave a very practical talk with a demonstration showing how conditions in the boiler-room must be adjusted to prevent smoke.

Mr. Saxe illustrated his talk by means of a common kerosene lamp. The first point he made was on the regulation of the draft to get fuel. He showed that the lamp without the chimney would burn without smoke with the wick turned very low—that is, with a small supply of fuel. By adding a chimney, the wick could be turned much higher and the combustion was more perfect, due to the increase in draft and the consequent increase in oxygen supplied to the flame. He then showed how smoke may be produced in a plant equipped with mechanical stokers by insufficient draft for the fuel being fed to the stokers. He demonstrated the effect in a boiler plant equipped with mechanical stokers where the steam pressure gets too high and the ash-pit doors are closed to reduce the draft without reducing the speed of the stokers at the same time. In a kerosene lamp a parallel case to this is when the lamp is burning without smoke, the wick being turned a certain height and a piece of cloth being wrapped around the lower part of the burner so as to shut off the air supply. The lamp immediately begins to smoke on account of the insufficient draft, just as does the furnace with too much coal for the air supply. When the draft is reduced in a boiler plant, the speed of the stoker should be decreased correspondingly if smoke is to be prevented.

Mr. Saxe called attention to another common cause of smoke in extremely cold weather; namely, lack of air supplied to the boiler-room itself. The plant may work very nicely without smoke until cold weather comes on. When all of the doors in the building are kept closed, the fires smoke for lack of air supply. He illustrated this fact with a kerosene lamp in a closed box, which, when adjusted to burn perfectly in the open air, began to smoke as soon as the box was closed.

Besides the perfect adjustment of draft, it is necessary that there be time for a complete combustion of the volatile gases before they strike the cold sheets or tubes of a boiler. These cold boiler surfaces reduce the temperature of the gases so that they produce smoke just as the insertion of a metal rod into the flame of the kerosene lamp causes it to smoke. To obviate this difficulty on the common horizontal return-flue type of boiler, it is necessary to build the grate out in front of the boiler some distance, a brick arch being put over the grates. With an oven of this kind, the volatile gases are burned before they strike the boiler sheets. This construction, of course, requires additional room in the boiler plant.

In the water-tube types of boiler, other methods than the building of an oven in front of the boilers can frequently be resorted to. With some water-tube boilers fire-brick baffles immediately over the fire give the gases an opportunity to burn before they strike the cold surfaces.

Mr. Saxe illustrated the effect of putting coal on a very little at a time versus throwing on a lot of coal at once, by manipulation of the kerosene lamp wick. The fireman usually prefers to throw on a lot of coal at once, so as to have a longer resting time between his labors. The effect of this method of firing was illustrated by turning the lamp wick very high, thus giving the flame more fuel than could be consumed by the air admitted through the burner. As the fire gradually burned down, the condition was analogous to turning the wick down gradually. When the fire does not have so much coke put on at once, or when the wick is not turned so high at once, there is no smoke.

Commercial Engineering.

In an address recently delivered before the Electrical Engineering Society of Columbia University, Mr. Robert T. Lozier took as a subject, "Commercial Phases of Engineering." He pointed out that in design, construction and operation, commercial requirements will frequently outweigh engineering considerations. In operation, the establishment of a standard rate adapted to the local conditions of a given plant and so adjusted as to equalize automatically between those customers who demand a large station capacity to supply their wants for a few hours of the day as against the customer who has a steady consumption of power for 24 hours in the day, is one of the best illustrations of sound commercialism in engineering undertakings.

The successful sales engineer, he said, does not limit himself to setting forth the engineering advantages of the apparatus which he is handling, but will also carefully point out to the prospective purchaser what the particular features of his apparatus mean to that person in dollars and cents; and when he finds that he has made the desired impression, he stops talking engineering and gets a fountain pen ready for signing the order. In these days of intensified business, it is well to remember that a salesman has generally less than an hour in which to make an impression upon the purchaser, and as there are probably five or ten or perhaps twenty other fellows, each trying to make a sale, time should not be wasted in trying to impress the prospective customer that one is a very decent sort of chap and would rather not force himself forward, but he should go straight to the point, which is to set forth the advantages of the apparatus in one's best manner, so as to convince the buyer that the object is to make a sale.

It is a fact that the engineer, like most professional men, is put in a class by himself in that his opinion, when sought, is generally accepted as being supreme. But whenever he is tempted to take himself too seriously, he should remember that with all of his technical training, highly developed apparatus, transmission lines and transmitting devices, he cannot produce electric light from coal at an efficiency to exceed 2 per cent, while the dissipated firefly produces his nocturnal illumination at an efficiency of 96.5 per cent and doesn't seem to try very hard either. If one is called upon to design a bridge he will doubtless employ a safety factor of not less than 4—because steel is an alloy compound of 13 elements, all of which have a direct effect upon its physical qualities and determine its ability to stand strains and stress. One should be at least equally rational in handling the personal equation, which is not only more complex, but the solution of which yields far more important returns.

Chicago Convention National Independent Telephone Association.

Important action was taken at the thirteenth annual convention of the International Independent Telephone Association held at the Auditorium Hotel in Chicago on Dec. 7, 8 and 9. A very radical plan of reorganization, designed no doubt to stop the leakage of Independent companies to the Bell interests, is under way, and was partially carried out at this convention. The name was changed to "National Independent Telephone Association," and hereafter jurisdiction will be confined to the United States.

By another amendment to the constitution the objects of the association were stated to be, among other things, "to strengthen the union of the Independent telephone companies through the association together of local companies into a more perfect national Independent telephone system; . . . to insure the permanent maintenance of such national Independent telephone system as a competitor of the America Telephone & Telegraph Company and its subsidiary and allied companies or successors, thereby securing to the people of the United States the continuance of the benefits of competition in public telephone service." The constitution was also amended to provide for the election of a board of 17 directors, who shall manage the affairs of the association and elect the officers. Heretofore the officers have been elected by the association itself.

The new board of directors was authorized to increase the dues assessed on each member to an amount not exceeding five cents for each telephone station of member companies. Heretofore this amount has been limited to one cent for each telephone. The old executive committee is abolished, and also all provisions of the old constitution inconsistent with these amendments.

Furthermore, a plan of reorganization was outlined in which some details remain to be perfected, which is to be carried out by the new board of directors, and to which the association formally pledged itself. It is proposed to reorganize the association as a corporate body and to issue stock to member companies in proportion to the number of telephone units represented by each member company, say, one share of stock to 500 units. One unit shall consist of one subscriber's telephone or one circuit-mile of toll line. The association will be made up of company members. The purpose is to make the properties of the members a part of a national Independent telephone exchange. The membership agreement will be in the form of a contract between the member companies and the association, by which the former agree to remain independent for 25 years and exchange business only with one another. This will be a contract that can be enforced by law, and it must be ratified by the directors of each member company. If the stock of a member company changes hands, the obligation will still hold good. This drastic plan, it is believed, will prevent telephone properties from slipping away from the Independent interests, as has been the case in Des Moines, Ia.; Richmond, Ind.; Springfield, Mo., and other places.

The new board of directors, which will be all-powerful in the affairs of the reorganized association, consists of the following named gentlemen: Mr. E. H. Moulton, Minneapolis, Minn.; Mr. Theodore Gary, Topeka, Kan.; Mr. E. B. Fisher, Grand Rapids, Mich.; Mr. O. C. Snider, Kansas City, Mo.; Mr. W. J. Uhl, Logansport, Ind.; Mr. Frank H. Woods, Lincoln, Neb.; Mr. Samuel W. Harper, Wheeling, W. Va.; Mr. Charles West, Harrisburg, Pa.; Mr. Richard Valentine, Janesville, Wis.; Mr. Manford Savage, Champaign, Ill.; Mr. E. F. Day, Council Bluffs, Ia.; Mr. Stephen A. Ward, Mansfield, Ohio; Mr. W. A. Jackson, Detroit, Mich.; Mr. Max Koehler, New York, N. Y.; Mr. H. D. Critchfield, Chicago, Ill.; Mr. Walter E. Doolittle, Chicago, Ill.; Mr. E. A. Boqua, Ft. Smith, Ark.

During the convention the interesting announcement was made that financial arrangements have been perfected which will result in the establishment of an Independent telephone system in Chicago between now and the 1910 convention of the association. This statement, which was made by Mr. H. D. Critchfield, of Chicago, was received with great enthusiasm.

The registered attendance at the convention was about 800, and there was the usual display of telephone exhibits.

OPENING PROCEEDINGS.

At the opening session on Tuesday morning, Dec. 7, an address of welcome was delivered by Mr. Bernard J. Mullaney, secretary to Mayor Busse, to which a felicitous response was made by Vice-President Fisher, Vice-President Holdoegel being in the chair.

The acting secretary, Mr. J. B. Ware, of Chicago, then presented an interesting report. He pointed out that the Independent companies operate about one-half of the six million telephones in use in the United States. While the last year has witnessed restlessness among Independent telephone men and threatened discord, the association still stands firm for fair, legitimate competition in the telephone business. Mr. Ware devoted considerable attention to the telephone statistics as given in the United States census report for 1907. He presented a number of interesting tables made up from the census figures in

groups of States. A table giving a summary of these statistics is as follows:

States.	Total Telephones.	Independent (Non-Bell.)	Bell (A. T. & T. Co.)	Independent with Bell-connection.	Independent exclusively.	No. of Co's.
Eastern	410,773	45,100	371,667	19,001	25,505	366
Middle	1,303,185	394,371	968,814	37,016	357,355	1,598
Central	1,774,534	1,056,253	718,281	258,987	797,266	5,117
Western	1,320,680	992,132	328,929	388,929	603,203	10,356
Southern	709,702	343,223	366,479	96,199	246,024	3,977
Mountain ...	533,704	155,430	378,274	35,148	120,282	1,557
Total	6,118,578	2,986,515	3,132,662	835,880	2,149,635	22,971

Analysis of the census report shows that in the six Central States (Illinois, Indiana, Ohio, Michigan, Wisconsin and West Virginia) there were 80,000 more Independent than Bell telephones, after deducting all the Independent companies having connections with both systems. Excluding Chicago, Milwaukee and Cincinnati, there were 280,000 more exclusively Independent than exclusively Bell telephones in the States named. In the seven Western States of Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota and South Dakota there were more than twice as many exclusively Independent than exclusively Bell telephones in 1907. Mr. Ware closed his report by referring to the defeat of proposed legislation in Wisconsin and Illinois which would cripple the Independents. In Wisconsin it was proposed to place telephone companies under the Railroad Commission as to franchises, thus practically preventing any more telephone companies being started in places now having telephone service. This plan was defeated after strong effort. In Illinois a bill was introduced to permit a telephone company to buy another telephone company or to sell its property to another telephone company. This bill would have legalized the proposed sale of the telephone privileges under the tunnel franchise in Chicago, but the proposed measure was defeated at the very closing hours of the session.

Mr. H. H. Houston, vice-president of the Doubleday-Page Company, addressed the convention on the subject of advertising the telephone business.

TELEPHONE MONOPOLY.

At the session of Wednesday morning Mr. F. Dagger, of Toronto, read a paper having as its title "Is the Telephone a Monopoly?" This question Mr. Dagger answered in the negative. The speaker stated that by competition the telephone service has flourished. In relation to the argument that two telephones cause needless expense to subscribers, the speaker gave statistics showing that in towns in Illinois where two telephone systems exist only 8.8 per cent of the subscribers have duplicate service. Perhaps, also, those using the two telephones would require two instruments in any event to handle their business. Competition has resulted broadly in a general diffusing of telephone service. The speaker gave figures from various cities substantiating this statement. Los Angeles, with competition, has 215 telephones to each 1000 inhabitants. In Chicago, the speaker said, there are 70 telephones to each 1000 inhabitants.

TELEPHONE FIRE INSURANCE EXCHANGE.

Speaking for a committee appointed at the last convention, Mr. J. B. Hoge, of Cleveland, made a report on the telephone fire insurance. The committee has organized a "Telephone Fire Insurance Exchange," a co-operative affair, which solicits a portion of the insurance business of the members of the association. Regular rates are charged. The yearly surplus is to be divided into thirds, one of which would be paid back to the policy-holder and two placed to the credit of a surplus fund. When this fund amounts to $15 per unit installed for each risk, the whole amount of the profits will be divided among the policy-holders. Mr. Hoge explained the details of the scheme, which includes also a provision for income insurance. He made the interesting statement that of an investment of $100 in telephone property, $40 worth is practically indestructible by fire, $40 worth is so widely scattered as to be very unlikely to be burned in any one fire, leaving $20 on buildings, switchboards, equipment, etc., which should be protected by insurance.

REORGANIZATION OF THE ASSOCIATION.

The amendments to the constitution and the plan of reorganizing the association, to which reference has previously been made, were presented to the association on Wednesday morning by Mr. Frank H. Woods, of Lincoln, Neb., chairman of the committee on amendments to the constitution. By unanimous vote the constitution was amended in the manner heretofore outlined. By resolution also the new board of directors was instructed to carry out the plan of organization heretofore described.

Mr. Woods, representing the board of directors, made an appeal for funds to finance the new plan of reorganization. He explained that the association will proceed temporarily under the old organization until the new membership contracts are ready. It is proposed to raise a fund of $50,000, to be used principally in putting the new plan into effect. The representatives of operating companies present were asked to pledge $50 per 1000 telephones to this fund.. In all, $9485 was subscribed at the session, making, with $10,000 previously subscribed by the Continental Telephone & Telegraph Company, nearly $20,000 towards the $50,000 fund.

TECHNICAL AND OPERATING CONFERENCE.

In opening the Technical Conference session, over which he presided on Tuesday afternoon, Mr. R. G. Johnston read a paper explaining the general object of this practical side of the convention work. The general subject treated was economy in telephone service. The discussion was continued by Messrs. Harry N. Tolles and J. H. Ainsworth.

Mr. Arthur Bessey Smith, of Chicago, former assistant professor of telephone engineering at Purdue University, read a paper on "The Telephone and the School," in which he advocated technical training for telephone men. Prof. Volney D. Cousins, of Purdue University, followed with a paper on "An Apprenticeship Course for Telephone Engineers." He advocated the establishment of an apprenticeship course by operating telephone companies.

TELEPHONE ENGINEERING.

"Economy of Proper Engineering" was the subject of a paper read by Mr. Kempster B. Miller, of Chicago. The speaker pointed out that good engineering and good management should go hand in hand. Beginning with the preliminary report on any telephone service proposition, engineering investigation and advice are constantly required. The engineer should lay out and supervise a telephone plant that will make the very best use of every dollar spent. From two-thirds to four-fifths of the investment in telephone properties is in buildings, wires, poles, conduits and the like, which are often left to the care of foremen of insufficient ability. Reports should be regularly made from various departments to the company's consulting engineer, so that he may detect any waste or inefficient administration. The work of the engineer has received too little consideration from Independent telephone companies, and Mr. Miller made a strong argument in favor of improvement in this respect.

OTHER TECHNICAL CONFERENCE PAPERS.

Mr. John W. Coffey, of Indianapolis, read a paper on "Office Accessories" at the Wednesday afternoon session. He spoke of the desirability of using modern office appliances by telephone companies. Mr. W. S. Vivian, of Grand Rapids, presented a paper entitled "Methods of Increasing Toll Business." He described the plan of co-operation adopted by the Michigan Telephone Traffic Association, one feature of which is the meeting of long-distance operators held at frequent intervals. "Patents" was subject of a paper read by Mr. Max W. Zabel, of Chicago. While praising the United States patent system in general, Mr. Zabel said that there is some difficulty in enforcing patent rights after they are granted. To reduce the expense of litigation, he advocated a reform in the taking of testimony. There should be improvement in the Patent Office, so that when claims are allowed the patentee may have reasonable assurance that they will not be found subsequently to have been anticipated.

The subject presented by Mr. J. P. Boylan, of Cleveland, was "Economy of Training Operators." Mr. Boylan advocated such training as of a decided economic advantage. The opera-

tor should not gain her experience at the expense of the public.

At the closing session of Thursday morning, a paper written by Mr. H. E. Davis, of Topeka, Kan., was read in his absence by Chairman Johnston. The subject was "Operators and Trouble Men."

Mr. C. H. Judson, of Seattle, spoke of the evils of free telephone traffic. He mentioned the surprising facts that 8 per cent of all conversations in the residence districts in Seattle were more than 30 minutes each, and that the average conversation in these residential districts was of 7.5 minutes' duration. The speaker advocated the extension of pay stations to clear the system of the enormous amount of free traffic.

Mr. Franklin H. Reed, of Chicago, followed with a talk on "Co-operation." He said that the Independent telephone business in particular is absolutely dependent on co-operation in its broadest sense. An intelligent use of technical journals, by preserving the issues and consulting the indexes, is an effective example of co-operation. Mr. Johnston reverted to the desirability of establishing working libraries of books and journals in telephone exchanges. Mr. Ainsworth added that suggestion boxes and departmental meetings of employees furnish effective co-operation.

Advanced Electrical Engineering Course at Massachusetts Institute of Technology.

During the past year, the regulations for the degree of Doctor of Engineering at the Massachusetts Institute of Technology have been made more definite and have been placed in the hands of the board, which also administers the regulations for the degree of Doctor of Philosophy. The requirements for the degrees of Doctor of Engineering and Doctor of Philosophy have now been made substantially equivalent, so far as the period of study and the candidate's attainments are concerned. The Executive Committee has voted to maintain two Austin research fellowships carrying a grant of $500 each and the remission of tuition fees, which are now to be open equally to candidates for the Doctor of Engineering and Doctor of Philosophy degrees. In addition to these Austin fellowships, other graduate scholarships and fellowships are maintained, numbering 15 this year.

During the present year 17 candidates for advanced degrees have been awarded fellowships or graduate scholarships. Two of these were for the encouragement of advanced study in Germany by graduates of the Institute of Technology and the remainder for the encouragement of advanced study in the Massachusetts Institute of Technology.

The number of candidates for the Doctor's degrees in Engineering and Philosophy have this year increased largely over the number of candidates last year. The increasing importance of this work at the Institute of Technology has led to a more effective organization of the arrangements for carrying on the work. The number of students entered as candidates for the Master's degree are also considerably increased over last year.

The advanced instruction in the theory of alternating currents and electrical transmission of power accompanied by advanced research is continued this year under the direction of Dr. Harold Pender, whose investigations in these branches are well known. Professor Pender's duties in the electrical engineering staff of the Institute of Technology include the direction of the important undergraduate course in the elements of electrical engineering which is provided for the junior students in electrical engineering and electrochemistry, and the naval constructors who are detailed by the United States Government for study at the Institute, and also include the advanced lectures for graduate students just referred to on alternating currents and the transmission of power and the investigations and research carried on by such students. Other work carried on by the department for the benefit of students desiring to do original research or who are studying with a view to obtaining advanced degrees, include the lectures and investigations under Professor Jackson on the organization and administration of public service corporations, and instruction in the designing of electric plants by Professor Wickenden. Various researches are now going on in the electrical engineering laboratories in connection with this graduate work.

In addition to the growing importance of the advanced study and research carried on by the electrical engineering department at the Institute, the undergraduate classes are growing rapidly, and this is particularly true of the junior and senior classes, which are recruited to a considerable degree by graduates from the humanistic or scientific courses of other institutions.

Forty per cent of the men who were graduated from the electrical engineering course of the Institute at the last commencement had previously received college degrees and had thereafter spent from one to three years in the electrical engineering studies at the Institute of Technology. The increased number of students following the electrical engineering instruction is particularly felt in the laboratories, and the number of student hours of instruction in the electrical engineering laboratory is now approaching a figure about twice as great as it was three years ago.

Meeting of Electric Boosters' Club.

About 150 members attended a meeting of the Pittsburgh Electric Boosters' Club held on Nov. 29. This club includes among its membership representatives of all electric interests in Greater Pittsburgh. It is organized on the lines of similar clubs in other cities and yet embodies in its essentials distinctive points among which may prove of interest, the nomenclature given to its officers, who are as follows: Mr. L. J. Kiefer, master controller; Mr. Aux. Henry Harris, auxiliary master controller; Mr. Ludwig Hommel, recording wattmeter; and Mr. C. B. Cushing, master electrotype.

The club meets for dinner weekly and holds monthly meetings for discussion of subjects of special interest to the membership. At the November meeting a paper entitled "Seventeen Years of Development in the Controller Industry" was presented by Mr. A. P. Munning. The speaker first referred to the fact that with the development of power-saving appliances when used with electric motors, the question of proper controllers had become so important as to practically dominate to a large extent the use of motor appliances, comparing it in this respect with conditions existing 17 years ago, where the controller was looked upon as purely a necessary evil in connection with the motor, and was designed essentially by rule-of-thumb. For instance, in 1892 a 1-hp, 220-volt starting rheostat, without any automatic features, sold for from $20 to $25; its dimensions were 24 in. x 24 in. x 18 in., and its weight about 60 lb.; to-day the same device with automatic features sells for approximately $3; its size is 9 in. x 9 in. x 4 in., and its weight 11 lb.

He referred largely to the development period occurring between 1892 and 1896, and beginning with a very simple automatic release, outlined and explained the various steps which had taken place since that time in the design and manufacture of controllers up to, for example, the intricate and massive controllers at present employed in steel-mill practice at Cary, Ind., and at Aliquippa. As an instance, he referred to the 1500-hp, 2200-volt, multiple-lever type speed regulators used at the Edgar Thomson Works of the Carnegie Steel Company, where the final contacts on the controller are arranged to carry 10,000 amp and the resistors for each controller consist of approximately 5000 ft. of culm T-rails. He also referred to the extensive use of self starters in connection with compresors, electric elevators, valve control systems, etc.

Mr. Munning referred to the subject of printing-press control, outlining in a general way the types of controllers used, beginning with the Hoe sextuple and octuple presses down to the simplest form of controllers for press work used with the ordinary cylinder or flat-bed types. In the use of larger motors for steel-mill work, attention was called to the application of the series-relay type of controller, and the speaker stated that

before the advent of this construction, mill tables were not as successfully operated, since the drum-type control previously employed involved a much greater strain on the machinery, required harder service on the part of the operators, and involved the use of a larger amount of time than with the new types. It was pointed out that the motors on mill tables are often times required to be reversed from full speed in one direction to full speed in the opposite direction under full-load conditions in from three to four seconds, approximately seven times per minute, for 24 hours per day, for six days per week, all of which involved the most rugged types of controller construction that could be designed.

Work of Accounting Committee, N. E. L. A.

A meeting of the committee on accounting of the National Electric Light Association was held at the headquarters in New York on Nov. 16 and 17. The sub-committee on uniform accounts and practices held a meeting at the same time.

The committee will prepare a classification of construction and operating accounts in such a manner as to meet the needs of companies of various sizes. The classification will divide companies into four classes, according to their gross revenue, as follows: $25,000 and less; $25,000 to $100,000; $100,000 to $500,000; $500,000 and over.

It has also been decided by the committee to issue a pamphlet outlining the principles of accounting and their application to electrical properties and giving explicit instructions to guide companies in their accounting methods. Forms will be included in the pamphlet.

New York Public Service Commission News.

A plan for a system of subways was submitted to the Public Service Commission last week which contemplated practically surrounding all of the boroughs of Greater New York. This plan was prepared by E. J. Farrell, John J. Hopper and associates. It proposes to build East Side and West Side subways through Manhattan and the Bronx, with five cross-town loops connecting them to a tunnel under the East River to Brooklyn, and there connect with the Fourth Avenue subway, and later cross from Fort Hamilton, under the Narrows, to Staten Island. It also contemplates a Fifty-ninth Street cross-town subway under the East River into Queens, reaching several of the more important Long Island points. The total expenditure involved in this system is estimated at about $130,000,000. Mr. Farrell was connected with the building of Sections A and B of the Canadian Pacific Railway, and has done other important work for the Dominion Government.

The Public Service Commission has decided that the recent order regulating the heat in cars must be posted. This was the portion of the order to which the railroad companies objected, claiming that it would result in many complaints that were unjustified. The commission, however, is disposed to think that the posting of the notices will enlist the co-operation of the public in having the proper conditions maintained.

The Interborough Rapid Transit Company has promised the Public Service Commission that it will install 16-cp lamps without shades on both the subway and elevated cars. The installation, it is said, will require two or three weeks, and will cost about $25,000. There has been no agreement made as to the lighting of subway stations.

The commission was informed last week that the Bradley Gaffney-Steers Company will adhere to the comprehensive plans for subway construction which it proposed some time ago. The company is only waiting for the commission to advertise for bids for subway construction. The many proposals which have been made since the Bradley plan was outlined have not in any way changed the views of that company.

According to a decision made last week by the Supreme Court of New York City, the present Board of Estimate and Apportionment cannot pass upon the proposed modifications of the franchise of the South Shore Traction Company, which is operating surface cars over the Queensboro Bridge. The board proposed to modify this franchise at its meeting on Dec. 23, but the court holds that a longer time is necessary to hear from taxpayers and other interests. The matter will, therefore, go over until the new city administration is in office.

The Board of Estimate and Apportionment has unanimously authorized the issue of $13,036,381 in corporate stock of the city of New York for the construction and completion of the six sections of the Fourth Avenue subway in Brooklyn, the contracts for which have been let.

The Public Service Commission, Second District, has sent notices to all gas companies in the district of a conference to be held at the office of the commission, Albany, to consider the necessity for a new standard in measuring the quality of gas. The quality is now measured by the photometric standard, by which gas is judged for its illuminating power. This standard has been in use for a number of years. For the past 14 months the Division of Light, Heat and Power of the commission has been engaged in a study of various features of the gas supply. The results of the inquiry, as embodied in a report of H. C. Hazzard, chief of division, to the commission discloses that the illuminating power of gas is no longer of primal importance, and that the real value of gas to the average consumer now lies in its heating power. This situation having been shown to exist, the commission at once decided to place the full results of the investigation before the companies, and to summon their representatives to Albany for a general discussion of the subject. This step may lead to the adoption of a "calorific" standard. If this result follows, it will mean that hereafter the gas supply must measure up in heat units to the new standard. Before such action is taken, however, the Legislature will probably be called upon to amend the Public Service Commission law. As it now reads, the law evidently restricts the authority of the commission to fixing "the standard of illuminating power" of gas to be manufactured or sold, not alone for lighting, but for "heating or power purposes," a function the illuminating power cannot fulfil.

The importance of the heating power of gas is due considerably to its extensive present-day consumption for fuel purposes and the prevailing use of the Welsbach mantle in lighting. The light secured from mantles is not dependent upon superior candle-power of the gas, but to the high temperature which the mantle is capable of attaining. A standard by which is determined and regulated the illuminating power of gas is of service, therefore, only in measuring the value of gas to those who use it in open-flame burners for lighting. That those who use gas in this manner constitute a minority of the gas consumers, and that the value of the gas furnished to the majority should be standardized, is the opinion of Mr. Hazzard, who summarizes the results of the inquiry as follows:

(1) That of the coal gas, carburetted water gas and mixed gas furnished within the territorial jurisdiction of this commission, the proportion used in open-flame burners probably does not exceed 20 per cent of the total supply. (2.) That the existing photometric standards by which is judged the illuminating power of the gas afford the proper basis of measuring the real value of this proportion of the supply. (3.) That unless and until the amount of the gas supply used in open-flame burners becomes diminished considerably below its present proportion of the total gas consumed, it is desirable that the existing photometric standards be maintained. (4.) That the present test for illuminating power is not suited to a determination of the real value of gas used in the various methods now employed in incandescent lighting, nor does it afford a proper standard of measure for gas used for heat and power. (5.) That the amount of gas used in these methods and for these purposes constitutes fully 80 per cent of the total gas supply. (6.) That the real value of this proportion of the gas supply lies in the heating properties of the gas, for which no standard of measurement exists in this State. (7.) That by reason of the large class of consumers to whom the value of gas as a generator of

heat is a matter of primal importance, it is desirable that the calorific power of gas be standardized by the introduction of appropriate tests."

The report of the chief of the division presents fully an analysis of the heat units found in the gas supply as at present manufactured and distributed without heat-unit regulations, and a discussion of the relation, if any exists, between the calorific power and illuminating power. This analysis is based upon upward of 700 tests made of the gas furnished by each company in the State.

The Public Service Commission, Second District, will hold a hearing the present week on the application of the Bennington & North Adams Street Railway Company for approval of a declaration of abandonment of a portion of its railroad in the village of Hoosick Falls; on the application of Moritz Mayer for consent to exercise franchises and operate an electrical plant in Camillus, Onondaga County; on the complaint of the Oneonta Common Council against the Oneonta Light & Power Company as to electric-lighting service rendered in that city and the complaint of residents of West Davenport as to station accommodations afforded by the Ulster & Delaware Railroad at that place, and a further hearing on the application of the Hornell-Bath Interurban Railway Company, which is seeking permission to build an electric road from Hornell to Bath, Steuben County.

Of 6220 meters tested in October, 1909, according to the reports filed with the New York Public Service Commission, Second District, 3998 were tested on the premises of companies and 2222 at plants. Of the total number 4507 or 72.46 per cent were accurate; 583 or 9.37 per cent were fast, and 1130 or 18.17 per cent were slow.

Maryland Public Utility Bill.

Attorney-General Strauss, of the State of Maryland, has completed a draft of a public utilities bill which he was requested to prepare by Governor Crothers and the other members of the Governor's cabinet. The measure includes by express provision railroad, gas, electric, power, refrigerating and heating, telephone, telegraph, water and other public service corporations. It provides for the regulation and control at just and reasonable figures of their rates and schedules of prices, of the quality of the service rendered to the public, and calls for the valuations of their franchises, property and plants; it also establishes systems of auditing and accounting and the control over the transfer of franchises and the insurance of stocks and securities. From the decisions and orders of the commission an appeal to the courts is provided. The bill is drawn mainly on the lines of the New York Public Utilities law passed in 1907, with features worked into it from the Wisconsin and Massachusetts acts, the report of the Connecticut commission and the bills introduced into the legislatures of New Jersey and Ohio.

The commission is to consist of three members appointed by the Governor. Their term of office is to be two years, and they are eligible to reappointment. The chairman of the commission is to be designated by the Governor. General and assistant counsel for the commission, necessary experts, etc., are also provided for.

The commission is given full power to summon witnesses with books and papers, and to compel these witnesses to testify. Each Commissioner may hold separate hearings, but his findings or decisions must be ratified by the commission before becoming effective. The commission is given jurisdiction and supervision over all of the railroads and common carriers lying within the State of Maryland. Among the powers vested in the commission with respect to gas and electric corporations are those of general supervision of all persons and corporations having authority under any general or special law or under any charter or franchise or under any ordinance of any municipal corporation or right granted by any county to lay down, construct or maintain pipes, mains, conduits, ducts, wires, poles or other fixtures and appurtenances in, over or under the streets, roads, highways or public thoroughfares and places of Baltimore City or any other municipality or of any county in the State for the purpose of transmitting, furnishing, selling or distributing gas, or of furnishing or transmitting or selling electricity for light, heat, fuel or power, or maintaining underground conduits or ducts for electrical conductors; of investigating from time to time the quality of gas, either natural or artificial, supplied by such persons or corporations; to examine the methods employed by them in the manufacture and supplying of gas or electricity, and to have the power of ordering and requiring such improvements as to quality and service as will best promote the public interest. It will also have the power to fix the standard of illuminating power and purity of gas, and to prescribe methods of regulating the electric supply system; to require all gas distributed or sold to equal the standard so fixed, and to establish regulations as to pressure at which gas shall be delivered; to make all inspections and investigations of the methods in manufacturing or transmitting or supplying artificial gas and in delivering and supplying natural gas, as well as electricity.

The commission is to have power to prescribe and require uniform methods of keeping accounts, records and books by such corporations; to require annual reports from their officers respecting their authorized capital stock and the amount thereof issued and outstanding, as to its bonded indebtedness, as to its receipts and expenditures during the preceding year, the amount of dividend upon stock and interest upon bonds, salaries or officers, location of plant or plants and full description of property and franchises, and also power to examine books and affairs and to compel production of books and papers. Provision is made for inspection by agents of the commission of gas and electric meters.

Transfers of franchises can only be made subject to the approval of the commission. Elaborate provision is made for the reception and hearing of complaints as to quality and to price of gas and electricity, for the investigation thereof by the commission, for notice and hearing, and for rendering of decisions and orders by the commission fixing just and reasonable prices, or requiring improvements in quality or service. Penalties are provided for violations of orders. The act provides for appeals to courts from any order of the commission upon the ground that the same is unjust, unreasonable or unlawful, and further provision is made for an ultimate appeal to the Court of Appeals.

Massachusetts Legislative Notes.

In anticipation of the forthcoming session of the Massachusetts Legislature, the Boston & Eastern Electric Railroad Company has filed with Secretary of State William M. Olin a petition for the right to construct a tunnel under Boston Harbor and the city proper to Post Office Square. The Massachusetts Railroad Commission has informally expressed its approval of the establishment of additional transportation facilities in the district which the Boston & Eastern desires to serve, and the Board, together with the Boston Transit Commission, will report to the next Legislature in a few weeks under what conditions, if any, it considers an entrance into Boston should be made in connection with the project. The company plans to furnish very high speed interurban service between Beverly, Salem, Lynn and Boston.

A petition has also been filed with the Secretary of State for the construction of a subway loop in connection with the Boston terminus of the Cambridge subway, the latter now being built by the Boston Elevated Railway Company within the limits of Cambridge. A number of large business interests in Boston are behind the petition, which plans for a double-track loop about 4300 ft. long, starting from the proposed terminus of the Cambridge subway at Park Street, and running below the present Tremont Street subway to Scollay Square, where the line would swing to the west through Bowdoin Square and under Cambridge Street to connect with the out-bound track of the Cambridge subway. The estimated cost of the work is $1,750,000.

CURRENT NEWS AND NOTES.

INDIANA ENGINEERING SOCIETY.—The thirtieth annual convention of the Indiana Engineering Society will be held at the Denison Hotel, Indianapolis, Jan. 13-15, 1910. An engineering exhibition will also be held. Mr. Charles Brossman, Union Trust Building, Indianapolis, is secretary.

RAILROADS PAY FOR STREET LIGHTING.—The city of Indianapolis has presented bills to the railroads entering the city for 30 per cent of the cost of maintaining arc lamps at street railroad crossings since June 1, 1907. An ordinance providing such payment has never before been complied with, but the railroads express willingness to do so now.

ELECTRICAL SUPPLIES FOR GUATEMALA.—As the outcome of the special legislation giving the Guatemalan Government direct supervision of all electrical enterprises, a presidential decree of Oct. 21, 1909, allows the importation of electrical supplies only on written permission granted by the War Department upon application. The decree also requires such enterprises now existing to furnish to the competent authority the description and destination of all orders for material placed before the promulgation of the present law.

CURB TO PUBLIC SERVICE COMMISSION.—The Court of Appeals has set aside the refusal of the Public Service Commission of the Second District of New York to authorize an issue of bonds by the Delaware & Hudson Company to pay for securities of the Hudson Valley Company. The court held that the Legislature did not intend to make the commission the financial manager of corporations or empower it to substitute its judgment and discretion for that of the directors and stockholders of a corporation as to the wisdom of a transaction.

SEARCHLIGHT ON NORTH CAROLINA COAST.—The United States Government will shortly install three powerful 60-inch dial searchlights at the mouth of Cape Fear, 30 miles below Wilmington, N. C., according to recent announcement. The new lights will be located on 150-foot towers, and will be of considerable importance in increasing the facilities of Fort Caswell, near the coast, which at present has only one light having a 36-in. dial. The new lights will also serve to guide mariners clear of the dangerous Frying Pan shoals on the Atlantic coast some miles from Fort Caswell.

HIGH-VOLTAGE DIRECT-CURRENT SYSTEM.—At a meeting of the Electrical Section of the Canadian Society of Civil Engineers, held on Dec. 9, Mr. A. H. Barringer presented a paper descriptive of a 2750-volt, direct-current generating and distributing system that has been in service at Twickenham, England, for the past five years. Use is made of two 200-kw, 2750-volt generators, which supply energy to direct-current rotary converters, having double-wound armatures, which deliver direct-current at 550 volts. The system as a whole is operated satisfactorily; the greatest trouble has been in the low-tension distributing cables.

DEEP WATERWAYS AND SUBWAYS MAY BE CONSIDERED BY ILLINOIS LEGISLATURE.—In Governor Deneen's call for a special session of the Illinois Legislature, to be assembled on Dec. 14, he specified 24 subjects to which he directed the special attention of the law-making body. Among these are two of more particular interest to electrical men. These are the enactment of legislation concerning the construction of a deep waterway and development of water-power between Lockport and Utica, Ill., on the Illinois River, and a proposed law to authorize cities to construct, maintain and operate subways and to control and regulate their use. The latter suggestion refers to the projected subways in Chicago.

N. E. L. A. MEMBERSHIP.—The membership of the National Electric Light Association has grown lately with most gratifying rapidity, and last week crossed the 4000 line. The increase in the last two months has been nearly 500, and the gain since July is about 1000. The Membership Committee, under Chairman H. H. Scott, has attacked its task with irresistible vigor and enthusiasm, and there is every indication that a total of 5000 members is not far off. A hopeful feature of the growth has been the steady accession of operating companies, and upon them the energies of the membership campaign are particularly concentrated. In fact, in view of the usefulness of the Association to member companies, and its value to literature, it is hard to understand why any central station should not enjoy all the benefits thus available.

WISCONSIN ELECTRIC RAILWAY TAXES.—All the street railway companies operating in Wisconsin have paid their taxes for the year, amounting to $422,015.21. Of this amount 15 per cent goes to the State and the remainder to the cities, towns and villages in which the property taxed is located. The principal payments were as follows: Milwaukee Electric Railway & Light Company, $249,763.87; Milwaukee Light, Heat & Traction Company, $62,869.62; Milwaukee Northern Railway Company, $18,175.04; Duluth Street Railway Company, $8,858.90; Chippewa Valley Railway, Light & Power Company, $8,858.90; Green Bay Traction Company, $8,287.36; La Crosse City Railway Company, $5,143.88; Sheboygan Light, Power & Railway Company, $7,315.74; Wisconsin Traction, Light, Heat & Power Company, $10,744.99; Wisconsin Electric Railway Company, $7,430.05; Wausau Street Railway Company, $21,868.25; Rockford & Interurban Railway Company, $3,372.10.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY ANNUAL REPORT.—President Richard C. Maclaurin, of the Massachusetts Institute of Technology, in his first annual report to the trustees urges the necessity of further endowment, and states that the present grant of $25,000 per year is absurdly inadequate, being less than 5 per cent of the total operating expenses of the institute. The need of a new location is also emphasized in the report, which states that the present site is conveniently situated, but noisy, dirty and subject to electrical and mechanical disturbances which interfere with its efficiency as an educational machine. The present buildings are also overcrowded and scattered. A new site of 25 acres is desired as near the center of Boston as is feasible, and with a provision for dormitories for many of the students whose present lodging conditions are not of the best. President Maclaurin suggests in conclusion that when the opportunity arises the institute should sell all its unrestricted property, secure a new site, and then, so far as necessary, throw upon the public the burden of erecting new buildings and installing new equipment.

N. E. L. A. GAS ENGINE COMMITTEE.—A preliminary meeting of the N. E. L. A. Gas Engine Committee was recently held, at which President Frueauff by letter suggested an outline of work, including securing data on the operation of isolated installations of gas engines, running either on city gas or on producer gas, which compete with central stations. In order to get this information promptly, and to divide the burden of the work between the various members of the committee, it was decided that each member of the committee should take personal charge of collecting data within a certain territory. It was also decided that the chairman should communicate with the manufacturers of gas engines and producers asking them to advise the committee what changes or improvements had been made in their apparatus since last described in a N. E. L. A. report. Mr. Klumpp, the consulting engineer of the committee, was delegated to obtain what information he could about the operation of the Gary blast-furnace gas-engine plant, and at a later date it may be desirable for the committee to visit the plant in a body.

SOUTH CAROLINA WATER-POWERS.—According to a recent report to the State Government, the textile mills of South Carolina now employ 45,478 hydroelectric horse-power, 16,375 electric horse-power generated by steam, 26,235 water horse-power and 76,734 steam horse-power.

MANCHESTER, ENGLAND, MOTOR SERVICE.—The municipal plant of Manchester, England, rents motors at prices ranging from $12 per annum for a ½-hp machine to $127 for a 50-hp machine. Consumers can also purchase motors on monthly payments extending over three years.

NEW NORWEGIAN ELECTRIC SMELTING WORKS.—A second works for the reduction of iron ore by the electric furnace method are to be erected by H. Boholm, director of the Cobber Mine & Smelter Company, of Trondhjem, Norway, one of the best-known metal concerns in Norway.

THE NOBEL PRIZES.—As previously noted, Marconi is among those to whom Nobel prizes were awarded this year. The prize for physics was divided between Marconi and Prof. Ferdinand Braun, of the University of Strasburg. Prof. William Ostwald received the prize in chemistry. The value of each prize is $40,000.

MONTREAL MUNICIPAL PLANT.—An election will be held in Montreal on Dec. 21 to vote upon a by-law passed by the Council involving an expenditure of $2,000,000 for a municipal lighting plant. The Legislature has already granted the city the right to borrow the money, provided that the plan is approved by a vote of the real estate owners.

CARBON-SILICON DYNAMO BRUSHES.—A patent issued Dec. 7 to Georg Egly, of Berlin, Germany, describes a dynamo brush consisting of carbon with an admixture of from 2 to 5 per cent of silicon. It is claimed that this type of brush has a sliding contact of excellent conductivity, is of great hardness, and gives a good polish to the commutator.

DENVER ELECTRICAL CLUB.—An electrical club for social purposes and for forwarding the general interests of electrical men has been formed in Denver with an executive committee made up of Messrs. G. A. Woolley, of the General Electric Company, and L. M. Cargo, of the Westinghouse Electric & Manufacturing Company, and Mr. Hall, of the Nernst Company.

ELECTRIC CLUB AT "DUTCH LUNCH."—An agreeable diversion from the usual program of technical discussions was afforded by the regular weekly meeting of the Electric Club of Chicago on Dec. 8, which took the form of a "Dutch Lunch." There were story-telling and informal speeches, and it was voted that a luncheon of this description should be held monthly hereafter.

MONEY BY CABLE FROM ENGLAND.—The British Post Office Department has made an arrangement with the Western Union Telegraph Company to make cable transfers of money between its offices in the United States and points in Great Britain and Ireland, where the orders will be cashed through the postal department. The arrangement will become operative on Jan. 1 next.

LONDON ELECTRICAL SUPPLY.—A new measure will be brought before the British Parliament having for its object to transfer to the London City Council the right, at present vested in the Borough Councils, to purchase the plants of five electrical supply companies. A previous act transferred to the Council the power to purchase the plants of a number of electrical supply companies, and the object of the proposed measure is to extend the power of purchase to the remaining companies of London, in order to place the Council in a position to take over by the year 1931 all of the electrical supply of the metropolitan district.

JOVIAN HEADQUARTERS IN CHICAGO.—The national headquarters of the Sons of Jove have been removed from Dallas, Tex., to Chicago, where a permanent office has been secured in the Monadnock Building. Mr. R. M. Van Vleet, the Mercury of the organization, and Mr. E. D. Strickland, assistant to Jupiter, are in charge of the office. The members of the organization are invited to send their mail or telegrams to the Chicago headquarters or make any other use of the office. Mr. F. P. Vose, of Chicago, is statesman-at-large for the Sons of Jove, and Mr. W. S. Taussig is statesman for Illinois.

THE WELSBACH TUNGSTEN LAMP.—A suit has been instituted by the English firm handling the Osram tungsten lamp against the Welsbach Incandescent Gas-Light Company, which recently, as noted in these columns, introduced a tungsten lamp that is offered to electric light users, payment to be on the basis of saving in electric light bills. The advertisements were ambiguous as to the origin of the lamp, and the plaintiff maintains that the wording indicates an infringement of its sole rights in Great Britain to the Osram lamp. There have already been a number of hearings in the suit, but the mystery surrounding the gas company's tungsten lamp has not yet been penetrated.

RAILROADS INTERESTED IN CONSERVATION OF FUEL.—In former issues the aims and methods of the International Railway Fuel Association were described. Recent conferences on the subject have been held at Washington by Mr. Emerson, chairman of the conservation committee of the International Railway Fuel Association; Mr. Pinchot, Government forester, and Dr. J. A. Holmes, expert in charge of the technological branch of the Geological Survey. The subject has been discussed by the joint committee on conservation in the Government departments at Washington, which also forms a sort of clearing house for the State conservation commissions.

PROPOSED MONTREAL ELECTRICALLY OPERATED TUNNEL.—There is a probability of the Canadian Pacific Railway Company constructing a tunnel under Montreal for the purpose of connecting its two stations, the trains to be operated by means of electricity. Plans for extensions to both stations are under way. While the distance between Windsor Street and the Place Viger is only a mile and a quarter, the trains having to make this journey must traverse no fewer than 18 miles of tracks, which long detour means a large added expense in the haulage of freight. It is thought that the tunnel would in the long run prove a great economy, and at any rate it is admitted that it forms the most feasible solution of the serious problem of transportation from one station to another.

AMERICAN BELL CANNOT DO TELEPHONE BUSINESS IN MICHIGAN.—The Supreme Court of Michigan has rendered a decision refusing to grant permission to the American Telephone & Telegraph Company to use its lines for telegraphy. The court stated that for more than a quarter of a century the Legislature has seen fit to keep separate these two lines of activity, which course has been followed, too, during a period in which the telephone business of the State has grown from an insignificant enterprise to one of great magnitude. "Wherever the telegraph line is, there, too, is the telephone. In the hands of the Independent agencies it may well be that a healthy competition for the transmission of information by electricity will ensue. We are of the opinion that the legislative enactments touching the question indicate a policy on the part of the State to afford its people a choice of two agencies of indepen-

Generating and Transmitting Equipments of the Tokyo Electric Light Company.

THE Tokyo Electric Light Company was established in 1883 with a capital of 200,000 yen (about $100,000). Since then, by process of either buying over or amalgamating with other companies, thereby necessarily augmenting its capital, it steadily increased in importance, until it became, in June, 1906, a concern with a capital of $3,575,000, having a generating equipment of 11,000 kw and also a monopoly of the electric lighting business for the entire city of Tokyo and suburbs. Previous to this, in 1904, the company decided to engage in hydroelectric development, and in pursuance of investigations carried out at that time and in execution of rights already secured in 1899 in making use of the River Katsura, in Yamanashi Prefecture, various preparatory measures, such as actual surveying, buying up land, etc., were completed in 1895. The work of construction for the new power plant was started in January, 1906, and was finished in February, 1908. As a result a total amount of power corresponding to 25,500 brake hp at the turbine shafts was obtained, and the company was enabled to discontinue entirely the use of its former steam plants. For 11,372 ft. the water runs in open canals. The gradient of the water course is 1 in 1200 in the tunnels and 1 in 2400 in the open canals, the difference of water levels between the intake and the penstock chamber being 13 ft. 9 in.

The machines installed in the generating station consist of double Francis turbines directly coupled with three-phase generators. The turbines are of the double-reaction type, each being capable of giving 4500 brake hp at 500 r.p.m. The generators are of three-phase, revolving-field type, each having a rating of 3900 kva at 6600 volts. The generating station contains six sets of these turbines and generators and two sets of exciters, also directly coupled with Pelton waterwheels, each rated at 265 brake hp at 600 r.p.m. Each exciter-generator has a rating of 180 kw. In addition, there are nine 2000-kw, single-phase step-up transformers.

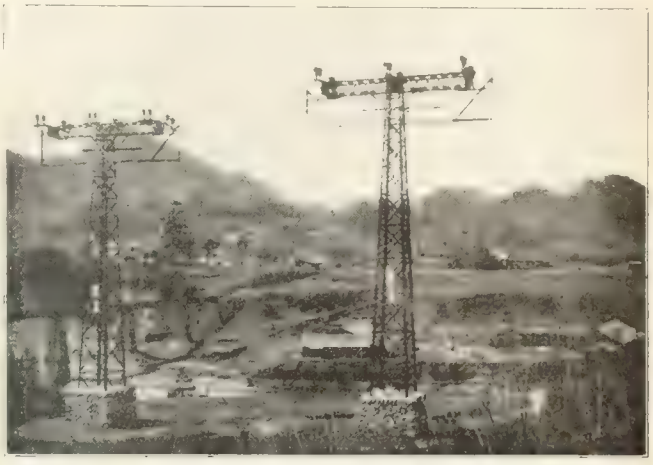


FIG. 2.—STEEL TRANSMISSION TOWERS.

At the Waseda receiving station nine 1800-kw step-down transformers are installed. Between the Komahashi generating station and the Waseda receiving station the energy is transmitted through a duplicate system of overhead lines supported by 4100 poles, the distance being 47 miles. Each of the six conductors is a bare cable 105 mils in diameter, consisting of 18 strands of copper.

On account of the rapidly increasing demand for electric lighting the company has found even its present large hydro-



FIG. 1.—GENERAL VIEW OF POWER HOUSE SHOWING PENSTOCKS.

electric plant insufficient to meet requirements, and it has been decided to secure a second source for hydroelectric power. In the meantime, as the load gradually increases recourse will be made to the old steam plant, which is always kept in order as a reserve.

The River Katsura, from which the company obtains its power supply, has its source in Lake Yamanaka, which in turn is fed by subterranean streams that drain through the sides of Mount Fuji and the surrounding ranges. The altitude and humidity being favorable, there is no danger at any time of the lake getting dried up. Furthermore, the land immediately surrounding the lake is of such a character that all flood water can be absorbed, and there is, therefore, no danger of the lake ever overflowing even after exceptionally heavy rainfalls. The River Katsura may, in consequence, be said to possess two qualifications necessary for hydroelectric purposes, namely, unfailing supply of water and non-fluctuation in flow.

The company has one intake and one generating station on the river. The quantity of water utilized is 750 cu. ft. per second, producing 22,500 hp at the turbine shafts at an effective head of 345 ft. Three-phase generators having a total rating of 15,000 kw and directly coupled to the turbine shafts produce electricity at an e.m.f. of 6000 volts. The pressure is stepped up



FIG. 3.—WOODEN POLE TRANSMISSION LINES.

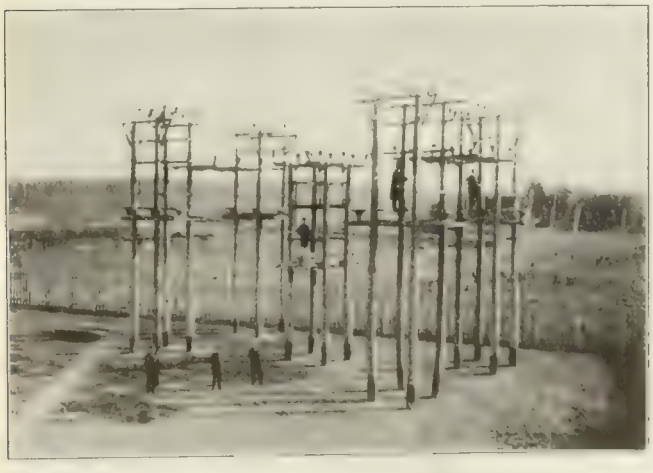


FIG. 4.—OPEN-AIR DISCONNECTING SWITCHES.

to 57,000 volts for transmission to Waseda receiving station, 47 miles distant from the generating station. At the receiving station the pressure is reduced to 11,000 volts, at which e.m.f. energy is distributed to the city substations by means of underground cables.

The length of water course between the intake and the penstock chamber at Komahashi is 22,229 ft. The water course contains nine tunnels, the longest of which is 3114 ft. The aggregate length of all the tunnels is 10,857 ft., and for the remaining distance of stand-by. In consequence of this condition the company has amalgamated with the Tokyo Electric Power Company, thus further securing water rights. The additional work will require three years for completion, and the result is expected to yield an additional 50,000 brake hp.

The total cost of construction of the 22,500-hp installation now in service was about $2,925,000, or about $130 per horse-



FIG. 5.—TRANSMISSION POLES ON MOUNTAIN SIDE.

power. The capital stock of the company at the present time is about $12,000,000, of which about $9,000,000 has been paid up. The president of the board of directors is Mr. Sakutaro Satake, and the general manager of the company is Mr. Unai Mochizuki.

The Power Plant of the Harvard Medical School.

THE lately completed buildings of the new Harvard Medical School, in the Fenway district of Boston, form one of the most imposing architectural groups in America. This department of the university is probably the most completely equipped school of medicine in the world at the present time, and its plant has attracted wide attention during the past two or three years. Representing an investment of over $3,000,000, the present buildings form the nucleus of a group destined to become essentially a university of medical instruction and research. The buildings are located at the head of the magnificent Avenue Louis Pasteur, now under construction through the Fenway, and surround a court of imposing dimensions. The buildings are of white marble, and occupy about two acres, the total area of the present site being about 30 acres. At the head of the court is located the Administration Building, and on each side are laboratory buildings constructed in such a way that each wing is composed of unit laboratories of flexible relations, with a central lecture-room in the main body of the building. In the accompanying general plan of the property, the buildings are designated as follows: Building A, Administration; Building B, Anatomy-Histology; Building C, Bacteriology-Pathology; Building D, Pharmacology-Hygiene. The architects were Messrs. Shepley, Rutan & Coolidge, of Boston.

The engineering services required by the school include power, heating, lighting, ventilation, refrigerating, water and compressed-air supplies, with various communicating equipment in connection with the temperature regulation and the usual telephone and bell requirements of a large institution. The power plant is one of the most complete in existence for institutional service. It, with the entire mechanical equipment of the institution, was designed by the engineering firm of Densmore & Le Clear, Boston.

The power house is located on Vila Street, about 650 ft. away from the nearest laboratory building, and it is connected

with the school by a service tunnel carrying all the supplies of energy generated at the plant. The plant is a brick and steel structure with concrete foundations, about 138 ft. long by 115 ft. wide. It was located at this distance from the school buildings in order to avoid encroaching upon the space to be occupied by future hospitals. The side of the power house facing the school is not provided with windows. The engine-room occupies the entire front of the power house, side windows and

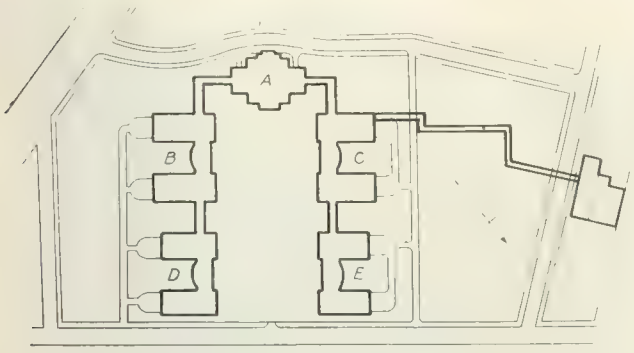


FIG. 1.—ARRANGEMENT OF BUILDINGS OF HARVARD MEDICAL SCHOOL.

a large skylight being provided. At the rear of the power-plant building is located the boiler-room, this arrangement being used to avoid noise and dirt in connection with coal handling on the side toward the future hospitals. The power house at present contains 954 hp in boilers, 725 kw in electric generating apparatus, a motor-driven and steam-operated refrigerating plant, live-steam and exhaust-steam heaters, air compressor and pumps of various types. A commodious basement, coal pocket, pumproom, office for the chief engineer and lavatory are provided. Both natural and forced draft is available, a brick stack being installed for the former service. The stack is 175 ft. high and 10 ft. inside diameter.

The boiler-room at present contains three units, space being reserved for a fourth without alteration of the room. Eight boilers can be installed by removing the present coal pocket. In such an event a new coal pocket could be installed at the south end of the boiler-room on the outside of the building. The boiler-room is about 86 ft. long, 47 ft. wide and 39 ft. high. The boiler-room has no basement, but an air tunnel for forced-draft service is carried beneath the floor. The present boiler installation consists of three 318-hp Stirling units, each having 3000 sq. ft. of heating surface and 285 3.25-in. tubes. The steam outlets are 7 in. in diameter. Each boiler has two shaking grates having a total area of 64 sq. ft. Two units are set in a single battery and the third in a half-battery. On account of the presence of the heating equipment, which is supported above the boilers, the center wall was made 12 in. thicker than usual so as to accommodate the necessary columns. Each boiler is built for a working pressure of 150 lb. per square inch, and when running at, or about, its rating with a 5/8-in. draft at the smoke connection, is guaranteed to utilize 75 per cent of the heating value of any freshly mined run-of-mine New River, Pocahontas or West Virginia coal. The steam is guaranteed to contain not over 1 per cent of moisture at full load, and 1.5 per cent at 30 per cent overload.

At the rear of the boilers is installed a smoke flue 42 in. x 48 in. in section at the beginning and increasing to a 60-in. x 120-in. section at the end of the batteries. The flue forms at the end of its run one leg of a "Y" which discharges the gases into a breeching 13 ft. high and 7 ft. wide, leading into the stack. When future boilers are installed the "Y" can be used to carry off their products of combustion. The flue is built of steel plates 0.25 in. thick, and is supported on I-beams at the larger end. On the outside of the flue, at the clean-out hole, is attached a collar to which may be fastened a canvas bag 18 in. in diameter while the flue is being cleaned. Dixon graphite paint was applied to both the inside and outside of the flue to prevent rust. Magnesia blocks covered with plastic cement were installed on top of the flue. The draft is controlled by two Spencer automatic regulators, one operating the main flue dampers and the other the throttle valve on the engine driving the forced-draft fan. The fan is a Sturtevant three-quarter housed wheel 42 in. in diameter and 6 in. wide, directly driven by a steam engine. The fan discharges into a 6-ft. x 5-ft. duct connected with the boiler furnaces. Inferior grades of coal can be burned by using the fan system.

Coal is delivered to the plant by wagons, which are drawn up an inclined approach, the fuel being dumped into the pocket by gravity. The holding capacity of the pocket is 500 tons. A bin for the temporary storage of ashes is located above the ground level, so that a wagon can be backed under it to receive the ash products. These are elevated above the boiler-room floor by a 1-ton hydraulic hoist and thence discharged into the bin. All the fuel used is weighed on a set of Howe scales having a 1000-lb. range exclusive of the hand-car weight. Three Hunt cars, each of 1000-lb. haulage capacity, are in service between the coal pocket and the furnaces, and arranged so that either side can be dropped for feeding coal to the boilers on each side of a center aisle. The boilers are fired by hand.

The medical school buildings are heated by hot water, and there are installed in the boiler-room for this service, and above the boilers, two live-steam and two exhaust-steam heaters. Room is left in the installation for two additional heaters of each type.

The feed pumps and several other auxiliaries of the plant are located in a special pump-room at the level of the boiler-room floor, 24 ft. long by 21 ft. wide. There are three Blake duplex inside-packed units; two of these have 9-in. x 5.25-in. x 10-in. cylinders, and the third 6-in. x 4-in. x 6-in. cylinders. The pumps were selected for the duty of feeding 2700 boiler hp, allowing for future equipment. The two larger pumps are lagged with Keasby & Mattison magnesia covered with Russia iron. The feed-water heater is a Whitlock outfit rated at 2500 hp. It contains 833 sq. ft. of heating surface and has 18-in. steam outlets.

The furnaces of the boiler plant are designed to burn soft coal mixed with enough screenings to avoid smoke, the forced draft being used as necessary. A 28-in. fire wall separates the boiler-room from the engine-room.

The engine-room is 134 ft. long by 43 ft. wide, and it is spanned by a transverse gallery separating the electric generating from the refrigerating and water-circulatory equipment. At a central point, and at one end of the gallery, is located the

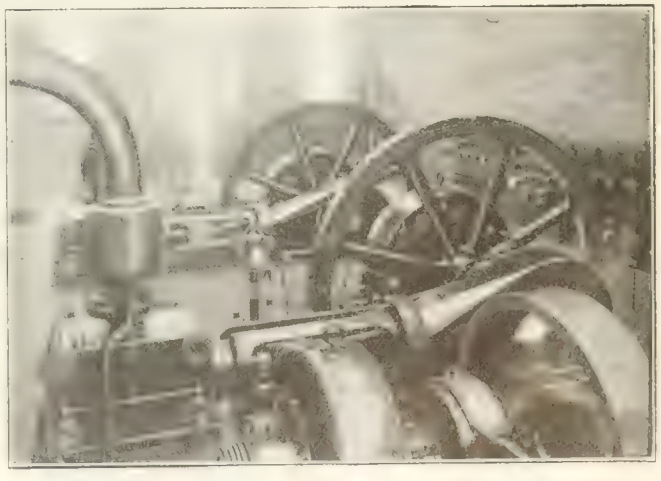


FIG. 2.—ENGINE-ROOM.

office of the chief engineer. A 10-ton hand-operated Reading crane spans the engine-room and serves its entire length. The electric generating units consist of one 125-kw Westinghouse generator directly driven by an American-Ball duplex compound engine, and two 300-kw Westinghouse generators directly driven by single-cylinder, non-condensing Brown-Corliss engines. The guaranteed efficiencies and water rates of the units are as follows:

Per cent load	[illegible]	100	[illegible]	[illegible]
Lbs. per hp-hour, 300-kw, non-condensing set	27.75	27	28	30
Efficiency of generator, per cent	[illegible]	92.5	9[illegible]	8[illegible]
Lbs. per hp-hour, 125-kw, non-condensing compound set	26	23	25	30
Efficiency of generator, per cent	91.5	92	91	86

The advantages of compound operation at full load are significant, although in this plant the use of the exhaust steam in the heating of the circulating water for the school buildings rendered the selection of simple non-condensing engines desirable for the heavier service of the installation. Cochrane separators are used on all of the units. Each generator is of the three-wire, direct-current type, giving 115 volts and 230 volts. The guaranteed speed regulation of the larger units is 2.75 per cent between no-load and 25 per cent overload, and of the smaller set, 1.5 per cent for sudden changes in load up to the foregoing limit.

From the generators cables carried in floor ducts lead to a 14-panel switchboard of Monson slate, the total length of the board being about 33 ft. There are three generator panels, one totalizing, one instrumental panel for motor and lamp service voltmeter indications, two lamp and two motor panels for the school buildings, two power-house lighting and motor service panels, two circulating motor panels, and a distribution panel for the Carnegie Institution Laboratory of Nutrition, located near the school. The Good Samaritan Hospital is also supplied with electricity by the school equipment. Weston indicating instruments, General Electric recording voltmeters, Bristol and Thomson watt-hour meters are installed on the board. The total output of the generators is measured by a 4000-amp ammeter and watt-hour meter; the totalizing panel also contains an indicating wattmeter of 1000-kw rating. Voltmeters are provided to show the potentials existing at important distribution centers in each of the school buildings. The lamp and motor loads in all of the buildings are measured by suitable indicating and recording equipment, so that the consumption of all divisions of the school can be determined with ease. A special feature is the installation of a small switchboard and thermophone system in the office of the chief engineer, which shows the temperature at different points in the distant buildings by electrical indicator connections. The power house is lighted by 110-volt, 5-amp enclosed-arc lamps of the General Electric Company's manufacture.

The hot-water supply for the buildings' heating system is forced through the piping by circulating pumps located in the

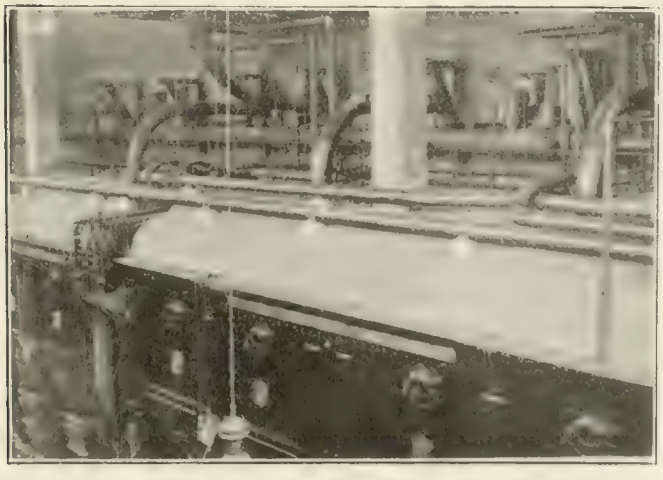


FIG. 3.—BOILERS AND PIPING OF POWER PLANT.

engine-room. Two pumps are installed, each capable of delivering 5000 gal. per minute against a pressure of 31 lb. per square inch at 550 r.p.m. Each unit consists of a single-stage Morris centrifugal pump directly driven on a horizontal shaft by a direct-current, 230-volt Thompson-Ryan motor, built by the Ridgway Dynamo & Engine Company, of Ridgway, Pa. Either pump is of sufficient size to handle the entire work; only one pump is run at a time, as the operation of two pumps in parallel does not increase the pressure. The only head against which the pumps operate is the friction head. The maximum efficiency of each pump is attained at an output of 4000 gal. per minute. Each pump is capable of sustaining a static pressure of 150 lb. per square inch. The motors are designed for variable speed control by field regulation between 275 r.p.m. and 550 r.p.m., and have an overload range of 25 per cent for 24 hours' run with a maximum temperature rise of 50 deg. C. above the

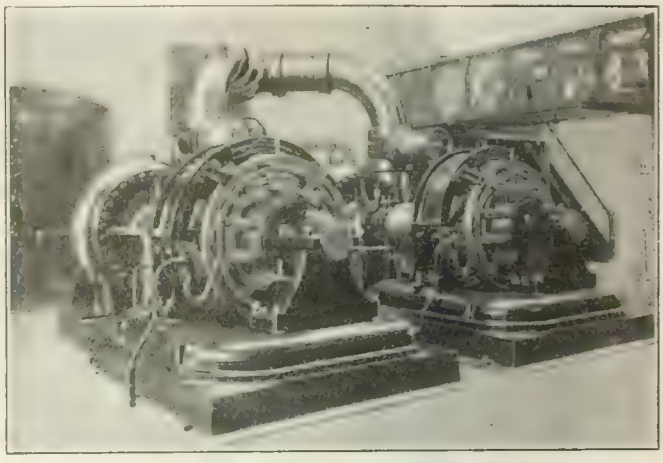


FIG. 4.—MOTOR-DRIVEN HOT-WATER PUMPS FOR HEATING BUILDINGS.

surrounding air. The commercial efficiency guarantee of each motor runs from 90 per cent at full-load to 86 per cent at half-load and 81 per cent at quarter-load.

Compressed air is supplied to the different buildings by a simple duplex Blake steam-driven compressor able to deliver 104 cu. ft. of air per minute at 50 lb. per square inch, with steam at 110 lb. pressure and a speed of 150 r.p.m., the indicated cylinder performance being 13.5 hp. The air cylinders are water-jacketed, and the suction pipe protected at its entrance by a wire screen. Air lines are extended to the different generators and motors to facilitate cleaning, the connections being made to a basement air receiver by 0.5-in. pipes. The compressor discharges into the receiver by a 3-in. line. The holding capacity of the tank is 63 cu. ft.

The exhaust steam from all the engines is used for heating the circulating water for the school buildings, in heaters located above the boilers. All of the steam pumps also discharge into this system. In case the supply of exhaust steam becomes inadequate, high-pressure steam can be turned into the heaters. The exhaust and live-steam heaters are separated so as to enable the condensation from the latter to be returned to the boilers. No pumps or traps are required for this service. A Venturi meter is installed in the station so that the water used in the heating system of the buildings can be readily observed. The two live-steam heaters are of Whitlock make, 42 in. in diameter and about 11.5 ft. high. Each has 10-in. water connections, a 6-in. steam supply and a 4-in. drip. The two large exhaust-steam heaters in the boiler-room were built by the York Manufacturing Company, of York, Pa. In each the steam circulates through vertical tubes surrounded by water. Each heater is 17 ft. high and 5 ft. in diameter; has 10-in. and 6-in. steam and water connections, and is piped so that either series or parallel operation can be had. Service hot water for the lavatories, etc., is supplied by a 100-gal. live-steam heater and by a 300-hp exhaust-steam heater of Whitlock make. Both of these are located in the pump-room, and their design insures operating at the maximum efficiency, as is true in the case of the larger heaters. A small motor-driven pump is installed to maintain the circulation in the service water-pipe lines.

The refrigerating apparatus was installed by the Carbondale Machine Company, of Carbondale, Pa.; it is capable of cooling 250 gal. of brine per minute from 5 deg. Fahr. to 0 deg. Fahr., or of producing 50 tons of ice in 24 hours. The equipment is of the absorption type, and receives cooling water from an

artesian well 315 ft. deep. Calcium chloride brine is used. This apparatus is in the main steam-driven, although a brine pump is provided of the motor-driven centrifugal type, the motor being designed for 25 per cent speed control through field variation. A complete system for metering the brine is installed. The brine mains are 5 in. in diameter for both supply and return lines, and are carried to the school buildings through the power-house service tunnel. The mains are supported by galvanized-iron pipe straps fastened to an outside covering of sectional cork put on in two layers with all joints broken. The straps are hung from cast-iron brackets attached to the wall of the tunnel, and have a minimum width of 8 in. The brackets are 8 ft. apart and are staggered on the supply and return mains to prevent the hangers passing through the insulation. Mains run in trenches in the power house are supported on heavy cyanized wooden cradles. Only one brine pump is used at a time. A storage tank in the power-plant basement makes it possible to run the brine circulating pumps and do a considerable amount of cooling after the refrigerating equipment proper has been shut down. Hohmann and Maurer thermometers are used. All this piping is of wrought iron tested for 100-lb. pressure. At certain points in the tunnel tees were left for the supply of brine to future buildings.

Steam ejectors are provided in the boiler-room for the blow-off and ash-hoist pit, and a Blake bilge pump is installed for clearing the forced-draft air duct of water. The boiler-feed water is measured by a Worthington duplex-piston meter, equipped with a by-pass. The water of condensation from the live-steam piping and separators is returned to the boilers by the Holly loop system, an 11-ft. x 4-ft. receiving tank being installed. Kieley traps are used on the live-steam service water heater, the steam cylinders of the air compressor, pump-exhaust main, hospital service steam main and the power-plant heating system. Foskett and Bishop traps are used at the high points of the hot-water heating and service systems. All traps and reducing valves are by-passed, and thermometers are liberally installed on all piping systems.

A central oiling system is installed for distributing lubrication to the machinery in the power house. A pure-oil reservoir of 65-gal. capacity is located in the pumproom about 8 ft. above the engine-room floor level, and from this a 1.5-in. line supplies oil to the engines and motors through suitable taps. From the machines the oil is piped into a White Star filter in the basement, having a daily output of 150 gal. and a storage capacity of 60 gal. Connected with the filters are two storage tanks which are used alternately, each of 120 gal. capacity. A noteworthy feature of the oiling system is the use of city water pressure instead of a pump or compressor. The plan was developed by Mr. H. A. Stevens, chief engineer of the institution.

The steam piping in the power house is flexible without being unduly complex. From each boiler a 7-in. supply pipe rises to the main header, 15-in. diameter, running practically the whole length of the room behind the boilers. Van Stone joints are used in the header. From it are taken the branches for the engines and pumps. The two 300-kw units are served by 8-in. lines which are provided with valves on the boiler-room side of the wall, as well as between the separators and the high-pressure cylinders. From one end of the header an 8-in. line drops to the basement and traverses the space beneath the engine-room floor in a loop which joins the main header again by a riser at the opposite end of the boiler-room. From this 8-in. line a 5-in. supply pipe leads to the 125-kw generating unit and a 6-in. lead in the basement supplies the air compressor, laboratory steam line and steam-heating service for the Good Samaritan Hospital. Laboratories are served by a 4-in. main through the tunnel, a tap being taken off for radiators used in the heating of the power house. At the end of the 8-in. loop next to the pumproom a 3-in. live-steam supply main for the boiler-feed and bilge pumps is taken off, this line being extended past the pumps and back through the boiler-room to the outside of the fan-engine compartment, where a 5-in. line connects it with the opposite end of the main steam header. A 2-in. tap supplies steam to the fan engine. These loops insure continuous service in case of trouble. The Good Samaritan Hospital is heated by steam.

The live-steam heaters are supplied by an 8-in. loop which enables either or both of them to be fed from the main steam header by either or both batteries of boilers. The live-steam service water heater is fed from the pump supply line. Van Stone joints are used on all live-steam piping. The condensation of the live-steam heaters is carried back into the boilers through check valves.

The exhaust piping is flexible in arrangement. The larger engines discharge into a 16-in. main in the basement, this line expanding to a diameter of 18 in. for collection of the exhausts from the smaller engine and other steam-using machinery. The usual feed-water heater connections are made, a by-pass being placed around the heater. The exhaust-steam water heaters for the school service are supplied from the trunk exhaust line. The piping for the hot-water heating service begins at the motor-driven centrifugal pumps in the engine-room. Two 12-in. pipes expand into 14-in. lines, one from each pump, and these form a "Y" whose common leg, 16 in. in diameter, connects with the heaters above the boilers. The outlet of each heater connects with a second 16-in. line parallel to the first, and cross-connections of this size are provided between the different mains and heaters. The valve connections provide for passing the water through the heaters either in series or parallel, and any heater can be cut out of service without interfering with the flow of water. From the boiler-room the hot-water line passes through a 16-in. Venturi meter to the tunnel leading to the school buildings. The return connection to the centrifugal pumps is by a 14-in. line. The feed-water piping is arranged on a closed circuit, with a 4-in. supplementary city supply for the boilers. In the power house the brine piping is of the Byers wrought-iron type; the ammonia piping is of extra-heavy lap-welded wrought iron.

The service applications of the institution are too numerous to review here. They include the driving of all ventilating fans by directly connected motors; the use of small motors to operate shades in the lecture-room amphitheaters, vacuum service, acid-proof glass, distribution of electric mains and terminals throughout laboratories, centralization of lamp and motor panel boards in corridors, subdivision of laboratory illumination, operation of repair-shop tools by electricity, temperature regulation by the Johnson automatic electric system, distribution of time to 48 secondary clocks by a Standard Electric Time Company's master-clock system, private branch exchange service of the New England Telephone & Telegraph Company, use of electric lighting under microscopes; utilization of movable lecture-room tables, operation of electric elevator service provided by the Whittier Machine Company, of Boston; installation of emergency water showers in certain laboratories, and use of electrically operated projectors. A complete X-ray equipment is in service at the school.

The power-house piping was installed by the Walworth Manufacturing Company, of Boston. Pipe covering was furnished by the Nightingale & Childs Company, Boston, and the switchboard and power-plant wiring was handled by Edwin C. Lewis, of Boston. The Warren thermophone system is used. Mr. H. A. Stevens is the chief engineer.

Centrifugal Starting Arrangement for Single-Phase Motor.

A patent issued on Nov. 23 to Messrs. B. G. Lamme, R. S. Feicht and G. H. Garcelon deals with means for rendering a single-phase induction motor selfstarting under full-load torque. The rotor of the machine is arranged to revolve independently of the shaft during the starting period. The arrangement is such that the rotor starts from rest with the machine operating as a split-phase motor. As the speed increases a centrifugal device first opens the auxiliary starting circuit, then short-circuits the added starting resistance in the secondary circuit and finally clamps the rotor upon the shaft, thereby bringing the shaft with its load up to the full-load speed of the machine.

Factors Affecting the Design of Self-Excited, Single-Phase Shunt Induction Motors—II.

By Val. A. Fynn.

BEFORE dealing specifically with the design features of the single-phase shunt induction motor it seems well to investigate more closely the negative torque, the existence of which was discussed in the previous issue. For this purpose the variation of OF, and OD, that is, of t_{i2} and e_{r3} of Fig. 6 have been plotted in Fig. 10 against the actual speed n, together with N_3 and $v_1N^0_1$. Where N_3 varies proportionately with $e_{r1} - i_3w_2$ or with the speed, e_{r3} and consequently also OE or t_{i2} or i_{2v} vary as $n\ (1 - S^2)$. From the curves in Fig. 10 it is easy to

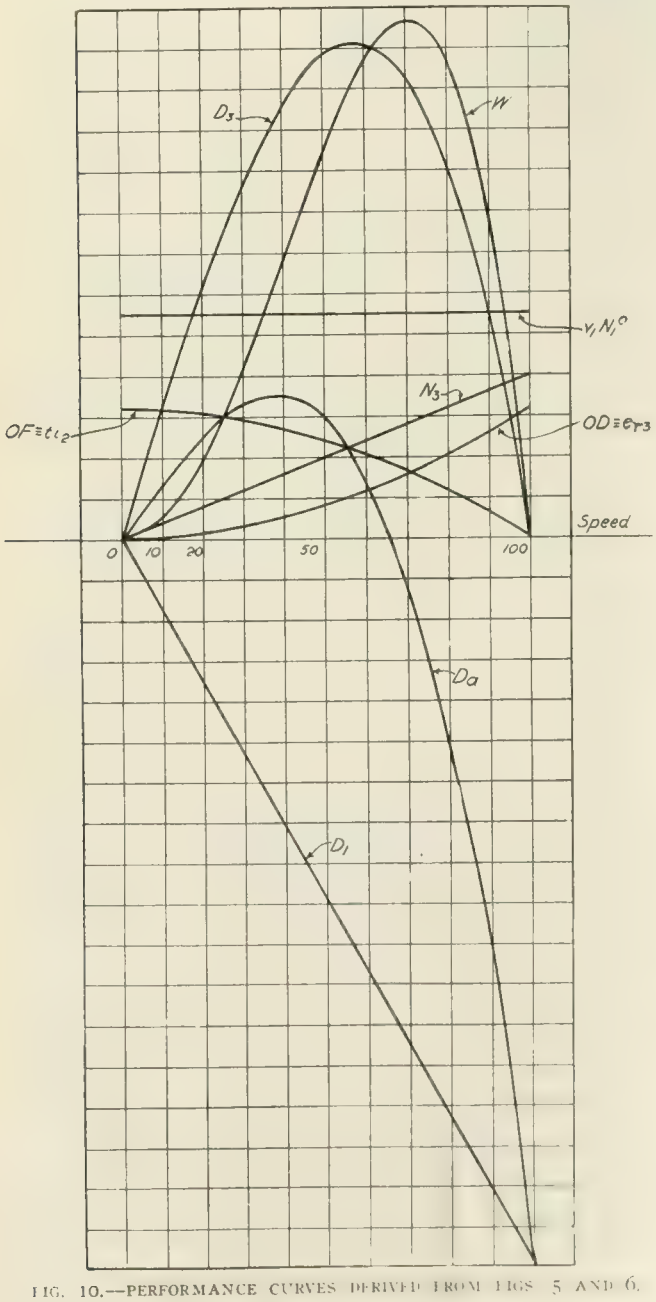


FIG. 10.—PERFORMANCE CURVES DERIVED FROM FIGS. 5 AND 6.

deduce the watts W available at any speed in the rotor and along the transformer axis. Thus $W = t_{i2} \times e_{r3}$, the main torque $D_3 = t_{i2} \times N_3$, the torque $D_1 = t_{i3} \times v_1N^0_1$ and finally the resultant torque $D_a = D_3 - D_1$. The deleterious effect of D_1 is well seen and it may be noted that this particular machine could not *run light* at more than about 65.5 per cent of the synchronous speed even if all its losses (D_1 excepted) were zero. It would require a large external torque to *drive* this motor up to synchronous speed and keep it at that speed. If Θ_2 is larger than zero, then D_1 is still further increased, for then OC leads OS and $< AOC$ becomes still smaller, as was shown in connection with Fig. 8.

It is known that the speed of a *polyphase* induction motor may be regulated within the widest limits by inserting ohmic resistance into the secondary; whereas these same means permit of only a very small variation in the case of a single-phase machine. The reason for this is clear from Fig. 10 and the trouble in the case of the single-phase machine is obviously due to the rapid increase of D_1 when w_2 is increased. Inserting resistance into the rotor of a single-phase induction motor, by means of slip rings, for instance, means that resistance is inserted not *only* into the armature circuit, as in the case of the polyphase machine, *but into the armature and into the field circuit.* It can be stated that:

Ohmic resistance in the motor field winding and iron losses along the motor field axis of the shunt-induction motor tend to reduce the magnitude of the motor field and to produce a negative torque.

Turning now to a practical shunt-induction motor—that is, to one having ohmic resistance, reactance and iron losses in the stator and rotor—the conditions are found to be rather more complicated. The complete diagram for such a motor at synchronous speed is shown in Fig. 11. The constants of the machine to which this diagram refers have been chosen as near to the values actually met with in practice as was compatible with clearness in the diagram; the constants are necessarily somewhat exaggerated. That is, $w_2 = 0.333$; $x_2 = 0.5$; $n = 1.00$; $\Theta_1 = \Theta_2 = 23.5^\circ$. It has further been assumed that $v_1N^0_1$ remains constant; in other words, that $w_1 = x_1 = 0$. This assumption does not vitiate the following deductions and is very nearly true for the no-load conditions of a practical machine of this type. In the diagram of Fig. 11, $OA = e_{r1}$; $AJ = e_{r2}$; $BJ = -i_2w_2$; $MB = -i_2x_2$; $OT = N^0_3$; $TS = N_3'$; $OS = N_3$; $OD = QR = e_{r3}$; $OC = i_3$; $OK = t_{i3}$; $OF = t_{i2}$; $ON = -i_2w_2$; $NR = -i_2x_2$; $OG = i_0$; $GH = -i_2$; $OH = i$, and $OM = -e_3^0$.

Any current i_2 in the rotor along the transformer axis of such a motor will now lag behind the resultant impressed e.m.f (OR)

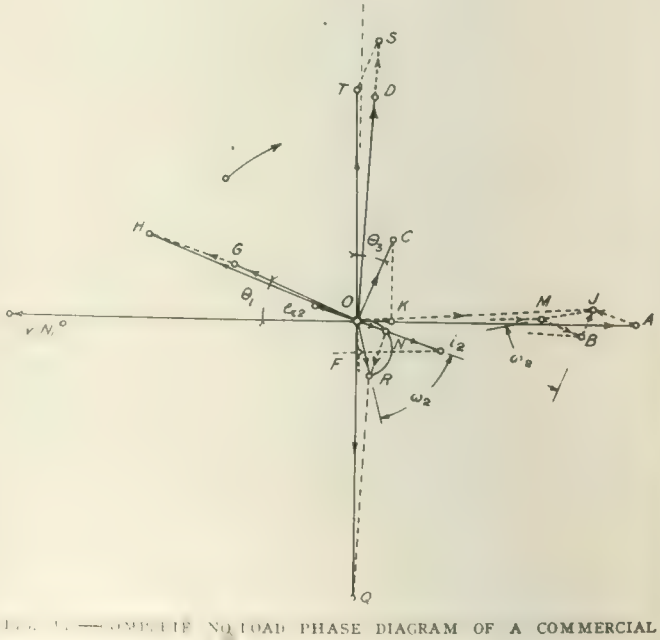


FIG. 11.—COMPLETE NO-LOAD PHASE DIAGRAM OF A COMMERCIAL SINGLE-PHASE INDUCTION MOTOR.

by a constant angle ω_2, the tangent of which is x_2/w_2 and is referred to as the time-constant of the rotor. Now x_2 is due to N_2' (the secondary leakage flux along the axis $a\,a$) and one must, therefore, take this flux into account. N_2' appears along the transformer axis, is cophasal with i_2 and has not been shown in any of the diagrams. It has been seen that e_{r1} opposed in phase to $v_1N^0_1$, is generated along the motor field axis by rotation in $v_1N^0_1$, which appears along the transformer axis; con-

versely then an e.m.f (e_{r_2}) will be generated along the motor field axis by rotation in N_2' and will be of opposite phase to N_2'. Thus two e.m.fs. will now be impressed on the rotor along the motor-field axis, instead of only one; they will add vectorially ($\overline{e_{r_1} + e_{r_2}} = OJ$) and their resultant OJ will be responsible for N_3. The field along the axis $b\,b$ will be proportional to OB only, and may be said to consist of two fluxes, $N^o_3 \equiv OM$ and $N_3' \equiv MB$, where $OM = e^o_3$ or the counter e.m.f due to N^o_3, and $MB = -i_3 x_2$ or the reactance voltage due to the rotor leakage flux N_3'. BJ represents the ohmic drop $i_3 w_2$. The back e.m.f. (e_{r_3}) along the transformer axis of the rotor is, of course, due to rotation in the *whole* of the field N_3 and is consequently in phase with $OS = N_3$. The main torque D_3 is only due to the component N^o_3 of N_3 and to the projection of i_2 on the prolongation of $N^o_3 = OT$.

Now, at synchronism OR will, as in Figs. 5, 6, 7 and 8, equal BA and lead the latter by 90 deg., but in this case, BA is not equal to $i_3 w_2$, nor is it equal to MJ, as might appear at first sight; it equals and opposes the vectorial sum $e_{r_2} + i_3 w_2$. As has been previously stated i_2 will lag by ω_2 behind OR. At synchronism i_2 will be a little smaller than i_3 and lead the latter by a little less than 90 deg. Equality and quadrature relation is reached for $w_2 = 0$. The point of interest is that although the speed is synchronous, yet D_3 is not zero and is positive; at the same time, D_1 is not zero and negative, as was the case in Fig. 8. If, by some means, Θ_3 were to be made zero, while the time-constant of the rotor remained unchanged, then D_1 would be greatly reduced, for OK would become small, but D_1 would still be different from zero and still negative. At the same time D_3 would also become small while remaining positive. It is only when w_2 is made equal to zero as well that both torques become zero at synchronism.

Since i_2 and therefore N_2' lead i_3 by a trifle less than 90 deg., then D_2, although very small, for it can never be proportional to more than a fraction of N_2', will be positive at synchronism. One can say that:

A self-excited, partly or self-compensated, shunt-induction motor, the rotor of which is not devoid of reactance, ohmic resistance and iron losses cannot run at or above synchronism, even at no-load. The no-load rotor current in the transformer axis of such a motor will always be in excess of the rotor exciting current i_3.

It should be noted that the magnitude of i_3 depends for a given reluctance and winding on that of OM only. Now the larger N_2', therefore the larger $i_3 x_2$ or MB and e_{r_2} or AJ, also the smaller OM and consequently the smaller i_3. It has been shown that i_3 is in this motor reflected to a certain extent in the primary stator winding and is vectorially added to the primary magnetizing current, thus increasing the no-load current of the machine. From the above it will be seen that the greater x_2, the less will be the wattless component added to the primary magnetizing current at no-load. At the same time, the added watt component will also decrease just a little owing to the slight decrease of the losses enumerated at the outset (under 4 and 7). Thus:

The time-constant of the rotor directly affects the magnitude and the phase of the no-load current of a practical or commercial shunt-induction motor.

It follows that in designing such a motor the rotor resistance should always be chosen as small as possible. The rotor reactance can, however, be made comparatively large with impunity if care is taken to make the full-load speed very near the synchronous indeed by making w_2 extremely small. A large x_2 secures a reduction of the no-load current. The field winding should always be such as to make all the field ampere turns $i_3 z_2$ as effective as possible—in other words, the field winding should not be distributed over the whole of the pole pitch. The iron losses along the motor field axis should be kept small.

It remains to consider *the fully or artificially compensated* shunt-induction motor, such as illustrated in Figs. 2, 3 and 4. Fig. 12 shows the diagram of such a motor at synchronism. The constants of this machine are identical with those of Fig. 11; the simplifying assumptions are also the same. In Fig. 12, $AL = e_c$; $LJ = e_{r_1}$ and $n = 130$.

The auxiliary compensating e.m.f. (e_c) is introduced into the rotor circuit along the motor field axis by way of the brushes $b\,b$. In magnitude, this auxiliary e.m.f. will, in practice, be equal to about one-fifth or one-fourth of the exciting e.m.f. (e_{r_1}) and this is the proportion which has been chosen in Fig. 12. The phase of e_c will, as a rule, coincide with that of the terminal voltage P, for e_c will generally be derived from the mains. The phase position of P, indicated by OP in Fig. 12, has been chosen arbitrarily in this case, but approximates to its true position in practice; therefore, $AL = e_c$ is made parallel to OP. Once the point L is located, the method of constructing this diagram is the same as that of the previous one, but the results now obtained are very different. Although the immediate effect of introducing e_c is only to shift N_3 through a comparatively small angle, some 13.5 deg. in this case, in the direction of $v_1 N^o_1$, yet this slight alteration of the phase of the motor field has the most far-reaching influence on the operation of the machine.

The resultant OR in the transformer axis of the rotor is thereby shifted through about *130 deg.* and now comes *to lead* e_1 *by about 117 deg.*, instead of *lagging* behind e_1 by about 13

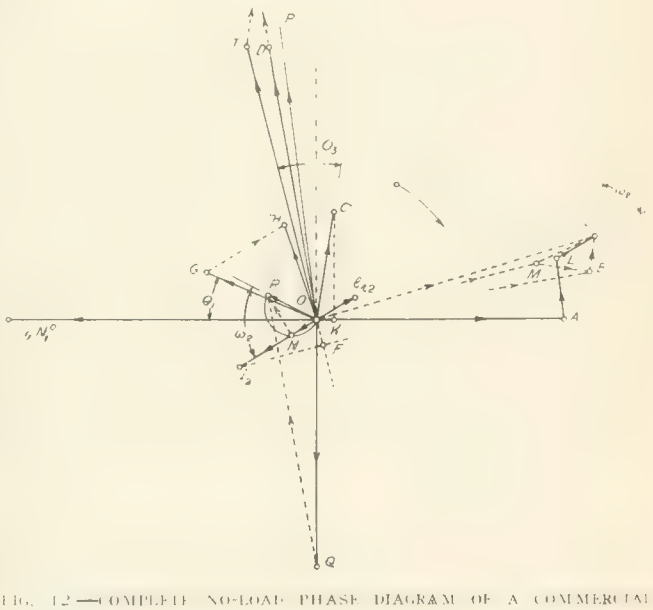


FIG. 12.—COMPLETE NO-LOAD PHASE DIAGRAM OF A COMMERCIAL INDUCTION MOTOR WITH ARTIFICIAL PHASE COMPENSATION.

deg. The result is that i_2 comes to lead e_1, and, therefore, may be made *to reduce the primary no-load current of the motor to a value even smaller than that of the primary magnetizing current and to bring the primary no-load current of the motor more into phase with the primary terminal voltage.* It is merely a matter of suitably choosing the magnitude of e_c. Although the losses in Fig. 12 have been taken abnormally great, yet $e_c = \frac{1}{4} e_{r_1}$ is seen to be nearly sufficient to secure phase coincidence between i and P at no-load. It will be observed that angle HOP is only about 11 deg., which corresponds to $\cos \theta = 0.981$—an extremely high no-load value of the power factor.

In this motor (see Figs. 2, 3, 4 and diagram 12) the self-compensating e.m.f. (e_{r_2}) is, of course, added vectorially to $e_{r_1} + e_c$ and the total e.m.f. impressed on the field circuit is $\overline{e_{r_1} + e_c + e_{r_2}} = OJ$. Although in the partly or self-compensated motor (Fig. 1 and diagram 11) the tendency of e_{r_2} was always to *reduce* the magnitude of OJ at no-load, the addition of this e.m.f. in Fig. 12 will tend to *increase* the resultant OJ as soon as e_c is made sufficiently large to bring i_2 into approximate phase coincidence with e_1. The resultant OR in Fig. 12 equals BA at synchronism and leads the latter by 90 time-degrees, as

was the case in Fig. 11, but $B A$ now equals and opposes the vectorial sum $e_{r_2} + e_c + i_2 w_2$. The importance of the rotor time-constant in this type of motor is considerably reduced, although its influence is not to be neglected. A power factor of unity will be reached with the smallest e_c when w_2 and Θ_3 are both equal to zero.

Perhaps the most striking feature of an artificially compensated motor is the fact that while running synchronously and with a power factor near unity, it can develop a powerful main torque D_3, as may be seen from Fig. 12. Furthermore, since N^0_3 or $O T$ leads $v_1 N^0_1$ by considerably less than 90 time-degrees, it is within the designer's power to make $D_1 = 0$ or even *positive* at no-load and nearly so throughout the load range of the motor. This condition can be reached with values of Θ_3 which are not extraordinarily small; in other words, the iron losses along the motor field axis can, in practice, be kept sufficiently low in order, with the help of e_c, to make $D_1 = 0$ and sometimes even positive. The torque D_2 is extremely small at all times, but it cannot be made zero even at no-load without making D_3 zero or negative, unless $x_2 = 0$, which is impossible in practice. Even for the unfavorable constants chosen for Fig. 12, it may be seen that $D_3 = O F \times O T$ is considerably larger than $D_1 = O K \times v_1 N^0_1$; the difference may easily be made sufficiently large to cover amply the losses enumerated at the outset (under 5 to 7). The significance of these statements is that:

An artificially compensated shunt-induction motor can run at no-load at a speed equal to or exceeding the synchronous. Such a machine will, therefore, even give a certain amount of useful output before its speed sinks below the synchronous.

The artificially compensated shunt-induction motor shown in Figs. 2 to 4 is the only one in which the condition for a constant rotor velocity can be fully satisfied. For that purpose, it is necessary that i_2 shall lead e_1 by such an angle that the component of i_2, which coincides in phase and in direction with $v_1 N^0_1$, shall have a value sufficient to represent the recoverable energy periodically required by the rotor for the upkeep of N_3. It is seen that this condition will be practically fulfilled when the motor is fully compensated according to the author's method.

In the case of artificially compensated shunt-induction motors with commutators, the design should be slightly altered as compared with that of the same general type of machine without commutator. The importance of as small a value for w_2 as feasible is just as great, but the realization of this condition is extremely difficult owing to the presence of the sliding contact resistance introduced by the brushes $a\,a$ and $b\,b$. This means that, unless they are compensated, the full-load speed of these machines will generally be lower than that of a slip-ring motor. In view of this lower full-load speed x_2 should be kept small. Since a continuous-current rotor winding is used, this condition is rather convenient than otherwise. The iron losses along the motor field axis should be small.

Nothing has so far been said about the design of the stator, but this point can be settled very easily and the conclusions reached will apply equally to all the motors dealt with in this paper. A reference to Fig. 13 will show that when the power factor is good—and a good power factor must always be aimed at—then the tendency of $i_3 w_1$ is to reduce greatly N_1, and therefore $v_1 N^0_1$, to slightly improve the power factor and to lower the efficiency while the tendency of e_1 is to slightly reduce $v_1 N^0_1$ and to reduce greatly the power factor. If $v_1 N^0_1$ is much reduced with the increasing load, then the motor field N^0_3 will be similarly affected and the maximum output of the motor will decrease. This is a far more serious consideration than the slight improvement in the power factor which can be secured by making w_1 large. The resistance of the primary winding should, therefore, be made small.

In view of the fact, well illustrated in Fig. 12, that the primary reactance can only be compensated for at the expense of the torque (D_3) per ampere and consequently at the expense of efficiency, it appears most important that the primary reactance should be kept as low as possible and that the primary magnetizing current should be kept small.

The iron losses along the transformer axis have no effect on the torque conditions, but they, of course, reduce the efficiency. In motors of the induction type, and which run at a speed near the synchronous, the transformer and the motor fields are very nearly equal, and since it has been seen that in the case of motors of that type having a shunt characteristic the losses due to the motor field should be chosen low, then it follows that the losses due to the transformer field will also be low, although these could be made large without interfering with the operation of the motor. It is of importance to use as good an iron as possible for such machines, and, although the better iron costs more money, yet it will be found that this extra cost will be compensated for by the improved performance.

In conclusion, it may be pointed out that the performance and power factor of these single-phase shunt induction motors can also be improved by connecting a condenser in parallel either with the field winding itself or with a coaxial winding on the stator or rotor. The capacity of such a condenser, if used in conjunction with the ordinary single-phase induction motor shown in Fig. 1, for instance, should be so chosen as to bring i_3 in Fig. 11 at least into phase with $O J$. The most objectionable effect of $i_3 w_3$ would thus be eliminated, N^0_3 would increase and lag by just 90 time-degrees behind $O J$, while i_2 would be practically in phase with e_1 and would consequently be considerably smaller for the same torque, D_3. As a result, $O H$ of Fig. 11 would approach the phase of $O S$ and its magnitude would decrease. If the capacity of the condenser is chosen still higher,



FIG. 13. SHORT-CIRCUIT DIAGRAM FOR THE MOTOR SHOWN IN FIG. 1.

then i_2 will come to lead e_1 and conditions similar to those in Fig. 12 will obtain. There is a value for the capacity of this condenser beyond which it is useless to go, because an increase beyond that point will reduce the lead of i_2 on e_1 instead of increasing it. Such condensers have been proposed and used before now, but their effectiveness has been explained according to a totally different theory.

The use of such condensers appears to be specially indicated when it is desired to regulate the speed of a single-phase induction motor by inserting resistances into its rotor. Not only could the capacity of the condenser be so adjusted as to reduce D_1 to very small proportions, but the power factor could be kept high notwithstanding that the speed was being regulated. Such a condenser can be connected to a winding disposed on the stator and in the motor field axis. Resistances can be inserted into the rotor circuits in the usual way by means of slip-rings. Under these circumstances, the resultant current in the rotor along the motor field axis will be greatly reduced and the motor speed will be diminished, not so much because resistance is being inserted into the field winding—the resistance inserted therein can only have a very small effect, because of the smallness of i_3—but mainly because resistance is being inserted into the armature circuit. Since the condenser itself is connected to a circuit which is in inductive relation to the field winding and which acts as a secondary in respect to that field winding, it follows that the current flowing in that secondary will affect the magnitude of i_3 without materially affecting the magnitude of the motor field. Because of the fact that the mag-

nitude of the motor field decreases proportionately with the speed, the range of speeds to be obtained under load must still remain below that which can be secured with a polyphase motor in which the two or more motor fields per pole-pair remain practically constant with varying speed.

The author is well aware that his treatment of this intricate, though fascinating, subject leaves much to be desired; he, however, hopes that it will be found sufficiently clear and that his effort may be of some little help to the designer and also to anyone who is willing to go deeper into the whole question. It is thought, nevertheless, that all the points of practical interest have been discussed.

The author particularly directs the attention of the reader to the question raised relating to the recoverable energy alternately absorbed and liberated by the motor field N_3 and invites further study as to the exact nature of this phenomenon and as to its influence on the primary current taken by the shunt induction motor.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Pacific Gas and Electric Magazine.

The Pacific Gas & Electric Company, San Francisco, has commenced the publication of a monthly organ, named the *Pacific Gas and Electric Magazine*, which differs materially from the usual central-station publication. A number of pages are given to excellently illustrated descriptions of parts of the company's plant, which is so extensive and varied that this feature can be continued over a long period. There is also in each issue a number of articles of a technical character likely to be of value to the employees of the company, and the August issue includes a well-written and illustrated history of gas lighting in San Francisco. Another feature is a biographical sketch in each issue of a member of the company's staff. About half of the contents relate specifically to the routine operations of the company. In typographical appearance, illustrations, arrangement of matter and evidences of editorial skill, the publication is much in advance of other central-station organs of this country, which considerations appear to justify the policy of the company in attaching a subscription price and aiming at a general circulation for the periodical.

A Form for Keeping Isolated Plant Data.

One of the important things in preparing to get the loads of various isolated steam and gas-engine plants by a central station is for the central-station company to get complete and accurate information regarding the isolated plants in its territory. The accompanying form was used by the Consolidated Light, Power & Ice Company, Joplin, Mo., under Mr. C. W. Hough, formerly general manager of that company, to whom we are indebted for the present copy. The items on this form are printed on a pamphlet with four leaves having dimensions 5¼ in. x 8¼ in.

DATA ON PLANT

Of .....
Location .....
Business .....
Chief Engineer.....
Address .....
Name of Party to See.....
Record Opened.....

STEAM PLANT

No. Boilers.....Water Tubes or Horizontal
Return Tubular..... Rated H. P.
Are Boilers fed by Pump or Injector
Where is Water Obtained?.....
Is a Feed Water Heater Used?.....
Bituminous or Anthracite Coal Used?.....
Is coal hauled by wagon or delivered from cars to boiler room?.....
Capacity of coal storage.....
No. of engines used.....
Are they slide valve, simple or compound-automatic cut-off high speed and what are they rated at in H. P.?.....

.....

.....

Is exhaust steam used and for what purpose?.....

.....

Is live steam used other than for engines? For what purpose?

GAS PLANT.

No. of engines used.....
Type..... Make.....
H. P. Rating.....Cooling Water.....
Date installed.....

Character of Work of Each Unit.

Mill .....
Compressor .....
Pump .....
Hoist .....
Incline Tram.....
Remarks .....

.....

ELECTRICAL PLANT.

No. dynamos.....Make.....
Voltage..... Age.....
Capacity .....
No. Motors.....Make.....
Voltage.....Age.....
No. (16-cp equivalent) lamps connected.....
No. incandescent arc lamps connected.....
No. high tension arc connected.....
Amperage .....
Maximum load.....
Average load.....
No. elevators.....If electric, size of motors.....
If hydraulic, size of pumps.....
No. Ice machines.....
System..... Capacity.....
How driven.....
What is the system of heating?.....
Direct or indirect radiation?.....
What is back pressure on engines?.....
Number of square feet radiating surface.....
Cubical contents of building.....
Character of building.....
Is it exposed?.....
Is the load steady or intermittent?.....
Approximate length of shafting.....

Remarks on Layout of Plant

.....

.....

Attached Cards from Engine Test or Readings from Test Meters.

.....

Expense of Operating Plant.

Fixed Charges.	Approximate.	Exact.
Interest upon $..... at 5 per cent..	$.....	.....
Depreciation upon $.....at 10 per cent..	.....	.....
Insurance, Fire.....	.....	.....
Insurance, Boiler.....	.....	.....
Insurance, Liability.....	.....	.....
Taxes	.....	.....
Rental value of space occupied by plant.....	.....	.....
Damage from heat and vibration.....	.....	.....
Total	$.....	.....

Operating Expense.

No. Engineers.....at.....	.....	.....
No. Firemen.....at.....	.....	.....
No. Electricians.....at.....	.....	.....
No. Dynamo-tenders.....at.....	.....	.....
No. Helpers.....at.....	.....	.....
Tons Coal.....at.....	.....	.....
Removal Ashes.....at.....	.....	.....
Water Rent.....at.....	.....	.....
Oil and Waste.....at.....	.....	.....
Repairs to Boilers.....	.....	.....
Repairs to Engines and Dynamos.....	.....	.....
Incandescent Lamps.....	.....	.....
Carbons	.....	.....
Tool Account.....	.....	.....
Miscellaneous	.....	.....
Total	$.....	.....

Hours daily plant is operated.....
Hours daily open for business.....
Monthly income from Steam or Electricity sold.....
General conditions and system of wiring.....
Regulation and General service.....

Propositions for Central Station Service.

.....

Special Street Lighting at Aberdeen, S. D.

One of the smallest cities in the country to adopt special lighting of its principal business street by means of lamps on artistic iron posts supplied by underground service is Aberdeen, S. D. This is a little city of about 10,000 inhabitants. From the appearance of its main street, which is excellently paved and brilliantly lighted, an impression is created on the visitor to the city which is seldom equaled in a town of this size. The



FIG. 1.—ARTISTIC LAMP POST AT ABERDEEN.

post used in this lighting is shown in Fig. 1, while Fig. 2 shows the appearance of Main Street at night.

Each post has five 60-watt tungsten lamps in opalescent globes. There are 39 posts in all. On Main Street five blocks are thus lighted. There are six posts per block. Four are placed at each street intersection at the corners of the sidewalks and two midway between street intersections, as indicated by Fig. 3. These posts are the property of the Aberdeen Light & Power Company. The city of Aberdeen pays the company $5 per month per post. The scheme was promoted by the Commercial Club, which secured the right-of-way for the company's wires over buildings from the alleys.

A rather unusual arrangement of electrical supply for these lamps is used. Fig. 3 shows the general scheme of wiring. In the alleys on either side are four transformers, two in each

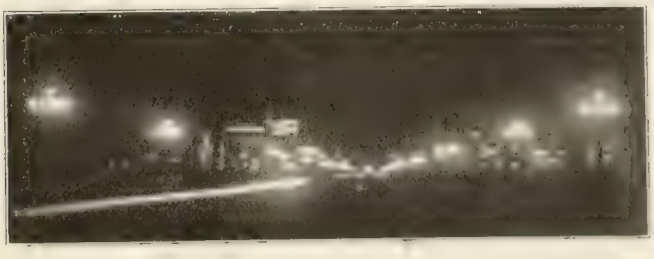


FIG. 2.—ABERDEEN STREET AT NIGHT.

alley. These transformers are connected on a three-wire system. One transformer gives 440 volts on its secondary, the other 110. The center lamp on each post, which burns all night, is connected to the 110-volt side and the other four lamps on the post are connected four in series on the other side of the three-wire system, which gives 440 volts. The top lamp burns all night and those on the arms are turned off at 11 p. m. A time switch in the company's office turns off the lamps on one side of the street and another time switch in a box on a post in the alley turns off those on the other side of the street.

The wires are brought from the secondary main in the alleys through an iron-pipe conduit over each building and down the front of the building to the sidewalk. There is one such feeder in the center of each block which comes down the front of the building opposite the middle post of each block and feeds both ways by means of iron-pipe conduit buried in the concrete sidewalk. Fig. 4, which was taken during construction, shows one of these conduit pipes coming down the side of the building and the partially filled groove in the sidewalk through which this conduit runs. The ends of the conduits, which were later covered by the post, are seen at the curb line of the sidewalk.

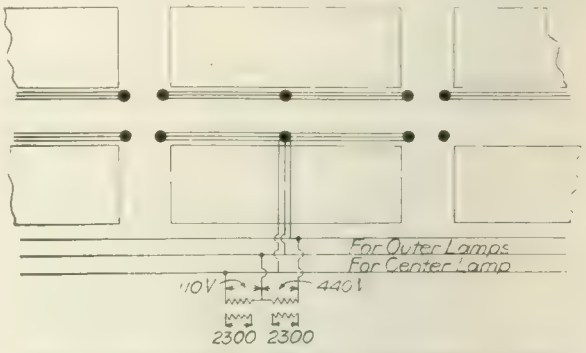


FIG. 3.—LAMP CIRCUIT DIAGRAMS FOR ABERDEEN POSTS.

Fusible cut-outs are placed at the central posts of each block. As the blocks are 300 ft. long, the circuits feed 150 ft. each way from the center of the block. The conduit is ¾-in. galvanized pipe smoothed out with a square-ended reamer. The secondary mains in the alleys from the transformers to the conduit are No. 8 weatherproof wire. For the pipes No. 14 single-braid rubber-covered wire is used. The trench was broken in the

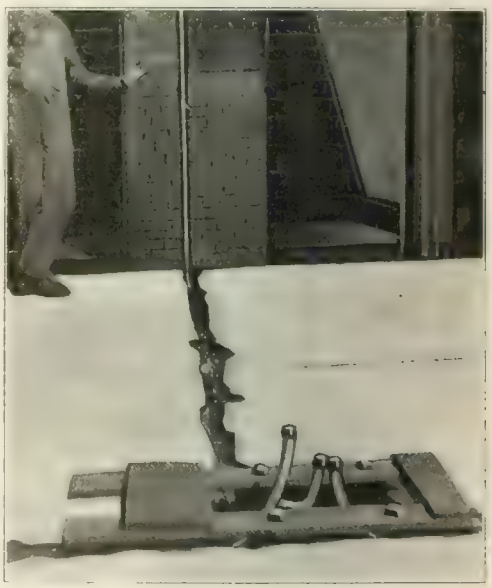


FIG. 4.—CONDUIT DOWN SIDE OF BUILDING.

concrete sidewalk by means of a railroad spike hammer. The cost of this installation complete was slightly over $100 per post. It was started in operation on June 15, 1909. The installation was planned by Mr. J. B. Gibbs, electrical engineer of the Aberdeen Light & Power Company.

English Gas and Electric Competition.

By Glenn Marston.

IN America, where the major portion of capital invested in lighting is in combined or affiliated gas and electric companies, co-operation between the two forms of lighting has taken the place of competition. In Great Britain, on the other hand, there is only one private company supplying both gas and electricity, although a considerable number of municipalities operate both services.

In America, where the majority of capital invested in lighting is in combined or affiliated gas and electric companies, co-

operation between the two forms of lighting has taken the place of competition. In Great Britain, on the other hand, there is only one private company supplying both gas and electricity, although a considerable number of municipalities operate both services.

The English gas man hates electricity as a monkey does water, and much energy is expended by each industry in showing how intolerable are conditions under the other. In America the gas man relies on cheapness in competing with electricity, and convenience in competing with coal. Not so his English brother. The most aggressive foe of electricity is the Gas Light & Coke Company, of London, and, as an editor once told the writer, "the slanders of our enemies only serve to arouse us to our own virtues." The gas man's arguments are not slanders, but they may serve to reveal opportunities for new business which make knowledge of them worth while.

Aside from the weekly repartee of the gas and electric journals, both industries produce quantities of pamphlets, good and bad, bearing on their respective merits. The journalistic digs of one service against the other are in themselves an education, for it seems to be felt that nobody would read the periodicals unless deeply interested in the subject, and they handle one another without gloves. That this feeling of safety from the layman's curiosity is well grounded is shown by one electrical journal's recent announcement of a special number: "Next week's issue will be twice as thick as usual."

Neither industry permits the other to occupy certain fields, as is done in America. Gas is used for lighting and electricity for heating to the utmost possible extent. The gas companies are attacking electricity, both on matters of cost and efficiency. Authorities whose reputations are backed up by long strings of letters resembling a child's train of building blocks are called in, and physicians innumerable (with only two or three alphabetical titles attached to their names) lend their influence in one direction or the other.

One of the most imposing of these dissertations is a paper by Dr. S. Rideal, prepared for the Royal Sanitary Institute, on "The Relative Hygienic Values of Gas and Electric Lighting." It is a book of 132 pages, illustrated with many diagrams, and has been reprinted and widely circulated by the Gas Light & Coke Company. The trend of the paper is to prove that in some respects gas is superior to electricity, while in no respect is electric light in the slightest degree superior to gas from the standpoint of hygiene.

Dr. Rideal's experiments covered the atmospheric changes in a room occupied by from one to eight persons; the ventilation produced by either type of lamp and the results thereof; the presence of organic matter and bacteria; the effect on respiration and other details of physical condition, and the sensitiveness of the eye under each form of light. A 50-cp Darwin inverted gas burner and an Edison & Swan 50-cp incandescent electric lamp were used in the experiments.

Some of the conclusions are rather remarkable from the standpoint of the central station. For example, Dr. Rideal finds that "the difference found between the two lights were so small as to be absolutely devoid of any hygienic significance; they were, in fact, much less than those that are constantly produced in healthy subjects by slight changes in their condition or environment."

Dr. Rideal holds that the circulation of air produced by gas lighting induces better ventilation and results in better atmosphere in the ordinary room than can be secured when electric lamps are used, since the heat from electric lighting is insufficient to create air currents. He then says, in the very next sentence, "The electric lamps really produced more heat than is commonly credited to them. This seems to be the explanation of the unexpected result that the average temperature of the rooms was practically the same under either illuminant, and that the electric lamps did not show the superiority of coolness usually claimed."

The only difference in the ophthalmic tests are so slight as to be ineffective under ordinary circumstances. Very delicate tests were necessary to detect any difference whatever. The presence of bacteria is reduced, according to Dr. Rideal, under gas light because the flame sterilizes all air which comes in contact with it.

Another pamphlet of this company is entitled "Towards the Solution of Two Urgent Problems of Modern City Life." The two problems are the abatement of London fogs and the servant question. The gas company says that the "pea-soup" fog of London is due to the smoke from the thousands of house chimneys. (Steam heat is unknown in England, save in a few hotel corridors and an occasional public building.) If all the fireplaces now burning coal were equipped with gas-grates, says the pamphlet, fogs would become ancient history.

One phase of the servant problem is solved by a customer who writes: "I would not be without my gas fires for anything. They cost me nothing, because on the day they were fixed I gave one of my maids notice, and my year's gas bill does not exceed the cost of that maid, while I save my coal bill as well."

It is but natural that the majority of the gas companies' publicity should be upon the value of illumination. On the side of the central station, very little work is done toward promoting new business. In Glasgow one canvasser is considered sufficient to care for almost a million prospective customers. Other cities do no canvassing whatever. There are only a few exceptions to the rule of letting electrical business take care of itself. A few central stations around London are active—spurred on by the energy of the Gas Light & Coke Company—but outside of the Metropolitan District new business organizations are confined almost wholly to the large companies, which operate over large areas and are chiefly interested in securing the patronage of concerns doing a large business.

That the gas industry in England is more progressive than the central stations is evident on all sides. Much important street lighting is done by gas companies. Gas stands first in public esteem because it is constantly before the public through the unremitting efforts of the publicity men. It is only within the past year or two that the electric plants have given serious attention to new business.

Strangely enough, the interest now manifested by central stations in new business methods is not due to the loss of customers to gas companies. The advent of the tungsten lamp has done more to awaken the British central stations to the necessity of aggressive new business methods than did all of the attacks of the gas companies.

The central stations have made no attempt to govern the sale of tungsten lamps or to direct their use along lines that would least affect the revenues. The sale of tungsten lamps has been pushed by the contractor and discouraged, ineffectively, by the stations. The contractors have sold low-wattage lamps and, as a result, cut down energy consumption to an alarming degree, in some cases to a point where the consumption does not bring in sufficient revenue to meet interest and maintenance charges. When this occurred the central stations had to get busy in order to save themselves from improvements in their own business, and they turned to the gas consumer as the most likely means of maintaining the lighting load so fast being depleted by tungsten lamps. The battle is now at its height. The tungsten lamp has forced action from both the central stations and the gas companies. One is striving to maintain its output, the other to retain its customers.

The City of Westminster Electric Supply Company, Ltd., which supplies energy in Southwest London, has adopted a novel scheme of bringing electricity to the notice of every resident of its district. A few weeks ago it began opening temporary display rooms, in which were exhibited all the usual appliances An exhibit is held for two or three weeks, then moved to another vacant store near by and again set up. It is the intention of the company to continue these exhibits until one has been held within a few hundred feet of every resident of its district. Much interest has been aroused by the exhibits and, if inquiries indicate possible customers, the experiment will be a complete success.

INTERIOR WIRING AND ILLUMINATION

Arrangement of Concealed Conduit.

An examination of most of the wiring plans prepared for concealed conduit work is apt to create the impression that conduit lines are run haphazard under or between floors, in walls, partitions, chaces, behind lathing, furring, etc. Such, however, is not the case. In all first-class installations certain general rules are followed, which may be summarized as follows:

Conduit laid under floors for the electrical circuit work is installed in a manner best suited for and adapted to the specific kind of flooring. As a general rule the conduit is run in straight lines and parallel with the walls of the building or of the rooms. If the floor is of concrete, mosaic or tile, the conduit, owing to the absence of wooden floor sleepers, may follow the most direct route in nearly all cases. Ordinarily, all horizontal runs of conduit are placed under the flooring of the floor to which they correspond, and horizontal or cross-runs in partition or side walls are rarely allowed. The number of bends in any section of conduit from one drawing point to another must not exceed four, not including those at the ends, and offsets, long bends, triangular "short-cuts," etc., should be used only where obstructions are to be overcome or certain difficulties present themselves.

The conduit must be properly secured in position by means of pipe clamps or other suitable fastenings, and sufficient fastenings must be provided to obviate sagging or play wherever the conduit is not embedded in concrete or other filling, or wherever it is not otherwise held in a firm position. If the proper support and fastening cannot otherwise be secured, suitable wooden supports must be provided for that purpose. Conduit must in general be adequately anchored in position and braced or guyed if necessary, so as to resist displacement or distortion when the wires are being pulled in or out.

Wiring of Christmas Trees.

At this time of year almost every electrical contractor and supply house is besieged by fond parents and others for Christmas tree outfits, and while many purchase the standard series outfits for connection to electric light sockets, very many purchase battery outfits, employing either storage or dry cells, usually the latter. Unfortunately, there seems to be a lack of knowledge on the part of those who make up these outfits as to the proper size of wire to employ. The impression prevails that because these are miniature outfits, small, inconspicuous magnet wire is all that is necessary, and if the lamps do not burn brightly a few more cells of battery are added to boost the voltage.

For the purpose of showing the error of this choice in wire size, a case may be assumed. It is desired to wire a 10 ft. tree with 10 1-cp 2-volt lamps. The average length of the 10 branches at whose end a lamp is to be placed is 3 ft. A 10 per cent drop in voltage is allowed. A miniature 1-cp lamp takes about 6 watts, so that with a tension of 2 volts a current of 3 amp is necessary for each lamp, or a total of 30 amp in all. In wiring the sockets it is assumed that each circuit is brought back to the trunk of the tree and connected to a riser running along the trunk from the battery on the floor or stand. If the average distance through which the entire current must pass is taken as 5 ft., and only one size of wire is desired, these values may be substituted in any wiring formula and it will be found that a wire with a cross-section of 16,500 circ. mils or a No. 8 wire is required. It is doubtful if any of the outfits sold over the counters of supply houses are equipped with so large a wire, and fortunately it is an easy matter to add a dry cell or two to compensate for the short-sightedness of the maker of the outfit. Batteries are more expensive than wire, however.

Ornamental Street-Lighting Posts at Salt Lake City.

Salt Lake City has recently gone in for lighting its downtown streets from ornamental posts carrying tungsten lamps.

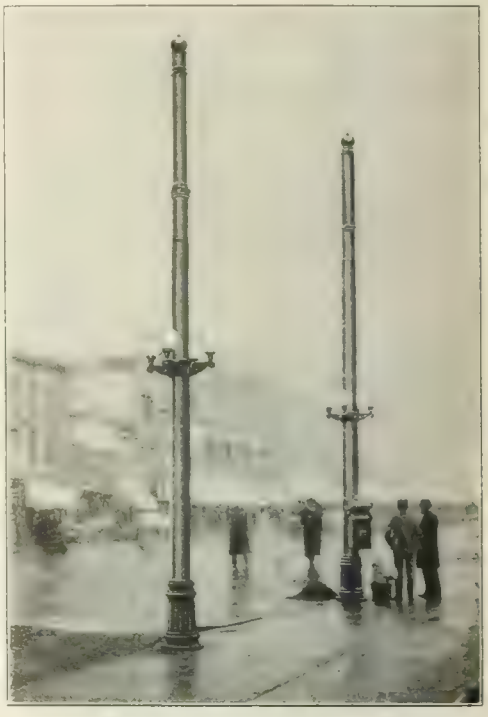


FIG. 1.—COMBINATION POST, SALT LAKE CITY.

One of the characteristic features of the work in Salt Lake City which differs from that in other cities is that some of the



FIG. 2.—LAMP POST, SALT LAKE CITY.

posts are combination lamp and railway posts, as shown in Fig. 1. The design used where a post is for lamps only is shown in Fig. 2.

Large Roof Signs in New York.

The accompanying illustrations show three large roof signs erected in the "White Way" district of New York City. The mineral-water sign, shown in Fig. 1, is located at the northeast corner of Broadway and Forty-second Street, in the center of the hotel and theatrical district. The sign is 32 ft. high by 50 ft. long, and contains more than 2500 lamps, the design calling



FIG. 1.—MINERAL WATER SIGN.

for three colors, green, white and red. The lamps are in continuous action, giving the effect of a fountain spurting up from the ground. A novel feature has been introduced into the display by utilizing steam coming from the heating plant of the building on which the sign is erected. Pipes extend to the top of the sign, so that when the steam is liberated it

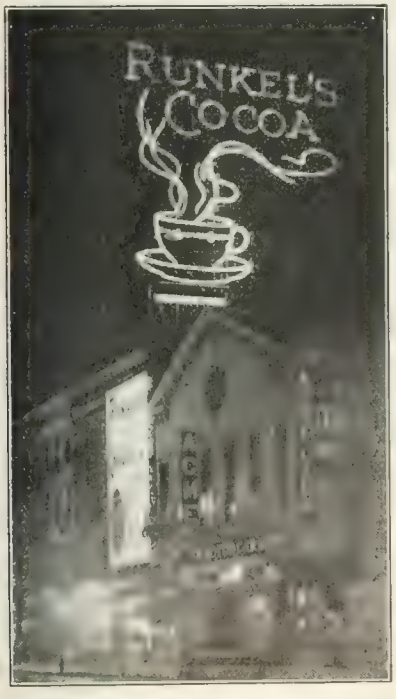


FIG. 2.—COCOA SIGN.

hovers above the letters, and imparts to the fountain an effervescent effect resembling spray in a real water fountain.

Located on the east side of Broadway, between Forty-fifth and Forty-sixth streets, is a cocoa sign, shown in Fig. 2. This overlooks Longacre Square, one of the greatest night centers in the world. The sign contains 1250 electric lamps of red, amber, blue and green, and is 44 ft. high by 50 ft. wide. Like the sign just described, this is also in continuous action. The cup and saucer remain fixed, and curved lines emerge so as to represent the vapor arising from a steaming-hot cup of the beverage advertised. Since the picture was taken the words "Highest Grade" are caused to appear in the vapor rising from the cup.

Fig. 3 shows a sign at the east side of Broadway, corner of Thirty-seventh Street. This is one of three all alike located at prominent points on Broadway; and while these are smaller than most of the large signs along the latter thoroughfare, be-



FIG. 3.—A BROADWAY SIGN.

ing 14 ft. high by 30 ft. long, the effective arrangement of the words gives a rather strong display. The signs flash on and off, first appearing blank, then the words at the upper left and lower right-hand corners are flashed, followed by the words at the lower left and upper right corners. Each of the signs contains 750 lamps.

New Telephone Patents.

NEW APPARATUS.

While transmitters have been designed with free-edge diaphragms, most transmitters are secured to some extent at the edges. The usual method consists in snapping a rubber ring over the circumference of the diaphragm, this latter being held in place by rubber-faced dampening springs.

Messrs. C. E. Egner and J. G. Hulmström, of Sweden, however, have found that a diaphragm under strong radial stress is more sensitive and they have, therefore, arranged and patented a transmitter with a view to this stressing. The edge of the diaphragm is held fast between flutings and a straining ring, with the circular knife edge forced down concentrically upon the diaphragm. This stresses radially all portions inside the knife edge, to the center of which portion the electrode is secured.

A receiver-supporting arm forms the subject of a patent granted to Mr. H. R. Palmer, of Seattle, Wash. The arm swings from a clamp secured near the base of a desk stand, and both the radial distance of the receiver and the angle of the bar are adjustable to meet the needs of any user. In the non-use position a latch on the arm serves the double purpose of depressing the switch lever and latching up the arm.

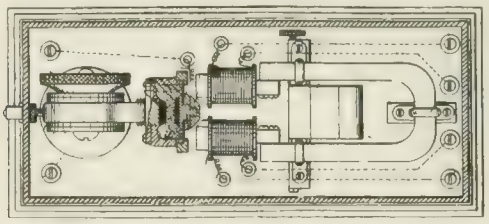
LOCK-OUT SYSTEM.

A lock-out system has been patented by Mr. F. E. Summers, of Scotland County, Missouri. The line is in sections normally connected together. In calling in one direction, the line behind is cut off. Thus, in the case of two stations, there can be no listening of stations beyond either, while any intermediate station breaking in cuts the line and gets in connection with one or other of the talking stations. In order to provide for emer-

gencies upon the outward ends of the line, cut off at each of two communicating stations, an extra receiver is provided at each station so connected electrically as to always be associated with the cut-off end; while it is so associated with the regular receiver mechanically that it is inconvenient not to have it against one of the ears while using the regular instrument with the other ear.

NEW REPEATER.

Mr. N. G. Warth, of Gallipolis, Ohio, who has obtained in the past several patents for telegraph repeater circuits, etc., has recently patented a repeater apparatus. This is shown in part section below, the view being a plan. The horseshoe magnet covers the receiving coils. The poles of these latter are beveled to conform to the bevel of the armature, a small block mounted directly upon the mica diaphragm of the transmitter. This cuts



WARTH TELEPHONE REPEATER.

down the moving parts to a minimum simplicity. The rear wall of the microphone button is re-entrant, to afford a better disposition of the granules. The air-gap of the magnetic circuit is adjustable through a spacing screw in the transmitter mounting, and the permanent magnet is provided with an adjustable magnetic shunt block for deflecting the polarizing field from the air-gap. These adjustments provide for the accomplishment of maximum efficiency of action.

RAILWAY DESPATCH SYSTEM.

In despatching trains by telephone under a positive block system, it is essential not only for the despatcher to have connection with every tower, but each of these latter must have communication with the one next on either side of it. To accomplish this requirement upon one circuit is the object of the invention of Mr. O. M. Leich, of Genoa, Ill., the patent being assigned to the Cracraft-Leich Electric Company. At each tower there are two phantom coils cut into the circuit. The two windings of one of these are so connected as to cut the line into sections. The second is cut in so that a despatch instrument will at all times be able to receive any message coming forward on the through line. At each tower there are taps led off from the neutrals of the first phantom coil, to which may be connected an auxiliary telephone instrument which works over the grounded local phantom so that the adjacent tower may be called and communicated with without interference with the through line.

MESSAGE REGISTERS.

A signaling and locking system for message registers is the subject of a patent granted to Mr. A. S. Spiegel, of Chicago, Ill. The system contemplated embraces an individual register for each line, a position register to give position totals, and a key connection with each cord pair to connect the registering current to the third or sleeve wire of the cord. The invention lies in a double winding of the line meter so that it operates under the influence of one of its windings and is locked by the other. The resistances are adjusted so that the position meter will fail until the line meter is locked, while when the position meter does work it causes a lamp to glow and indicate the fact. Mr. Spiegel's patent is assigned to the American Telephone & Telegraph Company.

This same company is assigned a patent granted to Mr. S. H. Browne, of Pittsburgh, Pa., for the application of a message counter to a telephone system of the call-distributing type. The total number of successful connections must be counted, irrespective of which trunk happens to be automatically selected to display the calling signal on the switchboard.

Letters to the Editor.

Electrical Units and Notation.

To the Editor of Electrical World:

Sir:—In your journal of Oct. 21 you have been good enough to discuss in a very friendly spirit the latest report of the Committee on Units and Notation of the Elektrotechnischer Verein, for which please accept our thanks.

It is the great desire of this committee to select such a notation and such names of units as appear to be best fitted to enter into international use. Your comment on the use of the letter *A* for *arbeit* (work) will be taken into consideration in a later revision of our propositions.

As to the second recommendation of the committee which you discuss, and which relates to alternating-current phenomena, we have not yet attempted to formulate a definite notation, that in the report being only employed to record formulas. The object of the recommendation was merely to suggest names and definitions for the more important quantities relating to alternating-current phenomena, and the preliminary notation used was not considered entirely satisfactory by the committee. Some of the suggestions contained in your editorial seem thoroughly worthy of attention.

Berlin, Germany. Karl Strecker,
Chairman Committee on Units and Notation,
Elektrotechnischer Verein.

The Lux as the Unit of Illumination.

To the Editor of Electrical World:

Sir:—I have read with much interest in your issue of Oct. 28 the letter by Dr. Berthold Monasch on the successively different values given to the lux in certain countries. I am entirely of the opinion of Dr. Monasch that it is very difficult to know with a sufficient exactitude the values of light units as they enter in the electrical literature of the last 10 years of the past century.

The excellent system of photometric units adopted in Geneva in 1896 on the proposition of Professor Blondel has made considerable progress. I agree with Dr. Monasch and recognize that it is very regrettable to find a difference of 13 per cent (from 0.98 to 1.11) between the value given in 1896 and in 1909 for the ratio of the bougie-decimale to the hefner; but should we conclude that during this period one of the units has varied 13 per cent? As a matter of fact, such a swift and summary judgment would be in error.

The hefner was investigated very completely in 1895, and had received a specification from the Reichsanstalt in 1893, since which date this lamp has not varied. I believe I can say personally (I have been engaged in photometry since 1894) that the difference of 13 per cent in the value of the bougie-decimale would similarly not be possible. The inconsistency is very readily explained by reference to the state of knowledge, at first very imperfect and then progressively more precise, of the ratio of the two units. When the Geneva congress decided in 1896 that for industrial measurements the bougie-decimale could be represented provisionally by the hefner, it relied upon the value given in 1891 by M. Violle for the ratio of the hefner to the bougie-decimale. The comparison, however, had been made before the specifications of the hefner lamp were put forth, which specifications are now recognized as necessary to insure exactitude. The Geneva proposal was adopted without either verification or opposition.

In 1898 I gave the ratio of the bougie-decimale to the hefner as 1 to 0.885, pointing out that my several results differed by 2 per cent. Subsequently a correction of 1 per cent was applied to this first result, and the ratio adopted by the International Commission of Photometry in 1907 of 1 to 0.895 is admitted to be within 1 per cent. Since then, in 1909, with a

view to simplification and as within the limits of approximation indicated in 1907 at Zurich, it has been agreed to accept 1 to 0.9 as the ratio of the bougie-decimale to the hefner.

Is it necessary to assert that the value of the lux or of the hefner-metre has varied? Not at all. Should we employ for the ratio of the bougie-decimale to the hefner the value 1 to 1.02 for photometric measurements made in 1896, and 1 to 0.9 for those of 1909? Certainly not. These variations simply show that in 1896 our knowledge as to the ratio to employ was not sufficiently exact, while at present this ratio can be stated as known to within 1 per cent. We can thus use without hesitation the present value for application to all previous photometric data whatever their date, provided, of course, that such measurements were made after, and were based upon, the specifications of the hefner. The present value of the ratio will probably not be subject to any important modification, for it seems now to be known with all approximation that one can expect from the definition and the constancy of the standards to which it applies.

PARIS, FRANCE.

F. LAPORTE,
Sous Directeur du Laboratoire, Central d'Electricite.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Field-Magnet System.—J. W. BURLEIGH.—An illustrated description of a new field magnet system for generators and motors. It consists of a number of horseshoe magnets with commutating poles arranged as shown in Fig. 1. The angle θ

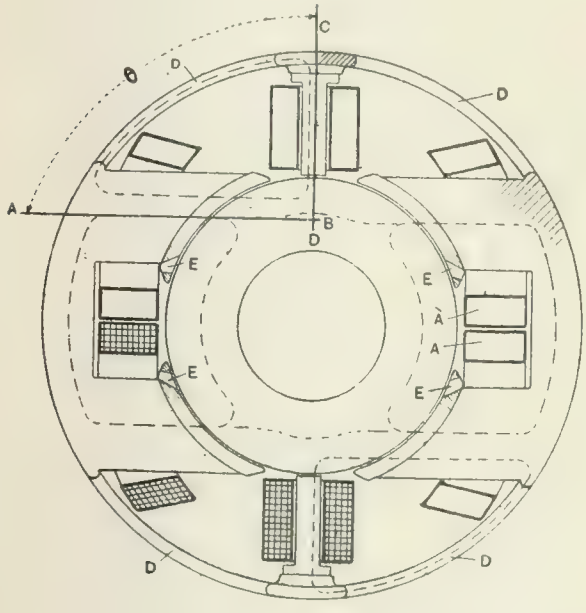


FIG. 1.—FIELD MAGNET SYSTEM.

between the axis of a main pole core and the axis of a commutating pole $= \frac{360 \text{ deg.}}{NP}$ — where NP equals the number of main poles. This is a distinctive feature of the design. The arrangement of the poles and windings is shown diagrammatically in Fig. 2. The full line represents a winding of a series-wound



FIG. 2.—DIAGRAM OF WINDING.

armature, the dotted lines the portions of the field coils, and the rectangles the commutating poles. Portions *AA*, Fig. 1, of the main exciting coils are brought directly over and parallel with the armature conductors undergoing commutation. This particular position of the field coils lessens the self-induction of armature coils undergoing commutation and saves a considerable amount of copper on the commutating poles. From actual tests it would appear that the excitation required on each commutating pole is not in excess of that required for each commutating pole in a machine having an ordinary magnet system, in which the auxiliary and main poles are equal in number. It is found, too, that the brush position is not nearly so sharply defined as in the usual commutating-pole machine. With this particular construction magnetic leakage is reduced to a minimum. The chief advantages of the system are claimed to be reduction of magnetic leakage, extremely light field cores and improved ventilation. Detailed figures are given of the design of a 500-volt, 12-hp, 1050-r.p.m. motor and a 500-volt, 200-kw, 400-r.p.m. generator.—Lond. *Elec. Review*, Nov. 26.

Regulation of Voltage of Alternators.—M. SEIDNER.—The use of inherent voltage regulation (making use of saturation and stabilization of the magnetic field) is uneconomical, since alternators provided with special voltage regulators can be built much more cheaply. The author discusses the general properties which regulators should have and briefly sketches the theory of the voltage drop in alternators. He then divides the different methods of voltage regulations of alternators into six groups as follows: In the first group the exciting current required for regulation is obtained from the alternating current of the generator by means of a commutator running in synchronism with the generator (Ganz, General Electric Company, Corsepius, Heyland, Alexanderson). In the second group the direct current for excitation is also obtained from the alternating current, but a special magnetic field is used to facilitate commutation. This group is subdivided into two classes, one of which comprises the converter methods in which the no-load current is also taken from the alternator, while the other class comprises those methods by which the no-load current is produced by exciters (Hutin-LaBlanc, Boucherot, Blondel, Rice, Danielson, Steinmetz, Ziehl, Roth, Union Company). In the third group the direct current for excitation is produced from the alternating current by means of aluminum electrolytic rectifiers (Dobrowolsky). In the fourth group the magnetic reaction of the armature is used for regulation (Walker, Heyland). In the fifth group the alternating current is not changed into direct current, but acts mechanically on a rheostat inserted in the shunt excitation circuit (Blathy, Thury, Dick, Thiele, Tirrill, Schwaiger). In the sixth a rheostat is acted upon, not mechanically, but by purely electric, magnetic or thermal methods (Seidler, Crompton & Company, Parsons). The author begins to discuss some 30 of the more important different methods. The article is to be continued.—*Elek. Zeit.*, Nov. 25.

Interpole Motors.—A anonymous article on direct-current machinery. Special reference is made to the connections of the field windings of compounded and interpole machines. The adjustment of the current in the interpole windings and the position of the brushes of interpole motors and generators are dealt with, and the influence of brush position on the speed characteristics of interpole motors are referred to. By giving the brushes a slight forward lead, surging and the rise of speed under full load, sometimes obtained with interpole motors, are avoided. The speed characteristic of an interpole motor of

500 volts, 40 hp, 800 r.p.m. is shown in Fig. 3. Curve I shows the speed with brushes at the neutral position, curve II with the brushes given half a segment forward lead. A good machine would usually allow of one segment forward lead being given

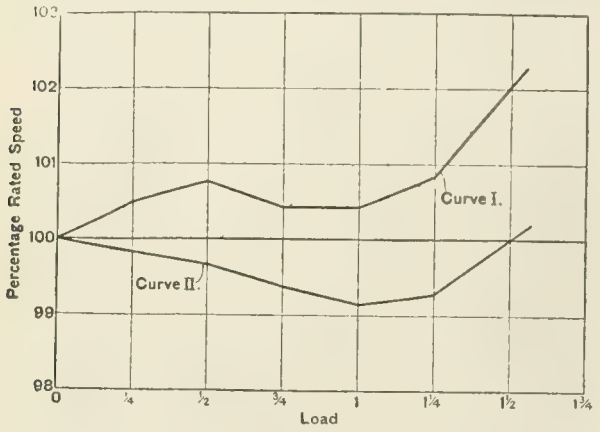


FIG. 3.—SPEED CHARACTERISTICS OF INTERPOLE MOTOR.

to the brushes before sparking commences. A much simpler way out of the above difficulty is to supply a series winding, so that as the load comes on the machine the series turns help the shunt field and keep down the speed and at the same time the machine is perfectly stable. This method is used in every case with a reversible motor, in which the brushes must necessarily be fixed on the neutral.—Lond. *Elec. Eng'ing*, Nov. 25.

Transformers.—W. R. Rogowski.—A theoretical paper on the stray flux and stray flux coefficient of transformers.—*Mitt. Forschungsarbeiten Ver. Deut. Ing.* No. 71; abstracted in *Elek. Zeit.*, Nov. 25.

Lamps and Lighting.

Illuminated Engineering.—S. P. Thompson.—In his inaugural presidential address to the (British) Illum. Eng'ing Society the author emphasizes the confusion which exists in photometric units. Agreement as to what shall be taken as the unit of light and what as the unit of illumination at a surface must be secured. The former appears to be settled, but about the unit of illumination there is still some disagreement, both the lux and the ft.-candle being used. Adopting the latter for present purposes, all authorities are agreed that for reading at night not less than 1 ft.-candle is required. Reading is impossible with an illumination of less than 0.1 ft.-candle, difficult and fatiguing with 0.25 ft.-candle, comfortable with from 1.5 to 3 or 4 ft.-candle, and dazzling if the illumination exceeds 6 ft.-candles. Very seldom does the artificial illumination exceed 3-ft. candles, though in a room receiving direct sunlight 4 or 5 ft.-candles may be attained. No one can have worked at the photometry or modern lamps without becoming conscious of much misunderstanding existing as to the elementary laws of illumination, the inverse-square law, if often misapplied, being used in calculations of illuminations from sources other than points. Other subjects which should be taken up are the specific brightness of surfaces of different kinds when subjected to a standard illumination, and a number of semi-physiological problems. For schoolrooms at least, rules should be formulated on illumination. They ought to require an illumination of 1.5 ft.-candles at the worst lighted seat, but excess illumination must also be avoided. Holland appears to be the only country in which legislation has fixed a statutory amount of illumination, the figure being from 10 to 15 meter-candles or from 0.9 to 1.35 ft.-candles.—Lond. *Electrician*, Nov. 26.

Tungsten Illumination.—A. J. Sweet.—An article giving fundamental rules on the best methods of using tungsten lamps, with applications to specific cases, like the lighting of stores, desk lighting, shop-window lighting, etc.—*Elec. Journal*, December.

Generation, Transmission and Distribution.

Multi-Speed Drive by Induction Motors.—H. C. Specht.—An illustrated article on the use of multi-speed drive in steel mills. During the process of rolling, the rolls working on different sections require different speeds; the smaller the section the faster the speed required. In a mill which always rolls the same material and the same sections, the different speeds at the respective rolls are generally obtained by mechanical devices and sometimes, in addition, by two or more motors. A number of rolls for the first passes are driven by one motor, faster and slower speeds being obtained by speed-changing devices, such as pulleys and belt, rope drive, or gears. A number of the

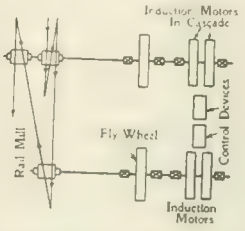


FIG. 4. LAYOUT OF MILL WITH MOTOR DRIVE.

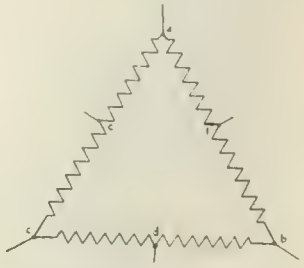


FIG. 5.—ARRANGEMENT OF PRIMARY WINDING.

succeeding rolls are similarly arranged in group drive to be operated by a second motor, which may itself operate at a higher speed than that of the first motor. A drive of this character is illustrated in Fig. 4. In a mill where different materials and different sections are to be rolled at various times some arrangement of multi-speed motors (depending on the special nature of the case) must be used. In general it is desirable to limit the number of speeds and select such speed ratios as can be obtained with the least complication and lowest cost. Several methods are described; one of them is used with a continuous mill at the works of the Pennsylvania Steel Company, Steelton, Pa. In this case a 300-hp, 300-volt, 25-cycle, three-phase motor of the two-speed type is used, the speed corresponding to this output being 375 r.p.m. (synchronous speed). The output at the slow speed, 187.5 r.p.m., is 150 hp. The primary (stator) consists of concentric windings with an average coil throw corresponding to 16 poles. For high-speed operation, corresponding to eight poles, the primary winding is connected in parallel-star, while for low-speed operation, or 16 poles, the winding is connected in series-delta. Six leads are brought out from the primary winding to the switching devices, as shown in Fig. 5. For the delta connection the leads *a*, *b* and *c* are connected to the three-phase line, the leads *d*, *e* and *f* being disconnected. For the star connection *a*, *b* and *c* are connected together, and the leads *d*, *e* and *f* are connected to the line. Another method is that of the Illinois Steel Company, where a large rail mill is operated by means of two identical cascade sets. The motors operate on a 2200-volt, 25-cycle, three-phase circuit, the rating of each set being 1800 hp at 83.3 r.p.m. (synchronous speed) and 1200 hp at 125 r.p.m.

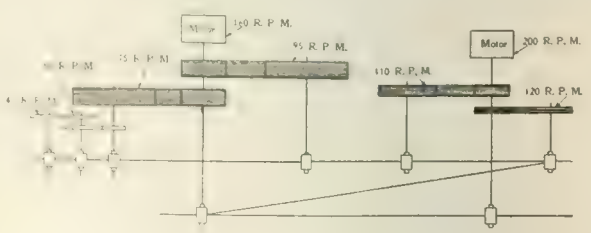


FIG. 6.—DIAGRAM OF MULTI-SPEED MILL DRIVE.

One motor of the set is wound for 24 poles and the other for 12 poles, the two rotors being mounted on a common shaft. The motors are directly connected to the roll spindle. A fly-wheel is also employed on the common shaft. To obtain the slower speed, the two motors of the set are connected in direct concatenation. For high-speed operation the 24-pole motor is operated as a single machine. In either case the primary of the 24-pole motor is connected to the line. This mill rolls rail from different materials and of various cross-sections and is also employed for rolling various sizes of bars. Although more

than two speeds could be obtained with this cascade set, only two are employed, the motors being designed accordingly. Operation at the high or low speed is of course dependent on the material being rolled; however, both sets are always operated at the same number of poles. Fig. 6 shows diagrammatically the arrangement of the motors and mill. The author finally discusses the use of multi-speed drive of pumps and blowers.—*Elec. Journal,* December.

Electric Power in Steel Mills.—C. F. Scott.—A paper in which the author explains how the use of electricity removes former limitations in steel mills. He discusses the cost of energy and the cost of motors and emphasizes that the latter is the least important item. As to the selection of motors and the use of alternating current he thinks that common-sense mechanical instinct will choose nothing but alternators and induction motors, the simplest kind of generator and the simplest kind of motor. Rotary converter, direct-current motor and synchronous motor are, therefore, put on the defensive. They must show specific advantages, which will more than compensate for their disadvantages. The question of power factor is discussed and summed up as follows: The power factor has little or no effect on the engine or the work which the motor does, but is a matter incident to the electric system alone. If proper provision be made, its effect should not appear in the mechanical operation of the apparatus. The power factor should be provided for in the design of the electrical system and although the induction motor does not require larger generating equipment, yet this can usually be provided and the system installed and operated more economically and efficiently than it could by any other class of apparatus; moreover, it is simpler.—*Elec. Journal,* December.

Regulation of Transmission Lines.—A. J. Soper.—After a general discussion of the principles of regulation and energy losses of transmission lines, the author describes a new and simple method for the predetermination of transmission line regulation. It requires no difficult mathematical calculations at all, but makes use of tables. It is based on the fact that the power that can be transmitted over a line at a given voltage multiplied by the distance of transmission is a constant for the same percentage voltage regulation and energy loss. If it is desired to find the size of wire to transmit a given amount of power over a given distance with a fixed percentage regulation it is only necessary to multiply the horse-power with the number of miles of transmission. This gives a figure which is looked up in the author's tables from which the size of the wire may be found immediately. The tables given in the article refer to copper conductors used for 60 cycles and 25 cycles and a power factor of 80 per cent; to transmission e.m.fs. between 1000 volts and 60,000 volts; and to spacings between 18 in. and 72 in. The tables may be used to solve any of the following problems: To find the size of wire for a given line drop; the size of wire for a given watt loss in the line; the line drop and watt loss for given sizes of wires; the maximum amount of power that can be transmitted for given sizes of wires with definite line drop or energy loss; the effect on the line drop of frequencies of 25 cycles and 60 cycles; the effect on the line drop and energy loss of the power factor of load with given sizes of wires. Various numerical applications of the method are added.—*Canadian Elec. News,* December.

Electric Marine Propulsion.—H. J. Oram.—Some notes on the reasons why the various proposals for electrical propulsion of warships had not received the most favorable consideration of the British Admiralty. In some of the electrical designs submitted the total increase in machinery weights was as much as from 15 to 20 per cent. The gain at low powers would require to be very substantial to balance such increases. Moreover, the voltages suggested were considered to be too high for safety. In the designs submitted to the Admiralty there had been no gain in the space occupied, but in some cases an increase.—Lond. *Elec. Eng'ing,* Nov. 25.

Pump.—H. A. Humphrey.—An illustrated paper read before the (Brit.) Inst. Mech. Eng. in which the author describes an internal-combustion pump in which the explosive force is exerted directly upon the water. Official tests show that a consumption of 1.06 lb. of anthracite coal per pump hp-hour has been obtained with only a small plant. The thermal efficiency at low pressures is much higher than with an Otto cycle. In conclusion, a suggested central station is outlined, in which pumps would supply water to water turbines coupled to electric generators.—Lond. *Electrician,* Nov. 26.

Traction.

Single-Phase Road in London.—A note on the opening of electric operation on the South London Elevated Electric Railway, which is the first line in England to commence electrification on the single-phase system. The equipment is with an overhead conductor supplying current to the trains at 6700 volts, 25 cycles. Each motor coach is equipped with four Winter-Eichberg 125-hp, single-phase commutator motors supplied at a pressure of from 150 volts to 750 volts from transformers on the coach.—Lond. *Elec. Eng'ing,* Nov. 25.

Installations, Systems and Appliances.

Swiss Power Station.—H. de Beaufort.—A description of the new water-power station of Lonza, in the Ackersand district in Switzerland. A waterfall of 730 m high is utilized. The plant will contain five generating units, of which only one has so far been erected. Each unit will have a rating of from 5500 hp to 6000 hp. The three-phase alternators give directly 15,500 volts. The number of revolutions per minute is 500. The current is 190 amp per phase. Among the features of the installation are the automatic oil interrupters, which opens instantaneously and without the slightest danger, a circuit carrying 30,000 hp.—*Revue Industr.,* Oct. 23; *La Lumière Elec.,* Nov. 13.

Electric Lighting and Electricity Charges.—H. W. Handcock and A. H. Dykes.—A paper read before the (Brit.) Inst. Elec. Eng. The authors first review the change brought about by the extensive adoption of metallic-filament lamps. They show that the flat rate of charging is certain to prove unsatisfactory, and that for small consumers excellent results can generally be obtained by a fixed charge of $3 per 25-cp lamp per year, including free wiring rental, no meters being used. Large consumers, for which this system would prove too expensive, would have a limit indicator fixed, and the charge would be based on the maximum number of lamps required to be used at one time. The authors prophesy a successful future for undertakings conducted on these lines.—Lond. *Electrician,* Nov. 26.

Electricity in Harbor.—O. Heinisch.—The conclusion of his illustrated article on electricity supply in the Ruhrort harbor. Current is supplied over a 10,000-volt double-cable line of 12 miles length from the electricity works in Essen. The distributing network has a total length of 11 miles with 44 transformer stations, the total rating being 3200 kva and the e.m.f. of distribution 5000 volts. Electricity is used for the operation of cranes, for loading coal and for lighting (523 arcs and 410 metallic-filament lamps of 100 cp). The lamps are lighted from a distance from 16 different points by automatic clock apparatus. The construction of this apparatus is described in detail.—*Elek. Zeit.,* Nov. 25.

Constant-Current Regulators.—H. A. Laycock.—An illustrated article on the principal arrangements of constant-current regulators. The cycle of operation of the current regulator is practically the same as that of the voltage regulator, with the principal difference that the regulating magnets of the former are designed with series coils instead of shunt coils.—*General Elec. Review,* December.

Switchboard.—L. B. Chubbuck.—An illustrated article on concrete switchboard structures.—*Elec. Journal,* December.

Wires, Wiring and Conduits.

Fuses.—M. T. Maccall.—A paper read before the Leeds Section of the Brit Inst. Elec. Eng. The usual formula due to Preece, namely, $I = k.D^{3/2}$ (where I = fusing current in amperes, D = diameter of wire in inches and k = constant for any particular material) is not applicable to stranded wires, because the wires diminish each other's emissive power to an extent which can be determined only by experiment. All that can be

predicted is that a two-strand fuse will carry less than twice the fusing current of either of its equal wires, and probably more than 1.41 times this current, and for a three-strand fuse the current will lie between 3 and 1.73 times that of the single wire, and so on. The objects of these experiments were to determine the variations in Preece's "constant" (or in the emissive power) with change of diameter; to determine the effect on fusing current of house service fuse holders, and to find the ratios of the fusing currents of single and stranded fuses in the open and in fuse holders. The experiments were confined to tin fuses in air and one type of fuse holder, and dealt chiefly with single and two-strand fuses. The wire contained 99.6 per cent tin, and corrections were made for temperature. The results for single wires connected for an air temperature of 16 deg. C. are given below:

Diameter mils.	S. W. G.		Fusing current amperes.	$10^3 \times E$	$k \times 10^3$
15.3	28	in Air	3.58	2.60	1.89
21.9	24	in Air	5.26	2.42	1.66
28.6	22	in Air	7.53	1.77	1.50
15.3	28	in Fuse Holder	4.58	4.27	2.42
21.9	24	in Fuse Holder	6.28	3.44	1.94
28.6	22	in Fuse Holder	8.17	2.08	1.69

The value for 28 S.W.G. in air is for the fuse in a horizontal position; all others are for the fuse in a vertical position. The value of E (the emissivity) can be calculated either from the actual fusing currents or from the values corrected as above to an air temperature of 16 deg. C. Preece's constant (k) is given for the diameter in inches. The values of E and k decrease with increasing diameter, especially for fuses in holders; in fact, in the latter case, the fusing current, instead of varying as $d^{3.2}$, does not vary even as rapidly as the diameter, but about as its 0.92 power. A similar table of two-strand fuses is given below:

Diameter mils.	S. W. G.	Twists per inch.		Fusing current amperes.	$10^3 \times E$	$k \times 10^3$
15.3	28	3¼	in Air	5.37	1.47	1.42
21.9	24	3	in Air	8.85	1.37	1.37
28.6	22	2	in Air	13.0	1.32	1.34
15.3	28	3½	in Fuse Holder	6.37	2.06	1.68
21.9	24	2¾	in Fuse Holder	9.38	1.53	1.44
28.6	22	2¼	in Fuse Holder	13.4	1.52	1.39

The same general results are seen here as for the single fuses, except that k varies less, especially in air, probably because the results for 28 S.W.G. are less affected by its being placed horizontally than they are in the case of single wire. The ratio of the fusing currents for single and double fuses varies from 1.39 to 1.73. A few experiments were made on three-strand fuses, which gave a fusing current of a little over twice that of single wires of the same size.—Lond. *Elec. Eng'ing*, Nov. 25.

Electrophysics and Magnetism.

Elementary Electric Charge.—R. A. Millikan.—The author describes a new modification of the cloud method of measuring the elementary electric charge. His determination gives 4.87×10^{-10} in absolute electrostatic units. The results of all the recent determinations by methods which seem least open to question are given below:

Planck	4.69
Rutherford and Geiger	4.65
Regener	4.79
Millikan	4.65
Begeman	4.66
Mean	4.69 × 10⁻¹⁰

The value of Begeman was obtained by the regular Wilson method.—*Physical Review*, December.

Electric Charges Acquired by Insulated Radioactive Substances.—J. C. McLennan.—An account of an experimental investigation of the electric charges acquired by insulated potassium salts and other radioactive substances in high vacua. The results of the research show that in high vacua both potassium sulphate and potassium nitrate emit an excess of charged particles of the beta type. The effect observed in all cases was small, and it required exceptional conditions to bring it into evidence. From the results obtained so far it has not been found possible to decide whether or not any radiation of the alpha type is emitted by the potassium salts.—*Physical Review*, December.

Double Refraction.—A paper by T. E. McComb on the dispersion of electric double refraction and ordinary dispersion in liquids, and a paper by C. A. Skinner on the dispersion of magnetic double refraction in liquids compared with that of electric double refraction.—*Phys. Review*, December.

Radioactivity.—J. Elster.—The conclusion of his lecture on the present status of our knowledge of radium and radioactivity.—*Elek. Zeit.*, Nov. 25.

Units, Measurements and Instruments.

Laboratory Applications of the Photo-Electric Current.—F. K. Richtmyer.—An abstract of a recent Physical Society paper. The production of measurable photo-electric currents from a sodium surface by extremely feeble illuminations suggests this phenomenon for use in making photometric measurements of monochromatic or of isochromatic light sources where observations by eye are extremely difficult. For example, the author has studied the decay of phosphorescence of a sample of Balmain's paint for a period of over an hour following a half-minute excitation by sunlight. The curve is of the usual form, and when plotted with $1/\sqrt{I}$ as ordinates, shows three distinct linear branches. It is also pointed out that this combination of photo-electric cell and electrometer acts as a time integrator for light intensity in much the same way that an electrolytic cell would measure total quantity of electricity. In this connection the cell might be used to study short decay phosphorescence, or, as has been done by the author, to measure the total quantity of light passing through a photographic shutter during exposure.—*Physical Review*, December.

Meters.—An official announcement of the Reichsanstalt, by which an induction meter of the Isaria Company is admitted for calibration at the Reichsanstalt. It is intended for two-phase or three-phase systems with unbalanced phases. The meter consists of two single-phase meters on the same axle. The construction and method of calibration are described.—*Elek. Zeit.*, Nov. 25.

Absolute Measurement of Electric Resistances.—Hurmuzescu.—A paper presented before the French Academy of Sciences on a method of absolute measurement of an electric resistance in electrostatic units. The principle of this method is as follows: A condenser with the charge $Q = CE$ is discharged from Q_1 to Q_2 through a resistance R. During this time its capacity decreases from C_1 to C_2, while the potential E remains constant so that $dQ = EdC$. The current I thus produced is $I = dQ/dt = E/R$. From these two relations it follows that $RdC/dt = I$. It is thus possible to obtain directly the value of R if the variation of the capacity in time, or the differential quotient of C with respect to time, can be measured. A suitable arrangement is a cylindrical condenser formed of two circular concentric cylinders.—*La Lumière Elec.*, Nov. 6.

Electromagnets.—A. Beringer and R. Edler.—A continuation of their experimental investigation of electromagnets for switches and apparatus. In the present installment they describe their experiments on the influence of heating on the tractive force. The effect of the temperature seems to be quite complicated.—*Elek. und Masch.* (Vienna), Nov. 7.

Measurement of High Inductions.—E. Gumlich.—The first part of a paper on the measurement of high inductions by a modification of the isthmus method of Ewing. The paper is to be concluded.—*Elek. Zeit.*, Nov. 11.

Localization of Cable Faults.—E. Raymond-Barker.—In a continuation of his illustrated article on cable fault localization graphs in practice the author considers the Heurtley test graphically.—Lond. *Elec. Review*, Nov. 5.

Paper Condensers.—E. H. Weiss.—An article on the design of condensers for telephone purposes, constructed of paper covered with a layer of tin. The author thinks that the cylindrical form is the most convenient one. In the present article he calculates the best ratio of height to radius of the cylinder.—*La Lumière Elec.*, Oct. 6.

Telegraphy, Telephony and Signals.

Telephony.—L. E. Wilson.—A paper read before the Manchester Section of the (British) Inst. Elec. Eng. on various problems of telephony. With respect to engineering matters in

connection with exchange work he referred to insulating tests. Taking 1000 lines under old conditions, the author stated that on a wet day 40 per cent tested under 100,000 ohms; the use of Sinclair-Aitken leading-in insulators, which introduces a dry section between the leading-in cable and the outside wire, raised the insulation considerably, and, under the same atmospheric conditions, only 23 per cent proved to be under 200,000 ohms. An investigation of low insulation and the cause subdivided the responsibility as follows: Outside lines, including the leading-in wire, 37 per cent; window terminals, 27 per cent; office wiring, 19 per cent; instruments, 7 per cent. After receiving individual attention, no line tested under 7 megohms. The author then analyzed the faults occurring in private telephones under the following headings: wiring, primary batteries, bell troubles, instrument cords, transmitters, generators, receiver, lightning arrester, damp walls and cradle switch.—Lond. *Elec. Eng'ing,* Nov. 25.

Wireless Telegraphy.—Two papers on coupled wireless telegraph systems. J. Kaiser deals with the transmitting system and discusses the effect of the degree of coupling on amplitude and damping of the waves produced. G. Heinecke deals with the receiving system and its best arrangement to get maximum effect.—*Phys. Zeit.,* Nov. 22.

Directive Wireless Telegraphy.—L. H. WALTER.—A note on the Belini-Tosi system of directive wireless telegraphy, with special reference to the problems of constancy of coupling and the phase relations.—Lond. *Electrician,* Nov. 26.

Cable Telegraphy.—K. W. WAGNER.—A mathematical paper on the transmission of telegraphic signs over long cables, with special reference to the effect of the insertion of condensers at the transmitting and receiving ends.—*Phys. Zeit.,* Nov. 22.

Barretter.—BELA GATI.—Some notes on the difficulties he has encountered in making half-micron (0.0005 mm) platinum barretters, and on their efficiency. The best current is 2.5 milliamp. With a current of 3 milli-amp the wire is destroyed in air.—*Phys. Zeit.,* Nov. 22.

Miscellaneous.

Birmingham.—E. A. ALLCUT.—The first part of an illustrated article on the University of Birmingham and its electrical engineering department.—Lond. *Electrician,* Nov. 26.

Ignition.—J. W. WARR.—An illustrated paper read before the (Brit.) Inst. Elec. Eng. on the principles of electrical ignition of internal combustion engines.—Lond. *Elec. Review,* Nov. 26.

Electric Laboratory.—ROESSLER.—The first part of an illustrated description of the electric engineering laboratories of the Institute of Technology of Danzig, Germany.—*Elek. Zeit.,* Nov. 25.

Apparatus for Melting-Point Determinations.—W. P. WHITE.—A paper discussing various apparatus especially useful for the determination of melting points at high temperatures. Platinum resistor furnaces of simple construction provide complete control of the temperature for melting-point work up to 1600 deg. C. Where uniformity of temperature throughout the working chamber is important special modifications are necessary. Small charges (2.5 grams) give very sharp points, are economical of material and permit of convenient manipulation. A number of advantages result from the use of a second thermo-element, which is made to show directly the furnace temperature about the charge. The measurement and regulation of the heat supply from the furnace is a factor of great importance in accurate melting-point determination. The author describes methods of [redacted]ulating thermo-elements and of avoiding the effects of contamination, suited to various conditions and kinds of work. He concludes with the description of several methods developed by him.—*Amer. Jour. of Science,* November.

NEW APPARATUS AND APPLIANCES

Transformer for Bell Circuits.

The transformer shown herewith is made by the Fort Wayne Electric Works, Fort Wayne, Ind., for the purpose of utilizing alternating current for operating electric bells, annunciators and similar low-voltage apparatus, to take the place of



TRANSFORMER FOR BELL CIRCUITS.

dry cells, which are oftentimes a source of more or less trouble. The transformer is built for 110-volt circuits, and has a secondary winding with taps brought out so as to obtain 4, 8 or 12 volts, depending upon the connections. In electric bell wiring, frequently the bell wires are run along the floor and are apt to be short-circuited. For this reason the transformer is designed so that it will operate for several hours on dead short-circuit without danger of burning up. This feature makes the transformer valuable for this class of work. The efficiency of the device is quite high for a transformer of this size. The core loss is said to be approximately 0.4 watt. The primary leads consist of two rubber-covered flexible cables brought out through an insulating piece, anchored inside the case to prevent injury to the winding, due to pulling of the leads. The secondary terminals consist of three binding posts giving three combinations of voltages. This is the maximum combination which can be obtained through this number of binding posts. The casing is of cast aluminum covered with a heavy coat of black japan, so that the transformer may be installed in places where the appearance of dry cells would be objectionable. There is an air space between the body of the case and the wall upon which it would be mounted. The core and coils are thoroughly impregnated and the same care and quality of material are said to be used as in the construction of the transformer as in large high-voltage transformers.

Tough Tungsten Lamps in a Wreck.

The collision between a Pennsylvania eastbound passenger train and an empty engine just outside Jersey City on the morning of Nov. 8 resulted in comparatively few injuries to the passengers due to the fact that the strong frames of the passenger cars resisted crushing. The damage to engines and cars, however, was considerable. One of the steel passenger coaches jumped the track and turned over on its side, denting in the steel plates about 18 in.

In the lighting equipment of this car were nine General Elec-

tric tungsten lamps. It is interesting to note that, after the wreck, when all the lamps were taken out and tested, the tungstens were found to be in perfect condition—a further proof of the rather remarkable strength and durability of the tungsten filament when specially adapted for train lighting service.

Automatic Acceleration Induction Motor.

The motor illustrated in Fig. 1 is similar in general appearance and operating characteristics to the Wagner self-starting, single-phase repulsion motor, but differs therefrom in being a polyphase machine of the usual induction type. It is provided with a secondary short-circuiting device operated by centrifugal force identical in every respect to the device used with the single-phase machine, but there are no brushes bearing on the commutator, and hence no mechanism for removing them when full speed is attained. The motor is, in fact, a polyphase induction machine which starts from rest with a secondary of high-resistance and operates under load conditions with a secondary of low-resistance, the change from high-resistance to low-resistance being accomplished by means of the centrifugal short-circuiting mechanism just referred to.

The performance of the motor during the starting period is indicated in Fig. 2. At the first instant of starting the motor consumes three times the normal current and exerts a torque

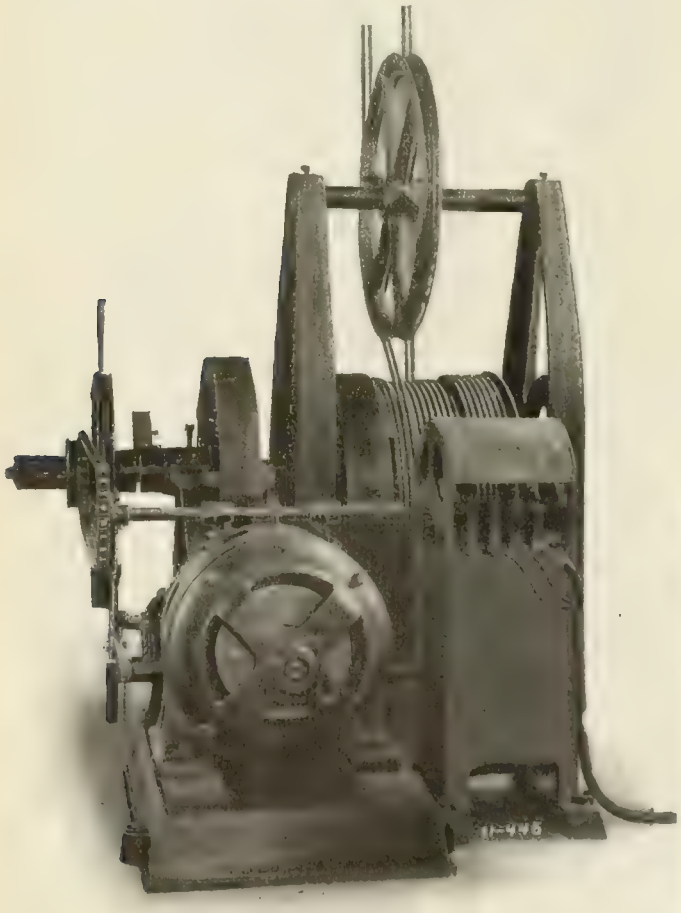


FIG. 1.—MOTOR-DRIVEN ELEVATOR.

three times the normal full-load value. As the rotor speed increases both the current and torque gradually decrease, until the speed has reached the value at which the centrifugal mechanism comes into action to decrease the secondary resistance when the current and torque are suddenly increased and the rotor rapidly accelerates to the speed indicated by the load and consumes a current corresponding thereto. The motor now operates in every respect as a polyphase machine with a rotor secondary of the squirrel-cage type.

In addition to possessing the desirable operating features of the low-resistance, squirrel-cage motor, the machine exerts a high torque while consuming a low value of current at starting, being in this respect similar to an induction motor of the slip-ring type. However, the only external starting device is a simple single-throw, three-pole, main line switch. The latter feature renders the motor particularly suitable for remotely controlled apparatus, such as pumps and elevators. The operation of the motor is entirely automatic, so that following any

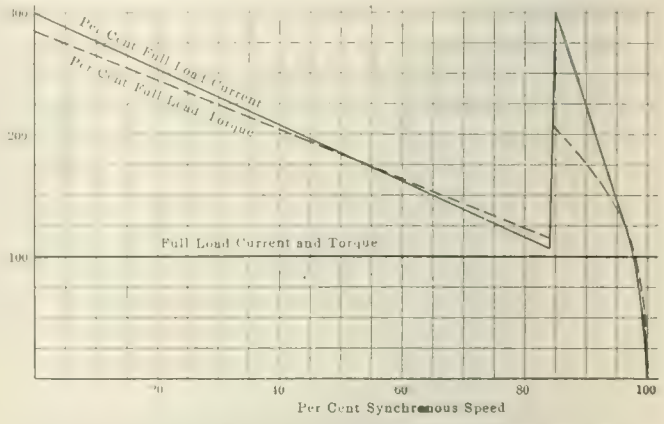


FIG. 2.—STARTING CHARACTERISTICS OF INDUCTION MOTOR.

interruption to the supply of energy the motor returns at once to the starting condition and accelerates from rest when the supply is restored.

The motor described above has been placed on the market by the Wagner Electric Manufacturing Company, St. Louis, Mo.

Westinghouse Electric Repair Department.

For some time past the Westinghouse Electric & Manufacturing Company has felt the need of a special department to handle repair work independently of all other work, so as to insure prompt attention and quick deliveries, but the crowded condition of the works required the erection of another building before such a department as the management had in mind could be established.

On account of the fact that there was no large space on the



FLOOR, NEW REPAIR DEPARTMENT BUILDING.

company's 47-acre plot unoccupied, it was necessary, in the erection of a new building, to depart from the established two-story type of structure and to erect an eight-story building. The available space was 110 ft. wide by 420 ft. long, and the building is 70 ft. x 400 ft. The distance from the ground to the top of the cornice is 130 ft. The building is of skeleton self-contained steel and brick construction, and is as near fireproof as a building can be made. It contains approximately 220,000 sq. ft. of floor space.

Although surrounded on all sides by other buildings, the new building has excellent receiving and shipping facilities. A covered shipping platform on the east side, paralleled by a railroad siding, extends the full length of the building. The ground floor is connected with the rest of the works by a narrow-gage industrial railway system, and the second floor is connected with the surrounding buildings by means of covered bridges.

To facilitate the handling of material from floor to floor one exceptionally large freight elevator and five high-speed combination elevators are employed. They are all electrically operated by means of Westinghouse motors and controlled by automatic elevator controlling apparatus.

The building affords working space for approximately 1500 people. In addition to providing for practically doubling the present output of detail apparatus, it affords ample room for handling in the most expeditious manner a large volume of repair work.

New Meter for Measured Telephone Service.

Engineers of the Chicago Telephone Company and other Bell telephone companies have been working for more than two years in an endeavor to produce a message register which could be placed at a subscriber's station and so operated as not to impede or interfere with the general service of the Chicago exchange. Before the passage of the recent telephone ordinance in Chicago the adoption of message registers which required the subscriber to ring a special bell or make a special signal when called upon to do so by the operator, after connection had been made, was discussed at considerable length. Such forms of register had been designed and manufactured to some extent, but never generally introduced. It was agreed at that time that the delays put upon the exchange service by registers operated in this way would be almost unbearable. The problem of designing a meter which overcomes this difficulty seems to have been finally solved by Associated Bell telephone engineers, and the latest model, just received by the Chicago Company, will overcome, it is believed, the difficulties previously encountered. The subject is still under consideration, however, by a committee of the Chicago City Council.

The new telephone meter recommended by the Chicago company consists of a small steel box about 5 in. x 2½ in. and standing out from the wall about 4 in. At the top is a small glazed aperture back of which four disk wheels carry the numbers indicating the number of calls furnished the subscriber. At the right is a push-button, to be operated by the subscriber when he originates a call. In calling, the subscriber presses the button. This signals the operator in the central office, who answers in the usual way. If the call is completed, the operator presses a key associated with her apparatus which operates the mechanism in the register which counts as one call.

If the call has not been completed, because the desired line is busy or for any other reason, the operator presses another key, which releases the mechanism, but does not register a call. The keys manipulated by the operator are identical with those used in the nickel service where the operator presses one key to drop a coin into the cash box and another to return it to the person calling. This register enables calls to pass along freely, just as in the case of the coin box where the nickel is first deposited to signal the operator. The subscriber who is called is not delayed, and a fair rate of speed of operating can be maintained. The instrument, therefore, seems to be well adapted to conditions of telephone service as they are found in Chicago and is applicable to measured-service lines.

After some further service tests on exchange lines in various localities the work of manufacturing tools by means of which this instrument may be turned out will be rapidly prosecuted, if the meter is finally approved by the city authorities, and everything possible done to get the instrument ready for introduction on the premises of such subscribers as may desire it and who have the class of service adapted to it.

English System for Securing 100 Per Cent Central-Station Load Factor.

A description appeared in a recent issue (Nov. 18) of the Therol water heater, which aims to secure 100 per cent load-factor customers for central stations, and which is being introduced in some British central stations. The Therol Company has now opened a New York office in the Hudson Terminal Buildings, 30 Church Street, where the apparatus is on exhibition.

Briefly, the Therol system is based on heat storage. The apparatus consists of an iron block, cylindrical in shape, enclosing a removable heating unit, a coil for producing superheated steam being imbedded in the block. When current is desired for lighting or other domestic uses it is automatically switched off from the heater, so that the load factor remains constant.

The apparatus has been in use for several months in British central stations, where special rates have been given, bringing the price of energy down to about a fifth of the ordinary rate for lighting. Auxiliary appliances are connected which provide for instantaneous boiling water at any time of day, and for other domestic purposes.

The standard size heater consumes 300 watts continuously, and is capable of producing 40 gal. of water at 100 deg. Fahr. in 24 hours. In case the apparatus is not used for lighting it can be automatically cut out during the station peak through the operation of a time switch which requires winding once in three months.

Among the arguments for the Therol system is that whereas up to the present time no system of heating or cooking by electricity has been devised which would not have to be considered as having an appreciable effect on the peak, the heat stored up by the Therol apparatus can be used for hours after the current which produced it is turned off, so the central station is in the morning perhaps, or even at dead of night, producing current which will be turned into heat for cooking or water heating during the afternoon and evening.

The cooking apparatus follows the same principles as the water heater described in former articles, and includes an auxiliary water heater if desired. The current consumption for an ordinary cooker is approximately 100 watts, as once the iron block is thoroughly heated it is only necessary to maintain the requisite temperature. In the cooker the iron heat-retainer is built around an oven-like chamber of firebrick, in which all cooking—boiling, roasting, etc.—may be done save broiling. An insulated table hung on counterweights forms the bottom of the cooker. On this are placed the articles to be cooked. The table is placed in position and requires no further attention until the cooking is completed.

There are no switches to be watched under the Therol system, as the whole current-supplying apparatus is automatically regulated. The heating units are in sections, and as soon as current is demanded for lighting or ironing as many heat units are disconnected as necessary, the current then being used for other purposes. When the lights are turned off the current is automatically taken up again by the heating units.

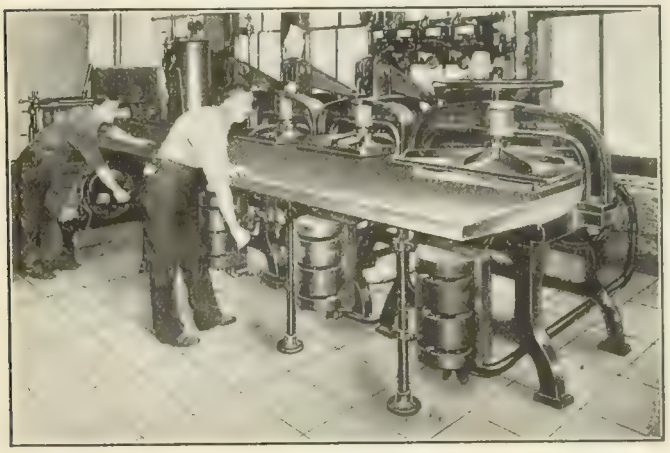
With a combined water heater and cooker the temperature of the cooker can be adjusted to any desired degree. The cooker is equipped with a thermostatic switch, which introduces current into the cooker's heating units in sufficient quantity to keep the iron block at a predetermined temperature, which current is drawn from the water heater's constant supply. In case a higher temperature is desired in the cooker than that indicated by the thermostat—for quick cooking, for example—the thermostat can be switched off and all available current introduced into the cooker, the water heater in the meantime, of course, consuming no current, thus maintaining the central station's 100 per cent load factor.

An important factor in the Therol system is the small amount of current constantly demanded. It is therefore possible to have a complete heating and cooking outfit in a residence without increasing either the size of services, the capacity of the station or the cost of producing current, save for fuel.

Electric Matrix-Drying Table.

In the daily race against time in the newspaper office, during the last hurried minutes before the paper is put to press, no appliance recently added to the printing-plant equipment has worked such practical improvement in speed, reliability, convenience, cleanliness and in comfort as the electric matrix-drying table.

With it, "mats" are dried in one-half to one-third the time required by older methods. The close control of the electric heat enables the temperature to be held accurately at the desired point. The controllers are mounted on brackets beneath the bed of the machine, convenient of access to the workman.



MATRIX-DRYING TABLE.

A very large number of temperature gradations is available. The temperature is shown by an electrical thermometer, the indicator of which is mounted upon an adjacent wall or firm support.

The superior economy of electric matrix driers over those heated by steam, gas or other means, lies in the possibility of applying the heat directly to the work, the other parts of the bed being thoroughly insulated against radiation and conduction losses. As a result of this isolation of the heating element, the temperature of the stereotyping room is much reduced, and since its atmosphere is not devitalized from supporting combustion as with the gas-heated table, an improvement in the comfort, health and work of the operators has been many times demonstrated as the result of the coming into the market of the electric matrix drier.

Combined with the greater pressure possible with the use of compressed air supplanting the effort of the hand-wheel, the high temperature of the electric hot-bed results in the production of matrices of greater sharpness and depth, and of superior printing quality. As noted before, the time of drying can be cut to one-half that of any other process, the actual amount depending, of course, on the quality of the work to be done. It is possible, however, to thoroughly "bone-dry" a matrix in less than two minutes, a speed of operation before considered impossible.

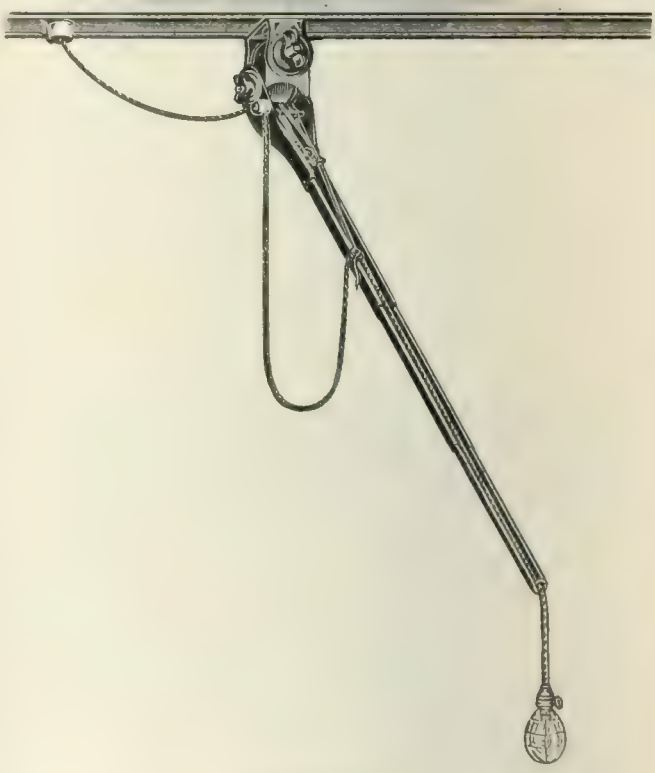
These electrically heated matrix-drying tables, for hand or compressed-air pressure, as manufactured by the F. Wesel Company, 70-80 Cranberry Street, Brooklyn, N. Y., employ the well-known Westinghouse heating elements. They are in the service of some of the most progressive newspapers of the country, and have greatly improved the conditions usually found in the stereotyping rooms, besides effecting an important saving in the time of preparing the plates for the various editions.

The resistance used has proved thoroughly reliable and permanent, and the expense of electrical operation with the Westinghouse heating element is unquestionably lower than by any other method, aside from its important advantages of temperature and convenience.

For use where the element of time is not so important in drying the matrix, a slower type of heating bed is supplied. Complete with heating elements, this bed is only 2 in. in thickness and is designed to be placed directly on the steam-heated bed, making a convenient source of heat quickly available without the delay or difficulty of resorting to steam heat. These electric beds for slow drying perform their service in about the same time as the gas or steam-heated beds, and with the same economy of the quick-drying unit.

Lamp Adjuster.

The Frantz Specialty Manufacturing Company, of Sterling, Ill., is the manufacturer of the lamp adjuster, the design of which is shown in the accompanying engraving. This device provides for automatically taking up the slack in the cord and keeping it out of the way of machinery and workmen. It is made of pressed steel and the arm telescopes in three sections. The weight is less than 4 lb. Three sizes are made, namely, 6 ft., 8 ft. and 10 ft. to accommodate different heights of ceilings. The 6-ft. length is suitable for a ceiling 12 ft. in height and will adjust a lamp to any size within a radius of 3 ft. horizontally and 5 ft. vertically. In addition to the telescoping of the device, which gives considerable vertical adjustment, the lamp cord can be pulled out beyond the end of the adjuster. The slack in the cord is always taken up by a drum around which winds a clock cord attached to the lamp cord as indicated in the engraving. This drum has a spring which keeps



LAMP ADJUSTER.

the cord in tension, but it is prevented from pulling the lamp and lamp cord up by a brake which works against the drum at all times except when a person wishes to adjust the lamp. Raising on the lamp or cord releases the brake sufficiently so that the drum winds up the slack. The device has a universal joint at the ceiling so that the arm can be handled in any position and will remain there if the tension on the set screws is properly adjusted. A feature of the device is that it does not abraid or kink the lamp cord. The winding drum makes a much longer range of adjustment possible without an objectionable amount of cord hanging in the way when the lamp is at its higher adjustment.

High-Tension Entrance Tubes.

One of the important features in high-tension transmission systems is the method for bringing high-tension conductors into the station. Appreciating the demand for a reliable, convenient method, the Central Electric Company, Chicago, Ill., is placing on the market the type of entrance tube illustrated.

Fig. 1 shows an entrance tube designed for capacities up to 300 amp at 13,200 volts. This device consists of three elements, a pair of highly glazed porcelain disks, a specially designed porcelain tube and a copper conductor extending the entire length of the tube. The horizontal tube is securely fastened to the supporting disks, forming a self-contained unit substantial in construction and easy to install. The copper core is provided with terminal lugs at both ends to which the line conductors are soldered.

The construction adopted insures a weatherproof, air-tight structure with a permanently high insulation factor, and which effectually excludes rain and snow. Another feature of this

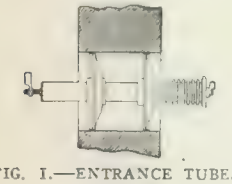


FIG. 1.—ENTRANCE TUBE.

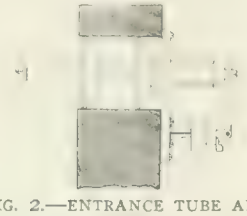


FIG. 2.—ENTRANCE TUBE AND DISCONNECTING SWITCH.

entrance tube is that it does not afford a location for bird's nests, as is more or less common with the open type of entrance. The closed construction likewise prevents insects from getting into the station.

The use of high-tension disconnecting switches is rapidly increasing, especially as their value and flexibility are being recognized. To meet the demand for a combined entrance tube and disconnecting switch the combination shown in Fig. 2 has been developed. This disconnecting switch is mounted on a 2-in. marble slab, which in turn is secured to the station wall.

By the use of this combination, the high tension can not only be safely brought into the building, but when found desirable, or necessary, the circuit can be absolutely "killed" at this point. These new entrance tubes are convenient from a construction standpoint in that it is simply necessary to leave a circular hole of the proper diameter, and after all work is completed the entrance tube can quickly be cemented in place. The construction adopted eliminates skilled labor and the personal equation, as but one thing has to be done—to place the device in position and cement the edges.

Exhibits at Chicago Telephone Convention.

At the convention of the International (now the National) Independent Telephone Association in Chicago on Dec. 7 to 9 there was the usual display of telephone apparatus in rooms at the Auditorium Hotel near the convention hall. The Automatic Electric Company, of Chicago, displayed both automatic and semi-automatic apparatus for straight-line, meter, four-party and district service, as well as a manual straight-line service. The company makes the statement that a recent canvass of subscribers having both manual (Bell) and automatic telephones showed that over 90 per cent of them were in favor of the automatic system. Particular attention was directed to the automatic traffic distributor in connection with manual equipment, designed to secure greater efficiency in manually operated telephone plants. The gentlemen in charge of this interesting exhibit included Messrs. John Meyer, W. F. Benoist, John Fisher, C. L. Fisher and John Russell.

The Kellogg Switchboard & Supply Company, of Chicago, had a large number of representatives, including Messrs. J. C. Kelsey, L. R. Foote, A. S. Hallstrom, H. N. Faris, E. G. Lawrence, G. A. Joy and J. C. Murray. The company demonstrated late ideas in ringing equipment, private-branch-exchange equipment, double supervisory, non-interfering cord circuits for magneto switchboards, and also made a representative display of apparatus and parts. It furnished automobiles to take visitors to its West Side factory.

The Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., showed a full line of central-energy telephone instruments and switchboards. New types of instruments were shown, as was also a good display of intercommunicating apparatus. Messrs. W. Roy McCann, H. C. Slemin, A. Kondolf, A. M. Haubrich and others were in attendance.

The Swedish-American Telephone Company, of Chicago, showed a general line of telephones, switchboards and accessories. The radio desk telephone holder attracted particular attention. Messrs. E. B. Overshiner, A. V. Overshiner, Fred Seeley and W. O. Rhode with others represented the company.

The American Steel & Wire Company made an exhibit of such of its products as are of particular interest to telephone men, including copper, iron and steel wire, galvanized messenger strand, Crosby clips, pole steps, rubber-covered wire, etc. Messrs. Conkling, Durant, Ryder and Moeller received visitors at this exhibit.

The Holtzer-Cabot Electric Company, of Boston, had some interesting apparatus, including a multicycle set for harmonic ringing and a four-frequency vibrator which does the same work as the machine. There were also pole changers, frequency meters, both stationary and portable watchmen's clocks, desk stands and wall telephones, flexiphone, mine telephones, intercommunicating sets, ringing and charging motor-generator sets, annunciators, electric drills and small motors, both alternating-current and direct-current, for all purposes. Messrs. E. R. Harding, C. I. Hickman, F. H. Tillotson and T. G. Minema, of the Chicago office, were in charge.

Frank B. Cook, of Chicago, made a practical display of useful appliances, including protectors, cable terminals, wire joints, guy clamps, etc. Mr. Cook, himself, with Mr. J. F. Tompkins, explained the use of the appliances exhibited.

Mr. J. R. Wiley, of Chicago, represented the Standard Under ground Cable Company of Pittsburg.

One of the new instruments shown at the convention was the telechronometer exhibited by the Telechronometer Company, of Rochester, N. Y. This is a time meter to record the time a telephone is used in measured service. By the use of the instrument a dial at the subscriber's station indicates the elapsed time. By an ingenious arrangement it is provided that if another subscriber listens in on a party line the meter of the eavesdropper will also register the time elapsing while he is listening in. In general, it is intended that the telechronometer shall perform a service in the telephone service akin to that of the watt-hour meter in the electric lighting and power field. It is adapted to the service of both the producer and the consumer. Messrs. Winslow Mead, of Albany, and Garrison Babcock and George Dickerson, of Rochester, were active in furthering the interests of this company.

Mathias Klein & Sons, toolmakers, of Chicago, represented by Mr. P. W. Herbst, distributed souvenir memorandum books.

The new Telephone Fire Insurance Exchange of Chicago, the co-operative insurance organization indorsed by the association, gave neat keyrings to delegates. Mr. J. B. Hoge was in charge of affairs.

The Indiana Steel & Wire Company, of Muncie, Ind., showed iron wire. Mr. E. F. Kitselman was the representative.

The Fibre Conduit Company, of Orangeburg, N. Y., exhibited a full line of fibre conduit and fittings. Messrs. W. W. Smythe, Jr., and H. M. Huffard, of the Chicago office, represented the company.

The American Electric Telephone Company, of Chicago, which has lately enlarged its force by the acquisition of Mr. W. E. Doolittle, well known in the telephone field, had a good display of switchboards, telephones and parts. The Dean Electric Company, Elyria, Ohio; the Monarch Telephone Manufacturing Company, of Chicago; North Electric Company, of Cleveland; Mungesser Electric Battery Company, of Cleveland, and others also made exhibits.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Cold weather and the near approach of the holiday trade did something to stimulate retail business during the past week. This was more particularly noticeable in the West and Northwest than in other sections of the country, although even throughout the South distribution to consumers was accelerated. The greatest improvement was noticeable in the cities of some size, as the impassable condition of country roads did something to retard business at county seats. The strike situation in the Northwest appears to be losing its effectiveness. The flour output and the movement of grain were noticeably better during the past week. It is generally expected, however, that requests for higher wages from all railroad employees will be presented during the spring. In fact, there is evidence of unrest among all classes of skilled labor, a condition undoubtedly due to the fact that the cost of living has advanced more rapidly than the scale of wages. In the industrial world there are still heard only reports of improvement and large orders. The necessity for supplying the demand for steel has caused quite a movement in the direction of building more open-hearth furnaces. Orders, particularly for railroad material and for structural iron, continue to be phenomenally large. The mills engaged in these manufactures have their books full of orders for many months to come. Collections were rather less free last week, due possibly to the labor troubles in the Northwest and to a disposition in the South to hold cotton for even higher prices. Failures for the week ended Dec. 9, as reported by *Bradstreet's*, were 259, against 230 the previous week, 298 in 1908, 284 in 1907, 220 in 1906, and 226 in 1905.

THE COPPER MARKET.

There was a distinctly better tone in the copper market during the past week, although there was very little increase in the actual sales of metal. There seems to be a general acceptance of the proposition that, whether the great merger is formed or not, something will be done to limit the production of copper, and thereby to control the price. This is really all that interests the outside copper traders. The present unsatisfactory conditions of the market are entirely due to the adverse statistical position. With production outrunning consumption by 20 per cent, it is impossible to maintain perpetually the price of metal. While there is every reason to believe that the big amalgamation will eventually go through, even if it fails the market conditions will be improved. This situation is the result of the change in the control of the Amalgamated Copper Company. As long as H. H. Rogers was alive, no unity of interest seemed possible. The Cole-Ryan influences are operating upon exactly the opposite basis. The figures of the Copper Producers Association for November show a production of 121,618,369 lb., the highest average daily production ever known. Deliveries were 122,124,468 lb., making an apparent reduction in stocks of 506,099 lb. At the end of the month the surplus on hand in this country amounted to 153,003,527 lb. During the month of November the total visible supply in this country and Europe increased 13,796,301 lb., and on Dec. 1 was 389,861,127 lb. Exports for the present month, including Dec. 14, have been 9,336 tons. The daily call on the Metal Exchange Dec. 14 quoted standard copper as follows:

	Bid.	Asked.	Settling price.
Spot	13.00	13.25	
December	13.00	13.25	13.12½
January	13.12½	13.37½	13.25
February	13.12½	13.37½	13.25
March	13.12½	13.37½	13.25
April	13.12½	13.37½	13.25

The London prices on Dec. 14 were as follows:

	Noon. £	s	d	Close. £	s	d
Standard copper, spot	60	5	0	60	5	0
Standard copper, futures	61	5	0	60	5	0
Market	Firm			Steady		
Sales of spot				400 tons		
Sales of futures				100 tons		

Extreme fluctuations for this year:

	Highest. £	s	d	Lowest. £	s	d
London, spot	64	5	0	£54	12	6
London, futures	64	17	6	55	10	0
Standard	13	15	0	12	12½	0
London, next quoted	67	15	0	59	0	0

NORTHERN COLORADO POWER COMPANY.—Very encouraging reports of increased business are being made by the Northern Colorado Power Company. On Dec. 31, 1908, the company showed a deficit of about $30,000; the officials now estimate that on the same date 1909 the company will show a surplus of about $35,000, showing an improvement of $65,000 in the year. They are also confident that the surplus for the year 1910 will be above $100,000. The Northern Colorado Power Company is a combination of practically all the small power plants in the northern part of the State of Colorado, including all of the larger towns. After the consolidation a bond issue was made, and the money from that bond issue spent on the properties has brought about the improved condition. The relations of the company with the Denver Gas & Electric Company are very close, W. J. Barker, superintendent of the latter company, being president of the Northern Colorado Power Company. The country served by this company is being rapidly developed. One of the principal drawbacks to it heretofore has been the lack of water, but it has now been demonstrated that excellent water for domestic purposes, and possibly for irrigation, is available at an average depth of 30 ft. There is a fine field open for the sale of power in pumping this water.

MEETING OF THE ELECTRICAL JOBBERS.—The Electrical Jobbers' Association held a successful convention at Hot Springs, Va., last week. There were present between 200 and 300, and much benefit resulted from the intercourse and interchange of ideas and from several papers that were read and discussed before the meeting. The gathering was more of a social than a business nature. Similar meetings are held at infrequent intervals throughout the year and have a tendency to bring into closer relationship the supply dealers, jobbers, manufacturers and contractors of the country.

ELECTRIC DRIVE IN WOOLEN MILLS.—The Ayer Mills of the American Woolen Company, at Lawrence, Mass., which have been designed by Mr. Charles E. Main, mill engineer, of Boston, Mass., are now well under way. Two mill buildings, one of six stories in height and 600 ft. x 125 ft. area, and another of 330 ft. x 125 ft. area and seven stories in height, are now closed in and work is being pushed on the power station, which will have an initial capacity of 5000 kw, made up of two 2500-kw units. The entire mill installation will be electric-driven.

THEROL ELECTRIC HEATING AND COOKING SYSTEM.—Messrs. James Lawrence and J. L. Nicholson, of London, have taken an office at 30 Church street, which has been fitted with an equipment to demonstrate the merits of the Therol system for electric heating and cooking, which has attracted much attention in Great Britain since its introduction there some months ago. The system is one of heat storage, which, if generally adopted, would enable a central station to operate at 100 per cent load factor.

PIEDMONT ELECTRIC COMPANY, ANDERSON, S. C., which started business five years ago, has decided, it is reported, upon the dissolution of the company, as additional stock is required to carry out the company's plans, and it is not deemed advisable to issue such at this time. The company will, it is expected, wind up its business by Jan. 1.

CHESTER, S. C., PROPOSED ELECTRIC RAILWAY.—A report from Chester S. C., says that the advisability of constructing an electric line from Chester to Great Falls, via Richburg and Lands, S. C., is being agitated. The principal power plant of the Southern Power Company is located at Great Falls, S. C.

SUPPLIES FOR ISTHMIAN CANAL.—Bids will be opened Dec. 23 by the Isthmian Canal Commission for supplies which include a variety of electrical switches, fuses, magneto bells, fuse links, wire fixtures, rubber-covered wire, etc.

McCALL FERRY POWER COMPANY.—The sale of the property of the McCall Ferry Power Company under foreclosure, which was announced in last week's issue, practically relieves that organization of all its financial troubles and insures reorganization according to the plans originally adopted by the bondholders. The purchaser of the property was William M. Barnum, chairman of the bondholders' reorganization committee. This committee represents every outstanding bond, so that the reorganization is unanimously approved. It is probable that the new company which was formed to take over the property will be called the Southern Pennsylvania Power Company. It will have an authorized issue of $12,500,000 of 5 per cent bonds and $8,500,000 of stock. The old bondholders, according to the plan, are to receive 40 per cent in new bonds and 60 per cent in new stock for their holdings. At the present time about 300 men are at work upon the construction of a dam and power house on the Susquehanna River. The Empire Engineering Corporation is in charge of this construction work. A representative of that company says that the dam will be completed, practically, some time early in the winter, with the exception of 14 40-ft. openings. It is expected that these will be closed some time in the spring. The power house will be sufficiently completed early in January to be ready for the installation of machinery. The hydraulic machinery will be furnished by the I. P. Morris Company, Philadelphia, and the electrical apparatus by the General Electric Company. It is eventually contemplated that there shall be 10 wheels and generators, with a peak-load rating of 13,500 hp for each wheel. The initial installation will probably be not more than five of these wheels. In this connection, there has been some uneasiness felt in Baltimore lest the power company change its plans, which are now to sell energy in that city. The only information concerning this to be obtained from representatives of the company is to the effect that definite arrangements for the disposal of energy have not yet been made. It is stated, however, that no plan to abandon Baltimore has been decided upon.

WASHINGTON, BALTIMORE & ANNAPOLIS ELECTRIC LINE.—Economies which are being practised by the receivers of the Washington, Baltimore & Annapolis Electric Line will, it is stated, save the road a large amount in operating expenses next year, and it is believed that this, together with a reduction of expenses which will result from the installation of the direct-current system, will aid materially in the rehabilitation of the property. Recently the general passenger agent's department has been consolidated with that of the treasurer of the road, and there has also been a revision of the mechanical department which will result in a further reduction of operating expenses. The plan of economy is being instituted without impairing the efficiency of the road. The receivers are seeing to it that the property is being well maintained, their idea being to keep it in the best physical condition in the future. The new equipment which is to be operated under the direct-current system will be in service about Feb. 1. Five of the new cars have already arrived and are being fitted up at the shops of the company located at Annapolis Junction. More equipment will be delivered about the first of the year. It has been estimated that the operating of this new equipment under the direct-current system will reduce the expenses of the Washington, Baltimore & Annapolis over $100,000.

ATHENS, GA., PROPOSED HYDROELECTRIC DEVELOPMENT.—A company is to be formed for the development of an estimated 4000-hp water-power on the Oconee River, near Athens, among those interested being Capt. James White, J. Y. Carithers and others, of the Athens electric railway system. The power generated will be utilized in operating an addition to the Star Thread Mills at Barnett Shoals, on the Oconee, doubling the mill's capacity, while power will also be developed for a new $500,000 cotton mill to be erected. The total development will represent over a million dollars. Extensions to the Macon street railway system will furthermore be supplied with power from the new hydroelectric development, which will be one of the largest in this section of Georgia.

SEVEN-MILE HYDROELECTRIC TUNNEL.—It is reported that the engineering work which is being promoted in San Francisco by H. V. Gates, of Oregon, has no equal in the Pacific Northwest. The project is to drive a tunnel 7 miles long, tapping Pitt River and cutting off 21 miles of the rapid stream. The fall is 100 ft. to a mile and will furnish one of the biggest electric systems this side of the Rockies. He claims that when completed they will take to San Francisco 200,000 hp at a cost of not to exceed $10 per hp per annum. John Hays Hammond has, it is stated, an option on the proposed system, and is taking the survey to New York. It is estimated that the system will cost $12,000,000.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in our present issue are announcements of proposed new plants or considerable extensions of present plants at Pittsfield, Mass.; Leavenworth, Kan.; St. Joe, Idaho; Wellsboro, Pa.; Charleston, S. C. Morgantown, W. Va.; Northfield, Vt.; Slater, Mo.; Winchester, Tenn.; Sabetha, Kan.; Taunton, Mass.; Pensacola, Fla.; Apache, Okla.; Richmond, Va.; Savannah, Ga.; Wichita, Kan.; Sturgis, Mich.; Haskell, Tex.; Guanajuato, Mex.; Vancouver, B. C., Can.; Millvale, Pa.; Athens, Ga.; Lyons, Col.; Colorado City, Col., and Phœnixville, Pa.

ROME, GA., HYDROELECTRIC PLANT.—The Stewart Morehead Company, of Savannah, has purchased the plant of the Raccoon Cotton Mills, at Raccoon, north of Rome, and a stock company will be formed to carry out the company's plans to develop an available water-power where electricity will be generated to run the mill and to sell to nearby towns and consumers for lighting and other purposes. The machinery of the Raccoon mills will be changed, the plans calling for a 5000 spindle mill.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—W. C. Webster, the sales manager of the New York office of the Westinghouse Electric & Manufacturing Company, has resigned his position, to take effect Dec. 15. He will be succeeded by Walter S. Rugg, who has been connected with the general engineering department and in charge of the sales department of large lighting interests. Mr. Webster has been with the Westinghouse Electric & Manufacturing Company for about 12 years. He is not ready to announce his future plans at this time.

MERGING OF BELT-CONVEYOR COMPANIES.—It is announced that a rearrangement of the management of the Robins New Conveyor Company has been effected, and a merger of that company will shortly take place with the Robins Conveyor Belt Company. At the meeting of stockholders of the company the following were elected as the board of directors: J. I. Atterbury, C. Kemble Baldwin, Harold Binney, H. J. Cook, Pierre Jay, Alvin W. Krech, Thomas Robins and Albert C. Wall.

RAILROAD ELECTRIFICATION AT CHICAGO.—The railroads have informed the local transportation committee of the City Council that the Illinois Central is the only road which has seriously considered electrification, and that it has decided that the electrification of freight terminals is impracticable. The proposition was considered with a view to the third rail and also to overhead trolley. The railroad companies also informed the committee that they know of no fuel in which the smoke can be entirely eliminated.

BRITISH COLUMBIA 20,000-HP TRACTION POWER HOUSE.—General Manager R. H. Sperling, of the British Columbia Electric Railway Company, on his return from England on Dec. 7, announced that the directors had passed a $6,000,000 appropriation for improvements to the company's system. One large work to be immediately undertaken will be the erection of a 20,000-hp steam auxiliary plant in Vancouver.

TELEPHONES ON THE ILLINOIS CENTRAL.—The Illinois Central Railroad Company has now 2216 miles of its road equipped with telephones, extending from Chicago to Omaha, from Indianapolis to St. Louis, and also in the neighborhood of New Orleans. These telephones practically cover every mile of main track of the railroad.

B. R. T. LINE TO JAMAICA.—The Brooklyn Rapid Transit Company will soon start work on the construction of a new trolley line through Utica Avenue and Avenue N to Jamaica. The new line will be about four miles long, and will serve as an extension of the present Reid Avenue line.

HAMMON ENGINEERING COMPANY.—The Hammon Engineering Company, of San Francisco, which is interested in power development work, has recently been incorporated with a capital stock of $1,000,000 by W. P. Hammon, A. E. Boynton, N. Cleveland, C. U. Black and C. S. Goodrich.

IMPROVEMENTS AT ALLIS-CHALMERS PLANT.—The additions and alterations to the plant of the Bullock Electric Manufacturing Company in Cincinnati, referred to in these columns Nov. 11, consist of a new storeroom, additional story to shop No. 2, extension to foundry, impregnating house, crane runways to shops Nos. 1 and 3, increasing the boiler capacity and installing a new air compressor. The new storeroom will be 303 ft. long by 29 ft. wide, with a 2-ton, electric-travel, eight-crane runway the full length; shop No. 2 will have an additional floor, 303 ft. long by 100 ft. wide. The present impregnating plant located in shop No. 2 will be installed in a special building of fireproof construction, connected to the adjoining shops by an elevator and bridges. The extension to the foundry will be 200 ft. long by 103 ft. wide. These various buildings have concrete foundation walls, brick superstructure, steel columns, trusses, etc. In shop No. 3 there will be an additional electric-crane runway and mezzanine floor 200 ft. long. The boiler capacity will be increased with four 300-hp boilers. There will also be installed a steam-driven air compressor, with a capacity of 500 cu. ft. per minute.

WINNIPEG ELECTRICAL MACHINERY CONTRACT.—We are informed by the Power Construction Department of the city of Winnipeg, Man., that an item which appeared in these columns in the issue of Dec. 2, concerning the award of a contract for electrical machinery, is incorrect. No award was made to the company named, which did not bid on the machinery of the Winnipeg generating station, and tenders have not yet been called for the equipment of the terminal station. Our news was obtained from a Canadian correspondent, who reported the item from a Canadian newspaper.

PHŒNIXVILLE (PA.), VALLEY FORGE & STAFFORD ELECTRIC RAILWAY COMPANY.—A company which was recently organized in Pennsylvania, known as the Phœnixville, Valley Forge & Stafford Electric Railway Company, has perfected plans for building a 10-mile electric line from Phœnixville to Stafford. The power plant and repair shops will be located at Valley Forge.

ROME WIRE COMPANY.—The Wire & Telephone Company of America, Rome, N. Y., will after Dec. 14 be known as the Rome Wire Company. In announcing the change of name the company states that the adoption of the new name was prompted by the fact that its manufacturing facilities are devoted exclusively to the manufacture of electrical wires, while pride in the industrial growth of Rome also entered as a factor.

CHICAGO, PEORIA & ST. LOUIS RAILWAY.—Plans are being prepared to change the motive power of the Chicago, Peoria & St. Louis Railway Company, known now as the "Bluff Line," from steam to electricity. The company is now in the hands of a receiver, but it is understood that it will be taken over by a syndicate of Illinois capitalists and converted into an electric line. The road is about 200 miles in length.

SAVANNAH (GA.) HYDROELECTRIC CONSTRUCTION COMPANY.—A new organization has been formed at Savannah, Ga., entitled the Savannah Hydro-Electric Construction Company, which proposes to construct a hydroelectric power plant on the Connooche River, 40 miles from Savannah. The capital stock of the new company is $300,000.

ELECTRIFICATION IN OAKLAND, CAL.—The Southern Pacific Railroad Company, through the name of the Central Pacific, has applied to the Board of Supervisors of the city of Oakland, Cal., for permission to equip about four miles of its track with electricity and also for a 50-year franchise to operate a double-track railway from Melrose to Stanley Road.

Financial Intelligence.

THE WEEK IN WALL STREET.

The moderate trading last week in Wall Street was of healthy tone and conservative temper. The business-like message of President Taft had a reassuring effect in the financial world, and, while it was followed by no particular boom in securities, there were general advances in the market, and legitimate buying was in evidence all through the list. The physical conditions of trade, of the industries and of the railroads are so satisfactory that there is no reason for Wall Street to be alarmed. During the spring and summer the prices of securities were pushed entirely too high to be on a parity with the condition of business. For the past two or three months the stock market has paused, and has been permitting commercial business to catch up. It is not likely that there will be soon any speculative movement which will carry prices far out of line. The demands of trade have stiffened up the money market to a position where speculation is not as easy as it was six months ago. The Wall Street prospect for the immediate future is for fair business upon a conservative basis. During the past week the money market, both at home and abroad, has been entirely satisfactory. Foreign banks have shown no disposition to increase rates of discount, and loans have been made by American bankers at about the same old level. Rates for money Dec. 14 were: call, 4@5 per cent; 90 days, 4¾ per cent. The quotations in the table are those of the close, Dec. 14.

NEW YORK.

	Dec. 6.	Dec. 14.	Shares sold.		Dec. 6.	Dec. 14.	Shares sold.
All.-Ch.	15½	15½	2,800	Int.-Met.,pfd..	58¼	61⅝	98,550
All. Ch., pfd.	55¼	53¾*	2,925	Mackay Cos..	92½	91½	1,100
Amal. Cop...	86¼	88⅛	184,600	MackayC.,pfd.	77⅛	76¼	700
Am. D. T....	20½*	20½*	———	Man. Elev....	139⅛	140½*	632
Am. Loc.....	60¾	61¾	4,850	Met. St. Ry..	23*	23*	1,563
Am. Loc , pfd.	114¾	114	305	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	83*	80	———	Steel, com....	89⅜	91⅞	723,320
Am. T. & T..	140	143	37,381	Steel, pfd....	124½	125½	7,770
B. R. T.....	81⅞	80¼	83,485	W. U. T.....	78¼	78½	9,530
Gen. Elec....	160	160½	3,000	West'h., com.	84½	84	5,400
Int.-Met.,com.	24⅜	24⅜	115,685	West'h., pfd..	134*	135*	300

PHILADELPHIA.

	Dec. 6.	Dec. 14.		Dec. 6.	Dec. 14.
Am. Rys.	45⅛*	47	Phila. Elec.	13½	13½
Elec. Co. of A.	12⅜*	12⅜*	Phila. R. T.	27½	28⅛
Elec. St. B'ty.	57	57¼	Phila. Trac.	88½*	88¾
E. S. B'tv. pfd.	30*	30*	Union Trac.	53¾	52½

CHICAGO.

	Dec. 6.	Dec. 14.		Dec. 6.	Dec. 14.
Chi. City Ry.	180*	180*	Chi. Tel. Co.	135	136
Chi. Rs., Ser. 1.	98*	100	Met. El., com.	17*	18
Chi. Rs., Ser. 2.	30¾	30	Met. El., pfd.	51½	56
Com. Edison.	117	118	Nat'l Carbon.	97½	105
Chi. Subways.	4½	5⅛*	Nat'l Car., pfd.	120*	123*

BOSTON.

	Dec. 6.	Dec. 14.		Dec. 6.	Dec. 14.
Am. T. & T.	140⅛	143⅛	Mex. Tel.	2¾*	2½
Cum. Tel.	145⅞*	145⅞*	Mex. Tel., pfd.	6*	5½
Edison E. Ill.	250	250	N. E. Tel.	134¾	136¼
Gen. Elec.	160½	160⅞*	W. T. & T.	12*	12
Mass. E. Ry.	15½	15⅞	W. T. & T., pfd.	90*	89½
Mass. E. R., pfd.	76¼	77½			

* Last price quoted.
Shares sold are for week of Dec. 6 to Dec. 11.

COPPER COMPANIES, CONSOLIDATED.—Arrangements for the merger of the Nevada Consolidated Copper Company, the Utah Copper Company and the Boston Consolidated Copper Company have been practically completed, and official announcement giving the terms of the deal is expected at any time. These three companies have a production of close to 150,000,000 lb. of copper per year, and the earning power of the merged company, based on 15-cent copper, will be about $10,000,000 a year. It is stated that this consolidation is the first step toward an amalgamation of the Cole-Ryan, Guggenheim and Amalgamated properties. Samuel Untermyer, attorney for the Boston Consolidated Copper Company, declares that the present merger has no connection with the more extensive consolidation that is being discussed. It is stated that the promoters of the great consolidation laid their plans before President Taft last week and succeeded in convincing him that the proposed merger would not be in violation of any law.

RUMOR OF STANDARD OIL IN TELEPHONE COMPANIES.—It is rumored in Pittsburgh that Standard Oil Company interests have financed the merging of the independent telephone companies of Pennsylvania and the Central West into the Continental Telephone & Telegraph Company, which was recently incorporated in New Jersey with a capital of $50,000,000. These reports originated from the fact that John G. Splane, vice-president and general manager of the Pittsburgh & Allegheny Telephone Company, one of the principal properties which have gone into the merger, was formerly an official in the Standard Oil Company and has always been closely identified with Standard Oil interests. His brother, W. W. Splane, for a number of years was general manager of the telegraph department of the Standard Oil Company, and it is also pointed out as significant that wherever the Standard Oil Company has obtained the right to lay pipe lines, it has also obtained the right to erect poles along the same right-of-way.

CENTRAL COLORADO POWER COMPANY MORTGAGE.—A second mortgage, aggregating $1,350,000, has been filed in Denver covering the real estate and chattels of the Central Colorado Power Company. It is drawn in favor of the Knickerbocker Trust Company of New York. The mortgage runs until 1929 and bears 5 per cent interest.

JAMESTOWN, N. Y., CENTRAL-STATION PROPERTY SOLD.—Following the recent special taxpayers' election in Jamestown, N. Y., at which the voters rejected the proposal to purchase the Jamestown Lighting & Power Company, comes the announcement that the capital stock, franchise and property of that company have been sold to A. N. Broadhead and associates, who control the Chautauqua Traction Company and the Jamestown Street Railway Company. The price paid was $90,000, which was the sum for which the plant was offered to the Board of Lighting Commissioners of Jamestown, to be incorporated with the municipal plant, but which the taxpayers refused to pay by a small majority. The company has a 50-year franchise, granted about 23 years ago. It is possible that by combining the electric light and power service with the street railway a sufficient demand for electricity may be created in Jamestown to make it profitable to use power transmitted from Niagara Falls. The Niagara power is already transmitted to Dunkirk, and if brought into Jamestown it will be delivered to the Chautauqua Traction Company's station at Mayville and there reduced in voltage for distribution throughout Jamestown. Ultimately the two local plants will be combined in the street railway power house near the boat landing in Jamestown. The Jamestown Light & Power Company is the successor of a company organized in 1887. The business progressed satisfactorily for a number of years, but declined after the establishment of a municipal plant. However, the company was reorganized, and of late years the business has considerably increased. A majority of the stock and bonds of the company was held by the United Electric Securities Company, of Boston.

WESTERN UNION TELEGRAPH COMPANY.—At the meeting of the directors of the Western Union Telegraph Company last week, the majority of the Gould representatives were retired from the board, and their places were filled by men representing the American Telephone & Telegraph Company. This is the natural sequence of the purchase of the Gould holdings by the big telephone company. The only members of the old régime who remain on the board are George J. Gould, Edwin Gould and J. J. Slocum, the latter representing the Russell Sage interests. Robert C. Clowry, the president of the company, remains on the board. The new directors elected were: Theo. N. Vail, president American Telephone & Telegraph Company; Edward J. Hall, vice-president American Telephone & Telegraph Company; Henry S. Howe and John I. Waterbury, directors American Telephone & Telegraph Company; Union H. Bethel, president New York Telephone Company; Henry B. Thayer, president Western Electric Company; Henry P. Davidson, of J. P. Morgan & Company; Robert S. Lovett, Harriman Estate; William H. Moore, United States Steel Corporation, and Robert Winsor.

QUEBEC RAILWAY, LIGHT, HEAT & POWER COMPANY.—The American Light & Traction Company has finally disposed of its holdings in the Quebec-Jacques Cartier Electric Company to the newly organized Quebec Light, Heat & Power Company. This practically completes the monopoly by the newly formed company of the public utilities in Quebec and the adjacent territory. The Cartier company was the last one to hold out against absorption. The underwriting of the bonds proposed to be issued by the new company has been very successful, there having already been underwritten $3,700,000 out of an issue of $4,000,000. Edward A. Evans, chief engineer of the Quebec Railway, Light & Power Company, has received instructions to prepare and revise the plans already made in connection with the building of the Quebec & Saguenay Railway from St. Joachim to Murray Bay. Mr. Evans is now engaged in making arrangements for the final survey and estimates for this work, which it is expected will be started next year.

CONTINENTAL TELEPHONE & TELEGRAPH COMPANY.—The business of acquiring control of independent telephone lines throughout the Middle West seems to be continued with fair success on the part of the Continental Telephone & Telegraph Company. Last week the new corporation acquired control of the American Union Telephone Company of Pennsylvania, which operates throughout the entire State of Pennsylvania, except in the cities of Philadelphia and Pittsburgh, and which also reaches over to New York, West Virginia and Maryland. This last acquisition gives the Continental company practically control of all the independent telephone lines operating east of the Ohio River from northern New York to West Virginia. John A. Howard, of Wheeling, who is president of the Continental company, is the active man promoting the merger of these enterprises. All of the officials of the new company are men who have been interested in independent telephone lines throughout Pennsylvania and West Virginia.

CHICAGO SUBWAY REORGANIZATION.—While all of the plans of the reorganization committee of the Chicago Subway Company have not as yet been announced, it is understood that the present $17,000,000 of bonds which are in the hands of the public will be converted into preferred stock, or into an income bond. In either case the new securities will be noncumulative as to dividends. In order to take care of the company's floating debt and to furnish capital to perfect the freight-carrying department, there will be a new first mortgage bond issued. The amount of these bonds will probably be about $13,000,000, and they will probably go to the Armour and Harriman interests, who are the chief holders of the floating debt. There is also proposed, in a tentative way, an assessment of $10 a share on the old stock. The members of the reorganization committee assert that with the proper financial basis the property could become a good earner.

SHAWINIGAN POWER COMPANY.—The stock of the Montreal Light, Heat & Power Company took on another upward trend during the past week on the Montreal Stock Exchange. It was reported that J. E. Aldred, president of the Shawinigan Water & Power Company, was to take the place of the late Mr. W. McLea Walbank on the directorate of the Montreal Power Company, thus emphasizing more clearly the close relations between the two companies, announcement of which was published Dec. 2. Messrs. R. Forget, M. P., and J. N. Greenshields, K. C., directors of the Montreal Power and Shawinigan Power companies, respectively, both deny that there is any intention, so far as they know, of completing a merger of the two companies.

CHICAGO UNITED RAILWAY COMPANY.—The first step toward the reorganization of the Consolidated Street Railway Company of Chicago, which is in the hands of a receiver, was taken at Springfield, Ill., last week, when a license was issued for the incorporation of the Chicago United Railway Company. This company was formed by the bondholders' committee of the Consolidated Company, and it plans to ultimately take over all of the old lines which are now known as the Yerkes properties. The nominal capital of the new company is $100,000, but this will be increased as necessity demands

PHILADELPHIA COMPANY STOCK DIVIDEND.—It was announced last week that the Philadelphia Company, of Pittsburgh, is about to issue at par, to both the preferred and common stockholders, 55,200 shares of common stock. This distribution of surplus was foreshadowed upon the ticker when transactions in the stock appeared Dec. 8. Sales were made at 103, a price which was 20 points higher than the last previous sale recorded in the stock exchange, which was in 1903.

SACRAMENTO VALLEY POWER COMPANY.—A deed of trust has been executed to the Central Trust Company, of San Francisco, Cal., by the Sacramento Valley Power Company, mortgaging the property to secure an issue of $500,000 of new bonds, the proceeds of which will be used for extensions and improvements. The company operates three power plants in Shasta County, California, with a system of transmission lines extending through the Sacramento Valley.

NEW ENGLAND TELEPHONE & TELEGRAPH COMPANY.—The report of the New England Telephone & Telegraph Company, which has just been filed with the Highway Commission of Massachusetts, shows gross earnings for the year ending June 30, 1909, of $11,031,289, an increase of $577,305. The net earnings were $2,724,816, an increase of $336,500. The number of stockholders were 3832, 89 per cent of whom live in Massachusetts.

BOSTON & EASTERN ELECTRIC COMPANY.—A petition has been filed with the Railroad Commissioners of Massachusetts by the directors of the Boston & Eastern Electric Company asking for such legislation as may be necessary to enable the company to construct a tunnel underneath Boston Harbor. The idea is to bring the proposed road into a terminal to be constructed under Post Office Square, in Boston.

PACIFIC TELEPHONE & TELEGRAPH COMPANY.—The Pacific Telephone & Telegraph Company, of San Francisco, had on Oct. 1 a total of 349,119 telephone stations, an increase of 31,607 stations since the first of the year. This is an increase of almost 10 per cent within nine months, and indicates how rapidly the company is growing.

INDEPENDENT TELEPHONE STOCK DEAL.—F. H. Goff, president of the Cleveland Trust Company, testified at a hearing in that city last week that he had taken options upon 19,000 shares of the stock of the United States Telephone Company to New York City and offered the block to officials of the American Telephone & Telegraph Company. These officials declined to purchase, but introduced Mr. Goff to a member of the firm of R. L. Day & Company, brokers, who agreed to buy the 19,000 shares. Mr. Goff says that a contract was made by which the purchaser would pay $40 a share for the common stock and $80 a share for the preferred stock. Mr. Goff said that he met in the office of Day & Company, James S. Brailey, Jr., who, it has been said, has recently acquired control of the United States Telephone Company. For several weeks there have been rumors that the Bell interests through the United States company had acquired control of the principal independent telephone properties in the Middle West. These rumors have been denied by Mr. Brailey.

ELECTRICAL UTILITIES CORPORATION.—The formation of a new holding company, known as the Electrical Utilities Corporation, which was announced in the last issue, gives to the General Electric Company four of these financial corporations. The new concern will have a capital of $7,500,000, and will be devoted almost entirely to the financing of electrical companies, rather than to the operation. In addition to the new concern, the General Electric Company now controls the United Electric Securities Company, of Boston, the Electrical Securities Corporation and the Electric Bond & Share Company, of New York. It is said that these financial companies have been of great service to the General Electric Company in enabling the manufacturing company to accept the securities of light, power and traction companies which were not prepared to pay for apparatus in cash, and to market them successfully.

INCREASE IN COMMONWEALTH EDISON COMPANY STOCK.—At the recent annual meeting of the Commonwealth Edison Company, of Chicago, as previously noted in these columns, the authorized capital stock of the company was increased from $30,000,000 to $40,000,000, the $10,000,000 of new stock to be issued at the discretion of the directors. The first installment of this new issue, $3,000,000, has now been announced by the directors. It will be offered to present stockholders at par on Feb. 1, each stockholder being allowed 10 per cent of present holdings. The first payment of 25 per cent for the stock will be due on that date, and remaining installments of equal size will be payable on May 2, Aug. 1 and Nov. 1, 1910.

RICHMOND, VA., MUNICIPAL PLANT BOND ISSUE.—Upon the recommendation of the finance committee of the city of Richmond, Va., the Common Council has voted an additional sum amounting to $65,000 to be used in the construction of the distributing system of the new municipal electric lighting plant, now in course of completion. This is in addition to $250,000 bonds, the proceeds of which are for paying for the electric plant proper, and $100,000 for water pumps to be electrically driven by power from the new power house. At the same meeting several minor contracts for parts of the electric system were approved. The total thus far authorized is $415,000.

JACKSON (MISS.) ELECTRIC RAILWAY, LIGHT & POWER COMPANY.—F. B. Trout and H. H. Corson, Nashville representative of the General Electric Company, together with some local capitalists, have taken over the plant and holdings of the Jackson Electric Railway, Light & Power Company. The price paid for the property was approximately $1,000,000. The company operates about seven miles of track and furnishes energy for electric street lighting. The General Electric Company, according to its officials, has nothing to do with the deal.

CONSUMERS' ELECTRIC COMPANY OF NEW ORLEANS.—Plans are being formulated by the bondholders of the Consumers' Electric Company of New Orleans for a reorganization to take the property out of the hands of the receiver. It is proposed that a new company be formed to take over the plant. The business of the company has increased under the administration of the receiver, and it is necessary to enlarge the plant, which, together with other improvements, will require an expenditure of about $1,000,000. Samuel Insull, president of the Commonwealth Edison Company, of Chicago, is receiver.

THIRD AVENUE RAILROAD COMPANY.—The stock of the Third Avenue Railroad Company sold as low as 12¼ on the exchange last week. This is taken to be a speculator's estimate of what the stock will be worth under the most recent reorganization plan. The latest plan proposes an assessment of $45 per share. It is said that the Interborough-Metropolitan Company practically sold out all of its holdings in the Third Avenue Company some time ago, when the price was much higher than it is at present.

COMMONWEALTH EDISON COMPANY.—It has been announced in Chicago that the Commonwealth Edison Company would sell $3,000,000 of the recently authorized $10,000,000 of new capital stock at par. This offering will be made to the present stockholders of the company on Jan. 20. Payments are to be made in quarterly installments. The balance of the authorized issue will be put out as the developments of the company require.

DIVIDENDS.

American Telephone & Telegraph Company, quarterly, 2 per cent, payable Jan. 15.

Butte (Mont.) Electric & Power Company, quarterly, 1½ per cent, payable Jan. 3.

Duluth-Superior (Minn.) Traction Company, quarterly, 1 per cent, payable Jan. 3.

Electrical Securities Corporation, semi-annual, 4 per cent, payable Jan. 3.

El Paso (Texas) Electric Company, semi-annual, 3 per cent, payable Jan. 10.

Manhattan Railway Company, quarterly, 1¾ per cent, payable Jan. 3.

Sao Paulo (Brazil) Tramway, Light & Power Company, quarterly, 2½ per cent, payable Jan. 1.

Toronto (Ont.) Railway Company, quarterly, 1¾ per cent, payable Jan. 3.

Twin City Rapid Transit Company, preferred, quarterly, 1¾ per cent, payable Jan. 2.

Union Railway Gas & Electric Company, quarterly, 1½ per cent, payable Jan. 3.

Union Traction Company, Philadelphia, semi-annual, 3 per cent, payable Jan. 1.

United Gas Improvement Company, Philadelphia, quarterly, 2 per cent, payable Jan. 15.

United Traction & Electric Company, Providence, R. I., quarterly, 1¼ per cent, payable Jan. 1.

Utah Consolidated Copper Company, quarterly, 10 per cent, payable Jan. 15.

Western Union Telegraph Company, quarterly, ¾ per cent, payable Jan. 15.

Wilkes Barre (Pa.) Gas & Electric Company, quarterly, 1¼ per cent, payable Jan. 1.

REPORT OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Boston Suburban Electric Companies:					
Year ended Sept. 30, 1909	[illegible]	[illegible]	$190,249	$146,382	$52,867
Year ended Sept. 30, 1908	[illegible]	[illegible]	177,222	35,339	141,883
Fairmount Park Transportation Company, Philadelphia:					
Year ended Oct. 31, 1909	[illegible]	[illegible]	73,654	49,400	24,254
Year ended Oct. 31, 1908	[illegible]	[illegible]	75,862	47,540	28,321
St. Joseph (Mo.) Railway, Light, Heat & Power Company:					
November, 1909	[illegible]	[illegible]	39,961	21,608	18,353
November, 1908	[illegible]	[illegible]	39,186	20,992	18,194
Schenectady Railway Company:					
Quarter ended Sept. 30, 1909	[illegible]	[illegible]	136,146	23,869	102,947
Quarter ended Sept. 30, 1908	[illegible]	[illegible]	95,158	26,780	63,670
United Traction Company, Albany, N. Y.:					
Quarter ended Sept. 30, 1909	[illegible]	[illegible]	241,557	94,732	163,859
Quarter ended Sept. 30, 1908	[illegible]	[illegible]	218,492	70,140	159,630
Westchester Electric Railroad Company:					
Quarter ended Sept. 30, 1909	[illegible]	[illegible]	49,876	14,970	35,069
Quarter ended Sept. 30, 1908	[illegible]	[illegible]	*14,153	17,549	*31,549

* Deficit.

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—The charter of the Birmingham & Gulf Railroad Company, recently incorporated, includes the privilege of operating street railway and general electric railway systems. J. M. Dewberry is first vice-president, and R. D. Johnston, Jr., secretary.

JACKSONVILLE, ALA.—Plans are being made for the construction of a large weaving mill in Jacksonville. The entire plant will be operated by electricity. George P. Ide and associates are interested in the enterprise.

BENSON, ARIZ.—The Benson Lighting Company is reported to be contemplating the installation of an electric light plant to furnish electricity in Benson.

WHITE CLIFFS, ARK.—It is reported that a 3000-bbl. plant, equipped with 150 kilns, will be erected on the property of the White Cliffs Portland Cement Company, which has been acquired by large financial interests, plans for which are being prepared. It is proposed to operate the machinery by electricity, which may be supplied from a hydroelectric development on the Red River, if gas engines are not installed.

BAKERSFIELD, CAL.—It is reported that the West Side Electric Company has decided to install a 600-kw generator instead of a 300-kw, as originally planned.

BEAUMONT, CAL.—The Beaumont Gas & Power Company has petitioned the Board of Supervisors for a franchise to construct and operate an electric and gas lighting system. The project will include the erection of power house, poles and pipe lines. Bids will be received by the Board of Supervisors for the franchise until Dec. 22. A. B. Pilch is county clerk.

BIG PINE, CAL.—The Buckeye Mining & Smelting Company has placed orders with the Allis-Chalmers Company, Milwaukee, Wis., for hydroelectric apparatus for its plant at Big Pine, Cal. The equipment consists of a horizontal turbine directed to a 300-kw, three-phase, 60-cycle, 2300-volt alternator and a 15-kw, 120-volt, motor-driven exciter set.

CASTELLA, CAL.—E. C. Newell and J. G. Cunningham, large stockholders of the Castle Lake Lumber Company, of Castella, have filed on three water-right locations aggregating 40,000 in. of the water running into Echo Lake, west of Castella. The water will be diverted through ditches and flumes, where it will be developed to generate electricity.

COALINGA, CAL.—The Coalinga Water & Light Company, recently incorporated, is making preparations to extend its electric service and water system into Coalinga. The transmission line will be extended from Lemoore. A. G. Wishon, manager of the San Joaquin Light & Power Company, of Fresno, Cal., is interested in the company.

EL PORTAL, CAL.—Extensive improvements are contemplated at the Hite Cove Mine, located on the south fork, near El Portal, during the coming year, which include enlarging the water-power plant, the installation of a larger dynamo and doubling the capacity of the stamp mill.

KING CITY, CAL.—Notice of appropriation of a power site on streams in the Coast Range, west of King City, has been filed by C. P. Baird, engineer, of King City, Cal.

LOS ANGELES, CAL.—The Home Telephone Company is preparing to establish four new exchanges in Los Angeles and proposes to double the capacity of the downtown cable system.

LOS ANGELES, CAL.—The City Council has adopted the resolution to issue $3,500,000 in bonds, the proceeds to be used for the construction of a municipal electric plant in connection with the Owens River project. H. J. LeLande is city clerk.

OAKLAND, CAL.—In connection with its plans to equip its suburban service for electrical operation, the Southern Pacific Railroad Company has applied to the Board of Supervisors in the name of the Central Pacific Railway Company for a 50-year franchise to operate a double-track railway from Melrose to Stanley Road, a distance of about four miles. From Stanley Road the railway will extend through San Leandro to Hayward.

REDDING, CAL.—The Sacramento Valley Power Company, which operates three power plants in Shasta County, with a system of transmission lines extending into the valley, has executed a deed of trust to the Central Trust Company, of San Francisco, Cal., to secure an issue of bonds to the amount of $500,000, the proceeds of which will be used for extensions to its system to various points in the Sacramento Valley.

SANTA CRUZ, CAL.—The advisory committee of the Council has recommended extending and improving the city lighting system, installing a uniform system and fixtures. An issue of bonds to the amount of $250,000 is favored.

SHINGLETON, CAL.—The Northern California Power Company has recently filed on two water locations, one for 1500 cu. in., flowing from Lava Springs into the creek, and 2000 cu. in. at another point. The water is to be diverted in turn to the Volta power house, thence to the South power house and finally to the power house at Inskip, in Tehama County.

COLORADO CITY, COL.—Plans are being considered for the construction of a new electric light and power plant in Colorado City. Stanley S. Effinger, of the firm of Effinger & Dunbar, is interested in the project.

DENVER, COLO.—It is reported that the transmission line of the Central Colorado Power Company between the Shoshone tunnel and Denver, which was badly damaged by the recent heavy snow storms, will have to be entirely rebuilt. The line cost in the neighborhood of $1,500,000 and furnished electricity to the Denver Gas & Electric Company from the Shoshone power tunnel, located near Glenwood Springs. The line had been in operation about two months.

GREELEY, COL.—The Greeley Street Railway Company, it is said, will petition the City Council for a franchise to furnish electricity for lamps as well as for street car service.

LYONS, COL.—R. W. Jones has filed on a reservoir site and pipe line on the North St. Vrain for power purposes. The reservoir will be located on the Billings Ranch and the water conducted by a 54-in. pipe to Lyons, about six miles distant, where the proposed power house is to be located. The estimated cost of the diversion dam is $36,000, and of the pipe line $60,000.

TRINIDAD, COL.—Plans are being considered by the Southern Colorado Power & Railway Company for a large power development, including a chain of electric plants extending along the Sangre de Cristo and Culebra ranges, if the present plans for reorganization are consummated. It is also proposed to extend the traction lines of the company.

BRIDGEPORT, CONN.—Preparations are being made by the Connecticut Company for the erection of an addition to its power house 120 x 42 ft., in which additional equipment will be installed. The cost of the extension is estimated at $20,000.

COLCHESTER, CONN.—Plans are being made by the National Electric Shoe Company for the installation of its proposed electric light plant. A 75-kw generator will be installed at first and a larger one later on.

EAST NORWALK, CONN.—The district committee has authorized the extension of the electric transmission lines from Gregory Boulevard to Marvin Ridge.

HARTFORD, CONN.—It is reported that the new syndicate, formerly the Northern Connecticut Power Company and the Enfield Power Company, has offered to purchase the hydraulic rights of the Connecticut River Power Company at Windsor Locks for $400,000.

NORWICH, CONN.—The Falls Company has installed two water wheels at its dam on the Yantic River and will erect a power house for the electric generators, which will supply electricity to operate its mills. The plant will have an output of about 200 hp.

DOVER, DEL.—The Delaware Central Construction Company, recently incorporated for the purpose of constructing an electric railway between Delaware City and Dover, it is said, proposes to take over the option on the rights-of-way for such a railway, which have been held by various companies. Dr. Thomas O. Cooper, of Wilmington, Del., is reported to be interested in the enterprise.

JACKSONVILLE, FLA.—The city is advertising for bids for lighting the streets and public buildings by electricity or gas for a term of one year, beginning Jan. 1, 1910. J. M. G. Carrera is city clerk.

MULBERRY, FLA.—The Prairie Pebble Phosphate Company, of Mulberry, Fla., is planning to make improvements to its power plant, including the installation of a new electric generating unit rated at about 500 hp.

PENSACOLA, FLA.—Arrangements have been made between the Bullock & Caldwell Real Estate Company and the Pensacola Electric Company for the construction of an electric railway to the Lakeview property.

PENSACOLA, FLA.—The Pensacola Electric Company is reported to be contemplating the installation of a 300-kw motor generator set and a 500-kw turbo-generator set. Stone & Webster, of Boston, Mass., are general managers.

ATHENS, GA.—Plans are being made to form a company for the purpose of constructing a hydroelectric plant on the Oconee River, near Athens. It is estimated that 4000 hp can be developed, which will be utilized to operate an addition to the Star Thread Mills at Barnett Shoals, and also for a new $500,000 cotton mill to be erected. The company will also furnish electrical power to operate the Macon street railway system. Captain James White, J. Y. Carithers and others are interested in the enterprise.

BREMEN, GA.—The contract for the installation of the municipal electric light plant has been awarded to McCrary & Company, of Atlanta, Ga. It is expected to have the plant ready to put in operation by Dec. 25.

COLUMBUS, GA.—The State Railroad Commission has ordered a material reduction in the rates charged for gas and electricity supplied by the Columbus Electric Company. Under the decision of the commission the prices for electricity for lighting purposes are fixed at from

10 cents to 5 cents per kw-hour, according to amount consumed, which is a reduction of from 10 to 15 per cent on the present rates. The price for arc lamps is placed at $60 per lamp per year and $24 per year for incandescent lamps of 32 cp for street lighting purposes. The rate for gas is reduced from $1.75 to $1.35 per 1000 cu. ft.

CORDELE, GA.—Application has been made for a charter by D. G. Zeigler, of St. Matthew, S. C.; H. S. Marshall, of Illinois; G. W. Hatcher, of Cordele, Ga., and others, for a company to be capitalized at $1,000,000, which proposes to construct a hydroelectric plant on Flint River. The present plans calls for the development of 9000 hp for electric transmission to Cordele and Americus.

ROME, GA.—The Stewart-Morehead Company, of Savannah, Ga., has purchased the Raccoon Cotton Mills at Raccoon, Ga., north of Rome. It is said that a company will be formed to operate the mills and develop an available water power to generate electricity to run the mill. The company will also furnish electricity to nearby towns for lamps and for commercial and industrial purposes.

SAVANNAH, GA.—The Savannah Hydro-Electric Construction Company, recently incorporated, proposes to construct a hydroelectric power plant on the Connooche River, 40 miles from Savannah. D. G. Zeigler & Company, of Jacksonville, Fla., are engineers in charge of the work.

BOISE, IDAHO.—Arrangements are being made by the Boise & Interurban Railroad Company to equip its Idaho Street city line from Seventh Street to Avenue A, to be operated by electricity, which will also be extended to the penitentiary grounds. W. E. Pierce is president of the Company.

MONTPELIER, IDAHO.—The Bear Lake Power Company has contracted with the Allis-Chalmers Company, Milwaukee, Wis., for the following equipment for its plant: One hydraulic turbine direct-connected to a 650-kw, 60-cycle, three-phase, 6600-volt generator and a 15-kw, 120-volt motor-driven exciter.

ST. JOE, IDAHO.—It is reported that contracts will soon be awarded by the Chicago, Milwaukee & Puget Sound Railroad Company for the construction of two electric power plants in the Bitter Root Mountains to furnish electricity to operate its railroad over the Idaho division, between St. Joe, Idaho, and St. Regis, Mont., a distance of over 100 miles. The two plants will develop 30,000. One will be located on the St. Joe River, at St. Joe, Idaho, and the other on the Missoula River, about 40 miles below Missoula, Mont.

JERSEYVILLE, ILL.—The Alton, Jacksonville & Peoria Railway Company is contemplating the construction of 17 miles of track during 1910, extending from Godfrey to Jerseyville, Ill. W. R. Heager is general manager.

JOLIET, ILL.—Plans for the installation of the boulevard system, to be installed in the business district of Joliet by the Economy Light & Power Company, are nearly completed, and work will commence on the system in the near future. The wires will be placed in underground conduits. Charles A. Munroe is general manager of the company.

OAK PARK, ILL.—Plans are being prepared for an addition to the power plant of the Oak Park Light, Heat & Power Company. A. E. Roberts, of Oak Park, is the architect.

PEKIN, ILL.—The Commissioners of the La March Drainage District are contemplating the installation of a motor-driven centrifugal pump, electricity for which will be supplied by the local electric plant. The headquarters of the Commission are located in Pekin.

PEKIN, ILL.—The stockholders of the Pekin Mutual Telephone Company have voted to increase the capital stock of the company from $20,000 to $40,000. The company has recently absorbed the Tazewell County Telephone Company, of Morton, and the Union Independent Company, of Tremont.

POLO, ILL.—Negotiations have been closed whereby the Oregon Power Company has secured the controlling interest of the Polo Electric Light & Power Company, taking possession of the same immediately. The new company will continue the service as before, giving an all-night service in addition. As soon as its plant in Oregon is completed the service in Polo will be furnished direct from the Oregon plant, and a 24-hour service established.

TAMPICO, ILL.—The Dixon, Rock Falls & Southwestern Electric Railway Company contemplates the construction of an electric railway extending from Tampico to Geneseo, via Rock Falls and Hooppole, a distance of 30 miles. Orders for rails have already been placed.

BRAZIL, IND.—The Board of County Commissioners has granted a franchise to the Electric Transmission Company, of Cincinnati, Ohio, to erect transmission lines in the Township of Lewis. The company at present operates an electric light plant at Jasonville, and proposes to extend its electric service to Coalmount, seven miles distant, and to farmers along the route. It is said the company proposes to extend its system to all parts of the county within the next two years.

DELPHI, IND.—The City Council has granted the Fort Wayne & Wabash Valley Traction Company, Fort Wayne, Ind., a franchise to furnish electricity for lamps, heat and motors in Delphi. The Carroll Electric Company is operating an electric plant in Delphi at present, but does not furnish a day service.

EVANSVILLE, IND.—The City Council has granted the Evansville Public Service Company a 25-year franchise to furnish electricity for lamps and motors and heat from a central station in Evansville. Under the franchise the maximum rate for electricity is 7½ cents per kw-hour, which is 2½ cents lower than the present rate. The company is capitalized at $250,000. A. L. Bernardin, David Ingle, George M. Snyder and others are interested in the company.

FORT WAYNE, IND.—Bids will be received by the Board of Public Works until Dec. 20 for furnishing and installing a steam boiler of from 350 to 500 hp, with automatic stoker and single-cylinder stoker engine, in the municipal electric light plant. Plans and specifications are on file at the office of the Board of Public Works.

INDIANAPOLIS, IND.—Bids will be received by the Board of Public Works until Dec. 20 for furnishing and installing all electric or gas lighting fixtures in the new city hall.

MONTICELLO, IND.—The Indiana Northwestern Traction Company has purchased the Chicago Heights & Eastern Electric Railroad, which will give it terminal facilities in Chicago, Ill. Arrangements have been made for an immediate survey of the route. The contract for construction of the railway has been awarded to the La Salle Supply & Construction Company, of Monticello, Ind.

NOBLESVILLE, IND.—A number of industrial manufacturing companies are making applications for locations and power in the city. The White River Light & Power Company, which is constructing a hydroelectric plant on the White River, will furnish the power service. The company is taking contracts at the rate of 5 cents per kw-hour. It is expected to have the plant ready for operation by Jan. 15.

SEYMOUR, IND.—The city controller has been enjoined temporarily from entering into a contract with the Indiana Public Utilities Company for street lighting. The City Council recently granted the utilities company a franchise to construct and operate a new plant. The injunction was secured by the Merchants' Electric Light Association, with which the new company would become a competitor. The Indiana Public Utilities Company proposes to go ahead with the construction of a new plant.

WEST POINT, IND.—The West Point Co-Operative Telephone Company has incorporated to construct and operate telephone lines and exchanges in Tippecanoe, Fountain and other adjacent counties. The principal office and exchange will be in West Point. Lewis J. Clement, John C. Whitehead, Benjamin Turner, J. F. Martin, S. R. Stover and G. R. Tubbs are incorporators.

DAVENPORT, IA.—We are informed that the Mississippi Shore Line Railway proposes to construct an interurban railway extending from Davenport to Muscatine. For further information address Walter D. Olney, Lock Box 430, Davenport, Ia.

KEOKUK, IA.—H. L. Cooper, 60 Wall Street, New York, N. Y., and associates are reported to be planning to commence work soon on the construction of a large dam in the Mississippi River in connection with a hydroelectric power project. The Keokuk & Hamilton Water Power Company is behind the project.

MARSHALLTOWN, IA.—F. G. Pierce, former mayor of the city and secretary of the Iowa League of Municipalities, is circulating a petition asking for a special election to vote on municipal ownership of the electric, gas and street railway systems, owned and operated by the Marshalltown Light, Power & Railway Company.

MARSHALLTOWN, IA.—At the special election held Nov. 29 the proposition to grant three public service franchises to run for a term of 25 years to Darling & Schroeder, of Chicago, Ill., was defeated. The franchises were for electric, gas and street railway systems, and were defeated because it was believed that the applicants were representing the present owners of the existing franchises for these utilities, which expire in eight years.

WATERLOO, IA.—It is reported that the William Gallaway Company, of Waterloo, Ia., is in the market for an engine and generator.

LEAVENWORTH, KAN.—Preparations are being made by the Leavenworth Light, Heat & Power Company for extensive improvements to its plant, which will involve an expenditure of about $25,000. The output will be increased from 1400 to 2400 hp. The work will include the erection of an addition to the boiler house, the installation of new boilers and two turbo-generator sets with a rating of 500 hp each. E. S. Springer is superintendent.

SABETHA, KAN.—At an election held recently the citizens voted to issue $65,000 in bonds, the proceeds to be used for the construction of an electric light plant and water-works system.

SALINA, KAN.—It is reported that the People's Light, Heat & Power Company is contemplating doubling the output of its generating plant.

WICHITA, KAN.—The City Commissioners have passed an ordinance compelling the Wichita Railroad & Light Company to build the Mt. Carmel extension within six months, making the penalty an absolute forfeiture of the franchise on that street.

WICHITA, KAN.—Plans are being considered by the Wichita Railway & Light Company for increasing the output of its power plant to 1500 kw, and building 10 miles of new track during 1910. W. A. Martin is purchasing agent.

WICHITA, KAN.—The American Power & Light Company, of New York, N. Y., which has taken over the properties of the Edison Light & Power Company, the United Gas Company and the Gas & Appliance Company, in Wichita, Kan., it is said, contemplates enlarging the present power house of the Edison Light & Power Company or constructing a new one.

CARLISLE, KY.—The East Telephone Company and L. C. Griffiths, of Louisville, Ky., each have purchased a franchise to construct and operate a telephone system in Carlisle. The franchises were offered to the highest bidder and sold at $100 each. The East Tennessee Telephone Company has been operating a telephone system for some time without a franchise.

LOUISVILLE, KY.—The Central Home Telephone Company, owning several lines and exchanges in Kentucky and Southern Indiana, was sold Dec. 1 to E. H. Cady, representing bondholders of Toledo, Ohio, for $250,000.

BANGOR, MAINE.—Negotiations have been closed whereby the Bangor Railway & Light Company has secured the entire property known as the Veazie Mills water power and dam. The company held one-quarter interest in property. It is understood that the company contemplates the construction of a new concrete dam.

PORTLAND, MAINE.—Plans and specifications for electric work and plumbing for the new city hall building, Portland, Maine, have been revised, and bids will be received by the City Hall Building Commission at the Mayor's office until Jan. 3, 1910. Plans and specifications can be seen at the offices of Architects Carrere & Hastings, 225 Fifth Avenue, New York, N. Y., and John Calvin Stevens and John Howard Stevens, Portland, Maine.

ROCKLAND, MAINE.—Plans are being considered by the Rockland, South Thomaston & Owl's Head Railway Company for the construction of a railway connecting Martin with South Thomaston, a distance of three miles. John T. Berry is superintendent.

POCOMOKE, MD.—The Electric & Ice Manufacturing Company has taken over the plant and holdings of the Stevenson Electric Light Company, of Pocomoke, Md. The new company is building a new power house and contemplates the installation of a 10-ton ice plant. Newton & Painter are consulting engineers. Riley M. Stevenson, of Pocomoke, Md., is president and manager.

EASTHAMPTON, MASS.—The cable connecting the Easthampton Gas Company's plant with the Connecticut River Power Company's system will be laid next spring. After the connection is made the present steam plant of the Easthampton Gas Company will be held for emergency purposes. When the new system is installed the company will be able to furnish electricity for motors, as well as lamps. It is expected when the new system is in operation that electricity will be used in several of the mills.

ESSEX, MASS.—At a special town meeting held recently the citizens voted to accept the proposition submitted by the Gloucester Electric Company to light the streets of the town. The company will furnish 100 incandescent lamps of 32 cp each for $1600 and will supply electricity for lighting the town hall to the amount of $50. For the next 25 lamps added the cost will be reduced to $15.50 per lamp, and for all over that amount the price will be $15 per lamp per year. E. L. Munger is manager of the Gloucester Electric Company.

LAWRENCE, MASS.—The Ayer Mills of the American Woolen Company, at Lawrence, Mass., now under construction, will be equipped for electric motor drive. The initial installation of the power house will include two units, with a rating of 2500 kw each.

MARBLEHEAD, MASS.—Work has commenced on the improvements to the municipal electric light plant, for which an appropriation of $30,000 was recently made. Two 100-kw turbine engines are being installed to replace four arc machines now in use. The present street lighting system will be replaced with new flaming arc lamps.

PITTSFIELD, MASS.—The Pittsfield Electric Company has engaged Stone & Webster, of Boston, Mass., to prepare plans for enlarging its plant at Silver Lake to increase the output to 1000 hp. As soon as the plans are completed, the company will petition the State Commissioners of Gas and Electricity for permission to increase its capital stock.

READING, MASS.—The town has voted to appropriate $1,800 to extend the electric service from the municipal electric plant to the filtration plant now being installed in connection with the water works system.

SPRINGFIELD, MASS.—The Council committee on lighting streets states that no immediate action will be taken on the permission granted by the Council to erect a large electric sign on the South End Bridge, as it has decided that the improvement in lighting Main Street is more important. About 25 additional arc lamps will be erected on Main Street, between Carew and Locust Streets.

TAUNTON, MASS.—The Globe-Taunton Nail Company is reported to be contemplating the construction of a new plant to replace the buildings destroyed by fire in September. The power plant equipment will include a 350-hp engine, 350-kw generator, 12 electric motors, etc. The company is now occupying temporary quarters.

THREE RIVERS, MASS.—Plans are being prepared for the construction of a new hydroelectric power plant for the Palmer mills of the Otis Company, at Three Rivers, Mass. The work will probably involve the erection of a new dam at the foot of the gorge below the mill and the abandonment of the present dam and canal.

WORCESTER, MASS.—A deal has been closed between the Worcester Electric Light Company and the Connecticut River Transmission Company, whereby the transmission company will acquire the right to use the poles, lines and conduits of the Worcester Electric Light Company throughout the city for the transmission of electricity. Under the terms of its franchise the transmission company cannot furnish electrical service to consumers using less than 300 hp. It is expected that the company will furnish energy in Worcester within a short time, as its substation at Glendale is practically completed and the transmission line has been extended nearly to the point where it will connect with the lines of the Worcester company. The company will furnish electricity to the south works of the American Steel & Wire Company to operate its large electric furnace, which will soon be started.

NILES, MICH.—The Michigan State Telephone Company is contemplating making extensive improvements to its system in Niles, which will involve an expenditure of about $30,000. The improvements will include the construction of a new telephone exchange and the installation of a new switchboard capable of handling 1,500 telephones.

STURGIS, MICH.—It is reported that bids will soon be called for machinery for a new municipal power plant, plans for which are now being prepared.

STILLWATER, MINN.—The State Board of Control has awarded the Washington County Light & Power Company a contract to furnish electricity for lamps and motors for the new state prison and its factories. The prison was formerly lighted by the steam plant located in the prison. The service will be supplied from the hydroelectric plant at Riverside on Apple River in Wisconsin. Work on construction of the transmission line will commence at once. This line will also enable the company to supply electrical service in Oak Park.

CHARLESTON, MISS.—Improvements are contemplated to the municipal electric light plant, water works and sewerage system, which will involve an expenditure of about $10,000.

MERIDIAN, MISS.—Application has been made to the City Council by M. R. Grant and associates for a franchise to construct and operate an electric light plant and street railway in Meridian.

SEMINARY, MISS.—The Home Telephone Cimpany, of Meridian and Jackson, has closed a deal with the local company to establish a telephone system throughout the county, to be known as the Covington County Telephone Company.

KANSAS CITY, MO.—It is reported that the Indiana Silo Manufacturing Company, of Anderson, Ind., is contemplating the construction of a large plant in Kansas City, Mo., which will be operated entirely by electricity. Power for operating the plant may be purchased.

KANSAS CITY, MO.—It is officially announced that the Kansas City, Lawrence & Topeka Electric Railroad Company expects to construct an electric railway from Monrovia to Lawrence, Kan., passing through De Soto and Hannibal, a distance of 32 miles. Willard W. Winner is purchasing agent.

LEES SUMMIT, MO.—Application has been made to the Council by Levi G. Morris and others for a franchise to construct and operate an electric light and power plant in Lees Summit.

MEXICO, MO.—We are informed that the Mexico, Santa Fe & Perry Traction Company expects to place contracts for material and apparatus for the construction of about 100 miles of track. All material will be purchased through Burns & Company, Isabelle Building, Chicago, Ill. The proposed railway will extend from Mexico to Columbia and Fulton, thence to Santa Fe, Parry and Hannibal. It is said that the company will soon award contracts for the construction of three power plants. C. W. Gaither is secretary.

ST. LOUIS, MO.—The Majestic Range Company, St. Louis, Mo., is contemplating the erection of an addition to its plant. The company is considering the installation of electric motor-driven machinery.

ST. LOUIS, MO.—Preparations are being made by the St. Louis, Lakewood & Grant Park Railway Company for the construction of a six-mile extension to the Meramac River during the coming year. E. G. Hughes is general manager.

ST. LOUIS, MO.—The North Missouri Central Railway Company has awarded a contract to the M. A. Talbott Company, of Baltimore, Md., for the construction of its interurban railway to extend from Jefferson City to Mexico, via Columbia, 60 miles in length. Headquarters of the company are in the National Bank of Commerce Building. St. Louis, Mo. O. F. Spaete is president.

ST. LOUIS, MO.—Preparations are being made to change the motive power of the Chicago, Peoria & St. Louis Railway from steam to electricity. The road, which is known as the "Bluff Line," is at present in the hands of a receiver, but it is understood that it will be taken over by a syndicate of Illinois capitalists and converted into an electric line. The railway is about 200 miles in length. J. P. Ramsey, president of the company, who is also receiver, is one of the incorporators of the new syndicate. Howard Beehler, J. J. Frazer, L. G. Lockbridge, B. F. Burns and others are interested in the enterprise.

SLATER, MO.—The City of Slater is contemplating the installation of a 250-hp gas producer plant or a steam-driven plant with electric generator and motor-driven deep well pump. The city would like to communicate with manufacturers and dealers in above apparatus. For further information address L. E. Shepherd, superintendent Slater Light and Water Works.

WHITEHALL, MONT.—Plans are being prepared by the Montana Independent Telephone Company for the construction of a telephone line to Dillon by the way of Twin Bridges and the Beaver head valley

and the erection of a branch line up the valley to Sheridan, Ruby and Virginia City.

HARVARD, NEB.—Preparations are being made by O. J. Shaw, of Aurora, Neb., who recently secured a franchise, to erect an electric light plant in Harvard. It is expected to have the plant completed by March 1

HASTINGS, NEB.—A company is being formed by residents of this city for the purpose of installing an electric light plant.

VALENTINE, NEB.—The contract for the construction of the municipal electric light plant and water-works system was awarded to the Katz-Craig Contracting Company, Omaha, Neb.

RHYOLITE, NEV.—The Buckeye Mill & Mining Company, of Fish Springs, contemplates the installation of an electric plant on Birch Creek to furnish electricity to operate its mill, now being erected. Leonard Davis is general manager.

MANCHESTER, N. H.—The Water Commissioners are considering the question of installing an electric pump at the low-pressure station.

FLEMINGTON, N. J.—Preparations are being made by the Flemington Electric Light, Heat & Power Company for the installation of a new lighting system. An all-night schedule will be established and 35 Westinghouse arc lamps of 2000 cp will be placed in the principal sections of the town. A large number of tungsten lamps will be installed. The new contract covers a period of five years.

POINT PLEASANT, N. J.—We are informed that the Point Pleasant Traction Company expects to place orders in the near future for two 150-hp water tube boilers. F. B. Musser, of Harrisburg, Pa., is purchasing agent.

ARTESIA, N. MEX.—Plans are being considered to erect a hydro-electric power plant on the Penasco River, to furnish electricity to operate pumps for irrigating a large portion of the Pecos River Valley in New Mexico. It is estimated that about 15,000 hp can be developed and the cost of pumping the water would be about $2 per acre. L. K. McGaffey and J. F. Hinkle, of Roswell, N. Mex., are interested in the project.

ROSWELL, N. MEX.—The Roswell Electric Light & Power Company has notified the farmers of the Roswell section that it is prepared to furnish electricity for the irrigation of 10,000 acres of land during the coming season, and that it will extend its transmission lines for a distance of 25 miles if the use of electrical energy for irrigating 5,000 acres is guaranteed.

ROSWELL, N. MEX.—The Roswell Telephone Company has placed a contract with J. A. Russell, representative of the Western Electric Company, for new equipment for its new building, including switchboard, power plant, new telephones, etc.

BROOKLYN, N. Y.—Preparations are being made by the Brooklyn Rapid Transit Company for the construction of a new electric railway through Utica Avenue and Avenue N to Jamaica, work on which will commence soon. The new line will be about four miles in length and will serve as an extension to the Reid Avenue line.

DUNKIRK, N. Y.—The Niagara & Erie Power Company has petitioned the Common Council for a franchise to extend its transmission line to the Brooks Locomotive Works in Dunkirk.

DUNKIRK, N. Y.—Application has been made to the City Council by the Dunkirk Power & Heating Company for a franchise to build conduits for the transmission of electricity in Dunkirk.

JAMESTOWN, N. Y.—Announcement has been made that the property of the Jamestown Lighting & Power Company has been purchased by A. N. Broadhead and associates, who control the Chautauqua Traction Company. The price paid for the plant was $90,000, which was the sum for which the plant was offered to the Board of Lighting Commissioners of Jamestown, to be incorporated with the municipal electric plant, but which the taxpayers refused to pay by a small majority.

LONG ISLAND CITY, N. Y.—The Long Island Railroad Company contemplates building 28 miles of new track during 1910.

LYONS, N. Y.—The plant and holdings of the Wayne County Electric Company have been purchased by William T. Morris and associates, of Penn Yan. The company furnishes electrical service in Lyons and Clyde.

NEW YORK, N. Y.—Plans have been filed by the Metropolitan Street Railway Company for a one-story substation to be erected on Madison Avenue, south of Eighty-sixth Street, at a cost of $3,500, which later will give place to a larger building.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, New York, N. Y., until Dec. 20 for repairs, alterations and additions to the electric equipment in Public School 11, 314 West Seventeenth Street, Borough of Manhattan. Bids will also be received at the same time and place for alterations to electric equipment in hall of Board of Education, corner of Park Avenue and Fifty-ninth Street, Borough of Manhattan, New York.

NORTH SYRACUSE, N. Y.—Plans are being considered for lighting the streets of the village of North Syracuse. It has not yet been decided whether gas or electricity will be used.

OSWEGO, N. Y.—The City Council has granted the Syracuse, Lake Shore & Northern Railroad Company a franchise to enter Oswego as a terminus for its proposed Fulton extension.

ROCHESTER, N. Y.—It is reported that the A. J. Bottom Company, of Rochester, N. Y., is planning to install two engines and generators, having a total capacity of [illegible] hp.

ASHEVILLE, N. C.—The Asheville & East Tennessee Railroad Company expects to construct during the coming year seven miles of track extending from Weaverville to Grantville, Ohio.

CONCORD, N. C.—The buildings of the Locke Cotton Mills Company have been completed and machinery is being installed. The equipment will include 35,000 spindles, 1000 looms, etc. Both steam and electrical power will be used, and from 1300 to 1400 hp will be required. J. Locke is president and treasurer.

DURHAM, N. C.—The new No. 4 mill of the Erwin Cotton Mills Company is ready for occupancy. The equipment will include 50,000 spindles and 1500 looms. The mill will be operated by electricity and will require 3000 hp, which will be generated at the company's own plant. The power equipment includes a 2500-hp steam turbine.

KENMARE, N. D.—The Northern Telephone Company is contemplating the installation of extensive improvements to its system.

WASHBURN, N. D.—The Independent Telephone Company contemplates the construction of a telephone line to Stanton.

DEFIANCE, OHIO.—The People's Gas & Electric Company proposes to add three miles of new track to its system during 1910.

ELYRIA, OHIO.—Improvements are being made to the equipment of the plant of the Elyria Iron & Steel Company, which will include the purchase of additional electrical apparatus.

MAUMEE, OHIO.—It is reported that the Phoenix Light & Power Company will require oil-filled, self-cooled static transformers of from 3[illegible] kw.

PERRYSBURG, OHIO.—The capital stock of the Suburban Light & Power Company has been increased from $15,000 to $50,000.

TOLEDO, OHIO.—Announcement has been made that the Toledo, Urban & Interurban Railway Company will, during the coming year, extend its railway from Findlay to Kenton, Ohio, a distance of 32 miles. C. F. Smith is purchasing agent.

TOLEDO, OHIO.—The Citizens Lighting & Heating Company has purchased the stock of the Maumee Valley Electric Company, which owns the old power plant used by the Maumee Valley belt line at Miami, and also the water rights granted by the State at the new dam at Grand Rapids. Work has commenced on improving the plant and enlarging the forebay and headgates as well as the penstocks; also for foundations for wheels and wheel pits. The old machinery will be discarded and new equipment installed. The plant when completed will have an output of 3000 hp. The company paid $60,000 for the property and will expend about $100,000 for improvements to the plant. James M. Ashley, local representative of the Citizens Heating & Lighting Company, who has already applied to the City Council for an extension of the franchise of the company, it is said, expects to petition for another extension, in January to cover the whole city. The company now has a franchise covering 28 blocks in the down-town section of the city; the present extension contemplates an addition of 25 blocks. When the company secures its complete franchise it is planned to make it the distributing company for the corporation that has purchased the water rights on the canal and river. It is said that the parties behind the company propose to generate 10,000 hp—3000 from the Miami plant, 3000 from the Grand Rapids dam and 4000 from two other water rights for which they are negotiating. The plans complete contemplate an expenditure of about $1,250,000.

APACHE, OKLA.—The citizens have voted to issue $8,000 in bonds for the construction of an electric light plant, plans for which are being prepared by the Southwestern Engineering Company, of Oklahoma City, Okla. H. Peeper is Mayor.

ENID, OKLA.—Contracts will be awarded by the Enid & Central Oklahoma Traction Company for the construction of its interurban railway between El Reno and Enid, 65 miles in length. W. S. Whitting hill is president.

SULPHUR, OKLA.—The plant of the Sulphur Light & Power Company, which was recently purchased by W. A. Swanson Electric Company, of Larned, Kan., is being entirely rebuilt.

ASTORIA, ORE.—Arrangements are being made by the Pacific States Telephone Company for the construction of long-distance telephone lines from Astoria to Seaside and also from this city to Hammond, Fort Stevens and Ilwaco.

FOREST GROVE, ORE.—A. Welch, of Portland, Ore., has submitted a new ordinance to the City Council relative to furnishing electricity in Forest Grove. Under the new ordinance the applicant will be given a 25-year franchise and will secure control of the present equipment owned by the city and also furnish 25 arc lamps for street lighting for a term of 25 years. The company will maintain a pump and furnish electricity to operate the same in case of emergency, at the rate of two cents per kw-hour.

PORTLAND, ORE.—The Oregon Electric Railway Company is planning to construct about 50 miles of new track during 1910, one branch extending from Tigard to McMinnville, Ore.; the other connecting Salem and Albany, a distance of 25 miles. George F. Nevins is purchasing agent.

SALEM, ORE.—Application has been made to the State Engineer by W. R. Winans for permission to appropriate water rights of the Hood

River, to be utilized for power purposes. Mr. Winans is interested in a project to construct an electric railway for the Hood River Valley, which will be a belt line and tap the apple districts of the valley. It is estimated that 20,000 hp can be developed at a point a few miles below the forks of the river.

CHARLEROI, PA.—The West Side Electric Street Railway Company is planning to construct an interurban railway extending from Charleroi to Ellsworth, a distance of 10 miles, next year. D. G. Callihan, of Belle Vernon, Pa., is general superintendent.

MILLVALE, PA.—Bids will be received at the office of H. H. Dixon, borough clerk, until Dec. 23 for furnishing machinery and constructing an addition to the municipal electric light and water plant, as follows: Steel or brick addition on concrete foundation; steam boilers and stack; steam engine, feed-water heater, piping; alternator, rectifiers, arc lamps, exciter, switchboard and appurtenances. Plans and specifications can be seen at the office of the borough clerk. William Fox is president of Council.

NORRISTOWN, PA.—Bids will be received until Dec. 29 by John L. West, steward of the State Hospital for the Insane of the southeastern district of Pennsylvania, for one air compressor, engine, dynamo, motor generator and switchboard.

OAKMONT, PA.—Preparations are being made for the construction of an electric railway extending from Oakmont to Kittanning. The road will be known as the Pittsburg & Allegheny Valley Street Railway.

PHILADELPHIA, PA.—The contract for furnishing and installing an arc lighting system for the electric towers in the college was awarded to J. F. Buchanan & Company for $4,087. William A. Anderson secured the contract for improvements to the power house, including a Westinghouse steam-driven air compressor and tank and making connection between the underground duct and filter house, for $4,620.

PITTSBURGH, PA.—The Pittsburgh, Chester & East Liverpool Street Railway Company expects to commence work on its proposed railway early in the spring. The railway will extend from Pittsburgh to East Liverpool, a distance of 35 miles. The motive power has not yet been definitely decided upon.

PHOENIXVILLE, PA.—The Phoenixville, Valley Forge & Stafford Electric Railway Company, recently organized, proposes to construct an electric railway, 10 miles in length, extending from Phoenixville to Stafford, which is the terminus of the Philadelphia & Western Railroad Company's third-rail system. The power plant and repair shops will be located at Valley Forge. The company will furnish electricity for lamps to towns along the route of its railway. Thomas E. O'Connell, of West Chester, Pa., is president and general manager.

WELLSBORO, PA.—The Tioga Traction Company, which proposes to construct an electric railway 15 miles long to connect Wellsboro, Whitneyville, Cherry Flats, Covington and Mansfield, has secured the necessary rights of way and expects to commence work early in the spring. The company proposes to locate its power plant and repair shops in Wellsboro. It will also furnish electricity for lamps to towns along its route. B. F. Edwards, of Wellsboro, is president, and George F. Keagle, of Avis, general manager and purchasing agent.

CHARLESTON, S. C.—The Charleston Consolidated Railway Gas & Electric Company expects to place contracts within the next few weeks for a 1000-kw turbine. P. H. Gadsden is president.

CHARLESTON, S. C.—A company has been incorporated by D. G. Zeigler, of Jacksonville, Fla.; G. H. Miller, S. J. Platsch, and others, for the purpose of constructing a hydroelectric power plant on the Edisto River, 28 miles from Charleston. The company is capitalized at $1,500,000 and proposes to develop 12,000 hp for electric transmission.

CHESTER, S. C.—It is reported that the construction of an electric railway from Chester to Great Falls, via Richburg and Lando, is under consideration. The principal power plant of the Southern Power Company is located at Great Falls, S. C.

BELLVILLE, TEX.—The amount necessary has been subscribed for the construction of an ice, light plant and creamery in Bellville. The Bellville Promoting Company has been formed by C. F. Hellmuth, C. Schauerhammer and others to operate the plant.

GALVESTON, TEX.—The City Council has adopted the report of the committee recommending the acceptance of the bid of the Lowe Electric Company, of Galveston, Tex., for the installation of turbo-generators rated at 2100 kw, together with condensers, at $11,900. The company is to allow the city $900 for the old engines, etc., in the power plant.

GREENVILLE, TEX.—The city is building a new municipal electric light plant. The cost of the entire plant is estimated at $80,000.

HASKELL, TEX.—The Haskell Power Company will install electric generating machinery and auxiliary apparatus in its plant this winter.

LEWISVILLE, TEX.—The Lewisville Light & Power Company is reported to be considering the construction of a new power house during the coming year.

WINCHESTER, TENN.—Bonds have been sold by the city to the amount of $14,000, the proceeds to be used for improvements to the municipal electric plant and water works. The power house will be remodeled and new water wheels installed.

PARK CITY, UTAH.—The City Council has granted the Park City Light, Heat & Power Company a 25-year franchise for lighting the city. Under the new franchise the rates for electricity for lamps will be reduced from 15 cents to 11 cents per kw-hour. The minimum charge is reduced from $1.50 to $1 per month. The price for street lamps is $1 per month and the company is to furnish electricity for lighting the city building free of charge.

SALT LAKE CITY, UTAH.—Steps have been taken by which it is hoped to accomplish a reorganization of the Salt Lake Public Service Company, of Salt Lake City, which was organized several years ago by parties from Columbus, Ohio. The receiver of the company has succeeded in getting an extension until 1910 of the water rights of the company, which will give ample time to complete construction of the plant and save the water rights, which are the most valuable assets of the company.

NORTHFIELD, VT.—Messrs. Moody & Allen, of Montpelier, Vt., who have the contract for street lighting in Northfield, are making preparations for the construction of another power plant above their present plant in Middlesex, where they own the water privilege and necessary land for flowage. The cost of the plant is estimated at about $55,000.

STOWE, VT.—The contract for the construction of the high-tension transmission line from Cady's Falls to Stowe has been awarded to the Northern Electric Company, of Burlington, Vt. The transmission line will furnish electricity from the Morrisville municipal electric plant to operate the Mt. Mansfield Electric Railroad, which extends from Waterbury to Stowe. M. C. Clark is general manager of the Northern Electric Company.

MARTINSVILLE, VA.—The Martinsville Cotton Mills Company has increased its capital stock to $600,000 and may install a larger plant than at first proposed. The buildings are ready and part of the machinery is in place. The equipment will include 18,000 spindles, 466 looms, etc., for the manufacture of fine sheeting. The plant will be operated by electricity, which will be supplied by the municipal electric light plant. The company has contracted with the city for 500 hp. Z. T. McKinney is president of the company.

RICHMOND, VA.—The Virginia Railway & Light Company contemplates the installation of an additional steam turbine electric generating unit in its power plant for emergency purposes.

RICHMOND, VA.—The City Council has appropriated an additional $65,000 for the municipal electric light plant, to be used for the construction of the distributing system. The total appropriation to date has been $415,000.

CHELAN, WASH.—The Chelan Electric Company, a subsidiary of the Great Northern Railroad Company, is contemplating the construction of a large dam across the Chelan River gorge at a point near Cape Horn, between Chelan and Chelan Falls on the Columbia River. It is estimated that about 80,000 hp can be developed at a cost of about $5,000,000. Electricity generated at the plant will be utilized to operate the electric lines of the Great Northern, and will also be furnished to cities for lighting and to pump water for irrigation from Lake Chelan and the Columbia. The exact location of the dam has not yet been decided upon.

RIVERSIDE, WASH.—The Okanogan County Telephone Company and the Johnson Creek Telephone Company have been consolidated under the name of the Okanogan County Telephone Company. It is said that extensive improvements will be made to the systems.

SEATTLE, WASH.—Contracts have been awarded by the Board of Public Works for the installation of a cluster lamp system on Eighteenth Avenue as follows: For conduits, etc., to C. F. McDonald for $15,020, for cast-iron poles and insulators to the Olympic Foundry Company for $2,902.

TACOMA, WASH.—The City Council has authorized the Commissioner of Public Works to advertise for bids for the construction of the dam, headworks and tunnel for the power canal in connection with the proposed municipal electric plant as soon as plans are prepared. It is expected that work on the plant will commence about Feb. 1, 1910. The work now to be undertaken will involve an expenditure of about $650,000; the entire plant will cost about $2,000,000. Frank C. Kelsey is engineer.

WALLA WALLA, WASH.—Announcement has been made by the Washington-Oregon Traction Company that owing to the failure to secure a franchise in Walla Walla the company will move to Pendleton, Ore., and from there will start work on its proposed traction system, which will involve an expenditure of $3,000,000.

WILKESON, WASH.—W. A. Corder Company, of Wilkeson, Wash., is reported to be in the market for a 100-kw generator.

MORGANTOWN, W. VA.—The Union Utilities Company will soon be in the market for a 200-kw, 60-cycle generator and a low pressure turbine. H. R. Warfield is general manager.

KILBOURN, WIS.—Owing to the engine in the municipal electric light plant having been wrecked beyond repair it has been decided to secure electricity from the hydroelectric plant of the Southern Wisconsin Power Company's plant in Kilbourn to operate the municipal electric light system.

LA CROSSE, WIS.—The La Crosse Street Railway Company has received permission for the State Commission to issue $50,000 in bonds, the proceeds of which to be used for the purchase of new cars, power house equipment and for improvements and extensions to its track system.

MILWAUKEE, WIS.—Permission has been granted to the Milwaukee Western Electric Railway Company to construct an electric railway to Beaver Dam, Wis., a distance of 56 miles, with a branch from Sussex through Pewaukee to Waukesha. It is said that the power house will be located in Hustisford.

NEW LONDON, WIS.—Preparations are being made by the Wisconsin Telephone Company for rebuilding its telephone lines and remodeling its exchange in New London, Wis., which will involve an expenditure of about $14,000.

STEVENS POINT, WIS.—Plans have been prepared by the Vetter Manufacturing Company for changing its present power system to electric motor drive.

TOMAH, WIS.—A new steam turbine power plant rated at 1200 hp is being installed by C. A. Goodyear Company to furnish electricity to operate its planing mill as well as the main factory. Alternating-current motors will be used for driving the planing mill.

RED DEER, ALT., CAN.—Negotiations are under way between the town officials and the Western General Electric Company with a view of purchasing the electric plant of the company.

PRINCE RUPERT, B. C., CAN.—The telephone committee of the Prince Rubert Board of Trade has secured stock subscriptions to the extent of $10,000, the amount necessary for the organization of a local company.

PRINCE RUPERT, B. C., CAN.—It is reported that a syndicate backed by London and New York capital is contemplating an expenditure of about $5,000,000 in Prince Rupert, which will include the installation of an electric lighting and street railway systems, and the erection of a smelter for the treatment of ores of the mining districts of the north and other industries. The project includes a steamship service to points between Prince Rupert and Portland Canal.

VANCOUVER, B. C., CAN.—The British Columbia Electric Railway Company has appropriated $6,000,000 for improvements to its system. It is said that work will commence immediately on the construction of a 20,000-hp auxiliary plant in Vancouver.

VICTORIA, B. C., CAN.—The British Columbia Telephone Company is contemplating extensive improvements to its system, including the laying of an additional cable across the gulf.

SELKIRK, MAN., CAN.—The Town of Selkirk is contemplating taking over the electric light plant now owned by the Selkirk Electric Light & Power Company, to be operated as a municipal plant. W. E. Skinner, of Winnipeg, has been engaged to place a valuation on the plant.

ESSEX, ONT., CAN.—The local electric light plant was completely destroyed by fire on Dec. 6.

FORT FRANCES, ONT., CAN.—Contracts have been awarded by the Corporation of Fort Frances for equipment for the municipal electric light system, as follows: Arc lamps to the Canadian Westinghouse Company; meters to the Canadian General Electric Company, and transformers to the Allis-Chalmers, Bullock Company. Power for operating the system will be secured from the International Falls Power Company, which is installing an electric plant equipped with four 1250-kw units. W. E. Skinner, of Winnipeg, Man., is consulting engineer for the Town of Fort Frances.

HAMILTON, ONT., CAN.—A recommendation has been submitted to the Council to install 52 arc lamps in the new annex district. It will cost about $2,300 a year to maintain the lamps.

HAMILTON, ONT., CAN.—The Board of Works has authorized City Engineer Macallum to confer with the Hydro-Electric Power Commission in connection with the erection of a transmission line from Dundas through the city to the Beach pumping station.

HAMILTON, ONT., CAN.—Extensions are contemplated by the Hamilton, Waterloo & Guelph Railway Company during 1910, which will require the construction of about 60 miles of new track. One line will extend from Hamilton to Berlin and the other from Hamilton to Guelph. John Patterson is general manager.

LONDON, ONT.—The Southwestern Traction Company contemplates the construction of extensions to its system of from 20 to 40 miles, one of which will extend from London to Ingersoll, and the other from St. Thomas to Aylmer, Ont. S. W. Mower is general manager.

OTTAWA, ONT., CAN.—At a meeting of the Board of Control a by-law was approved granting a franchise to the Metropolitan Electric Company, Ltd., upon the stipulation that the company must be in a position to deliver 1000 hp in Ottawa within three years from the date of passing the by-law. It is expected that the by-law will be submitted to the citizens at the January municipal elections.

OTTAWA, ONT., CAN.—Application has been made to the Dominion Parliament for incorporation of the Ottawa, Rideau Valley & Brockville Railway Company, with power to construct and operate a railway by electricity or other motive power from the city of Ottawa to the town of Brockville; also to operate a ferry service across the St. Lawrence River from Brockville to Morristown, N. Y., and to build an extension of the main line from Ottawa to High Falls, in the Province of Quebec. Permission is also asked to develop water power, to be utilized to generate electricity for lamps, heat and motors. D. H. McLean, of Ottawa, is solicitor for the applicants.

QUEBEC, QUE., CAN.—The Quebec Light, Heat & Power Company, of Quebec, recently organized, has purchased the holdings of the American Light & Traction Company in the Quebec-Jacques Cartier Electric Company, which completes the monopoly by the new company of the public service utilities in Quebec and adjacent territory. Instructions have been given to Edward A. Evans, chief engineer of the Quebec Railway, Light & Power Company, to prepare and revise plans already made in connection with the construction of the Quebec & Saguenay Railway from St. Joachim to Murray Bay.

GUANAJUATO, MEX.—The Guanajuato Electric & Power Company has increased its capital stock from $6,000,000 to $12,000,000, the proceeds to be used for the construction of new plants and extension of transmission lines. The company proposes to construct a new generating plant at Peruondero and another at Penjamo.

LLUVIA DE ORO, CHIHUAHUA, MEX.—The Lluvia de Oro Gold Mining Company is making extensive improvements to its power plant and has placed orders with the Allis-Chalmers Company, of Milwaukee, Wis., for equipment as follows: For one hydraulic turbine direct connected to a 400-kw, 60-cycle, three-phase, 6600-volt generator, a 25-kw, 120-volt exciter, belted to generator and a two-panel switchboard with necessary instruments, etc.

SAN BERNANDO, MEX.—The Mayo River Power & Land Company, which has its headquarters at Denever, Colo., is preparing to erect hydroelectric plants on the Mayo River in the State of Sonora, Mex. Surveys have been made for a series of dams to be built on the river, the first of which will be located near the San Bernando. It is stated that the intial plant will have an output of about 25,000 hp. The other plants will be built as the demand for power increases. The company owns the power concession which was originally obtained from the Mexican Government by W. O. Temple, of Denver, Col. The company is capitalized at $5,000,000. R. M. Jones, of Denver, Col., is hydraulic engineer, and R. E. Cowden, superintendent.

New Industrial Companies.

WILLIAM A. EVANS COMPANY, of Camden, N. J., has filed articles of incorporation with a capital stock of $50,000 for the purpose of doing a general electrical and mechanical engineering business. The incorporators are: W. A. Evans, C. R. Powell, W. J. McGinty, J. V. Colfitts and F. Vreeland, of Camden, N. J.

THE FARKAS TUNGSTEN LAMP COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 to manufacture lamps and electrical apparatus. The incorporators are: K. Farkas, G. V. Williams and W. L. Forbes, Jr., of New York.

THE FLANDRAU MOTOR CAR COMPANY, of West Nyack, N. Y., has been chartered by D. T. Wilson, K. U. Wilson and W. Moffat, of New York, N. Y. The company is capitalized at $52,500 and proposes to manufacture motors, engines, machines, etc., cars, flying machines, etc.

THE KEYSTONE CONTRACTING COMPANY, of New York, N. Y., has been chartered by R. H. Hibbard, F. J. McCann, of New York, N. Y., and W. S. Carter, of St. Louis, Mo. The company is capitalized at $50,000 and proposes to construct docks, railroads, subways, etc., and do a general contracting business.

THE LONDON CONTRACTING COMPANY, of New York, N. Y., has been incorporated by J. Brohm, C. F. McManus and W. A. Walling, of New York, N. Y. The company is capitalized at $1,000,000 and proposes to do a general contracting business, build bridges, ships, cars, etc.

THE MICHAELS & MINICK CONSTRUCTION COMPANY, of Marion, Ind., has been incorporated with a capital stock of $25,000. The company proposes to do a general construction business, but will make a specialty of building electric railroads. Charles A. Michaels, Robert J. Spencer and William H. Minick are directors.

THE NATIONAL ENGINEERING & CONSTRUCTION COMPANY has filed articles of incorporation with a capital stock of $500,000. The incorporators are: W. S. McGuire, of New York, N. Y.; J. D. Fackenthal, of Brooklyn, N. Y., and J. W. Williams, of Weston, Pa.

THE POWER EQUIPMENT COMPANY, of Camden, N. J., has been incorporated with a capital stock of $125,000 to manufacture engines, machinery, etc., by O. M. Scifie, of Philadelphia, Pa.; C. S. Eves, of Jenkintown, Pa., and F. Ferguson, of Camden, N. J.

THE RELIABLE ELECTRIC COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $30,000 to manufacture electrical supplies and equipment. The incorporators are: F. W. McNeal, O. C. Junge and G. W. Rodormer.

THE J. B. RILEY ELECTRIC COMPANY, of Terre Haute, Ind., has been incorporated for the purpose of installing electrical plants and to deal in electrical supplies and appliances. J. B. Riley, Harley Wadkins and J. E. Carter are directors.

THE SAUER POWER GENERATING COMPANY, of Camden, N. J., has been incorporated by Adelbert Sauer, Herman J. Veegite and V. A. Murray. The company is capitalized at $100,000 and proposes to manufacture, sell and lease motors and engines.

THE SAVANNAH HYDRO-ELECTRIC CONSTRUCTION COMPANY, of Savannah, Ga., has been incorporated with a capital stock of $300,000 by G. H. Miller, S. J. Platsch and others. The company proposes to construct a hydroelectric power plant on the Connoche River, 40 miles from Savannah. D. G. Zeigler & Company, of Jacksonville, Fla., are engineers in charge.

THE VIRGINIA ELECTRIC COMPANY, of Richmond, Va., has been chartered with a capital stock of $10,000 to deal in electrical supplies. The officers are: H. S. Hewitt, president; J. R. Tucker, vice-president, and Percy Montague, Jr., secretary and treasurer.

THE VIRGINIA ELECTRIC & MACHINE WORKS, of Charleston, W. Va., has been incorporated with a capital stock of $50,000 by Edwin M. Keatley, James F. Schwalm, A. W. Fitzwater and others.

THE WATSON STORAGE BATTERY COMPANY, of Memphis, Tenn., has been chartered by H. D. Hattel, C. J. Watson, Jr., M. B. Cooper and others. The company proposes to manufacture storage batteries.

THE WESTERN ENGINEERING COMPANY, of Dallas, Tex., has been incorporated with a capital stock of $25,000 to do a general engineering business. The incorporators are: Arthur A. Vardell, Jerome B. Dale, George T. Baldwin and Robert Kaye.

THE WESTPHAL POLPHONE COMPANY, of Camden, N. J., has been chartered with a capital stock of $30,000 to manufacture telephonic devices. The incorporators are: F. R. Hansell, George H. B. Martin and I. C. Glow, of Camden, N. J.

New Incorporations.

PETALUMA, CAL.—Articles of incorporation have been filed for the Petaluma Rural Telephone Company by D. M. Winans, T. G. King, George B. Robinson, S. L. Stice, E. P. Long and Frank Whitlach. The company is capitalized at $50,000 and proposes to construct and operate rural telephone lines, extending from Petaluma.

McINTOSH, FLA.—The McIntosh Telephone Company has been incorporated to establish a telephone line from McIntosh to Evinston by S. H. Walkup, president; E. W. Rush, vice-president; H. L. Dickson, secretary and treasurer, and W. E. Allen, manager.

IRWINTON, GA.—The Irwinton Railway Company has been chartered with a capital stock of $15,000 to construct an electric railway from McIntyre to Irwinton, a distance of 3¼ miles. The incorporators are: J. L. Byington, J. W. Lindsey, G. H. Carswell, I. B. Stinson and I. E. Burkett.

CHICAGO, ILL.—The Thayer Junction Railway Company has been chartered by A. L. Sweet, Walter Famer and E. E. Jones. The company is capitalized at $65,000 and proposes to construct and operate a railway from Thayer to Thayer Junction, Ill.

EVANSVILLE, IND.—The Evansville Public Service Company has been incorporated for the purpose of establishing and operating a central electric light, power, steam and hot-water plant in this city. The company promises to furnish electricity at 7½ cents per kw-hour, a reduction of 25 per cent from the present rates paid by the city and private consumers. The plan is to supply the business districts with steam heat and the resident sections with hot-water heat. The city is to receive 50 per cent of the net earnings of the company after deducting 6 per cent on the capital stock invested. The company is to be capitalized at $1,000,000. Work on the plant will commence early next spring.

SYRACUSE, IND.—The Syracuse Power & Light Company has filed articles of incorporation with the Secretary of State with a capital stock of $50,000. The object of the company is to supply light, heat and power in Kosciusko and Elkhart counties. The directors are: J. P. Dolan, L. A. Neff, H. D. Boozer, Charles Crow and A. B. Dolan. This company has constructed a dam in the Elkhart River and is reported to be generating electricity and distributing the same to farmers and townspeople in Syracuse and other towns nearby. The line in operation is six miles in length, but this will be extended to take in additional territory.

IOWA CITY, IA.—Articles of incorporation have been filed for the Iowa City, Ottumwa & Southeastern Electric Railway Company by S. J. Smith, Roscoe Wilson, Frank Farmer, of Iowa City, Ia., and G. P. Peterson, of Pierre, S. D. The company is capitalized at $2,500,000 and proposes to construct an electric railway 80 miles in length, connecting Iowa City and Ottumwa, Ia. Under its charter the company is authorized to furnish electricity to towns along the route of its railway.

PORTLAND, IA.—Articles of incorporation have been filed for the Pleasant Hill Telephone Company with a capital stock of $10,000 for the purpose of constructing and operating a telephone system. The officers of the company are: Grant McDowan, president; F. M. Brown, vice-president; J. S. Wilcox, secretary, and Henry Siewertsen, treasurer.

FREEBORN, MINN.—The Freeborn Telephone Exchange Company has filed articles of incorporation with the Secretary of State with a capital stock of $5,000. The incorporators are: Fred Feine, A. E. Gilmore and J. B. Purdue.

TINTAH, MINN.—The Tintah Telephone Company has been incorporated with a capital stock of $10,000 by G. W. Mace, J. R. Davidson, M. E. Coleman, J. P. Dahlquist and others.

KALISPELL, MONT.—The Root Mountain Water Power Company has been incorporated with a capital stock of $100,000 by N. Farrar and others. The company proposes to develop water power in the Flathead Valley to be utilized to generate electricity.

LEWISTOWN, MONT.—The Spring Creek Power & Electric Company has been incorporated to construct electric power plants and railways, etc.

SANTA FE, N. M.—Articles of incorporation have been filed for the Montana Power & Irrigation Company with a capital stock of $100,000. The directors are: G. F. Flick, F. C. Wilson and J. A. Massie.

LONG BEACH, N. Y.—The Long Beach Power Company has been incorporated with a capital stock of $200,000 by L. G. Wallace and A. B. Cadley, of Brooklyn, N. Y., and G. G. Fry, of Mamaroneck, N. Y. The company proposes to furnish electricity for lamps, heat and motors.

PARK RIVER, N. D.—The Park River Telephone Company has filed articles of incorporation with a capital stock of $20,000. The incorporators are: John A. Dunn, T. F. Waugh, E. Thornberg and others, of Park River, N. D.

VERMILLION, OHIO.—Articles of incorporation have been filed for the Farmers' Telephone Company, of Vermillion, with a capital stock of $10,000. The Bell Telephone Company has erected an exchange from which telephone lines will be extended through the corporation and township. The incorporators are: G. W. Shattuck, M. D. Power, W. J. Newburg, G. E. Leiber and H. W. Church.

THOMAS, OKLA.—The Farmers' Telephone Company has been chartered with a capital stock of $5,000 by W. A. Mechel, S. J. Hendry, T. C. Cooke and J. S. Houston and others, all of Thomas.

WOLF (P. O. MAUD), OKLA.—The Wolf Telephone Company has been incorporated with a capital stock of $2,000 by J. W. Villenes, S. W. Snyder, L. B. Kirker, J. D. McCraw and W. A. Cope, of Maud.

EUGENE, ORE.—The Eugene Heating & Electric Power Company has been incorporated by S. H. Friendly, J. D. Matloch and Eli Bang, with a capital stock of $15,000.

LEBANON, PA.—The Richland Electric Company has been incorporated with a capital stock of $5,000.

McKEESPORT, PA.—Articles of incorporation have been filed for the McKeesport Belt Line Street Railway Company for the purpose of constructing a street railway on the outskirts of McKeesport, two miles in length. The company is capitalized at $12,000 and the directors are: S. D. Foster, president; D. A. Foster, A. D. Foster and W. E. Hartman.

WILKESBARRE, PA.—The Wilkesbarre Railway Company has been chartered with a capital stock of $10,000 to construct and operate electric and cable railway.

BROOKINGS, S. D.—The Brookings County Telephone Company has been incorporated to take over the plant and holdings of the Thompson, Caldwell & Wilson Telephone Company.

AUSTIN, TEX.—Articles of incorporation have been filed for the New Sweden Telephone Company, of New Sweden, Travis County, with a capital stock of $3,500 by J. A. Stroburg, E. L. Landahl, A. F. Anderson and others.

WESTBY, WIS.—The Timber Conlie Co-operative Telephone Company has been incorporated with a capital stock of $680 by Torval Overhagen, Ole J. Dahl, Carl Clementson, Olaf Peterson and Amund H. Lund.

Personal.

MR. W. W. BRIGGS, manager of the San Francisco office of the Westinghouse Electric & Manufacturing Company, has gone to Honolulu on a business trip.

MR. F. V. T. LEE, assistant general manager of the Pacific Gas & Electric Company, of San Francisco, is absent on a two months' sea voyage. He will return from Australia early in January.

MR. RALEIGH C. THOMAS, city surveyor of Baltimore, Md., is being prominently mentioned for the position of assistant electrical engineer of that city. Mr. Thomas was formerly connected with the electrical commission, or subway department.

MR. A. T. THORP has been appointed resident engineer for the Herkimer County Light & Power Company at Little Falls, N. Y., to fill the vacancy caused by the resignation of Mr. H. F. Dennis, who has entered the employ of the Southern California Edison Company, Los Angeles, Cal.

MR. HUGH C. BAKER, who owned the first telephone exchange in Canada and who obtained the original charter for the Bell Telephone Company of Canada, has retired from the position of manager of the Ontario department, which he has held since 1880, to become special agent for the company.

MR. T. W. BORTHEN, of Trondhjem, Norway, has been appointed superintendent of the new 120,000-hp power station of the Rjulsanfos Company, now under construction at Rjulsan, Norway, and recently described in these columns. Mr. Borthen is at present in charge of the construction of a hydroelectric power station for the municipal electricity works of Trondhjem and will enter on his new work about Jan. 2, 1910.

MR. WILLIAM A. HOUSE, president of the United Railways of Baltimore, is taking an interest in the Red Cross stamp movement. By his order a placard was placed on the front of each car which bears the inscription "Everybody Helps," and below this is a picture of the stamp itself. The Chesapeake & Potomac Telephone Company is also helping the cause.

MR. EDWARD R. TAYLOR delivered an address before the New York State Waterways Association at Albany on December 1 entitled "Co-ordination of Water Interests." He advocated the storage of water

for canal purposes, the surplus being used for generating electrical energy, and mentioned the possibility of manufacturing finished products from the raw materials while in transit along the canals.

MR. T. C. MARTIN, executive secretary of the National Electric Light Association, will deliver an address on "The Status of Our Electrical Art" on Dec. 16, at St. Louis, before the League of Electrical Interests, of which Capt. Robert McCulloch is president and Mr. Walter Robbins secretary. This body formed not long ago to unify the electrical interests of the city and promote the common welfare, and a large and growing membership.

MR. ARTHUR WILLIAMS presided as host at a very interesting little banquet given at the Union League Club, New York, on Dec. 9. Among those present were Mr. Thos. A. Edison, as guest of honor, and Mr. Edward H. Johnson, the latter of whom spoke, although there were no formal speeches. The room was most tastefully converted into an electrical arbor by Singer, and the dinner was followed by a program of excellent vaudeville. On the ménu were clever outline portraits of the guests.

DR. A. E. KENNELLY is the author of a paper on "The Equivalent Circuits of Composite Lines in the Steady State," which appears in the November issue of the *Proceedings* of the American Academy of Arts and Sciences. The current volume of the *Proceedings* of the American Philosophical Society contains a paper by the same author entitled "The Linear Resistance between Parallel Conducting Cylinders in a Medium of Uniform Conductivity."

MR. G. LOUIS BOSSEVAIN. of the New York banking firm of Kean, Van Cortland & Company, has been elected president of the Netherlands Tramways Corporation, to succeed Mr. Henry J. Pierce, resigned, and Mr. W. Barklie Henry, of Philadelphia, has been elected vice-president, in place of Mr. Bossevain. The company, which is incorporated in Connecticut, owns all the street railways of Haarlem, Holland; a line from that city to Zandvoort, on the North Sea, next to Scheveningen, the largest Dutch seaside resort, and a line from Haarlem to Amsterdam.

MR. W. C. WEBSTER, manager of the Westinghouse Electric & Manufacturing Company in New York, has resigned his position and will probably terminate his connection with the company about the first of the year. Mr. Webster's experience with the Westinghouse interests has been quite varied and extensive for the past 12 years. His first position was in the sales department at East Pittsburgh. He later became assistant vice-president, with headquarters in New York, and for the last few years has been the New York manager, having in charge the New York end of the company's business. Mr. Webster as yet has made no plans for the future.

Trade Publications.

TUNGSTEN LAMPS are briefly described in leaflet No. 3766 of the General Electric Company, Harrison, N. J.

DRAWING TABLES for the use of contractors, manufacturers, technical schools, etc., are illustrated and described in a 48-page catalog of the Economy Drawing Table Company, Toledo, Ohio.

POLYPHASE MOTORS.—The Wagner Electric Manufacturing Company, St. Louis, Mo., has issued bulletin No. 89 dealing with automatic acceleration polyphase induction motors which are fully described and illustrated.

LIGHTNING ARRESTERS, of the automatic fusible type. arranged for handling successive discharges without heating, are well described in a booklet of the Automatic Fusible Lightning Arrester Company, Colorado Springs, Col.

CENTRIFUGAL PUMPS, well arranged for operation by electric motors, steam or water turbines, gas or steam engines, are thoroughly discussed in catalog C of the Alberger Pump Company, 95 Liberty St., New York.

HOLIDAY SUGGESTIONS—The Central Electric Company, Chicago, Ill., has issued a new 12-page booklet entitled "Holiday Suggestions," which describes a complete line of Christmas tree outfits, toys, vibrators, electrical heating devices, etc.

LAMP FOR WHITE LIGHT.—The Moore Electrical Company, 169 Malvern Street, Newark, N. J., has issued booklet No. 22 devoted to its vacuum-tube lamp which gives white light. It is said that this lamp is without a rival for location where colors are to be matched and that it is being widely introduced in the textile industry.

RYERSON'S REFERENCE BOOK.—Joseph T. Ryerson & Son, of Chicago, have issued a new edition of "Ryerson Reference Book," which is a comprehensive list of iron and steel specialties and machinery carried by that house. The book contains 364 pages and embraces in compact form a great deal of information useful to engineers, architects, contractors and others interested in iron and steel products.

MOTOR FIELD RHEOSTATS.—The Ward Leonard Electric Company devotes sections of its new perpetual catalog to motor field rheostats and to motor field rheostats equipped with no-voltage release. There is also shown a small panel, for use with variable speed motors, consisting of a snap switch and fuses and a no-voltage release field rheostat, the arrangement being intended for use where starting resistance is not used, and the entire speed control is by field regulation.

MULTILETS.—The Sprague Electric Company is sending out a folder (No. 434) describing and listing its line of stamped steel knock-out boxes known as "Multilets." As the name implies, one box is intended for many uses. The boxes are made in two sizes with a set of covers for each size, and can thus be used for any necessary combination with rigid conduit and Greenfield flexible steel conduit. They accommodate standard fittings and do not require special fittings for special work.

SMALL POLYPHASE MOTORS.—Bulletin No. 4691, issued by the General Electric Company, describes motors for use in connection with the smaller machines found in machine shops. Accompanying this bulletin is a diagram giving the dimensions of the motors of various sizes, the horse-power rating, synchronous and full-load speeds. This publication describes both single-phase and polyphase motors of types which can be arranged for use not only in a horizontal but in a vertical position.

LAUNDRY MOTORS.—"Motor Drive in the Laundry" is the title of publication No. 117, recently put out by the Crocker-Wheeler Company, of Ampere, N. J. The application of electric motor drive to laundry machinery has brought about greater cleanliness, better light, saving in power, increased output, saving in repairs, greater comfort to employees and greater flexibility of location of machines. The pamphlet is profusely illustrated with halftone engravings and many of these tell the story in themselves.

SYSTEM OF UNDERGROUND TRANSMISSION.—The Dielectric Company of America, Belleville, N. J., has issued a bulletin describing its system of underground transmission for power and lighting circuits. The essential and distinctive features of the system are the compound and insulators with their supports. The conductors are held on special porcelain insulators in a wooden box or trough, and are surrounded with "Dielectric." Bare copper is used, and the box serves merely as a mold or form for the insulating compound. The system is said to be applicable for any length of line and for any voltage.

FEED-WATER FILTRATION.—James Biggs & Company, 109 Liberty Street, New York, have issued a new, enlarged edition of "Feed Water Filtration," which explains how oil, dirt, etc., get into feed water, what damage they do within the boilers, and how to remove such impurities before this can occur. It shows how water of condensation and returns from heating systems may safely be used to cut down the coal and water bills, and explains the advantages and disadvantages of various methods of filtration. The Blackburn-Smith feed-water filter and grease extractor is described in detail.

Business Notes.

THE TREBERT GAS ENGINE COMPANY has moved its factory from Rochester, N. Y., to Butler, Ind. The new plant has a greatly increased capacity and is more centrally located to handle business.

THE TUNGSTOLIER COMPANY, Cleveland, Ohio, at a recent meeting elected the following officers: E. J. Kulas, president; W. H. Wissing, vice-president and general manager; T. M. Roche, secretary and field manager.

THE NEWHUB ELECTRIC COMPANY, of 227 West Exchange Street, Akron, Ohio, announces that it will hereafter conduct in its name the business formerly carried on by the Union Manufacturing Company. of Akron, Ohio.

P. E. CHAPMAN, who has purchased the business of the J. G. Barr Electric Company and the Geo. T. Dougherty Electric & Manufacturing Company, has moved his office from 17 North Tenth Street to the northeast corner of Tenth and Walnut Streets, Philadelphia.

EDWARD J. O'BEIRNE & COMPANY, Elgin, Ill., consisting of Edward J. O'Beirne, M. H. O'Beirne and C. G. Harper, has succeeded to the engineering business of Edward J. O'Beirne and the contracting business of the General Contracting Company. The firm controls the Gainesville Electric Company, of Gainesville, Texas, and Washita Electric Power Company, of Pauls Valley, Oklahoma, and will manage the plants of both companies.

DIAMOND RUBBER CHICAGO BRANCH.—The complete stock of rubber-covered wires and cables of the Diamond Rubber Company, which has been carried for some time at 211 Lake Street, has been transferred to the regular Chicago branch of the Diamond Rubber Company, located at 1523 Michigan Avenue. This stock includes practically the complete line of 30 per cent para, red-core and black-core, lead-encased cables, igniter cables, etc. Mr. W. I. Morrow, formerly of the Akron office, is in charge.

STERLING ELECTRIC COMPANY.—Mr. Thomas Duncan, managing director of the Duncan Electric Manufacturing Company and the Duncan Electric Transformer Company, of Lafayette, Ind., has been elected president of the Sterling Electric Company to succeed Walter Doolittle, resigned. Mr. Duncan has been a stockholder in the Sterling Electric Company for some time, has a wide acquaintance in the electrical world and is the inventor of a number of electrical devices. The Sterling Electric Company employs 400 men.

PARTRICK, CARTER & WILKINS COMPANY, Philadelphia, the old-established manufacturers of annunciators, burglar alarms, bells and other electrical house goods, has removed its general offices and salesrooms from Twenty-second and Wood Streets to 122 North Eleventh Street.

The factory will remain where it is, and the moving of the offices and salesrooms will give largely increased factory space. The office and salesrooms are now more centrally located for the convenience of architects and others who desire to show the apparatus in practical operation to their clients. The firm is also selling agent for the line of fire alarms, district boxes, etc., made by the Viaduct Electric Company, Baltimore.

THE WEST STEEL CASTING COMPANY, Cleveland, Ohio, which for the past three years has built up a large trade in medium and small steel castings made by the converter process, has lately enlarged its plant and is now installing crucible furnaces which will supply special small castings demanded by the automobile and general trade. The converter metal will be utilized as heretofore for casting of "West's electrical steel," which is largely used for dynamo frames and other electric castings. This same metal is also found valuable on account of its good strength and ductility for blank gears and general steel castings. The officers of the company are: Ralph H. West (son of Mr. Thos. D. West), president; Everett W. Pike, vice-president, and David P. Lansdowne, secretary.

KEELER BOILERS.—The E. Keeler Company, of Williamsport, Pa., has been awarded the contract by the Pennsylvania Railroad Company for three 408-hp Keeler water-tube boilers, built for a working pressure of 180 lb. per square inch. These boilers will be equipped with Green chain grate stokers, and the setting will be especially designed for this installation for the elimination of smoke in burning soft coal. The contract includes a self-supporting steel stack lined with brick throughout its height, together with the smoke flues and the brick settings for the boilers. This equipment will be installed in the new classification yards at Northumberland, Pa. An order has also been received from the United States Engineer Office at Boston, Mass., for three 150-hp water-tube boilers, to be installed in fortifications at Manila. These boilers will be equipped with superheaters. This contract follows a contract for six boilers which was placed early in the year. These boilers are now being installed at Fort Scott, Cal.; Fort Stevens, Ore., and Fort Casey, Wash. The Keeler company has also been awarded the contract for one 500-hp water-tube boiler for the water department for the city of Fort Worth, Texas.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 7, 1909.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y.]

942,046. PROCESS OF GENERATING AND STORING OZONE; F. M. Ashley, New York, N. Y. App. filed Dec. 15, 1906. Compresses oxygen, cools it, passes it into a chamber in which it receives an electric discharge and then delivers the ozone into a storage tank.

942,050. MOTOR CONTROLLING DEVICE; T. E. Barnum, Milwaukee, Wis. App. filed March 14, 1907. For automatically reversing the motor at intervals for use with washing machines by means of two drum sections on a shaft insulated from each other; contact sections carried by each drum and stationary contact fingers engaged by the contact sections.

942,068. ELECTRIC FURNACE WITH RAISED CHARGING PIT; A. Helfenstein, Vienna, Austria-Hungary. App. filed June 12, 1909. An electric furnace with a raised charging pit with openings in the roof which are closed by removable sand-sealed covers.

942,086. SUPPORT AND INSULATOR; E. F. Lindsay, Pringle, S. D. App. filed April 10, 1909. A divided support and insulator for electric conductors which holds them without tie wires by means of a block having a concave face.

942,091. HARMONIC SIGNALING SYSTEM; R. H. Manson, Elyria, Ohio. App. filed Feb. 8, 1906. Makes use of a source of current delivering energy in successive waves and boosts the available e.m.f. for each recurring wave. Uses an alternating-current translating device, a main source of current supplying energy in flattened waves and a supplemental source impressing synchronous accentuating waves in the circuit.

942,110. ELECTRIC FURNACE; F. T. Snyder, Oak Park, Ill. App. filed Sept. 25, 1906. For smelting ores in which an iron water jacket is used and a tap opening near the top of the crucible with a tube of heat insulating material extending through the wall of the crucible.

942,143. CATENARY SUSPENSION SYSTEM FOR THE TROLLEY WIRES OF ELECTRIC RAILWAYS; K. Von Kando, Vado Ligure, Italy. App. filed Oct. 2, 1908. A supporting arm, an insulator thereon and an intermediate member carried by the insulator to which the suspending wire is adjustably secured.

942,156. GRID RESISTANCE; H. J. Wiegand, Milwaukee, Wis. App. filed March 29, 1909. A grid having portions designed to be engaged by portions of the reinforcing members. Carries lugs with a reinforcing strip covering the edge and having portions bent around the lugs.

942,157. VAPOR ELECTRIC APPARATUS; H. I. Wood, Schenectady, N. Y. App. filed Jan. 18, 1904. A tubular exhausted envelope containing electrodes, a filament extending between them and a coil for magnetically attracting the filament to lift it out of contact with one of the electrodes.

942,186. MAGNETIC CLUTCH; H. W. Ravenshaw, Hanwell, England. App. filed Feb. 28, 1907. An annular electromagnet with annular keeper and an intermediate element having two rings of magnetic material secured together by a flexible ring of non-magnetic material.

942,187. MAGNETIC CLUTCH; H. W. Ravenshaw, Hanwell, England. App. filed Jan. 14, 1908. An annular electromagnet and an annular keeper, consisting of an open ring and a concentric ring sliding in the opening of the open ring.

942,188. MAGNETIC CLUTCH OR BRAKE; H. W. Ravenshaw, Hanwell, England. App. filed March 17, 1908. A magnetic clutch or brake with a boss connecting the driving and driven shaft. Sliding dogs on the boss and a magnetizing coil surrounding them.

942,195. SIGNAL CONTROLLING APPARATUS; W. M. Chapman, Needham, Mass. App. filed April 25, 1908. Contacts arranged to be closed by the trolley of the car and contacts including an insulated rail section closed by the wheels of the car with a signal circuit including both sets of contacts in series.

942,196. APPARATUS FOR CONTROLLING ELECTRIC MOTORS; Harry E. Dey, Jersey City, N. J. App. filed Aug. 6, 1908. A dynamo with a stationary and rotary element, a second dynamo with both elements rotary, one of which is connected mechanically to the rotary element of the first dynamo and a resistance for the field magnet and a counter resistance operated with the load.

942,197. APPARATUS FOR CONTROLLING ELECTRIC MOTORS; H. E. Dey, Jersey City, N. J. App. filed Aug. 8, 1908. Two dynamo-electric machines with one moving element of each machine mechanically connected to the moving element of the other and with the series wire of the field magnet of each machine in circuit with the armature of the other machine.

942,198. APPARATUS FOR CONTROLLING ELECTRIC MOTORS; H. E. Dey, Jersey City, N. J. App. filed May 21, 1909. A number of dynamos, a rheostat for varying the field strength and a pilot [illegible] the action of a [illegible] the operation the rheostat.

942,207. PROCESS OF TREATING THE SPENT LIQUOR OF PAPER MILLS; I. Kitsee, Philadelphia, Pa. App. filed Feb. 20, 1903. Subjects the spent liquor to an electric current in the positive compartment of an electrolytic apparatus, the negative compartment containing a second conducting fluid.

942,208. DUPLEX CABLE TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed May 20, 1908. A duplex telegraph in which the receiver includes a transformer with the primary in the line, a receiving instrument controlled by the transformer secondary and a third winding on the transformer for neutralizing the effect of the impulses in the transformer secondary.

942,240. PLURAL LAMP-HOLDING DEVICE; R. B. Benjamin, Chicago, Ill. App. filed Aug. 5, 1907. A plurality of radial legs, each carrying an insulating block, the blocks carrying electric contact and lamp-holding devices with a casing enclosing the blocks and devices, the casing having registering openings.

942,241. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Dec. 28, 1907. A casing for holding lamps, separate outer contacts for the holding means, a separate binding terminal for each contact, a continuous center contact with a binding terminal and a base, which is removable independently.

942,242. PLURAL LAMP-HOLDING DEVICE; R. B. Benjamin, Chicago, Ill. App. filed Dec. 28, 1907. A casing with a back plate and a bowl-shaped shell having lamp openings, an insulating bushing in each, a threaded socket shell in each bushing, an insulating base within the bowl-shaped shell, a contact carried by the base, the shells being electrically connected.

942,248. AUTOMATIC SELF-INDICATING FUSE; F. B. Cook, Chicago, Ill. App. filed March 1, 1909. The fuse is made with a hollow end cap which holds a spring under tension so that when the fuse melts the spring mechanism indicates the disruption of the wire.

942,255. BLOCK SIGNALING SYSTEM FOR RAILWAYS; J. Gaszper, Cleveland, Ohio. App. filed April 29, 1909. Automatically operated by moving trains so as to produce a continuous vibratory and flashing signal and a continuous visual signal when the train is within the block.

942,264. BRUSH HOLDER; A. Kimble, Chicago, Ill. App. filed March 22, 1909. A movable contact with a brush bearing thereon and a ring between the brush and contact with means for releasing the spring when the brush has been worn to a certain extent.

942,279. STORAGE BATTERY; D. P. Perry, Chicago, Ill. App. filed Oct. 12, 1903. A metallic cell, a horizontal cylindrical reticulated negative pole electrode, a cylindric positive electrode within the negative electrode and a cylindric conductor within the positive electrode.

942,308. IRON HEATED BY ELECTRICITY; J. Collicott, Salt Lake City, Utah. App. filed June 8, 1909. An electrically heated flat iron with an adjustable heating unit to which the electric wires are locked.

942,325. ELECTRIC GENERATOR; G. A. Huber, New York, N. Y. App. filed Feb. 10, 1908. A magneto with a fly wheel which drives the generator through a ratchet and pawl connection.

942,332. ELECTRICAL CONDUCTOR; I. Kitsee, Philadelphia, Pa. App. filed April 10, 1908. For telephone currents and the like, comprising conductively independent conductors arranged together, the resistance of the conductors being half of that between the conductors, and the mutual capacity twice that of the absolute capacity of the conductors.

942,334. MECHANICAL CODE SIGNALING DEVICE; F. A. Meissner, Manchester, Va. App. filed Dec. 11, 1908. For party line telephones in which a plate carries circuit breakers and a circuit closer has a pin which contacts with the plate and also a spring-pressed collar with means for sliding the plate for moving the breaker over the pin and means for disengaging the collar from the edge of the perforation in the plate when the plate reaches the end of its stroke.

942,349. PROCESS OF PRODUCING FERRO ALLOYS; E. F. Price, Niagara Falls, N. Y. App. filed June 1, 1907. Electrically smelts a finely divided charge of a metal compound, a reducing agent and a source of iron and surrounds and protects the reduction zone by a considerable body of the charge, withdrawing the gases beneath the surface of the charge.

942,350. ELECTRIC FURNACE; E. F. Price, Niagara Falls, N. Y. App. filed Jan. 27, 1908. An open vessel, oppositely arranged electrodes extending therein and a stack between the electrodes so that the air current flowing through the stack passes next to the electrodes.

942,378. VAPOR ELECTRIC APPARATUS; L. E. Dempster, Schenectady, N. Y. App. filed March 19, 1904. A plurality of mercury electrodes, a filamentary conductor initially connecting them with means for moving the conductor to break the connection, first at the negative electrode and then at the positive electrode.

942,382. MOTOR CONTROLLER; A. Kimble, Chicago, Ill. App. filed Sept. 7, 1909. For stopping, reversing and controlling a single-phase, alternating-current commutator motor by means of a brush-holder ring which carries brushes bearing upon the commutator and a series of stationary contacts engaged by contact members carried by the ring.

942,396. ELECTRIC DRILL; P. J. Lincoln, Birmingham, Ala. App. filed Nov. 18, 1908. A central field coil with a field coil on each side of the center and an end field coil for each side coil, an armature mounted to reciprocate between them with a drill rod carried by the armature.

942,433. ALARM APPARATUS; H. R. Bretney, Indianapolis, Ind. App. filed Jan. 11, 1909. An alarm apparatus with an indicator including an electromagnet with two coils each with an independent terminal and a brush adapted to be brought into engagement with the terminals.

942,463. METHOD OF AND MEANS FOR REGULATING THE SPEED OF ELECTRIC MOTORS; R. H. Rogers, Schenectady, N. Y. App. filed Aug. 5, 1908. The motor has two field windings and one of the field circuits is kept open when the motor is heavily loaded and closed when it is lightly loaded.

942,468. AUTOMATIC SIGNALING SYSTEM FOR RAILWAYS; G. H. Sloane, Boston, Mass. App. filed May 26, 1908. At each end of the block a semaphore is arranged controlled by a pair of solenoids, which are controlled by a switch shifted by the agency of the car as it approaches the block.

942,488. CONTROLLER FOR ELECTRIC AUTOMOBILES; H. P. Dodge, Toledo, Ohio. App. filed June 5, 1909. A hollow steering shaft for automobiles and a steering handle connected therewith with a case supported by the staff and an electric make and break in the case.

942,491. ELECTRIC SWITCH; W. L. R. Emmet and E. M. Hewlett, Schenectady, N. Y. App. filed Feb. 14, 1901. A base, a movable contact, an actuator, a latch engaging it to lock it to the base, a latch for locking the contact member to the actuator, an electro-responsive means for unlocking the contact member from the actuator.

942,497. SPEEDOMETER; W. R. Harris, Irvington-on-the-Hudson, N. Y. App. filed July 28, 1908. A contact member carried by the pivotal end of a rotating stem with a hand on a shaft making contact therewith during a part of the registering movement thereof. Provides an electric alarm which may be adjusted to give a signal when the vehicle is traveling too fast.

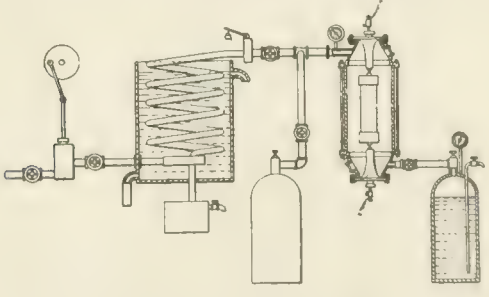
942,508. ELECTRIC CIRCUIT CONTROLLING RELAY; B. Menkin, New York, N. Y. App. filed Feb. 3, 1909. Automatic relay for burglar alarm, in which two circuits are energized from a common source, a third circuit includes a translating device, the first circuit controlling the second and the second the third.

942,513. SINTERING APPARATUS; R. Palmer, Larchmont, N. Y. App. filed Feb. 10, 1909. For welding highly refractory metals like tungsten by compressing the fine metal power into a mold, supplying gas thereto and then passing an electric current therethrough. Water-cooled clamps hold the material to be treated.

942,544. ELECTRIC TRANSFORMER AND GOVERNOR; E. R. Cliff, New York, N. Y. App. filed March 5, 1908. For regulating the strength of current in series arc systems by means of a transformer with a movable coil, the equilibrium between the primary and secondary coil being disturbed which produces the regulation as the load changes.

942,555. ELECTRIC RESISTANCE APPARATUS; M. Hankin, Brussels, Belgium. App. filed Jan. 5, 1909. The powdered resistance material is contained within a case between two terminals, rusty particles of cast iron filling the cases.

942,620. ELECTRIC TELEGRAPHY; J. A. L. Dearlove, London, Eng. App. filed March 1, 1908. For duplexing cables in which the artificial cable is made independent of variations in temperature. The cable is in strip form, having a negligible temperature coefficient, a series of inducing sheets attached thereto, earth plates and dieletric arranged between the conducting and inducing sheets.



942,046—Process of Generating and Storing Ozone.

942,623. AUTOMATIC CUT-OFF; P. Dixon, Atlanta, Ga. App. filed Dec. 20, 1907. For use with incandescent lamps which are automatically cut-off, even though forgotten by the user, from one minute to three hours after leaving it.

942,676. SIGNALING SYSTEM; F. E. Smith, Ames, Iowa. App. filed July 24, 1908. The train sets a distance signal on entering the block and clears it on leaving the block, and a series of controlling circuits are provided, including a trolley conductor, a signal, a movable electro magnet directly actuating the signal, and fixed electro magnets cooperating therewith to reciprocate the movable magnet in the line of travel of the vehicle.

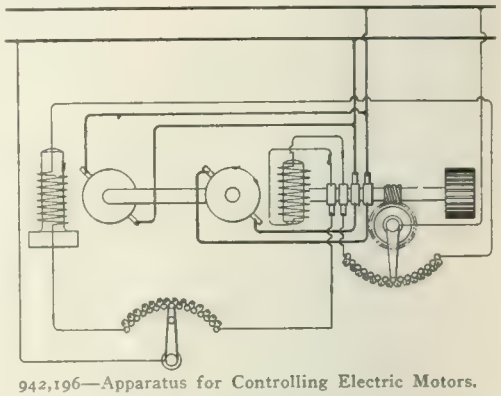
942,704. METHOD OF SECURING METAL CONTACTS TO CARBON ELECTRODES; S. Benko, Budapest, Austria-Hungary. App. filed July 8, 1909. Method of attaching metal contacts to carbon electrodes by heating the head portion of the electrode above the melting point and saturating it with molten metal which is absorbed by the heated carbon.

942,710. CONNECTION ROSETTE FOR ELECTRIC WIRES; J. L. Burton, Plainville, Conn. App. filed July 25, 1908. The fixed base has eccentric grooves carrying contacts and the removable member has curved projections engaging therewith with contact pieces conforming to the projections.

942,722. CONTROLLER REGULATOR; C. M. Feist, Sioux City, Iowa. App. filed June 5, 1909. A controller regulator having a pocket with a depression in the bottom wall with a dog pivoted in the pocket and arranged to drop into the pocket upon injury to its pivot.

942,729. ELECTROLYTE AND METHOD OF ELECTRODEPOSITING NICKEL; E. F. Kern, Knoxville, Tenn. App. filed Sept. 7, 1909. Electrolizes a solution containing fluosilicate of nickel.

942,730. FLAMING ARC-LAMP; G. L. Martin, Brooklyn, N. Y. App. filed Feb. 17, 1909. Feed mechanism for arc lamps, including a rod with feet and a plurality of cams with means for causing the rod to move upwardly and permitting the same to move downwardly and adjustable brackets engaging the cam to move the rod laterally to disengage the pawl.



942,196—Apparatus for Controlling Electric Motors.

942,767. TROLLEY-WHEEL; H. L. Baylies, Chicago, Ill. App. filed April 9, 1909. The hub of the trolley wheel has a concave body serving as an oil chamber and roller bearings are arranged between the inner and outer bearing bodies.

942,787. FLEXIBLE CONDUIT; C. H. Miller, West Pittsburgh, Pa. App. filed July 25, 1907. A non-metallic flexible conduit with a smooth inner layer and a tubular braided fabric surrounding it saturated with fireproof material and a spiral strip of paper surrounding the fabric.

942,788. CONDUIT FOR ELECTRIC WIRES; C. H. Miller, West Pittsburgh, Pa. App. filed July 25, 1907. A flexible conduit having an interlining of woven strips, the weft and warp strips being spirally wound in opposite directions.

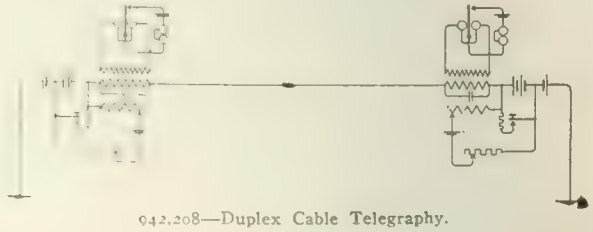
942,789. FLEXIBLE ELECTRIC CONDUIT; C. H. Miller, West Pittsburgh, Pa. App. filed July 25, 1907. Flexible conduit with a woven tubular fabric and a flexible spirally wound wooden strip.

942,790. FLEXIBLE CONDUIT FOR ELECTRIC WIRES; C. H. Miller, West Pittsburgh, Pa. App. filed July 25, 1907. A flexible non-metallic conduit consisting of an inner air and water-tight flexible tube surrounded by a spiral wrapping of paper which is surrounded by a muslin wrapper and this is surrounded by a braided fabric.

942,807. TELEGRAPHIC REPEATING APPARATUS; W. E. Athearn, New York, N. Y. App. filed June 12, 1909. A telegraph repeater with two sections, each comprising a pole changer, a polar relay operable by the pole changer with one section, a neutral relay controlled by the pole relay, extra contacts upon the pole changer and a repeating sounder controlled by the contacts and controlling the neutral relay.

942,814. MULTIPLEX TELEGRAPH; S. D. Field, Stockbridge, Mass. App. filed June 17, 1909. Main and artificial lines, a differentially wound relay with one winding in the main line and the other in the artificial line and the other relay with the coils in the main and artificial lines in bridge relation with the first relay and with an inductive capacity greater than the main line and artificial line coils of the first relay.

942,815. RELAY; S. D. Field, Stockbridge, Mass. App. filed June 17, 1909. For multiplex telegraphs. Has a movable armature, a main electromagnet and a holding electromagnet therefor and an auxiliary electromagnet acting in the same direction of the holding magnet.



942,208—Duplex Cable Telegraphy.

942,844. AUTOMATIC TELEGRAPH; L. M. Potts, Baltimore, Md. App. filed July 6, 1905. Page printing telegraph, in which the sending forms consists of a sheet of paper carrying perforations and the transmitter is a polarized relay and segmental ring forming a sending commutator, the brushes being driven by a motor. The receiving circuit includes a main relay and receiving commutator, and controls printing magnets.

942,867. MAGNETIC CLUTCH; H. W. Ravenshaw, Hanwell, England. App. filed Feb. 28, 1907. A driving and driven shaft, an annular electromagnet with annular keeper and intermediate element through which the magnetic circuit is completed back through the shaft.

942,871. VAPOR ELECTRIC APPARATUS; H. I. Wood, Schenectady, N. Y. App. filed Dec. 17, 1903. A starting device for vapor lamps of the horizontal type by means of an electromagnet which causes an arc started from one electrode to shift to another by disengaging one end of the filament and the electrode on which it rests.

942,874. ELECTRIC HEATER; G. E. Stevens, Lynn, Mass. App. filed May 29, 1907. An electric fluid-heating device in which the fluid is delivered under pressure with means controlled by the pressure for admitting fluid and closing the circuit of the heater.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Thursday of the same week.

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Wireless Telegraph Regulation.

Representative Roberts, of Massachusetts, has introduced in the House at Washington a resolution, as noted elsewhere, providing for a board to govern the operation of wireless tele graph stations, afloat and ashore. We most sincerely hope that Congress will give effect to the resolution, for the need of some kind of regulation of the use of the ether has become a crying one. As pointed out by Representative Roberts, the abuse of the present freedom of wireless operation on the part of amateurs is abominable, not only through interference with commercial working but, not infrequently, in violation of decency. Reference might also have been made to malicious interruptions of transmission by commercial rivals—occurrences happily now less frequent than formerly. One feature of the resolution that deserves particular commendation is that providing for a non-military majority on the proposed board. Usually proposals for wireless regulation have been based upon the assumption that the ether is an appanage of war, and that since in time of peace nations should prepare for war, the military control should at all times be supreme. The proposed board would doubtless give little countenance to any proposition that would confer precedence on a social message from a military source over communications relating to the business of the world.

Vector Diagrams of Polyphase Windings.

The subject of polyphase armature windings has received a new impetus of recent years, owing to the use of polyphase generators for the supply of single-phase currents to electric railway systems. The conditions are here somewhat peculiar, because in order to supply a polyphase system, a polyphase generator is necessary, while in order to supply a single-phase system, a single-phase generator is not necessary, a polyphase generator being available. In this case, the choice between a single-phase and a polyphase generator is a matter of expedience, cost and incidental utility. The article by Mr. M. V. Ayres, on page 1521 of this number, discusses the general case of an armature provided with six slots per pole. Two subtypes of this structure are considered, namely, two full-pitch coils per slot, and one full-pitch coil per slot. As might be expected, the deductions show that the former subtype has the greater flexibility, and is capable of affording a greater variety of combinations.

A number of interesting deductions are reached in the article Salient among them is the proposition that in any polygonally tapped single-reentrant closed armature-winding of full-pitch coils, all designed for the same current strength, the output is the product of that current and the perimeter of the selected polygon inscribed within the e.m.f. vector diagram. This is a beautiful and easily remembered generalization. It shows at a glance how much advantage a polyphase or polygonal tapping has over a simple single-phase or diametral tapping. It also

shows that a quarter-phase or two-phase tapping is superior to a three-phase tapping, in this type of winding used in rotary converters. Moreover, in such windings the quarter-phase system is actually a four-phase system, because within the generator armature there are four currents, of phases a quarter cycle apart. Another salient deduction from the article is that the three-phase connection of coils in the ordinary armature winding is, strictly speaking, not of the three-phase, but of the six-phase type, and enjoys, therefore, the advantage in point of output that the perimeter of a hexagon has over the perimeter of a triangle, when both are inscribed within the same circle. Consequently, the ordinary three-phaser of this type is superior in efficiency to the corresponding two-phaser, although in the closed simply-reentrant arrangement of a rotary converter the case is reversed. It is interesting to see in how many ways a polyphase winding can be connected up to furnish one single-phase alternating current. As regards output, none of them appears to be superior to a diametral connection of a rotary-converter winding; but for particular reasons this form of connection is not the favorite in practice. A certain connection carried across the center of symmetry of a delta winding is advocated in the article as offering special advantages.

Electrical Christmas Presents.

This year, to a greater extent than ever before, electrical dealers are calling the attention of the general public to the desirability of buying electrical appliances as Christmas presents. With a widespread use of electricity in the home there has followed an opportunity of making gifts suitable for either men or women, while there is now available a large stock of electric toys for the children. To some extent this opportunity for an electrical participation in holiday trade is met by general merchants and department stores, but central stations and electrical supply dealers are proving by advertising in the daily newspapers and by the use of other advertising methods that they appreciate this growing demand—a demand which could be still further encouraged, no doubt, by judicious publicity; that is, directing the minds of the public, not only at gift-buying seasons, but at other times, to the manifest advantages of a varied list of electrical conveniences. Only the outer edge of this field has been touched, and the holiday season forms a particularly appropriate time to call attention to what, to the great majority of the people, are still novelties—attractive novelties, no doubt, but still rather apart from the needs and pleasures of daily life. It is to induce the public to consider electrical devices as everyday home comforts, and to remove the impression that they are unduly expensive, that the efforts of electrical dealers should be directed.

It is not difficult to make a list of electric articles suitable for gifts, and no sheet of "Christmas suggestions" should now be complete unless it includes such a list. For the ladies, electric curling irons, little electric flatirons for traveling, electric chafing-dishes, coffee percolators, cereal cookers, toasters or disk stoves, a portable electric lamp, inexpensive or beautifully elaborate; a sewing-machine motor, or even an electric vacuum cleaner, may be considered appropriate. Men will appreciate electric-lighted shaving mirrors, electric shaving mugs, electric cigar lighters (doing away with burnt-match litter), a silk-hat iron and many other articles. Both men and women will find luminous radiators, foot warmers, heating pads, vibrators, ozone generators and the like useful. The children will rejoice in electric corn poppers, Christmas tree outfits and a bewildering array of toys, such as miniature railways, battleships, tiny street lamps and many mechanical devices. There is also the toy transformer, which reduces the e.m.f. of the 110-volt house circuit to the 3, 5, or 8 volts' pressure, or whatever may be required. Of course, the advantage of distributing these current-consuming devices, from the viewpoint of the electrical central-station man, is less the profit on the immediate sale than the prospect of a distinct, if small, increase of the connected load. For this reason the electrical interests themselves should be active in introducing these modern appliances.

Determination of Ratio of Transformation and Phase Relations in Transformers.

In the measurement of alternating current and voltage, current transformers and voltage transformers are often either absolutely necessary or very convenient. By means of such transformers, a few standard measuring instruments can be employed over a wide range of voltage and current. At the same time, the precision of the measurement is affected by the precision with which the ratio of transformation can be assigned. Recently this subject was treated in these columns, and the current number of the *Bulletin* of the Bureau of Standards contains an interesting paper on the ratio and phase of such transformers. The paper defines the ratio of transformation of a potential transformer as the ratio of the primary terminal e.m.f. to the secondary terminal e.m.f. under the particular load applied, and the ratio of transformation of a current transformer as the ratio of the primary to secondary current. These ratios if interpreted vectorially are not mere numerics, but are plane vectors—that is, they involve a phase-angle as well as a numerical magnitude. This phase angle may appreciably affect the measurement in certain cases. It approximates to 180 deg., but may differ therefrom appreciably. Several methods are described for measuring the ratio, and its phase angle, in transformers, and a number of measurements are given in the light of a theoretical discussion.

The effect of placing either non-inductive or inductive load upon a potential transformer is, in general, to increase the ratio of transformation, owing to the drop of pressure in the windings. On the contrary, the effect of an anti-inductive load is ordinarily to diminish the ratio of transformation, as that term is defined in the paper. In the case of a particular level transformer of 500 watts output-rating, the ratio increased nearly 4 per cent between no-load and rated load. On the other hand, a step-down potential transformer of 50 watts rating, 1100/110 volts, operated at 60 cycles per second, showed no appreciable change of ratio when the voltage was halved under constant secondary resistance. A slight decrease in ratio was observed with increase of frequency. As regards the angular phase difference from 180 deg., the measurements reported show that it is ordinarily very small in potential transformers operated at 60 cycles per second. In a particular case, it changed from about half a degree positive to a quarter of a degree negative between no load and rated load. Not far from half load there was no phase difference, or the secondary terminal voltage was

right opposite to the primary terminal voltage. In some of the current transformers tested, there was a very appreciable phase difference between primary and secondary currents. In particular cases, however, with carefully selected apparatus, there was hardly any.

Tungsten Lamp Life.

It has been characteristic of the tungsten lamp ever since brought upon the market that, barring accidental breakages and a certain number of defective lamps which blacken rather quickly, the life of the new lamp in general has been long, and has increased with improvements in manufacture. Life tests made abroad also indicate long life at the usual efficiencies at which these lamps have been burned there. We are now apparently on the eve of a quite natural difference of opinion between the central stations and lamp users on the one hand, and the lamp manufacturers on the other, as to the relative weight to be assigned respectively to life and to efficiency. The central stations and the lamp users naturally want the lamp which will give the lowest cost for light, the cost of energy and lamp renewals both being counted. If, however, a good tungsten lamp has normally a life so long as to result in a considerable reduction of lamp-renewal sales, manufacturers are faced with a decrease in product as compared with carbon lamp output. Certain central stations have, in fact, been for some time ordering lamps of a voltage higher than that of their circuits for the purpose of prolonging the life of the lamp and preventing in advance complaints of consumers about costly lamp renewals. The average user knows so little about lamp efficiency and life that he takes whatever the manufacturer or the central station gives him. It can be safely said that the larger central stations will eventually control the lamp situation as regards their own purchases as a matter of self protection. If they are convinced that lamps of lower efficiency than, say, 1.25 watts per horizontal candle, are best for their customers, all things considered, they will insist on getting such lamps, but small stations and users are, as before, dependent on the lamp manufacturers. The history of carbon lamps will doubtless repeat itself with the tungsten lamp—that is, the users who know nothing about the fact that the temperature of the filament governs lamp efficiency will ask for long-lived lamps without regard to efficiency. It will be interesting to see whether it will be possible to hold up the efficiency of the lamps in spite of this pressure.

The Law of Radiation in Incandescent Lamps.

An important paper by Féry and Chéneveau, abstracted in the Digest, has very direct bearing on the possibility of improved efficiency of incandescent lamps. So long as one depends for efficiency entirely upon elevation of temperature, even the best-known materials have very serious limitations. Further improvements have been closely bound up in the question of increased specific radiation. That tungsten and tantalum lamps give higher specific radiation than the older forms has been quite clearly shown by a number of experimenters. Nothing has as yet been published, however, which appears so definitely to show the amount of such improvement as the paper before us. Starting with Stefan's law for carbon lamps, the authors have gone on and enunciated an exponential relation between the luminous intensity and the energy which they have verified within wide limits. They appear to have shown that for the carbon lamp the luminous intensity is proportional to the cube of the energy only through a narrow range, the real law connecting the two being the exponential one. Modifications of theory of this character have often had to be made in other physical research. It is frequent that a given series of observations can be represented very accurately within a moderate range by some exceedingly simple law, sometimes even a linear one, which does not hold in the more general case that has to be considered when taking into account all the observations. Even in this latter case it is sometimes possible to find a simple law for several consecutive modest limits, so as to simplify the calculations.

Going on to the tungsten lamp, Féry and Chéneveau attempted to follow a similar process of evolution with respect to tungsten. Their method seems somewhat unsatisfactory in that it involved the perhaps somewhat considerable assumption that the law of radiation for tungsten would be closely similar to that for platinum, also a metal which is a fairly good reflector. Investigating by means of an optical pyrometer the relation between total radiation and temperature, they found that for platinum the law for connecting energy and temperature was not that of the simple 4th power of the temperature, as in the case of carbon, but of the 46th power. The next step, applying this law to the tungsten filament, was to determine the exponential relation between energy and luminous intensity corresponding to the temperature relation just stated. From the comparison of the figures thus obtained with those already secured with carbon, the authors deduced the temperatures with carbon and tungsten filaments as about 1780 deg. C. and 1875 deg. C., respectively. This difference is naturally considerably less than that obtained by previous investigators, taking less account of the question of specific radiative power. The specific efficiency they find from the exponential formula deduced to be practically three times as great for the tungsten filament as for the carbon, a figure which is in agreement with ordinary commercial experience. This result is particularly interesting as being derived from the establishment of empirical laws for the radiating capacities for the two materials.

The weak point in the argument seems to be the use of platinum as an intermediary. There can be little doubt that platinum and other metals which are good reflectors have a materially different law of radiation from black bodies. The previous experiments have not indicated that the law for various metals is substantially uniform. This, indeed, would seem to be a thing to be proved rather than to be assumed, but it is sufficiently evident from the results of this research that there is probably a larger variation in such metals from the laws of black body radiation than has heretofore been established. Whether it is so great as the present experimenters have found is another matter, and it would certainly be very desirable for them to repeat their pyrometrical experiments directly upon a tungsten surface. The difference in temperature deduced for carbon and tungsten filaments seems surprisingly small, and direct verification of the exponential formula for tungsten would seem desirable before accepting so large a difference in radiating capacity as here appears.

J. P. Morgan in Telephone Field.

Clarence Brown, of Toledo, Ohio, attorney for James S. Brailey, Jr., has announced that the real purchasers of the stocks of the United States and Cuyahoga Telephone companies are J. P. Morgan & Company, of New York. He states they purchased the stocks for their own account and that the Bell companies are not interested in them either directly or indirectly. In addition Mr. Brown states that Messrs. Morgan & Company have purchased a majority of the stocks of the Toledo Home Telephone Company, the Columbus Citizens' Telephone Company, Columbus, Ohio; the Dayton Home Telephone Company, Dayton, Ohio; the Indianapolis Telephone Company, the New Long Distance Telephone Company and the New Telephone Company, all of Indianapolis. All of these purchases were made, Mr. Brown stated, with the firm's own funds and for its own investment, without consultation or arrangements with any other interests. The United States Telephone Company, he states, will continue to co-operate with the Independent companies of Ohio and Indiana as in the past, and the management will remain the same as at present. Mr. Brailey added to this statement the assertion that J. P. Morgan & Company will operate these properties permanently as their own and there will be no general holding company.

Mr. Brown, before making this announcement, held a conference with members of the firm of J. P. Morgan & Company, and on his return addressed a letter to the presidents of the various companies affected, in which appears the following: "I am authorized by J. P. Morgan & Company to advise that, in their opinion, the business should be conducted precisely as it has been in reference to the construction, maintenance and operation of the property, with a view to securing the best possible results for the stockholders consistent with the duty which the company owes to its patrons and the public. The properties should be not only fully maintained, but improved and developed as business warrants."

The first announcement of the sale of the stocks to J. P. Morgan & Company early in the week was considered by Independents to confirm the belief of the public generally that they would go into the hands of the Bell interests, and some of those whose stock was sold thought it merely a dodge to escape the trouble of legal proceedings. Attorneys for the Independents stated that the announcement had made their chances for winning in the injunction suits at Cleveland and St. Louis brighter, because of the supposed affiliation of the Morgan and Bell interests. The election recently of Henry P. Davison, of J. P. Morgan & Company, to the Western Union board as reorganized by the Bell interests is offered in evidence of a community of interests.

Late Monday evening motions were filed in Common Pleas Court for receivers for both the United States Telephone Company and the Cuyahoga Telephone Company, the purpose being to protect the minority stockholders, it was declared. This action was taken on amended petitions in the suits of Samuel J. Schweer and J. W. Otto. The allegation is made in connection with the motions that the voting trustees have not discharged their duties properly, and instead of protecting the interests of the stockholders are practically in the service of the Bell companies.

The motions for receivers followed the announcement that the toll rates on the lines of the United States Telephone Company had been advanced to the figures that prevailed before the cut made in competition with the Bell lines some months ago. This step was taken by the attorneys for the Independents to mean that the Bell people were actually in control and that nothing could be lost now if the advance did turn business to the Bell lines which still maintain the cut rates.

It is said that E. G. Tillotson, president of the Cuyahoga Telephone Company and member of the rate committee of the United States Telephone Company, opposed the advance at this time and that he refused to recommend or approve the move. Barney Mahler, who told on the stand that he had but one share of the stock, and James S. Brailey, Jr., signed the recommendation, it is said. An idea of the rates as they now stand may be secured from the figures between Cleveland and the following towns:

	New rate	Old rate	Bell rate.
Akron	$.20	$.15	$.15
Canton	.35	.20	.20
Sandusky	.3	.20	.2
Wooster	.55	.25	.20
Youngstown	.40	.25	.25
Columbus	.80	.50	.35
Toledo	.60	.60	.30
Dayton	1.15	1.10	.75
Lima	.90	.50	.50
Mansfield	.45	.40	.30

Mr. Mahler claims that the change will result in a reduction at as many points as it will advance. He said that special rates had been made to certain large users who were furnished coupon books, but that this had been abolished also and all customers will be treated alike. This, he said, is in line with the principles established for all public-service corporations and is as it should be. He has defended the move from the standpoint of the user as well as the stockholders.

So far as can be learned, local officers of the Bell companies have had no instructions to advance rates and there is at present no indication that a change will be made. As may be seen from the figures given, Bell rates have been lower to most points all along than those of the United States. As a result, the company has been doing a heavy business, but the abolishment of night rates helped to equalize matters. The night business had got so heavy that there was no reason for longer maintaining lower rates and it is believed that, equalized as they are, the aggregate receipts will not show so much difference as might be expected.

The rates of the Cuyahoga Telephone Company are now two-thirds of a cent a mile, the distance reckoned on an air line. This, the officials state, is a rate that will be fair to all.

Frank L. Beam, president of the Ohio Independent Telephone Association and one of the directors of the Citizens' Telephone Company of Columbus which sold a controlling interest in its stock some time ago, is quoted as saying that the Independents are well satisfied if J. P. Morgan & Company have purchased the stocks of the Ohio companies and that Mr. Brailey was told this at a meeting in Columbus some time before the announcement was made. It has been stated, however, that all the Independents are not of Mr. Beam's opinion and that there may be some discussion on this point at the next meeting of the State association.

Stories of defections on the part of some of the Independent companies are in circulation. It is stated that the Independent company at Ironton has closed negotiations for Bell long-distance service and that some of the other southern Ohio companies have the matter under consideration. Whether this is true cannot be ascertained at this time.

From Columbus it is reported that a bill is being prepared to regulate telephone rates, and that it will come before the next General Assembly. This bill fixes a minimum charge for long-distance service and would act as a block in the way of merging the companies. In addition the bill seeks to put all telephone companies in the hands of a State commission, similar to the State Railroad Commission. It is said that the Independent companies desire the passage of this bill, now that the United States has increased its rates. The claim is made that the increase is so high that the company cannot command business in the face of the Bell rates. In this way people will be forced into the Bell service and only those who are not reached by Bell lines will have to pay the penalty of their misfortune in this respect. These people argue that the rates are being made prohibitive on purpose to force the business to the Bell lines.

E. W. Moore, of the Everett-Moore syndicate, on the stand in the deposition hearing before Notary Chestnutt last week, testified that James S. Brailey, Jr., had demanded a commission of $75,000 for putting through negotiations with certain Cincinnati and St. Louis parties. He said he considered this too much money to pay for the services and began to look to other possibilities. It was at this point that F. H. Goff came into the deal. He said that the anxiety to sell the securities of the com-

panies was caused by the condition of H. A. Everett's health and the necessity to clear up individual obligations existing among individual members of the syndicate. Mr. Moore was not aware of the fact that Mr. Brailey had anything to do with the transfer of the stocks until Mr. Goff spoke of his presence in New York when he was in consultation with the representative of R. L. Day & Company. He said that in the negotiations with Claud Ashborrk, of Cincinnati, and A. H. Bauer, of St. Louis, Brailey was acting only as agent, and that he had been paid $40,000 at one time for sales he had made. He put in evidence Brailey's letter regarding the evidence.

E. E. Newman, of the Cleveland Trust Company, submitted records of the transfers of stock that have been made since the sale was announced. James S. Brailey, Jr., has refused to appear and testify before Notary Chestnutt and as a result a fine of $50 has been assessed against him on the charge of contempt of court.

Attorney-General U. G. Denman is keeping a careful lookout for evidence that will connect the sale of the stock in any way with the Bell interests. In case evidence of sufficient weight and directness is obtained, it is the intention of the official to bring suit to prevent a merger or any arrangement that will bring about co-operation in rates and practices.

Maryland Public Utilities Bill.

The Public Utilities Bill, which was recently drafted by the Attorney-General of the State of Maryland, and noticed in these columns last week, is being held under advisement by the Governor's commission, which has made several important changes in the document. The bill as it now stands provides that the salaries of the members of the commission are to be $8,400 for the chairman, and $7,500 each for the other two. The counsel is to receive $4,800 instead of $6,000, as originally proposed in the bill, and the salary of the stenographer was cut from $1,800 to $1,500. The aggregate salary list will be $35,200, of which the city of Baltimore will pay $15,600. The period of incumbency is left open until the commission may determine whether or not a period of six years is constitutional. The suggestion that two of the commissioners should be appointed from Baltimore was left open for further consideration. The counsel is to be appointed by the Governor upon the recommendation of the commission. Whether the members of the commission may hold stock or securities of any corporation coming under the jurisdiction of the commission was not definitely determined. Corporation earnings are to be restricted to a "reasonable return" on the capital, this to be determined by the courts in individual cases. As yet the question of perpetuity of contracts is not touched on in the bill.

Street-Lighting Tables.

The street-lighting schedules which have been issued annually for many years by this journal form a supplement to the present number, and have this year been improved by the addition of an all-night lighting table based only on the times of sunrise and sunset, ignoring moonlight. According to the additional table, which is designated No. 1, the lamps are lighted one-half hour after sunset and are extinguished one hour before sunrise. By such a plan the lamps are in service for about 3830 hours per year. An "all-night" lighting schedule giving a total of about 4000 hours could be obtained by lighting 15 minutes earlier and extinguishing 15 minutes later than shown.

Table No. 2 is sometimes referred to as the "Philadelphia Moonlight Schedule." This schedule differs from that of Table 1 in that advantage is taken of moonlight, beginning with the fourth night after new moon—that is, after the moon has reached its first quarter. On moonlight nights the lamps are extinguished one hour after moonrise and lighted one hour before moonset, with the exception of the night before, the night of, and the night after full moon, when the lamps are not lighted. This schedule involves the use of the lamps for about 2000 hours per year.

Table No. 3 is calculated according to the well-known system of Mr. H. W. Frund, and ignores the moon until midnight throughout the year. After midnight the lighting hours are the same as in Table No. 1 except that the lamps are not used on the three nights before full moon. According to this schedule the lamps are used for about 3000 hours per year.

All of the tables are based on mean local time and are calculated for latitude 40 deg. north. They may be considered correct within 10 minutes for southern New York, Connecticut, Pennsylvania, Rhode Island, New Jersey, Ohio, Indiana, Illinois, Iowa, Delaware, Maryland, Virginia, West Virginia, Kentucky, Missouri, Kansas, Nebraska, Utah, Colorado, Nevada and northern California. They are also correct within 10 minutes for all places within the United States proper during the months of March, April, September and October. The maximum disagreements are reached in June, when the nights are shorter in the Northern than in the Southern States, and in December, when the reverse is the case. During these months the disagreement along the northern border of the United States and as far south as Charleston, Birmingham and Los Angeles will not exceed 20 minutes. A maximum disagreement of one-half hour may be assumed for Jacksonville, Fla., and Houston, Tex.

New York Telephone and Telegraph Investigation.

At the legislative investigation into the affairs of the telephone and telegraph companies in New York, last week, Theodore L. Cuyler, treasurer of the New England Telegraph Company, testified that the Postal Telegraph Company of Connecticut received 34 per cent of the gross receipts of the New England Company under the existing contract. He said that he did not know the reason for this arrangement. He could not explain why the accounts of the two companies were interwoven and admitted that he really knew very little about the affairs of the company.

Edward J. Nally, president of the New England Telegraph Company, and vice-president of the Postal Telegraph Company of Connecticut, was also a witness before the committee. He testified that the charges of the telegraph companies had to be raised because the cost of labor and everything had advanced. He said that in April, 1907, as a result of numerous conferences between the tariff superintendents of the Postal and the Western Union Telegraph companies, advances were made in about one-half of the 7138 rates on the schedules. He said that the Postal companies lost money on the strictly New York business and that there was no profit in the railroad business. Mr. Nally said that for about 80 per cent of the business there was active competition between the Postal and the Western Union companies. The Postal's business from non-competitive points amounts to only about 15 per cent of its total. He said that the Mackay Companies owned practically all the stock of the two companies in which he held official position and that he consulted with Mr. Mackay or other officials of the big company about policy.

As a mark of respect to the memory of State Senator John Raines, who died last week, the committee suspended its hearings until after the holidays.

Proposed National Wireless Telegraph Board.

Representative Roberts, of Massachusetts, has introduced a resolution in the House at Washington providing for the creation of a wireless telegraph board.

There is the greatest need for such control, Mr. Roberts said, as he has reports from the Navy Department, the revenue cutter service and the commercial wireless companies that the effect of the activities of amateur operators has been such as not only to make necessary a change from "C Q D" as the

distress signal, but to interfere seriously with the operations of all Governmental and private services. As a result of these reports Mr. Roberts, who is a member of the House Committee on Naval Affairs, considers it high time to take cognizance of the situation.

The perfection of wireless apparatus has reached such a stage, he said, that if the service is to be permitted to grow unchecked it is absolutely essential that the Government take steps in the matter. The simplest solution of the matter lies in the passage of the resolution presented, or a measure of similar character, placing in the hands of a wireless board the control of wireless plants afloat and ashore. It has been brought to his attention in an official way that the wireless service of the navy has been rendered practically useless at times by amateur operators, who send meaningless and oftentimes vile and unmentionable language through the air from their instruments.

Mr. Roberts's resolution authorizes the appointment of a board of seven members, "one expert each from the War, Navy and Treasury departments, three experts representing the commercial wireless-telegraph and wireless-telephone interests and one scientist well versed in the art of electric-wave telegraphy and telephony."

The duties of the board, according to the resolution, shall be "to prepare a comprehensive system of regulations to govern the operation of all wireless plants afloat and ashore which come under the cognizance of the United States, with due regard alike for Government and commercial interests."

It is provided that within 30 days of the organization of the board it shall submit its report and recommendations to Congress. To defray the expenses of the board $2,000 is appropriated.

A French Electrical Bank.

A bank has been formed in Paris named the Société Centrale pour l'Industrie Électrique, which is expected to have a beneficial effect on the development of the electrical industry in France. This bank is along the same lines as similar establishments in other European countries, particularly in Germany, and the electrical banks of Zurich, Berlin and Brussels are among the stockholders of the French bank, which has also the support of several of the strongest banks of Paris. It is understood that the new bank will continue the close relations with the Allgemeine Elektricitäts Gesellschaft, of Berlin, and the French Thomson-Houston Company, which have existed between these companies and two of the large French banks interested in the new bank.

Desplaines River Water-Power Case Taken to Federal Court.

As recently stated in these columns, the State of Illinois was defeated by a decision of the State Supreme Court in its attempt to declare the Desplaines River a navigable stream and to cause the removal of the water-power development works of the Economy Light & Power Company at Dresden Heights, Ill., as an obstruction. The State Supreme Court decided that the river was not a navigable stream in a legal sense, despite the fact that a great volume of water from the Chicago Drainage Canal has been turned into it in recent years.

Apparently the question is not settled, however, for by direction of the Attorney-General of the United States, a bill has been filed in the United States Circuit Court, Chicago, asking that the Desplaines River be declared a navigable stream, that the company be ordered to remove the structures already placed in the river in the building of its water-power development and that the company be enjoined perpetually from building a dam in the stream. The Government suit ignores the contracts between the Economy Light & Power Company and the Canal Commissioners of the State. The contention is that the State had no right to sell the title to the bed of the stream, as it was a navigable water-course under the control of the general Government. It is asserted that the rule in the Federal courts is that the mere fact that there are shallow places or rapids in portions of the river does not make it a non-navigable stream. The test, it is said, is whether by improvements the stream cannot be made navigable ultimately. If this view is upheld, the Economy Light & Power Company must obtain a permit from the War Department for the construction of the dam in question.

Governor Deneen convened the Illinois Legislature in special session on Dec. 14. He sent a long message to that body and among other things recommended legislation to provide for the construction of a deep waterway or canal from the present power plant of the Sanitary District of Chicago near Lockport (where the Drainage Canal enters the Desplaines River) to a point in the Illinois River near Utica, Ill. This proposition has been submitted to the citizens of the State and they have voted in favor of a constitutional amendment authorizing the issuance by the State of $20,000,000 in bonds in order to provide the funds necessary for the work. The Governor is very much in favor of the carrying out of this project. To this end he objects to the water-power development of the Economy Light & Power Company at Dresden Heights as interfering with the deep-waterway project, and in his message he urged that the case be taken to the United States Supreme Court, which has since been done, as related above.

Telephone Traffic in Chicago.

Mr. B. E. Sunny, president of the Chicago Telephone Company, gave an interesting and instructive talk to the Electric Club of Chicago at the meeting on Dec. 15. Mr. Sunny began by saying that to disarm criticism he should declare at the outset that the telephone service in Chicago is the very best in the world. He then read from the "Instructions from Subscribers" issued by the Bell Telephone Company of Illinois in 1879. This company was one of the predecessors of the present Chicago Telephone Company, and the elaborate instructions to subscribers at that early day are amusing in view of present practice.

In 1879 the Bell company and the American District company (owned by the Western Union Telegraph Company) both had exchanges in Chicago. In 1882 the Chicago Telephone Company was organized and succeeded both companies. At that time it had about 3500 subscribers' stations. Now there are 30 telephone exchanges in Chicago and 205,000 telephones. The service requires a total of 575,000 miles of wire, of which 460,000 is underground. The number of four-party stations is 85,000; two-party stations, 31,000; single-line stations, 43,000. In addition there are 2075 private branch exchange switchboards, supplying over 40,000 stations. About 1,300,000 originating calls are handled in an ordinary business day. There are 10,500 trunk lines connecting exchanges. In the central business district there are about 52,000 telephones, connected principally to the Main, Central and Harrison exchanges.

In answering calls the operator's average speed is about four seconds. The total time necessary to secure a complete connection, on an average, is from 20 to 25 seconds. It is the company's aim to have all of the calls answered within a maximum of eight seconds. To some extent accuracy in telephone service is sacrificed to secure speed, for one of the chief advantages of telephone communication is that it is practically instantaneous; but, after all, the work of the operators is computed to be 94.5 per cent accurate. There is also an improvement in the matter of accuracy. In 1900 the number of written complaints was 229 per 1000 subscribers' stations; in 1909 the number of such complaints had been reduced to 38 per 1000 stations. This improvement is attributed to more efficient operating and a closer relation between the company and the telephone public. It has also been brought about to some extent by doing away with 10-party lines, for which 4-party lines have been substituted.

The number of "busy" responses to telephone calls is decreasing, and is now about 13 per cent of all calls made. Analyzing

the disposition of a day's traffic, it is found that 78.5 per cent of calls are completed without trouble, 13 per cent are held up on account of busy lines, 3 per cent are not made on account of no responses being received from the person called, 1 per cent are interfered with on account of double connections, cut-offs, etc.; 3 per cent go astray owing to wrong numbers due to operating irregularity, and 1.5 per cent are not made in the first instance on account of errors in giving the numbers on the part of the subscribers. In the traffic department about 3500 operators are needed, in addition to 500 supervisors and 274 other operating employees. These figures are for Chicago service alone. About 1250 operators and 275 supervisors are required at the time of maximum load, in addition to managers and other male employees. The busiest hour of the day is between 10 and 11 a. m., 10 per cent of the day's telephone business being done in this hour. The busiest minute of the day is 10:10 a. m., and the busiest day of the year is the day before Christmas.

Some branches of the service rendered by the company are not understood by the public. Thus, the number of requests received daily for the time will amount to about 60,000. The maximum number of such requests comes between 7 and 8 a. m. The company's pay-roll for operators is about $6,000 a day, and if the time taken for this service is charged pro rata, it costs the Chicago Telephone Company $300 a day to tell its subscribers what time it is. Another branch of the service whose magnitude is not generally appreciated is in transmitting fire alarms and police calls. In the month of October the company handled 1488 fire calls and 4084 police calls, and the telephone is an important adjunct to these departments of public safety.

The number of cases of trouble reported in one year is about 1,250,000, or about 6.7 reports per station, but many of these are of a temporary nature and clear themselves. The total number of actual cases of trouble cleared in the year was 452,000, or 2½ per station. The number of men employed by the inside plant department is 1446, of whom 429 are regularly employed on maintenance. Rain and thunder storms in the summer and snow and sleet storms in winter give the telephone company much trouble. A severe storm may easily double the normal number of troubles. In case of a severe storm, extraordinary measures are taken to meet the emergency, gangs of men being sent over all routes with orders to put all lines, regardless of actual cases reported. In many cases these gangs are given rigs to enable them to cover more ground and to carry more material. The severe sleet storm of Jan. 12, 1908, gave a test to the telephonic protective apparatus. There were 111 cases of trouble reported due to high-tension crosses, besides an undoubtedly large number where the lines were cleared up before the trouble was traced to its original source. In no case did the high-tension current get beyond the arresters in the offices, and the only fire noted was in the wiring of one station, which was probably due to current coming in over an unprotected telegraph wire.

In closing, Mr. Sunny indorsed the recent contention of Mr. Samuel Insull before the same club, to the effect that public utilities ought to be monopolies in their communities if they are to be of the highest efficiency. This is particularly so in the telephone situation. The telephone must connect with everybody the subscriber wishes to reach to make it of the greatest service. Obviously this is not apt to be the case where there are competing systems. The speaker indorsed the principle of regulation of public-service companies by municipality or State. Under its present ordinance, the Chicago Telephone Company gives 17 classes of service at fixed prices. The bookkeeping of the company is done under the supervision of the City Comptroller. The service is given under the direction of the Commissioner of Public Works, and the legal interpretation of the ordinance is made by the Corporation Counsel. The ordinance was granted in 1907, and the city may purchase the system in 10 years or in 15 years from that time. It expires in 1927, and during its life the city reserves the right to regulate the price of telephone service for five-year periods. A very exhaustive study by a commission is now under way to determine what all classes of telephone service actually cost. On a fair basis a rearrangement of the rates should permit of maintaining the high standard of efficiency which the company is desirous of continuing.

In the discussion Mr. Charles A. Brown spoke of the wonderful improvement in the service since the early days. He ascribed much of the credit for this to Mr. Sunny. Mr. K. B. Miller pointed out that the company is now adding every year as many subscribers as it had all together 10 years ago. Relating to the question of telephone competition, Mr. Miller was not disposed to agree that the question could be settled by the broad generalization laid down by Mr. Sunny. There is much to be said on both sides of this problem. Others who spoke briefly were Messrs. J. B. Ware, H. V. Bennis, Charles W. Price, F. J. Holmes, J. W. Johnson and F. P. Vose. Mr. W. B. Potter, engineer of the railway department of the General Electric Company at Schenectady, who was a visitor, was the last to speak. He mentioned delays in the English telephone service and traced a relation between electrical transmission of messages and electrical transportation of persons. He alluded to the smoke nuisance in Chicago, and hoped it would soon be abated.

Trolley Car Destroys Wires in Nashville, Tenn.

Electric light, telephone, railway and telegraph companies of Nashville, Tenn., were recently put to no end of trouble by the destruction of their lines for eight blocks by a trolley car. The illustration herewith shows the scene of the wreck at noon of the day following, after large gangs of men had been at work clearing the street for 12 hours. The accident occurred shortly after midnight, when a Kain Avenue car was returning to the shed from its last trip. Someone had driven a wooden wedge in a frog, which threw the car, which was under full speed, from the track. The car crossed the street, and striking a telephone pole snapped it in two. Broad Street, on which the accident occurred, carries all the wires leading to South Nashville, and the weight of the wires and cables was such that the snapping of one pole resulted in the breaking of over half a hundred others. By actual count 60 heavily laden poles were down in the street, and cables and miscellaneous wires scattered all over. The Cumberland Telephone & Telegraph Company is said to have had over 3000 wires down, most of which were broken. The Nashville Railway & Light Company is said to have had 1500 wires in a mix-up, and besides the city's electric light and fire-alarm wires, the Western Union and Postal Telegraph companies had numerous circuits thrown out. The chief cause of the fall of the other poles has been attributed to 10 lead-covered telephone cables, which were said to have been too heavy for the poles. The management was about to place all of these lines in underground conduit, and it is claimed that necessary repairs were too long delayed.



POLE LINES DESTROYED BY TROLLEY CAR.

Electricity for the Rand.

The Victoria Falls Power Company, which has been supplying electric energy to mines on the Rand for the past two years from stations at Brakpan and Germiston, has recently increased its generating and transmitting equipments. Two 3000-kw, 50-cycle, A. E. G. steam turbo-alternators designed for 10,600 volts, three-phase, have been installed at Brakpan. At Simmerpan four similar 3000-kw units have been erected and provision is being made for two additional units of the same rating.

The transmission line will shortly be extended from Modderfontein to Randfontein, a distance of about 40 miles. The conductors consist of two sets of copper cables measuring 120 sq. mm and 70 sq. mm in area, operated at 10,600 volts and 40,000 volts respectively. These conductors are supported on steel lattice masts, 40 ft. in height, which are spaced, from Brakpan to Simmerpan, at 164 ft. intervals, but on the extension from Simmerpan to the West Rand will be placed 492 ft. apart. It will thus be apparent that the whole of the transmission line, with masts, is in duplicate, the object being to ensure continuity of supply. In the case of isolated mines along the Rand, conductors from both lines are introduced, and in the event of the supply failing on one line the switches are automatically transferred to the other supply. Each mast, in addition to the conductors, carries a 12-core pilot and telephone cable and three steel guard wires placed above all the circuits for purposes of protection against lightning. Horn lightning arresters, four in series, and two series in parallel, are placed on each lead on all the conductors, and at all roads and crossings a steel guard net is erected under the conductors to catch them in the event of breakage. At a distance of about six miles from Brakpan there is a large substation, the purpose of which is to control the potential of the line. At this place transformers are installed for reducing the e.m.f. from 40,000 volts to 10,600 volts. It is estimated that about 90,000,000 kw-hours per annum are now being sold, and owing to the demand having been increased it has become necessary to erect large additional stations. The engineers have investigated the suitability of sites at Rosherville and Vereeniging and have advised the company to put five 9000-kw turbo-generators and four 4000-hp turbo air compressors at the former place, and additional plant at Vereeniging, directly the rights-of-way have been granted by the Government. The engineers estimate that in 18 months' time the company will be producing 300,000,000 to 400,000,000 kw-hours per annum for the supply of contracts already secured. Part of this energy is to be delivered in the form of compressed air, and it is therefore proposed to erect compressor stations in the neighborhood of the Eckstein mines, where contracts have been obtained for supply beginning in October, 1910. At the present moment six electric air-compressor units, each of 4000 hp, are being constructed, but it is expected that 8 or 10 of such units will ultimately have to be installed. The price now being charged for energy is 1.5 cents per kw-hour, but in 18 months' time it may be reduced to 1.2 cents.

The main design of the stations at Brakpan and Simmerpan has been prepared by Prof. G. Klingenberg, of Berlin, working in conjunction with the engineers-in-chief, Sir. Douglas Fox and Partners, and Mr. Arthur Wright.

Large Power Plant for Boston Elevated.

The announcement has been confirmed in Boston of the purchase by the Boston Elevated Railway Company of a 25-acre tract of land in South Boston to be the site of a large generating station of the alternating-current type, which will ultimately supersede all or nearly all of the scattered plants which have for many years generated and distributed direct current at from 575 volts to 600 volts for the operation of the surface, elevated and subway lines of the system. Many of these separate stations have displayed excellent efficiency in their individual operation; but there is little question that broad opportunities for increasing the economy of production and distribution of power await the centralization of the steam and electrical system. The company's annual cost of electric motive power for the fiscal year 1908 was $1,641,902, or approximately 3.2 cents per car-mile. Over 409 miles of track are operated by the company. The site of the new power plant is adjacent to that of the L Street station of the Edison Electric Illuminating Company, of Boston, which supplies power from a central generating station on the water's edge through a territory of 500 square miles surrounding the Boston district. The location will permit the highest efficiency in the handling of fuel and the use of the water of Boston Harbor for condensing purposes. An initial step in the remodelling of the Boston Elevated power system is now under way in the construction of a rotary converter substation in the Forest Hills district, to be operated from the Dorchester plant of the company.

Electrical Engineering Staff of Cornell University.

As newly organized, the electrical engineering staff of Cornell University consists of sixteen members, as follows: Henry H. Norris, professor in charge of department; Vladimir Karapetoff, professor; assistant professors, George S. Macomber and Walter S. Ford; instructors, Boyd C. Dennison, Anson M. Holcomb, Fred H. Kroger, Alexander D. DuBois, Frank G. Anderson, John F. H. Douglas, Irving C. Pettit, William E. Hogan, Frank G. Tappan, Evan J. MacIlraith, Arden B. Holcomb; assistant instructor, John G. Pertsch.

Professor Norris during the present year officially took charge of the department as successor to Professor Ryan, who resigned in 1905. This fall there was transferred to the department the



CORNELL'S ENGINEERING STAFF.

electrical laboratory, which was administered up to 1905 by the department of physics. Since then it has been under the charge of the experimental engineering department of Sibley College. The work of the electrical department has been divided into three sections, as follows: (a) Introductory courses, in charge of Prof. G. S. Macomber; (b) advance theoretical courses, in charge of Prof. V. Karapetoff; (c) advance laboratory courses in charge of Prof. W. S. Ford. Each professor is assisted by a number of instructors, including one of a new grade established this year, which grade is filled by men of substantially the same training as assistant professor, being intermediate between an instructorship and a professorship. The intention is to devote the main strength of the department to instruction in the fundamental theory of electrical engineering. Some elective courses are offered, but they are merely designed to show the application of the fundamental principles. This year there are over 90 seniors in electrical engineering.

Rough Treatment of High-Tension Cables.

The operating department of the Commonwealth Edison Company of Chicago reports a remarkable case of the durability of high-tension, lead-covered cables under rough treatment. In the early part of December a 36-in. water main, located at Thirty-fifth Street and Lowe Avenue, in Chicago, burst, allowing such a deluge to escape as to flood the street for a quarter of a mile each side of the break and washing out a hole in the street about 15 ft. in diameter by 12 ft. deep. The conduit line of the Commonwealth Edison Company was within 2 ft. of this main. This conduit consisted of tile single duct embedded in concrete. The water continued to gush out of the break for a number of hours. The concrete was literally washed off of the tile duct and the duct was broken in short pieces so that it was strung along the high-tension cable like a string of beads. There were three 9000-volt, three-phase cables alive in these ducts. The Commonwealth Edison Company knew nothing of the break until the water had been running for several hours, as the cable maintained its insulation. The whipping about of the water stretched the cable somewhat, but it was found to test out in good condition as to insulation, and after being tied up at one side of the pit so that the water main repairs could proceed the cables were again put in service, with a man at the washout to see that no one damaged them mechanically, as they were exposed. The break in the mains occurred early in the morning and the company knew nothing of it until afternoon. About three-fourths of the original tile of the duct was still on the cable. The stretch will be taken out by pulling up the slack at the nearest manholes when the conduit is relaid.

India Rubber Importations.

The Department of Commerce and Labor in a report issued states that the importations of india rubber into the United States in the year about to end will exceed in both quantity and value those of any earlier year. During the 10 months ending with October, 1909, the importations of india rubber (including "balata," gutta-percha and "gutta-joolatong") reached the record total of $62,000,000, exceeding by over $6,000,000 the total for the entire calendar year, 1906, the banner year in this import trade. For the single month of October the imports of india rubber were valued at over $8,000,000, and should this rate be maintained during November and December, the total for the 12 months ending with December, 1909, would be over $75,000,000 as against $46,500,000 in 1908, $54,000,000 in 1907 and $56,000,000 in 1906.

The growth in demand for india rubber, measured by the increase in importations, has been a marked feature of the last 20 years, and few if any of the raw materials for which the United States is dependent upon foreign countries for its supply show a growth as rapid as that of india rubber importations, the increase being from $12,500,000 in 1889 to $46,500,000 in 1908, with every indication that the total for the year just drawing to a close will exceed $75,000,000.

This increase in the value of india rubber imported is due in part to the advance in price following the enlarged demand in various parts of the world, and especially in the United States, which consumes fully one-half of the world's output of india rubber. Thus, while the quantity of india rubber imported has increased from 32,000,000 lb. in 1889 to 55,000,000 lb. in 1899 and 73,000,000 lb. in the 10 months of 1909 for which figures are available, the average import price has advanced from 39 cents per pound in 1889 to 60 cents per pound in 1899 and 80 cents per pound in the elapsed months of the present year, while for the single month of October the average import price was practically $1.00 per pound.

The import price of the crude rubber brought into the United States during the 10 months for which figures are available has exceeded that in any earlier year, having averaged 80 cents per pound in the period in question, while the highest annual average in earlier years was 78 cents per pound in the fiscal year 1906, 76.6 cents per pound in 1907 and 74.2 cents per pound in 1905, the import prices prior to that time ranging from 68 cents per pound in 1904 down to as low as an average of 38 cents per pound in 1889.

Of the $62,000,000 representing the importation of the various classes of india rubber in the 10 months of 1909 for which detailed statistics have been completed by the Bureau of Statistics of the Department of Commerce and Labor, $58,500,000 represented india rubber proper; $2,000,000 scrap rubber, fit only for manufacture; $1,000,000 gutta-joolatong, an article similar to and mixed with rubber for use in various industries; $357,000 balata, and $123,000 gutta-percha.

Brazil is the chief contributor to the india rubber supply of the United States, the quantity imported from that country in the 10 months ending with October amounting to 34,000,000 lb., valued at $30,500,000, while the United Kingdom contributed, presumably from its African and East Indian colonies, 9,000,000 lb., valued at $10,500,000; Mexico, 15,000,000 lb., valued at $5,500,000; Germany, 4,333,333 lb. valued at $3,500,000; other Europe, 6,666,666 lb., valued at practically $6,000,000, while from the East Indies direct there was a total importation of a little over 1,000,000 lb., and from Central America slightly less than 1,000,000 lb.

The relation of india rubber importations to domestic manufactures in which that article is used as a raw material is apparent by reference to census figures, which show that the number of establishments engaged in manufacture of rubber and elastic goods has increased from 93 in 1880 to 224 in 1905; the capital employed from $6,000,000 to $46,000,000; the wages paid from $2,500,000 to nearly $9,500,000, and the value of the product from $14,500,000 in 1880 to $63,000,000 in 1905. Meantime, exportations of india rubber manufactures are assuming important proportions. In the calendar year 1889 they were valued at $937,497; in 1899, $2,081,588, and in the 10 months of 1909, $7,067,038, indicating a total of over $8,000,000 for the calendar year. Of the $7,000,000 worth of india rubber manufactures exported during the 10 months, boots and shoes were valued at $1,250,000; belting, hose and packing, $1,500,000, and $4,000,000 miscellaneous.

Suburban Electric Extensions Around Chicago.

Zion City, widely known as the headquarters of the religio-sociological enterprises of the late John Alexander Dowie, will be supplied with electricity by the North Shore Electric Company, of Chicago. In Dr. Dowie's time there was built an electric generating plant at this place, and the North Shore company has bought the distribution system from the receiver of the Dowie enterprises. The generating plant will be shut down and sold. It was a steam-operated plant, and supplied both alternating current and direct current. Zion City will be supplied with electricity by the central-station company direct from Waukegan, six miles distant. The transmission will be at 2300-4000 volts, three-phase, and the electrical energy will be used for both lighting and power.

The North Shore Electric Company is building a new transformer substation in Lake Bluff, a northern suburb of Chicago. The building is of brick and fireproof, and will provide a high-tension switching center. It is laid out for an ultimate capacity of 1500 kw, but the initial installment of transformers will be about 400 kw. The arrangement is such that one section will be built complete at first, and others may be added as needed.

Another extension of the North Shore company's service is to the village of Deerfield, about four miles west of Highland Park, another northern suburb of Chicago. The 40-watt series tunsten lamps will be used for street lighting, and commercial service also will be given. The same company is building an extension to Rockefeller, now called Area, two miles west of Libertyville. Commercial electric service will be available here.

A street-lighting contract has been entered into with the vil-

lage of Edison Park, near Chicago, by the North Shore Electric Company. Series tungsten lamps will be used, and the electricity will be supplied from the Park Ridge substation.

Commercial service has been extended into the villages of Niles Center and Niles, which are about six and seven miles west of Evanston.

Hydroelectric Plants.

At the meeting of the American Institute of Electrical Engineers, held on Dec. 16, Mr. Henry L. Doherty presented a paper containing comments on the development and operation of hydroelectric plants. He claimed that compared with almost every other class of investment, a water-power plant is far preferable. As a step toward the conservation of our national resources, the Government should remove as far as possible every unnecessary obstacle to water-power development.

A confused condition exists in the popular mind in regard to the marketing of energy. The inability of the public to understand this matter has been a great obstacle in the development of hydroelectric propositions—and in this matter the electrical engineering fraternity has been more or less to blame. Cost of energy is sometimes figured and stated on a kw-hour basis, and at other times on the basis of peak load, or what might be termed an equipment basis. Without knowledge of load-factor, or simultaneous demand-factor, figures stated in these different ways may prove so misleading as to bring about expectations of returns varying all the way from $8 to $300 per horse-power of station equipment. This confusion has played no small part in the mistakes which have been made; these mistakes have caused the investing public to mistrust their ability to make correct deductions.

The problem of reliable service from long transmission lines is much further from solution than all of the other problems that have done so much to contribute obstacles to rapid development. Good engineering talent and other proper precautions will insure that the cost of construction shall be no greater than that promised. One can also accurately determine the available power, and can insure against disappointments in market. The best of engineering talent does not seem, however, able to promise for a transmission line the same continuity of operation that can be secured from a steam plant located at the point where the energy is to be used, and this condition introduces many serious obstacles to the development of water-power projects. The importance of continuity of service varies in degree with almost every customer served. To some industries a mishap which causes even a fall in voltage or a change in frequency may be a serious matter.

In order to insure continuity of service, it has been suggested recently, in connection with two hydroelectric plants to be erected, to install a steam turbine auxiliary, the generator of the turbine being run normally as a motor and the governor being so arranged as to admit steam to the turbine in case the speed of the water-wheels decreased perceptibly. As a standby steaming equipment the internally fired boiler deserves careful consideration. This boiler is subjected to a small radiation loss, and is able to maintain tightness against ventilation when the fires are banked.

In all electrical undertakings the question of depreciation is one which has an important bearing. Practically all of the present assumptions for depreciation are too high. Figures applied to depreciation are used in a general sense without regard to what the plant consists of. The character of construction will largely influence the rate of depreciation. It is manifest that a plant having 10 per cent of its investment in wooden poles and 20 per cent of its investment in a masonry dam will have a higher rate of depreciation than the plant which has only 2 per cent of its entire investment in wooden poles and over 50 per cent of its entire investment in a masonry dam. Each individual class of property should be given its own true rate of depreciation, if any depreciation at all is to be figured, or else the different parts of the plant having the same relative rate of depreciation must be grouped together in figuring what the total depreciation will amount to on the entire property.

The price to be charged for service evidently depends largely upon the load factor of the customer's installation. No general and complete rules can be laid down whereby the maximum load factor can be secured to a hydroelectric company. Rational methods of charging, properly explained so they can be understood both by consumers and by prospective consumers, will do much to contribute to a good load factor.

Mr. Doherty expressed the opinion that the future situation in the hydroelectric supply business will eventually be that of the market greatly exceeding the supply, and the natural remedy will be the installation of steam plants by the hydroelectric companies to enable all possible available water to be used. Central-station steam-power plants have been made a success in competition with individual steam plants, and the success of steam plants in connection with hydroelectric plants should be even more pronounced.

DISCUSSION.

Mr. H. G. Stott discussed the use of a steam plant as a reserve equipment for a hydroelectric plant, and expressed the opinion that for this purpose the steam turbine is better adapted than the reciprocating engine. He showed curves of station loads as illustrating the variation in the most economical percentages of steam and hydraulic power. In one case, the best ratio was found to be 60 per cent hydraulic with 40 per cent steam in winter, and 40 per cent hydraulic with 60 per cent steam in summer.

Mr. S. E. Doane remarked that one of the fundamental reasons for the slow development of a market for the energy from hydroelectric plants has been the lack of information on the part of the public as to the cost of service. Illogical and unjust methods of charging have served to retard greatly the fullest and most complete utilization of the capital invested in electric service securities.

Dr. Cary T. Hutchinson discussed in detail the depreciation of the several parts of a hydroelectric installation. He stated that of the total cost of a hydroelectric generating and transmission plant 20 per cent is necessary to cover the expenses preliminary to actual construction, the buildings and hydraulic construction represent 30 per cent, the equipment of the power house 14 per cent, the transmission system 13 per cent, engineering 11 per cent and interest during construction 12 per cent. Of the six items specified the first and last two are not subject to depreciation, while the other three have an annual depreciation equivalent to 1.041 per cent of the total cost.

Mr. Harold W. Buck said that people in general have a very false idea as to the commercial value of waterfalls. The Government has adopted a discriminating attitude against water-powers as distinguished from other natural resources, such as timber lands, mines and farm lands. The Institute can do much toward correcting the wrong impressions that have been formed.

Mr. John Martin thought that the Government should not charge for the use of water, but should fix a maximum rate to be charged for energy derived from hydroelectric developments. He described the "load-despatching" system of the Pacific Gas & Electric Company, which is so arranged that one man has entire charge of the operation of its 600 miles of high-voltage transmission lines. Use is made of a dummy board for showing the exact condition of each line and switch throughout the whole system at each instant.

Mr. W. N. Ryerson claimed that long-distance transmission lines in general are unreliable and should not be depended upon exclusively when continuity of service is expected.

Mr. Julian C. Smith gave a tabulation of the interruptions during seven years to the 50,000-volt transmission equipment of the Shawinigan Water & Power Company, which operates a 100-mile system over two separate pole lines. The energy is received through synchronous motor-sets. Of the interruptions 27 per cent were due to the transmission line, 21 per cent to lightning, 11 per cent at the substations, 24 per cent at the power house, 13 per cent at the terminal stations and 4 per cent

unknown. Of the whole number of interruptions 20 per cent were caused by bad construction, 20 per cent by errors of operation, 7 per cent by interference by outsiders, 8 per cent by external extraordinary conditions.

Mr. Calvert Townley gave definite data on the cost of hydroelectric developments under New England conditions and the equivalent steam equipments for the same service, showing that although the operating cost of a hydraulic plant is very much lower than that of a steam plant, its fixed charges are so much higher that it cannot be run in competition therewith unless the load factor is very high.

Mr. D. B. Rushmore called attention to the fact that hydroelectric installations can be made reliable and cited the case of the 100,000-volt equipment of the Great Western Power Company, which has been practically free from line troubles.

Mr. Chas. H. Baker, in a written communication, claimed that the hydroelectric plant at Snoqualmie Falls, Wash., has no equal from any point of view in the shape of any steam plant in operation upon the Pacific Coast. This plant operates continuously with scarcely a second of interruption per year. This fact is attributable to absence of a flume, simplicity of wiring and to the use of a duplicate transmission line following a right-of-way cleared of all trees and other features which might affect the continuity of the service.

"Wireless" Discussed at Armour Institute.

At the regular meeting of the Armour Institute of Technology branch of the American Institute of Electrical Engineers in Chicago, on Dec. 16, much interest was shown in a paper presented by Prof. G. E. Marsh, of the electrical engineering department at Armour. The subject was "Wireless Telegraphy," and in the course of a two-hour talk the theory and fundamental principles involved in the generation and receiving of electric waves were outlined and explained in considerable detail. The structure of the electromagnetic wave as radiated from a vertical aerial was represented diagrammatically. Simple calculations giving the efficiency of this method of telegraphing and the sensitiveness of the modern wireless receiver were worked out, and the results were somewhat surprising to many in the audience.

The ohmic resistance given to high-frequency currents was exhibited by a table. Following this was interesting comment regarding the character of the limiting phenomena accompanying electric oscillations of very high frequency. A few experiments with oscillating currents were shown, as well as the operation of a set of wireless-telegraph sending and receiving instruments.

The talk was a résumé of some of the material which the speaker had presented previously before the regular weekly meetings of the Hertzian Society, a student organization active in the study of wireless telegraphy and telephony. Among the more interesting points dwelt upon in the discussion were the electromagnetic factors involved in the penetration of the outer boundaries of the earth's atmosphere by electric waves and the theoretical possibility of signaling to Mars.

Peculiar Trouble with Rotary Converters and Its Remedy.

A peculiar trouble has been experienced in the substations of the Chicago City Railway Company in which some 1500-kw and some 2000-kw rotary converters are used. Severe flashing over and arcing from brush-holder rings and commutator bars to bolt heads and grounded parts of the converter frames took place. That this could not be due to causes outside of the substations was demonstrated by the fact that the lightning arresters with very much shorter spark-gaps than the breaks arced over on the converters would not discharge before the breaking over took place on the converters. After attempting for some time to locate the source of trouble as coming from surges or unduly high potentials on the incoming lines it was concluded that the breaking over was due to static potentials caused by the rubbing of the brushes on the large commutators. The inductance of the path between the commutators of the rotary converters and the arresters prevented the static charge from finding its way to earth across the arrester points. The static charge would therefore take the most direct path to earth and the power current would follow it, resulting in tremendous flashes. The trouble has been remedied by the installation of aluminum-cell lightning arresters permanently connected between the positive terminal of each rotary converter and ground. Two 250-volt cells are connected in series between the bus ring of the converter and ground. In shunt with each of these cells is a balancing resistance of 20,000 ohms. It was found that without this resistance in shunt the continuous discharge to the arrester would unbalance the cells so that one might have a counter e.m.f. of 110 volts and the other 440 volts, with the result that the cell with the lower e.m.f. would heat. With the shunt resistances a balance is maintained and with the continuous passage of 0.033-amp dynamic current there is no heating. A small panel for plugging in an ammeter in series with the cells occasionally to determine the flow through the cells to ground is provided. The cells and panel are mounted on a slate shelf in the pit under each converter. In one substation arcing over occurred on an average of once a month. In the period of one year since this substation was equipped with the discharge sets there has been no recurrence of this trouble.

Chicago Electrical Show to Be a Brilliant Spectacle.

Interesting preparations are under way for the illumination and interior decorations of the Chicago Electrical Show, to be held in the Coliseum on Jan. 15 to 29, inclusive. The lighting scheme is new, elaborate, and should prove beautiful. Springing from the corner posts of each exhibit space will be two low arches meeting above the center of the space. From the point of intersection will be suspended a dome shade 3½ ft. in diameter, which will be made to represent colored art glass. This shade will contain five 100-watt tungsten lamps with Holophane reflectors, and will flood the exhibit with light. The height of the lamps will be about 12 ft. from the floor. In addition the corner posts, which are 9 ft. high, will each support a 60-watt tungsten lamp inclosed in a globe representing art glass. Intermediate between the corner posts will be larger posts about 13 ft. high, and these, too, will be surmounted by globes similarly made, each containing a 150-watt tungsten lamp. In all there will be on the floor in post lights and dome shades about 1200 tungsten lamps of the three sizes mentioned.

Around the balcony will be a frieze of canvas with molded ornaments at intervals of about 30 ft. Each of these ornaments will contain a transparency behind which will be a 16-cp carbon lamp, producing a pleasing effect.

But the greatest novelty of the illumination will be in the upper part of the building. The roof trusses will be concealed by dead-black bunting. At each end of the building, mounted in the galleries, will be three 30-in. searchlight projectors. Hanging from the ceiling will be ribbons of gold and silver tinsel of various lengths, and as these are waving in the air currents of the large interior, they will catch the light from the projectors and reflect it and scintillate it in a way which should make a brilliant spectacle. In this eye-arresting fashion it is proposed to produce an overhead illumination feature which will be a worthy successor of the night-sky effect of a year ago. The projectors will probably be some of those used at the recent Hudson-Fulton celebration in New York.

Suspended from the roof trusses will be the Wright aeroplane recently purchased by the Government from the Wright brothers. Lieutenant Foulois, of the Signal Service of the United States Army, will be in charge of this airship with a number of assistants, and he will place it in position and direct

its exhibition during the period of the show. The aeroplane will be equipped for wireless telegraph or telephone communication, and daily demonstrations will be made. This interesting feature of the show was not secured from the Government without considerable argument, the representative of the Electrical Show at Washington during the negotiations being Mr. Frank L. Perry.

About 90 per cent of the available exhibit space has been sold. There will be no exhibits in the balcony, and here about 3000 chairs are provided, where the weary may sit down to rest and to listen to the music of Weber's Band, which will be in attendance. An effort will be made to increase the attendance at the coming show during the daytime. Judging by the preceding shows, no such effort is necessary for the evening attendance. The Commonwealth Edison Company and the Chicago Telephone Company are sending out to 100,000 and 200,000 customers, respectively, attached to monthly bills, coupons which will be good for half-price admissions if used before 5 p. m. each day. The Commonwealth Edison Company will be in the Annex this year, and its exhibit will consist of a model garage for electric vehicles. Special attention will be paid to electric vehicles, and a number of manufacturers will have exhibits of this character. In addition to its garage, the Edison Company will have a lecture hall, where lectures and demonstrations will be given to show the advantages of various uses of electricity.

During the show there will be a number of "special days" particularly devoted to various electrical societies, such as the Wisconsin Electrical Association, Illuminating Engineering Society, Sons of Jove, American Institute of Electrical Engineers, Electric Club of Chicago, and the Thomson-Houston Association.

Attractive souvenirs will be distributed to paid-admission visitors on Monday, Tuesday and Wednesday of each week. The show is given by the Electrical Trades Exposition Company, of which, as in former years, Mr. Homer E. Niesz is manager.

St. Louis Electrical League.

The first annual banquet of the League of Electrical Interests of St. Louis was given at the Mercantile Club on the evening of Dec. 16. Capt. Robert McCulloch, president of the league, presided. Among the guests were Mr. T. Commerford Martin, executive secretary of the National Electric Light Association, who was the principal speaker, and Messrs. Henry Kent, H. H. Humphrey, Arthur Scudder, Jeptha Howe, James A. Waterworth, Edward Devoy, L. A. Hobson and Arthur S. Partridge.

Prior to the banquet a short business session was held, at which a constitution and by-laws was adopted, and the following committees appointed:

Questions of Public Interest.—Messrs. George D. Rosenthal, E. J. Pietzcker, A. S. Partridge, R. V. Scudder, Eugene Devine, William Clegg, Jr., H. C. Henley and J. P. Casey. Entertainment.—Messrs. L. M. Sperry, C. J. Sutter, Fred Johnson, J. R. Cullinane and R. J. Russell.

In his address, Mr. Martin declared that the American people to-day are paying twice as much for electrical service as for the bread they consume. The total figures, he said, have reached $1,200,000,000 a year, and probably in excess of that amount. The capital obligations in the electrical field are over $8,000,000,000. The farmers of the United States virtually earned that amount in 1908 for services rendered in crops. It may be put roughly as not far short of half the railroad capitalization of the country. This amount of stocks and bonds does not, however, include floating debt, a large part of which is incurred for new material, etc., and no one knows just what that is, additional. Moreover, this vast sum does not include the growing investments of the steam railroads in electrical equipment, nor the value of any of the 100,000 isolated plants in mines, factories, hotels, office buildings, country residences, etc. The point insisted upon is that this sum is not inert, but is very much alive, and that in maintaining it as active capital and in giving service, principally in public utilities, the electrical field affords one very clear definition of its purchasing power. That $8,000,000,000 is and must be reproductive, and can only be so by the incessant replenishment of apparatus and supplies. The capital liabilities of the electric railway field alone show a total of not less than $4,000,000,000, the data being furnished by the 1300 companies included. The increase during the year was over $350,000,000, most of which was new capital poured into the industry.

A more direct and less inferential way of envisaging the purchasing power of the field is to consider the earnings, said Mr. Martin, regardless of the investments. It may be stated without any fear of contradiction that the total annual expenditure on electrical appliances, current and service in the United States has reached the sum of about $1,200,000,000 and is probably much in excess of that amount. The data from which such a result may be reached are in sight, and may be gaged by anyone willing to take the trouble. Authentic census figures, which Mr. Martin compiled for the Government, for 1905-06, show that electrical manufacturing reached in that year the figure of $140,000,000 as the product of 784 establishments. But this does not include any wooden, iron or steel poles; it did not include a large quantity of glass and porcelain made only for electrical purposes. It omitted bare iron and copper wire. It did not reckon in the electric automobile. It excluded the whole group of electrochemical and electrometallurgical products, these all being technically in other branches of manufacture, but it is obvious that much comes naturally into the electrical scheme. Hence the product for 1906-08 may be put at $175,000,000. The average rate of increase in electrical goods for nearly two decades has been over 15 per cent per annum and in the great year of 1906 the gain was over 30 per cent. On such basis even a dull year like 1908 would reach $250,000,000 and 1909 might far overlap that mark.

Episodes in the Early Career of Edison.

A dinner was given to Mr. Thomas A. Edison, on Dec. 20, at the Plaza Hotel, New York, by representatives of moving-picture companies, at which Mr. Edison, in accepting a handsome trophy in silver, gave some reminiscences of first experiences in New York City around 1874, and particularly with respect to his abilities then as a financier.

One day he went from Newark to Wall Street with a faint hope of being able to market his first invention of the duplex system in telegraphy. He knew nothing of Wall Street or its methods, but he had the acquaintance of General Eckert, of the Seventh Regiment, then at the head of the ticker service, in the days when there was plenty of excitement in the gold market.

The General did not see his way to do anything with the duplex patents and Edison, disconsolate, was waiting around to see the General again when the ticker broke down. Consternation prevailed in the office and presently brokers came rushing in to find out why they did not receive the quotations. General Eckert was as much distressed as anybody else, but pretty soon Edison, who had been studying the mechanism, told the General that he thought he could fix it so that it would work again. Eckert told him to go ahead and try. Edison succeeded, to the immense relief of the General and the local community.

Next day General Eckert sent for Edison and told him that he thought the company could employ him and offered him $400 a month, a sum that staggered the inventor, as the largest pay he had received up to that time had been $100 a month. The stagger was the greater because he had felt himself down and out. While in the employ of this company Edison set himself to perfecting details in its mechanical instruments in connection with the other studies in the line of practical invention, and the next he knew General Eckert sent for him and wanted to buy his patents in telegraphy. Edison felt stumped, for he had no idea what value to set upon his inventions. He also had a wholesome dread of Wall Street, knowing it only by reputation.

He had never even had a bank check, nor had he ever been

inside a bank. He went home and spent the night awake thinking the matter over and finally arrived at the conclusion that the most he dared ask for his patents was $5,000. When he went back to see General Eckert the next day he did not dare speak this figure aloud, and when General Eckert asked him what he had decided on he was silent, trying to screw his courage up. General Eckert finally broke the silence and offered him $40,000.

Staggered, Edison pulled himself together as soon as he could and agreed that he thought that would be a fair amount for his patents. Eckert prepared a contract for him to sign, and he was so agitated that he signed it without even reading it. The General presently gave him a check for $40,000, and Edison, not having seen a check before, or at least not having had occasion to use one or see one used, did not even know what to do with it. He even thought that he had been buncoed, receiving a piece of paper for all his work.

He asked General Eckert what to do, and the General advised him to go to a bank with it and open an account. Edison went to the bank and did not even know what window to go to, but finally went to one where his piece of paper was accepted and taken away. As nothing was said to him he presently departed, sure this time that Wall Street had buncoed him, and wended his way back to his friend the General, who smiled and sent him back to the bank.

Edison was now awfully sore, as he said, and he was perspiring freely, although the thermometer recorded 5 deg. below zero. Back at the bank they laughed at him, but the president came out and asked him how he wanted his money. He responded in any way that was convenient to the bank, and they gave it to him, the whole $40,000, in small bills, which Edison took home in bulging pockets, only to sit up all night with it in his anxiety.

Then on advice he went back to the bank and opened an account.

"And," said he, "I bought a lot of machinery that I thought I wanted, and in six weeks I was down and out again without a cent. That's the kind of a financier I was in those days."

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission has authorized the East Boston Gas Company to issue 12,000 shares of stock for the purpose of exchange for the outstanding stock of the Chelsea Gas Light Company, the two companies having signed an agreement of consolidation. The board has also dismissed without prejudice the petitions of patrons of both companies asking for a reduction in the rates charged for gas, stating that the consolidated company should first be permitted to demonstrate whether the reduced price asked is reasonable. The price is to be 90 cents net per 1000 cu. ft. after Jan. 1, 1910. The relations of the new company with the engineering and executive administration of the Boston Consolidated Gas Company are to be close, and it is expected that the benefits of the consolidation may ultimately permit the same prices in East Boston and Chelsea as in the city proper.

The commission recently gave a hearing upon the petition of the Athol Gas & Electric Company for approval of an issue of capital stock to the amount of $170,000. The company was represented by its counsel, Mr. Edward C. Mason, of Boston, and considerable testimony of commercial and engineering interests developed in connection with an explanation of the company's plans for extending its service in the Athol and Orange district.

Mr. Mason stated that the entire stock interests of the central-station companies in Orange and Athol were purchased in the spring of 1909 by Mr. W. G. Webber, of Boston, president of the Athol Gas & Electric Company. It was then apparent that in these towns there was a possibility of the development of a considerable amount of cheap power for manufacturing and other purposes. Each of the companies was too small by itself to accomplish the development, not being in a position to incur the expense nor having the necessary credit The companies were merged for the reason that in combination they would furnish the required credit for developing a motor-load and putting the electrical service of the two towns on an economical basis.

The value of the Orange property purchased was listed at its present value, no allowance being made for good-will or for the value of the going business. It was found that the demand for motor service in the territory was greater than was estimated. In Orange and Athol at present there are plants and factories using steam power alone aggregating 4364 hp. With the development now under way at the Wendell station 1000 kw can be produced by water-power in two 400-kw and one 200-kw units. The demand for motor and lamp service in Athol and Orange has been unprecedented. Since the company has been working in the territory it has made no effort to increase the load, on account of lack of equipment, but despite this it has recently been obliged to take on 130 hp in the two towns. A 650-hp steam plant will have to be installed at the Wendell station as a reserve in case of accident. It will also be necessary to construct circuits for motors in both Athol and Orange in order that the lighting service may not be interfered with.

The Athol company desires to issue stock to cover the following improvements: Retire bonds, $50,000; 100,000 cu. ft. double-lift gas holder, $10,203.85; extension of gas mains, $4,000; additional 400-kw motor-service unit, $14,665; additional 650-hp steam plant, $20,400; new power and street-lighting lines, Orange, $19,598.75; meters for Orange, $6,189.31; transformers, Orange, $7,417; lines, Orange, $19,229.24; miscellaneous, $1,609.17; total, $153,312.32. These items were explained to the board and the hearing was closed.

Cost of Generating Electric Power.

The cost of power and general considerations bearing upon its production were informally discussed at a recent meeting of the Boston Society of Civil Engineers by Mr. Charles T. Main, consulting engineer, Boston, and Mr. F. M. Gunby. The conditions in the textile industry were the principal theme of the authors, who emphasized the importance of saving money by the use of receiver steam and the water of condensation in mills where the manufacturing process is based upon the production of colored goods. Where the so-called waste products of a steam plant can be used in the mill the cost of power is a minimum, if figured net. The opportunities for very low-cost power production are much less favorable with mills making simple white goods, and here the hydroelectric company or the central station stands a better chance of securing the business. Thus, in the case of a colored textile mill an offer of power at 1.2 cents per kw-hour was refused by the mill owner's engineers, since the cost of power was figured at a lower rate in the mill plant through the use of receiver steam for manufacturing purposes and the water of condensation for dyeing. The cost of power offered by the hydroelectric company was close to the best figure that the mill could produce, but even if the power had been taken from the transmission system it would have been necessary for the mill to install nearly as costly a boiler plant as though no hydroelectric power were available. This plant would have to be operated to furnish steam for manufacturing, and hence the use of outside service was not considered advisable. In a second textile plant, however, which made white goods only, the engineers recommended the taking of the hydroelectric power at the 1.2-cent rate, and not only was this practically the figure at which it was estimated that the mill could generate power, but the existence of the hydroelectric service saved the mill from a heavy investment in steam plant equipment.

A general discussion of the power question was included in the paper, and in this connection the evil effects of a poor load factor were briefly reviewed. The authors also considered the bearing of development cost on the success of hydroelectric power projects. It was stated that water-power plants are usually characterized by high fixed charge accounts and low operating expenses, and also that the reliability factor may have

an important bearing on a water-power privilege. Generally a water power tends to have a rather low factor of reliability, due to the fact that there is usually only one dam, one power house, and often a long transmission line, besides risks from floods and droughts. It is most important to avoid excessive fixed charges in water-power work. The neglect of incidental costs often leads to trouble. There is an idea commonly held that if a development will cost $100 per hp, it will be a safe investment, but when it reaches $200 per hp it is well to proceed with caution. There are sometimes occasional markets, notably in mines and remote places, where power costs are high, where it will pay to undertake a project even in the face of a high development cost.

The authors estimated that power could be produced in a 2000-kw textile plant with coal at $4.75 per long ton as follows, including fixed charges:

(*a*) Equipment, reciprocating engines and direct-connected generators, first cost of plant, $125 per kw. Cost of power, 3000 hours, $32 per kw per year, or 1.065 cents per kw-hour. For 24-hour-per-day power the production cost would be $57 per kw-year, or 0.792 cent per kw-hour.

(*b*) Equipment, steam turbine sets; first cost of plant, $100 per kw. Cost of power, $29 per kw-year, or 0.965 cent per kw-hour. For 24-hour power the yearly cost would be $52 per kw, or 0.734 cent per kw-hour.

In this estimate interest was assumed at 5 per cent; depreciation and repairs on equipment, 4 per cent; depreciation and repairs on buildings, 2.5 per cent; insurance and taxes, 1 per cent; total, 10 per cent on the equipment and 8.5 per cent on the building. It was stated that higher rates of depreciation would have to be allowed on a public-utility plant on account of the advances in the art, which would necessitate the discarding of apparatus in good mechanical condition in favor of more efficient units. It was also shown that the steam turbine does not lend itself as flexibly to the use of steam for manufacturing purposes as does the reciprocating engine. The authors hope to investigate this question in the future.

Referring to the cost of water-power, the authors said that by some it is believed that if a plant will cost $100 per hp for the development, if carried to its most economical point, it will be a safe investment, but when it reaches $200 per hp it will be well to proceed cautiously before investing any money in it. But, it was added, there are sometimes exceptional markets, for example, in mines and other remote places where power costs are high and where high prices can be obtained. Under such conditions a large cost for development is warranted. For example, there is one development in Mexico for which the authors were consulting engineers where the cost of power at the mines was from $150 to $200 a year, gold. A hydroelectric development was made and power delivered at $100 per hp, thus making a great reduction in cost to the mine owners and yielding a substantial profit to the electric company. Another case is a plant in California which cost about $400 per hp to develop. A small portion of this power could be disposed of at the mines for $75 per hp with comparatively short transmission lines, but the remainder had to be carried a long distance and sold in competition with other power. The fixed charges alone on this development were at least $30 to $35 a year, and the running expenses were also high. It was impossible to produce power cheaply enough to compete with other sources of powers and pay the fixed charges on the investment.

Canadian Hydroelectric Commission News.

The town council of Toronto, by a vote of 7 to 2, has decided to submit to a vote of the ratepayers at the municipal elections in January a by-law providing for the issue of debentures to the amount of $30,000 for the cost of a plant to distribute throughout the town electric power to be supplied to the town corporation by the Hydroelectric Commission from the transmission line now being constructed from Niagara Falls to London.

The opposition to the operations of the Hydroelectric Commission by means of recourse to the courts of justice is gradually being disposed of. On Dec. 16 the Division Court, sitting at Toronto, rendered judgment in the case of "Smith versus the city corporation of London," on the appeal by the plaintiff from the judgment of Mr. Justice Riddell of May 4, 1909. In this action the plaintiff, a ratepayer of London, Ontario, sought to restrain the municipality from entering into a contract with the Hydroelectric Commission for power for civic purposes. The effect of the present judgment is a decision that the whole ground of attack by the plaintiff has since been taken away by the legislation legalizing the contract and by-law.

Judgment was also rendered in the action brought by Walter D. Beardmore against the city corporation of Toronto, recently referred to in these columns. The learned justices stated that this action was practically identical with the Smith vs. London litigation and directed judgment to be entered accordingly.

The efforts of interests opposed to the power policy of the Ontario Government to have the Dominion Government intervene and disallow the hydroelectric legislation enacted by the Government of Sir James Whitney have been met with a very spirited reply by the Attorney-General of Ontario. It will be remembered from items appearing in these columns that very persistent efforts have been put forth to cause the Dominion Government to disallow the legislation on various grounds, chief among them being that such legislation was illegal, arbitrary and unconstitutional, and that it prejudicially affected the investment of capital in electric light and power corporations carrying on business within the territory to be covered by the operations of the Hydroelectric Commission.

The reply of the Ontorio Attorney-General, which was made to the Dominion Government on Dec. 7, and has since been made public, goes very exhaustively into the whole question, and after a very comprehensive recital of the important features connected with the formation and operation of the commission, the act creating the commission and providing for the transmission of electric power to municipalities is declared to be "not altogether illegal or unconstitutional, nor is it illegal or unconstitutional in part, being, in fact, both legal and constitutional; nor does it clash with the legislation of the Dominion Parliament; nor does it affect the interests of the Dominion generally."

The Dominion Government has until April next in which to take action on the request for disallowance. It is thought that the request will not be entertained, but that a reference may be made to the Supreme Court on the constitutional question involved.

New York Public Service Commission News.

At the first meeting held by the Public Service Commission of the First District of New York upon the second plan of reorganization proposed by the bondholders' committee of the Third Avenue Railroad, Mr. John M. Bowers, counsel for the committee, stated that the position of his clients would be to deny the authority of the commission to interfere with the plan. He said that, in view of the recent decision in the Delaware & Hudson case, it was his opinion that the commission had no power with respect to the reorganization plan except to see that the capitalization is not inflated over the existing capitalization, that the properties are properly in the hands of the organizers and that the capital issues, which it is proposed to replace by new securities, were originally properly authorized and made. When the commission rejected the first plan of reorganization offered by the bondholders' committee it laid down several propositions that are hostile to the provisions of the plan that is now under consideration. Mr. Bowers's announcement, therefore, is taken to mean that his clients are prepared to fight in court the rights of the commission to interfere with the present plan.

The Public Service Commission is dissatisfied with the tardiness of the Interborough Rapid Transit Company in equipping

its subway trains with side doors. It is claimed that the promises which were made last summer by the company have not been lived up to, and that by this time all of the express trains should have been fitted with side doors. As a matter of fact, only few such trains are in operation. The commission has decided to take steps immediately to enforce the carrying out of the original order, and is also considering the advisability of ordering the company to provide side-door trains on the express lines during the entire day, and an order directing the company to use side doors on the local trains as well.

The commission also last week adopted two orders calling for hearings to determine whether the Long Island Railroad Company should not be directed to provide station platforms as long as its trains on all lines operated by electricity, and also whether or not the company should be directed to provide the cars of its electric trains with platforms, gates, side doors, vestibule doors and trap platforms to be used to bridge the gap between the cars and station platform. These hearings will begin Dec. 29.

In the matter of the application of the Kings County Electric Light & Power Company before the Public Service Commission of the First District for permission to issue $5,000,000 of convertible debenture bonds, which has been under consideration for some weeks, permission was given the company to withdraw the original application and to submit an amended one. According to the amended application, the company will ask permission to issue $2,500,000 of construction bonds and $2,500,000 of reimbursement bonds. It is understood that the commission will approve the issue of the construction bonds, but there is a question as to whether it has a right to approve an issue of bonds to reimburse the company for work that has already been done. The matter will be considered at further hearings.

The New York City Interborough Railway Company has applied to the Public Service Commission for permission to abandon about three miles of disconnected rails in the Borough of the Bronx. It is stated that the Board of Estimate has already approved this move. These lines, it is claimed, are no longer necessary on account of new lines covering the same territory.

Application has been made to the Public Service Commission by representatives of the United Tax Payers' Association of Queens Borough, an organization composed of 27 civic associations, for permission to construct a new rapid-transit system in that borough, under the provision of the law which provides for the building of such lines at the expense of the property owners benefited. The system favored by the association provides for two main lines leading from Manhattan. One of these crosses the Queensboro Bridge, runs through Jackson Avenue on an elevated structure to Flushing, College Point and Whitestone. The other starts from the eastern terminal of the Williamsburg Bridge and runs through various streets in the direction of Jamaica, Elmhurst and other points in Queens.

The application of the Geneva & Auburn Railway Company for consent to issue $50,000 of 6 per cent cumulative preferred stock will be heard next week by the Public Service Commission of the Second District, and also the application of the Orange County Lighting Company for authority to issue a second mortgage for $200,000 and to issue at present $85,000 in convertible bonds and for authority to issue capital stock for the conversion; also the application of the Mineville Light, Heat & Power Company for authority to exercise franchises in the town of Moriah, Essex County, and to issue $10,000 of capital stock.

The Kingston Consolidated Railway Company has been authorized to issue a second mortgage on its property and franchises to secure an issue of $250,000 in 5 per cent 30-year bonds, and presently to issue $56,000 in bonds, to net the company not less than 80 per cent of the par value. It may also issue its corporate notes in the sum of $17,360, the proceeds to be realized from the sale of bonds and notes to be used to reconstruct its railroad property on Broadway, North Main Street, Wall Street and Main Street in the city of Kingston, and for the paving of that portion of the above-named streets occupied by the railroad. Whatever sum is realized from the salvage of plant or property replaced in the course of above construction shall be used in part payment for the new construction.

The commission has authorized the Auburn Gas Company to issue 5 per cent 20-year debenture bonds, par value $100,000, the bonds in question to be sold at par. A provision is approved which allows the company to redeem at any time on 60 days' notice such bonds as it may desire at 105 and accrued interest. The sum of $9,000 is to discharge certain obligations of the company, and $91,000 for the extension and improvement of its plant and distributing system.

The commission has authorized the New York, Westchester & Boston Railway and the New York & Portchester Railroad companies by joint agreement to consolidate their capital stock, property and franchises and the capital stock, property and franchises of each of them, and the commission approves of such consolidation, provided that the capital stock of the consolidated company shall not exceed the sum of $5,000,000, and that the final agreement of consolidation will be submitted to the commission for approval and for final execution. The corporation to be formed by the consolidation is authorized to abandon such portion of the routes of the consolidated corporations as are not necessary to form one continuous route from the Harlem River in the city of New York to the village of Portchester in the county of Westchester, with a branch line from about 177th Street in the city of New York to Throgg's Neck in said city, and with a branch from the city of Mount Vernon to White Plains, or to the village of Elmsford, in case the application to abandon that portion of the line extending from White Plains to Elmsford should hereafter be denied. The construction of the consolidated railroad as a single railroad is approved and authorized as a public convenience and a necessity.

Wisconsin State Commission News.

The application of the Cincinnati Construction Company for a certificate of convenience and necessity received a formal hearing before the Wisconsin State Commission on Dec. 15. The petition relates to a proposed electric interurban railway to connect Madison and Janesville, Wis., which will open up a new territory not now covered by the steam roads. Considerable testimony was offered, both by the company and by the citizens of both cities, to show the advantage of such a road, and as no objection to the construction was made the petition will undoubtedly be granted by the commission.

The commission has authorized the Monroe Electric Company to issue 251 shares of common stock of value $100 each and $40,000 par value of 20-year, first-mortgage gold bonds of a denomination of $500 each, to bear interest at the rate of 6 per cent per annum, payable semi-annually. This issue was made in order to allow the newly organized company to acquire the property and holdings of the old Monroe Lighting Company.

The Antigo Electric Company, a newly organized company, has been authorized to issue stock and bonds as follows:

(1) One thousand shares of common stock of the par value of $100 each.

(2) Thirty-five thousand dollars, par value, of bonds of the denomination of $100 and upward each, to bear interest at the rate of 5 per cent per annum and to be secured by first mortgage on all the property of the said company. These bonds are to mature on or before the year 1920. Forty-five thousand dollars of stock is to be issued and delivered to the present owners in exchange for all properties and privileges now owned by them in connection with the electric light plant in the city of Antigo. Fifty-five thousand dollars of stock shall be issued and sold for the purpose of supplying funds for making additions and improvements in the plant. The bonds are to be sold for the purpose of paying all outstanding indebtedness.

VALUATION OF WATER POWERS.

The hearings that have taken place in connection with the Beloit rate case have emphasized the fact that, for purposes of

rate making, it is absolutely necessary to put some value upon the water rights owned and controlled by hydroelectric companies. Values have been placed on water-powers in cases where those powers were to be sold, or where such power was damaged in any way, but these values, as a rule, are unsatisfactory when it comes to fixing a cost as a basis for an equitable rate. The commission bases its rates for electric power practically entirely upon the question of cost. In testifying on this question before the commission, Prof. D. W. Mead, a consulting hydraulic engineer, gave three bases upon which the value of water-power could be had. In pointing out these methods, he recognized the facts that water-power, like any commodity, has no actual value of itself, as its value depends solely upon the nature of the supply and demand which actually exists or may be created. A water-power at a point inaccessible under present conditions would have no value other than the speculative value dependent upon the possibility of future development and utilization. A water-power, even though utilized, would have a potential value depending upon its location relative to a market and the nature of such a market.

In speaking of the first method of valuing water-power, Professor Mead says: "The value may be measured by the market value of similar water-powers at such locality, provided such market value can be clearly established. Such value should not be measured by the price demanded by parties having a monopoly of such power, nor the price asked by owners having extra power for which they have no use and upon which they wish to realize. An equitable measure of value is usually difficult to apply except when large water-power developments are owned in common by numerous users."

As to the second method, he said: "The value of a water-power may be estimated on the basis of its rental value or the capitalized earnings which may be realized for the use of power under the conditions of its local use. This is a basis more readily applied and more definite and positive in its results."

According to the third method, the value of a water-power may be estimated on the basis of the saving actually effected by its use, compared with the use of such other method of developing power as would be normally used were the water-power not available. "The saving effected should be estimated on the basis of interest, depreciation, repairs, maintenance and operation of both classes of plants considered, and the contingencies and flexibility of service must be given due weight. In such a comparison the capitalized value of the extreme maximum development should not be used, as such a value would, in its practical outcome, ordinarily lead to the adoption of the more common method of power development. The value should be so placed as to make the development of the water-power an object to the plant considered. That is, an actual saving should be entailed by its ultimate use on the basis of the value fixed."

The theoretical horse-power that could be developed at Beloit was estimated by Professor Mead at from 1500 hp to 1675 hp, based upon a 40 per cent load factor, which is equivalent to a 10-hour service. The legitimacy of considering the load factor in the quantitative estimate of water-power depends on the rules governing its use. At Beloit the company is entitled to use its proportion, 40.75 per cent of the flow, no matter whether it uses it in 1 hour or 24 hours, so that the value of its water-power must be estimated on the basis of its load factor. This basis is obviously correct, for it is the basis on which all other portions of its power plant are purchased and installed. The value of the Beloit power should therefore be based on a 10-hour use.

From comparison of similar water-powers in the State, Professor Mead estimated that an entire value of the Beloit power could be fixed at $12.50 per theoretical horse-power as a conservative estimate, which with 1500 theoretical horse-power, would equal an annual rental of $18,750.

Mr. Benezette Williams prepared a very comprehensive report covering the costs of a steam plant of similar size and from his investigations he showed that when all facts were taken into consideration, the saving that could be made effective by the water-power plant would be equal to $17,677 per year, or a value essentially equal to the estimated rental value of the power.

The amounts above fixed as the annual earnings which the plant should make are net and should be capitalized (to ascertain the net value of the water-power) at a rate of interest corresponding to the rate fixed by the commission.

As this is the first case involving the cost of water-power for rate-making purposes the commission has been called upon to decide, it opens up a new question which will have to be definitely settled, as it sets a new precedent in such matters.

CURRENT NEWS AND NOTES.

ESTATE OF MILO G. KELLOGG.—A Probate Court inventory of the estate of the late Milo G. Kellogg, of Chicago, founder and president of the Kellogg Switchboard & Supply Company, shows that the deceased inventor left an estate valued at over $1,000,000. When the debts are deducted it is believed that the estate will be valued at an even million dollars.

MONTREAL MUNICIPAL PLANT LITIGATION.—The right of the city corporation to go into the manufacture of electricity for a lighting plant is to be tested in the courts. On Dec. 14 an application was made by C. S. G. Phillips, a prominent member of the Merchants' Association, for an injunction restraining the city from taking a referendum on Dec. 21 on the proposed establishment of a municipal lighting plant. It is claimed that the by-law is illegal and that the taking of a referendum will mean only added expense to the city.

MEETING OF WIRELESS TELEGRAPH ENGINEERS.—The regular monthly meeting of the Society of Wireless Telegraph Engineers was held at the factory of E. S. Ritchie & Sons, Brookline, Mass., on Monday, Dec. 6. Mr. Sewall Cabot gave a working demonstration of wireless transmitting apparatus employing a spark gap which consisted of synchronously rotating serial subdivisions. Electrical measurements were made indicating in a general manner the amount of electrical energy in the antenna circuit and the amount of damping in the radiated wave.

PROPOSED STREET-RAILWAY FRANCHISE DEFEATED IN KANSAS CITY.—By vote of 11,640 in the affirmative and 18,731 in the negative, the proposition to extend the franchise of the Metropolitan Street Railway Company, of Kansas City, for a period of 26 years from 1925 was defeated at a special election in that city on Dec. 16. The proposed franchise provided that not later than Jan. 1, 1913, the company should sell 25 tickets for $1 and 6 for 25 cents, but in other respects the provisions of the proposed ordinance were unsatisfactory to the voters.

INTERURBAN RAILWAY MERGER NEAR CHICAGO.—The Chicago, Joliet & East St. Louis Electric Railway Company has been incorporated, and it is said that this company has been formed as a holding company for four existing companies which will be merged in it. These companies are the Joliet & Southern Traction Company, Joliet, Plainfield & Aurora Electric Railway Company, Bloomington, Pontiac & Joliet Electric Railway Company and Chicago, Joliet & Central Illinois Electric Railway Company. Mr. H. A. Fisher, of Joliet, is prominent in the new enterprise, and in addition to serving an extensive territory south and west of Chicago, the purpose apparently is to connect the Illinois Traction System at Bloomington with the elevated railway system of Chicago, forming a connection with the latter at the terminus of the Douglas Park Branch of the Metropolitan West Side Elevated Railway Company.

COMBINATION WIRELESS TELEGRAPH RECEIVER.—In the article which appeared in our issue dated Dec. 2 (page 1355), describing a new type of combination wireless telegraph receiver adopted for use in the United States Navy, it should have been stated that the receiver is manufactured by the Wireless Specialty Apparatus Company from designs of Mr. G. W. Pickard, its consulting engineer.

KING LEOPOLD INTERESTED IN ELECTRIC RAILWAYS.—According to newspaper dispatches the fact has been revealed since the death of King Leopold, of Belgium, that among the American securities in his possession were many shares in interurban electric railway companies, especially in the State of Indiana. The late king was a notable business man, but it is not generally recognized that he was a heavy investor in American electric railway stocks.

SOCIETY OF AUTOMOBILE ENGINEERS.—The annual meeting of the Society of Automobile Engineers will be held Jan. 13 at the Automobile Club of America, New York City, during the automobile show to be held under the auspices of the Association of Licensed Automobile Manufacturers. The result of the annual election of officers will be announced at that time. The electrical exhibits of the "A. L. A. M." automobile show will be shown at Madison Square Garden and will include displays made by nine manufacturers of electric pleasure vehicles, five manufacturers of electric commercial vehicles and six makers of automobile batteries.

NEW YORK SECTION, I. E. S.—The New York Section of the Illuminating Engineering Society held its December meeting in connection with the National Commercial Gas Association's convention on Dec. 17. Mr. H. Thurston Owens presented a paper devoted to street-lighting fixtures in Europe. In a paper describing the lighting of the office building and display rooms of the Consolidated Gas Company in New York, Messrs. V. R. Lansingh and E. B. Rowe gave some interesting data relating to the absorption of light by walls of various colors. In five rooms having white ceilings the foot-candles of illumination produced by lamps of identical arrangement and candle-power varied according to the color of the side walls as follows: Green, 1.57; red, 1.87; blue, 2.36; cream, 2.93, and salmon, 3.34.

ELECTRICITY PREVENTS FIRES IN RAILROAD WRECKS.—An unusual number of railroad accidents have occurred in various parts of the country during the last few weeks, and accounts of these disasters in the newspapers have been read with sympathetic attention. However, it is to be remarked that further horror of fire has not been characteristic of recent wrecks, and this is at least partly due to the doing away with open-flame illuminants by the use of electricity. The use of electric heaters also prevents scalding from broken steam pipes in case of accident. Referring to a railroad wreck which occurred at Western Springs, Ill., on Dec. 18, a Chicago daily makes this significant comment: "The cars were heated and lighted by electricity, so that there was no danger from fire."

MUNICIPAL FREIGHT SUBWAY PROPOSED FOR CHICAGO.—At the recent meeting of the American Institute of Architects in Washington, D. C., Mr. F. A. Delano, president of the Wabash Railroad, discussed the railroad terminal problem in Chicago. He suggested that freight should be handled in less densely populated portions of the city, and to do this the municipality might furnish a tunnel or subway under the streets, bisecting the wholesale business district. This freight subway should be provided with a platform or conveyor moving intermittently or else continuously at slow speed having at intervals of, say, two to four blocks small stations for the receipt of freight. The conveyor should be arranged to move in a subway loop through the heart of the city, but emerging from that and proceeding along some railway right of-way to a convenient outside depot or clearing house for the loading of freight.

ELECTRIC MARINE PROPULSION.—In a paper presented before the Institute of Civil Engineers Dec. 7, Mr. H. A. Mavor advocated the use of electric motors for ship propulsion. To illustrate the advantages, comparisons were made on the basis of certain definite types of ships. In the case of an 840-hp cargo vessel, an oil-engine electrical equipment would weigh 270 tons as against 570 tons for a steam equipment, fuel being included in both cases, while the saving in operation would be $25 per day. In the case of a 770-hp vessel equipped with a gas-engine plant, the corresponding weights would be 229 and 446 tons, with an equally favorable economy of operation. The case was discussed of a 1030-hp cargo vessel equipped with a turbo-generator, and also that of a 16,200-hp passenger vessel with electrical equipment.

SAN FRANCISCO UNDERGROUND CONDUIT ORDINANCE.—At a meeting of the Board of Supervisors of San Francisco, on Dec. 6, an ordinance requiring metal conduits for insulating electric wires, instead of the wooden ones such as are used at present, was passed to print. The ordinance provides that "all electrical wires hereafter installed in or on buildings or other structures within the fire limits of the city and county of San Francisco shall be enclosed in 'National Code Conduit,' or other approved armored conductors; provided, however, that such wires when used for telephone, telegraph, district messenger, call bell or similar systems are exempted from the foregoing provisions. The ordinance does not prohibit temporary installations of other methods of electrical construction for decorative or display purposes, and the Department of Electricity is authorized to grant special permission for such temporary installations for a period not to exceed 60 days.

PRONUNCIATION OF NUMERALS OVER THE TELEPHONE.—For a long time telephone companies have instructed their operators to use the word "O" instead of the numeral "naught." This is intended to do away with errors. For instance, "Five-double-O-eight" comes more certainly over the telephone than "five thousand and eight" or "fifty-naught-eight." Following this, an effort is being made to identify the digit "three" by trilling the r's. Wherever "three" occurs in a telephone number, the operators in some of the large exchanges now trill the word so that it becomes "thr-r-r-ree." The purpose of this is far from being any affectation, but a laborious effort to identify this numeral at least so that it may not be confused with others. If some method could be devised similarly to differentiate "five" and "nine," telephone traffic managers would rejoice. With the same long vowel sound and with an indistinct aspirate in the case of "five," these numbers are often confused, and errors result in making connections.

GAS-ENGINE PRODUCER PLANTS FOR SHIP PROPULSION.—The engineer-in-chief of the U. S. Navy, in his annual report, refers to the rapid progress in the development of large gas-engine machinery operated in connection with gas producers and states that this prime mover is worthy of much more serious investigation and experiment than has yet been given it in the navy. It is possible, he said, to design a marine plant composed of bituminous coal gas producers furnishing power to gas engines. There are several such plants already in existence; and although they are small, they prove the feasibility of extending this system of developing power to larger installations. "Great possibilities for improving the economical operation of machinery are offered by the producer gas engine combination. We cannot afford to delay development of the gas engine for naval use until commercial gas-engine plants, directly adaptable to naval use, are regularly on the market, and it is, therefore, recommended that special authority be secured in the next appropriation act for the diversion of not more than $250,000 of the appropriation 'Steam Machinery' for the purchase and installation of a producer gas-engine plant in one of our colliers, if at any time during the year such an expenditure is deemed advisable."

ELECTRIC CLUB ENTERTAINMENT.—It is announced that the Electric Club of Chicago will give a smoker and vaudeville entertainment on the evening of Jan. 7 in the grill room of the Automobile Club. Tickets will be sold to members at 75 cents each. Mr. George H. Porter is chairman of the entertainment committee.

TELEPHONE SPEECH CURRENTS.—In a paper presented Dec. 14 before the Pittsburgh Section, A. I. E. E., Messrs. E. B. Tuttle and W. V. Read gave the result of a study of telephone transmission by means of the oscillograph. Mr. Tuttle has succeeded in obtaining oscillograph curves of telephone speech currents which are capable of accurate analysis to the ninth harmonic. It was found that the even harmonics are fully as important in speech current waves as are the odd harmonics.

PENSIONS TO ELECTRIC TRACTION EMPLOYEES.—The Brooklyn Rapid Transit Company, which employs 13,000 men, has adopted a pension system for veteran employees. Each employee who has served 35 years will be entitled to receive 50 per cent of his monthly pay when he reaches the age of 70 or is retired through incapacity between the ages of 65 and 69 years. The minimum limit of service to entitle the employee to participation is 25 years, the pension being graded down to 30 per cent for such workers.

ELECTRIC HEATERS CRITICISED FOR BEING TOO GOOD.—Electric heaters in cars have sometimes been accused of not furnishing enough heat, but one man who writes to the Chicago papers complains that they furnish too much. He contends that passengers on the Oak Park elevated cars suffer by being obliged to "sit on seats so hot that one's anatomy is roasted to an overdone condition." He suggests that passengers be furnished with asbestos pads to be used when sitting over the electric heaters. This is certainly a gratifying, if rather unusual, testimony to the efficiency of this class of apparatus.

N. E. L. A. COMMERCIAL PROGRAM COMMITTEE.—The first meeting of the Commercial Program Committee of the National Electric Light Association was held in New York on Nov. 27, to formulate plans for the next convention. A strong sentiment developed in favor of a curtailment in the length of the commercial program next year, in order that the principal topics of interest may be taken up and discussed widely. With this in view, fewer papers will therefore be presented next year, every effort being made to bring out a thorough discussion. The committee will hold its second meeting in Chicago during the week of the Electrical Show.

LOCOMOTIVE FUEL WASTES.—In a report of the U. S. Geological Survey, it is estimated that of 90,000,000 tons of coal consumed annually in this country by locomotives, 18,000,000 tons are wasted in standby and other periods when no load is being hauled, and 8,640,000 tons are lost in cinders and sparks. Both of these items are saved in electric traction, and the radiation and leakage, which correspond to 5,040,000 tons, greatly reduced. The heat actually transmitted to the boiler is 41,040,000 tons, which would be halved in the case of high-efficiency electrical generating engines. The saving in coal which electric traction renders possible is thus not far from 50,000,000 tons per annum, or more than 50 per cent.

UNIVERSITY OF MICHIGAN ENGINEERING DEGREES.—The University of Michigan has adopted a new schedule of engineering degrees whereby the former degree of bachelor of science in electrical engineering, etc., conferred at the end of four years' work, will be changed to read bachelor of electrical engineering, etc. The degree of master of science in engineering will remain unchanged. In the six years' course the degree of bachelor of science in preparation for engineering will be changed to master of science in engineering. The degrees of master of electrical engineering, etc., conferred at the end of six years, remains unchanged, as well as the degrees of civil engineer, etc., which are conferred upon those who receive a bachelor's degree after a five years' course and at least one year of professional work and also a year of advanced work accompanied by a thesis.

ENGINEER-PHYSICIST EXAMINATION.—The United States Civil Service Commission will hold an examination Jan. 12 for the appointment in the Bureau of Standards of an engineer-physicist at $3,000 per year and associate engineer-physicist at $2,000 per year. Applicants should be fully able to initiate and carry on independent research in the field of engineering physics, and should have training and experience in the inspection and testing of engineering and structural materials, the operation of testing machines and the interpretation of the results of investigations. There will be no educational examination for these positions, but it is essential that applicants should have made and published some contributions of recognized merit in engineering knowledge. Applicants should submit the titles of all papers they may have published and give references to the original source of publication.

DEATHS FROM ELECTRIC SHOCK IN SWITZERLAND.—The number of deaths annually in Switzerland due to electric shock has been almost stationary during the past five years, the figures being respectively 36, 30, 35, 35 and 36. Of the 36 victims of last year, 28 were engaged in electrical callings, and five were building mechanics killed while working by coming in contact with live conductors, principally on the roofs of buildings. Of the remaining three victims, one was a servant, another a factory hand and the third a child. An analysis made of the accidents showed that the greater number was due to lack of precaution on the part of the victims, particularly in the cases of the electrical employees. The servant attached a wire to a kite line to lengthen it and the wire came into contact with a 6000-volt conductor. The child climbed the pole of a high-tension line and touched a conductor, death in this case being probably due to the fall.

WIRES OVER RAILROADS.—The Railroad Commission of Indiana has issued a circular in which it is stated that information has come to the commission that numerous telegraph and telephone wires crossing interurban and steam railway rights-of-way are so constructed as to be sources of danger by reason of their coming in contact with high-tension wires or with the trolley wire of the electric lines, and that many wires crossing steam railways are too low for safety or are insufficiently supported. The peril from these defects arises either (1) from the wires being stretched too low; (2) or from their being fastened to weak or rotten poles, or with insecure fastenings; (3) or from their being constructed of inferior material which rusts out or breaks; (4) or because the supports are too far apart, causing sagging; (5) or from absence of guards to prevent sagging or dropping of the wire. Trainmen are exposed to extreme hazard if such wires sag or break, especially if they come in contact with others of higher potential, and the commission calls attention to the following section of the statutes: "All telegraph, telephone, electric light and all other wires of any kind hereafter constructed over the tracks of any steam railroad within the State of Indiana shall be supported by good, substantial wooden poles of a size not less than 12 in. in diameter at the bottom and not less than 6 in. in diameter at the top, or iron or steel poles not less than 5 in. in diameter at the bottom and 3 in. in diameter at the top, such poles to be set in the earth to a depth of not less than 6 ft. and to be well tamped. All such wires shall clear the top of the rails at least 25 ft. and shall be secured to the poles in such manner as will properly hold them; provided, that in case of the trolley feed and other wires of any electric railway extending over the tracks of any steam railroad in this State the height of such wires above the tops of the rails of such steam railroads shall be not less than 22 ft."

Madison River Hydroelectric Development.

THE Madison River Power Company is owned by the Butte Electric & Power Company, a corporation which is rapidly gaining control of the electrical situation in the State of Montana.

There are at present five generating stations included in this system, all of which are operated in parallel. These are the Madison plant, one at Big-hole on the Big-hole River, and smaller ones at Parrot, Livingston and Butte, the latter two being both generating and consuming stations. Besides these, there are now under construction at Great Falls, developments

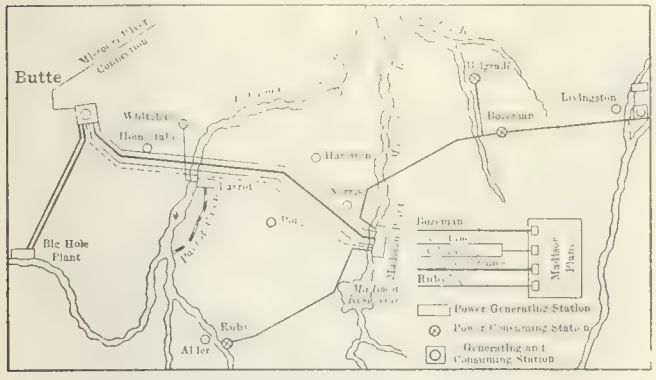


FIG. 1.—MAP OF TRANSMISSION SYSTEM

capable of at least 100,000 hp. It might be added that in winter the plant at Parrot cannot be operated as a generating station, owing to lack of water, and that then the units are used at this time as synchronous motors to improve the power factor of the system.

Of all the stations now in operation the Madison is the most important. This development consists of two generating



FIG. 2.—VIEW SHOWING SECTION OF STAVE PIPES AND STATION NO. 1.

plants in the Madison River Canyon, which is 60 miles southeast of the city of Butte. The river at this place flows into a narrow canyon formed by solid rock and hills rising precipitately to a height of several hundred feet above the river. At the head of this canyon an artificial lake has been formed by backing the water from a concrete dam, two miles below, into a large basin of meadow land. This reservoir is six miles long by three miles wide.

From the dam run two wooden stave pipes of 10-ft. and 12-ft. diameter. They follow a grade cut in the mountain sides for two miles and empty into a concrete pressure chamber above station No. 2. To lessen the constant danger of pipes being crushed by boulders, which not infrequently come bounding down the hills, a heavy guard fence has been erected. This fence is built of heavy log posts and 2-in. steel mine cable and has been tested to withstand almost any shock that falling rocks might inflict on it.

Station No. 1 was put in operation about 11 years ago. It contains two 1000-kw General Electric alternators, each directly connected to two 62-in. reduced capacity Leffel turbines operating at a 60-ft. head. At present this plant is run only at times of high peak, owing to lack of sufficient water to operate both plants at full rated output. At times of high peak this station is connected in parallel with station No. 2 and is loaded up with the wattless current of the system, thereby raising the power factor. Water is supplied to the two steel pressure chambers through an 8-ft. stave pipe tapped into the 12-ft. pipe at the head-works.

The real development, however, is in the lower station. From the pressure chamber above this station run four steel penstocks to the four units. Each unit consists of one 2400-kw General Electric alternator directly connected to two specially constructed high-head Leffel turbines. The average head is 110 ft. The speed of each unit is regulated by a Lombard governor which gives perfect control of the unit load, either from the floor or from the board in the gallery.

In Fig. 1 is illustrated the plan of the transmission system. There are five lines leading from the Madison station. The voltage of transmission on all lines is 60,000.

Of all the lines shown the three parallel lines running over the divide to Butte, 60 miles distant, require the most careful attention, as they carry the greater part of the station output. The power is used in Butte for illumination, street railway service and for the motors in the numerous copper mines; the big smelter at Anaconda also takes about 5000 kw in an induction motor load. Two of these Butte lines are of wooden pole construction and between these is a steel tower line.

On the pole lines use is made of aluminum cables insulated by the ordinary triple-petticoat glass insulator. On the tower line are copper cables; here the insulator consists of two



FIG. 3.—GENERAL VIEW OF STATION NO. 2

separate porcelain disks fastened together by a patent hanger; to these is suspended a yellow pine stick, 2 in. square by 2 ft. long, to which the cable is attached. The pine stick is heavily impregnated with paraffine and adds materially to the breakdown strength of the insulator. The longest tower span is 2500 ft., the average span being about 500 ft.

The country through which these three lines pass is well calculated to cause a maximum amount of trouble to continuous operation. The lines, passing through valleys and over moun-

tains, are subject to great potential differences to ground, due to differences of atmospheric potential in different regions. Terrific wind-storms often occur, defying almost any mechanical construction. There are great and sudden variations of temperature, often causing snapping of cables, particularly on the aluminum lines. In summer local thunder-storms occur almost daily over some part of the line, giving much trouble from lightning.

The station is protected from all lines by multi-gap arresters in series with horn-gaps. Since the Butte lines carry the greater part of the station output, extra precautions are taken to keep the service continuous. The tower line is so well protected from lightning by the overhead grounded cables, and so rigid in mechanical construction that grounds seldom occur, and multi-gap arresters alone are found sufficient for its protection.

On the pole lines, however, additional protection is offered by aluminum lightning arresters. Arcing grounds are not infrequent on the pole lines and the resulting current surges cannot, of course, be handled by any multi-gap arrester. The aluminum arrester satisfies this abnormal condition, as it is able to discharge continuously for half an hour. These arresters are placed outdoors in waterproof cases. The non-grounded neutral system of transmission requires three line stacks of aluminum cones and one ground stack. These cells cannot, of course, be permanently connected in circuit, as the small charging current would heat the electrolyte. They are, therefore, connected in series with horn-gaps. Furthermore, when the cells are left out of circuit for some time, the film

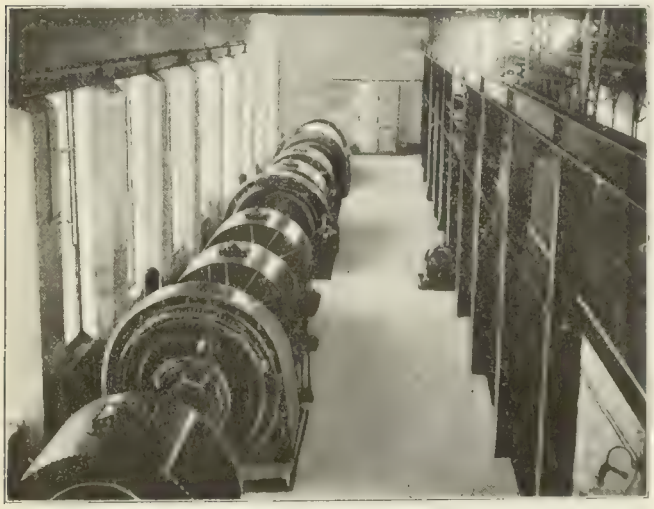


FIG. 4.—TWO GENERATORS WITH TWIN TURBINES, STATION NO. 2.

of aluminum hydroxide on the cones dissolves; the result is that if a high-tension surge should come over the arrester there would be an extremely heavy rush of current for an instant until a new film could form. By charging the cells daily and keeping the film formed at all times the initial rush of current is prevented and the ultimate temperature rise in case a current surge is minimized. The charging is done by the operator after each eight-hour shift, requiring only two or three minutes' time. It is accomplished by closing for an instant the horn-gaps first on the three line stacks, throwing these directly on the high-tension lines; then interchanging, by switches, one line stack and the ground stack and making the charged line stack act as the ground leg; the gaps are again closed, recharging the two remaining line banks of cells and also that bank of cells which is normally the ground leg. The switching is then returned to its normal position and the horn-gaps set properly.

Outside of the fact of keeping the cells in excellent operating condition at all times, this daily charging gives the operator a good idea of the condition of the cells. The operators become so skilful in judging the size and color of the spark at the gap that any disorder of the arrester is at once detected.

The two-pole lines to Butte are designated as the A line and the B line, and the tower line as the C line. Suppose a cable on the A line, for example, should break or be torn from its insulators by wind and should become grounded. Since the A and B lines are tied together at Madison and enter the station together, the heavy rush of current would trip both relays, thus dropping all load from both lines. The jolt due to the ground knocks all the motor load in Butte out of synchronism and if it is especially severe the induction motor load at Anaconda is also lost. At the first sudden rush of current the governors shift the turbine gates wide open; the relays immediately open the lines, and the turbines with full flow of water and practically no load take on a terrific speed until the governors can get the gates down. From the terminals of each generator, leads are run to a water rheostat buried in the river.

This rheostat can be connected to the machine through an oil switch either automatically or by hand. On the gate shaft of each turbine is a large cam; when the gates are closed to



FIG. 5.—VIEW OF STAVE PIPE IN COURSE OF CONSTRUCTION.

about the 800-kw mark this cam releases a pin, thereby allowing a counterweight to close the oil switch. Each rheostat can carry about 750 kw. The governors as a rule close the gates almost instantly, thus throwing in the rheostats as they pass the 800-kw mark. Occasionally, however, a gate sticks and the governor is unable to operate it quickly. In this case the three rheostats that are in service quickly decrease the speeds of their three generators down to a safe value and also pull on the fourth till the floor man can insert the rheostat by hand and work the gate down with a bar. It is seen that although one gate should stick even wide open and the other three should close promptly, the four rheostats together would throw a load or about 3000 kw on this machine and no racing would result.

The corporate interests of the Butte Electric Company at the Madison plant are in charge of Superintendent M. E. Buck, a pioneer in high-tension transmission work. To him is due all credit for the engineering features of the layout and construction of this hydraulic plant and for the economic and profitable basis upon which it is operated.

Train Operation in Chicago Freight Tunnels.

ONE of the interesting features of the system of freight tunnels underlying the heart of Chicago is the method adopted to secure safety in train operation. There are 60 miles of these tunnels laid under the streets in the central business district of the city. The tunnels are used for the transportation of freight on narrow-gage electric railways, and no passenger traffic is accepted. They are connected to all the freight houses of the railroads entering Chicago, and in addition to many wholesale and retail business houses and office buildings, as well as to buildings in course of construction for the removal of excavated material.

In addition to the transportation of freight and merchandise and the removal of earth from excavations, a considerable business is done in the delivery of coal to office buildings and the removal of ashes. Where excavated material is to be removed from building sites a chute is erected, extending down to the tunnel. For the handling of coal and ashes in a number of cases elaborate conveyors have been installed in sub-basements, or else shafts have been laid down to the tunnel through which coal is lifted up to the basement level and ashes taken down to the tunnel level.

The average depth of the bottom of the tunnels from the surface of the street is 42 ft. Tunnels are built of concrete 10 in. thick at the top and sides and 14 in. thick at the bottom. They are of the shape of a horseshoe. The interior dimensions of the typical tunnel are 6 ft. wide x 7½ ft. high, but in a few cases there are trunk tunnels 12 ft. wide and 14 ft. high. Fig. 1 gives a good view in the tunnels, showing a typical street intersection. The overhead cables shown enclose wires used in automatic telephone service. Fig. 2 shows the tunnel connection with the Heyworth Building at Wabash Avenue and Madison Street. Here a by-pass from the tunnel leads into the building, which has a deep level sub-basement. Fig. 3 shows another arrangement for building connection, in this case with the Majestic Theater Building on Monroe Street. Here there is a by-pass from the main tunnel and a shaft from the by-pass connecting with the coal conveyor in the building. In addition there is an ash chute 3 ft. in diameter.

Drainage is provided by electric pumps, the discharge pipes of which are connected with the city sewers. The suction pipes of the pumps are connected with special tile sumps distributed throughout the entire system. No special provisions for ventilation are needed, as with its many connections to the outside air the tunnels form in themselves a vast ventilating system, and there is always a current of air to be observed in them. The temperature of the air in the tunnels remains uniform during the year at from 55 deg. to 60 deg.

The track of the narrow-gage railway consists of 56-lb. rails, mounted on cast-iron chairs embedded in the cement, with a gage of 2 ft. An overhead trolley wire is used; the system is operated at 250 volts by direct current, it being thought that, owing to the small dimensions of the tunnel and the constant dampness, a higher potential would be unsafe. Electric energy is purchased from the Commonwealth Edison Company. Specially designed electric locomotives, resembling the mining type, are used, and to these are coupled platform cars having a carrying capacity of three tons each. These cars, which are provided with removable vertical stakes fitting in sockets, are 12½ ft. long and 4 ft. wide. Eight cars constitute an average train. Each locomotive is equipped with two 25-hp motors and hand brakes. Each motorman operates his own train without assistance, there being no conductors or brakemen. The movement of cars is in only one direction, up one street and down another.

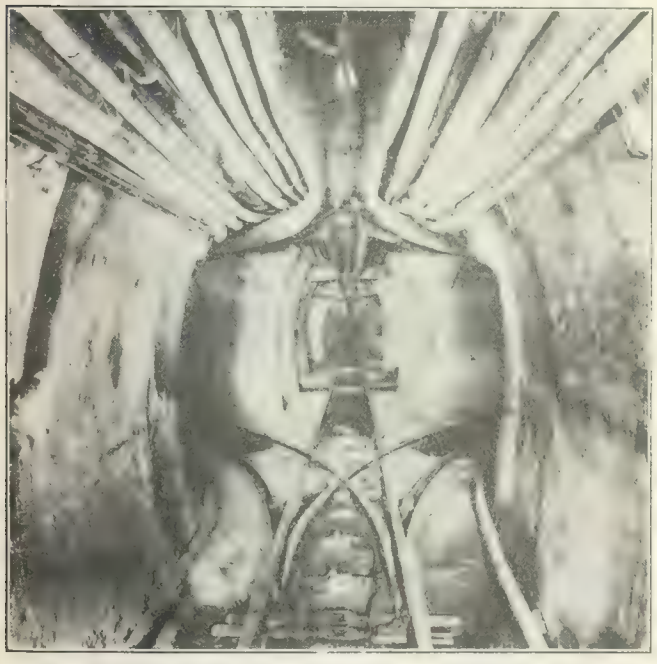


FIG. 1.—TYPICAL STREET INTERSECTION.

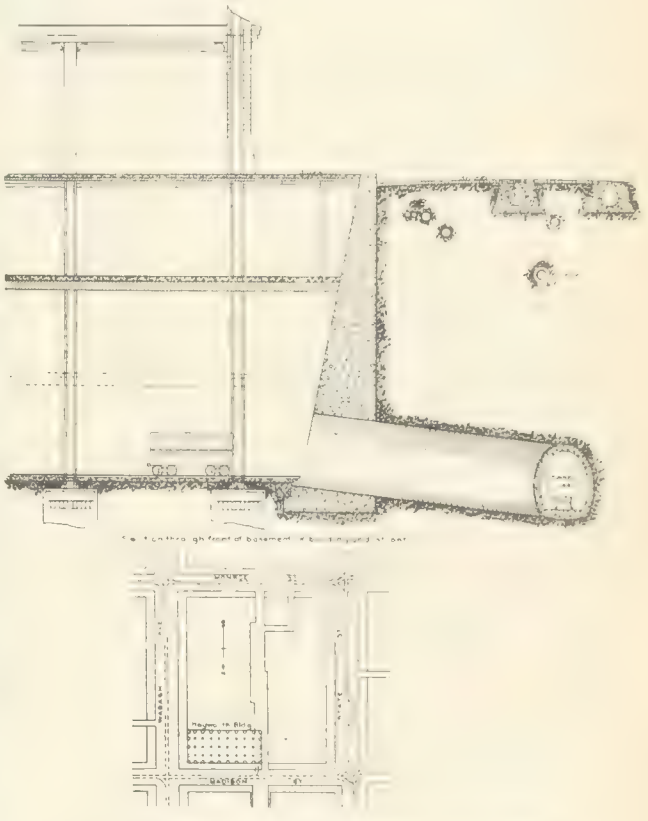


FIG. 2.—CONNECTION TO HEYWORTH BUILDING.

Fig. 4 is a map of the tunnel system, showing the location of intersections and curves. There are 593 tunnel intersections, of which 370 are two-way intersections, 94 three-way, 112 four-way and 17 of special construction.

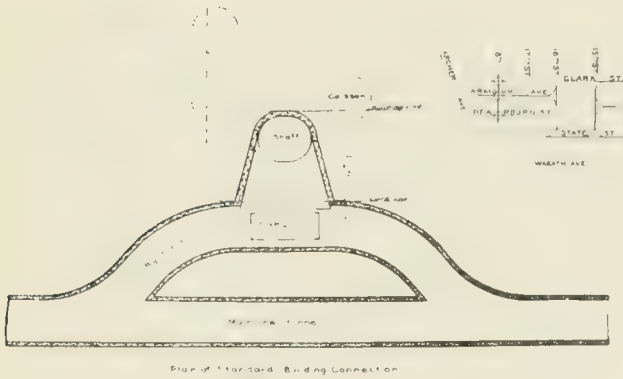
To provide a signaling system under the conditions met in these tunnels has been a perplexing task. Apparatus had to be devised to protect a river drift as well as the ordinary and special intersections mentioned. Some of the signals at the special intersections must be non-operative under certain conditions, but still give a cautionary signal. In addition there must be protection in the river drifts against runaway cars. Tunnel conditions are such that the use of track circuits is an electrical impossibility. In spite of the efforts to insure drainage, there is always moisture present in the tunnel, and this moisture is charged with various earth salts. It was therefore found necessary to abandon the idea of using the track rails

for signaling. This necessitated the use of trolley contactors or some specially insulated devices at the level of the tracks.

When the Illinois Tunnel Company, which operates the tunnels, asked for bids for equipping the subway with signaling devices, the management was informed by the signal manufacturers that the situation presented a different problem from any that had arisen in the history of railroad construction. The tunnels constitute a network of tracks, loops and crossings, with intersections at every city block, and how to protect the system by signal devices that would prove effectual and still permit the operation of trains without too much delay was indeed a difficult question.

Finally, Mr. S. S. Stolp, signal engineer of the company, and Mr. W. J. C. Kenyon, formerly vice-president, developed and installed a patented system of signals of their own which they called the Stolken system of automatic electric-railway-crossing block signals, the trade name being a word coined from the names of the two inventors. This system has been in operation in the subway for the last 18 months, and has been installed at 38 of the 50 especially congested points therein. It is being extended to other intersections as rapidly as possible. Formerly a flag system was in use at intersections, but the Stolken automatic apparatus saves about one-half the power and time formerly consumed with the flag system.

The apparatus for protecting a four-way intersection of two tracks, on each of which there is traffic in only one direction, comprises red signal lamps, though, of course, semaphores may be substituted for the lamps or used in connection with them.



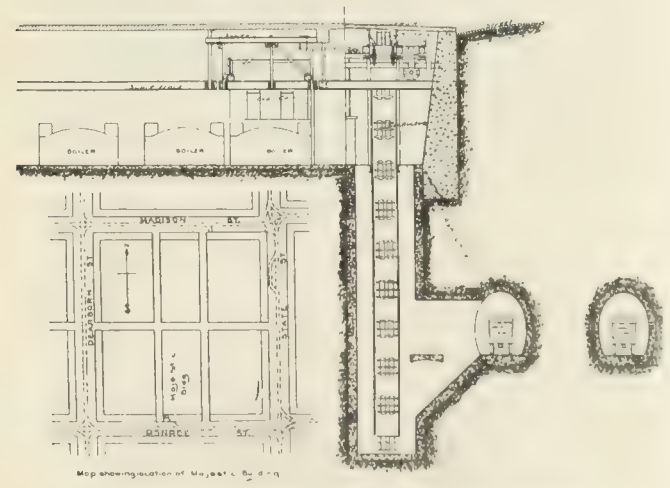


FIG. 3.—BUILDING CONNECTION FOR COAL AND ASHES.

Fig. 5 is a reproduction of a photograph taken at the entrance to a four-way intersection not shown in the picture. A train is shown entering the portion of the tunnel immediately adjacent to the intersection and protected by the signaling system. The two red lamps of the signal (ordinarily enclosed in an iron case with magnifying lenses) are shown prominently at the right of the picture. The trolley contactor is also shown just in advance of the trolley wheel. When this contactor is tripped by the passage of the trolley wheel, one of the lamps lights up. This is a signal to a following train, while that lamp is burning, that a train ahead is passing the intersection. The other lamp indicates, if lighted, that a train is passing the intersection from the other direction—that is, at right angles to the passage of the first train. After the train has set the signal in warning state it crosses the intersection, and its departure automatically restores the signal to the normal no-signal state. Thus both rear-end and crossing collisions are guarded against. In addition to the red lamps, a green lamp is provided on each track to indicate to the operator on an approaching train that his signals are working properly and gives him permission to go ahead.

The apparatus to accomplish these results consists of: (1)

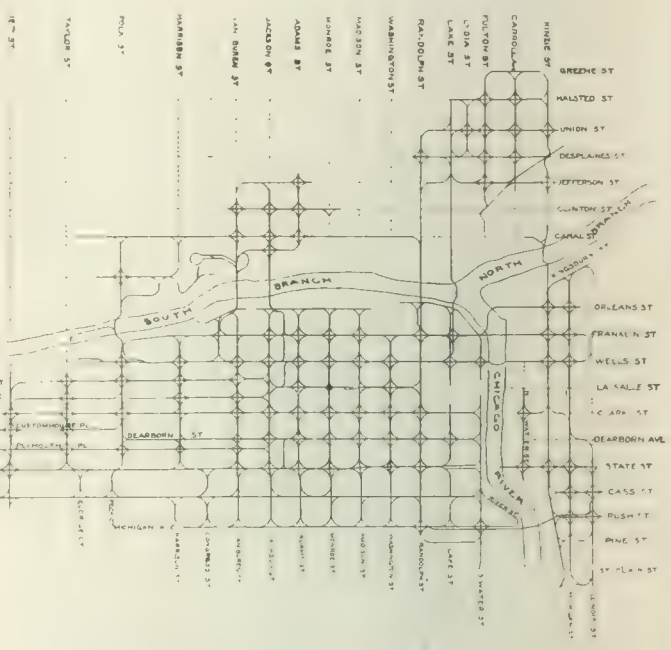


FIG. 4.—MAP SHOWING LOCATION OF TUNNEL INTERSECTIONS AND CURVES.

"On" contactors, which may be placed beside the track rails or above the trolley wire, as shown in Fig. 5. These are actuated by a train approaching the intersection. (2) A relay working in oil to which conductors lead in from all the contactors. (3) Signal lamps whose circuits lead out from the relay and are controlled thereby. (4) "Off" contactors placed similarly to the "on" contactors to be actuated by a train as it departs from the intersection.

In the same oil tank with the relay are simple switches, one for each track, which can be thrown over manually and thereby interchange each "on" contactor with its respective "off" contactor and also change the connections of the signal circuits, so as to adapt the system for traffic in a reverse direction.

It is obvious that the contactors are very vital and important features of the system. If the contactors work surely and properly there can be almost no chance of failure, because the relay working in oil is very certain in its operation, and the signal circuits are not liable to get out of order. The trolley contactor is a remarkably simple and sure device. It consists of a cast-iron box mounted upon the trolley wire and filled with an insulating medium, such as vaseline. A transverse shaft extends through the box, being journaled in its side walls, and the arms hang down from the ends of the shaft in the path of the trolley wheel or harp, as may be seen in Fig. 5. Inside the box the shaft carries a circuit-closing member. The relay is so arranged that when the depending arms are struck by the trolley wheel or harp and the circuit leading to the relay from the trolley wire is thereby closed within the box, then, even though the closure is only momentary, and even though it may be repeated by the arm swinging like a pendu-

lum, in any case the signal circuits are at once closed and held closed at the relay. The mechanical and electrical details of this trolley contactor are very simple and are well worked out.

The rail contactor also has its contact members working in a box of oil, and it is so constructed as to be unaffected by water and to be able to withstand the pounding it receives from the car wheels as they successively pass over it. In case two trains on respective tracks approach their respective "on" contactors at about the same time, the train which strikes its "on" contactor first, even though the difference be only one thousandth of a second, will get the green permissive signal to go ahead, while the other train will get a red warning signal to stop. However, by a simple artifice the relay is so constructed



FIG. 5.—VIEW SHOWING TROLLEY CONTACTOR AND SIGNAL LAMPS.

that when the first train actuates its "off" contactor on departing from the intersection, then automatically the red light, which holds the other train blocked from the intersection, will change to green, and all the other signals will change to correspond. Thus the second train is held until the first train clears the block and then the second train is given the right of way automatically.

In such a case as this, it will be noticed that if rail contactors are used, then the first wheel of the departing train that strikes the "off" contactor will release the waiting train to go ahead; if thereupon the waiting train starts up immediately its wheels will successively actuate the "on" contactor on the corresponding track at the same time that the successive wheels of the departing train are actuating the "off" contactor on the other track. This would obviously confuse the signals; therefore, when rail contactors are used a "time-element" is introduced so that a certain arbitrary time must elapse after the "off" contactor is actuated before the signals are effected thereby. The arbitrary time is made such that the departing train will surely entirely pass its "off" contactor before the permissive signal is given to the other train. Obviously, this time-element mechanism is not necessary when the trolley contactor is employed.

The time-element mechanism consists of a pendulum acting in combination with an electromagnet and a ratchet wheel and pawl so that the ratchet wheel is stepped along one tooth at a time for each beat of the pendulum. The closure of the "off" contactor sets the electromagnet to driving the pendulum and after the ratchet wheel has thus been moved to a certain distance an electrical contact is closed (or broken) so as to actuate the relay and make the appropriate change in the signal circuits.

Although the system is adapted to be supplied with all necessary electric current from ordinary trolley wires, it is so designed that nowhere is there any appreciable sparking or arcing at contacts. Another important practical feature is that whenever the apparatus is exposed in any way it is at that point thoroughly "fool-proof." For example, in the crossing bell, the apparatus is almost all inside a locked box, and what little apparatus is outside this box is extremely simple and strong.

Printed instructions are issued to motormen in the Illinois Tunnel System governing the operation of trains where signals are installed. It is announced that any employee disregarding a properly working signal will be immediately discharged. Employees are told that the green signal is a permissive signal to proceed with train under control. The red signal is a danger signal and means "Stop!" In addition there is, at some points, a "flag" signal—that is, the lighting up of a lamp behind a ground-glass plate bearing the word "Flag." This is occasionally used as a cautionary signal, and means "Proceed with caution." The absence of a signal means danger. If, for any reason, the signals do not work properly, or if the red danger signal remains set longer than three minutes, motormen may proceed with caution, reporting the circumstance to the dispatcher from the nearest telephone.

Vector Diagrams of Polyphase Windings.

BY M. V. AYRES.

THE general use of three-phase generators to supply energy for the operation of single-phase railways has led the writer to make a study of the theory of various polyphase and single-phase windings of generators with reference to their adaptability for supplying single-phase energy. This study developed into a systematic treatment of the general subject of polyphase windings, which, while it probably contains nothing new to designers of such apparatus, appears to be novel and instructive in method and scope.

In what follows there is assumed a machine having six slots per pole, that being the minimum number that will give all the combinations to be considered herein. Let this machine be wound with two coils in each slot, all of full pitch, and connected as they would be in a direct-current drum winding. The slots are 30 electrical space-degrees apart, and, therefore,



FIGS. 1, 2 AND 3.—E.M.F. VECTOR DIAGRAMS.

the e.m.fs. generated in the conductors of these slots will follow one another with 30 deg. time-phase displacement. Following a closed circuit around through the armature, and representing each e.m.f. by its appropriate vector line, there is obtained the 12-sided polygon, Fig. 1, in which the sides 1, 2, 3, 4, ... 12 represent the various e.m.fs.

By taking off taps at the points *A*, *B*, *C*, etc., which represent the ends of the various coils, one may obtain various different e.m.fs. Assume that the output of the machine is limited to a rated current per coil of *i* amp, and a rated voltage per coil

such that the diametrical volts $AG = 2e$ volts. Then e = the radial voltage OA.

Case I. Single-phase.—Taps are taken off at A and G in Fig. 1. E = external volts = $AG = 2e$; I = external current = $2i$; W = watts output = $EI = 4ie$.

Case II. Three-phase.—Taps are taken off at A, E and I, in Fig. 1. E = external volts = $AE = \sqrt{3}e$; I = external current = vector sum of two currents, of magnitude i, of phase relation of EI and AI; $I = i\frac{EX}{EI} = \sqrt{3}i$; W = watts output = $3iE = \sqrt{3}IE = 3\sqrt{3}ie = 5.196ie$.

Case III. Four-phase.—Taps are taken off at A, D, G and J. E = external volts = $\overline{AD} = \sqrt{2}e$; I = external current = vector sum of two currents of magnitude i, of phase relation of $\overline{DG}$ and $\overline{JG}$; $I = i\frac{DY}{DG} = \sqrt{2}i$; W = watts output = $4iE = 2\sqrt{2}IE = 4\sqrt{2}ie = 5.657ie$.

Case IV.—Six-phase.—Taps are taken off at A, C, E, G, I and K. E = external volts = $\overline{AC} = e$; I = external current = vector sum of two currents of magnitude i of phase relation of $\overline{AC}$ and $\overline{EC}$; $I = i\frac{AZ}{AC} = i$; $W = 6iE = 6IE = 6ie$.

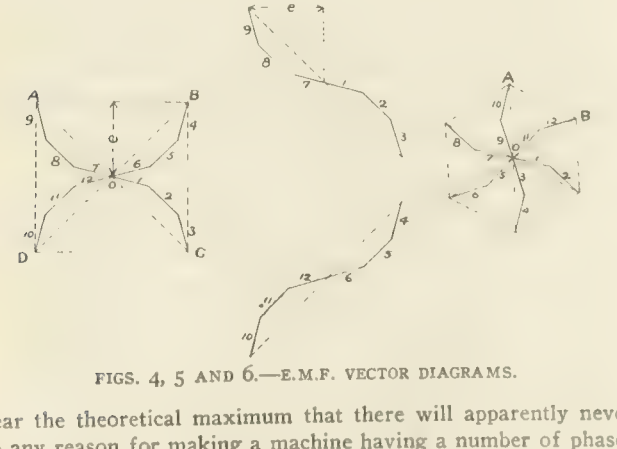
These first four cases represent conditions that can be obtained by taking off the appropriate taps from a direct-current armature winding. It is evident that if the number of slots is increased the polygon of e.m.fs. tends to become a circle; but any change in the number of slots will make no difference whatever in the values of I, E and W, provided that the number of slots per pole is a multiple of the number of phases.

In these first four cases the output W equals the current per coil i multiplied by the periphery of the e.m.f. polygon, as shown in Table I.

TABLE I.—RELATION OF OUTPUT AND EFFICIENCY TO NUMBER OF POLES.

Single-phase	$= W = i \times$ twice the diameter	$= 4.000ie$.
Three-phase	$= W = i \times$ three sides of triangle	$= 5.196ie$.
Four-phase	$= W = i \times$ four sides of square	$= 5.657ie$.
Six-phase	$= W = i \times$ six sides of hexagon	$= 6.000ie$.
Infinite number of phases	$= W = i \times$ circle $= i \times 2\pi e$	$= 6.283ie$.

While the output increases with the number of phases, the internal losses remain constant, so that the efficiency increases with the number of phases. The six-phase machine comes so



FIGS. 4, 5 AND 6.—E.M.F. VECTOR DIAGRAMS.

near the theoretical maximum that there will apparently never be any reason for making a machine having a number of phases greater than six; therefore, one may take the output of this machine ($6ie$) as standard for purposes of comparison.

If the machine shown in the first four cases has a rating of 1000 kw and an efficiency of 94 per cent at full load, unity power factor, as a six-phaser, then for the other arrangements it will have the following permissible outputs and efficiencies:

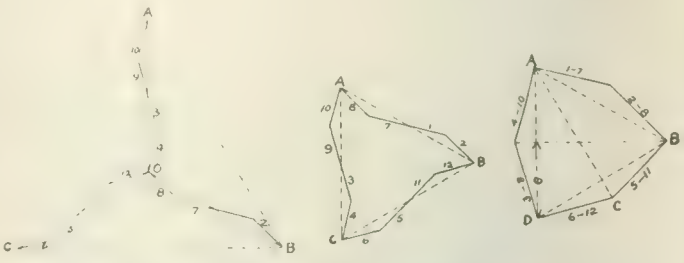
TABLE II.—RELATIVE RATINGS AND EFFICIENCIES.

Phases, number.	Output, kw.	Efficiency, per cent.
6	1000	94.00
4	944	93.64
3	866	93.07
1	667	91.00

The diagram of Fig. 1 represents correctly the conditions in rotary converters and double-current generators; however, hardly any other alternating machines are ever connected in this way. When use is made of the same slots and the same coils, but different connections, one can readily represent the resultant voltages by rearranging the e.m.f. vectors 1, 2, 3, 4, etc., as shown in the following cases:

Case V. Single-phase, single circuit.—The two voltages generated with two hemispheres of Fig. 1 are put in series, as shown in Fig. 2. I = external current = i; E = external volts = $AOB = 4e$; $W = iE = IE = 4ie$.

Case VI. Three-phase star.—The arrangement is shown in Fig. 3. I = external current = i; E_1 = volts per leg = AO =



FIGS. 7, 8 AND 9.—E.M.F. VECTOR DIAGRAMS.

$e\sqrt{3}$; E = external voltage = $AB = E_1\sqrt{3} = 3e$; $W = 3iE_1 = 3I\frac{E}{\sqrt{3}} = \sqrt{3}IE = 3\sqrt{3}ie = 5.196ie$.

Case VII. Four-phase star.—The arrangement is shown in Fig. 4. I = external current = i; E_1 = voltage per leg = $\overline{AO} = e\sqrt{2}$; E = external voltage = $E_1\sqrt{2} = 2e$; $W = 4iE_1 = 4I\frac{E}{\sqrt{2}} = 2\sqrt{2}IE = 4\sqrt{2}ie = 5.657ie$.

Case VIII. Two-phase (or quarter-phase) independent.—The arrangement is shown in Fig. 5. I = external current = i; E = external voltage = $2\sqrt{2}e$; $W = 2iE = 2IE \times 4\sqrt{2}ie = 5.657ie$. This is the usual arrangement of the commercial "two-phase" or "quarter-phase" machine.

Case IX. Six-phase star.—The arrangement is shown in Fig. 6. I = external current = i; E = volts per leg = $AO = e$; E = external volts = $AB = e = E$; $W = 6iE = 6IE = 6ie$. The diagram of Fig. 6 is interesting because of what may be derived from it. It exhibits three diameters having the relative phase displacements of regular three-phase e.m.fs., and evidently capable of being connected to form a three-phase winding. This is shown in Case X.

Case X. Three-phase star.—The arrangement is shown in Fig. 7. I = external current = i; E_1 = volts per leg = $\overline{AO} = e$; E = external volts = $AB = E_1\sqrt{3} = 2\sqrt{3}e$; $W = 3iE_1 = 3I\frac{E}{\sqrt{3}} = \sqrt{3}IE = 6ie$. There is here a three-phase connection of the same watt rating as the six-phase connections, and 15 per cent greater watt rating than the three-phase arrangements of Cases II and VI. This can readily be altered into the delta arrangement given in Case XI.

Case XI. Three-phase delta.—The arrangement is shown in Fig. 8. I = external current = $i\sqrt{3}$; E = external volts = $\overline{AB} = 2e$; $W = 3iE = 3\frac{I}{\sqrt{3}}E = \sqrt{3}IE = 6ie$.

Tables I and II show the three-phase machine at a disadvantage as compared with the four-phase machine. However, for nearly all commercial machines, except the rotary converter and the double-current generator, the three-phase connections given in Figs. 7 and 8, or their equivalent, are used. This arrangement gives the full output and efficiency of the six-phase machine. Therefore, in practice, the two-phase, quarter-phase or four-phase motor or generator is handicapped by 5.6 per cent in permissible output and about 0.35 per cent in efficiency as compared with the three-phase or six-phase machine.

The rotary converter and double-current generator have to be built with a continuous drum winding like that discussed in the first four cases, but with more slots. Therefore, the three-phase, double-current generator has only 86.6 per cent of the rated output of the six-phase machine and 91.8 per cent of that

of the four-phase machine when the machines are running strictly as alternators. This same ratio would hold in the case of rotary converters driven as alternating-current generators, but in the normal use of the rotary the ratio is altered by the variation in the path of the current between the collector rings and the commutator. However, these diagrams show one reason why the six-phase converter is preferable to the three-phase.

If instead of winding the above machine with two coils per slot it be wound with one coil per slot, some new effects are obtained. Phase windings 1 and 7, 2 and 8, 3 and 9, 4 and 10, 5 and 11, 6 and 12 are necessarily in series, because each coil fills the two slots giving parallel e.m.f. vectors. It then becomes impossible to construct a regular polygon from the e.m.f. vectors. The nearest one can come to it is shown in Fig. 9.

Case XII. Three-phase delta.—The arrangement is shown in Fig. 9, taps being taken off at A, B and D. E = external volts $= \overline{AB} = 2e$; I = external current, and is the vector of two currents of magnitude i, of time-phase relation of $\overline{AB}$ and $\overline{BD}$;



FIGS. 10, 11 AND 12.—E.M.F. VECTOR DIAGRAMS.

$I = i\sqrt{3}$; $W = 3iE = \sqrt{3}IE = 6ie$. This arrangement gives the same watt rating and the same terminal e.m.f. diagrams as Case XI, Fig. 8.

Case XIII. Three-phase star.—The arrangement is shown in Fig. 10. I = external current $= i$; E = volts per leg $= AO = 2e$; E = external volts $= AC = \overline{AO}\sqrt{3} = 2\sqrt{3}\,e$; $W = 3iE_1 = 3I\frac{E}{\sqrt{3}} = \sqrt{3}IE = 6ie$. This gives the same three-phase result as Case X. Obviously this winding, which has six coils per pair of poles, will not produce a six-phase or four-phase interconnected winding. It can be connected, however, for two-phase, as shown in Fig. 11.

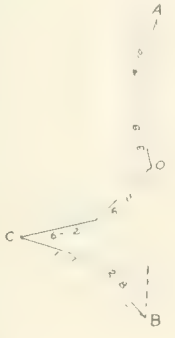
Case XIV. Two-phase.—The arrangement is shown in Fig. 11. I = external current $= i$; E = external volts $= \overline{AB} = \overline{BE} + \overline{EA} = e$ sec 15 deg. $+ 2e$ sec 15 deg. cos 30 deg. $= 2.8285\,e$; $W = 2iE = 2IE = 5.657\,ie$. This is neither better nor worse with respect to output than any of the two-phase and four-phase connections previously given.

SINGLE-PHASE OPERATION.

As shown in Table I, where machines have a uniformly distributed winding, the single-phase machine has only two-thirds of the permissible output of the three-phase machine of the same size, besides a much lower efficiency. If a generator is built for single-phase work alone the coils will be more or less concentrated, and it will show up somewhat better; but, at the best, the single-phase machine must be much heavier and more expensive than the three-phase machine. For this reason, among others, most of the single-phase railways are using three-phase machines as generators.

One proposed method of applying three-phase generation to single-phase service is to divide the line into three sections, connect the neutral point of the three-phase machine to the track and feed energy to each section from one leg of the generator. Another way is to divide the line into two sections and feed each from one lead of a two-phase generator connecting the other two leads to the track. A third proposed method is to connect one leg of a three-phase machine to the track and each of the other two legs to a section of the trolley line. All three of these methods are open to the objection that it is impossible to balance the load, even as applying to the general average, and quite out of the question to approach a balanced condition from moment to moment. They are also open to objection on account of the complication of feeders, switches, insulators, etc., that they involve. The third method is an unbalanced system by design. If the loads on the two sections of trolley could be kept the same, the current per coil being limited as in the cases previously considered, this case would work out as follows:

Case XV. Two-thirds of three-phase.—The arrangement is shown in Fig. 10, where terminal A is connected to the rail, and B and C to the trolley. Current in $A = i$; current in B and $C = \frac{i}{\sqrt{3}}$; E = external volts $= AB = 2\sqrt{3}\,e$; $W = 2\frac{I}{\sqrt{3}}E = 4ie$. This is the same output as given by the single-phase connections of Cases I and V. Of course, the total heating is a little less because only one-third of the coils are subject to the full rated load current. On account of the fluctuations in distribution of load between the two sections of line it is probable that this arrangement is actually at a disadvantage as compared with straight single-phase operation.



The New Haven Railroad Company has adopted yet another method. Use is made of a Y-connected three-phase machine, single-phase current being derived from two legs, the other leg being idle. Again assuming the same maximum current per coil, this arrangement works out as follows:

Case XVI. Single-phase from three-phase, star-connected machine.—The arrangement is shown in Fig. 10, the current being taken from terminals A and B. External current $= I = i$; external volts $= E = AB = 2\sqrt{3}\,e$; W = output $= IE = 2\sqrt{3}\,ie = 3.464\,ie$. This is only 57.7 per cent of the three-phase output and 86.5 per cent of the output of the same machine reconnected for single-phase operation.

Any three-phase, star-connected machine can be reconnected for single-phase operation by removing the neutral-point end of one phase from the neutral point to the extremity of one of the other legs. Fig. 12 shows this arrangement as derived from the diagram of Fig. 10.

Case XVII. Distorted three-phase.—(See Fig. 12.) External current $= I = i$; external volts $= E = AB = 2AO = 4e$; $W = IE = 4ie$. This gives the maximum single-phase output, the same as Cases I and V. Here the voltage is 1.155 times the voltage of the same machine used as a three-phase, star-connected machine; it is double the voltage connected delta.

There remains one method of obtaining single-phase current from a three-phase machine that appears to be open to less serious objection than any other. Let the machine having six slots, and three coils per pole, be delta connected as shown in Fig. 9. Three-phase e.m.f. may be taken from terminals A, B and D and single-phase voltage from terminals A and C. The single-phase voltage is the same as the three-phase voltage. In this case I = external current $= 2i$; E = external volts $= \overline{AC} = \overline{AB} = 2e$; $W = IE = 4ie$. This gives the same capacity as the other single-phase arrangements of Cases I, V and XVII; that is to say, it gives the greatest single-phase output possible for a distributed winding. It also does not interfere in any way with the simultaneous use of the machine as a three-phase generator of the same voltage.

It is not customary to use the delta connection for machines of so high an e.m.f. as 11,000 volts, but there are no serious difficulties in the way of doing so for machines of moderately large size. There is also no difficulty in using six slots per pole for 25-cycle machine of 11,000 volts and 1000-kw rating or greater, for ordinary engine-driven speeds. Steam-turbine-driven 25-cycle machines would probably work out satisfactorily for either two or three times this number of slots, which would permit of a connection having the same effective e.m.f. diagram.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Street-Lighting Arches in Wilmington, N. C.

The satisfactory results derived from the system of lighting Wilmington streets by arches of tungsten lamps during the Taft celebration in November have induced the city to extend the system so that the downtown section will be included, and an average of four arches to the block will be used. The material for the new arches has been ordered, and by the first of the new year, Wilmington believes it can lay claim to being the best-lighted city in the South with the exception of Atlanta.

The Salesman's Creed.

The November issue of the *Engineering Quarterly* of the University of Missouri contains an interesting paper by Prof. H. Wade Hibbard, of the mechanical engineering faculty of the university, entitled "The Science of Engineering Salesmanship." After a discussion of modern industrial and commercial methods the writer takes up the personal qualities desirable for salesmanship and analyzes the elements which enter into a sales transaction. Manufacturers, it is stated, who once said salesmen are born, not made, are now beginning to make them. Principles of selling are investigated and brought to uniform practice. "The day of the crafty, tricky, glib, ill-educated, loud and intemperate salesman is gone. Now he must be honest and have a reputation for honesty, be an expert in evidence, a trained logician, well educated and able to meet his customers on their own ground, of good health that his mind may be alert and personally attractive, acquainted with the practical physiology of typical customers, able to give proofs so pointedly that the purchaser can be brought quickly to the closing of the sale." The paper concludes with the following "Salesman's Creed":

"I believe in the goods I am selling, in the firm I am working for, and in my ability to get 'results.'

"I believe that honest goods can be sold to honest men by honest methods.

"I believe in working, not exacting; in laughing, not weeping; in boosting, not knocking, and in the pleasure of selling goods.

"I believe that a man gets what he goes after; that one order to-day is worth two orders to-morrow, and that no man is down-and-out until he has lost faith in himself.

"I believe in to-day and the work I am doing, in to-morrow and the work I hope to do, and in the sure reward which the future holds.

"I believe in courtesy, in kindness, in generosity, in good cheer, in friendship and honest competition.

"I believe there is an order somewhere for every man ready to take one.

"I believe I am ready—right now."

Christmas Display in Central-Station Office.

In one of the show windows of the Manchester Traction, Light & Power Company's office on Hanover Street, Manchester, N. H., is a very attractive Christmas setting arranged by the office staff. Among the features of the window display is a disappearing electric sign formed of tiny incandescent lamps, set in a background of evergreen, and showing the holiday motto, "Merry Christmas and a Happy New Year." As it operates the lamps are all extinguished and then flashed on again, one letter at a time, until the complete motto is shown in dazzling letters. The lamps are then extinguished, and one complete word at a time is lighted. After being once more extinguished the entire seven words flash out at once. The mechanism for operating the sign was devised by H. G. Sargent, of the company's electrical department. In the basement is a large wooden cylinder, caused to revolve slowly by means of a small motor. In a frame above the cylinder are 30 brushes ½ in. wide, set so that the ends sweep the cylinder as it revolves. Each brush is connected with one of the letters in the sign above, and the circuit is formed through brass plates set on the face of the cylinder. The device thus resembles the ordinary flashers on the market.

The window in which the disappearing sign is shown has its floor carpeted with pine needles, and in the center is a clearing surrounded by a forest of miniature fir trees. In the clearing stands a picturesque log cabin, with a hunter peering from the open door as if slipping out for a shot at a miniature deer shown among the fir trees. The whole setting is one which is particularly appropriate at this time, since the deer-shooting season in New Hampshire has just begun. The other show window of the company's office contains a setting appropriate to the Yuletide season, and suggestive of the beautiful home decorations possible with the aid of electric illumination. The window is decorated and carpeted with evergreen, and in the center is a Christmas tree about 6 ft. high, richly decorated with chains of popcorn and tinsel, and with many tiny electric lamps of various hues glimmering amid the branches. The display has proved very attractive, and as a result many persons have visited the company's offices for the purpose of purchasing holiday gifts from the numerous household devices and other electrical novelties on display.

Shutting Down Gas-Engine Plants in Brooklyn.

The power engineering branch of the sales department of the Edison Illuminating Company, of Brooklyn, has in the four months ending Nov. 30 succeeded in dismantling 38 isolated power plants operated by gas engines. The engine units were rated all the way from 2 hp up to as high as 40 hp, and were located in machine shops, bakeries, small mills, tailor shops and similar mercantile establishments. Probably the greatest factor in shutting down these gas-engine plants is the maximum demand power contract now offered in Brooklyn to motor users. The rates on this contract are as follows: Ten cents per kw-hour for the first 25 hours per month use of the maximum demand; 5 cents per kw-hour for the second 25 hours per month use, and 3 cents per kw-hour for all energy furnished in excess of 50 hours per month use of the maximum demand. Whenever the portion of the bill which is figured at 3 cents per kw-hour exceeds $25, the discount on such portion is 5 per cent; 10 per cent is allowed when the amount is $50; 20 per cent when it is $200; 40 per cent when it is $400, and 50 per cent when it is $1,000 and over. Intermediate discounts are determined by interpolation.

The term maximum demand as used in the contract is construed to mean the maximum kilowatts used at any one time during the period covered by a bill for electricity, as determined by assuming the maximum demand to be equal to a percentage of the capacity in horse-power of motors installed, as indicated by the manufacturers standard nominal rates, such percentage varying according to the following schedule: Installation under 10 hp where only one motor is used, 85 per cent; installations under 10 hp where more than one motor is used, 75 per cent; installations from 10 hp to 50 hp, both inclusive, irrespective of the number of motors, 65 per cent; installations over 50 hp, irrespective of the number of motors, 55 per cent. In consideration of the expense incurred by the

company in connecting its mains with this equipment, and the special rate and terms specified, the consumer agrees to pay the company each month during the term of the agreement not less than $1 per month per horse-power or fraction thereof in rated capacity of motor or motors connected, such charge, however, to be not less than $2 per month. Motors are of a type approved by the company.

A comparison of costs from the use of electricity for motors under this contract to that of gas engines, using illuminating gas costing 80 cents per 1000 cu. ft., shows that the electrically driven shop is as economical as one driven from gas engines. It further permits the owner to use small quantities of electricity as against the necessity for running a gas engine at practically constant speed, whether or not a load is being carried. The liability of fire with the use of the gas engine, together with its obnoxious odor, noise of gas explosion and the expensive piping (necessary according to Fire Underwriters' rules) to carry the products of combustion to the external air, have all proved talking points of value to the Edison solicitor. In the larger units the inability of the gas engine to operate elevators and similar machines requiring high starting torque has been a point in favor of electric service. The Brooklyn Edison Company is compiling a book of testimonials from satisfied customers who have replaced gas engines by electric motors.

Straightening a British Load Curve.

By Glenn Marston

CARLISLE is situated on the west coast of England close to the Scottish border, has a population of 50,000, and has such railway connections as make it a good manufacturing town. The city owns the gas and electric supply business and does not permit any active competition between the two, influence having until recently been exerted in favor of gas.

The present manager is Mr. S. T. Allen, who has been in charge of the station for about a year. Mr. Allen's predecessor had allowed the electric department to work out its development along the lines of least resistance—pithily expressed to the writer by the Town Clerk, who said: "We have a monopoly of the gas and electric supply. Therefore if anybody wants either service they must come to us, and it has been unnecessary for us to exert ourselves."

This is the attitude of the city authorities at the present time, and Mr. Allen has had to do what he has done in the face of complacent satisfaction on the part of councilmen and deep-rooted prejudice in favor of gas—gas having been longer in use and therefore worthy of greater respect.

Mr. Allen found a load curve resembling a cross-section of the Isthmus of Panama, and asked for permission to employ canvassers, which permission was refused as an unnecessary expense. Therefore Mr. Allen took matters into his own hands. He found a day load of 80 hp, with a peak of about 1,200 hp. At the same time the peak began to fall off through the advent of tungsten lamps. His load curve was flattening, but it was a doubtful blessing, as his departmental purse was flattening out at the same time.

He was one of the first of the few British managers to realize that hostility to tungstens would not prevent their introduction, and while he did not try to secure the use of higher candle-power lamps among his existing consumers he made a successful effort to secure new customers in order to offset the drop in lighting load caused by the tungsten lamps. At the end of the year, therefore, Mr. Allen was able to report no decrease in energy consumption, no increase in peak load, and a decided increase in the number of consumers.

While fighting single-handed to keep up his lighting load he was devising means for increasing the day load. The city of Carlisle issues a pamphlet entitled "Aspects of the City as an Industrial Center," but seemingly does not realize the full value of cheap electric energy as an asset, for it is not given half a dozen lines of consideration in the whole pamphlet, yet this pamphlet was handed to the writer by a city official as giving full information regarding electric service in Carlisle. On one page it says: "These advantages may be stated to be: (*a*) Its abundant water-power and available supply of electricity or gas for power purposes at reasonable rates," and, 12 pages further on, "Mains for the supply of electricity are laid throughout the city, and the corporation [the municipality] is in a position to supply energy to any new industry at prices which will compare in every way favorably with those offered elsewhere."

When Mr. Allen wanted a canvasser for motor service he was told that this pamphlet could be used to advantage. Here was an 80-hp day load, and a peak 15 times as high, with seven lines in a pamphlet recommended as a remedy! Mr. Allen had no elaborate calculations of what other motor users were paying, for there were no other motor users.

He secured the adoption of a new rate schedule increasing the cost of electricity for lamps and decreasing the cost for motors. In order to make the motor-service rate assist in filling the gap, 1,288 hours a year are restricted and a higher rate, more than double the off-peak rate, is charged. The present rates in Carlisle are as follows: Straight meter rate for lighting, without consideration of maximum demand, 10 cents per kw-hour; maximum demand, $35 per year per kilowatt of demand, plus 4 cents per kw-hour for energy. In commercial lighting the rate is 5 cents per kw-hour during the restricted hours. All motor users are supplied with two-rate meters governed by a time switch. The off-peak rate is 2 cents per kw-hour except during the restricted hours, when it jumps to 4½ cents. The restricted hours apply to afternoons and evenings from October to March; at other times only the 2-cent rate applies. Special rates are given to large users, but all contracts contain the restricted-hour conditions.

By constant personal solicitation Mr. Allen has in the past year increased the motor load from 80 hp to over 650 hp. One large customer has taken 100 hp and sold his steam plant outright. Mr. Allen's chief efforts have been directed toward the large users, from 25 hp up, on the assumption that the efforts expended on these prospective customers must become known to small motor users, and that they will be influenced to a large extent by the adoption or rejection of electric motor service among the leading industries. For example, the adoption of motors on the coal docks led to the installation of electrical equipment in several engineering works, and results are directly traceable to these installations in several cases where small machine shops have become motor users. A year ago there was not a single textile mill using electric motors, while to-day many minor details are taken care of by motors.

The situation in Carlisle is best summed up by Mr. Allen himself: "We needed motor business, and there was nobody but myself to get it. I found it took just as much argument to get a small consumer as a large one, and that many small ones followed the lead of the principal manufacturers. Our load is nothing to boast of, but I feel that it will not be long before I can convince the Council that canvassers for motor service are worth while."

Educating the Chinese in Things Electrical.

In every large city there are quite a number of Chinese laundrymen whose patronage is considerable. It is characteristic of their race that they work long hours and work steadily. For some reason or other the central-station companies have given little attention to developing business among these laundrymen, and in this connection it is interesting to note the campaign of education promulgated by the Edison Electric Illuminating Company, of Brooklyn, N. Y. This company realized at the outset that it is a difficult matter to wean a Chinaman away from ancient methods of performing his work, but, having found one progressive Oriental who could grasp the possibilities of equipping his shop with electrical apparatus, the Edison Company now appeals to other laundrymen in the city in their native language.

Fig. 1 herewith shows an electric washing machine located

in a Brooklyn laundry, which, in addition to being lighted with electricity, is also equipped with electric irons, so that washing



FIG. 1.—ELECTRIC WASHING MACHINE IN CHINESE LAUNDRY.

and ironing operations can be carried on simultaneously. The washing machine does not require the constant attention of the

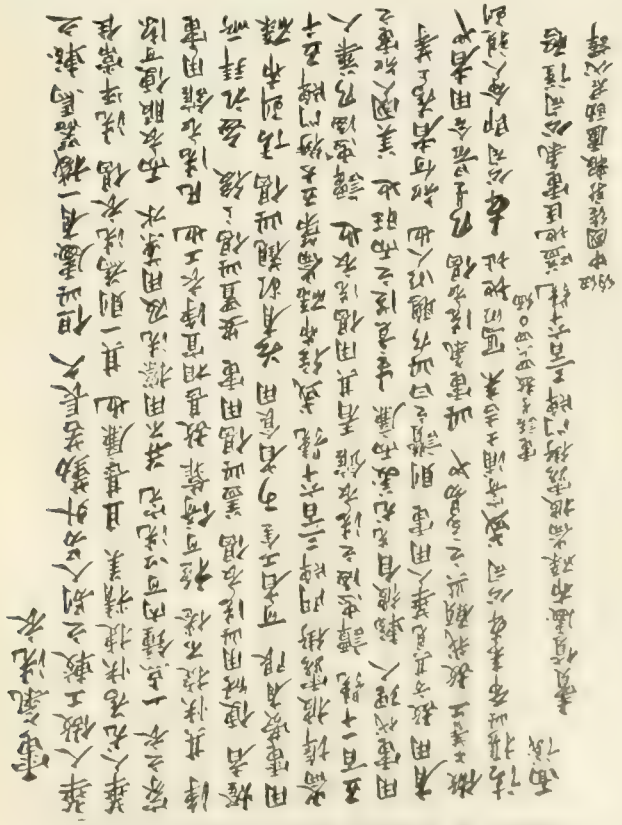


FIG. 2.—ELECTRIC LAUNDRY CIRCULAR IN CHINESE.

Chinaman, and by means of the electric irons unnecessary steps are saved in traveling to and fro from the stove heretofore used, and which is usually located in a back room.

Fig. 2 shows the communication sent to every Chinese laundry in the city. The circular is headed "The Electric Laundry," and a Chinaman ordinarily receives so little mail, outside of personal letters, addressed to him in Chinese characters, that the letter is bound to receive attention. The interpretation of the characters is as follows: "Chinamen can work harder, longer, than any other. But there are machines than can work harder, faster, better than even Chinamen—and cheaper, too. One of these is a washing machine. Does ordinary family wash in an hour. Gets the clothes clean without tearing them and without use of injurious acid. Is particularly fitted for laundry work, being so steady, reliable, swift and tireless. Any laundry that is electric lighted can have this great money-making washing machine. For it uses the electric light current. Cost of putting it in with electric light will be about $100. After that it will cost only about 1 cent per hour. Draws no wages, eats nothing. You can see it at our salesrooms, 380 Pearl Street, Brooklyn, or you can see it doing all the work at Tom Jung Hoy's laundry, 5510 Fifth Avenue, Brooklyn. Tom Jung Hoy is a bright Chinaman who does not believe in killing himself with hard work when electricity will do it for him cheaper and better than he can do it for himself; and give him the best light in the world at the same time. And also increase his business by making his neighbors think well of him. Americans know that electricity is good. When they see a Chinaman using electricity they say: 'That's a wise Chinaman. He knows what is best. He does good work. I want him to work for me.' The electric laundry is the best. We will make it for you. Come to us bringing this paper or write us a post card telling where to call on you."

The letter is signed with the name of the company, and gives the addresses of its various offices. Inasmuch as the laundryman would be a long-hour user, it is expected that a profitable load will be acquired as a result of the campaign.

The Selection of Stationary Motors.

By S. H. Sharpsteen.

ELECTRIC motor salesmen and engineers often find it difficult to select motors of the proper rating to drive the various machines that come up for consideration. In one case a certain engineer looked over the machinery of a shop that was fitting up structural steel for building purposes and secured data, for a contractor, on which to base an estimate for individual electric motors. A contract was awarded to another company that bid on the same make of motor, but agreed to do the work with smaller sizes. For example, a 5-hp motor was guaranteed to do the work where the first contractor had recommended one of 7.5 hp. The purchaser, according to agreement, constructed metal bases from drawings, furnished by the successful bidder, on which the motors were bolted and geared to the cutting-off machines. When the motors were placed in service it was found that although they were practically of the same rated output as the small individual steam engines that formerly did the work, yet after a cut was made the fuses would blow before the motors could get the speed of the cutting-off tools to a rate that would allow the motors to stop the excessive flow of current. Larger motors and motor bases had to be installed before the equipment would be accepted.

The above was a case of the motor first driving a heavy wheel, the momentum of the wheel and the motor combined later forcing the cutting-off tool through the structural steel. While the tool was going through the steel much more power was required than the full-load output of the motor, and more power than could be supplied by the motor and wheel combined to keep the speed sufficiently high to prevent the fuses from blowing.

When the engine was being used it would slow down with the flywheel while the cut was being made and later would accelerate the flywheel without causing any perceptibly bad results.

If the motors had been belted, with leather belts, the motor

pulleys might have been able to creep under the belt sufficiently, just at the time of cutting, to save the high-current peak, but the gear compelled the motor to run at a speed having a fixed ratio to that of the cutting-off machine.

In cases of the above kind the salesman should be careful in applying the information given by manufacturers who have no record of the operation of their machines driven with individual electric motors.

The elevator, dumb-waiter, and other hoisting apparatus deserve special attention on the part of the persons selling electrical apparatus in order to meet successfully the competitor's price and at the same time to have the motors work properly when orders are secured for them. Since the motors used for this kind of work have such intermittent runs and are idle much of the time, it is customary to rate them specially for the work. If a prospective buyer states that 10 hp will be required to lift a loaded elevator car, for which he wants a motor, one salesman might bid on a 10-hp motor, constant running, with full-load rating, and another salesman on a 7.5-hp or even a 5-hp motor rated for constant running service. Either of the motors might do the work, but one would be higher in price compared to the others. One make of motor may withstand a very high rating for this kind of work while another one, running successfully doing various other kinds of driving, would fail to give good results, as has been proved in practice.

When the elevator people commenced the use of motors of high rating, series windings were employed to excess. The result was a varying elevator running speed. If the counterweights were sufficiently heavy to more than balance the weight of the empty car, there should be a very light load on the motor, consequently a small amount of current passing through the series winding, and as it is usual to make series field coils a part of the normal field windings, the car speed would be much above normal while ascending with the attendant only, and when descending with a very heavy load the motor might be driven as a generator, thereby sending a current in the reverse direction through the series field coils and allowing the motor and elevator to run at an excessively high speed.

In a case of the latter kind in New York City an elevator contractor disconnected the series field coils and coupled the shunt windings in multiple, thereby obtaining a much more uniform speed; but field coils working under such conditions would soon give trouble if left in circuit for much of the time.

In some cases the motor field coils are used in multiple at start, and as the car is brought to speed, they are placed in series by the elevator controller. This answers the purpose of the series field coils for start and produces a more uniform running speed. In the change from multiple to series connection of the field coils for this purpose, it might, in some cases, be necessary to use resistance in connection with the field winding to prevent too sudden speed increase.

When the electric generating plants in the navy yards were small the naval specifications for elevator work were drawn to insure a current inrush decreased as much as possible, and they show in what respect trying to avoid one trouble may lead to another.

Several firms were awarded contracts for buildings, each building to have an elevator for freight purposes. In one case the elevator was reported as not complying with the requirements of the naval specifications. On investigation it was found that the other elevators were equipped with high-speed motors having much series field excitation, and would start in the specified time with allowable current inrush and a maximum four-ton load, but would descend with much increased speed with the maximum load.

The equipment that was rejected had a large slow-speed motor, would take a few seconds longer to start after the switch was closed and with the four-ton load would allow a larger current inrush than the specifications allowed, but would move at about the same speed regardless of the load or the direction of running.

When the facts were carefully placed before the officer in charge of the yard the equipment that was formerly not approved was accepted.

When induction motors are installed to operate elevators and hoists, especially when they are placed more than 50 ft. from the street or generator, care should be taken to use sufficient conductivity in the service wires, or the individual circuits, running to the motors, in order to minimize the I_2R losses while the motors are starting. A certain manufacturing company near New York City installed a 12-hp, three-phase induction motor to operate a dock hoist. The generator supplying the energy was of 50-kw rating. The motor was placed approximately 700 ft. from the switchboard, the copper in the circuit being of about the same cross-section that would be used to supply energy for a direct-current machine of the same size for constant running. The low power factor of the motor when starting under load caused so much loss of energy in the circuit that the load was excessive on the generating apparatus, even when no other motors were running.

The alternating-current generator was of a type that would maintain the proper voltage as long as the speed did not decrease too much and the engine, which had a shaft governor, was sufficiently large for the generator.

When the copper in the circuit was increased to about three times its former cross-section, the engine governor ceased knocking during the time the hoist was in use and the whole plant could be operated at one time.

INTERIOR WIRING AND ILLUMINATION

Seattle Street Lighting.

On account of their high efficiency tungsten lamps are being employed with considerable satisfaction for street lighting where carbon incandescent lamps would prove too expensive in operation and arc lamps would have been used previously. The substitution of incandescent for arc lamps permits of the use of street lighting fixtures much more artistic and desirable from an esthetic point of view than are commonly associated with street arc lamps.

One of the most impressive equipments for tungsten street

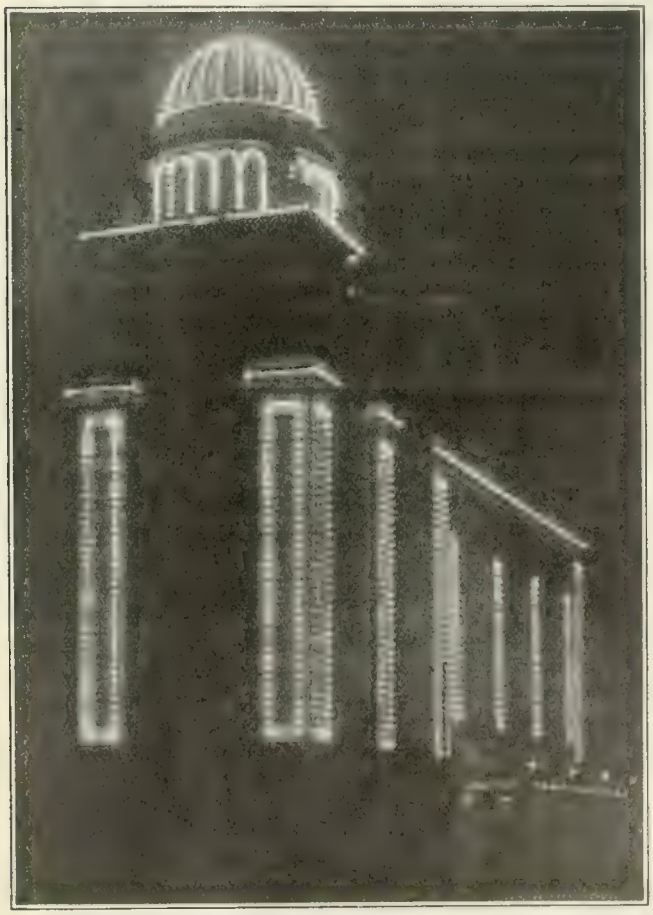


FIGS. 1 AND 2.—SEATTLE STREET LIGHTING.

lighting is to be found at Seattle, along Third Avenue, where the sidewalks are lined with graceful electroliers spaced at such frequent intervals as to provide almost uniform illumination, as will be noted from Fig. 1. A view of one of the electroliers, showing the arrangements of the lamps and frosted globes, is given in Fig. 2. The top ball contains one 100-watt lamp, and each of the other four is equipped with a 60-watt lamp.

Illumination of the Denver, Colorado, Auditorium.

The Auditorium in Denver, which is owned by the city, is one of the best known public buildings in that place. In 1908 it was used for the Democratic national convention and in 1909 it served for housing the recent convention and exhibition of the American Street & Interurban Railway Association. A night view of this building showing the incandescent lamps used for outlining the architectural features is shown in the illustration herewith.



DENVER AUDITORIUM BY NIGHT.

The building is equipped with its own isolated heating and electric service plant, but an emergency connection with lines of the Denver Gas & Electric Company is also provided. The equipment consists of Babcock & Wilcox boilers, Ideal engines and Northwestern direct-current generators. Two of the generating sets consist of engines directly connected to 125-kw, 220-volt lighting machines, while a third is a 60-kw, 500-volt set for supplying energy to motors.

The building is lighted with 16-cp incandescent lamps throughout. There are 14 "sunbursts" for general illumination on the ceiling, each containing 96 lamps. In addition, the galleries are outlined and there are ample facilities for stage lighting and other lighting wherever needed.

When arranged as a convention hall 12,500 people can be seated comfortably. By means of electric motors the hall can be transformed within an hour into a theater capable of seating 4000 people. Portions of the balconies are arranged to run on tracks and turn on a pivot, so that they can be moved into the hall or pulled back against the wall by a 10-hp motor operating a winding drum and an endless cable. The proscenium arch and the two pedestals on which it rests are lifted into and lowered from the rigging loft by three separate motors by means of steel cables.

Equipment of a Model Electrical Home.

A model electrical home recently opened by the South Metropolitan Electric Light & Power Company at Catford, England, is of interest both by reason of the scheme used for wiring and on account of the electrical devices placed in service. The circuits in the building have been arranged in two divisions, one of which is operated at 50 volts and the other at 200 volts. The power is in the rear portion of the house, where electric cooking is carried on and low-candle-power lamps are used. For this circuit use is made of neat open wiring, to which energy is supplied through a transformer. In the main portion of the house use is made of concealed wiring operated at the usual supply e.m.f. of 200 volts.

In the house every domestic operation, so far as possible, is carried out electrically. In addition to the usual lighting fixtures the hall is provided with an electric clock, a telephone, an electric hat pad and a cigar lighter. The library is provided with portable lamps, fans, radiator and a telephone. In the dining room are electric tea urns and hot-water jugs, electric candlesticks, radiator and a telephone. In the kitchen are two electric ovens, cookers, grills, hot plates, irons, water heaters and knife cleaners. The bathroom contains a water heater and a room heater. In the bedrooms are curling-tong heaters and hair dryers, illuminated watch stands and devices for reflecting the time upon the ceiling during the hours of darkness. The home is provided with a motor-driven vacuum cleaner, a sewing machine and shoe-shining machine.

The lighting throughout is accomplished by means of metal-filament lamps. The fittings have been chosen to harmonize with the styles of decoration, and comprise a variety of pendants, brackets, floor and table standards.

Technical Knowledge of the Wiring Contractor.

A recent issue of our London contemporary, *The Electrical Field,* contains an article by Mr. W. Perren Maycock, outlining the scope of the technical knowledge which a wiring contractor should possess. In discussing wiring, he stated that a very intimate acquaintance with the various systems of wiring and their respective mechanical and electrical advantages is necessary. What is proper for one class of premises will not necessarily be proper for another, and in any given installation different systems may be combined with advantage. The wide choice of systems for use in factories should be studied, and the advantages and disadvantages of lead-covered wire should be known. The cost of wiring is the main item in most installations. It may well be said that the safest of all wiring systems is that in which the wires are run in insulation-lined iron conduit, but by reason of the prohibitive cost, this system can be used only where money is plentiful. All other systems may be said to be less safe, and the problem is to determine how far safety may be sacrificed to cheapness. The margin of safety may, indeed, be decreased a good deal more than is supposed, for after all, the safety of the cheapest system is much greater than that of gas lamps, oil lamps and candles. The question of safety from fire-risk is mainly the bogey of the insurance companies, which seem to lose all sense of proportion when they distinguish between electricity and gas. They seldom understand that the use of electricity under any practical conditions should be a matter of far less worry to them than, say, a naked gas jet and the extensive use of matches.

In regard to lamps, it should be remembered that there are at least eight different types of lamp available—open and enclosed arcs with pure carbon electrodes; open and enclosed flame arcs, mercury-vapor, and metal, carbon, and Nernst filament lamps. The metal lamp and the open-type flame arc are, of course, by far the most extensively used, but each of the other types has its advantages for certain situations. If colors are to be diminished, flame arcs and mercury

lamps are useless, and it is necessary to fall back upon the old open or enclosed pure-carbon arc lamp. The enclosed flame arc is new, but has probably come to stay. Mercury-vapor lamps deserve more notice, as they give a better diffused light than any other. Their main drawback is the peculiar tint of the light, which prohibits their use where color work is done. But for offices of all descriptions, places such as watchmakers' shops, where small detail work is in progress, and small and even large workshops, they are extremely suitable. They have even been installed with success in such places as foundries and breweries, where the mechanism of arc lamps is apt to suffer. The Nernst lamp, although it labors under certain well-known disadvantages, possesses a distinctly soft mellow light, and it is only slightly less efficient than the best metal lamps.

A knowledge of the efficiency values of the various types of lamp is of the utmost importance. Though carbon lamps are the least efficient, it is often more economical in the long run to instal these in preference to the higher-priced metal lamps in places where light is required only at intervals. The mechanical as well as the electrical knowledge of the contractor has plenty of room for scope in discriminating between the numerous new makes of arc lamp on the market. Of course the dearest lamp is not necessarily the best designed, but most certainly the cheaper makes are to be avoided. It would pay a large contractor to buy a sample of every promising new lamp as it came out, and give careful study to its mechanism and working. Photometric measurements on arc lamps might present some difficulty, but certainly the contractor should be in a position to make tests of his own of the efficiency and life of incandescent lamps. Arc lamp accessories, such as auto transformers, resistors, hoisting gear, and so forth, require more attention, and their details should be the subject of special study.

The choice of incandescent lamp fittings should be governed by considerations of utility and harmony. As much care is necessary in selecting fittings for a workshop as for a drawing-room. Fittings of all kinds, however plain, should be well made; important details, such as ease of wiring, safety of wires, smooth working of counter-weights, etc., should be seen to. It may be too much to expect every contractor to possess great artistic perception, but this is something to be cultivated. It is true the customer generally has most to say in this matter, but as he is usually confronted with a bewildering array of designs when the time comes to select fittings he naturally expects some help from the contractor. The electrolier should be used with discretion; it is not necessary to follow slavishly in the wake of the gasolier. Counter-weight and fixed pendants, ceiling fittings, brackets, and portable table standards are generally preferable in small houses. Shops, shop windows, and workshops require special treatment.

Special attention should be paid to the arrangement of switches and circuits. The two-way switch does not represent the limit of things. Many convenient schemes may be utilized by employing double, intermediate, three-way, series-parallel and certain other ingenious switches, some of which are combined with plug connections.

The arrangement of the lamps requires the most careful consideration, and determines in great measure the types of fittings to be employed. The shading of the lamps is an even more important matter. It is safe to say that three-fourths of shop-window lighting is unsatisfactory and here special attention is required.

There are now on the market a number of different heating systems and appliances. Although electric heating is sure to make headway, some of the methods of obtaining and utilizing it will certainly not survive, and it would be unwise for any contractor to pin his faith to a particular system without first comparing it with all others. In fact, a close study of the generation and application of electric heat to utensils of various descriptions is extremely desirable.

The lamp radiator has proved its right to rank as a practical article, but much depends on the make both of lamp and frame.

New Telephone Patents.

IMPROVED SWITCHBOARDS.

It sometimes happens that a telephone switchboard must be installed where the conditions are such that a magneto system is alone economical at the time, and it is reasonably sure that before the switchboard has served its life, a change to a central energy system will be warranted. It is for such conditions that Mr. C. S. Winston, of Chicago, Ill., has devised the switchboard described in a recent patent granted to him; this patent is assigned to the Kellogg Switchboard & Supply Company. In this switchboard the apparatus is so designed that it will operate satisfactorily on either system. The wiring is so arranged as to be convertible by bringing it out at all points of

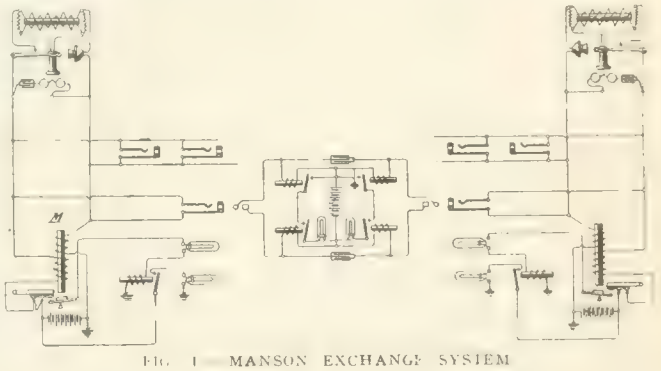


FIG. 1.—MANSON EXCHANGE SYSTEM.

difference to lugs at which all necessary connections may be made to effect a change from one system to the other.

Mr. R. H. Manson, of Elyria, Ohio, has patented a switchboard whose circuit system is shown in Fig. 1. It will be seen that the jacks are of the two-wire type. The double-wound cut-off relay is of the two-stage type. Under the influence of current through the subscriber's line and instrument, it operates its first stage and closes the lamp circuits. Under influence of current from the plug or cord circuit, it operates further to sever the lamp circuits, and to open one of its own windings. It remains in this condition until the plug is removed from the jack

TELEPHONE SYSTEM FOR AUDITORIUMS.

Under this title Mr. K. M. Turner, of New York City, has patented a telephone system comprising numerous receivers scattered throughout the space to be occupied by listeners; several transmitters scattered about more distantly and arranged so that one will always be within fairly close range of any chance speaker from the audience and a switching apparatus presided over by an operator. This latter observes the location of the speaker and switches into the circuit one or more neighboring transmitters. By listening, the operator determines when the best effect in the listening circuit has been secured.

"TELL-TALE" FOR RURAL LINES.

On rural lines, with their many stations, there always arises the suspicion of someone listening-in on one's conversation. This practice varies greatly in different localities, being particularly indulged in, however, wherever the telephone service is a novelty.

All sorts of schemes have been invented to overcome its possibility, but these generally were so cumbersome as to introduce troubles far outweighing the difficulty sought to be overcome, and troubles lasting long after the novelty of the service has worn off. Most of these preventives have taken the form of lock-out and selective devices, but Mr. T. W. Ralph, of North Augusta, Ont., has now invented what may be termed a "tell-tale" system.

A tilting track is attached to the hook lever at each station, so that it has a reverse inclination when the receiver is off or upon the hook. As the inclination reverses, a cylinder rolls down the plane, closing a circuit at intervals and sending out such a code of signals upon the lines that the interfering station may be at once identified. A latch device is arranged so

that this signal cannot be distorted, the hook being locked after rising until released by the roll reaching the end of its travel.

ADJUSTABLE RECEIVER.

For wireless telephony Mr. F. G. Sargent, of Westford, Mass., has patented an adjustable receiver. The coil has several intermediate terminals brought out, each of which terminates in a plug socket imbedded in the shell. One cord strand ends in a plug which may be inserted in any socket which will give the best results.

TRANSMITTER.

Mr. W. W. Dean, of Elyria, Ohio, has obtained the reissue of a patent describing an inverted solid-back type of transmitter. The cylindrical granule box is secured to the rear electrode through the usual mica washer, this rear electrode in turn being secured through its spindle to the bridge piece. A pair of springs extending from the bridge bear upon the granule box in a way to push it from the bridge. In assembling, the diaphragm receives the base of the microphone button at its center, the above-mentioned springs insuring the contact. It will, therefore, be seen that the maximum amplitude of vibration of the diaphragm is transmitted to the button, no matter at what particular point of the contact it occurs. Mr. Dean has assigned his patent to the Dean Electric Company.

AUTOMATIC SYSTEMS.

Three patents have been issued to Mr. E. E. Clement, of Washington, D. C., which he has assigned to the North Electric Company. These all relate to a method of arranging lines and apparatus to simplify the selection of the one desired. For example, in Fig. 2, are indicated by the upper left-hand row of arrows 10 lines numbered, say, 1 to 10. Next below are lines 11 to 20, and then lines 21 to 30. The energization of the magnet of any group serves to close the contacts to connect all 10 lines of the group to multiple extension wires, with each one of which a units relay is associated. Looking now at the machine

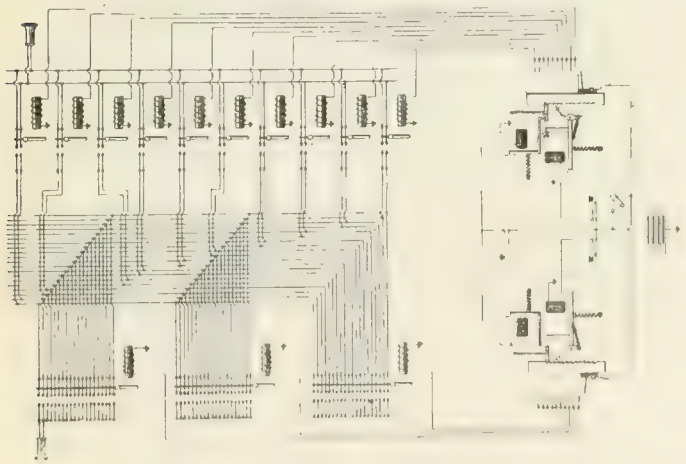


FIG. 2.—CLEMENT AUTOMATIC TELEPHONE SYSTEM.

shown at the bottom, it will be appreciated that each vertical step of the bar at the left selects a corresponding tens group, while each step of the right-hand part corresponds to a unit. Thus, two left and five right cut the tens group 21-30 on the subconductor system and then operate the fifth unit relay to connect No. 25 to the common wire of the units set. Thus 13 relays select any one of 30 lines and, continuing to 100 lines, require but 20 relays.

Mr. C. L. Zahm, of Los Angeles, Cal., has patented a system in which manual and automatic working are combined. The calling station is provided with selecting sending keys. By manipulating these in a prescribed manner, a first and second selector of the Strowger type are caused to operate in a manner to connect the calling line to a manual switchboard trunk and to display a signal for attention. By certain other manipulation the desired lines may be directly connected, the second selector reaching a connecting switch to do this. The subscriber's line thus connected may, of course, also terminate on the manual switchboard. The user thus has a choice of operating method.

Letters to the Editor.

Design of Illuminating Installations, Using Luminous Tubes.

To the Editor of Electrical World:

Sir:—I beg to point out that the article by M. D. Cooper in your issue of Sept. 23, entitled "Design of Illuminating Installations Using Luminous Tubes," is anticipated, so far as relates to its equations of illumination and photometry of lamps, by an article by the writer entitled "Beleuchtungs Berechnungen für Quecksilberdampflampen II," printed in the issue of Sept. 10, 1908, of the *Elektrotechnische Zeitschrift*. An abstract of my article was given in your Digest of Oct. 3, 1908, page 753. I shall be glad if you will give publicity to these facts relating to priority of publication.

Berlin, Germany. Konrad Norden.

Patent Reform and Engineering Societies.

To the Editor of Electrical World:

Sir:—The letter in your issue of Dec. 9 by Mr. Ludwig Gutmann, under the heading "The Patent System and Its Relation to Industrial Development," presents a very able statement of the present patent situation, which statement seems to me worthy of more than passing consideration, not only by individuals but also by technical and other societies. Mr. Gutmann is perfectly right when he says that concerted action by societies is necessary to bring matters of this kind to the attention of Congress, and his warning that inaction in this respect will prove a short-sighted policy should be taken very seriously.

It is true that the patent laws of this country were made "sporadically," there being as a consequence "no system or order about them." I agree, therefore, with Mr. Gutmann that the patent laws of this country should be thoroughly revised and new laws should be enacted to remedy the defects of the present system, some of which defects have repeatedly been made the subject of discussion in your paper.

One of the chief defects of the present patent laws of this country seems to me to consist in the absence of any enactment providing for the punishment of infringers where the infringement is committed with full knowledge of existing patents covering the invention which is being infringed.

With the exception of the United States, England and its colonies, including Canada and Australia, the patent laws of practically all countries make infringement a criminal offence when the infringement is committed with the intent and knowledge of infringing, or by gross carelessness on the part of the infringer when he can be supposed to have had knowledge of existing patent rights which he infringes in using a patented invention. Where the criminal intent of the infringer can be proved, or gross negligence on his part shown, the penalty imposed by the courts may consist in a heavy fine or imprisonment, or both, and confiscation of the articles which represent the patented invention. In addition to the fine imposed by the court, the infringer may be made the defendant in a civil suit for damages. Besides, the complainant is usually given the right to publish, at the cost of the infringer, the sentence of the court.

If such provisions were embodied in our patent laws, I believe that much of the evil that now exists under the present system would be eradicated, for individuals as well as corporations would be less hasty in using inventions protected by patents to another, and would show more consideration for the rights conveyed by a patent. If the Government gives to a patentee the exclusive right to the use of his invention, it should also stand behind the patentee in sufficiently protecting him against the unauthorized use of his patented invention by others. The wilful infringement of a patented invention is worse than theft, or even robbery, for the reason that it is not always easy for a patentee to discover the infringement; the infringer, who is usually backed by sufficient means, reaps large profits

from another's invention, thereby enriching himself, whereas the inventor, who in many cases is comparatively poor, has no means to stop the continuation of the crime. If a man steals an article, or even commits the crime of robbery or burglary, he does this act once, but the infringer, each time he makes or sells an article patented to another, commits the same crime over and over again. Such an infringer, who knowingly and wilfully uses for his own profit an invention patented to another, is by far worse than a common thief, and it is *extraordinary* indeed that such a crime should go unpunished by the Government.

Mr. Gutmann cites, among others, a case in which a large corporation appropriated to its use the invention of a young inventor, who was unable to stop the criminal practice of said corporation. The latter first had tried to cheat the inventor out of his patent rights by filing an application in the Patent Office for the same invention, but, fortunately for the inventor, he prevailed with his rights, receiving the patent. If our patent laws contained a provision making the wilful infringement of patents punishable by fine and imprisonment, and if such a law were strictly enforced against officers of large corporations, who sometimes make it a practice to infringe patents either openly or covertly, the conditions in this connection so often complained of would certainly soon be changed for the better.

Mr. Gutmann also speaks of the great expense involved in patent litigation, which expenses are incurred by the hiring of experts, lawyers, etc. I would like to point out here that in European countries suits brought against infringers are comparatively inexpensive, since the witnesses' testimony is heard in open court, and accordingly there are no such long delays as occur in this country by the taking of testimony in various parts of the United States and the continual delays thereby caused, and by the printing of the testimony.

One more word about the co-operation of technical and other societies in bringing about a revision of the present patent laws of this country. In the European countries the technical societies play an important rôle when it comes to the revision of patent laws. In bringing about the enactment of the first German patent law, for instance, the Verein Deutscher Ingenieure took a prominent part, and again had its full share in bringing about a revision of the German patent law in 1891, the first German patent law having been enacted in 1877. At present another revision of the German patent law is under consideration, and in the meetings of the branches of the Verein Deutscher Ingenieure, as well as in the annual meetings of the said society, those matters relating to patents and the protection of other industrial rights are discussed at great length and with a good deal of competent knowledge. Associations of manufacturers, as well as the Chemical Society of Germany and the Association of Electrical Engineers, also take active part in discussing the defects in the present law and the reforms to cure such defects. The same is true of other countries, as, for instance, France, where also the present patent law will be revised in the near future. In Austria, Switzerland and the Scandinavian countries there is always to be found a lively co-operation of societies to bring matters of this kind before the legislature of their country and urge remedial legislation where existing defects have shown that such legislation is needed.

Of course, the United States is a very big country, and many interests of various kinds have to be considered in the enactment of Federal laws; but, as Mr. Guttmann correctly says, action is required, and in spite of the many difficulties met with in introducing bills before Congress and bringing about the enactment of laws, the societies referred to should go to work at once and not wait until, as Mr. Gutmann so well has put it, "we shall drift more and more toward industrial serfdom."

NEW YORK. ALFRED MÜLLER.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Compound Generators in Parallel with Batteries.—JACOBI.—The author emphasizes that the old idea is no longer justified that parallel operation of compound-wound generators and storage batteries often result in troublesome reversal of polarity of the dynamo. Several systems by which such troubles are avoided are described and illustrated.—*Elek. Anz.*, Nov. 28.

Lamps and Lighting.

Metallic-Filament Lamps.—F. H. R. LAVENDER.—An account of tests in which the author investigated the effect of a change of voltage on the life of metallic-filament lamps. Life curves at different voltages were first determined, and then candle-hour curves. The number of candle-hours obtained from the lamp for a given life could then be read off. From the price of the lamp the "pence per candle-hour per lamp" was constructed, and on the same sheets the consumption curves corresponding to the lamps were plotted. From these the watt-hour curves were obtained, and these, together with the candle-hour curves, gave a curve of the ratio of watt-hours to candle-hours; thus the average specific consumption and, therefore, with a certain price of energy, the cost per candle-hour for any predetermined length of life could be read off. The "total efficiency per candle-hour" curves were plotted for energy at 2d., 4d., 6d. and 8d. per kw-hour. This at once gives the most economical life for the lamp. A set of curves of this description for the tantalum lamp operating at 100 volts is shown in Fig. 1. The curves in Fig. 2 show how the economical life of tantalum lamps decreases with an increasing voltage. It would seem that increased potential

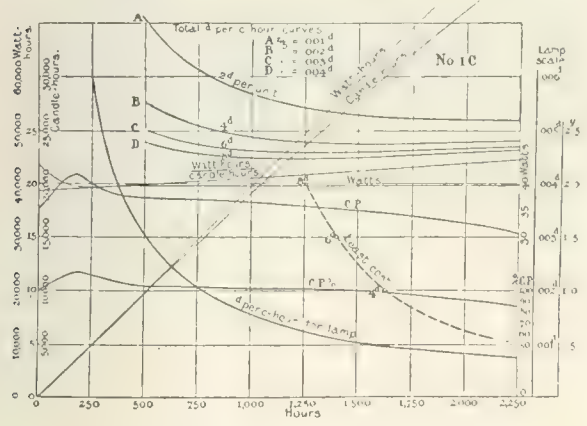


FIG. 1.—LIFE CURVES OF TANTALUM LAMPS.

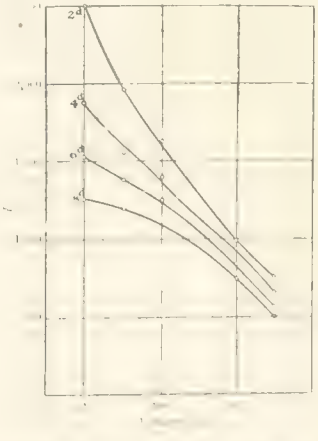


FIG. 2.—LIFE CURVES OF TANTALUM LAMPS.

difference has an effect on the absolute as well as the useful life. The useful life of tungsten lamps is much longer than that of tantalums, though the absolute life may be shorter, owing to the greater fragility of the filament.—Lond. *Electrician*, Dec. 3.

Radiation from Incandescent Lamps.—C. Fery and C. Cheneveau.—An account of an experimental investigation of the applicability of the radiation laws for carbon and tungsten lamps. For carbon lamps they found the following relation between the watts W consumed and the absolute temperature T of the filament (measured by means of the optical pyrometer):

$$W = a\,T^4. \quad a = 2.95 \times 10^{-12}.$$

Since this relation is a consequence of the Stefan law of total radiation, it follows that the conduction and convection losses are negligible in this case. For the luminous intensity I as a function of the watts W they find the following relation to hold good within wide limits:

$$I = 2.08 \times 10^6\, e^{-\frac{32.05}{\sqrt[4]{W}}}$$

For tungsten lamps the corresponding equations were found to be

$$W = a_1 T^{4.6}. \quad a_1 = 1.89 \times 10^{-12}$$

and

$$I = 3.08 + 10^6\, e^{-\frac{27.63}{\sqrt[4.6]{W}}}$$

In normal operation the temperature of the filament of the carbon lamp is about 1780 deg. C., that of the tungsten filament is 1875 deg. C.—*Academie des Sciences*, Nov. 8; *La Lumière Elec.*, Nov. 27.

Arc Lamp Patent.—A note on an arc lamp patent action in Germany. On Nov. 22 the German Patent Office revoked the German patent No. 186,758, owned by the Deutsche Beck-Bogenlampen Ges. The Regina Bogenlampen Company, of Cologne, had placed a flame-arc lamp on the market under the name of the Conta lamp, in which the tip of the negative electrode rested on a support at the base of the lamp, there being no clockwork feeding gear. The Beck Company alleged that this lamp infringed its patent, which covered this method of supporting the electrodes. As a reply to this the Regina Company applied for the revocation of the patent (apparently on the ground of anticipation), and was successful. In the Conta lamp, which can be used either on alternating-current or direct-current circuits, the negative electrode is placed perpendicularly and the inclined positive electrode is swung for striking and regulating by means of a sliding collar on the base plate, actuated by a series solenoid. The holders of the two electrodes are mechanically connected and feed down as the electrodes are consumed, the tip of the negative electrode resting on a swinging support under the base-plate. This support has an extension upward, which presses against the negative electrode for some few inches above the point. It is so pivoted that when the pressure of the electrode on the lower part is released the upper extension swings away from the electrode and allows it to descend until it again touches the lower part. By supporting the electrode from the side in this way the breakage of the point is avoided. As the arc is some 5 mm distant from the support, the latter does not require frequent renewal. These lamps are stated to run well in series with very even distribution of pressure across the arcs. The same company has also brought out a Conta lamp with an inner prismatic globe, which, being close to the arc and well swept by the air currents, remains free from deposit.—Lond. *Elec. Eng'ing*, Dec. 2.

Arc Lamps Without Regulating Mechanism.—R. Hopfelt.—An illustrated article with special reference to the Conta lamp.—*Elek. Anz.*, Nov. 25.

Arc Lamp Starter.—An illustrated article on a recent innovation made in the arc lighting system in Glasgow by the introduction of a number of interacting switches, all of which are controlled from a central point situated at the Cathedral Street substation. A small switchboard containing six panels is fixed at this substation, each panel controlling a line of interacting switches (these switches are conveniently termed "starters"), which lights and extinguishes all the arc lamps in a particular district. At present the arc lighting of the city is divided into six districts. The arc lamp starters were designed by J. Fergussen. Their arrangement is described and illustrated.—Lond. *Electrician*, Dec. 3.

Electric Train Lighting.—J. Zuendel.—An illustrated description of the new electric train lighting system of Brown, Boveri & Company. The lighting installation of each car is independent and metallic-filament lamps are used. A direct-current shunt generator is geared to one axle of the car and operates in parallel with a storage battery. A regulating mechanism insures that the lamps are always supplied with current at the proper voltage, and that the battery is being properly charged and discharged without being subjected to any undue stresses. The chief object of the battery is to supply energy during the time of stops; its size therefore depends on the number and length of stops. When the train starts the generator is excited—the position of the brushes being adjusted by automatic means according to the direction of the running of the train. With increasing speed the voltage increases. When it has risen to the amount necessary for charging the battery and supplying energy to the lamps, the automatic switch P in Fig. 3 connects the generator with the

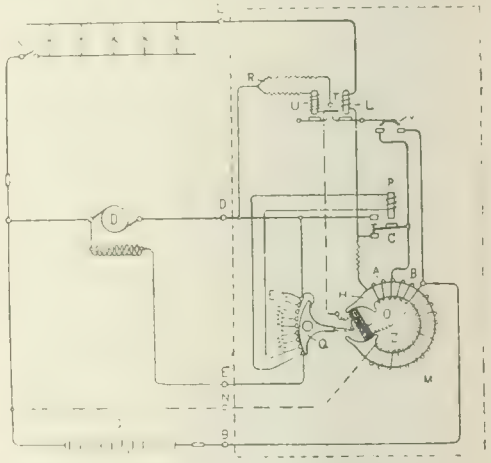


FIG. 3.—DIAGRAM OF TRAIN LIGHTING SYSTEM.

battery and lamp circuit. A further increase of the voltage is prevented by insertion of resistors in the shunt circuit. The resistor coils are marked E. The automatic regulation is accomplished by means of the regulator H, which slides the contact piece Q over a number of contacts connected with the different portions of the resistor coils E. The regulator H is actuated by a magnetic field in which the coil O is placed in a movable position. The magnetic field is produced firstly by a winding, M, in shunt with the generator, secondly by the winding B, through which the battery current passes. This winding acts in the same sense as M. A third winding, A, is supplied with the lamp current and acts in a direction opposite to that of M and B. The magnetic field produced by the united action of the windings M and B or M and A exerts on the coil O a torque which is counteracted by the action of the spring Z, which is so dimensioned that it yields constant torque. Detailed discussions of the action of the regulator under different conditions of the operation are given. The reliability and simplicity of the regulating mechanism is found to be the chief feature of the lighting system.—*Elek. und Masch.* (Vienna), Nov. 28.

Artificial Illumination.—L. Gaster.—A continuation of his lectures on modern methods of artificial illumination. The author deals with indirect lighting, photometry, school lighting, lighting of factories and hospitals, etc.—Lond. *Electrician*, Dec. 3.

Generation, Transmission and Distribution.

Rolling Mills.—An account of the discussion in Glasgow of Ablett's recent paper on electric driving of reversing rolling mills. Lamberton, although admitting the advantages of electrical drive for continuous rolling, was skeptical as to the capital expenditure required for an Ilgner installation being justified. T. Mackenzie gave figures to show the saving in costs obtained in a German mill by the adoption of electrical working and the economy in boiler equipment was demonstrated by S. A. Simon.

Some other engineers also spoke. Lond. *Elec. Engʼng*, Dec. 2.

Electric Motors in Textile Mills.—A comparison of the different methods of variable speed motors for the driving of machines for printing textiles. Direct-current shunt motors, single-phase commutator motors and three-phase variable-speed motors are compared, in favor of the three-phase system, speed variation being obtained by altering the number of poles.—Lond. *Electrician*, Dec. 3.

Steam Turbine.—P. ANDRE.—The first parts of an illustrated description of the Barbezat steam turbine, in which an attempt is made to combine the principles of the De Laval and Parsons turbines.—*La Lumière Elec.*, Nov. 20 and 27.

Draft Regulation.—An illustrated article giving a brief description (chiefly taken from patent specifications) of recent improvements in devices for the draft regulation of steam boilers.—*Elek. Anz.*, Nov. 18 and 25.

Traction.

Single-Phase Traction.—FREUND.—A continuation of the illustrated serial on single-phase traction on the Hamburg-Blankenese-Ohlsdorf road in Germany. In the present installment a description of the power plant is given. There are seven generators, of which five have a rating each of 1250 kw and give single-phase current at 6300 volts and 25 cycles for traction. A sixth machine of 600 kw gives single-phase current at 6200 volts and 50 cycles for lighting, and a seventh machine of 350 kw gives direct current at 220 volts for driving motors in the station. The alternators are driven by steam turbines running at 1500 r.p.m. For the 1250-kw machines the steam consumption is 8.24 kg per kw-hour and for a 600-kw machine it is 9.7 kg per kw-hour, with steam of 13 atmospheres and 300 deg. C. and a condenser temperature of 25 deg. C. The serial is to be continued.—*Elek. Zeit.*, Dec. 2.

Argentine.—A. C. KELLY.—An article, with map, on the very promising conditions at present for electric traction in the Argentine Republic.—Lond. *Engʼing*, Dec. 3.

Installations, Systems and Appliances.

Rates for Lighting.—An account of the extended discussion which followed the recent paper by Handcock and Dykes, read before the (Brit.) Inst. Elec. Eng. G. Wilkinson agreed with the authors that flat rates are practically doomed. The demand indicator tariff, again, is too complicated for the lay mind to grasp, and it is also expensive. The "contract demand tariff" mentioned by the authors was introduced into Harrowgate in September, 1908. In this case demand indicator consumers paid an average per 30-watt lamp of $1.81 per year, and on the flat rate the average price obtained was also $1.77. It was therefore decided to have a fixed price of $0.68 per quarter, or $2.72 per year per 30-watt lamp, which provided considerable margin on the foregoing average amounts. The basis on which the contract demand tariff was founded was that if a consumer used every lamp contracted for during eight hours every day of the year the supply authority could not lose money on the contract. That, he thought, was surely proof of a sound policy. In the Harrogate agreement the consumer undertook to pay quarterly in advance, to use the electrical energy only on dark days and in the evening, and not to use it in a wasteful manner; also that the energy be used for lighting purposes only, and that the rooms in which the lamps were fixed should not require artificial light during the hours of daylight. These conditions would bear examination and could be easily understood. He had actually removed meters to put installations on that system. A minimum demand of two lamps and a maximum of six are the limits of the contracts at present. A consumer may have 30 lamps in his house, but he cannot use more than he contracted for, because if he does so there will be set up a "blinking" which soon makes his eyes ache. W. R. Cooper thought the most serious objection to the paper of the authors was the suggestion of adopting as low a pressure as 25 volts for the sake of metallic-filament lamps. The objection is that it renders impossible the development of a load from heating or cooking or other domestic uses. Mr. Hirst, as a lamp manufacturer, said it was surprising how the demand is growing for lamps of large candle-power. The high candle-power of metallic-filament lamps had as much to do with their popularity as the actual saving in energy.—Lond. *Electrician*, Dec. 3.

British Central Station.—An abstract of the financial report of last year of the Leeds municipal central station; 12,395,118 kw-hours were sold at an average price per unit of 4.04 cents, compared with 12,412,861 kw-hours and 4.38 cents in the previous year. The most marked decrease in revenue is in the sales for private lighting, 5,241,523 kw-hours sold for this purpose producing $365,435, compared with $404,640 obtained in 1907-8 from the sale of 5,771,597 kw-hours. The average price per kw-hour for private lighting in the two years was 6.02 cents and 6.16 cents respectively, while the number of kw-hours sold per 8-hp lamp installed were 19.69 and 21.25, respectively. The sales for motor service show an increase in the number of kw-hours, namely, 6,164,810 kw-hours, compared with 5,746,255 last year, but the resulting revenue is less, namely, $129,555 as against $139,230. The total cost, excluding capital charges, was 1.44 cents per kw-hour sold, while including capital charges it was 3.72 cents.—Lond. *Electrician*, Dec. 3.

Load Limiting Device.—A description of a system employed by a British company for keeping the load of a consumer automatically below a certain predetermined value. This system is employed with the current-limit system of charging for energy. The device, as shown in Fig. 4, consists of a resistor and a thermal cut-out mounted on a slab of porcelain and inclosed in

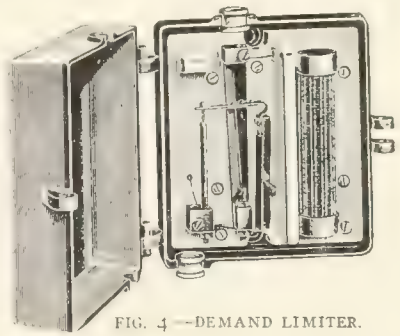


FIG. 4.—DEMAND LIMITER.

a cast-iron case. It is suitable for both alternating-current and direct-current circuits without modification. The thermal cut-out is made of three iron parts—a fixed bar carrying at the upper end a contact spring with adjusting screw, a wire traversed by the main current, and a pillar upon the upper end of which the contact is made. Normally the resistor, which is of the woven-wire type and cylindrical in shape, is short-circuited by the cut-out; when the predetermined limit of consumption is exceeded, even by 20 watts, the expansion of the wire due to its rise of temperature opens the contact and places the resistor in circuit. The resulting diminution of current strength allows the contact to close again, and the lamps therefore continue blinking until the current is decreased.—Lond. *Elec. Review*, Nov. 26.

Wires, Wiring and Conduits.

Definition of Constants of Cables.—A report of the committee of the Berlin Electrical Society, signed by H. Diesselhorst and F. Emde. There have been in the past some difficulties between manufacturers and customers concerning the meaning of certain terms, for instance, whether the capacity of a symmetrical two-conductor cable relates to the voltage between the two conductors or to the voltage against earth, further concerning the exact definition of capacity and inductance of three-phase cables. The present report makes proposals concerning the fundamental definitions and gives formulas for the calculation of capacities and inductances from geometrical dimensions with explanatory notes.—*Elek. Zeit*, Dec. 2.

Transmission Line Constants.—A continuation of the tables of transmission line constants. In the present installment the figures of inductive reactance are given for a loop formed by two wires of a three-phase transmission line.—*Gen. Elec. Review*, December.

Electrophysics and Magnetism.

Positive Electricity.—J. J. THOMSON.—A paper in which the author describes various experimental investigations concerning

the nature of positive electricity. The investigation was carried out chiefly with "canal rays" and with "retrograde rays." These were subjected to the influence of various electrostatic and magnetic fields, and the picture obtained from the deflected bundle of rays on a phosphorescent screen was investigated. Some interesting conclusions are being drawn concerning the presence of neutral doublets in the rays.—*Phil. Mag.*, December.

Uranium and Radium.—F. Soddy.—The measurements of the amount of radium in the uranium solutions purified and prepared by T. D. Mackenzie have now been in progress for nearly four years, and during the past year have all begun to yield certain evidence of the growth of radium. The quantity of radium in the oldest preparation, which contained 255 grams of uranium, remained almost constant within the error of measurement for the first two years, while in the next year a very slight increase was noticed. During the fourth year the measurements have been made with greater accuracy and have established that the production of radium within this period has been going on at a rate proportional to the square of the time, within the error of measurement. The period of the direct parent of radium calculated from these results, on the assumption that no other intermediate bodies intervene, is 18,500 years in the case of the oldest solution, for which the most complete data are available. But in the solution prepared last the total quantity of radium now present is less than what would have been produced from the radium, assuming the rate of production to have been the same as in the first solution. This suggests the existence of at least one new product, "uranium A," intermediate between uranium X and the parent of radium, with the period of the order of one year. From a mathematical investigation of the effect of such a body on the growth of radium it is concluded that it would not, if it existed, appreciably alter the production of radium according to the square of the time over the period observations have been made, but it would vitiate the calculations of the period of the average life of the parent of radium according to Rutherford's formula. The same issue contains a paper by the same author on the rays and product of uranium X.—*Phil. Mag.*, December.

Condensers.—H. A. Wilson.—An account of experiments on the variation of the capacity of condensers with solid dielectrics with the time of charging and with the potential difference. The influence of temperature on the results is also investigated. For a definite time of charging the capacity of a condenser is nearly independent of the potential difference. The variation is not more than one part in 1000, and is probably really much less than this. Small variations appear to occur, but they are evidently due to slight temperature changes or to the after effects of the previous chargings. There is consequently no reason to suppose that anything of the nature of true hysteresis exists. The capacity is a function of the time of charging, and in the case of ebonite and sulphur, varies from 5 per cent to 20 per cent in the course of half an hour. This large variation of the specific inductive capacity of sulphur and ebonite makes these substances very unsuitable for use as insulators in experiments in which exact electrostatic measurements are to be made, unless care is taken that the total capacity is large compared with the capacity due to the insulation. The capacity C at constant potential difference V is given very approximately by the formula $C = C_0 [1 + B \log (1 + pt)]$, where C_0 is the initial value of the capacity, t the time of charging, and B and p are constants. The constant p appears to be independent of the temperature.—Lond. *Electrician*, Dec. 3.

Hysteresis in Rotating Fields.—W. O. Fuller and H. Grays.—It was shown by Baily that the hysteresis losses due to a rotating field in iron reached a maximum value with an induction density B of about 16,000 lines per square centimeter. With a value of B equal to 20,000, the hysteresis was approximately 1/20 of the value. The present authors have investigated to what extent these results were modified by variation in temperature. The results of the authors show that the effect of increasing the temperature of iron is to reduce greatly the hysteresis loss at a given induction, and to cause the maximum to occur at a lower value of B.—*Phil. Mag.*, December.

Electrochemistry and Batteries.

Solder for Aluminum.—A note on a new solder for aluminum, which is composed of three metals, no flux is required, and a copper "bit" must on no account be used; a steel "bit" is required, or an old file will serve the purpose. Before soldering, it is necessary to scrape or file the surfaces, and so get rid of the oxide which is invariably present. The parts to be soldered are then "tinned" in the usual way with the solder, placed together with sufficient solder in between to effect a proper joint, and the hot steel "bit" is applied until the solder oozes from between the parts. When the solder has cooled it has a frosty appearance, and when polished it is difficult to distinguish where a joint has been made. The solder is also equally efficacious in making joints between aluminum and other metals, or glass or earthenware, and for filling holes in aluminum castings.—Lond. *Electrician*, Dec. 3.

Units, Measurements and Instruments.

Pendulum Meters.—Aron.—Although the Aron pendulum meter has been on the market for 25 years it is still being modified to be used for new purposes. It was first built as an ampere-hour meter for a two-wire system, a magnet being suspended on the pendulum. It was then adapted to the three-wire and the five-wire direct-current systems. By substituting a shunt coil for the magnet on the pendulum the meter then was made a watt-hour meter. For a three-phase system it was built with two pendulums. In recent years the great development of metallic-filament lamps has emphasized the importance of correct readings being obtained at all loads, even at very low loads. The author gives the results of some Reichsanstalt tests which show that a 1000-watt, 110-volt meter was almost exactly as accurate with a current of 0.09 amp as with a current of 9 amp. Some recent changes in the design are described.—*Elek. Anz.*, Nov. 28.

Reichsanstalt.—The first part of an abstract of the official report of the Reichsanstalt for 1908. Abstracts are given of investigations of the following subjects: Temperature coefficient of volume elasticity; measurement of very small gas pressures; rate of equalization of gas pressures through capillaries; velocity of sound; specific heat of solid elements and gases; heat of evaporation of water above 100 deg. C. Approximately the formula $L = 94.210\ (365 - t)\ 0.31249$ calories, which holds for the range 30 deg. C. to 100 deg. C., is found to hold also for 100 deg. C. to 180 deg. C. A most remarkable feature is the agreement of the new values, within 0.5 per cent of Regnault's values. Investigations were also made of saturation pressure of water vapor (50 deg. C. to 100 deg. C.); Stefan-Boltzmann law; masonry pillars; spectrum analysis; fluorescence of glass and quartz; anode rays; steel measures (lengths of 10 mm, 25 mm, 50 mm and 100 mm were tested concerning constancy; some very slight changes were observed and the different behavior seems to be due to the process of tempering); tachometer tests. The article is to be continued.—Lond. *Eng'ing*, Dec. 3.

Tachometer Tests.—A note on tachometer tests which were carried out in 1908 in the German Reichsanstalt. They comprised a Braun liquid gyrometer for 10,000 r.p.m. and various instruments for automobiles and stationary engines. Of the latter two, one was fitted with a drum of aluminum, the other with a drum of an alloy especially designed for a very small temperature coefficient. The examination at 0 deg. C., 20 deg. C. and 40 deg. C. proved that the special alloy (B) was much less influenced by temperature changes than the aluminum (A); the A instrument marking 100 r.p.m. when the actual speeds at the three temperatures mentioned were 926, 1006 and 1058 r.p.m., while the B instrument actually made 953, 1000 and 1018 r.p.m.—Lond. *Eng'ng*, Dec. 3.

Telegraphy, Telephony and Signals.

Long-Distance Telephony.—A note on a recent investigation of V. Karpen, who points out that the current by which the spoken word is transmitted is periodic in nature and can be split up into several harmonics differing from each other in



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STREET-LIGHTING TABLES FOR 1910

These schedules are made upon local mean time. Where standard time is used [illegible] the proper schedule to use at that time. The proper schedule to use at daylight saving time can be made [illegible]

Time from noon until midnight is in bold-face type; that from midnight until noon in light type. The light type shows time for the morning following the date of the night indicated.

January, 1910

Night of	Table No. 1 All Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting	Light	Exting
1	**5:15**	6:20	**5:15**	**11:45**	**5:15**	**12:00**
2	**5:15**	6:20	**5:15**	12:45	**5:15**	12:45
3	**5:15**	6:20	**5:15**	1:40	**5:15**	1:10
4	**5:15**	6:20	**5:15**	2:40	**5:15**	2:10
5	**5:15**	6:20	**5:15**	3:10	**5:15**	3:10
6	**5:15**	6:20	**5:15**	4:40	**5:15**	4:40
7	**5:20**	6:20	**5:20**	5:50	**5:20**	5:50
8	**5:20**	6:20	**5:20**	6:20	**5:20**	6:20
9	**5:20**	6:20	**5:20**	6:20	**5:20**	6:20
10	**5:20**	6:20	**5:20**	6:20	**5:20**	6:20
11	**5:20**	6:20	**5:20**	6:20	**5:20**	6:20
12	**5:25**	6:20	**5:25**	6:20	**5:25**	6:20
13	**5:25**	6:20	**5:25**	6:20	**5:25**	6:20
14	**5:25**	6:20	**5:25**	6:20	**5:25**	6:20
15	**5:25**	6:15	**9:50**	6:15	**5:25**	6:15
16	**5:25**	6:15	**10:00**	6:15	**5:25**	6:15
17	**5:30**	6:15	**11:10**	6:15	**5:30**	6:15
18	**5:30**	6:15	12:20	6:15	**5:30**	6:15
19	**5:30**	6:15	1:35	6:15	**5:30**	**12:00**
20	**5:30**	6:15	2:45	6:15	**5:30**	**12:00**
21	**5:30**	6:15	3:55	6:15	**5:30**	**12:00**
22	**5:35**	6:15	5:00	6:15	**5:35**	**12:00**
23	**5:35**	6:15	No	light	**5:35**	**12:00**
24	**5:35**	6:15	No	light	**5:35**	**12:00**
25	**5:40**	6:10	No	light	**5:40**	**12:00**
26	**5:40**	6:10	**5:40**	**7:25**	**5:40**	**12:00**
27	**5:40**	6:10	**5:40**	**8:30**	**5:40**	**12:00**
28	**5:40**	6:10	**5:40**	**9:30**	**5:40**	**12:00**
29	**5:45**	6:10	**5:45**	**10:30**	**5:45**	**12:00**
30	**5:45**	6:10	**5:45**	**11:30**	**5:45**	**12:00**
31	**5:45**	6:05	**5:45**	**12:30**	**5:45**	12:30

February, 1910

Night of	Table No. 1 All Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting	Light	Exting	Light	Exting
1	**5:45**	6:05	**5:45**	1:30	**5:45**	1:30
2	**5:45**	6:05	**5:45**	2:30	**5:45**	2:30
3	**5:45**	6:05	**5:45**	3:35	**5:45**	3:35
4	**5:45**	6:05	**5:45**	4:40	**5:45**	4:40
5	**5:50**	6:00	**5:50**	5:40	**5:50**	5:40
6	**5:50**	6:00	**5:50**	6:00	**5:50**	6:00
7	**5:55**	6:00	**5:55**	6:00	**5:55**	6:00
8	**5:55**	6:00	**5:55**	6:00	**5:55**	6:00
9	**5:55**	6:00	**5:55**	6:00	**5:55**	6:00
10	**5:55**	5:55	**5:55**	5:55	**5:55**	5:55
11	**6:00**	5:55	**6:00**	5:55	**6:00**	5:55
12	**6:00**	5:55	**6:00**	5:55	**6:00**	5:55
13	**6:00**	5:55	**9:00**	5:55	**6:00**	5:55
14	**6:05**	5:50	**10:10**	5:50	**6:05**	5:50
15	**6:05**	5:50	**11:25**	5:50	**6:05**	5:50
16	**6:05**	5:50	12:40	5:50	**6:05**	5:50
17	**6:10**	5:50	1:40	5:50	**6:10**	**12:00**
18	**6:10**	5:45	2:55	5:45	**6:10**	**12:00**
19	**6:10**	5:45	3:55	5:45	**6:10**	**12:00**
20	**6:10**	5:45	4:40	5:45	**6:10**	**12:00**
21	**6:10**	5:45	No	light	**6:10**	**12:00**
22	**6:10**	5:40	No	light	**6:10**	**12:00**
23	**6:15**	5:40	No	light	**6:15**	**12:00**
24	**6:15**	5:40	No	light	**6:15**	**12:00**
25	**6:15**	5:35	6:15	8:20	**6:15**	**12:00**
26	**6:15**	5:35	6:15	9:20	**6:15**	**12:00**
27	**6:15**	5:35	6:15	10:20	**6:15**	**12:00**
28	**6:20**	5:30	6:20	11:20	**6:20**	**12:00**

March, 1910

Night of	Table No. 1 All Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting	Light	Exting	Light	Exting
1	**6:20**	5:30	**6:20**	12:20	**6:20**	12:20
2	**6:20**	5:30	**6:20**	1:20	**6:20**	1:20
3	**6:20**	5:30	**6:20**	2:20	**6:20**	2:20
4	**6:25**	5:30	**6:25**	3:25	**6:25**	3:25
5	**6:25**	5:25	**6:25**	4:20	**6:25**	4:20
6	**6:25**	5:25	**6:25**	5:15	**6:25**	5:15
7	**6:25**	5:20	**6:25**	5:20	**6:25**	5:20
8	**6:25**	5:20	**6:25**	5:20	**6:25**	5:20
9	**6:30**	5:20	**6:30**	5:20	**6:30**	5:20
10	**6:30**	5:15	**6:30**	5:15	**6:30**	5:15
11	**6:30**	5:15	**6:30**	5:15	**6:30**	5:15
12	**6:30**	5:15	**6:30**	5:15	**6:30**	5:15
13	**6:30**	5:10	**7:50**	5:15	**6:30**	5:10
14	**6:35**	5:10	**9:10**	5:10	**6:35**	5:10
15	**6:35**	5:10	**10:30**	5:10	**6:35**	5:10
16	**6:35**	5:05	**11:40**	5:05	**6:35**	5:05
17	**6:35**	5:05	12:50	5:05	**6:35**	5:05
18	**6:35**	5:05	1:50	5:05	**6:35**	**12:00**
19	**6:40**	5:05	2:45	5:00	**6:40**	**12:00**
20	**6:40**	5:00	3:25	5:00	**6:40**	**12:00**
21	**6:40**	5:00	4:00	5:00	**6:40**	**12:00**
22	**6:40**	4:55	4:30	4:55	**6:40**	**12:00**
23	**6:45**	4:55	No	light	**6:45**	**12:00**
24	**6:45**	4:55	No	light	**6:45**	**12:00**
25	**6:45**	4:55	No	light	**6:45**	**12:00**
26	**6:45**	4:50	**6:45**	**8:10**	**6:45**	**12:00**
27	**6:45**	4:50	**6:45**	**9:10**	**6:45**	**12:00**
28	**6:50**	4:50	**6:50**	**10:10**	**6:50**	**12:00**
29	**6:50**	4:45	**6:50**	**11:10**	**6:50**	**12:00**
30	**6:50**	4:45	**6:50**	12:15	**6:50**	12:15
31	**6:50**	4:45	**6:50**	1:15	**6:50**	1:15

April, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting.	Light	Exting	Light	Exting
1	**6:50**	4:45	**6:50**	2:10	**6:50**	2:10
2	**6:55**	4:40	**6:55**	3:05	**6:55**	3:05
3	**6:55**	4:40	**6:55**	3:55	**6:55**	3:55
4	**6:55**	4:30	**6:55**	4:30	**6:55**	4:30
5	**6:55**	4:35	**6:55**	4:35	**6:55**	4:35
6	**6:55**	4:35	**6:55**	4:35	**6:55**	4:35
7	**7:00**	4:35	**7:00**	4:35	**7:00**	4:35
8	**7:00**	4:30	**7:00**	4:30	**7:00**	4:30
9	**7:00**	4:30	**7:00**	4:30	**7:00**	4:30
10	**7:00**	4:30	**7:00**	4:30	**7:00**	4:30
11	**7:00**	4:25	**7:00**	4:25	**7:00**	4:25
12	**7:05**	4:25	**7:05**	4:25	**7:05**	4:25
13	**7:05**	4:25	**10:35**	4:25	**7:05**	4:25
14	**7:05**	4:20	**11:45**	4:20	**7:05**	4:20
15	**7:05**	4:20	12:40	4:20	**7:05**	4:20
16	**7:05**	4:20	1:25	4:20	**7:05**	**12:00**
17	**7:10**	4:15	2:00	4:15	1:25	4:20
18	**7:10**	4:15	2:35	4:15	**7:10**	**12:00**
19	**7:10**	4:15	3:00	4:15	2:00	4:15
20	**7:10**	4:10	3:20	4:10	2:35	4:15
21	**7:10**	4:10	3:40	4:10	**7:10**	**12:00**
22	**7:15**	4:10	No	light	**7:10**	**12:00**
23	**7:15**	4:05	No	light	**7:15**	**12:00**
24	**7:15**	4:05	No	light	**7:15**	**12:00**
25	**7:15**	4:05	**7:15**	**9:00**	**7:15**	**12:00**
26	**7:20**	4:05	**7:20**	**10:05**	**7:20**	**12:00**
27	**7:20**	4:00	**7:20**	**11:05**	**7:20**	**12:00**
28	**7:20**	4:00	**7:20**	12:05	**7:20**	12:05
29	**7:20**	4:00	**7:20**	1:00	**7:20**	1:00
30	**7:20**	4:00	**7:20**	1:55	**7:20**	1:55

May, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting	Light	Exting	Light	Exting
1	**7:20**	4:00	**7:20**	2:30	**7:20**	2:30
2	**7:20**	4:00	**7:20**	3:10	**7:20**	3:10
3	**7:25**	3:55	**7:25**	3:45	**7:25**	3:45
4	**7:25**	3:55	**7:25**	3:55	**7:25**	3:55
5	**7:25**	3:55	**7:25**	3:55	**7:25**	3:55
6	**7:25**	3:50	**7:25**	3:50	**7:25**	3:50
7	**7:25**	3:50	**7:25**	3:50	**7:25**	3:50
8	**7:30**	3:50	**7:30**	3:50	**7:30**	3:50
9	**7:30**	3:45	**7:30**	3:45	**7:30**	3:45
10	**7:30**	3:45	**8:10**	3:45	**7:30**	3:45
11	**7:30**	3:45	**9:25**	3:45	**7:30**	3:45
12	**7:30**	3:45	**10:30**	3:45	**7:30**	3:45
13	**7:35**	3:45	**11:20**	3:45	**7:35**	3:45
14	**7:35**	3:45	**12:00**	3:45	**7:35**	3:45
15	**7:35**	3:40	12:35	3:40	**7:35**	3:40
16	**7:35**	3:40	1:05	3:40	**7:35**	**12:00**
17	**7:35**	3:40	1:25	3:40	**7:35**	**12:00**
18	**7:40**	3:40	1:50	3:40	**7:40**	**12:00**
19	**7:40**	3:40	2:10	3:40	**7:40**	**12:00**
20	**7:40**	3:40	2:30	3:40	**7:40**	**12:00**
21	**7:40**	3:40	2:50	3:40	**7:40**	**12:00**
22	**7:40**	3:35	No	light	**7:40**	**12:00**
23	**7:45**	3:35	No	light	**7:40**	**12:00**
24	**7:45**	3:35	No	light	**7:40**	**12:00**
25	**7:45**	3:35	**7:45**	**10:00**	**7:40**	**12:00**
26	**7:45**	3:35	**7:45**	**11:00**	**7:40**	**12:00**
27	**7:45**	3:35	**7:45**	**11:50**	**7:45**	**12:00**
28	**7:45**	3:35	**7:45**	12:35	**7:45**	12:35
29	**7:45**	3:35	**7:45**	1:10	**7:45**	1:10
30	**7:45**	3:30	**7:45**	1:45	**7:45**	1:45
31	**7:45**	3:30	**7:45**	2:10	**7:45**	2:10

June, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting	Light	Exting	Light	Exting
1	**7:50**	3:35	**7:50**	2:40	**7:50**	2:40
2	**7:50**	3:35	**7:50**	3:00	**7:50**	3:00
3	**7:50**	3:35	**7:50**	3:30	**7:50**	3:30
4	**7:50**	3:35	**7:50**	3:35	**7:50**	3:35
5	**7:50**	3:35	**7:50**	3:35	**7:50**	3:35
6	**7:55**	3:35	**7:55**	3:35	**7:55**	3:35
7	**7:55**	3:35	**7:55**	3:35	**7:55**	3:35
8	**7:55**	3:35	**7:55**	3:35	**7:55**	3:35
9	**7:55**	3:35	**7:55**	3:35	**7:55**	3:35
10	**7:55**	3:35	**9:55**	3:35	**7:55**	3:35
11	**7:55**	3:35	**10:35**	3:35	**7:55**	3:35
12	**7:55**	3:30	**11:05**	3:30	**7:55**	3:30
13	**7:55**	3:30	**11:30**	3:30	**7:55**	3:30
14	**7:55**	3:30	**11:50**	3:30	**7:55**	3:30
15	**7:55**	3:30	12:15	3:30	**7:55**	3:30
16	**7:55**	3:30	12:35	3:30	**7:55**	3:30
17	**8:00**	3:30	12:55	3:30	**8:00**	3:30
18	**8:00**	3:30	1:20	3:30	**8:00**	**12:00**
19	**8:00**	3:30	1:50	3:30	**8:00**	**12:00**
20	**8:00**	3:30	No	light	**8:00**	**12:00**
21	**8:00**	3:30	No	light	**8:00**	**12:00**
22	**8:00**	3:30	No	light	**8:00**	**12:00**
23	**8:00**	3:30	**8:00**	**9:45**	**8:00**	**12:00**
24	**8:00**	3:30	**8:00**	**10:30**	**8:00**	**12:00**
25	**8:00**	3:30	**8:00**	**11:15**	**8:00**	**12:00**
26	**8:00**	3:30	**8:00**	**11:50**	**8:00**	**12:00**
27	**8:00**	3:30	**8:00**	12:15	**8:00**	12:15
28	**8:00**	3:30	**8:00**	12:40	**8:00**	12:40
29	**8:00**	3:30	**8:00**	1:05	**8:00**	1:05
30	**8:00**	3:30	**8:00**	1:30	**8:00**	1:30

July, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting	Light	Exting	Light	Exting.
1	**8:00**	3:30	**8:00**	2:00	**8:00**	2:00
2	**8:00**	3:30	**8:00**	2:30	**8:00**	3:30
3	**8:00**	3:30	**8:00**	3:15	**8:00**	3:30
4	**8:00**	3:30	**8:00**	3:30	**8:00**	3:30
5	**8:00**	3:30	**8:00**	3:30	**8:00**	3:30
6	**8:00**	3:30	**8:00**	3:30	**8:00**	3:30
7	**8:00**	3:30	**8:00**	3:30	**8:00**	3:30
8	**8:00**	3:30	**8:00**	3:30	**8:00**	3:30
9	**8:00**	3:35	**8:00**	3:35	**8:00**	3:35
10	**8:00**	3:35	**9:30**	3:35	**8:00**	3:35
11	**7:55**	3:35	**9:55**	3:35	**7:55**	3:35
12	**7:55**	3:35	**10:15**	3:35	**7:55**	3:35
13	**7:55**	3:35	**10:35**	3:35	**7:55**	3:35
14	**7:55**	3:40	**11:00**	3:40	**7:55**	3:40
15	**7:55**	3:40	**11:20**	3:40	**7:55**	3:40
16	**7:55**	3:40	**11:50**	3:40	**7:55**	3:40
17	**7:55**	3:45	12:15	3:45	**7:55**	3:45
18	**7:55**	3:45	1:00	3:45	**7:55**	3:45
19	**7:55**	3:45	1:40	3:45	**7:55**	**12:00**
20	**7:50**	3:45	No	light	**7:50**	**12:00**
21	**7:50**	3:45	No	light	**7:50**	**12:00**
22	**7:50**	3:45	No	light	**7:50**	**12:00**
23	**7:50**	3:50	**7:50**	**9:45**	**7:50**	**12:00**
24	**7:50**	3:50	**7:50**	**10:30**	**7:50**	**12:00**
25	**7:50**	3:50	**7:50**	**10:45**	**7:50**	**12:00**
26	**7:50**	3:50	**7:50**	**11:10**	**7:50**	**12:00**
27	**7:45**	3:50	**7:45**	**11:35**	**7:45**	**12:00**
28	**7:45**	3:55	**7:45**	12:05	**7:45**	12:05
29	**7:45**	3:55	**7:45**	12:30	**7:45**	12:30
30	**7:45**	3:55	**7:45**	1:10	**7:45**	1:10
31	**7:40**	3:55	**7:45**	1:50	**7:40**	1:50

August, 1910

Night of	Table No. 1 All Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting	Light	Exting.	Light	Exting
1	**7:40**	3:55	**7:40**	2:45	**7:40**	2:45
2	**7:40**	3:55	**7:40**	3:50	**7:40**	3:50
3	**7:40**	4:00	**7:40**	4:00	**7:40**	4:00
4	**7:40**	4:00	**7:40**	4:00	**7:40**	4:00
5	**7:35**	4:00	**7:35**	4:00	**7:35**	4:00
6	**7:35**	4:00	**7:35**	4:00	**7:35**	4:00
7	**7:35**	4:00	**7:35**	4:00	**7:35**	4:00
8	**7:35**	4:00	**8:20**	4:00	**7:35**	4:00
9	**7:30**	4:05	**8:40**	4:05	**7:30**	4:05
10	**7:30**	4:05	**9:00**	4:05	**7:30**	4:05
11	**7:30**	4:05	**9:25**	4:05	**7:30**	4:05
12	**7:30**	4:05	**9:50**	4:05	**7:30**	4:05
13	**7:25**	4:05	**10:15**	4:05	**7:25**	4:05
14	**7:25**	4:10	**10:50**	4:10	**7:25**	4:05
15	**7:25**	4:10	**11:35**	4:10	**7:25**	4:10
16	**7:25**	4:10	12:25	4:10	**7:25**	4:10
17	**7:20**	4:10	1:25	4:10	**7:20**	**12:00**
18	**7:20**	4:10	2:35	4:10	**7:20**	**12:00**
19	**7:20**	4:15	No	light	**7:20**	**12:00**
20	**7:15**	4:15	No	light	**7:15**	**12:00**
21	**7:15**	4:15	No	light	**7:15**	**12:00**
22	**7:15**	4:15	**7:15**	**9:15**	**7:15**	**12:00**
23	**7:15**	4:15	**7:15**	**9:40**	**7:15**	**12:00**
24	**7:10**	4:20	**7:10**	**10:05**	**7:10**	**12:00**
25	**7:10**	4:20	**7:10**	**10:35**	**7:10**	**12:00**
26	**7:10**	4:20	**7:10**	**11:05**	**7:10**	**12:00**
27	**7:05**	4:20	**7:05**	**11:50**	**7:05**	**12:00**
28	**7:05**	4:20	**7:05**	12:40	**7:05**	12:40
29	**7:05**	4:25	**7:05**	1:40	**7:05**	1:40
30	**7:05**	4:25	**7:05**	2:40	**7:05**	2:40
31	**7:00**	4:25	**7:00**	3:50	**7:00**	3:50

September, 1910

Night of	Table No. 1 All Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting	Light	Exting	Light	Exting
1	**7:00**	4:25	**7:00**	4:25	**7:00**	4:25
2	**7:00**	4:25	**7:00**	4:25	**7:00**	4:25
3	**6:55**	4:30	**6:55**	4:30	**6:55**	4:30
4	**6:55**	4:30	**6:55**	4:30	**6:55**	4:30
5	**6:55**	4:30	**6:55**	4:30	**6:55**	4:30
6	**6:50**	4:30	**6:50**	4:30	**6:50**	4:30
7	**6:50**	4:30	**6:50**	4:30	**6:50**	4:30
8	**6:50**	4:30	**7:50**	4:30	**6:50**	4:30
9	**6:45**	4:35	**8:15**	4:35	**6:45**	4:35
10	**6:45**	4:35	**8:50**	4:35	**6:45**	4:35
11	**6:45**	4:35	**9:30**	4:35	**6:45**	4:35
12	**6:40**	4:35	**10:15**	4:35	**6:40**	4:35
13	**6:40**	4:35	**11:10**	4:35	**6:40**	4:35
14	**6:40**	4:35	12:10	4:35	**6:40**	4:35
15	**6:35**	4:40	1:20	4:40	**6:35**	**12:00**
16	**6:35**	4:40	2:35	4:40	**6:35**	**12:00**
17	**6:35**	4:40	No	light	**6:35**	**12:00**
18	**6:30**	4:40	No	light	**6:30**	**12:00**
19	**6:30**	4:45	No	light	**6:30**	**12:00**
20	**6:30**	4:45	**6:30**	**8:05**	**6:30**	**12:00**
21	**6:25**	4:45	**6:25**	**8:35**	**6:25**	**12:00**
22	**6:25**	4:45	**6:25**	**9:05**	**6:25**	**12:00**
23	**6:25**	4:45	**6:25**	**9:45**	**6:25**	**12:00**
24	**6:20**	4:50	**6:20**	**10:35**	**6:20**	**12:00**
25	**6:20**	4:50	**6:20**	**11:30**	**6:20**	**12:00**
26	**6:20**	4:50	**6:20**	12:35	**6:20**	12:35
27	**6:15**	4:50	**6:15**	1:35	**6:15**	1:35
28	**6:15**	4:55	**6:15**	2:45	**6:15**	2:45
29	**6:15**	4:55	**6:15**	3:50	**6:15**	3:50
30	**6:15**	4:55	**6:15**	4:55	**6:15**	4:55

October, 1910

Night of	Table No. 1 All Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting	Light	Exting	Light	Exting
1	**6:10**	4:55	**6:10**	4:55	**6:10**	4:55
2	**6:10**	4:55	**6:10**	4:55	**6:10**	4:55
3	**6:05**	5:00	**6:05**	5:00	**6:05**	5:00
4	**6:05**	5:00	**6:05**	5:00	**6:05**	5:00
5	**6:05**	5:00	**6:05**	5:00	**6:05**	5:00
6	**6:05**	5:00	**6:05**	5:00	**6:05**	5:00
7	**6:00**	5:00	**6:00**	5:00	**6:00**	5:00
8	**6:00**	5:05	**7:20**	5:05	**6:00**	5:05
9	**6:00**	5:05	**8:05**	5:05	**6:00**	5:05
10	**5:55**	5:05	**8:55**	5:05	**5:55**	5:05
11	**5:55**	5:05	**9:55**	5:05	**5:55**	5:05
12	**5:55**	5:05	**11:00**	5:05	**5:55**	5:05
13	**5:50**	5:10	12:10	5:10	**5:50**	5:10
14	**5:50**	5:10	1:20	5:10	**5:50**	**12:00**
15	**5:50**	5:10	2:35	5:10	**5:50**	**12:00**
16	**5:45**	5:10	3:45	5:10	**5:45**	**12:00**
17	**5:45**	5:10	No	light	**5:45**	**12:00**
18	**5:45**	5:15	No	light	**5:45**	**12:00**
19	**5:45**	5:15	No	light	**5:45**	**12:00**
20	**5:40**	5:15	**5:40**	**7:40**	**5:40**	**12:00**
21	**5:40**	5:15	**5:40**	**8:25**	**5:40**	**12:00**
22	**5:40**	5:20	**5:40**	**9:20**	**5:40**	**12:00**
23	**5:35**	5:20	**5:35**	**10:25**	**5:35**	**12:00**
24	**5:35**	5:20	**5:35**	**11:30**	**5:35**	**12:00**
25	**5:35**	5:20	**5:35**	12:35	**5:35**	12:35
26	**5:35**	5:20	**5:35**	1:45	**5:35**	1:45
27	**5:30**	5:25	**5:30**	2:50	**5:30**	2:50
28	**5:30**	5:25	**5:30**	3:50	**5:30**	3:50
29	**5:30**	5:25	**5:30**	4:55	**5:30**	4:55
30	**5:30**	5:25	**5:30**	5:25	**5:30**	5:25
31	**5:26**	5:30	**5:25**	5:50	**5:25**	5:50

November, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund Syste	
	Light	Exting	Light	Exting	Light	Exting
1	**5:25**	5:25	**5:25**	5:25	**5:25**	5:25
2	**5:25**	5:30	**5:25**	5:30	**5:25**	5:30
3	**5:25**	5:30	**5:25**	5:30	**5:25**	5:30
4	**5:20**	5:30	**5:20**	5:30	**5:25**	5:30
5	**5:20**	5:35	**6:00**	5:35	**5:25**	5:35
6	**5:20**	5:35	**6:50**	5:35	**5:25**	5:35
7	**5:20**	5:35	**7:15**	5:35	**5:25**	5:35
8	**5:20**	5:35	**8:15**	5:35	**5:25**	5:35
9	**5:15**	5:40	**9:50**	5:40	**5:25**	5:40
10	**5:15**	5:40	**11:00**	5:40	**5:25**	5:40
11	**5:15**	5:40	12:20	5:40	**5:25**	5:40
12	**5:15**	5:40	1:20	5:40	**5:15**	**12:00**
13	**5:15**	5:40	2:35	5:40	**5:15**	**12:00**
14	**5:10**	5:45	3:50	5:45	**5:10**	**12:00**
15	**5:10**	5:45	No	light	**5:10**	**12:00**
16	**5:10**	5:45	No	light	**5:10**	**12:00**
17	**5:10**	5:50	No	light	**5:10**	**12:00**
18	**5:10**	5:50	**5:10**	**7:10**	**5:10**	**12:00**
19	**5:10**	5:50	**5:10**	**8:10**	**5:10**	**12:00**
20	**5:10**	5:50	**5:10**	**9:15**	**5:10**	**12:00**
21	**5:05**	5:55	**5:05**	**10:25**	**5:05**	**12:00**
22	**5:05**	5:55	**5:05**	**11:35**	**5:05**	**12:00**
23	**5:05**	5:55	**5:05**	12:40	**5:05**	12:40
24	**5:05**	5:55	**5:05**	1:45	**5:05**	1:45
25	**5:05**	6:00	**5:05**	2:45	**5:05**	2:45
26	**5:05**	6:00	**5:05**	3:45	**5:05**	3:45
27	**5:05**	6:00	**5:05**	4:45	**5:05**	4:45
28	**5:05**	6:00	**5:05**	5:45	**5:05**	5:45
29	**5:05**	6:00	**5:05**	6:00	**5:05**	6:00
30	**5:05**	6:00	**5:05**	6:00	**5:05**	6:00

December, 1910

Night of	Table No. 1 All-Night Lighting		Table No. 2 Standard or Philadelphia System		Table No. 3 Frund System	
	Light	Exting	Light	Exting	Light	Exting
1	**5:05**	6:00	**5:05**	6:00	**5:05**	6:00
2	**5:05**	6:05	**5:05**	6:05	**5:05**	6:05
3	**5:05**	6:05	**5:05**	6:05	**5:05**	6:05
4	**5:05**	6:05	**5:05**	6:05	**5:05**	6:05
5	**5:05**	6:05	**6:50**	6:05	**5:05**	6:05
6	**5:05**	6:05	**7:50**	6:05	**5:05**	6:05
7	**5:05**	6:10	**8:50**	6:10	**5:05**	6:10
8	**5:05**	6:10	**10:00**	6:10	**5:05**	6:10
9	**5:05**	6:10	**11:05**	6:10	**5:05**	6:10
10	**5:05**	6:10	12:15	6:10	**5:05**	6:10
11	**5:05**	6:10	1:25	6:10	**5:05**	**12:00**
12	**5:05**	6:15	2:40	6:15	1:25	6:10
13	**5:05**	6:15	3:55	6:15	**5:05**	**12:00**
14	**5:05**	6:15	**5:15**	6:15	**5:05**	**12:00**
15	**5:05**	6:15	No	light	**5:05**	**12:00**
16	**5:05**	6:15	No	light	**5:05**	**12:00**
17	**5:05**	6:15	No	light	**5:05**	**12:00**
18	**5:05**	6:15	**5:05**	**8:05**	**5:05**	**12:00**
19	**5:05**	6:15	**5:05**	**9:10**	**5:05**	**12:00**
20	**5:05**	6:15	**5:05**	**10:25**	**5:05**	**12:00**
21	**5:05**	6:15	**5:05**	**11:35**	**5:05**	**12:00**
22

frequency, amplitude and phase. In fact, the speed of propagation and the constant of attenuation both increase with the frequency, with the result that during transmission the relative amplitudes and phases of the harmonics do not remain the same as at the start. The current at the receiving end is no longer of the same constitution as that produced in the microphone, and speech becomes unintelligible. It would, therefore, seem that it might be an advantage in certain cases to apply the methods used in "wireless" to ordinary telephony, to employ for transmitting purposes regularly damped oscillations of known frequency, produced by a singing arc or high-frequency alternator. The arrangements at the receiving end might be the same as those used in wireless telephony. The frequency being single, there would be no deformation of the voice, and greater distances could therefore be traversed. The difficulties of wave production would be less than in wireless telephony, for the frequency would be just sufficient for the oscillations to follow the modulations of the voice—by a variation of their amplitude. While this arrangement would do away with much of the simplicity of ordinary telephony, it would also possess many advantages.—From *Comptes Rendus*, abstracted in Lond. *Electrician*, Dec. 3.

Experiments on Telephone Lines.—DEVAUX CHARBONNEL.—A note on a recent paper read before the International Society of Electricians in Paris. (A series of articles by the same author on this subject in *La Lumière Elec.* was recently noticed in the Digest.) The author examined mathematically what passes in interurban telephone lines by supposing that all phenomena are due to the transmission of a sinusoidal current having a frequency of 1000. Experience has shown him that the results obtained by this method are sufficiently close to those derived from experiment. He took into account not only the impedance of the line, but also that of the transmitting and receiving apparatus, and found that the attenuation of the current with the distance takes place in accordance with an undulating exponential curve. On account of the first undulation it comes about that at a distance varying from 3 km to 15 km the current is stronger—that is to say, the communication is better than if the transmitter and the receiver were directly connected together without any line between them. This result has been verified by experiment. The formulas indicate another curious fact. The self-induction coil, designed by Pupin to overcome the capacity of telephone or telegraph lines, improves the transmission of the current when the insulation of the circuit is perfect, but may increase the attenuation when this insulation becomes low. Calculation shows, moreover, that on long lines the impedance constants of the instruments play a more important rôle than do those of the line. The author cites the curious fact that in certain cases a subscriber, by making use of a sensitive telephone instrument, renders communication easier to the person he is calling up, but harder for himself.—Lond. *Electrician*, Dec. 3.

Wireless Telegraphy.—L. DUBOIS.—An illustrated description of the wireless telegraph plant at the Eiffel Tower in Paris. The construction of the antennas is shown in Fig. 5. Owing

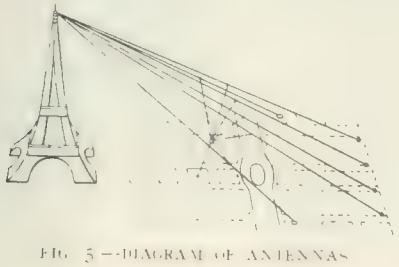


FIG. 5.—DIAGRAM OF ANTENNAS

to the fact that the tower is situated at one end of the Champs de Mars grounds and that these latter have a length which is considerably greater than the width, the antennas had to be laid out so as to conform to these dispositions of the ground. The area of the antennas will, however, be considerable, first, owing to the height, and second, due to the great angle of spread from the base of the tower. For the antennas there will be used a set of six steel cables 5 mm in diameter, and the cables will be supported at the top of the tower each upon a separate insulating bracket, seeing that the combined weight of the six cables would give too great a stress on the insulation material should all the cables be supported on a single anchoring point. For the six cables, the estimated total weight is 6.5 tons. The wave which will be produced from the high power plant will be about 2000 m long, and is of quite a different length from the wave which would be given by the metallic mass of the tower. —Lond. *Electrician*, Dec. 3.

Wireless Telegraphy in a Certain Direction.—R. E. NEALE.—It is difficult to explain the reason why bent antennas emit waves in a certain direction if the earth is a perfect conductor. But if the imperfect conductance of the earth is taken into account explanation is simple, as is shown by the author with the aid of diagrams.—Lond. *Elec. Review*, Dec. 3.

Miscellaneous.

Water Heaters.—A note on a recent British patent (15,786, Nov. 25, 1909) of A. Ponzini for electric water heaters for use on alternating-current circuits constructed in the form of a long cylinder of iron or steel, the outer wall of which is grooved at right angles to the axis. This cylinder is surrounded by a coil which induces eddy currents in the iron. On account of the skin effect, these currents are concentrated in the annular ridges between the grooves, which act as short-circuited turns of a transformer. The heat generated is transmitted through the wall of the cylinder to the liquid.—Lond. *Elec. Eng'ing*, Dec. 2.

Thermo-Luminescent Glass.—W. W. COBLENTZ.—An abstract of a recent Physical Society paper, in which the author gave an experimental demonstration of a thermo-luminescent glass made of feldspar formed into a perfect transparent rod, which was heated electrically. The luminescence appears as a faint white cloud at a temperature of about 800 deg. C., which increases in intensity with rise in temperature. The important point illustrated was that the light is white at all temperatures—that is, it does not pass through the usual chromatic changes found in the radiation from opaque substances, which would appear red at these temperatures. The absorption and behavior in a magnetic field will require further investigation.—*Physical Review*, December.

BOOK REVIEWS.

ELEMENTE UND AKKUMULATOREN. By Dr. W. Bein. Leipzig: Johann Ambrosius Barth, 241 pages, 98 ills.

A descriptive and statistical treatise on voltaic couples, both of the primary and secondary type. The book is designed for use either as an elementary text-book in electrochemistry or as a reference book for technologists who are not specialists in the field of voltaic electricity. A large number of voltaic cells are described and tabulated, while full descriptions are given of their methods of testing and comparative behavior.

THE CALCULUS AND ITS APPLICATIONS. By Robert Gordon Blaine, M.E. New York: Van Nostrand Company. 321 pages, 79 ills. Price, $1.50.

Though we have a plethora of text-books on the calculus, yet there is room for the present one. It is written for a purpose, which it fulfills in a satisfactory manner. It is evident from the subjects treated and the mode of treatment that the author came into close contact with the struggling engineering student, whom he takes by the hand, initiates into the new order of ideas of the calculus and helps over his many difficulties by well-chosen examples, by diagrams and graphs of various kinds.

Little space is given to subjects of a purely abstract value save those of fundamental importance, by which curtailment place is found for much matter of technical interest that one does not find in accepted text-books of similar scope. Not only are the theory and use of the planimeter given, as well as an exposition of simple harmonic motion and center of pressure, but also the indicator diagram, engineering problems

on moments of inertia, and the deflection of beams under varying conditions of load.

The author has done well in including in his book chapters on the simpler and more useful parts of differential equations with practical applications to electricity and engineering. The influence of Prof. John Perry is felt throughout the book, while his somewhat extreme and revolutionary views on the teaching of mathematics are wisely avoided by the author.

Direct and Alternating-Current Testing. By Frederick Bedell, Ph.D., assisted by Clarence A. Pierce, Ph.D. New York: D. Van Nostrand Company. 265 pages, illus. Price, $2.

A characteristic feature of this book is its complete discussion of the objects to be accomplished by each test rather than specific instructions for conducting the test. The authors have so arranged the descriptive matter that the student will be led to perform the experiments properly, but will not be driven to the mere taking of observations on instruments connected in circuit according to previously arranged plans, inserting data on blanks provided for the purpose, and substituting them later in formulas already developed. The method adopted is far preferable to the one just described in that the student obtains the maximum of mental benefit from each test, although he will be unable to report upon the maximum possible number of tests.

The manual is divided into seven chapters, dealing with direct-current generators, direct-current motors, synchronous alternators, single-phase currents, stationary transformers, polyphase currents and special transformers, respectively. In each chapter there are given first certain simple outline studies which are then followed by detailed tests. By means of this arrangement the laboratory instructor can omit more or less of the later tests, according to the limit in time to be devoted to the whole subject, without neglecting the fundamental experiments in any sub-division. A considerable portion of the work is devoted to single-phase circuits and stationary transformers, in the treatment of which very effective use is made of vectors and circle diagrams. The treatment throughout is characterized by accuracy and brevity. The book can be highly recommended as a laboratory manual for use in electrical engineering colleges.

The Elements of the Mechanics of Materials. By C. E. Houghton, A.B., M.M.E., Associate Professor of Mechanical Engineering in New York University. New York: D. Van Nostrand Company. 186 pages, 88 illus. Price, $2.00.

This work lays special stress on the practical side of the subject without, however, slighting the mathematical theory, inasmuch as a fair acquaintance with the calculus is necessary in order to read it with anything like profit. For a student whose time is rather limited, these "Elements" will be found very useful. A commendable feature is the number of typical engineering problems that are fully worked out in the text, as well as the series of questions and the collection of numerical problems which are appended to each chapter. The work will serve as an excellent introduction to the more elaborate treatises and books of reference on the subject.

NEW APPARATUS AND APPLIANCES

The 110,000-Volt Circuit-Breakers of the Southern Power Company.

Four groups of 110,000-volt oil circuit-breakers were recently put in service by the Southern Power Company on its high-tension transmission lines in the vicinity of Charlotte, N. C. This installation is the first in which switching apparatus is used at such a high potential, although several similar plants are now under construction and will shortly be in operation.

In the case of the Southern Power Company's lines not only is the voltage extremely high, but the magnitude of the currents being successfully handled under these severe conditions is unusual also. In this connection it is interesting to note the rated limit of operation of these 110,000-volt circuit-breakers, namely, that they shall successfully interrupt any short-circuit that may occur on a 120,000-kw transmission system.

As shown in the accompanying illustration, a feature of the construction of these circuit-breakers is the isolation of each pole in a separate tank. Each pole is thus entirely independent of the others except for the pull-rod which operates the contacts. This rod is released by the tripping mechanism shown at the left of the tanks, thereby allowing the contacts to open by gravity. The 47-in. break thus interposed into each lead occurs in the center of the tank, in oil free from sediment or moisture. By the arrangement of the operating mechanism, gravity assists in making a quick break during normal operation, while in case of any injury to the circuit-breaker parts the circuits tend to fall open—an important safety precaution.

A double break is made at each pole, spring-seated butt contacts assuring a firm closure. A small double-pole, double-throw switch operated by the contact mechanism provides a simple tell-tale for indicating the position of the breaker contacts, by lighting a red or green lamp. The tanks are of welded-seam boiler steel, filled with oil and fitted with a thick lining of specially treated insulation which encloses the contacts. The terminals are of the condenser type, and allow the line wires to be brought in directly from overhead.

The 110,000-volt breakers for the Southern Power Company are of both the hand-operated and electrically operated types. They are normally closed by energizing the operating solenoid from a low-voltage local circuit, but may also be hand-operated by a lever handle through a simple mechanical connection. Series relays, mounted on suspension insulators and inserted



Fig. 1.—Terminals of 110,000 volt transformer.

directly in the line, are provided for automatically tripping the circuit-breakers in case of overload. A wooden rod transmits the movement of the relay armature on the suspension insulator to the latch mechanism, thus providing a simple and quick-acting mechanical release effected directly by the line current.

Fifteen breakers of type and construction similar to the

110,000-volt apparatus will also be installed by the Southern Power Company for controlling its 88,000-volt transmission circuits. These breakers will be electrically operated and have their tripping coils energized from series transformers "built in" around the terminals and mounted as part of the tank case.

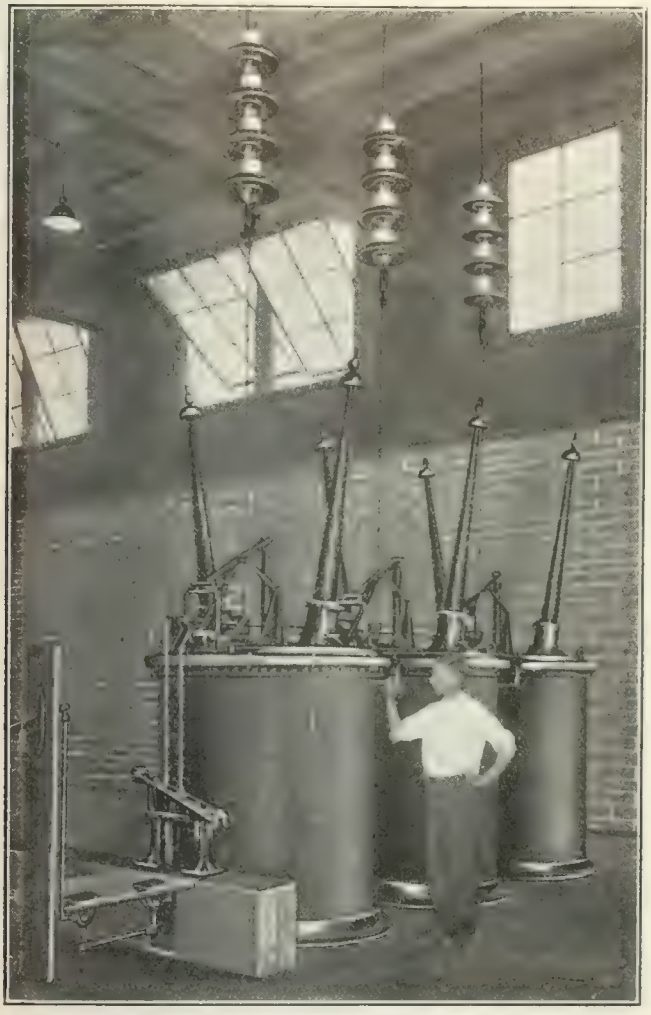


FIG. 2.—110,000 VOLT CIRCUIT-BREAKER DURING INSTALLATION.

This disposal of the series transformers contributes to the compactness and self-contained character of the breaker group, thus avoiding all external transformer or relay devices and wiring.

The 44,000-volt lines of the same company are controlled by

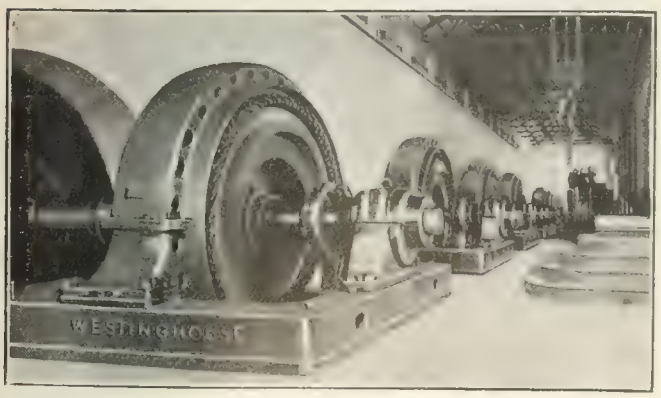


FIG. 3.—INTERIOR OF GREAT FALLS GENERATING STATION, SOUTHERN POWER COMPANY.

five sets of breakers of form similar to the high-voltage apparatus already described for operation at the lower voltage.

The 110-000-volt, 88,000-volt and 44,000-volt circuit-breakers described in the foregoing have been developed and manufactured by the Westinghouse Electric & Manufacturing Company.

Inspection Test Set.

The Herrick inspection test set, illustrated herewith, is a self-contained instrument for rapidly and accurately determining the condition of the electrical equipment of electric cars. The set was designed by Mr. A. B. Herrick, of New York, the well-known railway engineer, who has for a number of years made many reports upon the physical condition of electric railway properties and equipments.

One of the most useful tests of which the Herrick set is capable is that of permitting a rapid and thorough inspection of the equipment of a car at periodic intervals. The test used in this case is known as the inspector's test, and is accomplished by measuring for each controller point the entire resistance of the circuits through the car. If these values correspond to a standard value, the car is passed as in good condition electrically. If the values so obtained do not correspond to standard values, the car is taken out of service for a detailed test, by means of which the trouble is localized. In one instance where the above method of inspection was used the cars were tested when they came to the end of their run. The cars were operated under a three-minute headway, and were tested during one day without interfering with the schedule.

The set is arranged for seven tests, and connections for each



INSPECTION TEST SET.

test are made in the instrument by simply inserting a plug. An interlocking arrangement prevents the damaging of the instrument due to improper connections. The first test is known as the inspector's test, described above. The second test is the detail test, whereby the resistance of any portion of the equipment may be determined separately. By means of this test trouble showing in the inspector's test may be localized.

In addition to the above tests, the set may be arranged to measure resistance through a range of 1.5 ohms or 150 ohms, thus allowing for high or low resistance measurements. A setting is provided for the detection of grounds, and also one for the measurement of insulated resistance. The final test, known as the inductive balance test, detects a motor armature which is out of center, and also detects reversed fields.

The inspection set is portable, and can be carried from place to place in the car barn (or wherever else it may be employed) by two men. Convenient handles for this purpose are provided on the sides of the case. The testing current is 2 amp, the current being taken from the trolley circuit through lamp banks. The testing set is made by the Leeds & Northrup Company, Philadelphia.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Retail and holiday trade throughout the country was considerably stimulated last week by the seasonable weather. It is reported in many portions of the North and West that the returns are better than for any previous year. This is especially true in Chicago, Kansas City and Portland, Ore. In fact, the reports from the cities of considerable size are better than from the country towns. Reports from wholesalers and jobbers are very satisfactory. The majority of the orders, of course, that are being received at the present time are to fill in broken stocks, but these are coming in sufficient volume to make a very good trade. The switchmen's strike in the Northwest has done something to delay freights, and thereby impede the free movement both of the crops and of merchandise. It has, however, added very largely to the earnings of the express companies. Industrial operations are still extremely active. Mills are busy on old orders, and new orders are piling up for next year's delivery. Very heavy specifications are being received for structural materials, contracts for which were placed at lower prices early in the year. Railways have been good buyers of cars and other equipment. The prices of commodities continue to be at top figures, adding to the cost of living and threatening discontent among wage earners. Collections have fallen off perceptibly, as is generally the case just preceding the holidays. Business failures for the week ended Dec. 16, as reported by *Bradstreet's*, were 273, against 259 the week previous, 311 in 1908, 300 in 1907, 227 in 1906 and 235 in 1905.

EMPIRE DISTRICT ELECTRIC COMPANY BONDS.—Sales of the bonds of the Empire District Electric Company are being made in Wall Street, Williams, McConnell & Coleman, 60 Wall Street, being the distributing agents of these securities. It is stated that the original issue of these bonds was over-subscribed, and that since they have been issued they have been selling at a premium. H. L. Doherty, who is president of the company, will be in active management. The company will serve a population of more than 70,000, and will cover the lead and zinc mining districts of southern Missouri.

THE COPPER MARKET.

The copper market during the past week has not been active, nor has it been significant of any movement in either direction. Just at the present time the market seems to be unusually susceptible to speculative influences, and there are almost daily fluctuations, fractional for the most part, in electrolytic as well as standard copper. The takings by consumers, both here and abroad, have not been large, but reports from the manufacturers indicate that the actual consumption of copper is steadily increasing. It has been well known for a long time that the majority of consumers were very well stocked, and as at the present moment the prices of copper are not particularly attractive, it can hardly be considered surprising that there is a tendency to delay additional purchases until after the first of the year, in order that they may appear in the 1910 business. Statistically there is little change in the position of the metal market. Production continues at the top notch, and there is every reason to expect a considerable addition to the accumulations of copper in the December report. On the other hand, traders are continually encouraged by the prospect of a great merger or combination of interests that will control output if not prices. The practical success of the Guggenheim merger plans is taken to mean the eventual success of the larger plans which have been discussed for the past two months. Since the adverse decision in the Standard Oil case there has been some uneasiness lest such a merger as the Cole-Ryan interests proposed would prove illegal. It is now reported that sanction for this consolidation has been received from the very highest Federal authority. Exports have hardly been as active as during November. From the present prospects there will be about 24,000 tons shipped abroad during the current month. Exports so far reported for the month up to and including Dec. 20 amount to 17,951 tons. The daily call on the Metal Exchange, Dec. 20, quotes standard copper:

	Bid.	Asked.	Settling price.
Spot	12.87½	13.12½	——
December	12.87½	13.15	13.05
January	12.95	13.25	13.05
February	13.00	13.37½	13.15
March	13.05	13.40	13.25
April	13.10	13.50	13.30

The London prices Dec. 20 were as follows:

	Noon.	Close.
	£ s d	£ s d
Standard copper, spot	60 0 0	60 2 6
Standard copper, futures	61 2 6	61 5 0
Market	Firm	Firm
Sales of spot	500 tons	
Sales of futures	350 tons	

Extreme fluctuations for this year:

	Highest.	Lowest.
	£ s d	£ s d
London, spot	£64 2 6	£54 12 6
London, futures	64 17 6	55 10 0
Standard	13 45 0	12 12½ 0
London, best selected	67 15 0	59 0 0

GENERAL ELECTRIC TAKES OVER PART OF WESTERN ELECTRIC MANUFACTURING BUSINESS.—The long rumored deal between the General Electric Company and the Western Electric Company, whereby the latter will retire from the manufacture of heavy electrical apparatus, has been consummated. The deal involves the transfer to the General Electric Company of the patents and tools used by the Western Electric in the manufacture of light and power apparatus, with an arrangement under which the latter company will continue to sell heavy apparatus manufactured by the General Electric. The plant of the Western Electric Company will be devoted exclusively to the manufacture of telephonic apparatus and smaller electrical appliances. From an authoritative source in the Western Electric office, confirmation of this deal was obtained. It was said that the continued growth in the demand for telephone apparatus indicated even a more expanded demand in the future and that the Western Electric officials concluded that it would be wiser for the company to specialize on smaller electrical appliances, just as the General Electric and the Westinghouse Electric & Manufacturing have specialized on larger appliances. At the General Electric Company's office it was said that much of the heavy apparatus of the Western Electric Company had been made, for many years, by the General Electric Company and that the present deal was only an expansion of the existing relations.

SHAWINIGAN WATER & POWER COMPANY.—The Shawinigan Water & Power Company, of Montreal, has decided to carry out a most aggressive policy of expansion and development. The rapid growth of business all over the Province of Quebec has caused the directors to make this decision. On Dec. 16 the management announced that it had put into service the extra 10,000 hp, which gives the company a capacity of no less than 54,000 electrical hp in the generating station at Shawinigan Falls, besides which there is 35,000 hp sold as hydraulic horse-power direct from the head works. During the week contracts were placed for apparatus to increase one of the present 500-hp units to a capacity of 10,000 hp. The demand for power is in excess of the company's ability to install machinery to meet it. The financial position of the company is particularly strong at present, the gross earnings for November showing over $64,620. In regard to the rumored increase in capital, the treasurer, Howard Murray, stated that none would be made at present as the $500,000 recently issued would meet requirements for some time. Mr. Murray declined to say anything about a probable increase in dividends.

ROANOKE (VA.) ELECTRIC LIGHT & POWER COMPANY.—A large tract of land and water rights along the Staunton River, Virginia, in the vicinity of Brookneal, have been secured by the Roanoke Electric Light & Power Company, and it is proposed to erect a large hydroelectric plant at this point. It is estimated that 5000 hp can be developed, which will be transmitted to Lynchburg and other cities in the vicinity. The company is capitalized at $1,000,000.

MOTOR DRIVES FOR AUTOMOBILE SHOPS.—Among electric-motor equipments recently furnished by the Allis-Chalmers Company to the automobile manufacturers in the neighborhood of Detroit, Mich., are the following: The Everett-Motzger-Flanders Company, Detroit, three 300-kw generators and exciters, four 100-kw, oil-filled, water-cooled transformers and 64 induction motors. This company uses a 30-hp, 850-r.p.m. motor as standard and thus has to carry but few repair parts. To the Oak Park Power Company, of Flint, Mich., two 1000-kw. steam turbine units with direct-coupled exciters, one non-condensing, the other condensing, with turbo jet condenser and motor-generator exciter set; two 200-kw alternators with exciters, 21 transformers and a large number of motors. To the Weston-Mott Company, of Flint, Mich., a large number of induction motors of 40 hp, 850 r.p.m., as standard. To the Kelsey-Herbert Wheel Company, of Detroit, transformers and six induction motors. To the Rapid Motor Vehicle Company, Pontiac, Mich., two engines direct-connected to 600-kw, 60-cycle, 3-phase, 240-volt generators, and a 45-kw induction motor-generator exciter and a 40-kw engine exciter set. To the American Motor Castings Company a 100-kw engine generator set and six induction motors. To the Brush Runabout Company, Detroit, Mich., three 100-kw transformers and 20 induction motors. This company has adopted 20 hp and 850 r.p.m. as its standard.

GENERAL ELECTRIC COMPANY.—An official of the General Electric Company is responsible for the statement that the company expects to close the year with orders received which will amount well up toward the best previous year. It is true, however, that the business is in smaller material relatively than it has been in some former years. During the past season there has been an extensive demand for small apparatus, and this has kept the shops very busy. All over the country there has been a large Christmas trade in electrical household appliances. This business has been the largest ever known. The demand for electric meters from the lighting companies throughout the United States has been the largest ever known, and this in itself is an indication that there is a vast increase in the number of consumers.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in our present issue are announcements of proposed new plants or considerable extensions of present plants at Portland, Maine; Statesboro, Ga.; Chesaning, Mich.; Hamilton, Mont.; Berkley Springs, W. Va.; Santa Barbara, Cal.; Portland, Ore.; Grand Forks, N. D.; Boone, Ia.; Canal Dover, Ohio; Gainesville, Tex.; Apex, N. C.; Yacolt, Wash.; Plaquemine, La.; Erie, Kan.; McKinney, Tex.; Kooskia, Idaho; Massillon, Ohio; Cleveland, Ohio; Greenville, Ga.; Paragould, Ark.; Little Rock, Ark.; Millville, W. Va.; St. Paul, Minn.; Fort Wayne, Ind.; Boulder, Col.; Waycross, Ga.; Lynchburg, Va.; Lyons, N. Y.; Ralston, Okla.; Anoka, Minn.; Niles, Ohio, and Mount Vernon, Ohio.

FEDERAL CORPORATION TAX.—It is reported in Washington that there is a violent difference of opinion between the Treasury Department and the Department of Justice about the terms "net income and cash profits" in the new Federal corporation tax law. It is stated that Attorney-General Wickersham is very much affronted because the Treasury Department has issued regulations without consulting him. It is intimated, also, that the regulations issued may be recalled. The attorneys who are fighting the corporation tax in the Federal courts expect to win their cases, but the Treasury Department is still confident that the law will hold good.

JAPAN BUYS MORE AMERICAN TELEPHONE APPARATUS.—Another telephone switchboard order from the Far East has been placed with the Western Electric Company. The Japanese Department of Communications is the purchaser, the equipment being used to extend the service in the capital city of Tokyo. This board is standard equipment of the sort used by the Bell companies in this country and in general use abroad. It is a common battery switchboard of up-to-date type. The same company recently contracted to supply the Chinese Government the equipment for the first two modern telephone exchanges in that Empire, to be located in Pekin.

ELKHART (IND.) GAS POWER COMPANY.—A company is being formed under the name of the Elkhart (Ind.) Gas Power Company to compete with the Indiana & Michigan Electric Company. The citizens of Elkhart are back of the project. The formation of this new company, it is said, is the result of a recent increase in rates by the older corporation, which goes into effect Jan. 1. The stock of the new concern is subscribed for by a number of leading manufacturers, and it is proposed to equip a plant to supply electricity for power exclusively. The plant will be equipped with gasoline engines.

GUATEMALA GOVERNMENTAL SUPERVISION OF ELECTRICAL SUPPLIES.—As the outcome of the special legislation giving the Guatemalan Government direct supervision of all electrical enterprises, a Presidential decree of Oct. 21, 1909, allows the importation of electrical supplies only on written permission granted by the War Department upon application. The decree also requires such enterprises now existing to furnish to the competent authority the description and destination of all orders for material placed before the promulgation of the present law.

RUSH WORK ON ELECTRIC ENGINES.—Orders have been received at the East Pittsburgh shops of the Westinghouse Electric & Manufacturing Company to rush the work as rapidly as possible on the large electric locomotives of the Pennsylvania Railroad. These are the engines that are to be used in the New York terminal, and the company is almost ready to put them into service. Two of these engines have been delivered, and have been thoroughly tested on the Long Island Railroad tracks. It is said that they have proved entirely satisfactory.

NORFOLK & WESTERN RAILROAD USING TELEPHONES.—The Norfolk & Western has recently placed an order for four complete train despatching circuits with the Western Electric Company. These circuits will operate from Norfolk to Crewe, 130 miles, 27 stations; Crewe to Roanoke, 126 miles, 3 stations; Williamson, West Va., to Portsmouth, O., 113 miles, 22 stations, and Portsmouth to Columbus, O., 100 miles, 22 stations. These circuits are in addition to the two already in operation, which have been heretofore referred to.

HAMILTON, MONT., HYDROELECTRIC DEVELOPMENT.—The municipal plant of Hamilton, Mont., is preparing to construct a hydroelectric plant on Sleeping Child Creek, six miles from that city. The plans and specifications have been completed and contracts will soon be let. The cost of the construction will be about $150,000, and it is calculated that from 1500 to 2000 hp will be developed.

TULOROSA COPPER COMPANY.—F. P. Kern, president of the Tulorosa Copper Company, was in New York last week making contracts for electrical equipment to furnish power and light in the company's plant in New Mexico. The company's mill will have an initial capacity of 100 tons of ore a day. Recent prospecting upon the property gives promise of large values.

PIEDMONT ELECTRIC COMPANY.—The business of the Piedmont Electric Company, which was organized at Anderson, S. C., in 1904, is being closed out, and the company will retire from business. It is stated that the lack of capital is responsible for this step. The present stockholders were unwilling to invest more in the venture.

Financial Intelligence.

THE WEEK IN WALL STREET

The market in Wall Street during the past week has been irregular and, as far as trading is concerned, rather dull. The tone, however, has been fairly strong, and as a general thing there have been fractional advances in quotations. There have been very few developments during the week of sufficient importance to cause any pronounced fluctuations. The advance in the dividend rates of Louisville & Nashville and of Reading, of course, had a strengthening effect upon the market, but these advances had long been expected, and it might be said were long over due. On Dec. 20 there was a sharp advance in Consolidated Gas, due to reports that a melon of some character was about to be cut. One story was that a real estate company was being formed to take over unused property belonging to the Consolidated Gas Company, and that the stock of this company would be distributed among the shareholders of the gas company. Another story was that the dividend rate would be increased from 4 to 6 per cent on account of the excellent earnings during the past year. This seems to be the more reasonable story. In many respects the market has been manipulated during the past week or 10 days, and this is due to the fact that a large number of professional traders always expect an advance about the end of the year or

just after New Year. It is assumed that investors at this time will probably have money with which to buy, and that after having collected their dividends on securities which they now hold they will invest a portion of the money in new securities. For this reason it is not unusual for regular traders to load up with stocks about the middle of December in order to dispose of them when the outside buying begins. The physical condition of business is such that it would be almost impossible for the tone of the market to be otherwise than strong. The industrial world is prospering as never before, and even the threatened "declaration of war" made by the labor unions against the United States Steel Corporation has been ignored. In view of the present tremendous demand for steel products, there are not many people afraid that labor complications will seriously interfere with earnings. Returns from the railways show largely increased gross earnings. While the switchmen's strike in the Northwest has hampered traffic there, elsewhere shipments are heavy and rates are expanding. The monthly returns for November show an increase over the previous year of about 13.2 per cent. The money market continues to be in a fairly satisfactory condition, although in both London and Berlin there is a tightening tendency which is causing some restriction of loans. It is the general opinion, however, that this is temporary, and that after the first of the year the market will ease up. Locally there seems to be plenty of money to supply every demand, and rates have not been advanced sufficiently to cause any trouble. Quotations Dec. 20 were: call, 4½ @ 5 per cent; 90 days, 4½ per cent. The quotations in the table are those of the close, Dec. 20.

NEW YORK.

	Dec 14.	Dec 20.	Shares sold		Dec 14.	Dec. 20.	Shares sold.
All.-Ch.	15½	15⅛	900	Int.-Met ,pfd..	61⅝	61	30,650
All.-Ch., pfd..	53¾*	55	3,800	Mackay Cos..	91½	90½	200
Amal. Cop...	88⅛	87⅞	88,900	MackayC ,pfd.	76¼	77½*	500
Am. D. T....	20½*	———		Man. Elev....	140½*	139½	225
Am. Loc.....	61¾	60¾	1,700	Met. St. Ry..	23*	23*	———
Am. Loc., pfd.	114*	757		N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	80	77½*	43	Steel, com....	91⅞	91⅞	627,607
Am. T. & T..	143	142½	11,900	Steel, pfd....	125½	125	10,335
B. R. T.....	80¼	80½	16,390	W. U. T.....	78½	77½	4,71[illegible]
Gen. Elec....	160½	160	2,850	West'h., com.	84	81¾	8,500
Int.-Met.,com.	24⅝	24¼	39,100	West'h., pfd .	135*	133	50[illegible]

PHILADELPHIA.

	Dec. 14.	Dec. 20.		Dec. 14.	Dec. 20.
Am. Rys.....	47	47	Phila. Elec.....	13½	13[illegible]
Elec. Co. of A.....	12⅜*	12⅜*	Phila. R. T.....	28⅛	7[illegible]
Elec. St. B'ty.....	57¼	58¼	Phila. Trac.....	88¾	88[illegible]
E. S. B'ty, pfd.....	30*	30*	Union Trac.....	52½	52[illegible]

CHICAGO.

	Dec. 14.	Dec. 20.		Dec. 14.	Dec. 20.
Chi. City Ry.....	180*	180*	Chi Tel. Co.....	136	136
Chi. Rs., Ser. 1.....	100	105	Met. El., com.....	18	19¼
Chi. Rs., Ser. 2.....	30	33	Met. El., pfd.....	56	58
Com. Edison.....	118	118½	Nat'l Carbon.....	105	103[illegible]
Chi. Subways.....	5⅛*	4⅞*	Nat'l Car., pfd.....	123*	123*

BOSTON.

	Dec. 14.	Dec. 20.		Dec. 14.	Dec. 20.
Am. T. & T..	143⅛	142⅝	Mex. Tel.....	2½	2[illegible]
Cum. Tel.	145⅞*	145⅛*	Mex Tel., pfd.....	5½	5[illegible]
Edison E. Ill.....	250	250	N. E. Tel.....	136¼	137
Gen. Elec.....	160⅞*	160	W. T. & T.....	12	15
Mass. E. Ry.....	15⅞	15½	W. T. & T., pfd....	80½	96
Mass. E. R., pfd....	77½	79			

* Last price quoted.
Shares sold are for week of Dec. 13 to Dec. 18.

POSTAL TELEGRAPH CABLE COMPANY.—Charles P. Bruch, vice-president of the Postal Telegraph Cable Company, of New York, has confirmed the report of the forthcoming reorganization of at least two of the large telegraph systems, insofar as changes of name may be regarded as reorganization. The corporate title of the Postal Telegraph Cable Company is to be changed to the Transcontinental Cable Company, and that of the New England Telegraph Company to be changed to the Postal Telegraph Cable Company. There are now 16 companies operating in various States under the title of Postal Telegraph Cable Company, and six others operating as Postal Telegraph & Cable Company in various other States, and there are still others known as Postal Telegraph companies. These, with 79 other operating companies in various parts af the country, are owned or controlled by the Mackay Companies, a voluntary association. The present change is in name only, and does not involve any new financing or any change in method of operation.

QUEBEC RAILWAY, LIGHT & POWER COMPANY.—A final statement has been issued in connection with the consolidation of public utilities in the city of Quebec. It states that the merger has been entirely completed, and that the Quebec Railway, Light & Power Company will take over the Quebec-Jacques Cartier Electric Company, the Canada Electric Light Company, the Quebec Gas Company and the Frontenac Gas Company. As heretofore stated in these columns, the new company will have an authorized capital stock of $10,000,000 and an authorized bond issue of $10,000,000. It is expected that $9,500,000 of the stock will be issued, and $8,654,000 of the bonds. These issues will not only provide for full payment for the companies taken over, but will give the new company ample working capital.

NEW YORK & HARLEM RAILROAD COMPANY.—The directors of the New York & Harlem Railroad Company, which owns the Madison Avenue line in New York City, have filed a petition in the United States Circuit Court asking that the court direct the Metropolitan Street Railway Company receivers either to surrender the property or to assume the unpaid franchise taxes and all the obligations of the lease of 1896. It was under this lease that the Metropolitan Street Railway acquired control of the line. If the property is surrendered by the receivers, which seems more probable than that the back assessments will be paid, it would mean that all transfers between these lines and the Metropolitan system would be cut off.

SHORE LINE ELECTRIC RAILROAD COMPANY.—The Shore Line Electric Railroad Company, of New Rochelle, N. Y., was incorporated at Albany last week with a capital stock of $300,000. This company is a reorganization of the Tarrytown, White Plains & Mamaroneck Company, whose property was sold some time ago under foreclosure to F. L. Babcock for $450,000. Among the incorporators are F. L. Babcock, Edward A. Maher, president of the Bronx Traction Company; Reune Martin, secretary of the Union Railway Company; Dudley Olcott and E. Francis Hyde, president of the Central Trust Company.

INTERSTATE RAILWAYS COMPANY.—Arrangements have been made by the Earle readjustment committee of the Interstate Railways Company, of Philadelphia, to pay the charges and expenses of the Philadelphia Trust Company for acting as depositor of Interstate bonds under the plan of the former reorganization committee, which has since been dissolved. After these expenses have been paid a demand will be made upon the Philadelphia Trust Company by the bondholders for the release and delivery of their deposited bonds. This will put the company in a position to be reorganized by the bondholders.

LONG ISLAND ELECTRIC RAILWAY COMPANY.—During the fiscal year which ended June 30, 1909, the Long Island Electric Railway Company, running to Rockaway Beach and owned in part by the Long Island Railroad Company and the Interborough Rapid Transit Company, received $165,375 in five-cent fares. The other revenues of the company brought the total gross receipts to $185,368. The expenses for operation totaled $144,075, leaving a net revenue of $41,292. After paying taxes and corporate charges the surplus carried over for the year was $2,187.

MASSACHUSETTS ELECTRIC COMPANIES.—At the annual stockholders' meeting of the Massachusetts Electric Companies last week the old trustees were re-elected, and the stockholders authorized them to sell the preferred stock of the Boston & Northern and of the Old Colony Street Railway companies. They were also authorized to issue notes not to exceed $5,000,000, the proceeds to be used to refund the $3,500,000 4½ per cent notes coming due next July.

WESTBOROUGH (MASS.) GAS & ELECTRIC COMPANY.—The Gas Commissioners of Massachusetts have approved an issue of 115 shares of new capital stock of the Westborough Gas & Electric Company. The par value of this stock is $100. The proceeds are to be used for making improvements on the property and extending the transmission lines and mains of the company into new territory.

VIRGINIA RAILWAY & POWER COMPANY.—Securities of the Virginia Railway & Power Company, of Richmond, will probably be listed in a short time on the Philadelphia Stock Exchange. The common stock of this company during the past week has been selling for between 19 and 20, while the preferred has been selling for about 68. The 5 per cent bonds have recently sold at 90.

MAHONING & SHENANGO BONDS.—Lee, Higginson & Company and Blair & Company are offering the unsold balance of $3,800,000 first consolidated refunding mortgage 5 per cent bonds of the Mahoning & Shenango Railway & Light Company. The offer is made at 97 and interest. A considerable amount of the issue has already been placed with foreign investors.

J. P. MORGAN IN TELEPHONE DEAL.—Announcement was made last week that J. P. Morgan & Company are the purchasers of the United States Telephone Company and the Cuyahoga Telephone Company, of Cleveland; also the majority of the stocks of the Toledo Home Telephone Company, the Citizens' Telephone Company, of Columbus, O., the Dayton Home Telephone Company, the Indianapolis Telephone Company, the New Long Distance Telephone Company of Indiana and the New Telephone Company of Indianapolis. The United States Company was the long-distance operating company throughout northern Ohio and southern Michigan. James S. Brailey, Jr., who recently acquired the United States Company and the Cuyahoga Company, and large interests in the other companies, declares that these purchases were made by Mr. Morgan for his personal account, and that the properties will continue to be operated Independent. The fact that Mr. Morgan is known to have been interested with the American Telephone & Telegraph Company in the acquirement of practical control of the Western Union Telegraph Company leads to the assumption that the present deal is a transfer of Independent interests to Bell interests. In our last issue we told of the transfer of about 19,000 shares of the stock of Independent companies to R. L. Day & Company. This transfer was made, so it was stated, at the suggestion of officials of the American Telephone & Telegraph Company. It now appears that it was in reality the Morgan firm which bought the stock. Theodore N. Vail, president of the American Telephone & Telegraph Company, and Henry P. Davidson, of J. P. Morgan & Company, have made statements denying that there has been any absorption of the Independent companies by the Bell interests. These gentlemen declare that the purchase of the stocks of the Independent companies had no connection in any way with the American Telephone & Telegraph Company. The amount involved in these purchases is about $10,000,000. The system which Morgan & Company have acquired embraces 101,500 telephones and 40,000 miles of long distance lines, covering Ohio, Indiana and Michigan.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—It is given out by officials of the Westinghouse Electric & Manufacturing Company that the first six months of its fiscal year will show earnings more than sufficient to pay the regular dividends and all of the back dividends on the preferred stock. It is not expected, however, that all of the back dividends will be paid at one time. Robert Mather, chairman of the board, is determined that the policy of gradual payments shall be followed out. Previous to the first payment the default of back dividends amounted to $490,000. Three months ago the first payment was made, of about $140,000. The December payment will amount to about the same amount, leaving only about $210,000 to be paid. This could be easily covered at one dividend period, but it is the policy of the company to add to its accumulations. It is stated that the net profits of the concern are now running at the rate of $300,000 a month. The asset value of the assenting stock is now computed by insiders to be about 120. In the month of November the shipments made by the Westinghouse Electric & Manufacturing Company from Pittsburgh and Newark aggregated about $2,500,000, and with other shipments made by subsidiary companies the total business was about $3,000,000. This is the largest month that the company has had for many years. It is now estimated that the total business for the year of the Westinghouse company will amount to between $30,000,000 and $35,000,000.

TOLEDO RAILWAYS & LIGHT COMPANY.—Practically all of the $4,866,000 outstanding of the 4 per cent bonds of the Toledo Railways & Light Company which fell due July 1, 1909, and on which the company is in default, have been deposited with the bondholders committee, and 75 per cent of the capital stock is also in the hands of protective committees. There has been no plan yet announced for the readustment of the financial conditions of the company. Until the new city council meets in January the question of extending the company's franchise will not be considered. Practically all of the franchises now held by the company will expire before 1915, and the main difficulty in refinancing the company has been the uncertainty as to the renewal of franchises. It is now believed that the city administration will be liberal, and that franchises will be granted on terms which will permit the operation of a dividend paying company.

SOUTHERN CALIFORNIA EDISON COMPANY.—The general mortgage 5 per cent gold bonds of the Southern California Edison Company, which is the successor to the Edison Electric Company, of Los Angeles, are being offered by N. W. Harris & Company, of New York and Boston; E. H. Rollins & Sons, Boston, Chicago, Denver and San Francisco, and the Harris Trust & Savings Bank, Chicago. These bonds are being offered to the public at 97½ and interest, and at that figure will yield about 5.17 per cent. The company has generating plants, water and steam, approximating 60,000 hp. It serves Los Angeles, Pasadena, Riverside, Redlands and a number of other cities, having a total population of over 600,000.

VALUE OF BROOKLYN RAPID TRANSIT.—Bion J. Arnold, consulting engineer of the Public Service Commission, testified at a hearing last week that he estimated the physical value of the property of the Brooklyn Rapid Transit Company at $100,000,000. This estimate was based upon the cost of reproduction, and made no allowances for the organization costs or for discounts which had to be accepted upon the sale of securities. Mr. Arnold stated that if all these matters were considered the value of the property would probably be equal to its total capitalization, which is about $141,000,000.

CHICAGO-MILWAUKEE ELECTRIC COMPANY.—It is stated that the bondholders of the Chicago-Milwaukee Electric Company will take the road over from the receiver in January and will operate it under a new management. It is stated that the net earnings of the last fiscal year were about $159,000, or 1 per cent on the outstanding bonds. The $10,000,000 bonds of the Wisconsin division are held largely in Canada. The $5,000,000 of the Illinois division were held originally in the Netherlands, but many of these have recently been secured by Canadian and American interests.

SUPERIOR WATER, LIGHT & POWER COMPANY.—Redmond & Company, 33 Pine Street, New York, are offering to the public $100,000 of the 4 per cent sinking fund bonds of the Superior (Wis.) Water, Light & Power Company. The price at which these bonds are offered is 81 and interest, netting 5½ per cent to the investor.. It is stated that the earnings of the company during the past six years have about doubled. There are outstanding only $1,500,000 of bonds, and the net earnings for the past year were more than double the interest charge.

CALIFORNIA BOND CASE DECIDED.—In the case of the Merced River Electric Company, of California, the Supreme Court of that State has recently decided that a corporation cannot be prevented from issuing bonds because its actually subscribed stock is less than the amount of bonds sought to be issued. The company proposed to issue $1,500,000 of bonds while the actual subscriptions to its stock were only $2,500. The Secretary of State refused permission, and the present decision grants a compelling mandamus.

HUDSON & MANHATTAN RAILROAD COMPANY.—William G. McAdoo, president of the Hudson & Manhattan Railroad Company, has applied to the New Jersey Board of Assessors for the reduction of the tax assessment on the properties of his company in Jersey City and Hoboken. He states that so far the tunnels have not been a paying investment. He expressed the opinion, however, that when the system is entirely completed in Jersey City the return will be sufficient to pay a dividend upon investment.

BLUE LAKES (CAL.) WATER COMPANY BONDS.—The County Recorder of Jackson, Cal., has just recorded for the Mercantile Trust Company, of San Francisco, an acceptance of the trusteeship of the $5,000,000 bonds of the old Blue Lakes Water Company. This concern was one of the properties that eventually came into the control of the Pacific Gas & Electric Company.

HICKORY (N. C.) WATER-POWER DEVELOPMENT.—Col. M. E. Thornton, president of the Thornton Light & Power Company and of the Hickory Water-Power Electric Company, is offering a bond issue of $850,000, the proceeds to be expended in developing a 9000-hp water-power property owned by the last-mentioned company.

OKLAHOMA GAS & ELECTRIC COMPANY—William P. Bonbright & Company, New York, are offering $150,000, 7 per cent cumulative preferred stock of the Oklahoma Gas & Electric Company, Oklahoma City, at 98. This price nets the investor 7.14 per cent.

CONSOLIDATION OF WESTCHESTER ELECTRIC LINES.—The application made by the New York, New Haven & Hartford Railroad Company to the Public Service Commission of the Second District for permission to consolidate the New York, Westchester & Boston Railway with the New York & Portchester Railroad has been granted. The Board of Estimate and Apportionment of the City of New York has also given its permission to this consolidation. The new company will be called the New York, Westchester & Boston Railway. It is a joint agreement between the two traction companies to consolidate their capital stock, property and franchises, and it is provided that the stock of the new company is not to exceed $5,000,000. The new corporation is authorized to abandon those portions of the roads of the two consolidated companies which are not necessary to form one continuous line from the Harlem River to Portchester, with a branch from 177th Street to Throgg's Neck, and another branch from Mt. Vernon to White Plains. The commission refused to permit the abandonment of the line from Classon's Point to Throgg's Neck. It is planned to have a four-track line from 138th Street to Portchester. The original capitalization of the two companies was a total of $20,000,000 in stock and $35,000,000 in bonds.

GUGGENHEIM COPPER MERGER.—The proposed plan of merging the Nevada Consolidated Copper Company and the Boston Consolidated Copper Company into the Utah Copper Company, which was outlined in our last issue, is progressing in spite of the fact that a number of the minority stockholders of the Nevada Company are vigorously protesting. These stockholders declare that their property is more valuable than the Utah Company, and that the ratio of exchange, by which 2½ shares of the Nevada Company's stock are to be traded for 1 share of the Utah Copper Company's stock, is unfair and that they will resist any consolidation on such a basis. In the meantime steps have been taken to increase the capital stock of the Utah Copper Company from 750,000 shares to 2,500,000 shares, in order that it may be prepared to take over the other properties. It is said in copper circles that the present consolidation is but a forerunner of the big consolidation of copper interests that is being engineered by the Cole-Ryan party and the Amalgamated Copper Company.

NORTH AMERICAN COMPANY.—James Campbell, the newly elected president of the North American Company, said in St. Louis the other day that, so far as he was concerned, the administration of the company would be carried on in that city. He also denied that there was any truth in the report that the company was to become a holding organization for Standard Oil properties, or for 'Frisco and Rock Island Railroad properties. It is given out that the company does not contemplate the declaration of an extra dividend as a result of the recent sale of the Laclede Gas Company. Approximately $7,500,000 was realized in this transaction, but only about $3,500,000 has been paid, and the remainder is not due for some time. The officials think that this money should be placed in reserve, as it cannot properly be called profits. The earnings of the company are expected to exceed last year, and the outlook is considered very promising.

WESTINGHOUSE AIR BRAKE COMPANY.—The earnings of the Westinghouse Air Brake Company for the past year have been extremely large. At the quarterly meeting of its Board of Directors last week it declared the regular quarterly dividend of 2½ per cent, an extra dividend of 1½ per cent and a special dividend of 1 per cent. This means a disbursement of $700,000 upon its capital stock of $14,000,000. It is said that December bids fair to be larger than November, which was the third largest month in the history of the company. The plant is running night and day.

UNITED STATES GAS & ELECTRIC COMPANY.—The Wayne County Electric Company, of Lyons, N. Y., which was recently purchased by William T. Morris, has been taken over by the United States Gas & Electric Company. The company will be operated under its own name as a separate organization from the holding company. In the spring it is proposed to remove the plant and increase its efficiency.

HILL BUYS INLAND EMPIRE.—James J. Hill, chairman of the board of directors of the Great Northern Railroad Company, has announced that the railroad company has purchased a controlling interest in the Spokane & Inland Empire Railway System, of Spokane, Wash. He says that the road will be used as a feeder to the Great Northern system.

PORTLAND (ORE.) GAS COMPANY SOLD.—The Eastern stockholders of the Portland Gas Company have practically concluded arrangements for the sale of that property to the Electric Bond & Share Company, of New York. The price offered is said to be 30 per cent above par on the $1,950,000 of stock which has been issued.

ELECTRIC SECURITIES AT AUCTION.—At the regular auction of securities in New York last week 100 shares of New York & Queens Electric Light & Power Company, common par value $100, were sold at 65½; $10,000 Great Western Power Company first mortgage 5 per cent bonds were sold at 95½.

DIVIDENDS.

American Cities Railway & Light Company, preferred, quarterly, 1½ per cent; common, semi-annual, 1½ per cent, both payable Jan. 1.

Bangor (Me.) Railway & Electric Company, quarterly, 1½ per cent, payable Jan. 1.

Bell Telephone Company of Missouri, quarterly, 2 per cent, payable Jan. 2.

Boston & Worcester Electric Company, preferred, semi-annual, $1 per share, payable Jan. 1.

Chicago City Railway Company, quarterly, 1½ per cent, payable Dec. 30.

Detroit Edison Company, quarterly, 1 per cent, payable Jan. 15.

Duluth Edison Electric Company, preferred, quarterly, 1½ per cent, payable Jan. 1.

Manila Electric Railroad & Lighting Corporation, quarterly, 1 per cent, payable Jan. 1.

Massachusetts Lighting Companies, quarterly, 1½ per cent, extra ¼ per cent, payable Jan. 15.

Northwestern Elevated Railroad Company, Chicago, preferred, quarterly, 1 per cent, payable Jan. 18.

Otis Elevator Company, preferred, quarterly, 1½ per cent, payable Jan. 15.

Philadelphia Company, Pittsburgh, quarterly, 1½ per cent, payable Feb. 10.

Ridge Avenue Passenger Railway Company, Philadelphia, quarterly, $3 per share, payable Jan. 1.

Tri-City Railway & Light Company, Davenport, Ia., preferred, quarterly, 1½ per cent, payable Jan. 3.

United States Light & Heat Company, preferred, semi-annual, 3½ per cent.

Westinghouse Air Brake Company, quarterly, 2½ per cent, extra 1½ per cent, special 1 per cent, all payable Jan. 10.

Westinghouse Electric & Manufacturing Company, preferred, quarterly, 1¾ per cent, payable Jan. 15.

REPORT OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Chicago Railways Company:					
October, 1909	[illegible]	$776,748	$332,892	$203,626	$129,266
October, 1908	[illegible]	677,979	290,564	149,730	140,834
Cleveland, Painesville & Eastern Railroad Company:					
November, 1909	[illegible]	15,020	10,880	8,457	2,423
November, 1908	[illegible]	13,483	9,041	8,087	954
Cumberland Telephone & Telegraph Company:					
November, 1909	[illegible]	306,971	253,061	40,742	212,319
November, 1908	[illegible]	286,931	248,131	44,638	203,492
Third Avenue Railroad Company:					
Quarter ended Sept. 30, 1909	[illegible]	415,049	406,083	.....	.....
Quarter ended Sept. 30, 1908	786,527	509,331	277,196	.....	.....
Toledo Railways & Light Company:					
November, 1909	[illegible]	126,916	120,139	75,757	44,565
November, 1908	[illegible]	117,372	102,389	71,960	30,553
Union Railway Company of New York:					
Quarter ended Sept. 30, 1909	567,479	337,509	229,970	.....	.....
Quarter ended Sept. 30, 1908	[illegible]	340,022	128,851	.....	.....
United Railways Company of St. Louis:					
November, 1909	[illegible]	581,014	346,436	232,107	114,329
November, 1908	[illegible]	536,636	335,703	233,694	102,009

GENERAL NEWS

Construction News.

GLOBE, ARIZ.—An independent telephone company has secured control of the telephone system owned by the Inspiration Mining Company. It is said that the new company will install about 200 telephones in and around Miami.

PRESCOTT, ARIZ.—The Prescott Electric Light Company is reported to have entered into a contract with the Arizona Power Company for 600 hp. The Arizona company has a hydroelectric power plant at Fossil Creek.

LITTLE ROCK, ARK.—The City Council is reported to have engaged J. F. Jackson, of the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., to furnish an estimate of the cost of the proposed municipal electric light plant in Little Rock. E. A. Kingsley is City Engineer.

PARAGOULD, ARK.—The Crystal Light & Ice Company, which has been granted a 20-year franchise, contemplates improvements to its electric light plant, which will involve an expenditure of about $20,000.

CLOVERDALE, CAL.—The Board of Supervisors has granted a franchise to the Cloverdale Light & Power Company. The company proposes to distribute electricity for lamps and motors over the northern section of the county. Work on the plant will begin in the near future.

EUREKA, CAL.—The Electric Light Construction Company, of Eureka, Cal., is reported to have secured the contract to install an electric plant in the Clover Flat mine at Willow Creek.

EUREKA, CAL.—Notice of appropriation of 1500 cu. in. of water in Jacoby Creek has been filed by W. C. Elsemore, to be utilized for power and domestic purposes in the City of Eureka, Cal.

FRESNO, CAL.—The Fresno Traction Company has applied to the City Trustees for street railway franchises in this city. Two of the franchises are to replace franchises to be abandoned on present streets, and the third is a new one, which will connect Woodward's addition with the city and the projected line on J Street, making a loop around the western and southern end of the city.

LOS ANGELES, CAL.—The Los Angeles & Mt. Washington Railway Company, it is reported, contemplates the construction of a new power station after Jan. 1.

MERIDIAN, CAL.—It is reported that the Williams Alfalfa Mill Machinery Company is contemplating the erection of an alfalfa meal mill in Meridian, Cal. It is said that the plant will be equipped for electrical operation.

MODESTO, CAL.—The La Grange Light & Water Company has decided to make some improvements to its substation in Modesto. Work on the erection of its transmission line is being rushed to completion. John Coffee Hays is vice-president and manager of the company and V. H. Chrisman is construction engineer, both of Visalia, Cal.

OROVILLE, CAL.—The Board of Supervisors has passed the ordinance granting a franchise to the Sacramento Valley Power Company to furnish electricity in Oroville.

PASADENA, CAL.—The Edison Electric Company, of Los Angeles, has announced a new schedule of charges for electricity, as folows: To consumers using 2000 kw or over per month, 2¾ cents per kw-hour; 3¾ cents for over 1000 and less than 2000 kw per month; 4½ cents for over 500 and less than 1000 kw per month; 4¾ cents for over 100 and less than 500 kw per month, and 5 cents per kw for 100 kw or under. The city recently reduced the price of electricity supplied by the municipal electric plant to 3 cents per kw-hour to large consumers and 7 cents to small ones. When the city built the municipal plant the Edison company charged 12½ cents per kw-hour.

REDWOOD CITY, CAL.—It is reported that preliminary surveys are being made for an electric railway from Redwood City to Woodside, La Honda and Big Basin. A. H. Lohman, of San Francisco, Cal., is said to be interested in the project.

SANTA BARBARA, CAL.—Plans are being made to improve the old Merchants Mutual plant in Santa Barbara and bring it up to the standard of the plant now known as Edison No. 1.

SAN DIEGO, CAL.—A movement is on foot to replace the present arc lamps on Fifth Street between A and H streets with incandescent lamps placed on ornamental posts, and extend the system from Ash Street to the foot of Fifth Street.

SAN FRANCISCO, CAL.—Preparations are being made to commence work the first of the year on the construction of an electric railway from Oakland to Berkeley, Walnut Creek, Concord and Bay Point, 34 miles in length, for which surveys and final locations have been made. Electricity to operate the road will be purchased. The present plans call for the purchase of four cars and one electric locomotive. H. A. Mitchell, of San Francisco, Cal., is president.

BOULDER, COL.—The City Council is considering the question of utilizing the water power in connection with the city pipe line, which leads from the intake on the Boulder County ranch to this city, for which bonds to the amount of $40,000 were voted last spring. Surveys are being made and estimates are being prepared for the work.

DENVER, COL.—We are informed that there is no truth in the reports that the transmission line of the Central Colorado Power Company between the Shoshone tunnel and Denver, was badly damaged and would have to be rebuilt, as published in these columns Dec. 16. G. H. Walbridge, general manager of the company, states that the line has not been damaged further than the momentary swinging short circuits, resulting from the combined results of cold weather, heavy sleet and high winds, which occurred simultaneously on Argentine Pass and were easily remedied as soon as located.

DORCHESTER, COL.—An electric light and power plant is being installed for the United Colorado Mines Company, at Dorchester, Col. The equipment will include a 200-kw, three-phase, 2300 volt General Electric generator. The plant will be driven by a Pelton water wheel. Electricity will be transmitted from the power house to the mine, a distance of 2½ miles. About eight three-phase General Electric induction motors from 3 hp to 75 hp will be used in the concentrating mill, compressor house, etc. The company also furnishes electricity for lighting the mine and several buildings. The plant was installed by D. L. Solomonson, an electrical engineer, of Denver, Col.

LA SALLE, COL.—Preparations are being made for electrical service in La Salle, in anticipation of the extension of the transmission lines of the Home Electric Lighting Company, of Greeley, Col., which are already being rapidly constructed to Evans. The line will be operated at 6600 volts for the present, supplying both La Salle and Evans.

PUEBLO, COL.—The Pueblo & San Luis Railroad Power Company contemplates asking for a franchise to operate a street railway system on some of the principal streets in Pueblo.

PUEBLO, COL.—Mayor Fugard has sent an important communication to the City Council, recommending that the number of lamps be cut down from 350 to 150, as provided by contract, and that the money paid for the 200 lamps be used to install 500 gas arc lamps for street lighting. He also recommended that the city give serious consideration to the offer of the Pueblo & Suburban Traction & Lighting Company to furnish 100 lamps free for two years. The gas company offers at its own expense to install the gas lamps and supply the same number of lamps at nearly one-half the price demanded by the electric company, which would result in a saving of $15,000 per year. The city now pays $87.50 per lamp per year. The entire matter has been referred to a committee.

HARTFORD, CONN.—The capital stock of the Manila Electric Railroad & Lighting Corporation of Hartford has increased its capital stock from $6,000,000 to $8,000,000.

SAYBROOK, CONN.—The power house of the Shore Line Electric Railway Company is nearly completed, the equipment of which will include two 1500-kw, three-phase, 25-cycle, 11,000-volt Curtis steam turbo-generators. Provision has been made for the installation of two additional units of the same size in the future. Electricity generated at this station will be transmitted to two substations, one located in the car barn at Saybrook, and the other in Guilford, each of which will be equipped with three 200-kw, 600-1200-volt rotary converters. The cars will enter New Haven over the tracks of the Connecticut Company.

NEW CASTLE, DEL.—The American Power Company has applied to the levy court for permission to erect transmission lines from New Castle to Delaware City for the purpose of furnishing electricity for lamps. The levy court adopted a resolution granting the franchise, but included a clause requiring the company to provide 10 incandescent lamps of 32 cp per mile along the road to be kept in service every night. T. Bayard Heinsel is counsel for the company.

PENSACOLA, FLA.—The Dallas Land Company has applied to the City Council for a franchise for an extension of the North Hill street car line. The company proposes to build the railway and to pay the cost of operation until the line is on a paying basis, at which time the Pensacola Electric Company agrees to take it over.

DUBLIN, GA.—The City Council has granted the Dublin Street Railway Company a franchise, subject to certain conditions. It is said all necessary capital will be raised in Dublin.

GREENVILLE, GA.—Bids will be received by the Mayor and Council of Greenville, Ga., until Jan. 4 for the purchase of bonds to the amount of $30,000, of which the proceeds of $8,000 will be used for the construction of an electric light plant and $16,000 for water works and the remainder for sewer system. C. R. Williams is Mayor.

LA FAYETTE, GA.—W. A. Wardlaw, city recorder, writes that at an election to be held March 15, 1910, the proposition to issue bonds for the construction of an electric light plant will be voted on.

MACON, GA.—The Macon Railway & Light Company, it is reported, proposes to make improvements to its system during the coming year, including the completion of its railway out the Columbus road; extending the South Macon line one mile, and the extension of the East Macon line a distance of one mile.

STATESBORO, GA.—We are informed that plans are being considered for the installation of another dynamo and engine in the municipal electric light plant next season. H. B. Davis is manager.

TALLULAH FALLS, GA.—Louis Magid, of Tallulah Falls, is interested in a project to construct an electric railway from this town to his cement works, four miles distant.

WAYCROSS, GA.—A deposit of $10,000 has been made by Burdette Loomis, Jr., of Hartford, Conn., with the City Council to guarantee the carrying out of the franchise for the construction of an electric lighting plant in Waycross, work on which is to start within three months and is to be completed within one year. The company proposes to reduce the cost of electricity for lighting and gas about 35 per cent. A rate of $1 per 1000 cu. ft. for gas is promised.

KOOSKIA, IDAHO.—It is reported that Bates & Rogers, of Spokane, Wash., have secured the contract for construction of the concrete dam across the middle fork of the Clearwater River at Kooskia. The dam will furnish power to operate a plant which will furnish power in connection with large industrial improvement to be made in Kooskia by Chicago capitalists. The project will include the dam, power plant, cement factory and saw mill, calling for an expenditure of $1,500,000. Plans are also being considered for a large pulp mill. W. J. Bell, of Denver, Col., is said to be interested in the enterprise.

CHICAGO, ILL.—The Independent telephone companies which propose to establish a telephone service in Chicago have pledged $50,000 for the purpose. The stock of the reorganized body will be sold to the members of the International Independent Telephone Association, either to companies or individual stockholders in each company, and from this a fund of $1,000,000 will be obtained to finance the new service for Chicago alone. Contracts have been entered into for the construction of the plant and a guarantee has been given that the service will be in operation during the coming year. The system will connect 250,000 telephones within a radius of 500 miles of Chicago. The reorganization committee includes H. D. Critchfield, of Chicago, Ill.; Frank H. Woods, of Lincoln, Neb.; Theodore Gary, of Macon, Mo.; Mansford Savage, of Champaign, Ill., and Joseph B. Ware, of Chicago, Ill.

EVANSTON, ILL.—The City Council has renewed the contract for street lighting with the North Shore Electric Company for a period of ten years. The contract calls for alternating-current, 432-watt enclosed arc lamps, of which 375 will be installed at first; the number will be increased later. Under the terms of the contract the city is to pay $10 each per year more for lamps supplied from the underground service than for those furnished on overhead circuits. This proposition was accepted after a careful consideration on part of the city authorities, who agreed that it was a fair arrangement.

ROCK ISLAND, ILL.—The Central Union Telephone Company has submitted an ordinance to the City Council asking for a 25-year franchise and providing for the rebuilding of its present plant, including the placing of all its wires underground from Thirteenth to Twenty-fourth streets and First to Seventh avenues. If the franchise is granted the company proposes to expend about $150,000.

BRAZIL, IND.—Application has been made to the Commissioners of Clay County by the Terre Haute, Indianapolis & Eastern Traction Company for a franchise to erect a transmission line through Harrison and Lewis townships. It is understood that the proposed line will furnish electricity to smaller towns in the southern part of the county for lamps.

DELPHI, IND.—The Logansport, Frankfort & Indianapolis Traction Company, of Logansport, has applied to the County Commissioners for a franchise to operate its proposed electric railway over the Michigan road in Washington, Burlington and Carrollton townships. A. A. Newer, of Logansport, Ind., is interested in the project.

ELKHART, IND.—A company to be known as the Elkhart Gas Power Company is being formed to compete with the Indiana & Michigan Electric Company. The organization of the company, it is stated, is a result of the recent increase in rates of the Indiana & Michigan Electric Company, to go into effect after Jan. 1. A large number of manufacturers are back of the project, and it is proposed to equip a plant to supply electricity for power exclusively and later to branch out when conditions warrant it. The proposed plant will be equipped with gasoline engines. C. E. Fry, of the Elkhart Bristol Board Mill Company, has charge of organizing the company.

EVANSVILLE, IND.—Charles A. Gillham, secretary of the Evansville Public Service Company, announces that more than one-half of the $1,000,000 necessary to build its proposed plant has been pledged and that contracts for construction of the plant will soon be let.

FORT WAYNE, IND.—At the request of the Board of Public Works an ordinance has been introduced in the City Council appropriating $50,000 for the purpose of installing an additional 1200-kw turbo-generator unit in the municipal electric light plant.

LOGANSPORT, IND.—At a meeting of the stockholders of the Logansport & Frankfort Traction Company, held recently, arrangements were made for the reorganization of the company, by which the Cleveland Construction Company was taken into the organization. It is said that work will commence on the construction of the road within 90 days. The people of Clinton, Carroll and Cass counties have voted substantial subsidies in aid of the project.

OAKLAND CITY, IND.—The Oakland City Light & Power Company has increased its capital stock by $15,000, the proceeds to be used for improvements, extensions, etc. C. W. McLaughlin is president, and Henry Christmas, secretary.

RICHMOND, IND.—It is reported that the new administration which will take control Jan. 1 will purchase the local water-works system and operate it in connection with the municipal electric plant. It is proposed to equip the water plant to be operated by electricity supplied from the municipal plant.

SEYMOUR, IND.—The temporary injunction restraining the City Council from entering into a contract for lighting the city with the Indiana Public Utilities Company has been dismissed by agreement, the matter to be left to the new Council, which takes control Jan. 1. Three companies are bidding for the contract.

BOONE, IA.—Announcement has been made that Messrs. Hughes, McBride and Stevenson, of the Iowa Light & Traction Company, who were granted a franchise in August to furnish electrical service and operate a heating plant in this city, have broken off negotiations for the purchase of the Reynolds property in Boone, and the franchises will be turned back to the city. It is said that Mr. Reynolds will rebuild and improve the properties and ask for a new franchise at the expiration of the present one in 1913.

FORT DODGE, IA.—L. S. Cass, president of the Waterloo, Cedar Falls & Northern Railway Company, of Waterloo, Ia., is reported to be interested in a project to construct an electric railway to connect Mason City, Waterloo and Fort Dodge.

POSTVILLE, IA.—The transmission line of the Upper Iowa Power Company of Decorah, Ia., to extend from its plant at Lake Oneota to Postville, is nearly completed. The company expects soon to be ready to furnish electricity for lamps and motors in Postville.

ALTAMONT, KAN.—The Kansas Union Traction Company is planning to construct an electric railway from Parsons to Coffeyville, Columbus, Oswego, Altamont, Mound Valley and Cherryvale, 90 miles in length. The power plant and repair shops will be located in Altamont. The company proposes to furnish electricity for lamps, heat and motors. It is expected to begin work about the first of the year. William J. Jones, of Altamont, Kan., is president of the company.

ERIE, KAN.—J. C. Denious, city clerk, writes that owing to delay on account of making tests of water supply, bids for construction of electric light plant and water works system will not be opened until Jan. 15 or 20, instead of Dec. 15 as stated in these columns Nov. 25. Burns & McDonnell, Scarrett Building, Kansas City, Mo., are engineers.

VINE GROVE, KY.—Plans are being considered to organize a company to establish an electric light plant in Vine Grove. C. Bewley and Richard Wilkerson are interested in the project.

CROWLEY, LA.—The City Council has adopted a resolution providing for submitting the proposition to issue bonds for the construction of a municipal electric light plant and water works system to a vote of the people.

MANDEVILLE, LA.—It is reported that work will soon commence on the construction of the proposed light and ice plant of the Mandeville Electric Light & Ice Company.

PLAQUEMINE, LA.—R. E. Dunlap, representing the electric light company, has notified the City Council that it proposes to rebuild the electric light plant at once. He also asked for a franchise for a new water works system, agreeing to furnish water to the town at 15 cents per 1000 gal., the town to take not less than 3,000,000 gal, per month. The plant and equipment was destroyed by fire Nov. 1. The franchise and property was purchased at auction by J. H. Pugh for $8,500.

FREEPORT, MAINE.—A. W. Shaw Company has entered into a contract with the electric light company at Yarmouth to furnish electricity to operate part of its factory.

PEMBROKE, MAINE.—The Pennamaquan Light & Power Company has applied for a franchise to extend its transmission lines from Pembroke to West Pembroke. Later, it is said, the system will be extended to other nearby towns.

PORTLAND, MAINE.—The Portland Power & Development Company has purchased the property known as the Damariscotta plant of the Centrifugal Leather Board Company. It is said the company will develop the water power to generate electricity for transmission to Boothbay, Maine.

PORTLAND, MAINE.—Bids will be received at the office of the constructing quartermaster, 655 Congress Street, Portland, Maine, until Jan. 20, for the construction and remodeling of an electric lighting system at Fort William, Maine, plans and specifications of which are on file in the office of the chief quartermaster, Department of the East, Governor's Island, N. Y., and the office of the constructing quartermaster, 263 Summer Street, Boston, Mass. Plans, specifications, blank forms for proposals, etc., furnished upon application. A deposit will be required for plans to insure safe return of the same. Captain C. F. Humphrey, Jr., is constructing quartermaster.

ELKTON, MD.—The dam across the Big Elk Creek, owned by the Cecil Heat, Light & Power Company, was recently destroyed by the freshet, putting the hydroelectric plant of the company out of business. The dam was built about two years ago.

HAVERHILL, MASS.—The City Council is considering the question of purchasing the gas and electric light plants and systems in Haverhill. The gas plant is owned by the Haverhill Gas Company and the electric plant by the Haverhill Electric Company. The project will involve an expenditure of $1,500,000.

LYNFIELD CENTRE, MASS.—Buildings are being erected by the Saugus River Peat Company in Lynnfield Centre, which will be used as experimental stations by the company for the purpose of reducing the cost of generating electricity. The purpose of the company is to use certain fuels, among them peat, and if successful other plants will be established in various parts of the country.

REVERE, MASS.—The Suburban Gas & Electric Company, of Revere and Winthrop, has applied to the State Gas and Electric Light Commissioners for permission to issue additional capital stock to the amount of $165,000, the proceeds to be used to pay off a floating debt and to meet the cost of permanent improvements.

SOUTH WALPOLE, MASS.—The Massachusetts Railroad Commissioners have approved of the issue of the Norfolk & Bristol Street Railway Company's $50,000 5 per cent equipment bonds.

WORCESTER, MASS.—The transforming station of the Connecticut River Transmission Company in Greendale, Mass., was destroyed by fire Dec. 12, causing a loss of about $25,000. It is said the plant will be rebuilt at once and new machinery installed and that the company will be delayed but a short time in furnishing electricity in Worcester..

ATHENS, MICH.—The local electric light plant, owned by the Athens Electric & Power Company, was destroyed by fire Dec. 12, causing a loss of about $5,000.

CHESANING, MICH.—The Town Council is contemplating the erection of a hydroelectric plant on the Shiwassee River to furnish electricity to operate the municipal electric light plant and water works system.

SAGINAW, MICH.—Preparations are being made by the Saginaw & Flint Railway Company to begin work in the near future on its proposed extension to Vassar. Charles Arnold is superintendent.

SAGINAW, MICH.—The City Council and the Chippewa River Power Company have come to terms as to the rates to be charged in this city for electricity. The Council has granted the company a franchise. The price agreed upon is four cents per kw-hour for the first 75 kw and 2½ cents for all in excess of that amount. W. F. Davidson, of Port Huron, Mich., is vice-president of the company.

TRAVERSE CITY, MICH.—L. K. Gibbs is reported to be interested in a project to build a street railway in Traverse City, work on which will commence as soon as a franchise is obtained. It is said that surveys have already been made and rights of way secured.

ANOKA, MINN.—The Great Northern Development Company, which proposes to construct a large dam at Anoka in connection with a hydroelectric development has purchased 5½ acres of land as part of the site for its proposed plant.

FERGUS FALLS, MINN.—The Otter Tail Power Company, of Fergus Falls, Minn., is reported to have secured contracts to supply electricity for lamps and motors in Breckenridge and Wahpeton, 25 miles distant.

MINNEAPOLIS, MINN.—The City Councils of Minneapolis and St. Paul, Minn., have adopted resolutions pledging the payment of the $300,000 necessary for the construction of an additional 15 ft. on the lower Government dam just above the soldiers' home, the amount to be shared equally between the two cities. It is proposed to raise the dam from 15 to 30 ft. It is estimated by the Government engineers that 15,000 hp can be generated, the power to be disposed of between the two cities, the Government reserving only 1000 hp to supply Fort Snelling and the Federal buildings in St. Paul. As yet no plans have been made for distributing or utilizing the power.

MIZPAH, MINN.—The local electric light plant owned by W. A. Potter has been destroyed by fire, causing a loss of about $4,000.

ST. PAUL, MINN.—Bids will be received by the Minnesota State Board of Control, State Capitol, St. Paul, Minn., until Feb. 7, 1910, for the erection and completion of new buildings and improvements for the Minnesota State Prison, at Oak Park, Stillwater, Minn., in accordance with drawings and specifications prepared by Clarence H. Johnston, architect, 715 Manhattan Building, St. Paul, Minn., and Charles L. Pillsbury, consulting engineer, 805 Metropolitan Life Building, Minneapolis, Minn. Proposals will be received: First—for the entire work; Second—For parts of the work as follows: "A," for the entire mechanical equipment, including water, sewer and electric work, power plant, heating, ventilating and plumbing work; "B," for inclosing walls, guard house towers and entrance gates; "C," for power house building, factory and warehouse buildings; "D," balance of the work. Proposals must be prepared and submitted only on forms furnished by the architect and consulting engineer. No other forms will be considered. Copies of above plans and specifications may be seen at the Builders' Exchange, at St. Paul, Minn.; Builders' Exchange, Minneapolis, Minn.; Builders' Exchange, Duluth, Minn.; at the office of the State Board of Control, State Capitol Building, St. Paul, Minn.; Warden's office, State Prison, Stillwater, Minn.; Builders' Exchange, Chicago, Ill.; Builders' Exchange, Omaha, Neb.; Builders' Exchange, Kansas City, Mo., and at the Building Trades Employers' Association, New York City, N. Y. Extra copies of drawings and specifications may be obtained on application at the office of the architect or the consulting engineer on payment of cost of duplication as follows: For the entire work, $648; for mechanical equipment, $280; for inclosing walls, guard house towers and entrance gates, $56; for power plant building, factory and warehouse buildings, $112, and for remainder of work, $200, which will be returned to the bidders on return of the plans in good condition, less the amount which will be retained to cover the cost of duplicating the plans. Charles Halvorson is chairman of State Board of Control.

RULEVILLE, MISS.—The electric plant of the Ruleville Light, Ice & Coal Company was entirely destroyed by fire Dec. 13, causing a loss of about $9,000.

KANSAS CITY, MO.—At an election held Dec. 16 the proposition to grant the Metropolitan Street Railway a 42-year franchise was defeated. The company has a franchise which still has 16 years to run, but the company proposed to have it extended to 42 years, offering in return six tickets for a quarter, sold on the cars, and 25 tickets for a dollar, sold in drug stores in the two Kansas Cities.

BILLINGS, MONT.—The transmission lines of the Madison River Power Company, of Butte, Mont., have been extended as far as Big Timber, and plans for the extension of the line to Laurel, where they will connect with the lines of the Billings & Eastern Montana Company are now under way. It is expected to have the system extended to Billings by next spring.

BOZEMAN, MONT.—Thaddeus S. Lane and associates, acting for the Interstate Consolidated Telephone Company have purchased from J. S. Haley, of Bozeman, Mont., all the independent telephone lines with terminals at Logan and lines extending from Livingston to Gardiner, Bozeman to Salesville and Bozeman to Chimney Rock.

HAMILTON, MONT.—Preparations are being made by the Hamilton Light & Water Company for the construction of a hydroelectric plant to furnish electricity in Hamilton. Contracts for the work will be awarded as soon as plans and specifications are completed. The plant will be located on Sleeping Child Creek at a point about six miles from this city. The cost of the plant is estimated at about $150,000 and from 1500 to 2000 hp will be developed. W. O. Fisk is interested in the company.

LIBBY, MONT.—The Civic and Booster Club is agitating the question of establishing a municipal telephone system in Libby.

HASTINGS, NEB.—Improvements are being made to the municipal electric light plant, which include the installation of a new 500-kw turbo-generator set, cooling tower, condenser, etc., at a cost of about $18,000 A. T. Bratton is city clerk.

OMAHA, NEB.—Plans are being made for extensive improvements to the Nebraska Telephone Company's plant in Omaha, which will involve an expenditure of about $200,000. Orders have been placed for a switchboard capable of handling 10,000 telephones.

WEST STEWARTSON, N. H.—A new boiler is being installed in the plant of the William F. Allen Electric Company.

ATLANTIC CITY, N. J.—The Reading Railway Company has awarded a contract to the Federal Signal Company, of New York, N. Y., for the construction of a mechanical interlocking signal plant at Atlantic City, N. J.

AZTEC, N. M.—It is expected that electrical service will be furnished in Aztec by Jan. 1. The service will be supplied from the large hydroelectric plant on the La Plata River. Aztec and Denver capitalists are building an irrigation system on the San Juan River, which will cover several thousand acres of fine fruit land. The contract for the construction of the Illinois ditch, which will reclaim 12,000 acres west of Aztec, will be let by the first of the year. By April 1 the La Plata Land & Irrigation Company will finish the first of a series of reservoirs which will reclaim 10,000 acres.

BROOKLYN, N. Y.—The Public Service Commission has given the Kings County Electric Light & Power Company permission to withdraw its petition for permission to issue $5,000,000 in convertible bonds and to submit an amended one, in which the company will ask for permission to issue $2,500,000 in construction bonds and $2,500,000 of reimbursement bonds. It is understood that the commission will approve the issue of the construction bonds, but it is questioned as to whether it has the right to approve an issue of bonds to reimburse the company for work that has already been done.

BUFFALO, N. Y.—County Engineer Diehl in a communication to the Board of County Supervisors recommends that a new boiler house for the penitentiary be built in a more advantageous location and at least three 150-hp boilers and an additional 75-hp engine be provided. The cost of the plant is estimated at from $35,000 to $40,000.

JAMAICA, N. Y.—The New York & North Shore Railroad Company is acquiring the necessary right-of-way for laying a second track between Jamaica and Flushing. Work, it is said, will begin on construction of the track in the spring.

LYONS, N. Y.—The Wayne County Electric Company, which was recently purchased by William T. Morris, of Penn Yan, will be taken over by the United States & Gas & Electric Company, having headquarters at Penn Yan. The company will be operated under its own name and as a separate company. Only temporary improvements will be made at present. The new owners propose to rebuild entirely and remodel the plant in the spring. The new officers of the company are: William T. Morris, of Penn Yan, president and treasurer, and Morris Tracy, of Penn Yan, secretary.

NEW YORK, N. Y.—Judge Lacombe, of the United States Circuit Court, has authorized the receivers of the Metropolitan Street Railway Company to construct a double-track electric railway on Canal Street between Centre Street and the Bowery. This permit will give the company access to the new Manhattan Bridge.

ROUND LAKE, N. Y.—The question of establishing an electric light plant in Round Lake is under consideration.

APEX, N. C.—The city is reported to have awarded a contract to the Carolina Electrical Company, of Raleigh, N. C., for the installation of an electric lighting system, the contract to include power equipment, arc and tungsten street lamps, incandescent lamps, transformers, meters and inside wiring materials.

HICKORY, N. C.—Bonds to the amount of $850,000 are being offered for sale by Col. M. E. Thornton, president of the Thornton Light & Power Company and the Hickory Water Power Company, the proceeds to be used for the development of a hydroelectric project by the Hickory Water Power Company, by which it is estimated that 9000 hp can be developed.

MONTEZUMA, N. C.—The Montezuma Bobbin Company is reported to be in the market for electrical equipment.

REIDSVILLE, N. C.—The construction of the new power house for the municipal electric light plant is under way, and three boilers with a rating of 375 hp will be installed.

SALISBURY, N. C.—Extensive telephone connections are being built by the independent telephone interests from Salisbury to Lexington, Concord and other towns. The telephone company is endeavoring to secure a franchise in Spencer.

GRAND FORKS, N. D.—The City Council is reported to have decided to proceed with the installation of complete electrical equipment at the municipal electric plant for the purpose of furnishing electricity for street lighting and commercial service.

CANAL DOVER, OHIO.—The City Council is reported to be considering an additional bond issue for $15,000, the proceeds to be used for the purchase of more machinery for the municipal electric light plant.

CLEVELAND, OHIO.—Plans are being prepared by the George S. Rider Company for the construction of a large power plant for the Peerless Motor Company early next spring. The plant will have an output of from 2000 to 3000 kw. It is said that contracts will be placed for boilers, engines, generators, etc., as soon as plans are completed.

MASSILLON, OHIO.—Plans are being considered by the Massillon Electric & Gas Company for the reconstruction of its entire plant, work on which will begin soon after the first of the year. The company proposes to increase the output of its plant so as to be able to supply electricity for motors. Several of the local companies are contemplating the installation of electrical power to operate their plants. R. R. Choate is general manager.

MOUNT VERNON, OHIO.—The new owners of the Mount Vernon Railway & Light Company, it is said, will soon begin work on improvements to the property, which will include the construction of a new power house, the purchase of new cars and other improvements. The property has been in the receivers' hands for many months and was purchased some time ago by N. C. L. Kackelmacher, of Columbus, Ohio, and New York capitalists.

NAVARRE, OHIO.—The Massillon Electric & Gas Company has applied to the Town Council for a franchise to install and operate an electric system in Navarre. The company proposes to supply electricity for street and residential lighting and power purposes. The Navarre Light Company now has the franchise.

NILES, OHIO.—The Hydro-Electric & Gas Company, of Warren, Ohio, which has a contract to furnish the municipal electric light plant with electricity, will erect an auxiliary plant near the present municipal power plant to provide additional power to meet the increased demand for electrical service. Superintendent Holloway has been instructed to place meters on commercial, light and street circuits, also on the line for the air compresssors at the city lighting plant.

WILMINGTON, OHIO.—A company has been incorporated in Wilmington by A. J. Bailey, J. R. Clevenger, M. R. Denver, R. L. Owens and J. W. Lawhead for the purpose of constructing an electric light and power plant in Wilmington. The company proposes to furnish electricity to the Champion Bridge Works, the Augur Bit Works and other manufacturing interests in which the incorporators are interested.

WOOSTER, OHIO.—The capital stock of the Wayne County Telephone Company has been increased from $10,000 to $100,000.

ZANESVILLE, OHIO.—The Zanesville & Meigs Valley Company, it is reported, will on May 1 place the contract for the construction of its proposed railway down the valley from Zanesville to Beverly. In addition to the route first proposed the company will build a branch line to McConnellsville, eight miles long. The company also proposes to construct a 24-mile extension from Beverly to Parkersburg later.

FORT GIBSON, OKLA.—It is reported that surveys are being made by Charles B. Haggerty, engineer, on the Grand River, near Fort Gibson, for the H. M. Byllesby Company, of Chicago, Ill., which is contemplating the construction of a large hydroelectric power plant to generate electricity for transmission to a number of cities in Oklahoma.

MUSKOGEE, OKLA.—The isolated electric plant owned by G. W. Barnes, of Muskogee, was destroyed by fire on Dec. 12.

OKLAHOMA CITY, OKLA.—J. B. Taylor & Company, of New York, N. Y., are reported to have secured the contract for the engineering work in connection with the construction of the electric railways between Oklahoma City and Shawnee, Okla.

RALSTON, OKLA.—All bids received Dec. 15 for material and construction of a complete electric light plant and water-works system for Ralston were rejected, and new bids will be received Jan. 17. The work will include well, building, triplex power pumps, alternating-current generator, oil engine, steel tank and tower, poles, wire, cast-iron pipe, etc. Bids will also be received at the same time for the purchase of $25,000 in bonds. M. A. Earl & Company, of Muskogee, Okla., are engineers. T. E. Bryant is city clerk.

ASTORIA, ORE.—The Astoria, Seaside & Tillamook Railway Company is advertising for bids for the construction of its proposed railway from Smith's Point to Young's Bay Bridge. The company proposes to construct an electric railway from Astoria, Seaside and Tillamook, for which rights-of-way have been secured as far as Seaside, and franchises have been secured over the streets of Astoria and Seaside. The plans also provide for a branch line from Warrenton, Hammond and Fort Stevens. F. L. Evans is president.

KLAMATH FALLS, ORE.—Plans are being considered for equipping the local street car system, to be operated by electricity. It is stated that work will commence early in the spring.

MARSHFIELD, ORE.—At a special election held recently the citizens voted to grant a franchise to J. M. Blake to construct and operate an electric railway in Marshfield. The proposed railway will be about five miles long.

OREGON CITY, ORE.—It is reported that F. M. Smith, who is promoting the proposed Oregon City, Beaver Creek & Molala Railway, has secured stock subscriptions amounting to $100,000. The railway will extend from Oregon City to Silverton. It is said that work will commence at once on construction of the road.

PENDLETON, ORE.—Arrangements have been made between a committee of Pendleton business men and the representative of the Washington-Oregon Traction Company for the construction of an electric railway in Pendleton. Under the agreement the residents of Pendleton are to purchase $50,000 in capital stock of the company, in return for which the company agrees to build six miles of street railway in Pendleton and the suburbs within one year, the cars to be operated by gasoline motors to begin with, but to be equipped for electrical operation within two years. The company secured a franchise in this city 14 months ago and must build at least three miles of line in Pendleton within the next four months to comply with the franchise. The Washington-Oregon Traction Company proposes to develop 800 hp on the south fork of the Walla Walla River.

PORTLAND, ORE.—Bids will be received by the City of Portland, Ore., until Jan. 3, 1910, for the construction of a garbage incinerator. Bidders are also asked to submit estimates on the cost of the installation of a 500-hp steam generating plant to be operated in connection with the incinerator. Dr. C. H. Wheeler is city health officer.

PHILADELPHIA, PA.—The Pennsylvania Equipment Company, West End Trust Building, Broad & South Penn. Square, Philadelphia, Pa., is reported to be in the market for a 300-kw, alternating-current, three-phase, 60-cycle generator, with engine of sufficient rating to drive the same.

PITTSBURGH, PA.—The contract for installing an electric lighting plant for the Mission Street pumping station was awarded to the Dravo-Doyle Company, of Pittsburgh, Pa., for $2,300.

WILKES-BARRE, PA.—The Wilkes-Barre Street Railway Company, recently incorporated, has secured a lease of the Wilkes-Barre & Wyoming Valley Traction Company for a long term of years. By this deal the local interests again secure control of the road.

CANTON, S. D.—Owing to the City Council and the Canton General Electric Company being unable to come to an agreement in regard to the renewal of the street lighting contract the streets of the city have been in darkness since Dec. 4. The company, it is said, refuses to enter into a short term contract with the city.

DUNSEITH, S. D.—It is reported that John Gottbrecht contemplates the construction of an electric light and water power plant at Mineral Springs in the spring.

FLANDREAU, S. D.—The question of establishing an electric light plant in Flandreau is under consideration.

MEMPHIS, TENN.—Bids will be received until Dec. 27 by the Board of Education, Memphis, Tenn., for heating and ventilating, automatic temperature regulation, power plant motors and switchboard, electric wiring and conduits to be installed in the high school building now under construction. Plans and specifications may be secured from B. C. Alsup & Company, architects, Memphis, Tenn., or of J. H. Brady, designing engineer, Kansas City, Mo. Bidders will be required to make a deposit of $25 for plans. Proposals must be made on forms furnished by the designing engineer.

CALVERT, TEX.—The Calvert Water, Ice & Electric Light Company has engaged Louis Block, 45 East Forty-second Street, New York, N. Y., to take charge of the construction of its plant.

GAINESVILLE, TEX.—It is reported that the Gainesville Electric Company contemplates improvements to its plant, which will involve an expenditure of about $50,000.

HOUSTON, TEX.—Arrangements are being made by the Houston Lighting & Power Company for placing its wires underground within the fire limits in the City of Houston, work on which will begin about Jan. 1. About three years will be required to complete the work, which will cost approximately $300,000. Ford, Bacon & Davis, of New York, N. Y., have charge of the work.

McKINNEY, TEX.—The Lone Star Cotton Mill Company is planning to construct a 5000-spindle mill, which will be equipped with sprinkler system for fire protection, producer-gas plant, dynamo, motors, etc. It is said that bids for construction will be received about Jan. 1. The company is capitalized at $200,000. J. Perry is president.

MINERAL WELLS, TEX.—The contract for the construction of an interurban railway from Fort Worth over the northern route to Mineral Wells has been signed by the interurban committee of Mineral Wells and Judge James Watkins and Paul Hurley, of Fort Worth, promoters of the Mineral Wells & Northwestern Railway Company, which was recently incorporated to construct the railway.

MOBEETIE, TEX.—The J. B. Taylor Company, 30 Church Street, New York, N. Y., is reported to have secured the contract for 125 miles of engineering work for the Central Construction Company, of Mobeetie, Tex.

COALVILLE, UTAH.—Application has been filed with the state engineer by Moses W. Taylor, of Coalville, for permission to appropriate 20 cu. ft. per second of water from Chalk Creek, Summit County, to be utilized to generate electricity for transmission to various towns in Utah. The water will be carried through a ditch 18,000 ft. in length and 500 hp will be developed

FREMONT, UTAH.—The Utah Gold & Copper Mines Company has filed an application with the state engineer for water rights on the south fork of Atchinson Creek, to be utilized for the development of power, to be used for motive power in its mines at Fremont.

MARYSVILLE, UTAH.—Application has been made to the state engineer by Thomas Ferguson, of Salt Lake City, for appropriation of 15 second ft. of water from Pine Creek in Plute County, to be utilized to generate electricity for distribution in Marysville.

RICHFIELD, UTAH.—The Belknap Company is reported to have engaged J. Jensen as consulting engineer in connection with the installation of its proposed electric plant.

SALT LAKE CITY, UTAH.—Application has been made to Caleb Tanner, state engineer, by L. B. McCornick for 15 cu. ft. of water from Hard Scrabble Creek, Morgan County, to be utilized to generate electricity for lighting purposes. The application specifies a dam and a channel 6600 ft. in length, the water wheels to operate under a head of 105 ft., developing 140 hp.

LYNCHBURG, VA.—The Roanoke Electric Light & Power Company has secured a large tract of land and water rights along the Staunton River in the vicinity of the town of Brookneal, where it proposes to erect a large hydroelectric power plant. It is estimated that 5000 hp can be developed, which will be transmitted to Lynchburg and other places, to be utilized for lamps and motors. The company is capitalized at $1,000,000. Judge E. D. Newman, of Woodstock, Va., is president, and L. T. Stoneberger is secretary and treasurer of the company.

RICHMOND, VA.—Plans for the transmission lines for the municipal electric light plant have been approved, and the committee on electricity has been authorized to advertise for bids for the transmission system in connection with the plant as soon as funds are available. E. W. Trafford is consulting engineer.

STAUNTON, VA.—The Trustees of the Virginia School for Deaf and Blind have decided to petition the Legislature for an appropriation to install an electric light plant at the school to cost $10,000.

GRANITE FALLS, WASH.—The Granite Falls Electric Company has filed a petition with the Board of County Commissioners of Snohomish County asking for a franchise to erect transmission lines over the roads and highways of the county for the transmission of electricity for all purposes, also for a pipe line for water to be supplied for both public and private purposes.

MONTESANO, WASH.—The County Commissioners have granted Eldredge Wheeler a 50-year franchise to construct an interurban railway over the county roads. The franchise calls for the construction of a railway from Moclips on the sea beach to Gate City.

SEATTLE, WASH.—The Seattle Electric Company has been granted two franchises to construct new street car lines on Sixth Avenue Northwest and on Fourteenth Avenue.

SPOKANE, WASH.—The output of the Nine-Mile power plant on the Spokane River, located nine miles below Spokane, is to be increased from 10,000 hp to 20,000 hp. Contracts for machinery amounting to $110,000 have been awarded to the Westinghouse Electric & Manufacturing Company. The plant furnishes electricity for operating the city and interurban systems of the Spokane & Inland Empire Railroad Company.

YACOLT, WASH.—The City Council has granted J. M. McIntire and Edward McIntosh a franchise to furnish electricity for lamps and motors in Yacolt. Under the terms of the franchise service is to be established in the city within 60 days from the acceptance of the franchise. A steam plant will be installed at first. It is proposed to utilize the water power at Twin Falls on Cedar Creek, where it is estimated that from 1000 to 1500 hp can be developed. It is expected to have the hydroelectric plant in operation within one year.

BERKLEY SPRINGS, W. VA.—The Capacon Power Company has secured a site adjoining Berkley Springs on which they will erect a plant at a cost of about $100,000. F. R. Reed, of Berkley Springs, is president, treasurer and general manager, and J. Hammond Siler is attorney.

MILLVILLE, W. VA.—P. O. Keilholtz, 615 Continental Building, Baltimore, Md., consulting engineer, has been engaged by the Winchester & Washington Railway, of Winchester, Va., to prepare plans and superintend the construction of its steam plant at Millville, which will be used as an auxiliary to its hydroelectric power plant. It is proposed to install a 2200-volt, three-phase, 60-cycle plant with an output of 1500 kw to furnish electricity for light and power purposes; also for distribution through Jefferson and Berkeley counties in West Virginia, and Clarke and Frederick counties in Virginia.

WILLIAMSON, W. VA.—Application has been made by Captain E. L. Bailey to the City Council for a franchise to install and operate an electric light and power plant at his mine, and also to furnish electrical service in this city. Mr. Bailey now secures electricity from the Williamson Light & Ice Company.

CHIPPEWA FALLS, WIS.—C. R. Brant, of Madison, Wis., and his associates are reported to be interested in a project to construct an electric railway to La Crosse via Galesville.

LA CROSSE, WIS.—The Common Council has granted the La Crosse & Winona Traction Company a 50-year franchise in La Crosse. It is expected to have the railway completed into Galesville within two years, and it will ultimately be extended to Minneapolis and St. Paul.

MADISON, WIS.—The City Council has ordered the removal of poles and wires from several of the city streets, giving the companies until Aug. 1, 1910, to do the work. The Council has instructed the Southern Wisconsin Traction Company to replace the present wooden poles with iron trolley poles on State and University streets, a distance of 12 blocks, the work to be completed within six months.

STOUGHTON, WIS.—The new $15,000 power house of the Mandt Wagon Company is almost completed. The equipment will cost about $10,000 and will include a 360-hp engine and three large generators. Five large boilers with a total rating of 550 hp will also be installed.

CALGARY, ALTA., CAN.—Plans are being considered for making an extension of about 12 miles to the Calgary street railway system during 1910. Thomas H. McCauley is general manager.

PRINCE RUPERT, B. C., CAN.—The electric light plant and saw mill at Seal Harbor, owned and operated by the British Columbia Tie Timber Company, was entirely destroyed by fire on Dec. 4, causing a loss of about $60,000.

HAMILTON, ONT., CAN.—The fire and water committee is considering the question of purchasing transformers to use at the Beach pumping station in connection with the service furnished by the Hydro-Electric Power Commission. The Canadian Westinghouse Company was awarded the contracts for the motors last year, to be used for the Cataract Power Company service. Owing to the decision to use Niagara power it is necessary to use transformers with the motors on account of the high voltage.

TORONTO, ONT., CAN.—The municipalties of Milton, Toronto Township, Port Credit, Mimico and Brampton, all in Ontario, have made application to the Hydro-Electric Power Commission for electricity. If the service is furnished another transformer station will be established.

SASKATOON, SASK., CAN.—The lighting committee has adopted a new schedule of rates for electricity for lighting purposes as follows: From 1 to 100 kw, 11 cents per kw-hour; from 101 to 150 kw, 9 cents; from 151 kw and all above that amount 8 cents per kw-hour, with a 10 per cent discount if paid within 10 days.

SASKATOON, SASK., CAN.—The Saskatchewan Power Company has submitted a proposition to the city offering to supply the city with power at less than $30 per hp per year with a 24-hour service.

New Industrial Companies.

THE ALLEN ENGINEERING COMPANY, of Memphis, Tenn., with a capital stock of $40,000, has been organized by Thomas H. Allen and others for the purpose of doing an engineering business.

THE ALLEN ENGINEERING COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $40,000 for the purpose of manufacturing and dealing in iron, steel, coke, copper, lumber, engines, cars, etc., and constructing bridges, building boats, etc. The incorporators are: G. D. Raine, Jr.; N. Hill Martin, T. S. Allen and S. P. Walker, of Jersey City, N. J.

THE AMERICAN HYDRO-NUMATIC COMPANY, of New York, N. Y., has been chartered with a capital stock of $100,000 by C. M. Gilpin, W. M. Alberti, and H. M. Gaylord, of New York, N. Y. The company proposes to manufacture machinery.

THE AMERICAN "Z" ELECTRIC LAMP COMPANY, of Jersey City, N. J., has been chartered with a capital stock of $1,000,000 for the purpose of manufacturing electric lamps, etc. The incorporators are: H. Brunner, A. Romberg, Paris, France, and B. Treacy, Jersey City, N. J.

GEORGE R. BASCOM COMPANY, of Boston, Mass., has been incorporated for the purpose of manufacturing and selling machinery. The company is capitalized at $5,000 and the incorporators are: George R. Bascom and Guy W. Jones, both of Boston, Mass.

THE CHARLESTON ENGINEERING & CONSTRUCTION COMPANY, of Charleston, S. C., has been incorporated by T. C. Stevenson and John A. McCarmack. The company is capitalized at $10,000 and proposes to do a general engineering and contracting business.

THE ELECTROMAGNETIC APPLIANCE COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $50,000 by Harautium K. Kouyoumjian, Arthur Schwab, W. W. Selbert and others. The company proposes to manufacture and deal in electrical appliances.

THE EMMONS ELECTRIC COMPANY, of Chicago, Ill., has been incorporated by Carl T. Post, Charles P. Emmons and Henry W. Huttman. The company is capitalized at $10,000 and proposes to manufacture and deal in electrical supplies and fixtures.

THE GRANT TUNGSTEN LAMP COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $2,500 to manufacture electrical lamps and appliances. The incorporators are: Ernest O. Best, D. V. Rubidge and Edwin J. Mergard, all of Chicago, Ill.

THE HEER ENGINE COMPANY, of Portsmouth, Ohio, has been incorporated with a capital stock of $50,000 by Chris Heer, George A. Selby, G. M. Appel, Fred N. Tynes and H. W. Heer.

THE MITCHELL RAND MANUFACTURING COMPANY, of New York, N. Y., has been incorporated for the purpose of manufacturing electrical supplies, devices, etc. The company is capitalized at $20,000 and the incorporators are: Lyman F. Rand, William E. G. Mitchell and Charles L. Rand, all of Brooklyn, N. Y.

THE NEW HAVEN ELECTRIC MANUFACTURING COMPANY, of New Haven, Conn., has filed a certificate of incorporation with the Secretary of State. The company is capitalized at $50,000, but will start business with $5,000. The incorporators are: John Fruin, of Cheshire, Conn.; Henry C. Barber, of Plainville, Conn., and Epaphroditus Peck, of Bristol, Conn.

THE PRIMM OIL ENGINE COMPANY, of Van Buren, Ind., has been incorporated with a capital stock of $40,000 for the purpose of manufacturing engines. The incorporators are: J. M. Primm, B. J. Stranahan, I. C. Mills, W. B. Mills and A. B. Chauvant.

THE RAILROAD PROMOTION & CONSTRUCTION COMPANY, of Des Moines, Ia., has been incorporated for the purpose of constructing railroads operated by electricity, gasoline, steam, etc. Charles Philpot is secretary.

THE SOUTHERN GAS & ELECTRIC COMPANY, of Charlotte, N. C., has been chartered with a capital stock of $4,000 to manufacture gas engines and electrical apparatus. The incorporators are: W. D. Wilcox, William H. Monty and Albert M. Guillet.

THE UNION GAS & ELECTRIC COMPANY, of Oklahoma City, Okla., has been incorporated to do a general contracting business, including the construction of isolated lighting plants, wiring, heating, ventilating and dealing in fixtures and supplies. The company is capitalized at $50,000, and the officers are: F. L. Braniger, president; C. S. Stephenson, secretary and manager, and E. B. Brown, treasurer.

THE VACUUM SECURITIES COMPANIES, of East Orange, N. J., has filed articles of incorporation with a capital stock of $400,000 to manufacture vacuum cleaning machines and supplies. The incorporators are: K. K. Mackenzie, of East Orange, N. J.; J. M. Ryan, of New York, N. Y., and J. K. Berry, of Greenwich, Conn.

New Incorporations.

COALINGA, CAL.—The Coalinga Water & Electric Company has filed articles of incorporation with a capital stock of $2,000,000 for the purpose of supplying water and power to Coalinga and the oil fields. The directors are: W. C. Kerchchoff, A. C. Balch, K. Cohn and A. G. Wishon.

SACRAMENTO, CAL.—Articles of incorporation have been filed for the Western Consolidated Coal, Gas & Electric Company with a capital stock of $7,500,000. The company is now operating in Arizona and intends to undertake the development of extensive coal mining claims near Stone Canyon, Cal. Under its charter the company is given the privilege of supplying electricity for lamps, heat and motors and coal in any part of the State.

SAN FRANCISCO, CAL.—The Hammon Engineering Company has been incorporated with a capital stock of $1,000,000 by W. P. Hammon, A. E. Boynton, N. Cleaveland, C. U. Black and C. S. Goodrich. The company is interested in power development work.

DECATUR, ILL.—Articles of incorporation have been filed for the Progressive Light & Power Company with a capital stock of $100,000 by W. H. Suffern, R. I. Hunt and F. M. Ives. The company proposes to generate and sell electricity.

AUGUSTA, MAINE.—The United Water & Electric Company has been chartered with a capital stock of $2,000,000 for the purpose of supplying water and electricity. R. S. Buzzell is president, and E. J. Pike, of Augusta, Maine, treasurer.

OLDTOWN, MAINE.—The Kennebec Development Company has been incorporated with a capital stock of $200,000. The company proposes to deal in gas, electricity, etc. The officers are: C. H. Briggs, of Providence, R. I., president; H. E. Green, of Waterville, Maine, treasurer.

WHITE PLAINS, N. Y.—Articles of incorporation have been filed for the Westchester Street Railroad Company with a capital stock of $1,000,000. The company is a reorganization of the former Tarrytown, White Plains & Mamaroneck Railway Company, which went into receiver's hands about two years ago, by the New York, New Haven & Hartford Railroad Company. The directors are: Richard Sutro, William Greenough, Charles H. Sheafe, Jr., William L. Barnett, John L. Anderson, Frank E. Hall, Edward O. Brown, of New York, N. Y.; John S. Parker and Augustus S. May, of New Haven, Conn.

OKLAHOMA CITY, OKLA.—Articles of incorporation have been filed for the Union Gas & Electric Company with a capital stock of $50,000 by F. L. Brandiger, C. S. Stephenson and E. B. Brown.

YUKON, OKLA.—The Yukon Electric Company has been incorporated with a capital stock of $5,000 by J. F. Kroutril, F. L. Kroutril and A. F. Dobry.

EVANS CITY, PA.—The Evans City Light, Heat & Power Company has been formed for the purpose of constructing an electric light and power plant. Samuel A. Roelofs is interested in the enterprise.

TITUSVILLE, PA.—The Titusville Railroad Company has been chartered to construct and operate an electric railway between Titusville and Cory, 20 miles in length. Gasoline motor cars will be used. The incorporators are: W. J. Smith, of Titusville, president; P. T. Carolan, of New York, N. Y.; C. H. Ley, F. S. Fleming, C. W. Hawbaker, E. J. Robertson and A. N. Egbert, all of Titusville, Pa.

ALEXANDRIA, TENN.—The Alexandria Home Telephone Company has been incorporated with a capital stock of $3,000 by James S. Sampson, J. W. Rutland, J. W. Measle, W. B. Kyle, J. R. Hudson and O. D. Adamson.

NASHVILLE, TENN.—The Kragon Electric Company has been incorporated by J. Hugh Kessett, H. Edward Smith, Herman Cook and others. The company is capitalized at $5,000.

SALT LAKE CITY, UTAH.—Articles of incorporation have been filed for the Belknap Power Company, with a capital stock of $300,000. The officers are: James Long, Jr., president; J. C. Wright, vice-president; J. Winner, treasurer.

CLE ELUM, WASH.—Articles of incorporation have been filed for the Cle Elum Traction Company by Frank S. and M. E. Farquhar, of Tacoma, Wash. The company is capitalized at $300,000 and proposes to construct an electric railway extending from Cle Elum to Roslyn, a distance of 17 miles.

MADISON, WIS.—The Melville Settlement Telephone Company, Chippewa Falls, has filed articles of incorporation with a capital stock of $5,250. The incorporators are: George W. White, James W. Melville, James P. Maloney and James Ryan.

Personal.

MR. P. M. HAIGHT, treasurer of the Sprague Electric Company, was recently elected president of the Electrical Trades Society of New York.

MR. ORMOND HIGMAN has resigned as manager and engineer of the telephone system of the Alberta Government in order to engage in private practice, with offices in the Williams Building, Vancouver, B. C.

MR. W. E. WICKENDEN, formerly instructor in electrical engineering at the University of Wisconsin, has become assistant professor of electrical engineering in the Massachusetts Institute of Technology.

MR. LLOYD LYON, formerly secretary and auditor of the Mobile Light & Railroad Company, Mobile, Ala., has been appointed treasurer of the Mexico Tramways Company and the Mexican Light & Power Company, Ltd.

MR. J. W. CORNING, electrical engineer for the Boston Elevated Railway Company, delivered an address before the Worcester Polytechnic Institute branch of the A. I. E. E., entitled "Some Electrical Features of the Boston Elevated Railway System."

MR. ERNEST A. EDKINS has been appointed secretary of the advisory committee and superintendent of the employment bureau of the Commonwealth Company, succeeding Mr. Schayer. Mr. Edkins was formerly in the office of Vice-President L. A. Ferguson.

MR. O. H. ENSIGN, chief electrical engineer of the U. S. Reclamation Service, at Los Angeles, has been selected for membership on the advisory board of electrical engineers in charge of construction work of aqueduct power plants which the city of Los Angeles will erect at an estimated cost of $3,500,000.

MR. H. M. BEARDSLEY, secretary and treasurer of the Elmira Water, Light & Railroad Company, has also been appointed acting general manager of the company, taking up many of the duties relinquished by Mr. S. J. Dill, the general manager, who will hereafter be located in New York, as noted elsewhere in these columns.

PROFESSOR CHAS. L. KINSLOE, of the department of electrical engineering of the Pennsylvania State College, accompanied by 23 students of his department, is making a tour of inspection of places of special interest to electrical engineers in Philadelphia, Camden, Trenton, Harrison, Ampere, and New York City.

MR. JOHN J. SCHAYER has been appointed manager of Electric Shop of the Commonwealth Edison Company, Chicago, and has established his office in the Railway Exchange Building, where Electric Shop is located. The business of this handsome establishment has grown rapidly, and it now requires Mr. Schayer's entire attention.

MR. JOSEPH E. WAYNE has resigned from the commercial department of the Edison Electric Light Company, York, Pa., to become superintendent of the York Railways Company, York, Pa., in which position he succeeds Mr. F. P. Newman, who has become general manager of the Southern Cambria Street Railway, Johnstown, Pa.

MR. H. H. SEAMAN has recently been appointed assistant manager of the New York electrical department of the H. W. Johns-Manville Company. Mr. Seaman was associated for seven years with the Electric Storage Battery Company at Philadelphia, Detroit and Cleveland, and for the past two years has been manager of its Atlanta office.

MR. F. F. ESPENCHIED, consulting engineer and assistant to the general manager of the West Penn Railways, Pittsburg, Pa., has resigned from the company to become general manager of the Interstate Light & Power Company, which is building a modern transmission plant to serve Galena, Ill., and Plattville, Wis., and the intervening mining region.

MR. L. C. NICHOLS, chief electrician of the Lehigh Valley Transit Company, of Allentown, Pa., has severed his connection with that company and accepted a position with Messrs. Herrick & Stebbins, of New York, where he will devote his time to investigation and testing work. Prior to his connection with the Lehigh Valley Transit Company, Mr. Nichols was employed by the Utica & Mohawk Valley Railway Company.

MR. C. F. CRANE, general passenger agent of the Eastern Pennsylvania Railways Company, which operates the lighting plants at Pottsville, Tamaqua, Port Carbon, Minersville, Frackville, Palo Alto, and Orwigsburg, Pa., has just returned from an eight weeks' trip to Italy whither he went in search of much needed rest. Mr. Crane spent most of his time in Naples.

PROF. RALZEMOND DRAKE PARKER has received the appointment of assistant professor of electrical engineering at the University of Michigan, from which institution he was graduated in 1905. He obtained a master's degree the following year, and remained as instructor in the electrical department. Since graduation he has spent the summer months in practical work in electrical operating and manufacturing companies.

MR. PAUL WINDSOR, superintendent of motive power and rolling stock of the Boston Elevated Railway Company, presented a paper on "The Effects of Improvements in Old Types of Electric Railway Equipment on Maintenance" before the Boston Section of the A. I. E. E., on Dec. 15. "Power Station Economics" was the subject of a paper by Mr. Walter Goodenough, mechanical engineer of the Stone & Webster Engineering Corporation, presented at the same meeting.

MR. CLINTON E. PALMER, who has been superintendent of railways of the Eastern Pennsylvania Railways Company of Pottsville, Pa., for the past two years, has resigned his position to accept the post of general superintendent of the Chicago, Lake Shore & South Bend Railway Company, with headquarters at Michigan City, Ind. Prior to his connection with the Eastern Pennsylvania Railways Company, Mr. Palmer was associated with the Cincinnati & Northern Traction Company His resignation takes effect on Jan. 1.

MR. EDWIN BENNETT, who has been appointed assistant professor of electrical engineering at the University of Wisconsin, was graduated from the Western University of Pennsylvania in 1897. Subsequent to graduation he was employed in the research department of the Westinghouse Electric & Manufacturing Company. He was for a time electrician of the Nernst Lamp Company and chief electrician of the American Telephone & Telegraph Company. More recently he was electrical engineer for the Telluride Power Company at Provo, Utah.

PROF. HENRY HAROLD HIGBIE was promoted Oct. 1 from instructor to assistant professor of electrical engineering, Michigan University. Prof. Higbie, who is from New York City, in 1896 won the Pulitzer scholarship, which gave eight years' tuition in the Horace Mann High School, New York, and Columbia University. At Columbia he won the highest honors in the engineering department, in addition to a cash award of $1,750, and upon graduation in 1904 received the Illig medal in applied science. After serving for a year as instructor at Columbia, he went to the University of Michigan in 1905.

MR. S. J. DILL, who succeeded Mr. W. W. Cole as general manager of the Elmira Water, Light & Railroad Company, has been appointed assistant to Mr. George Bullock, president of the Susquehanna Railway, Light & Power Company, New York City. Mr. Dill has also been elected vice-president of the Railway Equipment Company, through which purchases are made for the Susquehanna Railway, Light & Power Company. He succeeds to the duties with these companies previously performed by Mr. Edwin Witherby, whose resignation was announced in the *Electrical World* Dec. 9. Although Mr. Dill will make his headquarters in New York he will retain the title of general manager of the Elmira properties.

Obituary.

MR. FRED R. FULTON, manager of the Pryor (Okla.) Electric Light Company, died in Iola, Kan., Dec. 15, at the age of 25 years.

Trade Publications.

CONTROLLER APPARATUS.—Bulletin No. 4677, issued by the General Electric Company, contains data relative to the Sprague-General Electric system of control, and forms a revision of similar data contained in a previous bulletin on this subject. The publication contains numerous illustrations showing the various pieces of apparatus used in connection with this system, with a description of each. It also contains a table of weights of this style of equipment for various horse-power ratings.

SMALL DIRECT-CURRENT MOTORS.—The application of small motors to laundry apparatus, printing presses and other machinery with similar requirements, has brought about changes and improvements in the respective industries which are having an important effect on their development. For this reason bulletin No. 118, just issued by the Crocker-Wheeler Company, of Ampere, N. J., describing apparatus of this type, is of interest for every up-to-date manufacturer. The pamphlet is well illustrated with engravings, showing applications of motors to various types of machinery.

SINGLE-PHASE MOTOR.—Bulletin No. 4675, issued by the General Electric Company, describes and illustrates a new single-phase induction motor of the repulsion induction type, developed for use in connection with installations where the starting torque of the resistance-reactance type of induction motor will not meet the demand of the driven machine, or where within certain limits invariable speed is required. The bulletin mentions various applications of this type of motor, illustrates and describes controllers for use in starting and in varying the speed, and contains certain other data including diagrams of connections.

CONDUITS AND CIRCUIT FITTINGS.—The Central Electric Company, Chicago, is distributing three new circulars descriptive of condulets and their application. A number of illustrations show the method of employing condulets in connection with pole type transformers, interior lighting, etc. Other recent publications of the same firm are a flier descriptive of meter connection blocks intended for use in installing and testing induction type service meters, and a circular devoted to a description of Alphaduct Flexible Conduit. Particular attention is called to the fact that this conduit is flexible, moisture proof, and will withstand any climatic changes.

Business Notes.

BELTED RAILWAY GENERATORS.—The National Machinery & Wrecking Company, Cleveland, Ohio, has issued a special bargain list on 5000 kw in belted railway generators of practically all sizes.

FIFTEEN HUNDRED LIGHTNING ARRESTERS SOLD TO ONE CUSTOMER.—The Lord Electric Company, New York, has been much gratified to learn that of 1500 lightning arresters sold during 1909 to a single customer, not one has proved defective.

THE GOODWIN & KINTZ COMPANY has opened a salesroom at 25 West Broadway, Crockery Exchange Building, New York, where in a handsome and well-lighted office it displays a full line of gas and electric portables, electroliers, dining-room domes, art-glass shades and other lighting specialties.

THE Q M S COMPANY (Quincy, Manchester, Sargent), Plainfield, N. J., announces that on Jan. 1 it will move its Western office from 1775 Old Colony Building to 738 First National Bank Building, Chicago, and that its interests in the West will hereafter be taken care of by Mr. John C. Hoof.

B. & W. BOILERS FOR ATLANTIC CITY POWER HOUSE.—The American Gas & Electric Company has selected Babcock & Wilcox boilers for the new power house at Atlantic City. Each of the four 500-hp boilers is to be equipped with a six-retort Taylor gravity underfeed stoker.

HYDRO-GROUND.—The Lord Electric Company some months ago placed on the market a device known as the "Hydro-Ground," which, it reports, is meeting with remarkable success, duplicate orders being received from various branches of the trade to be used in all classes of operation. The "Hydro-Grounds" is now in use on telephone and telegraph circuits, signal circuits, wireless telephone and telegraph circuits, and electric light, power and railway circuits wherever, in fact, a ground is desirable or necessary. A large company which several months ago installed quite a number of the device is now placing an order for several hundred, stating that it is the only commercial and legal ground yet found.

ALLIS-CHALMERS PACIFIC SLOPE OFFICE.—The San Francisco office of Allis-Chalmers Company has been moved from 599 Mission Street to the Byron Jackson Building, 160 Second Street, corner Natoma Street, in order to accommodate its increased selling force. The territory is in charge of Mr. R. B. Elder, who has been engaged in engineering on the Pacific Coast for the past 14 years. An attractive office has been provided with greatly increased facilities for the handling of the company's products, and with the advantages of a warehouse containing a complete assortment of small machinery such as breakers, motors, transformers, repair parts, etc., prompt and satisfactory service is assured.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 14, 1909.

[Conducted by F. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

942,894. ELECTRIC HEATER; R. Farren and C. T. Clark, Cleveland, Ohio. App. filed Dec. 3, 1908. Heater and radiator in which the water circulates around tubes heated by coils therein.

942,897. APPARATUS FOR RECEIVING SUBMARINE SOUNDS; T. A. Garrett and W. Lucas, Crouch End, England. App. filed Aug. 31, 1909. Uses a magnetized nickel rod surrounded by a coil of wire as transmitter, thus doing away with a carbon transmitter. One end of the rod is connected to the side of the vessel and a mass is fixed to the other end to put it in resonance with the sound.

942,901. APPARATUS FOR ELECTRICALLY IGNITING GAS-BURNERS; Alfred J. Hill, Woodford Green and F. C. D. Mann, Hayes, England. App. filed Jan. 4, 1909. A pair of insulated brackets mounted on the baffle plate with tubular arms, electrodes therewithin forming a spark gap.

942,960. STARTING SWITCH FOR ELECTRIC MOTORS; E. Garside, Darlington, England. App. filed Sept. 8, 1909. Cuts out resistance by a movable switch arm with dash pot, piston and carriage connected to the piston, the carriage carrying a contact connectable to the switch arm.

942,961. TRANSFORMER FURNACE; E. A. A. Grunwall, A. R. Lindblad and O. Stalhane, Ludvika, Sweden. App. filed May 2, 1907. Induction furnace for smelting having a primary coil and coils placed in the path of leaking lines of force so arranged that the magnetomotive-force generated by the coils will counteract the leaking lines.

942,963. BERTH-LAMP; W. S. Hamm, Hubbard Woods and T. A. Legge, Chicago, Ill. App. filed April 17, 1909. For berths of sleeping car, the lamp being within a wall pocket when not in use and carried by a pivot.

942,964. ELECTRIC-LIGHTING ATTACHMENT FOR BURGLAR-ALARM SYSTEMS; M. F. Juruick, New York, N. Y. App. filed Aug. 16, 1907. Throws the electric lamps in circuit when the burglar enters and rings an alarm, the alarm circuit being normally open and closing the lamp circuit through a drop.

942,981. ELECTRIC CONTROLLER; C. L. Taylor, Alliance, Ohio. App. filed March 6, 1909. For traveling cranes. Includes a series of conducting bars having arms carrying resistance elements electrically connected therewith.

942,990. STORAGE-BATTERY TANK; T. A. Willard, Cleveland, Ohio. App. filed May 14, 1907. An outside casing with a protecting coating and lead lining with a meltable layer between them so that they can be separated for repairs.

943,011. CONTROL SYSTEM FOR ELECTRIC MOTORS; A. C. Eastwood, Cleveland, Ohio. App. filed May 24, 1909. For two or more motors having series fields with a single set of reversing switches for reversing the current through the series field of all the motors.

943,016. ELECTRIC SWITCH; M. Guett, Hartford, Conn. App. filed Feb. 7, 1906. A face plate for plug receptacles with apertures and a pair of shutters for closing them.

943,047. APPARATUS FOR STARTING AND STOPPING ELECTRIC MOTORS; C. Spannagel, Mannheim, Germany. App. filed June 1, 1909. A control member, a switching member, two springs between them, a solenoid and a double pawl operated by the solenoid and acting upon two notched rims.

943,076. KEYLESS SOCKET; H. Hubbell, Bridgeport, Conn. App. filed Jan. 2, 1909. Two metal members with a threaded connection, a base with an annular shoulder carrying a screw shell and an insulating lining.

943,077. DETACHABLE CHAIN-GUIDE FOR PULL-SOCKETS; H. Hubbell, Bridgeport, Conn. App. filed July 23, 1909. A detachable chain-guide comprising a bell and bar having lugs.

943,078. MEANS FOR LOCKING ELECTRIC SOCKETS TO FIXTURES; Harvey Hubbell, Bridgeport, Conn. App. filed Sept. 4, 1909. For locking the cap to the bushing, the bushings being threaded and the fixture being threaded to engage them.

943,115. SELECTIVE SIGNALING APPARATUS; O. M. Leich, Rochester, N. Y.—App. filed Feb. 3, 1905. Supplies currents of different frequency, each to a substation and uses a selective signaling apparatus responsive to alternating-current of a given frequency, and also a second signaling apparatus with a non-resonant path and a serial impedance to cause a selective operation between the frequencies.

943,124. SWITCH-HANDLE; C. Schuster, Bellevue, Pa. App. filed Nov. 7, 1908. Non-conducting handle with a lateral socket to receive the blade terminal.

943,132. PROCESS OF PRODUCING NITRIDS; C. E. Acker, New York, N. Y. App. filed March 18, 1909. Repeatedly reacts with nitrogen on an alloy containing a nitrid-forming metal, separates and realloys.

943,147. WINDOW-SPRING; J. Hagerty, Scott Township, Allegheny Co., Pa. App. filed Dec. 21, 1908. When the spring is tampered with or the window moved, the bell rings. The sash carries a roller and a spring pressed lever controlling a circuit is contained in a metallic frame secured to the window casing.

943,155. ELECTRIC MOTOR; L. A. McCoubrie and C. F. Raydure, Philadelphia, Pa. App. filed April 29, 1909. Prevents forming ribs on commutators by special brush holder consisting of a hollow slotted casting, the slots of successive holders alternating in relative position, with springs for pressing down on the brushes.

943,166. ELECTRIC CONTROLLING APPARATUS; W. Schwagermann, Yonkers, N. Y. App. filed July 31, 1907. An electric motor with a reversing rheostat comprising two hand-controlled starting levers one of which starts the motor in one direction and the other in the other direction and a no-voltage device for each lever.

943,187. ELECTROLYTIC WATER-PURIFYING APPARATUS; H. B. Hartman, Pittsburgh, Pa. App. filed March 2, 1908. Keeps the plates clean and gives the oxygen time to act. Uses a plurality of electrodes with intermediate bipolar electrodes enclosed by a casing through which the liquid flows. Reverses the current.

943,188. METHOD OF PURIFYING WATER ELECTROLYTICALLY; H. B. Hartman, Pittsburgh, Pa. App. filed March 2, 1908 (See No. 943,187.) Causes the liquid to flow downwardly between long electrodes in a closed chamber and synchronously interrupts the flow of current and of the liquid, and reverses the current. The liquid is caused to flow rapidly.

943,190. ELECTRIC CHAIN-LINK-WELDING APPARATUS; C. L. Hoff, York, Pa. App. filed Dec. 5, 1907. The welding jaws are movable toward and from each other; a guide between the jaws positions the link, the guide being moved out of engagement with the link while the latter is heated.

943,196. ELECTRIC-RAILWAY SYSTEM; G. H. Maire, Seattle, Wash. App. filed Nov. 29, 1907. Prevents two cars from entering the block simultaneously. The line circuit has a normally open section controlled by a switch operated by the car.

943,215. ELECTRIC SWITCH. H. J. Carrigan and A. J. Sangster, Buffalo, N. Y. App. filed Sept. 22, 1908. Combination lock for induction coils for automobiles. An annular row of contacts, with two rotating arms, an outer hollow shaft for one arm and an inner shaft carrying the other.

943,224. ELECTRIC FURNACE; E. A. A. Gronwall, A. R. Linblad and Otto Stalhane, Ludvika, Sweden. App. filed July 28, 1909. Special shape of furnace. Heating chamber and stack with a free space between the charge and the top of the chamber. Electrodes enter the wall of the chamber.

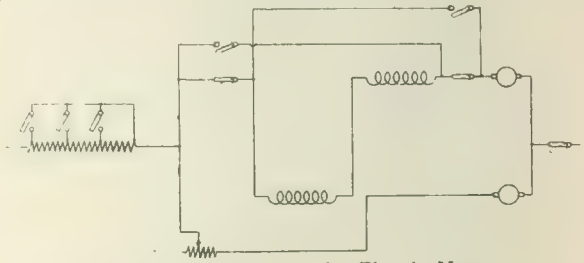
943,232. COMBINED BURGLAR-ALARM AND AUTOMATIC CAMERA; J. C. Ashe, Montreal, Quebec, Canada. App. filed Oct. 19, 1908. A movable floor section starts arc lights which ignites a fuse that controls a drop which releases the photographic plate of a camera to take the burglar's picture.

943,273. ELECTRIC-LIGHT SOCKET; R. A. Schoenberg, New York, N. Y. App. filed Feb. 20, 1909. A solid insulating base carrying a lock which locks the lamp to the base.

943,274. MECHANICAL MOVEMENT; R. A. Schoenberg, New York, N. Y. App. filed July 24, 1909. For make-and-break contacts in a lamp socket in which a reciprocating rod carries cam surfaces which actuates a driven member through a compression member.

943,275. BATTERY-ELEMENT SUPPORT; C. B. Schoenmehl, Waterbury, Conn. App. filed April 1, 1909. A pair of guide wires carries two channel strips and a sheet metal spring below the lower strip holds the plate between the strips.

943,281. ELECTRICAL CONTACT DEVICE; J. M. Smith, Philadelphia, Pa. App. filed Jan. 13, 1909. To prevent wires jarring out of binding posts by making a special spring pressed post.



943,011—Control System for Electric Motors.

943,287. CONDUIT-CAP FOR ELECTRIC INSTALLATION; W. H. Vibber, New London, Conn. App. filed May 10, 1909. A U-shaped frame with a removable hood having a U-shaped opening removably secured to the frame with an insulating cover for the hood.

943,290. ELECTRIC FURNACE; C. E. Wilson, Hood River, Ore. App. filed Feb. 1, 1909. For reducing wolframite to make tungsten. The furnace has removable and replaceable sides, and can be raised and lowered. A stationary electrode projects into the furnace.

943,345. STORAGE BATTERY; L. H. Flanders, Wilkinsburg, Pa. App. filed Feb. 23, 1905. A separator, plate comprising superimposed obliquely extending and intersecting members with a binding frame having holding lugs.

943,368. BURGLAR-ALARM SCREEN; P. Orance, Newark, N. J. App. filed Aug. 4, 1908. A roll having levers whose ends are secured to wires which when broken cause the levers to close an electric alarm circuit.

943,384. ELECTRIC HEATER; R. W. Brown, Amsterdam, N. Y. App. filed Oct. 22, 1908. Reinforced cement unit in which is embodied a heating wire coil, a metal prism surrounding the body and receptacle to receive the prism.

943,403. MELTING HEARTH FOR ELECTRIC INDUCTION-FURNACES; C. Grumwald, Bredeney, Germany. App. filed May 7, 1909. Has a melting trough with lateral serving openings, the shape of the trough permitting inspection and access through the openings.

943,440. ALARM APPARATUS; F. P. Moyer, Utica, N. Y. App. filed Jan. 22, 1909. Actuated by fire, smoke or water. A casing having walls consisting of diaphragms coated with a catalytic substance which reacts with the gases to cause the diaphragm to operate a circuit.

943,483. ELECTRICALLY-HEATED TOOL; Geo. E. Stevens, Lynn, Mass. App. filed Aug. 4, 1908. For sad irons, etc., a circuit controller is spring pressed to open position, locked closed by a latch. The latch is spring pressed, the spring being capable of a limited movement before the latch is moved.

943,503. DYNAMO-ELECTRIC MACHINE; J. B. Wiard, Lynn, Mass. App. filed Dec. 6, 1905. Avoids disturbing jars to the motor when the loom or machinery driven thereby suddenly stops by connecting the motor armature to the shaft by a yielding connection. Makes use of helical springs and friction members.

943,509. ELECTRICAL CABLEWAY SYSTEM; O. Adams, Dresden, Germany. App. filed April 20, 1908. An endless cable, a straining rope to keep the cable under uniform tension, an electric motor for operating the cable and straining rope, and a compensating generator driven by the straining rope operating element of the motor and energizing a compensating winding in the motor circuit.

943,531. PENDULUM ELECTRICITY-METER; C. Fery, Paris, France. App. filed Jan. 12, 1909. Two electrically controlled pendulums which are automatically started and run without solid friction. The coincidences of the pendulums are obtained by a rotary field motor.

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Controlling Devices for Single-Phase Trains.

That the controlling devices for a single-phase car equipment need not be more complicated than for a direct-current car will be apparent at once from the fact that any of the methods now used with the latter type of car can be applied immediately to the former without alteration. It is evident that by selecting a suitably low value of trolley e.m.f. the familiar series-parallel arrangement of motors with rheostatic acceleration can be applied to series motors of the single-phase type equally as satisfactorily as to those of the direct-current type. Moreover, with the alternating-current equipment it is possible to substitute reactance coils for the resistors of the rheostats and thereby eliminate a considerable portion of the energy dissipated as heat in the control circuits during acceleration. In addition, with the single-phase car there can be obtained conveniently any desired number of voltages to be impressed upon the motor circuits, and there is thus no necessity for limiting the e.m.f. to a single value as must be done with direct-current equipments. To this latter fact is attributable the essential difference between the controlling circuits of single-phase and direct-current cars.

In most of the so-called single-phase railway equipments that have been installed in this country it has been necessary to arrange for operation by both alternating and direct current. The problem of the controlling circuits has usually been solved by providing one set of controlling devices for direct-current operation and another set for alternating-current operation, only a few of the parts being common to both sets. For this reason, the controlling devices on almost all of the cars designated as single-phase have seemed much more complicated than those employed with direct-current cars. Our present issue contains an article by Mr. Ralph W. Krass describing in detail the controlling circuits for purely single-phase cars arranged for multiple-unit operation in trains. The four motors of each car are connected at all times in parallel, the variation in the torque for acceleration being obtained by changing the e.m.f. impressed across the motor circuits. In order not to open the motor circuits and not to short-circuit the transformer coils when changing the connection from one transformer tap to another, use is made of small induction coils which act as auto-transformers when the circuits are closed and as series reactors when one terminal is disconnected. Thus the current supplied to the motor decreases somewhat just before being increased when the e.m.f. applied to the motor circuits is changed to a higher value, but the torque is continuous, the circuit is never completely opened and the sparking at the transformer contacts is negligible. In the installation described by Mr. Krass all of the main switches are opened and closed by pneumatic plungers, the compressed air for which is admitted by valves electromagnetically operated. For controlling the electromagnets, use is made of a low voltage obtained from a storage battery, the current being distributed by means of a 12-conductor cable. A continuation of this cable throughout the whole train allows a

single master controller on either end of any car to govern the direction of motion and speed of the train. It is not essential to install a storage battery for supplying energy to the electromagnets, because the required e.m.f. can readily be obtained from a tap on the main transformer; certain advantages, however, attend the use of the battery, as pointed out in the article in this issue.

Definition of the Electrical Properties of Conducting Line Wires.

A recent number of the *Elektrotechnische Zeitschrift* contains a report, referred to in the Digest, from a committee of the Elektrotechnischer Verein, on the definitions and magnitudes of the fundamental constants of line conductors, particularly with reference to multiple cables. The discussion is taken up from the theoretical standpoint very thoroughly. In the case of a pair of parallel overhead line wires, employed for single-phase transmission, or distribution, the linear inductance, capacity and charging current are all simple and well-known quantities. The case of three equidistant parallel overhead line-wires as used in three-phase transmission presents but little extra difficulty. When, however, the line wires are placed in underground cables, perhaps with dissymmetrical arrangement, the case is not so simple, and special formulas have to be employed. The article discusses a number of different cases and arranges them in tabular form for reference. The table shows that even a considerable departure from the symmetrical condition can be dealt with by slight modifications of the standard formulas. Considering how much high-pressure distribution is carried on by underground cables, the report is well timed.

Economy of Electric Pumping.

While steam-pumping machinery in large water works is operated with the highest economy of any class of steam apparatus of similar size, the reverse is likely to be the case in small water works. Direct-acting, deep-well pumps and direct-acting pressure pumps, which make little use of the expansion of the steam, are common. These appliances are inherently uneconomical and it is an easy matter to make considerable saving by the operation of such pumps electrically. In a class of water works where the air lift seems to be necessary on account of the volume of water which it required from the well, the conditions are not quite so favorable to large fuel saving by the use of electric power. Nevertheless, such cases are by no means hopeless, and should be studied carefully. In a small station where an engine is being run to give day electric service, the addition of the load imposed by city water pumping will not cause as great an addition to the fuel consumed as the operation of a small compressor. In some cases it is possible to do away with the air lift and substitute a vertical-shaft centrifugal pump placed deep in the well. Such pumps are now made with outside diameters as low as 10 in., and a capacity of 75 gal. to 100 gal. per minute. The centrifugal pump, like the air lift, is to be considered chiefly in cases where the output from a well must be increased. In many cases the output obtainable from a well is not sufficient to justify the additional expense of either an air lift or centrifugal deep-well pump. For wells of limited capacity the electrically operated deep-well pump, although troublesome at times, can be counted upon to give as good results per dollar invested as anything that can be installed. Rods and plungers must be pulled up frequently for repairs, but that has to be figured in as a part of the regular work of maintaining the plant. Most deep-well supplies are sufficient only for small towns and there are apparently few cities of over 10,000 population dependent on deep-well supply. In the larger towns deriving supply from rivers or shallow wells, the electrically operated pumps either of the plunger or centrifugal type are the principal ones to be considered. One of the inherent difficulties under which the small central-station plant labors is the underloaded condition of its engines during a large percentage of the time they are in operation. Few managers of small plants realize what this underloading means in the shape of increased coal cost as compared to the results which could be obtained if it were possible to keep engines more fully loaded. The same general rule applies to boilers. The more nearly the engine and generator capacity in operation corresponds to the load, the lower the coal consumption per unit will be, and the addition of a pumping load conduces admirably to this condition.

Switching Arrangements for Synchronizing Alternators.

In any central station employing more than two synchronous alternators, some system of synchronizing an incoming alternator has to be adopted. That is, where only one alternator is used in an isolated plant, no synchronizing device of any kind is needed. Where only two such alternators are operated in parallel, a switching arrangement of the simplest kind suffices to permit of synchronizing the second machine after the first has been started. When, however, a plurality of such alternators are operated together in varying numbers, a synchronizing switching system of some kind is rendered necessary. The subject has recently received elaborate analysis in the *Elektrotechnische Zeitschrift* by Herr J. Teichmüller. The various methods of wiring the generator switchboards for synchronizing are classified and compared. In this country, rotary synchronism-indicators are now in very extensive use, connected between the main busbars and the incoming machine terminals, in a very simple and effective manner, so that very little trouble is ordinarily met with in synchronizing. Moreover, so effective is the automatic action between alternators running in parallel, toward the maintenance of synchronism, that it seems possible for the central station of the future to dispense entirely with speed governors on its engines.

Recent Suggestions in Non-Newtonian Mechanics.

Ever since the days of Isaac Newton, both scientists and engineers have worked side by side in the firm mutual belief that the mass of a body—for instance, that of a rifle bullet—was constant, and did not vary with the velocity of the body. Not only do all the sciences of dynamics, kinematics, ballistics, etc., depend upon this condition as an essential postulate, but our whole theory of astronomy depends upon it also. Now the electronists, not content with overturning the fundamental theories of chemistry in regard to the atom, are hammering at the fundamental conceptions of length, mass and time. At this rate, if the electronists have their way, the whole basis of physical science will have to be reconstructed in thought, although the actual difference in fact will be insignificant in the vast majority of cases. Is it any wonder that respectable scientific gentlemen who have comfortably screwed down their ideas are objecting to the iconoclastic proposals that the whole scheme of natural philosophy shall be revised?

It is contended by the electronists that the mass of a body, on the electronic theory, is not constant, but increases with its

velocity. The change is admitted to be extremely small until the velocity approaches the velocity of light, and at this velocity the mass is claimed to become infinite. The velocity of a rifle bullet as it leaves the muzzle is so small by comparison with the velocity of light that the suggested change in the bullet's mass would be quite negligible for all practical purposes. Probably no massive body in our world ever can attain a velocity great enough to make the question parctically serious. But in the vast distances of space surrounding us there should be chance for obtaining a practical test of the Newtonian versus the non-Newtonian theory of mass. The easiest direction in which to apply such a test is probably in that of our moon. Her velocity indeed is small, by comparison with the velocity of light, but her angular position among the stars can be observed with great precision, and errors of position due to errors in velocity accumulate with time progressively.

Now, it is admitted by all the great astronomers who have investigated the moon's motion that there is a small but distinct unexplained discrepancy between the actual and computed orbits of the moon. Whether this discrepancy is of such a direction and character as might be accounted for by the electronic theory has not been authoritatively announced as yet, and perhaps much time will be needed to review the lunar theory with reference to this question. The latest suggestion in non-Newtonian mechanics is that when a material body moves with ordinary velocity it not only undergoes an infinitesimal increase in mass, but it also undergoes an infinitesimal shrinkage of length in the direction of motion, a shrinkage that cannot be directly observed because the foot-rule applied to the moving body will also necessarily shrink during the motion. One comfort the engineer has, and that is, however greatly the physicist's ideas may have to be shaken up by physical progress in the time to come, owing to the activities of those who busy themselves with electrons, engineering is likely to go on serenely using the same formulas, rules and tables as at present, including the good old Newtonian mechanics and Ohm's law.

Quantitative Measurements in Radiotelegraphy.

A very interesting paper has recently been presented by Dr. J. A. Fleming to the Institution of Electrical Engineers in London on the subject of measurements in connection with wireless telegraphy. Although wireless telegraphy is carried on by electromagnetic waves, which are fundamentally of the same nature as those employed by electrical engineers in the transmission and distribution of energy, yet the measurement of volts, amperes and watts in wireless telegraphy is much more difficult than the measurement of these quantities in ordinary wire-connected systems. This difficulty is not merely on account of the feebleness of the received signals, but is also due to the high frequency employed. For example, in wire-connected systems using frequencies of 25 cycles or 60 cycles per second, we have no trouble in measuring the resistance of the ordinary sizes of copper wires used. The inductance and reactance of such wires must, of course, be taken into account in determining their impedance; but all copper wires below 1 cm in diameter have the same linear resistance, for practical purposes, at these frequencies, as with continuous currents. When, however, we use wireless telegraph alternating currents with frequencies in the hundreds of thousands per second, the case is very different. The current does not penetrate deeply into the copper wires at such frequencies, and the power wasted is thereby much increased. If we call the ratio of the resistance at a high frequency to the resistance with continuous currents the frequency-ratio of resistance, then this ratio due to imperfect current penetration is a number very considerably greater than unity.

Dr. Fleming describes a differential air-thermometer suitable for measuring the frequency-ratio of resistance in short lengths of wire in the laboratory. Formulas are also discussed for the computation of this ratio. It appears that, both by measurement and computation, the frequency-ratio of resistance in bare copper wire 2 mm in diameter—about No. 12—was 5.5 at a frequency in the neighborhood of 500,000 cycles per second. Consequently, a No. 12 copper wire carrying alternating currents of this frequency offers more than five times as much resistance as when carrying direct currents, owing to imperfect penetration of the current—that is, skin effect. This effect is, of course, independent of that due to inductance and reactance. Moreover, the paper shows that if a bare copper wire 0.16 mm in diameter —about No. 14—be wound into an open spiral of 2 cm in diameter and 2.6 turns per centimeter, the effect of the spiraling is not only to increase the inductance of the wire, but also to increase the frequency-ratio of its resistance from 4.5 to 5.6, at a frequency near 500,000 cycles per second. In this case, the magnetic field set up by the spiraling tended to distort the skin effect and to crowd the current penetration into the portions of the wire's surface outside of the helix. The measurements also indicate that although a copper wire as fine as No. 32 (0.2 mm in diameter) has a frequency-ratio practically unity at 500,000 cycles per second, yet if a strand of 19 such wires be layed up into a cable, each strand being separately insulated, the frequency-ratio of the cable was about 1.25. Consequently, although stranding a big wire does help the current penetration at high frequencies, and materially reduces the frequency-ratio of resistance, yet it does not ordinarily bring down that ratio to so low a value as that belonging to one of the individual strands acting alone. As yet we have no formulas for this case.

In German-silver wire, the skin effect is much less than in copper, owing to the lower conductivity. The frequency-ratio of a German-silver wire 1.4 mm in diameter was only about 1.3 near the same 500,000 frequency. Bare copper strip is also low in frequency-ratio. Consequently, as wireless telegraph engineers well know, all copper conductors should either be flattened, or hollowed, or finely stranded, in order to avoid marked skin effect. In regard to standard condensers, Dr. Fleming stands by oil condensers, using carefully dessicated paraffine oil. The capacity of such standards, as measured at, say, 100 cycles per second, can, it is claimed, be fairly depended upon up to 1,000,000 cycles per second. For standard inductances, single rectangles of copper wire are recommended for high-frequency work, and flat spirals for lower-frequency work. The efficiency of a particular wireless sending spark station is then discussed. Commencing with 2620 watts delivered to the direct-current side of a rotary converter, 800 watts were handed over to the step-up transformer. Of this power, 445 watts reached the oscillation condenser, and 94 reached the sending antenna. Of this power the antenna radiated 78 watts, making the net efficiency of the plant, in this case, about 3 per cent.

J. P. Morgan & Co. Dispose of Chicago Railway Properties.

Official announcement has been made that J. P. Morgan & Company have disposed of their syndicate holdings in the Chicago Street Railway properties, which deal was put through in New York, Dec. 24. Through the terms of the deal the shares of the City Railway Company, the Calumet & South Chicago Railway Company, the Southern Street Railway Company and the Hammond, East Chicago & Whiting Railway Company go into the hands of a group of Chicago capitalists, and a new company is to be formed to take over these properties, to be known as the Chicago City & Connecting Railways Company. It is understood that the Morgan interests are to receive $54,697,500 for their holdings in the Chicago City Railways Company. About four or five years ago Mr. Morgan and allied interests purchased about 95 per cent of the outstanding stock of this company for $200 a share. The company at that time was capitalized for $24,310,000, the transfer thus netting a profit of several million dollars.

The only official information of the deal which has been given out comes from Mr. Ira M. Cobe, who has been acting for the syndicate of Chicago capitalists who made the purchase from Mr. Morgan. Mr. Cobe says in his statement: "An agreement has been entered into whereby about 95 per cent of the shares of the Chicago City Railway Company, all of the shares of the Southern Street Railway Company and all of the shares of the Calumet & So. Chicago Railway Company, all of the shares of the Hammond, East Chicago & Whiting Railway Company have been taken over by Chicago interests. This marks the passing of the Chicago City Railway Company out of the hands of the Morgan interests. These shares, together with certain bonds heretofore placed upon the properties, will be deposited with trustees who will issue securities based upon the stock and bonds deposited. The doings and policies of the trustees will, by the terms of the trust agreement, be governed by a board of directors, the personnel of which is as follows: Messrs. J. B. Forgan, John J. Mitchell, Samuel Insull, John A. Shoor, Edward Morris, T. E. Mitten, E. K. Boisot and Ira M. Cobe.

The separate corporate existence of the several properties will continue. T. E. Mitten will remain as president of the Chicago City Railway Company, and will probably at an early date occupy the same position in the organization of all the roads. By vesting the ownership of the shares heretofore mentioned in trustees, under the proposed agreement, complete unity of management and operation of all the surface lines in the southern division of the city is accomplished. Whenever a feasible plan shall be worked out for a consolidation of all the surface lines operated in Chicago, then as to the southern division it can be dealt with from a practical standpoint as one ownership, thus greatly lessening the difficulty of harmonizing a number of interests."

This consolidation is considered as an initial step toward the organization of a large holding company, which may eventually take over all the public utilities of the city of Chicago. This company, it is predicted, will not only include the surface lines and elevated lines of the city, but will take in the electric light and gas concerns. A company with a capitalization of $400,000,000 is mentioned as being necessary to finance this extensive venture. The transportation companies of the city, together with the Commonwealth Edison Company, now represent a total capitalization in stocks and bonds of $326,514,281.

The four companies combined in the merger have stock issues of $24,310,000 and bonds of $26,425,000, a total of $50,735,000. The Chicago City Railway Company is by far the most important member of the group, its stock amounting to $18,000,000, with bonds of $20,000,000. The roads mentioned have 410 miles of single track and carry in the neighborhood of 320,000,000 passengers a year.

One feature of the combination is that it will greatly simplify interurban railway connections with Chicago from the South and East.

Federal Corporation Tax Law.

By George Hiram Mann.

The new Federal corporation tax law, part of the Payne-Aldrich Tariff Bill, is causing considerable uncertainty not only among corporations, but to the officials at Washington. Only an intimate knowledge of the peculiar circumstances under which this tax became law can reconcile one to realizing that so important and radical a piece of legislation was actually enacted while the millions of dollars of invested capital to be affected sat by in trance-like indifference, as it were. The tariff bill had already passed the House and was in the Senate when the Federal tax, backed by all the prestige of the Taft administration and sponsored by Attorney-General Wickersham and Senator Root, was presented at the Senate, and, after a short debate, accepted. The simile of Moses bringing the tablets down from the mount seems to be the only one strong enough with which to compare the charmed changelessness of the phraseology which emanated from the White House.

The tax, which covers the calendar year 1909, and which is 1 per cent on net profits, affects all corporations organized for profit having capital stock represented by shares whose net income exceeds $5,000 per annum. The sworn reports on which the tax will be computed must be made by the corporations before March 1, 1910.

The mooted questions in connection with the tax are many and perplexing. Probably the chief query now is: What is a reasonable allowance for depreciation? This remains unanswered, thought it is likely that the Commissioner of Internal Revenue will give opinions from time to time on this and other questions.

A number of suits to test the constitutionality of the act will be brought, some of them having powerful backing. It is the opinion in Washington, however, that both Senator Root and Attorney-General Wickersham believe the act to be constitutional, and that the tax will be collected.

Considering the overwhelming importance of this act, and the likelihood that the Federal camel, whose nose may be likened to the Corporation Tax, will endeavor to force the rest of his body into the corporation tent, the students of constitutional development, and especially those that view with uneasiness the expanding administrative power of the Federal Government, are watching the situation with keen interest. Apparently the world moves very rapidly these days.

The Morgan Telephone Deal.

Considerable of the interest attached to independent telephone conditions has centered about the office of the Attorney-General at Columbus during the past week, but at the same time nothing decisive has yet been done by that official or any one else. While an announcement was made a few days ago that the department is obtaining evidence to the effect that the Bell interests are taking over Independent properties in the Middle West, just what course is being pursued to obtain this information is not known. As to the purchase by J. P. Morgan & Company, the general idea conveyed is that the securities were obtained for the bankers' own account, and that the companies will be operated under directions from the New York office under policies similar to those which have been in use in the past. Those who had part in the negotiations with the firm were not informed as to the final disposition of the stock, and the only instructions F. H. Goff had was as to prices, and he kept well within them in the sale.

The only feature that has indicated that any affiliation with the Bell companies is contemplated is the advance in the toll rates charged by the United States Telephone Company and preparations on the part of certain of the Independent companies to make connection with the Bell long-distance lines. It is claimed that some of the rates now charged by the United States Telephone Company are practically prohibitive, and were made for the purpose of driving business to the Bell lines. As

the rates of the American Telephone & Telegraph Company have been allowed to remain as they have been for some months past, there is in reality some grounds for the speculations that have taken place.

Among the Ohio exchanges which have either made or are preparing to make connections with the Bell lines the following have been mentioned: London, Washington C. H., Millersburg, Wooster, Orrville and Bellefontaine. The exchanges at London and Washington C. H. are practically owned by the Citizens' Telephone Company, of Columbus, which was among those going to J. P. Morgan & Company. At Bellefontaine the Bell lines could not secure a franchise while the Independent strength was at its height, but when the advance in rates by the United States Telephone Company was made, there was a revulsion of feeling on the part of the city government and a franchise has been granted the American Telephone & Telegraph company for its long-distance lines.

The holdings of the banking firm in Ohio now amount to about 101,000 telephones and 40,000 miles of long-distance lines, with about 50 exchanges, counting those which the purchased companies control as subsidiaries. The companies have an aggregate capitalization of $12,500,000 bonds, $1,500,000 preferred stock and $11,000,000 common stock. The value of the property acquired is estimated at about $23,000,000, and the firm secured control by the payment of something like $10,000,000.

Officers of all the companies have received letters from J. P. Morgan & Company, stating that money will be furnished for all needed improvements and extensions, and instructions were given to proceed with the business in just about the same way that it has been conducted in the past. The independence of the companies is to be preserved, according to the understanding gained from the letter, and no changes are to be made in the management, for the present, at least.

Mr. Frank A. Davis, president of the Columbus Citizens' Telephone Company, was called to New York last week and it is understood that J. P. Morgan & Company offered him the general management or supervision of all its properties in the Central West, but no information has been made public as to the conclusion that has been reached. It is said that Mr. Davis hesitated to make a change because it would necessitate the removal of his home from Columbus to some other city.

Montreal Municipal Plant.

On Dec. 21 the property holders of the city of Montreal decided by a majority of 365 in favor of the corporation establishing an electric lighting plant, for which $2,000,000 may be borrowed. The authority given by the ratepayers is optional, and the probability is that the present City Council will not have time to deal with the matter, as the municipal elections take place early in February. The total vote cast was only 2855 out of 20,000 duly qualified electors, showing that very little interest was taken in the question. All the English-speaking wards were against the by-law, but this was more than offset by the vote of ratepayers in the French-speaking districts in favor of the by-law.

National Independent Telephone Association.

The newly elected board of directors of the National Independent Telephone Association held a meeting in Chicago on Dec. 20 and 21 and elected Mr. Frank H. Woods, president of the Lincoln Telephone & Telegraph Company, of Lincoln, Neb., as president of the association for the forthcoming year. Mr. Woods is also a member of the executive committee of the directors, and associated with him on that committee are Messrs. Theodore Gary, Macon, Mo.; W. J. Uhl, Logansport, Ind.; E. B. Fisher, Grand Rapids, Mich.; Charles West, Harrisburg, Pa.; H. D. Critchfield, Chicago, and Max Koehler, St. Louis, Mo.

Mr. Joseph B. Ware, Grand Rapids, Mich., was elected secretary and treasurer of the association.

Resolutions were adopted indorsing the Continental Telephone & Telegraph Company. In these resolutions it is said that this company has been engaged in the formation of a comprehensive long-distance telephone and telegraph company to operate in conjunction with the Independent telephone companies in the United States and Canada. It is the announced intention of the company to provide long-distance telephone and telegraph facilities from points west of the Missouri River throughout the entire country to the Atlantic Coast. The company now owns properties aggregating more than 200,000 telephone stations, it is said. The directors of the association formally indorsed this company and commended it to all Independent telephone men.

Lightning Protection on Niagara Lines.

The transmission lines of the Niagara, Lockport & Ontario Power Company running from Niagara Falls, Ontario, to Syracuse, N. Y., have recently been equipped throughout their entire length with a device designed by Mr. L. C. Nicholson, of the Buffalo office of the company, which is said to afford excellent protection against lightning troubles. A metal ring is supported on the frame of the tower just below the lower petticoat of the insulator in such manner that the distance between the line wire and the ring is shorter than the distance between the line wire and the insulator pin. The ring, which surrounds the insulator and is larger in diameter than the latter, is thoroughly grounded to the tower, so that the tendency would be for a lightning discharge to jump the shorter distance between the line and the ring, in preference to the longer route to the pin, and thence to the ground. Moreover, the arc, if there be any, in crossing the path thus formed is kept away from the insulator and trouble due to arcing is minimized. The device is claimed to have met all expectations.

Electrification Prospects at Boston.

Press dispatches from Boston state that at a recent conference between Governor Draper of Massachusetts; President C. S. Mellen and Vice-President T. E. Byrnes, of the New York, New Haven & Hartford Railroad, on the transportation situation at Boston, the subject of suburban electrification on the New Haven lines was discussed. Under a law passed by the Legislature of 1909 the control of the Boston & Maine Railroad passed to interests friendly with the New Haven system, and marked improvements in the handling of traffic are anticipated as a result of this change. The conference is of particular significance in view of the forthcoming session of the Legislature.

A feature of this situation is the falling off in traffic which the suburban lines of the New Haven have suffered since the opening of the Forest Hills extension of the Boston Elevated Railway Company. Estimates have been made in railroad circles that 60 per cent of the New Haven suburban traffic passing through the Forest Hills district has been deflected to the elevated line, and the Boston Elevated Railway Company states that by actual count the patronage of the Forest Hills extension is now 31,000 passengers per day. It is evident that the suburban traffic on the steam lines running out of Boston is immediately responsive to improved facilities on the street and elevated railway lines, and that electrification must come sooner or later if the standards of service are to reach the best levels.

Colorado Water-Powers.

At a Wednesday luncheon of the Denver Electric Club, held at the Kaiserhof Hotel, on Dec. 22, an interesting address was given by General Irving Hale, of the General Electric Company, on water-power from the standpoint of the electrical engineer.

In Colorado, the first water-power development was at Roaring Fork, in the Aspen Mining District, the initial installation being a 45-hp generator, utilizing a head of 400 ft. and voltage of 500 direct current. This gradually grew to much larger proportions and supplied the entire Aspen district. The second installation was at Ouray, the third at Telluride, gradually de-

veloping into the present Telluride Power Company, and the fourth at Silverton. In the second installation, 900-volt direct current was first used, but subsequent installations were with alternating current, at first single-phase and as soon as three-phase transmission was developed this system was substituted for the original installations. For these original installations a rich mining district made possible the water-power development, owing to the enormous prices of coal and the lack of any means of transportation.

General Hale then spoke of the fact that while the public so often has the impression that the water supply of the country is inexhaustible and cheap, this is very far from being the case; that water-powers as compared with steam developments usually have enormously higher initial costs, owing to the fact that the inequalities in water flow at different seasons must be equalized to some extent by the construction of expensive reservoirs. The public's idea is usually gained during the heavy flow off in the summer without regard to the minimum stream flow in the winter season.

As to the claims that water rights should be free to all, the fact was developed that thousands of excellent water rights taken out all over the State by individuals have failed through inability to secure financial backing, owing to the problematical demand and great cost per horse-power of development.

Taking up the United States Forestry departments system of charges for the water rights, the validity of the Government tax on the difference in level of the forest reservations was questioned. The other Governmental tax for maintenance of a steady flow by the preservation of forests was also questioned on the grounds that this steady flow was in no wise sufficient and that reservoirs are in all cases necessary, and also that the reservoirs themselves assist in the conservation and that they are thus rather beneficial than otherwise. This tax was to be considered rather as a tax on the development of the community. As to a coalition of water-power interests, owing to the multitude of water-powers and the active competition from steam and gas-engine plants with their comparatively low cost, this is extremely improbable. The General advocated the withdrawal of restrictions which would retard the development of water-powers with their possibilities for supplying light, railways and manufacturing, in districts which otherwise could not be properly developed.

The Denver Electric Club has been in existence only a month, but its plan for combining a weekly lunch and an interesting discussion of some live topic by men of the best acquaintance with their subjects, is proving of very great service to its members. At the close of General Hale's talk, a few pertinent subjects were proposed for future discussion by Judge Beaman, of the Colorado Fuel & Iron Company.

British Columbia $6,000,000 Electrical Extensions.

General Manager R. H. Sperling, of the British Columbia Electric Company, who has returned from attending the annual meeting of the company at London, England, announces that the directors have given authority for the expenditure of $6,000,000 in improvements and extensions to the company's power, lighting and railway plants in British Columbia, bringing the total capital invested in the Province up to over $19,000,000 Some of the work covered by this large appropriation is already under way, but the greater part has not yet been announced The plans call for increasing the car-building shops at New Westminster so that they will double their present output. Two hundred thousand dollars will also be spent on new rolling stock. A new terminal station will be erected next summer at New Westminster costing $60,000. A new office building will likely be started early in the new year, to be built upon the site of the old office at the corner of Hastings and Carrall Streets in Vancouver. Two hundred thousand dollars has been appropriated for this purpose. The railway extensions include seven miles through the municipality of Burnaby; one and one-half miles in South Vancouver, which will shortly be completed and in operation; seven miles extending the Powell Street line to the new exhibition buildings, and two and one-half miles in North Vancouver through the Lynn Valley. In Victoria the generating station on the Jordan River will be completed; work upon this power house is now proceeding and it is expected that power will be ready for delivery in Victoria before the end of next year. About $1,500,000 will be expended upon this plant. Several other important extensions to the company's system is planned for Victoria and Vancouver Island. In Vancouver about $600,000 will be expended upon the gas plant, quadrupling its present output, and $200,000 additional will be expended in the construction of new mains. Considerable improvements will also be made to the Victoria gas plant, and several miles of additional mains laid. A steam auxiliary station will be erected in Vancouver, which will ensure continuity of service in case of accident happening at the Lake Buntzen generating station.

Hydroelectric Scheme for Simla, India.

Proposals for utilizing water-power existing in the hills round Simla, the summer capital of India, lying at a height of from 2000 ft. to 8000 ft. above sea level, for the supply of energy for industrial purposes and also for lamps and motors in Simla itself, have long engaged the attention of the Indian Government. It is not too much to say that the development of such proposals has been hampered by the difficulty of finding capital for the purpose, whether in India, in Europe or in America. The application of capital to industrial work in India has been slow as regards capital raised purely in India. In regard to capital from outside India, it will suffice to quote the instance of the Bombay Tramways Company, Ltd., which was floated with American funds and from the winding up of which the stockholders have lately retired with a large profit on their original stock subscription, in addition to the very handsome profits realized during the whole time of the duration of the concern in question. The results of the foregoing considerations was that the question of the "electrification" of Simla was found to be one which had to be taken up by the Government, if it was to be initiated at all. It was thereafter decided to utilize the available water-power of the Nanti Klad, a stream about 18 miles, by road, from Simla for the purpose of supplying electricity for lamps and motors in Simla, and that this work should be done by the agency of Government combined with the agency of the Simla municipality. It may now be of interest to give a brief description of the proposed electrical work for its features of engineering interest.

There can be derived from the stream in question about 1000 brake horse-power without damming, or collecting water by reservoirs; as the collection of water for use in the dry season of March to June is not difficult, there is no reason to doubt that the output of the plant to be presently installed might rise to a very much larger total in the near future. As to the sale for the energy to works situated on the site of the presently proposed works, it will suffice to say that Simla has a population of 40,000 and that there is a large timber-producing district within reach, with boat haulage to the site of the development. There is also a railway 60 miles long connecting Simla to the standard-gage railway system of the plains of India. This railway is owned by the Government, and forms the greater part of the mileage of Indian lines. Simla is at present more of an administrative center and a summer health resort than an industrial center.

The applications of electric energy at present contemplated are for the operation of the existing steam water-works, the opening out of additional supplies of water by electric motors to supplement the existing supply of 200,000 gal. daily, and the general public supply of electrical energy in Simla. In opening out the new water supply it has to be kept in view that it will be extended, as the future demand arises, to 1,000,000 gal. a day. This work having received the approval of the Government, plans and details were prepared, and these are now under

the final consideration of the Government, so that the plant will shortly be arranged for and set to work. A start has been made with the civil engineering work involved, which, of course, will occupy the most time to construct.

Among the principal features of interest in this scheme is the situation of Simla, itself on a ridge with deep valleys all around the town. The absence of suitable timber very near the works, and the abundance of stone and lime, make it possible to construct a substantial cement flume line at a moderate cost. On the other hand, there exists, where it is needed, an abundance of suitable timber for poles. The exceptionally high lift required from the waterworks perhaps is also a leading feature, this lift being 1300 ft. in the existing waterworks and on the new waterworks 2700 ft. It should be added that there is a gravitation water supply, which varies in volume according to the season, but cannot be extended, and that the additional supplies referred to join with this and supplement it. A tunnel 1200 ft. long is required on the works flume line; it is lined with very hard limestone. A reservoir will be constructed holding about eight hours' supply of water for the power plant at full load, and from a point near this the customary steel penstock pipes will deliver the water to the station under a head of 550 ft. All these works are situated about 5000 ft. below Simla. The transmission line will be 12 miles in length, operated at 15,000 volts, and the distribution low-tension three-phase.

As communications are rather difficult, and a good deal of special road making has to be done, it has been necessary to limit the size and weight of the various parts of the plant. It will be of interest to trace the future development of this plant as the provision of electric energy gives rise to future public demand, and as the demand which experience has shown to be inevitable calls for the installation of additional equipment.

The Electrical Industry in Siam.

A United States consular report gives figures showing that while five years ago the imports of all kinds of electrical supplies into Siam amounted to only $107,913, during the year ended March 31, 1909, they amounted to nearly $300,000, of which $18,672 were from the United States, an increase of $14,526 as compared with the preceding year. The principal countries from which electrical goods were imported during the years ended March 31, 1909, were Great Britain ($113,084), Germany ($79,081), Sweden ($52,222) and the United States ($18,672).

Light and power for Bangkok is furnished by the Siam Electricity Company, a Danish company. Its equipment includes Babcock & Wilcox boilers, Brush dynamos, and a Curtis turbine. The distributing e.m.f. is 100 volts at 100 cycles, single-phase. The company began operations in September, 1890, and is the only electric supply company in Siam. It furnishes the electric power and light for the city of Bangkok, both public and private, and also supplies the electric power for the 25-mile, single-track, overhead-trolley system of tramways. This company represents an investment of $1,500,000, and paid a dividend last year of 12 per cent and a bonus of $1.50. The original shares were issued at about $50 each, and at last quotation were valued at about $180.

The telegraphs are owned and operated by the Government. The telegraphs and posts are under one directorship. The income from these two departments for the year 1906-7 was $352,381, and the expenditures $427,275, leaving a deficit of $74,894. Siam has, up to the present, no wireless telegraphy in operation.

The Government also owns and operates the telephones. A new installation was finished this year. It is of the central-battery system, for 1500 subscribers. The rate is $5.50 monthly. The contractors for this work were a firm of Stockholm, Sweden, and, as noted above, Sweden is credited with $52,222 worth of imports of electrical goods for last year. There is a uniform duty on all electrical goods at 3 per cent ad valorem.

Electrical Working Considered by American Railway Association.

At the semi-annual convention of the American Railway Association in Chicago on Nov. 17 a short report was presented from the committee on electrical working. The American Railway Association is composed of company members representing the great railroad systems of the United States. At the Chicago meeting there were about 200 representatives of the railroad companies present, including presidents, vice-presidents, general managers and lesser officials. Mr. F. A. Delano, president of the Wabash Railroad, is the president of the association and presided. The secretary is Mr. W. F. Allen, of New York. About 250,000 miles of railroad were represented at the convention.

The committee on electrical working consists of Mr. George Gibbs, chairman, chief engineer of electric traction, Long Island Railroad; Mr. J. F. Deems, general superintendent of motive power, rolling stock and machinery, New York Central Lines; Mr. J. D. Isaacs, consulting engineer, Union and Southern Pacific systems; Mr. W. J. Harahan, assistant to president Erie Railroad; Mr. C. S. Sims, second vice-president and general manager, Delaware & Hudson Company; Mr. L. C. Fritch, chief engineer, Chicago Great Western Railway; Mr. E. H. McHenry, vice-president, New York, New Haven & Hartford Railroad. Its report is dated Oct. 18, 1909. It is short, and as it is of importance as a carefully considered expression of opinion from a committee of the leading steam-railroad companies of the country in relation to electrification, it is given in full, as follows:

"The committee on electrical working held its first session in New York City on Oct. 6, 1909. At this session the permanent organization of the committee was effected by the election of Mr. George Gibbs as chairman, and discussion had of its best usefulness to the association.

"In the short time elapsing between organization of the committee and the meeting of the association, it was impracticable to prepare a lengthy report, or, indeed, to formulate definitely the lines of action which will be of greatest usefulness to the association. When it can be done properly, a report will be presented to the association, giving the present status of electric traction as applied to railway operation under steam-railroad conditions. In the meanwhile, the committee holds itself in readiness to make recommendations upon specific questions.

"As this committee supersedes the committee on standard location for third-rail working conductors, and as the latter committee had at the date of its last report some questions still under consideration, it was decided by the committee on electrical working to appoint a subcommittee, consisting of Messrs. Gibbs, Fritch and Isaacs, to give special consideration to third-rail and overhead working conductor clearances.

"Another subject discussed by the committee and considered by it of present importance is that of standardizing the location of electric connections between cars of passenger trains, especially the connections of electrically equipped cars for multiple-unit train operation. The connections are required for controlling current to the cars, for heating, lighting, etc., and they occupy considerable space at the ends and between platforms of coupled cars. It is considered that it will be useful to the members of the association to have information as to these electrical requirements, as well as suggestions for standard locations which will permit of their proper installation without interfering with the functions of other connections, such as couplings, air brakes, etc. A sub-committee, consisting of Messrs. Deems, Harahan and McHenry, has, therefore, been appointed to consider this subject in order that it may be brought to the attention of the association as soon as practicable.

"A third subject has been considered by the committee, namely, the effect of the electrical working of railways upon automatic signaling systems. The conclusion of the committee will be brought out fully in a subsequent report, but it may be of use to the members of the association to know that the electrical working requires the adoption of an alternating-current

track circuit for signals instead of the direct-current track-circuit control heretofore in general use. It would seem advisable, therefore, that in the installation of any new automatic signaling an alternating-current track circuit should be employed and that extensions to existing systems should also be made in the same way. This recommendation applies not only to roads contemplating the adoption of electric traction, but to those in localities where electric traction is, or may be, employed upon nearby roads."

The meetings of the association are not open to the public, but so far as can be learned, there was no discussion on this report, which was accepted. The committee was continued.

Competition in Telephone Service.

Mr. J. B. Ware, of Grand Rapids, Mich., secretary and treasurer of the National Independent Telephone Association, addressed the Electric Club of Chicago at its weekly luncheon on Dec. 22, on "Telephone Development and the Benefits of Competition." Mr. F. P. Vose, the president of the club, after a gracefully worded reference to the amenities of the season, said that the club had listened the week before to one who advocated monopoly in the telephone-exchange business (Mr. Sunny), and, being fair-minded, it was now pleased to entertain an advocate of the competitive idea.

Mr. Ware at the outset briefly sketched the history of the use of the telephone in this country, referring to the early competition in the business between the Bell and the Western Union companies. This early competition was fortunate, in the speaker's judgment, in favoring the rapid development of the invention. But from about 1882 to 1894 there was a practical legal telephone monopoly in this country in favor of the American Bell Telephone Company. Mr. Ware presented figures to show that the average gain in telephones installed during this period was only a little over 8 per cent. From 1894, when there was the first possibility of competition, to 1904, there was an average gain of 64 per cent a year in the number of Bell telephones installed. This showed the benefit of competition on the Bell companies themselves.

In 1907, according to the census figures of the United States Government, there were about six million telephones in use in this country, and this number was about equally divided between Bell and Independent companies. In the number of companies engaged in exchange service, however, the disparity in favor of the Independents was very great, the number of Independent companies being 22,900, whereas there were about 30 Bell licensed companies. The speaker believed that the remarkable growth of the telephone industry would have been impossible without the spur of competition. Better still, the quality of service was greatly improved by reason of the same spur. The introduction of metallic circuits was given as one evidence of an improvement forced by Independent competition. Mr. Ware also doubted whether the granular carbon transmitter would have been adopted generally without competition.

Only through the spur of competition is it likely that the residence business in cities and telephone business generally in small communities would be extended. Telephone rates vary, not according to the cost of service, but according to the classification of service. It is a business of averages. There is a temptation to develop the highly profitable class of service and neglect others; competition corrects this in a large measure. It is difficult, even by municipal regulation, to force a monopoly to develop telephone business in the outskirts of cities or in small towns and villages. The people of the United States generally have found this out, and the growth of Independent telephone systems has been the result. If 15 or 20 large cities were deducted from the Bell telephone returns, the remainder would make a woeful showing in comparison with the corresponding Independent figures.

Referring to the argument against useless duplication of telephones by competition, Mr. Ware said that this danger was greatly over-estimated. He gave figures resulting from checking the telephone directories of 43 cities where competition exists and showed that in a number of Illinois cities outside of Chicago under these conditions the duplication of telephone subscribers was 8.7 per cent. The average in other States is not far from this, Kansas City, Mo., with its 13.7 per cent, having practically the highest proportion of duplications found. The speaker believes that competition means better service and better rates, although he did not go into the question of rates extensively. Monopoly, he thinks, means slow development and inferior service.

In closing, Mr. Ware cited the example of the Citizens' Telephone Company in Grand Rapids, Mich., an Independent company, which has paid 8 per cent dividends regularly for 12 years. He said that he believed the Independent telephone-exchange industry offered a safe field for investment.

Cost and Depreciation of Steam and Hydroelectric Installations.

In the discussion of the paper by Mr. Henry L. Doherty presented before the American Institute of Electrical Engineers on Dec. 16, Mr. Calvert Townley and Dr. Cary T. Hutchinson gave much valuable data relating to the cost and depreciation of steam and hydroelectric installations. The estimate given by Mr. Townley on a 5000-kw hydroelectric development having a peak load of 4000-kw at the generating station and an average yearly load-factor of 30 per cent, was $125 per kilowatt for the development up to the transmission line. A 4000-kw substation equipment would cost $8 per kilowatt and a transmission line $50,000; the average loss in the line and substation was estimated at 10 per cent. The minimum flow of the assured steam being equivalent to 1000 kw, it would be necessary to install a 2500-kw steam relay with a 50 per cent overload range; the steam relay equipment would cost $100 per kilowatt of rated output. The annual labor and maintenance cost to operate the hydraulic station, substation, and to maintain the property, would be $25,000, and the cost to operate the steam relay plant and supply the inefficiency of power during two months and to hold it ready for emergency service at all times would be $3000 per year.

TABLE I.—COST OF 5000-KW HYDROELECTRIC DEVELOPMENT AND STEAM RELAY.

5000 kw at $125	$625,000
Pole line	50,000
Substation, 4500 kw at $8	36,000
Steam relay, 2500 kw at $100	250,000
Total investment	$961,000
Fixed charges, 10 per cent	$96,100
Operating and maintenance cost of hydraulic plant	25,000
Operating and maintenance cost of the steam plant	3,000
Total annual cost	$124,100

The total annual output of the above plant would be 13,140,000 kw-hours, of which 10 per cent would be lost in transmission, leaving 11,826,000 kw-hours for sale. The total cost per delivered kw-hour would be 1.05 cents.

The service assumed above could be obtained from a 4000-kw steam turbine plant, having a 50 per cent overload range, located at the point of utilization. Such a plant would cost $100 per kilowatt of rating. The labor and maintenance charges would be $25,000 per year. The coal consumption would be 3 lb. per kw-hour at a cost of $3 per long ton.

TABLE II.—COST OF 4000-KW STEAM TURBINE INSTALLATION.

4000 kw at $100	$400,000
Fixed charges at 12 per cent	48,000
11,826,000 kw-hours fuel cost	47,304
Other operation and maintenance charges	25,000
Total operating and fixed charges for the year	$120,304

On the basis of these values the cost per kw-hour would be 1.01 cents, which is slightly less than the estimate for the hydroelectric installation.

Table III shows an estimate made by Dr. Hutchinson as to the proportional cost of the several items entering into the total investment of a medium-head hydroelectric generating and transmitting plant.

TABLE III.—SUBDIVISION OF COST OF PLANT.

Item.	Proportional Cost.
1. Riparian rights for dam and flowage basin, real estate franchises, organization expenses, preliminary legal expenses, cost of financing, removal of railroads, highways, bridges and all expenses preliminary to actual construction work	20.00
2. Permanent construction, dam, power house and water ways, etc.	30.00
3. Equipment of power house	14.00
4. Transmission System.—	
a. Right of way	4.50
b. Copper	1.50
c. All else	7.00
Sum	27.00
5. General expense, engineering, administration, legal, etc	11.00
6. Interest during construction	12.00
Total	100.00

Item 1 of Table III covers the many costs that must be met, exclusive of the actual construction costs; Item 2 is principally made up of rock excavation and concrete. Item 3 is for the usual equipment, comprising water wheels, generators, switchboard apparatus, transformers and the various small parts of the power-house equipment. Item 4 covers the transmission system, including substations. Items 5 and 6 are self-explanatory. Of these items only 2, 3 and 4, comprising in all 57 per cent of the total, are subject to depreciation, and of these the greater portion of No. 2 is not subject to depreciation, as it covers rock excavation and concrete almost entirely. In Table IV is shown the depreciation of the several parts of the installation.

TABLE IV.—DEPRECIATION OF SYSTEM.

Items of Table I.	Proportional cost.	Assumed life years.	Annual amount for depreciation, in per cent of total cost.
1.	20	..	....
2.	30	50	0.168
3.	14	20	0.458
4.	13	25	0.415
5.	11	..	....
6.	12	..	....
			1.041

The annual charges being compounded at the rate of 4.5 per cent, the equivalent average life is about 39 years.

The various items forming the power-house equipment were assumed to have the costs and depreciation shown in Table V.

TABLE V.—COST AND DEPRECIATION OF EQUIPMENT OF POWER HOUSE.

Item.	Proportional cost.	Life years.	Annual amount for depreciation per cent of total cost
1. Stop logs, gates, and other wood exposed to air and water	0.80	5	0.146
2. Flooring, roofing and hardware, and miscellaneous fixtures	0.80	15	0.472
3. Tile wainscoting, sewage, plumbing system and metal window frames, etc.	2.45	15	0.118
4. Electric light and telephone	0.80	10	0.065
5. Switchboard equipment	4.35	10	.355
6. Cables and heavy wiring	3.90	10	.318
7. Cranes	1.25	15	0.060
8. Water wheels	33.75	25	0.157
9. Water wheel governors	2.90	10	.235
10. Generators and transformers	40.00	25	.898
	100.00		3.423

An annual depreciation of 3.423 per cent represents an equivalent average life of 19 years for the power-house equipment. The transmission line costs and depreciation were given as in Table VI.

TABLE VI.—COST AND DEPRECIATION OF TRANSMISSION LINE.

Item.	Proportional cost.	Life years	Annual amount for depreciation in per cent of total cost.
1. Right of way	17.	..	.
2. Towers	18.4	15	.885
3. Special structures	5.1	10	.415
4. Insulators	3.1	10	.170
5. Copper	34.7	25	.530
6. Installation	22.	..	..
	100.0		2.000

A 2 per cent depreciation is equivalent to a life of about 26 years for the transmission line.

TABLE VII.—DEPRECIATION OF SUBSTATION.

Item.	Proportional cost.	Life years.	Annual amount for depreciation in per cent of total cost.
1. Land	6.0	..	.
2. Buildings	36.	25	.67
3. Transformers	40.	20	1.28
4. Switches, etc.	16.	10	1.29
5. Installation	8.	.	..
	100.		3.24

The equivalent average life of the substation is 20 years. An estimate of the relative fixed charges on steam and water-power generating plants, expressed in per cent per annum, is given in Table VIII.

TABLE VIII.—FIXED CHARGES OF STEAM AND WATER-POWER GENERATING PLANTS.

	Steam.	Water.
Interest	6.00	6.00
Insurance	0.50	....
Taxes	0.50	0.50
Depreciation	5.00	1.00
Obsolescence	5.00	1.50
	17.00	9.00

In Table IX are shown the estimates for the cost of energy in cents per kw-hour for steam and water-power plants. These values are based on the assumption of a fixed annual charge of $13.60 per kilowatt plus an output charge of 0.5 per kw-hour for the steam plant and a fixed charge of $20 per kilowatt of demand on the water-power plant.

TABLE IX.—COST AND SELLING PRICE OF ENERGY PER KW-HOUR AT VARIOUS ANNUAL LOAD FACTORS.

Per cent. Load factor.	Cost of kw-hour in cents. Steam plant.	Water plant.	Selling price water power.
15	1.74	1.35	2.41
25	1.13	0.91	1.46
33	0.97	0.69	1.10
40	0.89	0.57	0.92
50	0.81	0.46	0.73
60	0.76	0.38	0.61
75	0.71	0.31	0.49

It is evident that at a high value of load-factor the hydroelectric plant can show a much larger profit than the steam plant, while the profits decrease as the load-factor becomes less. In the last column of Table IX is shown the price, at various load-factors, at which energy from the hydroelectric plant must be sold in order to produce a profit of 6 per cent on the investment.

Low-Tension Feeder Calculations for Street Railways.

At a joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the American Institute of Electrical Engineers, held on Dec. 22, Mr. R. H. Rice, assistant engineer, division of electrical transmission and distribution, of the Board of Supervising Engineers, Chicago Traction, read a paper on "Low-Tension Feeder Systems for Street Railways," which was followed by interesting discussion, during which Mr. H. M. Wheeler, assistant chief engineer, Chicago Railways Company, presented curves and methods useful in studying the interrelation of headway, speed and time and distance spacing of cars.

Mr. Rice first called attention to the extent of the surface transportation facilities in Chicago. The rehabilitation of the railway companies included 687 miles of track, the cars on which are operated from 15 distributing centers with a total rating of 95,000 kw. Only two of these distributing centers are steam-power plants. The calculations of the feeders for supplying electricity for these systems were based on the operation of 2264 cars. Alternating current at 9000 volts is purchased from the Commonwealth Edison Company and transmitted to substations. At the present time direct current is distributed to the cars at a pressure a little below 600 volts. When the rolling stock has been rehabilitated and the old motors replaced by those of later design 600 volts will be carried on the distributing network. The trolley wires are all sectionalized, and each section is fed through one or more independent cables. Trunk tie lines between the substations are not used, but certain sections of the trolley wires are fed from two stations, and the total capacity of these double-fed sections is sufficient to answer the need for tying together two stations. In case of a breakdown one station can thus distribute current through the trolley sections jointly fed, and this current in turn be distributed from the busbars of the inoperative station.

Mr. Rice described very completely the methods followed in calculating the design of the overhead construction and dealt in particular with the system used in determining the proper location for substations and the size of feeders. The length of

trolley sections is determined by operating conditions. Preliminary to this work it was necessary to obtain a figure for the power consumption of a standard type car. Fifteen tests, extending over three days' time, were made for this purpose. The cars were equipped with meters and careful logs were kept. Also, typical trolley-wire sections were chosen and arrangements were made to keep a careful count of the number of cars on the section and to measure the power fed to the section from the substation. As the maximum peak of the day in Chicago occurs in the afternoon, the above investigations were carried on from 12 m. to 8 p. m.

To determine on what basis to design the feeders, careful curves were plotted showing the railway load throughout the day. It was interesting to note that for one substation on the Chicago Railways Company the maximum swing is 15,600 kw. A two-hour average value was chosen as a basis for the maximum load to be fed out of a substation. Considering that a potential of 600 volts is carried on the direct-current busbars, a capacity of 40 kw per car was used to determine the required substation capacity. An average drop of 50 volts was to be permitted in the direct-current distribution system.

In the work preliminary to laying out the distribution system a map of the railway is first drawn and the location of the cars during the afternoon rush-hour is shown. With a demand of 75 amp from each car the concentrated load on each trolley section is next indicated on another map of the section. With these concentrated loads thus exhibited the center of gravity or the center of load is obtained in a way similar to the solution of a problem in moments. The number of amperes on each section and its relation to the center of load for the district determine the location of the substation and the capacity of the generating apparatus in that station. After the substation locations have been so chosen a feeder-route diagram is made showing the location of the trolley feeders on the streets, their size and loads. The ordinances under which the Chicago Railways Company and the Chicago City Railway Company are being rehabilitated specify a certain territory within which all feeders should be carried underground. Mr. Rice exhibited drawings showing the typical feeder connections and stated that the underground work was built with a view to future increase in load.

Mr. E. N. Lake, division engineer of electrical transmission and distribution, Board of Supervising Engineers, Chicago Traction, called attention to the lack of literature on the subject of feeder calculations for large street-railway systems. It is interesting to note that, based on the 1,000,000 circ. mil cable, which is taken as standard, and an assumed load of 800 amp and an allowable drop of 50 volts, 6000 ft. was found to be the limiting economical distance for feeding. In other words, under these conditions the ideal street railway system would have its substations so located that the average length of cable would not exceed 6000 ft. Two of the largest street-railway systems in Chicago now have an average length of direct-current feeder of 6700 ft.

Practical Operation of Electric Trucks.

The regular monthly meeting of the Electric Vehicle and Central Station Association was held at the Massachusetts Institute of Technology, Boston, on Dec. 20, with President F. J. Stone in the chair. President Stone opened the meeting with a pleasing reference to the "attitude of Missouri" on the electric vehicle question, as indicated by the progressive work of the Anheuser-Busch Company and the Union Electric Light & Power Company of St. Louis. Discussing a recent visit to New York, he stated that in one commercial house 32 out of 35 motor-vehicles were of the electric type, and the head of the transportation department stated that the cost of operation of the electric was one-third that of the gasoline machines. This was accounted for by the lower cost of insurance, tires, labor and repairs. In another house 20 electrics out of 23 trucks were in service, the first electric machine having been in operation nine years. In another case it cost only $65 per month to cover garaging, cost of energy, care and minor repairs of a five-ton truck of the electric type. In the case of a gasoline truck the gasoline alone amounted to this sum. This electric machine makes 13 trips per day, carrying 65 tons of freight; whereas the company's horse-drawn vehicles could make only eight trips with a total of 40 tons for the day's work. The electric vehicle with a 10-ton total weight easily climbed a 7 per cent grade. Four tow horses had to be used with the horse-drawn machines. This electric machine was making daily runs of 25 miles.

Mr. Stone said that Postmaster Morgan, of New York, is most enthusiastic over the record of electric vehicles in United States mail service. Some of the cars in New York have averaged 51 miles per day since entering the service. One of the batteries ran 5955 miles before any cleaning or other work was done upon it. Many of the largest concerns in the country are using electric vehicles with complete success. The work and expense in the development of this field are not as great as many central-station organizations seem to think.

The paper of the evening was prepared by Messrs. Frank A. Clark and Albert L. Clough, of Manchester, N. H., on the "Use of Electric Trucks at the Works of the Amoskeag Manufacturing Company, Manchester," one of the largest textile plants in the world, and employing over 16,000 persons. Mr. Clark is electrical engineer of the company. On account of his enforced absence the paper was read by Mr. Day Baker, of the General Vehicle Company, Boston. The Amoskeag company has five trucks in operation, all being of the electric type, and with haulage ratings varying from 1.5 to 5 tons. These operate mainly in the mill yards, which are over 150 acres in area, with a maximum length of two miles. Electric haulage was introduced about 2½ years ago in place of horses. A three-ton Columbia truck was the initial installation. The latest equipment is provided by the General Vehicle Company. It is probable that in the future all haulage by horses will be superseded in the plant. There are about 15 miles of concrete and paved roadways in the yards. The results indicate that there is a large saving in electrical operation compared with horse traction.

The company maintains a garage 90 ft. long and 70 ft. wide, the building being of fireproof construction and the approaches of tar concrete. The floor is of cement concrete, drained to the sewer. In the main the interior finish is white. Enclosed arc lamps provide the general lighting and each post carries a receptacle attachment from which an incandescent lamp cord may be carried over the floor. The wiring is in underground conduit or molding, and automatic sprinklers are in service, with standpipe and hose connections. The heating of the garage is effected by overhead pipes supplied with steam from the company's power plant. Compressed air service is available for cleaning and tire inflation. The sides of the garage are equipped with lockers, drawers, shelves, cabinets, compartments, and sacks for the storage of supplies, with a workbench for light repairs. A steam-heated distilling equipment is installed, with provision for the filling of carboys and the supplying of all parts of the floor with distilled water for use in the batteries. A concrete washstand is installed, and beneath each car is provided a drip pan of galvanized iron coated with asphaltum to avoid damage from spilled electrolyte.

A runway is installed over which cars may be operated for changing batteries. Between the guide rails of the runway is the platform of a hydraulic elevator which is used to lift the batteries to the cars and to take them away. A chain-and-falls is installed for handling the batteries. The garage is also provided with an inspection pit, and tire-setting machinery and apparatus for lead burning are installed. The batteries are charged either from the company's 10,000-kw private plant or from the lines of the local central-station organization, through a 37.5-kw motor-generator set. A feature of the switchboard is a Bristol recording ammeter, with locked cover, its record acting as a check upon the employees as to the times of starting and stopping the charging and the number of cars on charge. An adjustable water rheostat, with water and sewer connections, is provided, and also a Cutler-Hammer rheostat with a range

of from 5 amp to 60 amp, used frequently in charging ignition batteries. Charging plugs are located upon each post in the garage, and special holders are provided to protect the plugs from defacement through rough usage. A steam-heated sand supply is installed, as all cars carry sand boxes for use on the grades of from 10 to 17 per cent which are found in the mill yard. The reserve equipment consists of three complete batteries on trucks, and a full line of tires, chains, gears, brush rigging, cell parts, etc. So far as possible the equipment is standardized, in order to minimize the number required in the stock section of the garage. Batteries on the reserve list are charged at a low rate, not exceeding 10 amp. The nightly service charges of the batteries are 12 hours long, and consequently at a lower rate than that specified by the battery makers. The low rate conduces to long life.

Thorough inspection of the cars is made nightly, covering all contact parts, the filling of cells with distilled water, tests of a pilot cell, and recording of troubles. Chauffeurs report for duty in the morning in time for oiling and a general inspection of the mechanical equipment of each truck. A minute mechanical inspection is made of each car on Sundays. A blue print of each battery with cell numbers is posted in the garage, to facilitate the handling of the cells and the making of records. Each battery is washed three times during its life. In this installation the company makes a practice of renewing each battery once a year, including negatives, positives, and separators. As each car is run from 20 to 25 miles per day, or about 7000 miles per year, it is found better to renew all parts than to use the negatives twice over. Use is made of solid tires which last for about 5000 miles. Tops are used only in rainy weather. The drivers are mostly employees formerly occupied in the handling of horse-drawn vehicles, a slight increase of pay being granted to chauffeurs. The majority of the care are run over the same route daily, the principal use being to transfer rolls of goods between different mill departments. The cars are out of commission for from 0.4 per cent to 1.4 per cent of the time. The latest trucks purchased are equipped with single motors, commutated field control, silent chain transmissions and anti-friction countershafts and wheels, and they handle the same work with 30 per cent less energy than the older trucks with two-motor equipment, series parallel control, spur gearing and plain bearings.

In the discussion, Mr. Baker stated that the mileage was affected about 12 per cent in winter on account of the icy grades, but the cars negotiate the hills at all seasons. Two men constitute the maintenance force. He called attention to the fact that a yearly renewal of the batteries is the most severe condition which one can ordinarily find, and yet the company is convinced that there is a very substantial saving in the use of the electric vehicle compared with horse-drawn equipment. The cost of energy is an insignificant item from the mill plant, but even if the company had to pay 4 or 5 cents per kw-hour the energy charge would still be a small factor in the situation. Mr. F. J. Stone cited the use of eight electric trucks in the yard of the Pacific Mills of Lawrence, Mass., and of similar equipment in the mills of the Pepperill Manufacturing Company at Biddeford, Me., and of the Nashua Manufacturing Company, Nashua, N. H. The meeting closed with a short review of the advantages of the electric pleasure vehicle in its field or urban and suburban service. President Stone stated that the association will shortly have a meeting devoted to this particular subject, and cited the remarkable growth of electric pleasure vehicle service in Rochester, N. Y., several vehicles being used in the same family in one or two cases. Mr. S. G. Thompson, of the Studebaker Company, described a successful pleasure vehicle trip to Plymouth and Pawtucket.

Steam Trawlers and Ocean Cables.

Increasing attention is being called to the respective rights and relations of steam trawlers and of submarine cable owners. During the last quarter century the deep-sea fishing industry has been largely remodeled upon the basis of the small steamer towing a net. At the present time there are more than 2000 of these steam trawlers under register; about 80 per cent of them are British, comparatively few being in service, as yet, on the American coast. They are usually about 120 ft. long, with a few hundred tons displacement, and with engines of 80 hp. They operate either singly or in fleets of half a dozen, all over the shallow waters of western Europe, from the Arctic circle to the southern limit of Morocco. They have gradually increased their working depths until now they operate down to 300 fathoms or over. Each boat usually carries a crew of nine men in all, and the operating expenses of a trawler are about $500 weekly. Consequently, the steam-trawling interest represents in the aggregate a large personnel, invested capital and food supply for Europe.

The methods employed to keep a steam-trawl net moving over the sea bottom are very interesting. The net is commonly about 60 ft. wide at the bottom, and is fastened to two boards, one at each end of the foot-rope, or lower edge of the net. These boards, called otter boards, are about the size of a billiard table, and are made up of wood slabs, some 3 in. thick, rimmed with iron. They are water kites, being held near the center of one face by a steel rope and fastening. The steel rope forms the kite string, the otter board the kite, and the trawl net the kite tail. When the steamer goes over the ground at a speed of 2½ or 3 knots the two otter-boards skim over the bottom, each towed by a steel rope. They keep nearly in a vertical plane and tend to pull apart like a pair of kites heading away from each other, but kept in harness by the trawl net between and behind them. Such fish as come within the scope of the advancing net are unable to escape the rush of water, and are finally hauled up by winding in the steel ropes.

Steam trawlers naturally work along and across the numerous ocean telegraph cables, the nets and otter-boards passing over them hundreds of times without any interference. Occasionally, however, an otter-board engages a cable. This is either because there is some slight projection on the edge of the board, or possibly because the cable may be festooned from one submarine hillock to another, thus permitting the otter-board to work underneath the cable. When a trawler is unlucky enough to engage a cable it is a battle between rope and rope. The trawler winds in her warps as best she can. If the cable is very strong and taut, and the water deep, the warps break and the trawler loses net, catch, otter-boards and warps, to say nothing of time and temper. If, however, the cable is not very strong, the warps may hold and the cable may break, involving the cable company in much loss of money for traffic and repairs. Or the cable may be raised to the surface and be disengaged by the fishermen without rupture, but yet be injured, and put out of working order, by reason of the sawing and chafing it is subjected to under the plunging of the trawler in a heavy sea. In any case, the danger to the cable is very great.

Representations and protests have been made to the British Government latterly with increasing vigor by the representatives of the cable companies, particularly by the Atlantic cable companies, which claim that, off the coasts of the British Islands, their cables have been broken by trawlers nearly 40 times within the past 10 years. They regard the steam trawler as the greatest existing menace to submarine cables, and intimate that some day cable communication between Europe and America may be entirely severed by these depredations.

A board of inquiry was appointed last year by the British Postmaster-General, and this board has since published its findings, as well as the testimony taken from both of the parties in interest.

A suggestion was made, on behalf of a cable company, that a certain fishable area to the west of Ireland in the Atlantic cable zone and including about 2500 square nautical miles, should be proscribed to trawlers by legal enactment. The board did not suport this contention, partly because the closure of one such area would probably lead to the similar closure of various other fishable areas, to the great detriment of the fishing industry; besides which, the proscription could only be enforced by international agreement and much naval police duty.

The board acknowledged, however, the seriousness of the danger to submarine cables, and recommended closer and more harmonious relations between the cable and trawler interests for co-operation toward their mutual protection; also the proper official inspection of the otter-boards of outgoing steam trawlers at each port, and the replacement of lighter by heavier armored cable in fishable waters.

The report of the board seems, on the whole, very reasonable and fair. There is no doubt that the steam trawler is an institution that has come with its mind definitely made up to stay and to fish. There are likely to be more steam trawlers in future, rather than less, and they are likely to increase rather than to contract the zones of their operations. On the other hand, there is nothing except sunken wrecks that a steam trawl captain detests more than a hooked submarine cable, and he is likely to do all in his power to minimize the chance of hooking a cable so long as he is allowed to dredge over the bottom.

The best plan appears to be to improve the designs of otter-boards and to keep them carefully inspected. After that is done, there will still be cases, probably, of cables accidentally caught by trawlers, but these are likely to be less numerous than the cases of cables hooked accidentally by the deep-sea anchors of fishing vessels. Meanwhile it is to be hoped that fishermen can be shipped occasionally on cable vessels and cable men on fishing trips for the better mutual information of each other's ways. The proscription of thousands of square miles of land at the bottom of the sea is not an easy task to agree to internationally, and it would be practically impossible at the present time to enforce, even if agreed to. The distribution of charts among the fishermen showing the locations of the cables would naturally do no harm, but since a large number of that worthy folk never own a sextant and find their way home by compass, lead and special Providence, the information would be of rare avail.

Wisconsin Rate Commission News.

A considerable number of applications for modifications of rule No. 17 of the standards for gas and electric service have been granted by the Wisconsin Rate Commission recently. This rule states that all service meters shall be tested at least once a year; this test to be made at light load, half load and full load, the meter being connected in service. The applications come from the smaller companies who find it either impossible to complete the tests on time or who find it impossible to test the meter while connected in service. The commission in some of the cases has granted the extension of time asked for and in the others has permitted the tests to be made at the station.

The commission has modified rule No. 23, relating to a voltage fluctuation of not more than 6 per cent of the minimum, in the case of the Milwaukee Electric Light & Railway Company. This was done to enable the company to supply a small amount of lighting service from its power mains.

In connection with the cases against the Manitowoc and Hudson Electric Light companies alleging poor service and excessive rates, the engineers of the commission have made inspection tests of the services rendered by those companies. In the case of the former company voltage records were taken at various places in order to show, as nearly as possible, the regulation of the entire system. Ten records were taken, of which none shows a variation of less than 6 per cent of the minimum, the percentages varying all the way from 7½ to 24 per cent.

From tests made upon 28 of the companies' meters, chosen at random, only two were found to be within the requirements of rule No. 15, which states that "no electric meter shall be placed in service or allowed to remain in service which has an error of registration in excess of 4 per cent on light load, half load, or full load." It was found that a large proportion of the meters tested considerably under-registered the power used on light load. The percentage variation varied from 30 per cent slow to 30 per cent fast on light load and only 80 per cent of the meters registered within the 4 per cent limit at full load. This condition of affairs existed notwithstanding the fact that all meters had been tested and adjusted every other year by an employee of the company which built the meters.

The inspection made on the Hudson plant by the engineers of the commission showed that of the six voltage records made to determine the general voltage regulation, none was within the 6 per cent limit, but that the voltage fluctuations ranged from 7 per cent to 18 per cent.

This condition is partially accounted for by the fact that in one of the two power stations operated by the company where hand regulation had to be employed, there was no ammeter in use in the switchboard. Surprising as this condition of affairs seems to be, the engineers of the commission have found many cases of similar kind in other plants inspected by them.

The tests of the company's meters showed that the company was suffering through slow meters and that there were practically no fast meters. Of the 25 meters tested, 12 were found to meet all requirements—between 96 per cent and 104 per cent of absolute accuracy—and 13 were so far from accuracy as to merit condemnation.

The engineers of the commission spent several days in the city of Appleton making tests and examinations to determine whether or not the electrolytic action caused by the return electric railway currents had materially affected the life of the cast-iron water pipes. These tests, which were made in connection with the Appleton Water Works valuation case, failed to show conclusively that the electrolytic action had damaged the pipes sufficiently to affect their useful life, although a difference of potential of 1.2 volts positive existed between the water main and the rails.

Massachusetts Commission News.

The Massachusetts Gas and Electric Light Commission has issued a decision approving the purchase by the Edison Electric Illuminating Company of Brockton of the Bridgewater Electric Company. The board calls attention to the benefits of the consolidation in relation to the recently completed plant of the Brockton Edison Company at East Bridgewater. The Brockton company is now supplying electricity in Brockton, East Bridgewater, Bridgewater, Stoughton, Whitman, Abington and Rockland, and the plans of distribution include service in Cohasset and Scituate. The board states that "the Bridgewater company charges relatively high prices for its electricity and has never given a day service. With a restricted territory it has had a serious struggle for existence, and has never paid any dividends. By consolidation with the Brockton company its customers will receive at once the benefit of the latter's present prices and service, and the facilities will not be diminished, but increased thereby. Along with these obvious advantages in Bridgewater, it is reasonable to expect that the Brockton company by this extension of its business may improve its station load and incidentally to some extent increase the efficiency and economical operation of the plant."

The board has also approved the petition of the Edison Electric Illuminating Company of Brockton for the right to issue additional stock of the par value of $160,000, at a price of $140 per share, and for the purpose of paying promissory notes purchasing the property of the Stoughton Gas & Electric Company and paying the cost of additions to the company's plant.

Canadian Hydroelectric Commission News.

A new system of accounting for the electrical systems which is intended for the use of the municipalities taking power from the Hydroelectric Commission will be formulated within a short time. The commission at a hearing on Dec. 21 discussed the matter and appointed the following committee: A. C. Neff, representing Guelph; J. W. Scully, of Berlin; F. G. Jewell, of London, and R. R. Sweaney, of Toronto, who will be assisted by the Toronto city accountant and W. S. Andrews, who acts in the same capacity for the commission. A report will be prepared promptly and submitted to the Ontario Railway & Muni-

cipal Board. It was felt that if the municipalities were left to prepare their own system that there would be a lack of uniformity. At the present time the municipalities are required to report to the Ontario Railway Board, and it was thought to be of advantage to have a uniform system of accounting included in the reports to be made by the corporations using electric power to the Railway Board.

Hon. Adam Beck, Minister without portfolio in the Ontario cabinet and chairman of the Hydroelectric Commission, has been nominated and is being strongly urged to enter the contest for the Mayoralty of the city of London, his home city. On nomination day, Dec. 23, Hon. Mr. Beck failed to qualify, thus signifying his intention of not wishing to be again Mayor of London.

New York Public Service Commission News.

The Public Service Commission of the First District of New York has had additional hearings upon the second plan proposed by the reorganization committee of the bondholders of the Third Avenue Railroad Company. In the hearing last week Harry Bronner, of Hallgarten & Company, bankers, representing the bondholders, said that he considered it his duty as a member of the committee to protect to the full extent the principal and interest of the bondholders. Also, that the committee sincerely believed in the future of the Third Avenue company in regard to earnings, and that the junior security holders would reap their reward in the development that would come in the future under the present plan. When asked by Chairman Willcox if the company was able at this time to earn interest on a capitalization of $54,000,000, the amount suggested in the new plan, Mr. Bronner said that he did not think that it was, but that he believed that the possibilities were such that it would be able to earn an assured interest on this amount within a few years. There was a final hearing on this plan Dec. 27, and the decision of the commission is expected within a short time.

Acting upon a communication from the Public Service Commission of the First District, Attorney-General O'Malley has instituted proceedings against certain street railway companies operating in Manhattan for forfeiture of their franchises, on the ground that the companies have abandoned the operation of the lines. This action was taken in the cases of companies which have been simply running a few horse cars in order to hold franchises.

The Coney Island & Brooklyn Railroad Company has asked the Public Service Commission for a rehearing of its application for permission to issue $327,000 in bonds. The commission previously allowed the company to issue $107,000 of bonds. The rehearing was set for Jan. 17.

The Board of Estimate and Apportionment has granted the modified franchise asked for by the South Shore Traction Company to operate a line from the Manhattan end of the Queensboro Bridge to points in Queens County. Right was given to the company by the Board of Estimate about two months ago to use the bridge under an amended franchise granting more liberal terms than the original franchise, but an injunction was granted on the application of a citizen preventing further action in the matter. This injunction was upheld in the Supreme Court, but last week the Appellate Division of the same court reversed the first ruling, leaving the way open for the Board of Estimate to grant the franchise desired.

At the hearing before the commission as to why side-door trains were not operated throughout the day instead of being operated only in the rush hours, Mr. Frank Hedley, general manager of the Interborough Rapid Transit Company, stated that while the operation of these trains saved 20 seconds at each station stop during the rush hours, he considered that it was not necessary to operate them when traffic was light. Trains at this time were upon sufficient headway not to need the saving of time, and he believed that the use of side doors tended to add to the possibility of accidents. He stated that at the present time there were 17 side-door trains in operation, which number was in excess of the original order made by the commission.

The Public Service Commission of the First District has issued a preëmptory order directing the equipment of all the surface cars operated in the congested traffic parts of Brooklyn with wheel guards, as well as protecting fenders. This order is additional to the general order issued last summer upon the same topic.

The Public Service Commission of the Second District has granted permission and approval to the Mineville Light, Heat & Power Company to exercise franchises granted by the town of Moriah to operate in the villages of Mineville and Witherbee and also to issue capital stock to the amount of $10,000, of which $3,634 is to be issued for the purchase price of an electric plant heretofore constructed by the firm of Witherbee, Sherman & Company and the remaining amount to be issued for cash and the proceeds used for extension, improvement and enlarging the plant.

CURRENT NEWS AND NOTES.

WIRELESS TELEGRAPHY.—At a meeting of the Pittsfield Section of the American Institute of Electrical Engineers, held on Dec. 21, Dr. A. E. Kennelly delivered a lecture on "The Mechanism of Wireless Telegraphy."

BONUS FOR EMPLOYEES.—The United States Steel Corporation has offered to distribute to the officers and employees of the corporation and subsidiary corporations a bonus of over $2,000,000. This amount, which is determined by the annual earnings, is being paid 60 per cent in cash and 40 per cent in preferred stock at 124, or common stock at 90, in accordance with the wishes of the recipients.

AUSTRALIAN PATENT LEGISLATION.—The Australian Federation has enacted laws similar to the new patent laws of Great Britain, which have created considerable apprehension in the mother country, it being feared that British manufacturers will have to establish branches in Australia or lose their trade. It has been suggested that a reciprocal arrangement on the subject be made with Great Britain, which would in effect be a trade preference.

ELECTRICAL TRADES SOCIETY OF NEW YORK.—At its fourteenth annual meeting, held on Dec. 14, the Electrical Trades Society of New York elected the following officers: President, Mr. P. M. Haight; vice-president, Mr. W. B. Wallace; treasurer, Mr. W. H. Roberts; secretary, Mr. Frank Neilson. During the fiscal year the society handled about 4000 claims, aggregating more than $250,000, of which 78 per cent was collected through the association's efforts.

THE METRIC SYSTEM IN DENMARK.—The Danish Minister of Commerce has just decided that the metric system alone is to be employed in Denmark on and after April 1, 1910, in all custom houses and in connection with all public taxes. This decision is in conformity with a law voted by the Danish Parliament in 1907, which prescribed the adoption of the metric system in Denmark within three years in all matters pertaining to the operation of the customs and to public taxation. The date fixed for the general application of the metric system in commerce is April 1, 1912.

TELEPHONE IN SNOW STORM.—The New York Telephone Company has called attention to the proved reliability of the service from its underground circuits during the violent snow storm on Dec. 25 and 26, when transportation systems were not in operation and many telegraph lines were out of service. The telephone was found an excellent aid in returning the surface car transportation to its normal condition, more than 300 calls having been made over the telephone by the street cleaning commissioner in arranging for the removal of the snow. Of the telegraph companies, the Postal reported trouble between Hartford and Boston, Lowell and Boston, and Providence and Boston; the Western Union reported trouble also in the Boston neighborhood.

PEAT FOR FUEL.—Experiments relating to the use of peat for fuel are to be conducted on a large scale at Lynnfield Center, Mass., where the Saugus River Peat Company owns extensive peat bogs and hopes to be able to produce electricity at a low cost.

A B C OF TALKING OVER THE TELEPHONE.—Some of the telephone users of Chicago are placing on their telephone transmitters a little circular disk of celluloid bearing the words "Accuracy, Brevity, Courtesy." This is said to be the A B C of the use of the telephone.

RUSSIAN ELECTRIC STEEL MILL.—The Russian crown steel works at Slatons, in the Ural district, have secured the right to manufacture steel electrically by a process owned by a German company by making use of induction furnaces. An electric plant will be immediately installed by the Siemens-Halske Company, and the product is expected to be marketed within a short time.

WIRELESS TELEGRAPHY.—Of 282 steamships that carried steerage passengers to and from the United States during the first half of 1909, 143 were equipped with wireless telegraph apparatus. Of the 167 prominent coastwise vessels 97 are provided with wireless equipments. Secretary Nagel has recommended the passage of a bill requiring wireless installations on passenger steamers carrying more than a certain number of passengers over more than a given distance.

BALTIMORE ELECTRICAL INSPECTORS REDUCED.—As a result of the Budget which was recently made up in Baltimore, nearly all of the appropriations which were asked for by the various city departments were cut down. In the Building Inspector's office it was necessary to reduce the number of electrical inspectors in order that the salary list might not exceed the amount authorized for expenditure in that department.

OMISSION.—In an article by Mr. Einar A. Brofos, entitled "Norwegian 250,000-hp Hydroelectric Development," which appeared in our issue for Dec. 9, credit should have been given to the Allmänna Svenska Elektriska Aktiebolaget, of Westeras, Sweden, for supplying five of the 11,000-volt generators, the order for the 10 generators having been divided equally between this firm and Brown, Boveri & Company, of Baden, Switzerland.

AN ELECTRICAL ENGINEERING FRATERNITY.—A chapter of Eta Kappa Nu was installed Dec. 4 at Pennsylvania State College, State College, Pa. Eta Kappa Nu is a semi-honorary fraternity of electrical engineering students, which was founded at the University of Illinois in 1904. Its chapter roll now include Illinois, Ohio State, Armour Institute and Pennsylvania State, with alumni chapters at Chicago and Pittsburgh. The object of the association is to bring together the better students in all of the engineering schools of the country.

CORNELL GRADUATE SCHOOL.—The seventeenth annual report of President Schuman calls attention to the recently established Graduate School at Cornell University. The faculty of this school consists of those professors and assistant professors who are actively engaged in supervising the work of graduate students as members of the special committees in charge of major and minor subjects. During the past year there were enrolled in this school 310 students, 34 of whom received the degree of Doctor of Philosophy. The dean of this school is Prof. Ernest Merritt, of the Department of Physics.

OVERHEAD WIRES DOWN AGAIN IN BALTIMORE.—The heavy snow in Baltimore on Christmas day wrought havoc with the few remaining overhead wires in that city, and recalled the conditions of last March. The heavy wires of the United Railways Company were fortunately strong enough to stand the weight of the snow, but the broken telephone and electric light wires caused considerable inconvenience. The Postal-Telegraph Company had some trouble early in the evening in getting its New York lines in operation; the Western Union experienced difficulty with its minor lines, but the main lines were all in good working order. In the northwestern section of the city the wires were down, but the lines that were everywhere most affected by the storm were those leading to fire alarm and patrol boxes. Police calls in some districts were made under extreme difficulty and the Fire Department kept a close watch on its boxes to be sure that they were in good condition.

SIMON NEWCOMB'S DEFINITION OF THE MAGNET.—A writer in the *North American Review* who came into contact with the late Prof. Simon Newcomb in work connected with the compilation of the Standard Dictionary, relates the following anecdote referring to the great astronomer: Newcomb, who had general oversight of definitions in physical science, on one occasion came into the office greatly dissatisfied with the definition that had been framed for the word "magnet." The definition simply enumerated the properties of the thing, a course which in the absence of authoritative knowledge of their causes was thought to be the only rational procedure. But Newcomb's mind demanded a logical treatment, and, though he must have seen from the outset that this was a forlorn hope, his tenacity of purpose kept him, pencil in hand, writing and erasing alternately for an hour or more. Finally he confessed that he could do no better than the following pair of definitions: "Magnet, a body capable of exerting magnetic force," and "Magnetic force, the force exerted by a magnet." With a hearty laugh at his effort he threw down his pencil, and the imperfect and illogical office definition was accepted.

RIGHT TO FIX RETAIL PRICE OF PATENTED ARTICLE.—The United States District Court of the Southern District of New York, by the issue of an injunction, has sustained the right of the owner of a patent to fix the retail price of an article covered by said patent, and to require that all reasonable and proper conditions imposed as to the sale of such articles shall be maintained. The suit related to the sale of the Klaxon automobile horn, the charge being that the defendant had violated the terms of the license accorded him for selling the device by offering it at a price less than that fixed, by erasing the special serial number given to each horn, and by detaching prior to sale the license tag secured to the horn by a wire fastened by a lead seal. The injunction issued enjoined the defendant from selling the Klaxon horn at a price less than that fixed by the sales agreement, prohibited the license tags to be detached, altered or erased, or any of the marks, notices, license tag or labels being concealed in the case of any horn or any box containing one or more horns, and specifically prohibiting the erasure or rendering illegible the serial number stamped upon the name plate of a horn.

EXTENSION OF WIRELESS IN NAVY.—According to plans formulated by Rear-Admiral Cowles, chief of the Bureau of Equipment of the U. S. Navy, and submitted by him to Congress, wireless apparatus of the latest type is to be supplied to all the new vessels of the navy, including destroyers and all auxiliaries, as this latter class of vessel has proved very valuable in establishing wireless chains across long stretches of ocean without the necessity of disrupting the fighting fleet. Another shore station is contemplated at Dutch Harbor, Alaska, to carry wireless to Bering Sea, connecting with the Cape Nome station, permitting vessels from Nome to Lower California to keep in touch with the world. After the contemplated high-powered station in Washington has been completed it is believed a similar station will be found necessary in the following localities: The west coast of the United States, the Panama Canal Zone, Hawaii and the Philippines. With stations of such power at these places vessels will be within call while going to or from or while in practically all waters where naval operations of interest to the United States might be expected. Each station will cost $100,000.

Generating Station of the Lehigh Coal & Navigation Company.

THE Lehigh Coal & Navigation Company owns extensive anthracite coal properties extending from Mauch Chunk to Tamaqua, Pa. It also owns the canal paralleling the Lehigh River from Coalport to Easton, 48 miles, and leases the Delaware Division Canal, 60 miles. In addition, the company owns, controls and leases many steam railroads, chiefly freight roads, operating in or near its domains. For the purpose of supplying electricity to its many mines for haulage, pumping and lighting, the company, a few years ago, erected a large power house in the valley at Lansford, Pa. Besides supplying the mines the station feeds the circuits of the Panther Valley Electric Light, Heat & Power Company and the railway lines of the Eastern Pennsylvania Railways Company operating between Mauch Chunk, Lansford, Summit Hill, Nesquehoning and Tamaqua. The Panther Valley Electric Light, Heat & Power Company owns the lighting circuits in Lansford, Summit Hill, Coaldale and Nesquehoning. The Lehigh Coal & Navigation Company's canal is also the source of power for several electrical generating stations, notably those at Mauch Chunk, Easton and Raubsville, Pa., the electric generating companies at these towns leasing the water rights.

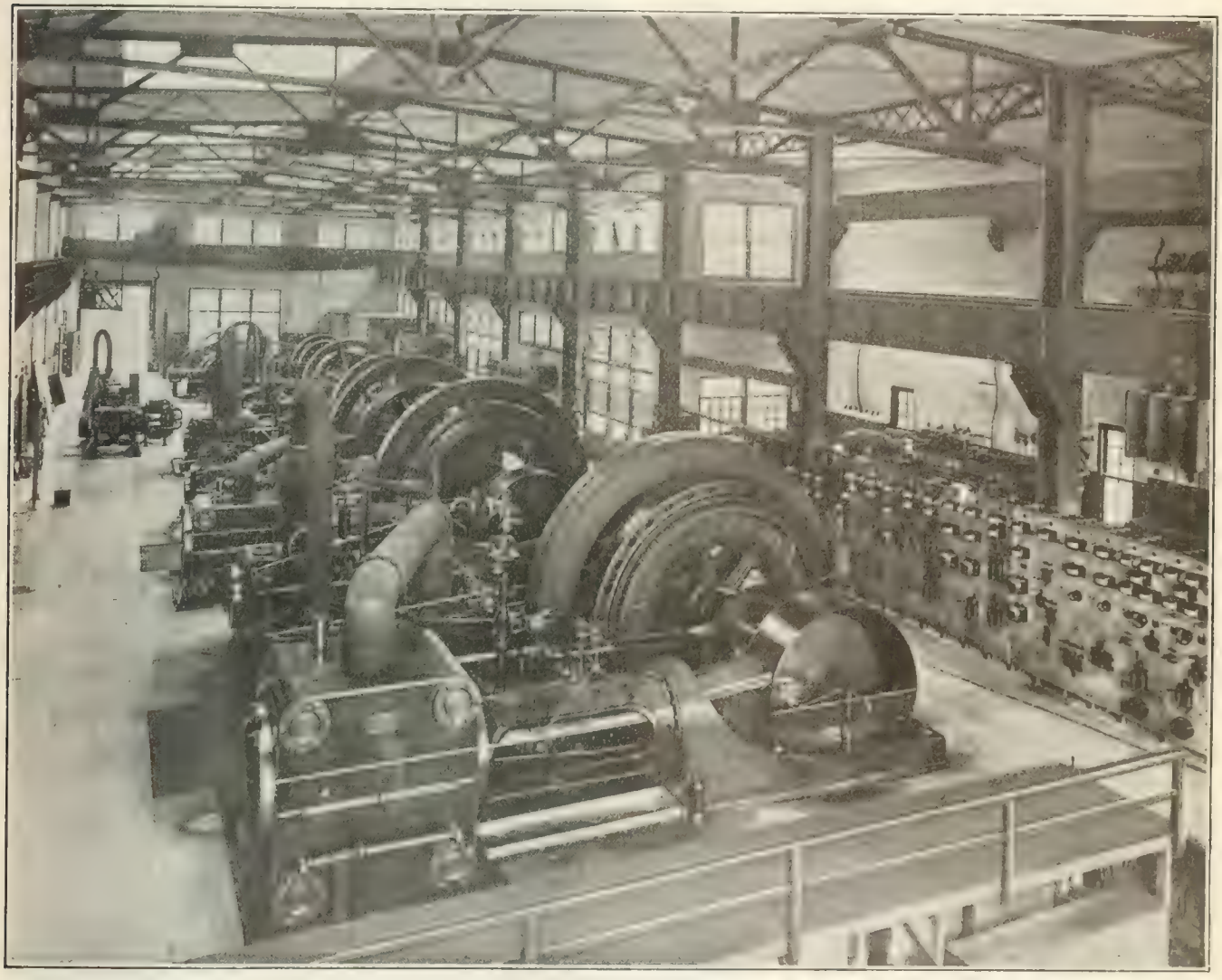


FIG. 1. GENERATOR ROOM OF LEHIGH COAL & NAVIGATION COMPANY'S LANSFORD STATION.

A general view of the generator room of the station at Lansford is shown in Fig. 1. The equipment consists of one 700-kw and one 400-kw, 25-cycle, 2300-volt, three-phase Westinghouse alternators, direct-connected to Allis-Chalmers cross-compound engines; one 200-kw, 60-cycle, 1100-volt, two-phase Crocker-Wheeler alternator, direct-connected to a Ball engine; and one 2300-volt, three-phase motor direct-connected to a 150-light Brush arc machine. These units were installed new, while the following equipment was moved from the old power station which had been furnishing energy to the Tamaqua & Lansford Railway Company and the Panther Valley Electric Light, Heat & Power Company for about 12 years; one 425-kw, 600-volt General Electric generator, direct-connected to a Wetherill simple Corliss engine; two 225-kw, 600-volt Walker generators direct-connected to Lane & Bodley simple Corliss engines; one 125-kw, 1100-volt, two-phase, 60-cycle generator belted to a Fischer enclosed-type engine, and one 75-light Wood arc machine belted to a Ball engine.

The boiler-room contains six 300-hp and three 500-hp Maxim water-tube boilers, fitted with flat stationary grates having 12 per cent air space, and equipped with Eynon & Evans and Parsons blowers, both under the grates and in the stacks. Buckwheat No. 3, washed from the company's own mines, is used under the boilers, and although fan blowers with exhaust steam might show a trifle better efficiency, with the class of labor and fuel used, steam jet blowers are found to answer best. An automatic pressure regulator is used in connection with the steam blowers so that a fairly constant steam pressure is maintained at all times.

The steam piping and heaters as originally laid out were found to be wanting in flexibility and at the present time the piping and feed-water systems are being redesigned. A Link Belt pan ash conveyor is also being installed beneath the boiler-room floor in a tunnel passing in front of the boilers. This conveyor will take the ashes the length of the boiler room and

then elevate them sufficiently to permit them to flow by gravity into railroad cars, whence they will be removed for track and other work.

There are three separate switchboards provided in the generator room, one for the mines, shops and storage yards, one for the circuits of the Eastern Pennsylvania Railways Company and the third for the circuits of the Panther Valley Electric Light, Heat & Power Company. These are all of standard design and are shown in the engravings. As there is a very bad load factor on the three simple Corliss engines feeding the trolley system and the two cross-compound mine engines, a 300-kw rotary-converter has been arranged so as to be used as a compound-wound rotary, an inverted compound-wound rotary or as a shunt-wound rotary, balancing the load on the alternating and direct-current generators. It is used as the latter almost altogether and has permitted the shutting down of the 400-kw alternator the greater part of the time.

The load fed from the station consists of four 20-ton, two 15-ton and 31 8.5-ton electric mine locomotives located 100 ft. to 1200 ft. below the surface; 300 hp in lamp and motor equipment in machine, boiler, car and carpenter shops and a briquetting plant; 525 hp in motors at a 150,000-ton storage plant; from 7 to 20 trolley cars equipped with four 50-hp motors; 250 kw in commercial arcs and incandescent lamps and 150 direct-current, series-arc lamps.

The mine locomotives are fed from five substations; three rated at 300 kw, one at 600 kw and one at 150 kw. Two of these substations are fed from 2300-volt, three-phase feeders and transform to 300 volts direct-current. Two are fed with 10,000-volt, three-phase current and supply direct-current at 300 volts. The fifth substation is supplied from 10,000-volt, three-phase circuits and has an output of 300 kw in 600-volt direct-current and 300 kw, 300-volt direct current, the former for the trolley system and the latter for the mines. The station supplies a territory 15 miles long and 6 miles broad and is already loaded to its full economical capacity. Plans are prepared for the installation of 600 kw additional equipment early next year.

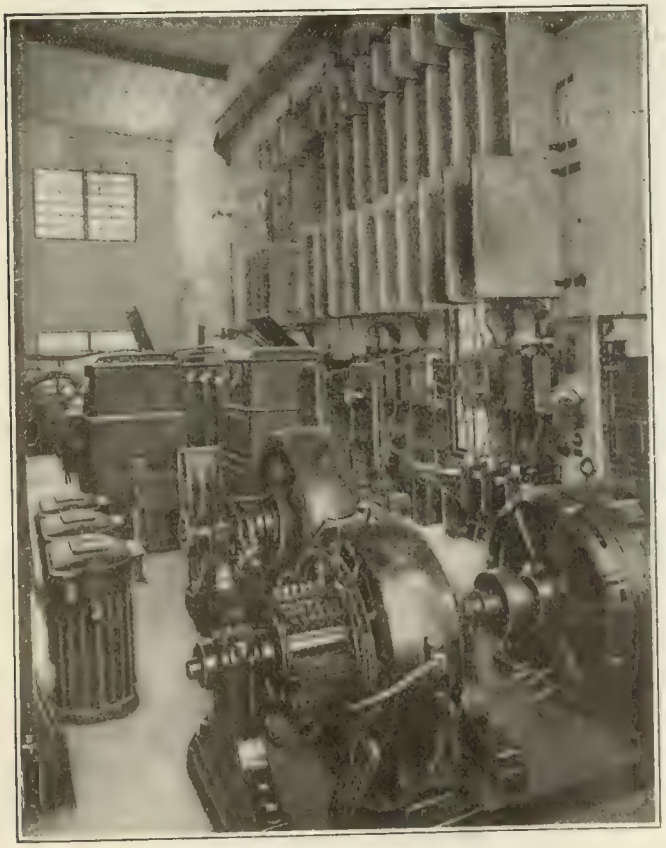


FIG. 2.—VIEW OF TRANSFORMING EQUIPMENT.

There are some features of operation which are worthy of note. At a substation in Nesquehoning there is a six-phase rotary which is started from the alternating-current side in such a way that the starting current is quite small. Three single-phase, 110-kw transformers, having 50 per cent and 25 per cent taps brought out from the secondary, are employed for this purpose. The 50 per cent taps of the three transformers are connected together and the 25 per cent taps are brought to the top points of a three-pole, double-throw switch and three to the bottom of a three-pole, single-throw switch. The method of starting is as follows: The 25 per cent taps are first connected to the rotary, then the ends having the same phase relation and finally the three leads 30 deg. apart from these.



FIG. 3.—ELECTRIC LOCOMOTIVE AT MOUTH OF NO. 5 TUNNEL.

At the storage yard, trouble was experienced because it was not possible to shut down motors quick enough in case of accident. The electrical engineer of the company, Mr. J. F. MacWilliams, designed a circuit-breaker which has worked satisfactorily for this purpose. The motors are operated at 440 volts and the circuit-breaker on each motor is fitted with a trip coil wound for 120 volts. The energy for operating these trip coils

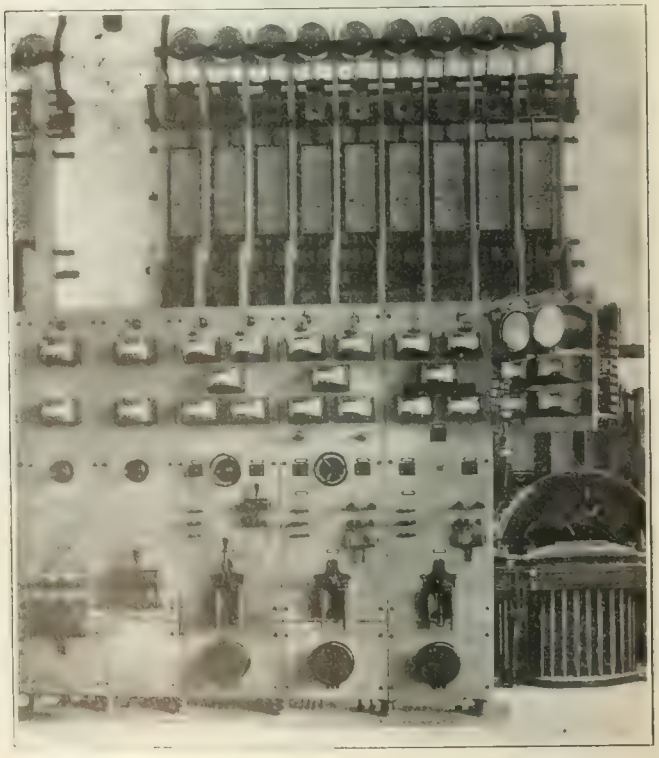


FIG. 4.—ONE END OF MINING SWITCHBOARD.

is brought from transformers connected on the main line and 25-amp switches are placed at every point where men are at work. These switches not only open the circuit-breaker, but also lock it open by an electro-mechanical device so that the circuit-breaker cannot be closed until the switch is opened at

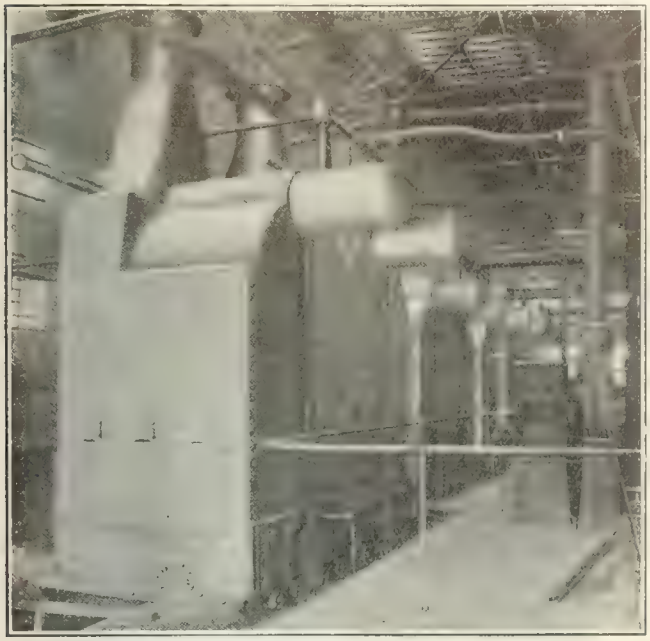


FIG. 5.—GENERAL VIEW OF BOILER-ROOM

the point of trouble. This tripping and locking device is also arranged as a fool-proof starter. Since there are 12 circuit-breakers, one main switch and one short-circuiting switch used in starting, any one switch thrown the wrong way opens the circuit-breakers so that the motor cannot be thrown into circuit.

In the mines trolley hangers and bonds differing somewhat from those used in other mines are employed. Owing to the great pitch in the coal veins, the hauls are long and the track must be changed from time to time so that a flexible bond on the tracks is not of much use. The pipe hangers employed are 1½ in. in diameter and the bonds are made with a pin having a slight taper. At the end opposite the head, a lock washer and nut are fitted and scrap copper is soldered in the head of the pin. Bonds of this type are readily removable and have given excellent service. The generating station was designed by Messrs. Dodge & Day, of Philadelphia.

Gas-Producer Central Station at Aberdeen, South Dakota.

ALMOST interesting central station using gas producers and gas engines as a source of power is that of the Aberdeen Light & Power Company, at Aberdeen, S. D. This company has been operating a producer gas plant since April, 1908, and the growth of its station has been rapid. Aberdeen is a city of about 10,000 population, the electric lighting history of which is very different from that of most Western towns. As a general rule, electric lighting throughout the West is used almost exclusively where such service is available, and gas, if used at all, is confined to cooking. In Aberdeen, however, gas lighting was used almost exclusively up to the spring of 1908, when the Aberdeen Light & Power Company began operations. There was a small central station in the town, but owing to unsatisfactory service and franchise troubles, no electric service whatever had been given for the year previous to the starting of the new plant.

The present gas-engine plant started in May, 1908, with a peak load of about 47 kva. By October, 1909, the peak as measured by the maximum hourly output shown by the watt-hour meters was 470 kw. The growth of the company's output and peak load is shown by Fig. 1. The dotted portions of the curves are for intervals where the records are incomplete, due to switchboard alterations, meter calibration, etc.

The equipment now consists of four Muenzel gas producers made by the Minneapolis Steel & Machinery Company, rated at

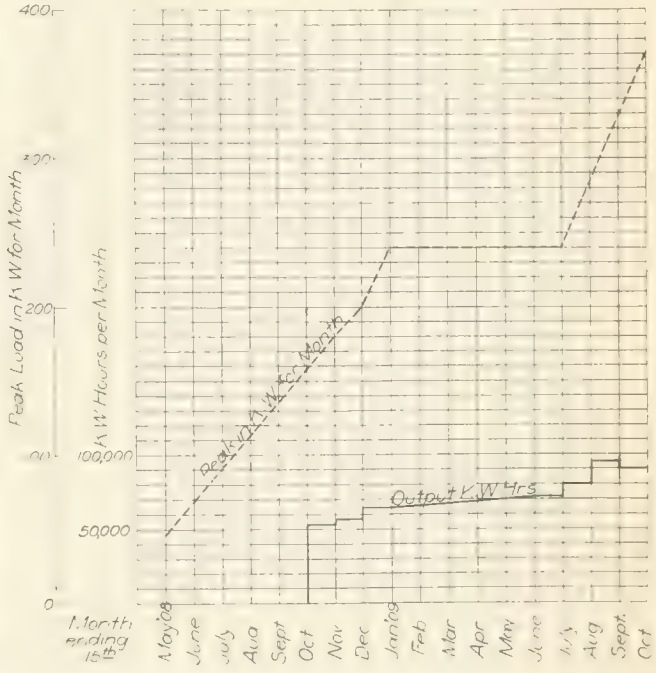


FIG. 1.—GROWTH OF OUTPUT AND PEAK, ABERDEEN, S. D.

150 hp each, and two twin Muenzel gas engines rated at 350 hp each and running at 190 r.p.m. One of these engines has cylinders 20¾-in. x 32-in. stroke, and the other 21-in. x 32-in. stroke. Fig. 2 shows a rather unsatisfactory view of half of each of these units. Each consists in reality of two single-cylinder engines connected to the same shaft and flywheel. Each engine is belted by a 23-in. belt to a 250-kw, three-phase, 60-cycle, 2300-volt generator made by the Electric Machinery Company, of Minneapolis. A 200-hp engine, 18¾-in. x 28-in. stroke, is being installed in an addition to the building. This is for the purpose of increasing the capacity and adjusting the engines in service more accurately to the loads.

The power-house building is of concrete blocks, 8 in. thick, reinforced with a layer of brick inside the concrete. The re-

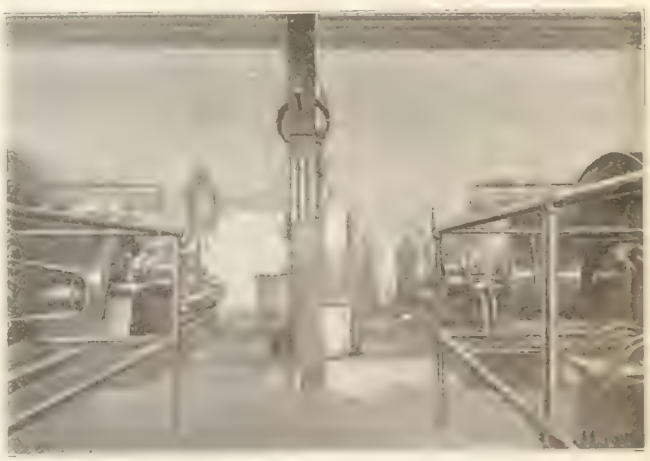


FIG. 2.—ENGINE ROOM, ABERDEEN, S. D.

cent addition, however, has concrete reinforcement inside of the concrete blocks, in place of the brick. The output is measured by watt-hour meters. Two air tanks, 30 in. x 72 in., built for a working pressure of 130 lb. per square inch, store air for starting the engines. In the center of the plant, behind the pillar seen in the center of Fig. 2, is a short lineshaft which

can be driven either by an electric motor or small gasoline engine. This lineshaft drives a compressor supplying the compressed-air starting tanks.

Fig. 3 shows a plan view of the plant, exclusive of the recent addition to the engine-room, and Fig. 4 gives a sectional elevation. The rear of the building in which the producers are

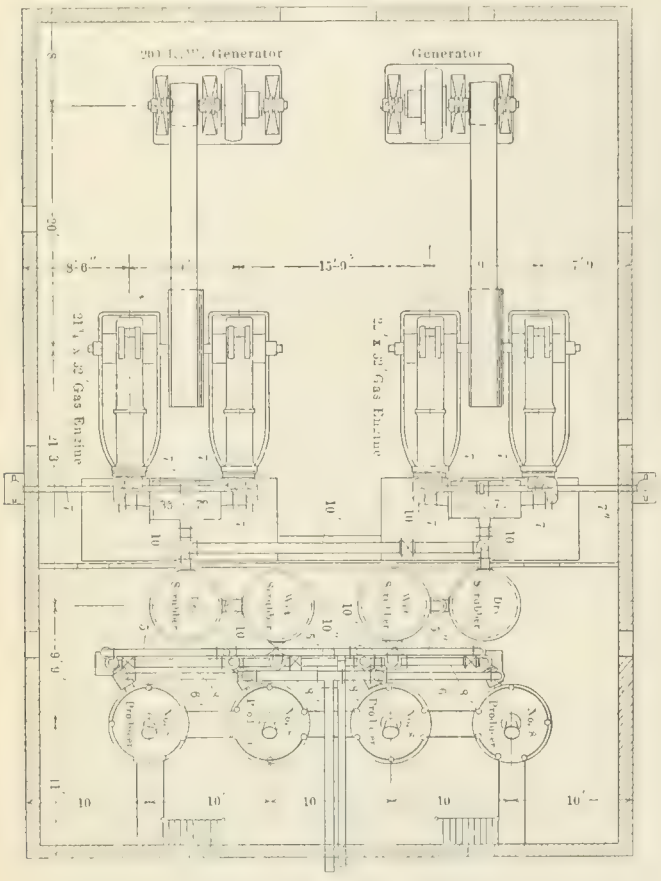


FIG. 3.—PLAN OF ABERDEEN STATION.

located faces a railroad siding, from which coal is unloaded by means of an elevator. The coal used is Pennsylvania anthracite. It is unloaded from cars through a chute which delivers the coal into a hopper from which it is taken by a motor-driven bucket conveyor into a hopper in the upper part of the elevator, whence it is drawn as occasion requires into a movable hopper for charging the producers. Below the upper hopper in the elevator is a bin for the storage of extra coal. The storage part of this coal elevator is made of 2 x 4 timbers laid flatwise to give strength.

Fig. 5 is a view in the gas-producer room showing three of

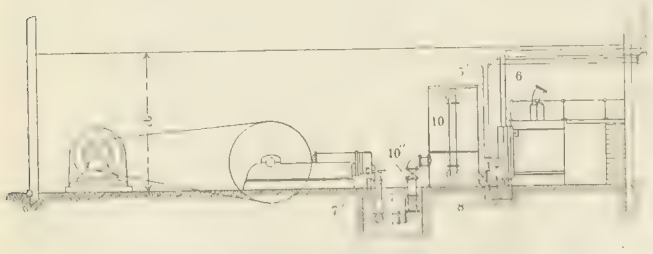


FIG. 4.—ELEVATION OF POWER PLANT.

the producers, and the movable hopper for charging the producers with coal. This movable hopper is suspended from an overhead tramway, and when filled with coal from the storage hopper in the top of the elevator, is run to the various producers. As shown in Fig. 3, all four of the producers are piped to a common header. From this header the gas is taken first through the wet scrubbers and then through dry scrubbers to the main header in the engine-room. There are two sets of scrubbers. By operating all four producers on one header, the gas supplied to the engines is more uniform and the poking and cleaning of fires are not so likely to interfere with the operation of the engines by altering the quality of the gas. On each dry scrubber is an asbestos-packed relief valve, consisting simply of a disk packed with asbestos and resting on a circular opening. This relief valve opens automatically in case explosions in the

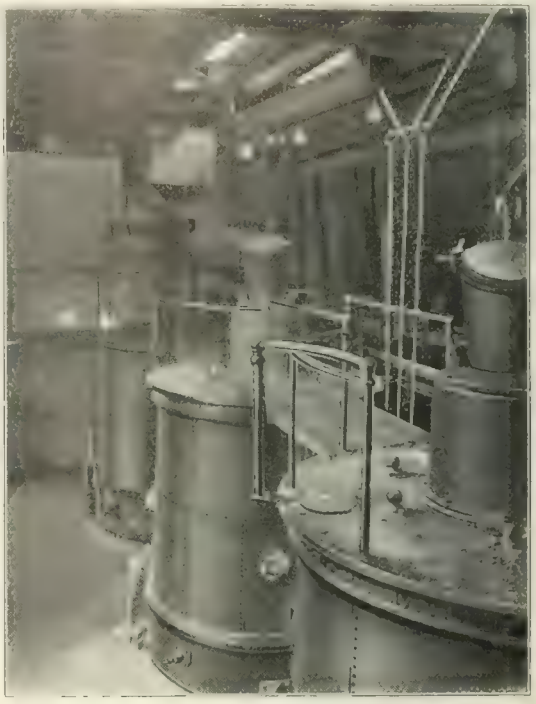


FIG. 5.—GAS PRODUCERS, ABERDEEN, S. D.

engine cylinders, during suction stroke, cause abnormal pressure on the scrubber.

Gas check valves are installed between each engine and the main header to prevent air from getting into the main gas header by any possible manipulation of an idle engine and thus interfere with the operation of another engine on the header. As a matter of fact, these check valves at the time of the writer's visit to the plant had been broken by back-firing of the engines, so that both engines were being operated off the header, without the check valves. As long as due care is used in the operation, this plan works well, but the check valves are a good safety precaution, because there is a constant suction on the main gas header and air will rush into it whenever it has a chance. The first producer, which started in May, 1908, was operated continuously without being shut down, until the writer visited the plant in October, 1909.

Coal costs about $7 per ton, and the producers are operated on a regular routine of shaking, poking and stoking, every two hours. Only one producer is stoked at a time, so that the change in the condition of the fire takes place in only one of the three producers at a time. This minimizes any change in the quality of the gas due to fixing the fires. Once a day the ashes on each producer are cleaned out, both from above and below the grates. For cleaning out above the grates, a poker with a short hook on the end is used. The operator first carefully hooks out a layer of ashes and small clinkers from around the outer portions of the grate. There are doors on opposite sides of the producer, so that half of the fire can be cleaned from each side. After the ashes are pulled out from under the outer edges, those in the center are pulled out and the fire falls down 2 in. or 3 in. Ashes are taken from under the grates at the same time.

The cleanliness of the producer room is greatly improved by piping water to each ash-pit door. A fine spray of water is kept running from the top of the ash-pit door during the time that ashes are being cleaned out, and water is also admitted to the ash pit to sprinkle the ashes as fast as they are pulled out from on top of the grate, and it keeps those falling through

the grate wet. This makes it both pleasanter for the operator and better for the general cleanliness of the plant. Much depends on careful and thorough cleaning of ashes from over the grates, so that clinkers are not allowed to accumulate. There is, however, little trouble with large clinkers.

The only troubles that have been experienced with the pro-

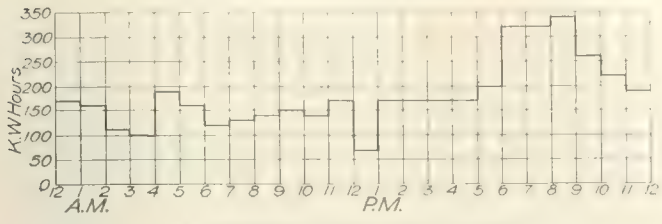


FIG. 6.—ABERDEEN LOAD, OCT. 14, 1909.

ducer end of the plant occurred at a time when there was a delay about getting the regular pea coal. To tide over, some chestnut anthracite was secured from local dealers. The chestnut worked well, but when the process of changing back to the pea size began, there was much trouble. The chestnut coal in the bottom of the producer seemed to admit too much air to the fine coal in the top if the fires were worked hard enough to keep the coarse coal burning in the bottom. The result was that the fires got very high, making the producers hard to handle because of the heat around the top. The situation was not relieved any by the fact that it was the hottest weather of the year.

For the operation of the plant 24 hours, six men are required. These men work in three shifts of 10 hours each, so that portions of the day the shifts overlap. The daily load curve of the plant for Oct. 14, 1909, is shown in Fig. 6. This is taken from the hourly readings of the watt-hour meters at the switchboard. Section gages are placed at four points between the producers and the engines, as follows: One at the producer outlet, two at the wet-scrubber outlet, three at the dry-scrubber outlet and four at the engine. These section gages have oil columns instead of water, on account of the more rapid evaporation of water. The suction on the engine gages is kept at from 3½ in. to 6 in., according to the load.

It is not feasible to carry a load of over 400 kw on the two 250-kw units with the four 150-hp producers in operation. The full 250-kw rated load of one engine unit can be carried with the three producers supplying the engine. The engine capacity of the plant is, therefore, in excess of the producer capacity. The accompanying table shows the coal consumed per kw-hour for eight different periods since the plant started operation. From this it is seen that the coal consumption, which was 2.1 lb. per kw-hour for the first period for which records are obtainable, was reduced to 1.5 lb. in the fall of 1909. The chief engineer of this plant is Mr. R. D. Parks, a man of much experience in gas-engine producer work, having been connected with gas-producer manufacture before going to Aberdeen. The president and manager of the Aberdeen Light & Power Company is Mr. A. H. Pease, and the electrical engineer Mr. J. D. Gibbs.

A number of other producer gas-engine central stations have been installed in some of the smaller towns of South Dakota. These plants are partially owned by the same interests that control the Aberdeen plant. At Wagner, S. D., there is an

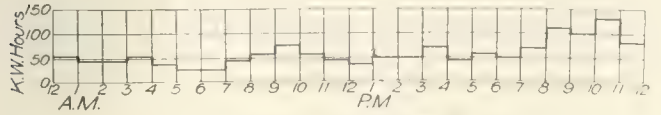


FIG. 7.—ABERDEEN LOAD, JUNE 8, 1909.

80-hp and a 45-hp engine with two Muenzel producers. This plant has been in operation since 1907. At Armour, S. D., a 100-hp Muenzel engine and producer have been in operation since December, 1907. At Platt, S. D., there is a 85-hp engine and a Muenzel producer. At Geddes there is one three-cylinder vertical Fairbanks-Morse producer. There are now being installed one 35-hp and one 40-hp Muenzel engine. At Scotland, S. D., an 85-hp Muenzel engine and producer are being in-

COAL CONSUMPTION ABERDEEN (S. D.) PRODUCER GAS PLANT.

	Kw-hours	Lbs. coal	Lbs. per Kw-hour.
Oct. 15 to Nov. 15, 1908	56,826	118,435	2.1
Nov. 15 to Dec. 15, 1908	58,265	129,085	2.2
Dec. 15, 1908, to Jan 1, 1909	64,845	145,451	2.2
Jan. 15 to Feb. 1, 1909	31,740	69,[illegible]	2.1
June 15 to July 15, 1909	77,585	154,[illegible]	2.[illegible]
July 15 to Aug. 15, 1909	88,474	167,[illegible]	1.9
Aug. 15 to Sept. 15, 1909	95,090	167,400	1.8
Sept. 15 to Oct. 15, 1909	100,[illegible]78	170,[illegible]	1.5

stalled. At Platt, S. D., the consumption of coal is from 1.25 lb. to 1.5 lb. per hp-hour. The service in these small plants is stated by Mr. Parks to be very reliable, as they operate only at night, and during the day small repairs on engines may be made.

Most of the troubles experienced at Aberdeen have been due to engine details. The operation at Aberdeen has on the whole been reliable, considering the fact that the load has been growing so fast, and that the entire plant has to be operated during the heavy-load hours of each day, thus leaving no reserve capacity.

The rapid growth of the Aberdeen load, as shown by Fig. 1, is a powerful illustration of the fact that people in a progressive Western town are eager for electric service, if only good service is offered. The daily load curves, Figs. 6 and 7, show that a considerable motor load has been picked up in the short time the plant has been operating. This motor load has made it necessary to operate both engine units much of the day in order to take care of the sudden fluctuations which sometimes occur.

Multiple Unit Circuits for Single-Phase Trains.

By Ralph W. Krass.

In view of the scarcity of general information concerning the details of the multiple-unit control equipments used with single-phase trains, it is believed that a description of the operating features of an installation that has been in successful use in trunk-line service for the past three years will prove of interest at this time.

On each of the motor-cars of this equipment there are three distinct circuits, namely, the high-potential, the low-potential and the control.

HIGH-POTENTIAL CIRCUITS.

The alternating current is taken from the trolley wire at 11,000 volts potential by means of a pantograph. From the pantograph trolley it passes down the side of the car (through the lorricated conduit) and on to the line switch. From the line switch the current passes through the high-tension winding of the transformer.

PANTOGRAPH TROLLEY.

The pantograph trolley consists of a light collapsible pantograph of steel tubing supporting a copper shoe, which slides along under the trolley wire. It is raised by springs and lowered by air cylinders. The supply of air to these cylinders is controlled by small magnet valves ("Trolley Up" and Trolley Down").

When it is desirable to lower the trolley shoe, the coil of the "Trolley Down" magnet is energized, thus allowing air to pass into the main cylinder and lower the trolley. The trolley is forced downward until a spring latch on the under side of the shoe engages with a pin of the latch cylinder. The air is then released from the main cylinder and the trolley held down.

TROLLEY UP.

The trolley shoe is raised by energizing the "Trolley Up" coil, which allows air to flow into the latch cylinder and release the shoe by pushing out the pin.

LINE SWITCH.

The line switch is used for the purpose of breaking the high-potential circuit. It is a pneumatically operated oil switch with

an overload release. The circuit is broken under oil. The line switch can be operated from the controller by inserting a plug switch into the controller, and also by means of a handle, which can be reached through a hole in the floor of the car.

AUTO-TRANSFORMER.

The purpose of the auto-transformer as used on single-phase

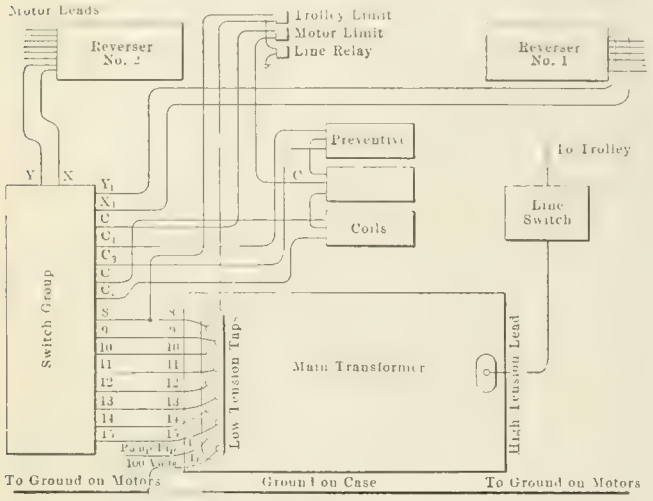


FIG. I.—ARRANGEMENT OF MAIN WIRING AND APPARATUS.

multiple-unit trains is to reduce the e.m.f. from the high value at the trolley wire to a low value to be applied at the motors. The transformer is of the single-coil type, oil insulated and self-cooling. There are three high-potential taps on the transformer so as to allow for adjustment to line voltage. There are eight low-potential taps, the highest of which gives about 300 volts at the motors. A single tap (100 volts) provides the required voltage for heating, lighting and auxiliary motors.

LOW-POTENTIAL CIRCUITS.

The current passes from the low-potential taps on the transformer (Fig. 1) successively through the switch group, the "preventive" coils, the reversers, motors, to the truck, and then back to the grounded end of the transformer (through ground wire).

SWITCH GROUP.

The switch group consists of a number of independent switches, grouped together and operated by means of small cylinders controlled by electromagnetic valves. The switch group used on these cars is of the standard pneumatically operated type, as is used in connection with multiple-unit control systems. The valve magnets are energized by current obtained from the control circuit at 12 volts. The piston is lifted, air is allowed to enter, the switches forced up and the various contacts thereby made. Thus the closing of the various switches results in introducing various transformer taps into the circuit and thereby varying the voltage impressed on the motors. The normal position of the switches is open, and the failure of the air supply or the interruption of the control circuit opens all of the unit switches.

In changing the voltage applied to the motors by means of the switch group, it is essential not to interrupt the current. This means that the next voltage switch must be closed before the last previous voltage switch is opened. To prevent excessive currents at this instant use is made of "preventive coils" connected across the switches of the switch group. These coils are simply auto-transformers placed in the circuit to prevent the burning out of short-circuited transformer coils during the process of "notching up" for higher speeds. The action of the preventive coils can be explained readily by referring to the diagram of connections shown in Fig. 2. The first position on the transformer is 1-2-3-4, thus requiring the controller to be moved four points to give the first position on the transformer—that is, for the lowest speed. To obtain the next highest speed, coil 1-2 is cut out of the circuit and coil 4-5 is placed into the circuit. Thus, while passing to the second position the coil 1-2 is short-circuited through the preventive coil, which because of its high inductance allows only a small current to pass through the transformer coil, and thereby prevents it from being burned out.

From the diagram it is seen that three such coils are essential in this particular instance, so that for all the running positions on the switch group each of the transformer coils is short-circuited through an inductance during the process of "notching up."

REVERSER.

The function of the reverser as used in any system of automatic control is to govern the direction of motion of the cars by properly interconnecting the armature and field circuit terminals. The reverser is a switch the movable part of which is mounted on a rod actuated by two air cylinders. Each of these cylinders is controlled by a separate valve magnet, the energy for the coils of the magnets being obtained from the auxiliary control circuit. The connections are so arranged that only one coil can be energized at a time, the valve magnets being energized alternately, depending upon the direction in which it is desired to turn the switch. The wires from the armature and field circuit terminals lead to contact fingers which press against metallic strips mounted upon the movable part of the reverser. The arrangement of the fingers relative to the contract strips is such that the current will be made to flow in reverse direction through the armature when the reverser is thrown from one extreme position to the other. There is also a connection from the switch group to each reverser (two wires), which serves to interlock the motion of the reverser with switches of the switch group. Two reversers are used on each car, so that it is possible to control the car from either end.

CONTROL CIRCUITS.

The control circuits consist of wires by means of which current from a small storage battery is made to operate the magnet valves controlling the air on all of the various switches and pieces of apparatus. These currents are governed by the master controller.

BATTERY CONTROL APPARATUS,

All of the magnet valves in the car are operated by current

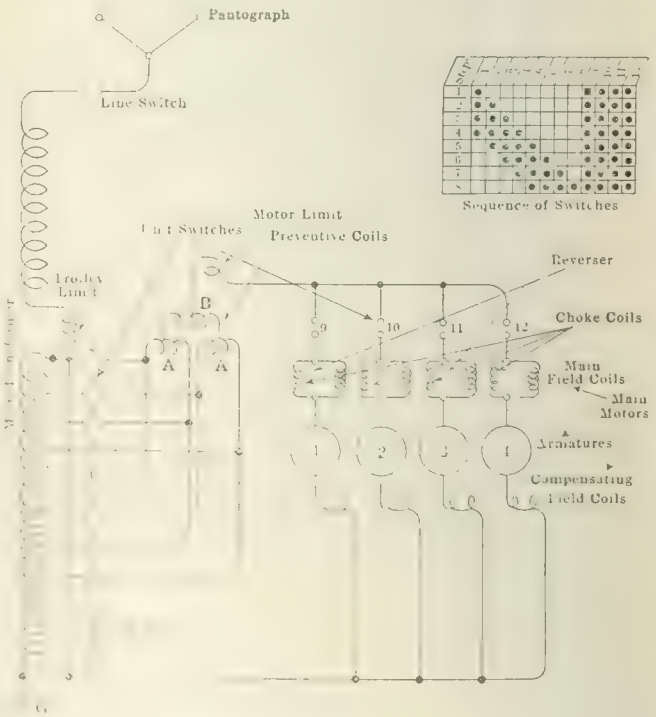


FIG. 2.—SCHEMATIC DIAGRAM OF QUADRUPLE EQUIPMENT OF SINGLE-PHASE SYSTEM.

obtained from a 12-volt storage battery set. There are several reasons for using battery control rather than alternating current control: (1) The circuit is no more complicated with direct current than with alternating current. (2) An alternating current valve magnet is less economical than a direct current valve magnet on account of special features of design necessitated by

the use of alternating current. (3) With alternating current the men are more afraid to handle the control apparatus, although voltage is not sufficiently high to do harm. (4) With alternating current control it is necessary to have the main auto-transformer in circuit while testing the apparatus. (5) The motorman loses entire control of his train in case the line voltage and brakes fail when alternating current control is used.

The storage battery is a very small one, capable of handling the car for only a short time, and must be frequently charged by the motor-generator.

MOTOR-GENERATOR.

The motor-generator consists of a single-phase motor directly connected to a shunt-wound, direct-current generator. It is self-starting, and the circuit is so arranged that the "set" is running all the time the car is in operation. The motor-generator is connected in parallel with the battery through a plug on the master controller, so that when the plug is out it is disconnected on the direct-current side and the battery is prevented from running the motor when no energy is being supplied through the trolley.

CONTROLLER.

The master controller of this equipment is somewhat larger than is usually found on multiple-unit trains, on account of the fact that it contains many switches and other devices which constitute separate parts in other equipments. It is of importance to note that the master controller is of what is known as the "dead man's type"—that is, it is so arranged that if for any reason the handle is moved to the middle position while the train is in motion the current is immediately taken from the motors and the air brakes are automatically applied as for emergency service.

In connection with the controller use is made of a removable handle to which is chained a switch plug used to reset the line switch when it has been opened by an overload trip. Resetting is accomplished by momentarily inserting the plug while the controller handle is in the off position. There are operating receptacles having three positions, the first of which makes contact to close the line switch only, the second makes contact for the master controller operated without the line switch being closed, and the third, on operating position for making contact for the operation of the line switch and controller together. There is a push-button for giving extra high speed and one for unlocking and lowering the trolley. There is an outlet for a 12-conductor train-line cable and an outlet for cables joined to the emergency brake relay valve magnets. There are two such controllers on each car, thus permitting operation from either end. The master controller is connected to a train line, so that the entire train can be operated from any one controller.

Junction boxes are used throughout for the purpose of making convenient connections to the train line. The train line terminates in receptacles at the end of the car and is connected between cars by means of jumpers.

TRAIN LINE.

The train line consists of a 12-conductor cable. This line is made continuous throughout the train by junction boxes, train-line receptacles and train-line jumpers. All of the magnets in the train are connected to the train line, and hence may be operated by means of the master controller. By means of the junction boxes it is possible to connect the wires of the train-line cable to those of the master controller switch-group, line switch, line relay, reverser and other pieces of auxiliary apparatus. The wires of the train line terminate in the train line receptacle. Each wire is connected to a separate pin, and each pin is insulated from the other.

TRAIN LINE JUMPER.

The train line jumper consists of two jumper heads connected together by a piece of 12-conductor cable. This jumper forms the battery control circuit between the cars of the train. There are four receptacles per car, but only one jumper is used to connect two train line receptacles. The jumper head and train line receptacle are so constructed that it is impossible to insert the train line jumper in any but the correct position. It is held in place by the spring-actuated cover of the train line receptacle, but will pull out readily in case of accident to the cars.

LIMIT SWITCHES.

Interlocks are placed on the various switches of the switch group and reversers so that the switches can be closed only in a predetermined order. The acceleration of the car is controlled by means of two "limit switches," a motor limit and a trolley limit. During series operation there is a heavy starting current, and when the motors are thrown in multiple the current naturally increases. Thus it is evident that in ordinary series-multiple operation heavy intermediate peaks are thrown on the line. In the equipment being described the motors are always operated in multiple, and in order to reduce the peaks on the line the use of "Motor and Trolley Limits" is resorted to. The combined effect of the "Motor and Trolley Limit" is to smooth out the wave of current.

The motor limit is a coil of high inductance in series with the motor circuit, is operated by low-potential current taken by all of the motors, and is so designed as to allow a certain predetermined maximum current to flow through the motor. The maximum starting current in this installation is 460 amp per motor, or about 1800 amp per car. Thus at no time with the motor limit in the circuit is it possible for the current to reach such a dangerous value as to burn out the motors. Moreover, the total input to the cars is also limited, and the peaks of the line are kept down as much as possible. This is the prime function of the trolley limit (operated by current taken through the trolley). The trolley limit is a coil of high inductance, so designed as to limit the maximum current drawn from the trolley by the car. (See Fig. 2 in article on "Low-Potential Circuit.) The acceleration of the car is still further affected by the "line relay" and by "induction coils" shunted across the field circuits of the motors.

LINE RELAY.

This is a magnet switch opened by gravity and closed by current passing through the coil. This relay is of the low voltage type, so that if for any reason sufficient current is not passing through the coil the armature will drop making contact, thus causing the trolley magnet valve to be energized. Air will then flow into the main cylinder, pull the trolley down, and make the car perfectly safe.

CHOKE COILS.

The purpose of the induction coils is to make the performance curve of the motors more like the direct current motor curve. The theory of the operation of these coils is that the motor is designed with a stronger field than would otherwise be used, and thus gives it a low speed at light loads. When the field circuit is shunted with the coils little effect is had at light loads, but the coils considerably weaken the field at heavy loads and thus make the speed higher than would otherwise be the case.

AIR BRAKE EQUIPMENT.

The controller is provided with a direct connection to the brake pipe by means of the pilot valve and emergency brake valve. The brake valve is controlled by the brake relay valve magnet. When this magnet is energized the valve is opened to the atmosphere and all source of power is cut off from the motors. A cam bears against the stem of the pilot valve and allows air to escape from the upper part of the emergency valve. The brake pipe pressure forces up the piston in the emergency valve and allows air in the train line to escape to the atmosphere, thus applying the brakes immediately.

The air compressor, which is driven by a 700-volt motor, is placed under the car and suspended in a cradle provided with rubber cushions to prevent the vibrations from being transmitted to the car and to deaden the noise.

The compressor is automatically started and stopped by the pump governor. The governor is so adjusted that when the maximum pressure is reached the switch opens the circuit and stops the motor. When the pressure reaches the minimum the switch is again closed and the motor started. Thus the circuit

is made and broken when predetermined maximum and minimum pressures occur in the main reservoir.

OPERATION.

In order to have a clear conception of the operation of single-phase multiple-unit trains, it is necessary to understand the inter-relations between the various circuits described above.

The current passes from the 11,000 volt trolley down the side of the car (through a lorricated conduit) and onto the line switch. From the line switch the current passes through the high-tension winding of the auto-transformer, thus making the low-tension winding alive. The flow of current is then controlled by the various unit switches of the switch group. From the switch group the current passes through the preventive coils, trolley limit, unit switches 9, 10, 11, 12, and on to the motors. From the diagram showing the sequence of switches it will be seen that the unit switches 9, 10, 11, 12 are always in the circuit, and in order to obtain the first point on the auto-transformer (1, 2, 3, 4), it is necessary to move the master controller through four points. To obtain the next higher speed, the auto coil 1, 2 is cut out of the circuit and 4, 5 introduced; thus the second position on the auto-transformer (2, 3, 4, 5) is obtained by advancing the controller handle to point 5, and so on for the other positions. The various currents, as referred to above, can readily be traced from the main wiring diagram shown in Fig. 2.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

New-Business Work of Toronto Electric Light Company.

The sales department of the Toronto Electric Light Company has been reorganized, Mr. Martin retaining his position of sales manager and Mr. Eugene Creed, late power chief, becoming assistant sales and advertising manager. The new business secured during the past year has been extremely satisfactory to the company, and the outlook for 1910 is very bright. Two power and four lighting specialists have been added to the department. The sales agents have been very successful in closing sign prospects, so that Yonge Street is now a blaze of light from the Traders' Bank Building to Bloor Street. Many novel signs are in course of erection. The number of heating appliances sold during the holiday season ran up into the hundreds. The demonstrator in charge was kept busy from morning until night, while the delivery service was taxed to the limit.

Notes from Dayton, Ohio.

The City Council of Dayton, Ohio, has authorized the Board of Public Service in that city to take bids upon 300 ornamental lamp-posts, which will be a sufficient number to light the entire business district of Dayton with the special boulevard system of lighting. A sample block of ornamental posts has already been installed by the Dayton Lighting Company and has been in use some time. The plan is to place these posts 90 ft. apart opposite each other. This will give about six pairs of posts per block. A 100-watt lamp is placed on the top globe and four 60-watt lamps on the arms. The 60-watt lamps burn only until midnight.

Tuesdays, Thursdays and Saturdays are market days at Dayton. On these days large numbers of housewives do their buying from market wagons backed up along the curb on certain market streets. The Dayton Lighting Company hires a boy to quietly drop circulars advertising household electric service in the baskets of these women while they are purchasing. Thus the distribution is easy and the circular is likely to receive more attention than if mailed or left at the house.

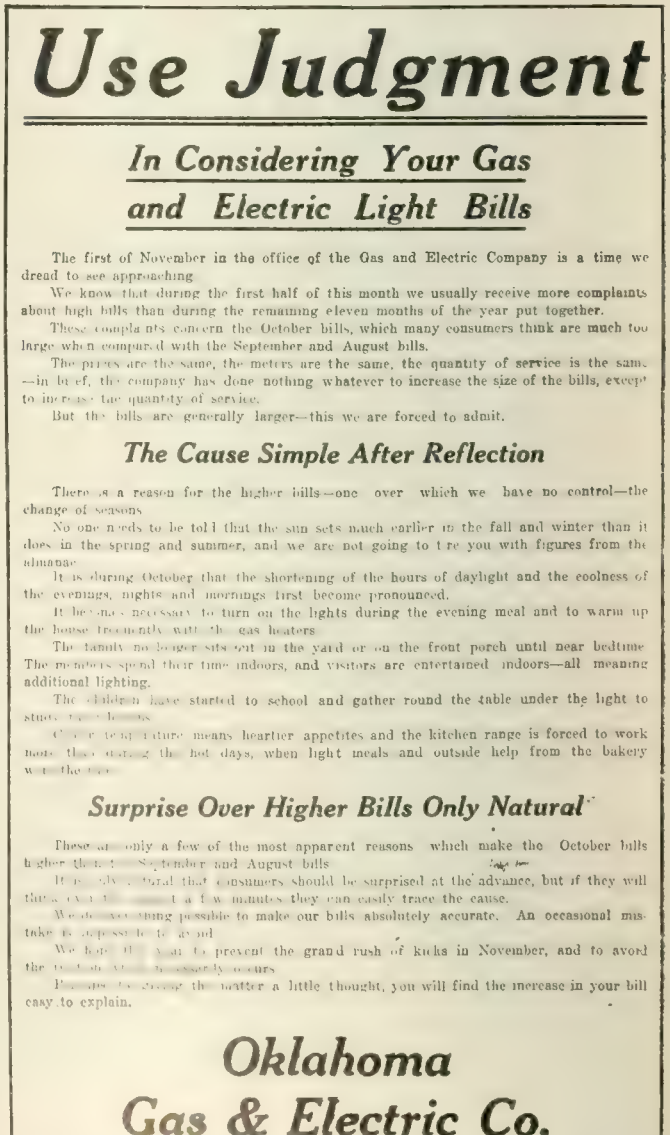
Oklahoma City Publicity.

By Glenn Marston.

Almost a year ago the Oklahoma Gas & Electric Company took up a campaign of publicity which has not only redounded to the credit of the company, but which has brought the community favorably before the country in a number of ways.

Beginning with a series of advertisements setting forth the history of the company, which were prepared by a publicity firm in Chicago, the series developed into a confidential strain setting forth the relations of the company and the consumer, with suggestions as to how the two could co-operate to the best advantage.

After firmly establishing itself in the good-will of the people the company's advertising went into detailed representation of the benefits of electricity. Photographs were taken of the most prominent installations, windows, signs, power, etc. These



Use Judgment

In Considering Your Gas and Electric Light Bills

The first of November in the office of the Gas and Electric Company is a time we dread to see approaching.

We know that during the first half of this month we usually receive more complaints about high bills than during the remaining eleven months of the year put together.

These complaints concern the October bills, which many consumers think are much too large when compared with the September and August bills.

The prices are the same, the meters are the same, the quantity of service is the same—in brief, the company has done nothing whatever to increase the size of the bills, except to increase the quantity of service.

But the bills are generally larger—this we are forced to admit.

The Cause Simple After Reflection

There is a reason for the higher bills—one over which we have no control—the change of seasons.

No one needs to be told that the sun sets much earlier in the fall and winter than it does in the spring and summer, and we are not going to tire you with figures from the almanac.

It is during October that the shortening of the hours of daylight and the coolness of the evenings, nights and mornings first become pronounced.

It becomes necessary to turn on the lights during the evening meal and to warm up the house frequently with the gas heaters.

The family no longer sits out in the yard or on the front porch until near bedtime. The members spend their time indoors, and visitors are entertained indoors—all meaning additional lighting.

The children have started to school and gather round the table under the light to study their lessons.

Cooler weather means heartier appetites and the kitchen range is forced to work more than during the hot days, when light meals and outside help from the bakery were the rule.

Surprise Over Higher Bills Only Natural

These are only a few of the most apparent reasons which make the October bills higher than September and August bills.

It is only natural that consumers should be surprised at the advance, but if they will think over the matter a few minutes they can easily trace the cause.

We are exerting every possible effort to make our bills absolutely accurate. An occasional mistake is impossible to avoid.

We hope this year to prevent the grand rush of kicks in November, and to avoid the [illegible] which necessarily occurs.

Reasoning the matter a little thought, you will find the increase in your bill easy to explain.

Oklahoma Gas & Electric Co.

Telephone F. B. X. 14 *110 North Broadway*

AN [illegible] CENTRAL-STATION NEWSPAPER ADVERTISEMENT.

photographs were published in the company's advertising space, with a short summary of the results accomplished by the installation of electricity. Although these advertisements were the company's products, they had a most wholesome effect in

impressing the public with the value of electricity. The merchants and business men thus advertised appreciated the compliment implied by special attention on the part of the company, while the public realized that such testimonials must be authentic and sincere, since the company would not, of course, dare to publish them otherwise.

Meanwhile articles were prepared by the company's publicity department, which have been published in leading magazines and newspapers, indicating the activity of the company in promoting civic improvement.

One of the most recent products of this company is the advertisement shown on page 1572, which is a frank and concise statement of the causes which increase bills during the winter. A unique idea is that of publishing, once a month, the number of complaints received the month before, classifying them as to cause, explaining the steps taken to prevent their recurrence, and asking for more complaints, the company's constant request being to "bring your complaints to the manager, not to your neighbor."

Wilmington (Ohio) Central-Station Notes.

The Wilmington Water & Light Company, of Wilmington, Ohio, operates in a town of about 5000 population, and is under the management of Mr. J. C. Martin, a prominent attorney and capitalist of Wilmington. The company has about 700 electric consumers and 400 water consumers. The relatively small number of water consumers is due to the fact that water service has been given for only about two years.

The company purchased the electric lighting plant from the city in 1902, at which time the plant was in a very decrepit condition. The present substantial electric light and water plant was erected in 1903-4, and service was started on Oct. 1, 1904, from the new plant with 150 consumers. The increase to 700 consumers in five years, therefore, has been rapid.

DAY SERVICE.

Day service was begun three years ago. At that time, in order to get the business, a flat rate of $1.50 a month per horsepower was made. This low rate was made because the company had to maintain a crew to operate its water-works plant during the day in any event, and it was considered that the additional cost of giving day electric service was small. At this rate there were secured several factories and other small users that yielded a revenue of about 4 cents per kw-hour, which was considered satisfactory. However, since taking on more motor load the flat rate does not net so much per kw-hour, and additional business is taken only on a meter basis at a 4-cent rate.

Those contemplating starting day service in a small town and figuring on possible sources of income will be interested to know that as a result of starting day service in Wilmington there was an increase of $250 per month in revenue from commercial lighting caused by the use of light in stores and basements during the day time. The starting of the day service was also useful in meeting a very active gas competition.

The company operates 143 alternating-current, 6.6-amp, inclosed street lighting arcs, which indicates that the town is unusually well lighted for one of its size.

EFFECT OF INSTALLING METERS.

With 150 customers at the start, the apparatus then in use was fully loaded. These customers were all on a flat rate. The company put on 100 meters and began to give all-night service, while previously service had been given only until 11:30 p. m. The result of the installation of meters was to reduce the coal bill by two-thirds, in spite of the additional hours of operation. The company also added 75 more consumers without increasing the station equipment.

EMPLOYEES.

The company employs, in addition to the manager, who gives only a part of his time, 11 men for the maintenance and operation of the water and lighting plants and the carrying on of a contracting and supply business. These men are as follows:

One lineman, one assistant lineman, two interior wiremen on contracting and consumers' repairs, one man to make water connections, one collector, one bookkeeper and stenographer, four power-station men. The power station is operated with two men on a shift.

POWER PLANT.

The power plant is a substantial brick building containing steam water-works pumping apparatus in addition to the electric generating plant. There are two 250-hp Erie water-tube boilers, both of which are kept in operation continuously. The generating equipment consists of one 225-kw, two-phase, 60-cycle Bullock alternator belted to an I. & E. Greenwood Corliss engine and a 115-kw alternator belted to a Lane & Bodley Corliss engine. The average indicated horse-power on the plant for a typical day in June, 1909, was measured as 226 for a 24-hour run. Similar measurements for a day in March, 1909, indicated 256 hp. The high average load is caused by the steady demand of factories using electric motors.

A very simple method of weighing coal is employed. Coal is taken from the coal storage to the boiler room on a four-wheeled truck of the usual type for such purposes. It has been found that the amount of coal per truck averages 1000 lb. The door between the boiler room and coal storage is just about wide enough to allow the truck to pass, and an iron frog is placed on the floor near the coal-room door, so that whenever the truck goes through it must operate a projecting lever arm. This lever arm, whenever pushed in a direction away from the coal room, makes an electrical contact, closing a circuit, which causes current to flow through the coils of an electro-magnet which operates a cyclometer counter in the engine room. Every time a truck load of coal passes the lever, therefore, it moves the cyclometer counter along one notch and records 1000 lb. of coal. The cyclometer therefore reads directly in 1000 lb. of coal, and the chief engineer does not have to rely on the firemen's record for the number of truck loads.

Formerly much trouble was experienced with scale in the boilers. The company had a 14,000-gal. cypress tank on hand, and from this Mr. W. E. Turner, chief engineer, built a water-softening plant that cost about $350, exclusive of the tank. The water is treated according to the usual lime and soda-ash process. Saturated solutions of lime and soda ash are fed into the tank by means of a certain proportion of the feed water which is by-passed through the solution tank. The feed water entering the tank falls over an overshot water wheel for stirring the solutions. Trouble from scale has been practically eliminated by the softening of the feed water in this way.

Central-Station Improvement Costs at Athol and Orange, Mass.

In connection with a petition recently submitted to the Massachusetts Gas and Electric Light Commission for authority to issue new capital stock, the Athol Gas & Electric Company filed several detailed estimates of the cost of improvements in its territory which are of general interest. These related in general to a 400-kw enlargement of the Wendell power station, to the addition of a 650-kw reserve steam plant at the same point, the construction of new motor service and street-lighting circuits, and to certain transformer changes. The more important electrical estimates are given below on account of their value as specific analyses of improvement cost. The company states that the work has progressed so far that the accuracy of the estimates is thoroughly well established.

ESTIMATE OF ADDITIONAL 400 KW WATER-POWER UNIT.

Two parts 33 in. horizontal wheels (f. o. b. Wendell)	$1,50[illegible]
Lining and erecting same	47[illegible]
One [illegible] second hand [illegible]	[illegible]
Setting and connecting governor	140.00
400-kw, 60-cycle, three-phase, 2300-volt alternator (f. o. b. Wendell)	[illegible]
20-kw, 125-volt exciter, directly connected to generator	850.00
Foundation and erection of generator	300.00
Electric connections to switchboard, oil switch, ammeter	275.00
Total	$14,[illegible]00

The estimated cost of the addition per kilowatt of generating rating was $36.66.

ESTIMATE OF 650-HP ADDITIONAL STEAM PLANT.

650-hp compound condensing engine (f. o. b. Wendell)	$6,000.00
213-hp Stirling boiler, set complete	3,150.00
One 8x10x8-in. boiler feed pump	225.00
One 10x18x20-in. horizontal jet condenser	850.00
One 10x16x18-in. horizontal jet condenser	500.00
Chimney, 110 ft. high, 40.5 ft. diameter	2,200.00
Steel breeching boilers to chimney	450.00
600-hp open heater	950.00
Resetting present engine in new position	350.00
Steam piping complete, with fittings	2,350.00
Foundation and erection of engine	425.00
Alterations in boiler house, including roof	1,200.00
Excavation and concrete walls for coal bunker	750.00
Hand-operated traveling crane, 7 tons, 40-ft. span	1,000.00
Total	$20,400.00

The engine is of a type specially designed to run at the generator speed, 200 r.p.m. It is planned to run the engine and water-wheels together when necessary by throwing out the water-wheel governor and setting the wheels at one-half or one-third gear, according to the flowage in the stream, and letting the engine take care of the fluctuations in load. The feed pump is of a rating sufficient to handle the full boiler equipment. The smaller condenser is to be attached to the present engine, which is a non-condensing outfit. The chimney estimate consists of $1,800 for a Custodis section 100 ft. high, with $400 for the concrete base, including foundations and building up to 20 ft. above grade. The high-pressure pipe covering is to have 85 per cent magnesia and the low-pressure 50 per cent. The width of the boiler house is to be practically doubled, and a concrete roof installed. The plant is located beside the Boston & Maine Railroad, and aside from the chance of fire, it was deemed wise to put a concrete slab over the boiler house in place of the present wooden roof. The estimated cost includes moving out the present boiler house far enough to erect a fire wall, cutting off part of the present power house. Part of the old plant will be dismantled and a fire wall built. Between the boiler house and the railroad track is a convenient coal storage space, which can be utilized at small cost on account of a difference of 12 ft. in the elevation of the tracks and the boiler-room floor. A concrete wall is to be built directly under the track with facilities for unloading by gravity into the coal pocket. The crane estimate consists of $400 for trackway and supports and $600 for the crane proper.

ESTIMATED COST OF NEW MOTOR-SERVICE LINES TO ORANGE.

9000 lb. wire at 17 cts.	$1,530.00
150 4-pin cross-arms with pins, insulators, bolts, braces	210.00
Erecting the above wire	200.00
Meters	600.00
Transformers	2,800.00
Transformer stands and erecting	300.00
Service connections, including setting meters	250.00
Incidentals	300.00
Total	$6,190.00

ESTIMATED COST OF NEW MOTOR SERVICE LINES TO ATHOL.

8,000 lb. wire at 17 cts.	$3,060.00
174 4-pin cross-arms, with pins, insulators, bolts, braces	525.00
Erecting the above wire	400.00
[illegible] chestnut poles set	1,123.75
Meters	1,200.00
Transformers	3,000.00
Transformer stands and erecting	600.00
Service connections and setting meters	400.00
Incidentals	500.00
Total	$12,408.75

DISTRIBUTION LINES AND ARC-LAMP INSTALLATION AT ORANGE.

3 miles No. 1 copper wire } 10840 lb. at 17 cts.	$2,027.11
21.2 miles No. 6 copper wire }	
475 chestnut poles	2,137.50
Setting and guying poles, including tree trimming	1,575.00
566 cross-arms with pins, insulators, etc.	718.00
96 transformer stands, installed	1,282.00
Erecting 24.2 miles of wire	1,800.00
384 service connections to customers, including setting meters	4,771.00
Incidentals	600.00
Total	$15,879.54

About three miles of streets are to be covered by the Athol lines, there being about 2600 ft. of No. 0, 20,000 ft. of No. 2, and 17,500 ft. of No. 4 weather-proof wire. The extension of street-lighting circuits will require 115 new poles, with 40 new poles for purely motor-service lines. In the case of these poles an allowance of from $2 to $2.50 was made for setting. The first cost per pole varied from $2.75 in the case of small poles at the ends of streets where no possibility of motor business exists to $8 or $9 in the case of the heavier poles with concrete foundations and carrying transformers.

ARC LAMPS.

6 commercial enclosed arc lamps, installed, at $35	$210.00
46 public street arc lamps, at $50	2,300.00
70 series street lamps, 32 cp.	87.50
70 goose-necks and fixtures	420.00
37 Nernst lamps	332.20
Total	$3 349.70

INTERIOR WIRING AND ILLUMINATION

Holiday Lighting in Pennsylvania.

For the past year or two business men in various parts of Pennsylvania have utilized electricity to hold the local market and to increase sales in the Christmas and New Year shopping period. The details of the plans vary with the different cities; but the general scheme is to arouse the Christmas spirit, to make the city and the stores assume an air of the chief festal occasion of the year, to induce people to come into town to see the decorations and to participate in the general jollity and good feeling of that time of the year. In this manner people are brought to the city from points within convenient reach and the attractive displays in the stores induce increased shopping.

At Wilkes-Barre, Pittston, Sayre and Waverly the streets are at present illuminated by means of incandescent lamps festooned across the roadway in many cases, but chiefly along both sides of the street on the outer edge of the sidewalks. The lighting is supplemented by other attractions, such as parades, flag raisings, speechmaking, etc. As indicative of the class of attraction often given, the three weeks' festival at Elmira, N. Y., last year is typical. The carnival, which ended on New Year's day, had as its opening feature a street car pulled over the main street by three elephants, on one of which Santa Claus was seated. This novel, though by no means elaborate, parade was viewed by some 30,000 people, most of whom remained in the business section for many hours, with the result that the holiday sales were greater than ever. At Waverly there was a night parade on Dec. 16, in addition to extra carnival lighting paid for by the merchants. This parade drew people from Sayre, Athens and Elmira, taxing not only the streets in Waverly, but the transportation facilities as well.

Show-Room Windows at Dayton, Ohio.

The Dayton Lighting Company has an excellent show room on a prominent downtown corner. In this show room there is a large amount of window space by virtue of its being on the corner, with show windows on each street. These windows are arranged according to high-class ideas of show-window displays, with but a few appliances in each window, so that attention is not distracted by the multiplicity of things to be seen. The displays in these windows are changed every Friday. Even the lettering is changed. Temporary letters which make an excellent appearance for a week are cut from plain white paper and pasted on the windows. These letters have the general appearance of high-priced porcelain letters. Before Christmas for one week considerable prominence was given to the new Federal shaving mirror, which is provided with a tubular lamp and reflector below the mirror, and forms a complete lamp and mirror unit, which can be set on a chiffonier top or any other convenient place.

In the basement the company maintains a sample show window to illustrate the effect of different methods of lighting a given window. This window is fitted up with dry goods. One plan of lighting is by the old method of placing a border of 16-cp lamps at the top, bottom and sides of the window. Another method is by tungsten lamps with prismatic reflectors hung from short fixtures in the center of the window ceiling. The third and most approved method is by means of a row of tungsten lamps in concentrating prismatic reflectors placed at a slight angle, pointed inward, next to the window pane. Just in

front of the row of lamps on the window pane is a sign with a black-paint background and translucent letters which the lamps serve to illuminate. Merchants are taken to the basement to see this practical demonstration of the striking effects of the various methods of lighting.

A Semi-Concealed Church Lighting Installation.

An unusual lighting installation of considerable interest has been made in a building in Chicago erected for a church and now occupied by the Jewish Institute. The interior of this audience room, which is of the Gothic style of architecture, is shown in the accompanying engraving. The electrical installation and lighting were planned by Mr. J. N. Pierce, president of the Pierce Electric Company, which had the contract for the wiring. The architect did not wish to intrude any fixtures below the arches, and the contractor fully appreciated the desirability of keeping lamps out of the range of vision. He consequently arranged a scheme of lighting whereby no lamps are directly visible to a person seated in the audience. The lamps are so arranged that the eyebrows, ordinarily, completely shade the eyes.

Lighting is accomplished by placing tungsten lamps in opaque silvered, mirrored, concentrating reflectors at the apex of the cross arches. The effect is rather better than is shown by the photograph, as the photograph brings out contrasts more strongly than they are apparent to the eye. On each side of the central arch are mirrored-surface helmet reflectors, which were designed primarily for high show-window lighting and are very concentrating. These reflectors are placed flush with the arched ceiling. On each side of the central arch at the apex is a 60-watt tungsten lamp in a conical reflector of the mirrored-surface type. There are two 100-watt lamps concealed in niches on each side of the platform, and also two 100-watt lamps concealed behind the arches over the platform. The main audience room, exclusive of the platform, is 78 ft. 5 in. x 51 ft. 3 in., making an area of approximately 4000 sq. ft. For lighting this area 1800 watts in tungsten lamps are required, or a little less than 0.5 watt per square foot. The height to the center arch is 35 ft. The height of the arches on either side is 29 ft. The effect is rather unusual. One of the objects of this design—



SEMI-CONCEALED CHURCH LIGHTING.

namely, that of keeping direct light out of the eyes of the audience—is well accomplished. The architect is also well pleased on account of the general effect and the absence of obtrusive fixtures. Reflectors which distribute light efficiently over a little wider angle than the helmets used in this case were not known to be available at the time this installation was made, but would have been desirable. The illumination on the seats is more than ample as regards reading purposes. The direction of most of the light rays is so nearly perpendicular, however, that the faces of persons a little distance away appear to be insufficiently lighted. Thus the illumination is rather deceptive. This drawback could be partially overcome by using reflectors of later design, giving a somewhat wider light distribution. These reflectors would show less light on the horizontal reading plane, but would eliminate some of the shadows caused by the perpendicular rays on the faces of persons in the audience. For audience-room purposes, however, the present arrangement is very comfortable and efficient. The extra lighting of the stage gives ample illumination on the faces of speakers. Illumination on the faces of the audience is of secondary importance. Comfort of the eyes is first to be considered, and, second, ability to read easily, both of which are accomplished by the plan used. Architecturally the effect is excellent, and, as said before, much better than appears from the photograph.

Street Arches at Wilkes-Barre, Pa.

The public square at Wilkes-Barre, Pa., instead of being lighted as heretofore by means of arc lamps located at street intersections, is now lighted by arches of tungsten lamps strung at intervals from curb to curb. In all there are 240 60-watt, frosted-tip, tungsten lamps employed, arranged in 24 arches each of which contains 10 lamps. To make the arches alike, a span wire is stretched across the roadway from pole to pole



FIG. 1.—EAST SIDE OF PUBLIC SQUARE.

and attached to this are 10 triangular-shaped, paraffine-soaked pieces of wood about 4 in. long on a side. A hole is provided in each corner of the wooden triangles, the span wire passing through the upper one, and the two lower holes are used for



FIG. 2.—SOUTH SIDE OF PUBLIC SQUARE.

the electrical conductors. The lamps are fed from the latter as indicated in Fig. 3, one lead being attached in front of and the other in back of the wooden triangle. By this means a very symmetrical set of arches is obtained. The arches are spaced

70 ft. apart and the length of the span is 40 ft. The center lamp is placed about 25 ft. above the roadway and the sweep of the arc is quite regular, as will be observed from the engravings.

A porcelain-enameled shade is fitted to a skirted porcelain socket of the type shown in Fig. 3, the feature of which is that it forms both a drip loop and an extra support for the wires relieving the contacts from tension and giving a drop lamp which hangs plumb. At present 100-volt lamps are employed in the arches, fed from alternating-current mains passing around the square. It is the intention to replace the lamps with 10-volt tungstens arranged 10 to an arch and 10 arches being then connected in series across the present 100-volt circuit. In this

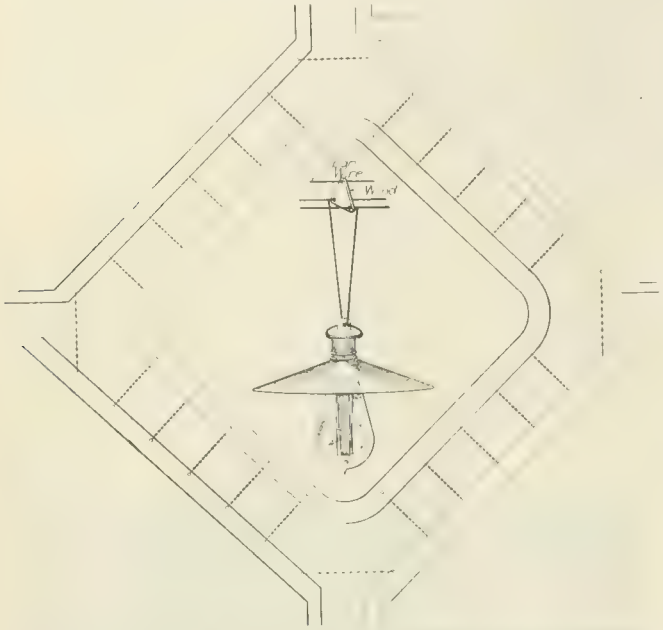


FIG. 3.—DIAGRAM OF ARCHES AND OF METHOD OF SUSPENSION.

way longer life will be obtained and breakage due to wind and storm minimized. The arches are rather inconspicuous during the day and the distribution of light from them at night is quite even and pleasing. The arches form part of the regular city lighting service contracted for by the Wilkes-Barre Gas & Electric Company.

Street and Show-Window Illumination.

It is high time again to call attention to the annoyance, if nothing worse, produced by the prevalent custom of hanging arc lamps provided for the purpose of display too near the sidewalk. With the increasing use of powerful flaming arcs for display purposes, has come a state of things which is needlessly distressing to the man in the street. Used for street lighting, or swung high, such lamps are extremely valuable owing to the flood of light they give, and when they are far removed from the eye the effect of their high intrinsic brilliancy, after all much lower than that of the unshielded arcs they have replaced, is not serious. When, however, they are brought within 10 ft. or 12 ft. of the sidewalk the results are somewhat painful. If there were need of thus placing them in order to obtain the desired illumination, some question might arise as to the propriety of their use; but when, as a matter of fact, a lamp 20 ft. or 25 ft. up gives all the light that can reasonably be desired, there is no proper reason for putting them so low as to annoy the passersby. The practical cause of thus suspending them is, we think, no desire on the part of the users to produce unpleasant results, but merely the fact that one occupying the first floor of a building cannot readily obtain the necessary location for hanging his lamps high. The remedy, however, is simple enough. One can obtain the most brilliant and attractive effects for display purposes by proper screening of the lamps. Proper grouping of smaller sources of light will obtain equally striking results without any greater expense and without causing any glare upon the sidewalk. There is no need of using a 2000-cp or 3000-cp source in a 10-in. or 12-in. globe in order to attract attention. The situation offers a good chance for missionary work on the part of the electric supply companies and those who furnish fixtures for display lighting. One occasionally sees on the streets very rich and beautiful effects of most attractive character produced without resorting to extreme means, and we are inclined to think that these attract more beneficial attention from the public than do the cruder devices.

The subject of artistic electric signs and display is one which is receiving some attention, but considerably less than it deserves. There are excellent examples now in use and there ought to be very many more. It is the unusual and the beautiful in illumination that catches the eye, which after all is the essential point in all advertising. Electric advertising is only in its infancy, as the public is wont to say of many things electrical. The huge plain sign in lines of light is useful in its proper place. Experience has already shown, however, that it can be replaced by something much finer in effect when it comes to signs not intended for visibility at a great distance, but to attract compelling attention. On narrow streets in particular, the need of artistic novelty is strongly felt, and the chance for skilful design in this work is almost unlimited. A little attention to this matter ought to bring good results, both to those who advertise and to those who supply the material. The time has gone by when a huge light thrust out over a doorway is either novel or edifying. This sort of garish display is most unpleasant so far as the public is concerned, and we do not see why it should not be subject to regulation like other matters pertaining to signs. Occasionally one sees some flagrant offender in the matter of window lighting, such as glaring lamps thrust forward in the eyes of the passersby. This is almost as offensive as the obtrusive arc, and cases have arisen where the effect of such lighting has been to injure neighbors across the street. A plate-glass window is a very good mirror, and when it reflects with offensive brilliancy the lights without, the effect of lighting within is in a great measure lost, with a result distinctly annoying to the passersby. This particular matter cannot be easily remedied except by an appeal to the courtesy of the advertising public, but it is a matter which should be borne in mind. The glaring arc, however, can be and ought to be abolished; regulations governing its use would be welcomed by the public at large and would not, in view of the many resources of electric advertising, bear heavily upon the present, often unwitting, offenders.

New Telephone Patents.

"BALLAST" SWITCHBOARD SYSTEM.

In the so-called "ballast"-type, common-battery switchboard system, the signal lamps operate in series with the subscriber's line, and thus with a common and uniform source of potential the current in the lamps varies with each length of line. Ordinarily, this is overcome by including the lamp in an exclusively local circuit, controlled by a relay. This latter is in turn included in the subscriber's line circuit and being capable of satisfactory operation over great ranges of current strength, the varying line resistance is of no effect. On the other hand, the allowable range of a lamp is small and to reduce the effect of the subscriber's line resistance, a ballast resistance is inserted which will make the net changes at the lamp terminal small. It will be evident that the ballast may be of so high resistance that the difference between the resistance of the shortest and longest subscriber line produces an unimportant effect at the lamp terminals. Again, the ballast may have a counteracting temperature coefficient, its resistance mounting rapidly as the current flow exceeds the normal flow.

Such a ballast may be made one with the signal lamp, in which case a tungsten or tantalum lamp may be used. This will give a double ballasting effect: the one due to the high

internal resistance of the lamp and the other the effect of coefficient. Mr. J. N. Wallace, of La Crosse, Wis., has patented such an arrangement of combined lamp and ballast, having assigned his patent to the Vote-Berger Company.

IMPROVEMENTS IN SEMI-AUTOMATIC SYSTEMS.

In the semi-automatic system a central-office operator is usually required to carry out a part of the switching, this part varying with different systems. In the present case, on plugging in and receiving a number, she selects through automatic means the desired number and then disconnects herself. It is this latter step with which we are concerned, Mr. William Christensen, of Belmont, Mass., having found that unnecessary time was consumed in directing the attention and moving the hand to the particular listening key through which the connection was maintained. He therefore mounts a trip bar along the keyboard, a single depression of which will release any of the listening keys which may chance to be set. It will thus be seen that the trip of the listening keys becomes mechanical, requiring no attention whatever and being accomplished alike for any or all keys. The patent for this arrangement is assigned to the American Telephone & Telegraph Company.

The patent granted to Mr. D. S. Hulfish, of Chicago, Ill., and assigned to McMeen & Miller, relates to a very different method of operation. In his system, a team of operators is assigned to a group of lines, the answering terminals and line signals of which are multipled to appear before each. Each operator has a rotating arm serving as a call-finder. This arm trails continually over a row of contacts to which the various lines are connected in proper series. As soon as a calling line, unanswered, is reached, the arm stops, displays a signal to the corresponding operator and then on being released proceeds upon its way. Thus it will be understood that each call is automatically distributed to that operator best able to handle it. Further, the number of positions in any team may be reduced at any time by merely stopping the corresponding machine upon a neutral contact.

ANTI-SIDE TONE OR REPEATING CIRCUIT.

The anti-side tone and the repeater circuit problem are the same for at least one feature, viz.: the transmitting element must not have any effect upon the receiving element. The scheme contemplates the use of a coil with an adjustable core and with two windings. These latter are so arranged that one is in the circuit of the receiving element and the other in that

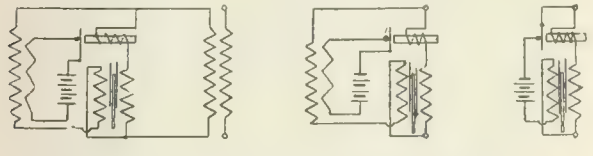


FIG. 1.—ANTI-SIDE TONE OR REPEATING CIRCUIT.

of the transmitting element. The coils are so connected that the induced current in the receiving circuit opposes the current which would flow because of the conductive relation. The inductive effect is adjusted by means of the core until a balance is effected. The illustration shows rudimentary circuits which may assist in understanding the arrangement.

SUBSCRIBER'S STATION APPARATUS.

When one is working in the ordinary type of bell box, the sides of the box, in close proximity to the apparatus, are sometimes an interference, especially if the adjustment to be made is deep in the box. To obviate this, to some extent at least, Mr. C. E. Oxford, of Fayetteville, Ark., has not only provided his bell box with a door, but he has arranged it so that the whole thing may be lifted off the base to gain access from the rear. The electrical circuits must, of course, be provided for by means of registering clips which readily separate and recontact.

An antiseptic device forms the subject of a patent granted to Mr. Geo. Rowlands, of Schenectady, N. Y. The invention has an antiseptic surface which is hygroscopic, and therefore remains moist, so that germ-laden material will stick to it.

A switching attachment for party lines has been invented by Mr. C. B. Mitchell, of Franklin, Tex. The line is cut through the switch so that when the telephone is being used in one direction, the leg of the line going the other way is cut off the talking circuit and is connected to the bell. The return of the receiver to the hook serves to trip off the switch after use so that it will assume its normal position.

SWITCHBOARD SYSTEMS.

In the divided multiple, multi-signal system it becomes necessary to give the subscriber means to select that one of his line signals located upon the division of the switchboard carrying the multiple of the desired number. The selection may be effected by varying the flow of current so as to cause relays to fail under one current and operate under a greater one. This current flow is, of course, controlled by cutting in different resistances at the subscriber station. For example, in Fig. 1 the

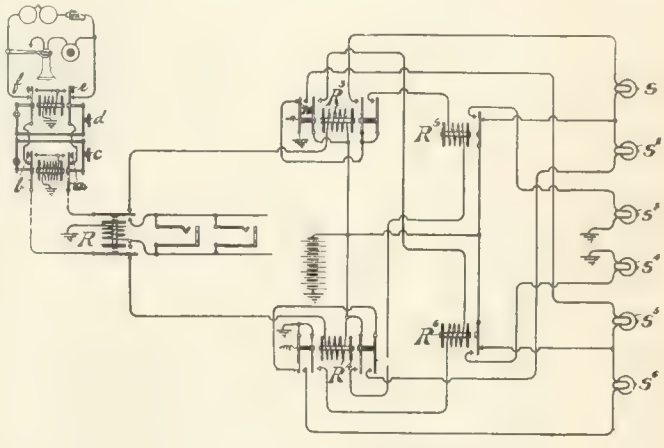


FIG. 2.—WEBSTER SWITCHBOARD.

relays R^3 and R^4 are two-stage, shifting their right-hand contacts on low currents and all contacts on high currents. The keys at the subscriber station are magnetically locked. Key *a*, high-resistance, operators lamp S, through partial operation of relay R^3. Key *b* through R^4 lights S^2. Lamp S^6 requires full operation of R^3 and S^6 of relay R^4. Relay R^5 responds to partial operation simultaneously of R^3 and R^4 and relay R^6 of full simultaneous operation. There are other combinations which might be arranged, but the above is typical.

Mr. H. G. Webster, Chicago, Ill., has been granted a patent for this change of resistance method of control, having assigned his patent to the Kellogg Switchboard & Supply Company.

The patent granted to Mr. C. L. Zahm, of Los Angeles, Cal., deals with an improvement in automatic systems, which lies in the substitution of a bridged battery for talking purposes at or near the completion of the operation of the connector. This bridged battery is cut in through the two windings of a release relay which, being upon opposite ends of the core, act as impedances for talking currents and differentially for steady currents.

OUTLYING SELECTIVE SWITCH.

At times it is desired to control over a main line a distant or outlying switch, to connect a branch line to the main line. Mr. John H. Swanson, of Baldwin, Wis., has invented such a switch, which is of rather simple construction. A polarized magnet is provided with two armatures. One is a tilting armature such as is used on a ringer. The other is a contact armature. This latter will not respond to an energization of the magnets by the weak main line current, but it will respond to a local winding. When a main-line current of proper polarity arrives, the tilt armature responds, closing the local circuit. The contact armature now responds, connecting in the branch line. The contact armature shunts the magnetic field and permits the tilt armature to restore, but the contact armature is held by the polarizing magnet. An alternating current serves to dislodge this armature when disconnection is desired.

Letter to the Editor.

Polyphase Magnetomotive Forces.

To the Editor of Electrical World.

Sir:—The writer wishes to thank Mr. John D. Nies for his letter in your issue of Nov. 11 criticising a letter in your issue of Oct. 14 relating to polyphase magnetomotive forces. On account of an erroneous assumption that the torque due to the fictitious motor III increases from standstill instead of decreasing, the maximum value of the negative torque was shown in the diagram at a slip of + 166 per cent in the case of backward running instead of at + 133 per cent, as properly stated by Mr. Nies in an article in your issue for Aug. 26.

It seems well to call attention to the fact that in my letter no attempt was made to expound any new method for calculating flux and induced e.m.f. in an induction motor, but merely to point out that the effective e.m.f. induced by a distorted flux wave cannot be determined by calculating the values of the individual fictitious components and adding them algebraically, as one is apt to infer from the statements in Mr. Nies' article. That is to say, the method given by Mr. Nies is likely to be confusing and misleading. It should be remembered that the field at any point of a magnetic circuit is defined by its strength and its direction—not directions—that is, it is a vector quantity. Hence there is no such thing as one flux moving at a certain speed in one direction and another flux moving at a different speed in the opposite direction. In a distorted flux wave it is customary to consider the harmonics individually in some cases, in order to express mathematically the effects produced by the deviation from the true sine shape, but the method used by Mr. Nies is not permissible.

During the past 10 years the effect of the distortion of the field flux upon the performance of induction motors has been investigated by many engineers. Their investigations have shown that when a motor does not accelerate to synchronism but runs at some definite speed which is a fraction of the synchronous speed, the trouble can be overcome without recourse to a fractional-pitch winding. In the case of a motor with a squirrel-cage rotor, the selection of the proper number of bars per pole per phase will insure a good performance, while when the rotor is of the coil-wound type the starting resistance may easily be so selected that the irregularities in the speed-torque curve are smoothed out during acceleration.

Chicago, Ill. Henry Hermann.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Automatic Voltage Regulation of Alternators.—M. Seidner.—A continuation of his extensive article giving brief descriptions of and critical remarks on various methods of voltage regulation of alternators. In the present instalment he deals with the methods of Corsepius, General Electric Company, Alexanderson, Hutin, Boucherot, Rice, Danielson, Union Elek. Ges., Steinmetz, Le Blanc, Walker and Heyland. The article is to be concluded.—*Elek. Zeit.*, Dec. 9.

Ratio of Transformation of Transformers.—E. B. Rosa and M. G. Lloyd.—A theoretical article on the determination of the ratio of transformation and of the phase relation in transformers, with application to potential and current transformers. The results of tests are given in tables and diagrams.—*Bull. Bureau of Standards*, Vol. 6, No. 1 (October).

Mercury-Vapor Rectifier.—F. von Keller.—An illustrated lecture before the Berlin Electrical Society on the Cooper Hewitt mercury-vapor rectifier and its application in practice.—*Elek. Zeit.*, Dec. 9.

Lamps and Lighting.

Train-Lighting System.—In a single-battery train-lighting system developed by the Tudor Accumulator Company the generator is spring-suspended and belt-driven from a coach axle. The machine is placed in circuit at 300 r.p.m. and the voltage is kept down with rising speed by an opposing series field. An automatic switch reduces the shunt excitation when the battery is fully charged, and the lamp pressure is kept constant within 4 per cent by means of iron-wire series resistors. Fifteen cells are required, the lamp pressure being 24 volts. The connections are illustrated in Fig. 1. With the coach at rest the lamps are supplied with energy from the battery, and as there is no voltage across the generator brushes, the switches *A* and *B* will be in the open and closed positions, respectively. As the coach starts the brush rocker will move into the proper position to excite the machine, and the field current will pass from the brush through the shunt field winding to the two groups of iron-wire resistors *RP* (which allow a definite current to pass, independent of a large voltage fluctuation); here it splits up and a definite portion passes to the terminals 1 and 2 of the switch *B*, and thence to terminal 3 and through the resistor *K* to the positive brush. As soon as the machine attains a speed of 300 r.p.m. it generates the necessary voltage and the main switch *A* closes; as the speed further increases, the output rises and when the current exceeds the lamp load the excess goes to charge the battery. When the battery voltage attains the full charge value the switch *B* breaks circuit at the terminals 1, 2 and 3, so that the resistors *P* are cut out. This action decreases the field current, and the generator output is reduced to the lamp load, the remaining field current being that flowing through resistors *R* and *M* and switch *S*. If, now, the main lamp switch *S* is opened, the field current is reduced to a very small value, namely, that which passes through the group of resistors *R, M, N* and *K*. This small field current is just sufficient to make the generator give 2 amp or 3 amp at high speeds, and serves to top up the battery and prevent switches *A* and *B* from hunting. As the generator speed decreases the output gradually falls, switch *A* opens, and when it comes nearly to rest, *B* closes. The lamps *L* are permanently connected across the battery and are run in series with iron-wire

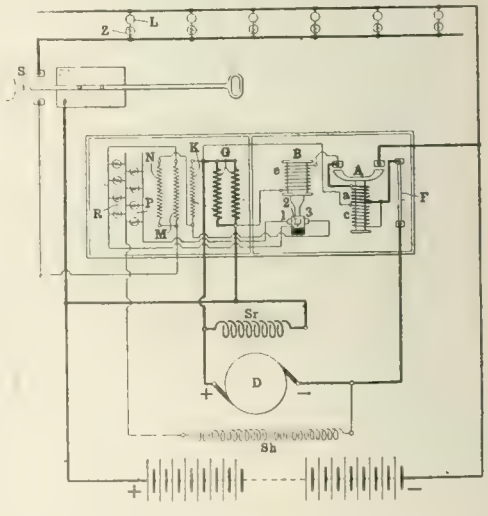


FIG. 1.—DIAGRAM OF CONNECTIONS.

resistors *Z*, which absorb the fluctuations due to the battery either being on charge or discharge.—Lond. *Elec. Eng'ing*, Dec. 9.

Metallic-Filament Lamp.—A note on a recent British patent of the French Welsbach Company (24,212, 1908; Dec. 2, 1909)

for supporting metallic filaments. A central porcelain rod carries a series of nickel-wire supports forming a helix. Fine platinum or platinum-iridium hooks are fused to the ends of the supports. These lessen the cooling of the filament by conduction, and do not melt at the high temperature attained by the filament.—Lond. *Elec. Eng'ing,* Dec. 9.

Two-Hundred Volt Osram Lamp.—A note stating that since the General Electric Company has placed its 32-watt, 200-volt osram lamp on the market, over 500,000 lamps have been sold. The company and its agents have been rather behindhand on deliveries both of this size and other sizes recently.—Lond. *Elec. Eng'ing,* Dec. 9.

Beck Lamp.—A note stating that the German Beck lamp patent which has been revoked is not the fundamental one, but a later one for a particular arrangement in which the negative electrode is supported.—Lond. *Elec. Eng'ing,* Dec. 9.

Arc Lamps.—J. LADOFF.—The first part of a historical review of the use of conductors of the second class (electrolytic conductors) as arc-lamp electrodes.—*La Lumière Elec.,* Dec. 11.

Generation, Transmission and Distribution.

Steam Turbine.—ANDRE.—The conclusion of his article on the Barbezat steam turbine. An actual installation of this turbine is described with a detailed account of the results of tests. —*La Lumière Elec.,* Dec. 4.

Traction.

Abandonment of Electric Operation on the Seebach-Wettingen Road.—For several years the Oerlikon Company has operated the Seebach-Wettingen road electrically and has made extended studies of heavy electric traction on this line. It had been hoped that the Swiss railroad department would buy the electric equipment, but it has not done so, since it was found that, even with the lowest rate at which electrical energy was offered, operation would cost from $14,000 to $17,000 a year more than steam traction. The road in question is not specially suitable for trials with heavy locomotives and high speeds on account of the comparatively weak track construction and its many curves and grades. The railway department asked the Oerlikon Company to continue electric operation and was willing to pay from $2,000 to $4,000 per year to the Oerlikon Company, but the latter decided to abandon electric operation, since the department did not want to buy the equipment outright.—*Elek. Zeit.,* Dec. 9.

Tramway Costs.—The first part of an article on electric tramway costs and statistics. The article is illustrated by numerous forms of records.—Lond. *Elec. Review,* Dec. 10.

Bow Collectors.—A. SCHMIT.—An illustrated comparison of the relative advantages of bow collectors and trolley-wheel collectors, pointing out the advantages of the former.—Lond. *Elec. Eng'ing,* Dec. 9.

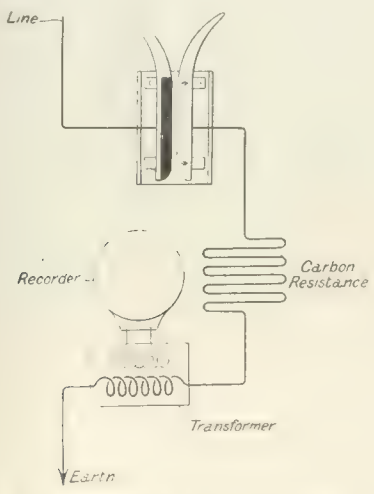


FIG. 2.—DIAGRAM OF CONNECTIONS.

Installations, Systems and Appliances.

Recorder for Lightning Arrester.—An illustrated description of a recording device for showing when lightning arresters and other protective spark-gaps have been in action, which is in use on the Heysham-Morecambe section of the Midland Railway. The arrangement is shown in Fig. 2 in which the spark-gap is of the horn type, with the "line" side of the gap faced with carbon. The other side is connected through a special non-inductive resistor and the primary of a small transformer to earth. The secondary of this transformer actuates a simple form of recorder. This instrument has the movement of the pointer constrained by two steps, so that the passage of a current impulse, due to the spark-gap having been in action, makes a V-shaped notch in the line traced by the pen. The circular disk chart revolves once in 24 hours, and the position of the stop is shifted by hand every day, so that the traces for every day of the week are concentric circles. The carbon resistor consists of a zigzag groove of special shape in a fire-clay block containing a special carbon powder.—Lond. *Elec. Eng'ing,* Dec. 9.

Circuit-Breaker.—An illustrated description of a simple circuit-breaker made by a British company. One coil serves as both overload and blow-out magnet, and carries the whole current. There are no springs and remarkably few working parts. A fuse in the body of the switch is in series with the main contacts.—Lond. *Elec. Eng'ing,* Dec. 9.

Wires, Wiring and Conduits.

Price of Copper.—GLIER.—The first part of a statistical article on the fluctuations of the copper price during the last 40 years. The author begins with statistical data showing that the price of coal, wheat, meat, cotton and metals has gone up during the last 40 years and that it is wrong to make protective tariffs responsible for this general and international rise of prices. With respect to copper, data are given on the prices in Frankfort, Hamburg, England and the United States. There have been large fluctuations of the price of copper, but in general there is a rising tendency. Six times since 1879 the price of copper imported to Hamburg per 220 lb. was below $25 (in 1886, 1887, 1894, 1895, 1896 and 1897), but since that time this has not occurred; even the enormous drop of the price of copper from 1901 and 1902 and that from 1907 and 1908 did not bring the price for 220 lb. again below $25.—*Elek. Zeit.,* Dec. 9.

Definition of Conductors and Cables.—The conclusion of the report of a committee of the Berlin Electrical Society (H. Diesselrost and F. Emde) on the definition of the electric properties of conductors and cables. The present instalment is chiefly of mathematical character.—*Elek. Zeit.,* Dec. 9.

Electrophysics and Magnetism.

Insulation of Induction Coils.—A. CAMPBELL AND J. L. ECKERSLEY.—With high-frequency coils, such as are used in wireless telegraphy and even with telephonic frequencies, the distributed capacity of a highly inductive coil (say 1 henry) will show itself by altering the effective resistance and inductance. But there are in addition the effects of low insulation in such cases. These effects may give trouble in standard inductance coils, and may even cause unexpected energy losses in the more important case of the inductive loading coils used on telephone circuits. The authors give a mathematical theory of

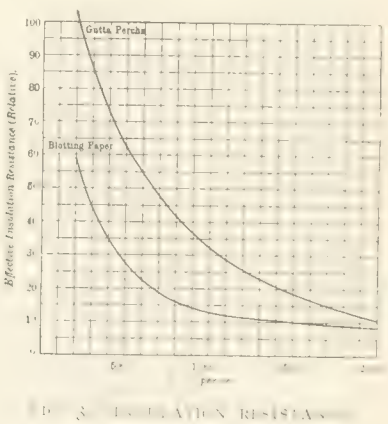


FIG. 3.—INSULATION RESISTANCE.

a leaky induction coil. When the leakage is relatively small the increase in effective resistance is practically proportional to the square of the frequency, and thus the errors due to bad insulation are much accentuated as the frequency rises. Moreover, it is very important to remember that in nearly all insulating materials the effective leakage increases as the frequency is raised, one reason being that the leakance includes the energy due to dielectric hysteresis. The authors give the results of some tests on a length of guttapercha-covered wire placed in water and a small condenser made of blotting paper and tinfoil. Fig. 3 shows how rapidly the effective insulation resistance falls off as the frequency rises. They determined the effective insulation resistance by Wien's method (see abstract below under Units and Measurements).—Lond. *Electrician,* Dec. 10.

Thermo-Electromotive Forces.—J. Weiss and J. Koenigsberger.—The authors have determined thermo-electromotive forces of some metallic oxides, sulphides, etc., against copper. The thermo-electromotive force in volts per degree within the range from 20 deg. C. to 80 deg. C. of silicon against copper is —0.000 44, pyrite + 0.000129, graphite + 0.0000053, magnetite + 0.000055, molybdenite + 0.000727. The positive sign means that the current passes from the material to copper at the hot joint. These thermo-electromotive forces are from 10 to 20 times as great as those of metals against copper.—*Phys. Zeit.,* Dec. 1.

Nature of Electricity.—H. Witte.—The conclusion of his article on the attempts which have been made to find an explanation of the nature of electricity. He emphasizes that any mechanical explanation of electrical phenomena must make use of the hypothetical ether and that the latter cannot be assumed to be continuous, but must be supposed to have an automatic structure. In modern physics the attempts to devise such a theory have been abandoned and it seems more rational to try to find an explanation of all physical phenomena on an electromagnetic basis.—*Elek. Zeit.,* Dec. 9.

Units, Measurements and Instruments.

Measuring Insulation Resistance.—A. Campbell and J. L. Eckersley.—In an article on the insulation of inductance coils the authors describe Wien's series-resistance method for determining insulation resistance. The connections are shown in Fig. 4. K is the condenser to be tested, its insulation resistance

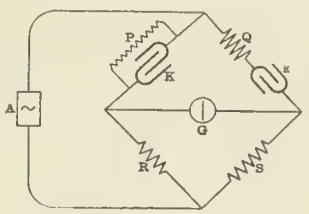


FIG. 4.—DIAGRAM OF CONNECTIONS.

being represented by P; k is a standard condenser with very small (negligible) absorption and leakage, Q is a resistor of adjustable resistance (non-inductive), R and S are proportional arm resistors, the resistance of one of which is adjustable. A is a source of alternating current (for example, a wire interrupter or a microphone hummer), while G is a vibration galvanometer or tuned telephone. By successive adjustments of Q and either R or S the indication of G is brought to zero, in which case

$$K = kS,\ P = R\,(1 + \omega^2 k^2 Q^2) \text{ and } P = R\,(1 + \omega^2 k^2 Q^2)/S\omega^2 k^2 Q$$

where $\omega = 2\pi \times$ frequency. When testing small condensers it is convenient to use a small air condenser of variable capacity as standard, but even with this it is often necessary to have considerable inequality between the arms R and S. This inequality and other causes tend to introduce considerable error due to the capacities to earth of the various parts of the network. The presence of the error is indicated when, on reversing the connections to the source A, the readings are altered. When the alteration is made, it is usually sufficient to take the mean of the two sets of readings. A better way, however, is to interpose between A and the bridge a special transformer, in which the primary and secondary coils are well insulated from one another, and have between them a guard screen consisting of a coil connected to earth.—Lond. *Electrician,* Dec. 10.

Magnetic Induction in Straight Bars.—C. W. Burrows.—A long illustrated article giving a description of a method of making precision magnetic measurements in use at the Bureau of Standards. A close approximation to uniformity of flux along the test rod may be secured by using properly constructed specimens and yokes and properly distributed magnetizing coils. The double bar and yoke form of magnetic circuit seems to offer the greatest number of advantages and the fewest disadvantages. The reluctance of the yoke and joints should be small. This is accomplished by having the yokes short and of moderately large cross-section, and making the surface of contact between specimens and yoke of considerable area. The corners of the yokes should be rounded off so as to avoid, as far as possible, disturbing end effects. The magnetomotive force may be advantageously distributed in three sections, a uniform solenoid over the test specimen, a second one over the auxiliary rod, and the third section subdivided into four short coils and placed over the four ends of the rods as near to the yokes as feasible. These three magnetomotive forces should be capable of independent adjustment and simultaneous reversal. The test coils to be used as indicators should be long enough to avoid errors due to local irregularities attributable to the inhomogeneity of the rods. One coil should be wound under the middle section of each magnetizing solenoid and the third should be distributed with one-half over each end of the test bar, but not too near to the yokes. In the measurement of the magnetizing force and the magnetic induction these quantities are obtained by zero methods directly from potentiometer readings. As to accuracy, it was hoped at the beginning of this investigation that the magnetizing force required to produce any induction between 1000 and 20,000 gausses might be obtained to within 1 per cent. Investigations now in progress indicate that this accuracy has been secured.—*Bull. Bureau of Standards,* Vol. 6, No. 1, October, 1909.

Iron in Dynamometer Wattmeters.—C. V. Drysdale.—One of the principal defects of the dynamometer wattmeter has been the small torque which is obtainable when the power consumption and shunt reactance of the instrument are kept within suitable limits. This is due to the absence of iron in the wattmeter. An impression seems even now to be prevalent that if iron is introduced into a dynamometer wattmeter in sufficient quantity appreciably to improve the torque, it must necessarily introduce an unallowable amount of error. The author discusses mathematically the effect of iron on the indication of a wattmeter and gives briefly the design of an iron-clad wattmeter devised by himself in which use is made of his theory. The instrument has a phase displacement less than would produce any readable error, and shows the possibility and utility of employing iron in wattmeters. The instrument also appears to give very fair results on direct current and it would, therefore, appear possible to extend the principle to a motor meter of the Thomson form, which should have a much higher torque than is usual in such meters.—Lond. *Electrician,* Dec. 10.

Paper Condenser.—E. H. Weiss.—An article on the design of condensers of tin-plated paper. The author deals with the problem of finding those dimensions for which the capacity becomes a maximum within a given volume.—*La Lumière Elec.,* Dec. 11.

Telegraphy, Telephony and Signals.

Meters.—An official communication of the Reichsanstalt by which a direct-current magnet motor meter (amp-hour meter) of Keiser & Schmidt is admitted for calibration. A description of its construction and action is given.—*Elek. Zeit.,* Dec. 9.

Wireless Telegraphy.—J. Bethenod.—The formula of Bjerknes permits the determination of the damping effect of an antenna of a wireless telegraph system by measurements with a hot-wire ammeter inserted in an auxiliary circuit which

is subjected to the influence of electromagnetic waves emitted by the primary circuit. Independently of Bjerknes, others, like Fleming, have devised various methods. The present author shows how the equations of Bjerknes can be brought into a particular form, so as to further simplify the method of Fleming.—*La Lumière Elec.*, Dec. 4.

Wave Detector.—An illustrated description of the new magnetic wave detector of Rossi, pointing out its great sensibility with respect to the high-frequency currents of wireless telegraphy and its small sensibility with respect to the atmospheric discharges and the currents of other frequencies.—*Elek. Zeit.*, Dec. 9.

Loaded Telephone Cables.—A. W. MARTIN.—The first part of a paper discussing the principles of loading telephone lines with inductance coils.—Lond. *Elec. Review*, Dec. 10.

Miscellaneous.

Berlin Electrical Society.—At the meeting of Nov. 20, 1909, the thirtieth anniversary of the formation of the society was celebrated. The president, Wilhelm von Siemens, gave a brief review of the work of the society during these 30 years. The Siemens-Stephan memorial tablet, which had been founded on the occasion of the twenty-fifth anniversary, was awarded for the first time. Professor Warburg, the president of the Reichsanstalt, was the recipient and made a speech especially on the work of Werner von Siemens. Count Arco then gave an experimental lecture on wireless telegraphy.—*Elek. Zeit.*, Dec. 9.

NEW APPARATUS AND APPLIANCES

The High-Efficiency Ortho-Chromatic Carbon Arc.

BY S. D. GILBERT.

By the process of evolution through thousands of years, the human eye has gradually become accustomed to daylight, or, as it is ordinarily called, white light. Any artificial light is therefore more nearly natural and better adapted to the uses of mankind the nearer it approaches daylight.

By white light is not meant full sunlight, as we comparatively seldom work with objects thus illuminated; it is rather the diffused light made up of sunlight reflected and diffused from the sky and terrestrial objects that must serve as our normal standard of white light. This, of course, varies somewhat from day to day and month to month, but for purposes of comparison a reliably close approximation may be obtained on any fair day.

In comparing the different kinds of artificial light sources now available there is found a startling variation of color, ranging from the deep orange of the flame carbon to the greenish blue of the mercury arc. With the incandescent lamps the color is roughly indicated by the efficiency. All of the lamps of this class give a yellowish light, which becomes more nearly white as the specific consumption decreases. For instance, carbon, Gem, tantalum and tungsten are in the order of their efficiency and also of color, the last mentioned having the lowest figure of specific consumption and being the most nearly white, although it still varies considerably from our standard of white light, as a rough comparison will readily show.

When used to illuminate commercial interiors, especially where colored fabrics are displayed, the selection of an illuminant having the characteristics of diffused daylight is imperative. So many claims for whiteness of light are made for illuminants whose light is obviously tinted that such claims have to some degree been discredited.

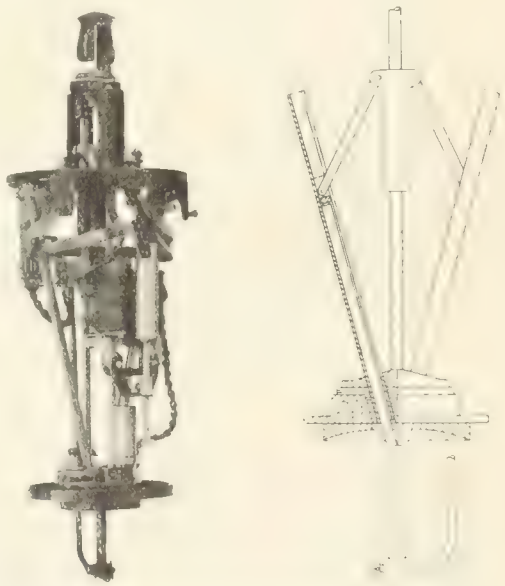
In order to illustrate the superiority of the inclosed carbon arc for color matching and selection, the lumichromoscope and the well-known color booth are available. By these devices the effect of daylight, together with the rays from various artificial sources, can be compared simultaneously, and the superiority of the arc over other artificial illuminants readily observed.

In making comparisons it is imperative that the artificial illuminants be operated at their proper commercial ratings. If gas lamps are to be brought into the comparison, the observer must know that the mantles used are of the commercial type, for by the use of specially prepared mantles, the life of which is extremely short, the quality of light can be improved.

The crater of a carbon arc is very much hotter than the filament of the incandescent lamp, so-called, and at the same time gives a much whiter light. Added to this white crater light there is a small percentage of light from the arc stream proper, in which the waves of blue and violet predominate. This predominance may, however, be eliminated by the use of opalescent glass, which has the property of absorbing more of the blue and violet than of light of the longer wave lengths, and at the same time producing the proper diffusion.

Whenever illuminating requirements are exacting and the selection and matching of colors are of importance, the inclosed arc, when properly equipped, will be found well suited for use.

Fig. 1 represents the mechanism of a new design of arc lamp known commercially as "the intensified arc." It will be noted that the arrangement of its mechanism differs materially from



FIGS. 1 AND 2.—MECHANISM OF ARC LAMP.

conventional designs of inclosed arc lamps heretofore produced. Use is made of two small-diameter (6 mm) positive-cored carbon electrodes, brought into abutment as shown in Fig. 2.

A sliding weight bears upon these converging electrodes, thereby insuring a wedging contact near their burning ends and obviating the necessity of upper holders and flexible current conductors. The arrangement also maintains the arc at a fixed position in the inclosing globe, without the mechanism usually required for maintaining a focusing arc.

The arc is formed and regulated by the movement of the lower negative carbon electrode, which is somewhat larger in diameter (9.5 mm) than the positive electrodes, it having been found that this increase in diameter has practically no effect upon the efficiency and distribution of the direct-current arc. At 5 amp and 80 volts (at the arc) an electrode life of between 75 and 100 hours is claimed by its manufacturers. This life, considering the small diameter of the positive electrodes, is made possible by the use of the abutting principle referred to above.

The principal advantages derived from the use of small positive electrodes are efficiency and steadiness of operation. Al-

though in the intensified arc lamp two positive electrodes are used, they are burned alternately. At 5 amp, therefore, the current density is relatively high, and as the heat cannot pass off by conduction, as in the larger electrodes, the end of the electrode is maintained at a high state of incandescence. Under such operating conditions the end of the positive electrode is apparently in the area of the crater, thus preventing the wandering of the arc and insuring high efficiency and steady operation.



FIGS. 3 AND 4.—EXTERIOR VIEWS OF ARC LAMPS.

The lamp when equipped with a clear inner globe (no outer) and small metal reflector is said to have a specific consumption of about 0.6 watt per maximum radial candle. By maximum radial candle is meant the average candle-power at the maximum angle, as shown by plotting a curve of average distribution in a vertical plane; using the same equipment and expressing the specific consumption in watts per mean hemispherical candle-power, a figure of 0.91 is obtained. This low initial consumption readily admits of the use of diffusing globes adaptable to specific installations.

It may be safely stated that in the past many artificial illuminants of inferior characteristics have been selected by reason of the artistic effect of the installation, rather than for correct illumination. With the advent of the so-called intensified arc lamp, a unit of artistic design embodying the requirements essential to modern high-class illumination is available. It is evident, however, that no one design and finish of casing will harmonize with all of the various periods of architectural construction, and variety of designs and finishes suitable to meet the demands generally imposed must be produced. Where the requirements are most exacting individual designs harmonizing with the interiors to be illuminated shall be used.

It would seem that in the intensified arc lamp there is embodied the features desirable for both the esthetic and the economical illumination of commercial interiors.

"Beehive" Reflector.

The National X-Ray Reflector Company, of Chicago, has brought out a new reflector for large tungsten lamps which is called the "Beehive" on account of its resemblance in shape to the old-fashioned beehive. This reflector was designed specifically for the lighting of the track room of the Northwestern University gymnasium at Evanston. This is a very large interior, with lamps placed from 30 ft. to 40 ft. above the floor. Mr. J. R. Cravath, illuminating engineer for the gymnasium building, wished a reflector which would give an efficient distribution of light from 100-watt tungsten lamps placed at this height and which would at the same time shade the direct rays of the lamp from the eye of anyone looking the length of the room. He designed this reflector to accomplish this purpose for this particular case and the manufacturers have since placed it upon the market for general use in the lighting of large interiors where opaque reflectors are desirable. It has the usual corrugated mirror reflecting surface, and is of one piece of glass, as are all reflectors of this make.

The distribution of light from this reflector with a 100-watt

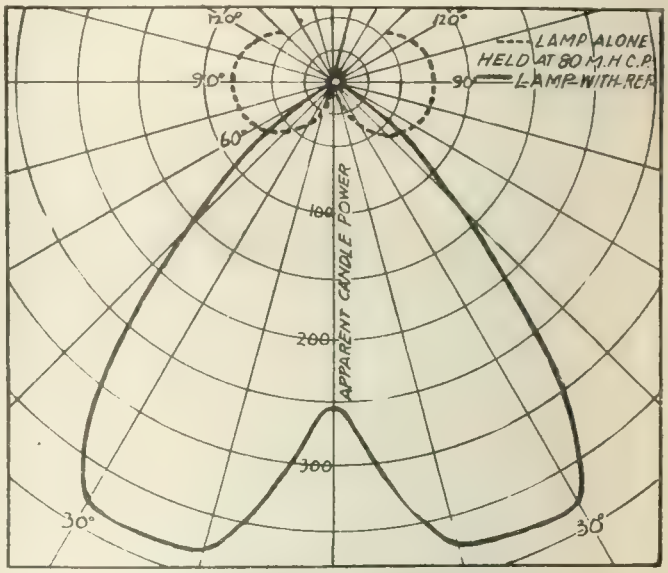


FIG. 1.—LIGHT DISTRIBUTION OF "BEEHIVE" REFLECTOR.

tungsten lamp operated at 80 mean horizontal candle-power is shown in Fig. 1. The shape of the reflector is shown in Fig. 2. Its total depth is 11⅝ in. As will be seen from the distribution curve, this reflector with a 100-watt tungsten lamp will give a fairly even illumination over a surface extending 30 deg. from a vertical line through the lamp axis. With a 250-watt tungsten lamp, the area lighted is increased to 45 deg., but the shading of the lamp by the reflector is, of course, not so complete.

The special field for this type of reflector is in the lighting of factories, gymnasium rooms, foundries and other places where it is desirable to place the lamps high out of the range of vision and at the same time obtain high efficiency and shade the lamps so that ordinarily no direct rays from the lamp will enter the eye.

An analysis of the distribution curve shown in Fig. 1 brings out the fact that the mean candle-power between the vertical



FIG. 2.—"BEEHIVE" REFLECTOR.

and 60 deg. from the vertical (which is practically the entire range of the reflector) is 131.1 cp, giving 610 lumens. With a lamp consuming 100 watts, this would give lumens per watt equal to 6.1 and watts per lumen 0.164. In other words, with the lamp and reflector clean, as under test conditions, an average illumination within the range of the reflector of 1 foot-candle could be obtained with an expenditure of 0.164 watt per square foot without regard to the color of ceilings or walls. For locations where ceilings and walls are dark and have little reflecting power, this type of reflector is, therefore, well adapted and gives high efficiency. With light ceilings and walls more diffusion than is obtained from an opaque reflector of this kind is desirable. Where the room to be lighted with opaque reflectors of this kind is large, a sufficient number of lamps [illegible] that shadows are not annoying.

Combination Electric Heater, Cooker and Toaster.

The new combination heater, cooker and toaster shown in the accompanying illustration is being marketed by the Central Electric Company, of Chicago. As will be seen from the illustration, the heater is provided with a rectangular metal frame, which not only serves to embody the heating element, but also forms a chamber in which is located a little toasting oven in the shape of a drawer. In this little oven the bread is toasted

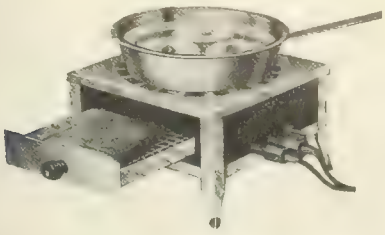


FIG. 1. TOASTING DRAWER OPEN.

by the evenly distributed heat radiated downward from the heating element. The construction is such that any of the ordinary cooking utensils may be used upon it. It is built to combine mechanical strength with electrical durability along lines that

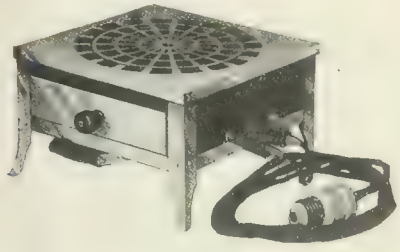


FIG. 2.—TOASTING DRAWER CLOSED.

experience has shown to be most economical and satisfactory for articles to be used by persons inexperienced in the handling of electrical devices.

The heating units, composed of special non-oxidizing alloy, are spiral in shape and of such construction that they can be readily renewed without the use of tools other than a pair of pliers. A mica strip running lengthwise of each heating unit serves as a support for every convolution of wire, thus preventing any possibility of short circuits. A three-contact switch is provided, which enables low, medium and high heats to be secured, thus insuring a minimum consumption of energy.

The new heater is designed to appeal to those who would prefer to prepare light meals by electricity, but who find that a sufficient selection of heaters, toasters and special utensils is discouragingly expensive, and also to those living in hotels or apartments where space is at a premium and gas not easily accessible, who enjoy having a dainty midnight luncheon after an evening at the card table, when it is possible to do so without destroying the effect of the evening's entertainment.

Steam Regenerator.

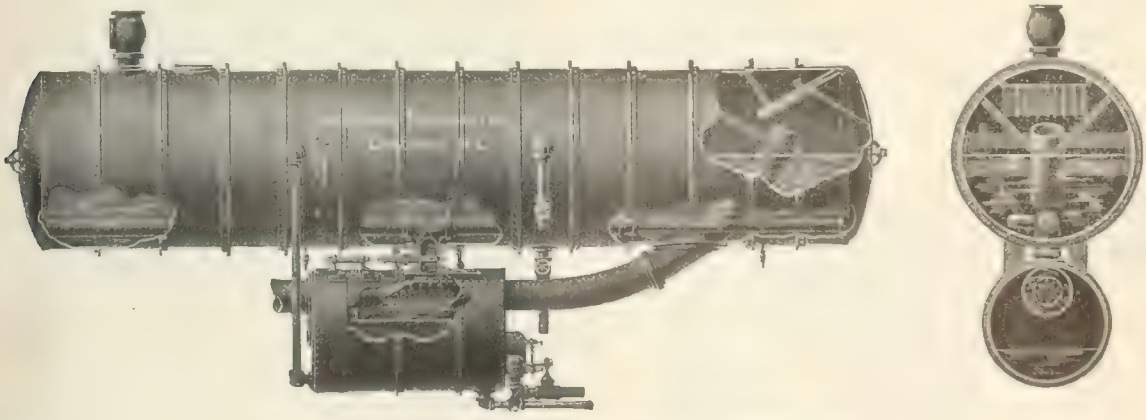
The steam regenerator shown in the accompanying illustration is intended for use in connection with a combination reciprocating engine and steam turbine plant. It acts to store the energy of the exhaust steam from the reciprocating engine, to be supplied as needed by the steam turbine.

The regenerator is so designed that each particle of steam entering the apparatus comes into contact with many times its own weight of that portion of water at the lowest temperature, and since the hottest water is delivered on the surface of the water in the regenerator, the circulation is excellent and all the contained water is effective.

Referring to the illustration herewith, the water from the larger tank falls through a pipe containing a valve into an annular space surrounding the perforated spray pipe through which the exhaust steam from the engine enters at the left. In entering the lower chamber the exhaust steam operates a vane, which in turn controls a valve in the pipe connecting the upper and lower chambers; thus the amount of water supplied to the outside of the spray pipe is always proportioned to the amount of exhaust steam passing through it. In this manner the steam comes into thorough contact with every particle of the water, so that the water is heated to the full temperature of the exhaust steam. The momentum of the steam is sufficient to carry the mixture of water and steam up through the eduction pipe into the upper tank, where the mixture is delivered against suitable baffles and separated from the steam.

A steam regenerator can be employed to advantage in a number of cases, namely: (1) where the output of steam by the engine is intermittent or fluctuating and the requirements for steam by the turbine are uniform; (2) where the engine and the turbine supply power to the same busbars through electric generators, so that the loads on the generators vary in conjunction with each other; (3) where the engine delivers steam uniformly, but the turbine load fluctuates; (4) where the output of steam by the engine is intermittent or fluctuating and the requirements for steam by the turbine are independently intermittent or fluctuating also.

The use of a regenerator in each of the above cases serves to smooth out the variations between the momentary discharges of the reciprocating engine and the demands of the steam turbine. The regenerator is to the steam turbine-reciprocating engine combination what the storage battery is to the electrical circuit, or the flywheel is to the reciprocating engine. The regenerator herein described is built by the American Regenerator Company, Chicago, Ill.



SIDE AND END SECTIONAL ELEVATIONS OF REGENERATOR.

Walpole Tapes.

In connection with the development of its already extensive line of insulating materials the Massachusetts Chemical Company, of Walpole, Mass., has had exceptional opportunity to study the effect of a wide variety of materials and processes upon the strength, durability, adhesiveness, insulation and other qualities of insulating tape, and as a result has placed on the market a new tape known as Walpole tape. This tape is packed in 80 ft. lengths, ¾ in. wide, in round tin boxes. It is made upon a strong fabric, manufactured expressly for this purpose, thoroughly impregnated with a special compound claimed to have remarkable qualities of insulation, adhesiveness and resistance to atmospheric action. Under many tons pressure this compound is rolled into the fabric, filling every pore, crowding between the fibers, closing the most minute pinholes, and providing an absolutely impervious coating upon each side of the fabric. The friction is noticeably smooth. The result is perfect protection from the elements and as a consequence, enduring strength. The composition of the compound keeps it constantly "tacky," without variation under extremes of temperature, and amply adhesive for all requirements, but not so much so as to interfere with easy handling. The compound contains nothing that will corrode copper or in any way affect the materials with which it may come in contact.

The tin box in which Walpole tape is packed makes it distinctive. Although the guarantee upon this box specifically covers only one year, it is stated that the tape will retain its superior qualities for years, no matter what the climate or the altitude. The box preserves any unused portion of the roll and is in itself an inducement to care and economy in the use of the tape.

Motor-Driven Meat Chopping Machine.

An example of the simplicity, convenience and efficiency of the electric motor drive is the application shown in the illustration, a 10-hp alternating-current motor gear-connected to a large meat chopper. This machine has a capacity for cutting



MEAT CHOPPER.

and recutting 1500 lb. of beef three times per hour, and 3000 lb. of pork twice per hour. The compact drive secured by mounting the motor on the chopper frame has the added advantage of lifting the electrical equipment above the floor, always wet and more or less greasy in a sausage room. Besides the protection from dirt and grease thus afforded the motor windings and parts, virtually no space that is occupied by the driving apparatus.

The improved sanitary conditions, as well as efficiency, secured by avoiding moving belts and shafting are important results of employing electric drive in the preparation of foodstuffs. The self-contained construction of the present application prevents the stirring up of dust or foreign particles in the chopping room. Gear drive has also worked a considerable economy in operation, for while the type of machine illustrated ordinarily requires 10 hp when belt-driven, it has been found to take only 7½ hp with the spur transmission shown. This economy of power, as well as the low cost of the installation, is perhaps the strongest point in favor of this method of applying electric power, although the convenience, compactness, simplicity and cleanliness of this drive should not be overlooked.

The machine illustrated is a No. 66 Enterprise chopper, and was equipped with a Westinghouse three-phase induction motor for the Ziemsen Butchers' Supply Company, Chicago, Ill.

Conduit Bender.

The universal bending machine shown in the accompanying illustration is well adapted for use as a conduit bender for use

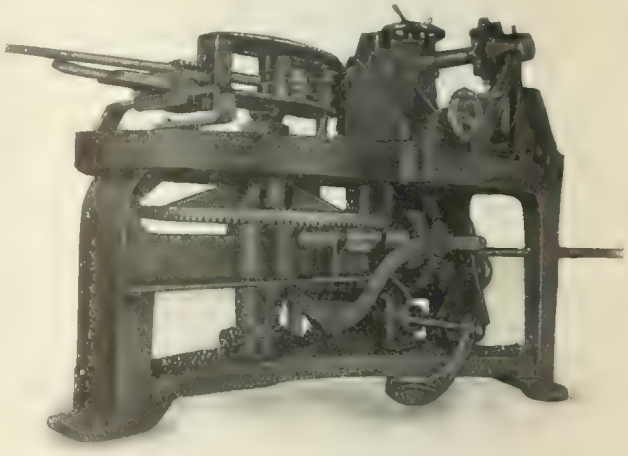


FIG. 1.—SIDE VIEW OF BENDING MACHINE.

by wiring contractors. Some idea of the constructive details and methods of use can be gained from Fig. 2. By means of adjustments in various planes the pipe or conduit can be bent

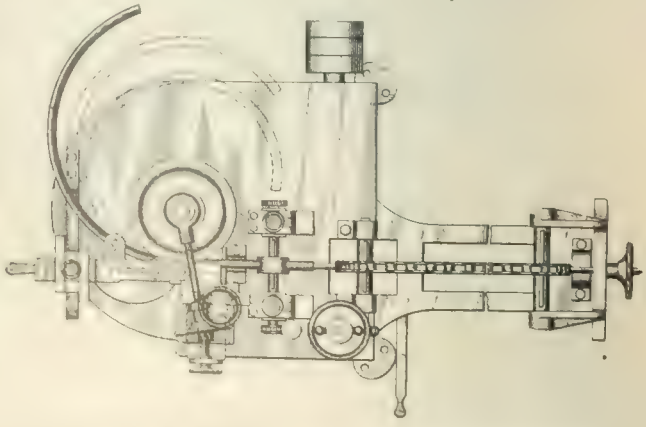


FIG. 2.—[illegible] OF MACHINE SHOWING RADIAL BENDS.

into any required size or shape, while with proper attachments the machine produces bends automatically. This machine has been placed on the market by J. Fillmore Cox & Company, Bayonne, N. J.

Electric Furnace Demonstration Room in Chicago.

The Hoskins Manufacturing Company, of Detroit, has opened a demonstration room in connection with its Chicago branch office at 321 Dearborn Street, where the actual operation of the company's various electric furnaces and heating appliances is



FIG. 1. HOT PLATES AND ELECTRIC FURNACE

shown. By means of an installation of pyrometers, the temperatures attained by the various devices are also indicated. The series of five furnaces illustrated on the right in Fig. 1 include a crucible, tube and three sizes of muffle chamber styles, all designed for operation on standard 110 or 220-volt circuits. The crucible form *A* is used in a variety of chemical work, such as making incinerations and fusions. The tube chamber furnace *B* is specially adapted to use in steel laboratories for the determination of carbon in steels by what is known as the direct combustion method. The muffle furnaces of this type, *C, D* and *E,* cover a wide range of uses in the manufacturing arts, such as for hardening carbon steels, annealing small metal parts, and enameling, as well as for chemical and optical works. Behind each of these furnaces is a rheostat which is used to control the current, and hence the temperature.

A crucible and tube-chamber furnace of a different type are shown at *A* and *B,* Fig. 2. This type of furnace is designed to operate at very low voltage, with a high current. The resistance element is of the same patented alloy as is used in the furnaces *A* to *E,* Fig. 1, only of much larger cross-section. This makes possible a higher temperature than can be obtained in the standard-voltage type. The transformers necessary to step the line tension down to the required point, together with the rheostats for controlling the temperature, are shown immediately below the furnaces. The crucible furnace, *C,* Fig. 2, has a patented carbon plate resistance element. This furnace is used for melting gold and metallic alloys. It operates on a low volt

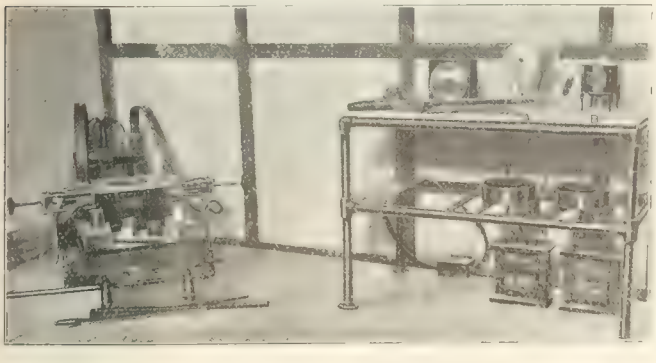


FIG. 2.—CRUCIBLE AND TUBE FURNACES

age with a high current density, and the transformer is shown immediately behind it.

A tube chamber furnace of this type is shown at *C,* Fig. 3. The furnace is mounted directly over the transformer. The hose connections shown are for a circulation of water, which is necessary to cool the terminals. This furnace is used for welding tubing and for other allied operations requiring the high temperatures it produces. Two different types of electrically heated hot plates are shown at *Y* and *Z,* Fig. 1. These plates operate on standard-voltage circuits, and are used for a variety of laboratory work.

The installation of thermo-electric pyrometers is a feature of

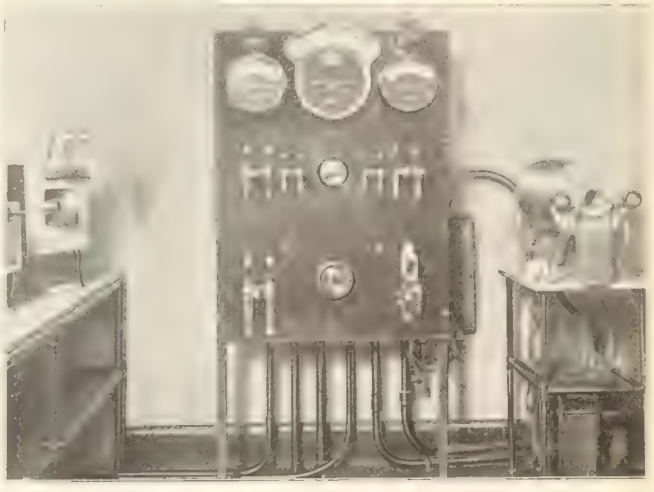


FIG. 3. SWITCHBOARD WITH PYROMETER AND FURNACE

the display. A thermo-couple is shown inserted into the crucible furnace *A,* Fig. 1. The leads of this couple connect with the large illuminated dial meter in the center of the switchboard. This meter is graduated to read directly in degrees Fahrenheit, and it indicates temperatures as high as 2550 deg. By means of an eight-point switch immediately below it, any one of eight thermo-couples which may be located in different furnaces can be connected to the meter. These products should interest engineers and central-station managers, since they open a field for the application of electric energy to heat production for a variety of industrial purposes.

Weatherproof High-Tension Pothead.

A new type of outdoor pothead for use in connecting between high-tension, overhead lines and lead-covered cables is illustrated herewith, and has been placed on the market by the Central Electric Company, Chicago, Ill. The pothead is of weatherproof construction and designed to be mounted on a cross-arm or pole, so that it is applicable for connecting high-tension transformers to underground distributions. The porcelain insulators have a continuous passage in which is located a hollow steel pin lined with treated wood. Means are also provided for effectually sealing the insulator cones against the entrance of moisture. The supporting case of the pothead is of iron or aluminum, as desired, and is provided with a metal chamber ar-

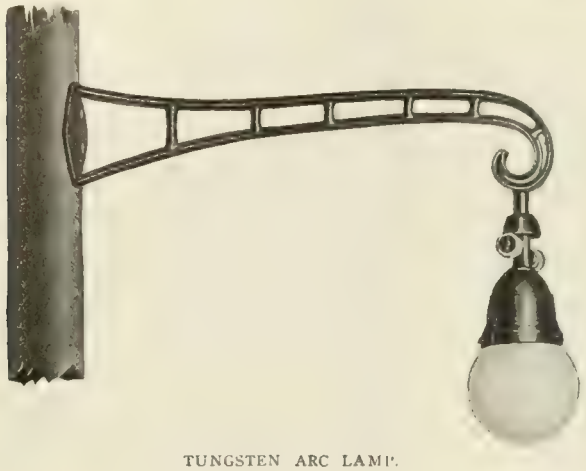


POTHEAD

ranged to be filled with insulating compound. As will be seen from the illustration, the lead-covered cable enters from the bottom of the chamber and the three high-tension lines leave at the sealing cones of the insulators.

Tungsten Arc.

The Philadelphia Electrical & Manufacturing Company, Philadelphia, Pa., has recently put on the market a new lamp known as the "Tungsten Arc." These lamps are designed to take the place of gas arc lamps and are adapted for interior and window lighting, as well as for street lighting. It is claimed for these lamps that they are in many respects superior to the ordinary



TUNGSTEN ARC LAMP.

enclosed arc lamp, as there is an absence of all shadows, the light is steady and uniform in color; the lamps are safer and much cleaner, no trimming is required, and especial attention has been given to getting the best possible distribution of light. In connection with these lamps this company is also manufacturing an extensive line of ornamental brackets, one of which is shown in the accompanying illustration. This bracket has an extension of 3½ ft., and while the weight is but 18 lb., it is rigid and stiff

Gasoline-Electric Express Wagon for Suburban Service.

The Champion Wagon Company, of Owego, N. Y., is the builder of the gasoline-electric express wagon intended for suburban service and illustrated herewith. Vehicles of this type possess all the merits of individual gasoline and electric machines, combining the economy of a gasoline prime mover with

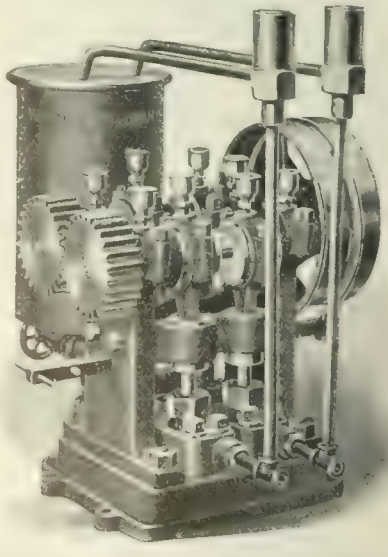


GASOLINE-ELECTRIC EXPRESS WAGON.

the advantages of electric drive and control. A four-cylinder gasoline engine is direct-connected to a 7.5-kw compound-wound generator rated at 50 amp, 125 volts. The engine and generator are mounted on a subframe in front of the wagon under the hood. The subframe has a three-point suspension, the rear end being a pivoted support. Inasmuch as the generator has but one end bearing, the armature being bolted to the engine flywheel, a very compact set results. All the valves of the engine are on one side; the oiling system is self-contained in the crankcase, and is supplied from the sump below the crankcase, which holds about 2 gal. The generator is designed to withstand momentary overloads as high as 200 per cent without sparking. Unlike some combination machines, the controller is used only when starting and stopping the car, speed variations being obtained by using the spark and throttle lever. The controller is placed in circuit on very low voltage, and as the car starts the engine speed is gradually increased and the vehicle brought to running speed without shock or jar. While the controller is in circuit the voltage may be reduced and the brakes applied to slow up or to stop the car without stalling the engine. The brakes are of the internal expanding type, faced with an asbestos lining. The normal rating of the motor used in driving the vehicle is 40 amp, 85 volts, and there is a double reduction between the motor and the wheels; a Morse chain is used between the motor and the countershaft, and a roller chain between the countershaft and the driving wheels. Motor, generator, countershaft and hubs are equipped with annular ball bearings so as to minimize friction, and speeds ranging from 1 to 16 miles per hour are obtainable, the average speed of the wagon, loaded, being 12 miles per hour. The carrying capacity of the vehicle is 3 5 tons.

Multi-Service Hydraulic Pump.

The four-cylinder, two-pressure, line hydraulic pump illustrated herewith represents a type by means of which one, two, three or four pressure lines may be served independently of each other, but from a common reservoir. Each pressure line has a separate pressure chamber, safety valve and release line, and is served by a separate pair of cylinders having eccentrics



MULTI-SERVICE HYDRAULIC PUMP.

set to give a continuous flow. Any pressure up to 600 lb. per sq. in. may be delivered into any line, the limit in each instance being determined by the setting of the safety valve, which opens as the pressure tends to exceed the limit and lets the surplus liquid pass back through the release pipe to the reservoir. Any pressure line can be thrown out of service entirely by opening the safety valve, in which instance all the liquid in that line pumps directly back to the reservoir.

The one, two, three and four-pressure line pumps are practically identical in design save for change in the length of the bedplate and the shafts to accommodate the required number of pressure chambers, cylinders, piston rods, eccentrics, etc., and may be fitted with an electric motor instead of the pulley shaft shown. These pumps are made by the Watson-Stillman Company, of New York.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

The condition of trade during the past week showed further progress and expansion. For the most part, weather conditions have been favorable to a liberal holiday trade, and from almost every section of the country the reports of the retailers are that the Christmas business has been entirely satisfactory. Except in the Northwest, where the strike of the switchmen has to some extent restricted transportation, there has been a large movement of goods. In some sections the country roads have been in such condition that the farmers have been unable to visit the county towns, but in all of the smaller cities, however, reports indicate that retail trade has been better than since 1906. As far as jobbers and wholesalers are concerned, there has been little new business booked. This is true of the pre-holiday season every year. There have been, however, quite a number of re-orders received, and in many instances there have been demands for rush shipments, indicating that the retailers have sold more goods than was anticipated when they made their original purchases. There is continued expansion in the industrial world. The iron and steel business goes on with the same tremendous amount of activity that has been in evidence for several months. The electrical industries all report better sales, especially in smaller apparatus. The woolen manufacturers and the boot and shoe makers are all busy. In the cotton industry alone there is some contraction, owing to the unusually high price of raw material and the necessity of marking up the price for finished products. Collections for the past fortnight have been rather dull; this, however, is always to be expected at this season. Failures for the week ended Dec. 23, as reported by *Bradstreet's*, were 264, as against 273 the previous week, 196 in 1908, 248 in 1907, 161 in 1906 and 212 in 1905.

THE COPPER MARKET.

There was considerable activity in the copper market during the few days just before the holidays, although the buying by consumers was rather small. The exporters were in the market and purchased quite liberally for February and March deliveries, together with moderate purchases for January shipment. The prices ranged from 13½ to 13⅝ cents f.o.b. for electrolytic. The activity has been considerably stimulated by what appears to be the more favorable statistical position as to copper metal. It was estimated that deliveries for the month into domestic consumption will be upward of 60,000,000 lb., while deliveries for export may be in the neighborhood of 70,000,000 lb. It is claimed, also, that there has been a decrease in the output of refined copper during the month, due not only to the holidays but to the fact that the daily rate of production will show a slight decrease. All of these things lead to the expectation of a marked falling off in the surplus stocks when the next report of the Copper Producers' Association is made public. Of course, it is understood that the actual consumption of copper is still far below the actual production, but conditions at the present time are more favorable to speculation, and it seems that there are always enough speculators to take hold at every opportunity. Exports for the current month, including Dec. 27, have been 22,499 tons. The daily call on the Metal Exchange Dec. 27 quoted standard copper as follows:

	Bid.	Asked.	Selling price.
Spot	13.12½	13.37½	.....
December	13.25	13.37½	13.32½
January	13.25	13.37½	13.32½
February	13.25	13.37½	13.32½
March	13.25	13.37½	13.32½
April	13.25	13.37½	13.32½

The London prices Dec. 24 were as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	60 15 0	*.....
Standard copper, futures	61 7 6	*.....
Market	Firm	*.....
Sales of spot		1,600 tons
Sales of futures		1,000 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
London spot	£64 2 6	£54 12 6
London future	64 17 6	55 10 0
Standard	13 4	12 12½
London, best selected	67 1	59 2 0

THE "MAZDA" METALLIC FILAMENT LAMP.—A metallic filament lamp will be placed on the market at the beginning of the year by a number of lamp companies under the trade name of the "Mazda" lamp, the distinctive word apparently being drawn from Zoroastrianism and signifying "light." The technical difference between the "Mazda" and tungsten filament lamp has not yet been divulged.

CALIFORNIA LAMP FACTORY.—Negotiations by the National Electrical Lamp Association for the purchase of a block of land in West Oakland lying between Peralta and Campbell and Sixteenth and Seventeenth Streets, have been completed. It is the purpose of the company to erect a large factory on the new site.

CENTRAL STATION DEVELOPMENT COMPANY.—The Central Station Development Company, of Cleveland, Ohio, has been organized for the purpose of co-operating with central stations in developing commercial departments. The work of the company will be based upon methods used by its vice-president and general manager, W. H. Wissing. In the development of the new business department of the Union Electric Light & Power Company, of St. Louis, Mo., which work attracted at the time much attention in central station circles throughout the country. The aid to be rendered to central stations will be quite wide in scope, including a complete system for the organization of new business departments, including forms, index cards, etc., and specific plans for new business campaigns. In addition, central stations will be instructed as to well-tried means of locating prospects and securing the co-operation of dealers and contractors. As above stated, W. H. Wissing, who is general manager of the Tungstolier Company, of Cleveland, will be general manager of the Central Station Development Company. E. J. Kulas, president of the Tungstolier Company, is president of the new company, of which T. M. Roche is secretary and field manager. These gentlemen are assisted by a staff of 10 practical men with central station commercial experience.

AUTOMOBILE INDUSTRY EXPANDING.—According to the statistics of the American Motor Car Manufacturers' Association, there were actually made and sold in this country during 1909 more than 82,000 cars of various types. This is an increase of about 50 per cent over the previous year, and the value of the product was $98,400,000. It is estimated by the same authority that there will be built during 1910 at least 200,000 cars which will be worth something like $240,000,000. At present there are about 275,000 cars in private ownership in this country or one for every 175 of population. These cars are estimated to be worth more than $400,000,000. It is said that the chief drawback to the expansion of the automobile industry is the enormous increase in the cost of tire material. Only the best grade of Para rubber can be used in the manufacture of automobile tires, and the price of this material has more than doubled in the past 18 months. Not only that, but the supply of rubber is not sufficient to meet the demands of the tire makers.

OTIS ELEVATOR COMPANY.—In common with all other industrial concerns, the Otis Elevator Company has experienced something of a boom within the past 12 months. The fiscal year of the company is the same as the calendar year and it is estimated that the earnings for the current year are likely to be considerably in excess of those for 1908, which were $832,772. Many of the contracts taken by the company require a considerable time for execution, and for that reason the full effects of the business booked during the past year will not be felt until well along in 1910. All of the plants of the company are in excellent shape and are running at full capacity. During the year, a new foundry and warehouse have been added to the Yonkers plant and an addition to the manufacturing end of the same plant is being constructed.

THE DUKES IN COTTON MILL DEVELOPMENT.—There is a persistent report afloat in the Piedmont section of North Carolina that the Duke interests are backing a tremendous proposition which looks to the erection of 21 of the largest cotton mills in the country, to be located at various points on the transmission system of the Southern Power Company. The Dukes are practically the owners of the Southern Power Company, which is a $10,000,000 concern, and which operates a number of hydroelectric stations in both North and South Carolina. It is now reported that these interests propose to establish a string of big mills, which will become customers for the energy generated by the Southern Power Company. Some weeks ago it was announced that an organization had been formed with $500,000 capital to construct a cotton mill at Great Falls, S. C. This is the site of one of the Southern Power Company's largest generating plants, and this is believed to be the beginning of the project. The Southern Power Company has recently taken over Lookout Shoals in Catawba County, North Carolina, and will construct a plant there. The big plant at Ninety-nine Islands, South Carolina, will be completed in April. The dam at this site is 75 ft. high and 1500 ft. long. It has also been stated that the Southern Power Company would likely take over the Whitney plant near Salisbury, N. C. The Southern Power Company has been for years doing all that it could to induce manufacturers of all classes to establish their plants along its lines. It is estimated that when all of the sites the company now owns are developed it will have 200,000 hp for market.

EXCELLO LAMPS FOR NEWARK.—The Market Street Business Men's Improvement Association, of Newark, N. J., and the Public Service Corporation of the same place have decided to use 58 pairs of "Excello" flaming arc lamps for lighting the business section of the city. These lamps are to supplant other lamps, and each pole will bear one pair of lamps. Already 16 pairs of these lamps have been delivered, and the others will be furnished as rapidly as the Excello company can secure the lamps. This is part of the movement on the part of Newark business men to make the city more brilliant. The Excello company reports that the demand for its flaming arc lamps has been very brisk within the past few months. One order recently received was from the Nichols Copper Company, of Brooklyn, for 100 lamps to be installed in its Laurel Hill plant.

NEW PLANT OF DETROIT FUSE & MANUFACTURING COMPANY.—The Detroit Fuse & Manufacturing Company, Detroit, Mich., has just completed the erection of a new factory building in Detroit for the manufacture of "Arkless" enclosed fuses and Detroit iron-clad switches. Motors aggregating 70 hp furnish the power, and among the features of the factory are a finely equipped tool department for the manufacture and maintenance of special tools and dies; an electrical laboratory for testing fuses and for experimental and development work, and a drafting department for work in connection with the Detroit line of iron-clad switches. The new building greatly enlarges the manufacturing facilities of the company, which have become too small for its growing business in fuses and switches.

IDAHO POWER & TRANSPORTATION COMPANY.—Since the purchase by the Idaho Power & Transportation Company, of Idaho Falls, of the property of the St. Anthony Light & Power Company, which was referred to in our issue of Nov. 25, extensive plans for development have been formed. The St. Anthony Company was furnishing the light and power for Rexburg, Teton City, Sugar City, Salem and St. Anthony. All of these cities are now furnished with energy from the plant at Idaho Falls, and the smaller plants at St. Anthony and Teton City are being used as auxiliaries. The company has put in two more units at its central station near Idaho Falls of 600 kw each, and expects to be able to keep up with the demand for power in its immediate section. It has now about 75 miles of transmission lines.

CHEAP POWER FOR ZACATECAS MINES.—The Cia. Electricia de Zacatecas, which supplies the city of Zacatecas, Mexico, with light and power, has made an application to the State authorities for a modification of its present charter and franchise which will enable the company to increase its service and extend the field of its operations. It asks permission to build transmission lines into neighboring towns in order to supply them and various mines with power. If this permission is granted it will largely increase its generating plant. The mines in this section have always been handicapped by the high cost of power. It is claimed that with intelligent management and with cheap power, these mines can be made very profitable.

ELECTRIC POWER FOR EDMONTON, CANADA.—For some time past engineers have been engaged on a project to secure power from the Saskatchewan River, and, after a thorough investigation of the upper stretches of the river, a point 110 miles distant from Edmonton has been decided upon. Charles Tupper, B.Sc., of McGill University, son of Sir Charles Hibbert Tupper, and Charles H. Colgross, M.E., have been conducting the investigations. The estimated cost of the project will be about $1,500,000, and the minimum power that can be developed is approximately 20,000 hp. It is expected that Montreal capital will become associated with the local interests who are identified with the project.

GREAT IMPROVEMENT IN CONDUIT BUSINESS.—The demand for underground conduit has improved very materially during the latter half of 1909. Conditions now are practically normal. "We have had a very satisfactory year," said B. S. Barnard, of the Standard Vitrified Conduit Company, in discussing the conditions of trade. "Our business has been very good, and the demand for our product is constantly increasing. If we do all the business next year that the present indications promise, we will have the best year in the history of the company. Of course, the winter is the off season for underground work, but there is so much development work in prospect that we expect to be busy by the first of March."

NO CONSOLIDATION OF TECHNICAL JOURNAL PUBLISHING COMPANIES.—An article printed last week in a New York City daily newspaper and reprinted in other newspapers, gave a circumstantial account of an alleged consolidation of several companies publishing technical journals, the McGraw Publishing Company, publishers of the *Electrical World*, being included in the list. The story had absolutely no foundation, present or prospective, so far as relates to the publishers of the *Electrical World*; and we are informed by the other publishers mentioned that the article is similarly without truth in its references to them.

ELECTRICAL CONSTRUCTION.—Among the items printed under Construction Notes in our present issue are announcements of proposed new plants or considerable extensions of present plants as Sheboygan, Wis.; Johnstown, Pa.; Kimball, Va.; Goldstone, N. C.; Stillwater, Okla.; Erwin, Tenn.; Jourdanton, Tex.; Highbridge, Ky.; Millersburg, Ky.; Baltimore, Md.; Granite Falls, Minn.; Lafayette, Ga.; St. James, Mo.; Sylvan Beach, N. Y.; Lainsburgh, Mich.; Santa Barbara, Cal.; Marion, Kan.; Marion, Ia.; Logan, Utah, and Evansville, Wis.

MOORE ELECTRICAL COMPANY.—The Moore Electrical Company, of Newark, N. J., reports a large demand for the Moore tube light. These tubes are especially being used in the various silk manufacturing concerns and dye works in the eastern section of New Jersey. It is claimed that the light which they give is perfect for matching colors. Among the recent purchasers of tubes are the United Price Dye Works, of Lodi, N. J., and Formann, Stumpf & Sharpe, of Paterson, N. J.

TUNGSTEN CONCENTRATES.—The Primos Mining Company, Boulder, Col., is building a new mill which, it is stated, will have an annual capacity of more than $250,000 in tungsten concentrates. The Primos company also will build a hydroelectric plant of 2500 hp, of which 500 hp will be used in its mines and mills and the remainder sold to operators in the Boulder district.

DUPLEX METALS COMPANY.—Officials of the Duplex Metals Company declare that there has been quite an active demand for copper-covered wire within the past few months. This demand has been largely for signal and telephone work and for use on railroads. It is claimed that the use of this kind of wire is broadening out and that it is becoming available for new purposes all the time.

EQUIPMENT OF TOKYO ELECTRIC LIGHT COMPANY.—We are informed that, with the exception of the generators, all of the equipment of the plant of the Tokyo Electric Light Company, which was described in our issue dated Dec. 16, was furnished by the General Electric Company.

UNITED SERVICE COMPANY.—There has recently been organized under the laws of New York the United Service Company, with a capitalization of $100,000. This company will have its office at 40 Wall Street, New York. It has been organized for the purpose of dealing in supplies of all kinds, especially equipment and other material necessary to the operation of electric railways, electric light companies, gas and water companies. It will also do the purchasing for the subsidiary companies of the Susquehanna Railway, Light & Power Company. The company will take over, dating Jan. 1, the entire business of the Railways Equipment Company, which has been operating in a similar line. The officers are: S. J. Dill, president; Henry Morgan, vice-president; A. V. Wainwright, secretary; W. D. Martin, treasurer; F. G. Robinson, purchasing agent.

Financial Intelligence.

THE WEEK IN WALL STREET.

In spite of the fact that the volume of business, both in railroad and industrial enterprises, is continuously increasing, and that there is every reason why the Wall Street market should be strong, the past week was one of particular dullness and inactivity. Trading was listless during the days that preceded the holidays, and the general tendency of prices was to sag. There was no definite movement, however, of importance sufficient to cause any sharp breaks. The general condition of stagnation is well illustrated by the fact that the average net change for the week of 20 of the most active railroad and industrial issues was less than one point. There are still many speculators who are expecting the traditional year-end rise, and who believe that the rather heavy profit-taking by dealers who wanted money for Christmas is responsible for the postponement of this advance. In many directions there should undoubtedly be advances recorded. Quite a large number of prominent railroads and industrial concerns have advanced their rates of dividends, and earning reports are encouraging from almost every source. One of the big features of the week was the remarkable flurry in Rock Island common, which occurred shortly after the exchange opened Dec. 27. Within a few minutes the stock advanced from 50 to 81, a storm of buying orders having suddenly appeared upon the floor. Almost as suddenly the buying ceased and the stock reacted, closing at the end of the session only 1¾ points above the close Friday, Dec. 24. As this little flurry was not accompanied by any reports of deals or dividend increases, it was generally taken as a manipulative movement by a party of speculators, who in some manner slipped a cog in their program. The feature of the money market during the past week was the sudden advance at one period of call money to 6 per cent, then the reaction to normal rates. Quotations Dec. 27 were: call, 4¾ @ 5½ per cent; 90 days, 4½ @ 4¾ per cent. The quotations in the table are those of the close, Dec. 27.

NEW YORK.

	Dec. 20.	Dec. 27.	Shares sold.		Dec. 20.	Dec. 27.	Shares sold.
All.-Ch.	15⅛	15*	750	Int. Met. pfd.	61*	62	38,010
All.-Ch., pfd.	55	54¼	1,400	Mackay Cos.	90½	91½	433
Amal. Cop.	87⅞	87¾	100,700	Mackay Co. pfd.	77½*	77*	700
Am. D. T.	20½	20½*	—	Man. Elev.	139½	138¼	1,200
Am. Loc.	60¼	59¼	1,900	Met. St. Ry.	23*	23*	—
Am. Loc. pfd.	114*	116	200	N.Y.A.N.J. Tel.	130*	130¼	—
Am. Tel. & C.	77½*	77½*	—	Steel, com.	61⅝	60⅝	365,150
Am. T. & T.	142½	142½	10,850	Steel pfd.	125	125⅜	6,425
B. R. T.	80½	79½	13,240	W. U. T.	77½	76⅝*	2,400
Gen. Elec.	160	159½	3,296	West'h., com.	81¾	81½	9,600
Int.-Met., com.	24¼	24⅛	40,300	West'h., pfd.	133*	133*	—

PHILADELPHIA.

	Dec. 20.	Dec. 27.		Dec. 20.	Dec. 27.
Am. Rys.	47	47	Phila. Elec.	13⅞	13⅞
Elec. Co. of A.	12⅜*	12⅜*	Phila. R. T.	27¼	27⅜
Elec. St. B'ty.	88¼	90	Phila. Trac.	88½*	88½*
E. S. B'ty, pfd.	30*	30*	Union Trac.	52⅛	52

CHICAGO.

	Dec. 20.	Dec. 27.		Dec. 20.	Dec. 27.
Chi. City Ry.	180*	180*	Chi. Tel. Co.	136*	137*
Chi. Rs., Ser. 1	105	109	Met. El., com.	19¼*	17¼
Chi. Rs., Ser. 2	33	32	Met. El., pfd.	58	58½*
Com. Edison	118½	118½	Nat'l Carbon, com.	103¾	100
Chi. Subways	4⅞*	4¼*	Nat'l Car., pfd.	123*	122½*

BOSTON.

	Dec. 20.	Dec. 27.		Dec. 20.	Dec. 27.
Am. T. & T.	142⅝	142½	Mex. Tel.	21½*	21¼
Cum. Tel.	145⅜*	145⅜*	Mex. Tel., pfd.	51½*	51½*
Edison E. Ill.	250	250½	N. E. Tel.	137	138
Gen. Elec.	160	159*	W. T. & T.	15	17*
Mass. E. Ry.	15⅝	16⅛	W. T. & T., pfd.	96	93
Mass. E. R., pfd.	79	78½			

* Last price quoted
Shares sold are for week of Dec. 20 to Dec. 24.

CONSOLIDATED GAS COMPANY.—It was announced last week that the Consolidated Gas Company of New York had completed negotiations for the purchase of the New York & Queens County Electric Light & Power Company and the Kings County Electric Light & Power Company. The former of these companies is controlled by Frank Tilford, of Park & Tilford, and the latter by Anthony N. Brady, who is deeply interested in the Consolidated Gas Company. The purchase of these companies practically gives the Consolidated Gas Company direct control of the entire lighting and power business of Greater New York. The Queens County Company supplies electric lighting to the entire borough of Queens, while the Kings County Company does a large part of the lighting business for the borough of Brooklyn. The latter company now has an application before the Public Service Commission for permission to issue $5,000,000 of new bonds.

HODENPYL-WALBRIDGE MERGER.—The proposed merger of Michigan power properties, which is being engineered by Hodenpyl, Walbridge & Company and W. E. Clark & Company, will be completed, so it is said, by Jan. 1. The merger will embrace the Grand Rapids Railway Company, Grand Rapids-Muskegon Power Company, the Commonwealth Power Company, the Michigan Light Company and the water rights on the Ausable River. The entire capital involved in the merger will be in the neighborhood of $25,000,000. It is claimed that the water rights on the Ausable River are the most valuable in the State of Michigan. Though they are not yet developed, they offer great possibilities. These rights formerly belonged to the Louds and were taken over by the Hodenpyl interests last summer. In addition to these power and electric plants the merger will take in the gas properties at Kalamazoo, Jackson, Pontiac, Saginaw and Bay City.

AMERICAN TELEPHONE & TELEGRAPH FINANCING.—While there will, of course, be some additional financing during 1910 by the American Telephone & Telegraph Company, it is generally understood that there will be no new issues of telephone company stock or bonds during the early part of the year. It may be that the present shareholders will be offered a limited subscription some time in the fall. It is roughly estimated that the merger of the Bell companies with the Western Union Telegraph Company will save the former something like $50,000,000 of new construction work that would have had to be undertaken in the next five or six years. It is said that construction work for 1910 will be at least $10,000,000 less than it would have been if there had been no merger with the telegraph company.

NATIONAL CARBON COMPANY.—It is said that the earnings of the National Carbon Company for the current year will be the largest in the history of the organization. The fiscal year of the company closes Jan. 31, and based on the 10 months which ended Nov. 30, it seems probable that the net profits of the company will reach $1,100,000. Last October the company placed its common stock on a 5 per cent basis and it is promised that 6 per cent will be paid in 1910. It is said, in fact, that the company is earning about 14 per cent on its common stock. At the same time, the National Carbon Company is selling its product on a narrower margin of profit than ever before. The vast expansion in the electrical lighting industry is responsible for the increased earnings.

GUANAJUATO POWER & ELECTRIC COMPANY.—The Guanajuato (Mex.) Power & Electric Company, which is controlled by Colorado Springs capitalists, has increased its capital stock from $3,500,000 to $5,000,000 for the purpose of absorbing other electric power properties in the same district of Mexico. The properties to be absorbed are located in Leon, Selao, Trapato, Aile de Santiago and Jenjamo, the field embracing a population of about 300,000. At present the company covers a field of 11,250 square miles, and its contemplated expansion will develop manufacturing enterprises and irrigation schemes on a large scale.

SOUTHERN COLORADO POWER COMPANY SOLD.—The Northern Securities Company bought at sheriff's sale Dec. 24 the property of the Southern Colorado Power & Railroad Company. The price paid was $500,000, and the sale occurred at Trinidad. It is stated that the Northern Securities Company is a temporary holding company for the Colorado Railway, Light & Power Company, which was incorporated Dec. 21 with a capital stock of $5,000,000.

EDISON ELECTRIC ILLUMINATING COMPANY OF BROCKTON.—The Gas Commissioners of Massachusetts have approved an issue of $160,000 additional capital stock of the Edison Electric Illuminating Company of Brockton. The stock is to be issued at $148 per share. The proceeds of 771 shares are to be used for the payment of an equal amount of promissory notes which have been outstanding since last May; the proceeds of 302 shares are to meet obligations incurred in the purchase of the Stoughton Gas & Electric Company. The balance of the money is to be used to pay for additions to the company's plant which were made last summer. The Gas Commissioners have also approved the purchase of the Bridgewater Electric Company. The Brockton Company bought this plant for $6,000, subject to a mortgage of $15,000.

NO EXTRA WESTINGHOUSE DIVIDENDS.—At the regular quarterly meeting of the directors of the Westinghouse Electric & Manufacturing Company no action was taken in the direction of paying any portion of the overdue dividends on the cumulative preferred stock. The regular quarterly dividend was declared, but it was deemed wiser to make certain offset charges rather than pay any portion of the back dividends at this time. At the meeting in September last 3½ per cent was declared on the 12½ per cent that was overdue. It was understood that the balance of the 9 per cent would be taken up in 3 per cent payments during the next three-quarters. The earnings of the company are very satisfactory, but it is the policy of the company to proceed conservatively.

OHIO MAY HALT MORGAN TELEPHONE DEAL.—U. G. Denman, Attorney-General of Ohio, declares that the recent purchase of the United States Telephone Company and the Cuyahoga Telephone Company, of Cleveland, by J. P. Morgan & Company, is contrary to the telephone laws of the State, and he promises to take action in the courts to prevent the consummation of the deal. Mr. Denman says that the sale is virtually a combination between the telephone trust and the independent lines.

WETMORE LEAVES UNION ELECTRIC LIGHT & POWER COMPANY.—C. W. Wetmore, former president of the North American Company, resigned last week from the board of directors of the Union Electric Light & Power Company of St. Louis. James Campbell, the new president of the North American Company, was elected to the board in Mr. Wetmore's place. It is said that at the next meeting of the board of directors Alton S. Miller, vice-president and general manager of the company, will be elected president.

CHARLESTON (W. VA.) TELEPHONE COMPANY SOLD.—It is announced that the Charleston (W. Va.) Home Telephone Company has been sold to Cyrus Huling, of Columbus, Ohio, representing a syndicate of capitalists, for $200,000. A promise was exacted from Mr. Huling that control will not be allowed to pass into the hands of the Bell interests. It is generally believed that J. P. Morgan & Company is back of this deal.

ELECTRIC STORAGE BATTERY DIVIDEND.—The Electric Storage Battery Company, of Philadelphia, has declared increased dividends on both its preferred and common issues. The new rate is 1 per cent quarterly on each issue, which is an increase of ¼ per cent over the rate that has prevailed during the earlier part of the year.

SEATTLE LIGHTING COMPANY.—N. W. Harris & Company, of New York, have purchased $1,200,000 of the 5 per cent refunding bonds of the Seattle Lighting Company. These bonds are being offered to the public at 97½ and interest.

DIVIDENDS.

Bell Telephone Company of Canada, quarterly, 2 per cent, payable Jan. 15.

Carolina Power & Light Company, Raleigh, N. C., preferred, quarterly, 1½ per cent, payable Jan. 1.

Central & South American Telegraph Company, quarterly, 1½ per cent, payable Jan. 8.

Electric Boat Company, preferred, quarterly, 2 per cent, payable Dec. 31; common, annual, 2 per cent, payable Jan. 10.

Electric Storage Battery Company, preferred and common, quarterly, 1 per cent each, payable Jan. 3.

International Nickel Company, preferred, quarterly, 1½ per cent, payable Feb. 1; common, quarterly, 1½ per cent, extra ½ per cent, payable March 1.

Metropolitan West Side Elevated Railroad Company, Chicago, preferred, quarterly, ¾ per cent, payable March 1.

Mexican Telegraph Company, quarterly, 2½ per cent, payable Jan. 15.

Milwaukee Electric Railway & Light Company, preferred, quarterly, 1½ per cent, payable Jan. 15.

Narragansett Electric Lighting Company, quarterly, $1 per share, payable Jan. 1.

Oklahoma Gas & Electric Company, preferred, quarterly, 1¾ per cent, payable Jan. 15.

Ottumwa (Ia.) Railway & Light Company, quarterly, 1¾ per cent, payable Jan. 15.

Pacific Telephone & Telegraph Company, preferred, 1½ per cent, payable Jan. 15.

Providence Telephone Company, quarterly, $1 per share, payable Jan. 1.

San Diego (Cal.) Consolidated Gas & Electric Company, preferred, quarterly, 1¾ per cent, payable Jan. 15.

Southern New England Telephone Company, quarterly, $1.50 per share, payable Jan. 15.

Union Switch & Signal Company, preferred and common, quarterly, 3 per cent, payable Jan. 10.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
American Light & Traction Company:					
November, 1909	$333,040	88,044	$325,004	.....	.....
November, 1908	[illegible]	[illegible]	280,695	.....	.....
American Telephone & Telegraph Company:					
November, 1909	[illegible]	246,907	1,902,894	$524,182	$1,378,712
November, 1908	[illegible]	169,388	1,891,450	638,867	1,252,589
Aurora, Elgin & Chicago Railroad Company:					
November, 1909	[illegible]	69,535	53,263	29,585	23,678
November, 1908	[illegible]	94,979	44,943	27,723	17,220
Central & South American Telegraph Company:					
Quarter ended Dec. 31, 1909 (estimated)	445,500	167,000	278,500	143,565	140,135
Quarter ended Dec. 31, 1908	[illegible]	165,000	250,000	143,565	110,935
Detroit United Railroad Company:					
November, 1909	[illegible]	[illegible]	235,732	157,910	88,424
November, 1908	[illegible]	[illegible]	196,026	132,819	69,704
Edison Electric Illuminating Company of Brockton, Mass.:					
October, 1909	[illegible]	[illegible]	13,808	3,165	10,642
October, 1908	[illegible]	[illegible]	9,197	2,861	6,336
Lake Shore Electric Railway Company, Cleveland:					
November, 1909	90,705	48,984	41,721	35,392	*6,328
November, 1908	80,476	47,439	33,036	34,242	*1,205
Lowell (Mass.) Electric Light Corporation:					
October, 1909	[illegible]	[illegible]	16,466	3,566	12,900
October, 1908	[illegible]	[illegible]	12,848	2,849	9,999
Mexican Telegraph Company:					
Quarter ended Dec. 31, 1909 (estimated)	[illegible]	[illegible]	157,500	.....	84,765
Quarter ended Dec. 31, 1908	172,000	41,000	131,000	.....	77,752
Montreal Street Railway Company:					
November, 1909	334,871	200,138	134,733	30,785	103,949
November, 1908	301,578	180,682	120,896	29,662	91,234
Northern Ohio Traction & Light Company:					
November, 1909	175,742	99,972	75,770	43,399	32,370
November, 1908	151,934	87,976	63,958	44,011	19,946
Northern Texas Electric Company:					
October, 1909	[illegible]	[illegible]	71,102	16,189	54,912
October, 1908	119,298	56,103	63,195	15,187	48,008
Portland (Me.) Electric Company:					
November, 1909	[illegible]	11,864	25,034	9,194	15,840
November, 1908	32,335	10,714	21,630	8,983	9,647
Savannah Electric Company:					
October, 1909	[illegible]	[illegible]	17,645	15,954	1,691
October, 1908	[illegible]	[illegible]	20,766	15,911	4,855

*Deficit.

GENERAL NEWS

Construction News.

BRIDGEPORT, ALA.—A company has been organized to establish an electric light plant in Birmingham. A. W. Scarborough and associates are interested in the enterprise.

NOME, ALASKA.—The plant and holdings of the Nome Light Company have been sold to the Seward Peninsula Power Company, 521 Mutual Life Building, Seattle, Wash.

FLORENCE, ARIZ.—Arrangements are being made to light the streets of the city, electricity for which will be supplied from the electric plant at the Territorial penitentiary.

PHOENIX, ARIZ.—Plans are being formulated for the completion of several more units of the hydroelectric system planned by the Reclamation Service for the benefit of this valley.

RAY, ARIZ.—Preparations are being made by the Ray Consolidated Copper Company to install a subsidiary electric power plant at its main working shaft in order to prosecute development on ore bodies until the main electrical shaft at Winkelman is completed.

TUCSON, ARIZ.—It is reported that the Helvetia Copper Company contemplates the installation of a large electric power plant on its holdings in the near future.

COMPTON, CAL.—Application has been made to the Board of Trustees by W. L. Frew and W. G. Logg, of the Consolidated Utiltities Company, for a franchise in this city for the transmission of electricity for lamps, heat and motors. Bids for the franchise will be received by H. T. Dunning, city clerk, until Jan. 4.

LOS ANGELES, CAL.—The Los Angeles Railway Company is planning to construct about 80 miles of new track during 1910. H. E. Huntington is general manager.

OAKLAND, CAL.—Application has been made to the City Council for a franchise on several streets in the city by the Peninsular Railroad Company.

REDWOOD, CAL.—A petition has been presented to the Board of Supervisors by Benjamin Cunha, asking that steps be taken to sell a franchise for installing and maintaining electric lamps in Miramar, Halfmoon Bay and Pursima school districts.

SANTA BARBARA, CAL.—Plans for the construction and operation of a co-operative electric light plant are being perfected by the business men on State Street between Haley and De la Guerra streets, to supply electricity for their own use.

SANTA BARBARA, CAL.—J. H. Hiller, chairman of the city water works commission, states that a hydroelectric power plant and an overhead distributing system for supplying electricity in Santa Barbara could be installed in Mission Canyon by the city at a cost of about $100,000. It is said that plans will be prepared for the plant provided the citizens want it.

VISALIA, CAL.—J. B. Fleming has completed the plant of the Globe Light & Power Company at Daunt, Cal., and is now constructing a hydroelectric plant in the Sequoia National Park for the Mount Whitney Company.

COLORADO SPRINGS, COL.—The Grand Junction & Grand River Valley Railway Company has surveyed the route for its proposed electric railway between Grand Junction and Fruita, a distance of 20 miles. The pole bracket type of overhead construction will be installed. Contracts will soon be awarded for material for the construction of a power plant. Orders will also be placed in the near future for three interurban cars and possibly an electric locomotive.

CANAAN, CONN.—Plans are being considered by the Berkshire Power Company for the construction of a large addition to its power plant on the Housatonic River next spring. The company proposes to install an auxiliary steam plant to supplement its water power.

NEW HAVEN, CONN.—The committee on lighting has voted to award the contract for electric lighting to the United Illuminating Company. There are about 630 electric lamps in use in the city.

NEW LONDON, CONN.—It is reported that the New London & East Lyme Street Railway Company will construct about 10 miles of new track during 1910. L. S. Rudd is superintendent.

WASHINGTON, D. C.—Bids will be received until Jan. 21 by the Department of the Interior, Washington, D. C., for remodeling the power plant at the Government Hospital for the Insane, Washington, D. C., in accordance with plans and specifications, copies of which, with proposal forms, can be secured on application at the Department. J. E. Wilson is assistant secretary.

TIGER BAY, FLA.—The Palmetto Phosphate Company has recently placed in operation its new producer gas electrical generating plant, the equipment of which includes one 1100 hp producer gas plant in three units, three 18 x 24-in. single-tandem gas engines direct connected to 200-kw, 2300-volt generators together with the necessary exciters, transformers, switchboards, etc. A large number of motors have also been installed. The equipment was furnished by the Allis-Chalmers Company, of Milwaukee, Wis.

EDISON, GA.—The question of issuing $8,000 in bonds for construction of an electric light plant will be submitted to a vote of the people.

LA FAYETTE, GA.—The City Council would like to receive propositions for the installation of an electric light plant and water works system. For further information address C. J. Hammond, city recorder.

MARIETTA, GA.—The Board of Water Commissioners has placed orders with the Allis-Chalmers Company for a 16 x 36 non-condensing engine, direct connected to a 175-kw, 60-cycle, three-phase, 2300-volt, 150 r.p.m. generator and a 15-kw, 125-volt belted exciter set; also switchboard with equipment.

IDAHO FALLS, IDAHO.—The Idaho Power & Transportation Company, which recently purchased the property of the St. Anthony Light & Power Company, which furnishes electrical service in Rexburg, Teton City, Sugar City, Salem and St. Anthony, is installing two additional units, with a rating of 600 hp each, in its power plant near Idaho Falls. The company now has about 75 miles of transmission lines.

OSBURN, IDAHO.—It is reported that the United Lead Mining Company contemplates the installation of electrical power to operate the machinery recently installed at its mines.

CANTON, ILL.—The Illinois Central Electric Railway Company contemplates extending its system from Norris to Fairview, Ill., which will require the construction of about eight miles of new track. L. W. Morton is purchasing agent.

CHICAGO, ILL.—The capital stock of the Standard Gillett Light Company has been increased from $50,000 to $100,000.

CHICAGO, ILL.—Bids will be received by the City of Chicago, Ill., until Jan. 29, for furnishing and installing the lighting fixtures for the new city hall building, according to plans and specifications on file at the office of the Department of Public Works, room 705, City Hall. A deposit of $25 will be required to insure the safe return of the plans. John J. Hanberg is Commissioner of Public Works.

EAST MOLINE, ILL.—The Root & Vandervoort Company is reported to be making preparation to operate its plant by electricity. The United Light & Power Company will furnish electrical service.

MURPHYSBORO, ILL.—The Murphysboro Electric Railway, Light, Heat & Power Company contemplates the construction of seven miles of new track between Murphysboro and Carbondale during 1910.

TREMONT, ILL.—The capital stock of the Farmers' Mutual Telephone Company of Tazewell County has been increased from $20,000 to $40,000.

BLOOMFIELD, IND.—The capital stock of the Home Light & Water Company has been increased from $20,000 to $30,000. E. H. Dugger is president.

EVANSVILLE, IND.—The Evansville Public Service Company, which was recently granted a 25-year franchise in Evansville, has selected a site at Sixth and Canal streets, on which it will build its proposed power plant, providing the City Council will permit the Evansville Suburban & Newburgh Railway Company to run steam-hauled coal cars into the plant.

FAIRMONT, IND.—The Citizens' Co-operative Telephone Company has purchased the plant and holdings of the Fairmont Telephone Company, which is part of the independent telephone system of the State. The Citizens' company is allied with the Bell telephone system.

FORT WAYNE, IND.—The Board of Public Works has awarded the contract for the installation of a 425-hp Lyons safety boiler in the municipal electric light plant to the P-K Engineering Company, of St. Louis, Mo., for $6,250.

GARY, IND.—The Gary & Southern Traction Company contemplates connecting Crown Point with Gary in the spring of 1910, which will require the building of about 12 miles of new track.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company has commenced work on the erection of lamp posts on Washington Street in connection with the plan for the illumination of the entire downtown district. Each post will carry five lamps, the merchants bearing the cost of electricity for the same.

LINTON, IND.—Plans are being considered to change the course of the Eel River so as to run through Linton and Jasonville and to develop the water power of the river near Linton to furnish electricity for both cities and surrounding towns.

UPLAND, IND.—It is reported that the Council will soon award contracts for construction of a combined electric light and water works plant.

DYERSVILLE, IA.—Preparations are being made by the Interstate Telephone Company for extensive improvements to its system, work on which will begin early in the spring. Its toll lines and many rural lines will be rebuilt. J. M. Dunn, of Earlville, is president.

EARLHAM, IA.—Work has commenced on the construction of the municipal electric light plant and water works system in Earlham.

FARRAR, IA.—An independent telephone company has been organized by farmers residing in and near the Town of Farrar. The company is capitalized at $5,000 and the officers are: J. T. Dunlap, president; Asa Turner, vice-president and H. E. Fleagle, secretary and treasurer.

MARENGO, IA.—At an election held Dec. 14 the citizens voted in favor of renewing the franchise of the Marengo Electric Light & Power Company for 10 years.

MARION, IA.—At an election held Dec. 20 the proposition to extend the franchise of the Marion Light, Heat & Power Company for its lighting and heating systems was carried by a large majority.

MARSHALLTOWN, IA.—Plans are being considered by the Iowa Central Railroad Company for further extensions to its repair shops. It is said that motor-driven tools and probably a crane will be required later.

SPIRIT LAKE, IA.—The City Council is reported to have sold the municipal electric light plant. Under the terms of the sale the parties purchasing the plant are to pay $1,000 in cash and to furnish electricity for street lighting for a term of five years. Municipal ownership of the lighting plant in this city has been a failure. The plant was given to the city free of debt and in good condition nine years ago. Since that time the city has expended $21,434 on the plant, which has furnished street lighting for the town and power for the municipal water plant. It is estimated that the service could have been obtained from a private plant for $12,600.

CANEY, KAN.—The City Council is contemplating the purchase of the local electric light plant owned by the Caney Electric Light & Power Company.

CANTON, KAN.—The question of establishing an electric light plant and water works system in Canton is reported to be under consideration.

MARION, KAN.—The contract for the construction of an electric light plant and water works system in Marion was awarded to the Squire Electric Company, of Kansas City, Mo., for $60,000. Burns & McDonnell, of Kansas City, Mo., are engineers.

SYRACUSE, KAN.—The city is reported to have voted to issue $39,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system.

ADAIRVILLE, KY.—S. C. Robb and Dr. Gilbert, both of Nashville, Ky., promoters of the proposed Nashville & Adairville Interurban Railway Company, have assured the citizens of Adairville that if the people along the railway would subscribe for stock to the amount of $100,000 that the road would be immediately located and contracts for construction awarded.

HIGHBRIDGE, KY.—Arrangements are being made by the Madison Electric Power Company for the construction of a hydroelectric power plant on the Dix River, near Highbridge. The company proposes to build a dam 150 ft. high and 522 ft. long which will develop about 8000 hp for transmission by electricity. The cost of the plant is estimated at about $800,000. Robert E. Hughes, of Richmond, Ky., is president.

MILLERSBURG, KY.—The Council has awarded a contract to Siebert-Herndon Electric Company to install an electric light plant to furnish electricity for lighting the streets, public buildings and places to cost $8,200. The company was granted a franchise to construct a power plant to furnish electricity for commercial lighting and residences at a cost of $12,500.

DOVER, MAINE.—Extensive improvements are being made to the power station of the Dover & Foxcroft Light Company at East Dover, which includes the installation of a new 150-hp boiler and a 250-hp engine, increasing the output of the plant to 500 hp. The station will be used as an auxiliary to the water power plant. The company furnishes electricity for lamps in Dover, Foxcroft and Sangerville.

FREEPORT, MAINE.—The A. W. Shaw Company is reported to have entered into a contract with the electric light company at Yarmouth to furnish electricity to operate part of its factory. It is understood that the necessary changes will be made in about 60 days.

BALTIMORE, MD.—Plans are being prepared by the Baltimore & Ohio Railroad Company for the construction of an addition to its electric plant at 1029-1031 Park Avenue, Baltimore, Md., to cost about $10,000. A. M. Kinsman, of Baltimore, Md., is chief engineer.

ELKTON, MD.—It is understood that a bill will be presented to the next Legislature asking that the Town Council of Elkton be given authority to issue bonds sufficient to construct an electric light plant and water works system.

BROCKTON, MASS.—The Board of Gas and Electric Light Commissioners has issued an order approving an issue of 1488 shares of capital stock of the Edison Electric Illuminating Company of Brockton at $140 per share, the proceeds to be used as follows: Of 771 shares to the cancellation of promissory notes; 302 shares to the payment of obligations incurred in the purchase of the property of the Stoughton Gas & Electric Company, and 415 shares to the payment of costs of permanent additions to the plant. The board has also given its approval to the terms under which the Edison Company is to absorb the Bridgewater Electric Company.

GREENFIELD, MASS.—The Connecticut Valley Street Railway Company has filed a petition with the Secretary of the Commonwealth for presentation to the State Legislature asking for permission to build a street railway in the Mt. Sugar Loaf Reservation in South Deerfield.

LEE, MASS.—The auxiliary plant of the Lee Electric Light Company, located in East Lee, was destroyed by fire on Dec. 20, causing a loss of about $6,000.

NEW BEDFORD, MASS.—The citizens of East Fairhaven are contemplating asking the New Bedford Gas & Edison Light Company to extend its service from Mattapoisett to East Fairhaven.

ROWLEY, MASS.—At a special town meeting held recently the citizens voted to install an electric light system. The service is to be furnished from the municipal electric light plant at Ipswich.

SALEM, MASS.—The Common Council has passed an order to petition the Legislature for authority to require the placing of all electric wires underground in the thickly settled parts of the city.

WESTBORO, MASS.—The State Gas and Electric Light Commissioners have authorized the Westboro Gas & Electric Company to issue 115 shares of its capital stock at par value of $100 per share, the proceeds to be used to pay for the cost of additions to its plant.

BIRMINGHAM, MICH.—The Village Council is reported to be considering the installation of an electric light system.

BUCHANAN, MICH.—The Village Board is considering the question of replacing the present street lamps on Main Street with tungsten lamps.

DETROIT, MICH.—Orders have been placed by the Detroit Copper & Brass Rolling Mills Company with the Allis-Chalmers Company for additional machinery for its power plant as follows: One 750-kw, 480-volt, 60-cycle, three-phase alternator direct connected to a low pressure turbine and a 200-kw, 240-volt, synchronous motor-generator set.

LAINSBURGH, MICH.—Preparations are being made by J. Naldrett, of Lainsburgh, Mich., for the construction of an electric light plant, work on which will begin in April, 1910. The cost of the work is estimated at from $7,000 to $8,000.

LOWELL, MICH.—It is reported that a special election will be held to vote on the proposition to issue $7,000 in bonds, the proceeds to be used to complete the municipal electric light plant.

PONTIAC, MICH.—The City Council has refused the Detroit Edison Company permission to erect a large transformer station in Pontiac on the ground that the company asked too many privileges.

SAGINAW, MICH.—Plans are being considered by the Erd Motor Manufacturing Company, of Saginaw, Mich., for construction of a new plant for manufacturing gasoline engines. A number of machines, tools, presses, pneumatic appliances, and other apparatus will be required, together with power equipment.

GRANITE FALLS, MINN.—The City of Granite Falls has awarded a contract to the Power Engineering Company, Minneapolis, Minn., to design, construct and furnish material for a complete hydroelectric power plant, consisting of a new reinforced concrete flume, one unit of four horizontal wheels, complete rope transmission, etc., work to commence on the plant April 1, 1910. E. H. Sorlein is Mayor.

MARBLE, MINN.—It is reported that the Oliver Mining Company will install a lighting plant in Marble.

MINNEAPOLIS, MINN.—Arrangements are being made by the Northwestern Telephone Exchange Company for extensions to its system and the installation of cables, which will involve an expenditure of about $1,200,000. It is said that the same amount will be expended in St. Paul, Minn.

ST. PAUL, MINN.—The only bid received by the City Council for lighting the streets by electricity for the coming year was submitted by the St. Paul Gas Light Company. Under the bid submitted the price of arc lamps is reduced from $85 to $80 per lamp per year for lamps served on overhead system and the city is allowed to increase the number to 900 on the overhead circuits at the same rate. For all over 900 the rate will be $7 per month per lamp. A reduction of $1 per lamp per year was made on the gas lamps. Under the contracts for 1910, the city will save about $12,500 as compared with this year.

STILLWATER, MINN.—The capital stock of the Washington County Light & Power Company has been increased from $100,000 to $1,000,000. The company, it is said, proposes to extend its transmission lines to furnish electrical service in other cities and towns.

WADENA, MINN.—Work will soon commence by the Leaf River Rural Telephone Company for the construction of its main telephone line and branches.

JACKSON, MISS.—The Home Telephone Company, which is erecting long distance telephone lines from Meridian and Hattiesburg into Jackson, is planning to build a long distance line from Hattiesburg into Natchez, traversing the right of way of the Mississippi Central railway. A line will also be erected from Jackson to Bogalusa along the line of the New Orleans Great Northern Railroad. The company has applied for a franchise in Natchez and proposes to install a local system in that place if the franchise is granted.

ASH GROVE, MO.—An election will soon be held to vote on the proposition of granting a franchise to J. A. Long, president of the Ash Grove Milling Company, and J. L. Hine, of the Merchants' National Bank, of Springfield, Mo., a franchise to operate an electric light plant in Ash Grove. It is proposed to install an electric plant to be operated by power from the Ash Grove mill. The cost of the equipment is estimated at from $8,000 to $9,000.

CARROLLTON, MO. Arrangements are being made by the Bell Telephone Company to rebuild its system in Carrollton, which will involve an expenditure of about $13,000.

EAST ST. LOUIS, MO.—It is reported that the American Steel Foundries Company will install two engine-driven generators with a rating of 500 hp each in its power plant at East St. Louis.

KANSAS CITY, MO.—The Kansas City Steel Scraper Company is contemplating the erection of a large foundry and manufacturing plant, equipped with traveling cranes, hoists, conveyors and special machinery. Power for operating the plant will be furnished from a central station, the equipment of which will include boilers, engine, generator, etc. The works will be equipped for electric motor drive throughout.

KIRKWOOD, MO.—The Municipal Electric Light Commission has awarded a contract to the Raming Machine Company, of St. Louis, Mo., for the installation of a 180-kw generator and 230-hp engine. The new equipment will more than double the present output of the plant.

LEES SUMMIT, MO.—L. G. Morris, who recently purchased the local electric light plant owned by L. Screechfield & Son, has applied to the City Council for an electric light franchise. The granting of the franchise will be subject to a vote of the people.

MONETT, MO.—It is reported that bonds have been voted to establish a municipal electric lighting system in Monett.

ST. JAMES, MO.—The St. James Ice & Power Company is contemplating the installation of a steam turbo-generator set to take care of the day load. L. E. Zweig is manager and A. B. Bridgeman is chief engineer of the company.

ST. LOUIS, MO.—It is reported that the J. C. Kupferle Foundry Company contemplates the construction of a new plant, which will be equipped with electric motor-driven machinery throughout.

LINCOLN, NEB.—The State Railway Commission has granted the Burt County Telephone Company permission to increase its capital to the amount of $75,000. The company has recently purchased the plants at Lyons, Oakland and Decatur and expects to extend and enlarge them.

HOBOKEN, N. J.—The Public Service Corporation of New Jersey has purchased the plant and holdings of the Weehawken Contracting Company, which has for some time been furnishing electricity for lamps in the northern part of Hudson County.

NEWARK, N. J.—The Breeze Carburetor Company, of Newark, N. J., is reported to be in the market for equipment for a power plant, including engine, generator, boiler, heater, pumps, etc.

CLOVIS, N. M.—The City Council has granted E. J. Howard, J. D. Hammett and A. R. Hammett, of Moberly, a franchise to construct and operate a street railway system in Clovis.

BROOKLYN, N. Y.—Bids will be received by the Board of Health, Department of Health, Fifty-fifth Street and Sixth Avenue, New York, N. Y., until Jan. 4 for furnishing and installing electric and gas lighting fixtures, etc., in the office building at Fleet and Willoughby Streets, Brooklyn, N. Y. Blank forms and plans may be obtained at the office of the chief clerk of the Department of Health at the above office. Thomas Darlington, M.D., is president, Department of Health.

CAMDEN, N. Y.—The question of abandoning the municipal electric light plant is under consideration. It has not yet been decided whether to maintain the present system or to sell the franchise and lease the system to a private company. It is proposed to hold a special election to vote on the matter.

DUNKIRK, N. Y.—The Dunkirk Power & Heating Company is constructing a large addition to its power plant to provide space for the installation of three-phase, alternating-current apparatus in units aggregating several thousand hp. The company is seriously considering the installation of gas engines to drive its plant. H. T. Litchfield is vice-president and secretary.

FULTON, N. Y.—No bids were received by the City Council for the franchise offered for sale Dec. 20 to furnish electricity for lamps and motors in Fulton. It is said that the Niagara-Oswego Company did not make a bid on the franchise, hoping to obtain a more favorable franchise from the administration which will take charge of affairs Jan. 1.

HILTON, N. Y.—The Hilton Electric Light, Heat & Power Company contemplates the construction of an electric light plant in Hilton.

HORNELL, N. Y.—The Public Service Commission, Second District, has granted the Hornell & Bath Interurban Railway Company a certificate for the construction of a street railway to extend from Hornell to Bath, a distance of 24 miles. The company is capitalized at $250,000.

LONG ISLAND CITY, N. Y.—The Stevenson Construction Company is reported to be in the market for complete equipment for a power plant of from 200 to 300 hp for a new factory.

MINEVILLE, N. Y.—The Public Service Commission, Second District, has granted the Mineville Light, Heat & Power Company permission to exercise its franchises granted by the Town of Moriah to operate in the villages of Mineville and Witherbee; also to issue capital stock to the amount of $10,000, of which the proceeds of $3,634 is to be used for the purchase of an electric light plant built by Witherbee, Sherman & Company and the remainder to be used for extensions and improvements to the plant.

NEWARK, N. Y.—The plant and holdings of the New Electric Light, Heat & Power Company, of Newark, N. Y., has been purchased by W. T. Morris and associates. The Morris syndicate already owns the controlling interest in the Newark Gas Light & Fuel Company. The new officers were elected as follows: W. T. Morris, president and treasurer and Morris Tracy, secretary.

NEW YORK, N. Y.—The Walter D. Carpenter Company, 39 Cortlandt Street, New York, N. Y., is reported to be in the market for a 200-hp electric generating unit, together with auxiliary apparatus.

NEW YORK, N. Y.—Bids will be received at the General Depot of the Quartermaster's Department, Army Building, New York, N. Y., until Dec. 31, for electric wiring system for the United States Army Building, New York, N. Y., in accordance with circular schedule No. 26. William S. Patten, assistant quartermaster-general, U. S. A., is chief quartermaster.

NEW YORK, N. Y.—Bids will be received by John W. Brannan, president of the Board of Trustees, Bellevue and Allied Hospitals, 411 East Twenty-sixth Street, New York, N. Y., until Jan. 7 for furnishing and installing electric and gas lighting fixtures in the pathological department and male dormitory of the new Bellevue Hospital, situated on First Avenue between Twenty-sixth and Twenty-ninth Streets. Blank forms may be obtained at the office of the contract clerk, 419 East Twenty-sixth Street.

NEW YORK, N. Y.—Announcement has been made that negotiations have been completed by the Consolidated Gas Company for the purchase of the properties of the New York & Queens County Electric Light & Power Company and the Kings County Electric Light & Power Company, which gives the Consolidated company control of the entire lighting business of Greater New York. The Queens County company supplies electricity for lighting the entire Borough of Queens, and the Kings County company a large part of Borough of Brooklyn. The last-named company now has an application before the Public Service Commission for permission to issue $5,000,000 in bonds.

SYLVAN BEACH, N. Y. The Board of Trustees has decided to install an electric lighting plant at Sylvan Beach, having sufficient output to furnish electricity for 1,000 lamps of 16 cp. No contracts have been placed for equipment as yet. The plant will be driven by a gasoline engine. E. J. Brown is clerk.

UTICA, N. Y.—The Allis-Chalmers Company, of Milwaukee, Wis., will furnish the power equipment for the new factory now being built by the Utica Fine Yarn Company, which will include one 937-kva, 600-volt, 60-cycle, three-phase alternator direct connected to a steam turbine, a 22½-kw, 850 r.p.m., 125-volt motor-driven exciter set and a 17½-kw, 125-volt exciter driven by a 5x5-in. duplex double-acting automatic engine.

WILSON, N. Y.—The Newfane Electric Company, of Newfane, N. Y., has offered to furnish electricity for street lamps in Wilson providing a site for a plant is given the company free of charge. It is said that a deed of the site will soon be given the company.

DILLSBORO, N. C.—Charles J. Harris is reported to be contemplating the construction of an electric light plant on Huckaselgee River.

GOLDSTON, N. C.—O. D. Barber is contemplating the construction of a power plant on Bear Creek to furnish electricity for flour mill, etc. The dam will be about 100 ft. long and 14 ft. wide and will develop about 200 hp. For further information address E. W. Myers, Greensboro, N. C.

NORTHWOOD, N. D.—Plans are being considered by the Red River Valley Telephone Company for the construction of new telephone lines during the coming year.

COLUMBUS, OHIO.—The Casparis Stone Company, of Columbus, Ohio, has recently placed orders with the Allis-Chalmers Company for two large stone-crushing plants, one to be located at Havre de Grace, Md., and the other at Patterson's Creek, W. Va. The power equipment of the Havre de Grace plant includes one 750-kva, three-phase, 60-cycle, 600-volt steam turbo-alternator; one 22½-kw motor-driven exciter set and one 22½-kw engine-driven exciter and switchboard; four 316-hp Heine water tube boilers; one feed water heater and duplicate boiler feed pumps; one 200-hp, one 125-hp and seven 50-hp induction motors for driving various machines. The power apparatus at the Patterson's Creek plant is a duplicate of the Havre de Grace plant.

DAYTON, OHIO.—The People's Railway Company is reported to be contemplating the construction of a new power house at a cost of about $125,000.

YOUNGSTOWN, OHIO.—Plans are being considered by the United Engineering & Foundry Company for the construction of a new machine shop at its works at Youngstown, Ohio, to be equipped with motor-driven tools and pneumatic appliances. An increase in power capacity, it is said, will be required in the near future.

STILLWATER, OKLA.—Bids will be received by the State Board of Agriculture, State Agricultural and Mechanical College, Stillwater, Okla., until Jan. 15 for the construction of power house and heating plant to cost about $[illegible]. J. H. Connell, of Stillwater, Okla., is president.

WALTER, OKLA.—At a recent election the citizens voted to issue $7,000 in bonds for the construction of an electric light plant.

CANYON CITY, ORE.—Owing to an accident in the boiler room in the local electric plant, the city is without electric light. The streets will be in darkness until the plant is repaired. The company has recently been reorganized. I. D. Marks, president, states that it is proposed to put the plant in first-class condition.

EUGENE, ORE.—The City Council has entered into a contract with the Northwestern Corporation whereby the latter is to furnish electricity for lighting the streets of the city for another year as follows: For arc lamps at the rate of $6 per lamp per month; for incandescent lamps of 32 cp at $2 each per month and 16-cp lamps at $1 each per month and $2 each per month for alley lamps. The city is constructing a municipal electric plant on the McKenzie River, which is expected to be completed within a year.

GRANTS PASS, ORE.—The City Council has granted J. R. Allen a franchise for an electric railway in Grants Pass, Ore. Under the terms of the franchise work must begin on the railway within a year.

MILTON, ORE.—The municipal electric light plant which has been closed for 50 days has been put into service again. Improvements and extensions have been made which will more than double the output of the plant. The output of the power station has been increased from 100 hp to 300 hp and new water wheels and other machinery have been installed, representing an expenditure of about $50,000.

BEAVER, PA.—Plans are being made for the construction of a new plant by the W. E. Leard Machine Company, of Beaver, Pa., and considerable new equipment will be required. The plant will be equipped throughout for electric motor drive.

COLUMBIA, PA.—The Pennsylvania Railroad Company, it is reported, contemplates the installation of a complete electric plant in its round house in Columbia to furnish electricity to operate the machinery and to light the yards and buildings.

CONNELLSVILLE, PA.—The Connellsville Iron Works, which recently decided to enlarge its plant, is contemplating operating its plant by electricity.

JOHNSTOWN, PA.—The plant of the Union Radiator Company, at Johnstown, Pa., will be enlarged and additional power equipment installed.

JOHNSTOWN, PA.—Arrangements are being made by the Cambria Steel Company for the erection of a substation at Johnstown, in connection with its new power system in this place. New equipment will be required, including a rotary converter, transformers, switchboard, etc.

MERCER, PA.—The contract for the equipment for the new power house at the court house has been awarded to the American Heating & Ventilating Company, at a cost of $19,918.

MILTON, PA.—The Milton Manufacturing Company has placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a two-stage, single-suction, horizontal shaft, centrifugal pump with a capacity of 2,000 gal. per minute against a head of 237 ft., driven by a 200-hp, 220-volt, direct-current motor.

ORBISONIA, PA.—The Orbisonia Telephone Company has filed a notice of an increase of its capital stock from $10,000 to $50,000 with the Secretary of State.

PITTSBURGH, PA.—The Borough Council of Walls Borough has decided to light the borough by electricity and has awarded a contract to the United Electric Light Company, of Wilmerding, Pa., for furnishing arc lamps at the rate of $60 each per year.

SHARTLESVILLE, PA.—The Shartlesville Rural Telephone Company has awarded the contract for the construction of its telephone lines to William Kauffman, of Reading. The company proposes to build its own line from Hamburg to Shartlesville.

ABERDEEN, S. D.—Application has been made to the City Council for a franchise by Gilborne Brothers to install a lighting and heating plant in Aberdeen, S. D.

HETLAND, S. D.—A movement has been started to establish an electric lighting system in Hetland. It is proposed to ask the Lake Preston Electric Light Company, of Lake Preston, to extend its transmission lines to this town and furnish the service.

BRISTOL, TENN.—The East Tennessee Telephone Company has leased a building on State Street in which equipment will be installed costing about $15,000. The company has commenced work on the erection of two new copper circuits between Bristol and Knoxville.

ERWIN, TENN.—It is reported that P. O. Heat & Company, of Charlotte, N. C., have purchased the "Devil's Looking Glass" water power. The company, it is said, will construct a 35-ft. dam to develop 3000 hp for transmission by electricity.

HUNTINGDON, TENN.—At an election to be held Jan. 22 the proposition to issue $10,000 in bonds, the proceeds to be used to extend the electric lighting system to the East End and other improvements, will be submitted to a vote.

DEL RIO, TEX.—The Del Rio Western Telephone Company has filed an amendment to its charter increasing its capital stock from $60,000 to $80,000.

JOURDANTON, TEX.—Wallace Brothers have secured the contract to construct a water, light and ice plant to cost $40,000 in Jourdanton.

SAN ANTONIO, TEX.—The San Antonio & Southwestern Telephone Company has purchased the plant of the Bandera Telephone Company and several private telephone lines running to Kerrville, Fredericksburg and other points. The company proposes to extend the line to San Angelo and give that section of the country direct connection with San Antonio.

LOGAN, UTAH.—Work will be started at once on the construction of a power plant near Logan to furnish electricity for lamps and motors for the buildings of the Utah Agricultural College. The college owns sufficient water rights in the Logan River to develop 300 hp. The last Legislature made an appropriation of $20,000 to install a power plant for the college buildings.

MURRAY, UTAH.—James W. Cahoos, president of the Progress Company, has applied to the City Council for an extension of the franchise of the Progress Electric Company in Murray.

KIMBALL, VA.—The contract for the proposed electric light plant and water works system has been awarded to L. Kaufman, of Northport, Va. The cost of the work is estimated at $100,000.

PETERSBURG, VA.—Bids will be received by the water committee until Jan. 10 for the complete installation of a pumping plant of 1800 gal. per minute capacity. Propositions will be received and considered on steam, producer-gas and electrically driven pumps. R. D. Budd is city engineer.

RICHMOND, VA.—The Richmond & Chesapeake Bay Railway Company, it is reported, is contemplating two extensions to its system, one of which will extend from Ashland via Fredericksburg and Manassas, Va., to Alexandria, Va., and thence to Washington, D. C., 115 miles in length; the other from Ashland to a point in Stafford County on the Potomac River, a distance of about 80 miles. Cecil L. Reid, of Fredericksburg, Va., will have charge of making the surveys.

SPOKANE, WASH.—The Board of Public Works has recently awarded a contract to the Allis-Chalmers Company, of Milwaukee, Wis., for equipment for the new municipal water works pumping station, which includes six single suction, horizontal shaft, two-stage centrifugal pumps driven by three 900-hp, 2200-volt, 60-cycle, three-phase induction motors. A three-panel switchboard will carry the controlling apparatus.

HUNTINGTON, W. VA.—The Citizens Light & Ice Company contemplates the installation of a 500-hp gas engine in the near future. H. H. Hughes is manager.

MOOREFIELD, W. VA.—A 25-year franchise has been granted to J. H. Marshall and H. O. Barncord, both of Midland, Md., for the construction and operation of an electric light plant in Moorefield, W. Va.

WHEELING, W. VA.—Contracts will be placed by the City & Elm Grove Railroad Company for the construction of 1½ miles of new track in the near future. J. W. Smith is general manager.

EVANSVILLE, WIS.—Arrangements are being made by the Baker Manufacturing Company for new equipment for its power plant, which will include generator with a rating of 112 kw belted to Corliss engine, with exciter and other apparatus.

KAUKAUNA, WIS.—Plans have been prepared by the Fibre Development Company, of Appleton, Wis., for the construction of a 40-ton sulphite mill to be erected by Frank Becker, of Kaukauna, Wis. It is understood that a large battery of boilers, one or more Corliss engines or turbines, generators, motors, etc., will be required.

LA CROSSE, WIS.—The large Dells dam, located two miles above Hatfield, built by the La Crosse Water Power Company, is completed. The Hatfield and Dells dams have cost more than $2,000,000 and furnish power to operate the power plant at Hatfield, which furnishes electricity in the cities of La Crosse and Winona, and will also furnish energy to operate the proposed interurban railway to extend from Winona, La Crosse and Sparta. Announcement is made by the La Crosse Water Power Company that two more dams will be built next year, which will double its water storage capacity.

MERRILL, WIS.—The W. C. Collar Company is contemplating the installation of a new engine and possibly an electric power plant.

MILWAUKEE, WIS.—The Kiel Furniture Company contemplates the installation of a new power plant, which will be equipped with a dynamo and engine rated at 200 hp, with condenser, exciter, boilers, pumps, feed-water heater, etc.

RACINE, WIS.—Preparations are being made by the American Seating Company, of Racine, Wis., for the construction of a new power plant and factory buildings. The equipment required will include three water-tube boilers, Corliss engine, generator, motors, pumps, etc.

SHEBOYGAN, WIS.—Preparations are being made by J. M. Kohler Sons Company, of Sheboygan, Wis., for the installation of electrically driven centrifugal pumps for fire protection.

SHEBOYGAN, WIS.—The Sheboygan Light, Power & Railway Company is reported to have decided to install a 1000-kw steam turbine and generator in its plant. The new unit, it is said, will be purchased about Jan. 15.

SPARTA, WIS.—Preparations are being made for the installation of a power and heating plant at the Monroe County buildings at Sparta, Wis. The equipment will include boilers for a 250-hp automatic engine, electric generator and some small motors. For further information address Chandler & Park, Racine, Wis.

WAUSAU, WIS.—The City Council is considering the construction of a new pumping station, which will probably be equipped with motor-driven centrifugal pumps.

EDMONTON, ALB., CAN.—Engineers who have been making investigations of the upper Saskatchewan River for the purpose of power development have decided upon a site for the proposed plant located about 110 miles from Edmonton, where it is estimated that a maximum of 20,000 hp. can be developed at a cost of about $1,500,000. It is understood that Montreal capitalists will become associated with local

interests which are identified with the project. Charles Tupper, B. Sc., of McGill University, and Charles H. Colgross, M. E., have been making the investigations.

PRINCE RUPERT, B. C., CAN.—The Grand Trunk Pacific Railroad Company is fitting up a temporary electric plant on the wharf to supply its office buildings with electricity for lamps, until the plant at Seal Harbor, recently destroyed by fire, is rebuilt.

PRINCE RUPERT, B. C., CAN.—The British Columbia Provincial Government has declined to advance $75,000 to the municipality of Prince Rupert for the installation of an electric lighting plant. The private electric lighting plant at that place was destroyed by fire a short time ago.

PRINCE RUPERT, B. C., CAN.—The Board of Trade is agitating the installation of a civic lighting plant. It is not expected that anything will be accomplished as it is probable that the Columbia Tie & Timber Company's saw mill at Seal Harbor will be rebuilt and a larger electric lighting plant installed in connection with it.

BRANTFORD, ONT., CAN.—Application has been made to the Council by T. R. Varding, of Buffalo, N. Y., for a franchise to construct and operate an electric railway in the Township of Brantford.

HAMILTON, ONT., CAN.—The City Council has awarded the contracts for electrical equipment for the pumping plant at the Beach, which includes the installation of two 500-hp motors, with all equipment, two transformers and pumps. The Westinghouse Company secured the contract for motors and transformers, at $16,624, and the John McDougall Caledon Iron Works Company for pumps, at $7,220. The Westinghouse Company was also awarded the contract for motors, pumps and other equipment for the annex sewage disposal plant, at $4,000.

LONDON, ONT., CAN.—Announcement has been made that the London & Lake Erie & Transportation Company contemplates improvements to its system, which will involve an expenditure of about $150,000. The company is successor to the Southwestern Traction Company.

PORT ARTHUR, ONT., CAN.—An extension four miles in length will be built by the Port Arthur & Fort William Electric Railway during 1910. N. C. Pilcher is purchasing agent.

MONTREAL, QUE., CAN.—At an election held Dec. 21 the property owners voted in favor of establishing a municipal electric light plant. The election is not regarded as having any special value, as out of 20,000 qualified voters only about 2800 voted.

SHERBROOKE, QUE., CAN.—The City council has approved a by-law granting the Sherbrooke Street Railway Company a 40-year franchise, under the terms of which the city will have the privilege of purchasing the property at the end of 20 years. The railway will be extended as soon as additional power is developed.

QUEBEC, QUE., CAN.—It is reported that the Quebec Railway, Light & Power Company will soon place contracts for the construction of a substation at Ste. Anne de Beaupre. The company has submitted a proposition to the Council of Montcalmville for the extension of its tracks from the boundary of the City of Quebec through the municipality to Cape Rouge and St. Foye Church.

GUADALAJARA, MEX.—Plans have been prepared by the Chapala Hydro-Electric & Irrigation Company, of Guadalajara, Mex., for the construction of an electric railway to connect Guadalajara with Chapala, on the northern shore of Lake Chapala, a distance of about 32 miles. Emilio Pinzon is manager.

ZACATECAS, MEX.—The Cia. Electricia de Zacatecas has applied to the State authorities for an amendment to its present charter, which will enable the company to increase its service and extend its system. The company asks for permission to erect transmission lines into neighboring towns to supply electricity for lamps and motors. If authority is granted the company will enlarge its generating plant.

New Industrial Companies.

THE AMERICAN HYDRO-NUMATIC COMPANY, of New York, N. Y., has been chartered with a capital stock of $100,000 for the purpose of manufacturing machinery by C. M. Gilpin, W. M. Alberti and H. M. Gaylord, of New York, N. Y.

THE AUTOMATIC STREET RAILWAY SWITCH COMPANY, of Camden, N. J., has been incorporated by A. M. Haldeman, J. G. Ryan and C. Blake, of Philadelphia, Pa. The company is capitalized at $50,000 and proposes to manufacture automatic railway switches.

THE CONSTANTINE CONSTRUCTION COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $25,000 as general contractors. The incorporators are: Dennis J. Constantine, John S. Constantine and Patrick Constantine, all of Buffalo, N. Y.

THE CUTHBERT TRANSMISSION SYNDICATE, of Atlantic City, N. J., has filed articles of incorporation with a capital stock of $75,000 for the purpose of manufacturing power transmission appliances. The ncorporators are: E. F. Hall, H. A. Locha and A. F. Hall, of Atlantic City, N. J.

THE ELECTRICAL ENGINEERS' EQUIPMENT COMPANY, of Chicago, Ill., has been chartered with a capital stock of $10,000 for the purpose of doing a general electric and contracting business by J. T. Tyrrell, J. B. Dunn and P. Steele.

THE ELECTRIC STEEL ALLOYS COMPANY, of Wilmington, Del., has been incorporated with a capital stock of $1,000,000 by F. M. Shive, S. E. Robertson and H. W. Davis, of Wilmington, Del.

THE ELEVATOR & MACHINERY MAINTAINING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $25,000. The company proposes to do electrical work of all kinds. The incorporators are: J. J. Cole, of Jersey City, N. J.; W. W. Bridgeman, of Nutley, N. J.; and A. Annis, Borough of Bronx, New York.

THE FRIEDERICH ELECTRIC & MANUFACTURING COMPANY, of New York, N. Y., has been incorporated by J. J. Sullivan, H. E. von Pein and T. Faber, of New York, N. Y. The company is capitalized at $60,000 and proposes to manufacture X-ray tubes, interrupters, etc.

THE KEYSTONE CONTRACTING COMPANY, of New York, N. Y., has been chartered with a capital stock of $50,000 for the purpose of doing a general contracting business, building docks, railroads, subways, etc. The incorporators are: Robert H. Hibbard, Francis J. McCann, of New York, N. Y., and William S. Carter, of St. Louis, Mo.

THE MARKIMSEE METER COMPANY, of New York, N. Y., has been incorporated with a capital stock of $100,000 by F. R. Kimbley, B. L. Seelye and A. J. Marshall, of New York, N. Y. The company proposes to manufacture meters and motors.

THE MARSH-CAPRON MANUFACTURING COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $100,000 for the purpose of manufacturing machinery. The incorporators are: Herbert D. Crocker and Gilbert Noxon, both of Chicago, Ill.

THE PORTSMOUTH MANUFACTURING & POWER COMPANY, of Kittery, Me., has been incorporated with a capital stock of $50,000. The company proposes to manufacture machinery and tools. The officers are: J. K. Bates, president, and C. W. Brewster, treasurer, of Portsmouth, N. H.

THE SOUTH SIDE CHANDELIER COMPANY, of Chicago, Ill., has been incorporated by S. Burns, Jacob L. Burgard and A. B. Shaw. The company is capitalized at $2,500 and proposes to do a general electrical construction and installation business.

THE S. K. F. BALL BEARING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 by Samuel T. Hubbard, of Yonkers, N. Y.; Frederick H. Poor, of Buffalo, N. Y., and Myron Grennell, of Waymart, Pa. The company proposes to do a general mechanical and electrical engineering business.

THE UNION LIGHT & SUPPLY COMPANY, of Chicago, Ill., has been chartered with a capital stock of $5,000 to deal in manufactured products and patents. The incorporators are: S. L. Page, J. B. Lewis and R. M. Shaw.

THE UNITED SERVICE COMPANY, of New York, N. Y., has been chartered by G. Bullock, S. J. Dill, and H. Morgan, of New York, N. Y. The company is capitalized at $100,000 and proposes to do a general contracting and construction business.

New Incorporations.

OAKLAND, CAL.—Articles of incorporation have been filed for the People's Light & Power Company with a capital stock of $500,000. The company is an adjunct of the Great Western Power Company, organized for the purpose of local distribution of electricity for lamps and motors. The directors are: D. U. Toffelmeier, of San Leandro, Cal.; J. H. Hornung, A. C. Sprout, F. H. Woodward and W. H. Spaulding, all of Oakland, Cal.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Mount Shasta Power Company with a capital stock of $1,000,000. The company proposes to unite a large number of individual claims along the Pitt River and proposes to expend $2,000,000 in developing the property. The incorporators are: William A. Cooper, R. C. Johnson, of San Francisco, Cal.; John C. Hays, of Visalia, Cal.; H. V. Gates, of Hillsboro; Jesse A. Lilienthal, Albert Raymond and C. J. Treat, of San Francisco, Cal.

SAVANNAH, GA.—The Savannah Hydro-Electric Company has been incorporated with a capital stock of $300,000 for the purpose of constructing a hydroelectric power plant on the Connooche River, 40 miles from Savannah, by G. H. Miller, S. J. Platsch and others of Savannah, Ga. D. Z. Zeigler & Company, of Jacksonville, Fla., are engineers.

LERNA, ILL.—The Lerna Telephone Company has filed articles of incorporation with a capital stock of $3,000. The incorporators are: R. G. Hall, S. O. Beale and M. C. Wortham.

LOUISVILLE, KY.—The Southern Hydro-Electric Company has filed articles of incorporation with a capital stock of $6,000 by George G. Fetter, J. H. Cochran and Wallace Hoeing, all of Louisville, Ky., and others. The company proposes to develop the water power of the Dix River.

CHILHOWEE, MO.—The Chilhowee Telephone Company has been chartered with a capital stock of $2,000 by J. E. Cahill, S. R. Sweeney, C. H. Gains and others.

KALISPELL, MONT.—The Bitter Root Mountain Water Power Company has been incorporated with a capital stock of $100,000 for the purpose of developing electricity in the Flathead Valley. C. A. Farrar and others are the incorporators.

ORANGE, TEX.—The Orange Home Telephone Company has been incorporated with a capital stock of $40,000 by William D. Dean, John B. Fletcher, Hugh L. Runkle, Allen Edwards, H. M. Shingle and E. L. Bruce.

UVALDE, TEX.—The Uvalde & Leona Valley Interurban Railway Company has been incorporated by Charles Peterson, A. M. Avant and M. M. McFarland. The company is capitalized at $50,000 and proposes to construct an interurban railway connecting Uvalde and Sansom.

ALEXANDRIA, VA.—Articles of incorporation have been filed for the Roanoke Electric Light & Power Company with a capital stock of $1,000,000 for the purpose of developing the water power of the Roanoke River and tributaries. The officers are: M. Coffman, of Woodstock, Va.; I. T. Stoneburner, secretary and treasurer, of Edinsburg, Va. The directors are: M. Funkhouser, C. C. Skyles and E. C. Geary, all of Woodstock, Va.

Personal.

MR. EUGENE CREED has been appointed assistant sales and advertising manager of the Toronto Electric Light Company, Limited.

MR. HERBERT W. RIDGELY has been appointed superintendent of the Alexandria Electric Light & Power Company, of Alexandria, Va., to succeed Mr. T. C. Roderick.

MR. HARRY H. MORRELL, formerly constructing engineer with the Electric Storage Battery Company, has been appointed manager of the Tate Accumulator Company of Canada, Toronto, Ont.

MR. R. D. APPERSON, president of the Lynchburg (Va.) Traction & Light Company, was presented on Dec. 11 with a handsome silver dish by employees on the occasion of their annual supper.

MR. W. B. MacDONALD, who recently resigned as vice-president and manager of the Evansville Gas & Electric Light Company, of Evansville, Ind., has been appointed manager of the new Public Service Corporation in that city.

MR. B. R. SHOVER has been transferred to the position of electrical engineer of the Youngstown District, Carnegie Steel Company, with address at Youngstown, Ohio, from a similar position with the Indiana Steel Company.

MR. H. P. PAGE, of Baltimore, has been engaged to make an examination of the books of the Ft. Wayne (Ind.) municipal lighting plant in view of charges that the service supplied is more costly than that furnished by private corporations.

MR. ROBERT J. McCUEN, superintendent of the department of lamps and lighting of Baltimore, Md., has returned to his desk after an illness of six weeks, during part of which period Mr. McCuen directed over the telephone the more important business of his department.

MR. ARTHUR N. CANTRIL, formerly with the Denver Gas & Electric Company, and more recently with the Pueblo Gas Company, has been made general manager of the Spokane Gas Light Company, which was recently acquired by the Doherty interests.

MR. E. A. WAKEMAN, until recently general manager of the Citizens' Gas & Fuel Company, of Terre Haute, Ind., has accepted an appointment as general superintendent of the Susquehanna Railways, Light & Power Company, with headquarters in New York City.

MR. ROBERT C. HOUSE, formerly of the sales department of the Safety Insulated Wire & Cable Company, has accepted a position with the Sprague Electric Company, 527 West Thirty-fourth Street, New York City, N. Y., in its motor and generator sales department.

MR. WALTER LORING WEBB, C. E., has become associated with the Roberts & Abbott Company, Inc., consulting, supervising and operating engineers, Cleveland, Ohio. Mr. Webb will represent the company in Philadelphia and vicinity, with offices in the Real Estate Trust Building.

MR. W. S. TAUSSIG, until recently a manufacturer's agent in Chicago, has accepted a position with the Chicago office of the General Electric Company, where he will be connected with the power and mining department. Mr. Taussig is secretary of the Electric Club of Chicago.

MR. GEORGE R. WILLIAMS has been appointed division superintendent of the Eastern Pennsylvania Railways Company, with office at Lansford, succeeding Mr. J. C. Bell, whose promotion is announced elsewhere in this column. Mr. Williams was formerly train master at the main office at Pottsville, Pa.

MR. GEORGE G. WARD, vice-president and general manager of the Commercial Cable Company, was presented on Dec. 27, by the employees of the company, with a beautiful silver centre-piece as a testimonial of their regard for him. The design of the centre-piece is emblematical of the nature of the company's business and is a work of art.

MR. J. C. BELL, division superintendent of the Eastern Pennsylvania Railways Company, stationed at Lansford, Pa., has been promoted to the position of superintendent of railways with office at Palo Alto, in charge of transportation and roadway departments. Mr. Bell succeeds Mr. C. E. Palmer, whose resignation was announced in the *Electrical World* of Dec. 23.

MR. B. J. ARNOLD was married on Dec. 22 in New York City to Mrs. Margaret Latimer Fonda. The bride, who has during her residence in New York City the past seven years devoted much of her time to charity work in connection with the St. Thomas Episcopal Church, is a member of the Women's Club, the Rubinstein Club and the Daughters of the British Empire.

MR. C. W. WETMORE, former president of the North American Company, has resigned from the board of directors of the Union Electric Light & Power Company. Mr. James Campbell, the new president of the North American, has been elected to the board in Mr. Wetmore's place. Aiten S. Miller, vice-president and general manager of the Union Electric, will probably be elected president in a few weeks.

MR. L. E. HOLDERMAN, of Terre Haute, Ind., has resigned as assistant general manager of the Terre Haute, Indianapolis & Eastern Traction Company to become secretary and manager of the new Central States Tie & Gravel Company, of Terre Haute. Mr. Holderman was formerly connected with the Eastern Wisconsin Railway & Light Company, of Fond du Lac, Wis., and has a wide experience both in the railway field and in central-station service.

MR. J. S. CORBY, assistant manager for the Bryan-Marsh Company in Chicago, has resigned to become manager of sales of the Monarch Incandescent Lamp Company. The latter is a new company incorporated under the laws of Ohio, with headquarters in Chicago, to manufacture and sell all kinds of electric incandescent lamps. It is licensed by the National Electric Lamp Association, and Fairbanks, Morse & Company are the sole distributors of its output. Mr. Corby, who is well-known in the incandescent-lamp field, will have his office at 481 Wabash Avenue, Chicago.

MR. FREDERIC H. KEYES, formerly general manager of the Robb-Mumford Boiler Company, has associated himself with Messrs. Timothy W. Sprague, Henry Docker Jackson and others to carry on a general consulting engineering business under the name of Timothy W. Sprague, Frederic H. Keyes, Henry D. Jackson and Associates, 88 Broad Street, Boston, Mass. The firm will make complete reports and investigations, and furnish designs and supervision for all sorts of power plants for lighting, railway or industrial purposes; also mining reports, investigations and power plants. The combination takes place on Jan. 1, 1910.

MR. P. O. KEILHOLTZ, who has been for over 20 years consulting engineer for the railway and lighting properties of Baltimore, Md., has opened an office as consulting engineer in the Continental Building of that city. Mr. Keilholtz has been closely identified with most of the important electrical work planned and constructed in Baltimore during the last 20 years. He is a graduate of the United States Naval Academy, and after resigning from the navy took a post-graduate course at the Johns Hopkins University. Mr. Keilholtz has just been commissioned to prepare the plans and supervise the construction of a power plant at Millville, Va., for the Winchester & Washington City Railway Company.

MR. RICHARD E. SLADE, who will become general manager of the gas and electric departments of the New Orleans Railway & Light Company on Jan. 1, has long been identified with the gas lighting industry, but has had considerable experience with electrical properties as well. Previous to entering upon his present duties as treasurer and general manager of the Hartford City Gas Light Company, in 1904, for three years he was superintendent of the Lockport Gas & Electric Light Company—now the Lockport Light, Heat & Power Company. Mr. Slade was born at Yonkers, N. Y., in 1865. He was graduated from the Columbia School of Mines in 1887 and was appointed assistant superintendent of the Yonkers Gas Light Company. Subsequently he was placed in charge of the gas works at Asheville, N. C., and later was connected with the gas and electric company at White Plains, N. Y.

Obituary.

PROF. FRANK J. SHORT, for a time in charge of engineering research at Cornell University, died in Fort Collins, Col., Dec. 22, of tuberculosis. Professor Short was graduated from the University of Wisconsin in 1897.

MR. DUMONT CLARKE, director of the Commercial Cable Company, the Commercial Cable Company of Cuba, the Long Island Consolidated Electrical Company, Long Island Railway Company, and numerous other companies engaged in industrial undertakings, died on Dec. 26 at his home in Dumont, N. J. Mr. Clarke was 69 years old. He came of a family of bankers and had been president of the American Exchange National Bank, New York, since 1893.

MR. FRED LESLIE, superintendent of the Muncie Electric Light Company, of Muncie, Ind., and well known to electrical men of the Middle West, died of typhoid fever on Oct. 17. Mr. Leslie was secretary of the Indiana Electric Light Association, the formation of which was largely due to his efforts, and he was popular among his fellow central-station men. He was but a young man, and his untimely and unexpected death is deeply regretted by a wide circle of friends.

MR. J. F. McCUSKER, for five years assistant city electrician of Denver, died on Dec. 21 from an acute attack of double pneumonia after an illness of only four days. Mr. McCusker was a pioneer in the electrical history of the West, gaining his original training in the Brush and Thomson-Houston works. To him is due much of the credit for the development in the last few years of Denver's interior wiring requirements until it now ranks among the first few cities of the country.

DR. CHARLES R. DUDLEY, president of the American Society for Testing Railway Materials, international president of the Society for Testing Materials, and president of the American Chemical Society,

died at Altoona, Pa., on Dec. 21. Dr. Dudley received his degree from Yale University. He was chief chemist of the Pennsylvania Railroad Company, and was well known among railway men, chemists and scientists. One of his most important contributions to scientific knowledge was his investigation of the composition of steel rails.

Trade Publications.

TACHOMETERS, of the magneto-generator type, designed for marine use, are illustrated and fully described in bulletin No. 33 of the Industrial Instrument Company, Foxboro, Mass.

DIMMER FOR INCANDESCENT LAMPS.—The Anylite Manufacturing Company, Newbery, Ore., has issued a folder devoted to an attachment to be inserted between an incandescent lamp and its socket for the purpose of regulating the light given by the lamp.

ARC LAMPS.—A bulletin of the Allgemeine Elektricitäts-Gesellschaft, Berlin, Germany, gives illustrations and brief outline description of flaming arc lamps for direct-current and alternating-current circuits. These lamps are arranged with particular reference to street lighting.

ARC LAMPS.—Circular No. 1506 of the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., contains a reprint of a paper by Mr. C. E. Stevens, entitled "Recent Types of Arc Lamps and their Operation," read before the National Electric Light Association in June, 1909.

ELECTRIC VEHICLES.—The Fritchle Automobile & Battery Company, Denver, Col., has issued a well-illustrated booklet describing in detail a 2140-mile tour made in a Fritchle "100-mile" electric vehicle in winter from Lincoln, Neb., to New York City, thence to Washington, D. C.

RECORDING GAGES.—Bulletin No. 117 of the Bristol Company, Waterbury, Conn., describes and illustrates recording gages for pressure and vacuum and also water-level gages. In these gages there are no multiplying devices, the recording pen arm being attached directly to the pressure tube.

TUNGSTEN LAMPS.—Users of electricity for illuminating purposes will be interested in a booklet issued by the General Electric Company, entitled "A Revolution in Lighting Due to a New Lamp," and numbered 3841. This booklet tells in a simple way the advantages to be derived from the use of the tungsten lamp.

VACUUM CLEANERS, designed for operation by means of electric motors, are well discussed in a booklet issued by the Keller Manufacturing Company, Philadelphia, Pa. These cleaners are of the portable type intended for residence service. Cleaners for hotel service of the portable and stationary types are described in bulletins Nos. 30 and 32 of the same company.

WESTERN ELECTRIC MOTORS AND GENERATORS.—The Western Electric Company has published a new edition of its bulletin No. 5131, which shows in detail its type IL of motors and generators. A new edition has also been issued of bulletin No. 5132, taking up the type ELC motors of interpole design.

POLYPHASE INDUCTION MOTORS.—The General Electric Company has issued bulletin No. 4674, illustrating and describing its polyphase induction motors and the controlling apparatus for use with them. An interesting illustration in this bulletin is that of a 6000-hp, 6600-volt induction motor installed at Gary, Ind.

ARC LAMPS.—The American Flaming Arc Lamp Company, 148 Purchase Street, Boston, Mass., has issued an illustrated bulletin devoted to flaming arc lamps. Complete descriptions are given of the controlling devices and operating characteristics, while directions for installing and trimming the lamps are also included. The company has issued an illustrated price-list of rates of these lamps.

VOLTAGE REGULATION.—Two folders of special interest to central station managers, and referring to the voltage regulation of feeder circuits and generator circuits, are being issued by the General Electric Company under numbers 3846 and 3847, respectively. These folders describe briefly the apparatus used in accomplishing this regulation, and state the advantages to be derived from its use.

GRAPHITE AS A LUBRICANT.—The Joseph Dixon Crucible Company, Jersey City, N. J., has issued a new edition, the eleventh, of its well-known treatise upon the theory and practice of graphite lubrication. The matter is treated in seven chapters covering 59 pages and the matter is given concentrated and convenient form. The greater part of the pamphlet deals especially with the lubrication and treatment of power house machinery.

OXHYDRIC CUTTING.—The American Oxhydric Company, Milwaukee, Wis., has issued a bulletin devoted to the "Oxhydric" process for the cutting and welding of metals by means of oxygen and hydrogen. This process is based on the well-known fact that metals made intensely hot burn easily and rapidly in an atmosphere of oxygen gas. An illustration is given of the cutting of a 9-in. nickel-chrome plate at the rate of 5 lin. in. per minute.

ELECTRIC DRIVE FOR PRINTING PRESSES.—The managers of printing establishments should be interested in bulletin No. 4672 of the General Electric Company and entitled "Electric Drive for Large Printing Presses," inasmuch as it has to do with a subject of vital importance to the up-to-date printer. This bulletin refers to certain electrical installations and, with the [illegible] describes the most modern method of operation and control of large presses

MODERN SANITARY CLEANING.—This pamphlet, which of course treats of vacuum cleaning machinery, is issued by the Palm Engineering Company of Detroit, Mich. In it is contained a short illustrated description of the company's system for removing dust and dirt. A reciprocating pump is employed for creating the vacuum and the clearance space between the piston and the cylinder is filled with a flowing water packing. This not only serves as lubrication but makes possible the elimination of wet and dry separators, the finer particles of dust being drawn into the cylinder and discharged into the sewer with the water.

MAGNETO NON-MULTIPLE SWITCHBOARDS.—The Western Electric Company has issued for general distribution bulletins Nos. 1001 and 1002, which take up in detail the construction and operating features of magneto non-multiple switchboards, with self-restored and manually restored line signals. They contain illustrations of the different essential parts of line-circuit apparatus, cord-circuit apparatus as well as different styles of switchboards. Numerous diagrams are also shown illustrating the wiring connections for the various parts. These bulletins are the first of a series of 10 switchboard bulletins which are to be issued by the Western Electric Company describing its newest and latest designs of switchboards and telephone apparatus and will be sent to any address on request.

Calendars.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has issued a pocket-size celluloid calendar card covering the whole of the year 1910. On the reverse side are shown the Packard lamp and the Sangamo watt-hour meter.

THE DEARBORN DRUG & CHEMICAL WORKS, 225 Postal Telegraph Building, Chicago, is distributing a wall calendar for office use, in connection with which attention is called to the Dearborn scientific water treatment for preventing corrosion and pitting of boilers.

THE MITCHELL-RAND MANUFACTURING COMPANY, New York, has prepared for its customers and friends a calendar of generous proportions containing the one word "Insulation" in addition to the name of the firm. Besides showing the phases of the moon for the month, each sheet contains a miniature calendar covering the previous and the succeeding months.

Business Notes.

BARLOW & JOHNSTON is the name of the new electrical contracting and engineering firm of Baltimore, Md. Mr. Barlow was for years associated with the Highland Electric Company, of that city.

DOSSERT PRODUCTS IN SOUTH AFRICA.—Dossert & Company, of New York, have concluded an arrangement through the Western Electric Company whereby the last named company's representative, Mr. J. W. Keefe, at Johannesburg, will act as sole agent for Dossert connectors in South Africa. Mr. Keefe has just cabled orders for 2,500 Dossert connectors of various types to be used in extensive electrical installations in South African mines.

THE WESTINGHOUSE BALTIMORE BRANCH is conducting an active campaign for new business, including some very clever advertising, with demonstrations in the large show window of its handsome Baltimore Street store. Not only are these public demonstrations given in the store of the company, but they are also held in the shops of some of the most prominent supply dealers. In conjunction with this the company has issued an illustrated descriptive folder to every consumer of electric current in the city, which has met with quick results and has been the means of causing a quantity of Westinghouse toasters and heaters to be sold for Christmas presents.

OHIO BRASS COMPANY'S SALES AGENTS.—The Ohio Brass Company, Mansfield, Ohio, has appointed the Holabird-Reynolds Company, of San Francisco, Holabird-Reynolds Electric Company, of Los Angeles, and Holabird Electric Company, of Seattle, as exclusive sales agents for O-B Hi-Tension porcelain insulators in the States of California, Oregon and Washington. Pierson, Roeding & Company, with offices at San Francisco, Los Angeles and Seattle, will continue to be exclusive sales agents for Ohio Brass overhead material, rail bonds, car equipment specialties and catenary material, including such special porcelain insulators as are used in catenary construction. The Hendrie & Bolthoff Manufacturing & Supply Company, of Denver, Col., has been appointed special sales agent for the company for materials for the mining trade in Colorado, Wyoming, Utah, Arizona and New Mexico, as well as for certain railway properties located in the mining districts of this territory. The business of railway and mining companies located at Salt Lake City, Denver, Cheyenne, Colorado Springs Pueblo and Telluride will be, as heretofore, handled by the Brass Company's regular salesman, Mr. F. V. Cook, who will also give special attention to Hi-Tension Insulator business in all five of the States mentioned. Mr. J. C. Barr, 84 State Street, Boston, Mass., has been appointed Boston sales agent and will solicit business in all of the New England States with the exception of Connecticut. Mr. R. G. Campbell, of the New York office, will continue to visit the trade in Connecticut in addition to his other territory.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 21, 1909.

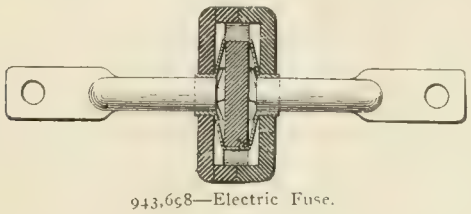
[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

943,647. BURGLAR-PROOF LOCK; I. L. Bridges, Powersville, Mo. App. filed April 10, 1909. This invention is a safety device adapted to be applied to locks of bank, vault or safe doors and is designed to cause an electric current to pass through the lock should the same be tampered with during a predetermined period of time.

943,681. SEPARABLE ATTACHMENT-PLUG; Harvey Hubbell, Bridgeport, Conn. App. filed June 5, 1908. A separable attachment-plug of simplified construction.

943,697. MAGNETO ELECTRIC MACHINE; T. M. Mueller, Dalton, Mass. App. filed Feb. 25, 1909. A machine designed for ignition of the gaseous charge in an internal combustion engine. It is of the inductor alternator type.

943,698. ELECTRIC FUSE; T. E. Murray, New York, N. Y. App. filed Feb. 8, 1909. A fuse comprising two separated members con-



943,658—Electric Fuse.

stituting circuit terminals having a partition of insulating material therebetween.

943,699. SWITCHBOARD AND CUT-OUT; T. E. Murray, New York, N. Y. App. filed June 1, 1909. This device consists of a series of units, each unit comprising a block of refractory insulating material mutually crossing circuit conductors and means operable from the exterior of the unit for electrically connecting the conductors therein and at their crossing points.

943,721. ELECTROPLATING TANK; G. L. Wallace, Bridgeport, Conn. App. filed April 1, 1909. An electroplating device of the tumbler type so constructed that the movable receptacle for retaining the work to be plated can be readily removed or replaced.

943,772. INCANDESCENT LAMP SOCKET; L. Dorner and G. H. Norquist, Denver, Col. App. filed Dec. 11, 1908. The socket consists of separable sections which may be readily detached and is provided with means for locking the sections in assembled positions.

943,809. RAILWAY ELECTRIC SWITCH; R. B. Bryant, Nashville, Ark. App. filed Feb. 11, 1908. This device is designed to enable a motorman to open or close a railway switch without leaving the car. It is devoid of relays, circuit changers and other auxiliary apparatus usually employed in automatic electric railway switches.

943,831. TWO-POLE SNAP SWITCH; L. Kellner, New York, N. Y. App. filed Nov. 17, 1908. A wall switch designed to be substantially flush with the surface of the wall and includes a two-button snap switch by which a circuit or plurality of circuits are controlled.

943,861. ELECTRIC WELDING MACHINE; A. E. Buchenberg, Toledo Ohio. App. filed March 26, 1909. A welding machine in which the levers carrying the work-clamping jaws are permitted to have free relative lateral movements as required without disconnecting the jaw-carrying levers and also provided with means adapted to permit the said levers to have relative oscillatory movement.

943,883. ELECTRICAL SIGNALING AND SWITCHING APPARATUS; R. H. Manson, Elyria, Ohio. App. filed May 29, 1907. A combined self-restoring drop and jack, consisting of a tubular iron-clad electromagnet, a drop shutter controlled thereby, a spring jack and a long spring movable with one of the jack springs when a plug is inserted to push up and restore the drop shutter.

943,914. SWITCH INDICATOR; C. A. Clark, Hartford, Conn. App. filed Sept. 21, 1908. An indicator designed to be applied to the cover of a switch mechanism in predetermined relation of parts so that the registrations of the dial of the indicator will always correctly show the position of the parts of the switch mechanism.

943,918. ELECTRICAL MEDICAL APPLIANCE; B. R. Davenport, Philadelphia, Pa. App. filed May 15, 1908. A device adapted to subject a portion of the body of a person to an electric current intermittently whereby different portions of the body may be subjected to an electric current intermittently and in prescribed order and whereby the intensity of the current may be regulated.

943,924. ELEVATOR SIGNAL; B. E. Fanning, Los Angeles, Cal. App. filed Sept. 11, 1907. A signal designed to be used on passenger elevators which will immediately notify the operators in the elevator cars of any intending passenger the floor he is waiting on and the direction in which he wishes to be taken, and a system whereby the call is immediately retracted when any operator answers it.

943,931. DAMPER REGULATOR; F. C. Guptill, Elgin, Ill. App. filed Nov. 9, 1908. A thermostatically actuated automatic damper regulator for controlling the combustion in furnaces, steam generators or hot-water boilers.

943,933. ELECTRIC CLOCK SYSTEM; H. O. Harrison, Wichita, Kan. App. filed March 16, 1908. A clock system under the control of a master clock, which causes the periodic sending to the line of electrical impulses, which in turn actuate the local clocks all at the time and to the same extent, the duration of the impulses being very short, as compared with the time period between said impulses.

943,940. THEATER CHAIR-SIGNAL SYSTEM; P. T. Kenny, New York, N. Y. App. filed Nov. 24, 1908. A system connecting the theater seats with the office whereby the person in the office can tell at any time what seats in the house are vacant

943,958. FLUSH PLATE FOR FLUSH RECEPTACLES; F. T. Wheeler, Plainville, Conn. App. filed Dec. 7, 1906. A flush plate for flush receptacles adapted to protect the parts of the receptacle, yet permitting of easy access to its interior.

943,960. SYSTEM OF DIRECTED WIRELESS TELEGRAPHY; E. Bellini and A. Tosi, Paris, France. App. filed Oct. 1, 1907. A wireless system employing electromagnetic waves and which permits a receiving station provided with a plurality of dirigible aerials to radiate mainly in any given direction without it being necessary either to turn the aerials or to employ a great number thereof.

943,969. SPACE TELEGRAPHY; L. De Forest, New York, N. Y. App. filed Jan. 29, 1907. A space telegraphy system provided with a discharger for an opened or closed circuit, an electrical condenser which shall permit of a regular and constant spark frequency.

944,003. ELECTRIC SIGNAL SYSTEM; A. L. Sohm, Los Angeles, Cal. App. filed Sept. 24, 1907. A system provided with electrical connections with outlying signal stations and having means to automatically disconnect such station from the signal, indicating means after a signal has been sent from any signal station until the signal indicating means is reset.

944,040. OVERLOAD AND REVERSE CURRENT RELAY; P. O. Keilholtz, Baltimore, and F. E. Ricketts, Derwood, Md. App. filed Aug. 5, 1908. A device designed to protect electrical apparatus included in an alternating circuit by means of an overload and reverse-current relay.

944,050. ELECTRICAL STEAM GENERATOR; E. I. Rains, New York, N. Y. App. filed Feb. 11, 1909. An electrical steam generator having a common casing, a plurality of independent water containers therein, each communicating with a common steam space, and a plurality of independent electrical heating elements in each container.

944,060. RHEOSTAT; H. L. TRUESDALE, Somerville, Mass. App. filed Aug. 20, 1909. A rheostat wherein the resistant material is fluid instead of metal, the electrodes being submerged in the fluid, and adapted to move in closer relation to each other.

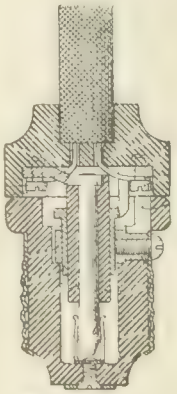
944,061. ELECTRICAL MEASURING INSTRUMENT; T. W. Varley, New York, N. Y. App. filed Feb. 3, 1906. A measuring instrument wherein a movable element is employed in connection with a shifting or changing field adapted to impart movement to said movable element and a substantially constant field adapted to retard the movement of the movable element by inductive action.

944,078. COUPLING FOR BATTERY ELEMENTS; F. A. Decker, Philadelphia, Pa. App. filed Oct. 5, 1906. A coupler whereby a close engagement is automatically maintained, the parts insulated so that a metal envelope can be used in the cell and the destruction due to the electrochemical action greatly reduced.

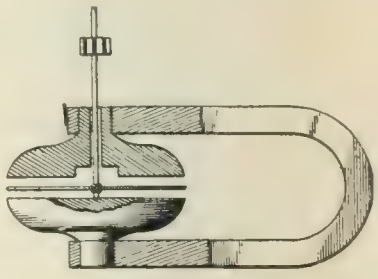
944,079. ELECTRIC BATTERY; F. A. Decker, Philadelphia, Pa. App. filed June 20, 1907. An electric battery comprising a vessel in which there is a plurality of removable cells, each having a resistance duct connecting its interior with the interior of the vessel.

944,131. OVERHEAD SWITCH FOR ELECTRIC RAILWAYS; E. E. Gilmore, Philadelphia, Pa. App. filed Sept. 27, 1905. A switch designed to obviate as far as possible the excessive wear.

944,139. ELECTRODE FOR ELECTRIC ARC LAMPS; A. D. Jones, Holloway, London, Eng. App. filed April 18, 1908. An electrode



943,681—Separable Attachment Plug.



944,061—Electrical Measuring Instrument.

for electric arc lamps of the enclosed type carrying a mixture of calcium tungstate and calcium flourid, and a steadying salt of an alkali metal.

944,167. INDUCTION SUPPLY METER FOR POLYPHASE ELECTRIC CURRENTS; H. Aron, Charlottenburg, Germany. App. filed July 28, 1908. A supply meter in which the space occupied by the apparatus is reduced by making the iron cores of the electromagnet of both sets of driving coils in one piece, so that the magnetic lines of force of both sets pass partly together through the same portion of the iron.

944,186. OVERHEAD CONSTRUCTION FOR ELECTRIC RAILWAYS; E. E. Gilmore, Philadelphia, Pa. App. filed July 18, 1907. A switch adapted to maintain a balance of strains between switch and guy wires and also arranged so that the branch trolley wire will throw no strain on the main wire

944,208. ELECTRIC LAMP SOCKET; F. P. Poole, Bridgeport, Conn. App. filed Sept. 21, 1909. A socket designed to give a double brake with the key is turned to cut out the current.

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